NATURAL PROPAGATION AND HABITAT IMPROVEMENT

VOLUME I - OREGON

Final and Annual Reports, 1986

Published by
Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
January 1987

Table of Contents

Collowash River Habitat Improvement Project
Hot Springs Fork Collawash River
Table of Contents i

Collawash River Falls Passage Improvement Project 20
Table of Contents 21

Oak Grove Fork Clackamas River Habitat Improvement Project 48
Table of Contents 49

Lake Branch/West Fork Hood River Habitat Improvement Project 72
Table of Contents 73

Fifteenmile Basin Habitat Improvement Project 141
Table of Contents 142

Aquatic Ecosystem Inventory - Mt. Hood National Forest 183
Table of Contents 184

Fifteenmile Basin Habitat Enhancement Project 265
Table of Contents 266

Monitoring and Evaluation of Mt. Hood National Forest Stream Habitat
Improvement end Rehabilitation Projects 326
Table of Contents 328

Grande Ronde Habitat improvement Project: Joseph Creek and
Upper Grande Ronde River Drainage 394
Table of Contents 395

Grande Ronde River Habitat Enhancement of the Wallowa-Whitman
National Forest 448
Table of Contents 449

Middle Fork John Day River and Tributaries 476
Table of Contents 476-A

John Day River Fish Habitat Enhancement 488
Table of Contents 489-A

North Fork John Day River Habitat Improvement 520
Table of Contents 521

1986 ANNUAL REPORT

CLACKAMAS/HOOD RIVER HABITAT ENHANCEMENT PROGRAM

Mt. Hood National Forest
2455 NW Division Street
Gresham, OR 97030

Program Leader: Dave Heller (503) 666-0762

Assistant Program Leader: Harv Forsgren (503) 666-0605

PROGRAM OVERVIEW

Fisheries habitat improvement work is being done on priority drainages in the Clackamas and Hood River sub-basins under program measure 704(d)(l) of the Northwest Power Planning Council's Fish and Wildlife Program. This report describes the work completed in 1986 for Bonneville Power Administration (BPA) project 84-11, the Clackamas/Hood River Habitat Enhancement Program. The program is composed of six projects. This ongoing program was initiated in 1984, although some of the projects were begun with BPA funding support as early as 1983. The projects are complemented by a variety of habitat improvement and management activities funded from a variety of Forest Service sources.

This report describes the activities implemented for five of the six projects. A separate annual report on the 1986 habitat improvement and monitoring/ evaluation efforts in the Fish Creek drainage has been prepared. Work completed by the Oregon Department of Fish and Wildlife, as part of the Fifteenmile drainage project, is reported following the Forest's annual report for the Fifteenmile project. The 1986 annual report titled "Monitoring and Evaluation of Mt. Hood National Forest Stream Habitat Improvement and Rehabilitation Projects" is included (less the report's appendices) following the five project reports.

Species for management emphasis include spring chinook and coho salmon, and summer and winter steelhead trout. Project work in 1986 primarily focused on increasing the quantity and quality of available rearing habitat, and improving access at passage barriers. The underlying theme of the improvement work has been to increase habitat diversity through the introduction of "structure". Structure provided by logs and boulders serves to deflect, pond, or otherwise disrupt flow patterns within a stream channel. This alteration of flow patterns results in formation of an increased number of habitat niches (i.e. pools, glides, alcoves, etc.) in which a variety of species and age groups of

salmon and trout can rear. It also results in the sorting of gravel, rubble and boulders being transported downstream, creating high quality spawning and rearing habitats, and food producing areas.

In 1986, a total of 3.7 miles of stream were treated; 74 log structures (including: "deflector", "digger", "si11". and "cover" logs), 149 multi-log/boulder complexes' and 98 boulder structures (including: "berms", "alcoves"' and "clusters") were completed to meet habitat improvement objectives. Two side channels, totaling more than 1400 feet in length, were also constructed to provide off channel rearing habitat during high flows, coho spawning habitat, and low flow rearing habitat for coho and steelhead. The 323 "structures" completed far exceeded the work statement target of 139 structures. More importantly, the area targeted for treatment was exceeded in both a quantitative (total stream area) and a qualitative (addition of preferred habitat) sense.

In addition to these direct habitat improvement activities, BPA and the Forest Service financed a number of project and program assessment activities that have improved the efficiency and effectiveness of the Forest's fisheries management program. Notable findings relate to the durability of habitat improvement structure, the associated changes in physical habitat, and biological response to the improvement activities.

During February of 1986 a rain on snow event resulted in stream flows on the Mt. Hood National Forest with return intervals of 15 to 25 years. The high flow conditions offered an excellent opportunity to examine the durability of habitat improvement structures installed with USFS and BPA funds since 1981. Of the 632 structures reviewed, approximately 90% of the structures were functioning as designed. Of the 10% non-functioning structures, about half were repairable. The structures can be divided into two categories; those implemented by hand crews and those implemented with heavy equipment. While the projects implemented by hand represent less than 15% of the total structures evaluated, they account for about half of the structures which failed. This disparity in success rate reflects size and design capability differences between hand and machine implemented projects, and improved effectiveness over time (i.e. the hand implemented projects were, in general, the first projects implemented on the Forest). The failure rate for structures installed during the two years previous to the 1986 flow event was less than 4%. The type of structure implemented also appears to influence durability. Full channel width structures such as boulder berms and log sills appear to be most vulnerable to damage. These type of structures experienced a 15% failure rate, even when implemented with heavy equipment. With boulder berms, a second factor affecting durability is the use of instream material, which can be of inadequate size to withstand high flows. While only 2% of the boulder berms constructed by equipment with hauled rock failed, more than 25% of the boulder berms constructed by equipment with in-channel materials failed.

Prior to treatment, most project areas on the Forest were dominated by riffle habitats. There was little instream structure or habitat diversity. Treatment of these areas resulted in an 8 to 65% reduction of riffle habitat, and a substantial increase in habitat diversity. Not too surprisingly, the amount of

habitat change brought about through the addition of structure is a direct function of the treatment intensity (number of structures per area treated).

Salmonid population densities in the pre-treatment areas ranged from 0.04 - 0.60 fish/square meter. Densities in post-treatment areas ranged from 0.06 - 1.06 fish/square meter. Post-treatment densities were usually higher than sampled densities from the areas prior to treatment. Control sites did not show a corresponding increase in density. The increase in density was most noticeable in l+, and older, steelhead trout- the target species and life stage of much of the work. Utilization of added structure, particularly woody structure, and the associated new habitats was high. This preferential use provides credence to the assumption that the habitats being created by project activities are the type fish will seek out and utilize. Determining actual increases in production due to project work requires more intensive studies such as the Forest's Fish Creek Evaluation.

REPORT CONTENTS

Annual Reports for the individual projects of the Clackamas/Hood River Habitat Enhancement Program were prepared by the biologists implementing the projects. The reports are presented in the following order:

1. Collawash River Habitat Improvement Project, Hot Springs Fork;
   Tom Cain and Dave Hohler

2. Collawash River Falls Passage Improvement Project;
   Ron Medel

3. Oak Grove Fork Clackamas River Habitat Improvement Project:
   Ron Medel

4. Lake Branch/West Fork Hood River Habitat Improvement Project;
   Ken MacDonald and Corey Sue Hutchinson

5. Fifteenmile Basin Habitat Improvement Project;
   Ken MacDonald and Corey Sue Hutchinson (USDA Forest Service)

6. Fifteenmile Basin Habitat Enhancement Project;
   Roger C. Smith and Greg W. Short (Oregon Dept. of Fish and Wildlife)

7. Monitoring and Evaluation of Mt. Hood National Forest Stream Habitat Improvement and Rehabilitation Projects;
   Brent Higgins and Harv Forsgren.

COLLAWASH RIVER HABITAT IMPROVEMENT PROJECT
HOT SPRINGS FORK COLLAWASH RIVER

ANNUAL REPORT FY 1986

by

Tom Cain, Fisheries Biologist
and
Dave Hohler, Fisheries Biologist

Mt. Hood National Forest
Estacada Ranger District
Estacada, Oregon

Prepared for

Kathy Anderson, Project Manager
U.S.Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-A179-84 BP16726
Project No. 84-11

April 1, 1987

TABLE OF CONTENTS

LIST OF PHOTOGRAPHS ii

ACKNOWLEDGEMENTS iii

ABSTRACT iv

INTRODUCTION 1

DESCRIPTION OF STUDY AREA 1

METHODS AND MATERIALS 2

RESULTS AND DISCUSSION 4

SUMMARY 5

SUMMARY OF EXPENDITURES 5

APPENDIX A - PROJECT AREA MAPS

APPENDIX B - PROJECT PHOTOS

APPENDIX C - LOG ANCHORING AND BOULDER SEATING TECHNIQUE

LIST OF PHOTOGRAPHS

1. Typical Pre-project Reach
2. Treated Reach
3. Bedrock Pool
4. Bedrock Pool with Cover Added
5. Individual Tree Placement
6. Multi-log "V" Structure
7. Debris Trapped by Log Structure
8. Backhoe Moving Boulder
9. Boulder-berm
10. Sidechannel and Spill Structure
11. Habitat within Sidechannel
12. Partial Barrier Waterfall

ACKNOWLEDGEMENTS

We would like to thank the following people who provided valuable input and manpower during the course of the project:

Harvey Forsgren	Fisheries Biologist Mt. Hood National Forest Supervisor's Office
Dave Heller	Fisheries Biologist Mt. Hood National Forest Supervisor's Office
Brent Higgins	Fisheries Biologist Mt. Hood National Forest Supervisor's Office
Lynn Hood	Biological Technician Siuslaw National Forest Mapleton Ranger District
Richard Wheeler	Hydrologist Mt. Hood National Forest Supervisor's Office

ABSTRACT

The Hot Springs Fork of the Collawash River is a major sub-drainage in the Clackamas River drainage. Emphasis species for natural production are spring chinook and coho salmon, and winter steelhead. Increased natural production appears limited by a lack of quality rearing habitat. Habitat complexity, over approximately 70% of the area accessible to anadromous fish, has been reduced over the last 40 years by numerous factors. Additionally, natural passage barriers limit anadromous fish access to over 7 miles of high quality habitat.

In the second year of a multi-year effort to improve fish habitat in the Hot Springs Fork drainage, a 0.9 mile reach of the Hot Springs Fork mainstem (river mile (RM) 2.9 to 3.8) was treated. The objectives of this years work were: 1) to increase channel complexity, and 2) improve low flow and overwinter rearing conditions. Seventy-five trees were felled and more than 165 boulders, l-4 cubic yards each, were hauled in and used to construct approximately 135 instream structures. On site materials (downed logs and boulders) were also used where available. The logs and boulders were positioned to scour pools in riffle dominated areas and to provide cover in existing pools. A large track mounted backhoe was used to construct the rock and log structures. A perennial side channel was also created by excavating out a high flow channel. The side channel will provide additional spawning habitat and slow water refuge during periods of high flows in the mainstem. The side channel may also provide low flow rearing habitat for coho salmon, resident and steelhead trout. Initial attempts to improve passage over a waterfall (RM 7.1) were made using non-explosive techniques. These attempts were unsuccessful due to the nature of the rock and additional work is needed to improve passage. Prior to project implementation pre-project monitoring, consisting of physical and biological data collection, was completed in the project area.

INTRODUCTION

In 1986 habitat improvement project work was completed on the mainstem of the Hot Springs Fork Collawash River. The Bonneville Power Administration funded the project as part of the Clackamas/Hood River Habitat Enhancement Project agreement (Project 84-11). A total of $31,197 was budgeted for project planning and implementation in 1986. Expenditures for completion of the project totaled $37,516.99. Project costs were higher than originally anticipated because on site rock was not available and boulders to anchor wood accumulations was hauled in from local rock pits. Benefits derived from the projects include improved anadromous fish access to over four miles of habitat, the creation of approximately 437 additional square meters of low flow pool rearing habitat, and improved cover for existing habitats.

DESCRIPTION OF THE STUDY AREA

The Hot Springs Fork is a fourth order tributary to the Collawash River, entering the mainstem at RM 4.0 (APPENDIX A). Mainstem length is 14.6 miles with 10.2 miles accessible to anadromous fish. The basin area is 60 square miles and is entirely on National Forest System lands. The Hot Springs Fork supports natural production of spring chinook and coho salmon, winter steelhead and resident trout. In addition, the Oregon Department of Fish and Wildlife (ODFW) annually outplants summer steelhead to provide a summer sport fishery. Major tributaries to the Hot Springs Fork include Pansy, Nohorn, Alice, and Whetstone Creeks. Migration barriers on the mainstem and tributaries, and reductions in rearing habitat complexity limit anadromous fish production in the drainage. Fisheries habitat is rated good to excellent in the lower 2.5 miles and fair to good in the upper 7.5 miles. Passage is partially obstructed by a nine foot falls at RM 7.1. Spawning habitat is patchy in distribution; although there are about 2,400 square meters of gravel much of it is located in the lower 2.5 miles. The reach between RM 2.5 and 5.0 has virtually no spawning habitat and very little hiding cover. In many areas a loss of organic structure has resulted in a broad channel, which during low flows is shallow and lacks complexity and effective hiding cover. Rearing habitat is limited in the upper four miles of the Hot Springs Fork.

Fish habitat improvement work prior to 1985 on the Hot Springs Fork has concentrated on passage improvement. Pegleg Falls (RM 6.0) was bypassed by the completion of a fish ladder in 1966. Access to Pansy and Nohorn Creeks was improved in 1985 in a cooperative effort between BPA and the Forest. In 1986 the waterfall at RM 7.1 of the Hot Springs Fork was worked on to improve passage conditions. Channel rehabilitation efforts to improve spawning and rearing conditions have been conducted in the lower reach of Pansy Creek (1985) and on the Hot Springs Fork mainstem from RM 2.9 to 3.8 (1986).

METHODS AND MATERIALS

An evaluation of all the potential project areas in the lower 7 miles of the Hot Springs Fork was completed during winter and spring flows in 1986. The primary objective was to identify project areas and prioritize them according to need for treatment. The reach selected for work in 1986 had good pool volume, but little effective hiding cover, and lacked spawning habitat. Prior to implementation, pre-project monitoring was conducted in the project area to measure existing habitat conditions (1986 Monitoring Report). Fish sampling in one control and two treatment sites was also conducted at this time to measure pre-project densities of salmonids. Post-project monitoring in subsequent years will help to determine the project's effectiveness in meeting habitat objectives and identify corresponding changes in fish densities.

To improve habitat conditions in the 0.9 miles of stream, approximately 165 large boulders were hauled to the site and about 75 trees were felled in stands adjacent to the project site. The logs and rock were placed with a large track mounted backhoe to promote the scouring of pocket pools in riffle dominated areas and to provide hiding cover in existing pools (APPENDIX B). The majority of this work will benefit steelhead (aged l+) and resident trout. In addition to increasing mainstem habitat complexity, minor modifications of a waterfall at RM 7.1 were planned to improve upstream passage for anadromous fish. The waterfall is a partial passage barrier limiting anadromous fish access to over three miles of good quality habitat. The waterfall is located along the Bagby Hot Springs Trail. A foot bridge for the trail passes immediately over the waterfall. In order to minimize the safety risk, and to evaluate a new technique, a portable rock drill and a non-explosive expansion agent were used in an attempt to modify the falls.

Implementation of the project was divided into four stages; 1) boulder haul, 2) tree falling, 3) backhoe operation, and 4) cabling/securing. The methods and materials used at each stage are discussed below.

Boulder Haul

To minimize disturbing boulders already incorporated in the channel, approximately 165 boulders, l-4 cubic yards each, were hauled to the project area and stockpiled at four sites. Boulders located above the high water mark in the project area were also used. The boulders were placed individually and in groups to act as scouring agents in riffles, to provide cover in pools, and to act as anchoring points for large woody debris (LWD).

Tree Falling

A professional tree faller was hired to fell approximately 75 trees throughout the project area. The trees, which were pre-selected and marked, ranged in size from 24" to 72" in diameter. In order to protect the streambanks and stream shading, no bank side trees were cut. Trees to be felled were back from the bank and were dropped between standing trees (APPENDIX C). With a large portion of the tree on the bank and wedged between standing trees it is less likely that they will rotate out of the channel and/or float away during high flows. The trees were also anchored by cable to standing trees and to boulders

in the channel. The majority of the trees were left whole and used as cover structures in pools and as flow deflectors/scouring agents in riffles. A few trees were limbed and bucked to be anchored in the bank as flow deflectors. These structures were cabled to buried deadmen. The deadmen consisted of buried 55 gallon drums filled with gravel. Two to three deadman were used for each log, depending on log length.

Backhoe Operation

A large excavator/backhoe with operator was rented to place the logs and boulders, excavate pools and construct the sidechannel. The backhoe was first used to move boulders from the stockpile areas to the sites where they were used. Some boulders were placed to scour pocket pools and provide cover and others were placed to act as anchor points for LWD. When a boulder was placed it was 'seated' into the substrate to stabilize it (APPENCIX C). Boulders used as scouring agents were seated low enough to allow flows to pour over the top of the boulder to assist the scouring. Boulders used as anchoring points were placed on the upstream side of the felled trees. This was done to avoid the log floating up and coming to rest on top of the boulder. To minimize bank disturbances caused by heavy equipment, the backhoe accessed the channel at one point and exited the channel at one point. Disturbed soil areas were grass seeded upon the completion of the project.

Cabling/Securing

The anchoring system employed an electric, pneumatic drill and a polyester resin. Pairs of 8’ to 10' deep holes were drilled into the anchor boulders and partially filled with a polyester resin. One end of l/2" cable was inserted into one hole of each pair of holes, the cable was wrapped around the log, and the free end inserted into the other hole. The resin takes a few minutes to set up and can bear a full load in approximately one and one-half hours. The number of anchor rocks and cables used to secure each log, or group of logs, varied by structure. One-half inch diameter cable and cable clamps were used to anchor the cut end of the logs to standing trees.

RESULTS AND DISCUSSION

Although the original project budget was exceeded with the addition of the contract to haul in boulders, this did not result in additional expense to BPA. Additional Forest Service funds were shifted to another BPA project to free up enough money to pay for the boulder haul. The addition of boulders to the project allowed for an increased intensity of treatment in the project area from the work statement target of 25 structures to the actual accomlishment of 135 structures. Changes in project treatment intensity and method reflect incorporation of the results of the Fish Creek habitat improvement evaluation. Rearing and spawning habitat improvements included the construction of 17 multi-log/rock 'V' complexes, five boulder berms, 35 single log deflectors' 68 individual boulder placements, 10 cover logs, and the excavation of a 400 foot sidechannel rearing area. Selected logs and boulders along the banks were also pulled into the stream and secured to increase the amount of channel structure and to provide cover.

The structures were designed to increase rearing habitat by impounding and slowing water upstream, by scouring pools in the plunge immediately downstream, and providing overhead and instream cover. Spawning habitat in the project area is expected to increase behind many of the structures and in front of some the multiple boulder structures. Gravels deposited behind the structures should be in larger beds and positioned in the channel better than those observed in the area prior to the project. The multi-log/rock complexes were generally arranged in a "V" shape with the vertex pointing across and downstream. The vertex is the lowest point in the structure, providing a slot to improve the scouring action between structures. The accumulation of logs and boulders that form the structures should also provide overwintering habitat for juvenile steelhead and resident trout. Additional overwintering habitat was created by excavating a sidechannel along the floodplain margin. The sidechannel will provide protected' quiet water habitat during periods of high flows in the main channel. A log/boulder flow deflector was constructed to help divert low flows into the sidechannel.

Initial observations after the first high flow indicated that the structures were generally quite effective in achieving project objectives. Three structures had shifted enough to partially diminish their function. The gravel deposition was greater then anticipated for the first winter after implementation. Most of the structures were fully seeded with gravel. The majority of structures functioned well and had begun to create the expected changes in habitat diversity. The creation of overwinter quiet-water habitat also appeared successful upon review of the sidechannel during mean high water. The sidechannel provides approximately 260 square meters of new overwinter habitat. It also appears that the sidechannel experienced enough scour to provide low flow rearing habitat.

The technique used to attempt to enlarge the jump pool at the Hot Springs Fork falls (RM 7.1) was not successful. Passage will be improved using traditional blasting methods as soon as conditions permit. The use of explosives was avoided initially because of the sensitive location of the area. In the interim' coordination with the permittee at Bagby Hot Springs has provided for mitigation of his concerns.

Post project monitoring in the project area, in the future, will map physical habitat changes associated with the project and document changes in salmonid densities within the project area. Survey of spawning areas upstream of modified passage barriers will help to determine the success of the passage improvement work on the mainstem of the Hot Springs Fork.

SUMMARY AND CONCLUSIONS

In the second year of a multi-year effort to improve fish habitat in the Hot Springs Fork of the Collawash River, a 0.9 mile reach of the mainstem of Hot Springs Fork was treated. The objectives of this year's work were: 1) to increase channel complexity, and 2) to improve low flow and overwinter rearing conditions. Channel complexity was dramatically improved through the addition of seventy-five trees felled from stands adjacent to the project area, and more than 165 boulders hauled in from off site locations. On site downed woody

materials and boulders were also used when encountered. The logs and boulders were positioned with a large track mounted backhoe to form structures which scour pools in riffle dominated areas and provide cover in existing pools. Approximately 135 of these structures were completed. The track mounted backhoe was also used to excavate a 400 foot long side channel at the margin of the flood plain. The side channel is designed to provide slow water refuge during periods of high flows in the mainstem. It appears that the side channel will also provide low flow rearing habitat for coho salmon, resident and steelhead trout, and additional coho spawning habitat.

Efforts to improve fish passage at RM 7.1 by modifying a falls with non-explosive techniques were not fully successful. The required modification will be implemented in 1987 with traditional explosive techniques. Implementation costs for 1986 totaled $37,516.99.

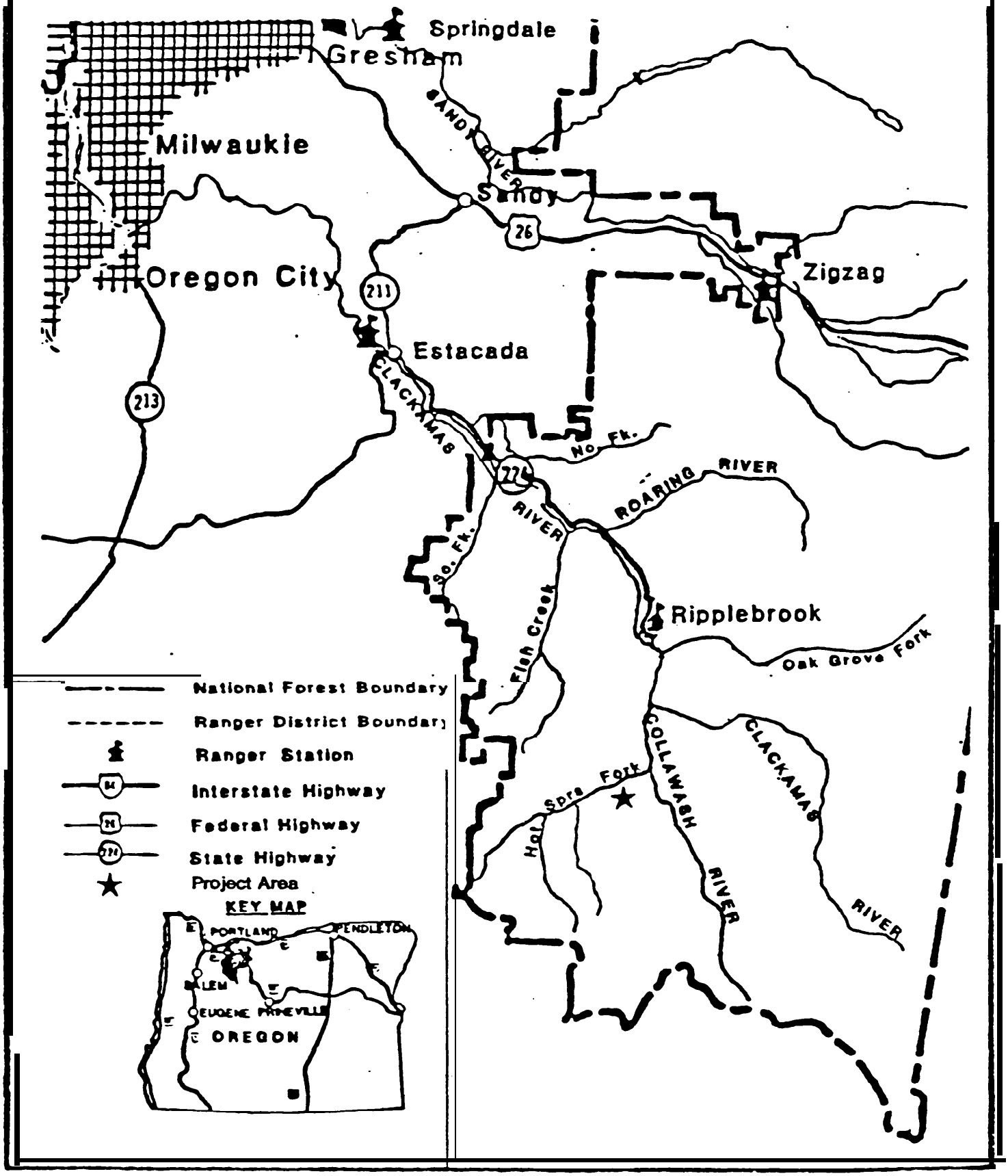
SUMMARY OF EXPENDITURES

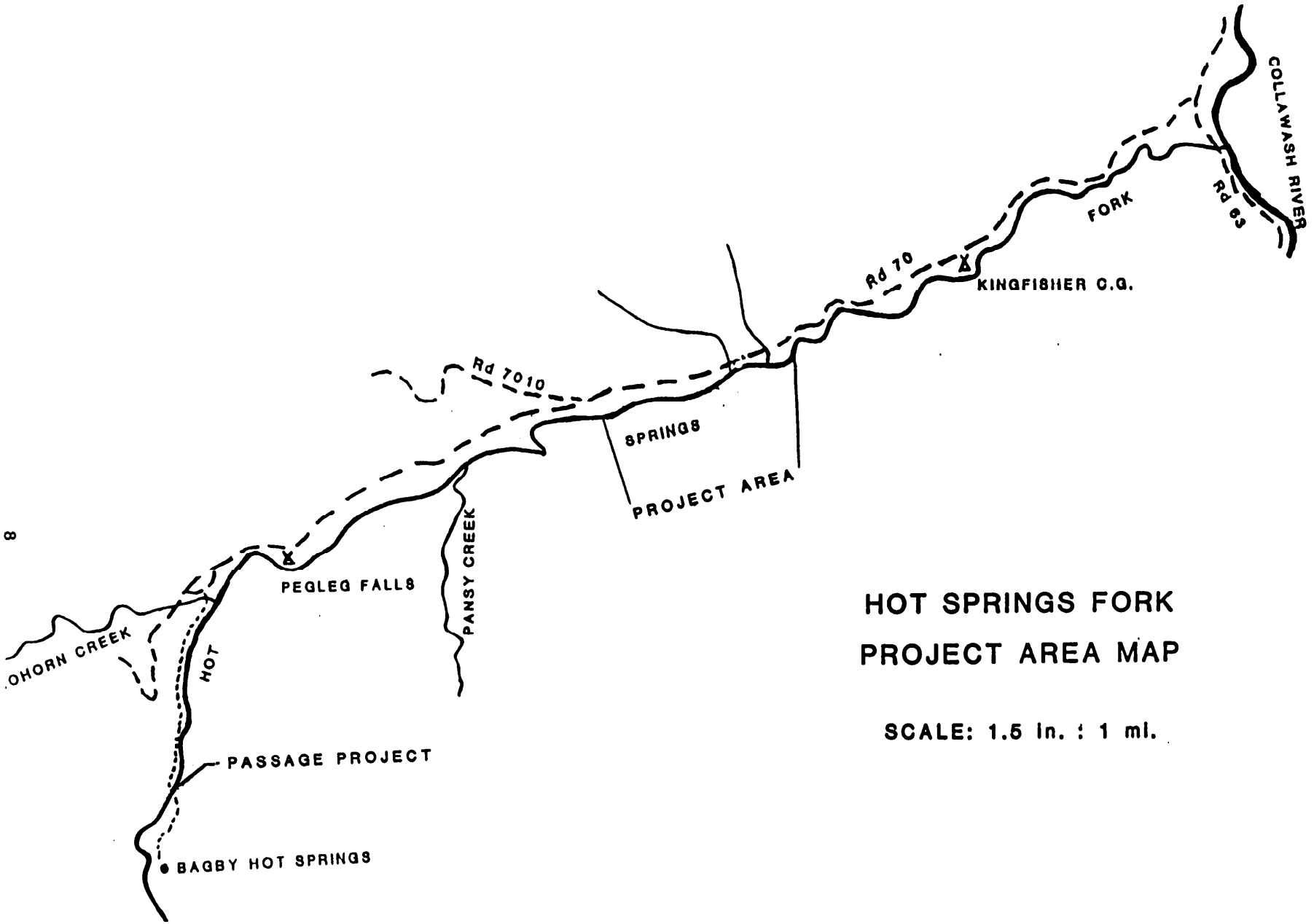
1. Personnel	19.676.61
2. Travel	145.33
3. Expendable equipment	4,001.27
4. G&A Overhead (@12%)	2.858.78
5. Sub-contracts	10.835.00
6. Total Cost	$37,516.99

APPENDIX A:

PROJECT AREA MAPS

VICINITY MAP.
HOT SPRINGS FORK SUB-DRAINAGE



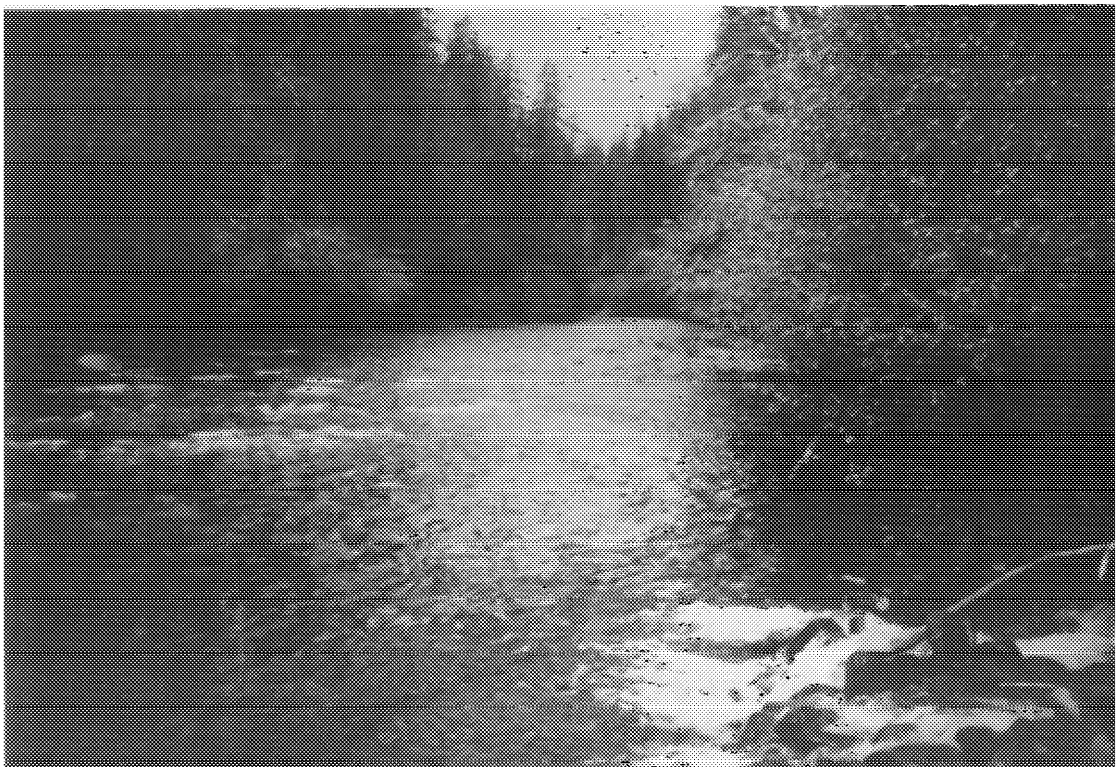


HOT SPRINGS FORK
PROJECT AREA MAP

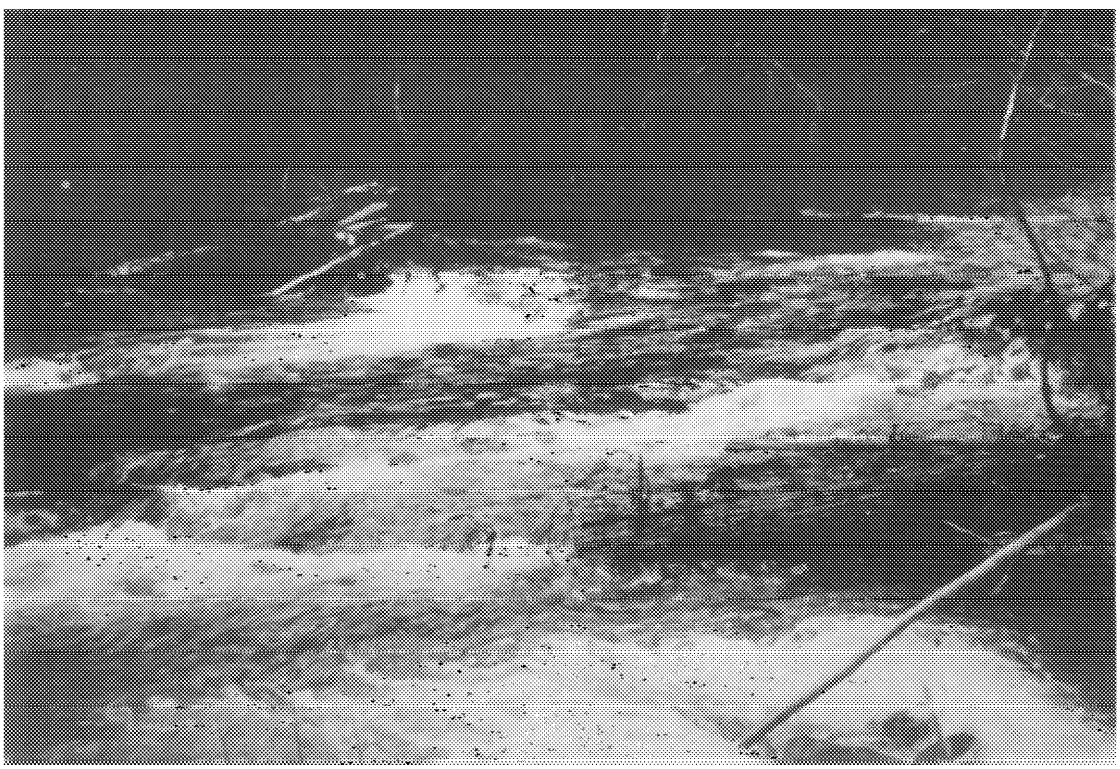
SCALE: 1.5 in. : 1 mi.

APPENDIX B:

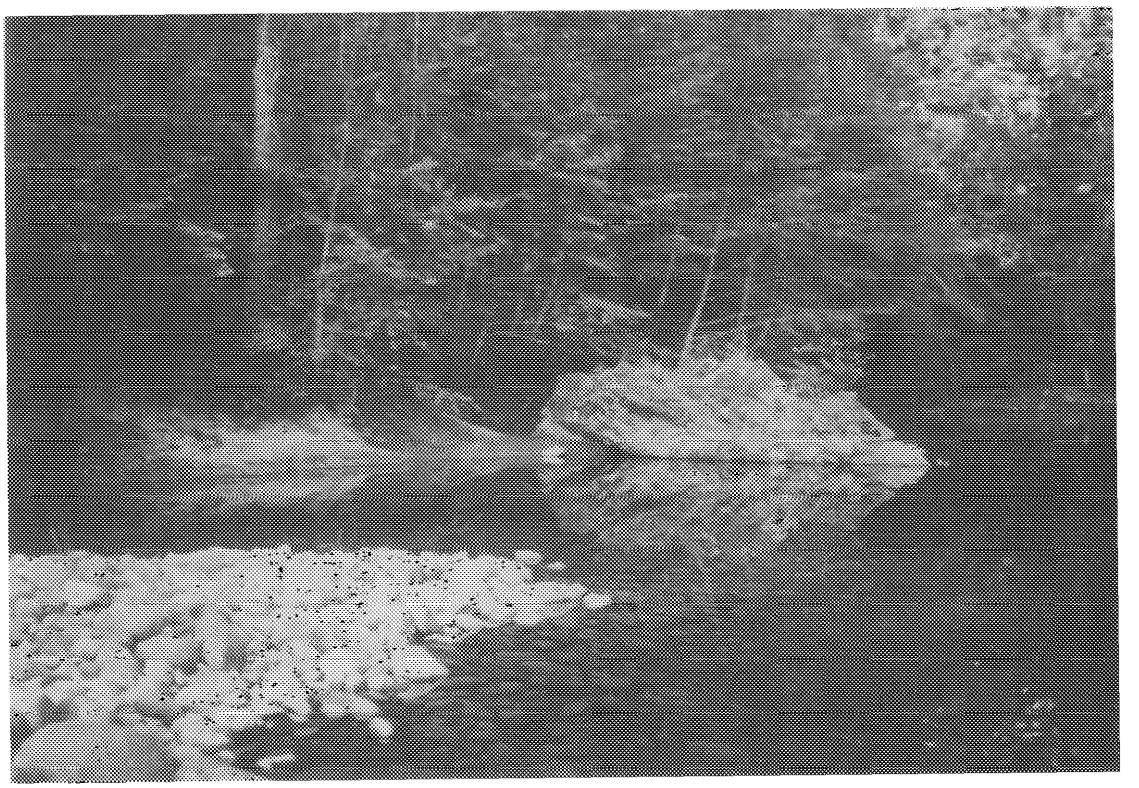
PROJECT PHOTOS



The Hot Springs Fork is a broad channel, high energy stream with limited large channel structure and habitat complexity.

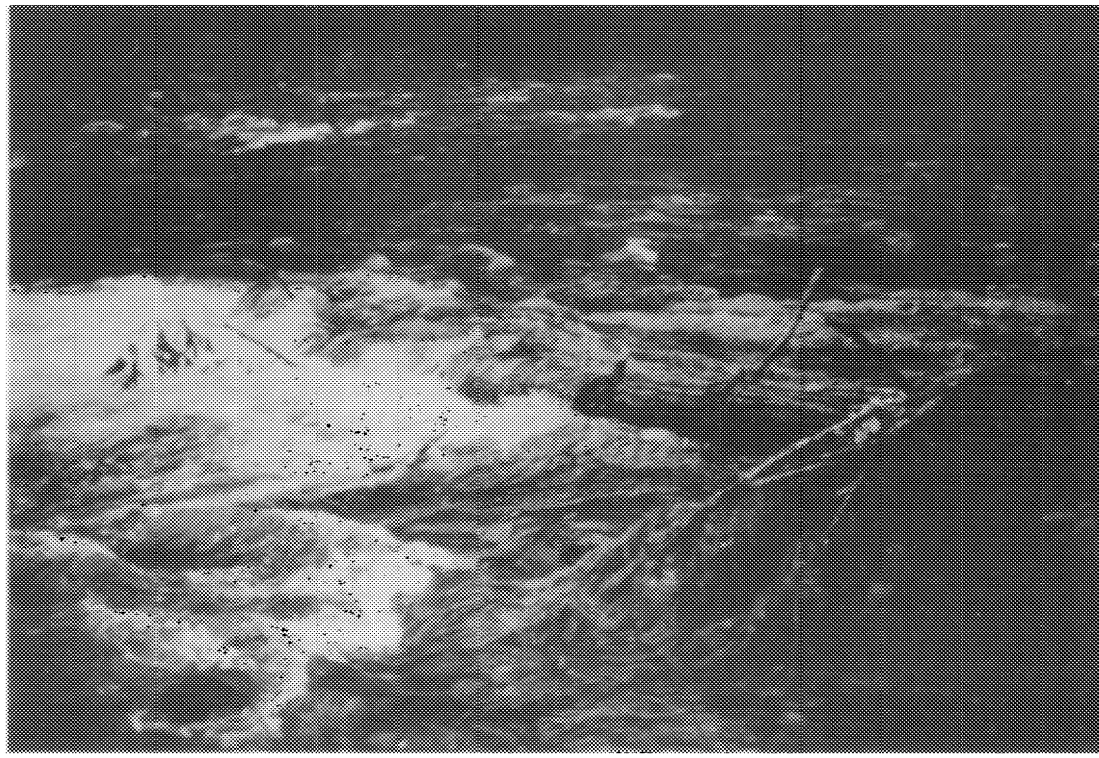


Trees and boulders were used to scour pocket pools and to provide cover during high flows. This photo is taken from the same area as the previous photo, only at a different angle.

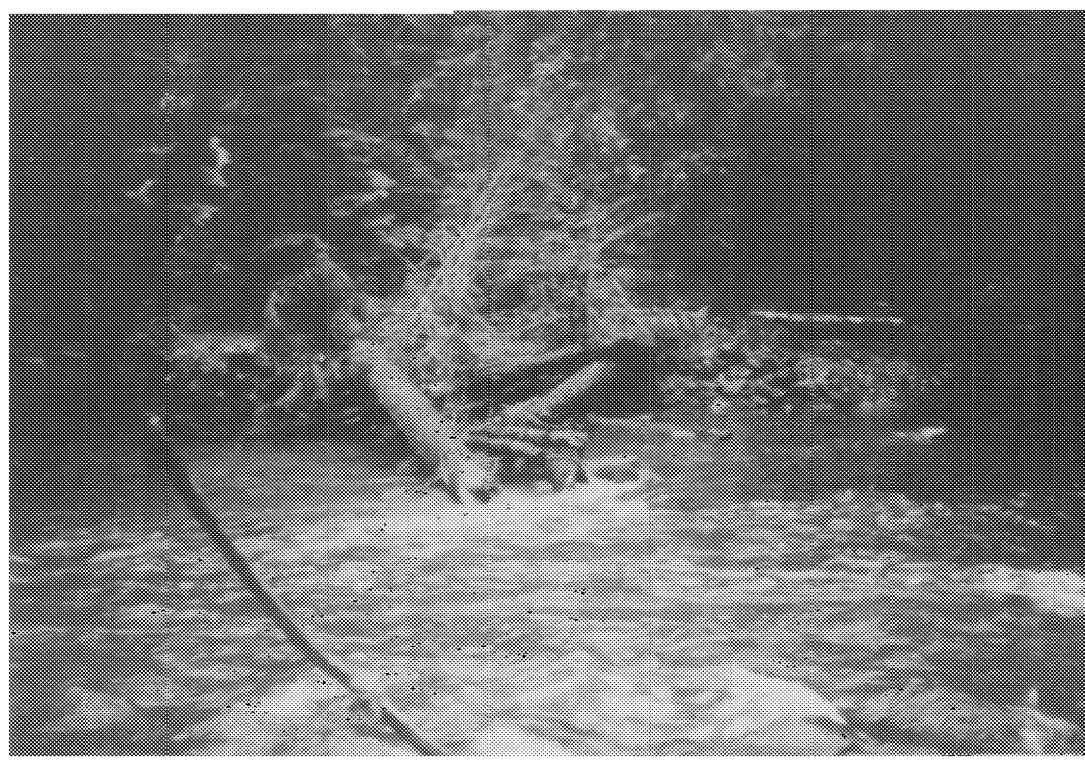


Bedrock controls in the Hot Springs Fork are responsible for scouring large deep pools. These pools typically lack effective hiding cover.

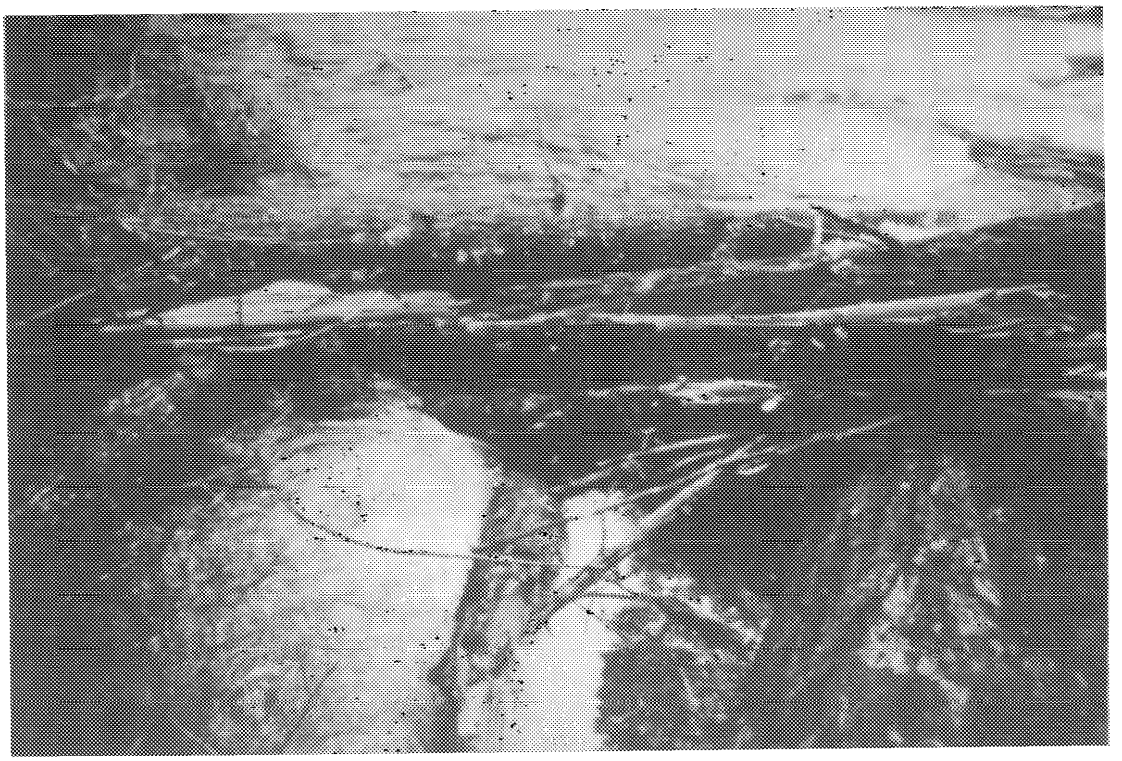
Logs and boulders were added to pools in the project area to provide cover. The log in the foreground was originally oriented at a different angle, but was one of three structures that shifted during a high flow event in November 1986.



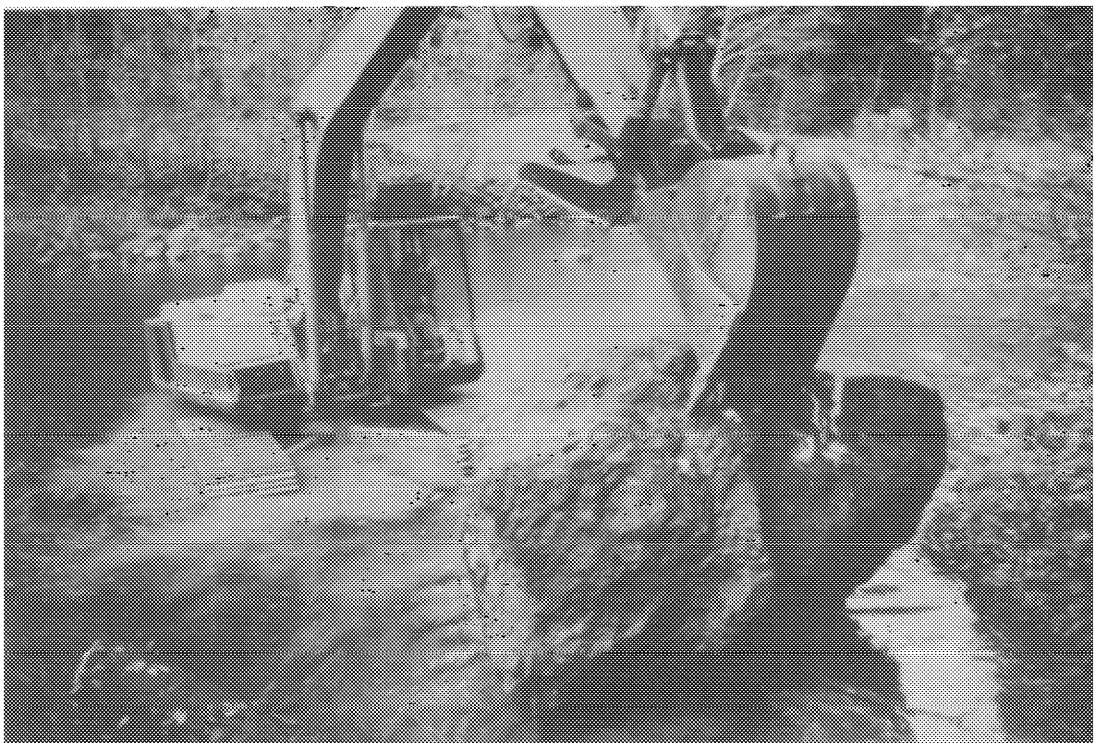
Trees were placed individually...



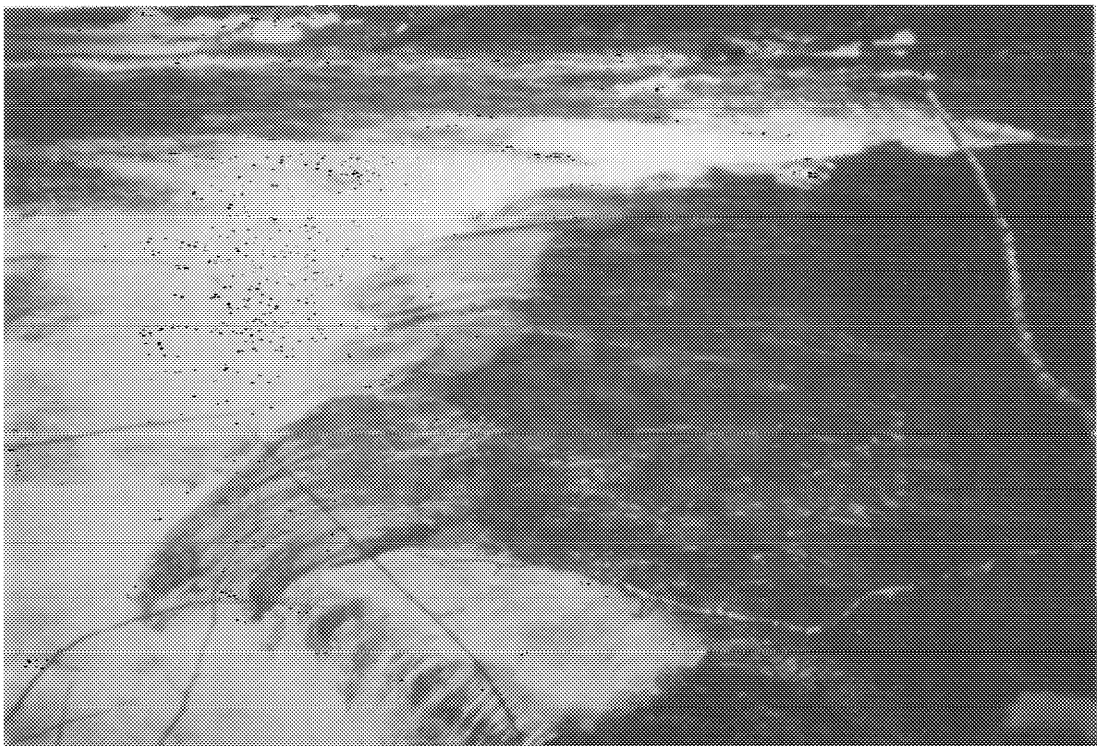
...and in multi-log "V" structures.



Small floatable debris trapped by the logs help increase the complexity of the structures. The debris pictured here was caught inside a log "Y".



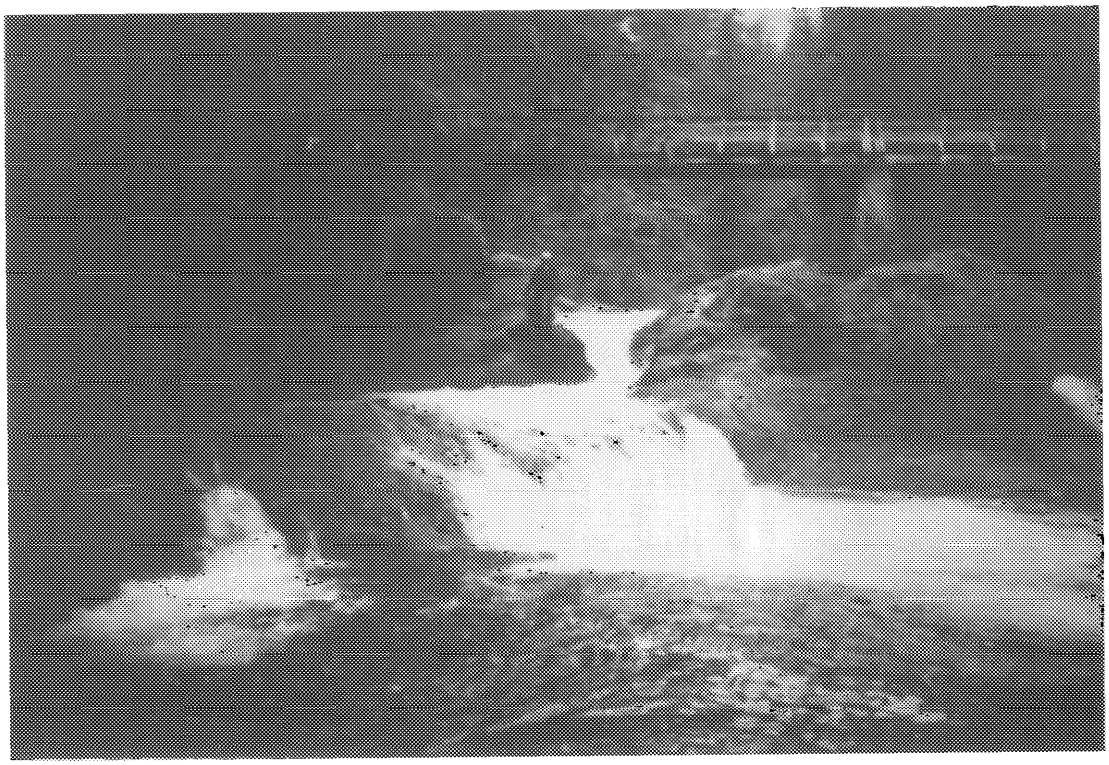
A large track-mounted backhoe was used to place the logs and rocks. Here the backhoe moves a boulder to be placed in the stream.



Boulders hauled to the site were used to anchor trees and to provide structure in the channel. This half-berm was designed to trap gravels for spawning and to scour pocket pools.

The excavated side channel is actually an extension of a secondary channel. This photo shows the flow release structure that diverts water into the excavated channel while allowing higher flows to spill back towards the mainstem.

The side channel was designed to provide overwinter rearing habitat and additional spawning habitat. Initial structure (downed logs) was pulled into the channel at the time of excavation. Additional structure will be added after the channel has been allowed to flush for a season.

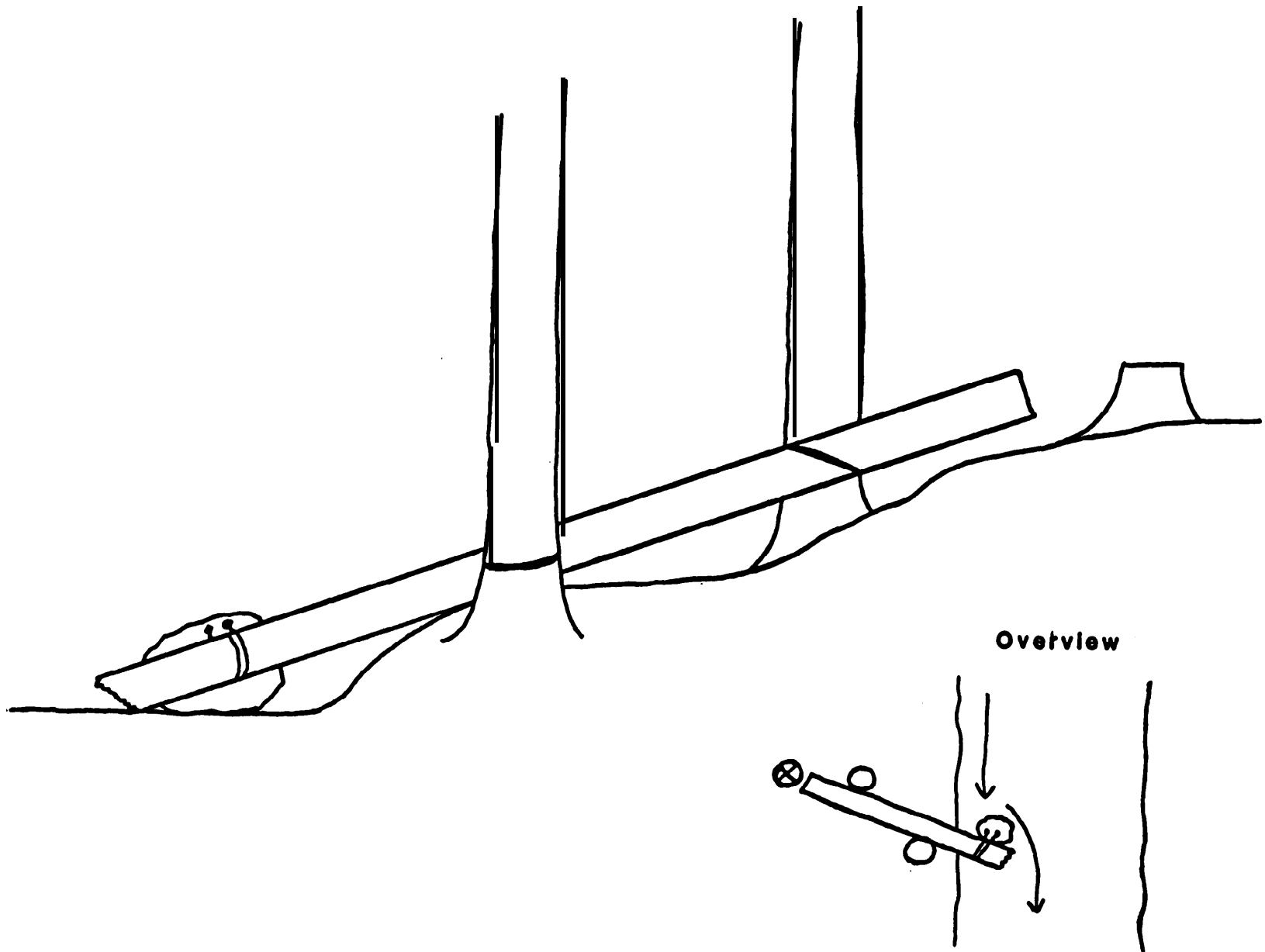


This waterfall at RM 7.1 is a partial passage barrier to three miles of good quality habitat. Modifications to the falls using non-explosive techniques were not successful in 1986. Additional work, scheduled for 1987, is needed to improve passage.

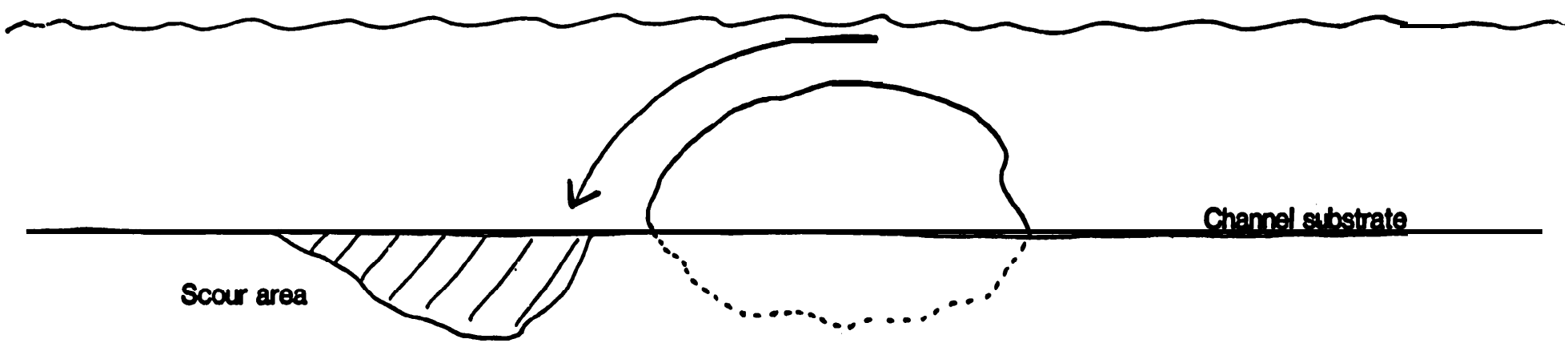
APPENDIX C:

LOG ANCHORING AND BOULDER SEATING TECHNIQUES

Appendix C - 1 Log Falling and Anchoring Technique



Appendix C - 2 BOULDER "SEATED" IN STREAM



COLLAWASH RIVER FALLS PASSAGE IMPROVEMENT PROJECT

ANNUAL REPORT FY 1986

by

Ron Medel, Fisheries Biologist
Mt. Hood National Forest
Clackamas Ranger District
Estacada, Oregon

Prepared for

Kathy Anderson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-A179-84 BP16726
Project No. 84-11

April 1, 1987

Table of Contents

List of Figures 22

Acknowledgements 23

Abstract 24

Introduction 25

Description of the Study Area 25

Methods and Materials 27

Results and Discussion 27

Summary and Conclusion 29

Summary of Expenditures 29

Appendix A - Environmental Assessment 30

List of Figures

Figure 1. Project Location Map 22

Figure 2. Alternative 2 (Preferred > Project Site Map 28

ACKNOWLEDGEMENTS

Appreciation is expressed for the support and assistance of Dave Hohler, Harv Forsgren, Dave Heller, Elizabeth Holmes, Dale Kanen, Lynn Smith and Sherrie Wise.

ABSTRACT

The Collawash River is the largest tributary of the upper Clackamas River, providing approximately one third of the low flow volume. Fish habitat is generally rated good to excellent throughout the Collawash. A 12-15 foot falls at RM 7.4 is a partial to complete barrier (depending on discharge) to spring chinook, coho salmon, and steelhead. The falls blocks access to an estimated 10 stream miles of upstream anadromous fish habitat.

1986 was the third year of planned multi-year efforts to improve anadromous fish passage at Collawash River falls. Accomplishments for 1986 included the processing of environmental documentation stating selection of the preferred action alternative (pool development), preliminary designs for jump pool construction by a fisheries engineer, intensive project site surveys and topographic map development, and preparation of the contract for final design and construction.

All work was completed within the programmed budget and time frames identified in the 1986 work statement.

INTRODUCTION

In 1986 site surveys and preliminary project designs were completed for a passage facility to improve upstream migration conditions at Collawash Falls, on the mainstem Collawash River, a major tributary to the Clackamas River. A contract package for final design and construction was also prepared. The Bonneville Power Administration funded the project as part of the Clackamas/Hood River Habitat Enhancement Project Agreement (Project 84-11). A total of $33,864 was budgeted for project planning in 1986. Actual expenditures totaled $10,365. When implemented in 1987, the project will provide unimpeded upstream passage for spring chinook and coho salmon, and steelhead trout into about 10 miles of high quality spawning and rearing habitat.

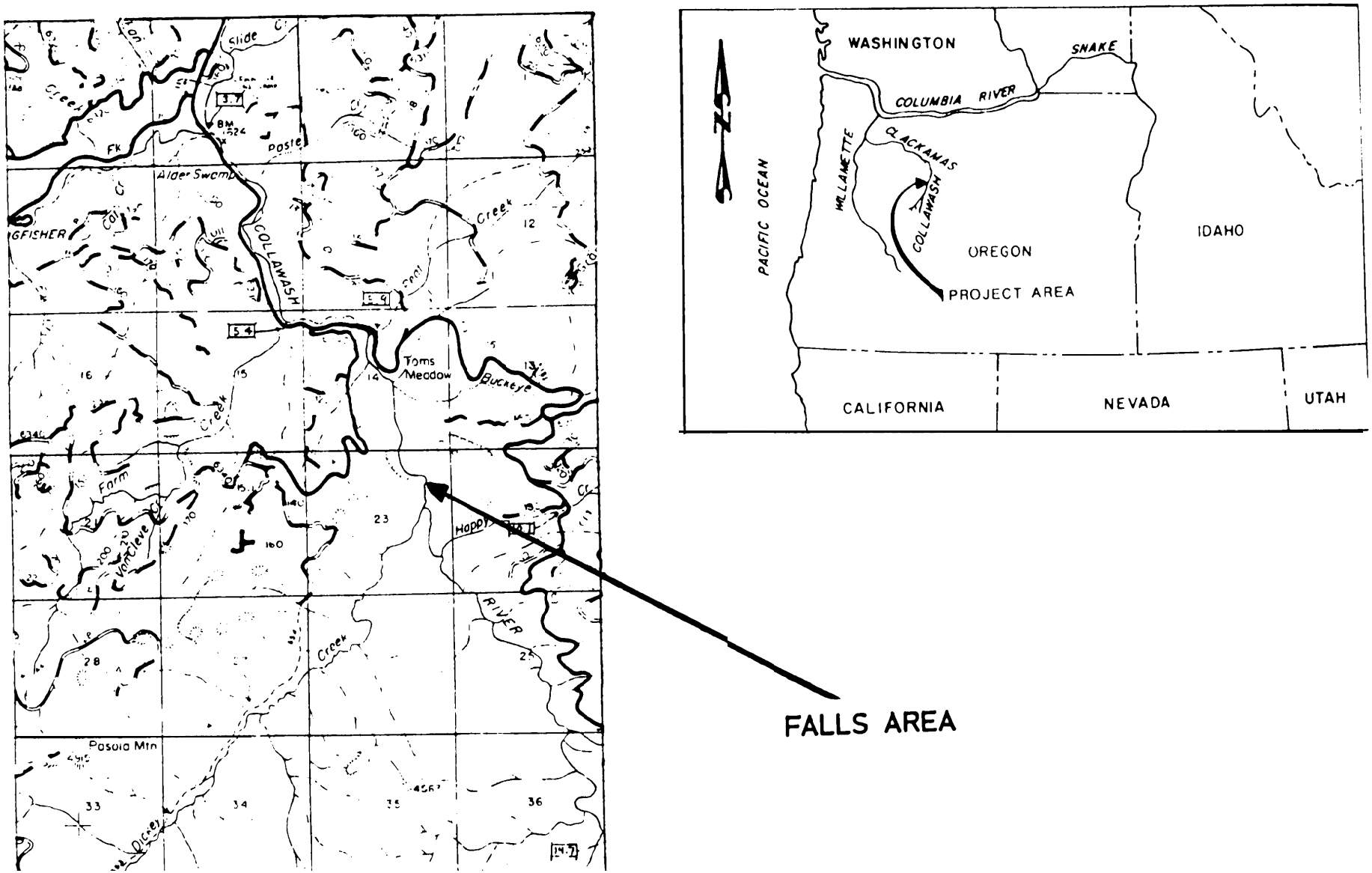
DESCRIPTION OF THE STUDY AREA

The Collawash River is the largest tributary of the upper Clackamas River, with a mainstream length of 11.6 miles and a basin area of 150 square miles (FIGURE 1). The stream provides one third of the low flow volume of the Clackamas River. The entire Collawash River drainage is on National Forest System lands. Overall fish habitat is rated good to excellent, with good holding and rearing habitat present throughout the system. Depending on flows during migration, a 12-15 foot falls at RM 7.4 is a partial to complete barrier to spring chinook and coho salmon, and steelhead. The falls restrict access to approximately 10 miles of upstream habitat, including an estimated lO,OOO-12,000 square yards of high quality spawning gravels. An additional 5 miles of habitat could be made available in the East Fork of the Collawash with minor blasting work on small chutes and falls.

Native cutthroat and rainbow trout populations are present above the falls. Summer steelhead have been observed to pass the falls at an estimated 10 to 20 per cent success rate. Current management emphasis is to increase naturally reproducing runs of anadromous fish in the drainage. Construction of a fish liberation access site above the falls, for the PGE/ODFW spring chinook trap and haul program, was accomplished by the Forest Service in summer of 1984. In summer of 1985, 30,000 spring chinook presmolts were stocked at this liberation site.

The falls are located in a deeply incised gorge. Access and working conditions at the site are difficult. In 1974-1975 the USDA Forest Service invested more than $40,000 to improve fish passage at the falls and several upstream cataracts. Although successful at the upriver sites, work at the main falls was terminated due to safety concerns over stability and condition of the steep headwall adjacent to the project area. The project feasibility report by Ott Water Enginnering (1986) identified four passage alternatives that could safely be implemented to meet the project objective of improving fish passage.

FIGURE 1. Project location map for Collawash Falls passage improvement.



METHODS AND MATERIALS

The Collawash Falls Project Environmental Assessment (APPENDIX A) selecting the preferred action alternative was developed by the Forest Service and formally signed in May of 1986. The selected alternative (number II) was pool excavation. FIGURE 2 is a diagram of the proposed improvement plan. The alternatives evaluated were based on those described in the Ott Water Engineering feasibility report (1985 BPA Attainment Report). The Ott Water report evaluated the economic and engineering feasibilities of four alternatives for providing passage at Collawash Falls.

Preliminary design plans, for the selected alternative, were needed to provide contract development direction. In June of 1986, a Forest Service fisheries engineer and passage facility specialist, Dale Kanen, was detailed to the Mt.Hood National Forest from the Chatam Area of the Tongass National Forest. Upon completion of the assignment, Mr. Kanen produced preliminary jump pool designs and recommendations for implementation of the selected action alternative.

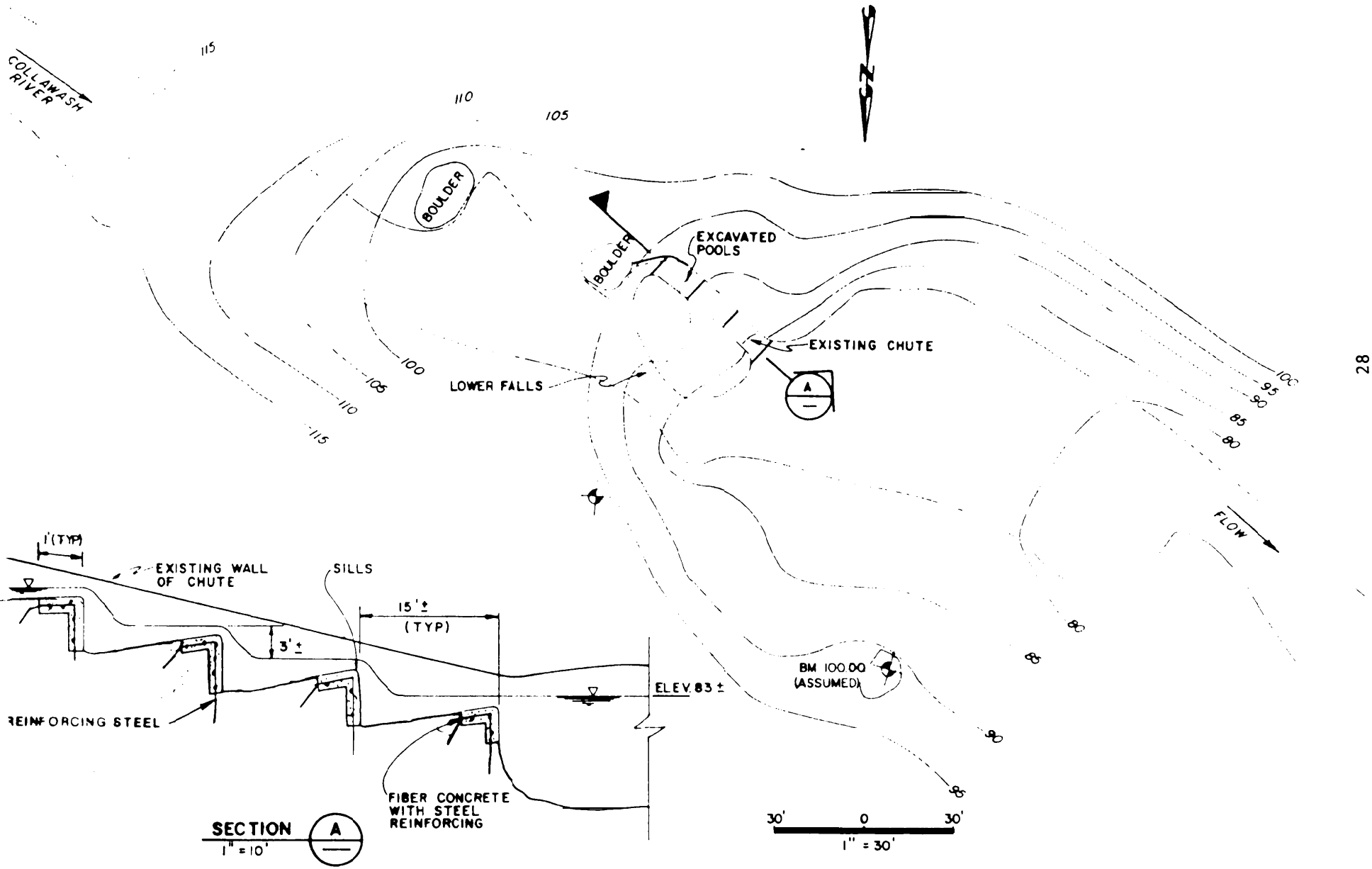
In October of 1986, Forest Service engineers on the Mt. Hood National Forest conducted intensive site surveys at the falls, during an unseasonally low flow period. Conventional survey equipment was used to conduct the surveys. This was followed by production of topographic blue line project site maps. This information, as well as that from Mr. Kanen, was used in development of the final design and construction contract package.

The design and construction contract package development began in January of 1987 in the Mt. Hood Supervisors Office's contracting department. Forest engineers and contracting specialists utilized preliminary project specifications from the District Fisheries Biologists (Estacada, Clackamas), and a sample fish passage project design and construction contract from the Stikine Area of the Tongass National Forest (Irish Creek Project) to develop the contract specifications. Comments from persons involved in the Irish Creek project regarding contract implementation problems were helpful in developing the Collawash Falls contract. The target date for advertisement is May 1, 1987. An award date of July 1, 1987 is anticipated; with construction planned for July 15 to August 30, 1987.

RESULTS AND DISCUSSION

Collawash Falls project work scheduled for 1986 proceeded as scheduled until final design contract development. Adjustments were made to ensure specifications of the contract would be accurate, and well defined. A recently developed (1984) "design and construction" contract for a fish passage facility on Irish Creek in Southeast Alaska was used to facilitate contract preparation. Communication with project leaders for the Irish Creek project, identified problems encountered with implementation of that project. Proper development and precise wording of the Collawash Falls project design and construction contract specifications are viewed as critical elements in accomplishing the project objective within projected costs.

FIGURE 2. Preferred alternative for passage facility at Collawash Falls. (Alternative 2 of Ottwater Engineering Feasibility Report)



The objective of successfully improving fish passage over the falls, and doing so within the programmed budget' resulted in a decision to complete the project with a single "design and construction" contract rather than with separate "design" and "construction" contracts. It is felt that combining the contracts will result in a decrease in cost, and improve construction contractor "ownership" in the design. Successful bypass of Collawash Falls will make accessible about 10 miles of high quality spawning and rearing habitats, capable of producing at least **33,798** additional smolt annually' including about **7,984** steelhead, **18,593** chinook' and 7,221 coho.

SUMMARY AND CONCLUSIONS

Activities for the **1986** BPA contract period included selection of a preferred alternative addressed in an Environmental Assessment on the Collawash Falls fish passage project, preliminary designs for pool construction and development by a fisheries engineer, intensive project site surveys and topographic map production, and preparation of the final design and construction contract.

Final design and implementation of the project is scheduled for **1987.** Completion of the project will provide chinook and coho salmon and steelhead trout unimpeded access to about 10 miles of high quality spawning and rearing habitat. It has been estimated that as a result of the project, approximately **33,798** smolt will be produced annually.

Project expenditures for **1986** were substantially less than the budget amount approved by BPA. This is principally due to the decision to combine the "design" and "construction" contracts. The funds budgeted in **1986** for the design contract will be expended in the **1987** work period.

SUMMARY OF EXPENDITURES

1.	Personnel	**$9,008.04**
2.	Travel/Per Diem	**103.50**
3.	Expendable Materials	**143.36**
4.	G&A Overhead (12%)	1,110.59
5.	Total Costs	$10,365.49

APPENDIX A:

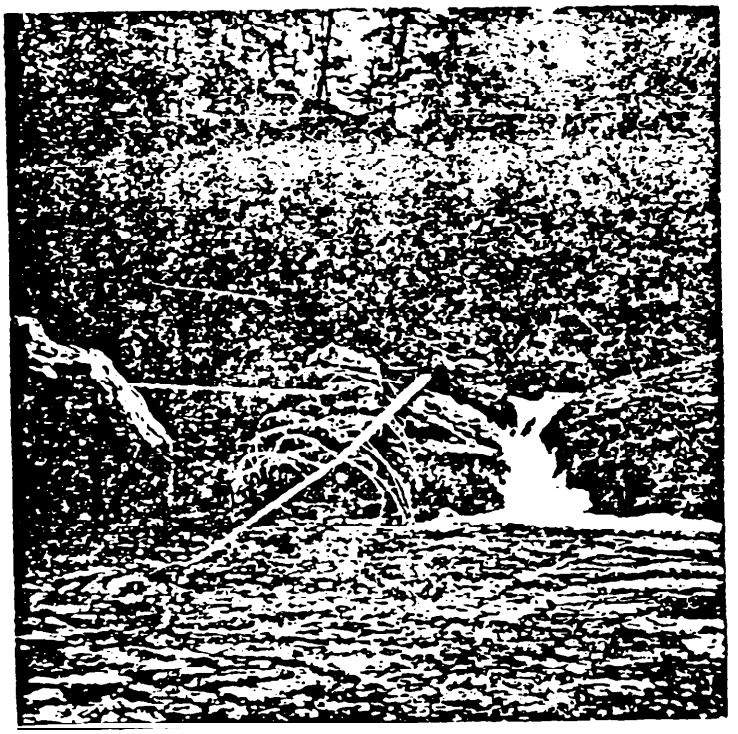
Environmental Assessment for the Collawash River Falls Passage Project

PROVIDE ANADROMOUS FISH PASSAGE

OVER THE COLLAWASH RIVER FALLS

MT. HOOD NATIONAL FOREST

ENVIRONMENTAL ANALYSIS REPORT



U.S.D.A. FOREST SERVICE ENVIRONMENTAL, ANALYSIS REPORT

PROVIDE ANADROMOUS FISH PASSAGE
OVER THE COLLAWASH RIVER FAILS
MT. HOOD NATIONAL FOREST

PREPARED BY: RAYMOND W. SCHARPF

January 31, 1974

ENVIRONMENTAL ANALYSIS REPORT SUMMARY

USDA FOREST SERVICE ENVIRONMENTAL ANALYSIS REPORT

PROVIDE ANADROMOUS FISH PASSAGE
OVER THE COLLAWASH RIVER FAILS

MT. HOOD NATIONAL FOREST

SUMMARY SHEET

1. Administrative (X) Legislative ( )

II. This project is designed to provide anadromous fish passage over two falls on the Collawash River. These falls are located approximately 7.5 miles upstream from its confluence with the Clackamas River in Clackamas County, Oregon.

III. After analyzing all impacts, . none are considered to have significant adverse effects on the environment.

IV. Alternatives considered were:

A. No change. Leave river in its present state.

B. Develop a series of jumping pools by blasting simple holes in the bedrock chute along the east river bank. (Preferred alternative)

C. Construct a detailed ladder facility along the west bank by blasting a chute in the bedrock and forming pools with a system of stop-logs.

D. Install a portable fish ladder.

V Comments were requested and received from the following:

Federal Agencies

National Marine Fisheries Service, Columbia Fisheries Program Office, Portland, Oregon.

Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Portland Area Office, Portland, Oregon.

Forest Service, Mt. Hood National Forest, Portland, Oregon

State Agencies

Oregon State Fish Commission, Office of the Director, Portland, Oregon.

Oregon State Game Commission, Office of the Director, Portland, Oregon.

VI. Significant Environmental Impact ( ) Yes ( ) No

CONTENTS

		Page
I.	DESCRIPTION	1
	A Proposal	1
	B. Objectives	1
	1. Environment	1
	2. Economic and Social	2
	c. Location	2
	D. Size	2
	E. Landownership	2
	F. Physiography	2
	l. Landform	2
	2. Spawning Gravel	3
	G. Climate	6
II.	ALTERNATIVES TO THE PROPOSED ACTION	
	A. No change. Leave river in its present state.	6
	B. Develop a series of jumping pools by blasting simple holes in the bedrock chute along the east river bank.	6
	c. Construct a detailed ladder facility along the west bank by blasting a chute in the bedrock and forming pools with a system of stop-logs.	6
	D. Install a portable fish ladder.	7
III.	ENVIRONMENT IMPACTS	7
	A. Economical and social	7
	B. Physical	8
	1. Soil Impact	8
	2. Visual Aspect	8
	3. Watershed Impact	8
	c. Biological	9
IV.	FAVORABLE ENVIRONMENTAL EFFECTS	9
	A. Economical and social	9
	B. Biological	9

		Page
V.	ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED	10
	A. Economical and Social	10
	B. Physical	10
	1. Soil Movement	10
	2. Visual Changes	10
	. 3. Water Quality Changes	10
	C. Biological	10
VI.	RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE OF LONG-TERM PRODUCTIVITY	10
VII.	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES	10
VIII.	SUMMARY OF ALTERNATIVE ASSESSMENT	ll
Ix.	CONSULTATION WITH OTHERS'	12
X.	MANAGEMENT REQUIREMENTTS AND CONSTRAINTS	13
XI.	APPENDIX A	
	Physical and Biological Stream Survey	
	APPENDIX B	
	Maps	
	APPENDIX C	
	Comments Received	

I. DESCRIPTION

A. Proposal

The Mt. Hood National Forest and the Oregon State Fish Commission have proposed to enter into a cooperative agreement to provide anadromous fish passage over two impassable falls on the Collawash River. The anadromous fish involved are spring chinook salmon (Oncorhynchus tschawytscha), coho salmon (Oncorhynchus kisutch), and steelhead trout (Salmo gairdneri). This project has been on the Clackamas Ranger District% Wildlife Project Funds Request, Five-Year-Action-Plan, for approximately ten years.

While the upstream falls is relatively low. and can be removed by blasting a few large boulders, the lower falls is much higher and will require a more complicated solution. The lower falls will require some type of facility which will provide several jumping pools. Although numerous types of fish ladder designs exist, most must be eliminated due to the remoteness of the site in question, and the insurmountable, problems involved in building road access to the falls. Therefore, engineering and fisheries personnel agreed to three possible structures which could be constructed without road access. Those structures considered were:

1. Installation of a portable type, such as the Alaskan Steepass (a sectional structure utilizing light weight aluminum materials).

2. A constructed facility involving the blasting of simple holes in a bedrock chute along the east bank.

3. A constructad facility involving the blasting of a chute in the bedrock along the west bank, but which would require construction of weirs utilizing channel iron and wooden stop logs.

The objective of this report is to determine if the proposed passage is possible without causing major conflicts to other resources, and for reaching a decision on this project.

B. Objective

1. Environmental

a. Provide passage for anadromous fish over two impassable falls on the Collawash River.
b. Make available excellent but inaccessible spawning gravels and rearing areas for anadromous fish.

2. Economic and Social

a. Increase sport and commercial fisheries resource values. These values will accrue to the Clackamas, Willamette and Columbia River systems, as well as to the ocean.
b. Develop an inexpensive facility that will pass -fish, and which will require a minimum amount of maintenance.

c. Location

The lower project site is located on the Collawash River approximately 7.5 miles upstream from its confluence with the Clackamas River. The upper site is approximately 0.3 miles upstream from the lower site. Both sites are located on the Clackamas Ranger District, Mt. Hood National Forest, Clackamas County, Oregon. More specifically, the project sites are located on the NW$\frac{1}{4}$ of the NE$\frac{1}{4}$ of Section 23, T.7S, and R.6E., W.M.

The nearest road is approximately 1.25 miles from the project. The project is reached over 1.25 miles of trail of which .75 miles is in existence and the other .50 miles is cleared, but without a defined walkway. The project area is approximately 13 miles from the Ripplebrook Ranger Station.

D. Size

The combined size of the two sites covers an area approximately one half acre in and adjacent to the Collawash River.

E. Landownership

The land is all National Forest.

F. Physiography

1. Landform

The elevation is approximately 2,000 feet in the area of the two falls, with a 60% slope on both sides of the river.

On the east side of the lower falls, the river is bordered by a large active landslide. The surface is marked by steep scarps, hummocky slide blocks, split trees and tension cracks, which are features of an active slide. The slide is displacing the river channel to the west by movement of large slide blocks into the channel. The west channel bank is a vertical to overhanging cliff some 100 to 1% feet in height, which rises directly from the bedrock ledge.

The ledge proper is a resistant zone which crosses the channel and dips below the stream bed, both up and down the stream from the constriction. 1/ The river above the falls cascades for 300 feet through a bedrock chute that. has a vertical height of 15 feet. The falls itself has a vertical drop of approximately ten feet.

The upper falls is characterized by landslide activity on the east bank and an exposed resistant zone of bedrock on the west bank. Upstream from the two falls, river gradient becomes moderate. In this reach are large quantities of excellent spawning gravels.

The rock units at the lower falls are interbedded volcanic sediments, breccias and lava flows which have been warped upward into a large fold. The axis of this fold crosses the river at the constriction, hence the narrow exposure of resistant rock. The west side cliff exposes the typical bedrock sequence. From the channel upward, this consists of the resistant ledge overlain by 30 to 40 feet of bedded sediments and breccia. These are, in turn, overlain by $0 to 70 feet of lava flows which are vertically jointed, cross-jointed and fractured. The cross joints dips steeply toward the channel, thus providing planes for sliding failure of joint blocks. A talus apron blankets the lower cliff toe. The cliff top is blanketed by a stoney soil *mantle* which has locally sloughed into the canyon. 2/

2. Spawning Gravel

The river above the falls contains many thousand yards of excellent spawning gravel. A survey was conducted in August, 1972, to determine the number of square yards of gravel suitable for anadromous fish. At maximum utilization this gravel could accomodate in excess of 3,000 spring chinook salmon, 2,000 steelhead trout, and 1,000 coho salmon.

Fry production from the gravel could amount to 7,000,000 spring chinook salmon, 3,000,000 steelhead trout, and 1,500,000 coho salmon. 3/ For additional information see the Physical and Biological Stream Survey in Appendix A.

1/ Patterson, P.V., 1972. Reconnaissance Investigation for Bedrock Ledge Removal, Collawash River above Buckeye Creek, NW¼ of NW¼ Sec. 23, T.7S., R.6E., W.M.

2/ Ibid

3/ Collins, M.D., 1973. Biological Justification for Providing Fish Passage at Collawash River Falls.

G. Climate

The isophyetal map shows the area receives 70 to 80 inches of precipitation annually. Snow usually covers the area from late December through March.

II. ALTERNATIVE TO THE PROPOSED ACTION

Analysis of data indicate the following alternatives are possible:

A. No Action - Leave the river in its present state

With this action, approxitely 27,000 square yards of excellent spawning gravel would continue to be inaccessible to anadromous fish. Also, excellent holding areas for adult fish and rearing areas for juvenile fish would continue to be virtually unused. A-fisheries valued conservatively at $119,000.00 per year, would be lost.

Factors that would remain unchanged with no action alternatives, would be the water quality and aesthetic value of the river frontage.

B. Develop a series of simple, inexpensive jumping pools in the boulders and bedrock along the east bank.

With this action, there would be approximately 27,000 square yards of spawning gravel made available and capable of supporting 3,000 spring chinook and 1,000 coho salmon and 2,000 steelhead trout spawners. These fish could contribute an estimated $ll9,000.00 annually to Oregon's economy through sport and commercial fishing.

The estimated cost of this facility is $l0,000.00. It would require a minimum of maintenance. *There* is some chance that the facility could become inoperative by mass sloughing from tie east bank,

Impacts resulting from this alternative are minimal. They include:

1. Short-term increases in stream turbidity during construction.
2. Reduced fishing success downstream: during periods of increased turbidity.

c. Construct an elaborate and expensive ladder facility by blasting a chute through the bedrock on the west side of the stream and installing iron and wooden weirs to form jumping pools.

This action would provide tie same fishery resource benefits as described in Alternative Number Two. However, it would in all probability be more efficient in passing fish upstream during periods of high stream now.

Conservative construction costs for this type of structure would be $40,000.00. Maintenance costs would be approximately the same as those required for the more simple structure described in Alternative Number Two. This facility would also be exposed to the danger of being filled by sloughing of large materials from tie west bank.

The impacts from this alternative are slightly greater than Alternative Number Two. They include:

1. Short-term increases in stream turbidity. However, this alternative would require a greater number of days for construction than that required by Alternative Number Two.

2. Reduced fishing success downstream during periods of increased turbidity.

3. Visual quality of the falls would be reduced slightly for some, individuals during periods of low. stream flow, due to the appearance of the facility flow.

D. Install a portable fish ladder.

This action would also provide the same benefits as those described in Alternative Number Two. It would be the most efficient of all alternatives but also the most difficult to protect and maintain. It would cost an estimated $40,000.00 to install. Risk factors of loosing such a facility during floods is extremely high. This type of structure also requires costly maintenance to keep it operational.

Environmental impacts for this alternative are primarily visual. Being man-made and installed above the river would reduce visual qualities much more than the rock cuts described in Alternatives Two and Three. Impacts on water quality and fishing success would be greatly reduced in comparison to the other structures described.

III. ENVIRONMENTAL IMPACTS

A Economic and Social

The project area is located approximately 13 miles from the nearest community. This community consists of a Forest Service Ranger Station, a Civilian Conservation Center, and attendant employee housing. Estacada, the nearest town to the project sites, is approximately 39 miles away, and has a population in excess of 1,200 residents. The city's economy is based on the timber industry. Estacada receives its domestic water supply from the Clackamas River of which the Collawash River is a tributary.

If accomplished, this project would increase the anadromous fishery resources in the Clackamas River portion of the Willamette River system. Benefits would also accrue to the Columbia River and ocean fisheries.

This would increase the number of fish available to both the sport and commercial fishermen. Portland General Electric has undertaken extensive work on Ladder facilities at River Mill Dam to improve and expedite passage.

Projected fish production from this proposal is not presently available to either sport or commercial fishermen. Therefore, if the project was not completed, it would *not* create a community distress. In the very near future, this picture could change drastically. As demonstrated by other resource shortages, an increased demand for sport and commercial fish species may occur.

B. Physical

There are three physical environmental impacts related to the immediate project sites. These are impacts to soil, visual aspects and watershed.

1. Soil Impact

The extent of soil disturbance that could occur is dependent on which passage alternative is selected. If the river is left in its present state with no provisions for passage, there will be no soil disturbance caused by man's activity. However, if the most elaborate rock cut facility is developed, it is possible that blasting might cause the slide on the east bank to move, and would create some downstream sedimentation. The chances of this occurring are not very probable. It is also possible that some rock might be dislodged from the overhang on the west side of the river during blasting operations.

Other alternatives with less elaborate structures would probably create lesser amounts of soil disturbance.

2. Visual Aspect

The amount of visual impact will depend on the selected alternative. If the river is left in its present state, changes to the aesthetic value of the river frontage would be left to the hands of nature. Any type of engineered structure installed would create some visual impact.

The question of how much of a visual impact can be tolerated in this section of the river would have to be considered, and the type of design to reduce the visual impact would have to be determined.

3. Watershed Impact

Removal of materials from the river channel for construction purposes will create some turbidity. However, due to type or the solid nature of these materials, combined with a dilution factor, turbidity levels should not affect potability for downstream users.

If the river was left in its present state, the only changes to

water quality would be caused by natural means.

C. Biological

It appears that the only biological impact involves aquatic resource At present, there is a small resident population of cutthroat trout (Salmo clarki), which are found above and below the project sites. Other species found below the project include rainbow trout (both resident and anadromous), and coho and chinook salmon. Turbidity created from possible blasting operations would have minimal impact on these fisheries. The adverse impact will involve reduced fishing success from turbid water. This impact should be less intensive than that which occurs during periods of high water caused by winter storms. Aquatic animals may be temporarily disturbed during periods of blasting operations. The disturbance should be of a short duration.

IV. FAVORABLE ENVIRONMENTAL EFFECTS

Several of the above environmental impacts have a favorable effect on the environment.

A. Economical and Social ,

By providing fish passage, both sport fishermen and commercial fishing industry would benefit. The following chart shows approximate annual values that could be accrued by the State of Oregon from fish production above the Collawash falls.

Species	No. Fish	Lbs./Fish	Tot. Lbs.	$/Lb.	Total Value
Spring Chinook 4/	3,000	18	54,000	$1.00	$ 54,000
Coho 4/	7,000	7	49,000	1.00	49,000
Winter Steelhead 4/	2,000	---	---	8.00/fish	16,000
			Total		$119,000

The above chart is based on the relationship of data involving catch to escapement values. In the case of spring chinook and steelhead trout, it is safe to assume at least one fish is caught for each one returning to spawn.

Based on extensive marking study data, it is realistic to believe that- for every seven coho salmon caught, one will return to spawn. 4/

B. Biological

By providing some type of passage, 27,000 square yards of inaccessible spawning gravel would be made available to anadromous fishes. At maximum utilization, this gravel could accommodate in excess of 3,000 spring chinook salmon, 2,000 steelhead trout and 1,000 coho salmon,

4/ Ibid

with a fry production potential of 7,000,000 spring chinook salmon, 3,000,000 steelhead trout and 1,500,000 coho salmon.

V. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

A. Physical

1. Visual Changes

With the development of any type of engineered structure, a certain amount of visual changes will be created, The two sites are isolated from areas of concentrated use. The amount of visual impact that can be tolerated will have to be determined. This factor should not be of the magnitude to eliminate the development of an engineered structure.

2. Water Quality Chances

With the construction of any type of facility, there will be a certain amount of water quality change during construction. A certain amount of turbid material would enter the river from blasting operations, The turbidity in the river would only be short-lived. As soon as the construction phase was over, the water should be back to its original quality.

B. Biological

Turbidity created from blasting operations could adversely affect downstream fishing success. This impact should be less than that experienced during periods of runoff. The turbidity would only be a short-lived impact, occurring during blasting operations.

Also, some aquatic animal life may be temporarily disturbed during periods of blasting operations. This would be a short-lived impact.

VI. RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE OF LONG TERM PRODUCTIVITY

The short-term effect of providing fish passage would be to increase the number of anadromous fish available for both the sports fishermen and the commercial fishing industry. If fish passage was a reality tomorrow, it would be approximately five to ten years before maximum utilization of fisheries resource would be possible.

In essence, this is not a short-term project, for it is a planned program to restore the Clackamas River system to one of the outstanding rivers in Oregon with an excellent run of anadromous fish.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT TO RESOURCES

There are no irreversible or irretrievable commitment of resources except for the opportunities foregone by investing in this project.

VIII. SUMMARY OF ALTERNATIVE ASSESSMENT

ALTERNATIVE ASSESSMENT

Alternatives	Economic & Social Impacts	Physical Impacts: Soil	Physical Impacts: Visual	Physical Impacts: Water	Biological Impacts
A. No action; leave the river in its present state.	A loss of an estimated $119,000.00 annually to Oregon's economy through sport & commercial fishing would continue to exist.	None	None	None	A loss of production of 27,000 yards of spawnir gravel would continue t exist. Resident fisheries down stream from the constriction would not be effected by construction.
B. Develop a series of simple, inexpensive jumping pools in the boulder and bedrock along the east bank.	The construction cost of the facility would be $10,000.00 with a maintenance cost of $300.00 annually. Risk of loss to the facility would be low to moderate. The fisheries created would contribute an estimated $119,000.00 annually to Oregon's economy through sport & commercial fishing.	A slight risk of soil disturbance to the east bank is possible.	None	A slight amount of turbidity would be created for a short duration.	This alternative would make available 27,000 yards of spawning grave for anandramous fish bu would cause a temporary disturbance to resident fisheries during the construction of the facility.
C. Construct an elaborate and expensive ladder facility by blasting a chute through the bedrock on the west side of the stream and installing iron & wooden weirs to form jumping pools.	The construction of the facility would be $40,000.00 & annual maintenance cost of $300.00. Risk of loss of the facility would be moderate to high. The fisheries created would contribute an estimated $119,000.00 annually to Oregon's economy through sport and commercial fishing.	Some risk of soil disturbance on both the east & west banks.	This facility would reduce visual quality of the river frontage slightly.	Same as "B" above.	Same as "B" above.

D. Install a portable fish ladder.	The construction cost of the facility would be $40,000.00 with a maintenance cost of $2,000.00 annually. The risk to loss of the structure would be from high to very high. The fisheries created would contribute an estimated $119,000.00 annually to Oregon's economy through sport & commercial fishing.	Some risk of soil disturbance on the east bank.	This facility would reduce the visual quality of the river front because it would be a man-made structure.	Same as "B" Above	Same as "B" above with one addition: this facility would be the most efficient of all alternatives for passing fish.

Alternative "B" was preferred because it met all of the environmental and economical and social objectives with low to moderate risk of facility.

Alternative "A" the no action proposal, did not meet the environmental objective of providing passage for anadromous fish.

Alternatives "C" and "D" did not meet the economical objective of being an inexpensive facility and having moderate to very high risk factor.

IX. CONSULTATION WITH OTHERS

A. Consultation with Federal Government Agencies.

1. National Marine Fisheries Service, Columbia Fisheries Program, Portland, Oregon.

   According to the letter from Fred Cleaver, Program Director, they concur that there is a possibility that this type of passage facility may work, but they would need more detailed information to adequately evaluate the success of the plan.

2. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Portland Area Office, Portland, Oregon.

   The letter from Roger E. Vorderstsasse, Acting Field Supervisor for the Bureau, indicated they approve the proposed passage project.

3. Forest Service, Mt. Hood National Forest

   a. Richard N. Ross, Range and Wildlife Staff.
   b. Charles R. Whitt, Fishery Biologist.
   c. P.V. Patterson, Engineering Geologist.

   They support the proposal to remove the two barriers.

B. Consultation with State Agencies

1. Oregon State Game Commission, Office of the Director, Portland, Oregon.

   According to the letter from C.J. Campbell, Chief Fishery Division, they are in favor of the proposed fish passage.

2. Oregon State Fish Commission, Office of tie Director, Portland, Oregon.

   The letter from Robert N. Thompson, Assistant State Fisheries Director for the Commission, agreed the Commission would be a party to a memorandum of understanding with the Forest Service that would commit to Commission to handle the technical engineering supervision of the project. This commitment would not include funding of the project or maintenance responsibilities of the facility completed.

X. MANAGEMENT REQUIREMENTS AND CONSTRAINTS

The following apply:

1. The Oregon State Fish Commission and the Forest Service have agreed to cooperate in the barrier removal project on the Collawash River.

2. The Oregon State Fish Commission is responsible for the technical supervisory aspects of the project only. They will not provide funds for the project nor for maintaining it in an operational condition after completion.

3. The Forest Service is responsible for funding, administration, contracting, and coordination of the project.

4. A special streamside management unit will be established along the Collawash River from the lower barrier upstream to the confluence of Elk Lake Creek. Another unit will be established along Dickey Creek from the confluence of Dickey Creek with the Collawash River upstream to the first major fish passage barrier. Management guidelines for these units will be directed toward maximum protection of the fishery resources. The width of the units will be three chains on either side *of* the Collawash River and Dickey Creek.

5. Trail construction will be prohibited along these special streamside management units.

6. Avoid accelerating bank movement in and adjacent to the project.

7. Maintain water quality of tie Collawash River to meet Class I Stream Management Unit guidelines, as well as state standards.

8. Maintain aesthetic quality of tie area in and around the project.

9. Maintain safe working conditions during the construction phase of the project.

10. Remove all safety hazards before the project is completed,

OAK GROVE FORK CLACKAMAS RIVER HABITAT IMPROVEMENT PROJECT

ANNUAL REPORT FY 1986

by

Ron Medel, Fisheries Biologist
Mt. Hood National Forest
Clackamas Ranger District
Estacada, Oregon

Prepared for

Kathy Anderson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-A179-84 BP16726
Project No. 84-11

April 1, 1987

Table of Contents

List of Figures 50

Acknowledgements 51

Abstract 52

Introduction 53

Description of Study Area 53

Methods and Materials 55

Results and Discussion 58

Summary and Conclusions 59

Summary of Expenditures 60

Literature Cited 61

Appendix A - Project Area Maps/Line Drawings 62

Appendix B - Project Area Photographs 68

List of Figures

Figures 1. Project Vacinity Map 54

Figure 2. Project Treatment Reach Map 56

ACKNOWLEDGEMENTS

This year's project completion would likely have not occurred without considerable input, support, and assistance from:

Dave Heller	Fisheries Biologist Mt. Hood National Forest Supervisor's Office
Dave Hohler	Fisheries Biologist Mt. Hood National Forest Estacada Ranger District
Harv Forsgren	Fisheries Biologist Mt. Hood National Forest Supervisor's Office
Sherry Churchill	Fish and Wildlife Biologist Mt. Hood National Forest Clackamas Ranger District
Elizabeth Holmes	Fisheries Biologist Mt. Hood National Forest Clackamas Ranger District
Steve Mellor	Hydrologist Mt. Hood National Forest Columbia River Gorge Ranger District
Kevin Godbout	Hydrologist Mt. Hood National Forest Columbia River Gorge Ranger District

ABSTRACT

The lower Oak Grove Fork of the Clackamas River is a fifth order tributary supporting depressed runs of coho and chinook salmon, and summer and winter steelhead. Stream flow is regulated for power production all year. The stream contributes less than 10% of the low flow of the Clackamas River at their confluence. Virtually the entire low flow of the Oak Grove Fork is diverted at Harriet Dam to the Three Lynx Power Station, operated by Portland General Electric (PGE). Habitat condition rating for the lower Oak Grove Fork is good, but smolt production estimates are below the average for Clackamas River tributaries. Limiting factors include the lack of quality rearing habitat and heavy channel scour resulting from periodic high flows. Quantity and distribution of spawning gravel are viewed as a secondary limiting feature.

1986 was the second year of a multi-year effort to improve fish habitat in the lower Oak Grove Fork and increase anadromous fish production. Habitat improvement activities included channel treatment of a 1650 foot section of the stream immediately below the Hwy 224/FS Road 46 bridge crossing, and the development of a 1050 foot long side channel through placement of a diversion structure located 2000 feet upstream from the bridge. The channel improvement work involved off-site recruitment and placement of about 135, 4-5 ft. diameter boulders. These boulders were placed with a track-mounted backhoe to form wing deflectors, berms, cluster groups and alcoves. The side channel development resulted in excavation and placement of 9 log sill structures and rearing ponds. Approximately 1825 square yards of excellent perennial rearing habitat was created by the side channel.

Baseline assessment stations were established for these two project reaches. Each will be evaluated through and following the 1986-87 high flow period. Additional enhancement opportunities and project reaches in lower Oak Grove Fork have been identified through stream inventory and habitat assessments, communications with ODFW and PGE personnel, and post project field reviews. Project proposals, feasibility reports, and associated environmental documents are being processed. Additional habitat improvement work is planned for 1988 and beyond.

Proposed 1986 work was accomplished on time with minor schedule modifications, BPA funded the projects under the Clackamas/Hood River Habitat Enhancement Project No. 84-11 agreement. A total of $38,569 was budgeted for 1986. Actual expenditures totaled $36.984.88.

INTRODUCTION

1986 represented the second year of a multi-year habitat improvement effort in the lower Oak Grove Fork, and the first for project implementation. The lower Oak Grove Fork improvement project was implemented in two reaches; the half mile of stream between the Hwy 224/FS Road 46 bridge and the Clackamas River, and the half mile upstream of the bridge crossing. The primary objective of the project was to improve and increase low flow rearing habitat for l+ and older juvenile salmon and steelhead. The secondary objective was to improve and increase available overwintering and spawning habitat.

A baseline assessment program has been established to determine effectiveness of structure placement in meeting project objectives. Photo points have been located for each treatment reach to provide a visual record of channel changes associated with the structures, and to document impacts of high flow periods on the structures and side channel.

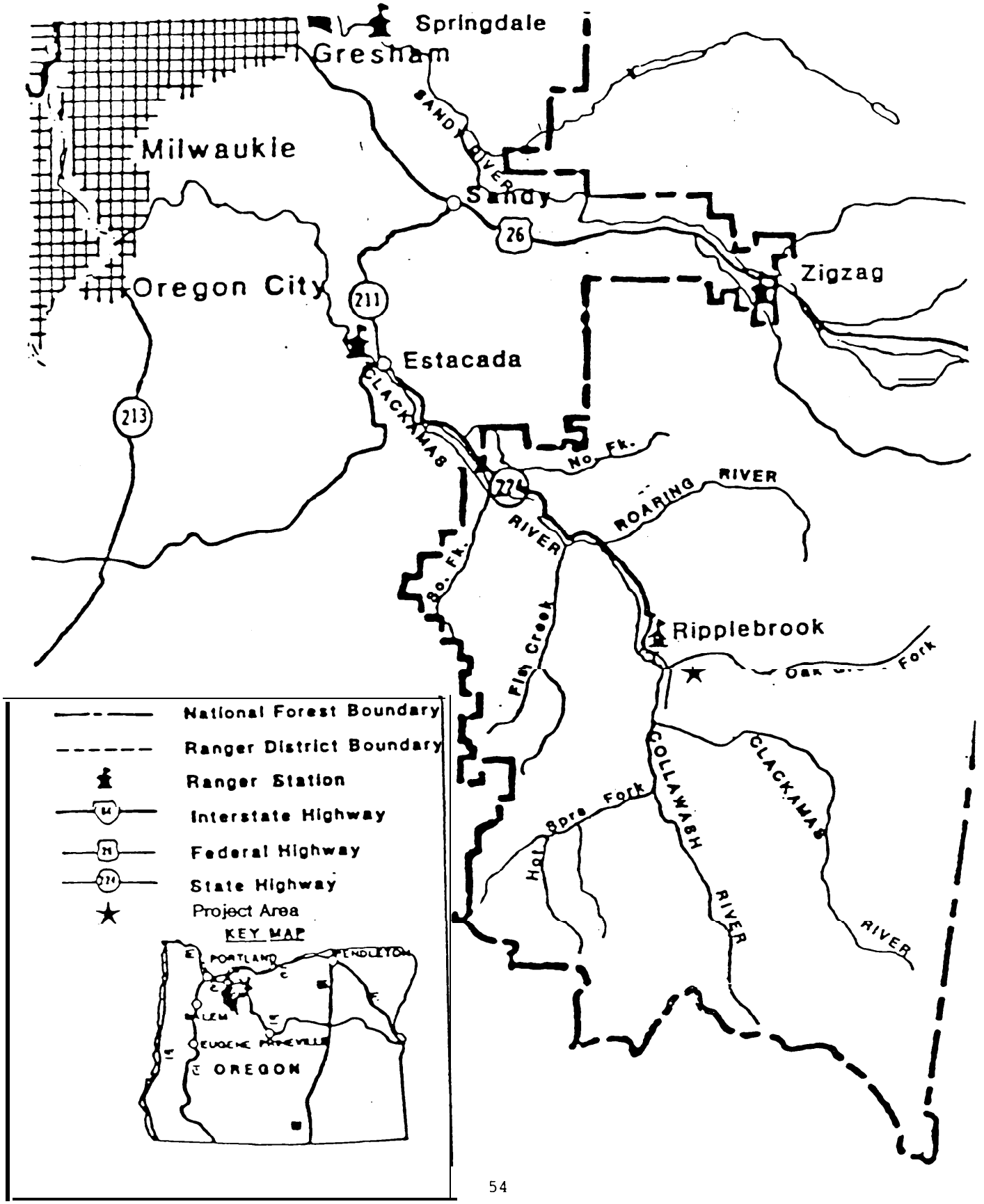
Future fisheries management in the Oak Grove Fork of the Clackamas River will be guided by the Willamette Basin Management Plan. A Clackamas River Sub-Basin Plan is also being cooperatively developed by the Oregon Department of Fish and Wildlife (ODFW) and the Forest Service to promote effective management of the fish resources and habitat in the drainage. Preliminary planning efforts have focused on protection and restoration of the natural salmon and steelhead runs of the Clackamas River above North Fork Dam.

DESCRIPTION OF THE STUDY AREA

The Oak Grove Fork is a major, fifth order, anadromous fish producing tributary of the Clackamas River (FIGURE 1). The basin area for the Oak Grove Fork is 140 square miles and mainstem length is 21 miles. Flow entering the Clackamas, however, provides less than 10% of the Clackamas River's low flow volume due to nearly complete diversion of the Oak Grove Fork at Harriet Dam. This occurs at river mile (RM) 4.8 for all but peak flow periods. The diverted flows are used for generating power at PGE's Three Lynx station. A 15 foot fall at RM 3.8 has historically limited anadromous fish migration, but the lower stream supports runs of chinook and coho salmon, and winter and summer steelhead. Salmon populations are currently depressed. Progeny from late run (wild) coho will be stocked in the newly created side channel/rearing ponds to supplement natural production.

Fish habitat condition rating for the Lower Oak Grove Fork is "good" - 7.3 on a scale of 10 (Uebel et al, 1982). Low amounts of quality rearing habitat and spawning habitat, as well as the effects of periodic high flows resulting in heavy channel scour, act as limiting factors. Flow in the Oak Grove Fork is regulated at Harriet Dam and surplus runoff is passed over the spillway when storage requirements are met. It appears that the factors affecting development of habitat diversity are not duplicated in the flow regulated stream. Large woody debris is not common in the main channel. Debris and debris fragments are deposited on the higher banks and against standing trees

FIGURE 1. Vicinity map of the Oak Grove Fork sub—drainage.



at the heads of side channels, but generally do not contribute significantly to habitat diversity or development.

METHODS AND MATERIALS

Two stream reaches were selected for treatment during the 1986 project year; Reach 1 extends from RM 0.4 to 0.7, and Reach 2 from RM 1.0 to 1.25 (FIGURE 2). Selection of treatment areas was based on the proximity of roaded heavy equipment access to stream reaches with identified opportunities for improvement. In Reach 1, boulder placements were used to increase pool ratios, rearing habitat area, and trap spawning gravels. In Reach 2, a diversion structure was constructed in the main channel, utilizing a 3 foot diameter sill log and three cabled logs, to control and direct/deflect high flows into an excavated side channel. Approximately 4 cfs is directed into the 1050 foot long side channel at low flow. Nine additional sill log structures were placed in the side channel to increase the quality and quantity of rearing habitat. Above and below each sill a pond was excavated to further increase the quantity of rearing habitat.

Reach 1

Seventy boulders, five feet in diameter, and sixty-five boulders, four feet in diameter, were collected off-site for delivery and stockpiling at two designated storage sites. The sites were streamside and adjacent to treatment Reach 1 in Rainbow campground. The boulders were placed with a track-mounted backhoe which accessed the channel via two pre-flagged routes.

Moving in the main stream channel, the excavator proceeded downstream, manipulating the boulders and instream material to create approximately 20 structures. Each structure was located at or near a pre-flagged site, and designed to perform a desired in-stream function. Schematic maps of the improvement structures placed in Reach 1 may be found in APPENDIX A. Included in the final total are: four flow deflector wings abutting one side of the channel and extending to approximately mid-stream; five boulder berms; and about eleven multiple boulder clusters and alcoves.

The boulders were not secured to 'permanent' channel materials, such as bedrock or other large boulders. The size of the boulders used should inhibit movement or rearrangement of the structures. Two pieces of existing in-stream large woody debris were incorporated into two of the boulder clusters. No additional, standing large woody debris was recruited from the adjacent forested riparian areas. Seven photo points were established to provide a visual record of structure performance and change. APPENDIX B presents sample photos of Reach 1. A total of 1650 feet of the main channel was treated in Reach 1.

Reach 2

Following selection of the side channel and diversion site, a track-mounted backhoe crossed the main channel and entered the flood plain. The backhoe traveled upstream, excavating the side channel as it proceeded along a pre-flagged route. A number of rock and log sills were incorporated into the side channel during its construction to dissipate energy and provide suitable

FIGURE 2. Reach location map for the Oak Grove Fork improvement project.

rearing habitat. At the diversion site in the main channel, several 2-3 foot diameter green cedars were felled and used in the construction of the diversion headworks. The backhoe was used to excavate the trenches required for placement and cabling of the two deflector logs and sill. The sill log was placed, armored, and sealed with hardware and filter cloth, then back filled to serve as a hydrological control point in the stream. The resultant water surface elevation ensures flow into the side channel during low flow periods. The sill log resulted in a l-2 foot drop into a 4 foot deep plunge pool. The quality of the plunge pool was enhanced through excavation. Boulders, rubble, and gravel ballast material was placed on each end of the 60 foot sill. Immediately upstream two deflector logs were installed to direct and regulate flow into the side channel. A long, deep (approximately 60 foot x 4 foot) pool was excavated under the upstream most deflector log acting to underscour and regulate flow. The second deflector acts to direct and regulate flow in a 40 foot long excavated channel leading from the mainstem to the margin of the flood plain and an existing intermittent overflow channel. It is the lower part of this overflow channel that was enlarged to form the developed side channel. Additional woody debris was manipulated to lessen the likelihood of the side channel capturing more flow during high flow periods than desirable. A trash rack was incorporated into the base of the deflector log and into the channel side slope to prevent immediate filling of the diverted flow channel. The channel banks and deflector log bases were further armored with ballast material.

Following preliminary evaluation of the side channel, after introduction of water, it appeared desirable to re-enter the project area and make some adjustments. The backhoe was again used to refine placement of the sill logs, and enlarge the excavated ponds above and below each sill log. The first pond excavated is approximately 150 feet downstream from the diversion inlet. This provides a lengthy buffer of undisturbed riparian vegetation between the diversion structure and the area of side channel development. A felled cedar was trimmed and manipulated to form the first sill log structure in the side channel. This sill was armored, hardware and filter clothed, then backfilled. Cover was added to the pond in the form of downed alder.

Spaced roughly 100 feet apart, the next eight sill log structures were placed in similar fashion, along the far edge of the flood plain. Half of the structures were constructed with existing large woody debris, the rest required additional recruitment. In an attempt to evaluate construction technique, two of the structures were not clothed (structure numbers 3 and 9). and four more were only filter clothed. All were armored and backfilled. No spill is more than 2 feet from sill lip to plunge pool elevation. The average drop is 14 inches. Pool widths range from 5 to 40 feet, and average about 15 feet. Depth varies from 1.5 to 3 feet. In-pond cover structure includes large and small woody debris, small boulders and rock, and is variable in amount. Structure was introduced as the backhoe worked downstream in the side channel, sill to sill, without moving into the adjacent timber stands to recruit additional woody debris.

The last sill directs flow into an existing spring-fed pond in the floodplain. It is the largest pond and the outlet flows back into the Oak Grove Fork. A minor amount of additional main channel boulder manipulation occurred as the

backhoe operator exited the project reach. Schematic maps of the improvements completed in Reach 2 are located in APPENDIX A.

Photo stations were established to monitor the impact and effects of high flows on the diversion structure, as well as its performance in meeting project objectives. In addition to the photo points, each sill will be evaluated on an individual and collective basis using standardized forest procedures for monitoring structure performance. APPENDIX B contains sample photos from Reach 2. Approximately 1050 feet of side channel was developed, resulting in creation of at least 1825 square yards of high quality rearing habitat.

RESULTS AND DISCUSSION

Tasks identified in the 1986 work statement agreement included:

1) Preparation, and implementation of a heavy equipment contract to transport materials and complete improvement activities;
2) Excavation of two side channels, l.lkm in length to create an additional 1,600 square meters of rearing habitat. A minimum of 35 structures were to be placed in the side channels to provide proper grade:
3) Installation of at least 20 boulder structures in the mainstem of Oak Grove Fork, to provide suitable overwintering habitat and to collect spawning gravel;
4) Project monitoring and planning for out-years implementation.

These project goals were met, although with some modification of the implementation plans. More off channel rearing habitat was created than planned, although in one rather than two side channels. The mainstem boulder structures were successfully constructed. Project monitoring and planning activities were also completed for the project. A more detailed description of the results follows.

Reach 1

Placement of 135 boulders resulted in 20 new instream structures of varied design and complexity. The structures are designed to direct and dissipate the high energy flows of the Oak Grove Fork, and provide for more diversity within the channel. As an immediate consequence of project activities, new low-flow rearing habitat was created throughout the reach. This is especially evident where excavation was used in connection with boulder placement (about 40% of the structures). No large woody debris was recruited into the channel, although two in-stream pieces were incorporated into two of the boulder structures. The use of woody debris would improve the effectiveness of efforts to increase channel complexity. None of the boulder structures were secured to the stream bottom or each other. This, and the decision not to use woody debris, was in response to concerns for visual impacts adjacent to the recreation sites.

Photo points have been established to document the effectiveness of the structures to meet project objectives, and to assess the impacts of high flows on the structures.

Reach 2

Construction of the diversion structure and development of the 1050 foot side channel was not completed until early October 1986. This project reach should provide considerable additional high quality rearing area for 1+ age anadromous fish in the Lower Oak Grove.

Established photo stations focus on assessing diversion structure performance. Sill log stabilities, as well as related resource impacts, such as riparian vegetation recovery, will be tracked though the side channel photo stations. Additional assessment efforts will be directed at identifying fish response to the improvement activities.

Proposed Project Reaches

At least two potential project reaches have been identified upstream of the side channel diversion structure. They include an established, but intermittent, side channel located on the north side of the stream at approximately RM 2.0, and the lower end of Butte Creek as it flows through a low gradient riparian area to its confluence with the Oak Grove Fork. Butte Creek joins the Oak Grove Fork from the south at RM 2.0.

Proposal development has included on-site reviews to determine project access, feasibility, and potential benefits. Initial field reviews have included numerous Forest Service resource personnel to evaluate potential project impacts on sensitive resources in the Lower Oak Grove Fork. Visually sensitive, and spotted owl management areas have been designated in portions of the lower Oak Grove Fork. Preparation of required environmental analyses will continue in 1987.

SUMMARY AND CONCLUSIONS

Lower Oak Grove Fork activities in the 1986 contract period included: project reach site selection; environmental documentation: contract preparation, advertisement, award, and implementation; baseline assessment station establishment; and development of new project reach proposals.

Main channel rehabilitation (1650 foot) and development of a flowing side channel (1050 foot) was accomplished to improve and increase salmon and steelhead smolt production of the lower Oak Grove Fork. The project goal was to increase rearing habitat by increasing channel complexity and to entrap and hold suitable spawning gravel. Planned monitoring of structural performance, and fish response to those structures, will provide for effective planning of additional projects in the lower Oak Grove Fork.

Project costs varied from the initial estimates for individual items, but the overall budget was within the amount originally requested from BPA.

SUMMARY OF EXPENDITURES

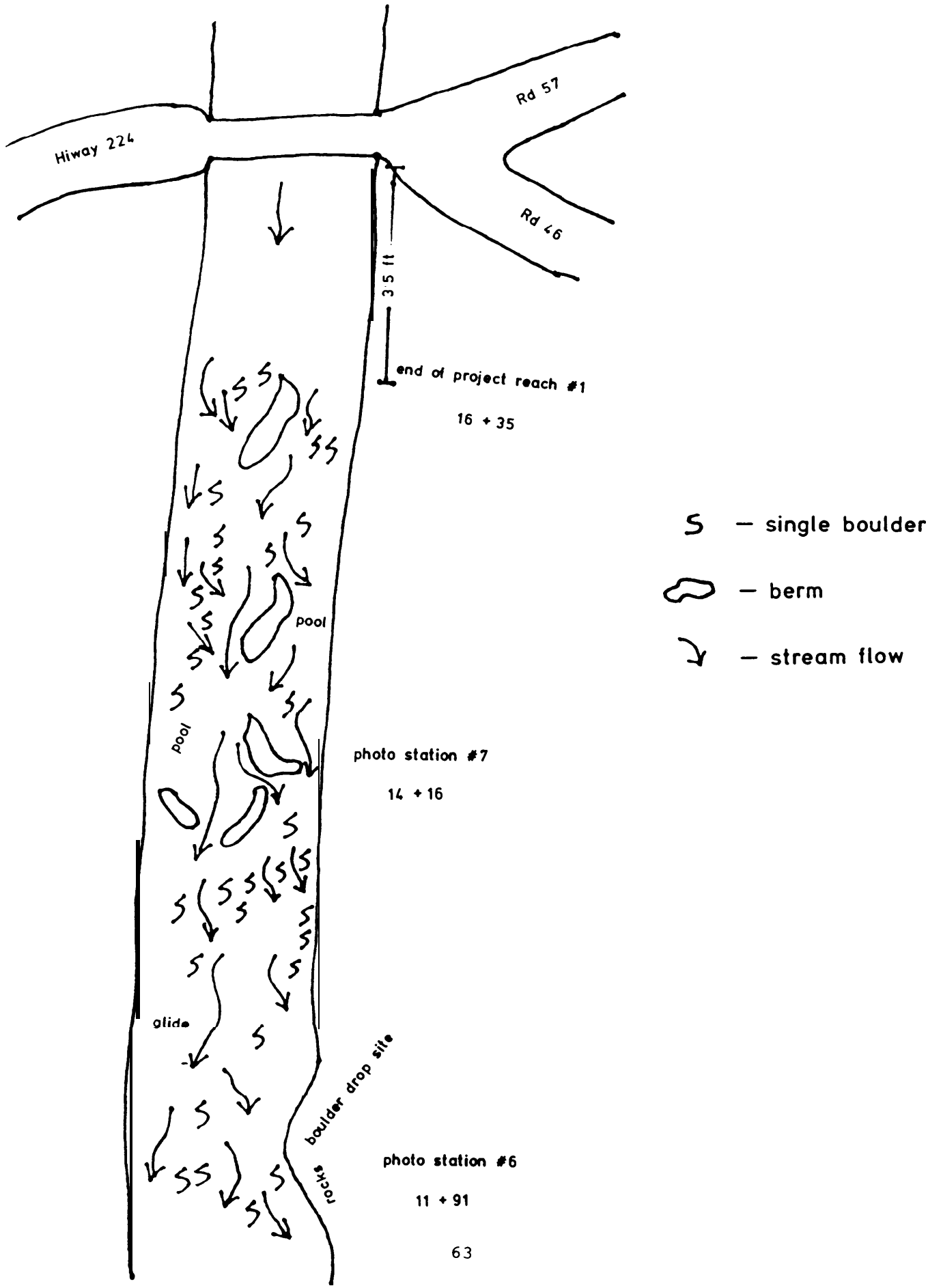
1.	Personnel	$12,643.16
2.	Travel	54.80
3.	Expendable Equipment	1,450.55
4.	General Services	173.82
5.	G&A Overhead (12%)	1,718.69
6.	Contract Costs	20,943.86
7.	Total Cost	$36,984.88

LITERATURE CITED

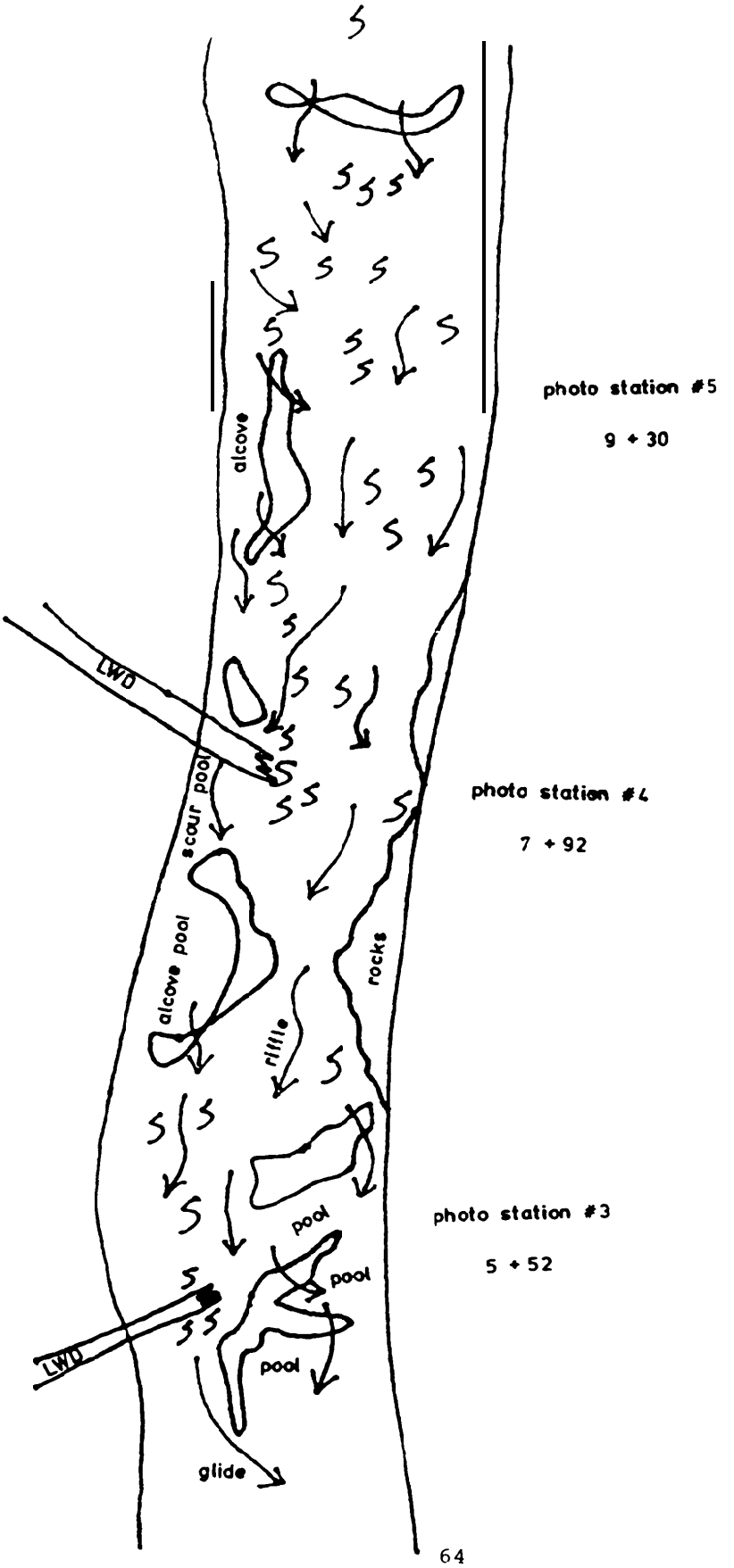
Uebel, J., K. Godbout. 1982. Riparian Area Resource Assessment, Summer 1982. USDA Forest Service, Mt. Hood National Forest.

APPENDIX A - PROJECT AREA SCHEMATIC MAPS

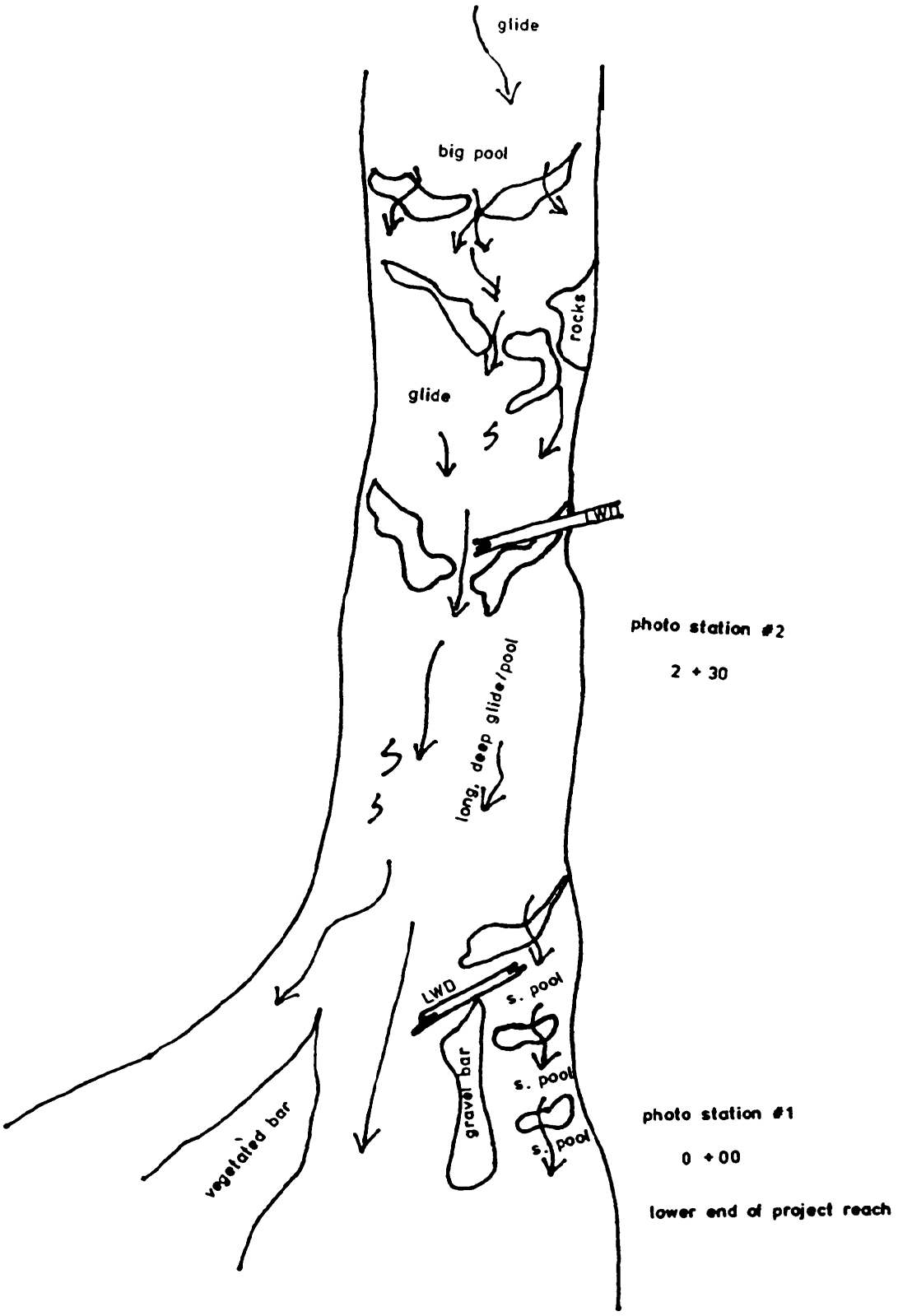
APPENDIX A—1. Lower Oak Grove Fork project reach 1, post—treatment map.



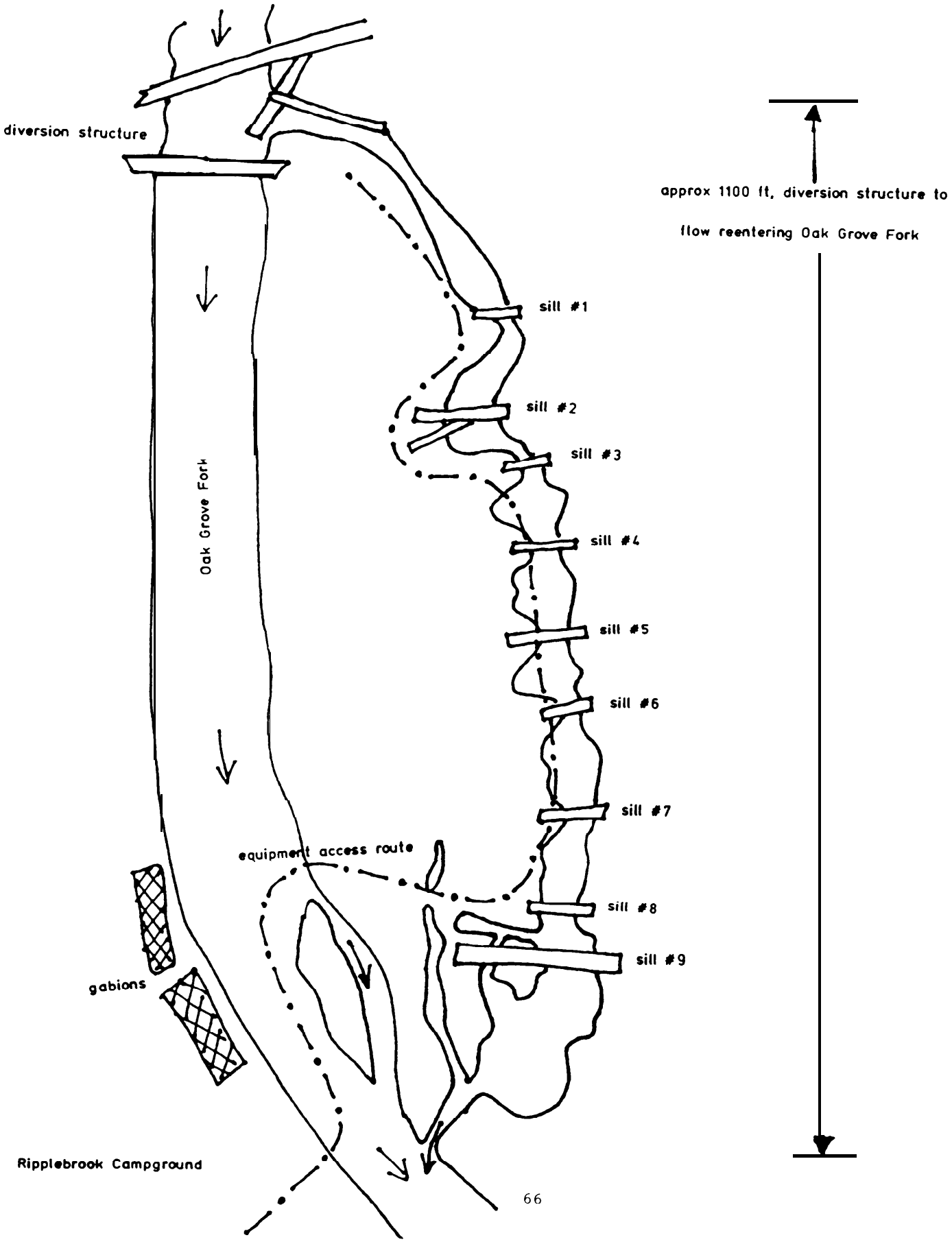
APPENDIX A—2 Project reach 1 continued



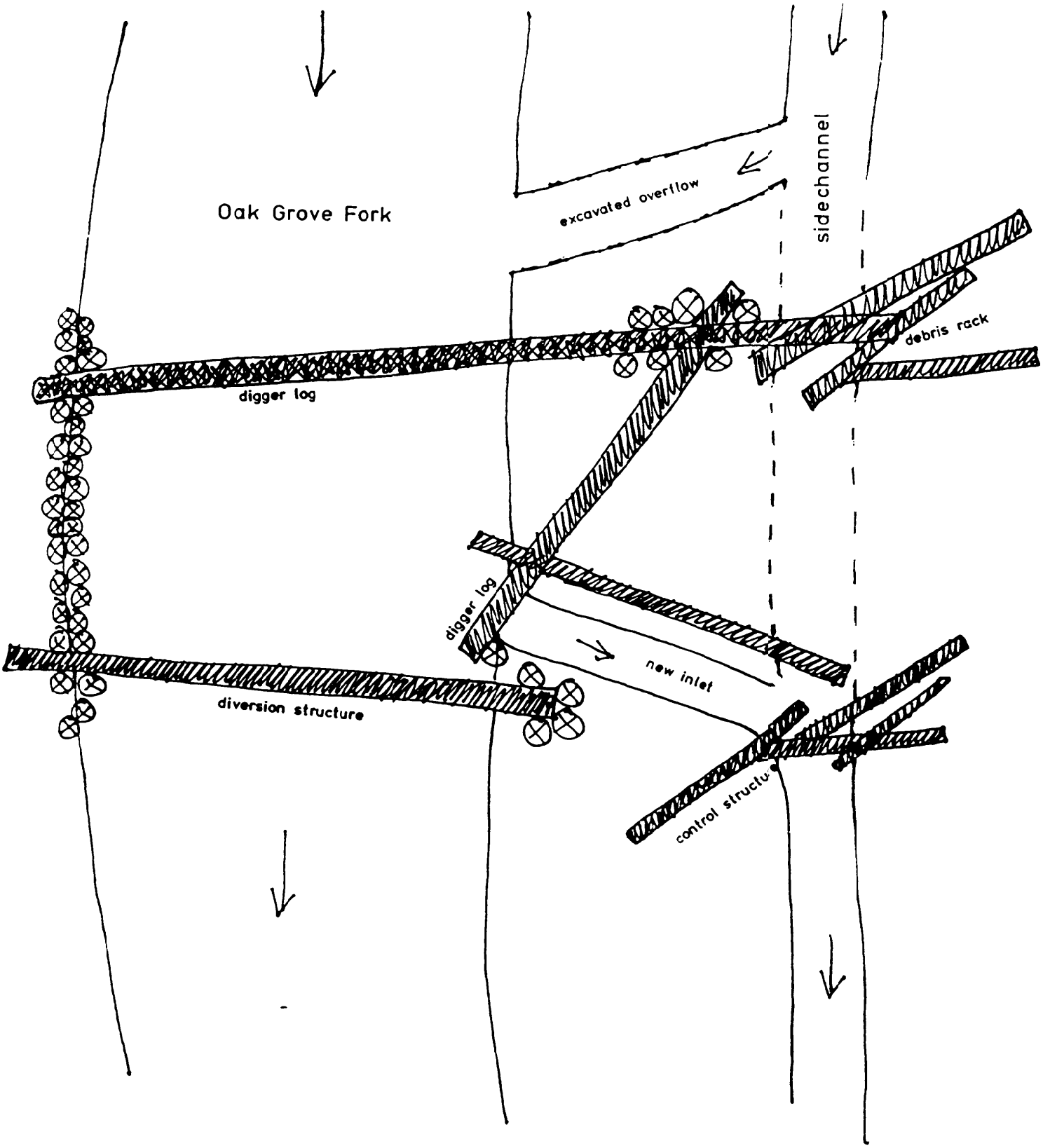
APPENDIX A—3. Project reach 1 continued.

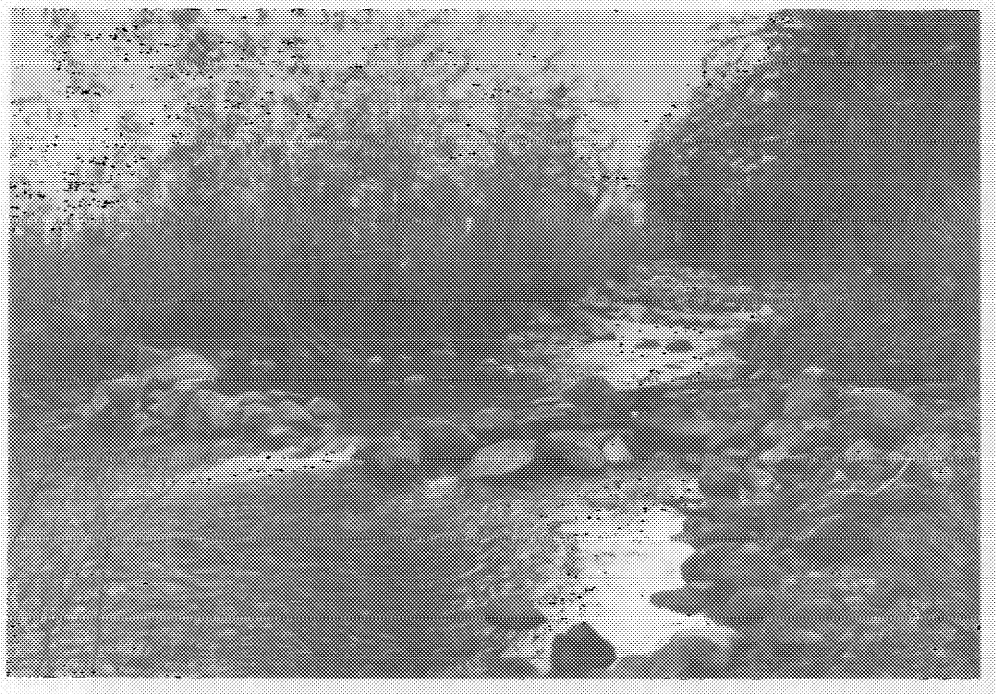


APPENDIX A—4. Lower Oak Grove Fork project reach 2, post—treatment map.



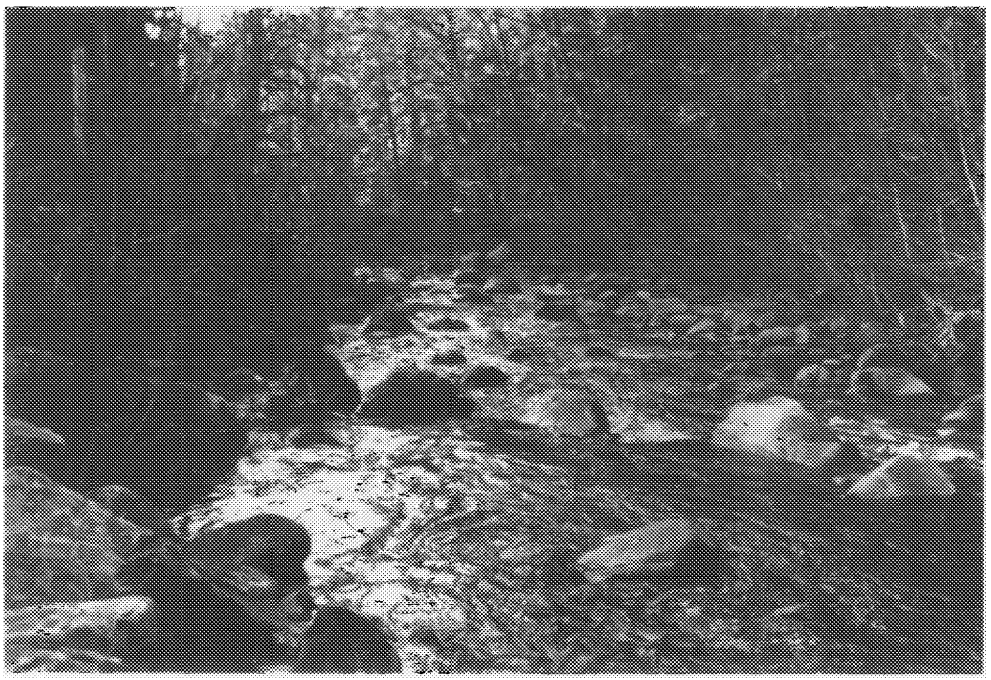
APPENDIX A—5. Diversion inlet control for sidechannel (Reach 2) on Lower Oak Grove Fork.



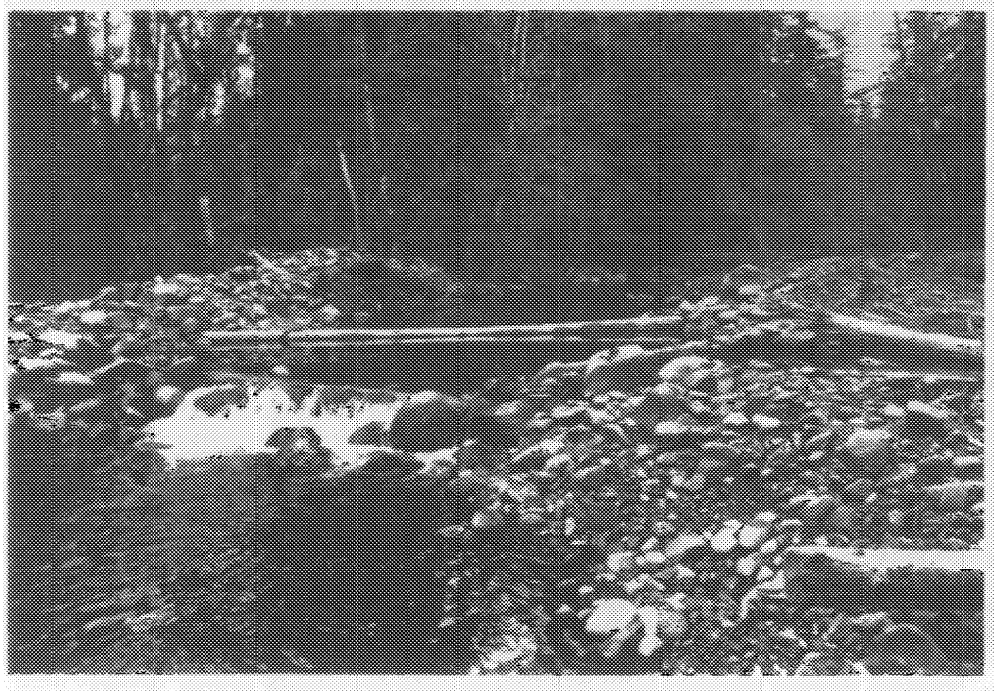


BOULDER BERM AT PHOTO STATION #2, LOWER OAK GROVE FORK PROJECT REACH 1. ADDITIONAL BERMS VIEWABLE IN UPSTREAM BACKGROUND.

BOULDER BERM ACTING AS A WING DEFLECTOR AT STATION #3, LOWER OAK GROVE FORK.



SINGLE BOULDERS PLACED JUST ABOVE STATION #5, DOWNSTREAM VIEW.



DIVERSION STRUCTURE ON LOWER OAK GROVE FORK, PROJECT REACH 2.

CONTROLLED FLOW FROM DIVERSION STRUCTURE ENTERING THE DEVELOPED SIDE CHANNEL (FLOW TO LEFT).

OVERVIEW OF THE SIDE CHANNEL SILL STRUCTURES AND PONDS, PROJECT REACH 2, LOWER OAK GROVE FORK. SILL POND (AND STRUCTURE) #5 IS IN IMMEDIATE FOREGROUND, WITH PONDS #6 AND #7 IN THE BACKGROUND.

LAKE BRANCH/WEST FORK HOOD RIVER
HABITAT IMPROVEMENT PROJECT

ANNUAL REPORT FY 1986

by

Ken MacDonald, Fisheries Biologist
and
Corey Sue Hutchinson, Fisheries Biologist

Mt. Hood National Forest
Hood River Ranger District
Mt. Hood, Oregon

Prepared for

Kathy Anderson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-A179-84 BP16726
Project No. 84-11

April 1, 1987

Table of Contents

List of Figures 74

List of Photographs 75

Acknowledgements 76

Abstracts 77

Introduction 78

Description of Project Area 80
Lower Lake Branch Rearing Habitat Enhancement 80
Upper Lake Branch Channel Rehabilitation 80
West Fork Hood River Habitat Enhancement 81

Methods and Materials 83
Spawning Surveys and Resting Hole Counts 83
Physical and Biological Assessment 83
Planning 84
Project Implementation - McGee Creek 85

Results and Discussion 89
McGee Creek Implementation 89
Maintenance Needs 89
Planning 91
Physical and Biological Assessment 91
Spawning Surveys and Resting Hole Counts 91

Summary and Conclusions 92
Lower Lake Branch Rearing Habitat Enhancement 92
Upper Lake Branch Channel Rehabilitation 93
West Fork Hood River Habitat Enhancement 94

Summary of Expenditures 95

Literature Cited 96

Appendix 97
A. Typical Structure Designs 97
B. Log Sill Detail 99
C. Photos of McGee Creek Project Implementation 101
D. Spawning Surveys 106
E. Resting Hole Counts 108
F. Consultant Report 110

List of Figures

Figure 1. Hood River Drainage Vicinity Map 79

Figure 2. Project Work Area Map 83

Figure 3-4 McGee Creek Implementation Site, Reach A 87

ABSTRACT

The Lake Branch/West Fork Hood River habitat improvement project, in 1986, was in the fourth year of a coordinated effort between the Oregon Department of Fish and Wildlife (ODFW), and the USDA Forest Service, Mt. Hood National Forest, to improve anadromous fish production in the West Fork Hood River drainage. The project has been divided into three sub-projects: 1) Lower Lake Branch rearing habitat enhancement; 2) Upper Lake Branch channel rehabilitation, and; 3) West Fork Hood River habitat enhancement.

During 1986, activities in lower Lake Branch primarily involved assessment of past habitat improvement work and planning future project activities. Activities in upper Lake Branch centered on planning a channel rehabilitation project to provide year-round rearing habitat in a stream reach that currently flows subterranean in summer. This improvement activity is scheduled for implementation in 1987. Project design and environmental assessment was completed in March, 1987. Past project work in upper Lake Branch was also assessed. Emphasis in the West Fork Hood River drainage was on project implementation in McGee Creek, a tributary stream. Log structures, including sills, wings and diggers were placed at 19 sites. Additionally, six large trees were felled in McGee Creek at sites lacking heavy equipment access.

INTRODUCTION

The West Fork Hood River is the major anadromous fish producing tributary to the Hood River (FIGURE 1). The West Fork enters the Hood River at river mile (RM) 12.1 with an average annual low flow of 267 cfs. Approximately 75 percent of the drainage is within the contiguous Mt. Hood National Forest Boundary. Lake Branch is the largest anadromous fish tributary to the West Fork.

The primary anadromous fish species inhabiting the West Fork system is summer steelhead trout. The drainage is also utilized by winter steelhead trout and the Oregon Department of Fish and Wildlife (ODFW) is working to re-establish spring chinook salmon through hatchery outplants and hatchboxes operated by STEP (Salmon Trout Enhancement Program) volunteers.

The Lake Branch/West Fork project is a multi-year, fish habitat improvement effort coordinated between the USDA Forest Service, Mt. Hood National Forest (Forest Service) and ODFW to increase anadromous fish production in the Hood River system. Habitat improvement work completed prior to 1986 has included: a 1985 ODFW project funded by the Bonneville Power Administration (BPA) to improve passage at the "moving" falls on the West Fork Hood River; a 1985 STEP project allowing low flow passage through a boulder drop at RM 2.8 of Lake Branch; and a variety of habitat improvement projects funded by BPA and implemented by the Forest Service on Lake Branch in 1983, 1984, and 1985. In addition to the BPA funded work, the Forest Service has completed road rehabilitation projects, to improve watershed conditions. Complementary KV projects have also been completed and are planned for 1988 in Lake Branch and McGee Creek.

Habitat ratings for anadromous fish producing streams within the West Fork drainage ranges from poor to excellent. Areas of poor habitat are generally associated with a lack of large woody debris. The primary focus of habitat improvement activities in the West Fork drainage is to provide instream structure in reaches where natural large debris is lacking and thereby improve rearing habitat for l+ and older juvenile steelhead trout. The project work will also benefit winter steelhead, resident trout and will benefit spring chinook salmon as they become established in the system.

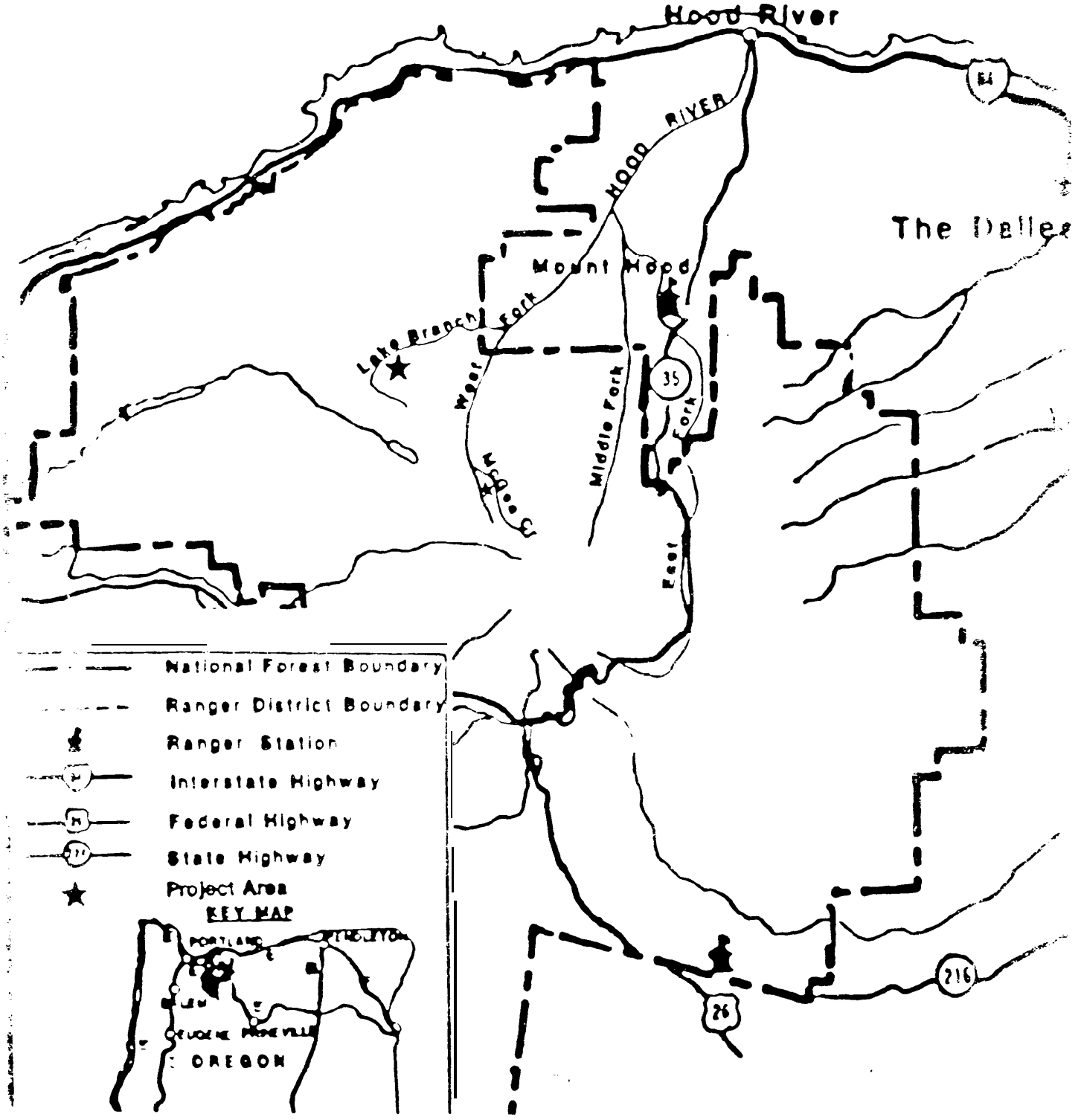
The Lake Branch/West Fork project has been divided into three sub-projects based upon geographic location and habitat improvement objectives:

1) Lower Lake Branch Rearing Habitat Improvement (RM 3.4-8.0)
2) Upper Lake Branch Channel Rehabilitation (RM 8.0-9.0)
3) West Fork Hood River Habitat Improvement.

VICINITY MAP

HOOD RIVER DRAINAGE

Figure 1



DESCRIPTION OF PROJECT AREA

Lower Lake Branch (RM 3.4-8.0)

Lake Branch is the largest anadromous fish producing tributary to the West Fork Hood River. Lake Branch originates at Lost Lake and flows approximately 11 miles before joining the West Fork near the community of Dee, Oregon (FIGURE 2). Fish habitat in lower Lake Branch is generally rated as being good, although anadromous fish habitat capability appears to be locally limited by poor low flow rearing habitat for 1+ and older juvenile steelhead trout. Hood River steelhead smolt as l+, 2+ and 3+ fish (Howell et al 1985) making the presence of diverse, quality rearing habitat important. Summer steelhead are the management emphasis species in Lake Branch, but there is suitable habitat for spring chinook salmon, which are being re-introduced. Winter steelhead are probably also present in Lake Branch. Large instream woody debris is important in lower Lake Branch, especially above RM 5.0, to provide the structural control necessary to form a diverse, quality aquatic habitat. Below RM 5.0 the stream gradient and energy increases. Boulders become the dominate hydraulic control feature. Although wood is still important, it is generally associated with large, infrequent log jams. Local reaches of habitat rated as poor to fair appear to be associated with past stream cleanout practices.

The objectives of the Lower Lake Branch sub-project are to use instream structures to improve rearing habitat and increase habitat diversity. Tasks identified to be performed under the 1986 Work Agreement with BPA were:

1) Conduct a high flow stream survey in spring 1986 to identify and map overwinter rearing habitat improvement opportunities;
2) Fall at least 10 alcove trees to provide margin habitat and scour pools, install eight log structures to improve rearing habitat and blast a minimum of two pools in bedrock to provide optimal rearing habitat and protected spawning habitat;
3) Continue assessment of past projects;
4) Maintain projects implemented in 1983 and 1985.

Upper Lake-Branch (RM 8.0-9.0)

Fish habitat in upper Lake Branch is rated as poor except where instream habitat improvement projects have been completed. Much of this reach was obtained by the Mt. Hood National Forest within the last ten years through a land exchange. Prior to transfer of the land to the Forest Service, the stream corridor and flood plain had been logged and the channel "cleaned". The stream channel is now riffle dominated, flowing over a small boulder/cobble substrate.

Low flow rearing habitat is limited to a few shallow pools (less than one fact in depth), spawning habitat is scarce and an approximately one-quarter mile long reach flows subterranean in summer. The channel banks are unstable and the streambed is constantly shifting. It is believed that current channel and habitat condition are due to past removal of large woody debris. Because of past land use practices there is also a very limited source of future woody debris.

A stream improvement project, completed in 1984 (MacDonald 1984) tested a variety of structures for future use in upper Lake Branch. Structures included double log accelerators, log sills, single wing deflectors and side channel development. The objective of the upper Lake Branch sub-project is to use experience gained on earlier projects to design an improvement project that will effectively increase channel stability, the quantity and quality of rearing habitat, and provide summer flows to reaches now flowing subterranean.

Tasks identified in the 1986 Work Agreement with BPA were:

1) Maintenance of project work completed in 1984
2) Continue assessment the 1984 project
3) Complete project design and environmental assessment for the proposed 1987 project.

West Fork Hood River

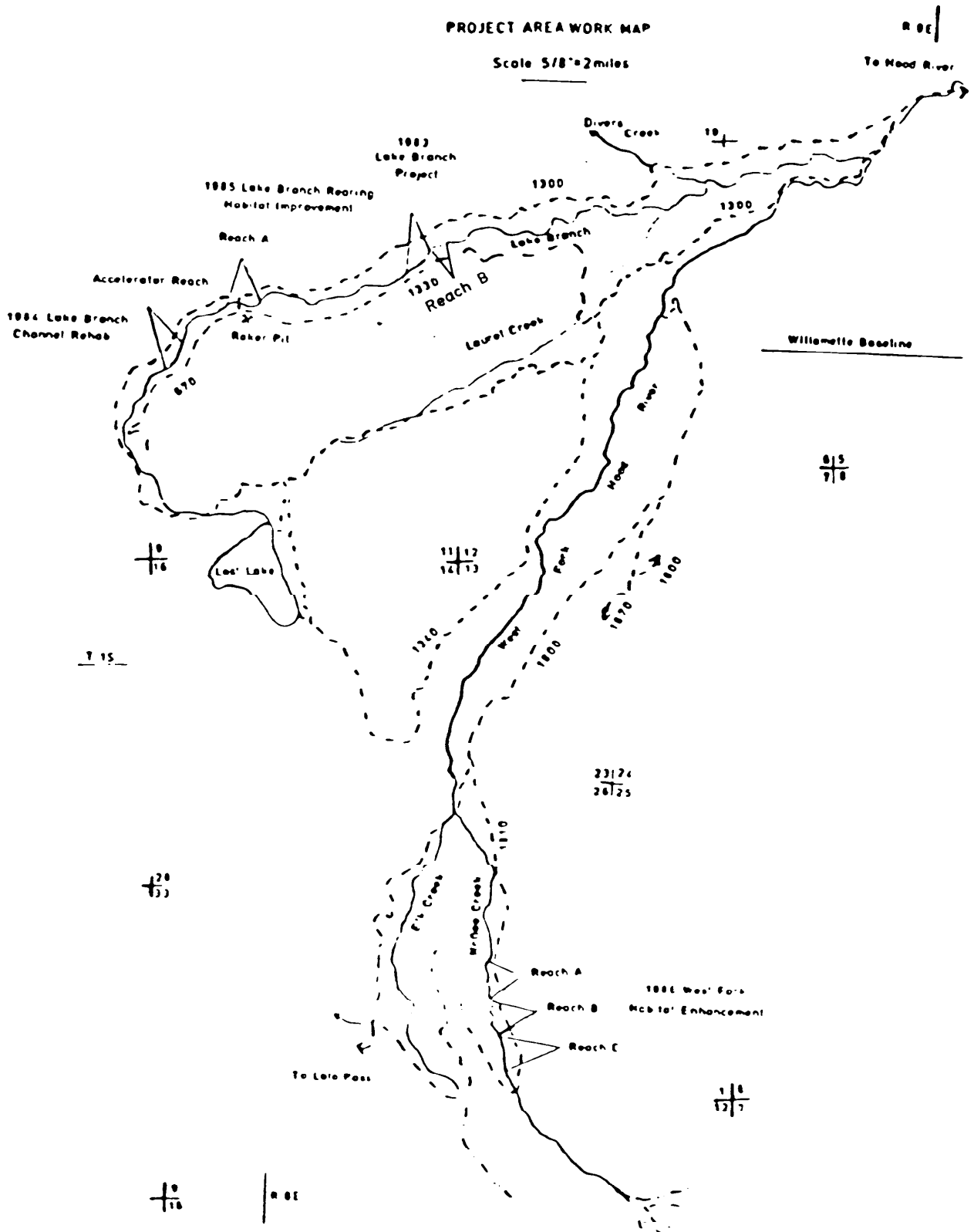
This project area includes the uppermost reaches of the West Fork Hood River and McGee Creek (FIGURE 2). Initial rehabilitation efforts have focused on McGee Creek. McGee Creek is a headwater tributary to the West Fork. Originating on the northwestern slopes of Mt. Hood, McGee Creek flows approximately four miles before joining Elk Creek, forming the West Fork Hood River. The lower two miles of McGee Creek flow through private forest land, confining Forest Service activities to above RM 2.0. The upper West Fork flows through a patchwork of National Forest and private forest. Due to the mixed land ownership and potential land exchanges, habitat rehabilitation efforts are being closely coordinated with ODFW.

Fish habitat in McGee Creek is rated as fair (Cain and Kinzey, 1984). Habitat condition is limited by a lack of quality low flow pools (the pool to riffle ratio is about 2:8) and poor habitat diversity. Summer steelhead trout are the emphasis species in McGee Creek. A lack of instream large woody debris accounts fcr the preponderance of shallow riffle habitat and poor diversity.

The objective of the West Fork Hood River habitat improvement project is to provide additional habitat diversity and low flow rearing habitat. Tasks identified for completion during the 1986 work statement period with BPA are:

1) Prepare contract and implement the 1986 McGee Creek project. A minimum of 15 structures were planned for construction to improve low flow rearing habitat.
2) Complete pre-project baseline assessment of the McGee Creek project site.
3) Scoping and project identification for the mainstream West Fork Hood River.

Figure 2


PROJECT AREA WORK MAP
Scale 5/8"=2miles
To Hood River
Divers Creek
1983
Lake Branch
Project
1985 Lake Branch Rearing
Habitat Improvement
Reach A
Accelerator Reach
1984 Lake Branch
Channel Rehab
Baker Pit
1330
Reach B
Lake Branch
1300
Laurel Creek
Willamette Baseline
Hood River
West Fork
Lost Lake
1310
1800
1870
Reach A
Reach B
Reach C
To Lake Pass

METHODS AND MATERIALS

Spawning Surveys and Resting Hole Counts

Little is known about the status of anadromous fish populations in the Hood River basin. The summer steelhead population provides a locally popular sport fishery, but to what extent returning adults are hatchery products or naturally produced is not known. The winter steelhead population is depressed and spring chinook, fall chinook, coho salmon and sea run cutthroat trout populations are very depressed. In an effort to obtain baseline information and monitor fish populations in the West Fork system, steelhead spawning surveys and resting hole counts for summer steelhead and spring chinook salmon were initiated. These are coordinated with similar efforts being conducted by the Forest Service and ODFW throughout the Hood River basin.

Spawning surveys were conducted on lower Lake Branch and the upper West Fork Hood River (APPENDIX D). The surveys were conducted for steelhead in late April and May. Lower Lake Branch was surveyed on 4/16/86 between RM 5.5 and 6.3, on 5/5/86 between RM 3.9 and 5.4 and on 5/6/86 between RM 5.4 and 7.8. The West Fork was surveyed from the confluence of McGee and Elk Creeks (RM 13.9) to the Dry Run Bridge (RM 8.5). The surveys were performed by one or two people. The Lake Branch surveys were conducted by the surveyors walking upstream while the West Fork reach was surveyed by snorkeling downstream. Surveyors recorded visibility, relative discharge, weather, number of redds, and number of live and dead adults by species. Numbers of juveniles wereidentified by species when practical.

The resting hole counts were made in August and September (APPENDIX E). The counts are made by a team of two or three divers snorkeling the stream reach, proceeding downstream, counting the number of adult anadromous fish observed. Summer steelhead were identified as either natural, or hatchery produced, or if origin could not be determined, unknown. The identification of hatchery or natural origin was made by observing whether the fish possessed an eroded dorsal fin or clipped fin. If fin condition could not be positively identified, the fish was recorded as unknown. The resting hole counts were made in cooperation with ODFW and the target species were summer steelhead trout and spring chinook salmon.

Resting hole counts were conducted on two days, 8/28/86 and 9/15/86. The stream reaches surveyed both days were approximately RM 2.0 (mouth of Diver's Creek) to RM 0.0 of Lake Branch and from the Lake Branch/West Fork confluence to the Lost Lake Road bridge crossing on the West Fork (approximately RM 4.5).

Physical and Biological Assessment

A physical and biological assessment program was continued on Lake Branch and the West Fork. The evaluation includes measurements of physical habitat and associated fish populations in pre-treatment, post treatment and control reaches. The objective of the assessment program is to determine if project activities are providing expected changes in habitat and fish production. A description of the monitoring program is contained in the Mt. Hood National Forest Monitoring Report.

Planning

A major effort was made to complete planning for implementation of the 1987 upper Lake Branch channel rehabilitation project. The upper Lake Branch project area provides poor fish habitat due to low summer flows, (one reach becomes subterranean in summer) and an unstable channel. Where summer flows are maintained there is little rearing habitat and scarce amounts of anadromous fish spawning habitat. The objectives of the project are to improve rearing habitat where summer flows are maintained by increasing the quality and quantity of pool habitat. Structures designed to improve pool habitat should also provide anadromous fish spawning habitat. The second objective is to stabilize the channel and provide year around flow and rearing habitat where the stream flows subterranean in summer.

Returning summer surface flow to the subterranean reach was perceived to be risky in terms of success, therefore the services of a consultant, Dr. John Orsborn was contracted. Dr. Orsborn was specifically asked to:

1) Assess existing conditions in the reach from RM 8.5-9.0;
2) Develop alternative methods or combinations of methods for rehabilitation of fish habitat in this reach, primarily during low flow;
3) Discuss the feasibility of achieving the project objective by alternative methods;
4) Provide an analysis of problem solving techniques and guidance to aid District personnel in completing a feasibility assessment of the project;
5) Prepare working drawings of recommended methods.

According to Dr. Orsborn (APPENDIX F), the existing habitat and channel conditions are a result of past logging without maintaining a buffer strip resulting in a loss of bank and root structural integrity. The stream was also extensively "cleaned" of woody debris. Subsequent floods eroded the banks. The loss of roughness elements within the channel, and decreased streambank stability along the channel margins, resulted in increased stream velocities, widening of the channel, and removal of organic and inorganic fines which had help seal the substrate. The result is a straight steep channel with loose banks and bed.

General steps recommended to achieve some degree of restoration are:

1) reduce the permeability of the substrate;
2) restore habitat and woody debris structure to the stream;
3) increase bank and bed stability;
4) change the predominant form of energy dissipation in the channel from primarily friction to expansion losses in plunge pools and around obstructions;
5) reduce the amount of flood flow in the main channel in order to reduce the impacts on channel modifications and allow more rapid recovery;
6) concentrate the low flow in the main channel to maximize summer habitat.

The stream reach was mapped, longitudinal profile of the channel determined and observations made regarding local material for rehabilitation structures. Four wells were drilled within the project reach to map the water table. The information gathered is being used to develop alternatives for an Environmental Assessment and project plan.

Project Implementation - McGee Creek

The objectives of the McGee Creek project were to increase low flow rearing habitat for 1+ and older juvenile steelhead trout, increase habitat diversity and secondarily, improve spawning habitat. Hood River steelhead out migrate as l+, 2+ and 3+ smolts (Howell et al, 1985). thus a diverse, quality rearing habitat is important to support the different age classes. The project was divided into three reaches (A, B, C) for planning purposes (FIGURE 2). In all three reaches instream wood structures, including sills, diggers and wings, were placed to achieve habitat objectives. Heavy equipment was used for construction in reaches A and C. While in reach B machine access was poor so the work was completed by hand labor.

Project work in reaches A and C was completed under a Forest Service administered equipment rental contract. The contract specified a large track-mounted backhoe/excavator (equivalent to a Cat 225) with operator. The excavator bucket was equipped with an opposable thumb. The machine retained by the contract, a Hein-Werner C14-B was fully capable of moving the large logs and excavating the channel. Forest Service personnel directed the operator during construction and performed the necessary hand labor.

Logs for reaches A and C were obtained from nearby timber stands. Trees directly adjacent to the channel were not used because none were available in reach C and in reach A there are so few trees remaining that it seemed more prudent to leave stream adjacent timber as sources of future large woody debris. Forest Service personnel felled, limbed and bucked the trees to the desired lengths. The logs were then skidded to the sites by the backhoe. Originally a crawler tractor was to be rented to skid the logs, but based upon discussions with a local logger, and the lower than anticipated backhoe hourly rate, the backhoe was used to skid logs instead of moving in a second piece of equipment. Log stringers from a replaced bridge provided several logs for reach C. A local logger with a front-end loader in the vicinity was hired to load the stringers on a self-loading log truck for transport to the project area, thus reducing the number of green trees that needed to be felled. Logs for structures ranged from thirty to sixty-five feet in length and were generally greater than twenty-four inches in diameter. APPENDIX A presents drawings of typical designs for improvement structures.

Log sills were constructed to create plunge pools, or act as downstream controls for scour pools upstream (See APPENDIX B for log sill detail). The sills should also collect spawning gravel. Log sills were anchored at least six feet into each bank for stability. The upstream sides of the sills were lined with filter and hardware cloth to prevent undercutting. Plunge pools were excavated downstream of the sills to hasten pool development. The pools are expected to fill and shift slightly due to bedload accumulation and modification of channel hydraulics at the structures. Digger logs were

anchored into the banks in the same manner as log sills, only instead of being placed in the low flow channel, diggers were constructed to bridge the low flow channel. These digger logs force higher flows under the log creating a scour pool, the log providing overhead cover. Excavated banks associated with both sills and diggers were rip-rapped with rock obtained in excavation.

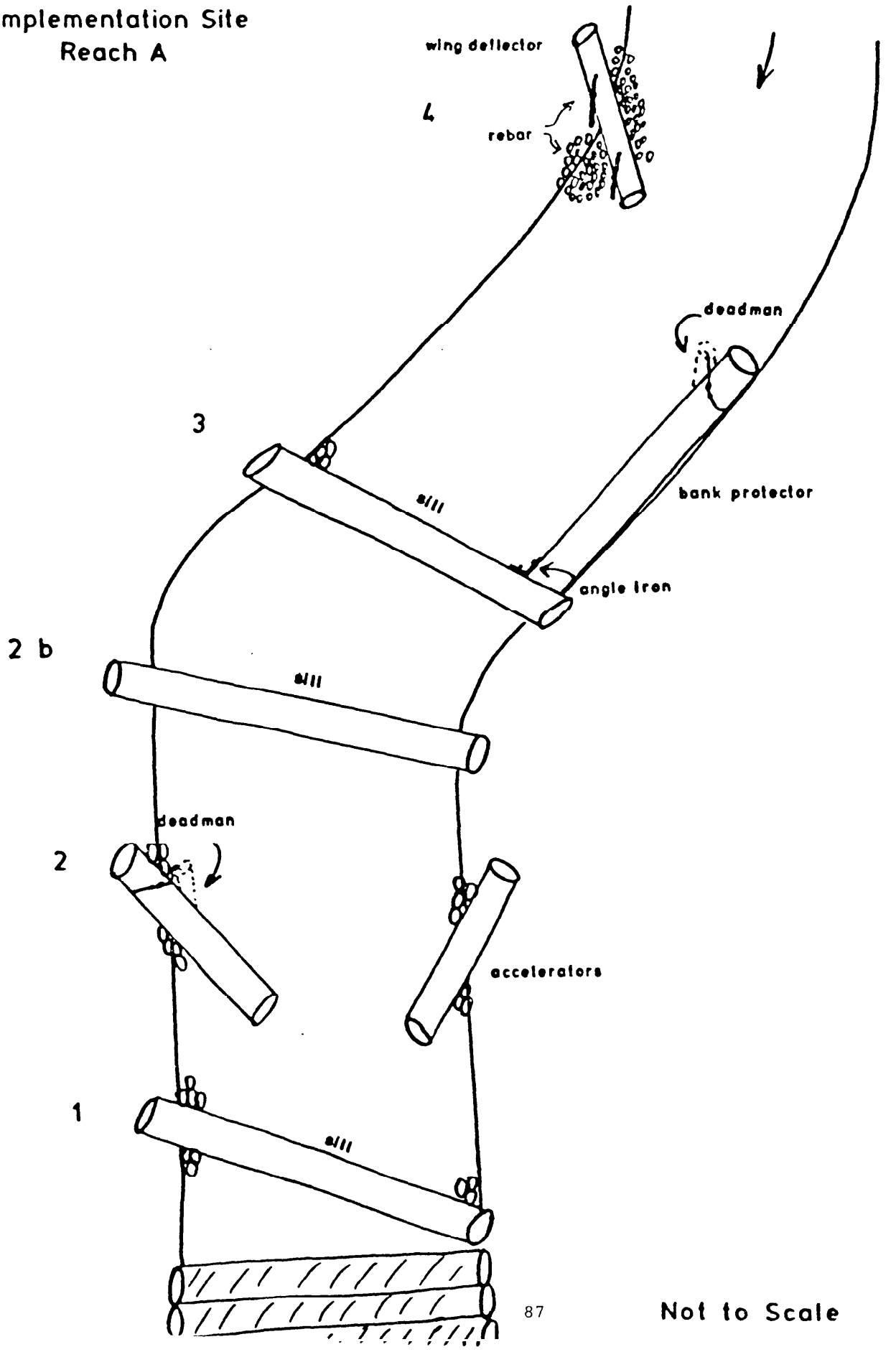
Log wings were placed at between a 30°-45° angle pointing downstream. The purpose of the wings are to create scour pools, increase sinuosity and provide cover. The wings may also collect some spawning gravel. Where possible, the wings were buried into the bank at least as far as they extended into the stream. If, due to log length or bank condition, a wing log couldn't be anchored far enough into a bank to insure stability, 55 gallon drums filled with concrete were used as "deadmen". The drums were buried under the log. Aircraft cable (3/8" or l/2" diameter) was run through the drum before concrete was poured so that the concrete set around the cable and then the cable was wrapped around the log and clamped with cable clamps. One wing, placed on a wide floodplain where it was not possible to anchor the log into streambanks and where insufficient numbers of drums were available, was anchored by drilling the log with a chainsaw powered wood drill and driving two pieces of l/2" diameter rebar through the log into the substrate. It is felt that considering the length and size of the log, and its placement on the inside of a bend, that the rebar will sufficiently anchor the structure.

The channel was slightly excavated at the downstream end of the wings to enhance scour pool formation. Large boulders, when available, were placed in pools for cover. One minor inconvenience during construction was the fewer than expected number of large boulders available for ballast on the ends of the structures or to place in pools. The structures should be sufficiently anchored to the banks though to provide stability. As rubble is transported into the pools cover will improve. If needed in the future, selected trees may be felled and anchored by cable in the pools for additional cover.

Poor machine access to reach B prevented heavy equipment access without road construction. If a road was built it would have either had to cross a swampy riparian area or come down a steep side slope. The monetary and environmental costs to access reach B with heavy equipment could not be justified. Six old growth trees were felled into or across the channel to improve rearing habitat diversity. Within this reach, there are other old growth trees available as future sources of natural wood input. The trees were felled by Forest Service personnel. The size of trees prevented using a chainsaw winch to move the bole to anchor to the stump; therefore only trees large enough to span the channel, with at least approximately one-third of the bole on both banks, were used. The length and size of the boles should prevent transport in high flows. In one case two trees were felled across each other for added stability and habitat complexity. Most of the trees will act as diggers. The double tree structure, depending upon bedload collection will act as a sill, a digger or establish a small log jam; an impassable jam should not form though, as there appears to be plenty of opportunity for the stream to cut under, plunge over or form a scour pool around the trees.

Figure 3

McGee Creek
Implementation Site
Reach A



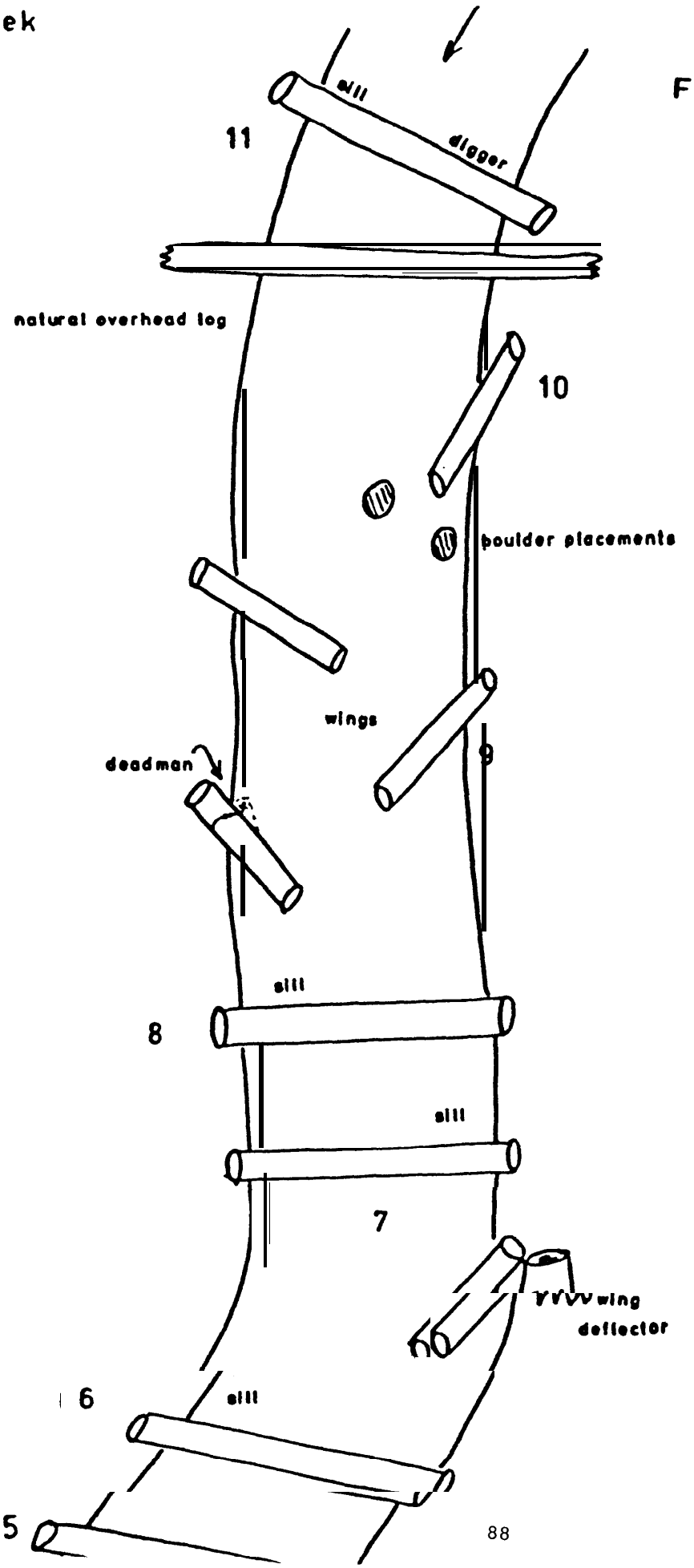
Not to Scale

McGee Creek

Reach A

Continued

Figure 4



RESULTS AND DISCUSSION

McGee Creek Implementation

The McGee Creek project was completed within the planned budget. Structures were placed at eleven sites in reach A and eight sites in reach C (FIGURES 3 and 4). Six large trees were felled into the channel within reach B. Structures in reach A included six log sills, one double wing accelerator, five single log wings, a digger log and a combination sill/digger. Structures completed in reach C are similar to those in reach A and include a double sill structure, five single log sills a log wing and a combination wing/sill. The structures are similar in design and construction to other structure placed in the West Fork basin (APPENDIX C contains photos of McGee Creek project implementation).

The original estimated cost for the McGee Creek project was $18,791 with benefits estimated over 20 years to be $24,372 for a benefit cost ratio of 1.3/1.0. The approximate actual cost of implementation including final planning and contract preparation, was $17,000 for a projected benefit cost ratio of 1.4/1.0.

Maintenance Needs

Project work completed in 1983, 1984 and 1985 on Lake Branch was reviewed for maintenance needs. A ten to fifteen year flood event occurred during the winter 1985/86 providing the first high flow test of the structures. The following is a discussion of the instream structures after the high flows.

1983 Lake Branch Project: Five cross channel V-shaped berms and four rearing berms were constructed in 1983 (Heller, 1984) at approximately RM 7.5. Two gabions were constructed at RM 7.5 and a log jam was partially removed to improve adult passage. The objectives of the V-berms were to collect spawning gravel and improve low flow rearing habitat. The objective of the rearing berms was to concentrate low flow down the left-hand side of the channel improving rearing habitat. The gabions were built as downstream "V's", primarily designed to collect spawning gravel.

During 1986 all structures were functioning as designed. The gabions and berms collected spawning gravel and large plunge pools were maintained below the cross-channel berms. One steelhead redd was observed on gravel collected by the gabions. Habitat associated with the structures will be measured next year to quantify the extent to which objectives were met. The rearing berms are also intact and no maintenance is anticipated.

The 1983 log jam modification involved hand removal of small debris to create two passage slots, while leaving the bulk of the jam intact, maintaining the good pool habitat and accumulation of spawning gravel associated with the jam. One of the slots had jammed with debris while the other was open. The river had also naturally created a side channel around the jam, providing additional passage. As the side channel deepens, it will provide high quality rearing habitat.

1984 Lake Branch Channel Rehabilitation Project: The objectives of the 1984 channel rehabilitation project were to test a variety of structures designed to narrow and deepen the low flow channel and increase rearing habitat for juvenile steelhead. Collection of spawning gravel was a secondary objective. Results of the project would be applied to future projects in Lake Branch and the West Fork. The structures were placed in a reach of stream dominated by shallow riffles (less than one foot deep) flowing over small boulder and cobble substrate. Four double wing accelerators, two single log wings, two log sills, a log "K" structure and a side channel were constructed (MacDonald and Ragan, 1985). Overall, the structures are functioning as designed. The sills and "K" structure have maintained plunge pools four to five feet deep in low flow. The single wings are providing cover. Two pairs of double log accelerators have maintained scour pools and collected some gravel. One set of accelerators did not funtion as well as as the other. Apparently the accelerators work best when a downstream control structure, such as a sill or natural hardpoint, is present. The accelerators providing the best results were built on a flatter gradient than the others and the tail-out of the downstream accelerator acted as the control. A log sill is planned to be added downstream of the less effective accelerator in 1987.

The side channel did not function as planned. This side channel was constructed in an abandoned overflow channel that had been blocked by bedload from an intermittent tributary. Preliminary evaluation suggested that the tributary was no longer routing large amounts of bedload. However, the side channel filled slightly with bedload from the tributary in winter 1984/1985 and was re-excavated in 1985. The tributary channel was also diverted into an old channel in hopes of dissipating energy and debris. During the 1985/1986 event, bedload from the tributary partially filled the side channel again. The side channel still retains some summer flow, but not the amount desired. Due to the unstable nature of the tributary, no further action is anticipated.

1985 Lake Branch Rearing Habitat Improvement: The objective of this project was to improve low flow rearing habitat. The project was divided into reaches A and B (MacDonald and Ragan, 1986). Work in reach A (RM 7.4-7.5) included boulder groupings in riffle/glide habitat and creating a year round side channel in a high water overflow channel. Twelve boulder structures were placed in reach B.

The boulder groupings in reach A appear to be functioning as designed. Cover is increased where they were placed and depth of the glide maintained. The side channel worked well in mean high water; however, during the 1985/1986 flood event a natural log jam washed out allowing a breach of the protection structures' filling the channel mouth with debris. Maintenance planned in 1987 includes repair of protection structures, replacement of side channel habitat structures and construction of the inlet control structure. Work at this site is risky because it deals with stabilization of a gravel bar. It is felt though, that by constructing an inlet control, and improving the high water deflectors, the side channel can be maintained.

Reach B (RM 5.4) was also a risky site in that the project reach was a depositional area created by an old log jam which had been removed. The reach B channel was wider and shallower than upstream or downstream reaches, and a

mid-channel berm existed which split low flows. Six boulder berms were placed in the right hand channel and are functioning as designed. Another six berms were placed on the left side of the channel. Five of these berms were filled, as the gravel bar shifted. One is functioning as designed, and several boulder placements are working. Pool habitat was increased from 35.3 square meters to 119 square meters and 25 square meters of gravel were collected. No further work is planned for reach B at this time.

Planning

A project plan and environmental assessment is currently being formulated for the 1987 upper Lake Branch channel rehabilitation project. A variety of alternatives identified in Dr. Orsborn's report (APPENDIX F) have been considered. The most cost effective alternative appears to be installation of log structures, including wings, "K" structures and log sills to narrow the channel and provide friction elements to reduce stream velocities and create pools. Data from wells monitoring the water table, indicate that excavating the channel to remove accumulated bedload in combination with instream structures should capture the subterranean flow. Treatment of the reach in two stages is planned to further enhance the cost effectiveness of the project. The project will require the use of large logs (30+ inches in diameter, up to 70 feet long) and heavy equipment.

Physical and Biological Assessment

Results of the physical and biological assessment are contained in the "Mt. Hood National Forest Monitoring Report".

Spawning Surveys and Resting Hole Counts

APPENDICES D & E summarize the findings of spawning surveys and resting hole counts.

A one day spawning survey was conducted in late April on the West Fork Hood River. The survey was conducted from the confluence of McGee and Elk Creeks (RM 13.9) to the Dry Run Bridge (RM 8.5). Eight redds and three adults were counted between the McGee/Elk Creek confluence and the point where Ladd Creek enters the West Fork (approximately RM 12.0). Numerous steelhead smolts were also observed.

Only nine redds and two adults were counted, and few smolts observed, between Ladd Creek and the Dry Run bridge. However, this area is difficult to survey, due to steep gradient and large boulders. It is possible that redds were unnoticed. Most spawning between Ladd Creek and the bridge is confined to small accumulations of gavel associated with pocket pools. Interestingly, observations made during the spawning survey indicated that observed steelhead were likely winter steelhead.

Results of the spawning surveys on Lake Branch were disappointing. Only one redd and two groups of smolts were counted between RM 5.5 and RM 6.3 on April 16. This was the only reach snorkeled. A second survey on May 5 between RM

3.9 and 5.4 revealed two redds. During the third survey on 5/16/86 between RM 5.4 and 7.8 five redds were counted. It should be noted that unobstructed passage into Lake Branch and the West Fork was not provided until late summer 1985 when the ladder at the West Fork Falls was complete and a low flow barrier at RM 2.8 was made passable at all flows. Poor passage conditions likely account for the apparent poor escapement.

Two resting hole counts for summer steelhead and spring chinook salmon were completed. The reaches surveyed both days were approximately RM 2.0 of Lake Branch to the mouth of Lake Branch, and from the confluence of Lake Branch and the West Fork to RM 4.5 of the West Fork. RM 0.0 to 2.0 is below the National Forest boundary and contains most of the high quality adult holding water. On August 28, 1986, 121 adult summer steelhead were counted in Lake Branch. Of these 121 fish, 33 had fin marks indicating hatchery origin, 27 were unmarked indicating natural origin and the remaining 61 could not be determined. No fish were seen in the West Fork due to poor visability associated with glacial runoff from Ladd Creek. A second survey was completed on September 15, 1986. A total of 152 adult summer steelhead were counted in Lake Branch; 55 were of hatchery origin, 65 fish were unmarked and 32 were of unknown origin. In the West Fork, 61 steelhead were counted, including 17 hatchery fish, 27 unmarked and 17 unknown fish. One spring chinook salmon was also seen. The relative numbers of fish appearing to be of natural origin was interesting because the success of natural production in the system had been questioned. The surveys also showed that poaching is a problem in the system. The reaches surveyed are closed to fishing and places of active "snagging" were observed. The Oregon State Police have been notified of the poaching.

SUMMARY AND CONCLUSIONS

Tasks identified in the 1986 work statement by subproject are discussed below.

Lower Lake Branch Rearing Habitat Enhancement (RM 3.4-8.0)

Tasks to be completed in this subproject were:

1) Conduct a high flow stream survey in spring, 1986 to identify and map overwinter rearing habitat improvement opportunities;
2) Fall at least 10 alcove trees to provide margin habitat and scour pools and blast a minimum of two pools in bedrock to provide optimal rearing habitat;
3) Continue assessment of completed projects;
4) Maintenance of the 1983 and 1985 projects.

The high flow survey was conducted in conjunction with spawning surveys. A primary objective of the survey was to locate potential areas for side channel development. Two potential side channels were observed, one at approximately RM 5.4 and another at about RM 5.9 or 6.0. At this time no work is anticipated on the side channels as the stream is naturally flowing into them and excellent rearing and spawning habitat is provided, especially by the one at RM 5.4.

Below RM 5.4 the stream gradient increases, and the canyon narrows. Large boulders dominate the channel substrate and opportunities for side channel development is very limited. The large boulder substrate may be providing adequate winter rearing habitat for steelhead. A review of the lower Lake Branch project area by a biologist from the Mt. Hood National Forest and ODFW is planned for 1987 to determine if all habitat improvement opportunities have been identified.

No tree falling or blasting was completed. It was questioned whether tree falling would be successful in the steep canyon reaches. Trees naturally falling into the stream above RM 5.3, however, are providing excellent habitat. Wildfire suppression duties in summer 1986 prevented further exploration into the tree falling. The pool blasting was not completed because, upon further review, the limited amount of blasting planned was not felt to be cost effective. The tree falling question is planned for review by Forest Service and ODFW biologists in 1987.

The assessment of completed projects was continued. Physical habitat was measured and fish populations sampled in completed project reaches and control reaches. Results of the monitoring are in the "Mt. Hood National Forest Monitoring Report". Spawning surveys and resting hole counts were initiated to provide an index to escapement and to population trends.

No maintenance of the 1983 or 1985 projects was performed. The projects were reviewed and overall the structures were found to be performing as designed. A side channel constructed as part of the 1985 project was partially filled when a natural log jam washed out, allowing a breach in the high flow protection structure. Maintenance is planned for 1987 when heavy equipment will be in the vicinity, thus saving mobilization costs. An inlet control structure will be added, a high flow deflector replaced and log structures replaced in the side channel. Several small rock structures were filled with bedload in the reach B section of the 1985 project (MacDonald and Ragan, 1986). Overall, the project was successful as pool habitat was increased by 291 square meters above preproject levels and 23 square meters of additional spawning gravel was collected. No further maintenance is anticipated.

Upper Lake Branch Channel Rehabilitation (RM 8.0-9.0)

Tasks identified in the 1986 Work Agreement with BPA for the upper Lake Branch subproject were:

1) Maintenance of project work completed in 1984;
2) Continue assessment of the 1984 project;
3) Complete project design and environmental assessment for the proposed 1987 project.

The 1984 project was reviewed and the two log sills, three single log wings, "K" structures and two of the four accelerators are functioning as designed. Two other double log accelerators are partially functioning. A log sill, to act as a downstream control, will be added below the partially functioning set of accelerators to hasten pool development. Efforts to prevent bedload from an intermittent tributary from entering the side channel constructed in 1985 have

not been successful. The channel has partially filled with bedload but does maintain some summer flow. No further work is planned and it is hoped that over time, high flows from Lake Branch will scour the side channel.

Assessment of project work was continued and the results are contained in the Monitoring Report.

A project plan and environmental assessment is currently being formulated for the 1987 upper Lake Branch channel rehabilitation project. The objective of the project is to provide quality anadromous fish rearing habitat in a reach of stream that currently flows subterranean in the summer. The project will involve excavation of the channel and installation of log structures to maintain pools, confine the channel and dissipate high flow energy. The environmental assessment should be completed by mid-April, 1987.

West Fork Hood River Habitat Enhancement

Work included in the 1986 Agreement with BPA for the West Fork Hood River subproject included:

1) Prepare contract and implement the 1986 McGee Creek project; A minimum of 15 structures were planned to improve low flow rearing habitat;
2) Complete pre-project assessment of the McGee Creek project site;
3) Scoping and project identification for the mainstem West Fork Hood River.

The McGee Creek project was implemented as planned and within budget. Log structures including sills, diggers and wings were placed at 19 sites and six large trees felled into the channel. Pre-project assessment, including measurements of physical habitat and population samples, was completed in a treatment and control reach. Results are in the Monitoring Report.

Project scoping and identification for the mainstem West Fork was continued. The upper West Fork flows through a mix of National Forest and private land. A land exchange that would bring this private land into public ownership is likely. Planning for future implementation is being closely coordinated with ODFW. Formulation of a habitat improvement program with ODFW is planned for 1987.

SUMMARY OF EXPENDITURES

1.	Personnel	$22.170.11
2.	Travel/Per Diem	765.20
3.	Expendable Materials	2,129.17
4.	General Services	11.85
5.	G&A Overhead (@12%)	3,009.15
6.	Contract Costs	8,577.50
7.	Total Costs	$36,662.98

LITERATURE CITED

Cain, Tom and Doug Kinzey. 1984. Riparian area resource assessment (1984). USDA Forest Service, MHNF, Gresham, OR.

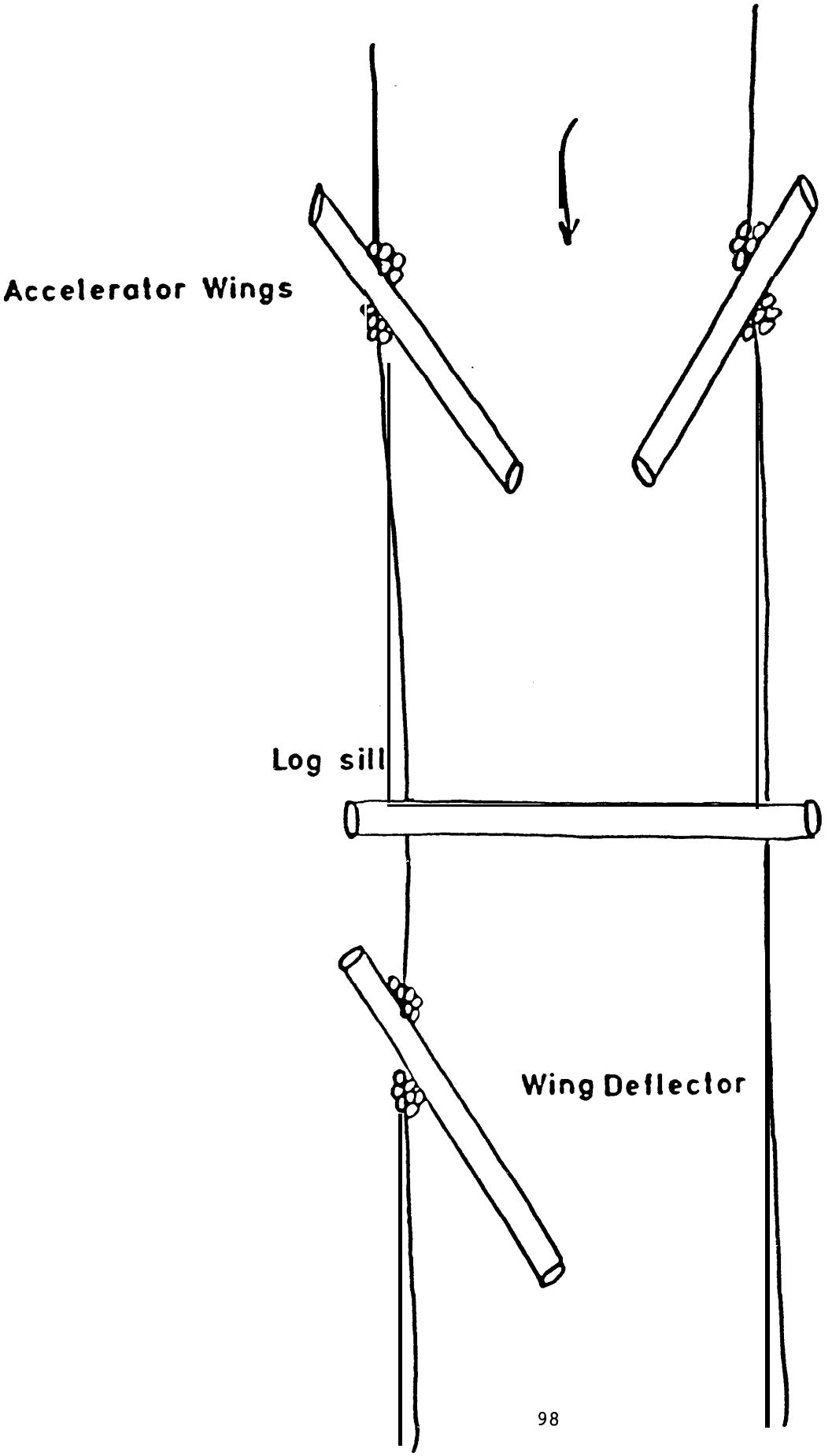
Heller, D. 1984. Lake Branch Habitat Improvement Ammia; Report, 1983. In Natural Propogation and Habitat Improvement, Vol. I-OR. Department of Energy, Bonneville Power Administration.

Howell, Philip, K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, D. Ortman. 1985. Final Report. Stock Assessment of Columbia River Anadromous Salmonids. Vol. I. Department of Energy, Bonneville Power Administration.

MacDonald, K. and R. Ragan. 1986. Lake Branch Habitat Improvement Annual Report, 1985. In Natural Propogation and Habitat Improvement. Vol. I-OR, Department of Energy, Bonneville Power Administration. Pages 103-123.

APPENDIX A - TYPICAL STRUCTURE DESIGNS

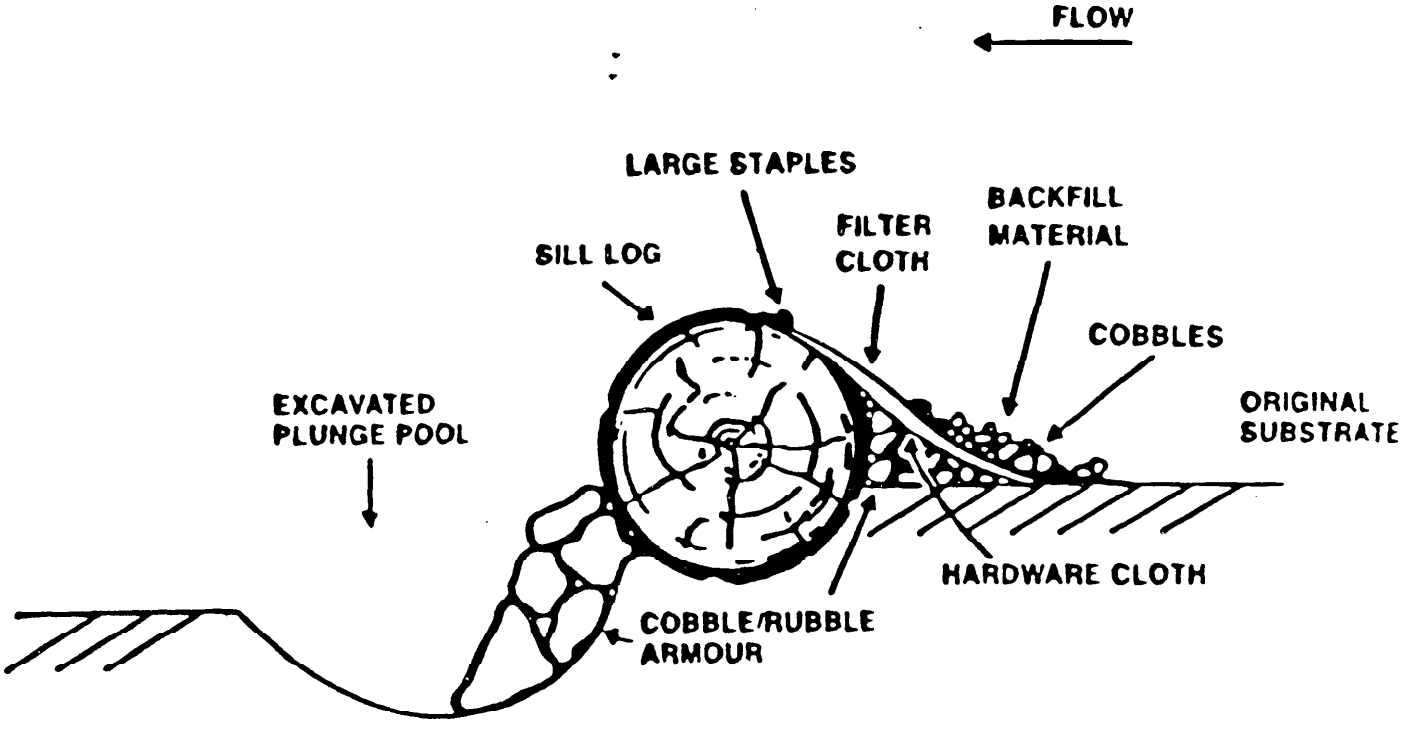
Typical Structure Designs



APPENDIX B - DETAIL OF TYPICAL LOG SILL

APPENDIX B

TYPICAL CROSS-SECTION OF A LOG SILL ON MCGEE CREEK

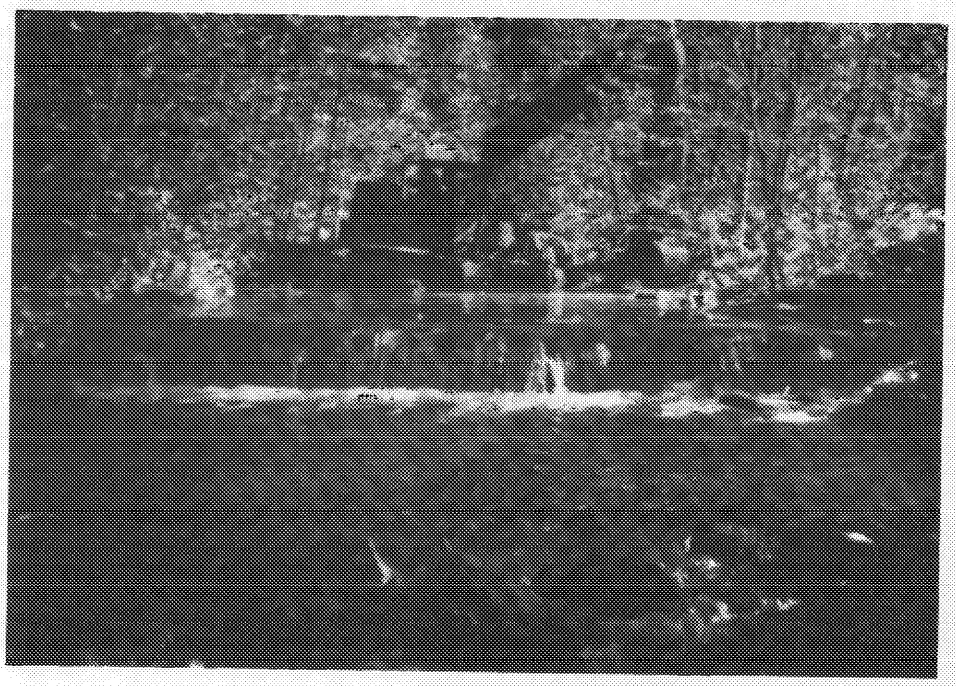


APPENDIX C - PHOTOS OF MCGEE CREEK PROJECT IMPLEMENTATION

APPENDIX C-1

MCGEE CREEK

REACH A



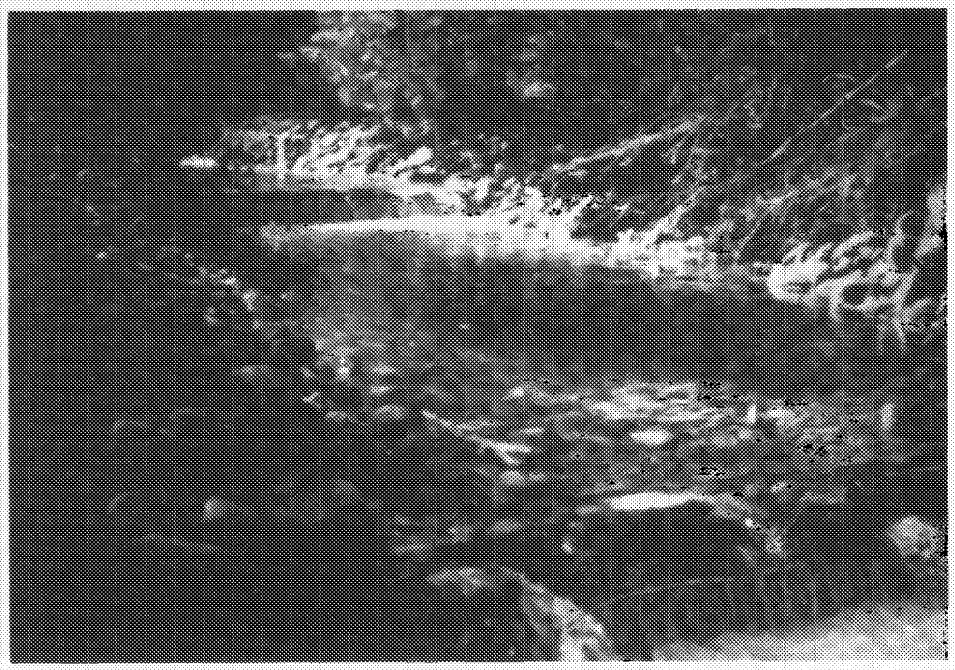
Hein-Warner C14-B at work excavating bank to key in log wing at s Site #9

Double wing accelerator and diagonal sill. Site #s 1 & 2.

Objective was to deepen pools and provide structural integrety integrity.

MCGEE CREEK
REACH A

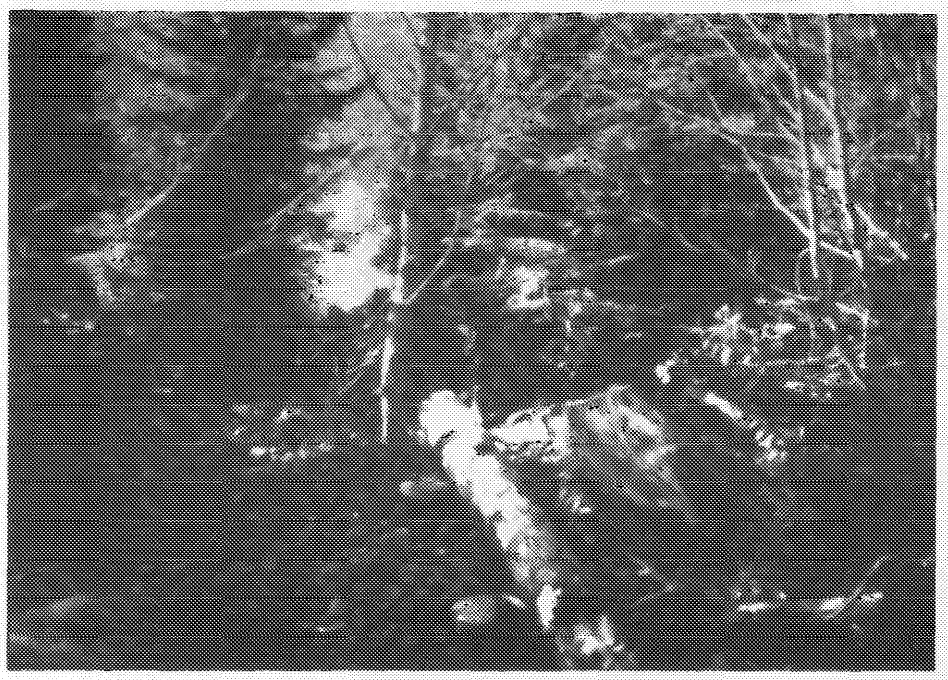
Typical riffle section before project work.



Log sill pool development. Site #s 2b & 3.

MCGEE CREEK

REACH C



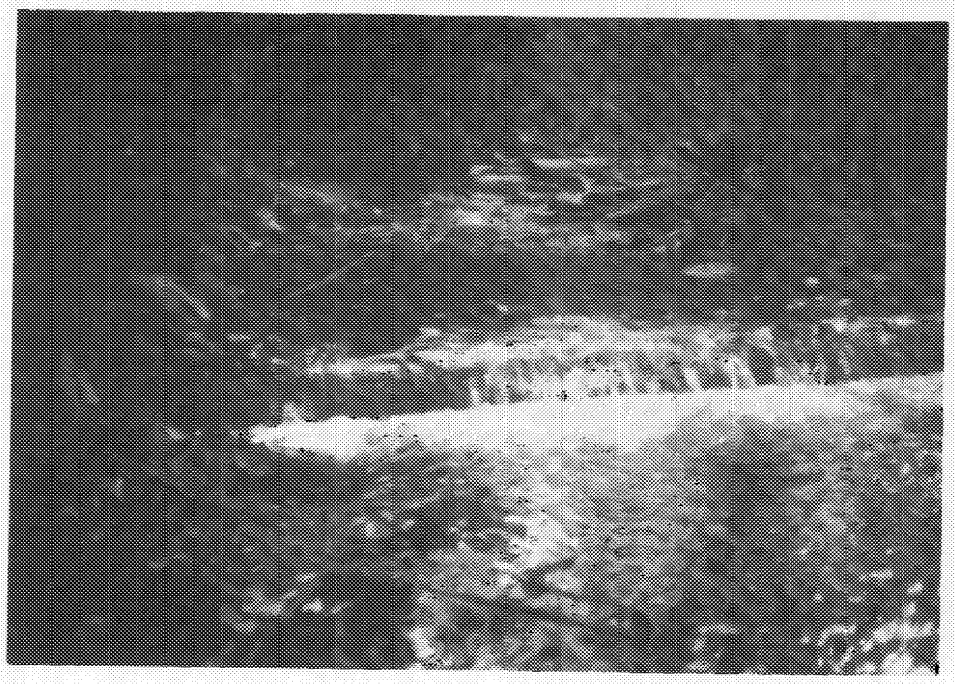
Use of Stihl chainsaw drill to bore holes for rebar.

Double diagonal sill structures .

Intent was to provide pool area and decrease high flow velosities.

MCGEE CREEK

REACH C



Log wing and sill.

Log sill pool development.

APPENDIX D - SPAWNING SURVEY RESULTS

APPENDIX D

SPAWNING SURVEYS
HOOD RIVER BASIN
WEST FORK SUE-BASIN
LAKE BRANCH

Date	Distance Surveyed	Water temp * Air temp	Visability	Flow	Weather	#Redds	#Adults	Comments
4/16	5.5-6.3	40'F 49'F	1	M	R	1	2	redd seen at lower end of 1985 project (Reach B)2 grou of smolts seen
5/5	Skipper Cr. to No Name Creek	41'F 43'F	1	M	O-R	2		most gravel un-used
5/6	No Name Cr. to above Raker Pit	40'F	1	M	C-O	5		
			WEST FORK HOOD RIVER					
Late April snorkled	13.9-12.0		1	M	C	8	3	numerous smolt no younger age class seen.Adu appear to be winter fish.
	12.0-8.5		1	M	C	9	2	few smolts, hard to snorkl steep gradient
			MCGEE CREEK					
4/29	USFS boun-dary up 1.3 miles	38'F 44'F	1	M	O			one possible log jam barrie

* KEY

Visability: 1=can see well into riffles
2=can see into riffles
3=can not see into riffles

Flow: L=low
M=moderate
H=high

Weather: C=clear
O=overcast
F=foggy
R=rain
S=snow

APPENDIX E - RESTING HOLE SURVEY RESULTS

APPENDIX E

Resting Hole Counts
Lake Branch/West Fork Hood River
8/28/06

On 8/28/86, Rick Ragan and Ken MacDonald snorkel surveyed Lake Branch from the road just upstream of the confluence with Divers Creek to the confluence with the vest Fork of Hood River. The survey was for summer steelheed and spring chinook. No salmon were sited. Steelhead were counted as fin marked, unmarked or unknown if it could not be determined. An eroded dorsal fin counted as fin marked. It should be noted the this is not a statistical survey. but more useful for noting trends over time.

Unmarked	Harked	Unknown
27	33	61

Total= 121

The West Fork was to be surveyed, but was to silty due to glacial runoff from Ladd Creek.

Lake Branch
Divers Creek road to mouth
9/15/86

Steelhead

Unmarked	Harked	Unknown
65	55	32

West Fork Hood River
Confluence w/Lake Branch to upstream of concrete bridge

Unmarked	Harked	Unknown
27	17	17

Chinnook

1

Numerous smolts in both streams.

APPENDIX F - ATERNATIVES FOR RESTORATION OF ANADROMOUS FISH HABITAT IN PORTIONS OF THE LAKE BRANCH OF HOOD RIVER AT RIVER MILE 8.5-9.0

Prepared by John F. Orsborn, P.E.

APPENDIX F

ALTERNATIVES FOR RESTORATION OF ANADROMOUS FISH HABITAT IN PORTIONS Of THE LAKE BRANCH Of HOOD RIVER AT RIVER MILE 8.5-9.0

Prepared for the

Hood River Ranger District
USDA Forest Service
Mt. Hood National Forest
6780 Highway 35
Mt. Hood -- Parkdale, Oregon 97041

Prepared by

John F. Orsborn, P.E.
Pullman. WA 99163

Work Completed Under Purchase Order 40-04U9-6-68

August 31. 1986

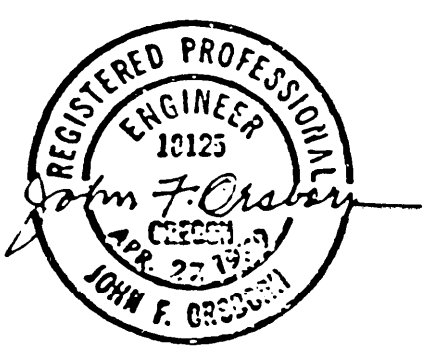


TABLE OF CONTENTS

Page

Introduction. 1

Existing Conditions 2

Alternatives for Stream Flow and
Habitat Restoration 5

Alternative Methods for Accomplishing
the Various Restoration Objectives. 8

Considerations. 16

Appendix I -- References

Appendix II -- Photographs

Appendix III -- Hydrologic Information
and Calculations

Alternatives for Restoration of Summer Anadromous fish Habitat

in Portions of the lake Branch of Hood River at River Mile 8.5-9.0

INTRODUCTION

The reach of the Lake Branch of Hood River between River Mile (RM) 8.5-9.0 is located in Mt. Hood national Forest in the NE l/4 of Section 5, Township 1 South, Range 8 East. As a result of logging to the streamside zone, the banks have lost their root structure and the channel has been significantly widened by flood flows. Vegetation has reestablished Itself on the new banks, but the widened stream bed will not support summer low flows.

High up In the project reach the summer flows disappear into the cobble substrate, and do not reappear until they arrive at the lower end of the project.

As a result of an earlier study of 5 miles of Lake Branch just downstream of this reach, habitat improvement work on portions of those 5 miles have been completed (Orsborn, 1982). The personnel of the Hood River Ranger District wish to examine ways in which this uppermost half mile of altered stream channel can be restored to maintain surface continuity in the summer stream flows.

This report has been prepared at the request of District personnel to:

1) assess existing conditions in the reach from RM 8.5 to 9.0;
2) develop alternative methods, or combinations of methods for rehabilitation of fish habitat in this reach, primarily during low flows;
3) discuss the feasibility of achieving the project objective by the alternative methods;

4) provide an analysis of problem-solving techniques and guidance to aid District personnel in completing a feasibility assessment of the project; and

5) prepare working drawings of the recommended methods.

These project steps are discussed In detail in the subsequent sections.

EXISTING CONDITIONS

The plan view and location of the site are shown In Blueprint (BP) No. 1 (8610-l at the back of the report). A preliminary field survey was completed on May 28-29, 1986 during which the following information was obtained:

1) location and dimensions of the project reach for mapping the site (a Forest Service survey line on the northwest bank was used as a reference line most of the way), see BP 8610-l;

2) elevations of the stream were measured to determine its longitudinal profile;

3) photographs were taken of typical and unique physical features, and the general existing conditions in each subreach of the stream; and

4) notes were compiled about local building materials, existing stream features, access, channel bed and bank conditions and possible alternative modifications to restore the channel back to a productive, continuously flowing reach during the summer low flow period.

Observation wells had been established by the forest Service prior to the field survey at two sites In the downstream one-third of the project reach, and some miscellaneous stream flow measurements had been made by forest Service personnel. During discussions held on Hay 28-29 it was recommended

that a flow accretion-depletion study should be made durtng the summer, and that another well should be Installed near the upstream end of the project. On the days that stream flow measurements are made, the water levels In the wells should be recorded so that stream flow and ground water levels can be correlated. Subsequently, three (3) more wells were Installed and some measurements of water levels in the wells, and discharges In Lake Branch, were made in the summer of 1986. Locations of the wells are shown In BP 8610-l. The data is with the hydrologic analysis In Appendix III.

The photographs of existing conditions are presented In Figs 2-25. Their locations are noted in BP 8610-l and the!r captions describe the features in detail. The photographs are in Appendix II.

Existing physical hydraulic, geometric and habitat conditions In the project reach can be summarized as listed below (refer to BP 8610-1):

1) as a result of logging to the shore, and not leaving a buffer strip, the steam has widened In some subreaches an steepened In others;
2) there Is very little pool volume In the entire reach (on the order of a few percent by area);
3) flow infiltrates into the stream bed near the head of the project reach during low flow periods In the summer;
4) the flow resurfaces about 3000 ft. downstream near a bedrock outcrop, and just upstream of habitat Improvement structures which were installed In 1985;
5) there is a drop in elevation of 78.0 ft. in a length of 2480 ft. along the survey line which parallels the stream; this average slope Is 3.14 percent, varying between less than 1% and as high as 6%,

6) there are two major flood overflow (secondary) channels existing along the left (north) bank;

7) the right (south) bank was not explored In detail, but there are several low-lying places where high flows could be diverted out of the main channel Into infiltration channels to reduce Impacts, encourage vegetatlve growth In the main channel and recharge ground water: a channel or two can possibly be built on the north shore;

8) there is probably adequate large rock In the reach to use for riprao, rock berm construction, fish rocks for rearing space, and narrowing the channel, although some large (3 ft) rock may be needed;

9) trees are available on the north bank of adequate diameter and length for building drop structures and elevation controls in the channel and at the entrances to overflow channels;

> access is possible from the lower end, but equipment will have to be walked to the top of the project, and build their way back downstream; an access road could be built to Wahout Creek, but from there equipment should probably walk in the stream channel when it is dry:

there are two wide, shallow reaches which will have to be narrowed in order to support the summer low flow and restore vegetation to the banks (shown In BP 8610-l);

the active channel divides into two channels In two places in the upper subreach of the project; the geometry should be changed to keep he low flow in the larger of the two channels;

13) two major high flow (overflow) channels could be used as by-pass channels for excess high flows to reduce impacts In the main channel;

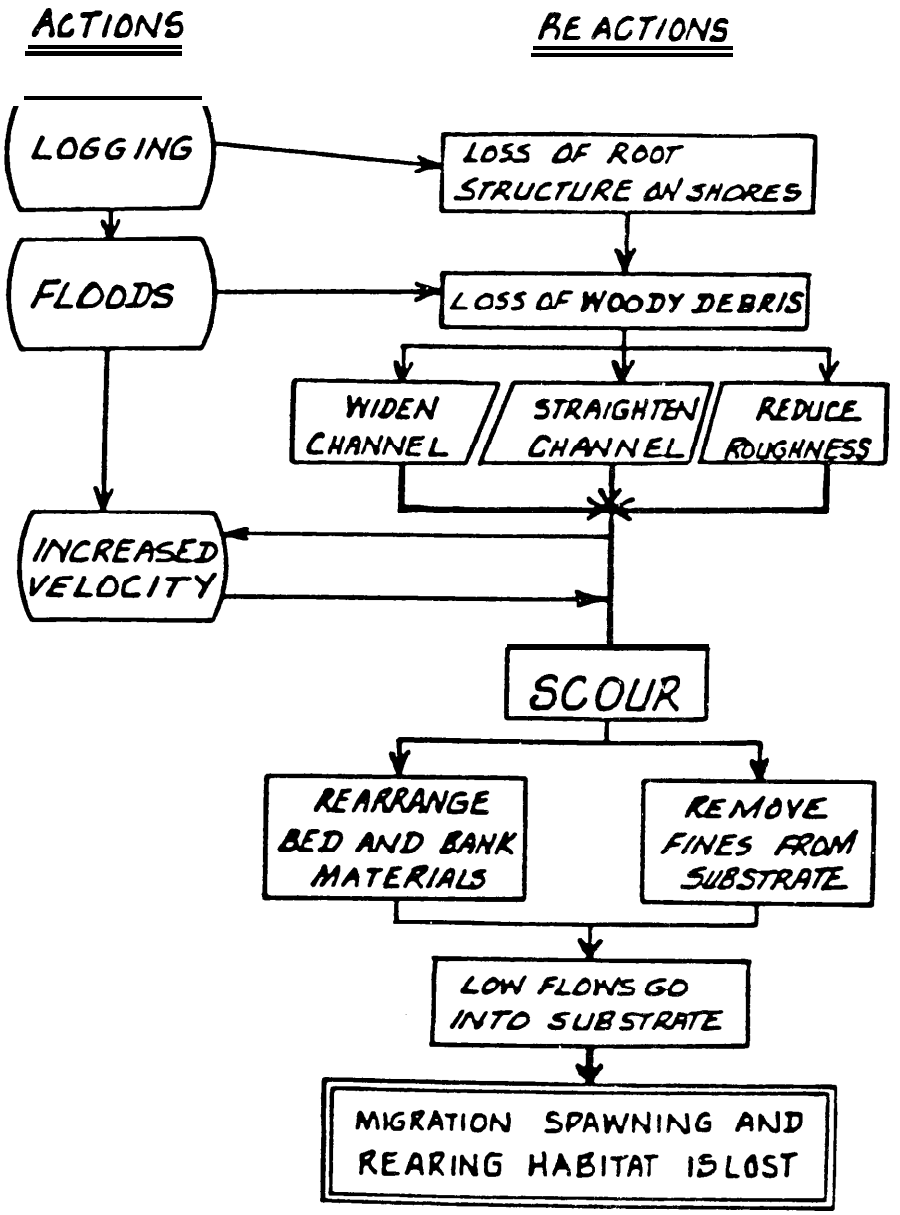
14) there Is some instream woody debris available, but more should be anchored In the channel; and

15) under existing conditions flood flows annually change the channel geometry to some degree. but It will take an extremely long time before small debris and silt fi 11 the voids in the substrate enough to sustain summer flows above the bed of the stream.

ALTERNATIVES FOR STREAM FLOW AND HABITAT RESTORATION

The probable sequence of events which has led to the loss of low flows to the substrate of Lake Branch Is depicted in Fig. 1. Logging wi htout avlng a buffer strip was the Initial action which led to present dry nditions in the summer. This action caused a loss of bank and root uctural integrity. When flooding occurred In subsequent years, the banks e eroded, woody debris was remove from the banks (or buried under the fting bedload) an the substrate was scoured, sorted and redistributed. At average gradient of 3.11, the **MEAN** velocity would be about 11.0 fps, and lly it would have been much higher.

As a consequence, organic and inorganic fines, which had helped seal the trate, were removed to a depth which causes low flows to go underground. he same time, the structural integrity of the stream, and its habitat sity, were lost. All that remains is a fairly straight, steep channel, loose banks and bed, over most of the half-mile project reach. Some



ig. 1. Sequence of Events (Actions) and Processes (Reactions) Leading to the Loss of Stream Flow into the Substrate of Lake Branch Between R.M. 8.5-9.0.

vegetation has begun to develop bank stabilization, but is will be many years before the substrate is resealed to an adequate degree, and the channel resumes its former structure and habitat diversity.

The steps required to achieve some degree of restoration must reverse the degradation process which has occurred as shown in Fig. 1. The general steps to follow, or the processes to reverse, would be (not necessarily in sequence):

1) reseal (reduce the permeability of) the substrate;
2) restore habitat and woody debris to the structure of the stream;
3) increase bank and bed stability;
4) change the predominant form of energy dissipation in the channel from primarily friction to expansion losses in plunge pools and around obstructions;
5) reduce the amount of flood flow in the main channel in order to reduce the impacts on channel modifications and allow more rapid recovery; and
6) concentrate the low flow in the main channel to maximize summer habitat.

The number of alternatives employed and the degree to which each of these alternatives is utilized will govern the rate of recovery for summer stream flow, channel stability and habitat diversity. Each of these general objectives will be addressed next in the context of the alternative methods which are available for achieving the objectives at various levels of effort and probability of success.

ALTERNATIVE METHODS FOR ACCOMPLISHING THE VARIOUS RESTORATION OBJECTIVES

A set of alternative methods for achieving the restoration objectives will be listed and briefly described. Then, these problem solving techniques will be weighted and rated in terms of their relative cost and relative probability of success in a matrix. Structural drawings and plans for these recommended methods are presented in blueprint BP 8610-2.

Objective 1: Reduce Substrate Permeability.

Purpose: to keep more flow above the streambed during low flow season.

Methods:
1) introduce gravels, sands and fines Intermittently throughout the reach (and especially in pool tailouts), or just gravels and sands; and/or
2) put extensive geocloth membranes upstream of log drop structures; or
3) do both methods 1 and 2.

Problems: have to use crushed rock from quarry downstream, and haul gravel and sand, unless an alternative river gravel source can be found. Still have to haul. Also, future floods might wash out fines unless channel is restructured to reduce Instream floods by using off-channel diversions, bank stability measures and energy dissipation structures.

Objective 2: Increase Supply of Ground Water to Lou flow in the Stream (Delay Runoff).

Purpose: to provide more flow to stream than it now has durfng the summer.

Methods: 1) divert a portion of high to medium flows into a series of side channels on the south side of the stream, so flow infiltrates Into valley deposits and reappears as stream flow by raising the local ground water table;

2) divert a portion of high to medium flows Into a channel (or two) through the trees on the North side of the stream for Infiltration and subsequent summer low flow supply (this alternative needs to be investigated in more detail -- a partial remnant stream channel is available, but its extent has not been determined).

3) divert water into dry secondary channels and install rock and/or log berms in the side channels to improve infiltration to stream supply, provide debris accumulation and off-channel rearing; and

4) complete all three sets of diversions.

Problems: rate of flow through valley deposits might be too rapid to provide flow to the stream during the entire low flow period. Gradient could be steeper down valley than towards the stream. Estimate of retention and release rate should be made. Fry might enter channels, and get trapped, but trapping can be avoided by proper design.

Objective 3: Improve fish Passage To and Through This Reach During Low flow Period.

Purpose: to provide utility of the reach all year for spawning and or rearing.

Methods: 1) place large rock in riffles to increase depth of flow and provide rearing habitat;

2) narrow and deepen the wide channel sections by building the flood plain into the channel and/or placing flow deflectors on the banks to narrou and deepen the channel;

3) Install log berms (LB) (mostly or K-dam type) to create plunge pools, deepen the channel and provide habitat, as well as to force the substrate flow over the log berms with deep laid geocloth (heavy wire mesh will be needed to support the geocloth); and

4) integrate all these alternatives into a comprehensive design which controls the low flow throughout most of the reach.

Problems: mainly one of equipment access, but this can be accomplished with a bulldozer grading a path for the backhoe(s). While the backhoe(s) is (are) preparing a site(s) the dozer could be cutting the side channels for high/medium flow diversion (if chosen). The equipment should probably start at the top and work its way downstream, but these procedures should be worked out as part of the design work.

Objective 4: Stabilize the New Channel Geometry and Habitat Diversity Against future flood Alterations.

Purpose: to avoid maintenance, repairs and loss of structural Integrity and habitat space and diversity.

Methods: 1) install woody debris berms, deflectors and rood wads to break UP the flow and dissipate stream power;

2) break up the flow Into eddies, plunge pools and flow channel diversions and divisions during higher flows to avoid concentration of flood flows in one channel;

3) Stabilize banks and new flood plains (see channel narrowing under Objective 4, Method 2) with rocks, logs and willow plantings;

4) change the form of headloss from what Is mostly friction (due to high velocity flow) now to expansion losses in pools and eddies with flow deflectors and drop structures and

5) encourage overbank flow and flood plain infiltration.

Problems: mainly equipment access, as these steps are phases (fine tuning) for Objective 3.

Hydraulic objectives which can be achieved by the methods mentioned earlier include:

1) reducing flood flow (impacts) in the main channel; and

2) concentrating low flows in one channel.

By the introduction of rock and log structures for habitat improvement and flow control, as well as the generous addition of woody debris, the flood flow will tend to be delayed in channel storage instead of passing through the reach so rapidly as it does now.

These alternatives will require a detailed design and stake out in the field. Mote importantly, they will require careful construction followed by monitoring and possibly some fine tuning. A preliminary assessment of the alternatives is presented in the next section.

WEIGHTING AND RATING THE ALTERNATIVE METHODS

The previously suggested methods for restoring summer flows in this reach of the Lake Branch of Hood River can be arranged in three general groups:

1) water control, both surface and subsurface;
2) habitat Improvements; and
3) structural stability and habitat diversity.

Reorganizing the methods into these three groups gives the following arrangement of possible steps.

1) Surface and subsurface water control

   a) reduce infiltration through stream bed by adding fines to the substrate; the more area covered (especially tailouts) the more effective will be the treatment;

   b) force substrate flow to the surface by putting geocloth on the upstream side of all log structures (berms, sills and deflectors);

   c) divert portions of all flows above low flows into flat gradient, infiltration channels on both sides of the stream to increase potential ground water supply to the stream;

   d) install structure(s) in the stream to retard the flow and change the form of energy loss from high velocity friction to drops and eddies in structure wakes; and

e) install structures to raise the level of the stream at variably spaced locations as controls on the gradient of the stream; and

f) Install structures to narrow and deepen the channel by reestabllshlng the flood plain and placing deflectors to concentrate the flow.

2) Habitat Improvements

a) Pools of various sizes and forms, behind and beneath hydraulic control structures, and woody debris anchored into place at the banks, or instream.

b) deeper water achieved by drop structures, deflectors, narrowing the channel (concentrating the flow).

c) Improving the riparian zone with plantings to provide cover, shade and litter;

d) providing midstream habitat in faster water behind rocks for larger rearing steelhead; and

e) adding a significant amount of diversity by installing a design mixture of the previously mentioned habitat devices to achieve an integrated level of potential habitat based on existing conditions, relative ease of modification and relative gain In amount, quality, and type of habitat.

3) Structural Stability and Habitat Diversity.

These two aspects of channel improvement are hterdependent. Large hydraulic structures, such as log berms (drop structures), provide spawning habitat upstream and downstream, as well as rearing habitat for various age classes in different seasons (flow levels and

temperatures) on the upstream edges, and in the downstream pool and eddies.

But l unless banks are stabilized with riprap, seeding and/or plantings, large hydraulic structures will be lost, or at least have their potential effectiveness reduced.

Therefore, in making habitat inprovements under the activities in Group 2, structural stability of the channel, stability of the new structures, and a balance and diversity in generated habitat, must be part of the final design.

To compare these various methods of achieving the objectives of passage and habitat improvement and stability, they have been placed in a matrix form in Table 1.

The general alternatives for consideration in the project reach of Lake Branch are:

1) do nothing;
2) restore surface streamflow during the low flow season;
3) increase summer low flow depth for passage and habitat improvement:
4) improve the amount and diversity of spawning and rearing habitat (restore this 0.5 mile of stream to a productive conditions); and
5) stabilize channel to avoid future damages.

There are a variety of ways to accomplish these alternatives. Some are independent, some are interdependent and some are sequential.

In Table 1 the ratings from O-10 are in terms of relative cost, such as the amount of hauling, for each method used to accomplish the alternative. The methods are weighted and rated vertically in the table for each

Table 1. Matrix of Alternatives, Methods and Cost/Success Factors for Lake Branch Project at RM 8.5-9.0.

METHODS	ALTERNATIVES (Sequential 2-5)				
	(1) Do Nothing	(2) Restore Summer Flow	(3) Increase Depth	(4) Improve Habitat	(5) Stabilize Channel
(1) Add fines	0	8	5	3	0
(2) Add drop logs with geocloth	0	8	7	8	7
(3) Build infiltration channels in flood plains	0	6	2	4	6
(4) Fix overflow channels	0	4	1	8	4
(5) Narrow main channel	0	2	10	7	6
(6) Add large rocks	0	0	10	8	3
(7) Add woody debris	0	4	10	9	7
(8) Stabilize the banks	0	0	5	4	8
(9) Add willows	0	0	2	6	8
(10) Others . . .	—	—	—	—	—
COST/SUCCESS FACTORS					
(1) Hauling materials	10	3	3	1	3
(2) Installing structures	10	3	3	1	5
(3) Time to achieve productivity	1	10	10	10	3
(4) Probability of success	2	9	9	9(+)	8
(5) Others . . .	—	—	—	—	—
TOTALS:	23	57	77	78	68

alternative. The best method for achieveing an objective (alternative) receives its rating (8-10), then the worst method receives it rating (say 0-3). The other methods are then rated according to their relative values between the best and the worst. The important consideration is not the actual value of the rating, but its relative value with respect to that method as applied to the other alternatives. The same is true when comparing the cumulative scores of the alternatives. The scores give a relative (comparative) rating among alternatives. These ratings (0-10) are indices; 0 means no activity and 10 is least cost or most benefit.

The methods have been arranged in a possible sequential fashion to achieve stream flow restoration, improve habitat and reduce the risk of future losses of habitat by increasing channel and structural stability. In the first comparison we are dealing with only two alternatives, whether or not to try and return the low flow to the streambed surface -- do it or do nothing. Thereafter, the rest of the alternatives deal with various degrees of channel stability, habitat improvement and the probability of project success. Therefore, the alternatives cannot be directly compared, because each one adds to the level of cost. One must therefore compare the alternatives according to what each method will do for that alternative, rather than by cumulative totals.

For example, adding fines would be a temporarily effective method to reduce Infiltration (rating 8), but hauling the fines and placing them would be relatively expensive (rating only 3). So one cannot consider only the relative effectiveness of each method, but must consider also the relative expense by using relative cost indices such as for trucking sand and gravel to

the s\te from the quarry site downstream about 1.0 mile from the middle of the project reach. But the cost and success factors must consider the relative cumulative expense of all the methods and their relative success (or contribution) to each alternative, Also, one must consider the relative amount of time until a reasonable level of productivity Is achieved, and the probability of achieving a reasonable level of success. In the case of Method 1, Just adding fines to the stream bed, the time to achieve productivity by Itself (even if the summer surface flow was restored) would. be very (relatively) long (rating 1) without using other methods to accelerate habitat recovery. Also, the channel would still be susceptible to floods which could remove the fines, and bury them at depth. Also, a one shot addition of fines may not be sufficient. The existing, steep stream geometry is not conducive to trapping and storing sands and gravels. Therefore the probabilityof success is low and the rating is 2. with the additon of each method for achieving habitat restoration, there will be a degree of added diversity and stability.

Extra blank copies of Table 1 are attached at the back of the report for forest Service personnel to do their own matrix analyses. They may have special methods or conditions which were not included in Table 1.

CONSIDERATIONS

- Quantification of exact amounts of materials cannot be determined without more detailed surveys and designs, and the selection of alternative methods. But, considering the various suggested methods, following are some guidelines and recommendations.

Method No.	Comments
1	Adding fines -- delete unless needed later.
2	Drop-log structures: 40 at 40-ft. of length with 1000 sq. yds. of geocloth and 1000 sq. yds. of heavy wire mesh, plus local rock for riprap. These would provide materials for water level control, and structures at diversions.
3	To build infiltration channels will require about 4000 to 5000 ft. of level ditching with a bulldozer.
4	Local rock can be used, and/or logs, to make about 20 drop structures, each about 15-20 ft. long, In the two overflow channels. The secondary channels would make good rearing space, and spawning in the upper one. Water level control structures (log and rock) would have to be Installed at the upstream and downstream ends of the channels In the main stream (part of Method 2). Narrowing the main channel is needed for a length of about 1800 ft. Large rocks would be needed to create a new shoreline, and backfill behind the rocks would provide a new lower floodplain about 10-15 ft. wide on each side of the stream. Some large rocks (3 ft) may need to be imported (say 50-100) for providing rearing habitat, cutting a deeper channel In the wide, shallow reaches and as turning rocks on bends to reduce bank erosion and provide habitat. A supply of woody debris (trees, trunks and root wads) is readily available on the north bank of the project reach. Wood is more readily available than large rock to make deflectors for narrowing the channel and scouring

	pools. As much woody debris as is reasonable should be anchored in the bed and banks to create habitat diversity and headloss. .
8	Bank stabilization is not very extensive, but is required at a few sites where loose banks may cause channel shifts. the bank stabilization is needed primarily where new log structures for trapping gravel, and controlling water levels, are needed.
9	Willows would be planted where stream banks are unstable, where the new shores are built to narrow the channel, and where backwater and soil conditions would support them.

- Some type of access road will need to be constructed for equipment unless only Method 9 (Willows) is employed.
- The most promising methods for achieving the restoration of summer low flows and year round habitat would Include all those which add diversity and structure to the stream.
- The diversion of a percentage of all flows, above say the average annual flow, or less, would increase Infiltration into the valley groundwater supply for the stream.
- Construction of the channels (say 5) would not be complex or expensive, but they would require some log structures for wafer level control.
- Diversions into the infiltration and secondary flood (2) channels would help reduce flood impacts on the channel, encourage the deposition of gravels and add to habitat diversity.
- If the infiltration channels are constructed level, small fish would be encouraged to swim back to the main stream as the flood flows recede.

- The rock and/or log drop structures in the secondary channels will trap fines, help infiltration into the groundwater system, and provide additional rearing space during lower flow periods. They already have better vegetative cover than the main channel.
- Before a more detailed plan of an appropriate mixture of improvements can be made, a more extensive survey of the site will be required, including the flood plain areas and more numerous channel transects at control and diversion sites. Generating detailed alternatives for economic comparison at this badly eroded and distorted stream reach is much like restoring a valley which has been dredged for gold (Orsborn, 1985).
- It is recommended that a critical assessment be made of the potential fisheries resource which could be developed and sustained Of this half mile of stream was restored to a more natural and stable reach with good habitat diversity. The dollar value of this potential fisheries resource should indicate a reasonable dollar value which could be assigned to restoration activities, or whether restoration is indeed feasible. Based on your cost experience with other habitat structures, certain levels and mixes of development could be assumed, the costs could be estimated and then compared with the value of the potential fishery.

EXAMPLE NO	COMPONENTS	ESTIMATED COST
1	20 log and rock structures with geocloth and wire mesh (like K-day downstream).	_____
	50 large (3-ft.) boulders for Instream habitat and channel deepening.	_____
	3,000 ft. of infiltration channels with one-pass dozer construction.	_____
	500 willow cuttings planted.	_____
	TOTAL COST:	$_____
	30 log and rock, K-structures with geocloth and wire mesh.	_____
	100 large (3-ft.) boulders.	_____
	1,500 ft. of channel narrowing.	_____
	5,000 ft. of infiltration channels.	_____
	1,000 willow plantings.	_____
	TOTAL COST:	$_____

APPENDIX I -- REFERENCES

Orsborn, J.F., et al. 1975. Relationships of Low, Average and Flood Flows for Streams in the Pacific Northwest. State of Washington, Water Research Center Project A-074-WASH, Washington State University, Pullman, Washington.

Orsborn, J.F. 1982. Lake Branch Habitat Improvements and Stream Channel Restoration, Hood River Ranger District, Mt. Hood National Forest, U.S. Forest Service, Mt. Hood, Oregon. 21 p.

Orsborn, J.F., et al. 1985. Crooked River Habitat Improvement Project -- Planning for the Restoration of Meanders on a Trial Basis. For the Nez Perce National Forest. Dept. of Civil and Environ. Engr., Washington State University, Pullman, Washington.

APPENDIX III -- HYDROLOGIC INFORMATION AND CLACULATIONS

APPENDIX III. 1/1/

8/29/86 JFO

LAKE BRANCH OF HOOD RIVER
WELL LEVELS AND STREAMFLOW

DATE	WELL NO.*	WATER LEVEL	STREAMFLOW (cfs)	NOTES
9/3/85	DH-1	96 in.	–	From Top of Pipe (TOP)
	DH-2	67" (TOP)		Pipe 24"; Water 43" Below Ground
9/6/85	DH-1	168"	–	T.o.P.
	DH-2	61"		T.o.P. 37" below ground.
7/1/86	3	79"	2.5	T.o.P.
	5	61"	5.6	Above stream surface
8/12/86	1	114"	Some water in channel	T.o.P.
	2	55"	Dry	
	3	78"	1.2	T.o.P. (?)
	4	Dry at 19'+.	Some water in channel but goes dry just downstream.	
	5	112"	2.1 cfs	T.o.P.

NOT ENOUGH DATA TO DEVELOP CORRELATIONS

* Well locations on BP 8610-1. Data provided for well water levels and streamflow by Forest Service personnel.

JFO
8/31/86

LAKE BRANCH OF HOOD RIVER
PRELIMINARY ESTIMATE OF STREAM FLOWS

Reference: Orsborn (1975).

The region on the West Side of Mt. Hood has a higher level of precipitation than does the region on the northeast side where the Lake Branch drainage does. The east side of the Cascade Mountain Range has very little streamflow data, and most of it has been taken on streams well to the South of Lake Branch.

One gage (No. 14880) Lake Creek near Sisters, OR. has a drainage area of 22.2 sq. mi., but has a lake in its basin similar to LAKE BRANCH. For comparison purposes the data for the Salmon River near Government Camp were considered also. One cannot be sure what percent of the Lake Branch flow is on the surface, even well downstream of the project site, so these flow estimates must be considered as surface flows, assuming the project was undertaken and the stream structure was restored.

SUMMARY OF DATA

AREA (sq.mi)	SITE/STA.	GAGE No.	AVER. FLOW (cfs)	(2-YR) AVER HIGH. (cfs)	(2-YR) AVER. 7-DAY LOW (cfs)
8.0±	LAKE BR.	—	—	—	—
8.7	SALMON R.	141340	44	190	18
22.2	LAKE CR.	140880	52	140	25

JFO
8/31/86

PRELIMINARY LAKE BRANCH
HYDROLOGY ~ Cont'd.

Comparing the Lake Cr. and Salmon R. gage values shows:

(1) A higher <u>average annual flow</u> in the smaller Basin (Salmon R.)

$$\frac{\bar{Q}}{A} : \frac{44 \text{ cfs}}{8.7 \text{ sq.mi}} = 5 \text{ cfs/sq.mi} \text{ -vs- } \frac{52}{22.2} = 2.3 \text{ cfs/sq.mi}$$

(SALMON) (LAKE CR.)

This indicates the relative amount of precipitation, also. In the equation

$\bar{Q} = C(P \cdot A)$, the value of $C = f(\text{Precip})$ but is about 0.060 in this region.

$$\therefore P = \bar{Q}/CA \qquad P_{SALMON} = \frac{44}{.06(8.7)} = 84 \text{ in/yr.}$$

$$P_{LAKE\ CR.} = \frac{52}{.06(22.2)} = 40 \text{ in/yr.}$$

The Unit values for Precipitation (P) and Average flow ($\bar{Q}$) for LAKE BRANCH are probably in between those for the Salmon R. and Lake Creek, and would tend to reflect the effects of the Lake on low flows and floods.

<u>The Unit lows</u> for the two gages are:

Salmon R. 18/8.7 = 2.06 cfs/sq.mi. and

Lake Cr. 25/22.2 = 1.12 cfs/sq.mi.

JPO
8/31/86

PRELIMINARY LAKE BRANCH
HYDROLOGY ~ Cont'd.

The <u>Unit high flows</u> for the two gages are:

Salmon R. $190/8.7 = 22$ cfs/sq. mi. and

Lake Cr. $140/22.2 = 6.3$ cfs/sq. mi.

USING THE 1, 2, 3 power relationship from the 1975 reference:

$$Q7L2 = C \frac{\bar{Q}^3}{QF2^2}$$

For Salmon R., $C = \frac{(18)\,190^2}{44^3} = 7.6$

For Lake Cr., $C = \frac{25\,(140)^2}{(52)^3} = 3.5$

This coefficient reflects the relatively lower level of precipitation and high flows on the east side versus the west side.

IF: one assumes LAKE BRANCH at the project site, if restored, would act like <u>Lake Cr.</u>, then: <u>or like Salmon R.</u>

$\overline{Q7L} = 9$ cfs or $Q7L = 16$ cfs

$\bar{Q} = 18$ cfs or $\bar{Q} = 40$ cfs

and $\overline{QF2} = 50$ cfs or $\overline{QF2} = 176$ cfs

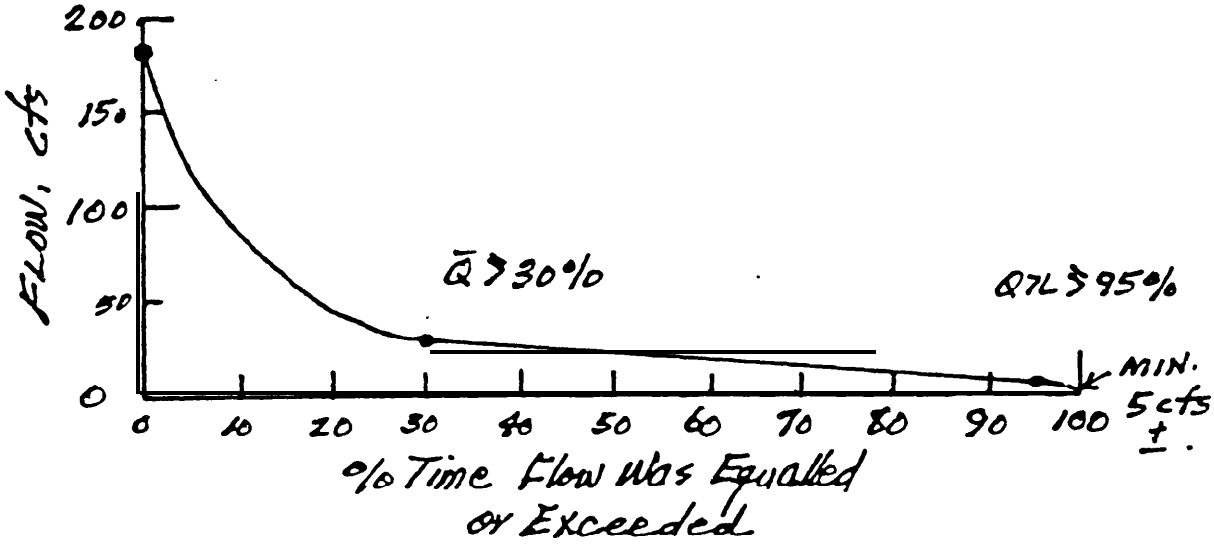
PRELIMINARY LAKE BRANCH
HYDROLOGY ~ Cont'd.

FOR CRITICAL DESIGN CONDITIONS:

Assuming the worst of conditions, the average flood could be assumed to be about (QF) 80 cfs; and the average low flow about 9 cfs. (QTL)

The average flow would be on the order of 30 cfs ($\bar{Q}$).

The duration curve would be about:



THIS IS ONLY A PRELIMINARY ESTIMATE OF THE NATURAL CHARACTERISTIC FLOWS IN LAKE BRANCH AT R.M. 9.0.

IF IT IS DECIDED TO DESIGN THE PROJECT, then a stream gaging site will have to be established UPSTREAM, and the measured flows correlated against the flows at a long-term gage.

FIFTEENMILE BASIN
HABITAT IMPROVEMENT PROJECT

ANNUAL REPORT FY 1986

By

Ken MacDonald, Fisheries Biologist
and
Corey Sue Hutchinson, Fisheries Biologist

Mt. Hood National Forest
Hood River Ranger District
Mt. Hood, Oregon

Prepared for

Kathy Anderson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Agreement Number: DE-A179-84 BP16726
Project Number: 84-11

April 1, 1987

Table of Contents

List of Figures 143

List of Photographs 144

Acknowledgements 145

Abstract 146

Introduction 147

Description of the Study Area 147
Ramsey Creek 147
Fifteenmile, Eightmile and Fivemile Creek 149

Methods and Materials 150

Results and Discussion 157

Summary and Conclusions 163

Summary of Expenditures 165

Literature Cited 166

Appendix

A Typical Structure Designs 167

B Log Sill Detail 172

C Photos of Ramsey Creek Implementation 174

D Description of Macroinvertebrate Site Locations 180

F Spawning Survey Data 182

List of Figures

Figure 1. Map of Basin 148

Figure 2. Map Spawning Surveys, Physical and Biological Sampling Sites, Macroinvertebrate Sampling Sites and Thermograph Sites 152

Figure 3. Vicinity Map of Ramsey Creek Project 155

Figure 4. Ramsey Creek Implementation Site Map (Reach A) 156

Figure 5. (A-D) Ramsey Creek Implementation Site Map (Reach B) 158

LIST OF PHOTOGRAPHS
(Appendix C)

1. Diagonal log sill and cover log structures in Ramsey Creek

2. Detail of upstream "V" structure in Ramsey Creek

3. Log sill creating pool habitat above road crossing

4. Digger log providing overhead cover

5. Typical pre-project riffle section in Reach B Ramsey Creek

6. Diagonal digger and sill series in Reach B of Ramsey Creek

7. Shallow riffle section prior to habitat improvement work

8. Pool habitat created by project work (log sill)

ACKNOWLEDGEMENTS

The authors express their gratitude to the following people who provided assistance at various stages throughout the project.

Harv Forsgren	Fishery Biologist Mt. Hood National Forest Supervisor's Office
Dave Forward	Engineer Mt. Hood National Forest Hood River Ranger District
Dave Heller	Fishery Biologist Mt. Hood National Forest Supervisor's Office
Dave Hohler	Fishery Biologist Mt. Hood National Forest Estacada Ranger District
Mike Lohrey	Hydrologist Mt. Hood National Forest Supervisor's Office
Rick Ragen	Hydrologist Mt. Hood National Forest Hood River Ranger District
Daniel Rife	Fishery Biologist Mt. Hood National Forest Zig Zag Ranger District

ABSTRACT

The Fifteenmile Basin Habitat Improvement Project is an ongoing multi-agency effort to improve habitat in the Fifteenmile drainage and increase production of the depressed wild, winter steelhead run. Cooperating agencies include Oregon Department of Fish and Wildlife, USDA Forest Service, USDA Soil Conservation Service, and the Confederated Tribes of Warm Springs. The Oregon Department of Fish and Wildlife is administering project work on state and private lands, while the U.S. Forest Service is administering project work on National Forest land. This report reflects the U.S. Forest Service portion of the project.

Primary activities in the Fifteenmile basin involved habitat improvement work on Ramsey Creek; and continuation of physical and biological baseline data collection, spawning ground surveys and macroinvertebrate sampling on Fifteenmile, Eightmile, Fivemile and Ramsey Creeks. A draft Fifteenmile basin fish/habitat management implementation plan has been developed by the cooperating agencies. It identifies the goals and objectives of the basin improvement program, identifies project opportunities, prioritizes those opportunities, and provides for coordinated implementation of the program throughout the basin.

The primary project objectives of implementation activities on Ramsey Creek were to increase juvenile rearing habitat and enhance passage at the road 4450 culvert. Log structures including sills, diggers, wings and diagonal series were placed at 24 sites. A total of 27 structures were constructed. Project implementation will continue on Ramsey Creek in 1987 along with continued watershed evaluation and identification of enhancement needs throughout the basin.

INTRODUCTION

Fifteenmile Creek is a fifth order tributary to the Columbia River, entering the Columbia just downstream of The Dalles Dam (FIGURE 1). Fifteenmile Creek and its major tributaries, Eightmile Creek, Ramsey Creek and Fivemile Creek support the eastern most population of wild winter steelhead trout in the Oregon portion of the Columbia River Basin. The winter steelhead run is very depressed relative to historic levels and estimated potential production levels. This basin improvement program is being jointly implemented by the Oregon Department of Fish and Wildlife (ODFW) and the USDA Forest Service, Mt. Hood National Forest (Forest Service), in consultation with the USDA Soil Conservation Service and the Confederated Tribes of Warm Springs.(See ODFW Annual Report for additional information).

Fifteenmile Creek drains the northeast corner of the Mt. Hood National Forest. The upper third of Fifteenmile Creek, and the above mentioned tributaries, flow through National Forest land, while the lower reaches of the streams flow through private agricultural lands. Fish habitat on National Forest land is generally rated as fair to good. Negative factors influencing habitat capability include quantity and quality of low flow rearing habitat, locally limited spawning habitat, irrigation diversions, siltation and passage obstructions. Anadromous fish habitat on the private agricultural land is severely limited by irrigation diversions, a lack of rearing habitat, poor spawning habitat, siltation and high summer water temperatures.

Past enhancement efforts in the basin have focused on passage improvements, including an ODFW project to improve passage at a falls at the mouth of Fifteenmile Creek and Forest Service projects to provide passage at two culverts on Ramsey Creek. The Forest Service has also completed a road rehabilitation project on Fivemile and Ramsey Creeks to improve watershed conditions. ODFW and the USDA Soil Conservation Service were involved in rehabilitation of private agricultural lands following the 1974 flood. The Forest Service and ODFW have also conducted spawning surveys, stream habitat surveys and population surveys to better estimate current and potential anadromous fish production.

DESCRIPTION OF PROJECT AREA

Ramsey Creek

Ramsey Creek is a third order tributary to Fifteenmile Creek. The mouth is approximately 7.5 miles downstream of the National Forest boundary. According to a Forest Service stream survey (Kinzey and Hutchinson, 1985), average fish habitat condition is rated as fair to moderate. Project work on Ramsey Creek is currently being concentrated between RM 7.5 and RM 8.4. Fish habitat in this reach is rated as poor. The reach is riffle dominated (pool/riffle ratio = 3/7) and the pools have little effective cover. The substrate is dominated by large gravels and cobble (85%) and boulders (10%). Small gravel, suitable for steelhead spawning, is scarce ((10%). Pool formation and gravel collection

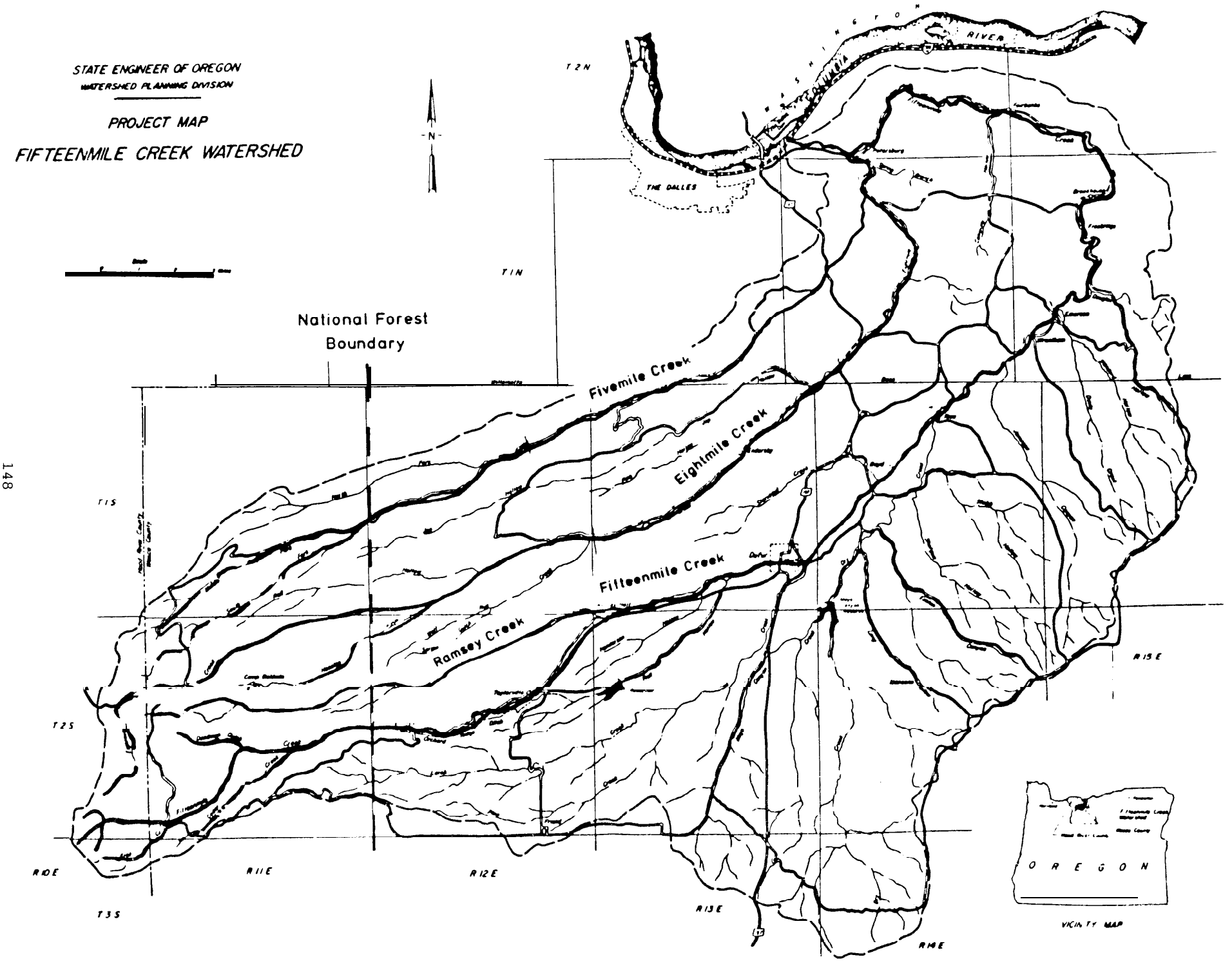

STATE ENGINEER OF OREGON
WATERSHED PLANNING DIVISION
PROJECT MAP
FIFTEENMILE CREEK WATERSHED
N
T 2 N
T 1 N
T 1 S
T 2 S
T 3 S
R 10 E
R 11 E
R 12 E
R 13 E
R 14 E
R 15 E
WASHINGTON
COLUMBIA
RIVER
THE DALLES
National Forest
Boundary
Fivemile Creek
Eightmile Creek
Fifteenmile Creek
Ramsey Creek
OREGON
VICINITY MAP

Figure 1

in Ramsey Creek is dependant upon the presence of large woody debris. Past debris removal appears to have been a major factor in the degraded fish habitat between RM 7.5 - 8.4.

Tasks identified to be completed under the 1986 work statement with BPA included:

1) Complete project design and environmental assessment for 1986 project work on Ramsey Creek;
2) Implement passage enhancement at the 4450 road culvert. Baffles had been installed in the culvert in 1984. The proposed activity was to further enhance passage and rearing habitat by constructing pools upstream and downstream of the culvert. It was anticipated that a minimum of two boulder berms would be constructed downstream of the culvert and four upstream;
3) Improve anadromous fish passage at "Iceberg Lake". Activities were to include modification, or replacement, of the dam with a log structure and placement of a minimum of three log sills below the dam;
4) Implement rearing habitat improvement between RM 7.5 - 8.4 of Ramsey Creek. This work was scheduled to include log sills, "K" weirs, wings and cover logs. A minimum of 15 structures were planned;
5) Complete project plan and environmental assessment for instream work to be implemented in 1987;
6) Conduct spawning surveys and pre-project monitoring on Ramsey Creek;
7) Identify high priority watershed enhancement needs for project planning in 1987 and implementation in 1988;
8) Cooperate with ODFW, SCS, and the Confederated Tribes of the Warm Springs in the development of a fish habitat management framework for the Fifteenmile Creek basin.

Eightmile, Fifteenmile, Fivemile Enhancement

No instream habitat improvement project implementation was planned for Eightmile, Fifteenmile or Fivemile Creeks during the 1986 work statement period. Most work for these project components consisted of gathering baseline information concerning fish production and physical habitat, and coordination of planning efforts with ODFW. Those efforts resulted in the first draft of a fish/habitat management plan for the basin.

Anadromous fish habitat condition on the National Forest portion of Fifteenmile Creek is generally rated as good, although habitat capability is suspected to be locally limited by the quality of spawning and rearing habitat. Fish habitat below the National Forest boundary is generally poor, as is true for the other streams in the basin. Below the Forest boundary, habitat is degraded by a lack of instream structure, siltation and poor riparian cover which has resulted in high summer water temperatures.

Eightmile Creek is a fourth order tributary to Fifteenmile Creek, entering the mainstem below the National Forest boundary at about RM 2.7 of Fifteenmile Creek. The probable upstream limit of potential anadromous fish habitat is approximately RM 31.5. Fish habitat condition in Eightmile Creek is generally rated as good within the National Forest boundary. Anadromous fish production potential appears to be limited by passage obstructions, locally poor low flow rearing habitat and an unscreened irrigation diversion.

Fivemile Creek is the northernmost tributary of the Fifteenmile system. Fivemile enters Eightmile Creek approximately 1.5 miles above the Eightmile/Fifteenmile confluence. The lower 18.2 miles of Fivemile Creek flows through private land. The confluence of the Middle and South Fork Fivemile is just upstream of the National Forest boundary at RM 18.4. The North Fork Fivemile enters Fivemile Creek below the Forest boundary and is intermittent on National Forest land. Anadromous fish habitat on Fivemile is rated poor to fair. Major limiting factors appear to be low summer discharge, poor pool quality (shallow depth, little effective cover) and sparse spawning gravels. Irrigation withdrawals completely dewater the stream channel about two miles below the National Forest boundary for most of the summer.

Tasks to be completed under the 1986 agreement included:

1) Cooperate with ODFW, Soil Conservation Service and the Confederated Tribes of Warm Springs in the development of fish/habitat management framework for the Fifteenmile basin;
2) Conduct spawning surveys and baseline evaluation of habitat use and limiting factors on all anticipated work areas. A water temperature monitoring program is also included;
3) Identify high priority watershed enhancement needs for project planning in 1987 and implementation in 1988;
4) Complete project design and environmental analysis for a 1987 project on Eightmile Creek;
5) Implement a macroinvertebrate analysis program to assess changes in water quality.

METHODS AND MATERIALS

Spawning Surveys

Seeding is recognized as a limiting factor for wild, winter steelhead production in the Fifteenmile drainage. Two major contributing factors have been partial passage barriers and the poor habitat conditions of lower stream reaches. In 1985, ODFW completed a passage improvement project at a partial barrier falls above the mouth of Fifteenmile Creek, which along with the voluntary discontinuance of the Indian dip net fishery, has increased escapement into the system. Several other passage restrictions have recently been modified and it is believed returning spawners are now beginning to reach Forest Service land.

Spawning surveys of the Fifteenmile Basin (See FIGURE 2 for spawning survey locations) were conducted in the last three weeks of April. Each stream was walked and numbers of redds and adult fish were tallied. Juveniles were counted where applicable and the presence of resident trout was noted (APPENDIX F). Physical conditions such as relative flow, visability and weather were noted. Air and water temperatures were also measured. The length of stream surveyed depended on whether fish or redds were present.

A description of the areas surveyed on each stream follows:

Fifteenmile Creek: The length of stream surveyed varied, but the starting point was an irrigation diversion sill approximately one-eighth mile below the 4421 bridge crossing (FIGURE 2). The upper limit of the surveys was approximately three miles upstream of the diversion, at the confluence of Cedar and Fifteenmile Creeks. The upper two miles are on National Forest land.

Eightmile Creek: Eightmile Creek surveys started at the National Forest boundary and extended upstream approximately 1.5 miles. The stream was also surveyed about one mile below the boundary to determine if any migration barriers are present.

Fivemile Creek: The mainstem was surveyed from the National Forest boundary, upstream approximately one-eighth mile to the confluence of the South and Middle Forks. The South Fork was surveyed to the 4431 road crossing. Approximately one-eighth mile of the Middle Fork was surveyed.

Ramsey Creek: Spawning surveys were conducted on Ramsey Creek from the National Forest boundary to the 4400190 crossing (RM 7.5 - 8.4).

Macroinvertebrate Sampling

The Forest Service and ODFW contracted with Dr. Fred Mangum (Aquatic Ecologist, USDA Forest Service, Region 4). to establish a macroinvertebrate sampling program in the Fifteenmile Basin. Macroinvertebrates respond more rapidly than fish populations to changes in water quality, thus monitoring changes of macroinvertebrate populations should be a good indicator of changes in aquatic habitat as a result of habitat improvement work.

The Forest Service sampled sites on National Forest land (FIGURE 2) and ODFW, working with Wasco County Soil/Water Conservation District, sampled sites on private land. Samples were collected twice in 1986, once during summer low flow and once in fall. According to Dr. Mangum, it is best to sample in spring, summer and fall for several years to develop baseline information on local macroinvertebrate population characteristics. Three samples will be obtained in 1987

Samples were obtained from 15 sites (see APPENDIX D) throughout the drainage. Each site represented a stream reach identified in the draft Fifteenmile Basin Fish/Habitat Management Plan. All sites except one on Ramsey Creek are pre-project sites. One sample site on Ramsey Creek was added to monitor silt impacts as a result of instream habitat improvement work. Samples were sent to

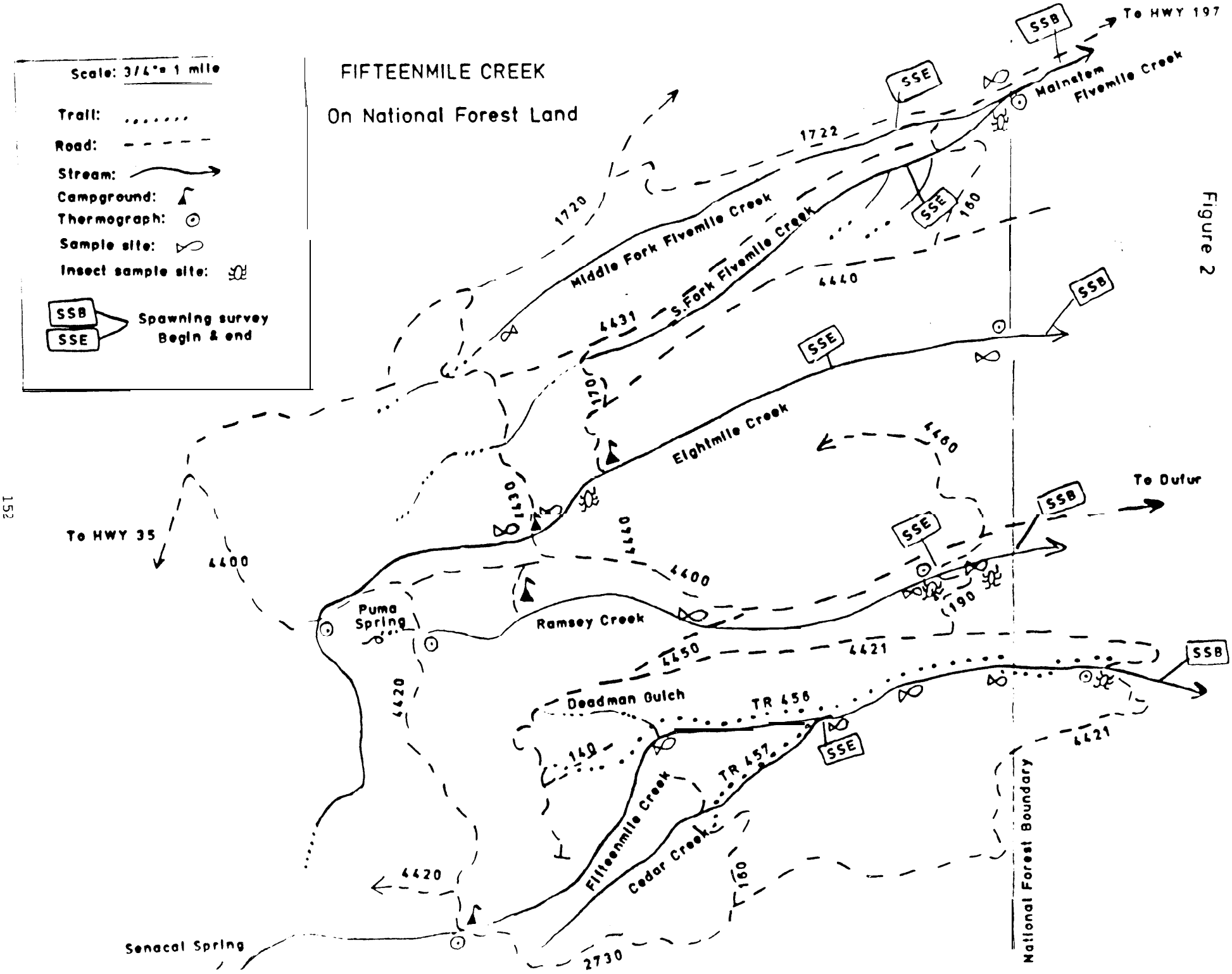

FIFTEENMILE CREEK
On National Forest Land
Scale: 3/4" = 1 mile
Trail:
Road:
Stream:
Campground:
Thermograph:
Sample site:
Insect sample site:
SSB
SSE
Spawning survey Begin & end
To HWY 197
Mainstem Fivemile Creek
Middle Fork Fivemile Creek
S.Fork Fivemile Creek
Eightmile Creek
To Dufur
To HWY 35
Puma Spring
Ramsey Creek
Deadman Gulch
TR 456
TR 457
Fifteenmile Creek
Cedar Creek
Senacal Spring
National Forest Boundary
1722
1720
4431
4440
4460
4450
4421
4420
4400
2730

Figure 2

the Aquatic Ecosystem Analysis Lab, at Brigham Young University for analysis by Dr. Mangum.

Samples were taken in a riffle area with a gravel/cobble substrata. Three samples were collected at each site in accordance with procedures described by Mangum (1985) A modified surber sample net was placed on the streambed to collect the macroinvertebrates. The substrate was stirred and rocks scrubbed clean of insects and organic material. The sample was then transferred to a bread pan full of saturated salt water solution to float organic material. The sample was strained through a 250 micron seive to separate the organic from the inorganic material. The organic material was then placed in a plastic bottle and preserved with an ethyl alcohol/formalin solution and labeled. Physical and water chemistry data was collected. Water samples were analyzed for conductivity, alkalinity and sulfate using a Hach water monitoring kit.

Thermographs

Summer water temperatures in the lower portions of the Fifteenmile drainage can reach and remain at high levels. Temperatures in the 80F range are common and a temperature of 85F was recorded near the mouth of Fifteenmile Creek in 1986. An objective of the Fifteenmile Creek project, on private land, is to increase shading from riparian vegetation to reduce water temperatures. Thermographs were placed throughout the basin in an effort to monitor temperatures (FIGURE 2). ODFW placed two thermographs in Fifteenmile Creek and one each in Eightmile and Ramsey Creeks in July. Water temperatures were monitored through September. The Forest Service placed thermographs in the headwaters, and at the National Forest boundary, on Fifteenmile, Eightmile and Ramsey Creeks. A thermograph was placed at the boundary on Fivemile Creek. Water temperatures were monitored May through September on Forest lands. Omnidata Datapod recorders were used at all sites except for the headwater sites on Ramsey and Eightmile Creeks, where Peabody-Ryan thermographs were used.

Physical and Biological Sampling

Pre-project data collection was continued for the second year on the National Forest. The objectives of this assessment are to gather baseline information on fish production and habitat in the basin (to provide a means to evaluate the results of the treatment activities), to help identify habitat factors limiting fish production capability and, to prioritize streams and reaches for habitat improvement. A full description of the assessment methods is contained in the Mt. Hood National Forest Monitoring Report.

Project Implementation

Initial project work on Ramsey Creek is focusing on the lower reaches within the Mt. Hood National Forest boundary (RM 7.5 - 8.4). This area contains the poorest fish habitat on National Forest land (Kinzey and Hutchinson, 1985) and offers the best opportunity to achieve benefits. Three years are planned for full implementation of the Ramsey Creek project.

The 1986 project was divided into two sections, reach A and B (FIGURE 3). Work in reach A included improving passage at the road *4450* culvert. The culvert was baffled in 1984 to enhance passage. The objective of the 1986 project was to further enhance passage by reducing the drop associated with the culvert outfall, and provide resting and holding pools upstream and downstream of the culvert (FIGURE 4). The work will also improve juvenile rearing habitat. Reach B is located between RM 7.5 and 8.4. Fish habitat in reach B is generally classified as poor. Instream woody debris is scarce, due mostly to past removal in logging corridors. This lack of large woody debris has reduced habitat diversity by creating a riffle dominated channel with an absence of spawning gravel. Existing pools are of low quality because of the lack of cover and shallow depths during summer low flows. The objective of this project is to increase habitat diversity in Ramsey Creek by increasing instream structure, in the form of large woody debris and boulders, and thus increase habitat capacity for winter steelhead. The instream structures are designed to create scour and plunge pools, accumulate spawning gravel and provide additional cover (FIGURE 5). Work will continue within this reach in 1987.

Project work was completed under a Forest Service administered equipment rental contract. The contract specified a small track-mounted backhoe/excavator equipped with an opposable thumb, and an operator. The machine retained by the contract, a Kabota KH-28L, was fully capable of moving the necessary logs and excavating the channel. The opposable thumb is very helpful in placing logs and boulders. Unlike many small backhoes in this size class, the Kabota is capable of a 360° pivot which increases the efficiency and flexibilty of operation, and is valuable in reducing damage to riparian vegetation. Forest Service personnel directed the operator during construction and performed necessary hand labor.

Logs for construction were obtained from timber stands adjacent to the stream. Trees were selected, felled, limbed and bucked to length by Forest Service personnel.

Care was exercised to maintain the potential for long term woody debris recruitment. The logs were skidded to the project site by the backhoe. The short skid distance and capacity of the Kabota eliminated the need to use a separate skidder. Structures included log sills, diagonals, digger logs, "V" structures and diagonal log series. Log sills were placed either perpendicular to the flow or at 30°-40° angles. The function of the sills was to create downstream plunge pools, collect gravel or provide a downstream control to raise pool depth associated with an upstream structure. Sills were also used to increase jump pool depth associated with two log jams, and reduce the culvert outfall depth at the road *4450* crossing. When a sill was used to provide a jump pool, act as a water level control for an upstream pool, or reduce the culvert outfall, a hand level was used to insure proper height. Height was critical when reducing the culvert outfall because if water backs up into the culvert debirs will collect. The height of pools acting as downstream controls was important to keep flow through the pool since plunge and scour pools are more productive for steelhead rearing than backwater pools. Diagonal sills functioned the same as perpendicular sills, but were used to "divert" flows in a desired direction in order to concentrate low flow or enhance a desired natural condition (i.e. undercut bank).

Vicinity Map of Ramsey Creek Project

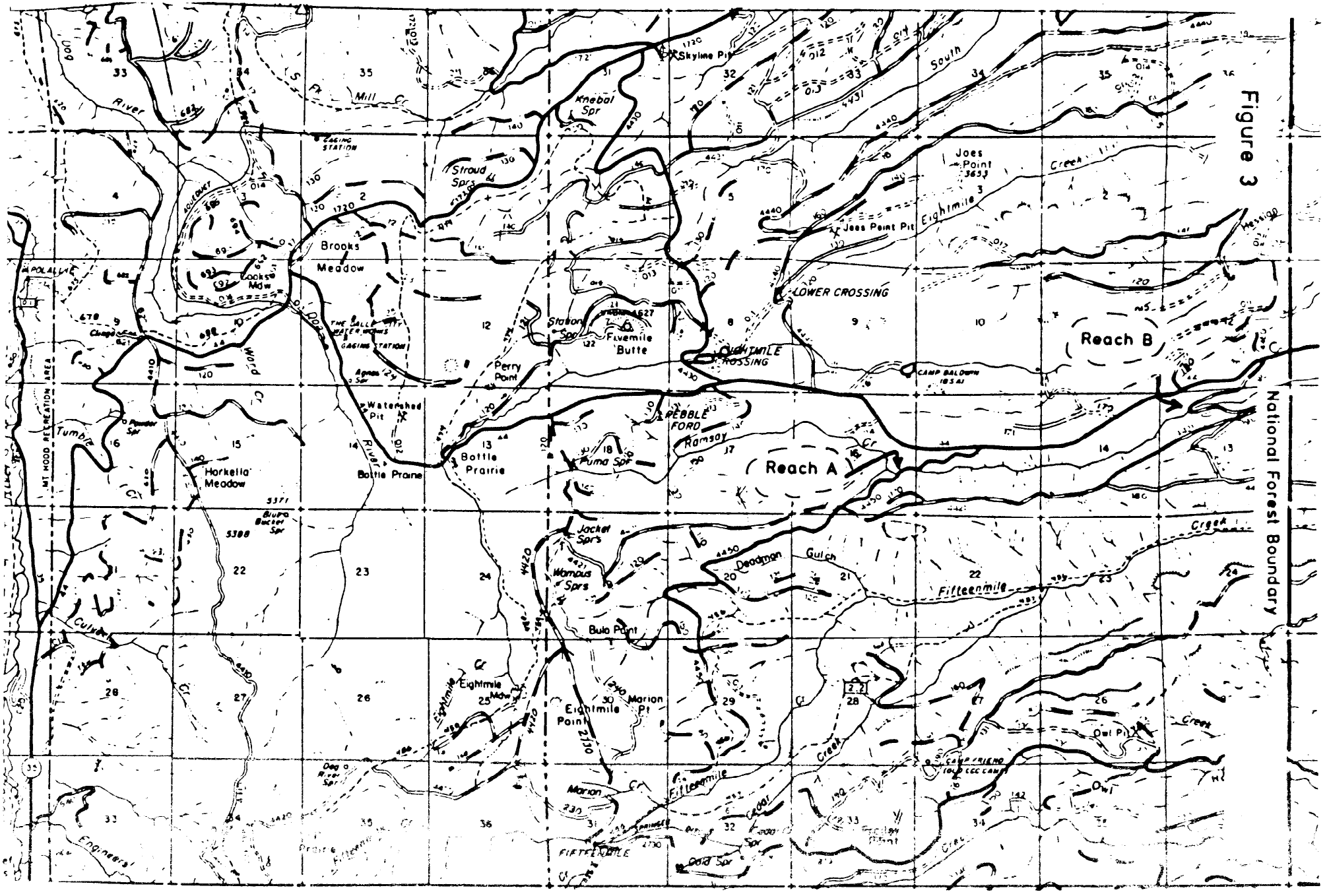
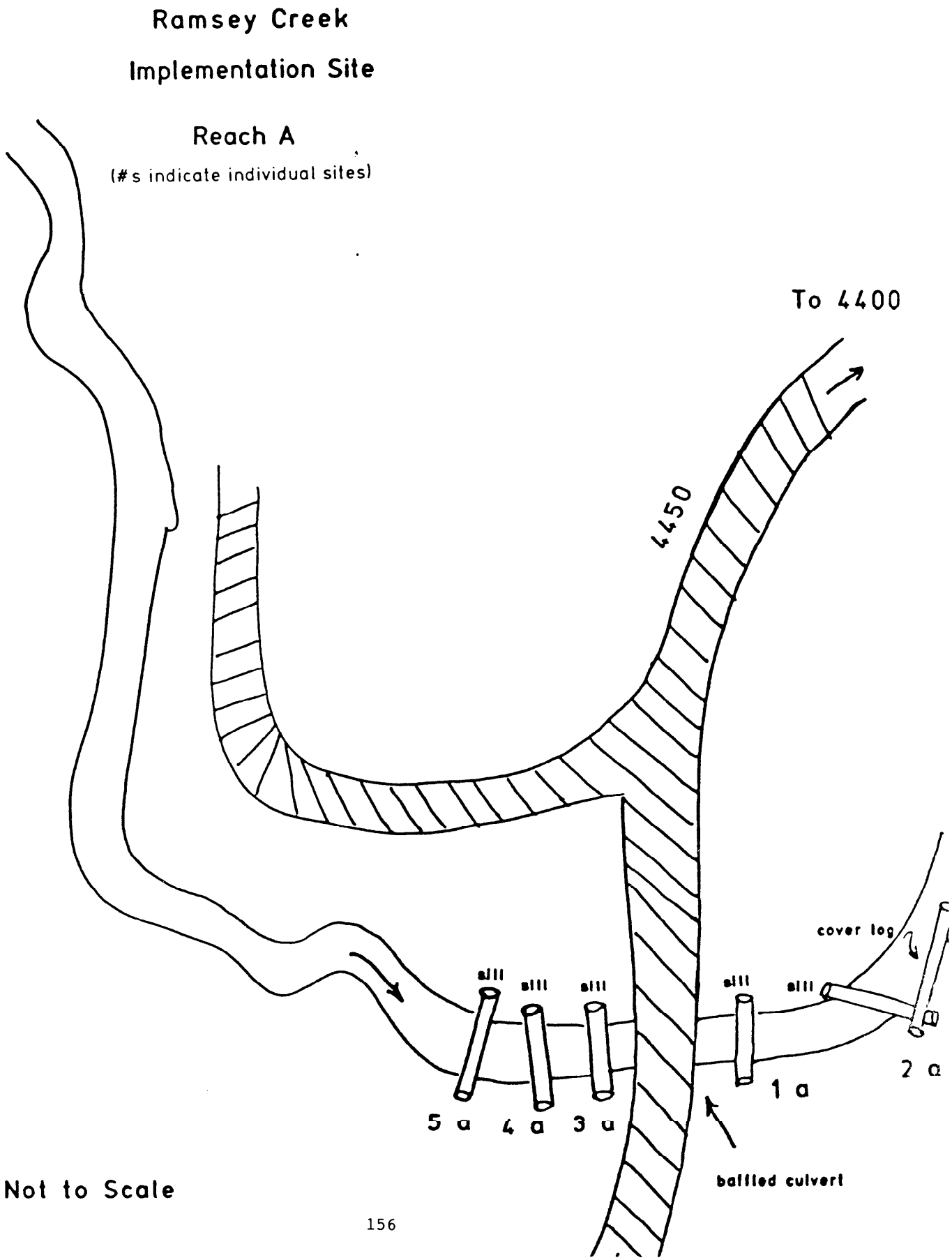


Figure 3

Figure 4


Ramsey Creek
Implementation Site
Reach A
(#s indicate individual sites)
To 4400
4450
sill
sill
sill
sill
sill
cover log
5 a
4 a
3 a
1 a
2 a
baffled culvert
Not to Scale

Sills were generally anchored five to six feet into both banks for stability and then rip-rapped. The upstream sides of the sills were lined with filter and hardware cloth to seal and prevent undercutting (APPENDIX B). In some cases, only hardware cloth was used as the structures sealed immediately, and the hardware cloth seemed to be sufficient to hold material and prevent undercutting. Plunge pools were excavated downstream of the sills to hasten pool development. Spoils from excavation were used to rip-rap sill ends and protect excavated banks. Large boulders were usually placed in excavated pools to provide additional cover.

Digger logs (FIGURE 5A) were anchored into the banks in the same manner as log sills. Instead of being placed in the low flow channel, diggers were positioned to bridge the low flow channel, forcing higher flows under the log to create a scour pool and provide overhead cover.

Diagonal series (FIGURE 5B) were used to increase diversity, creating a plunge pool/scour pool complex with woody cover. The series consisted of two or more logs in combination. The first log in the series was a diagonal sill constructed as described above. The next logs were either sills or diggers, or a combination of sill and digger. Logs were anchored into the banks as described above and anchored to each other using 1/8" strap iron as a brace and four inch lag bolts. Connecting logs were notched to provide a "better fit". The diagonals were set at 30° to 45° angles downstream to the flow.

One upstream "V" structure was constructed to create a plunge pool (FIGURE 5C). This structure consisted of two logs angled upstream at an approximately 45 degree angle from each bank and meeting in the middle. The vertex is set lower than the ends in order to concentrate flow. The upstream side was lined with hardware and filter cloth as in a sill, and the logs joined with angle iron and lag bolts.

All sites were accessed by "walking" the backhoe through timber stands adjacent to the stream. The small machine is very maneuverable and only brush species and very small conifers were damaged. Vegetative recovery is expected to occur rapidly.

RESULTS AND DISCUSSION

Ramsey Creek Project Implementation

A total of twenty-seven log structures were constructed at 24 sites on Ramsey Creek (APPENDIX C). Twenty-two of the sites are between RM 7.5 and 8.4. Structures at those sites included five diagonal series, or some similar combination, nine log sills, four diggers, one log wing and one upstream "V". A survey of the stream, where the work was completed, showed that the pool/riffle ratio has increased to 5/5. Before implementation the pool/riffle ratio was 3/7. Pools, before implementation were shallow with poor cover, while newly constructed pools are deeper (up to four feet) and have increased cover.

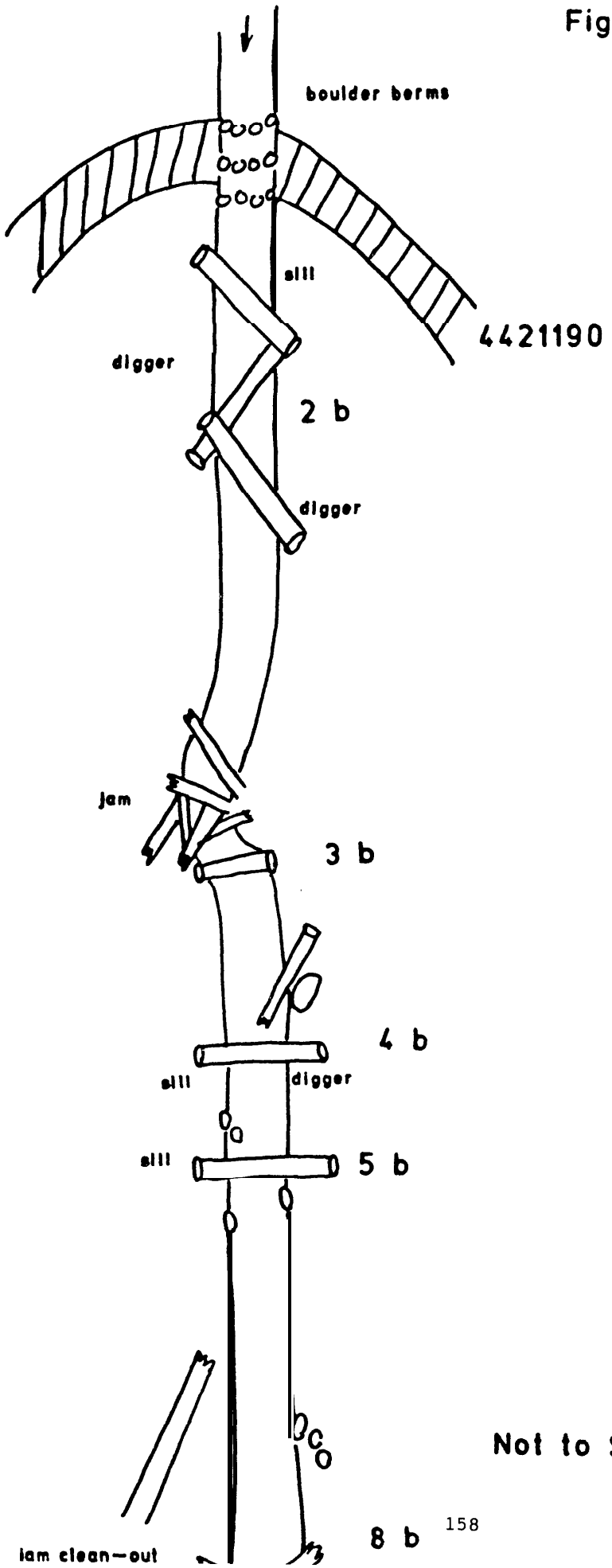
Figure 5a

Ramsey Creek

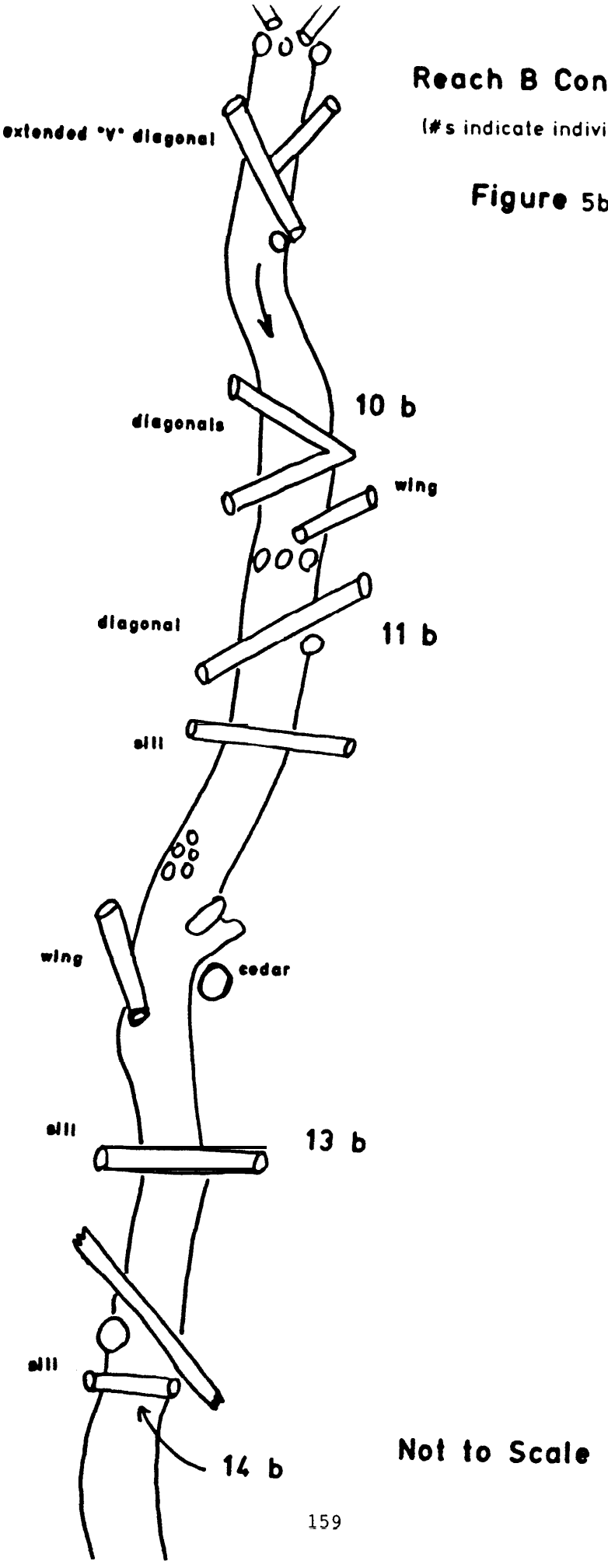
Implementation Site

Reach B

(#s indicate individual sites)



Not to Scale



Reach B Continued

(#s indicate individual sites)

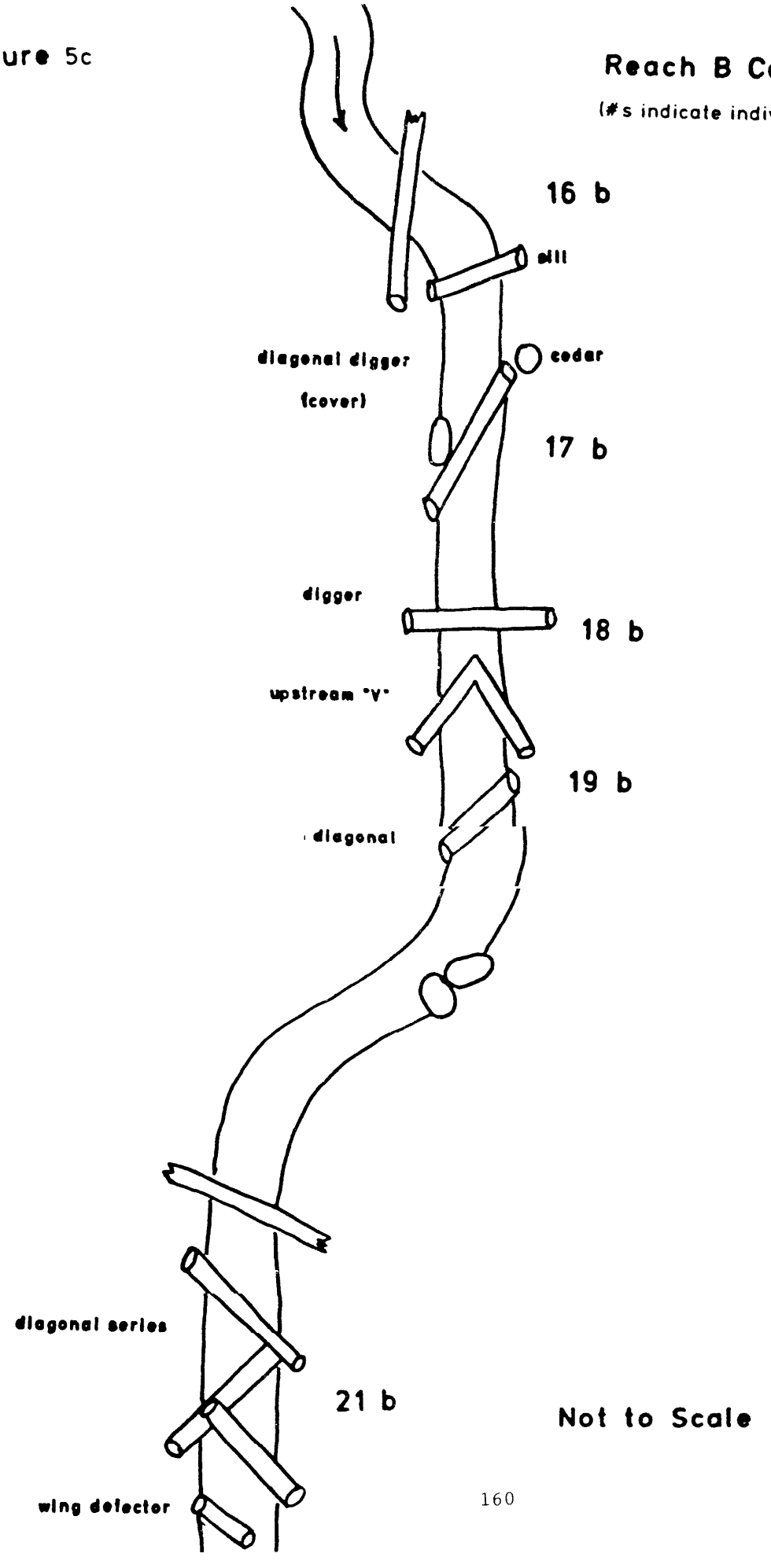
Figure 5b

Not to Scale

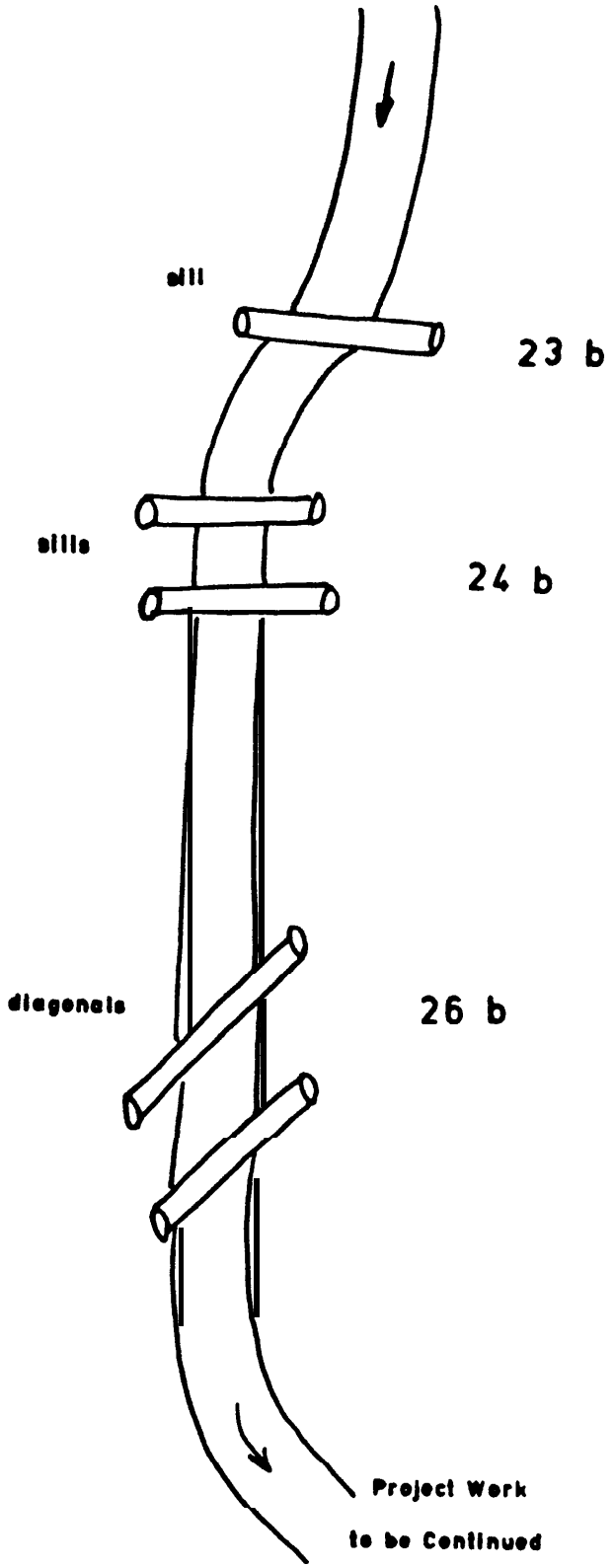
Figure 5c

Reach B Continued

(#s indicate individual sites)



Not to Scale



Reach B Continued

(#s indicate individual sites)

Figure 5d

Not to Scale

Five of the sites were in association with the Road 4450 culvert. A total of five sills were constructed, one at each site (FIGURE 4). Two of the sills were placed below the culvert to reduce the jump height into the culvert. Three sills were constructed above the culvert to provide adult resting and juvenile rearing habitat.

Planning continues on Ramsey Creek. Twenty-eight additional sites have been identified between RM 7.5 and 8.4, thirty-three potential sites have been identified between RM 8.4 and the Road 4450 culvert. Eight potential sites have been identified upstream of the 4450 road.

The original project plan called for providing passage at Iceberg Lake, RM 11.4. The Boy Scouts of America own the land around the reservoir and constructed the concrete structure that forms the lake. The land has been targeted for an exchange with the Mt. Hood National Forest, but the land exchange has yet to be consumated. Iceberg Lake is near the upper reaches of potential steelhead habitat. Completing passage work at this site has been deferred in favor of other downstream work.

The Ramsey Creek project is a multi-year effort; and the projected benefit/cost ratio is being computed as part of the Fifteenmile Basin Plan. The original plan for 1986 called for constructing 20 structures at 19 sites at a cost of $9,582. For approximately the same cost, 27 structures were completed at 24 sites. The small track-mounted backhoe was extremely effective on a stream the size of Ramsey Creek. The machine was fully capable of moving logs 30 inches in diameter and 30 feet long. The Kabota only exerts 4 pounds per square inch ground pressure, and little damage was done to riparian vegetation and soils. Actual costs of the 1986 portion of the Ramsey Creek project are presented below under the Summary of Expenditures.

Spawning Surveys

Spawning surveys were conducted for the second year in 1986 within the National Forest portion of the Fifteenmile Basin (APPENDIX F). In 1985 five spawning surveys were conducted on Fifteenmile Creek. During those surveys no redds or adult fish were observed upstream of the National Forest boundary, but three redds were observed on 5/16/85 at a ditch diversion approximately one mile downstream of the National Forest boundary (RM 43.3). During 1986, adult steelhead and redds were observed on two occasions above the National Forest boundary. Four adult fish and three redds were seen on 4/24/86 in the first mile above the National Forest boundary. On 4/29/86, Fifteenmile Creek was surveyed from the National Forest boundary upstream 1.5 miles. Two adult steelhead and sixteen redds were counted. The redds were distributed throughout the 1.5 miles of stream. Whether the increased redd count from 1985 to 1986 is a result of improved passage at the mouth of Fifteenmile Creek, the cessation of the Indian dip-net fishery, a "stronger" 1986 run, or a combination of factors is unknown.

No redds or adult fish were observed on Ramsey, Eightmile or Fivemile Creeks within the National Forest boundary. The absence of adult fish in Fivemile Creek is not surprising because of the extremely poor habitat conditions throughout the stream, especially below the National Forest boundary. Although

no redds were seen on Eightmile Creek, counts by ODFW on privately owned land were higher in 1986 than1985. One redd was observed below a beaver dam approximately one-half mile below the National Forest boundary. It was felt that the beaver dam may be a barrier to migration. Several beaver dams may also be partially blocking upstream passage to National Forest land on Ramsey Creek. The passage barriers, depressed winter steelhead population numbers, and long reaches of poor habitat on private land may all be factors contributing to the current lack of spawning adults within the National Forest portion of the drainage. It is anticipated that as passage work continues and habitat improvement work is completed in the lower reaches, seeding will increase throughout the drainage and adults will begin to access spawning habitat in these streams,

Macroinvertebrate Analysis

A report from the macroinvertebrate analysis lab at Brigham Young University is presented as APPENDIX E.

Water Temperature Monitoring

Results from the thermograph monitoring is in the process of being read from the data pods and transferred to the Forest Service computer. This data was not available for the Annual Report.

Physical and Biological Monitoring

Results of the physical and biological monitoring may be found in the Mt. Hood National Forest Monitoring Report.

SUMMARY AND CONCLUSIONS

Ramsey Creek

All tasks identified for Ramsey Creek under the 1986 work statement were addressed.

An environmental assessment for the 1986 Ramsey Creek project was completed. This assessment and design, with some minor final design work will cover most of the work planned for Ramsey Creek through 1988. Twenty-seven log structures were placed at 24 sites in 1986. Another 61 sites have been identified for future work. Passage improvement activities were not completed at Iceberg Lake. This land is still owned by the Boy Scouts of America so future work by the Mt. Hood National Forest depends on a land exchange. Iceberg Lake is at the upper end of potential anadromous fish habitat in Ramsey Creek so passage is not a high priority at this time.

Spawning surveys and pre-project baseline data collection were completed in Ramsey Creek. Assessment included measurements of physical habitat and

biological sampling in a treatment and control reach. Spawning surveys recorded no steelhead spawning in 1986. Possible reasons include depressed status of the Fifteenmile winter steelhead population and possible passage barriers at beaver dams downstream of the National Forest boundary. The dams will be further analyzed during spawning flows in 1987.

A watershed survey was completed in the Ramsey Creek sub-drainage and no further highpriority watershed enhancement needs were identified.

Fifteenmile, Eightmile and Fivemile Creeks

All tasks identified for Fifteenmile, Eightmile and Fivemile Creeks under the 1986 work statement were addressed.

An initial draft of a Fifteenmile Basin fish/habitat management implementation plan was initiated. Work on the management plan is on-going and will incorporate results of survey work and monitoring completed by ODFW and the Forest Service in 1986. The draft includes species emphasis, habitat deficiencies and production goals of the stream reaches.

Spawning surveys and baseline monitoring of habitat and production were completed. The monitoring included physical habitat measurements and biological sampling on all three streams. Results are included in the Monitoring Report. Spawning surveys were completed in all three streams. Sixteen redds were counted on Fifteenmile Creek in the 1.5 mile reach immediately upstream from the Forest Boundary. The redds were distributed throughout the reach. No redds were observed on the National Forest portion of Fifteenmile in 1985. The increase in 1986 may be due to improved passage at the mouth of Fifteenmile Creek, cessation of the Indian dip-net fishery at the mouth, a "stronger" 1986 run, or a combination of the above mentioned factors. No adult fish nor redds were observed in Fivemile or Eightmile Creeks. The lack of redds in Fivemile Creek may be attributed to the very poor anadromous fish habitat on private land below the National Forest boundary. The absence of adult fish in Eightmile Creek may have been due to the overall depressed condition of winter steelhead populations in the Fifteenmile basin, long reaches of poor spawning habitat below the National Forest boundary, and possible passage barriers due to beaver dams below the National Forest boundary.

High priority watershed enhancement needs were identified. Most problems are associated with Forest roads. The Forest will correct many of the identified problems in 1987 with KV funds.

Project design and an environmental analysis for Eightmile Creek was not completed. More project opportunities than were initially projected were found on Ramsey Creek so most planning activity focused on Ramsey. Fish habitat condition in Eightmile, on the National Forest is generally rated as good. Two areas of Eightmile Creek needing habitat improvement have been identified and are scheduled for improvement in 1987 using funds from timber sale revenues. Further evaluation of habitat improvement opportunities on Eightmile Creek will be done in 1987. The Fifteenmile Basin Fish/Habitat Implementation Plan will guide future work in Eightmile Creek.

Fifteen sites for macroinvertebrate sampling were established. The sites were sampled in summer and fall. Results are available in APPENDIX E.

SUMMARY OF EXPENDITURES

1. Personnel	$16,657.11
2. Travel/Per Diem	214.81
3. Expendable Materials	764.55
4. General Services	148.51
5. G&A Overhead (@12%)	2,134.19
6. Contract Costs	7,559.58
7. Total Costs	$27,478.75

LITERATURE CITED

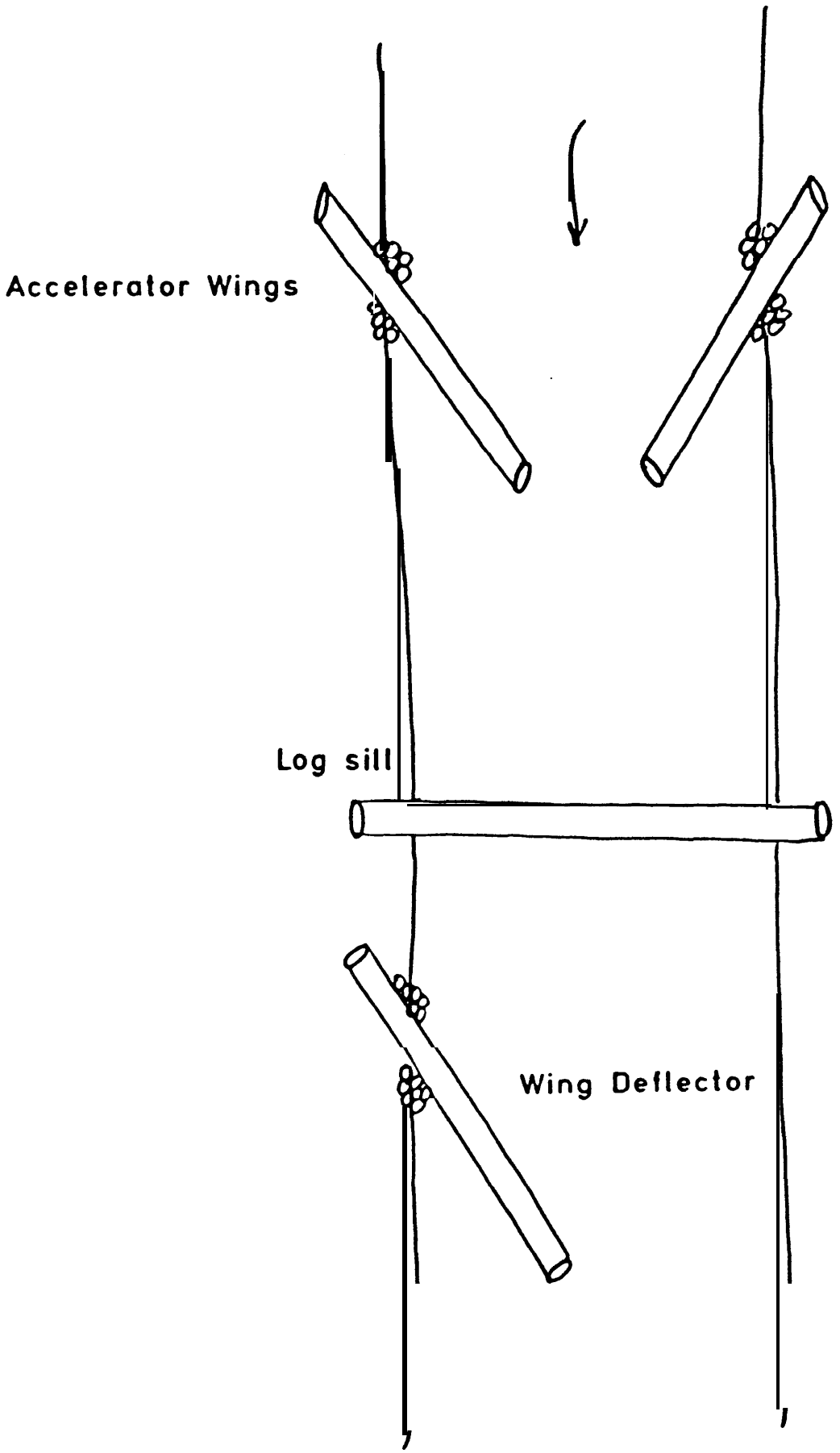
Kinzey, Doug and Corey Hutchinson. 1985. Riparian area assessment (1985) USDA Forest Service, MHNF, Gresham, OR.

Mangum, F. 1985. Aquatic Ecosystem Inventory, Macroinvertebrate Analysis. In Fisheries Habitat Surveys Handbook (R-4 FSH 2609.23) Chpt. 5.

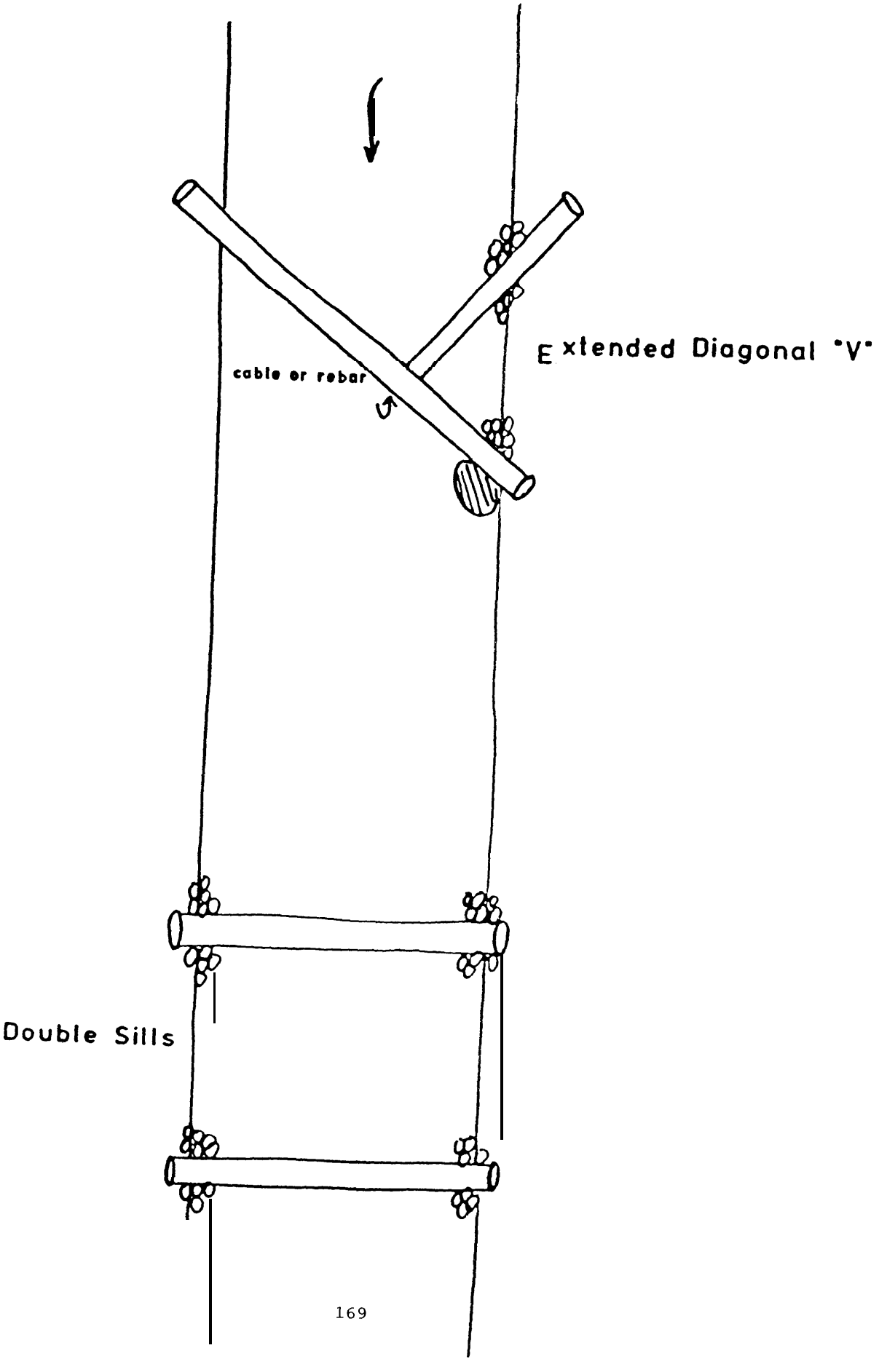
APPENDIX A - TYPICAL STRUCTURE DESIGNS

APPENDIX A—1

Typical Structure Designs



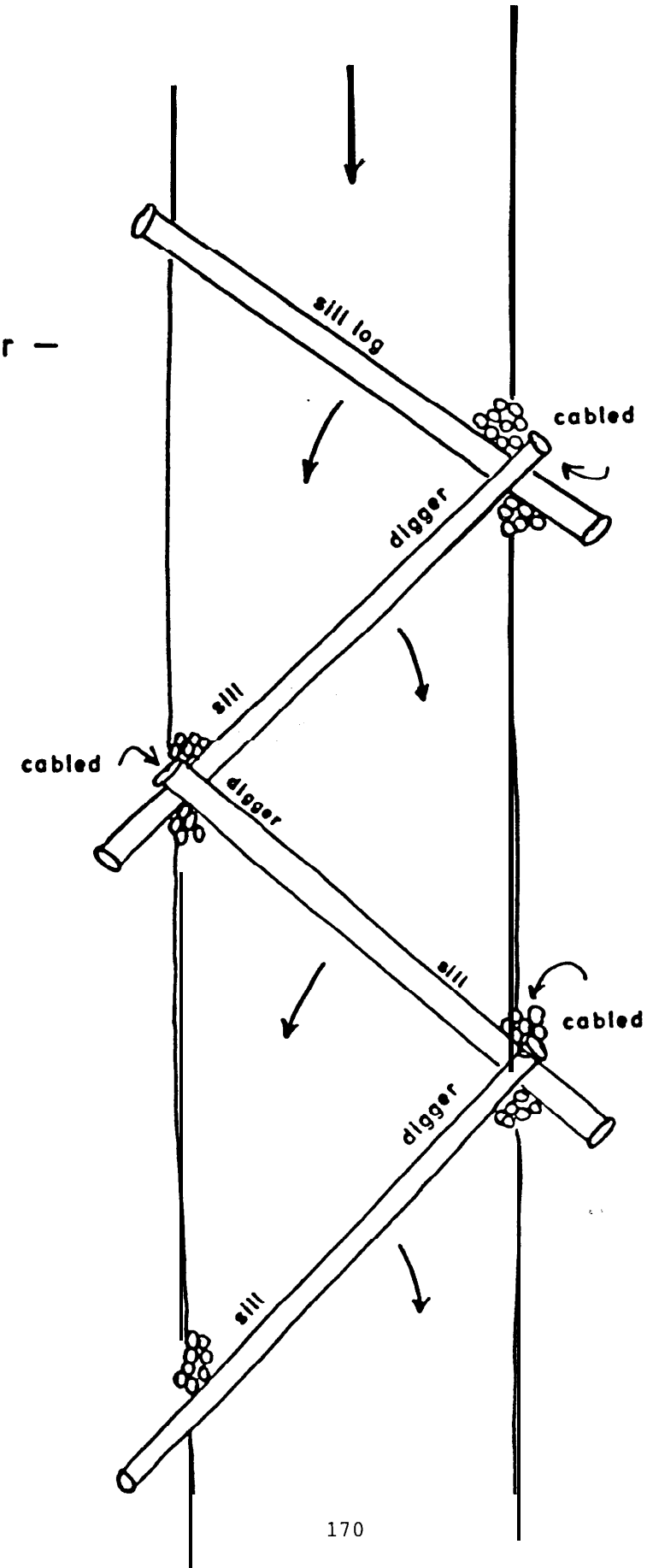
Typical Structure Designs



Typical Structure Designs

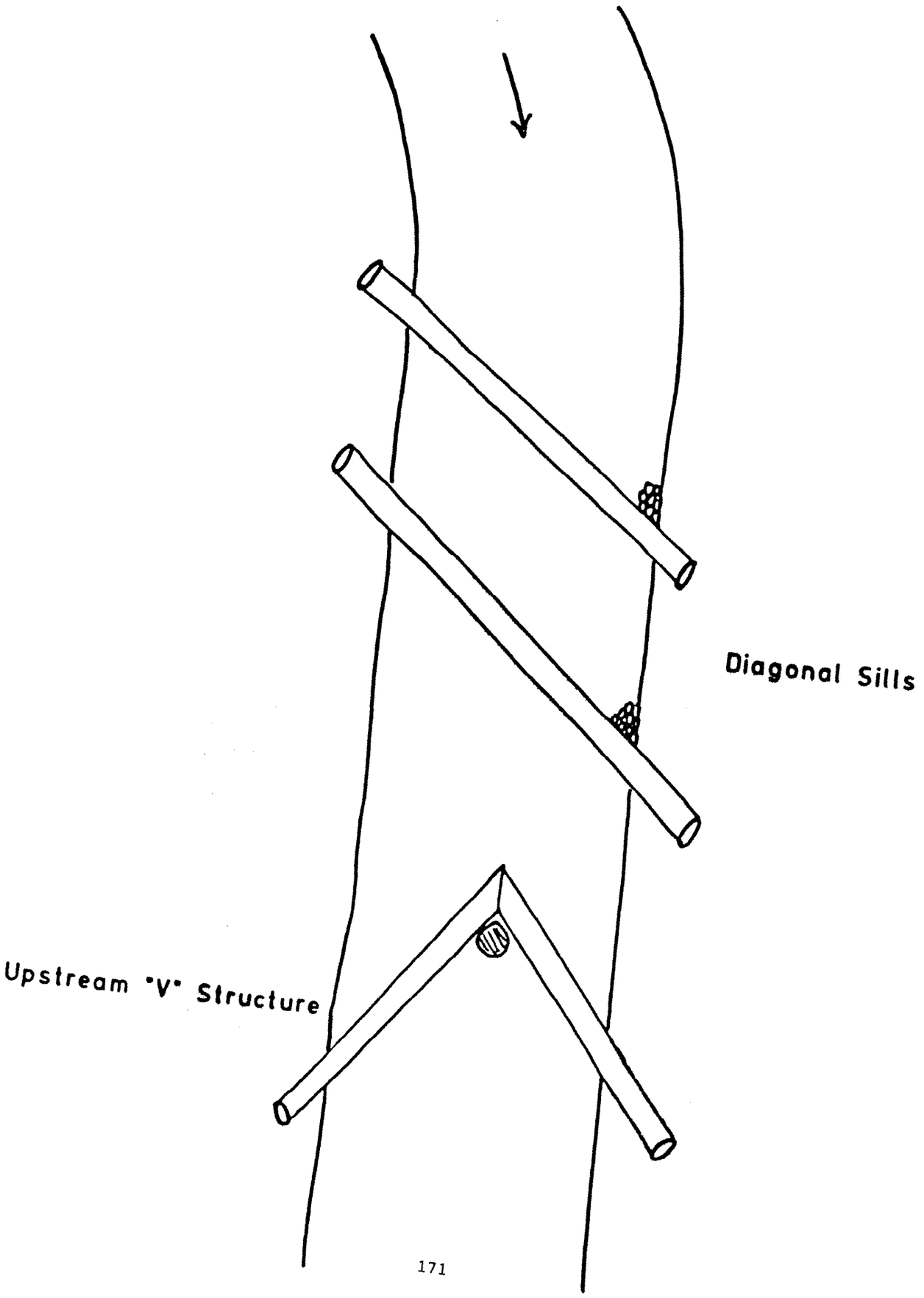
Diagonal Digger —

Sill Series



Typical Structure Designs

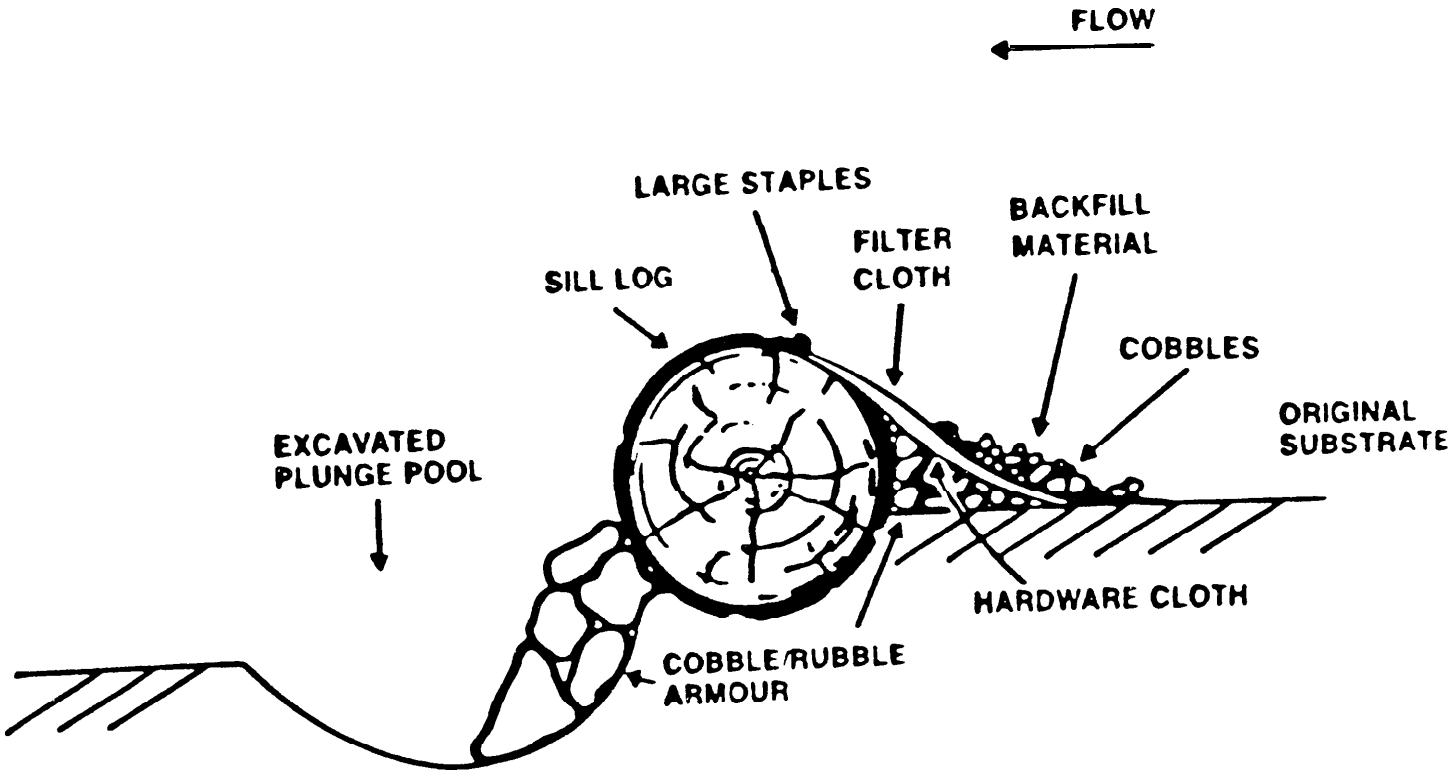
APPENDIX A -4



APPENDIX B - DETAIL OF LOG SILL STRUCTURE

APPENDIX B

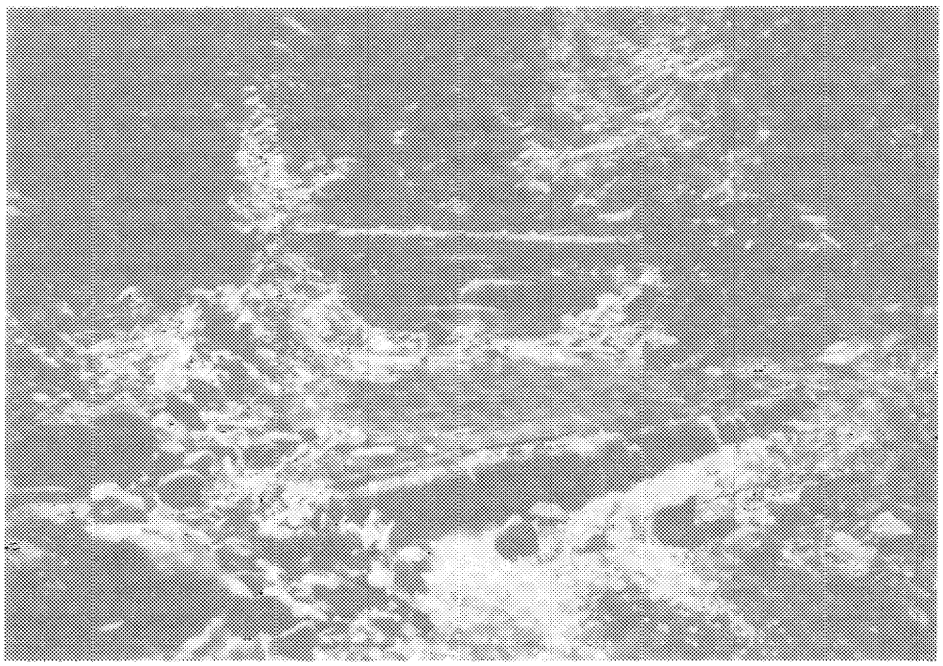
TYPICAL CROSS—SECTION OF LOG SILL DESIGN ON RAMSEY CREEK



APPENDIX C - PHOTOS OF RAMSEY CREEK IMPLEMENTATION

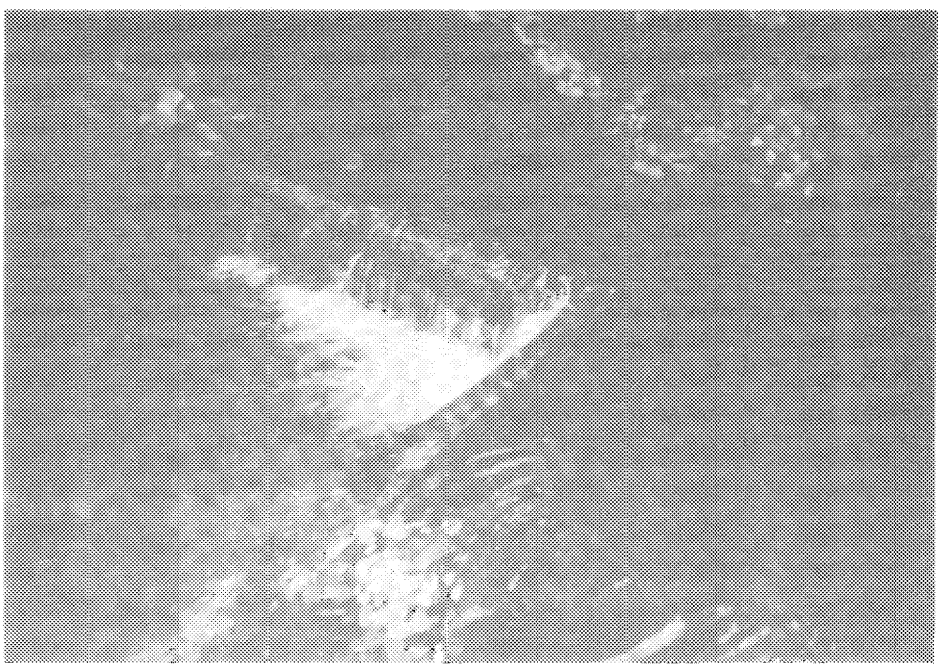
RAMSEY CREEK

REACH B



Site 19B: Diagonal sill— providing control for upstream "V."

Overhead cover log spans the channel.

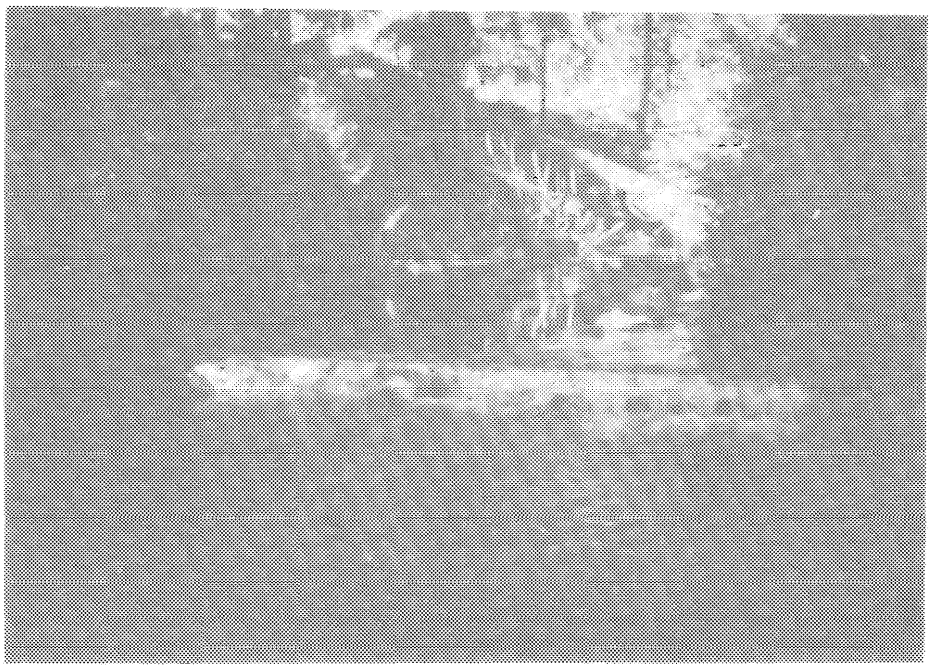


Site 19B: Detail of upstream "V". Backwater & plunge pool created

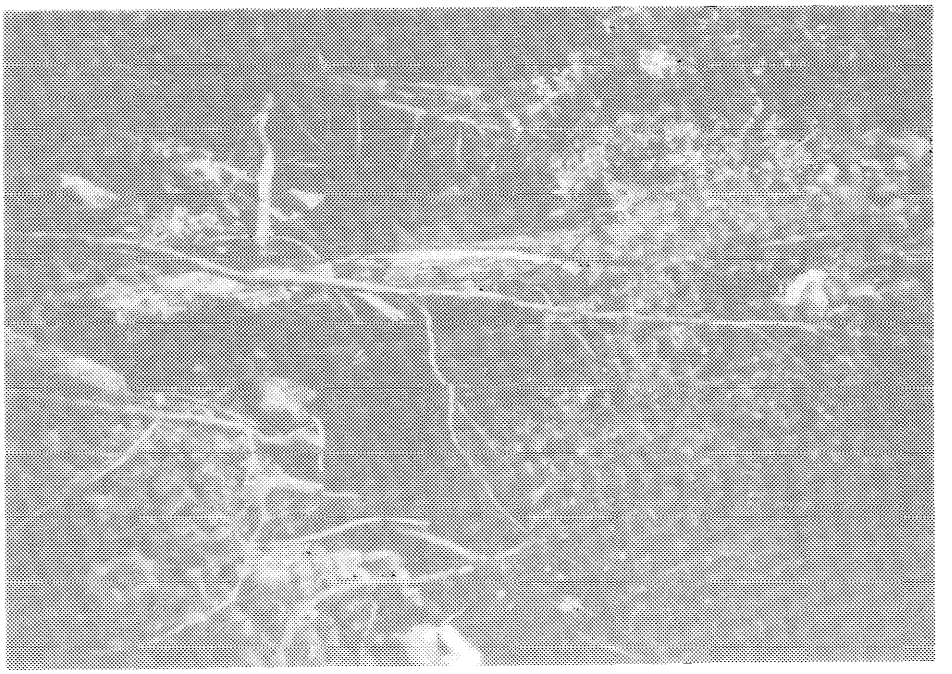
APPENDIX C-2

RAMSEY CREEK

REACH A



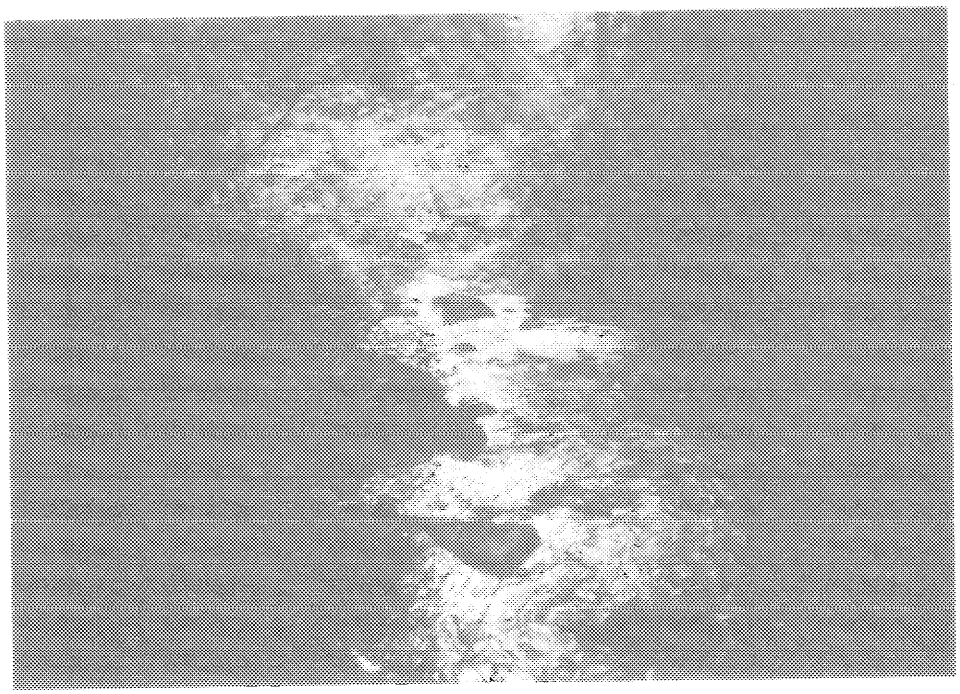
Site 4A: Log sill above 4450 road crossing. Pool habitat created.



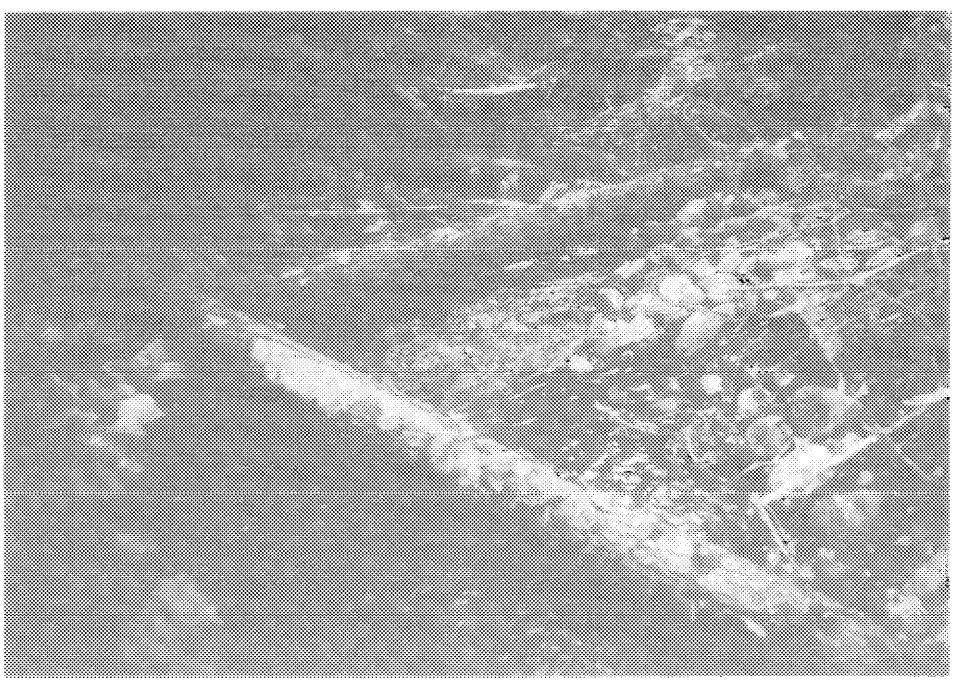
Site 26B: Digger log intended to provide overhead cover and cause high flow scouring.

RAMSEY CREEK

REACH B



Site 21B: Typical riffle section before project work.



Site 23B: Looking upstream at diagonal digger & sill series.

Div rse pool and cover habitat created.

RAMSEY CREEK

REACH 8

Site 23B: Shallow riffle area before project work.

Site 23B: Pool habitat after completion of sill.

APPENDIX D - DESCRIPTION OF MACROINVERTEBRATE SAMPLE SITE LOCATIONS

APPENDIX D

Fifteenmile Drainage Macroinvertebrate Sample Sites on National Forest

Eifteenmile Creek
- Site # 5: At Road 4421 crossing, riffle just below bridge.

Eightmile Creek
- Site # 3: Riffle above culvert at Lower Eightmile Campground, at Road 4440 crossing.

Fivemile Creek
- Site # 2: At Road 4421 crossing just above the National Forest boundary. Riffle @50 feet below culvert.

Ramsey Creek
- Site # 2: This site is below the pulled culvert @ 200 feet, just above a log jam.
- Site # 3: At riffle above pulled culvert @ 75 feet.

Site Locations on State and Private Lands

Fifteenmile Creek
- Site # 1: Approximately 1/2 mile above mouth. Upstream of the upper bridge just below Seufert Falls.
- Site # 2: Approximately 20 yards upstream of Wrentham bridge.
- Site # 3: Right below Lester Ashbrooks pump station, just south of Dufur off of Main Street.
- Site # 4: Approximately 400 yards upstream of Dufur City water intake.

Fivemile Creek
- Site # 1: Approximately 30 yards above the HWY 197 crossing just below a cattle fence.

Ramsey Creek
- Site # 1: Above cattle fence on Omsley Rodgers land, @ 1 mile off 4400.

Dry Creek
- Site # 1: Approximately 50 yards above confluence with Fifteenmile Creek.

Mays Canyon Creek
- Site # 1: Approximately 20 yards above confluence with Dry Creek.

APPENDIX E - MACROINVERTEBRATE ANALYSIS REPORT Prepared by Dr. Fred A. Mangum

AQUATIC ECOSYSTEM INVENTORY
Macroinvertebrate Analysis

MT. HOOD NATIONAL FOREST
1986

Fred A. Mangum
Aquatic Ecologist
USDA - Forest Service
Intermountain Region
Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602
(801) 378-4928

Table of Contents

Introduction 185

Dry Creek 187

Eight Mile Creek 191

Fifteen Mile Creek 206

Five Mile Creek 230

May's Canyon Creek 241

Ramsey Creek 245

Notes on Sampling 260

AQUATIC ECOSYSTEM ANALYSIS

FOR SELECTED STREAMS ON THE

MT. HOOD NATIONAL FOREST

1986

BACKGROUND AND METHODS

In recent years land managers on many of our forests and BLM districts in the west have improved the stability and reliability of land management plans and decisions by sampling aquatic organisms which act as natural monitors of management activities within the drainages on public lands.

During short-term exposure to water of poor quality or adverse changes in habitat, organisms that cannot tolerate the stress are destroyed and the aquatic macroinvertebrate community structure changes. Since aquatic organisms respond to their total environment, they can become an effective tool for detection of environmental changes.

Our analysis of aquatic ecosystems is based upon multiple factors including:

1. Various macroinvertebrate data - Community dry-weight biomass/sample expressed in gm/m^2; number of individuals per taxa (resident populations?); DAT Diversity Index, which combines a measure of dominance and number of taxa; habit, habitat and feeding preferences of individual taxa or species; specific tolerances of taxa; community composition; and BCI (Biotic Condition Index), which indicates as a percentage how close an aquatic ecosystem is to its own potential.

2. Physical parameter data and

3. Water chemistry data

Effective use of the Biotic Condition Index (BCI) depends upon the availability of data on stream gradient, natural capability of instream substrate (may not be the composition present if man-influenced sedimentation is found at the sample station), total alkalinity, and sulfate in mg/l.

Because of the way that macroinvertebrates occupy space within a stream, it generally takes at least three samples to represent the community accurately at a given station. One sample per station costs less but has little value for aquatic habitat assessment, one never knows if such single samples represent the best, the worst or an average of possible conditions at the sampling site. Also as a side benefit, three samples per station provides a basis for various statistical analyses, if random samples are all taken from a rubble substrate in as similar habitat as possible, taking into account mainly the velocity of flow and depth in the stream. Biologists have found that compared to other sampling devices, the Winget-modified surber net yields the highest coefficient of correlation (similarity of samples).

A stream's natural potential for productivity, habitat quality and water quality can be compared to the "actual" by taking quantitative samples of aquatic macroinvertebrates. Careful analysis of macroinvertebrate communities can reveal condition and trends in aquatic ecosystems. Sampling and analysis is conducted in accordance with procedures outlined in FSH R-4 2609.23, March 1985, Fisheries Habitat Surveys Handbook.

This report is based upon 84 aquatic macroinvertebrate samples from fifteen stations on six streams, along with physical and chemical data provided by your aquatic specialists Streams monitored as part of an action plan to improve aquatic ecosystems used as spawning and rearing areas by anadamous fisheries, particularly steelhead, were: Dry Creek, Eight Mile Creek, Fifteen Mile Creek, Five Mile Creek, Mays Canyon Creek, and Ramsey Creek.

DRY CREEK

When sampled on November 18, the aquatic macroinvertebrate community in the reach of stream, approximately fifty yards above its confluence with Fifteen Mile Creek, was dominated by those taxa tolerant to sedimentation and organic enrichment. None of the cleanwater mayflies were present, and the only cleanwater caddisfly present was *Arctopsyche grandis*, which indicated that there was some fairly good instream substrate in the reach sampled. The observed number of shredders in the community is generally found where riparian habitat is in fair to poor condition or where instream habitat quality is limiting to these members of the macroinvertebrate community.

The potential for use by a resident or anadamous fishery was only fair in this reach of stream. The macroinvertebrate standing crop of 9.9 g/m^2 would be an excellent food base for the fisheries; however, the dominance of sediment-tolerant species and scarcity of cleanwater species indicated that there would be very little, if any, suitable spawning substrate in the reach sampled.

The BCI value of 60 indicated that there were severe stress conditions in this reach of stream, and it appeared there would be opportunities for management to improve the instream habitat quality, water quality, and riparian habitat in this aquatic ecosystem.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District Mount Hood National Forest

Stream DRY CREEK

State/County Oregon, Wasco County

Forest Service Cat. No.

B.

Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Biotic Condition Index BCI 53	No. of taxa
1	11-18-86	13.0	9.9	60	29

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF DRY CREEK DATE: 11 18 86

REPL	TOTAL NO SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	29	38395.	20305.	56485.	16613.19	24.98	43.27	3.3981	0.3009	86.	89.

SPECIES ANALYSES

STATION: 1 MT HOOD NF DRY CREEK DATE: 11 18 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		T	57.39	1.759	30.	53.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		S	1262.51	3.101	108.	335.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		S, O	2639.79	3.422	72.	246.	
INSECTA	PLECOPTERA	LEUCTRIDAE				57.39	1.759	18.	32.	
INSECTA	TRICHOPTERA					315.63	2.499	72.	180.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE	GRANDIS	T	1090.35	3.038	18.	55.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		S	1520.75	3.182	108.	344.	
INSECTA	TRICHOPTERA	HELICOPSYCHIDAE			T	143.47	2.157	18.	39.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	ALISOTRICHIA		S	57.39	1.759	108.	190.	
INSECTA	COLEOPTERA	ELMIDAE			S	3758.83	3.575	104.	372.	
INSECTA	ODONATA	COENAGRIONIDAE	ARGIA		S	114.77	2.060	108.	222.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		S T	57.39	1.759	24.	42.	
INSECTA	DIPTERA	TIPULIDAE	HOLORUSIA		S	60.97	1.785	72.	129.	
INSECTA	DIPTERA	SIMULIIDAE			O	774.72	2.889	108.	312.	
INSECTA	DIPTERA	CHIRONOMIDAE			S, O	8263.68	3.917	108.	423.	
INSECTA	DIPTERA	MUSCIDAE	LIMNOPHORA		S	86.08	1.935	108.	209.	
INSECTA	DIPTERA	CERATOPOGONIDAE			S, ch	602.56	2.780	108.	300.	
INSECTA	DIPTERA	PSYCHODIDAE				28.69	1.458	36.	52.	
GASTROPODA		PLANORBIDAE				659.95	2.820	108.	305.	
CRUSTACEA	OSTRACODA				S	7288.11	3.863	108.	417.	
GASTROPODA		PHYSIDAE	PHYSA			373.01	2.572	108.	278.	
OLIGOCHAETA					O, S	7058.56	3.849	108.	416.	
ARACHNIDA	HYDRACARINA				S, O	114.77	2.060	98.	202.	
NEMATODA					S	200.85	2.303	108.	249.	
CRUSTACEA	AMPHIPODA	TALITRIDAE	HYALELLA	AZTECA	O	1032.96	3.014	98.	295.	
CRUSTACEA	AMPHIPODA				O	516.48	2.713	98.	266.	
GASTROPODA		LYMNAEIDAE	LYMNAEA			57.39	1.759	108.	190.	
HIRUDINEA					O	143.47	2.157	108.	233.	
CRUSTACEA	COPEPODA					57.39	1.759	108.	190.	
				TOTALS		38395.27	4.584			9.90

Symbols used

— = 'clean water' species

T = moderately tolerant species

S = Sediment tolerant species

O = Organic Enrichment tolerant species

⊥ = large stoneflies

▭ = Shredders (those requiring deciduous flora in Riparian habitat)

ch = those species that compete best in adverse water chemistry

EIGHT MILE CREEK

Three stations were sampled in September and November on this stream. The lower station was near the mouth, Station 2 was just above Highway 197, and Station 3 was above the culvert and Road 4440. The aquatic macroinvertebrate communities at Stations 1 and 2 were dominated by those taxa tolerant to sedimentation and organic enrichment. All of the analysis elements indicated that Station 2 was even worse off than Station 1 on the September sampling date, At the upper station, cleanwater species indicated that there was good water quality and good instream habitat conditions. There were some indications of moderate amounts of sedimentation and organic nutrients, but there was a contrast in the condition of the stream at the upper station when compared with the lower stations, The observed number of shredders along this stream is generally found where riparian habitat is in fairly good condition.

When sampled in November, there was an extreme dominance of those taxa tolerant to organic enrichment and indications of excessive sedimentation at Station 1. Cleanwater species were scarce at that station, and moderately tolerant taxa did not have resident population numbers.

At Station 2, a cleanwater mayfly present in fairly good numbers indicated there was good water quality and some good instream substrate. There was still an abundance of those taxa tolerant to sedimentation and organic enrichment, but conditions in November appeared to have improved since September. Station 3 continued to have a better diversity of cleanwater species, but even they were limited on this sampling date. Numbers of sediment- and organic enrichment-tolerant taxa did not indicate severe impacts in that reach of stream, but conditions did not appear to be as good in November as they were in September.

The potential for support of anadamous and resident fisheries on this stream appeared fair to poor at the lower two stations and good at the upper station. Cleanwater species present at the upper station indicated there should be suitable spawning substrate available, and the macroinvertebrate biomass from 0.7 to 1.2 g/m^2 would be sufficient to provide nutrients for the fisheries, This productivity was lower, however, than one would expect in a stream that had 57 to 92 mg/l alkalinity. The potential for support of fisheries at the lower two

stations was not as good. Scarcity of cleanwater species and dominance of sediment-tolerant taxa indicated that there may be very little, if any, suitable spawning substrate in these reaches of stream, and the macroinvertebrate biomass of 0.3 to 0.5 g/m^2 would be more limiting to the number and size of fish that could be supported in these aquatic ecosystems.

All of the analysis elements shown on the data sheet indicate the variation of habitat quality in the reaches sampled, particularly the BCI values, which show that there were stress conditions at the lower two stations in September, and particularly at the lower station in November. The BCI value of 94 indicated that conditions at the upper station were better in September than in November, and the value of 74 at Station 2 indicated that conditions had improved to the fair range. It appeared there would be opportunities for management to improve the instream habitat quality and water quality at the lower two stations in this aquatic ecosystem.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator: Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District: Mount Hood National Forest

Stream: 8-MILE CREEK

State/County: Oregon, Wasco County

Forest Service Cat. No.

B.

Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Biotic Condition Index BCI 50	No. of taxa
(mouth) 1	9-24-86	14.3	0.5	66	31
(abv HW 197) 2	9-24-86	7.5	0.3	59	21
(rd 4440) 3	9-18-86	27.4	1.2	94	40
1	11-13-86	12.0	0.5	64	25
2	11-13-86	15.2	0.5	74	27
3	11-4-86	25.6	0.7	82	42

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF WASCO CO. EIGHT MILE CREEK AT MOUTH) DATE: 09 24 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	31	3522.	1390.	5654	1957.62	32.09	55.58	3.3853	0.3201	71.	76.

SPECIES ANALYSES

STATION: 1 MT HOOD NF WASCO CO. EIGHT MILE CREEK (AT MOUTH) DATE: 09 24 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			14.35	1.157	30.	35.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA			1.52	1.333	21.	28.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA			[illegible]	1.458	54.	79.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		[illegible]	0.655	48.	27.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		S	21.52	1.333	108.	144.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		S	312.04	2.494	24.	60.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		S	157.81	2.198	72.	158.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA	BICORNUTA		3.59	0.555	24.	13.	
INSECTA	PLECOPTERA					190.09	2.279	48.	109.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA			14.35	1.157	18.	21.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			17.93	1.254	48.	60.	
INSECTA	PLECOPTERA	CAPNIIDAE				53.80	1.731	32.	55.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			3.59	0.555	16.	9.	
INSECTA	PLECOPTERA	PERLIDAE	HESPEROPERLA			3.59	0.555	18.	10.	
INSECTA	TRICHOPTERA					39.45	1.596	72.	115.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		S	107.60	2.032	108.	219.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		S	555.93	2.745	108.	296.	
INSECTA	COLEOPTERA	ELMIDAE			S	900.25	2.954	104.	307.	
INSECTA	ODONATA	COENAGRIONIDAE			S	10.76	1.032	108.	111.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		S	21.52	1.333	36.	48.	
INSECTA	DIPTERA	SIMULIIDAE			S	10.76	1.032	108.	111.	
INSECTA	DIPTERA	CHIRONOMIDAE			S	638.43	2.805	108.	303.	
INSECTA	DIPTERA	EMPIDIDAE			S	46.63	1.669	95.	159.	
INSECTA	DIPTERA	MUSCIDAE	LIMNOPHORA		S	7.17	0.856	108.	92.	
INSECTA	LEPIDOPTERA	PYRALIDAE	PARAGYRACTIS		S	3.59	0.555	72.	40.	
GASTROPODA	ANCYLIDAE	LAEVAPEX				17.93	1.254	96.	120.	
CRUSTACEA	CLADOCERA		DAPHNIA			3.59	0.555	108.	60.	
OLIGOCHAETA					S	93.25	1.970	108.	213.	
ARACHNIDA	HYDRACARINA				S	204.44	2.311	98.	226.	
NEMATODA					S	10.76	1.032	108.	111.	
CRUSTACEA	COPEPODA					3.59	0.555	108.	60.	
				TOTALS		3522.11	3.547			0.50

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF EIGHT MILE CREEK (ABOVE HW 197) DATE: 09 24 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	21	11198.	160.	22235.	10136.41	52.26	90.52	2.3151	0.4740	74.	82.

SPECIES ANALYSES

STATION 2 MT HOOD NF EIGHT MILE CREEK (ABOVE HW 197) DATE: 09 24 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			7.17	0.856	21.	18.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			14.35	1.157	30.	35.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	157.81	2.198	48.	106.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		S	1872.24	3.272	108.	353.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		S	7.17	0.856	24.	21.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			7.17	0.856	72.	62.	
INSECTA	PLECOPTERA					64.56	1.810	48.	87.	
INSECTA	PLECOPTERA	CAPNIIDAE			T	28.69	1.458	32.	47.	
INSECTA	TRICHOPTERA					21.52	1.333	72.	96.	
INSECTA	TRICHOPTERA	HELICOPSYCHIDAE			T	28.69	1.458	18.	26.	
INSECTA	COLEOPTERA	ELMIDAE			S	1362.93	3.134	104.	326.	
INSECTA	ODONATA				S	7.17	0.856	90.	77.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		S	14.35	1.157	36.	42.	
INSECTA	DIPTERA	SIMULIIDAE			O	7.17	0.856	108.	92.	
INSECTA	DIPTERA	CHIRONOMIDAE			S,O	5523.47	3.742	108.	404.	
INSECTA	DIPTERA	CERATOPOGONIDAE			S, ch	35.87	1.555	108.	168.	
CRUSTACEA	CLADOCERA		DAPHNIA			918.19	2.963	108.	320.	
OLIGOCHAETA					O,S	746.03	2.873	108.	310.	
ARACHNIDA	HYDRACARINA				S,O	344.32	2.537	98.	249.	
NEMATODA						7.17	0.856	108.	92.	
GASTROPODA	ANCYLIDAE	LAEVAPEX				21.52	1.333	96.	128.	
				TOTALS		11197.57	4.049			0.30

TOTAL SAMPLE STATISTICS

STATION: 3 MT HOOD NF EIGHT MILE CREEK (LOWER CROSSING) DATE: 09 18 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	40	9376	4980.	13771	4037 11	24.86	43.06	4.5781	0 1394	54.	53.

SPECIES ANALYSES

STATION: 3 MT HOOD NF EIGHT MILE CREEK (LOWER CROSSING) DATE: 09 18 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				86.08	1.935	64.	124.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		129.12	2.111	21.	44.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		208.03	2.318	30.	70.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		82.49	1.916	21.	40.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		276.17	2.441	54.	132.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	319.21	2.504	48.	120.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	89.67	1.953	2.	4.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA	118.36	2.073	24.	50.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		685.05	2.836	24.	68.	
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS		164.99	2.217	48.	106.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		555.93	2.745	72.	198.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	43.04	1.634	24.	39.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HETEROCAUDATA	136.29	2.134	24.	51.	
INSECTA	PLECOPTERA				358.67	2.555	48.	123.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			283.35	2.452	24.	59.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		10.76	1.032	18.	19.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		107.60	2.032	48.	98.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		43.04	1.634	48.	78.	
INSECTA	PLECOPTERA	CAPNIIDAE			243.89	2.387	32.	76.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		168.57	2.227	16.	36.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		1269.68	3.104	24.	74.	
INSECTA	PLECOPTERA	LEUCTRIDAE			215.20	2.333	18.	42.	
INSECTA	PLECOPTERA	PERLODIDAE			114.77	2.060	48.	99.	
INSECTA	PLECOPTERA	NEMOURIDAE	VISOKA		35.87	1.555	108.	168.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS		114.77	2.060	24.	49.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		337.15	2.528	24.	61.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		211.61	2.326	18.	42.	
INSECTA	COLEOPTERA	ELMIDAE			161.40	2.208	104.	230.	
INSECTA	DIPTERA				17.93	1.254	108.	135.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		7.17	0.856	24.	21.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		14.35	1.157	24.	28.	
INSECTA	DIPTERA	SIMULIIDAE			32.28	1.509	108.	163.	
INSECTA	DIPTERA	CHIRONOMIDAE			538.00	2.731	108.	295.	
CRUSTACEA	OSTRACODA				563.11	2.751	108.	297.	
PELECYPODA					14.35	1.157	108.	125.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		129.12	2.111	108.	228.	
OLIGOCHAETA					728.09	2.862	108.	309.	
ARACHNIDA	HYDRACARINA				728.09	2.862	98.	280.	
NEMATODA					10.76	1.032	108.	111.	
CRUSTACEA	COPEPODA				21.52	1.333	108.	144.	
				TOTALS	9375.55	3.972			1.20

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF EIGHT MILE CREEK DATE: 11 13 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	25	11312.	4261.	18363.	6475.57	33.05	57.24	2.9086	0.3745	75.	78.

SPECIES ANALYSES

STATION: 1 MT HOOD NF EIGHT MILE CREEK DATE: 11 13 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		14.35	1.157	30.	35.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		28.69	1.458		31.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA		35.87	1.555	54.	84.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		28.69	1.458	108.	157.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		193.68	2.287	24.	55.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		688.64	2.838	72.	204.	
INSECTA	PLECOPTERA				93.25	1.970	48.	95.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		28.69	1.458	48.	70.	
INSECTA	PLECOPTERA	CAPNIIDAE			860.80	2.935	32.	94.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		28.69	1.458	16.	23.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIOPTERYX		236.72	2.374	48.	114.	
INSECTA	TRICHOPTERA				7.17	0.856	72.	62.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		114.77	2.060	108.	222.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		200.85	2.303	108.	249.	
INSECTA	COLEOPTERA	ELMIDAE			286.93	2.458	104.	256.	
INSECTA	ODONATA	COENAGRIONIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	SIMULIIDAE			1032.96	3.014	108.	326.	
INSECTA	DIPTERA	CHIRONOMIDAE			4712.88	3.673	108.	397.	
INSECTA	DIPTERA	EMPIDIDAE			50.21	1.701	95.	162.	
CRUSTACEA	OSTRACODA				93.25	1.970	108.	213.	
OLIGOCHAETA					1987.01	3.298	108.	356.	
ARACHNIDA	HYDRACARINA				387.36	2.588	98.	254.	
NEMATODA					7.17	0.856	108.	92.	
CRUSTACEA	COPEPODA				136.29	2.134	108.	231.	
				TOTALS	11312.35	4.054			0.50

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF EIGHT MILE CREEK DATE: 11 13 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	27	4964.	468.	9459.	4128.55	48.02	83.17	3.6790	0.2274	65.	67.

SPECIES ANALYSES

STATION: 2 MT HOOD NF EIGHT MILE CREEK DATE: 11 13 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			161.40	2.208	21.	46.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			14.35	1.157	30.	35.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA			114.71	2.080	21.	43.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		322.80	2.509	48.	120.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES			28.69	1.458	108.	157.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			279.76	2.447	24.	59.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			286.93	2.458	72.	177.	
INSECTA	PLECOPTERA					104.01	2.017	48.	97.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			3.59	0.555	48.	27.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			39.45	1.596	12.	19.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA			82.49	1.916	48.	92.	
INSECTA	PLECOPTERA	LEUCTRIDAE				355.08	2.550	18.	46.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			111.19	2.046	108.	221.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE			71.73	1.856	108.	200.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE			7.17	0.856	18.	15.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA			3.59	0.555	18.	10.	
INSECTA	COLEOPTERA	ELMIDAE				405.29	2.608	104.	271.	
INSECTA	DIPTERA					3.59	0.555	108.	60.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA			32.28	1.509	24.	36.	
INSECTA	DIPTERA	SIMULIIDAE				197.27	2.295	108.	248.	
INSECTA	DIPTERA	CHIRONOMIDAE				1230.23	3.090	108.	334.	
INSECTA	DIPTERA	EMPIDIDAE				7.17	0.856	95.	81.	
INSECTA	DIPTERA	CERATOPOGONIDAE				3.59	0.555	108.	60.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			21.52	1.333	36.	48.	
OLIGOCHAETA						577.45	2.762	108.	298.	
ARACHNIDA	HYDRACARINA					469.85	2.672	98.	262.	
CRUSTACEA	CLADOCERA		DAPHNIA			28.69	1.458	108.	157.	
				TOTALS		4963.95	3.696			0.50

TOTAL SAMPLE STATISTICS

STATION: 3 MT HOOD NF EIGHT MILE CREEK DATE: 11 04 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	42	7166.	622.	13711.	6010.28	48.42	83.87	4.2020	0.2226	60.	61.

SPECIES ANALYSES

STATION: 3 MT HOOD NF EIGHT MILE CREEK DATE: 11 04 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA					10.76	1.032	64.	66.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			14.35	1.157	21.	24.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			444.75	2.648	30.	79.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA			43.04	1.634	54.	88.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		89.67	1.953	48.	94.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI		21.52	1.333	2.	3.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA		25.11	1.400	24.	34.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES			3.59	0.555	108.	60.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			347.91	2.541	24.	61.	
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS			89.67	1.953	48.	94.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			760.37	2.881	72.	207.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX		10.76	1.032	24.	25.	
INSECTA	PLECOPTERA					229.55	2.361	48.	113.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE				68.15	1.833	24.	44.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			46.63	1.669	48.	80.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			114.77	2.060	12.	25.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA			39.45	1.596	48.	77.	
INSECTA	PLECOPTERA	CAPNIIDAE				10.76	1.032	32.	33.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			32.28	1.509	16.	24.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA			864.39	2.937	24.	70.	
INSECTA	PLECOPTERA	LEUCTRIDAE				93.25	1.970	18.	35.	
INSECTA	PLECOPTERA	NEMOURIDAE	VISOKA			107.60	2.032	108.	219.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE			10.76	1.032	18.	19.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS			143.47	2.157	24.	52.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA			96.84	1.986	24.	48.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA			204.44	2.311	18.	42.	
INSECTA	COLEOPTERA	ELMIDAE				125.53	2.099	104.	218.	
INSECTA	DIPTERA					17.93	1.254	108.	135.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA			14.35	1.157	24.	28.	
INSECTA	DIPTERA	SIMULIIDAE				17.93	1.254	108.	135.	
INSECTA	DIPTERA	CHIRONOMIDAE				964.81	2.984	108.	322.	
INSECTA	DIPTERA	EMPIDIDAE				17.93	1.254	95.	119.	
INSECTA	DIPTERA	CERATOPOGONIDAE				28.69	1.458	108.	157.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			28.69	1.458	36.	52.	
INSECTA	DIPTERA	DIXIDAE				14.35	1.157	108.	125.	
CRUSTACEA	OSTRACODA					792.65	2.899	108.	313.	
GASTROPODA		PLANORBIDAE				71.73	1.856	108.	200.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA			161.40	2.208	108.	238.	
OLIGOCHAETA						211.61	2.326	108.	251.	
ARACHNIDA	HYDRACARINA					724.51	2.860	98.	280.	
NEMATODA						7.17	0.856	108.	92.	
CRUSTACEA	COPEPODA					43.04	1.634	108.	176.	
				TOTALS		7166.16	3.855			0.20

FIFTEEN MILE CREEK

Five stations were sampled on this stream: the lower Station (1), approximately 100 yards below Seufert Falls; Station 2, approximately 20 yards upstream from Wrenthum Bridge; Station 3, near Ashbrook's pumping station; Station 4, about 400 yards above the Dufur intake; and Station 5, just below the 4421 bridge.

When sampled in September, the macroinvertebrate community at Station 1 was completely dominated by those taxa tolerant to sedimentation and organic enrichment. The only cleanwater species in the community was apparently a short-term visitor or drifter into the area. Moderately tolerant species were also severely limited in this environment.

The aquatic macroinvertebrate commmunity at Station 2 indicated that the environment in this ecosystem was limiting to moderately tolerant species, and cleanwater species were completely missing from the community. The community was dominated by those taxa tolerant to sedimentation and organic enrichment, and was apparently more limiting than the environment at Station 1. All of the analysis elements indicated that this aquatic ecosystem was under severe stress conditions. The observed community composition at Stations 1 and 2 is generally found where an area has been severely overgrazed.

At Station 3, cleanwater mayflies Epeorus and Rhithrogena were present in resident population numbers and indicated that there was good water quality and some good instream substrate. There was an abundance of those taxa tolerant to sedimentation and indications of at least moderate amounts of organic enrichment, but conditions appeared to be considerably better than at the lower two stations.

At station 4, the community was dominated by those taxa tolerant to sedimentation and organic enrichment. Cleanwater species were limited. There were some moderately tolerant taxa present, however, with near resident population numbers, which indicated that conditions were fairly good at this station. There appeared to be something that was limiting to the more sensitive species that may have been more than just sedimentation and organic enrichment.

Conditions at the upper Station (5), in contrast, appeared to be good to excellent. The aquatic macroinvertebrate community had excellent diversity, and a majority of the organisms were cleanwater and moderately tolerant species. Cleanwater species indicated good water quality and good instream substrate at the upper Station (5).

The observed number of shredders in the communities at Stations 1 and 2 is generally found where riparian habitat is in fair to poor condition, at Stations 3 and 4 where riparian habitat is in good condition, and at Station 5 where riparian habitat is in excellent condition,

The potential for support of resident and anadamous fisheries appeared to be poor at the lower two stations, fairly good at Stations 3 and 4, and excellent at the upper station. Cleanwater species present at Stations 3 and 5 indicated there should be suitable spawning substrate at those stations. Dominance of sediment-tolerant taxa at the other stations indicated there may be very little, if any, suitable spawning substrate at those stations, The macroinvertebrate biomass at Station 1 could support a fishery but was extremely limiting at Station 2. At Station 3, the biomass was good, at Station 4, it could support a fairly good fishery, and at Station 5, the macroinvertebrate biomass would provide good support for fisheries.

When sampled in November? the environment at Station 2 was still the most limiting, and conditions, although they had improved slightly, were still in the poor range at Station 1. Both communities were dominated by those taxa tolerant to sedimentation and organic enrichment. Cleanwater species at Station 3 indicated that there was good water quality and some good instream substrate at that station. There were still, however, indications of an abundance of sedimentation and organic enrichment at that station. The abundance and diversity of cleanwater species at Stations 4 and 5 indicated there was good water quality and good instream substrate at those stations. There was an abundance of moderately tolerant taxa in these stream reaches. There were indications of at least moderate amounts of sedimentation, particularly at Station 4. The observed number of shredders in the communities at Stations 1 and 2 is generally found where riparian habitat is in fair condition, at Stations 3 and 4 where riparian habitat is in good condition, and at Station 5 where riparian habitat is in excellent condition.

It appeared there would be good potential for support of resident and anadamous fisheries on this stream, Macroinvertebrate biomass at Stations 1, 3, and 5 would be sufficient to provide nutrients for good fisheries, and cleanwater species present indicated there should be suitable spawning substrate at Stations 3, 4, and 5; however, the sedimentation indicated at these stations could still be somewhat limiting to spawning success.

In November, the BCI value of 61 at Station 1 indicated that the stream reach had stress conditions, and the BCI value of 57 at Station 2 indicated that conditions there were even more stressful than in September. All of the analysis elements showed a contrast in habitat quality in the stream reaches sampled. Conditions at Station 3 appeared to be good but could be better. At Station 4, conditions were somewhat improved in November, and at Station 5, conditions appeared to be the best. The most sensitive mayflies were limited even at the upper two stations on this stream. It appeared there would be opportunities for management to improve the instream habitat quality and water quality, particularly at the lower two stations on this stream.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District Mount Hood National Forest

Stream 15-MILE CREEK

State/County Oregon, Wasco County

Forest Service Cat. No.

B.

	Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Biotic Condition Index BCI 50	No. of tax
(mouth)	1	9-23-86	9.9	5.0	54	22
(Wr. Bridge)	2	9-22-86	5.2	0.5	54	12
(p. station)	3	9-22-86	11.2	6.2	83	26
(intake)	4	9-22-86	15.7	0.9	83	32
(upper)	5	9-17-86	25.9	2.3	94	45
	1	11-14-86	11.9	4.0	61	32
	2	11-13-86	6.8	0.8	57	21
	3	11-12-86	17.7	•	82	35
	4	11-12-86	17.7	0.6	90	35
	5	11-4-86	23.5	1.2	93	37

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF FIFTEEN MILE CREEK (MOUTH) DATE: 09 23 86

REPL	TOTAL NO SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	22	28830.	14554	43105	13110.54	26.26	45.48	2.9417	0.3405	88.	92

SPECIES ANALYSES

STATION: 1 MT HOOD NF FIFTEEN MILE CREEK (MOUTH) DATE: 09 23 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN W-T GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		1	28.69	1.458	21.	31.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	5	86.08	1.935	48.	93.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		5	57.39	1.759	108.	190.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		5	114.77	2.060	24.	49.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		10	659.95	2.820	72.	203.	
INSECTA	PLECOPTERA	CAPNIIDAE				57.39	1.759	32.	56.	
INSECTA	TRICHOPTERA					172.16	2.236	72.	161.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		5	1578.13	3.198	108.	345.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		5	2783.25	3.445	108.	372.	
INSECTA	COLEOPTERA	ELMIDAE			5	3952.51	3.597	104.	374.	
INSECTA	DIPTERA					28.69	1.458	108.	157.	
INSECTA	DIPTERA	SIMULIIDAE			10	3844.91	3.585	108.	387.	
INSECTA	DIPTERA	CHIRONOMIDAE			5	9325.33	3.970	108.	429.	
INSECTA	LEPIDOPTERA	PYRALIDAE	PARAGYRACTIS		5	200.85	2.303	72.	166.	
GASTROPODA	ANCYLIDAE	LAEVAPEX				57.39	1.759	96.	169.	
CRUSTACEA	OSTRACODA				5	172.16	2.236	108.	241.	
GASTROPODA		PHYSIDAE	PHYSA			200.85	2.303	108.	249.	
OLIGOCHAETA					0.5	4562.24	3.659	108.	395.	
ARACHNIDA	HYDRACARINA				5.0	114.77	2.060	98.	202.	
NEMATODA						57.39	1.759	108.	190.	
CRUSTACEA	AMPHIPODA	TALITRIDAE	HYALELLA	AZTECA	5.0	487.79	2.688	98.	263.	
CRUSTACEA	COPEPODA					286.93	2.458	108.	265.	
				TOTALS		28829.63	4.460			5.00

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF FIFTEEN MILE CREEK (WRENTHAM BRIDGE) DATE: 09 22 86

REPL	TOTAL NO SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	12	8493	6453	10533.	1873.27	12.73	22.06	2.0489	0.4291	82	92.

SPECIES ANALYSES

STATION: 2 M T HOOD NF FIFTEEN MILE CREEK (WRENTHAM BRIDGE) DATE: 09 22 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	S	14.35	1.157	48.	56.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		S	373.01	2.572	108.	278.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		S	14.35	1.157	24.	28.	
INSECTA	PLECOPTERA	CAPNIIDAE				28.69	1.458	32.	47.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		T	14.35	1.157	24.	28.	
INSECTA	COLEOPTERA	ELMIDAE			S	466.27	2.669	104.	278.	
INSECTA	DIPTERA	CHIRONOMIDAE			S,O	3228.00	3.509	108.	379.	
CRUSTACEA	OSTRACODA				S	265.41	2.424	108.	262.	
OLIGOCHAETA					S	3349.95	3.525	108.	381.	
ARACHNIDA	HYDRACARINA				O,S	14.35	1.157	98.	113.	
NEMATODA					O,S	14.35	1.157	108.	125.	
CRUSTACEA	COPEPODA				S	710.16	2.851	108.	308.	
				TOTALS		8493.23	3.929			0.50

TOTAL SAMPLE STATISTICS

STATION: 3 MT HOOD NF FIFTEEN MILE CREEK (below L. Ashbrook pump sta.) DATE: 09 22 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	26	59395.	23862.	94929.	32632.84	31.72	54.94	3.1578	0.3283	57.	60.

SPECIES ANALYSES

STATION: 3 MT HOOD NF FIFTEEN MILE CREEK (BELOW L. ASHBROOK PUMP STA) DATE: 09 22 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 TQ	X MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			1319.89	3.121	21.	66.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			1664.21	3.221	30.	97.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA			631.25	2.800	21.	59.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		5796.05	3.763	48.	181.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES			2811.95	3.449	108.	372.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			11018.24	4.042	24.	97.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			918.19	2.963	72.	213.	
INSECTA	PLECOPTERA					57.39	1.759	48.	84.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE				57.39	1.759	24.	42.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA			459.09	2.662	18.	48.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			57.39	1.759	48.	84.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			172.16	2.236	12.	27.	
INSECTA	PLECOPTERA	CAPNIIDAE				114.77	2.060	32.	66.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			401.71	2.604	16.	42.	
INSECTA	PLECOPTERA	PERLODIDAE	PERLINODES			57.39	1.759	48.	84.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			3959.68	3.598	108.	389.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA			114.77	2.060	24.	49.	
INSECTA	TRICHOPTERA	HELICOPSYCHIDAE				688.64	2.838	18.	51.	
INSECTA	COLEOPTERA	ELMIDAE				20314.88	4.308	104.	448.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA			114.77	2.060	36.	74.	
INSECTA	DIPTERA	CHIRONOMIDAE				4648.32	3.667	108.	396.	
INSECTA	DIPTERA	EMPIDIDAE				114.77	2.060	95.	196.	
GASTROPODA		PHYSIDAE	PHYSA			172.16	2.236	108.	241.	
OLIGOCHAETA						1205.12	3.081	108.	333.	
ARACHNIDA	HYDRACARINA					2238.08	3.350	98.	328.	
NEMATODA						286.93	2.458	108.	265.	
				TOTALS		59395.21	4.774			6.20

TOTAL SAMPLE STATISTICS

STATION: 4 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK (INTAKE) DUFUR DATE: 09 22 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	32	18009.	11771.	24247.	5728.69	18.37	31.81	3.4382	0.3127	56.	60.

SPECIES ANALYSES

STATION: 4 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK (INTAKE) DUFUR DATE: 09 22 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				14.35	1.157	64.	74.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		1707.25	3.232	30.	97.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRANDIS	100.43	2.002	24.	48.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	236.93	2.458	48.	118.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	28.69	1.458	2.	3.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		387.36	2.588	24.	62.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		961.23	2.983	72.	215.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	86.08	1.935	24.	46.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	247.48	2.394	24.	57.	
INSECTA	PLECOPTERA				114.77	2.060	48.	99.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			157.61	2.198	24.	53.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		14.35	1.157	12.	14.	
INSECTA	PLECOPTERA	PTERONARCYIDAE	PTERONARCELLA		28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		769.07	2.897	16.	46.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YOHAPERLA		14.35	1.157	24.	28.	
INSECTA	PLECOPTERA	PERLODIDAE			28.69	1.458	48.	70.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		516.48	2.713	108.	293.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		243.89	2.387	18.	43.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		57.39	1.759	24.	42.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		28.69	1.458	108.	157.	
INSECTA	COLEOPTERA	ELMIDAE			846.45	2.928	104.	304.	
INSECTA	DIPTERA				86.08	1.935	108.	209.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		57.39	1.759	24.	42.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	36.	42.	
INSECTA	DIPTERA	CHIRONOMIDAE			6183.41	3.791	108.	409.	
INSECTA	DIPTERA	EMPIDIDAE			100.43	2.002	95.	190.	
INSECTA	DIPTERA	CERATOPOGONIDAE			43.04	1.634	108.	176.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		1276.85	3.106	36.	112.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		14.35	1.157	108.	125.	
OLIGOCHAETA					2309.81	3.364	108.	363.	
ARACHNIDA	HYDRACARINA				746.03	2.873	98.	282.	
NEMATODA					516.48	2.713	108.	293.	
				TOTALS	18008.66	4.255			0.90

TOTAL SAMPLE STATISTICS

STATION: 5 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 09 17 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	45	18382.	14092.	22672.	3939.72	12.37	21.43	4.2225	0.2315	53.	53.

SPECIES ANALYSES

STATION: 5 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 09 17 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				28.69	1.458	64.	93.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		57.39	1.759	21.	37.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		932.53	2.970	30.	89.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		43.04	1.634	21.	34.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRAND IS	57.39	1.759	24.	42.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	272.59	2.436	48.	117.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	143.47	2.157	2.	4.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		28.69	1.458	108.	157.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		602.56	2.780	24.	67.	
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS		14.35	1.157	48.	56.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		2736.63	3.437	72.	247.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	Hystrix	215.20	2.333	24.	56.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE			114.77	2.060	48.	99.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	114.77	2.060	24.	49.	
INSECTA	PLECOPTERA				659.95	2.820	48.	135.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			208.03	2.318	24.	56.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		28.69	1.458	18.	26.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		71.73	1.856	48.	89.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		444.75	2.648	48.	127.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		1377.28	3.139	16.	50.	
INSECTA	PLECOPTERA	PERLIDAE	HESPEROPERLA		57.39	1.759	18.	32.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		172.16	2.236	36.	80.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		659.95	2.820	24.	68.	
INSECTA	PLECOPTERA	LEUCTRIDAE			57.39	1.759	18.	32.	
INSECTA	PLECOPTERA	PERLIDAE	CLAASSENIA		14.35	1.157	6.	7.	
INSECTA	TRICHOPTERA				143.47	2.157	72.	155.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		301.28	2.479	108.	268.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		286.93	2.458	18.	44.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		157.81	2.198	24.	53.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		315.63	2.499	18.	45.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		157.81	2.198	24.	53.	
INSECTA	COLEOPTERA	ELMIDAE			1047.31	3.020	104.	314.	
INSECTA	DIPTERA				28.69	1.458	108.	157.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		243.89	2.387	24.	57.	
INSECTA	DIPTERA	SIMULIIDAE			71.73	1.856	108.	200.	
INSECTA	DIPTERA	CHIRONOMIDAE			3070.19	3.487	108.	377.	
INSECTA	DIPTERA	EMPIDIDAE			43.04	1.634	95.	155.	
INSECTA	DIPTERA	CERATOPOGONIDAE			14.35	1.157	108.	125.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		143.47	2.157	36.	78.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		14.35	1.157	108.	125.	
OLIGOCHAETA					2152.00	3.333	108.	360.	
ARACHNIDA	HYDRACARINA				789.07	2.897	98.	284.	
NEMATODA					229.55	2.361	108.	255.	
CRUSTACEA	COPEPODA				28.69	1.458	108.	157.	
				TOTALS	18381.67	4.264			2.30

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 11 14 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	32	29210.	4050.	54370.	23106.40	45.67	79 10	2 4642	0.5077	75.	82

SPECIES ANALYSES

STATION: 1 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 11 14 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			28.69	1.458	21.	31.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA			28.69	1.458	21.	31.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	HEPTAGENIA			28.69	1.458	54.	79.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		7.17	0.856	48.	41.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES			28.69	1.458	108.	157	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			114.77	2.060	24.	49.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			265.41	2.424	72.	175.	
INSECTA	PLECOPTERA	CAPNIIDAE				86.08	1.935	32.	62.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA			7.17	0.856	24	21.	
INSECTA	PLECOPTERA	LEUCTRIDAE				215.20	2.333	18.	42.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIOPTERYX			279.78	2.447	48.	117	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			531.25	2.800	108	302.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE			1163.40	3.073	108.	332.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA			7.17	0.856	24.	21.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA			28.69	1.458	108.	157.	
INSECTA	COLEOPTERA	ELMIDAE				1087.01	3.298	104.	343.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA			84.56	1.810	24.	43.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA			7.17	0.856	36.	31.	
INSECTA	DIPTERA	SIMULIIDAE				1764.64	3.247	108.	351.	
INSECTA	DIPTERA	CHIRONOMIDAE				11032.59	4.043	108.	437	
INSECTA	DIPTERA	MUSCIDAE	LIMNOPHORA			7.17	0.855	109.	92.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			7.17	0.856	36.	31.	
GASTROPODA						143.47	2.157	108.	233.	
CRUSTACEA	OSTRACODA					157.81	2.198	108.	237.	
GASTROPODA		LYMNAEIDAE	LYMNAEA			35.87	1.555	108.	168.	
CRUSTACEA	CLADOCERA		DAPHNIA			35.87	1.555	108.	168.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA			7.17	0.856	108.	92.	
OLIGOCHAETA						10379.81	4.016	108.	434.	
ARACHNIDA	HYDRACARINA					251.07	2.400	98.	235.	
NEMATODA						143.47	2.157	108.	233.	
CRUSTACEA	AMPHIPODA	TALITRIDAE	HYALELLA	AZTECA		93.25	1.970	98.	193.	
CRUSTACEA	COPEPODA					150.64	2.178	108.	235.	
				TOTALS		29209.82	4.466			4.00

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 11 13 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	21	26871.	19841.	33902.	6456.62	13.87	24.03	2.2133	0.4966	84.	88.

SPECIES ANALYSES

STATION: 2 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 111386

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	157.81	2.198	48.	106.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		2553.71	3.407	108.	368.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		286.93	2.458	72.	177.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMA		28.69	1.458	32.	47.	
INSECTA	PLECOPTERA	CAPNIIDAE			200.85	2.303	32.	74.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIOPTERYX		57.39	1.759	48.	84.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		229.55	2.361	108.	255.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		86.08	1.935	108.	209.	
INSECTA	TRICHOPTERA	HELICOPSYCHIDAE			28.69	1.458	18.	26.	
INSECTA	COLEOPTERA	ELMIDAE			1635.52	3.214	104.	334.	
INSECTA	ODONATA	COENAGRIONIDAE	ARGIA		57.39	1.759	108.	190.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		86.08	1.935	24.	46.	
INSECTA	DIPTERA	SIMULIIDAE			258.24	2.412	108.	260.	
INSECTA	DIPTERA	CHIRONOMIDAE			13112.85	4.118	108.	445.	
CRUSTACEA	CLADOCERA		DAPHNIA		28.69	1.458	108.	157.	
CRUSTACEA	OSTRACODA				28.69	1.458	108.	157.	
GASTROPODA					28.69	1.458	108.	157.	
OLIGOCHAETA					7058.56	3.849	108.	416.	
ARACHNIDA	HYDRACARINA				57.39	1.759	98.	172.	
NEMATODA					114.77	2.060	108.	222.	
CRUSTACEA	COPEPODA				774.72	2.889	108.	312.	
				TOTALS	26871.31	4.429			0.80

TOTAL SAMPLE STATISTICS

STATION: 3 MT HOOD NF FIFTEEN MILE CREEK (L. ASHBROOK POWER HOUSE) DATE: 11 12 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	35	29490.	3301.	55678.	24050.53	47.09	81.56	3.8189	0.2559	62.	61.

SPECIES ANALYSES

STATION 3 MT HOOD NF FIFTEEN MILE CREEK (L. ASHBROOK POWER HOUSE) DATE: 11 12 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	:-cc10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				143.47	2.157	64.	138.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		1129.80	3.053	21.	64.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		114.77	2.060	30.	62.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		401.71	2.604	21.	55.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRANDIS	68.15	1.833	24.	44.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	3500.59	3.544	48.	170.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		1474.12	3.169	108.	342.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		6054.29	3.782	24.	91.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		735.27	2.866	72.	206.	
INSECTA	PLECOPTERA				814.17	2.911	48.	140.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		17.93	1.254	24.	30.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		86.08	1.935	48.	93.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		946.88	2.976	12.	36.	
INSECTA	PLECOPTERA	PTERONARCYIDAE	PTERONARCYS		128.69	1.458	18.	26.	
INSECTA	PLECOPTERA	CAPNIIDAE			383.77	2.584	32.	83.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		114.77	2.060	36.	74.	
INSECTA	PLECOPTERA	LEUCTRIDAE			717.33	2.856	18.	51.	
INSECTA	TRICHOPTERA				86.08	1.935	72.	139.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		1187.19	3.075	108.	332.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		1119.04	3.049	108.	329.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		229.55	2.361	18.	42.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		114.77	2.060	24.	49.	
INSECT-A	TRICHOPTERA	HELICOPSYCHIDAE			573.87	2.759	18.	50.	
INSECTA	COLEOPTERA	ELMIDAE			5042.85	3.703	104.	385.	
INSECTA	DIPTERA				10.76	1.032	108.	111.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		57.39	1.759	24.	42.	
INSECTA	DIPTERA	SIMULIIDAE			383.77	2.584	108.	279.	
INSECTA	DIPTERA	CHIRONOMIDAE			2765.32	3.442	108.	372.	
INSECTA	DIPTERA	EMPIDIDAE			57.39	1.759	95.	167.	
INSECTA	DIPTERA	MUSCIDAE	LIMNOPHORA		10.76	1.032	108.	111.	
INSECTA	DIPTERA	CERATOPOGONIDAE			57.39	1.759	108.	190.	
GASTROPODA		PHYSIDAE	PHYSA		10.76	1.032	108.	111.	
OLIGOCHAETA					670.71	2.827	108.	305.	
ARACHNIDA	HYDRACARINA				369.43	2.568	98.	252.	
CRUSTACEA	COPEPODA				10.76	1.032	108.	111.	
				TOTALS	29489.58	4.470			4.70

TOTAL SAMPLE STATISTICS

STATION: 4 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 11 12 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
• NUMBERS DATA											
3	35	17029.	9253.	24806.	7141.31	24.21	41.93	3.3571	0.3463	51.	55.

SPECIES ANALYSES

STATION: 4 MT HOOD NF WASCO CO. FIFTEEN MILE CREEK DATE: 11 12 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		559.52	2.748	21.	58.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		4131.84	3.616	30.	108.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		71.73	1.856	21.	39.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	1994.19	3.300	48.	158.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	14.35	1.157	2.	2.	
24	INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA	286.93	2.458	104.	256.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		2008.53	3.303	72.	238.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	100.43	2.002	24.	48.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	28.69	1.458	24.	35.	
INSECTA	PLECOPTERA				157.81	2.198	48.	106.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			143.47	2.157	24.	52.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		14.35	1.157	18.	21.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		86.08	1.935	12.	23.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		57.39	1.759	48.	84.	
INSECTA	PLECOPTERA	CAPNIIDAE			28.69	1.458	32.	47.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		57.39	1.759	16.	28.	
INSECTA	PLECOPTERA	LEUCTRIDAE			86.08	1.935	18.	35.	
INSECTA	PLECOPTERA	PERLIDAE			28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA		172.16	2.236	36.	80.	
INSECTA	PLECOPTERA	PERLODIDAE	PERLINODES		14.35	1.157	48.	56.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		344.32	2.537	108.	274.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		86.08	1.935	18.	35.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		14.35	1.157	24.	28.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		28.69	1.458	108.	157.	
INSECTA	COLEOPTERA	ELMIDAE			430.40	2.634	104.	274.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		100.43	2.002	24.	48.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		43.04	1.634	24.	39.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	36.	42.	
INSECTA	DIPTERA	SIMULIIDAE			243.89	2.387	108.	258.	
INSECTA	DIPTERA	CHIRONOMIDAE			4017.07	3.604	108.	389.	
INSECTA	DIPTERA	EMPIDIDAE			57.39	1.759	95.	167.	
INSECTA	DIPTERA	CERATOPOGONIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		258.24	2.412	36.	87.	
OLIGOCHAETA					1262.51	3.101	108.	335.	
ARACHNIDA	HYDRACARINA				57.39	1.759	98.	172.	
				TOTALS	17029.50	4.231			0.60

TOTAL SAMPLE STATISTICS

STATION: 5 MT HOOD NF FIFTEEN MIL≤ CREEK DATE: 11 04 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	37	16592	10603	22580.	5499.66	19.14	33.15	4.0712	0.2187	54	54.

SPECIES ANALYSES

STATION: 5 MT HOOD NF FIFTEEN MILE CREEK DATE: 11 04 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			616.91	2.790	21.	59.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			1262.51	3.101	30.	93.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		645.60	2.810	48.	135.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA		71.73	1.856	24.	45.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			710.16	2.851	24.	68.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			2065.92	3.315	72.	239.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX		329.97	2.518	24.	60.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA		28.69	1.458	24.	35.	
INSECTA	PLECOPTERA					100.43	2.002	48.	96.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE				43.04	1.634	24.	39.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			28.69	1.458	48.	70.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			86.08	1.935	12.	23.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA			616.91	2.790	48.	134.	
INSECTA	PLECOPTERA	CAPNIIDAE				100.43	2.002	32.	64.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			373.01	2.572	16.	41.	
INSECTA	PLECOPTERA	CAPNIIDAE	ISOCAPNIA			114.77	2.060	24.	49.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA			875.15	2.942	24.	71.	
INSECTA	PLECOPTERA	LEUCTRIDAE				344.32	2.537	18.	46.	
INSECTA	PLECOPTERA	NEMOURIDAE	MALENKA			229.55	2.361	36.	85.	
INSECTA	TRICHOPTERA					28.69	1.458	72.	105.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			172.16	2.236	108.	241.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA			43.04	1.634	24.	39.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA			344.32	2.537	18.	46.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA			28.69	1.458	24.	35.	
INSECTA	COLEOPTERA	ELMIDAE				473.44	2.675	104.	278.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA			258.24	2.412	24.	58.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA			28.69	1.458	24.	35.	
INSECTA	DIPTERA	SIMULIIDAE				186.51	2.271	108.	245.	
INSECTA	DIPTERA	CHIRONOMIDAE				3672.75	3.565	108.	385.	
INSECTA	DIPTERA	EMPIDIDAE				129.12	2.111	95.	201.	
INSECTA	DIPTERA	CERATOPOGONIDAE				28.69	1.458	108.	157.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			344.32	2.537	36.	91.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA			28.69	1.458	108.	157.	
OLIGOCHAETA						1721.60	3.236	108.	349.	
ARACHNIDA	HYDRACARINA					373.01	2.572	98.	252.	
NEMATODA						57.39	1.759	108.	190.	
CRUSTACEA	COPEPODA					28.69	1.458	108.	157.	
				TOTALS		16591.92	4.220			1.20

FIVE MILE CREEK

Two stations were sampled on this stream in September and November. The lower Station (1) was about thirty yards upstream from the U.S. 197 crossing, and the upper Station (2) was at the forest boundary. When sampled in September, the aquatic macroinvertebrate community at Station 1 was dominated by those taxa tolerant to sedimentation and organic enrichment. The macroinvertebrate community at the upper Station (2) was dominated by cleanwater and moderately tolerant taxa, which indicated that there was good water quality and good instream substrate. The observed number of shredders at the lower station is generally found where riparian habitat is in fairly good condition, and at the upper station, where riparian habitat is in good to excellent condition. All of the analysis elements, including those on the data sheet, show a contrast in the quality and habitat conditions of the two stations sampled.

When sampled in November, the macroinvertebrate community at Station 1 had an extreme dominance among those taxa tolerant to sedimentation and organic enrichment, The community composition is often found where there has been extreme overgrazing in an area. There were no cleanwater species in the community, and it was surprising to find that there were some moderately tolerant shredders in the community, which indicated that some instream habitat was in at least fair condition and that there was fairly good riparian habitat in upstream reaches. At the upstream Station (2), there was a good diversity among cleanwater and moderately tolerant species and a good balance among the trophic groups, but some did not have resident population numbers, which means that conditions were not as good as they could be. There were some indications of at least moderate amounts of sedimentation and organic enrichment.

The potential for resident and anadamous fisheries appeared to be fair to poor at the lower station and good at the upper station. Abundance of sediment-tolerant taxa and lack Of cleanwater species at the lower station indicated there would be a lack of suitable spawning substrate. Cleanwater species at Station 2 indicated there would be suitable spawning substrate in that stream reach. The macroinvertebrate biomass of 0.5 g/m^2 at the lower station and 0.3 g/m^2 at the upper station in September would be limiting to the number and size of fish that could be supported in this aquatic ecosystem.

Macroinvertebrate biomass was much higher on the November sampling date, when the extreme dominance of tolerant species increased the standing crop to 8.7 g/m2 at the lower station and the biomass at the upper station increased to 6.9 g/m^2. The large stonefly Doroneuria found at the upper station is an important source of nutrients, particularly for the larger fish in the ecosystem.

The BCI values of 57 and 62 in September and November, respectively, at Station 1, indicated that this reach of stream had some serious impacts, and BCI values of 92 and 88 in September and November, respectively, at Station 2, indicated that that reach of stream was fairly close to its potential but could be better. It appeared there were opportunties for management to improve instream habitat conditions at the lower Station (1), and warning numbers of sediment-tolerant taxa indicated there may be some opportunity to improve instream habitat quality, even at the upper Station (2) in this aquatic ecosystem.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District Mount Hood National Forest

Stream 5-MILE CREEK

State/County Oregon, Wasco County

Forest Service Cat. No.

B.

Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Biotic Condition Index BCI 50	No. of taxa
(ab HW 197) 1	9-24-86	7.6	0.5	57	23
(blo 4431) 2	9-18-86	26.2	0.3	92	42
1	11-13-86	11.9	8.7	62	25
2	11-13-86	21.8	6.9	88	36

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF FIVE MILE CREEK (ABOVE HW 197) DATE: 09 24 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	23	14322.	7055.	21588.	6673.73	26.90	46.60	2.5632	0.4338	85.	88.

SPECIES ANALYSES

STATION: 1 MT HOOD NF FIVE MILE CREEK (ABOVE HW 197) DATE: 09 24 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X MEAN TQ	WT GM/SQM
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	57.39	1.759	48.	84.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		43.04	1.634	108.	176.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		28.69	1.458	24.	35.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		14.35	1.157	72.	83.	
INSECTA	PLECOPTERA				43.04	1.634	48.	78.	
INSECTA	PLECOPTERA	CAPNIIDAE			315.63	2.499	32.	80.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		86.08	1.935	108.	209.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		100.43	2.002	108.	216.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		57.39	1.759	18.	32.	
INSECTA	COLEOPTERA	ELMIDAE			1420.32	3.152	104.	328.	
INSECTA	ODONATA	COENAGRIONIDAE	ARGIA		3.59	0.555	108.	60.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		28.69	1.458	24.	35.	
INSECTA	DIPTERA	SIMULIIDAE			14.35	1.157	108.	125.	
INSECTA	DIPTERA	CHIRONOMIDAE			4017.07	3.604	108.	389.	
INSECTA	DIPTERA	EMPIDIDAE			57.39	1.759	95.	167.	
INSECTA	DIPTERA	CERATOPOGONIDAE			14.35	1.157	108.	125.	
GASTROPODA	ANCYLIDAE	LAEVAPEX			14.35	1.157	96.	111.	
CRUSTACEA	OSTRACODA				86.08	1.935	108.	209.	
OLIGOCHAETA					5236.53	3.719	108.	402.	
ARACHNIDA	HYDRACARINA				516.48	2.713	98.	266.	
NEMATODA					1750.29	3.243	108.	350.	
CRUSTACEA	COPEPODA				387.36	2.588	108.	280.	
CRUSTACEA	AMPHIPODA	TALITRIDAE	HYALELLA	AZTECA	28.69	1.458	98.	143.	
				TOTALS	14321.56	4.156			0.50

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF WASCO CO. FIVE MILE CREEK MAINSTREAM BELOW 4431 DATE: 09 18 86

REPL	TOTAL NO SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	42	13550.	1200.	25901	11342.04	48.33	83.70	4.3556	0.1933	55.	54.

SPECIES ANALYSES

STATION: 2 MT HOOD NF WASCO CO. FIVE MILE CREEK (MAINSTREAM BELOW 4431) DATE: 09 18 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X MEAN WT TQ	GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			114.77	2.060	21.	43.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			1345.00	3.129	30.	94,	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		172.16	2.236	48.	107.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA		269.00	2.430	24.	58.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			1176.43	3.071	24.	74.	
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS			32.28	1.509	48.	72.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			681.47	2.833	72.	204.	
INSECTA	PLECOPTERA					121.95	2.086	48.	100.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE				64.56	1.810	24.	43.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS			28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA			487.79	2.688	40.	129.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			35.87	1.555	12.	19.	
INSECTA	PLECOPTERA	PTERONARCYIDAE	PTERONARCELLA			86.08	1.935	24.	46.	
INSECTA	PLECOPTERA	CAPNIIDAE				1004.27	3.002	32.	96.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			1083.17	3.035	16.	49.	
INSECTA	PLECOPTERA	PERLIDAE	DORONURIA			28.69	1.458	18.	26.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA			28.69	1.458	24.	35.	
INSECTA	PLECOPTERA	LEUCTRIDAE				28.69	1.458	18.	26.	
INSECTA	PLECOPTERA	PERLIDAE				136.29	2.134	24.	51.	
INSECTA	PLECOPTERA	PERLODIDAE				129.12	2.111	48.	101.	
INSECTA	TRICHOPTERA					17.93	1.254	72.	90.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			333.56	2.623	108.	273.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA			961.23	2.983	24.	72.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA			713.75	2.854	18.	51.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA			286.93	2.458	24.	59.	
INSECTA	TRICHOPTERA	LEPIDOSTOMATIDAE				3.59	0.555	18.	10.	
INSECTA	COLEOPTERA	ELMIDAE				728.09	2.862	104.	298.	
INSECTA	DIPTERA					32.28	1.509	108.	163.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA			100.43	2.002	24.	48.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA			57.39	1.759	36.	63.	
INSECTA	DIPTERA	SIMULIIDAE				28.69	1.458	108.	157.	
INSECTA	DIPTERA	CHIRONOMIDAE				1814.85	3.259	108.	352.	
INSECTA	DIPTERA	EMPIDIDAE				60.97	1.786	95.	170.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			365.84	2.563	36.	92.	
INSECTA	DIPTERA	PSYCHODIDAE	MARUINA	CALIFORIENSIS		67.39	1.759	36.	63.	
GASTROPODA		LYMNAEIDAE	LYMNAEA			60.97	1.785	108.	193.	
CRUSTACEA	OSTRACODA					60.97	1.786	108.	193.	
OLIGOCHAETA						269.00	2.430	108.	262.	
ARACHNIDA	HYDRACARINA					43.04	1.634	98.	160.	
NEMATODA						60.97	1.786	108.	193.	
CRUSTACEA	COPEPODA					433.99	2.637	108.	286.	
CRUSTACEA	DECAPODA					3.59	0.665	108.	60.	
				TOTALS		13550.43	4.132			6.90

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF FIV≤ MIL≤ CREEK DATE 11 13 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	25	33485.	27380	39591.	5607.10	9.67	16.75	2 7433	0.4095	76.	80.

SPECIES ANALYSES

STATION: 1 MT HOOD NF FIVE MILE CREEK DATE: 11 13 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X MEAN TQ	WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		28.69	1.458	30.	44.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	200.85	2.303	48.	111.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		28.69	1.458	108.	157.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		746.03	2.873	72.	207.	
INSECTA	PLECOPTERA				172.16	2.236	48.	107.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		28.69	1.458	48.	70.	
INSECTA	PLECOPTERA	CAPNIIDAE			2.56	2.780	32.	89.	
INSECTA	PLECOPTERA	LEUCTRIDAE			573.87	2.759	18.	50.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIOPTERYX		200.85	2.303	48.	111.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		1463.36	3.165	108.	342.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	CHEUMATOPSYCHE		172.16	2.236	108.	241.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		143.47	2.157	108.	233.	
INSECTA	TRICHOPTERA	HELICOPSYCHIDAE			28.69	1.468	18.	26.	
INSECTA	MEGALOPTERA	SIALIDAE	SIALIS		28.69	1.458	72.	105.	
INSECTA	COLEOPTERA	ELMIDAE			3385.81	3.530	104.	367.	
INSECTA	ODONATA	COENAGRIONIDAE			28.69	1.458	108.	157.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		268.24	2.412	24.	58.	
INSECTA	DIPTERA	TIPULIDAE	HOLORUSIA		143.47	2.157	72.	155.	
INSECTA	DIPTERA	SIMULIIDAE			3127.57	3.495	108.	377.	
INSECTA	DIPTERA	CHIRONOMIDAE			8148.91	3.911	108.	422.	
INSECTA	DIPTERA	EMPIDIDAE			57.39	1.759	95.	167.	
OLIGOCHAETA					12940.69	4.112	108.	444.	
ARACHNIDA	HYDRACARINA				688.64	2.838	98.	278.	
NEMATODA					114.77	2.060	108.	222.	
CRUSTACEA	COPEPODA				172.16	2.236	108.	241.	
				TOTALS	33485.12	4.525			8.00

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF FIVE MILE CREEK DATE: 11 03 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	36	5473	808.	10139.	4284.54	45.20	78.28	4.1396	0.1990	58.	57.

SPECIES ANALYSES

STATION: 2 MT HOOD NF FIVE MILE CREEK DATE: 11 03 86

CLASS	ORDER	FAMILY	GENUS	SPECIES		MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X MEAN TQ	WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS			254.65	2.406	21.	51.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA			720.92	2.858	30.	86.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS		10.76	1.032	48.	50.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI		14.35	1.157	2.	2.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA		121.95	2.086	24.	50.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA			459.09	2.662	24.	64.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS			355.08	2.550	72.	184.	
INSECTA	PLECOPTERA					21.52	1.333	48.	64.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE				64.56	1.810	24.	43.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS			71.73	1.856	12.	22.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA			799.83	2.903	48.	139.	
INSECTA	PLECOPTERA	CAPNIIDAE				32.28	1.509	32.	48.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA			14.35	1.157	16.	19.	
INSECTA	PLECOPTERA	LEUCTRIDAE				82.49	1.916	18.	34.	
INSECTA	PLECOPTERA	PERLIDAE				46.63	1.669	24.	40.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE			405.29	2.608	108.	282.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA			215.20	2.333	24.	56.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA			136.29	2.134	18.	38.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA			136.29	2.134	24.	51.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	ALISOTRICHIA			10.76	1.032	108.	111.	
INSECTA	COLEOPTERA	ELMIDAE				182.92	2.262	104.	235.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA			107.60	2.032	24.	49.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA			28.69	1.458	36.	52.	
INSECTA	DIPTERA	SIMULIIDAE				39.45	1.596	108.	172.	
INSECTA	DIPTERA	CHIRONOMIDAE				702.99	2.847	108.	307.	
INSECTA	DIPTERA	EMPIDIDAE				25.11	1.400	95.	133.	
INSECTA	DIPTERA	CERATOPOGONIDAE				14.35	1.157	108.	125.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA			39.45	1.596	36.	57.	
INSECTA	DIPTERA	BLEPHARICERIDAE				14.35	1.157	2.	2.	
CRUSTACEA	OSTRACODA					28.69	1.458	108.	157.	
GASTROPODA		LYMNAEIDAE	LYMNAEA			28.69	1.458	108.	157.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA			68.15	1.833	108.	198.	
OLIGOCHAETA						136.29	2.134	108.	231.	
ARACHNIDA	HYDRACARINA					64.56	1.810	98.	177.	
NEMATODA						10.76	1.032	108.	111.	
CRUSTACEA	COPEPODA					7.17	0.856	108.	92.	
				TOTALS		5473.25	3.738			0.30

MAY'S CANYON CREEK

The station sampled was about twenty yards from the confluence with Dry Creek. The aquatic macroinvertebrate community was completely dominated by those taxa tolerant to sedimentation and organic enrichment. The observed number of shredders in the community is generally found where riparian habitat is in poor condition.

The potential for a resident or anadamous fishery in this stream appeared to be poor. Lack of cleanwater species and dominance of sediment-tolerant taxa indicated there would be a lack of suitable spawning substrate, but the macroinvertebrate biomass of 1.7 g/m^2 would be sufficient to sustain fisheries if other factors were favorable.

The BCI value of 60 indicated serious impacts in this reach of stream. It appeared there may be opportunities for management to improve instream habitat quality, water quality. and riparian habitat quality in this aquatic ecosystem.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District Mount Hood National Forest

Stream MAY'S CANYON CREEK

State/County Oregon, Wasco County

Forest Service Cat. No.

B.

Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m^2 (mean)	Biotic Condition Index BCI 53	No. of taxa
1	11-18-86	7.7	1.7	60	21

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below 72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF WASCO CO MAY'S CANYON CREEK DATE: 11 18 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	QD
* NUMBERS DATA											
3	21	17001	12066	21936	4532.30	15.39	26.66	2.4245	0.4487	85.	88.

SPECIES ANALYSES

STATION: 1 MT HOOD NF WASCO CO. MAY'S CANYON CREEK DATE: 11 18 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT TQ	LOG10 X MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		57.39	1.759	30.	53.
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		14.35	1.157	108.	125.
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		1233.81	3.091	72.	223.
INSECTA	EPHEMEROPTERA	BAETIDAE	CALLIBAETIS		71.73	1.856	72.	134.
INSECTA	PLECOPTERA				100.43	2.002	48.	96.
INSECTA	PLECOPTERA	CAPNIIDAE			28.69	1.458	32.	47.
INSECTA	PLECOPTERA	LEUCTRIDAE			28.69	1.458	18.	26.
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		43.04	1.634	108.	176.
INSECTA	TRICHOPTERA	LIMNEPHILIDAE	HESPEROPHYLAX		14.35	1.157	108.	125.
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		114.77	2.060	24.	49.
INSECTA	COLEOPTERA	ELMIDAE			186.51	2.271	104.	236.
INSECTA	DIPTERA	SIMULIIDAE			5695.63	3.756	108.	406.
INSECTA	DIPTERA	CHIRONOMIDAE			5666.93	3.753	108.	405.
INSECTA	DIPTERA	CERATOPOGONIDAE			57.39	1.759	108.	190.
CRUSTACEA	OSTRACODA				459.09	2.662	108.	287.
GASTROPODA		PHYSIDAE	PHYSA		129.12	2.111	108.	228.
OLIGOCHAETA					2754.56	3.440	108.	372.
ARACHNIDA	HYDRACARINA				100.43	2.002	98.	196.
NEMATODA					143.47	2.157	108.	233.
CRUSTACEA	COPEPODA				71.73	1.856	108.	200.
GASTROPODA		PLANORBIDAE			28.69	1.458	108.	157.
				TOTALS	17000.80	4.230		1.70

RAMSEY CREEK

Three stations were sampled in September and November on this stream. The lower station was located at Emsley Rogers' place, Station 2 was above the log jam, and Station 3 was just above the culvert. When sampled in September, cleanwater macroinvertebrates in the community at Station 1 indicated good water quality and some good instream substrate. There were, however, indications of moderate amounts of sedimentation and organic enrichment, and the observed number of shredders at Station 1 is generally found where riparian habitat is in at least fair condition.

At Stations 2 and 3, cleanwater species were present, but not in resident population numbers, which indicated there were some limiting conditions in those stream reaches. The benthic communities were dominated by moderately tolerant taxa, and there were warning numbers of those taxa tolerant to sedimentation. The observed number of shredders is generally found where riparian habitat is in good condition.

When sampled in November, there was at Station 1 a good resident population of the cleanwater mayfly _Epeorus_, which indicated that there was good water quality with the exception of organic enrichment, and that there was some good instream substrate at this station. High numbers of those taxa tolerant to sedimentation and organic enrichment, however, indicated that there were impacts in this reach of stream. The observed number of shredders found during the sampling period is generally found where riparian habitat is in just fair condition. Most of the analysis elements indicated that there was a contrast in the quality of Station 1 compared to Stations 2 and 3, which appeared to be in better condition.

The community diversity was much higher at Stations 2 and 3 than it was at Station 1; however, good resident population numbers at each of the stations indicated there was good stability in each of these aquatic ecosystems. At Stations 2 and 3 there was a good balance among the trophic groups in the community.

The potential for resident and anadamous fisheries on this stream appeared to be fairly good. Cleanwater species present indicated there could be suitable spawning substrate at each of the stations sampled. Abundance of sediment-tolerant taxa indicated that the spawning success would probably have been

lower at Station 1, however, than at Stations 2 and 3.

There are those who have suggested that because of the steelhead's ability to clean the gravel that sediment-indicating macroinvertebrates do not necessarily indicated a problem for spawning of such fish, which may be true. However, the subsequent development and oxygenation of the eggs spawned by these fish will probably be more successful where gravel interstices have not been filled with sediment. The presence of aquatic macroinvertebrates is extremely important in an anadamous fishery to provide variously sized sources of nutrients for the smolt until they are ready for their downstream migration.

The macroinvertebrate biomass, from 0.7 g/m^2 to 1.1 g/m^2 at Stations 1, 2, and 3 in September and at Stations 1 and 2 in November was lower than one would expect in a stream with alkalinity of 70 to 90 mg/1. The macroinvertebrate biomass of 2.2 g/m^2 at Station 3 in November was about what one would expect in such a stream and could provide a good source of nutrients for the fisheries.

BCI values in the upper 70's at Station 1 on both sampling dates indicated that this aquatic ecosystem was in just fair condition. It appeared there may be opportunities for management to improve the instream habitat quality, water quality, and riparian habitat quality in that stream reach. At Stations 2 and 3, the BCI values in the high 80's and in the 90% indicated that those aquatic ecosystems were in good condition but could be better. It appeared there may be opportunities for management to improve instream habitat quality in those aquatic ecosystems.

USFS - INTERMOUNTAIN REGION - ANNUAL PROGRESS REPORT

MACROINVERTEBRATE ANALYSIS

Prior to field season fill in Sections A and C for each stream that will be sampled and forward to:

Aquatic Ecosystem Analysis Laboratory
105 Page School
Brigham Young University
Provo, Utah 84602

A. Investigator: Dave Heller/Ken McDonald/Harvey Forsgren

Forest/District: Mount Hood National Forest

Stream: RAMSEY CREEK

State/County: Oregon, Wasco County

Forest Service Cat., No,

B.

Station	Date(s)	Diversity Index DAT (mean)	Standing Crop g/m² (mean)	Biotic Condition Index BCI 50	No. of taxa
(Ems. pl.) 1	9-22-86	9.7	1.1	77	26
(abv. jam) 2	9-10-86	19.7		94	36
(abv. culv.) 3	9-10-86	23.4	1.0	86	39
1	11-12-86	10.7	0.9	79	26
2	11-4-86	24.3	0.7	96	41
3	11-4-86	23.7	2.2	96	38

Scale:	DAT	Standing crop	BCI
Excellent	18 - 26	4.0 - 12.0	above 90
Good	11 - 17	1.6 - 4.0	80 - 90
Fair	6 - 10	0.6 - 1.5	72 - 79
Poor	0 - 5	0.0 - 0.5	below72

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF WASCO CO. RAMSEY CREEK DATE: 09 22 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	26	12969.	7344.	18595.	5166.30	23.00	39.83	2.6783	0.4310	61.	65.

SPECIES ANALYSES

STATION: 1 MT HOOD NF WASCO CO. RAMSEY CREEK DATE: 09 22 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				143.47	2.157	64.	138.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		444.75	2.648	21.	56.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		57.39	1.759	30.	53.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		86.08	1.935	21.	41.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRANDIS	57.39	1.759	24.	42.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	502.13	2.701	48.	130.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	28.69	1.458	2.	3.	
INSECTA	EPHEMEROPTERA	TRICORYTHIDAE	TRICORYTHODES		28.69	1.458	108.	157.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		487.79	2.688	24.	65.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		301.28	2.479	72.	178.	
INSECTA	PLECOPTERA				114.77	2.060	48.	99.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		28.69	1.458	48.	70.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		186.51	2.271	16.	36.	
INSECTA	PLECOPTERA	PERLODIDAE			14.35	1.157	48.	56.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		803.41	2.905	108.	314.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		57.39	1.759	18.	32.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		100.43	2.002	108.	216.	
INSECTA	COLEOPTERA	ELMIDAE			473.44	2.675	104.	278.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		43.04	1.634	24.	39.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		57.39	1.759	24.	42.	
INSECTA	DIPTERA	CHIRONOMIDAE			7202.03	3.857	108.	417.	
INSECTA	DIPTERA	CERATOPOGONIDAE			43.04	1.634	108.	176.	
CRUSTACEA	OSTRACODA				57.39	1.759	108.	190.	
OLIGOCHAETA					932.53	2.970	108.	321.	
ARACHNIDA	HYDRACARINA				702.99	2.847	98.	279.	
NEMATODA					14.35	1.157	108.	125.	
				TOTALS	12969.39	4.113			1.10

TOTAL SAMPLE STATISTICS

STATION: 2 MT HOOD NF RAMSEY CREEK (ABOVE JAM) DATE: 09 10 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	36	8676.	2318.	15034.	5839.17	38.86	67.30	3.6845	0.2874	49.	53.

SPECIES ANALYSES

STATION: 2 M T HOOD NF RAMSEY CREEK (ABOVE JAM) DATE: 091086

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X MEAN TQ	WT GM/SQM
INSECTA	EPHEMEROPTERA				7.17	0.856	64.	55.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		3.59	0.555	21.	12.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		821.35	2.915	30.	87.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRANDIS	3.59	0.555	24.	13.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	1309.13	3.117	48.	150.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	14.35	115.7	2.	2.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA	14.35	1.157	24.	28.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		71.73	1.856	24.	45.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		290.52	2.463	72.	177.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	200.85	2.303	24.	55.	
INSECTA	PLECOPTERA				290.52	2.463	48.	118.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			3.59	0.555	24.	13.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		14.35	1.157	12.	14.	
INSECTA	PLECOPTERA	CAPNIIDAE			312.04	2.494	32.	80.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		118.36	2.073	16.	33.	
INSECTA	PLECOPTERA	PERLIDAE	CALINEURIA	CALIFORNICA	3.59	0.555	24.	13.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		60.97	1.785	24.	43.	
INSECTA	PLECOPTERA	LEUCTRIDAE			28.69	1.458	18.	26.	
INSECTA	TRICHOPTERA				46.63	1.669	72.	120.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		28.69	1.458	18.	26.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		659.95	2.820	24.	68.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		78.91	1.897	18.	34.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		43.04	1.634	24.	39.	
INSECTA	COLEOPTERA	ELMIDAE			129.12	2.111	104.	220.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		885.91	2.947	24.	71.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		14.35	1.157	24.	28.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	36.	42.	
INSECTA	DIPTERA	CHIRONOMIDAE			2320.57	3.366	108.	363.	
INSECTA	DIPTERA	EMPIDIDAE			32.28	1.509	95.	143.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		182.92	2.262	36.	81.	
CRUSTACEA	OSTRACODA				43.04	1.634	108.	176.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		204.44	2.311	108.	250.	
OLIGOCHAETA					164.99	2.217	108.	239.	
ARACHNIDA	HYDRACARINA				93.25	1.970	98.	193.	
NEMATODA					121.95	2.086	108.	225.	
CRUSTACEA	COPEPODA				43.04	1.634	108.	176.	
				TOTALS	8676.15	3.938			0.70

TOTAL SAMPLE STATISTICS

STATION: 3 MT HOOD NF RAMSEY CREEK DATE: 09 10 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	ETQA	ET
* NUMBERS DATA											
3	39	14612.	9621.	19603	4583 78	18.11	31.37	3.8148	0.2783	56.	58

SPECIES ANALYSES

STATION: 3 MT HOOD NF RAMSEY CREEK DATE: 09 10 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		602.56	2.780	30.	83.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	GRANDIS	28.69	1.458	24	35.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	1032.96	3.014	48.	145.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	71.73	1.856	2.	4.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA	315.63	2.499	24.	60.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		43.04	1.634	24.	39.	
INSECTA	EPHEMEROPTERA	SIPHLONURIDAE	AMELETUS		28.69	1.458	48.	70.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		774.72	2.889	72.	208.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	1154.91	3.063	24.	74.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	14.35	1.157	24.	28.	
INSECTA	PLECOPTERA				272.59	2.436	48.	117.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			14.35	1.157	24.	28.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		43.04	1.634	18.	29.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		14.35	1.157	24.	28.	
INSECTA	PLECOPTERA	CAPNIIDAE			416.05	2.619	32.	84.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		430.40	2.634	16.	42.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		86.08	1.935	24.	46.	
INSECTA	PLECOPTERA	PERLIDAE			14.35	1.157	24.	28.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		14.35	1.157	108.	125.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	PARAPSYCHE		14.35	1.157	6.	7.	
INSECTA	TRICHOPTERA	LIMNEPHILIDAE			57.39	1.759	108.	190.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		1219.47	3.086	24.	74.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		100.43	2.002	18.	36.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		71.73	1.856	24.	45.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		28.69	1.458	108.	157.	
INSECTA	COLEOPTERA	ELMIDAE			473.44	2.675	104.	278.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		243.89	2.387	24.	57.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		14.35	1.157	24.	28.	
INSECTA	DIPTERA	SIMULIIDAE			14.35	1.157	108.	125.	
INSECTA	DIPTERA	CHIRONOMIDAE			4748.75	3.677	108.	397.	
INSECTA	DIPTERA	EMPIDIDAE			28.69	1.458	95.	138.	
INSECTA	DIPTERA	CERATOPOGONIDAE			43.04	1.634	108.	176.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		387.36	2.588	36.	93.	
CRUSTACEA	OSTRACODA				301.28	2.479	108.	268.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		559.52	2.748	108.	297.	
OLIGOCHAETA					373.01	2.572	108.	278.	
ARACHNIDA	HYDRACARINA				200.85	2.303	98.	226.	
NEMATODA					200.85	2.303	108.	249.	
CRUSTACEA	COPEPODA				157.81	2.198	108.	237.	
				TOTALS	14612.08	4.165			1.00

TOTAL SAMPLE STATISTICS

STATION: 1 MT HOOD NF WASCO CO. RAMSEY CREEK DATE 11 12 86

EPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
NUMBERS DATA											
3	26	21965.	-1387.	45316.	21445.17	56.37	97.63	2.1567	0.5418	60.	63.

SPECIES ANALYSES

STATION MT HOOD NF WASCO CO. RAMSEY CREEK DATE: 11 12 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	OG10 O/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		746.03	2.873	21.	60.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		215.20	2.333	30.	70.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		43.04	1.634	21.	34.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	344.32	2.537	48.	122.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		1549.44	3.190	24	77	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		1377.28	3.139	72.	226.	
INSECTA	PLECOPTERA				100.43	2.002	48.	96.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		86 08	1.935	18.	35.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		100.43	2.002	48.	96.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		28.69	1.458	12.	17.	
INSECTA	PLECOPTERA	CAPNIIDAE			14.35	1.157	32.	37.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	HYDROPSYCHE		114.77	2.060	108.	222.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		28.69	1.458	18.	26.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		14.35	1.157	24.	28.	
INSECTA	TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA		114.77	2.060	108.	222.	
INSECTA	COLEOPTERA	ELMIDAE			789.07	2.897	104.	301.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		401.71	2.604	24.	62.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		43.04	1.634	24.	39.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		14.35	1.157	36.	42.	
INSECTA	DIPTERA	SIMULIIDAE			14.35	1.157	108.	125.	
INSECTA	DIPTERA	CHIRONOMIDAE			14246.24	4.154	108.	449.	
INSECTA	DIPTERA	MUSCIDAE	LIMNOPHORA		57.39	1.759	108.	190.	
INSECTA	DIPTERA	CERATOPOGONIDAE			14.35	1.157	108.	125.	
OLIGOCHAETA					1133.39	3.054	108.	330.	
ARACHNIDA	HYDRACARINA				329.97	2.518	98.	247.	
CRUSTACEA	COPEPODA				43.04	1.634	108.	176.	
				TOTALS	21964.75	4.342			0.90

TOTAL SAMPLE STATISTICS

STATION: 2 M 1000 NF WASCO CO RAMSEY CREEK DATE: 11 04 86

REPL	TOTAL NO SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	41	5276.	1886	8666	3112.87	34 06	59.00	4.2346	0.2092	47.	52.

SPECIES ANALYSES

STATION: 2 MT HOOD NF WASCO CO. RAMSEY CREEK DATE: 11 04 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 X TQ	MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				7.17	0.856	64.	55.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		351.49	2.546	21.	53.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		552.35	2.742	30.	82.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	RHITHROGENA		10.76	1.032	21.	22.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	TNERVIS	209.03	2.319	48.	111.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	DODDSI	3.59	0.555	2.	1.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA	46.63	1.669	24.	40.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIDAE	PARALEPTOPHLEBIA		104.01	2.017	24.	48.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		365.84	2.563	72.	185.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	43.04	1.634	24.	39.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	3.59	0.555	24.	13.	
INSECTA	PLECOPTERA				14.35	1.157	48.	56.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			104.01	2.017	24.	48.	
INSECTA	PLECOPTERA	PERLODIDAE	MEGARCYS		3.59	0.555	24.	13.	
INSECTA	PLECOPTERA	PERLODIDAE	CULTUS		3.59	0.555	12.	7.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		186.51	2.271	48.	109.	
INSECTA	PLECOPTERA	CAPNIIDAE			175.75	2.245	32.	72.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		182.92	2.262	16.	36.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		50.21	1.701	24.	41.	
INSECTA	PLECOPTERA	LEUCTRIDAE			147.05	2.167	18.	39.	
INSECTA	PLECOPTERA	NEMOURIDAE	VISOKA		25.11	1.400	108.	151.	
INSECTA	PLECOPTERA	PERLIDAE			17.93	1.254	24.	30.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		10.76	1.032	18.	19.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	BRACHYCENTRUS		17.93	1.254	24.	30.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		157.81	2.198	24.	53.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		71.73	1.856	18.	33.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		3.59	0.555	24.	13.	
INSECTA	TRICHOPTERA	LEPIDOSTOMATIDAE			14.35	1.157	18.	21.	
INSECTA	COLEOPTERA	ELMIDAE			89.67	1.953	104.	203.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		132.71	2.123	24.	51.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		10.76	1.032	24.	25.	
INSECTA	DIPTERA	TIPULIDAE	HEXATOMA		28.69	1.458	36.	52.	
INSECTA	DIPTERA	SIMULIIDAE			50.21	1.701	108.	184.	
INSECTA	DIPTERA	CHIRONOMIDAE			1255.33	3.099	108.	335.	
INSECTA	DIPTERA	EMPIDIDAE			53.80	1.731	95.	164.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		46.63	1.669	36.	60.	
CRUSTACEA	OSTRACODA				172.16	2.236	108.	241.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		150.64	2.178	108.	235.	
OLIGOCHAETA					233.13	2.368	108.	256.	
ARACHNIDA	HYDRACARINA				60.97	1.785	98.	175.	
CRUSTACEA	COPEPODA				107.60	2.032	108.	219.	
				TOTALS	5275.99	3.722			0.70

TOTAL SAMPLE STATISTICS

STATION 3 MT HOOD NF WASCO CO. RAMSEY CREEK DATE: 11 04 86

REPL	TOTAL NO. SPECIES	MEAN /SQM	CONFIDENCE LIMITS (80 PERCENT) LL	UL	STANDARD DEVIATION	PERCENT SE OF MEAN	COEFF. OF VARIATION	DBAR	R	CTQA	CTQD
* NUMBERS DATA											
3	38	8038.	3844	12231	3850 98	27 66	47.91	4.0804	0.2234	52.	52.

SPECIES ANALYSES

STATION: 3 MT HOOD NF WASCO CO. RAMSEY CREEK DATE 11 04 86

CLASS	ORDER	FAMILY	GENUS	SPECIES	MEAN NO/SQM	LOG10 NO/SQM	TOLERANCE QUOTIENT	LOG10 TQ	X MEAN WT GM/SQM
INSECTA	EPHEMEROPTERA				7.17	0.856	64.	55.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	EPEORUS		215.20	2.333	21.	49.	
INSECTA	EPHEMEROPTERA	HEPTAGENIIDAE	CINYGMULA		487.79	2.688	30.	81.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	INERMIS	566.69	2.753	48.	132.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	SPINIFERA	86.08	1.935	24.	46.	
INSECTA	EPHEMEROPTERA	LEPTOPHLEBIIDAE	PARALEPTOPHLEBIA		57.39	1.759	24.	42.	
INSECTA	EPHEMEROPTERA	BAETIDAE	BAETIS		1083.17	3.035	72.	218.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HYSTRIX	64.56	1.810	24.	43.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	HETEROCAUDATA	28.69	1.458	24.	35.	
INSECTA	EPHEMEROPTERA	EPHEMERELLIDAE	EPHEMERELLA	MARGARITA	28.69	1.458	24.	35.	
INSECTA	PLECOPTERA				129.12	2.111	48.	101.	
INSECTA	PLECOPTERA	CHLOROPERLIDAE			86.08	1.935	24.	46.	
INSECTA	PLECOPTERA	PERLODIDAE	SKWALA		14.35	1.157	18.	21.	
INSECTA	PLECOPTERA	PERLODIDAE	ISOPERLA		3.59	0.555	48.	27.	
INSECTA	PLECOPTERA	TAENIOPTERYGIDAE	TAENIONEMA		566.69	2.753	48.	132.	
INSECTA	PLECOPTERA	CAPNIIDAE			86.08	1.935	32.	62.	
INSECTA	PLECOPTERA	NEMOURIDAE	ZAPADA		329.97	2.518	16.	40.	
INSECTA	PLECOPTERA	PERLIDAE	DORONURIA		14.35	1.157	18.	21.	
INSECTA	PLECOPTERA	PELTOPERLIDAE	YORAPERLA		57.39	1.759	24.	42.	
INSECTA	PLECOPTERA	LEUCTRIDAE			272.59	2.436	18.	44.	
INSECTA	PLECOPTERA	NEMOURIDAE	VISOKA		14.35	1.157	108.	125.	
INSECTA	TRICHOPTERA	HYDROPSYCHIDAE	ARCTOPSYCHE		50.21	1.701	18.	31.	
INSECTA	TRICHOPTERA	BRACHYCENTRIDAE	MICRASEMA		1090.35	3.038	24.	73.	
INSECTA	TRICHOPTERA	RHYACOPHILIDAE	RHYACOPHILA		86.08	1.935	18.	35.	
INSECTA	TRICHOPTERA	GLOSSOSOMATIDAE	GLOSSOSOMA		100.43	2.002	24.	48.	
INSECTA	COLEOPTERA	ELMIDAE			172.16	2.236	104.	233.	
INSECTA	DIPTERA	TIPULIDAE	ANTOCHA		129.12	2.111	24.	51.	
INSECTA	DIPTERA	TIPULIDAE	DICRANOTA		7.17	0.856	24.	21.	
INSECTA	DIPTERA	SIMULIIDAE			57.39	1.759	108.	190.	
INSECTA	DIPTERA	CHIRONOMIDAE			1463.36	3.165	108.	342.	
INSECTA	DIPTERA	EMPIDIDAE			43.04	1.634	95.	155.	
INSECTA	DIPTERA	PSYCHODIDAE	PERICOMA		71.73	1.856	36.	67.	
CRUSTACEA	OSTRACODA				43.04	1.634	108.	176.	
TURBELLARIA	TRICLADIDA	PLANARIIDAE	PLANARIA		186.51	2.271	108.	245.	
OLIGOCHAETA					150.64	2.178	108.	235.	
ARACHNIDA	HYDRACARINA				157.81	2.198	98.	215.	
NEMATODA					14.35	1.157	108.	125.	
CRUSTACEA	COPEPODA				14.35	1.157	108.	125.	
				TOTALS	8037.72	3.905			2.20

NOTES ON SAMPLING

On the computer printout sheets, with the heading "Total Sample Statistics," the percent standard error of mean values should be under 20. They provide an indication of whether the number of samples taken was adequate. The coefficient of variation values should be under 50. They indicate the correlation of samples, which reflects the efficiency of taking samples and elimination of variables. Elimination of the variables can be at least partially accomplished by trying to duplicate as closely as possible the depth, velocity, and substrate composition for each of the samples taken at a given station. A visual check of these values on the computer printouts indicates that more than three samples may be needed at some stations to get better correlations and that there may be a need for elimination of variables, if possible. Sometimes when a stream has severe impacts, it is nearly impossible to get good correlations, no matter what you do. For many of the samples, there was an indication that three samples were adequate and that there was good sampling technique.

APPENDIX F - SPAWNING SURVEY DATA

APPENDIX F--1

SPAWNING SURVEY DATA

FIFTEENMILE BASIN
FIFTEENMILE CREEK

1985

Date	Distance Surveyed	Water temp Air temp	* Visability	Flow	Weather	#Redds	#Adults	Comments
4/10	46.7-45.5							
4/16	43.4-43.7	41'F						
4/24	46.6-44.5, 43.3	41'F						redd 1 mile below USFS boundary at ditch diversion 47'F at Dufur
5/1	46.7-45.0							
5/16	46.7-44.8, 43.3							redds 1 mile below USFS boundary at ditch diversion

Note: no redds or fish were observed on Eightmile,Fivemile or Ramsey Creeks.

* KEY

Visability: 1=can see well into riffles
2=can see into riffles
3=can not see into riffles

Flow: L=low
M=moderate
H=high

Weather: C=clear
O=overcast
F=foggy
R=rain
S=snow

FIFTEENMILE BASIN
FIFTEENMILE CREEK

1986

Date	*Distance Surveyed	Water temp Air temp	Visability	Flow	Weather	#Redds	#Adults	Comments
4/9	43.3-44.3	4.0'C 11.0'C	1	M	0	1	1	fish seen 1/8 mi. above 4421 bridge 14.0' at mouth
4/11	44.3-45.3	3.0'C 8.0'C	1	M	0			mostly cobble substrate, with some good gravel patches
4/16	43.3-44.3	4.0'C 6.5'C	1	M	O		1	resident trout seen throughout, adult in same area as on 4/9
4/24	43.3-45.3	3.5'C 9.0'C	1	M	O			redds distributed evenly in reach
	below boundary					8	6	
	above boundary					3	5	most fish bright, on or digging redds
4/29	44.3-45.8	39.0'F 46.0'F			O-C	16	2	

*USFS boundary is at RM 43.3

EIGHTMILE CREEK**

4/14	24-0-25.5	4.0'C 11.0'C	1	M	C			good gravel, resident fish obsvd.
4/23	23-0-24.5		1	M	C		1	large beaver da-. @½ mile below boundary, appears to be a barrier, redd seen below dam, fish seen @ 1 mile below boundary

**USFS boundary at RM 24.0

FIFTEENMILE BASIN
RAMSEY CREEK

1986

Date	Distance Surveyed	Water temp Air temp	Visability	Flow	Weather	#Redds	#Adults	Comments
4/16	7.5-8.4	3.5'C 7.0'C	2	L-M	R			very little wood or gravel in channel,resident fish throughout
4/21	7.5-8.-	7.0'C 18.0'C	1	M	C			

FIVEMILE CREEK

4/10	18.2-18.4 S.Fk 0.0-0.4 M.Fk 0.0-0.2	3.0'C 8.0'C	2	M	C			water milky in color, S.Fk.often without defined channel
4/18	18.2-18.4 S.Fk 0.0-0.2 M.Fk.0.0-0.2							

FIFTEENMILE BASIN HABITAT ENHANCEMENT PROJECT

1986

Annual Report

BY

Roger C. Smith, Project Leader

and

Greg W. Short, Field Assistant

Funded By

Bonneville Power Administration

Division of Fish and Wildlife

Kathy Anderson, Project Manager

Administered through

Dave Heller, Project Manager

Mt. Hood National Forest

Contract No. DE-AI79-84BP16726

Table of Contents

Figures and Tables 267

Abstract 268

Acknowledgements 269

Introduction 270

Description of Study Area 271

Methods 273

Summary of Results 275

Objective One – Collection of physical information for identification of limiting factors 275

Objective Two – Collection of baseline biological information 277

Objective Three – Formulation of habitat enhancement basin plan 277

Discussion 277

Literature Cited 279

Appendix A 280

Appendix B 285

Appendix C 305

Appendix D 324

Figures and Tables

Fifteenmile Creek Basin Map 272

Data Pod and Flow Station Locations 274

Macroinvertebrate Sample Stations 276

Historical Anadromous Production/Distribution 281

Current Anadromous Production/Distribution 282

Historical and Present Steelhead Habitat 283

Estimated Adult Steelhead Escapement Based on Rearing and Spawning-Based Smolt Production 284

General Stream Survey Format (STEP) 288

Fifteenmile Creek Basin Stream Survey Summary 289

Fifteenmile Creek Basin Erosion Index 295

Fifteenmile Creek Basin Barriers 299

Fifteenmile Creek Water Temperature Data, 1986 304

Baseline Biological Data Collection Schedule 309

Data Pod Information, Summer/Fall 1986 310

Fifteenmile Creek Basin Flow Data, 1986 311

Sample Watershed Photo Point Sheet 321

Insect Station Description, 1986 322

Sample Macroinvertebrate Analysis Physical Habitat and Chemical Data Sheet 323

Budget Expenditures, 1986 325

ABSTRACT

A physical stream survey of the Fifteenmile Creek Basin was conducted to determine limiting factors to wild winter steelhead production. These factors were found to be, upstream and downstream passage problems, the lack of suitable rearing habitat, lethal water temperatures, low summertime flows and poor water quality due to high silt input.

Baseline biological data was collected to assess the effectiveness of fish habitat enhancement activities. Data collected includes, water temperature monitoring, flow monitoring and macroinvertebrate collection.

The initial phase of the project (Phase I) was to document existing basin deficiencies for winter steelhead production and to provide a management plan to address the solutions to these problems.

ACKNOWLEDGEMENTS

This Study was funded by the Bonneville Power Administration.

Assistance was provided by many different individuals and agencies during the initial phase of the Enhancement Project. A special thanks to Jim Newton, Steve Pribyl and Tim Unterwegner of the Oregon Department of Fish and Wildlife; Dave Heller, Ken MacDonald, Harv Forsgren and Rick Ragan of the Mt. Hood National Forest, and to Greg Short who endured temperatures from 110° to 20° while conducting the stream survey.

INTRODUCTION

The Fifteenmile Creek Basin currently supports the eastern-moat naturally reproducing winter steelhead population in the Columbia River Basin. The winter steelhead run contributes to a sport trout fishery in the Fifteenmile Creek Basin and to the Treaty Indian harvest in the Columbia River.

The current winter steelhead population is depressed over historic values. An estimated 200 escaping adults returned to the system in 1985 while the basin has the potential to maintain an estimated spawner escapement of 752 adult winter steelhead (U.S. vs. Oregon subbasin capacity report). Steelhead production in Fifteenmile Creek is limited by passage problems at Bonneville Dam on the mainstem Columbia and by habitat problems within the Fifteenmile Creek Basin.

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501) was adopted to set up a regional Electric Power and Conservation Plan. The Northwest Power Planning Council administers the plan and responsibilities include the development of a program to enhance and protect fish and wildlife, and to mitigate for losses attributable to operation of hydro-electric facilities on the Columbia River.

The Fifteenmile Creek Basin was selected as a mitigation site for winter steelhead habitat enhancement. A cooperative effort between the US Forest Service and the Oregon Department of Fish and Wildlife has been undertaken to enhance winter steelhead habitat to optimum conditions, within the constraints of current land use. The US Forest Service will work primarily on public lands while the Oregon Department of Fish and Wildlife performs enhancement activities on private lands.

Goals of the Fifteenmile Basin Project include:

(1) Provide unobstructed passage for adult and juvenile steelhead to allow for full utilization and production from all potential habitat.

(2) Provide in-stream water quality conditions suitable for rearing steelhead throughout all areas of the basin.

(3) Increase the amount and quality of spawning and rearing habitat commensurate with the potential of individual streamsor stream reaches.

(4) Monitor physical changes in treatment areas to evaluate the success of habitat improvement efforts.

DESCRIPTION OF STUDY AREA

The Fifteenmile Creek Basin is located in north central Oregon (Figure 1). Headwaters of the system originate on the east slope of Mt. Hood and flow in a northeasterly direction for 35 miles to Emerson. Below Emerson, the creek changes direction and flows northwesterly to its confluence with the Columbia River directly downstream of The Dalles Dam.

Fifteenmile Creek and its major tributaries, which include Eightmile Creek, Fivemile Creek and Ramsey Creek, have their headwaters located on the Mt. Hood National Forest. These streams flow from National Forest lands downstream through private lands before emptying into the Columbia River.

Primary use of private lands in the drainage basin is agricultural, of which grain, livestock and hay production constitute the majority. The Fifteenmile Creek watershed has been exposed to 2 one-hundred year magnitude floods in the last 50 years. Stream channels have been modified to attempt to correct for damage that was caused during these high water events. Stream channels (Fifteenmile, Eightmile, Fivemile and Ramsey Cr.) were straightened or channelized and moved to a more agriculturally suitable location. This resulted in a modified unstable stream channel, devoid of habitat diversity, with a decreased ability to produce winter steelhead.

After the flood of 1974, habitat enhancement work was conducted by the Soil Conservation Service with input from the Oregon Department of Fish and Wildlife. This work primarily was conducted for bank stabilization purposes, but contributed very positively to winter steelhead habitat enhancement. Methods used for bank stabilization and habitat enhancement were the addition of rock drop structures, revetments and riparian fencing. Ten miles of stream were treated in 1975 at an approximate cost of $350,000. Today these treated areas are characterized by generally stable banks and good riparian vegetation, which contributes to both insect production and reduced water temperatures through shading. Current densities of juvenile salmonid populations within the treated areas are approximately nine times greater than those occurring in untreated areas, Newton (personal communication, 1987)

Additional measures have recently been enacted to increase escapement into the system. In 1984, the ODFW Salmon and Trout Enhancement Program (STEP) constructed a fish ladder at Seufert Falls to facilitate upstream passage of returning adult steelhead. In 1986, the Seufert Falls fish ladder was modified to increase the range of flows that returning adult steelhead could negotiate.

Concurrently, the US Forest Service has been providing access to suitable spawning grounds through the removal and modification of culverts that are causing delays in passage. In addition, the US Forest Service has been providing improved rearing areas for increased smolt production on the National Forest. The Confederated Tribes of the Warm Springs voluntarily suspended the dipnet fishery at Seufert Falls to allow the steelhead run to rebuild. These measures, combined with restricted fishing regulations, improved

MAJOR TRIBUTARIES- FIFTEENMILE CREEK BASIN

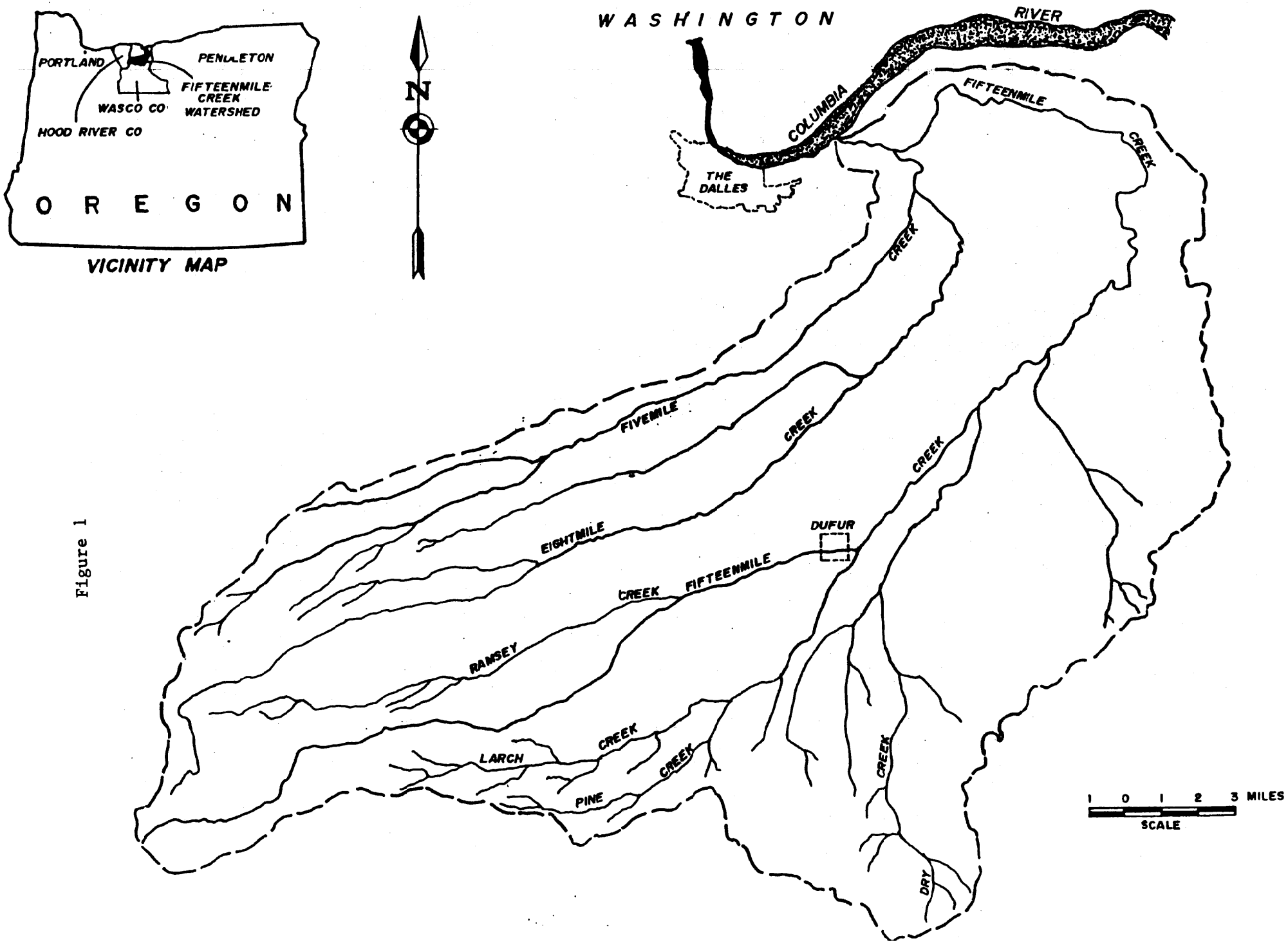


Figure 1

passage at Bonneville Dam, and an improved Columbia River water budget, have increased the number of returning winter steelhead to the system. Through habitat improvement efforts conducted within the Fifteenmile Basin, the current steelhead population may again reach historic values by providing increased production of nut-migrating juveniles.

The project is planned to be initiated in the FY 87 to FY 91 time frame. Cooperators include: Bonneville Power Administration, Oregon Department of Fish and Wildlife (ODFW), US Forest Service, Confederated Tribes of the Warm Spring (CTWS), the US Soil Conservation Service and the Wasco County Soil and Water Conservation District.

The initial phase (Phase I) proposed for FY 86 consisted of activities that will facilitate a subbasin fish habitat enhancement plan to be used for future enhancement activities.

Objectives to be completed under Phase I of FY 86 Work Statement include:

I. Collect physical information for identification of factors Limiting steelhead production in the Fifteenmile Creek Basin.

II. Collect baseline biological information to be used in assessment of enhancement activities.

III. After collection of physical and biological information formulate a Habitat Enhancement Basin Plan for BPA, ODFW, USFS, CTWS, SCS and SWCD review.

METHODS

Stream Survey

A physical stream survey was conducted on streams located in the Fifteennile Creek Basin to determine the physical factors limiting winter steelhead production. A modified version of the ODFW Salmon and Trout Enhancement Program (STEP) stream survey was used. Modifications to the STEP survey were made to emphasize the physical condition of the stream and adjacent riparian zone. See Appendix B for specific methodology.

Baseline Biological Monitoring

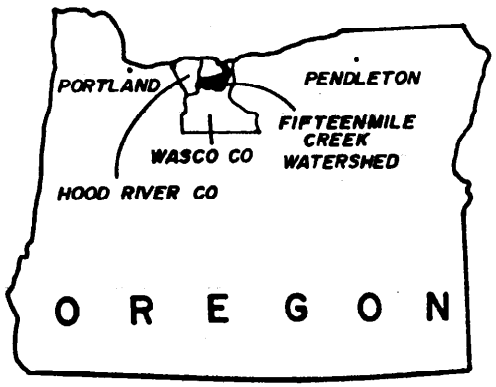
Water temperature was monitored on Fifteenmile, Eightmile, and Ramsey Creeks for the period 5 September through 24 October, 1986. Water and air temperatures were recorded with Data Pod digital recording devices Located at RM 4.5 and RM 30.5 Fifteenmile Creek, RM 11.5 Eightmile Creek, and RM 2.0 Ramsey Creek (Figure 2).

Stream discharge (flow) was monitored using a Marsh McBirney current meter and top-setting wading rod. Flows were calculated at ten sites including the mouths of Fifteenmile Creek, Eightmile Creek and Dry Creek.

Macroinvertebrate samples were collected to be used as indicators of habitat deficiencies and habitat recovery. Samples were collected at RM 0.25, RM 20.5, RM 30.5 and RM 40.0 on Fifteenmile Creek, RM 2.0

Figure 2

MAJOR TRIBUTARIES- FIFTEENMILE CREEK BASIN



VICINITY MAP

Data Pod Stations - (W)

Flow Stations - (F)

Major Landmarks - ●

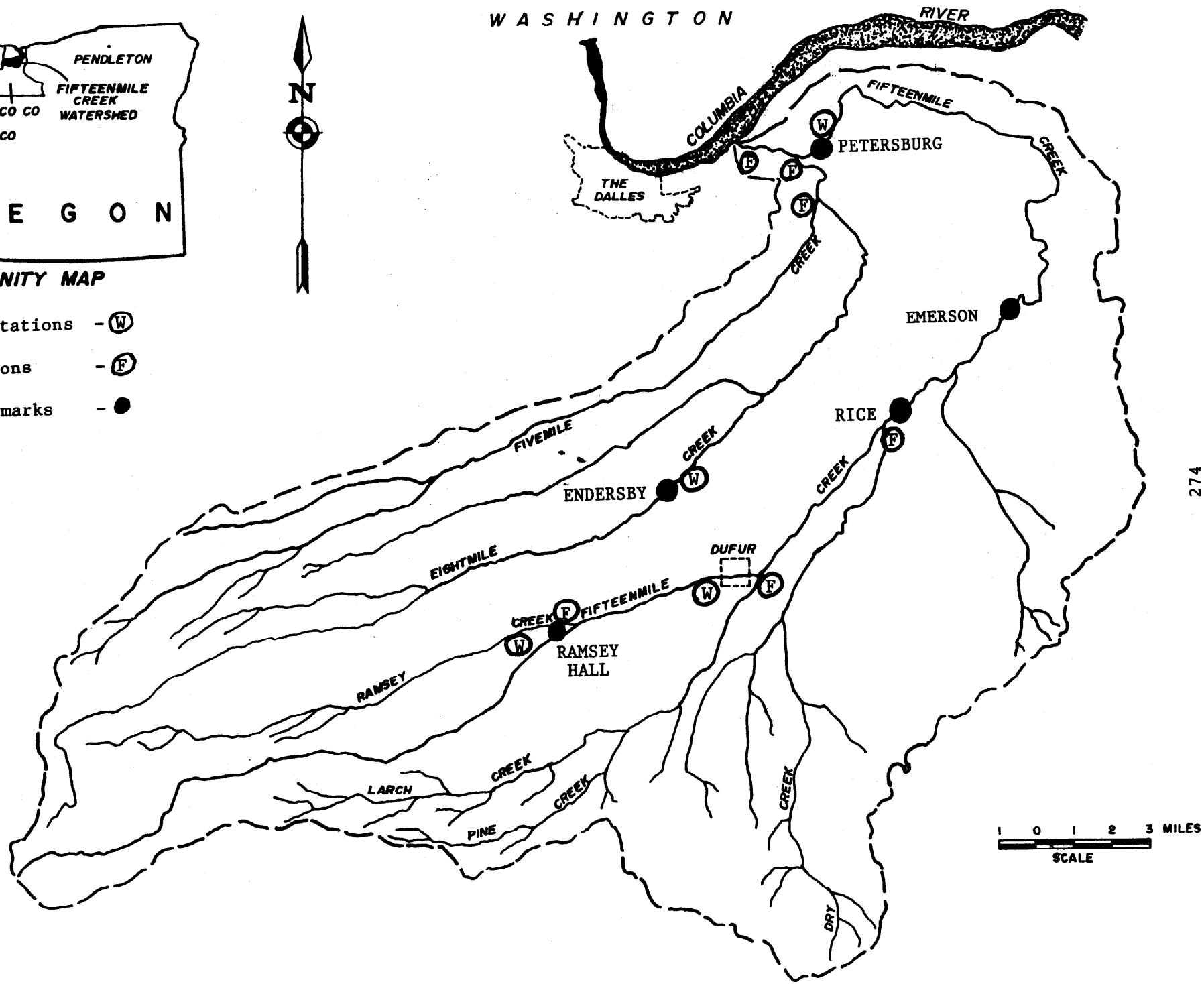


Figure 2

on Ramsey Creek, RM 0 and RM 7.5 on Eightmile Creek, RM 3.0 on Fivemile Creek, Rm 0 on Dry Creek, and RM 0 on May's Canyon Creek (Figure 3). Appendix C contains the baseline biological data collection schedule, specific methodology used in collecting baseline biological data, location and description of sample sites, flow calculations, stream survey temperature data, sample physical and chemical data sheet, and sample photo point data sheet.

SUMMARY OF RESULTS

Objective I - Collection of physical information for identification of limiting factors.

A total of 125 miles on ten stream systems in the Fifteenmile drainage were surveyed and are assessed (Table B-2, Appendix). Physical factors limiting winter steelhead production were determined to be:

1 - Passage problems

2 - Lack of habitat diversity

3 - Siltation

4 - High summer water temperatures

5 - Low summer flows

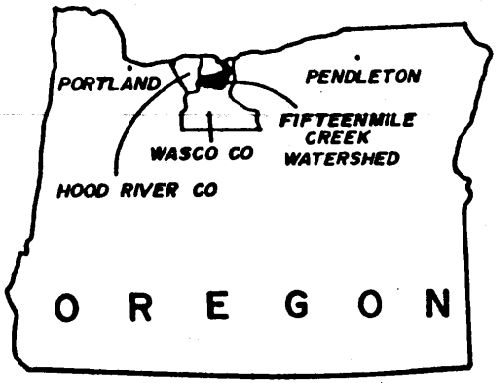
Several barriers exist in the basin that impede upstream adult migration and/or downstream smolt migration (Table B-4, Appendix). Delays at both man-made and natural obstructions have resulted in underseeding and a lack of access to all available spawning habitat. These delays also increase the probability of mortality of both adults and juveniles migrating within the system. Juvenile steelhead are exposed to direct mortality through unscreened irrigation diversions and by irrigation dams preventing seasonal migration to avoid lethal summer water temperatures.

A lack of habitat diversity is also limiting steelhead production by not providing the quantity (40-50% pool) and quality of pools for optimum steelhead production (Table B-2, Appendix). Past agricultural activities (channelization, cultivation, grazing, etc.) have created a riffle dominated system with little habitat diversity or overhead (escape) cover.

Water quality has been greatly reduced through sedimentation caused by bank as well as upland erosion (Table B-3, Appenix). Poor gravel conditions (siltation and compaction) have undoubtedly reduced spawning success and macroinvertebrate diversity. Of the 40,210 m^2 available gravel on mainstem Fifteenmile creek, it is estimated that only 12,000 m^2 is currently suitable for salmonid spawning. Maximum summer water temperatures currently exceed the lethal limit for salmonids in the lower reaches of the basin. Information from the continous recording Data Pods is not available as of this writing. However, water temperatures were recorded while conducting the stream survey. A hand-held thermometer was used to record water temperature at the beginning of each survey reach. A temperature of 85" F was recorded on lower Fifteenmile Creek on August 6, 1986 (Table B-5, Appendix). The preferred water

Figure 3

MAJOR TRIBUTARIES- FIFTEENMILE CREEK BASIN



VICINITY MAP

Macroinvertebrate sample stations- Ⓜ

Major landmarks - ●

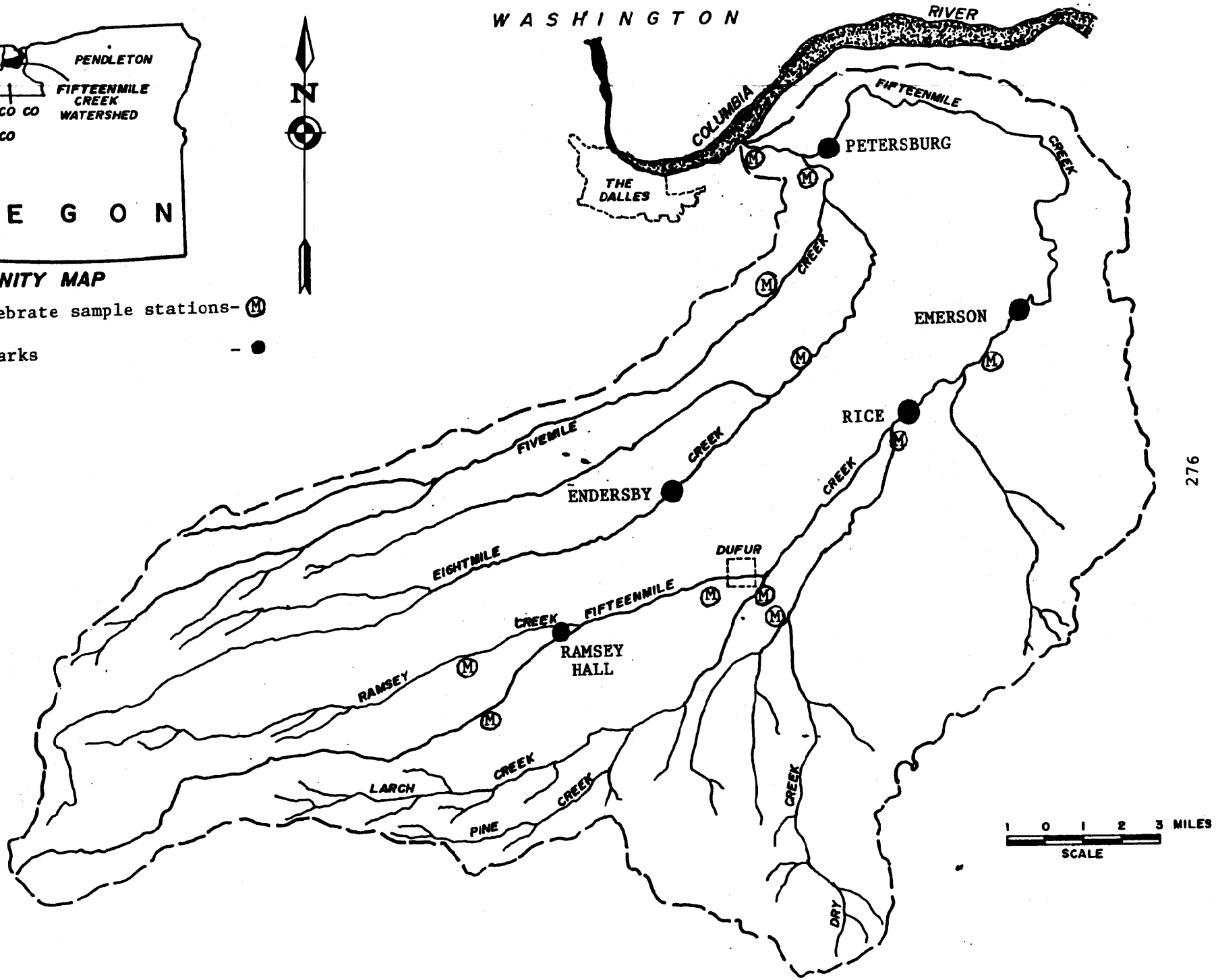


Figure 3

temperature for most salmonids is below 19° C (66° F) and the 7-day upper lethal limit for rainbow trout is 25° C (77° F) (Cherry, 1977).

Low summertime flows are limiting steelhead production by reducing rearing area and contributing to high water temperatures. Low flows also limit macroinvertebrate abundance and diversity.

Objective II - Collection of baseline biological information

The baseline temperature data for the 1986 field season is not available at this writing. Results will be tabulated upon retrieval from the Datapod Data Storage Modules. Temperatures recorded during the stream survey have been tabulated and are included in Appendix B.

Flow monitoring results for the 1986 field season are also included in Appendix C.

To date, the results of macroinvertebrate sampling are not available. Information will be distributed once the analysis has been returned from the Utah laboratory.

Objective III - Formulation of habitat enhancement basin plan

A cooperative effort between the Oregon Department of Fish and Wildlife, the US Forest Service, the Confederated Tribes of the Warm Springs, the Soil Conservation Service and the Wasco County Soil and Water Conservation District has been undertaken to rehabilitate the remnant Fifteenmile Basin stock of wild winter steelhead. The goal of the project is to provide the most immediate and substantial increase to the wild winter steelhead population through habitat improvement. A basin implementation plan has been drafted to address existing problems throughout the basin and to formulate strategies for solving these problems. The goal of the plan is to identify existing habitat problems, solutions, goals and objectives, priorities, project costs, and associated benefits. An attempt will also be made to protect the habitat investment over the long term, within the constraints of current land use practices.

The Basin plan incorporates all physical and biological information available at this time and is currently in draft form.

DISCUSSION

Winter steelhead production has been limited through man's current and past activities. The lands surrounding the drainage basin have been put into agricultural production with little to no effort given for watershed or fisheries management. The watershed's water and soil retention capacities have been greatly reduced through the cultivation of crops with shallow root systems, the destruction of upland vegetative buffers and the removal of riparian vegetation.

These changes in the watershed have greatly increased the ability of the stream system to create new channels through agricultural

areas. Solutions to the problem in the past were to remove any remnant riparian vegetation and to straighten or channelize the system. This "solution" intensified both thestreams ability to destroy croplands and the streams inability to produce wild winter steelhead.

The remnant run of winter steelhead will greatly benefit from enhancement efforts in the basin. Enhancement efforts must be done through tested and acceptable means. To solve the problems of lack of habitat diversity and poor riparian vegetation, both instream structures and fencing must be used. Instream structures will provide habitat diversity and create pools, while riparian fencing will reduce water temperature through shading, reduce silt and sediment loading, and provide channel stability by creating a vegetative buffer.

Passage improvement will immediately benefit the basin by allowing all available reaches to be seeded and by eliminating direct losses caused by delays and diversions.

Literature Cited

Cherry, D.S., K.L. Dickson, J. Cairns Jr., and J.R. Stauffer. 1977. Peferred, avoided, and lethal temperatures of fish during rising temperature conditions. J. Fish. Res. Board Can. 34: 239-246

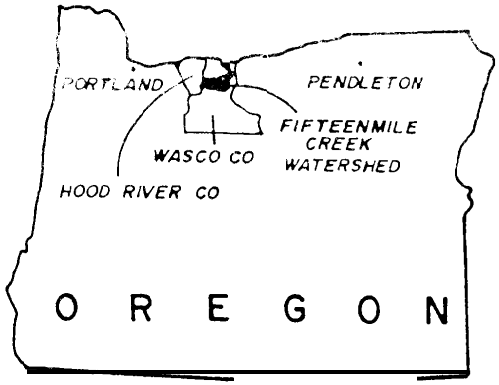
Newton, J.A. 1987. Personal Communication

Wheeler, C.L. 1975. Fifteenmile Creek Watershed preliminary report. Page 3-4.

APPENDIX A

HISTORICAL AND PRESENT WINTER STEELHEAD DISTRIBUTION AND HABITAT

MAJOR TRIBUTARIES - FIFTEENMILE CREEK BASIN

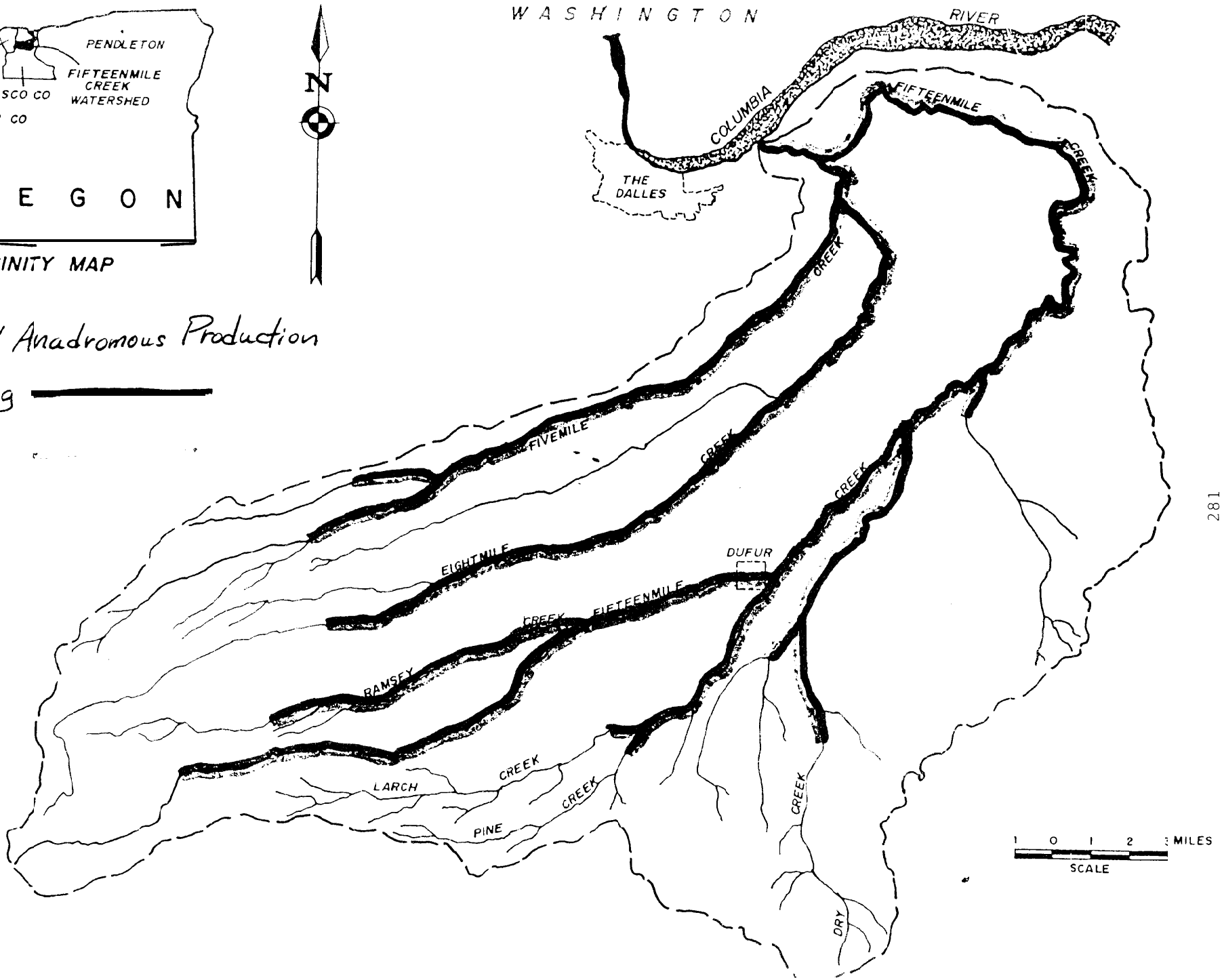


VICINITY MAP

Historical Anadromous Production

Spawning

Rearing



MAJOR TRIBUTARIES- FIFTEENMILE CREEK BASIN

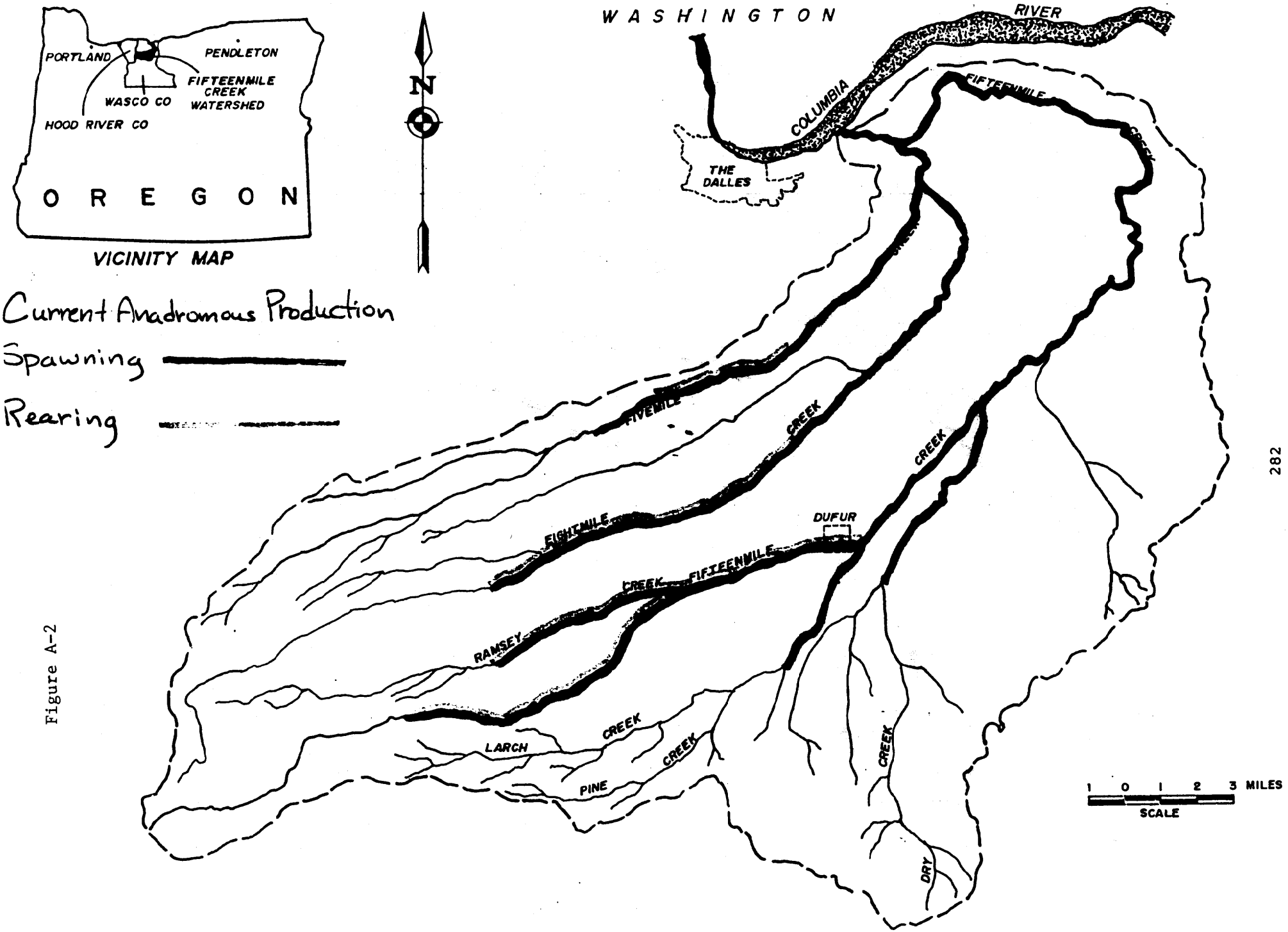


Figure A-2

Table A-3

Historical and Present Steelhead Habitat

Creek	Historical Spawning(mi.)	Current Spawning(mi.)	Historical Rearing(mi.)	Current Rearing(mi.)
Fifteenmile	50.0	46.0	50.0	20.0
Eightmile	31.0	24.5	31.0	14.5
Fivemile	19.0	12.0	19.0	4.0
Ramsey	10.0	6.0	10.0	6.0
Dry	12.0	1.0	10.0	0
May's Canyon	2.0	0	0	0
Pine	7.0	2.0	5.0	0
Larch		0		0
Total	131 miles	91.5 miles	125 miles	44.5 miles

Current spawning is 70% of the historic values

Current rearing is 36% of the historic values

Table A-4

Estimated Adult Steelhead Escapement based on rearing and spawning-based smolt production.

Average Spawning-based smolt production X =	104,202, (97,028 - 111.375)
Smolt to Adult Survival	.07
Total Returning Adults	7,294 *
Average rearing-based smolt production	18,344
Smolt to Adult Survival	.07
Total Returning Adults	1,284 *

* These figures do not reflect mortalities of fry due to unscreened diversions and irrigation dams within the Fifteenmile Watershed. These problems, combined with historical passage problems at Bonneville Dam and water quality are responsible for the current under seeded escapement of 250 adults.

APPENDIX B

STREAM SURVEY METHODOLOGY, SUMMARY, EROSION INDEX, LIST OF BARRIERS, AND TEMPERATURE DATA

Stream Survey

Approximately 145 miles of stream exist in the Fifteenmile Basin Project Area. These streams include Fifteenmile Creek, Eightmile Creek, Fivemile Creek, Ramsey Creek, Dry Creek, May's Canyon Creek, Pine Creek, Larch Creek, and several smaller tributaries. To date, stream survey work has been completed on the private segments of the above streams, for a total of 125 river miles.

Methods

The stream survey method used was a modified version of the Salmon and Trout Enhancement Program (STEP) survey. Our method was modified to emphasize riparian zone condition, degree of erosion, degree of grazing, and location of existing fence and buffer zones along cultivated fields. Modifications to the STEP survey were made because project streams flow through agricultual lands intensely managed for wheat, alfalfa,and livestock.

All survey work began at the mouth of the stream (River Mile = RM 0) and proceeded upstream in one-quarter mile reaches. One-half mile reaches were sometimes used in the headwaters or smaller streams with little habitat diversity. A belt chain distance meter was worn by the surveyor to accurately measure distance (yds) and quanitfy spawning gravel. On average, one and one half to two miles were surveved per day (6-8 reaches).

At the beginning of each reach, air and water temperatures were recorded and the time of day noted in the survey fieldbook (Fig. B-1). Active and bank-full channel widths were then measured and recorded. A Clinometer was used to measure stream slope (%). When possible, landmarks were used to identify starting and ending points, otherwise colored flagging was used. The thread from the belt chair: was secured to an object and the surveyor proceeded upstream, noting landmarks, barriers, pump stations, erosion points, fencing, land use practices and amount and quality of spawning gravel.

Spawning gravel was quantified using the belt chain. Whenever a significant patch of suitable spawning gravel was encountered, the length was measured in yards. Average width in yards was visually estimated by the surveyor. Length of gravel multiplied by average width of gravel yields the area of spawning gravel in square yards (yds^2). This amount was then recorded in a field notebook and at the end of the reach all entries were summed to yield the total square yards of spawning gravel per reach.

The remaining information in the survey fieldbook (substrate type, % pool, % shade, streamside cover type, erosion, barriers, instream structure, profiles, pollution sources, land use, water clarity, water withdrawal, and relative fish abundance) was then filled out according to the notes taken in the field notebook and the surveyor's overall perception of the reach. (This survey method

is therefore qualitative and would vary somewhat between different surveyors.) However, stream survey work or: this project was conducted by a single surveyor and therefore provides consistent data for all streams surveyed.

Information recorded under "additional comments" in the stream survey fieldbook contains a general summary of the reach. This includes quantity of gravel (yds^2), riparian condition/shade, degree of erosion, grazing intensity, land use, general substrate type and stream characteristics, and presence or absence of fencing. Any unusual or extra information was recorded in the field notebooks and referred to in the stream survey fieldbooks.

Stream survey data has been summarized for each stream and is shown on Table B-2. For management purposes, each stream was divided into several management reaches of similar size and habitat type, using major landmarks.

An erosion index was formulated to determine the relative degree of erosion for each management reach (Table B-3).

A list of barriers (partial and complete) has been compiled for the entire Fifteenmile Basin (Table B-4).

Temperature data collected during the stream survey has also been tabulated for Fifteenmile Creek and is shown on Table B-5. Because of the many variables affecting this data it is only useful as a general reference. It is interesting to note, however, the August 6, 1986 Fifteenmile Creek water temperature taken at 2:00 PM was 85° F.

Figure B-1

GENERAL STREAM SURVEY

PART A.

Stream _____ River System _____

County _____ Surveyors _____

Date _____ Stream mouth location: TWP____ R____ Sec____

Survey Data:

Survey Section: River mile___ to River mile___ Total length___ miles

Landmarks: Starting point_____ Ending point_____

Stream width_____ Ft. today_____ Ft. at high water line.

Air temp____°F Water temp.____°F

Flow: Avg. width_____ft. Avg. depth_____ft.

Feet/sec. velocity_____ Time of day _____am _____pm

Bottom type: Rough (0.8)_____ Smooth (0.9)_____

Calculate CFS (W × D × V × bottom factor) = _____

Substrate type, by percentage:

_____% Boulder (3'+) _____% Cobble (6"–3') _____% Gravel (1"–6")

_____% Sand (1"–) _____% Bedrock

Percentage of section in pools:

0	10	20	30	40	50	60	70	80	90	100

Percentage of section shaded:

0	10	20	30	40	50	60	70	80	90	100

Streamside cover type:

Type	Abundant	Moderate	Sparse
Conifer Trees			
Deciduous Trees			
Grass and/or shrubs			

Erosion Points: Severe_____ Loc. Rm_____ : Moderate_____

Loc. Rm_____ : Slight _____ Loc. Rm_____

Barriers:

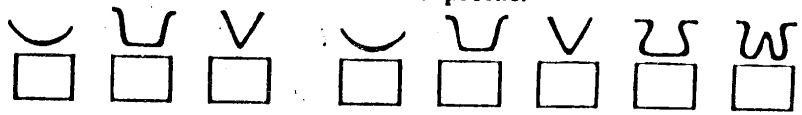
Type	Height (ft.)	Location (rm)
Dam		
Falls		
Culvert		
Log Jam		

Instream Structure (woody debris):

Type	Abundant	Moderate	Sparse	None
Logs				
Root Wads				
Limbs				
Brush				

PART B.

Valley profile: Channel profile:



Pollution Sources: Silt_____ Sewage_____ Industrial_____

Animal waste_____ Irrigation return_____ Other_____

Gradient: Flat_____ Moderate_____ Steep_____

Surrounding land use: Forest_____ Agric_____ Range_____

Suburban_____

Water Clarity: Less than 1'_____ Between 1' and 3'_____

Over 3'_____

Water Withdrawal: Location, Rm_____ Type: Ditch_____

Size_____ Pump_____ Size_____ Screened? Yes_____

No_____ Unknown_____

Relative Fish Abundance:

Species	SIZE (inches)	NUMBER/100 FEET 0-5	6-50	50+	METHOD OF OBSERVATION Visual	In Hand
Chinook						
Coho						
Steelhead						
Rainbow						
Cutthroat						
Other						

Additional Comments: _____

Table B-2

Fifteenmile Creek Stream Survey Summary, 1986

Reach	Gradient	% Pool Habitat	% Shade	Gravel*
1.) RM Ø to RM 3.2 Mouth to Petersburg bridge crossing	2.3%	41.3	29.2	3,971 yds^2
2.) RM 3.2 to Rm 8.8 Petersburg bridge crossing to Company Hollow Rd. bridge crossing at Fairbanks	1.1%	41.8	19 3	Data not available
3.) RM 8.8 to RM 13.1 Company Hollow Rd. bridge crossing to Fifteenmile Rd. bridge crossing above Fulton Canyon	1.0%	61.4	3 3	Data not available
4.) RM 13.1 to RM 20.1 Fifteenmile Rd. bridge crossing above Fulton Canyon to Wrentham crossing	1.3%	39.5	5.6	Data not available
5.) RM 20.1 to 23.5 Wrentham crossing to Fax Rd. bridge crossing at Rice.	1.0	51.1	18.2	15,055 yds^2
6.) RM 23.5 to RM 27 Fax Rd. bridge crossing at Rice to Boyd bridge crossing.	1.2%	29.4	40.5	7,490 yds^2
7.) RM 27 to RM 30.7 Boyd bridge crossing to route #44 bridge crossing at Dufur.	1.2%	24.5	29 8	7,055 yds^2

* [illegible] available

Table B-2 cont.

Fifteenmile Creek Stream Survey Summary, 1986 (cont.)

Rea	d	%	H itat	% Shade	Gravel*
8.) RM 30.7 to RM 36.2 Route #44 bridge crossing at Dufur to route #44 bridge crossing below Ramsey Hall.	2.2%		9 4	16 0	10,655 yds^2
9) RM 36.2 to RM 39.8 Route #44 bridge crossing below Ramsey Hall to Taylor Grade bridge crossing.	3.1%		14.3	48.6	2,180 yds^2
10.) RM 39.8 to RM 43.6 Taylor Grade bridge crossing to Forest Boundary.	2.9%		7.6	55.6	1,645 yds^2

* Conservative estimate of gravel

Table B-2 cont.

Table B-2 cont.

Ramsey Creek Stream Survey Summary, 1986

Reach	Gradient	% Pool Habitat	% Shade	Spawning Gravel *
RM 0 to RM 8				
Mouth to Forest Boundary	3.0%	7 8	49 4	1,779 yds^2

* Conservative estimate of spawning gravel

Table B-2 cont.

Table B-2 cont

Eightmile Creek Stream Survey Summary, 1986

Reach	Gradient	% Pool Habitat	% Shade	Gravel*
1.) RM 0 to RM 6.75 Mouth to Eightmile Rd. bridge crossing below U.S. Hwy 197	1.8%	16.4	47.8	740 yds^2
2.) RM 6.75 to RM 12.75 Eightmile Rd. bridge crossing below US Hwy 197 to Endersby bridge crossing	1.7%	19.6	36.2	1850 yds^2
3.) RM 12.75 to RM 19.5 Endersby bridge crossing to Walton Grade, Eightmile Rd. diverges from creek.	2.4%	11.1	44	630 yds^2
4.) RM 19.5 to RM 25.5 Walton Grade where Eightmile Rd. diverges from creek to forest boundary.	3.1%	7.4	37.1	339 yds^2

* Conservative estimate of gravel

Table B-2 cont.

Fivemile Creek Stream Survey Summary, 1986-87

Reach	Gradient	% Pool Habitat	% Shade	Gravel*
1.) RM Ø to RM 2.5 Mouth to U. S. Hwy 197 crossing	1.85%	8.4	14.8	1,198 yds^2
2.) RM 2.5 to RM 5.25 U.S. Hwy 197 crossing to just below the Orville Thompson Ranch	2.5%	15.1	28.0	698 yds^2
3.) RM 5.25 to RM 8.75 Just below Orville Thompson Ranch to first bridge crossing above Pleasant Ridge Road junction.	2.0%	11.8	35.0	980 yds^2
4.) RM 8.75 to RM 12.0 First bridge crossing above Pleasant Ridge Road junction to the third bridge crossing.	2.25%	16.1	47 5	215 yds^2

* Conservative estimate of gravel

Dry Creek, May's Canyon Creek, Pine Creek and Larch

Stream Survey Summary, 1986

Reach	Gradient	% Pool Habitat	% Shade	Gravel *
Dry Creek				
1.) RM 0 to RM 2 Mouth to fence crossing	1.5%	5.8	1.0	1,740 yds^2
2.) RM 3 to RM 7	1.6%	4 8	2 8	6,175 yds^2
May's Canyon Creek				
1.) RM 0 to 2.5 Mouth to US Hwy 197 crossing	1.4%	4.6	4.2	Very little suitable spawning gravel
2.) RM 2.5 to RM 4.5 US Hwy 197 crossing to bridge crossing	1.6%	8.3	15.0	250 yds^2
Pine Creek				
1.) RM 0 to 6.5 Mouth to Approximately 1 mile above confluence fo Larch Creek	10.1%	12.6	2.4	Very little suitable spawning gravel, extremel silty angular, compacted substrate, poor fish habitat.
Larch Creek				
1.) Rm 0 to 3.5 Mouth to Larry Wolf Ranch			2.7	Very little suitable spawning gravel, extremel silty for this high in th system, angular, compacte substate. Poor fish habitat.

* Conservative estimate of gravel

Table B-2 cont.

Table B-3

EROSION INDEX

For each survey reach, degree of erosion was recorded as none, slight, moderate, or severe. These categories are described in detail below and assigned a point value:

Points	Erosion Category	Description
(0)	None	No erosion problems, very few low cut banks, excellent riparian vegetation and stream is well buffered from agricultural cultivation.
(1)	Slight	Slight erosion problems, low cut banks (1-3 feet), past erosion problems have been stabilized, good riparian vegetation and an adequate buffer from agricultural cultivation.
(2)	Moderate	Moderate erosion problems, several cut banks (4-6 feet), some active erosion and past stabilization work may be inadequate, fair riparian vegetation but poor buffer from agricultural cultivation in places.
(3)	Severe	Severe erosion problems, high cut banks (6 feet and up) and active erosion may be threatening roads, houses, or cultivated fields. Generally poor riparian vegetation due to vertical banks and poor to non-existent buffer from agricultural cultivation. Past stabilization work is inadequate and the reach needs additional work.

Each stream was divided into management reaches of similar habitat type. A management reach consists of many survey reaches (i.e. a 5 mile management reach would have 20 quarter-mile survey reaches). The erosion category points of all survey reaches were summed and averaged for each management reach. The equation below summarizes this calculation.

$$\text{Erosion Index} = \frac{\Sigma \text{ Erosion Category Points of all survey reaches within the management reach}}{\text{No. of survey reaches in the management reach}}$$

The erosion index was calculated for all streams surveyed in the Fifteenmile Basin. The higher the erosion index, the more severe the erosion.

Table B-3 cont.

EROSION INDEX

Fifteenmile Creek

Management Reach	Erosion Index
#1 RM 0 to 3.0 Mouth to Petersburg bridge crossing	0.7
#2 RM 3.0 to 8.8 Petersburg bridge crossing to Company Hollow Road crossing	1.4
#3 RM 8.8 to 13.1 Company Hollow Road crossing to Fulton Canyon Bridge crossing	2.4
#4 RM 13.1 to 20.1 Fulton Canyon bridge crossing to Wrentham bridge crossing	1.9
#5 RM 20.1 to 27.0 Wrentham bridge crossing to Boyde bridge crossing	1.7
#6 RM 27.0 to 36.2 Boyd bridge crossing to Route #44 bridge crossing below Ramsey Hall	1.7
#7 RM 36.2 to 39.8 Route #44 bridge crossing below Ramsey Hall to Taylor Grade bridge crossing	1.9
#8 Rm 39.8 to 43.6 Taylor Grade bridge crossing to North/South road bridge crossing	0.5

Ramsey Creek

#1 RM 0 to 8 Mouth to Forest boundary	2.1

Table X-3 cont.

Eightmile Creek

Management Reach	Erosion Index
#1 RM 0 to 6.75	1.7
#2 RM 6.75 to 12.75	1.8
#3 RM 12.75 to 19.5	1.4
#4 RM 19.5 to 25.5	0.9

Fivemile Creek

#1 RM 0 to 2.5	2.0
#2 RM 2.5 to 5.25	1.2
#3 Rm 5.25 to 8.75	2.4
#4 RM 8.75 to 12.0	2.2
#5 RM 12.0 to 18.75	1.4
North Fork RM 0 to 4.3	2.2

Dry Creek

RM 0 to 7	2.3

May's Canyon Creek

RM 0 to 4.5	1.7

Pine Creek

RM 0 to 6.5	1.6

Table B-3 cont.

Larch Creek

Management Reach	Erosion Index
RM 0 to 3.5	1.3

Jameson Creek

RM 0 to 3.0	2.5

Davis Creek/Standard Hollow

RM 0 to 3	2.7

Table B-4

Fifteenmile Creek Barriers

Rivermile	General Location	Description of Barrier(s)
0	Underneath bridge crossing at mouth	Bedrock cascade, velocity barrier/delay at high flows
0.25	Seufert Falls Weir	Passage has been improved by construction of weirs and deflector wall (STEP project). A delay at high flows may exist.
1.6	Mid-way between mouth and Petersburg	5' stop log irrigation dam, complete summer-time barrier.
33.3	.7 miles downstream of Underhill diversion site	4' man-made earthen dam/pump station
34.0	Underhill diversion site	5' stop log irrigation dam (Underhill diversion site) summertime barrier.
35.0	1 mile above Underhill diversion site	4' rock fill dam/pump intake, partial summertime barrier.
35.5	Below mouth of' Ramsey Creek	Two 3-4' rock fill dams/pump intakes, partial summertime barriers.
36.0	Upstream of mouth of Ramsey Creek	3'rock fill and plastic dam/pump intake, partial summertime barrier.
40.0	Dufur Intake	6' diversion dam, unscreened (Dufur water intake) partial barrier/delay.
43.5	Below the North-South Road bridge crossing	5' log jam, possible partial barrier at low flows. Man-made log dam at Orchard Ridge ditch intake

Table B-4 cont.

Ramsey Creek Barriers

Rivermile	General Location	Description of Barrier(s)
0.75	Below route #44 bridge crossing	3-4' rock fill and plastic earthen dam, pump station, partial summertime barrier.
1.0	1200 yds upstream of Route #44 bridge crossing	2-3' log jam, possible partial summertime barrier"
2.0	Below cattle waterway of ODFW/Olson fencing project (1985)	4' old concrete diversion dam structure partial barrier/delay
3.0 - 3.5	Below Mt. Fir property boundary	Several large beaver dams, partial barriers? low flows
4.0	Upstream of unimproved skid road crossing	3' log jam, partial barrier, low flows.
5.5	Upper Ramsey Creek	4' log jams, partial barrier, low flows
6.0	Upper Ramsey Creek	Two large log jams, partial barriers, low flows.
6.5	Upper Ramsey Creek (old homestead location)	Log/debris jam, braided channel, and beaver dams, partial barrier, low flows.
7.0	Upper Ramsy Creek above old homestead	Log/debris jams, braided channel, beaver dams, partial barriers.
7.5	Upper Ramsey Creek below Forest boundary	3.5' falls, log/debris jams partial barriers

Table B-4 cont.

Eightmile Creek Barriers

Rivermile	General Location	Description of Barrier(s)
5.5	Upstream of the third bridge crossing on 8mile road	4' log jam, could be partial barrier at low flows.
6.75	Downstream of fourth bridge crossing on 8mile road.	4' log jam could be partial barrier at low flows.
8.75	Downstream of Jap Hollow bridge crossing	2' log jam, could be partial barrier at low flows.
19.75	Walton grade, where 8mile Rd. leaves creek.	Log jam, creek flows underground for a short distance, partial barrier.
22.5	Below Hesslan Canyon, upper 8mile Cr.	Several log jams, low flow barriers, possibly partial high flow barriers.
23.5	Upper 8mile Creek	3' log jam, partial barrier at low flows.
24.0	Upper 8mile Creek	Large beaver dam, several smaller dams and large log jams are partial barriers and may be complete barriers at low flows.
24.5	Upper 8mile Creek	Large beaver dam, large log jams, barriers at low and possibly moderate flows.
25.0	Upper 8mile Creek	Large beaver dam/log jam complete barrier, several log/debris jams are possible barriers.
25.5	Upper 8mile Creek	Large beaver dam, excess woody debris, several log/debris jams are possible barriers.

Table B-4 cont.

Fivemile Creek Barriers

Rivermile	General Location	Description of Barrier(s)
8.25	Upstrearn of Pleasant Ridge Rd. junction	4' log jam, possible partial barrier
10.25	Downstream of the second bridge crossing above Pleasant Ridge Rd. junction.	7' log/debris jam, partial barrier
11.25	Approx. 1 mile upstream of second bridge crossing above Pleasant Ridge Rd. junction	3' log jam, partial barrier
11.5	Approximately 1.25 miles upstream of second bridge crossing above Pleasant Ridge Rd. junction	5' log jam, partial barrier
16.0	Approx. 2 mile above Dutch Flat Rd. junction	Log/debris jam, partial barrier
16.5	2.5 miles above Dutch Flat Rd. Junction	Log/debris jams, barriers
17.0	3 miles above Dutch Flat Rd. junction	2 log/debris jams, barriers
18.0	Approx. 1 mile below Forest Boundary	Lop, jam/beaver dam 4' debris jam/falls partial barriers.
18.5	0.5 miles below Forest Boundary	Large log jam/beaver dam

North Fork Fivemile Creek Barriers

2.2	North Fork Canyon on gated dirt road	Kelly cistern, concrete irrigation impoundment in channel, 7' high, total barrier
2.4	North Fork Canyon on gated dirt road	Earthen/plastic fill dam creates a large stock pond, partial barrier.

Table B-4 cont.

Dry Creek Barriers

No physical barriers

May's Canyon Creek Barriers

Rivermile	General Location	Description of Barier(s)
3.5	0.5 mile upstream of Hwy 197.	4' lumber/debris jam, partial barrier

Pine Creek Barriers

No physical barriers

Larch Creek Barriers

.124	Above confluence of Larch & Pine Creek	4' log/debris jam, partial barrier

Table B-5

Fifteenmile Creek Water Temperature Data, 1986

Date	Reach	0900	1000	1100	1200	1300	1400	1500	1600
7-18	#1	60,60	62,62	64	66	68	68	70	70
7-21		-	67	68	-	-	-	-	-
7-22	#2	62,62	63	65	70	74	76	-	-
7-23		-	65	65	69	70,71	69	69	-
7-28		62	64	-	70	72,72	73	-	-
7-31	#3	63	69	71	76	77	78	82	-
8-5		66	66	69	77	80	82	-	-
8-6	#4	67	69	71	-	80	85	-	-
8-7		67	-	76	-	-	-	-	-
8-12		-	67	70	74	-	-	-	-
8-13		68	-	-	72	-	80	80,80	-
8-14	#5	69	-	71	76	78	78	83	-
8-15		67	-	73	-	77	-	-	-
8-19	#6	62	64	-	67	70	75	-	-
8-20		-	-	61	64	-	69	70	-
8-21	#7	61	61	66	70	71	-	74	-
8-25		-	60	62	67	69	72	74	-
8-26	#8	-	62,64	-	69	70	74	74	-
8-27		-	-	64	66	71	-	69	-
8-28		61	-	-	62	64	-	66	-
9-3	#9	-	58	58	-	-	64	-	-
9-4		-	55	-	-	60	-	61	-
9-9	#10	-	-	50	52	54	54	-	-
9-11		45	46	-	48	-	-	-	-

APPENDIX C

BASELINE BIOLOGICAL MONITORING METHODOLOGY. WATER TEMPERATURE. FLOW, RIPARIAN CONDITION, AND MACROINVERTEBRATES

Baseline Biological Data Collection

The evaluation and monitoring portion of the Fifteenmile Project will consist of four major components. These are water temperature, stream flow, macroinvertebrates, and riparian condition. Monitoring these four parameters should provide sufficient baseline data to quantify and evaluate the results of any enhancement activities (Fig. C-1).

Water Temperature Monitoring

Temperature monitoring will involve the use of four Model DP212 Datapod digital recorders. These recorders measure both air and water temperatures of a given site at intervals of one hour. Once the temperatures are read by the Datapods they are stored in a data storage module. The "burned" data storage modules can then be "read" by a Datapod reader and entered into a compatible computer. This data can then be tabulated and/or graphed to illustruate any changes in stream temperature resulting from ehancement work.

Four Datapod stations have been selected in the Fifteenmile watershed (figure 2 of this report). Station number one is located on Fifteenmile Creek about one-eighth mile upstream of Petersburg. Station number two is also located on Fifteenmile Creek about one-eighth mile upstream of Dufur. Station number three is located on Ramsey Creek just below the Route #44 bridge crossing at Ramsey Hall. Station number four is located on Eightmile Creek just below Endersby, These locations were used as thermograph stations in the past, and previous temperature data is therefore available.

During 1986, datapods were put into operation from 5 September to 24 October (Table B-2). During future field seasons, datapods will be installed during May and retrieved in late September. This will enable documentation of temperature readings before, during, and after the irrigation season.

Stream Flow Monitoring

Stream flow will be monitored throughout the duration of the project to quantify changes in flow resulting from restoration of the riparian zone. Six flow stations have been identified (see figure 3 of this report). Station 1 is located at the mouth of Fifteenmile Creek. Station 2 is located at the mouth of Eightmile Creek. Station 3 is located at the mouth of Fivemile Creek. Station 4 is located at the mouth of Dry Creek and station 5 at the mouth of Pine Creek near Dufur. Station 6 is located above the mouth of Ramsey Creek. These stations will be marked with a fluorescent section of rebar or fluorescent paint on a fixed object. This will ensure that flow measurements be taken at the same location during consecutive field seasons. Additionally, flows are measured during macroinvertebrate sampling. This data will be incorporated into the stream flow data base.

A Marsh McBirney Model 201 portable liquids flowmeter and top-setting wading rod will be used to measure flow using the direct discharge method. This will result in a flow measured in cubic feet per second (cfs).

During the 1986 field season flows were calculated at each macroinvertebrate sample station. This data is included in Table C-3. During consecutive field seasons, flows will be measured at each flow station at least three times per year. The first flow will be taken in May before irrigation begins. A second flow will be taken in August during the minimum flow period and peak of the irrigation season. A third flow will be taken in late September or early October between the end of the irrigation season and the fall rains. Because flow can fluctuate dramatically with irrigation demands, it is necessary to measure streamflows before and/or after the irrigation season. This will ensure that the flow data can be used to document flow changes resulting from enhancement work. The mid-summer flow measurement will be useful in documenting low flows throughout the watershed and to correlate low flows with maximum summer water temperatures.

Riparian Condition Monitoring

The recovery of riparian vegetation as a result of streamside fencing will be monitored with the use of photo points. Prior to any riparian enhancement work, photo point stations will be identified and marked with a colored section of rebar or fluorescent paint on a fixed object.

Photo documentation will be conducted before, during, and after riparian enhancement activities. The photos will be take during the same time of year at intervals of at least once per year. This should provide a visual, qualitative documentation of improvements in th riparian vegetation. See figure C-4 for an example of a photo point data sheet.

Macroinvertebrate Sampling

Macroinvertebrate sampling was conducted to document biological changes occurring in the Fifteenmile Basin as a result of the Habitat Enhancement Project. The methodology used was taken from the Fisheries Habitat Surveys Handbook of the U.S. Forest Service.

During the initial phase of the Fifteenmile Project, summer and late fall macroinvertebrate samples were collected. A total of eleven stations were identified on the non-forest portion of the Fifteenmile watershed. Table C-5 lists the stations, dates sampled, and their specific locations. Spring, summer, and late fall samples will be conducted during 1987. In addition, one sample will be collected during the fall of each following year for a period of at least five years. This will enable the monitoring of any changes in the macroinvertebrate community resulting from habitat enhancement work.

Physical habitat and chemical data were also recorded as part of the sampling procedure. A sample data sheet is shown on Table C-6. This data will be used in the final analysis of the macro-inbertebrate samples.

Macroinvertebrate samples were sent to the Aquatic Ecosystems Analysis Laboratory, Brigham Young University, Provo, Utah. Upon completion of analysis, data returned will include the raw field data as well as several indices used to express macroinvertebrate diversity and abundance. Using the supplied indices the status of the macroinvertebrate community can be compared with it's potential and thus aid in monitoring the biotic condition of the watershed.

Fifteenmile Basin, Baseline Biological Data Collection Schedule

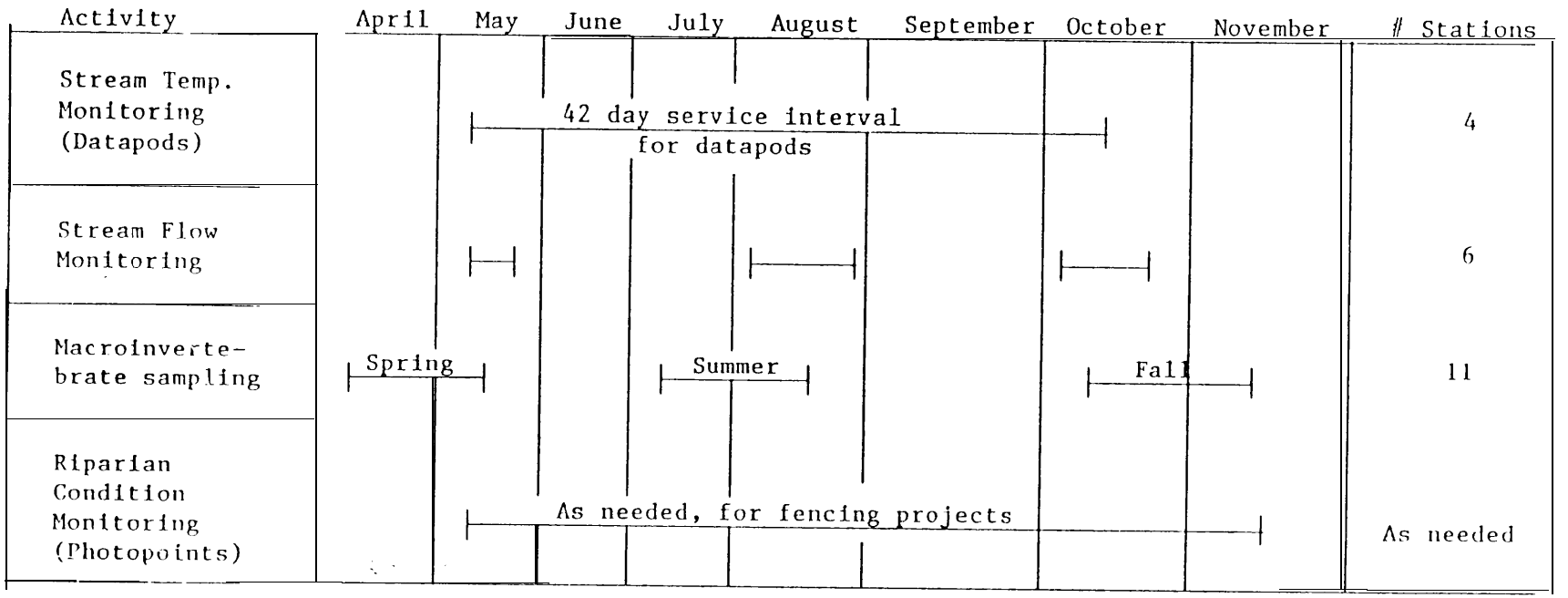


Figure C-1

Figure C-2

DATAPOD INFORMATION

Summer/Fall 1986

Station	Location	Date/Time Activated	Date/Time Deactivated	Comments
#1	Fifteenmile Cr. (Petersburg)	9/5/86 at 1600 hrs	10/24/86 at 0956	Checked 9/12 ok
#2	Fifteenmile Cr. (Dufur)	9/8/86 at 1030 hrs	10/24/86 at 1118 hrs	Checked 9/12 ok
#3	Ramsey Cr. (Route 44 Bridge)	9/8/86 at 1130 hrs	10/24/86 at 1132 hrs	Checked 9/12 on run (button is bad)
#4	Eightmile Cr. (Endersby)	9/10/86 at 1600 hrs	10/24/86 at 1035 hrs	Checked 9/12 ok

Date: 11-14-86

Samplers Name: Greg Short
Roger Smith

Table C-3
Fifteenmile Creek (Mouth)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q
2.0	0.40		-.15		0
3.0	0.30		.14		.042
4.0	0.70		1.84		1.288
5.0	1.30		1.59		2.067
6.0	1.55		1.77		2.7435
7.0	1.75		1.46		2.555
8.0	1.80		1.30		2.34
9.0	1.75		1.30		2.275
10.0	1.90		1.11		2.109
11.0	1.10		.97		1.067
12.0	0.90		.79		.711
13.0	0.90		.66		.574
14.0	0.35		.59		.2065
					18.0

Q = 18 0 cfs

Comments:

Date: 11-12-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.

Fifteenmile Creek (Wrentham)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	c
0	0.70		0		0
2.0	1.50		.03		.090
4.0	2.00		.01		.040
6.0	2.10		.14		.588
8.0	2.15		.28		1.204
10.0	1.80		.37		1.332
12.0	1.55		.28		.868
14.0	1.20		.36		.864
16.0	0.90		.33		.594
18.0	0.80		.45		.720
20.0	0.80		.42		.672
22.0	0.75		.39		.585
24.0	0.60		.34		.408
26.0	0.35		.25		.175
28.0	0.10		0		0
30.0	0.05		0		0
					8.14

Q = 8.14 cfs

Comments:

Date: 11-12-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.

Fifteenmile Creek (just above Dufur)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q
1.0	0.20		0		0
2.0	0.70		0.05		.035
3.0	0.70		0		0
4.0	0.50		0.40		.200
5.0	0.40		0.30		.120
6.0	0.60		1.20		.720
7.0	0.60		1.48		1.08
8.0	0.60		1.36		.816
9.0	0.60		1.70		1.020
10.0	0.50		2.05		1.025
11.0	0.40		2.05		.820
12.0	0.30		1.75		.525
13.0	0.30		1.55		.465
14.0	0.30		1.33		.399
15.0	0.20		1.16		.232
17.0	0.10		0		0
18.0	0.10		0.08		.016
20.0	0.10		0		0
					7.47

Q = 7.47 cfs

Comments:

Date: 11-12-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.
Upper Fifteenmile Creek

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q	
0	0.50		.03		.030	
2.0	1.50		.25		.375	
3.0	1.30		.48		.624	
4.0	1.10		.82		.902	
5.0	1.20		.52		.624	
6.0	1.10		.40		.440	
7.0	0.90		.55		.495	
8.0	0.70		.75		.525	
9.0	0.60		.68		.408	
10.0	0.60		.60		.720	
12.0	0.40		.46		.368	
14.0	0.20		.15		.060	
16.0	0		0		0	
					5.571	Q = 5.57 cfs

Comments:

Date: 11-12-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

TAble C-3 cont.
Ramsey Creek

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	0.6	0.8	a	
1.0	.30		.78		.234	
2.0	.50		.53		.265	
3.0	.40		.84		.336	
4.0	.40		1.06		.424	
5.0	.40		.95		.380	
6.0	.35		.45		.1575	
7.0	.30		.18		.054	
8.0	0		0		0	
					1.85	Q = 1.9 cfs

Comments:

Date: 11-13-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.

Eightmile Creek (Near mouth)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q	
0'=3'						
4.0	.10		0		0	
6.0	.35		0		0	
8.0	.35		0		0	
9.0	.35		1.09		.3815	
10.0	.60		1.02		.612	
11.0	.85		.70		.595	
12.0	.70		1.13		.791	
13.0	.65		1.68		1.092	
14.0	.65		1.30		.845	
15.0	.65		1.66		1.079	
16.0	.80		.61		.488	
17.0	.70		1.12		.784	
18.0	.70		.56		.392	
19.0	.60		.17		.102	
20.0	.40		.07		.028	
21.0	.35		.03		.0105	
22.0	.20		0		0	
					7.20	Q = 7.20 cfs

Comments:

Date: 11-13-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.
Eightmile Creek (Above US Hwy 197)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q	
2.0	.15		0		0	
3.0	.35		.97		.3395	
4.0	.50		.70		.350	
5.0	.70		.28		.196	
6.0	.90		.85		.765	
7.0	.90		.85		.765	
8.0	.70		.69		.483	
9.0	.20		.97		.194	
10.0	.65		.61		.3965	
11.0	.30		.53		.159	
12.0	.35		.54		.189	
13.0	.40		.30		.12	
14.0	.10		0		0	
14.5	.10		0		0	
					3.96	Q = 3.96 cfs

Comments:

Date: 11-12-86

Samplers Name: Greg Short
Corey Hutchinson (USFS)

Table C-3 cont.
Fivemile Creek

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	0.6	0.8	q	
1.0	.30		0		.0675	
2.0	.45		.15		.065	
3.0	.50		.13		.156	
4.0	.60		.26		.060	
5.0	.40		.15		.0855	
6.0	.45		.19		.040	
7.0	.40		.10		.016	
8.0	.40		.04		.164	
9.0	.40		.41		.081	
10.0	.30		.27		0	
12.0	.25		0		0	
14.0	.10		0		0	
15.0	.10		0		0	
					0.735	Q = .74 cfs

Comments:

Date: 11-17-86

Samplers Name: Greg Short
Patty Matulock

Table C-3 cont.
Dry Creek (Near Mouth)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q	
1.0	0		0		0	
2.0	.20		0		0	
3.0	.35		0		0	
4.0	.30		.15		.045	
5.0	.15		.03		.0045	
6.0	.15		.15		.0225	
7.0	.25		.32		.080	
8.0	.90		.60		.540	
9.0	.70		.46		.2254	
10.0	.25		.16		.040	
11.0	0		0		0	
					0.96	Q = .96 cfs

Comments:

Date: 11-17-86

Samplers Name: Greg Short
Patty Matulock

Table C-3 cont.

May's Canyon Creek (Near Mouth)

FLOW CALCULATION WORK SHEET

Distance	Depth	Velocity 0.2	Velocity 0.6	Velocity 0.8	q
0	0		0		0
1.0	.35		.15		.0525
2.0	.40		.06		.024
3.0	.40		.12		.048
4.0	.10		0		0
5.0	0		0		0
					0.12

Q = .12 cfs

Comments:

Figure C-4

WATERSHED PHOTO POINT

Timber sale/Stream _____

Photo number-_____ Azimuth _____ Slope gradient % _____

Ground cover_____ Canopy cover_____%

Canopy type_____

REMARKS:

Table C-5

INSECT STATION DESCRIPTION, 1986

Stream	Station No.	Summer	Late Fall	Sample Site Location
Fivemile Creek	1	9-24	11-13	RM 3.0 Approx. 30 yds upstream of US.S Hwy 197 crossing, below fence crossing
Ramsey Creek	1	9-22	11-12	RM 2.0 Approx. 25 yds upstream of cattle waterway at downstream end of Emsley Roger's Ranch.
Eightmile Creek	1	9-23	11-13	RM 0 Approx. 50 yds upstream of Fifteenmile Rd. bridge crossing near mouth
	2	9-24	11-13	RM 7.5 Approx. 20 yds upstream of U.S. Hwy 197 bridge crossing
Fifteenmile Creek	1	9-23	11-14	RM 0.25 Approx. 100 yds downstream of Seufert Falls.
	2	9-23	11-13	RM 20.5 Approx. 20 yds upstream of Wrentham bridge crossing
	3	9-22	11-12	RM 30.5 Just below Lester Ashbrook's pump station about ¼ mile upstream of Dufur
	4	9-22	11-12	RM 40.5 Approx. 500 yds upstream of Dufur water intake
Dry Creek	1	no flow	11-18	RM 0 Approx. 50 yds from confluence with Fifteenmile Creek at Rice.
May's Canyon Creek	1	no flow	11-18	RM 0 Approx. 20 yds from confluence with Dry Creek
Pine Creek	-	no flow	no flow	RM 0

Figure C-6

MACROINVERTEBRATE ANALYSIS PHYSICAL HABITAT AND CHEMICAL DATA

Forest/Agency_____ 2. District_____

Stream_____ 4. Date_____

Specific Location_____

Station Number____ 7. Method: Modified Surber____ 8. Other_____

Elevation (ft)_____ *10. Gradient %_____ 11. Water Temp (^{o}F)_____

12. Width (ft)_____ 13. Depth (ft)_____ 14. Velocity (fps)_____

15. Discharge (cfs)_____ 16. Low Flow (cfs)_____
Mean Summer (cfs)_____

*17. Substrate type: (Rate in order of dominance 1-6, 1 = most dominant 6 = least dominant; if not present, do not rate)
Boulder_____
Rubble & Boulder____
Rubble_____
Gravel & Rubble____
Gravel_____
Sand, Silt_____

*18. Streambank riparian vegetation: (Rate in order of dominance 1-5, 1 = most dominant 5 = least dominant)
Bare Soil____
Grass_____
Grass & Low Shrubs_____
Tall Shrubs & Trees_____
Trees_____

*19. Alkalinity (as HCO_3)_____mg/l

*20. Specific conductance_____UMHOS/cm at 25° C.

21. pH_____

22. Sulfate_____mg/l

23. Nitrate Nitrogen (NO_3N) (optional)_____mg/l

24. Ortho phosphate (PO_4) (optional)_____mg/l

25. Remarks:

26. Recorded by_____

*Specific items to be included for each sample to assist in analysis.

FS-R4-2600-12 (3/85)

APPENDIX D

BUDGET EXPENDITURES, 1986

Budget Expenditures 1986
Fifteenmile Creek Habitat Project

Wasco Co. SWCD Expenditures	$ Spent
9/1/86 - 9/30/86	3,305.71
10/1/86 - 10/31/86	3,109.58
11/1/86 - 11/30/86	3,648.85
12/1/86 - 12/31/86	2,948.29

Subtotal as of 12/31/86	13,012.43
Plus Estimate for Jan-Mar. 31	3,883.47
Grand Total SWCD (1986-March 31, 1987)	$16,985.90

ODFW Expenditures

June-Sept. 30

26,787.85
- 225.00 OFfice storage rental
26,562.85 - 3,442.43 SWCD = 23,120.42 (ODFW Expenses only)

Oct.-Dec.

34,270.41 - 9,706.72 SWCD = 24,563.69

Jan.-March (estimate)

33,249.00
+ 100.00 Field supplies
+ 1,468.05 (Capital. outlay) 2 way radio
+ 150.00 PH meter
34,967.05 - 3,883.47 SWCD = 30,648.58

Total Expenditure Apl. 1, 1986-Mar.31,1987 78.332.69

78,332.69 ODFW Expenditures
16,895.90 WCSWCD Expenditures
95,228.59 Total Estimated Spent

132.846.00 Original budget
95,228.59 Expenditures 1986
337,617.41 Estimated carry over

($38,500.00 Estimated carry over from USFS, 1/13/87)

MONITORING AND EVALUATION OF

MT. HOOD NATIONAL FOREST

STREAM HABITAT IMPROVEMENT AND REHABILITATION PROJECTS

1986 Annual Report

Prepared
by

Brent Higgins

and

Harv Forsgren

Mt. Hood National Forest
2955 N.W. Division St.
Gresham, OR 97030

ACKNOWLEDGEMENTS

The authors express appreciation to Joe Kinney for his dedication and leadership in collection of the field data. His assistance in organization of the data and early data analysis was also an important contribution. Data provided by Dan Rife and Corey Sue Hutchinson for the Fifteenmile Creek drainage is appreciated. Gratitude is extended to Dave Hohler for providing initial direction and guidance in collection of the field data. Report format recommendations and editorial comments provided by Dave Heller were invaluable in completion of this report.

Table of Contents

Acknowledgements 327

Abstract 329

List of Tables 330

List of Figures 331

Introduction 333

Methods 334

Results and Data Summary 334

Discussion 345

Pre-Treatment Findings 345
. Jordan Creek 345
. Fifteenmile/Eightmile/Fivemile Creeks 346
. Ramsey Creek 351
° McGee Creek 353
° Hot Springs Fork 353
. Camp Creek 355
'Lost Creek 358
. Still Creek 358

Post-Treatment Findings 360
. Still Creek 362
. Oak Grove Fork' 369
° Cub Creek 374
° Rock Creek 376
° Lake Branch 379

Structure Durability Findings 383

Summary and Conclusions 390

ABSTRACT

In the summer and fall of 1986 the Mt. Hood National Forest continued its fish habitat monitoring and evaluation program. This included: pre-treatment baseline data collection on 10 streams scheduled for future improvement work and post-treatment monitoring-evaluation on 5 streams with recently completed habitat work. Methods included an extensive survey of stream habitat condition and types in the project drainages and an intensive physical and biological mapping of 200 foot sample sections in the treatment areas. Control sections outside the treatment area were also intensively mapped.

Baseline monitoring of the pre-treatment project areas revealed them to be heavily (>80%) dominated by riffle habitats. The project areas contain little in-stream structure, typically provided by large woody debris and boulders, and have low habitat diversity and complexity. These habitat characteristics are very similar to pre-treatment conditions in the five areas where improvement projects have been completed. Post-treatment surveys of project areas show a reduction in riffle habitat ranging from 8 to 65%. The addition of in-stream structure has increased habitat diversity by creating pocket pools and slack water areas in many of the previously homogeneous riffles and glides. Several new lateral and alcove pools have been created in the project areas. At least a doubling of both pool and glide habitat occurred at each project.

Salmonid population estimates in the pre-treatment areas ranged from 0.04/m2 to 0.60/m2. Salmonid population estimates in post-treatment areas ranged from 0.06/m2 to 1.06/m2. The post-treatment densities were typically higher than sampled densities from these areas prior to enhancement work. Control sites did not show similar increases in densities. Generally, the increase was most noticeable in 1+ and older rainbow/steelhead trout, the target population for much of the work. Utilization of the added structure and the associated new habitats appeared high.

Evaluation of more than 600 habitat improvement structures following a flood event with a 15 to 25 year return interval, identified a number of factors which influence the durability and performance of in-stream structures. More than 90% of the structures were found to be functioning as designed after the storm flow. This high survival rate appears to partially answer questions raised in the early 1980% regarding the feasibility of using in-stream structures in Cascade mountain streams with high gradients (2-6%) and highly variable flow regimes. Structures installed without the assistance of heavy equipment failed about 7 times more frequently than equipment installed structures. Of the equipment installed structures, those spanning the entire channel failed 30 times more often than non-cross channel structures. Among equipment installed structures, boulder berms accounted for more than 853 of the failures. Almost all (>94%) of the boulder berms which failed were constructed with boulders collected from within the active stream channel. Use of in-channel materials, often of limited size, provided structures for 10-20% of the cost of those built using off site boulders meeting minimum size specifications.

List of Tables

Selected Summer Low Flow Hydraulic Characteristics of Inventoried Streams 335

Habitat Composition Characteristics for Selected Project Areas in the Clackamas and Sandy River Drainages 336

Salmonid Density Estimates by Drainage, Stream and Project Area 337

Age Distribution of Salmonid Populations Sampled in Project Areas 338

Salmonid Population Densities Measured in the Fifteenmile Creek Drainage During 1985 and 1986 351

Salmonid Population Densities Measured in the Lake Branch of the West Fork Hood River in 1984, 1985, 1986 383

List of Figures

Clackamas River Drainage Rainbow/Steelhead Age Class Distribution . . . 340

Fifteenmile Creek Drainage Rainbow/Steelhead Age Class Distribution . . 341

Hood River Drainage Rainbow/Steelhead Age Class Distribution 342

Sandy River Drainage Rainbow/Steelhead Age Class Distribution 343

White River Drainage Rainbow Age Class Distribution 344

Map of Jordan Creek Intensive Monitoring Sites 347

Map of the Fifteenmile Creek Drainage 350

Map of Ramsey Creek Intensive Monitoring Sites 352

Map of McGee Creek Intensive Monitoring Sites 354

Map of Hot Springs Fork Intensive Monitoring Sites 356

Map of Camp Creek Intensive Monitoring Sites 357

Map of Lost Creek Intensive Monitoring Sites 359

Map of Still Creek, Reach 1, Intensive Monitoring Sites 361

Percent Riffle Habitat Reduction as a Function of the Density of Added In-stream Habitat Improvement Structure 363

Map of Still Creek, Reach 2, Intensive Monitoring Sites 365

Comparison of 1985 Habitat Composition for Two Control Sites in Still Creek 366

Comparison of 1985 Pre-Implementation and 1986 Post-Implementation Habitat Composition at Treatment Site 2, in Reach 2 and Still Creek 367

Comparison of Habitat Composition at Two Treatment Sites on Still Creek During the Summer of 1985 (Following One Year of Treatment:, and During the Summer of 1986 (Following the Second Year of Treatment) 368

Comparison 0f 1985 and 1986 1+ and Older Salmonid Numbers in Reach 2, of Still Creek 370

Map of Off-Stream Rearing Ponds Associated With Still Creek 371

Salmonid Densities for the Still Creek Rearing Ponds 372

Map of the Oak Grove Fork Intensive Monitoring Sites 373

List of Figures (Continued)

Map of Cub Creek Intensive Monitoring Sites 375

Map of Rock Creek Intensive Monitoring Sites 377

Comparison of Pool Habitat Area and Volume in the Rock Creek Project Area for 1984, 1985, and 1986 378

Comparison of Salmonid Densities in the Rock Creek Project Area for 1984, 1985, and 1986 380

Map of Lake Branch Creek Intensive Monitoring Sites 381

Performance of In-Stream Habitat Improvements Following the 1986 Rain on Snow Flood Event 384

Comparison of the Durability of Habitat Improvement Structures Installed With and Without the Assistance of Heavy Equipment 385

Comparison of the Durability of Equipment Installed Cross Channel and Non-Cross Channel Structures 387

Comparison of the Durability of Boulder Berms Constructed With In-Channel Boulders vs Hauled Boulders 388

Comparison of the Durability of In-Stream Habitat Improvement Structures by Structure Type 389

INTRODUCTION

Increased emphasis is now being placed on the maintenance and improvement of anadromous fisheries in the Pacific Northwest. Stream habitat rehabilitation and improvement has become an important tool in meeting this challenge. The Mt. Hood National Forest has over 300 miles of stream habitat available for the production of salmon and steelhead. The Forest is implementing a program directed toward increasing the capability of this habitat through restoration and enhancement. In conjunction with this program, the Forest initiated a monitoring and evaluation effort in 1985 to evaluate the effectiveness of the individual projects and to examine the overall success of the improvement program,

As monitoring and evaluation continued in 1986, the role and value of a well planned and conducted monitoring and evaluation process became more apparent. In the broad perspective, there is a responsibility to the funding agencies, and other interested parties, to report the results of our efforts, both successes and failures. Secondly, as more data is collected it becomes possible to begin developing an overview of the wide range of improvement work in progress or already completed. This provides a basis to evaluate the uses, and limits of, various types of projects and will suggest more cost effective means for improving the productive capability of fish habitat. In the narrow perspective, an objective and thorough evaluation of the individual project is necessary to judge their effectiveness and success.

The goals of the monitoring and evaluation effort can be divided into "drainage improvement evaluation goals" and "project evaluation goals". Three broad drainage evaluation goals have been identified. They are:

1) Determine changes in limiting habitat features that have occurred as a result of the habitat improvement program;

2) determine the resulting change in production of the targeted specie(s); and,

3) determine the cost effectiveness of the habitat improvement program.

Project evaluation goals include:

1 Determine if physical changes associated with the in-stream structures meet project habitat objectives;

2 determine the durability of project structures over a wide range of discharges; and,

3) determine the cost effectiveness of stream habitat improvements by project type and application.

METHOD

A brief summary of the monitoring/evaluation methods is presented in this, section. A complete description of the survey and data analysis methods, materials, and assumptions may be found in APPENDIX A. The monitoring and evaluation procedure is conducted in two phases. The first phase entails, conducting an extensive habitat survey of the stream to be treated. The extensive survey is conducted by walking the stream in one direction, recording individual habitat units (i.e. pool, glide, riffle) in order of occurrence, and the estimated average width, length and depth of each unit. For a systematic sample of each habitat unit, the actual dimensions are measured. A correction factor is thus determined for each habitat type, and applied to the estimated dimensions to improve the accuracy of the inventory. A rating system based on pool location, depth and cover characteristics, is used to determine pool "quality".

The second phase consists of intensive surveys of selected stream sections. Selected stream sections are located in areas that are to be improved, and in similar habitats that are not to be treated. The intensive survey provides a detailed map of the aquatic habitat units, and associated fish population characteristics. Habitat composition is determined by actual measurement and expressed by type in terms of surface area and water volume. Care is taken to identify the juxtaposition of habitat units, the relationship of habitat units to physical features within or adjacent to the channel, and the relationship of fish use to the habitat units. Fish population characteristics are determined by a combination of snorkle observation and electrofishing techniques. Total numbers and biomass are determined by species and age class for each sampled stream section.

Following project implementation the extensive and intensive surveys are repeated to provide the data to make the comparisons necessary to meet the objectives of the evaluation effort. Additionally habitat improvement structures are periodically examined for current condition and effectiveness. An extensive, post project survey was conducted following a major flood event in 1986. This low intensity field review was conducted Forest-wide to provide a general evaluation of in-stream stucture performance and durability following such a flow event. More than 600 structures were examined. Each structure was assigned to one of four condition categories: 1) undamaged and meeting project objectives, 2) damaged, but meeting project objectives, 3) no longer meeting project objectives but can be repaired or modified, and 4) no longer meeting project objectives and can't be repaired or modified. A copy of the inventory form and instructions for its completion may be found in Appendix A.

RESULTS AND DATA SUMMARY

APPENDIX B provides an extensive presentation of habitat and population data for each of the streams and project areas inventoried in 1986. These data have been summarized and are presented in this section as Tables 1 through 4. TABLE 1 presents the hydraulic features of each stream in the project areas. The average water width, discharge, gradient, substrate composition, and spawning areas reflect conditions in the project areas during summer low flow periods.

TABLE; 2 displays the percent composition by habitat unit in selected project areas. Percent pools, glides, and riffles is shown in terms of total surface area and water volume. Percent habitat composition provides important insights into the habitat diversity of project areas.

TABLE 3 provides the estimated total salmonid densities for each project area. Densities are shown as numbers and grams of fish per square meter of stream surface, and per cubic meter of water volume. Differences in salmonid densities are apparent between streams draining the east side of the Cascade Range and those draining the western flanks of the Cascades.

TABLE 4 summarizes the characteristics of the sampled fish populations for each project area. Age distribution, total number, and weight are shown by salmonid species, drainage and project area. The bar graphs comprising Figures 1 through 5 visually display the age class distribution of the rainbow/steelhead population sample in each project area.

TABLE 1. Selected summer low flow hydraulic characteristics of streams evaluated on the Mt. Hood National Forest in 1986. Streams in the top half of the table are west of the Cascade mountains, those in the lower half are east of the Cascades. Missing data shown as a dash.

Drainage Stream	Width (m)	Discharge (cfs)	Gradient (%)	Substrate	Spawning (m2/100m)
Clackamas River:					
Hot Springs	13.9	28	2.0	SmBoulder	64
Oak Grove	16.1	53		SmBoulder	
cut,	9.4	33	2.5	SmBoulder	5
Sandy River:					
Lost	10.0	34	3.0	SmBoulder	34
Camp	9.4	37	2.5	SmBoulder	119
Still					
Reach 1	11.8	41	2.5	Rubble	72
Reach 2	8.5	39	4.0	SmBoulder	20
Fifteen Mile:					
15 mile		8		Rubble	
8 mile		4	2.0	Cobble	
5 mile		1	2.0	Cobble	
Ramsey	3.0	2	3.0	Cobble	9
Hood River:					
McGee		-	3.0	-	
Lake Branch		-		-	-
White River:					
Jordan	2.1	4	3.0	Rubble	12
Rock	2.7				

TABLE 2. Habitat composition characteristics for selected project areas in the Clackamas and Sandy River drainages. Percent pools (P), glides (G), and riffles (R) of total stream surface area, and water volume is shown for project areas by stream. Missing data are indicated by a dash (-).

Drainage Stream	Total Project Area (m2)	% P-G-R	Total Volume	% P-G-R
Clackamas River:				
Hot Springs	14793.5	48-19-33	6419.6	71-13-16
Oak Grove	9737.6	5-23-72	5385.1	6-18-76
Cub	6304.4	25-36-39	2253.8	39-37-24
Sandy River:				
Lost	5632.1	11-20-69		
Camp	6398.9	6-12-82		
Still				
Reach 1	14285.7	15-32-53	3442.4	26-41-33
Reach 2	8853.1	10-18-72	2333.2	21-16-63

TABLE 3. Average total salmonid density by stream, in both numbers and grams of salmonid fish per square meter of water surface and per cubic meter of water volume for the project areas. Missing data are indicated by a dash (-). The top half of the table is comprised of streams draining the western flanks of the Cascade Mountains. The streams in lower half of the table drain east of the Cascades.

Drainage Stream	Density (#/m2)	Biomass (g/m2)	Density (#/m3)	Biomass (g/m3)
Clackamas River:				
Hot Springs	0.17	1.28	0.42	3.03
Cub	0.06	0.97	0.23	3.25
Sandy River:				
Lost	0.16	1.61		
Camp	0.17	3.07		
Still				
Reach 1	0.19	1.05	0.65	3.68
Reach 2	0.20	2.09	0.71	7.37
Ponds	1.06	7.12	1.92	12.91
Fifteen Mile:				
15 mile	0.28		1.60	
8 mile	0.18		1.90	
5 mile	0.60		3.03	
Ramsey	0.45	8.44		
Hood River:				
McGee	0.11		0.63	
Lake Branch	0.19			
White River:				
Jordan	0.04	1.78		
Rock	0.74	7.49		

TABLE 4. Age distribution of salmonid populations sampled in stream habitat improvement project areas on the Mt. Hood National Forest during the summer and fall of 1986. Total numbers, percent by age class and total weight are displayed by drainage, stream, and species for each project area sampled. Part A summarizes population characteristics for streams draining the west side of the Cascade Mountains. Part B summarizes population characteristics for eastern draining streams.

Drainage / Stream / Species	0+ (%)	1+ (%)	2+up (%)	Total (#)	Total (g)
PART A					
Clackamas River:					
Hot Springs					
Rainbow/Sth	68	31	1	248	1524.8
Cutthroat	0	25	75	4	298.6
Cub					
Rainbow/Sth	71	19	10	31	344.8
Cutthroat	0	75	25	8	212.5
Sandy River:					
Lost					
Rainbow/Sth	54	33	13	52	1186.6
Coho	99	1	0	95	298.6
Cutthroat	0	0	100	1	53.5
Chinook	100	0	0	1	6.3
Camp					
Rainbow/Sth	13	70	17	135	3860.1
Coho	99	1	0	93	208.1
Chinook	100	0	0	1	11.0
Still (Reach 1)					
Rainbow/Sth	51	47	3	79	927.3
Coho	95	5	0	339	1366.8
Cutthroat	0	100	0	3	71.0
Chinook	100	0	0	2	17.4
Still (Reach 2)					
Rainbow/Sth	56	36	8	525	6231.2
Coho	94	6	0	155	762.1
Cutthroat	25	50	25	4	102.3
Chinook	100	0	0	3	48.3

TABLE 4. CONTINUED

Drainage Stream Species	0+ (%)	1+ (%)	2+up (%)	Total (#)	Total (g)
PART B					
Fifteen Mile:					
15 mile					
Rainbow/Sth	74	19	8	367	-
8 mile					
Rainbow/Sth	31	62	7	98	-
5 mile					
Rainbow/Sth	43	39	18	168	-
Ramsey					
Rainbow/Sth	22	62	16	209	3924.1
Hood River:					
McGee					
Rainbow/Sth	31	49	20	61	-
Lake Branch					
Rainbow/Sth	34	43	23	391	-
Brook	11	67	22	9	-
Brown	0	0	100	1	-
White River:					
Jordan					
Rainbow	40	40	20	15	601.2
Rock					
Rainbow	83	16	1	320	3247.0

FIGURE 1. Age class distribution of rainbow/steelhead trout collected from 2 streams in the Clackamas River drainage on the Mt. Hood National Forest. Sampling was conducted during the summer of 1986.

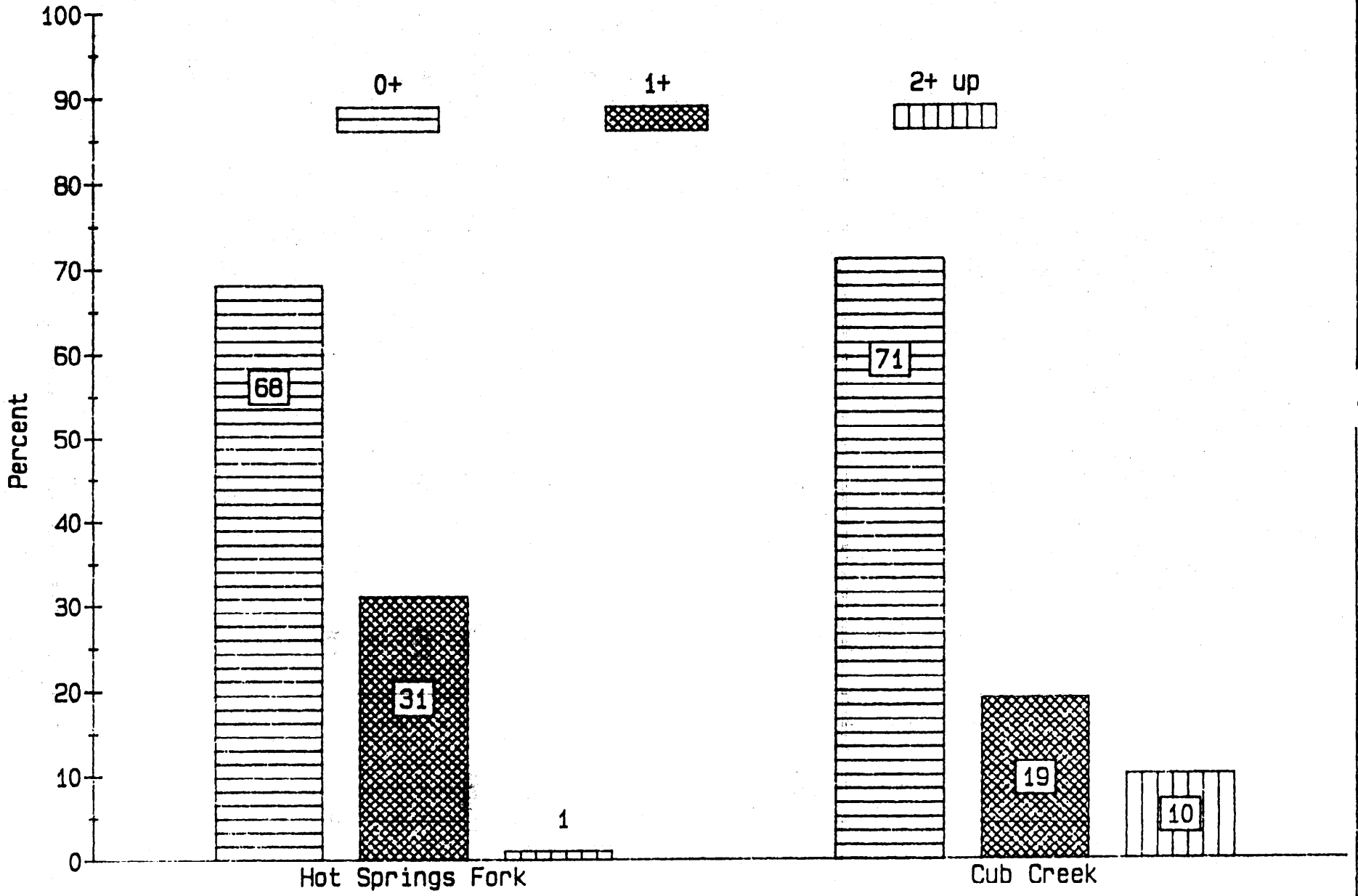


FIGURE 2. Age class distribution of rainbow/steelhead trout collected from 4 streams in the Fifteenmile Creek drainage on the Mt. Hood National Forest. Sampling was conducted during the summer/fall of 1986.

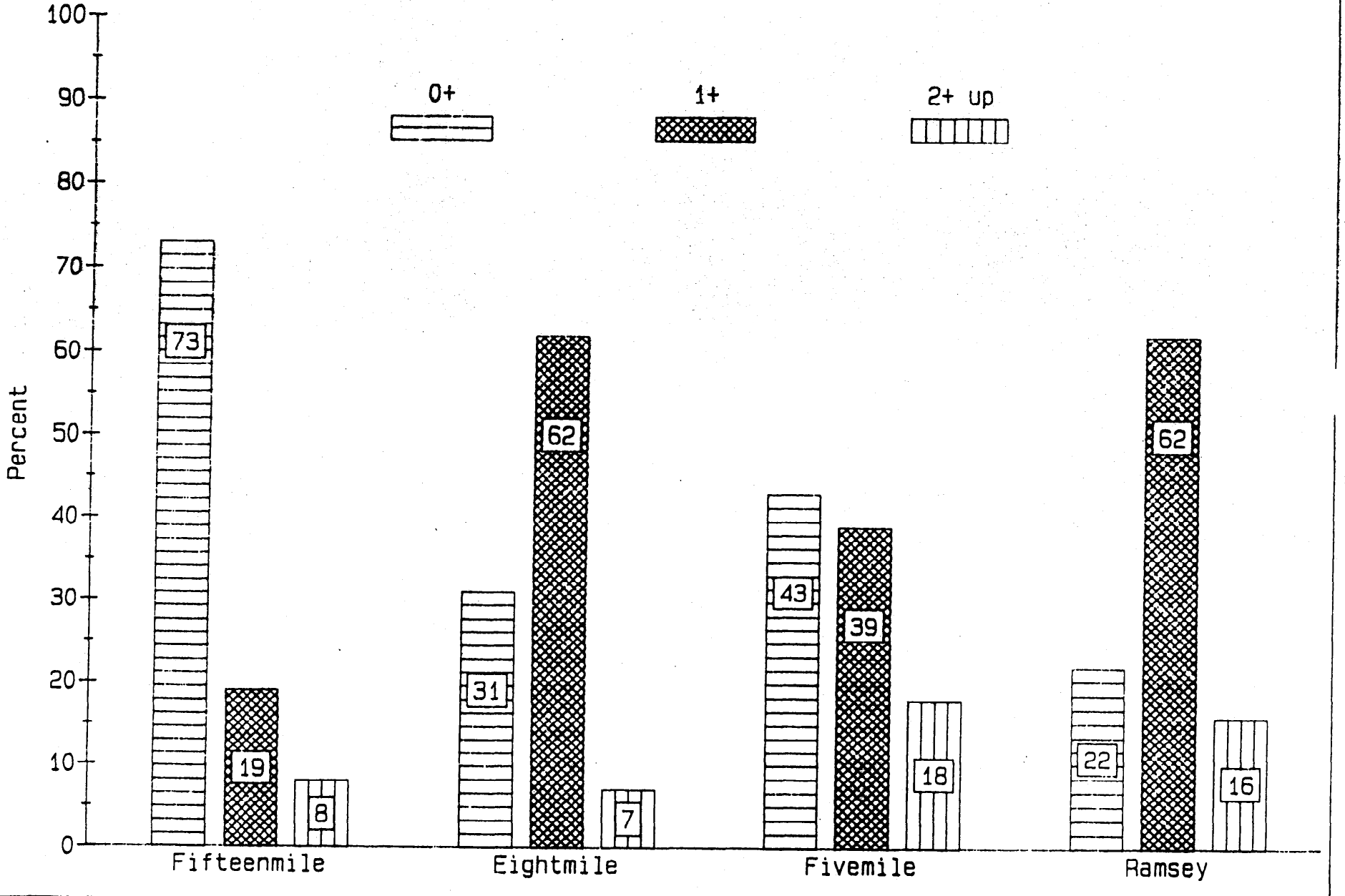


FIGURE 3. Age class distribution of rainbow/steelhead trout collected from 2 streams in the Hood River drainage on the Mt. Hood National Forest. Sampling was conducted during the summer/fall of 1986.

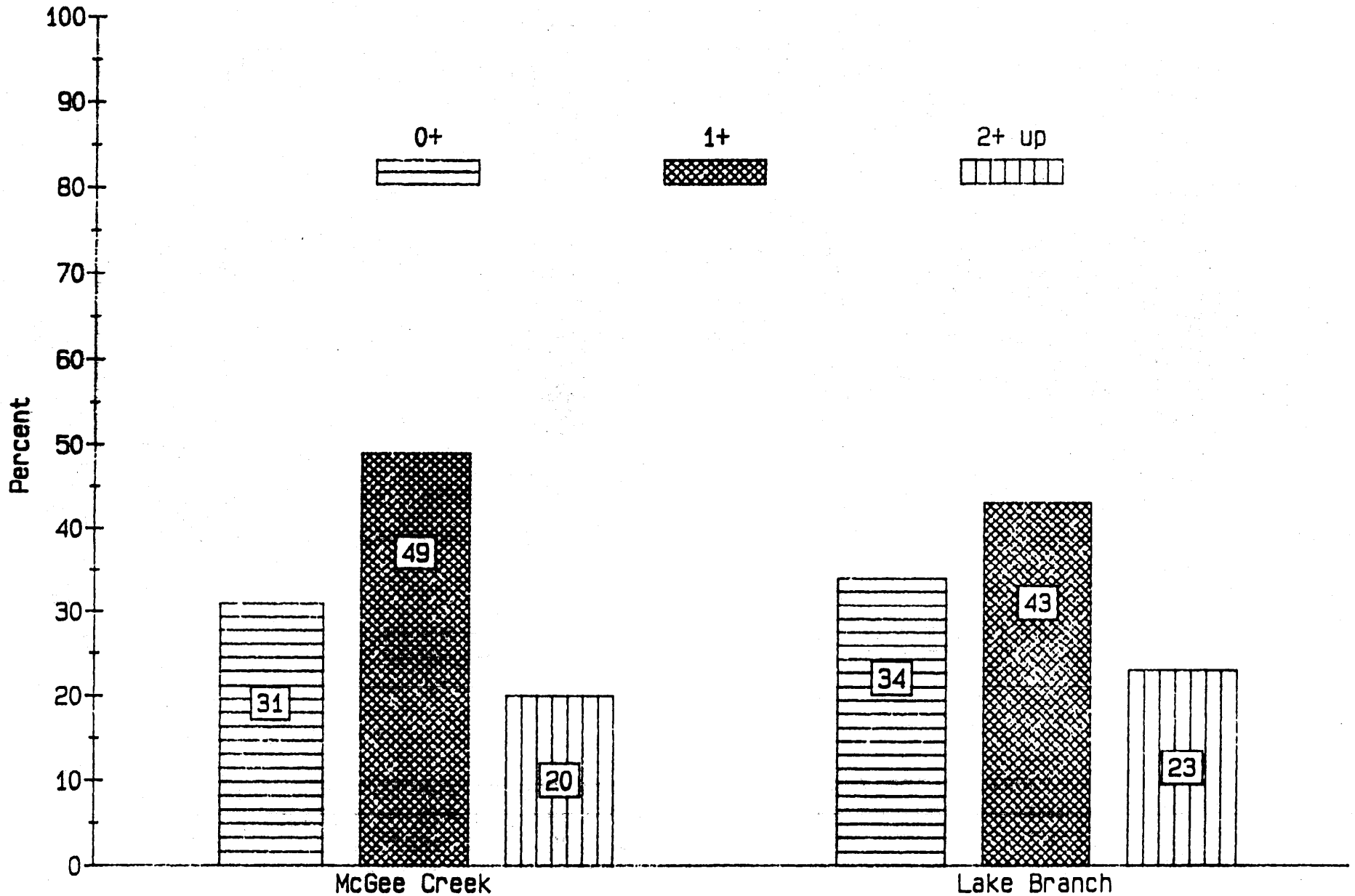


FIGURE 4. Age class distribution of rainbow/steelhead trout collected from 3 streams in the Sandy River drainage on the Mt. Hood National Forest. Sampling was conducted during the summer of 1986.

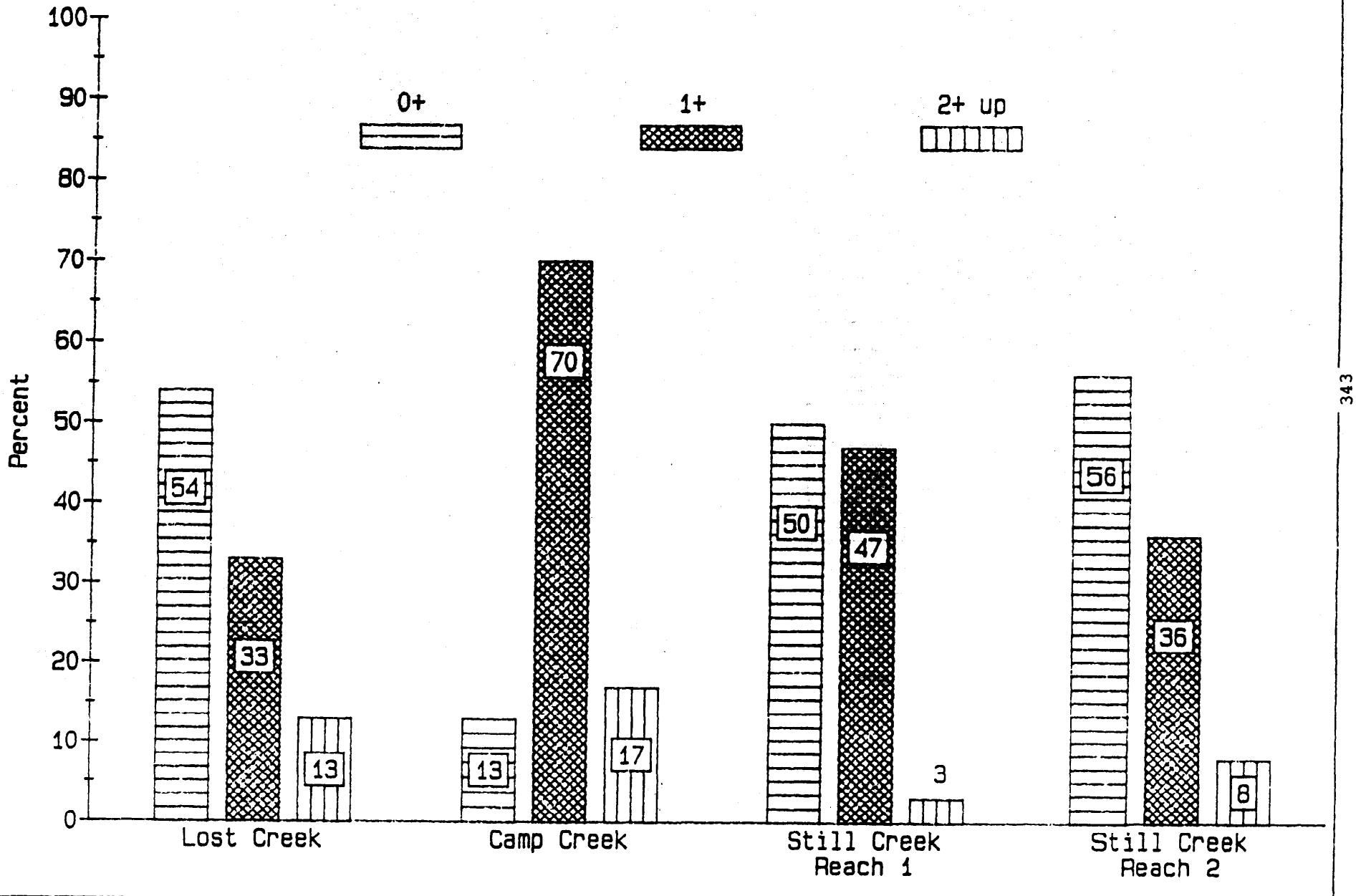
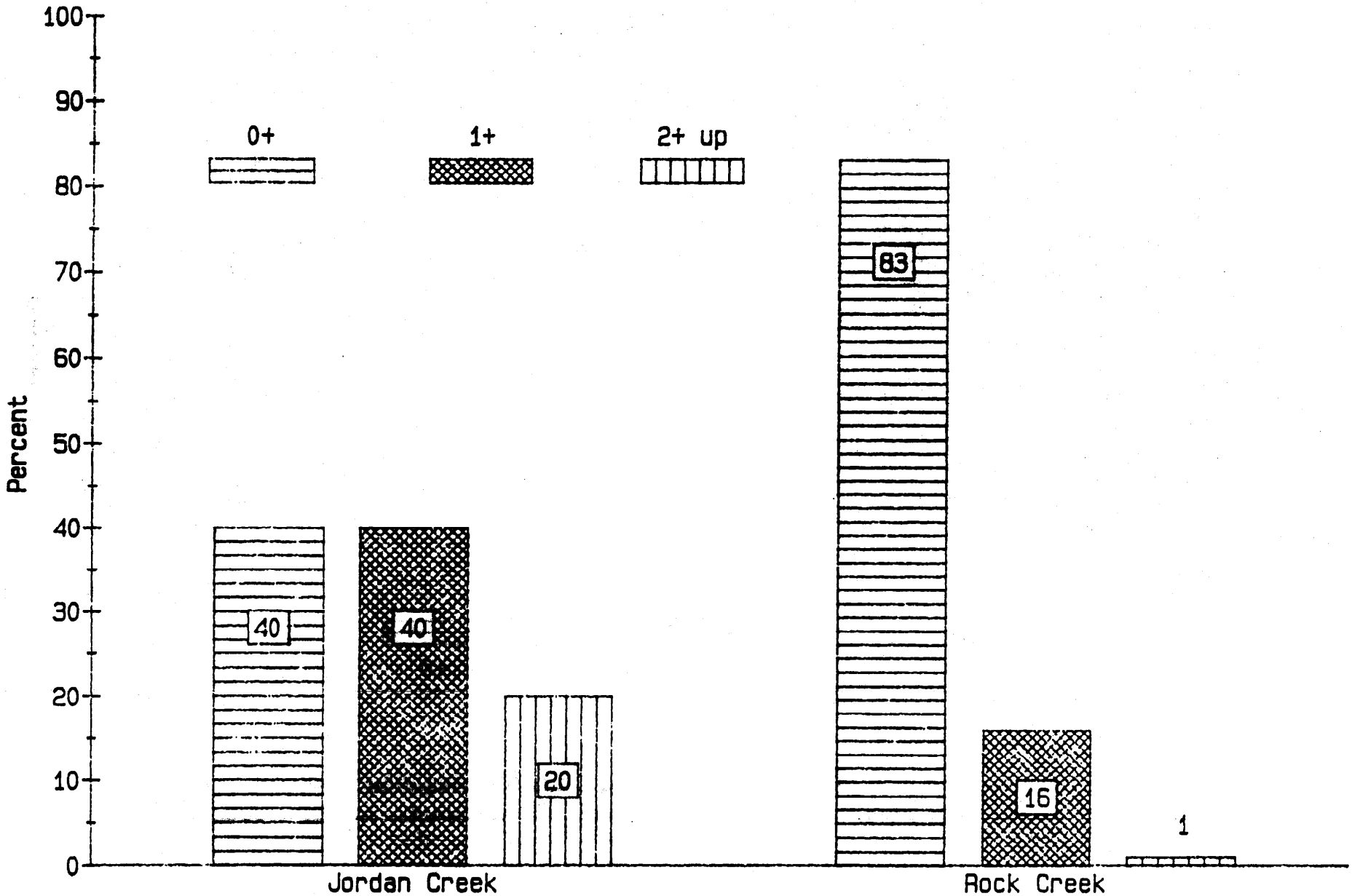


FIGURE 5. Age class distribution of rainbow/steelhead trout collected from 2 streams in the White River drainage on the Mt. Hood National Forest. Sampling was conducted during the summer of 1986.



DISCUSSION

Pre-Treatment Findings

Ten streams in the Mt. Hood National Forest were surveyed to collect pre-project, base-level information. The surveys were conducted during the summer low flow period of 1986. Projects to be implemented on these streams are at various stages of the planning process. Seven areas within these streams had projects which were implemented following monitoring in the summer/fall of 1986. One area has a project scheduled for implementation during the summer of 1987, and two areas are being examined for possible enhancement in 1988 or later.

Six of the monitored streams are on the east side of the Cascade Mountain Range. These streams are small (average width <5m) and have low summer flows (<10cfs). Generally the habitat composition and diversity is fair but the pool quality is poor to low. This is usually due to lack of effective cover and low water volume. Sampled salmonid population densities in east side streams have generally been higher and more variable than those on the west side. Salmonid populations are typically composed of resident and steelhead trout. Most of the projects are directed toward improving pool quality and adding in-stream structure to increase available rearing habitat for 0+ salmonids and add holding water for juvenile steelhead.

Four of the monitored streams are on the west side of the Cascade Mountain Range. These streams are relatively large (average width >10m) with moderate summer flows (>20cfs). Generally habitat composition and diversity is poor, with the project areas dominated by riffles. Most of these sections lack in-stream structure, especially large woody debris (LWD) which was removed during several clean-out and salvage efforts. The result has been the development of broad, shallow channels composed mostly of homogeneous riffles and glides. The salmonid population is a mix of steelhead, coho and chinook salmon, and resident trout. The projects are directed toward reducing riffle habitat while increasing pool habitat, adding in-stream structure to create habitat diversity and to help create a defined low flow channel through the riffles. Particular emphasis will be on enhancing summer rearing habitat for 1+ steelhead and chinook, and overwintering habitat for coho.

A brief summary of pre-treatment inventory information follows for each of the streams surveyed in 1986.

Jordan Creek. Jordan Creek is part of the White River drainage. The project area (RM 12.5) is located in a narrow, steep, "V" shaped canyon. The area was logged in 1984 with sections of clear cuts extending through the stream and up both sides. This has created a series of 200-300 foot sections of stream alternating in forested and clear cut areas. The clear cut areas have little woody riparian vegetation remaining. The resulting lack of shading and high probability of large water temperature fluctuations, with deleterious high temperatures during the low summer flow are of primary concern. A campground located above the project area results in at least moderate recreational fishing use.

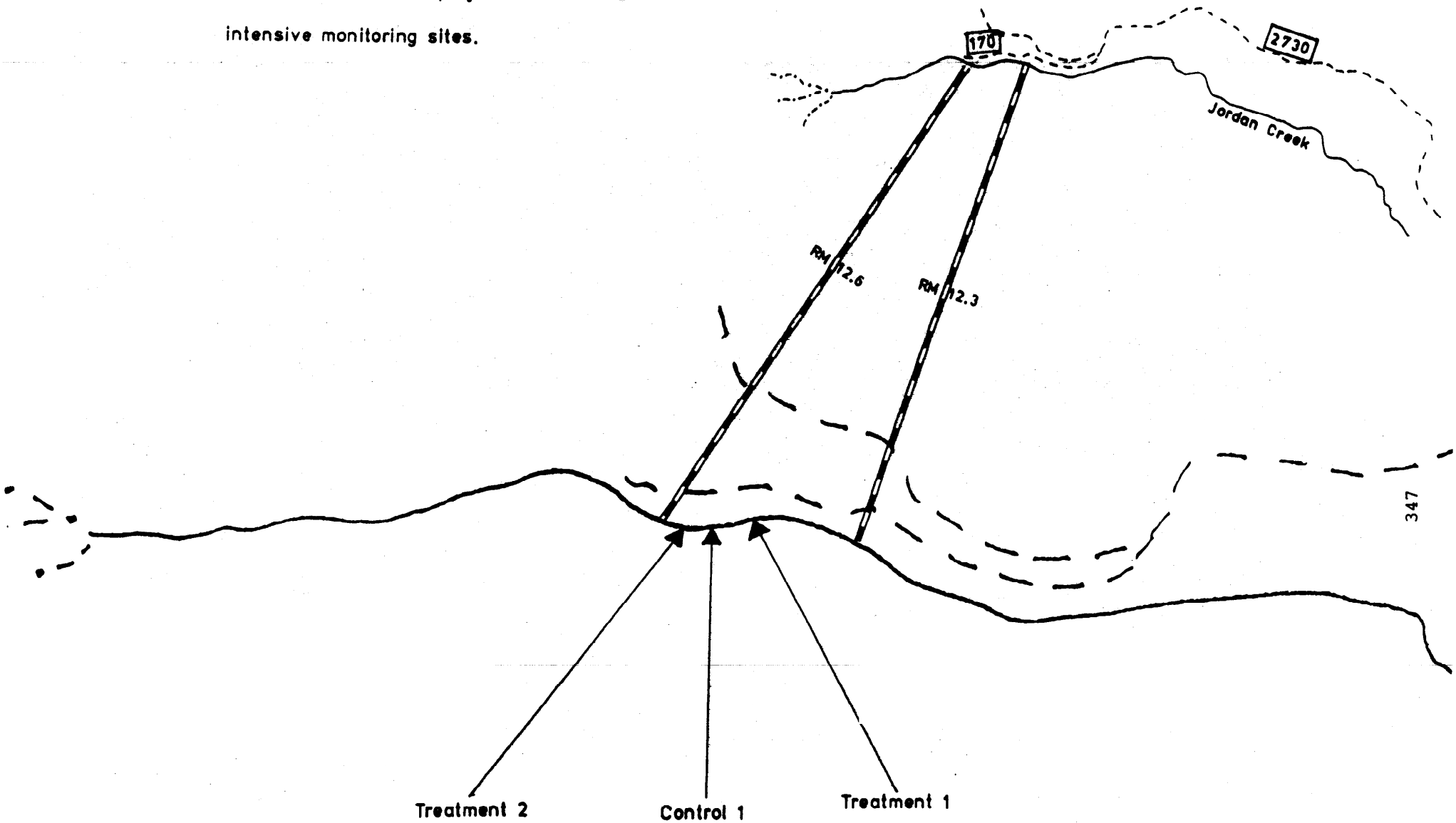
In the project area, Jordan Creek is small with an average width of 2 meters and an average depth of less than 0.2 meters at low flows. The habitat composition is 15% pool, 37% glide and 48% riffle. The habitat units are small with 3 to 4 distinct units in every 10 meter length of stream. Habitat diversity is good in both the logged and unlogged sections, and adequate potential spawning gravel is available. However, pool quality is low because of a lack of depth, water volume, and effective cover. Two treatment and one control sites were established for intensive monitoring (FIGURE 6). Population sampling indicated a salmonid density of 0.04/m2 in the project area. This is extremely low for an east side stream and considerably lower than sampling densities in this reach prior to the logging. In 1982 measured salmonid densities were 0.27/m2 (Cain 1982); densities measured in 1983 were 0.18/m2 (White River Falls Fish Passage Feasibility Report 1985). All fish collected were resident rainbow trout. Sixty percent of the sample was age class 1+up, and were collected in the deeper pools. Much of the holding water and in-stream structure is not being utilized. The low percentage of 0+ fish may indicate rearing habitat or seeding is the limiting factor.

The first phase of the habitat rehabilitation project was the planting of small cottonwoods along the stream banks. This was completed prior to the monitoring. The second phase of the project included addition of in-stream structure to increase habitat diversity and cover, and was scheduled for completion during the summer of 1986.

Fifteenmile, Eightmile and Fivemile Creeks. Fifteenmile Creek is the main stream of the Fifteenmile Drainage. It empties into the Columbia River below the Dalles Dam. Eightmile Creek, Fivemile Creek and Ramsey Creek are major tributaries to Fifteenmile Creek (FIGURE 7). A coordinated effort by the Forest Service, the Oregon Department of Fish and Wildlife (ODFW), the Wasco County Soil and Water Conservation District and the Confederated Tribes of the Warm Springs is being made to increase the run strength of wild steelhead throughout the system. Approximately 20% of the stream mileage in the drainage is within the boundaries of the Mt. Hood National Forest. Initially the major effort will be directed toward rehabilitating the lower reaches of Fifteenmile Creek and Ramsey Creek, much of which travels through private agricultural land. In these areas, the watershed has suffered heavy degradation and the streams have been subjected to major modifications, including channel straightening and relocation, and the removal of most of the wood structure. Because of past grazing and agricultural practices, extended sections currently have little or no woody riparian vegetation. Summer stream temperatures have been recorded as high as 86F on Fifteenmile Creek.

Enhancement and rehabilitation projects have been implemented by ODFW on several reaches of Fifteenmile Creek over the past several years. These have included in-stream work and the fencing of many stream sections to encourage re-establishment of a healthy riparian environment. This has helped to create stable banks in these areas and provided the necessary shading to relieve some of the temperature stress. ODFW plans to expand implementation of these projects in 1987. In 1985, they completed a passage improvement project at a partial barrier falls above the mouth, which along with the voluntary discontinuance of the Indian dip net fishery, has increased escapement into the system.

FIGURE 6. Map of Jordan Creek project section and intensive monitoring sites.



In the project area, Jordan Creek is small with an average width of 2 meters and an average depth of less than 0.2 meters at low flows. The habitat composition is 15% pool, 37% glide and 48% riffle. The habitat units are small with 3 to 4 distinct units in every 10 meter length of stream. Habitat diversity is good in both the logged and unlogged sections, and adequate potential spawning gravel is available. However, pool quality is low because of a lack of depth, water volume, and effective cover. Two treatment and one control sites were established for intensive monitoring (FIGURE 6). Population sampling indicated a salmonid density of 0.04/m2 in the project area. This is extremely low for an east side stream and considerably lower than sampling densities in this reach prior to the logging. In 1982 measured salmonid densities were 0.27/m2 (Cain 1982); densities measured in 1983 were 0.18/m2 (White River Falls Fish Passage Feasibility Report 1985). All fish collected were resident rainbow trout. Sixty percent of the sample was age class 1+up, and were collected in the deeper pools. Much of the holding water and in-stream structure is not being utilized. The low percentage of 0+ fish may indicate rearing habitat or seeding is the limiting factor.

The first phase of the habitat rehabilitation project was the planting of small cottonwoods along the stream banks. This was completed prior to the monitoring. The second phase of the project included addition of in-stream structure to increase habitat diversity and cover, and was scheduled for completion during the summer of 1986.

Fifteenmile, Eightmile and Fivemile Creeks. Fifteenmile Creek is the main stream of the Fifteenmile Drainage. It empties into the Columbia River below the Dalles Dam. Eightmile Creek, Fivemile Creek and Ramsey Creek are major tributaries to Fifteenmile Creek (FIGURE 7). A coordinated effort by the Forest Service, the Oregon Department of Fish and Wildlife (ODFW), the Wasco County Soil and Water Conservation District and the Confederated Tribes of the Warm Springs is being made to increase the run strength of wild steelhead throughout the system. Approximately 20% of the stream mileage in the drainage is within the boundaries of the Mt. Hood National Forest. Initially the major effort will be directed toward rehabilitating the lower reaches of Fifteenmile Creek and Ramsey Creek, much of which travels through private agricultural land. In these areas, the watershed has suffered heavy degradation and the streams have been subjected to major modifications, including channel straightening and relocation, and the removal of most of the wood structure. Because of past grazing and agricultural practices, extended sections currently have little or no woody riparian vegetation. Summer stream temperatures have been recorded as high as 86F on Fifteenmile Creek.

Enhancement and rehabilitation projects have been implemented by ODFW on several reaches of Fifteenmile Creek over the past several years. These have included in-stream work and the fencing of many stream sections to encourage re-establishment of a healthy riparian environment. This has helped to create stable banks in these areas and provided the necessary shading to relieve some of the temperature stress. ODFW plans to expand implementation of these projects in 1987. In 1985, they completed a passage improvement project at a partial barrier falls above the mouth, which along with the voluntary discontinuance of the Indian dip net fishery, has increased escapement into the system.

FIGURE 6. Map of Jordan Creek project section and intensive monitoring sites.

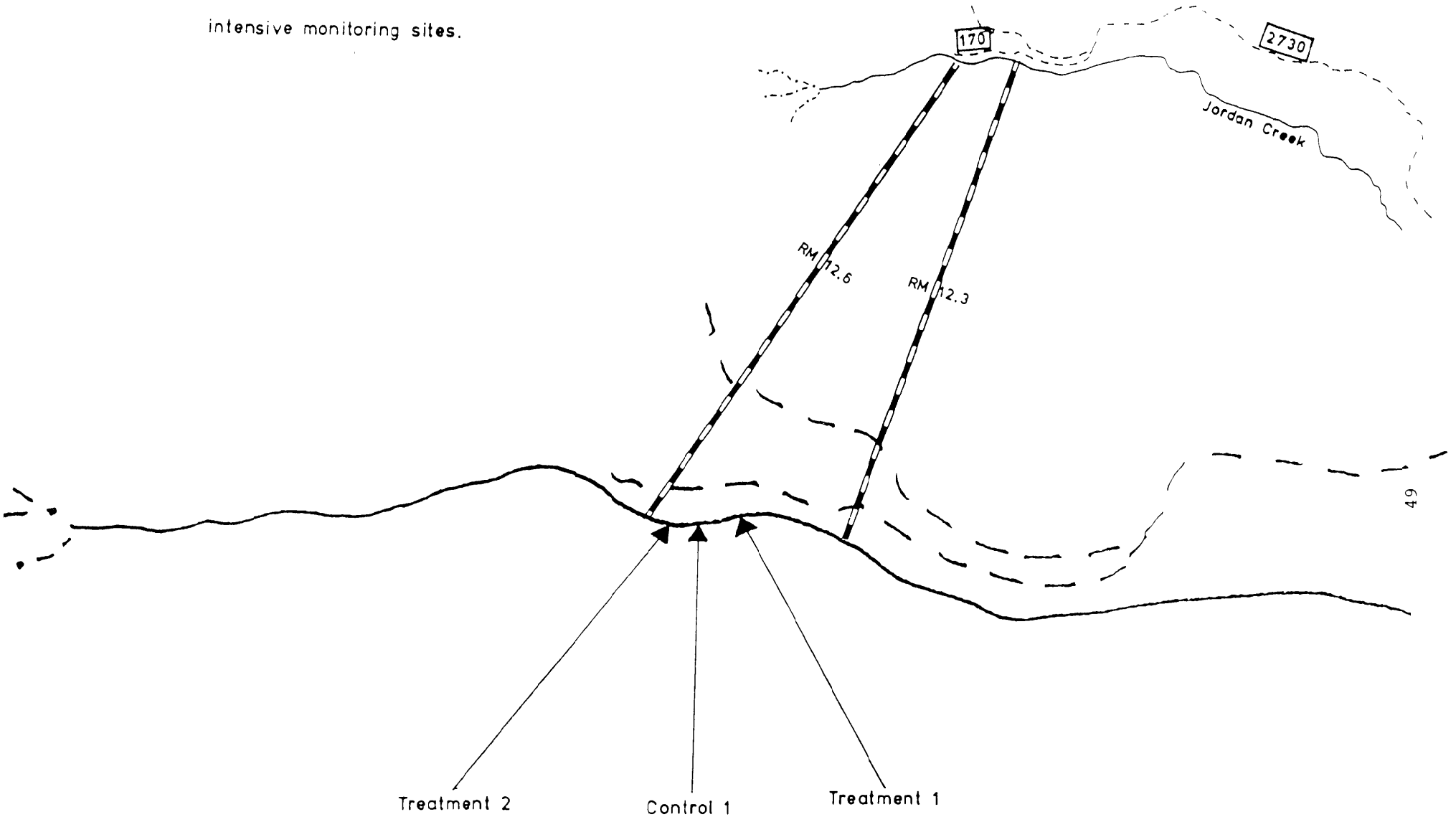
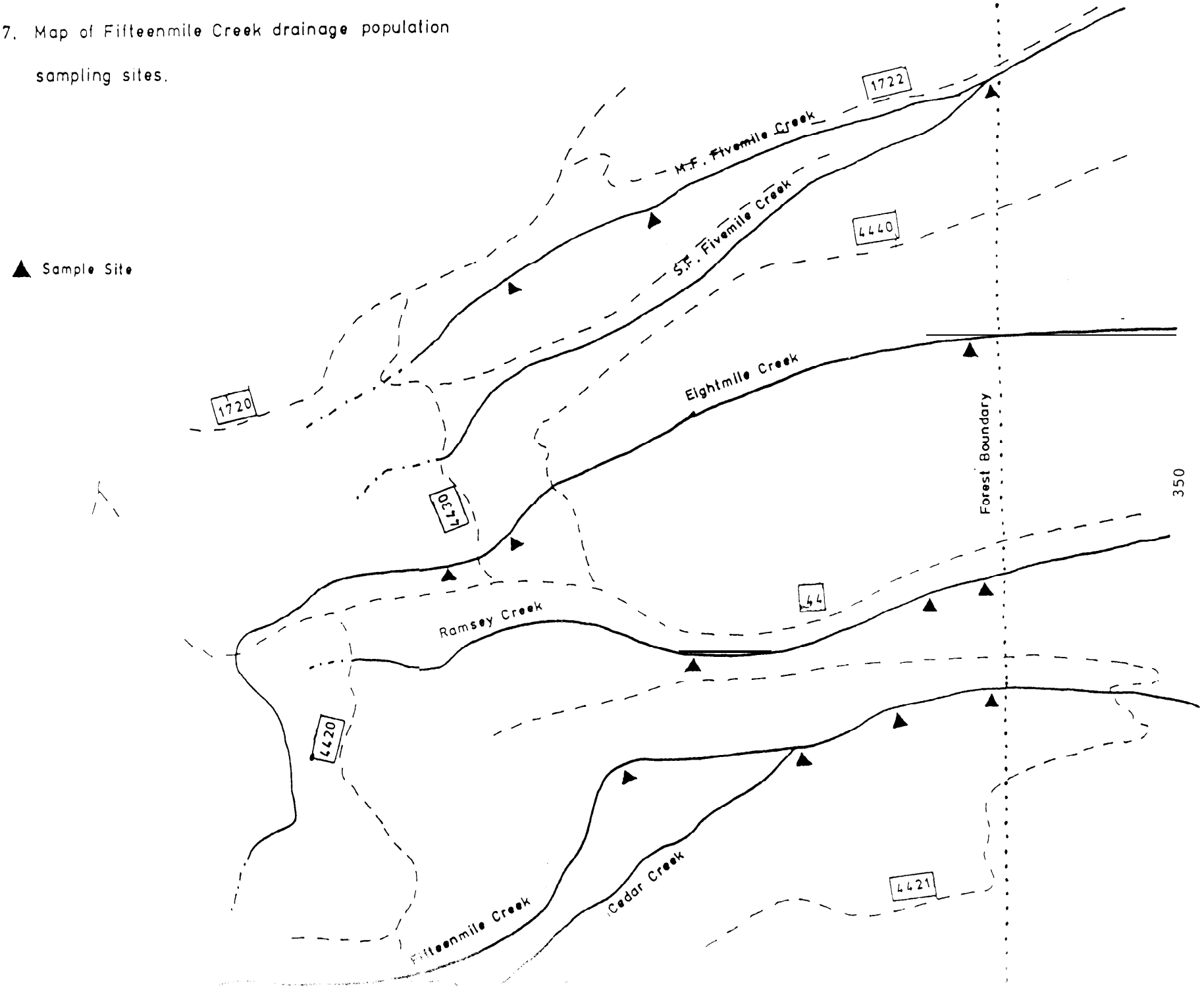


FIGURE 7. Map of Fifteenmile Creek drainage population sampling sites.



The Forest Service began preliminary population sampling of the upper reaches of the system in 1985. Enhancement and rehabilitation work was conducted on Ramsey Creek this year and will continue in 1987. Implementation of an enhancement project on Eightmile Creek is also planned for 1987. Future work in this drainage, on Forest land, will focus on the elimination of passage barriers and increasing in-stream habitat complexity. Population sampling for 1985 and 1986 is summarized in TABLE 5. Figures in TABLE 5 appear to demonstrate the result of increased escapement to the streams. Sixteen redds were seen in Fifteenmile Creek on the Forest in 1986 while none were spotted in 1985.

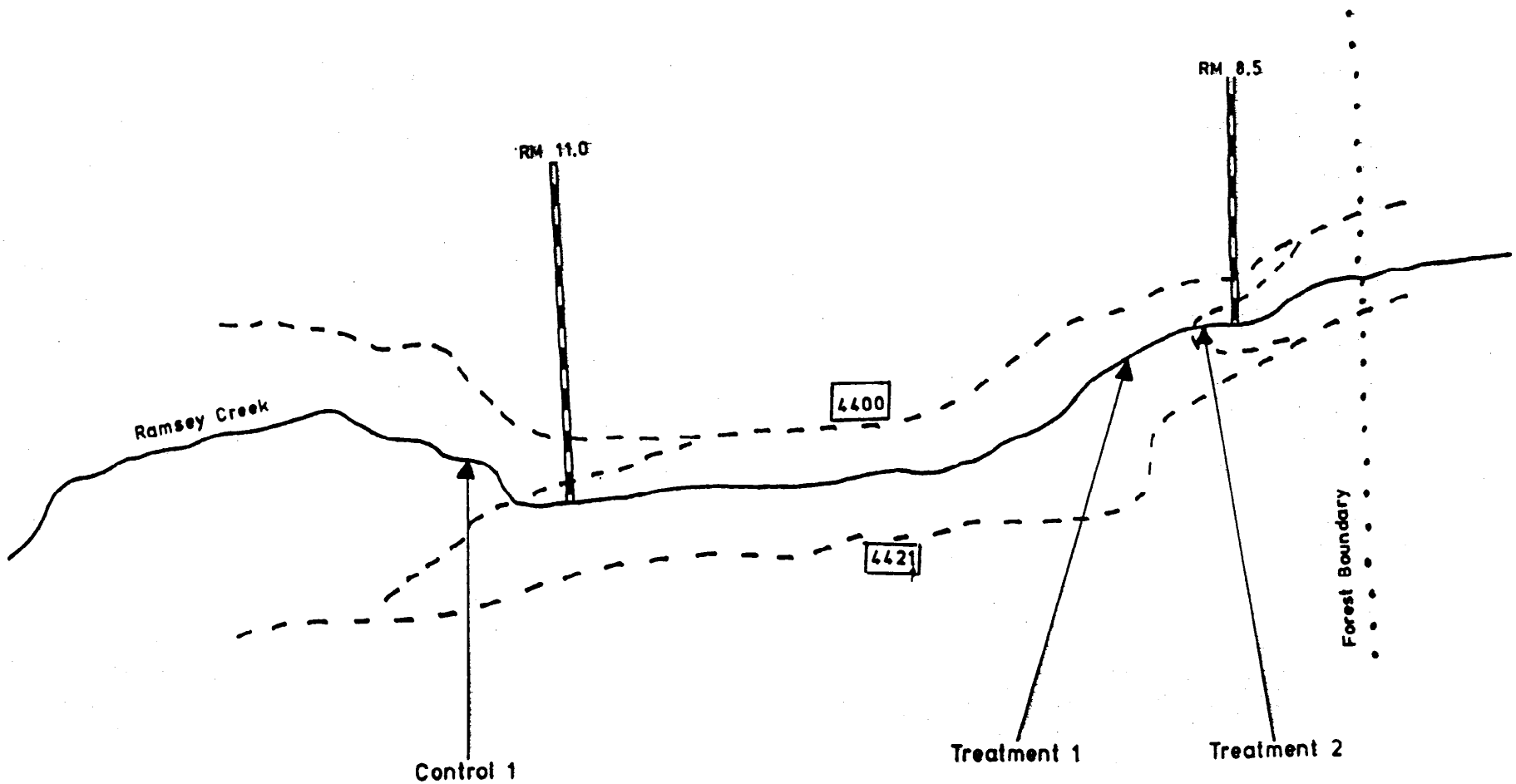
TABLE 5 Total salmonid densities measured in Fifteenmile Creek drainage streams during the 1985 and 1986 low summer flow period. Densities are expressed as number of salmonid fish per square meter of water surface area.

Stream	1985 Density (#/m2)	1986 Density (#/m2)	Number Sample Sites
15 Mile	0.12	0.28	4
8 Mile	0.10	0.18	3
5 Mile	0.66	0.60	3
Ramsey	0.26	0.45	3
Average	0.28	0.37	

Ramsey Creek. Ramsey Creek is part of the Fifteenmile Creek drainage. The project area (RM 8.5-10.5) is just inside the Forest boundary. This section has had some corridor logging activity in the past, which removed much of the in-stream wood structure as well as much of the potential future source of LWD. An access road crossing the project area has recently been closed to vehicle traffic and the culvert removed to improve fish passage conditions.

Ramsey Creek is small with an average low flow width in the project area of 3.0 meters and an average depth of 0.2 meters. The habitat composition is 18% pool, 28% glide and 54% riffle. The habitat diversity is fair and potential spawning gravel is fair. A few quality pools exist but most pools are shallow (<0.3m) and lack structure. Many of the riffles are of the rapids type and contain some pocket water.' The glides are shallow with little structure. Vegetative cover along the banks occurs in isolated spots. Two treatment and one control site were established for intensive monitoring (FIGURE 8). Fish sampling indicated a salmonid density of 0.45/m2 for the project area in 1986 and was the second highest for the streams sampled in this drainage. This is up from the 0.26/m2 density found by the monitoring team last year (Rife 1985). All fish collected were rainbow trout with 78% in age class 1+up. Like

FIGURE 8. Map of Ramsey Creek project section and intensive monitoring sites.



Jordan Creek, this may indicate a lack of quality rearing habitat or low spawning success. However, it may be skewed due to the time of sample (early July) or lower success in capturing small fish.

The enhancement and rehabilitation project on Ramsey Creek was initiated in the summer of 1986 and will continue in 1987. The main objective is to increase the pool area, and particularly, pool volume. Structure will be added to all habitat types to create diversity and increase cover, and several structures will be positioned to collect and retain spawning gravel.

McGee Creek. McGee Creek is a tributary to the West Fork of the Hood River. The project area (RM 2.0-2.9) is above a pocket of private property surrounded by Forest land. McGee Creek enters the West Fork Hood River within the private land. The 2.0 miles of stream on private land is mostly a straight channel comprised of long riffles, much of this condition is attributable to past logging activities. On the Forest, the creek also has been impacted by timber harvesting. Areas of previous clear cut harvest extend to the water's edge. Stream clean-out activities removed most of the wood structure. Currently, these reaches appear to contain only resident trout but are accessible to Hood River steelhead.

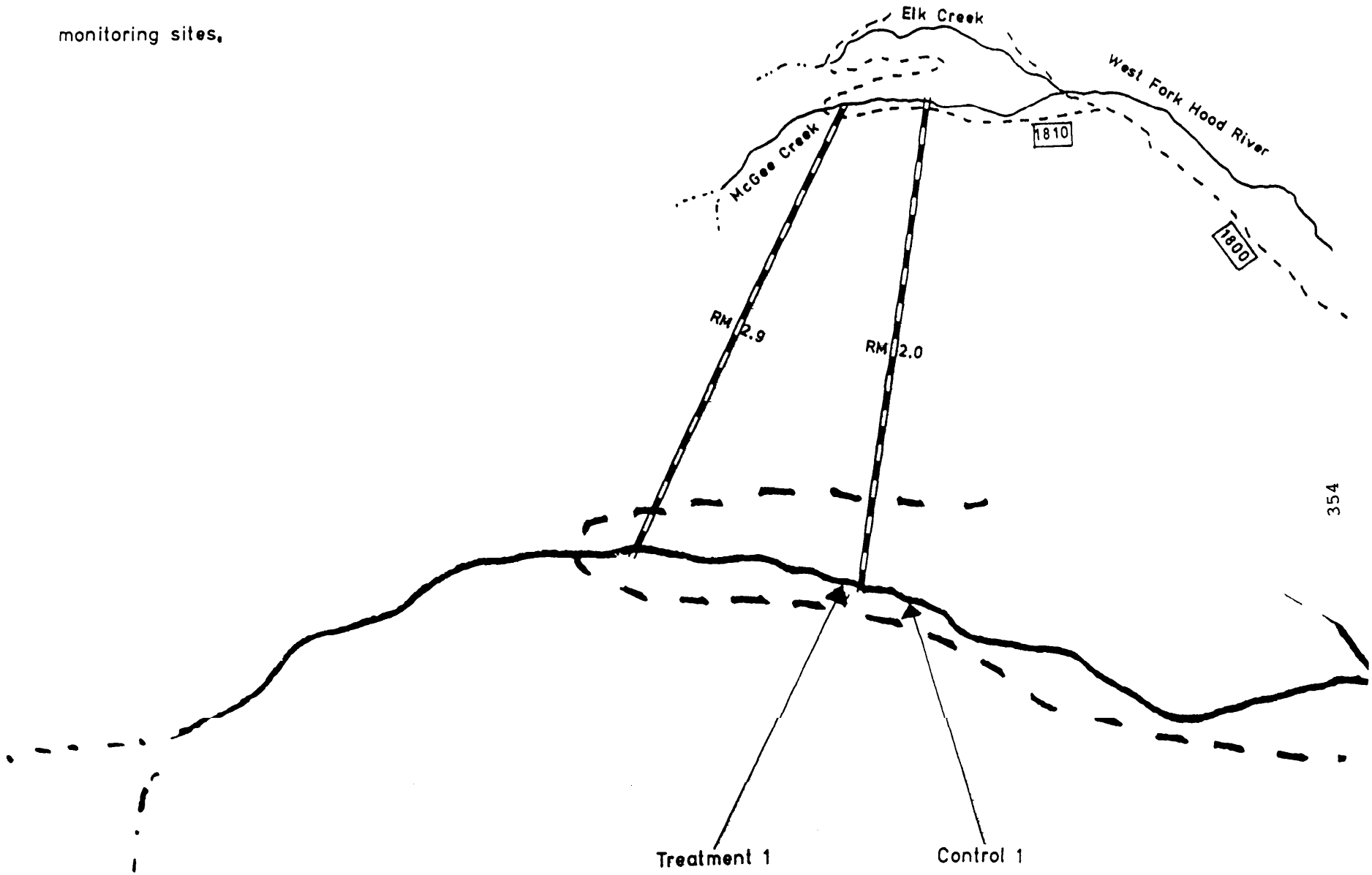
In the project area McGee Creek averages 5 meters in width and slightly less than 0.2 meters in depth during low flows. Habitat diversity is low, mostly comprised of low gradient riffles with cobble substrate. There are few full channel pools. Most of the pools lack structure and average less than 0.3 meters in depth. Potential spawning gravel is low. One treatment and one control site were established for intensive monitoring (FIGURE 9). A salmonid population density of O.ll/m2 was indicated for the project area in 1986. Sampling in 1985 indicated a salmonid density of 0.13 fish/m2 in this area.

The McGee Creek enhancement project was implemented during the summer of 1986. The use of wood structure to increase habitat diversity is the primary objective of the project. Several wood sills were positioned to create full channel plunge pools. Additional structure was added along the channel edges to add l+ rearing habitat. Some of the added structure is expected to collect spawning gravel and future utilization by steelhead is anticipated.

Hot Springs Fork. The Hot Springs Fork of the Collawash River is part of the Clackamas River Drainage. It is a main tributary to the Collawash River. Stream improvement work has been conducted on two tributaries to the Hot Springs Fork in the last two years. Most of this work involved the removal of passage barriers and some addition of pool habitat. These projects, along with the (earlier construction of a fish ladder on Hot Springs Fork at Peg Leg Falls, were Implemented to increase the habitat available to anadromous salmonids. The 1986 project area (RM 2.9-3.8) is above Kingfisher Campground near the mouth of Dutch Creek.

In the project area, Hot Springs Fork is moderately large with an average low flow width of 14 meters and an average depth of 0.5 meters. The habitat units are large with the median size in the project area 380 square meters. This section has a good habitat composition of 48% pool, 19% glide and 33% riffle, but diversity is low and the overall condition is only fair. The pools are

FIGURE 9. Map of McGee Creek project section and intensive monitoring sites.



generally large and deep but quality is low due to a lack of structure and effective cover. The riffles are panned out in broad flood channels and become quite shallow during low flows. The glides have little structure and contain only small amounts of pocket and holding water. Lack of low velocity holding water is accentuated during high, fast flow periods. Overwintering habitat is considered to be one of the limiting factors in this area. Two treatment and one control site were established for intensive monitoring (FIGURE 10). Population sampling indicated a salmonid density of O.l7/m2 for 1986. All collected salmonids were rainbow/steelhead except for 4 cutthroat trout, 3 of which were large adults. Almost all the 2+up fish were collected in association with the limited structure of pool habitats.

The enhancement project was initiated during the summer/fall of 1986. The objectives were the addition of structure and cover in the pools, a narrowing and deepening of the channel through the riffles, addition of structures in the glides and riffles to create pocket pools and holding water and the creation of a side channel for overwintering habitat.

Camp Creek. Camp Creek is part of the Sandy River Drainage. The project area (RM 1.5-1.8) is in Camp Creek Campground. A recent salvage sale occurred on the west side of the stream. The campground has heavy use during the summer but is closed during the winter. This area is stocked with hatchery fish during the summer and receives heavy angling pressure. The creek is used by winter steelhead, coho and chinook salmon, and a small population of resident trout. This stream, along with many in this drainage, had most of the in-stream structure removed during several flood control projects.

In the campground reach, Camp Creek averages 9.4 meters wide and has an average depth of 0.25 meters at low flows. The habitat composition is 6% pool, 12% glide and 82% riffle. There is little habitat diversity, as the area is almost entirely low gradient riffle with only a few scattered boulders. The channel is generally broad and shallow, contains minimal wood structure and lacks pocket and holding water. The few pools are low quality with limited effective cover. This area contains a high quantity of potential spawning gravel. However, it is almost totally void of good rearing habitat, particularly for steelhead. Two treatment and one control site were established for intensive monitoring (FIGURE 11). Population sampling indicated a total salmonid density of 0.17/m2 in the project area. This density is somewhat misleading though. At least 10% of the rainbow population could be identified as hatchery plants and one sampling site contained one of the few good coho rearing habitats.

The Camp Creek enhancement project was completed during the summer of 1986. The main emphasis was the addition of wood structure. The objective is to create mainstem and off-channel pool habitat, diversify the habitat in the riffles by creating pocket and holding water, and establish rearing habitat along the stream edges. The expected benefits are a better retention of hatchery planted fish, to upgrade recreational value, and increased use by anadromous salmonids because of added rearing habitat and improved steelhead holding water. This high profile area can also be used for public education on the benefits of habitat enhancement and rehabilitation.

FIGURE 10. Map of Hot Springs Fork project section and intensive monitoring sites.

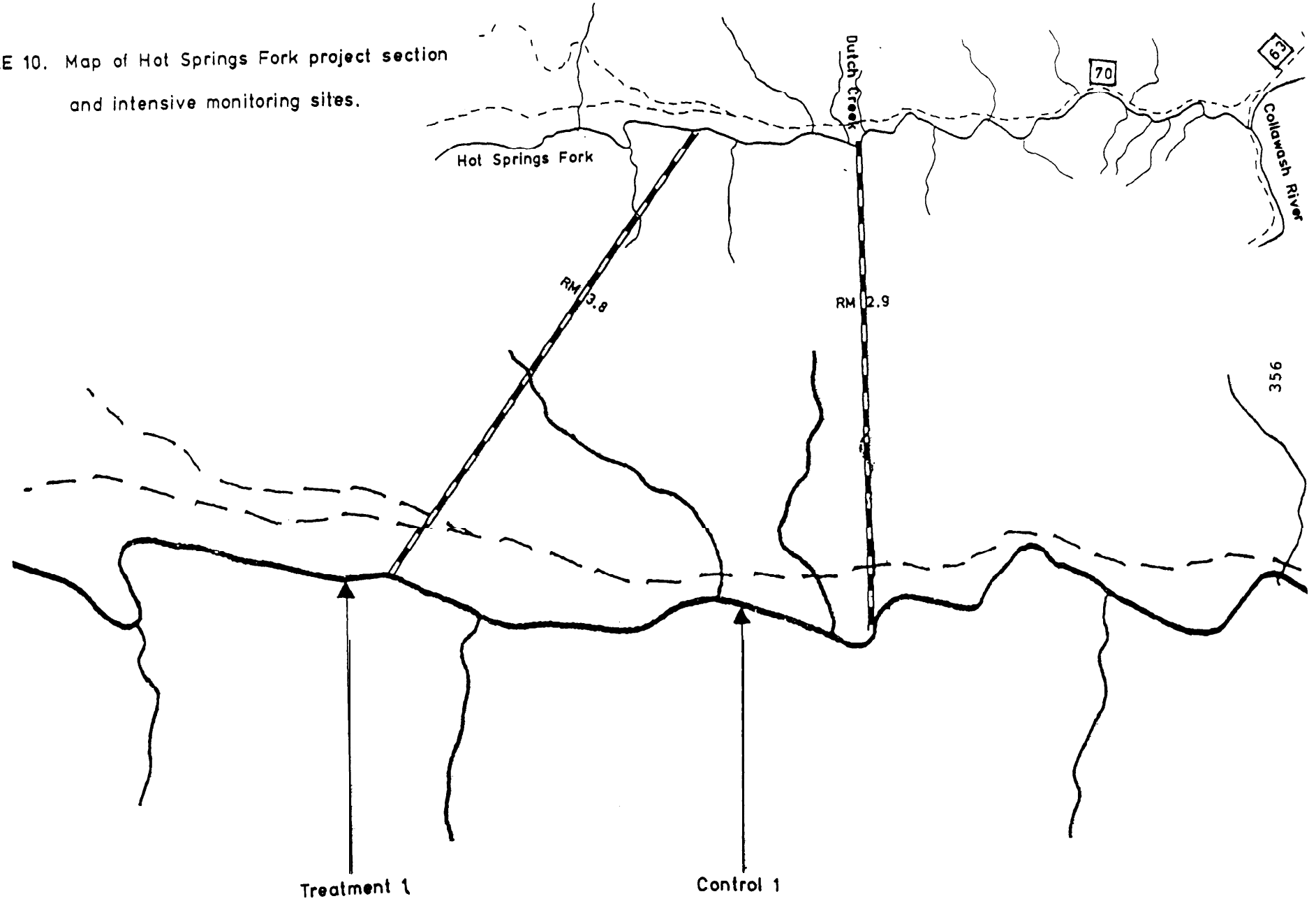
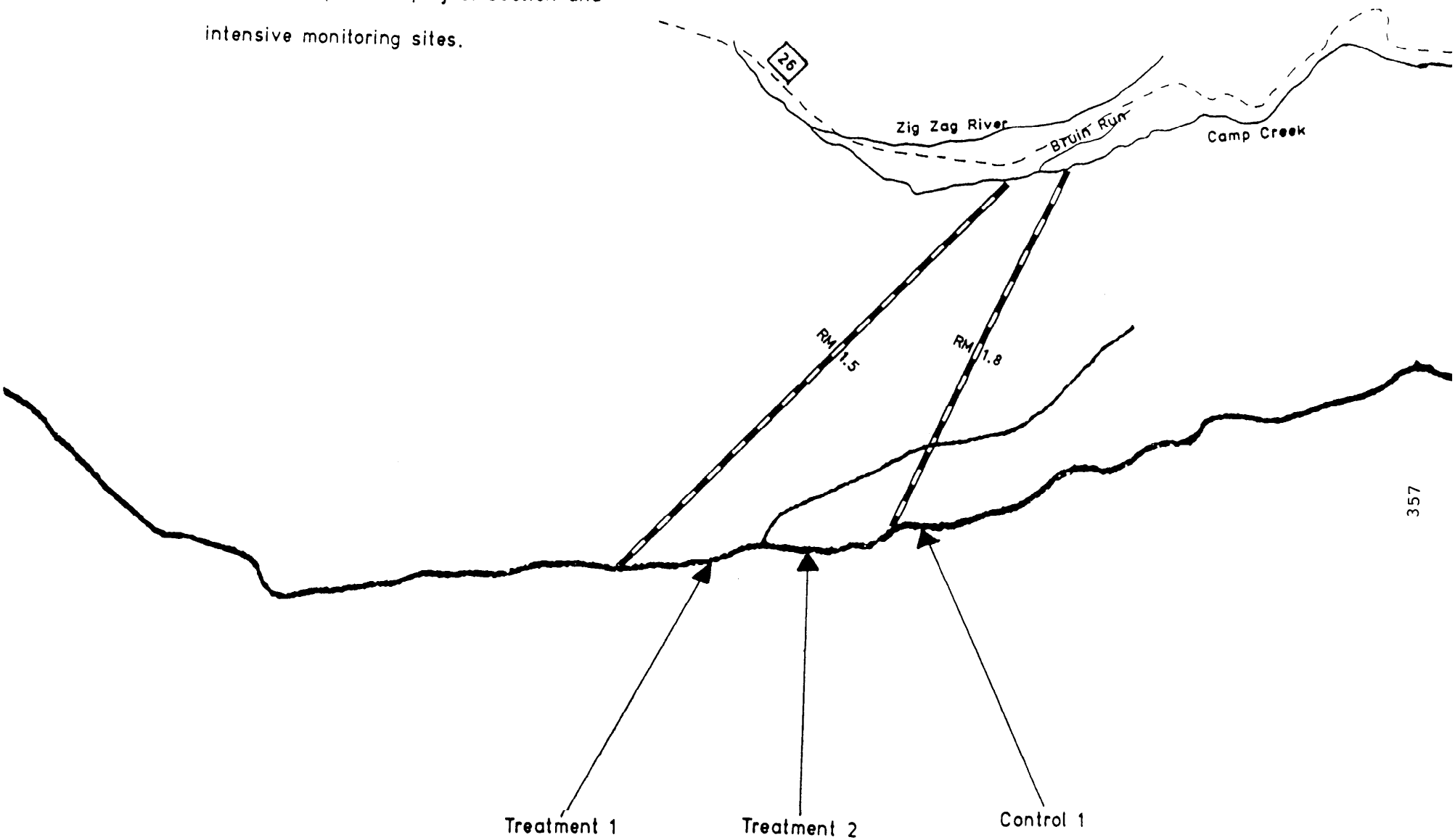


FIGURE 11. Map of Camp Creek project section and intensive monitoring sites.



Lost Creek. Lost Creek is part of the Sandy River Drainage. The project area (RM 0.3-0.8) runs through two recent timber sales. Much of the in-stream structure had already been removed prior to the timber sales. Lost Creek supports populations of winter steelhead, coho and chinook salmon and resident rainbow and cutthroat trout.

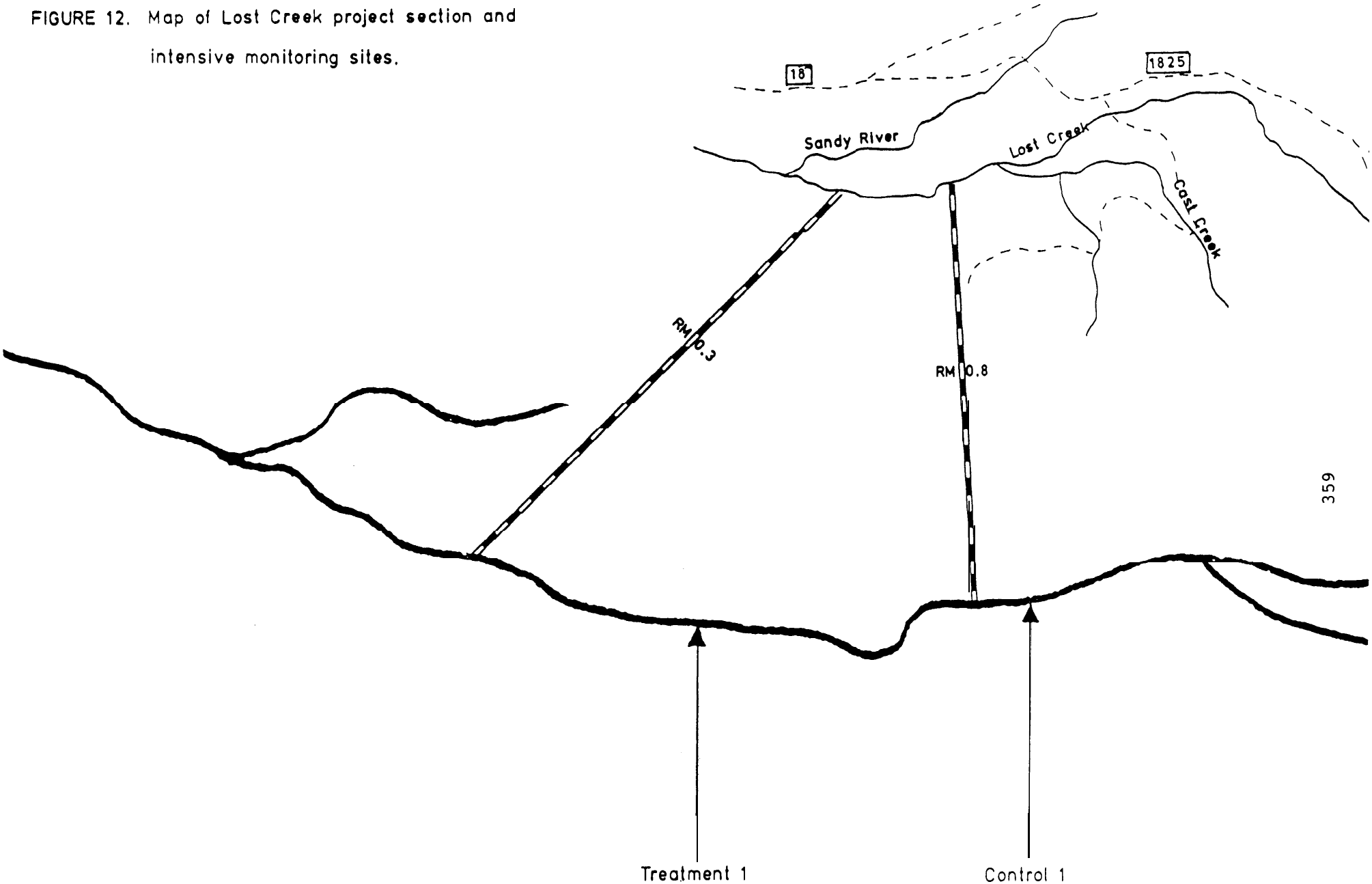
In the project area Lost Creek has an average width of 10 meters and an average depth of 0.3 meters at low flows. The habitat composition is 11% pool, 20% glide and 69% riffle. Habitat diversity is low. Most of the project area is composed of broad, shallow riffles alternating with short, shallow glides. Although a few of the pools are large and deep, they have no significant structure and little effective cover. A fair quantity of potential spawning gravel is present but rearing habitat is limited. One treatment and one control site were established for intensive monitoring (FIGURE 12). Population sampling indicated a total salmonid density of O.l6/m2 in the project area. Of the fish captured, 63% were 0+ coho, mostly collected at the margins of the stream.

The Lost Creek enhancement project was completed in the summer of 1986. A major part of the project was the addition of large woody structure. The objective is to enhance the quality of the already existing large pools by increasing complexity and effective cover; add structure to the glides and riffles to force a narrowing of the channel and creation of pocket and holding water. Several side channels received work to increase low flow volume to improve summer rearing habitat conditions. Work was also completed to increase the volume of structure, thereby improving overwintering habitat quality.

Still Creek. Still Creek is part of the Sandy River drainage. Enhancement and rehabilitation work was begun on Still Creek (Reach 2) in 1984 (see Post-Treatment Findings portion of the DISCUSSION). The 1986 project area (Reach 1) begins at the crossing of Road 20 and extends upstream for two miles, (RM 1.0-3.0). bringing the total miles of treated stream to 3.5. The 1986 project area runs through a section of summer homes. The gradient is lower (2.5%) and the dominate substrate smaller (rubble) than the area of the 1984 work. Most of the wood structure was removed from this section of the stream after the 1964 and 1974 floods. The salmonid fish population is made up of winter and summer steelhead, coho and spring chinook salmon, and some resident trout. Hatchery planting of coho pre-smolts and adults, summer steelhead smolts, and spring chinook smolts has occurred at various times in recent years. Recent sampling suggests that an early run of wild spring chinook salmon has persisted in Still Creek, despite hatchery outplanting of a later returning chinook race.

In the Reach 1 project area, Still Creek averages 12 meters wide but has an average depth of only 0.25 meters at low flows. Since the removal of woody structure, this section has formed a broad, shallow flood channel dominated by shallow riffles and glides. Large amounts of very shallow (l-3 inches) margin water occurs along the edges of the riffles and glides during low flows. The overall habitat composition is 15% pool, 32% glide and 53% riffle. The habitat units are large and there is low diversity with little pocket or holding water. A few large pools exist but they lack structure and effective cover. Structure is limited to a few boulders and some small pieces of wood debris. A number of large gravel bars are present and potential spawning gravel is high.

FIGURE 12. Map of Lost Creek project section and intensive monitoring sites.



habitats produced desired increases in the pool/riffle ratio. The degree of change usually related to the concentration of work, or amount of added structure per area. FIGURE 14 demonstrates this general relationship, based on data from the Oak Grove Fork Project.

A significant increase in glide habitat also occurred in all project areas. At the Still Creek project, glide habitat accounted for 84% of the riffle reduction. Since glide habitat often contains a mix of pocket pools and slack water, this is a good indication of success in adding habitat diversity. Glides often contain the habitats preferred by l+ and older steelhead. The strategic placement of boulders in many of riffles, also created pocket pools and holding water for steelhead.

At all five project areas an effort was made to improve the quality of pool habitats by increasing effective cover. Overall, however, the pool quality and effective cover remained low in the project areas. Pool quality can be a difficult condition to modify, since stream side vegetation, undercut banks, depth and substrate often supply much of the effective cover. The addition of wood debris in several pools showed promising results; population sampling indicated heavy utilization of this cover.

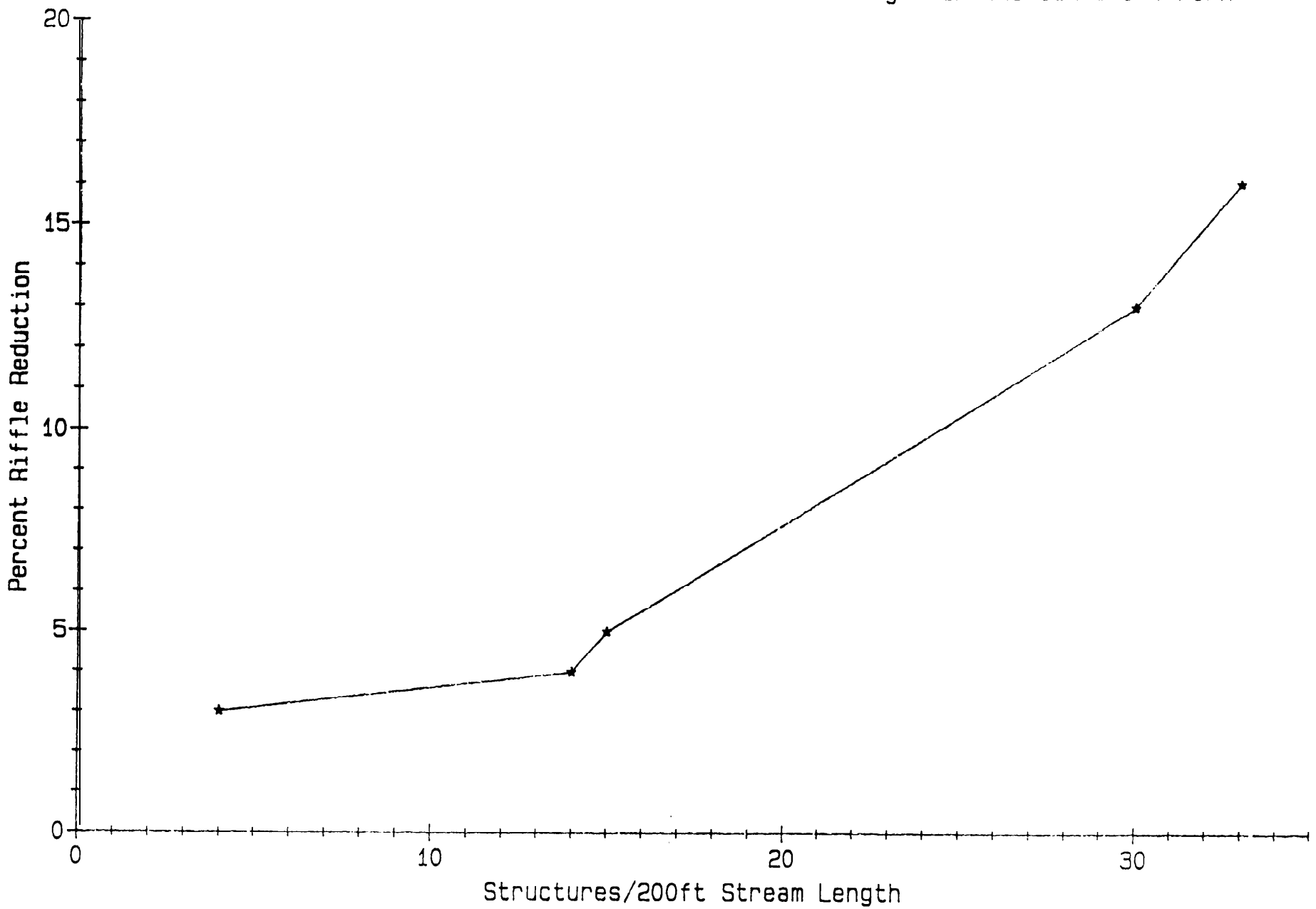
Population sampling in 1986 indicated higher use of the project sites by salmonids than prior to project implementation. This was particularly true of l+ fish. The l+ fish were frequently captured around, and in association with the new habitats and added structure. This utilization is encouraging both as an indication that the enhancement procedures and techniques are successfully creating the preferred habitat types and that the assumed habitat deficiencies were correct. Population densities in control sections did not show corresponding increases, but remained similar to pre-project levels. This appears to indicate higher survival, especially of l+ fish, and an increase in population rather than a re-distribution of the population within the area.

A brief summary of the post-treatment data and evaluation follows for each of the project areas examined in 1986.

Still Creek. Still Creek is part of the Sandy River Drainage. The project area runs from RM 3.0 to RM 4.5. In 1964 and 1974, after damaging floods on Still Creek, the Forest Service removed most of the woody debris in and around the stream channel. The removal of large wood eliminated many of the factors which helped to dissipate high flow energy and maintained the previously diverse habitat characteristics of the system. Thus began a process which eventually changed the creek to a broad, shallow, riffle dominated habitat. Prior to the enhancement project, Still Creek had become 95% riffle in some reaches. The objectives of the project are to reduce the riffle habitat, diversify habitat composition, create habitat for l+ steelhead, add additional coho rearing habitat, improve overwintering conditions, and create adult holding water for spring chinook salmon.

The first work in the project area was conducted during the summer of I984 and consisted mainly of boulder placement in the stream channel. The emphasis was on creating small pocket pools in the main channel, small alcove pools along the periphery, and modifying flow patterns and reducing velocities to create glide habitat. In the summer of 1985 additional work was done in this area.

FIGURE 14. The percent riffle reduction achieved as a function of the number of structures added in 200feet of stream length in the Oak Grove Fork



It included the reworking of some sites and new work at additional sites. The necessity for using multiple boulder placements for certain desired results had become evident. In the summer of I986 this enhancement effort continued in a different reach (see the Pre-Treatment Findings section of the DISCUSSION).

In 1985 three treatment and two control sites were established for intensive monitoring within Reach 2 (FIGURE 15). Treatment sites #1 and #3 were first treated in 1984. Additional treatment measures were completed at these sites in 1985. Treatment site #2 was also treated in 1985. Control site #l is representative of the poor condition (i.e. shallow riffle dominated) in Reach 2 of Still Creek prior to project implementation. Control site #2 is above the treatment area and is overall higher quality habitat. Still Creek at control site two is characterized by a more will defined, deeper channel with some structure.

FIGURE 16 displays the habitat composition of the control sites in 1985 and their habitat composition during the 1986 survey. Control site #l shows almost no change in composition from 1985 to 1986. At control site #2 only a very small shift in habitat composition is indicated. This figure is included to demonstrate that changes in habitat composition within the treatment sites, noted below, are not likely due to natural variation in the stream channel.

FIGURE 17 presents a comparison of habitat composition in treatment site #2 between 1985 and 1986. Habitat evaluation in 1985 was made prior to implementation of improvement activities; the 1986 habitat composition represents post-implementation habitat characteristics. The tremendous reduction in riffle habitat (74%) was probably due in part to the nature of the section (i.e. the channel was easily confined, replacing a long riffle with a long glide), but may also indicate improvement in implementation technique obtained after the first year's experience.

FIGURE 18 provides a comparison of the habitat composition at treatment sites #l and #3 for 1985 and 1986. Habitat composition measured in 1985 represents the stream's characteristics following initial (1984) treatment activities. The 1986 habitat composition represents stream characteristics following implementation of additional improvement activities in 1985. Increasing the density of improvement structures, and improving the siting of some structures at these treatment sites resulted in substantial conversion of riffle habitat to pool and glide habitat.

The amount of pool habitat area measured in 1986 within the Reach 2 treatment area, although small, is significant. The added pool habitat area resulted form the creation of a large number of small alcove and lateral pools that averaged less than 50 square meters in size. Only three pools larger than 75 square meters were surveyed. Had the evaluation technique provided for inclusion of "pocket pool" habitat, about 20% more pool habitat would have been identified.

Total salmonid population densities in 1986 were down slightly from the 1985 sampling at all sites. However, in 1985 over 20,000 coho pre-smolts were released in the system, and this species made up more than 50% of the 1985 captures. In 1986 there was no coho release in the system and this species made up less than 25% of the captured fish. An examination of the rainbow/steelhead trout captured for each year shows an increase for this

FIGURE 15. Map of Still Creek (Reach 2) project section and intensive monitoring sites.

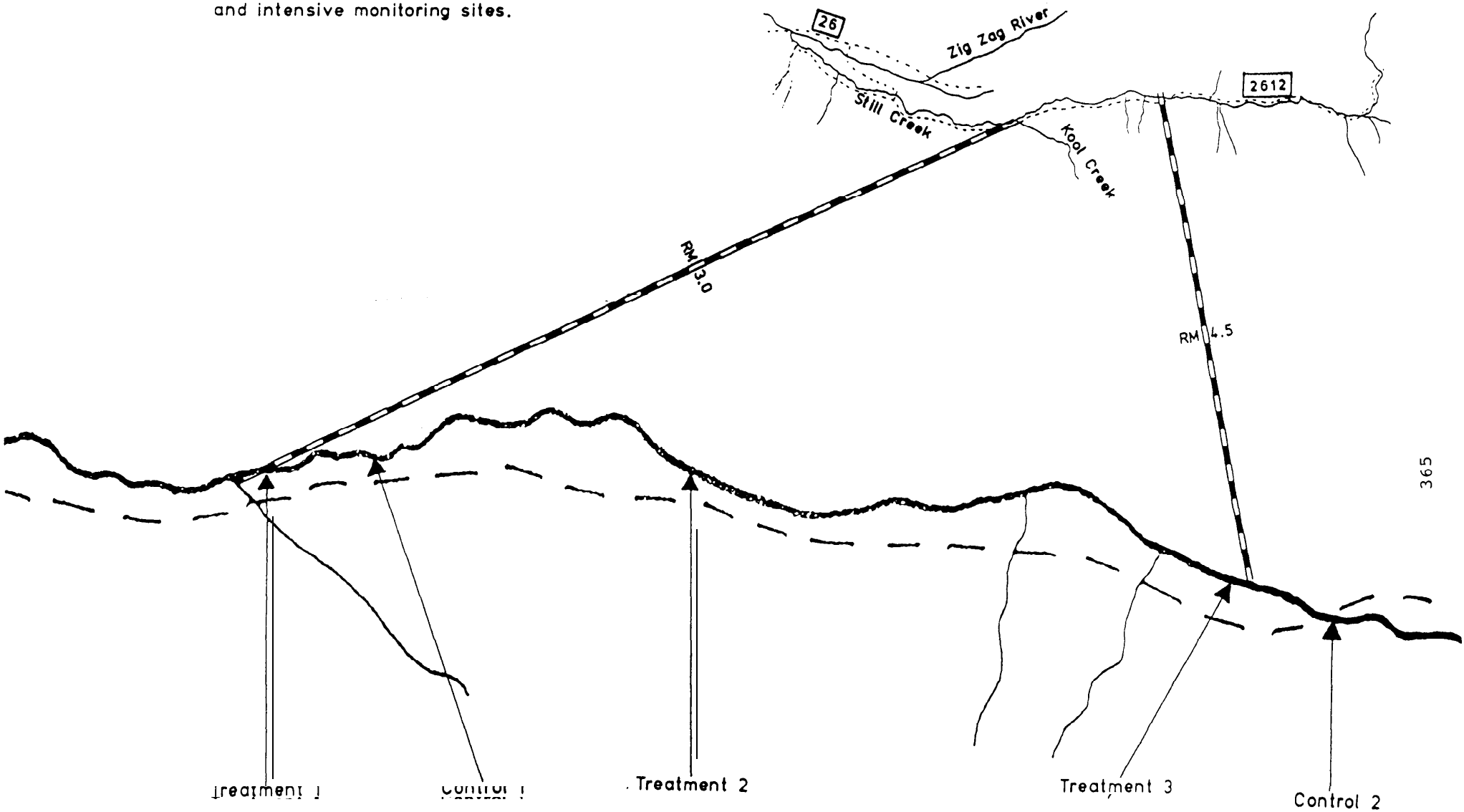


FIGURE 16. Comparison of the habitat composition at the 2 control sites on Still Creek during the summer of 1985 and during the summer of 1986.

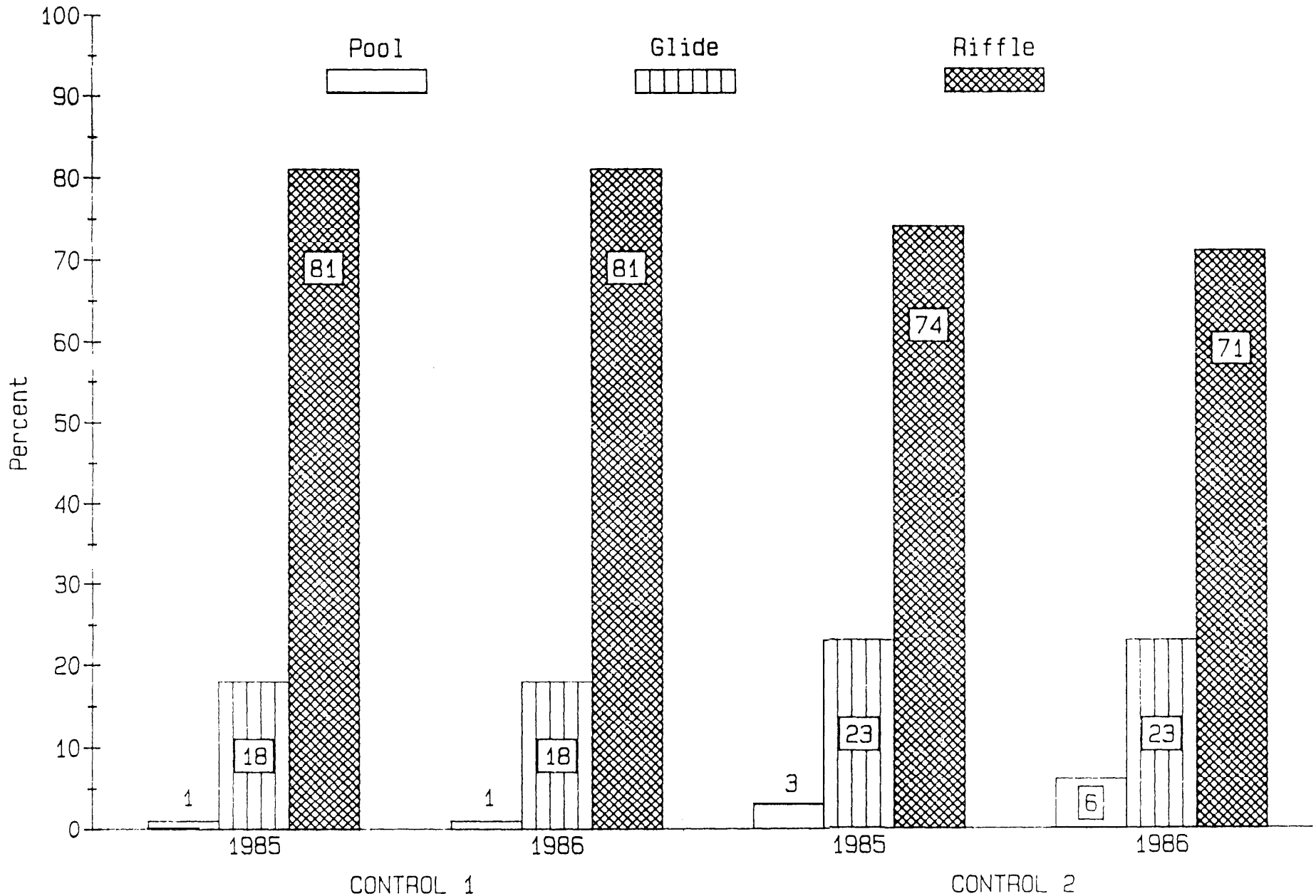


FIGURE 17. Comparison of the habitat composition at 1 treament site on Still Creek during the summer of 1985, prior to treatment, and during the summer of 1986, 1 year after treatment.

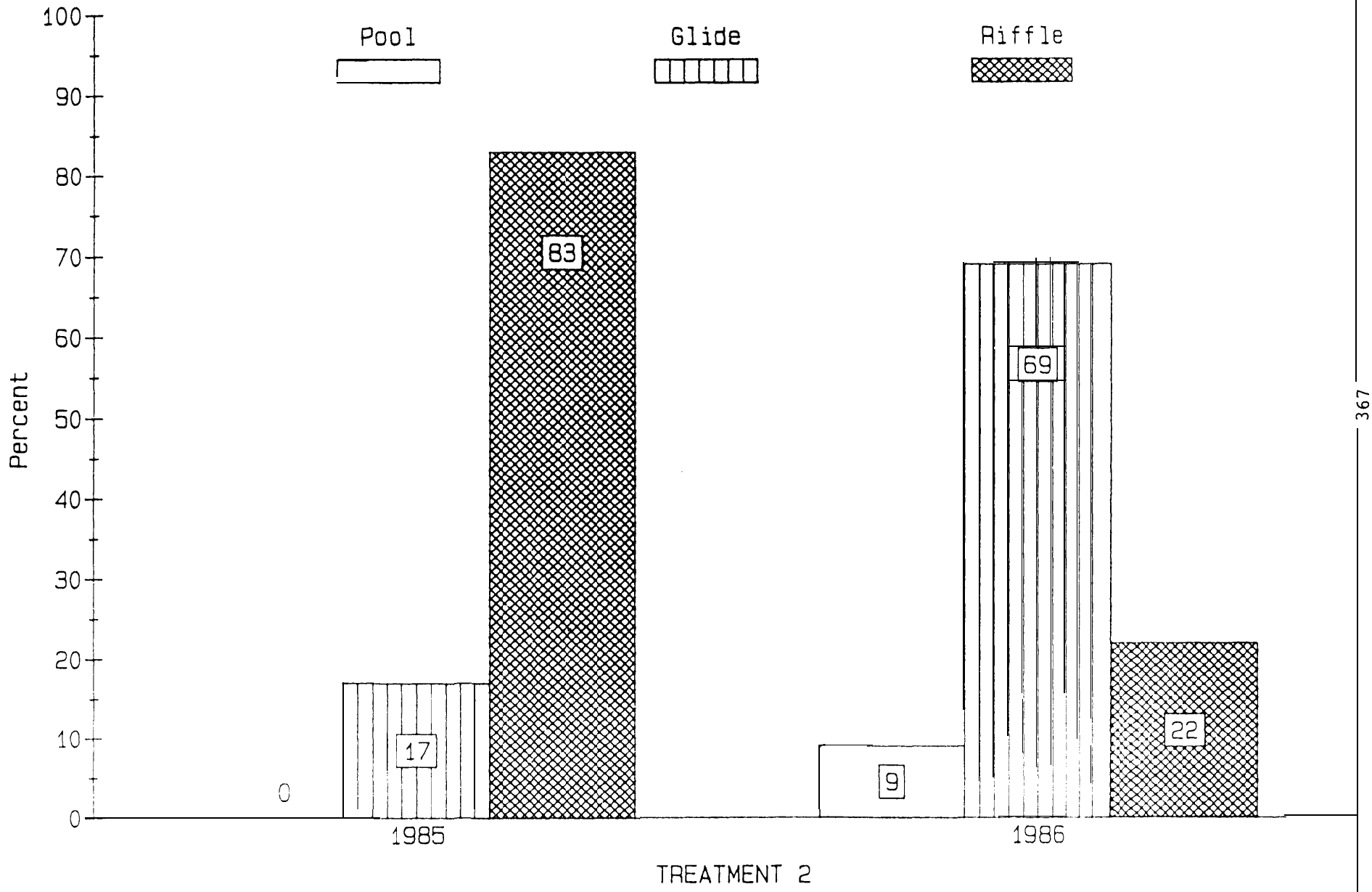
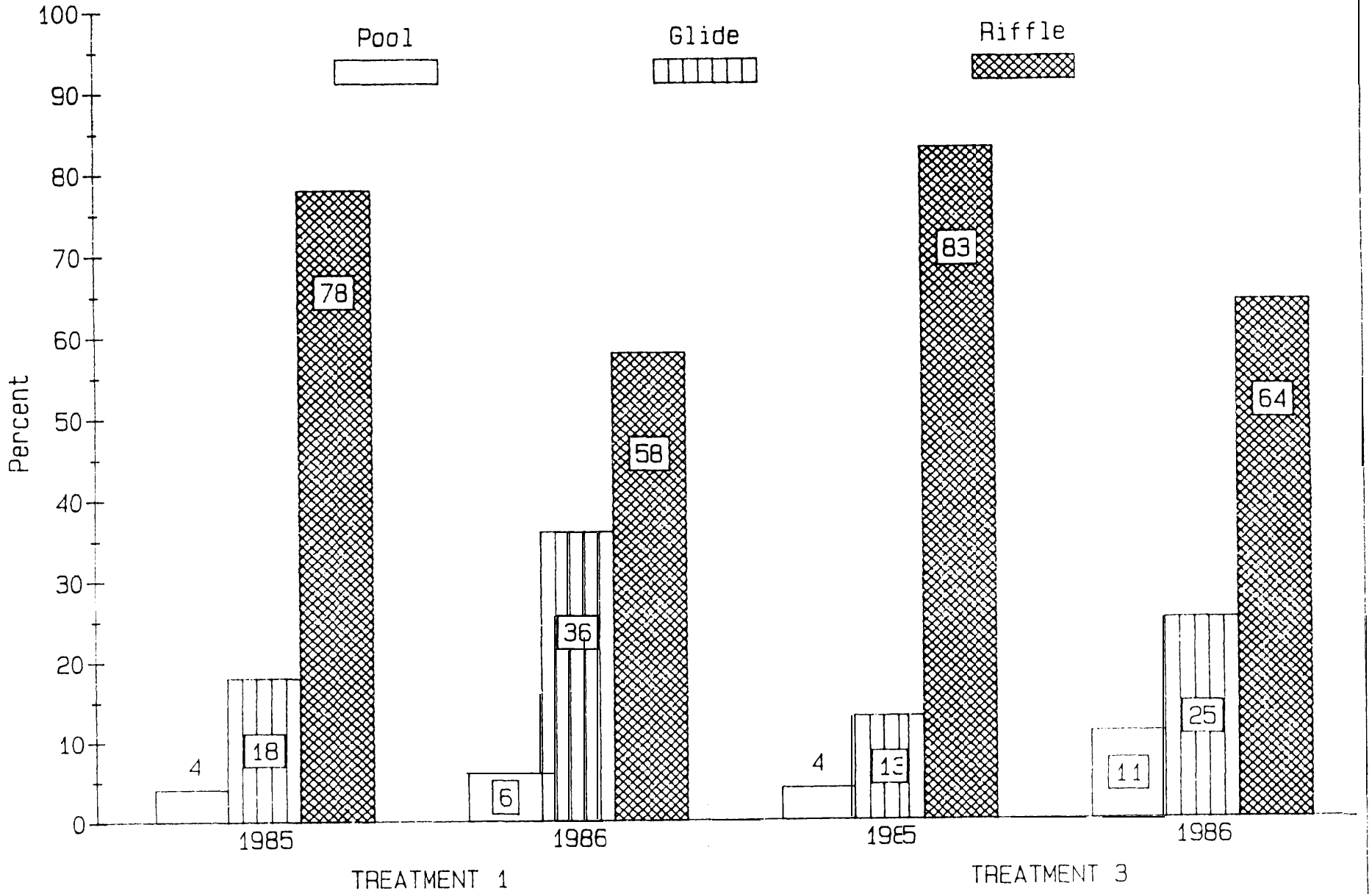


FIGURE 18. Comparison of the habitat composition at 2 treatment sites on Still Creek during the summer of 1985, 1 year after treatment, and during the summer of 1986, after the second year of treatment.



species in 1986 at all sites except treatment site #2, which remained about the same as 1985. The increase was particularly evident in the older age classes, 2+up. Capture numbers of l+ and larger fish from each site for 1985 and 1986 is shown in FIGURE 19. Treatment site #3 and control site #2 contained many small, deep, pocket pools which provide excellent habitat for the larger steelhead.

Treatment site #3 proved to be very successful in holding legal size fish, even though this site receives considerable angling pressure, as it is crossed by a road. On the survey day, 7 fisherman passed through the area during the period of the inventory. Of the 132 rainbow/steelhead captured by electrofishing techniques, 49 were of legal size. In spite of the angling pressure, the data show a large increase (about 100%) in 1+ rainbow/steelhead associated with the diversified habitat. The treatment consisted of placement of a number of large boulders to modify flows in some of the riffle and glide habitat. Although no large pools were created, many small areas of pocket water and holding water, favored by l+ steelhead, were created around and behind the boulders. The overall change was a reduction of 20% in the riffle habitat.

Off-stream rearing ponds for coho were created in several locations in 1984 (FIGURE 20). These man-made ponds attempt to mimic off-channel beaver ponds. Two beaver ponds, #l and #2, and two man-made ponds, #3 and #4, were shocked in 1985 and 1986. Densities for these ponds are shown in FIGURE 21. Densities were higher in 3 of the 4 ponds in 1985. This is likely due to the 1985 release of hatchery coho fry in the stream. In 1985, man-made pond #4 showed a comparable density to the beaver ponds, but the density of man-made pond #3 was very low. A lack of effective cover was considered the probable problem, and woody debris was added in 1985. In I986 all the ponds showed similar densities, with pond #3 actually having the highest density.

Still Creek improvement activities have successfully meet project habitat objectives and are showing promising increases in the rainbow/steelhead population. The lack of structure has been addressed and the desired rearing habitats are being created and utilized. As the project continues, the overall habitat change should become more evident and will have a synergistic effect on the overall condition and stability of the stream.

Oak Gove Fork. The Oak Grove Fork is a major tributary to the Clackamas River. The project area (RM 9.2-11.2) is between Timothy Lake and Harriet Lake and contains only resident trout (FIGURE 22). Timothy Lake is used for storage and flow peaking to produce electricity. The resulting high discharges and velocities have resulted in channel scouring. High flows appear to be prevalent in this section even during the summer months. The first attempt to survey the project area found the discharge and water depth too high to work in, and much greater than encountered during the 1985 pre-project survey. The monitoring was delayed until the discharge was reduced for maintenance on the Timothy Lake dam.

This reach of the Oak Grove Fork contains several side channels which provide excellent habitat and may hold a large percent of the trout population in this reach. The project area is more than 90% riffle habitat. This condition appears to be related to the frequent high flows and a general lack of in-stream structure. The project, almost exclusively, used large boulders in

FIGURE 19. Comparison of the number of 1+ and older rainbow/steelhead trout captured at 3 treatment and 2 control sites on Still Creek during the summer of 1985 and the summer of 1986.

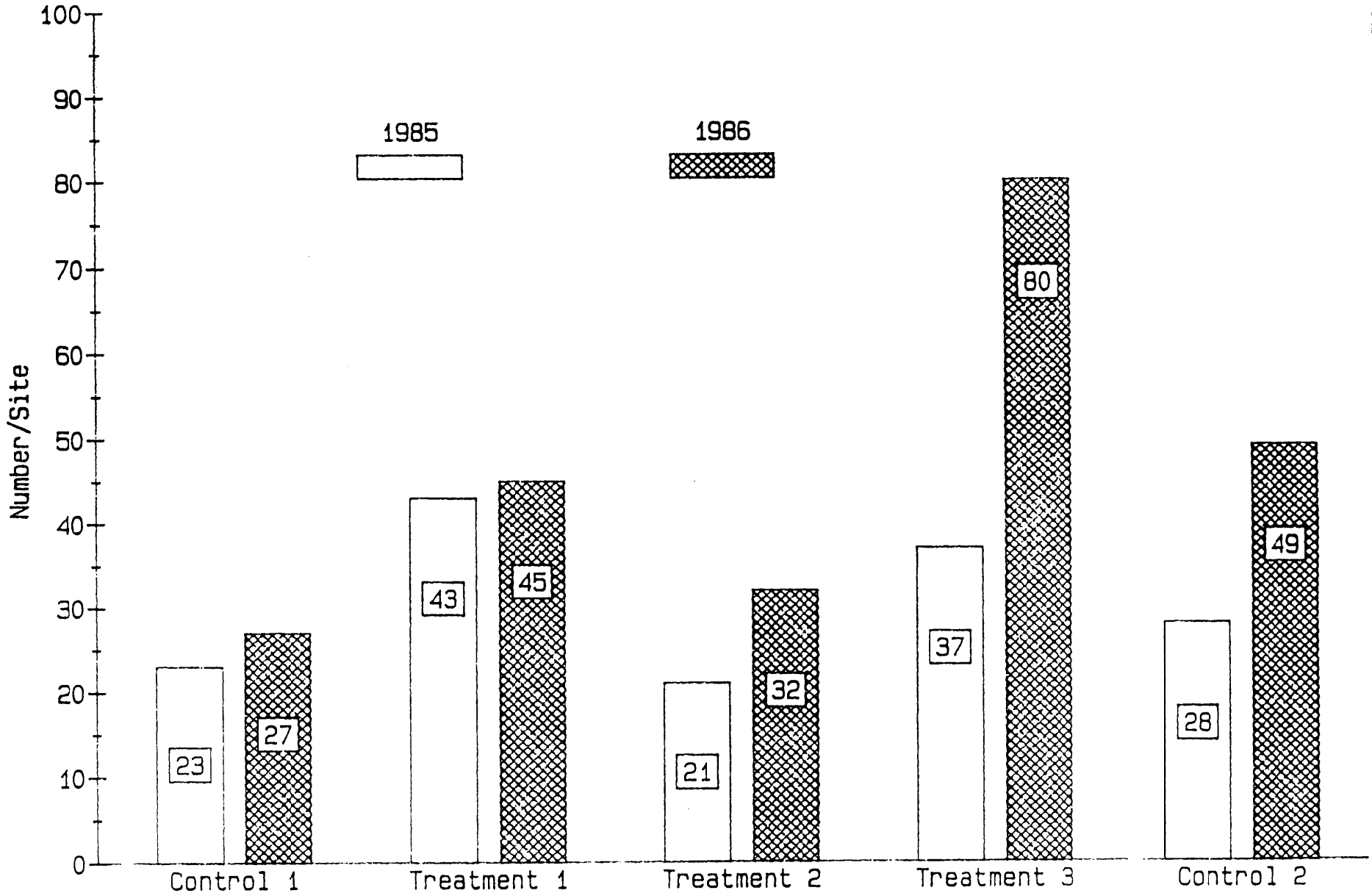


FIGURE 20. Map of off-channel ponds along Still Creek (Reach 2) which were intensively monitored.

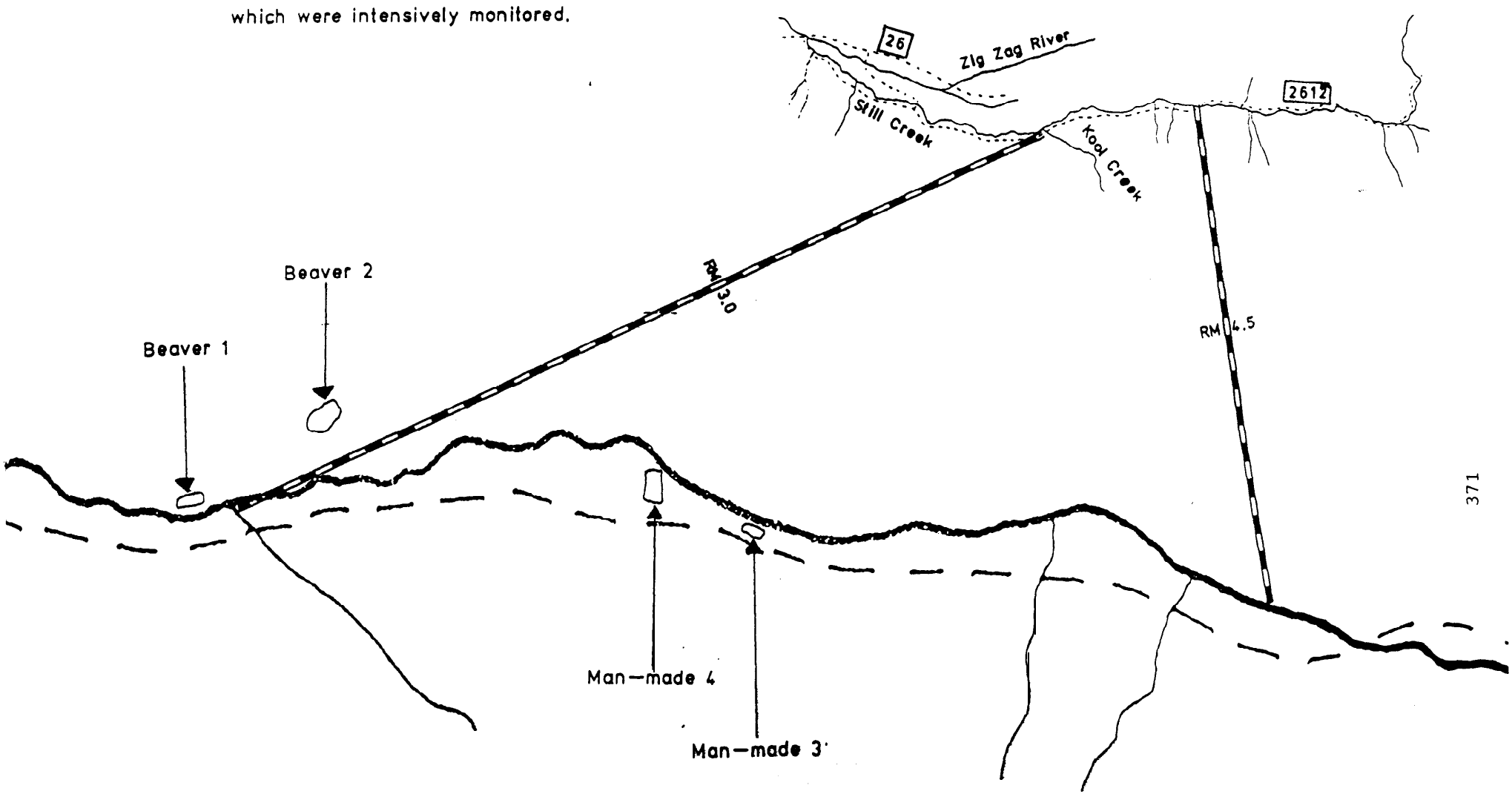


FIGURE 21. Comparison of the salmonid density in 2 beaver and 2 man-made off-channel ponds along Still Creek during the summer of 1985 and the summer of 1986.

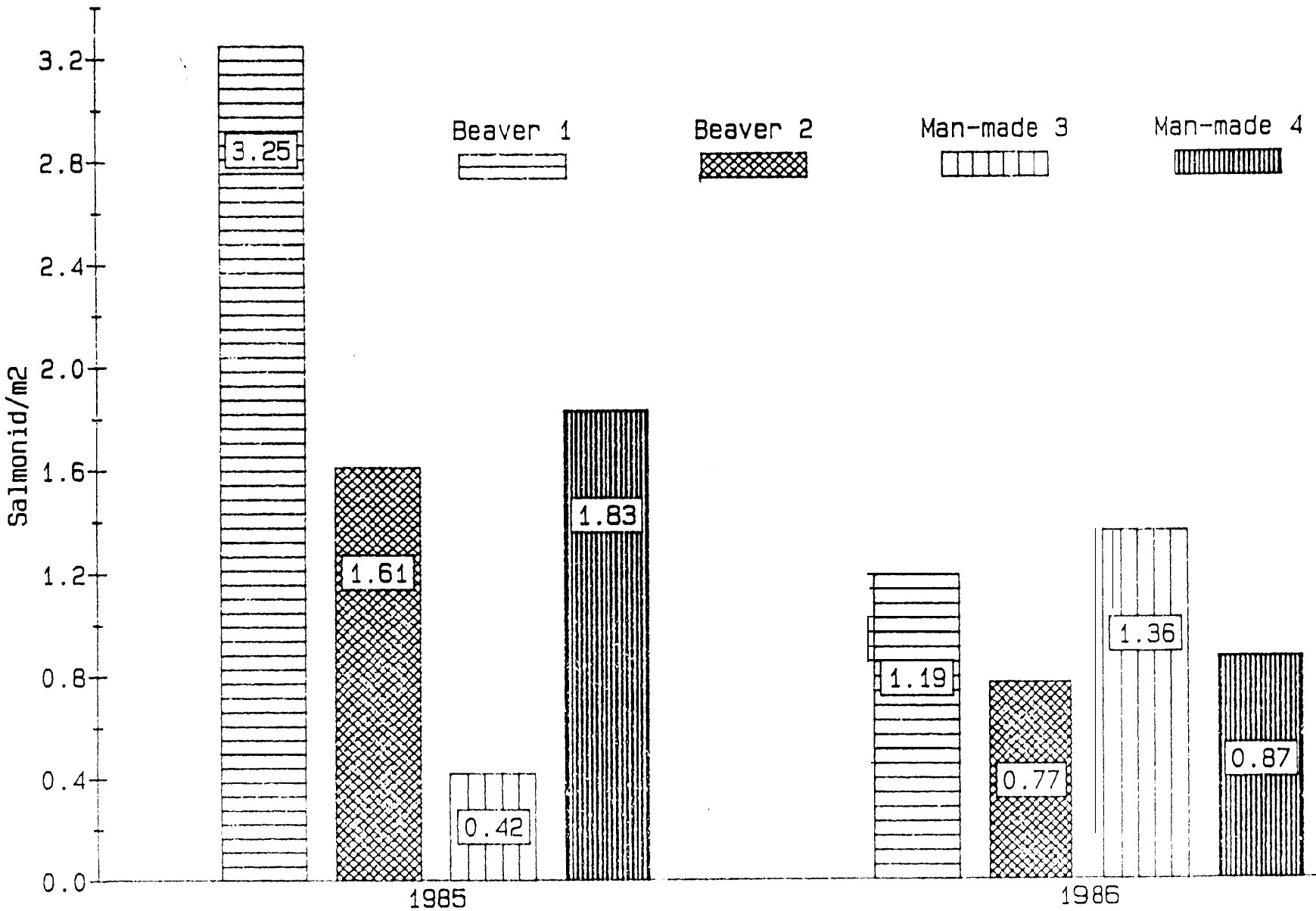
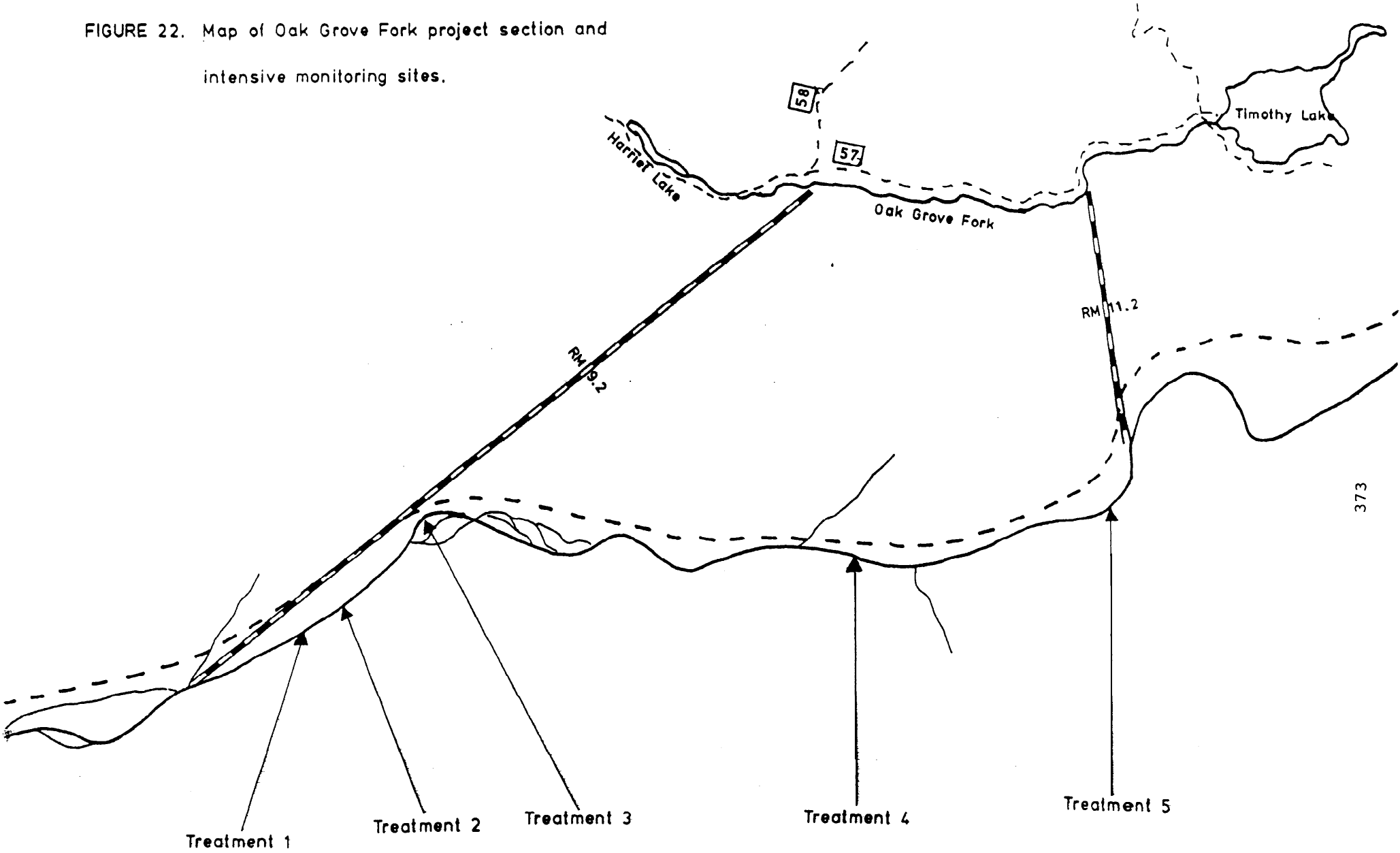


FIGURE 22. Map of Oak Grove Fork project section and intensive monitoring sites.



attempting to reduce stream velocities and create additional pool and glide habitat'. Five short sections in a 2.0 mile reach were treated. The overall project had somewhat limited success. When placement of boulders were made along the periphery of the channel, minor modifications in flow occurred. This was especially true when the structure was added to areas that already had some control factor modifying the habitat. Boulders placed in the middle of the channel, appeared to have little effect on flow characteristics and habitat diversity. Achievement of the desired changes in the channel will require larger boulders, more complex structures, and more intensive treatment.

Two of the work sites were in sections of the stream already containing some diversification of habitat (75% riffle). These sites received the most concentrated treatment (i.e. greatest number of structures/200feet of stream length) and showed the greatest reduction of riffle habitat (FIGURE 14). Riffle habitat at these sites was reduced from 75% to 60%, with most of the conversion to glide habitat. A couple of alcove pools were enlarged and some good pocket areas scoured at the sides of the channel. In one of the sites, three logs were used to deflect the main flow away from a side area creating an extended glide. The other three sites were in areas composed almost entirely of riffle and received only minor boulder placement. These sites remained mostly riffle (>90%).

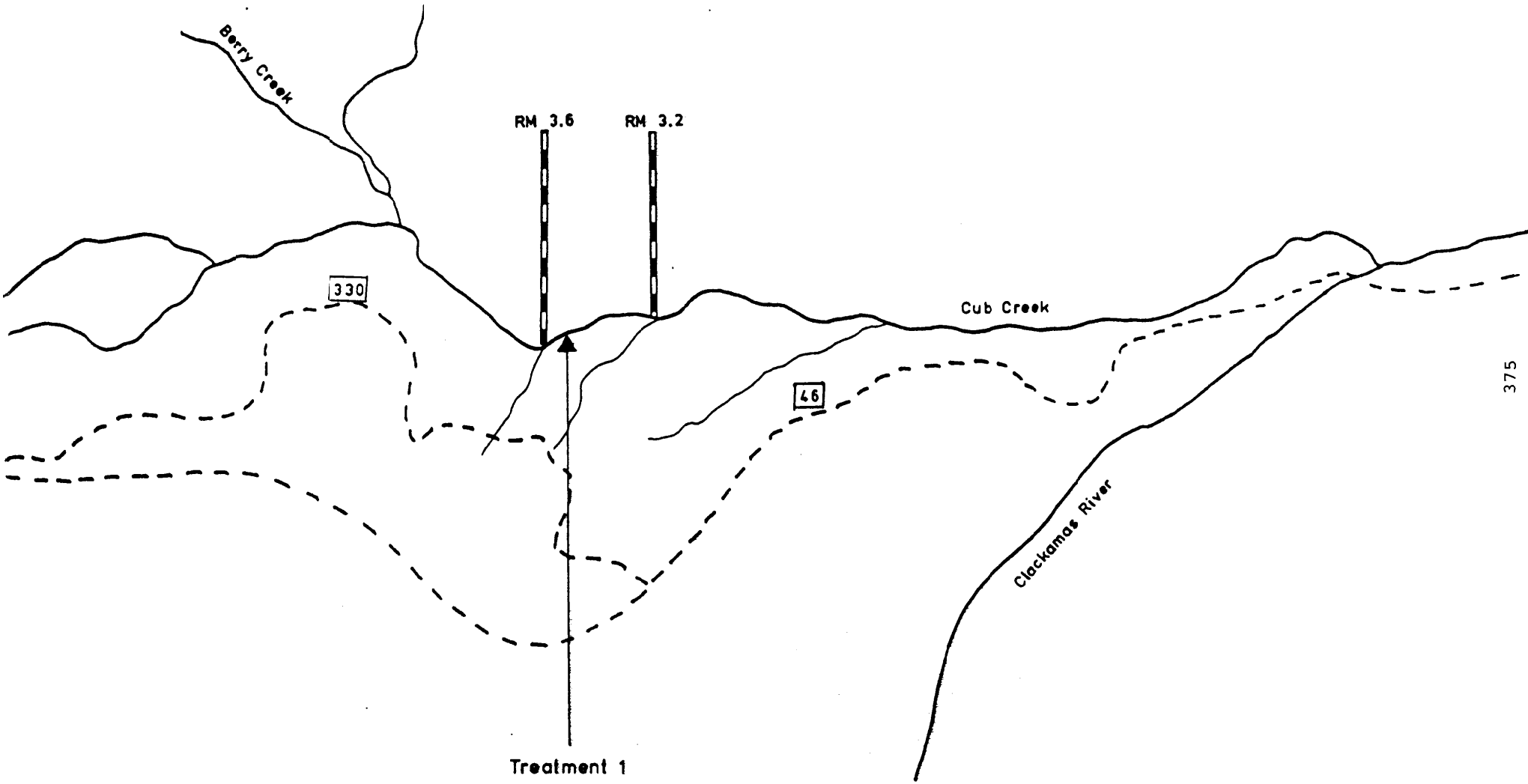
This reach of the Oak Grove Fork poses some special problems for habitat enhancement. It will require a large concentration of treatment, and large structures, to accomplish a major adjustment in habitat composition. Minor modifications can be made along the periphery, but in general, these also will require concentrated treatment. The area does have very good side channel habitat. This side channel habitat should be protected.

Cub Creek. Cub Creek is in the Clackamas River Drainage. In conjunction with a timber sale, a habitat enhancement project was implemented in 1985 just below the Berry Creek junction (RM 3.2-3.6). The objectives of the project include: the collection of spawning gravel, addition of rearing habitat, and increasing the number of quality pools. The project included the use of large boulders and several large logs. Digger logs were placed across the channel in "V" configurations to create plunge pools below the logs and collect spawning gravel above them. Additionally, boulder berms and log wings were constructed to create rearing habitat and collect gravel.

The success of the project can only partially be judged at this time. Cub Creek contains a coarse substrate which may require several winters of high flow to scour and create the desired habitats. Some minor habitat changes are evident, however. Gravel is beginning to collect at many of the structures. New scouring has occurred at several structures and some additional pool area is available. The overall habitat change is low, but this is predictable, since the treatment was not concentrated. Less than 20 structures per l/2 mile of stream were constructed.

The addition of structure to provide cover at existing pools and to diversify glide habitat appears to be working. Population sampling was conducted at one-200 foot long site in 1985 prior to treatment and was repeated in 1986 (FIGURE 23). In 1985 the total salmonid population estimate for the section was 5. The 1986 estimate was 40. Of the captured fish, 25% were legal size,

FIGURE 23 Map o Cub Creek project section and intensive monitoring site.



several larger than 200mm in length. Most of the fish were taken near three logs added to a small pool at the site. Part of the increase in population may be a re-distribution of fish to more highly perferred habitats. Steelhead seeding in the upper Clackamas drainage is currently considered the most likely limiting factor.

Cub Creek has good habitat composition and diversity. Pocket water and small holding pools are available in most sections. The apparent low salmonid density is surprising; outward appearance suggests the potential for good salmonid production. More sampling should be done to develop a more accurate estimate of the population. If, in fact, the densities are actually this low, the limiting factor(s) should be identified and considered for future modification.

Rock Creek. Rock Creek is part of the 'White River Drainage. The project area (RM 9.2-10.0) is l/2 mile above Rock Creek Reservoir, just inside the Forest boundary. In 1974 the Rocky Burn eliminated most of the vegetation in this area. Cattle grazing in the area since that time has not allowed full recovery of the riparian vegetation. Salvage and cleanup operations after the fire removed most of the in-stream wood structure. Although this area has a broad flood plain (about 140ft), the lack of riparian vegetation and energy dissipating factors within the stream have resulted in channel down-cutting and the development of high, vertical, unstable banks.

In 1984 the stream was surveyed and given a poor fish habitat rating (Cain 1984). The condition of the riparian environment was a major contributing factor to the stream condition rating. Unstable stream banks, aggravated by livestock use had resulted in siltation of the channel substrate, reducing the quantity and quality of potential spawning gravel. The loss of stream shading, high siltation, and low summer flows (2cfs) combined to produce high water temperatures (>75F) as early as June. In the project area, the habitat was riffle dominated with less than 15% pool habitat. These pools were all shallow, had low volume, lacked structure and effective cover.

A stream rehabilitation project was implemented in 1984. The first objective was improvement of the riparian environment. About 0.8 miles of stream were fenced to protect the flood plain from livestock grazing. In conjunction with the fencing, severely eroded stream banks were graded back and planted with cottonwood seedlings. In-stream work was directed toward creating and improving pool habitat. Several boulder berms and wood sills were built to enhance scouring and add pool volume and depth. Boulders and wood debris were added to pools to provide effective cover. A total of over 80 structures were installed in the treatment area. Two treatment and one control site were established for intensive monitoring of pool habitat and trout population characteristics (FIGURE 24).

Full riparian recovery is expected to require many years. However, the first returns from the fencing effort are already apparent. The ungrazed grasses are beginning to stabilize stream banks and reduce sedimentation. The cottonwoods are taking hold, and willows are re-invading stream side areas.

FIGURE 25 presents pool habitat area and volume in the project area from pre-treatment (1984) and post-treatment (1985, 1986) surveys. In the first

FIGURE 24. Map of Rock Creek project section and intensive monitoring sites.

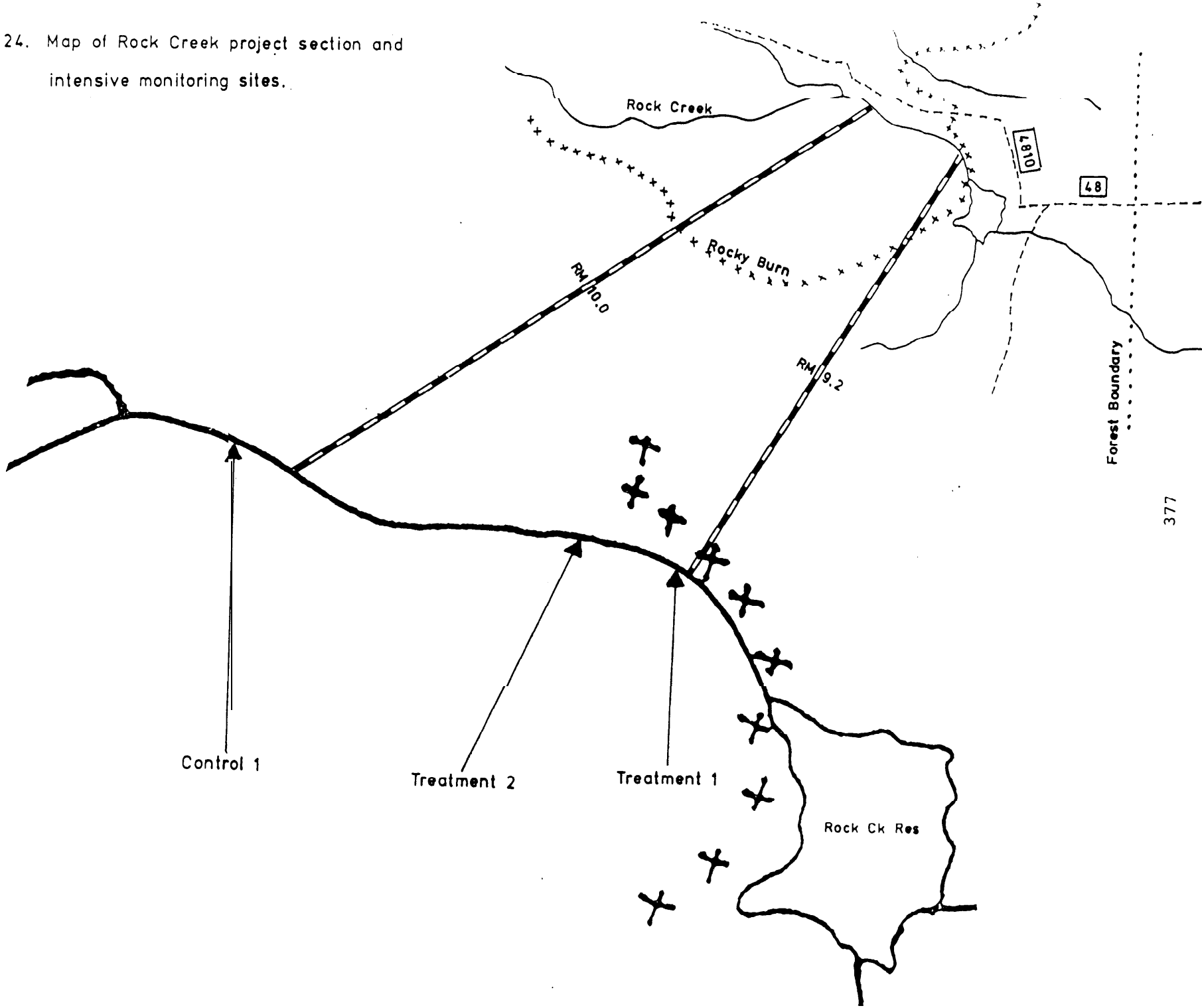
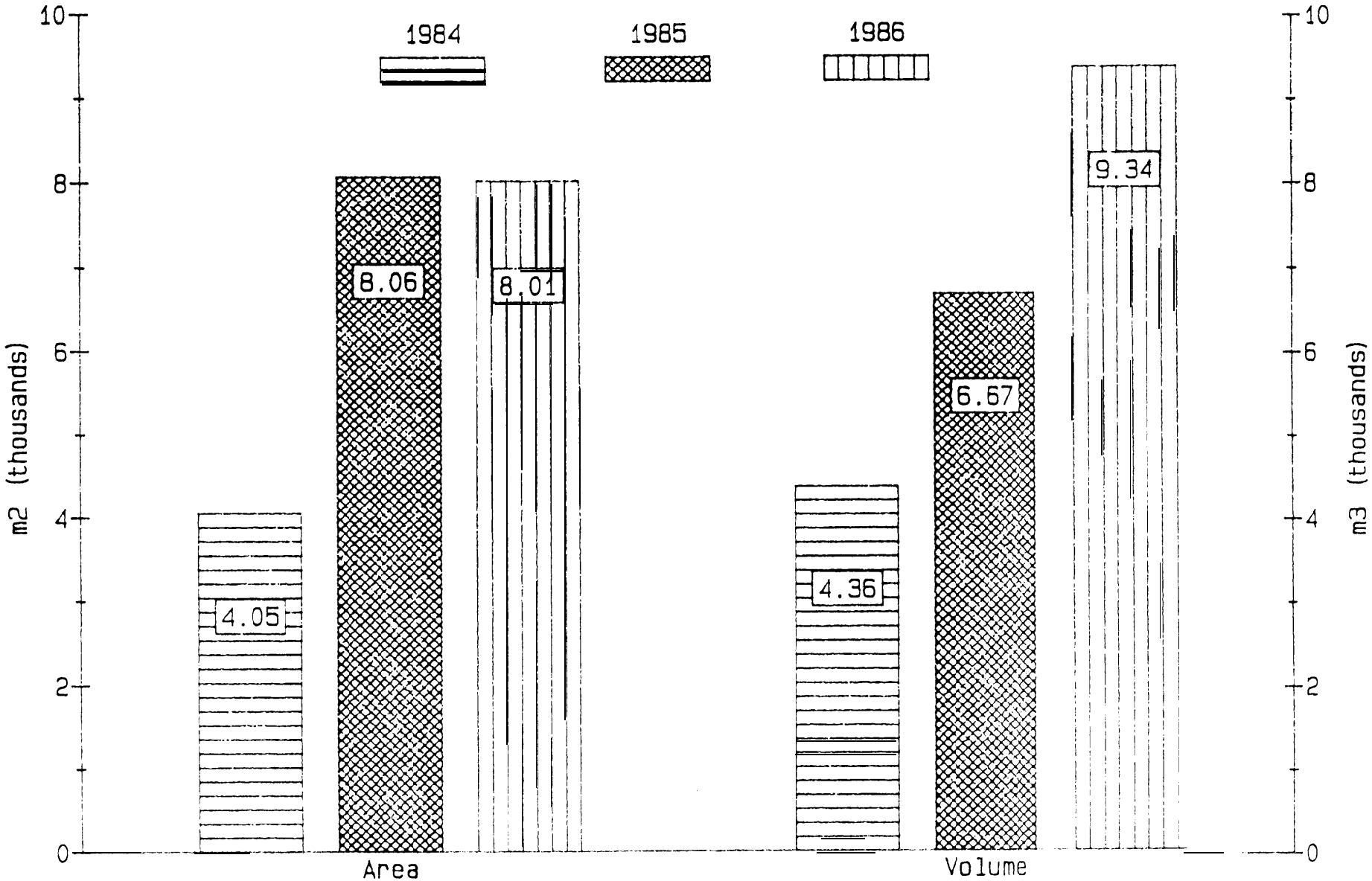


FIGURE 25. Comparison of the pool area and the pool volume in the project section of Rock Creek during the summer of 1984 prior to the enhancement project and during the summers of 1985 and 1986 following the enhancement project.



year after completion of the enhancement work, pool area had doubled but pool volume had increased by only 50%. This indicates that in the beginning, although pool habitat was increased, the new pool areas were often shallow. The average pool depth actually dropped from 1.08 feet to 0.83 feet. In 1986, the pool area remained the same as in 1985, but new scouring increased the pool volume 40%. Average pool depth in 1986 increased to 1.17 feet. A 114% increase in pool volume was measured over the two years following project implementation.

Salmonid population sampling was conducted in 1984, 1985 and 1986. The total number of salmonids captured in the treatment sites was higher in post-treatment 1985 than pre-treatment 1984, but the sample area had increased from the treatment and the density remained almost the same (O.64/0.63). In the control site the density decreased. In 1986 there was a further increase in the salmonid capture in the treatment sites, while the stream area of the sample site remained the same. As a result, the density showed an increase to 0.83/m2. The control site again showed a decrease in density. FIGURE 26 shows the density changes by individual sites. One treatment site (T-2) actually had a slight decrease in density each of the two years. The other treatment site (T-l) had a moderate increase the first year and a large increase the second year. There are several possible explanations for these changes. Since the overall population showed only a small increase, this may indicate a re-distribution of the population into more highly preferred habitats. On the other hand, the control site may be showing a yearly population flucuation (drop) that did not occur at the treatment sites because of improved survival within the enhanced area. A third, and highly probable explanation for the population changes is the increased angling pressure associated with the habitat improvement project. The number of legal fish sampled dropped in each of the post-treatment years. The improved habitat may have made the area more attractive to fishermen and increased the harvest of the larger members of the population. The decrease in density in the control site may also reflect this pressure. In the treatment sites, this pressure may be partially off-set by increased survival associated with the improved habitats.

Overall habitat changes were greatest for the lower treatment area. The enhancement work may have been particularly effective in the lower sites for two reasons. In general, the pre-project conditions within the stream channel became worse going from the top of the treatment section to the bottom. This is supported by initial salmonid population densities. On the other hand, the lower treatment site was in an area which had received less grazing use, and the riparian vegetation was in better condition, and able to respond to protective measures more quickly.

Lake Branch. Lake Branch is a major tributary to the West Fork Hood River, in the Hood River drainage (FIGURE 27). The stream flows northeasterly from Lost Lake. The lower 3.4 miles and a small upstream reach (RM 7.9-8.0) are in private ownership. Lake Branch currently supports summer steelhead trout and resident trout, primarily rainbow and eastern brook. ODFW is currently engaged in a program to re-establish naturally reproducing runs of spring chinook to the West Fork drainage, including the Lake Branch. Based upon 1982 habitat assessment reports, major habitat factors limiting increased production included adult passage and low flow rearing habitat for l+ and older steelhead trout.

FIGURE 26. Comparison of salmonid density at 2 treatment and 1 control site on Rock Creek during the summer of 1984 priorto the enhancement project and during the summers of 1985 and 1986 following the enhancement project.

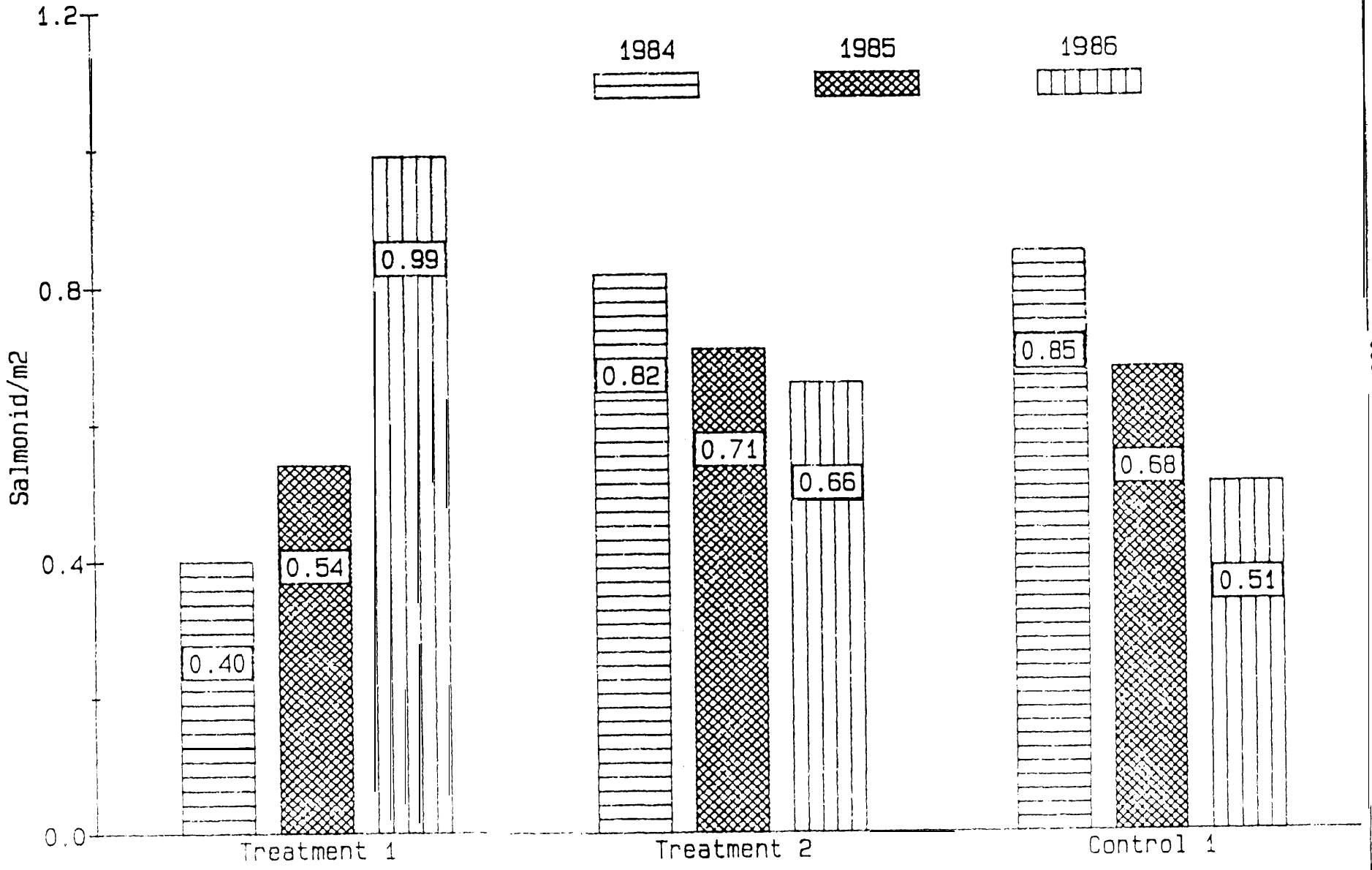
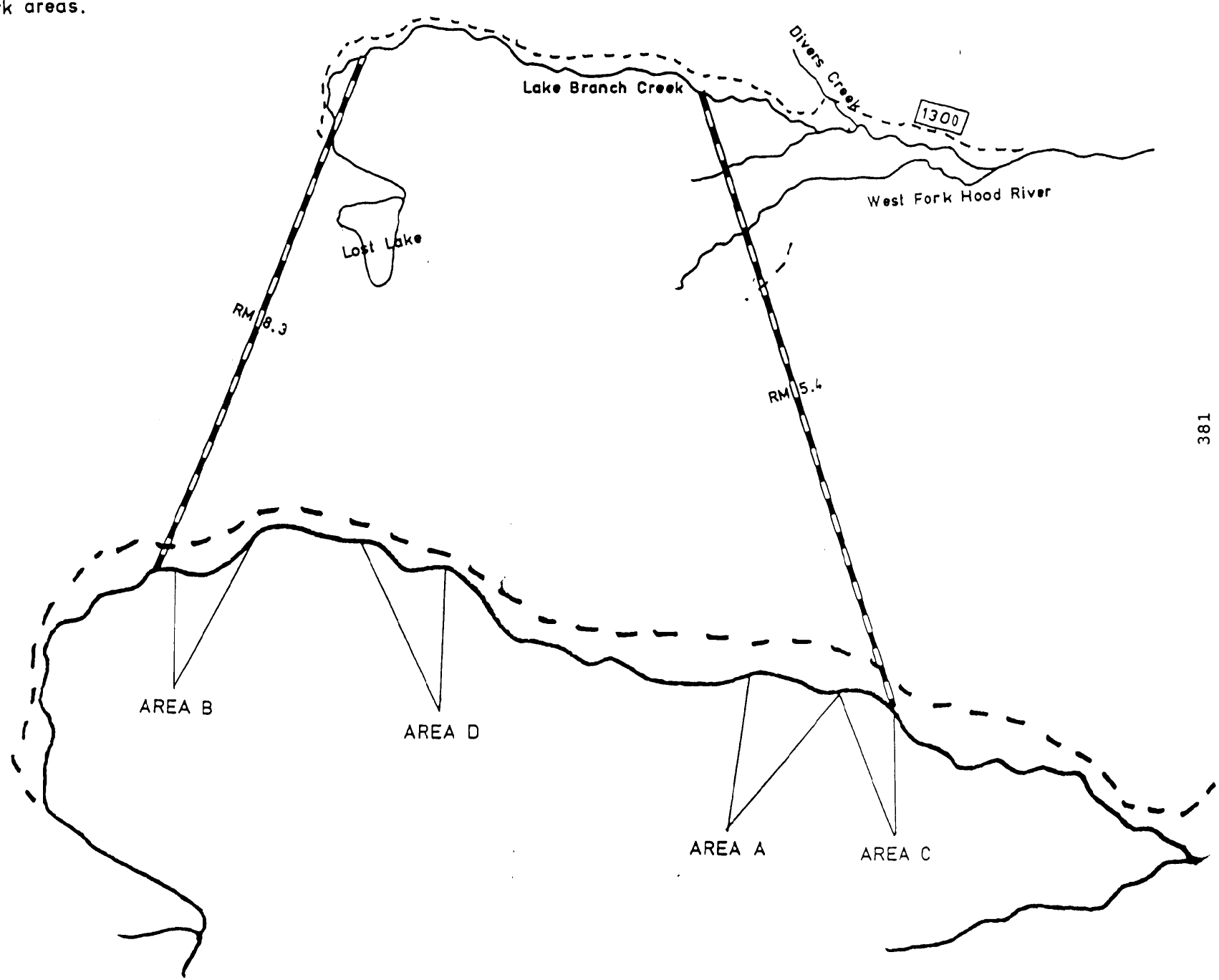


FIGURE 27. Map of Lake Branch Creek project section and work areas.



Enhancement and rehabilitation work began on Lake Branch in 1983. Improvement activities in treatment area A (RM 5.6-6.4) included the construction of gabions and boulder berms to add habitat diversity and increase low flow rearing habitat for l+up steelhead. In 1984, boulder and wood structures were place in the main channel, and a side channel created, in treatment area B (RM 8.2-8.4) to increase diversity, provide low flow rearing habitat for l+ steelhead, and improve overwintering conditions. In 1985, enhancement work was completed in treatment areas C (RM 5.4) and D (RM 7.4-7.5). In treatment area C, boulder berms and boulder clusters were placed in the stream to increase low flow pool habitat and effective cover in a stream reach where the flood plain broadens and the low flow channel is divided. In treatment area D, boulder placements were used to improve cover and maintain depths in a glide-riffle section. ODFW also completed a STEP project in 1985 to improve low flow passage at a boulder drop at RM 2.8.

The 1986 monitoring and evaluation consisted of a habitat survey of treatment areas C and D and a continuation of population sampling in all treated areas. Although the overall habitat composition of treatment area D had not changed, localized changes were evident. Several small pocket pools are now present and a slight increase in depth along one side of the channel has increased the volume of glide habitat. Treatment area C habitat composition showed a dramatic increase in pool area. The main channel and side channel have a combined area of 570 square meters. Before project implementation this included only 41 square meters of pool habitat. Following implementation pool habitat expanded to 332 square meters, a net increase of 291 square meters. The main channel accounted for less than 30% of the increase. Deposition was high in this stream reach over the winter, most occurring in the main channel. Many of the boulder structures in the main channel are currently buried in the substrate and non-functional. However, this deposition increased the potential spawning gravel in this area from 2 square meters to 25 square meters.

TABLE 6 presents a summary of the salmonid population densities sampled in Lake Branch from 1984 to 1986. In treatment area D the post-project density was relatively unchanged from the pre-project density. However, in treatment area C, the post-project density was significantly higher than the pre-project density. Treatment area B showed a slight increase in 1985, the first post-project year and was more than double the pre-project level by 1986. Sampling in treatment area A indicated a lower density in 1986 than in 1985. However, densities shown for 1985 are for pool habitats only, which typically hold more fish per unit area than do other habitat unit types. The 1986 densities reflect the average density for all habitat unit types in the sample area. Additionally, in 1985 summer steelhead smolts were planted below the project areas and many were still in the system during the sample period. In 1986 there was no similar outplanting of steelhead smolts.

TABLE 6. Total salmonid densities sampled in the Lake Branch of the West Fork of the Hood River in 1984, 1985, and 1986. Densities are expressed in terms of total number of salmonid fish per square meter of water surface sampled. Dashes (-) indicate that no population sampling was completed for the treatment area in a given year.

Treatment Area	Year	River Mile	1984 Density (#/m2)	1985 Density (#/m2)	1986 Density (#/m2)
A	1983	5.6-6.4	-	0.23	0.13
B	1984	8.2-8.4	0.12	0.15	0.29
C	1985	5.4		0.07	0.17
D	1985	7.4-7.5	-	0.12	0.11

Structure Durability Findings

A field inventory of over 600 instream structures, following a major 1986 flood event, provided some interesting findings. In general, the inventory found a very high rate of individual structure "success". More than 90% of the structures were found to be functioning as designed after the flood (FIGURE 28). Only 7% of the structures were obliterated or severely damaged, and no longer meeting project objectives. This relatively high rate of success at least partially answers concerns raised in the early 1980's regarding the feasibility of using in-channel structures in Cascade mountain streams. Many reviewers had concerns about the durability of in-channel structures in high gradient (2-6%) streams with highly variable flows, such as those treated in many areas of the Forest.

Examination of the data suggest that two factors largely determine the success of these structures. Those two factors are installation method (i.e. structures installed by hand vs. heavy equipment) and structure type (i.e. structures which span the entire channel vs. structures occupying only a portion of the channel).

Installation method. Of 539 equipment installed structures, only 4% were damaged by the high flows to the extent that they were no longer meeting the objectives of the habitat improvement project. Ninety per cent of these structures were not damaged at all (FIGURE 29). Of the 93 hand installed structures, 27% were no longer meeting project objectives. Only 60% of the hand installed structures were undamaged by the storm flows (FIGURE 29). While structures installed by hand represent less than 15% of the sample, they contribute more than 50% of the failures. Two factors may account for the disparity between success of equipment vs. hand installed structural habitat improvements. The first factor is the intrinsic limitations on size of material and useable techniques when work is done by hand. Because of the size

FIGURE 28. Performance of 632 fish habitat improvement structures installed on the Mt. Hood National Forest since 1981. Evaluation followed a 1986 rain on snow flood event with a 15 - 25 year return interval.

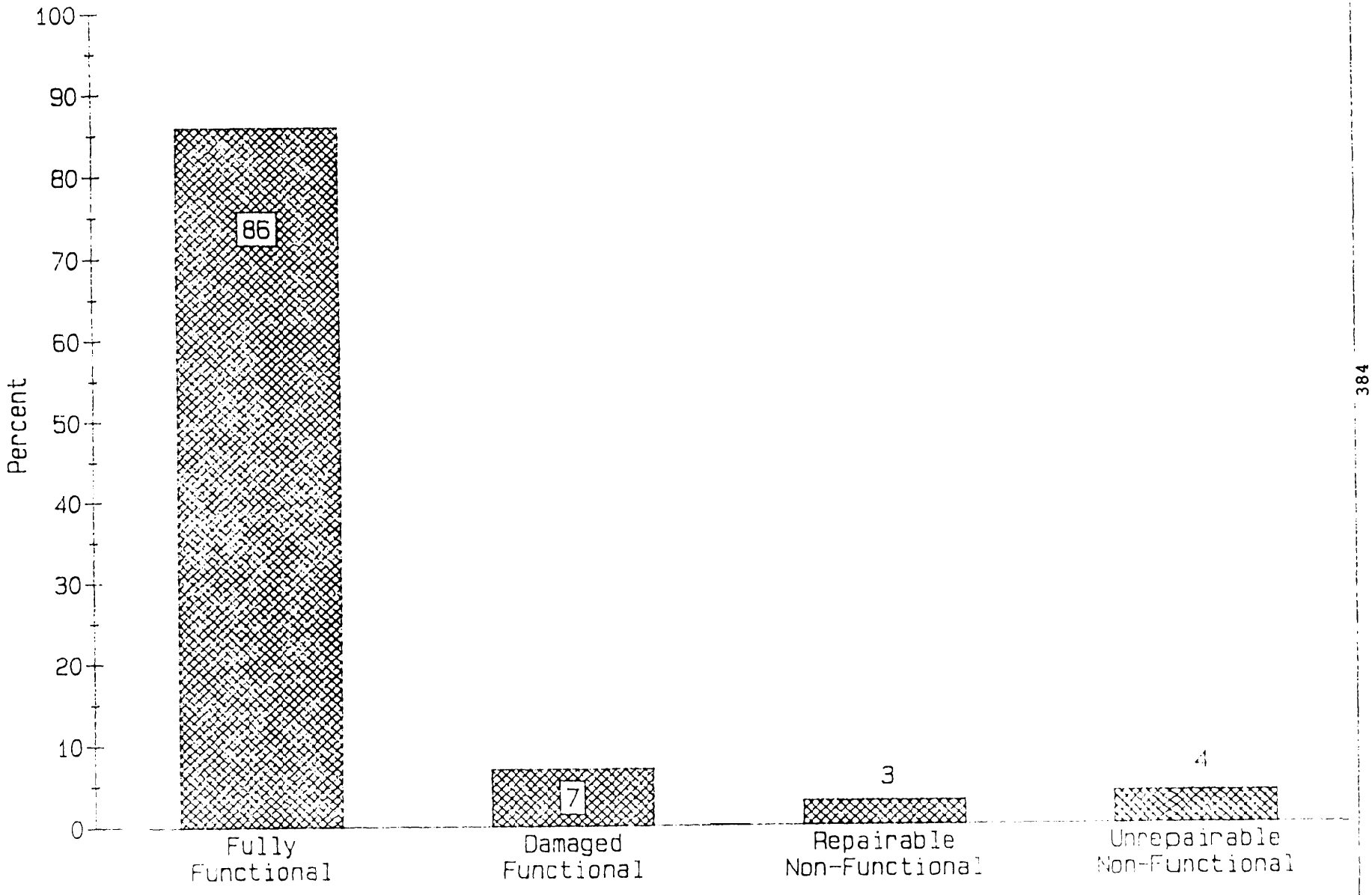
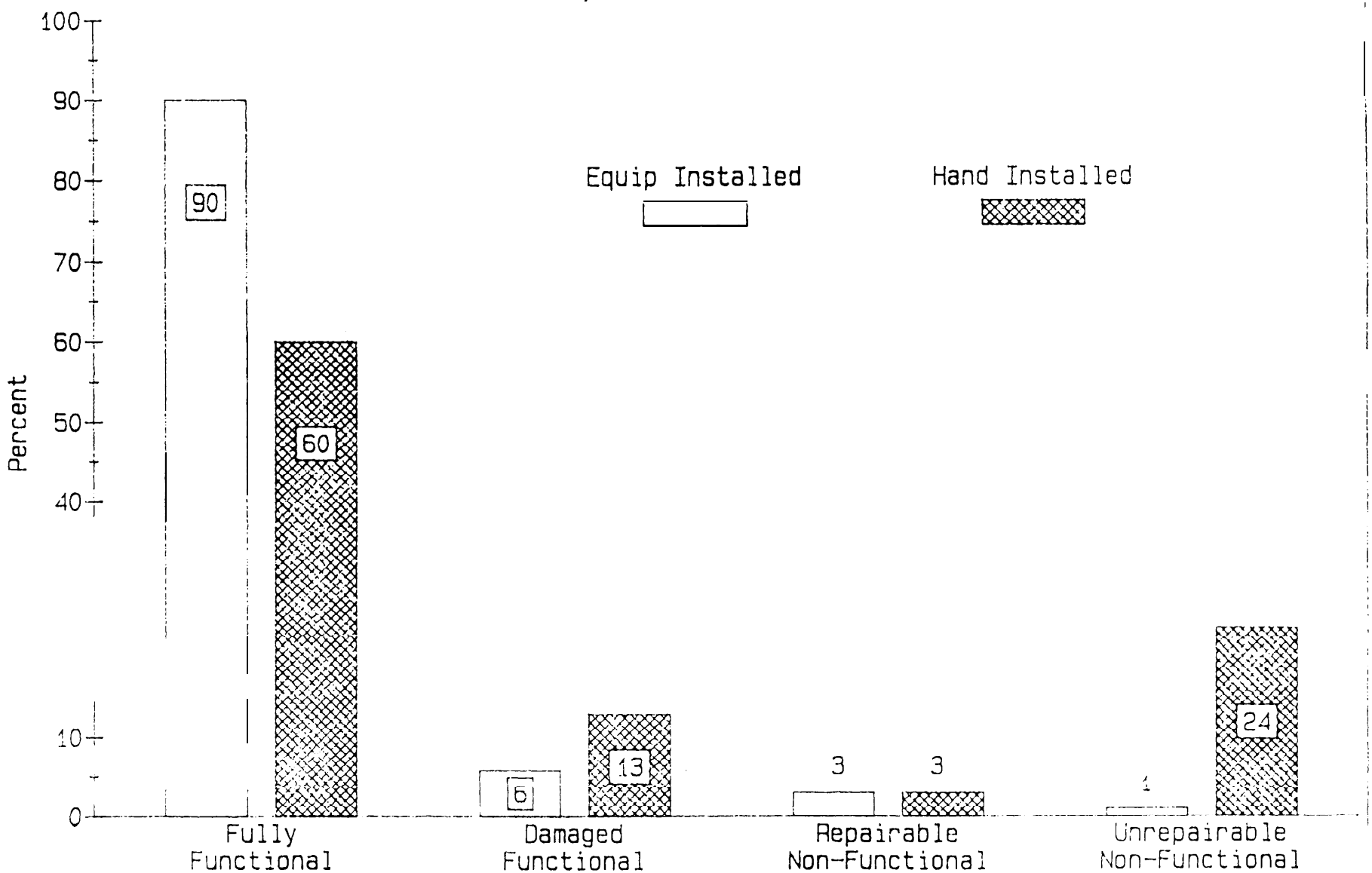


FIGURE 29. Comparison of performance of 539 equipment installed and 93 hand installed fish habitat improvement structures, constructed on the Mt. Hood National Forest since 1981. Evaluation followed a 1986 rain on snow flood event with a 15 - 25 year return interval.



limitation, site selection for project implementation becomes critical. Secondly, most of the hand installed structures were completed during early development of the Forest's fish habitat improvement program, with limited site selection experience.

Given these factors, it is interesting to note, that nearly three-quarters of the hand installed structural failures are accounted for by only two projects. The two projects are on streams characterized as being moderately high energy, "flashy" systems. The structures which failed were primarily located in stream reaches with a relatively broad flood plain, where the bed and bank materials are composed of highly erodible materials. Without heavy equipment it was not possible to adequately armor the structures/stream banks. The storm flows also resulted in channel changes that stranded a number of structures in an abandoned side channel.

Structure type. Structure type also influenced performance. While 15% of 127 equipment installed cross-channel structures failed during the flood flows, less than 1% of the 412 equipment installed non-cross channel structures were severely damaged or destroyed (FIGURE 30). Boulder berms, with a failure rate of about 16%. accounted for more than 85% of the equipment installed structures which failed. Almost all (>94%) of the boulder berms which failed were constructed with undersized rock collected from within the channel. While only 2% (1 of 48) of boulder berms constructed by equipment with hauled rock failed, more than 25% (17 of 67) of the boulder berms constructed by equipment with in-channel materials failed (FIGURE 31). The use of undersized and rounded in-channel rock is considered to be the primary factor contributing to their failure.

It should be noted that the use of in-channel material in constructing berms was a conscious decision made by the project biologists. They realized that these berms would be more vulnerable to high flow damage but chose to use in-channel material because of the much cheaper implementation cost. The 12 times higher failure rate is very nearly balanced by the 10 times less expensive implementation cost. Berms constructed with heavy equipment by rearranging in channel boulders have an average cost of about $250, while those constructed with hauled boulders average about $2500 to construct. Repair for most of the berms no longer meeting project objectives is estimated at only $100 each,since typically only the middle portion of the berms failed.

Gabion berms are the only equipment installed habitat improvement structures with a higher failure rate than boulder berms (FIGURE 32). The 17% failure rate represents one gabion out of the six that have been installed. This gabion, although fully intact after the storm flow was rated as a failure because it was severely undercut by the high flow, is in imminent danger of collapsing or rolling, and impedes upstream passage of coho salmon.

Log deflectors represent the only other type of equipment installed structures that have failed to meet project objectives (FIGURE 32). The 7% failure rate, is due to the damage or loss of two structures in the same stream. It appears that these structures, located in a depositional reach, were inadequately anchored and/or armored. One structure was washed away, the other pivoted out of the channel and came to rest on the stream bank.

FIGURE 30. Comparison of the performance of 127 cross channel and 412 non-cross channel equipment installed fish habitat improvement structures, constructed on the Mt Hood National Forest since 1981. Evaluation followed a 1986 rain on snow flood event with a 15 - 25 year return interval.

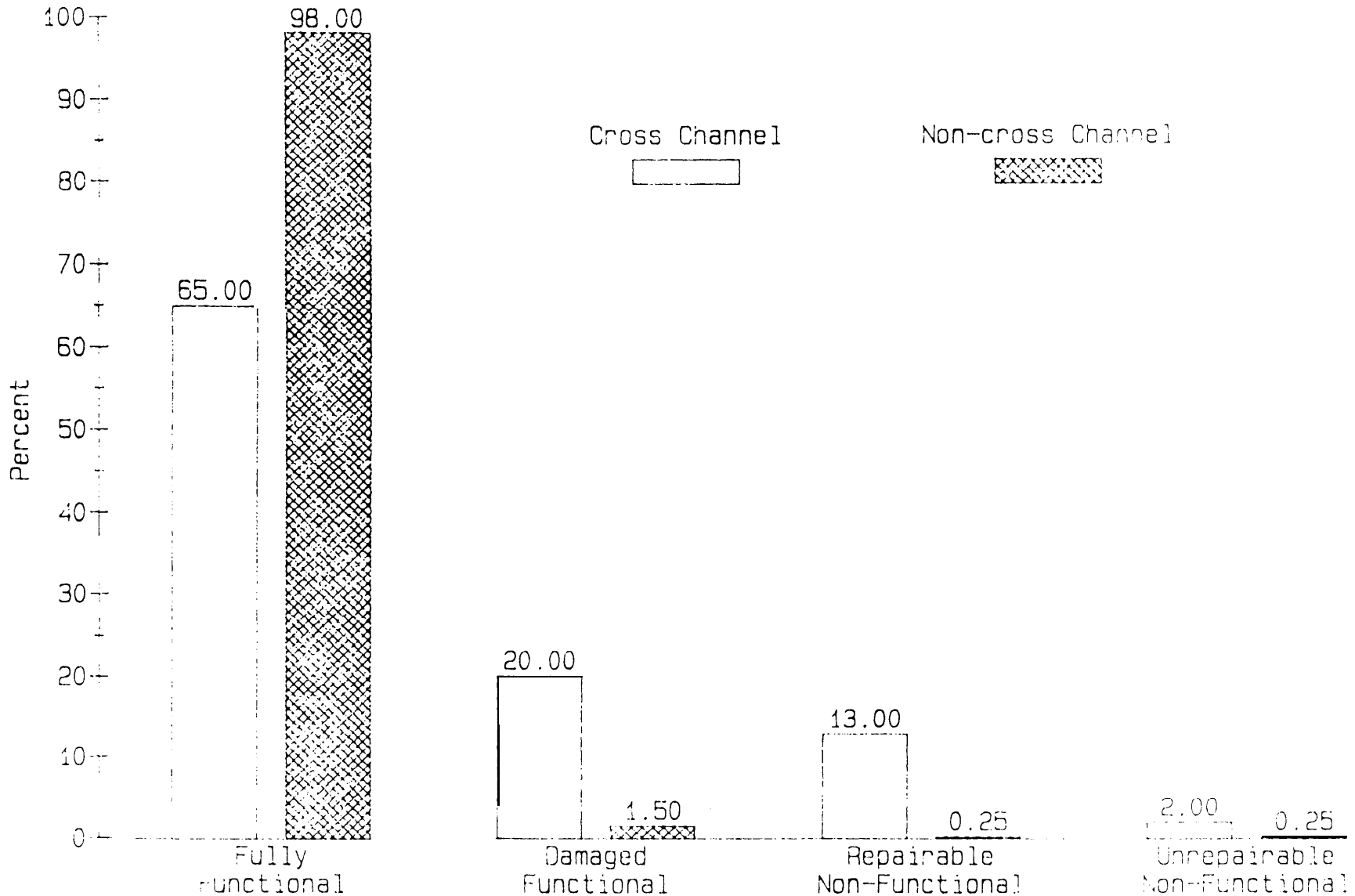
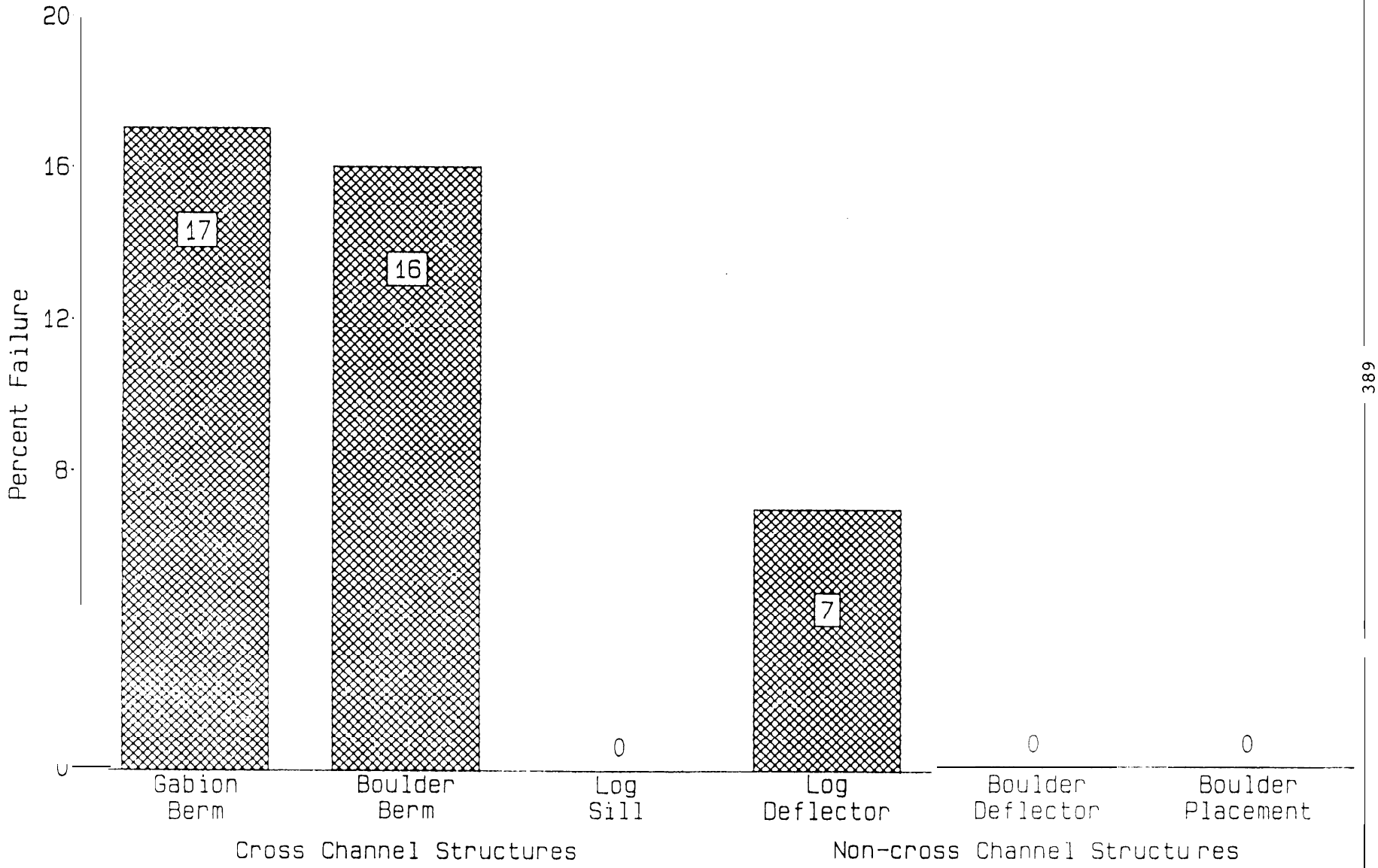


FIGURE 31. Comparison of performance of boulder berms using local in-channel material and boulder berms using hauled-in, off-site material, constructed on the Mt Hood National Forest since 1981. Evaluation followed a 1986 rain on snow flood event with a 15 - 25 year return interval.

FIGURE 32. Comparison of the performance of fish habitat improvement structures, by structure type, installed by equipment on the Mt. Hood National Forest since 1981. Evaluation followed rain on snow flood event with a 15 - 25 year return interval.



A total of 17 "off-channel" habitat improvement structures were inventoried. These included 6 side channels and 11 ponds. Nine of the off-channel ponds were ground water fed, and two were fed by a stream diversion/pipeline. Of the off-channel structures, 82% were functioning as designed following the flood event. Of the three structures not meeting design objectives, all were side channels. Viewed as a separate group three of six (50%) of the side channels were not meeting the design objectives. The most frequent problem identified was loss, or severe damage, of the side channel inlet structure(s). Of the 11 off channel ponds all were functioning as designed following the flood. Over half (6 of 11) of the ponds required minor hand maintenance to remove deposited bed load at the inlet pipe or groundwater fed pond outlets.

A minimum life expectancy of l0-20 years is currently used for planning and benefit-cost analysis of improvement project structures. This assumption appears highly reasonable for the structures completed on the Forest. Failure of structures completed in the two years prior to the flood was less than 4%.

SUMMARY AND CONCLUSIONS

Restoration of the once vigorous runs of naturally reproducing anadromous salmonids in the Columbia River Basin depends substantially on improving the productive capability of the rivers and streams on National Forest System lands. Although habitat improvement techniques have been used for many years, the science, or perhaps more appropriately, the "art" of habitat improvement is developmentally very young, Although success can not be guaranteed, well planned, designed, and implemented improvement projects can eliminate most of the risk. The establishment of a feedback loop with a monitoring process is an important part of improving the likelihood of meeting habitat improvement goals.

Pre-project implementation fish habitat and population conditions were evaluated on ten streams. The six streams inventoried that drain the eastern flanks of the Cascade Range, are generally small (with an average width of <5m) and have low summer flows (<lOcfs). Generally habitat, composition and diversity is fair but the quality of pools is poor. Salmonid populations are typically composed of resident and steelhead trout. Sampled population densities were typically higher and more variable for east side streams than for the inventoried streams west of the Cascades. In further contrast, the four streams evaluated on the west side are relatively large (with an average width >l0m) and have moderate summer flows (>20cfs). Generally habitat composition and diversity is poor, with the project areas dominated by broad, shallow riffle habitats. Salmonid populations are typically composed of a mix of steelhead, coho and chinook salmon, and resident trout.

Post-project implementation fish habitat and population conditions were evaluated on five streams. Where target species are coho or chinook salmon, general emphasis of the improvement projects is on increasing "quiet water" habitats such as pools, alcoves and off-channel rearing ponds. Where the target species is steelhead trout, project emphasis is generally on increasing main stem glide and pocket pool habitat area. The desired increase in pool and glide habitats is achieved by reducing the dominance of riffle habitat. Post-treatment monitoring and evaluation indicates that the completed projects are meeting most of the planned objectives.

Measurable riffle reduction occurred in all project areas. Reductions ranged from 8% at the Oak Grove Fork project site, to 65% at the Lake Branch project. With the exception of the Lake Branch project, most of the pools created by the habitat improvement structures were small, pocket, lateral, and alcove type pools.

Most project work involved boulder placement. Generally, boulders were placed in groups, and in some cases were combined with large woody debris and/or whole trees. This created significant additional areas of glide habitat, and scattered pocket pool habitat. Both are preferred habitat for l+ steelhead. The addition of glide habitat at Still Creek was particularly striking. The area of glide habitat in Still Creek was doubled in two treatment areas, and more than quadrupled in the third. Data from the Oak Grove Fork of the Clackamas River, demonstrated a strong relationship between reduction of riffle habitat and the number of boulder structures placed per unit length of stream.

The overall quality of added and existing pools in project areas remained low. This is due to a lack of effective cover and/or depth in most of the pools. Lack of depth may reflect the relative "newness" of many of the structures; future high flows should produce additional pool scouring. In several individual pools, effective cover was increased by the addition of wood debris.

Biological sampling indicated an increase in total salmonid populations in all project areas since completion of habitat enhancement. The highest increase was in Cub Creek which showed a 800% increase at one sample site. Much of the Cub Creek increase, as at the other projects, was in numbers of l+ fish. Most of the l+ fish were captured around and in association with the new habitats and added structure. Population densities in untreated sections generally remained similar to pre-project levels, suggesting the density increases in treated sections are probably attributable to the enhancement efforts, rather than a re-distribution of the fish in the stream.

High flow conditions resulting from a rain on snow event during the winter of 1985/1986 provided an excellent opportunity to examine the durability and effectiveness of in-stream habitat improvement structures. Flood intensity varied by drainage, but ranged from a 15 to 25 year flow event. Following the storm flow a field review of more than 600 structures, constructed in the past five years, was conducted. Over 90% of the habitat improvement structures survived the flood event with little or no damage. Selection of implementation technique and type of habitat improvement structure for a particular site will largely determine its ability to withstand high flows and continue to meet project objectives. Overall, structures installed without the assistance of heavy equipment were obliterated or damaged and no longer meeting project objectives, about 7 times more frequently than equipment installed structures. Of the equipment installed structures, those spanning the entire channel failed 30 times more often than non-cross channel structures. Among the equipment installed structures, boulder berms accounted for more than 85% of the failures. However, almost all (>94%) of the boulder berms which failed were constructed with undersized boulders collected from within the active stream channel.

Nine general conclusions can be drawn from the 1986 monitoring effort, and should be considered when evaluating these projects and/or those scheduled for future implementation.

1. Many of the streams on the Forest are riffle dominated and have limited habitat diversity. This generally means a lack of quality rearing habitat for 0+ and l+ salmonids.

2. Many of the Forest streams were "cleaned" by removal of large woody debris (LWD). This lack of in-stream structure, in conjunction with moderate gradient(>3%), is probably the major contributor to low habitat diversity characteristics.

3. The amount of change possible by the addition of structure is a function of treatment intensity. Small structures (individual boulders) will have only localized effects, while large structures (LWD or several boulders) will increase the effect.

4. Large differences in the characteristics of streams, and reaches within streams, means the same type of structure can create different changes in aquatic habitats. Design, size and type of structure, and implementation technique must be site specific.

5. Change within aquatic ecosystems can take time. A major flow event may be the required catalyst. In general, structures should be designed to have an extended "functional" life expectancy. Most structures examined this year met this requirement.

6. The pool-glide-riffle classification used in habitat quantification can be difficult to apply because of the continuum of stream characteristics. Comparison of specific habitat types from different streams should be done with caution because of the broadness of the categories.

7. Sampled salmonid densities were quite variable, both within a stream and among the streams. It is assumed that this is related to the habitat factors that are being addressed. However, time (both seasonal and diurnal) and sampling technique may mask this relationship. Until a large sampling base has been collected, population estimates are relative and should be used with reservation.

8. There is a general need to increase the amount of effective cover being provided with most structures designed to improve rearing habitat. Snorkling observations consistently indicate that even when hydraulic and habitat objectives are met by a structure, actual fish use is largely determined by the abundance of associated cover. Structures with multiple pieces of wood and/or boulders,and single structures with high cover attributes (e.g. root wads, single trees with limbs attached) appear to provide cover sufficient to promote active fish utilization.

9. Post-treatment results indicate that most of the habitat modification objectives were successfully met. The assumed link between physical habitat and biological production was not proved by the 1986 monitoring and evaluation process. Additional time and effort would be required to provide significant definition of these relationships. Such expenditures of time and effort may

better be left to those conducting formal research. Verifying significant increases in habitat diversity and complexity may be sufficient proof of "project success" in most cases. The Still Creek project resulted in just such a broad, overall change in habitat diversification and was biologically successful.

Grande Ronde Habitat Improvement Project: Joseph Creek and Upper Grande Ronde River Drainages

Annual Report
by

Stephen H. Williams, Program Leader
Ann L. Reece, Technician

Oregon Department of Fish and Wildlife
La Grande, Oregon 97850

and

William T. Nell, Project Leader
Randal N. Reeve, Technician

Oregon Department of Fish and Wildlife
Enterprise, Oregon 97828

Funded by
Ms. Kathy J. Anderson
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Contract No. DE-AI79-84BP16114
Project No. 84-25

January 1987

Table of Contents

List of Illustrations 397

Figures 398

Abstract 399

Introduction 399

Description of Study Areas 406

Joseph Creek Drainage 406
Upper Grande Ronde River Drainage 406

Methods and Materials 409

Prework 409
Project planning 409
Onsite preparation 409
Riparian lease procurement 409

Implementation 409
Habitat inventories 409
Instream structures 409
Plantings 410
Fencing 410
Miscellaneous field activities 410

Postwork 410

Results and Discussion I. Field Activities 411

Prework 411

Project Planning 411
Design and layout 411
Landowner coordination 412
Developmant of contracts and contracts specification..... 414

Onsite Preparation 414

Riparian Lease Procurement 415

Implementation 415

Inventories 416

Instream Structures 416

Planting 419

Fencing 419

Miscellaneous Field Activities 421

Postwork 422

Maintenance 422

Monitoring and Evaluation 422

Results and Discussion II. Administrative and Interagency Coordination/Education . . . . . l 426

Administrative . . . . . , ... 426

Reports 426

Budgets 426

Personnel 426

Interagency Coordination 426

Education 427

Appendices

A Riparian Habitat Inventory Methods 429

B Swamp Creek Breeding Bird Survey l 435

C BPA-Funded Fish Habitat Projects from Union County SWCD 1986 Annual Report . . . . . l . l l l 437

D Plant Porpogation Techniques Used with Riparian Vegetation A Report 439

List of Illustrations

The Estimated Amount of Riparian and Instream Habitat Work Needed Within the Joseph Creek Drainage by Stream, and in Priority Order 400

The Estimated Amount of Riparian and Instream Habitat Work Needed Within the Upper Grande Ronde River Drainage, 1966 through 1986 401

Summer Steelhead Spawning Ground Counts in the Joseph Creek Drainage, 1966 though 1986 403

Spring Chinook Spawning Ground Counts in the Joseph Creek Drainage, 1967 though 1986 403

Counts of Returning Adult Spring Chinook and Summer Steelhead Over Lower Granite Dam on the Lower Snake River, 1975 through 1986 405

Mapping Activities Completed for Private Properties Along the Joseph Creek and Upper Grande Ronde River Drainages, through December 31, 1986 . . . 413

Landowners Contacted in the Joseph Creek and Upper Grande Ronde River Drainages for the Purpose of Discussing Riparian Management Programs and/or Riparian Lease Development in 1986 414

Leased Riparian Lands in the Joseph Creek and Upper Grande Ronde River Drainages, 1985 and 1986 415

A Summary of Habitat Inventory Data Collected from Priority Streams in the Joseph Creek and Upper Grande Ronde River Drainages in 1986 417

Reslults of the 1986 Evaluation of Riparian Plantings Made Along Swamp Creek in1985 423

List of Figures

The Joseph Creek Drainage as ir Relates to the Grande Ronde River Basin of Northeastern Oregon and Southeastern Washington 407

The Upper Grande Ronde River Drainage as ir Relates to the Grande Ronde River Basin of Northeastern Oregon 408

Instream Structures Placed in Chesnimnus Creek 418
boulder placements
a: rock deflectors
d. log sills

Riparian Fences Constructed in 1986 420
a. Elk Creek barbed wire
b. Chesnimnus Creek high tensile smooth

Photopoint Documentation of Riparian Project Areas 424
Swamp Creek, November 1984 424
a. Swamp Creek, October 1985 424
c. Elk Creek, October 1984 425
d. Elk Creek, November 1986 425

Sign Designed for Use Along BPA Funded Riparian Enhancement Projects . . 428

ABSTRACT

On July 1, 1984 the Bonneville Power Administration and the Oregon Department of Fish and Wildlife entered into an agreement to initiate habitat enhancement work in the Joseph Creek drainage, a tributary of the Grande Ronde River in northeast Oregon. On July 1, 1985 the upper Grande Ronde River and 33 of its tributaries were added to the contract (Contract No. DE-AI79-84BP16614). Titled The Grande Ronde Habitat Improvement Project: Joseph Creek and Upper Grande Ronde River Drainages, Project 84-25, this project's primary objective is to provide additional spawning and rearing habitat for summer steelhead and spring chinook, thereby increasing smolt production and complimenting ongoing efforts to restore Columbia and Snake River stocks. This project provides for implementation of Program Measure 704 (d)(1) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program and will be done as offsite mitigation for mainstem fishery losses caused by the Columbia River hydro-electric system.

All work being done by the Oregon Department of Fish and Wildlife is on private lands and therefore requires considerable time be spent developing landowner rapport to insure their acceptance of, and cooperation with, the program.

During 1986, leases were signed with three landowners which will protect 6.8 miles of stream and 106.6 acres of riparian habitat. At the close of 1986 an additional five leases were being negotiated.

Fencing, planting, instream structure work, and habitat inventories were all undertaken during 1986; construction of 1.9 miles of fence, maintenance of 4.4 miles of fence, instream work on 3.6 miles of stream, planting of 0.6 miles of stream, and inventorying 119.4 miles of stream were all completed in 1986.

INTRODUCTION

The Joseph Creek and upper Grande Ronde River drainages have recently been examined as part of a Grande Ronde Basin study undertaken by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Oregon Department of Fish and Wildlife (ODFW). The study, funded by the Bonneville Power Administration (BPA), was designed to "compile, by major drainage, the basic information necessary to identify, evaluate, prioritize, and recommend site-specific solutions to major problems impacting the anadromous salmonid resource and fisheries", and "prepare an integrated overall plan for the study area". The identification, prioritization, and implementation of habitat work within these drainages represents a consensus among field staff from State, Tribal, and Federal entities (Tables 1 and 2).

Though Joseph Creek and its tributaries have historically been excellent producers of summer steelhead, and the upper Grande Ronde River and its tributaries excellent producers of summer steelhead and spring chinook, recent redd counts indicate returns to these drainages to be well below those observed in the late 1960's and early 1970's (Tables 3 and 4). Reasons for declines of anadromous fish include:

Table 1. The estimated amount of riparian and instream habitat work needed within the Joseph Creek drainage by stream, and in priority order.

Joseph Creek Drainage	Species Affected	Priority	Miles of Stream			Miles of Riparian Work				Instream Structures	
						Fencing		Planting			
			USFS	Private	Total	USFS	Private	USFS	Private	USFS	Private
Peavine Creek	Stld	1	8.0	0.0	8.0	4.5	0.0	4.5	0.0	43	0
Elk Creek	Stld	2	3.5	5.0	8.5	3.5	5.0	3.5	5.0	25	35
Chesnimnus Creek	Stld	3	12.0	8.0	20.0	12.0	8.0	8.0	4.0	60	40
Crow Creek	Stld	4	1.0	13.0	14.0	1.0	13.0	0.0	10.0	10	50
Swamp Creek	Stld	5	5.0	10.0	15.0	5.0	10.0	2.5	5.0	10	20
Pine Cr. System	Stld	6	2.0	20.0	22.0	2.0	18.0	2.0	18.0	10	40
Devil's Run Cr.	Stld	7	5.0	0.0	5.0	2.0	0.0	2.0	0.0	10	10
Davis Creek	Stld	8	7.0	3.0	10.0	7.0	3.0	4.0	3.0	10	0
Butte Creek	Stld	9	0.0	4.0	4.0	0.0	4.0	0.0	3.0	0	10
TNT Gulch	Stld	10	2.0	0.0	2.0	2.0	0.0	2.0	0.0	10	0
Joseph Creek	Stld	11	0.0	12.0	12.0	0.0	12.0	0.0	12.0	0	80
Sub-Basin Totals			45.5	75.0	120.5	39.0	73.0	28.5	60.0	188	285

Source: Confederated Tribes of the Umatilla Indian Reservation. 1984. Grande Ronde River Basin. Recommended Salmon and Steelhead Habitat Improvement Measures. 92 pp.

Table 2. The estimated amount of riparian and instream habitat work needed within the Upper Grande Ronde River Drainage by stream, and in priority order.

Upper Grande Ronde River Drainage	Species Affected	Priority	Miles of Stream			Miles of Riparian Work				Instream Structures	
						Fencing		Planting			
			USFS	Private	Total	USFS	Private	USFS	Private	USFS	Private
Grande Ronde River	Ch, Stld	1	6.0	5.0	11.0	2.0	5.0	1.0	4.0	130	175
Sheep River	Ch, Stld	2	7.0	5.0	12.0	1.0	5.0	0.5	2.5	210	175
Fly Creek	Stld	3	6.0	6.0	12.0	1.0	5.0	0.5	3.0	180	180
Spring Creek	Stld	4	5.0	0.0	5.0	1.0	0.0	2.5	0.0	150	0
S. Fork Spring Cr.	Stld	5	3.0	0.0	3.0	1.0	0.0	1.5	0.0	90	0
N. F. Catherine Cr.	Ch, Stld	6	3.0	0.0	3.0	0.0	0.0	0.0	0.0	90	0
McCoy Creek	Stld	7	4.0	7.0	11.0	1.0	7.0	3.0	4.0	120	210
Rock Creek	Stld	8	0.0	6.0	6.0	0.0	8.0	0.0	3.0	0	90
Dark Canyon Creek	Stld	9	1.0	2.5	3.5	0.0	2.5	0.0	0.0	15	38
Meadow Creek	Stld	10	7.0	7.0	14.0	1.0	7.0	0.5	0.5	210	210
Indian Creek	Ch, Stld	11	1.0	5.0	6.0	0.5	3.5	0.0	0.0	30	150
Chicken Creek	Stld	12	5.0	2.0	7.0	1.0	1.0	0.0	1.0	75	70
Catherine Creek	Ch, Stld	13	0.0	5.0	5.0	0.0	4.0	0.0	0.0	0	150
Beaver Creek	Stld	14	1.5	5.0	6.5	0.0	3.0	0.0	0.0	45	150
Five Points Creek	Stld	15	5.5	0.5	6.0	0.0	0.5	0.0	0.5	165	15
Clark Creek	Ch, Stld	16	0.0	6.0	6.0	0.0	4.0	0.0	3.0	0	180
Little Catherine Cr.	Stld	17	1.0	4.0	5.0	0.0	2.0	0.0	1.5	15	60
Bear Creek	Stld	18	5.0	0.5	5.5	0.0	0.0	0.0	0.0	75	8
Limber Jim Creek	Ch, Stld	19	2.0	0.3	2.3	0.0	0.0	1.0	0.3	30	5

- Continued -

Table 2 continued.

Upper Grande Ronde River Drainage	Species Affected	Priority	Miles of Stream			Miles of Riparian Work: Fencing		Miles of Riparian Work: Planting		Instream Structures	
			USFS	Private	Total	USFS	Private	USFS	Private	USFS	Private
Pelican Creek	Stld	20	3.0	0.5	3.5	0.0	0.0	0.0	0.0	45	8
Peet Creek	Stld	21	2.0	1.0	3.0	0.0	0.0	1.0	0.5	60	30
Little Fly Creek	Stld	22	3.0	2.5	5.5	0.0	0.0	0.0	1.0	90	75
Whiskey Creek	Stld	23	1.0	8.0	9.0	0.0	4.0	0.0	2.0	15	120
Jordan Creek	Stld	24	2.0	8.0	10.0	0.0	4.0	0.0	2.0	30	120
N. Fork Limber Jim	Stld	25	2.0	0.0	2.0	0.0	0.0	0.0	0.0	30	0
McIntyre Creek	Stld	26	2.5	5.0	7.5	1.0	3.0	1.0	5.0	75	150
Waucup Creek	Stld	27	5.0	0.0	5.0	0.0	0.0	1.0	0.0	150	0
Burnt Corral Cr.	Stld	28	6.0	0.2	6.2	0.0	0.0	0.0	0.0	90	4
Lookout Creek	Stld	29	3.5	0.8	4.3	0.0	0.0	0.0	0.0	53	24
Little Dark Canyon Cr.	Stld	30	2.0	0.0	2.0	0.0	0.0	0.0	0.0	60	0
Phillips Creek	Stld	31	0.0	6.0	6.0	0.0	2.0	0.0	0.0	0	180
Gordon Creek	Stld	32	0.0	7.0	7.0	0.0	4.0	0.0	2.0	0	210
Dry Creek	Stld	33	0.0	8.0	8.0	0.0	6.0	0.0	4.0	0	240
Cabin Creek	Stld	34	0.0	3.0	3.0	0.0	2.0	0.0	0.0	0	90
Sub-Basin Totals			95.0	116.8	21.8	10.5	82.5	13.5	39.8	2328	3117

Source: Confederated Tribes of the Umatilla Indian Reservation. 1984. Grande Ronde River Basin. Recommended Salmon and Steelhead Habitat Improvement Measures. 92 pp.

Table 3. Summer steelhead spawning ground counts in the Joseph Creek drainage[1,2], 1966 through 1986[3].

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Redds Observed	780	611	234	357	267	148	209	103	113	17	29	34	40	9	93	103	87	75	76	463	417
Miles Surveyed	56	52	51	63	47	53	55	60	54	34	50	30	51	58	59	59	45	58	49	49	46
Redds/ Mile	13.9	12.9	4.6	5.8	5.7	2.8	3.8	1.7	2.1	0.5	0.5	1.1	0.8	0.2	1.8	1.8	1.9	1.3	1.6	9.45	9.07

1 Streams included in the Joseph Creek drainage summer steelhead spawning ground counts include Butte, Chesnimnus (mainstem, north, and south forks), Crow, Devil's Run, Elk, Peavine, Swamp, and TNT Gulch creeks. All of these creeks, however, may not be inventoried on any given year due to river conditions. This annual variation is reflected in the "Miles Surveyed".

2 Since the Joseph Creek and upper Grande Ronde River drainages are both within the Grande Ronde River basin, it is felt spawning ground trends within the Joseph Creek drainage are also representative of those within the upper Grande Ronde River drainage.

3 Summer steelhead spawning ground counts were obtained from Kenneth L. Witty, District Fish Biologist, Wallowa District, Oregon Department of Fish and Wildlife.

Table 4. Spring chinook spawning ground counts in the upper Grande Ronde River drainage[1], 1967 through 1986[2].

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Redds Observed	310	390	447	198	422	323	295	186	106	205	102	122	48	106	68	110	112	72	132	117
Miles Surveyed	40.5	38	27	27	27	27	27	27	27	27	19	21	27	27	27	28	27	27	27	27
Redds/Mile	7.7	10.3	16.6	7.3	15.6	12.0	10.9	6.9	3.9	7.6	5.4	5.8	1.8	3.9	2.5	4.1	4.2	2.7	4.9	4.3

1 Streams in the upper Grande Ronde River drainage spring chinook spawning ground counts include North Fork, South Fork, and mainstem Catherine Creek, mainstem Grande Ronde River, and Sheep Creek.

2 Spring chinook spawning ground counts were obtained from Duane C. West, District Fish Biologist, La Grande District, Oregon Department of Fish and Wildlife.

1) problems with passage at mainstem Columbia and Snake River dams,
2) user demands for the fishery resource, and
3) degradation of spawning and rearing habitat.

Considerable effort and money has already been put into resolving mainste dam passage problems and controlling ocean and river harvest of these stocks. There are now indications these efforts are resulting in increased numbers of spawning steelhead, and to a lesser degree spring chinook, returning to their native spawning grounds in lower Snake River tributaries (Table 5).

Observations in the Joseph Creek and upper Grande Ronde River drainages however, indicate optimum rearing areas for summer steelhead and spring chinook are limited in large portions of these drainages by degradatio of riparian and instream habitats. Several factors have contributed to this habitat degradation within project areas, including cattle grazing farming practices, timber harvest practices, road construction and stream channelization; cattle grazing and farming practices being the main factors on private lands. The result of this degradation has been loss of shade-producing streamside vegetation, thereby causing high summer water temperatures, and destruction of natural pool/riffle ratios which are necessary for good smolt production. It has been estimated there is currently a 28 percent shade cover over most streams within project areas and, with proper habitat enhancement measures, this can be increased to seventy percent; a 250 percent increase over present shade cover. Installation of instream structures can restore pool/riffle ratios to an acceptabl 50:50 ratio. Therefore, through an aggressive habitat enhancement program, optimum habitats for returning adults and their progeny may be realized.

Table 5. Counts of returning adult spring chinook and summer steelhead over Lower Granite Dam on the lower Snake River, 1975 through 1986.

Year	Summer Steelhead (June 1 - October 31)	Spring Chinook[3] (April 1 - June 17)
Annual Counts[1,2]		
1975	13,523	17,639
1976	20,020	20,475
1977	48,037	38,770
1978	23,565	41,006
1979	20,281	7,539
1980	32,677	6,758
1981	33,234	13,642
1982	63,070	12,746
1983	76,673	10,026
1984	86,448	7,921
1985	102,104	27,737
1986	116,622	32,929

1 Counts for 1975 through 1984 were taken from the Oregon Department of Fish and Wildlife, Columbia River Management, Columbia River Fish Counts Report. January 1985.

2 1979, 1983, and 1984 revisions to the table, and 1985 and 1986 figures were obtained through personal communication with Howard Jensen, Oregon Department of Fish and Wildlife, Clackamas, Oregon. January 26, 1987.

3 Count includes adults and jacks.

2-20

DESCRIPTION OF STUDY AREAS

Joseph Creek Drainage

The Joseph Creek System constitutes a major drainage within the Grande Ronde River basin of northeast Oregon; it drains approximately 556 square miles of the 3,950 square mile Grande Ronde River basin and empties into the Grande Ronde River 4.3 miles above the confluence of the Grande Ronde and Snake rivers (Figure 1). Approximately 75 percent of the Joseph Creek system is within the project area. Not included in the project area is lower Joseph Creek in Washington state, and the Cottonwood Creek subdrainage which enters Joseph Creek 4.4 miles above Joseph Creek's confluence with the Grande Ronde River (Figure 1).

Within the project area 120.5 miles of stream have been identified as in need of habitat enhancement; 75 miles on private land and 45.5 miles on National Forest lands (Table 1).

Upper Grande Ronde River Drainage

The upper Grande Ronde River drainage constitutes approximately 1,622 square miles of the Grande Ronde River basin above the confluence of the Grande Ronde and Wallowa rivers at Rondowa; 81.4 miles upstream from the confluence of the Grande Ronde and Snake rivers (Figure 2). A major portion of the upper Grande Ronde River drainage, including the mainstem Grande Ronde River and 33 of its tributaries are within the project area.

Within the project area 211.8 miles of stream have been identified as in need of habitat enhancement; 116.8 miles on private lands and 95.0 miles on National Forest lands (Table 2).

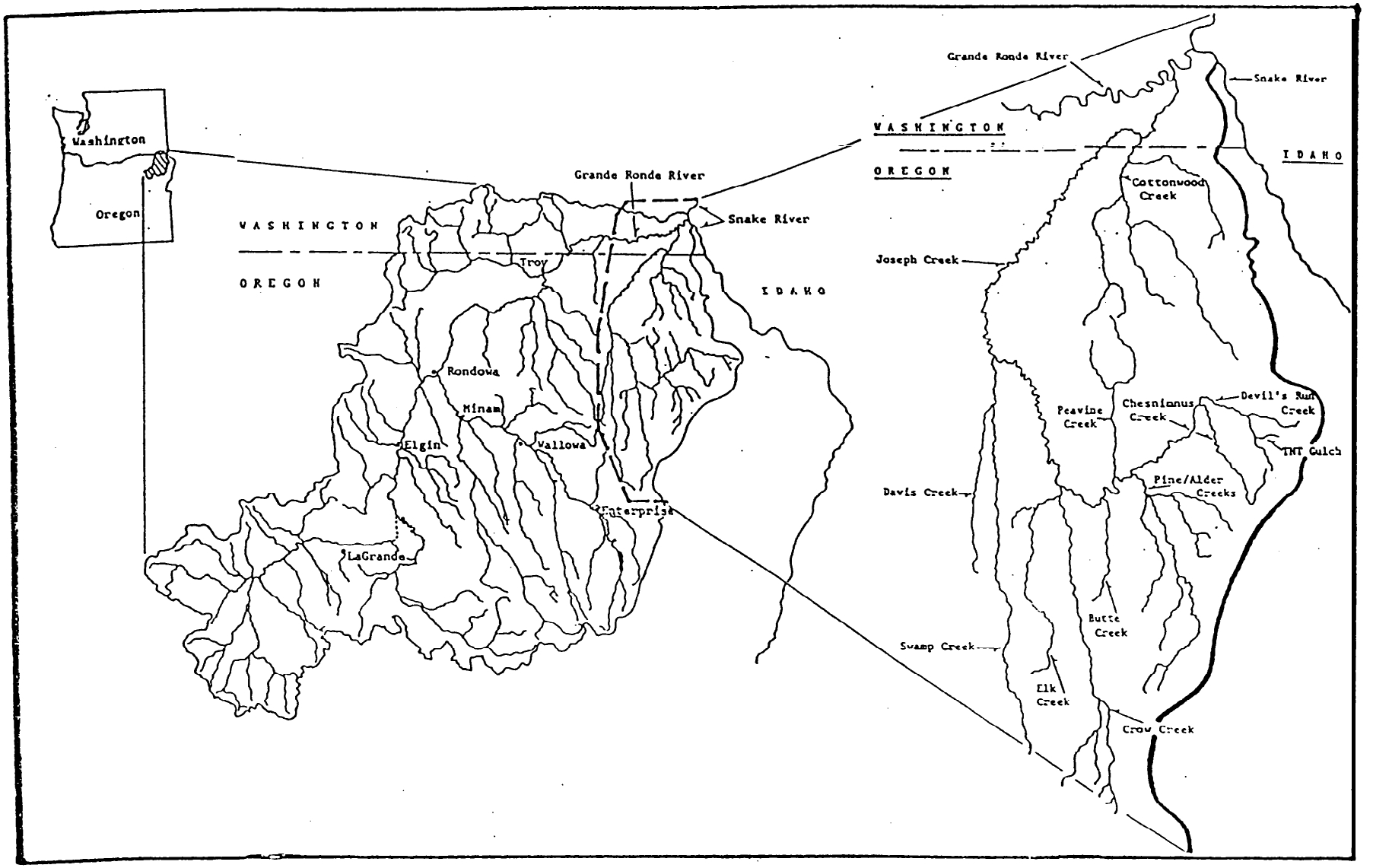


Figure 1. The Joseph Creek Drainage as it relates to the Grande Ronde River Basin of northeast Oregon and southeast Washington.

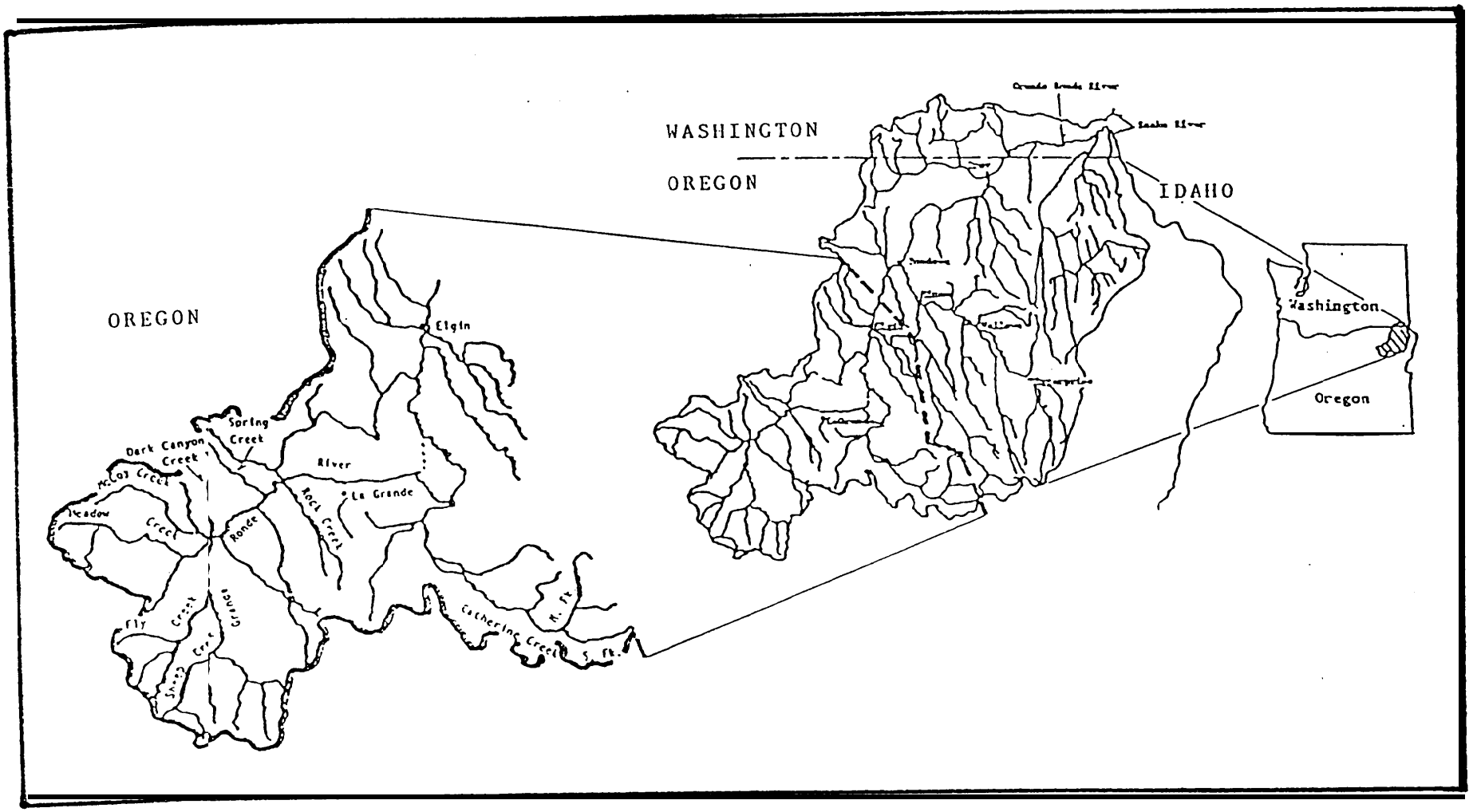


Figure 2. The Upper Grande Ronde River Drainage as it relates to the Grande Ronde River Basin of northeast Oregon.

METHODS AND MATERIALS

The objective of this project is to provide optimum spawning and rearing habitats for summer steelhead and spring chinook in selected portions of the Grande Ronde River basin. To accomplish this objective work will progress in three phases:

1) planning and preparation (prework),
2) implementation, and
3) maintenance and evaluation (postwork).

Prework

Prior to actual project implementation the following activities are to be conducted:

1. Project planning Project planning includes design and layout of all work to be done onsite, landowner coordination, developing contract specifications, contract development for proposed work, and obtaining necessary permits to do work.

2. Onsite preparation Onsite preparation includes locating sites for all structural improvements and plantings, and surveying and staking proposed easements.

3. Riparian lease procurement In order to insure access onto private lands for the purposes of implementation, maintenance, and monitoring, the ODFW plans to acquire leases for proposed work areas. Additionally, landowners will be made aware of their eligibility for Oregon's Riparian Tax Incentive Program. Under this program the protected riparian areas are eligible for property tax exemption.

Implementation

Implementation will entail the actual on-the-ground work phase of the project. Implementation activities will normally be accomplished in the following sequence:

1. Habitat inventories Inventorying of physical parameters (i.e., flow features, substrate type, riparian vegetation, etc.) within riparian areas is necessary to determine which parameters, if any, are in need of restoration or enhancement. Prior to designing or implementing any riparian work on a priority stream, standard physical parameters will be measured and evaluated. The data from these inventories will be used to help determine which streams are in greatest need of work and, when working with landowners, to help explain habitat enhancement needs.

2. Instream structures During late summer and early fall, when stream flows are lowest, structures will be installed in streams at locations preselected by fishery biologists and/or hydrologists. Structures of various types will be used to provide optimum pool/riffle ratios and collect spawning gravels, thereby increasing rearing and spawning habitats. Rock jetties and deflectors will be the primary

structures used to stabilize streambanks; boulders will be used to create small rearing pools and hiding cover.

3. Plantings During the early spring vegetation will be planted at preselected locations along streams within the project area. Since high summer water temperatures are considered to be the drainages main limiting factor, these plantings are intended to provide stream shade, thereby reducing summer water temperatures and increasing steelhead utilization of streams. The maximum shade attainable for most streams in the project area is approximately eighty percent. The objective of this phase of the project is to reach a minimum of seventy percent shade and have water temperatures of no more than 68°F within ten years of project implementation.

4. Fencing Destruction of streamside vegetation by domestic livestock has been a major problem within project areas. To provide protection from livestock and thereby promote rapid growth of existing and planted vegetation, fences will be constructed along riparian zones within project areas.

5. Miscellaneous field activities Numerous miscellaneous field activities (e.g. seeding of disturbed ground in project areas; setting up transects, photopoints and monitoring stations; etc.) will be necessary to tie all other activities together and help with evaluating the overall program.

Postwork

Postwork will entail all maintenance, monitoring, and evaluation of work which has been done within the project areas. This phase of the work will usually begin the year following completion of implementation and will continue for several years. Currently, State and Federal agencies and the Indian Tribes are in the process of developing standard methods to be employed for evaluating fishery and habitat changes that may occur as a result of BPA funded habitat restoration work.

RESULTS AND DISCUSSION

I. FIELD ACTIVITIES

It is planned to accomplish habitat enhancement work on private lands in three phases:

1) planning and preparation (prework),
2) implementation, and
3) maintenance and evaluation (postwork).

Activities undertaken during this year were within all phases.

PREWORK

Prework activities are divided into three successive stages:

1) project planning,
2) onsite preparation, and
3) riparian lease procurement.

During this year activities within all three stages were undertaken.

Project Planning

Work done in the project planning stage included: a) design and layout of onsite work, b) landowner coordination and, c) development of contracts and contract specifications.

a. Design and Layout Identification of property boundaries for privately owned lands along priority streams in the Joseph Creek and upper Grande Ronde drainages is the first step in preparation for doing habitat enhancement work. To accomplish this, county ownership maps were obtained from the respective County Assessor's offices. Once land ownerships and property boundaries have been identified on these maps and/or transferred to topographic maps, aerial photographs (at a scale of 16 inches per mile) are obtained from the U.S. Department of Agriculture - Agricultural Stabilization and Conservation Service (USDS-ASCS). Individual streams were then traced from these photographs onto acetate; property lines and major geographic features added, and ozalid copies of these maps produced. Once completed, ozalid maps were broken down into 8½ x 11 inch segments and reproduced for use in on-the-ground planning activities, and as descriptive parts of riparian lease agreements, as parts of contract specifications for contracted riparian enhancement work.

During 1986, acetate, ozalid, and 8½" x 11" maps for 29.3 miles of Joseph Creek tributaries and 73.2 miles of upper Grande Ronde tributaries were completed. Additionally, mapping of 2.0 miles of Beaver Creek in the upper Grande Ronde drainage was completed through the acetate mapping stage, and all private lands on the top 26 priority streams in the upper Grande Ronde drainage were mapped onto topographic maps (except for Beaver Creek,

priority stream 14 and Limber Jim Creek, priority stream 19, [Table 6]).

In addition to preparing the above described maps, maps of project areas were also developed for use in locating priority stream reaches for low level infra-red photography which was to be completed by the BPA. It is hoped that when completed these photographs will be used to aid in detecting changes in riparian habitat through time.

In preparation for contacting landowners, approximately 27.1 and 16.5 miles of creek were hiked in the Joseph Creek and upper Grande Ronde River drainages, respectively. These surveys helped to determine the feasibility of undertaking habitat enhancement projects on several private properties.

Hydraulic Engineering consultants John F. Orsborn and Tom Bumstead were hired to design instream work for Chesnimnus Creek. Work performed included a preliminary survey of 3.0 miles of creek, design for 1.5 miles of instream work, preparation of a report, establishment of photopoints, and provision of working blueprints of the project. This data was forwarded to the ODFW engineering section who then incorporated it into a contract bid package.

b. Landowner Coordination Considerable time was spent during the year meeting with landowners in the Joseph Creek and upper Grande Ronde River drainages. Contacts were in the form of telephone conversations, on-the-ground inspection of proposed project sites, slide presentations, and letters. During these meetings emphasis was placed on meeting needs of the fishery resource while, at the same time, benefiting landowners.

During 1986, ten private landowners in the Joseph Creek drainage and twelve private landowners in the upper Grande Ronde River drainage were contacted regarding possible work on their properties (Table 7).

An onsite meeting was held with Mr. Matt Kneisel of the Baker, Oregon Bureau of Land Management (BLM) office to evaluate riparian habitat needs along Sheep Creek and to begin development of a cooperative agreement between BLM and ODFW. This agreement would allow ODFW to construct riparian fences along approximately 0.6 miles of Sheep Creek, thereby tying together projects on Sheep Creek which includes the USFS, BLM, ODFW, and private landowners.

Table 6. Happing activities completed for private properties alone the Joseph Creek and Upper Grande Ronde River drainages, through December 31, 1986.

	County Assessor Maps	Topographic Maps	Aerial Photos Purchased	Acetate Maps (miles)	Ozalid Maps (Miles)	8½ x 11 Maps
Upper Grande Ronde River Drainage						
Grande Ronde River	X	X	X	3.8	3.8	3.8
Sheep Creek	X	X	X	7.5	7.5	7.5
Fly Creek	X	X	X	7.8	7.8	7.8
Spring Creek	No private Lands					
S.F. Spring Creek	No Private Lands					
N.F. Catherine Creek	No Private Lands					
McCoy Creek	X	X	X	8.6	8.6	8.6
Rock Creek	X	X	X	14.4	14.4	14.4
Dark Canyon Creek	X	X	X	1.9	1.9	1.9
Meadow Creek	X	X	X	10.2	10.2	10.2
Indian Creek	X	X	X	11.7	11.7	11.7
Chicken Creek	X	X	X	---	---	---
Catherine Creek	X	X	X	9.2	9.2	9.2
Beaver Creek	X	---	X	2.0	---	---
Five Points Creek	X	X	X	2.4	2.4	2.4
Clark Creek	X	X	X	---	---	---
Little Catherine Creek	X	X	X	5.5	5.5	5.5
Bear Creek	---	X	---	---	---	---
Limber Jim Creek	X	---	X	---	me-	---
Pelican Creek	---	X	---	---	---	---
Peet Creek	X	X	X	---	---	---
Little Fly Creek	X	X	X	---	---	---
Whiskey Creek	X	X	X	9.3	9.3	9.3
Jordan Creek	X	X	X	---	---	---
N. F. Limber Jim Cr.	No Private Lands					
McIntyre Creek	X	X	X	---	---	---
Waucup Creek	No Private Lands					
Burnt Corral Creek	---	---	---	---	---	---
Lookout Creek	---	---	---	---	---	---
Little D. Canyon Cr.	No Private Lands					
Phillips Creek	---	---	---	---	---	---
Gordon Creek	---	---	---	---	---	---
Dry Creek	---	---	---	---	---	---
Cabin Creek	---	---	---	---	---	---
SUBTOTALS	---	---	---	75.2	73.2	73.2
Joseph Creek Drainage						
Peavine Creek	No Private Lands					
Elk Creek	X	---	X	---	---	1.8
Chesnimnus Creek	X	---	X	10.2	10.2	10.2
Crow Creek	X	---	X	15.7	15.7	15.7
Swamp Creek	X	---	X	14.3	14.3	14.3
Pine Creek System	X	---	X	18.8	18.8	18.8
Devel's Run Creek	No Private Lands					
Davis Creek	X	---	---	---	---	---
Butte Creek	X	---	X	4.6	4.6	4.6
TNT Gulch	No Private Lands					
Joseph Creek	X	---	X	4.5	4.5	4.5
SUBTOTALS	---	---	---	68.1	68.1	69.9
T O T A L S	---	---	---	143.3	141.3	143.1

Table 7. Landowners contacted in the Joseph Creek and upper Grande Ronde River drainages, for the purpose of discussing riparian management programs and/or riparian lease development in 1986.

Joseph Creek Landowners	Stream Involved	Upper Grande Ronde River Landowners	Stream Involved
Bennett/Snodderly	Swamp Creek	Abel1	Rock Creek
Boise Cascade Corp.*	Swamp Creek	Beck	Indian Creek
Darnielle	Chesnimnus Cr	Belsma/O'Brien	Rock Creek
Dawson	Chesnimnus Cr	Clark	Beaver Creek
Fleshman*	Crow Creek	Correa	McCoy Creek
Ketscher	Pine Cr System	Lynch	Rock Creek
McClaran	Pine Cr System	Musgrove*	McCoy Creek
Snyder/WJS*	Crow Creek	Schiller*	Sheep Creek
Stein*	Crow Creek	Smith*	Fly Creek
Yost*	Chesnimnus Creek	Snow	McCoy Creek
		Waite	Meadow Creek
		Williams*	Rock Creek

*Landowners with whom considerable time was spent to develop an acceptable riparian management plan and/or lease agreement.

C. Development of Contracts and Contract Specifications Considerable time during this year was devoted to development of work contracts and contract specifications for fence construction, materials procurement, and instream structure construction.

Specifications for construction of 1.4 miles of barbed wire fence along Elk Creek and repair of an additional 4.4 miles of barbed wire fence along Swamp Creek were developed during 1986. The construction specifications were further modified for a proposed contract to build approximately 5.5 miles of barbed wire fence along Rock Creek. Work was also begun to further modify these construction specifications for use with high tensile smooth wire fencing. In preparation for developing high tensile smooth wire fencing specifications, several already completed fencing projects in N.E. Oregon were inspected and a seminar on high tensile smooth wire fence construction was attended. Additionally 0.5 miles of this fence was constructed on the Chesnimnus Creek project site by ODFW personnel to help better understand the idiosyncrasies of this type of fencing prior to developing the construction specifications.

All construction and repair specifications for barbed wire fencing were included in bid packages and contracts which were implemented on Elk and Swamp creeks in 1986.

Construction specifications for instream work along 3.0 miles of Chesnimnus Creek were developed by engineering consultants and then modified by the ODFW engineering section and included in a work contract which was implemented in October.

Prior to all fencing and instream work, prebid inspection tours were conducted by ODFW personnel for all interested bidders.

Contract and/or purchasing specifications were also developed for obtaining fence and instream structure construction materials.

2. Onsite Preparation

Prior to signing leases or constructing fences, the location of all proposed fencelines must be staked and agreed upon by the landowner and/or fencing contractor; all instream structure locations must also be staked prior to implementation of instream work contracts.

During 1986, ten miles of fenceline in the Joseph Creek drainage and 24.5 miles of fenceline in the upper Grande Ronde River drainage were staked. Additionally 4.4 miles of existing riparian fence was surveyed and marked for repairs.

Instream structure sites on 3.0 miles of Chesnimnus Creek and 7.2 miles of Elk Creek, both in the Joseph Creek Drainage, were staked prior to implementation of instream work contracts.

3. Riparian Lease Procurement

Riparian leases were signed with two Joseph Creek drainage landowners and one upper Grande Ronde drainage landowner in 1986. These three leases will protect 6.8 miles of creek and 106.6 acres of riparian habitat for fifteen years each. Combined with leases signed in 1985 we now have 9.8 miles of creek and 130.5 acres of riparian habitat leased (Table 8).

Table 8. Leased riparian lands in the Joseph Creek and upper Grande Ronde River drainages, 1985 and 1986.

Property Owner	Creek	Creek Miles Leased	Acres Protected
1985			
Olsen	Swamp Creek	2.4	16.2
Birkmaier	Elk Creek	0.6	7.7
1986			
Boise Cascade	Swamp Creek	2.6	48.6
Smith	Fly Creek	1.2	76.2
Yost	Chesnimnus Creek	3.0	41.8
Totals		9.8	130.5

In addition to the three leases signed in 1986, five more leases were under negotiation at the end of the report period.

IMPLEMENTATION

Implementation activities undertaken during this year were in the planting, fencing, instream structure, inventories, and miscellaneous field activities categories.

1. Inventories

Though some habitat inventories were completed in 1985, intensive efforts were not made prior to the 1986 field season. During 1986 ODFW personnel spent considerable time coordinating with the Baker, La Grande, and Wallowa districts of the U.S. Forest Service to develop and fine tune standardized riparian habitat inventory methods (Appendix A).

Over a three month period, four temporary employees inventoried 119.4 miles of streams; 63.6 miles in the Joseph Creek drainage, and 55.8 miles in the upper Grande Ronde River drainage. Subsequently all collected data was summarized for future reference (Table 9).

In November, work was begun to develop an intensive physical habitat monitoring plan. This plan will be completed and implemented in both the Joseph Creek and upper Grande Ronde drainages in 1987.

Assistance was given to district fish biologists in both drainages when they *were* conducting spawning ground inventories for spring chinook and summer steelhead.

A breeding bird survey along the leased riparian habitat area of Swamp Creek was conducted by ODFW district personnel on July 1 (Appendix B).

2. Instream Structures

Two instream structure contracts, one on Elk Creek and one on Chesnimnus Creek were implemented in 1986.

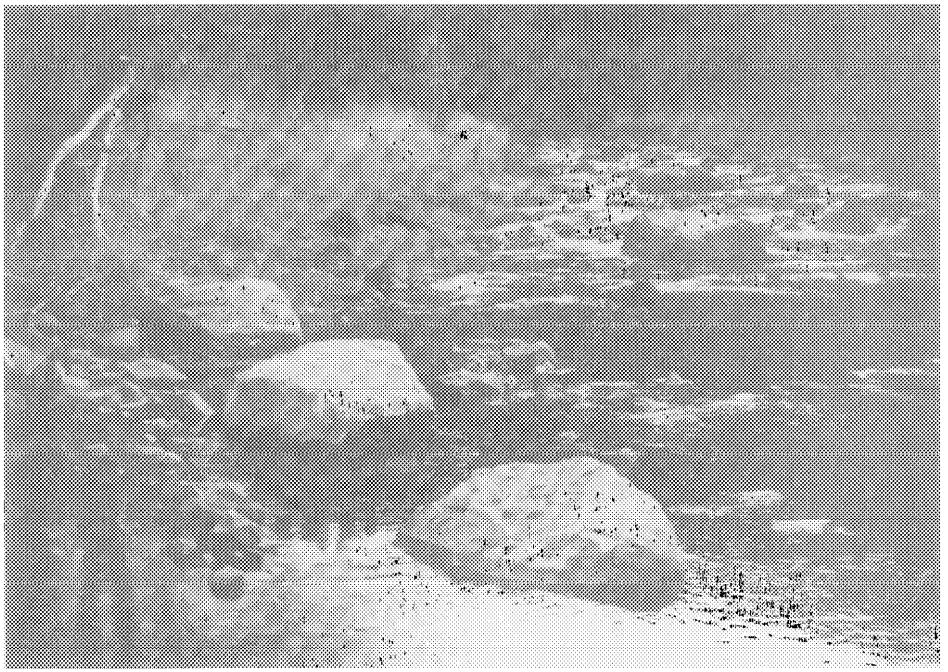
Work on Elk Creek consisted of 22 boulder placements, excavation of pools and armoring ends of seven existing digger logs, excavation of pools and armoring ends of five existing log sills, renotching of three digger logs, placement of 65 yd3 of riprap material (20 Yd^3 to armor log sill ends and 45 yd3 to riprap a streambank), and placement and armoring of one wing log.

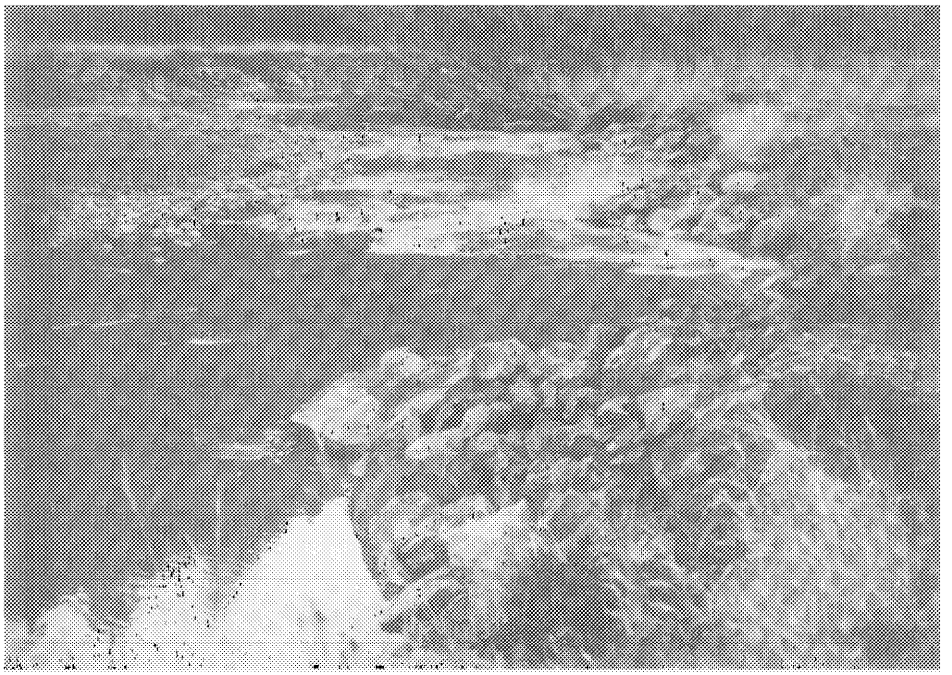
Instream work on Chesnimnus Creek consisted primarily of placing 492 boulders (Figure 3a), placing 1,900 yd3 of riprap rock [(used for 21 new rock deflectors (Figure 3b), repair of six old rock deflectors[1], construction of two rock berms and armoring the ends of seven log sills)], construction of seven log sills, and excavation of rearing pools directly below each of the seven log sills (Figure 3c).

1/ These rock deflectors were originally constructed under the direction of the Soil Conservation Service (USDA-SCS) in 1978 to mitigate flood related streambank drainage.

Table 9. A summary of habitat inventory data collected from priority streams in the Joseph Creek and upper Grande Ronde River drainages in 1986

			Joseph Creek Drainage (63.6 miles)									Upper Grande Ronde River Drainage (55.8 miles)					
			Alder Cr.	Butte Cr.	Chesnimnus Cr.	Crow Cr.	Dry Salmon Cr.	Pine Cr.	S.E. Alder Cr.	Salmon Cr.	Swamp Cr.	Catherine Cr.	Dark Canyon Cr.	Indian Cr.	Meadow Cr.	McCoy Cr.	Rock Cr.
Miles of Completed Inventory			3.1	4.6	10.2	15.7	1.1	7.2	1.0	6.4	14.3	13.7	1.9	7.0	10.2	8.6	14.4
FLOW FEATURES	Pool %		15	12	7	35	24	19	10	21	23	18	30	27	32	40	31
	Glide/Run %		63	44	64	40	67	62	76	57	39	12	28	22	36	23	24
	Riffle %		22	44	29	25	9	19	14	22	38	70	42	51	32	37	45
	Depth Class		1.1	.9	1.5	1.6	1.2	4.5	1.1	1.4	1.4	2	1	1.4	1.4	1.7	1
	Perimeter Cover		50	51	46	54	67	58	34	63	52	34	50	54	43	44	47
	Surface Cover		18	30	43	37	39	29	15	34	36	60	3	50	20	14	23
SUBSTRATE RIFFLE-GLIDE/RUN	Boulders %		9	7	18	12	9	13	8	11	8	17	14	27	8	8	16
	Cobbles %		33	27	47	31	41	29	28	27	23	46	58	44	46	42	42
	Gravel %		36	40	21	28	36	23	41	22	37	28	20	22	32	35	31
	Fines %		18	23	11	22	13	29	22	26	25	8	5	6	9	12	10
	Hardpan %		4	3	3	7	1	6	1	14	5	1	3	1	5	3	0.4
RIPARIAN VEGETATION DENSITY CLASS	< 5' tall within 10' of bank	Deciduous	19	7	13	4	3	10	11	6	6	11	9	12	6	7	7
		Conifer	0.5	0	.05	.007	0	.03	0	0	0.7	0.4	1.3	1.5	0	0.7	0.8
	> 5' tall within 20' of bank	Deciduous	16	26	20	22	12	7	4	6	19	33	15	29	6	6	12
		Conifer	6	0.4	2	1	0	1	0	0	12	3	6	8	1	3	4
Shade Density Class			25	30	9	19	11	15	6	6	28	7	17	20	3	7	10
CHANNEL WIDTH	Flood		34	27	84	33	39	36	40	37	39	51	21	33	53	54	30
	Present		3	3	23	7	4	8	2	5	8	35	11	20	27	15	13
STREAM TEMPERATURE	High		70	66	76	63	64	75	81	68	69	53	68	68	79	70	72
	Low		63	55	55	49	53	56	68	52	55	47	59	59	60	57	52
	Average		66	58	64	59	57	65	73	59	62	50	62	64	68	64	64





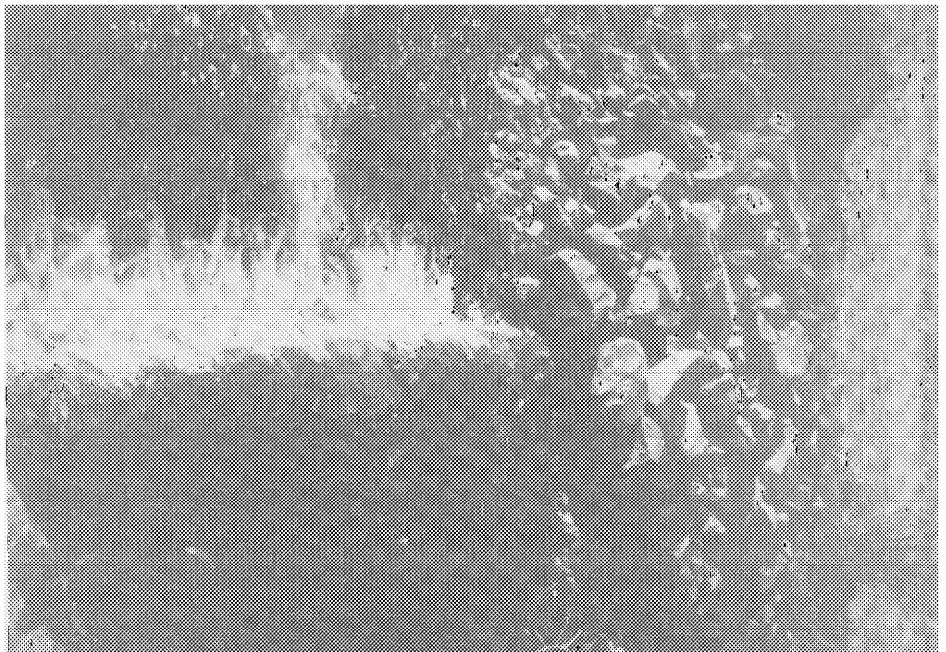


Figure 3. Instream structures Placed in Chesnimnus Creek:

a. boulder placements
b. rock deflectors
c. log sills

3. Planting

Planting of the Elk Creek project area was completed during 1986: 652 redosier dogwood (Cornus stolonifera), 290 ponderosa pine (Pinus ponderosa), and 287 Douglas fir (Pseudotsuga menzesii) were planted.

Initial monitoring of redosier dogwood plantings along Elk Creek were made in August of 1986. Of 117 plants which were marked when planted, 38 (32.5%) were still alive. These results, however, did not appear to be indicative of the survival throughout the Elk Creek project site; survival in most areas appeared to be considerably higher, perhaps 75%. Survival seemed to be moisture dependent and almost totally independent of soil quality; most dogwoods planted in gravel bars adjacent to the creek survived while those planted in loamy soil on higher creek banks had very low survival. Survival rates for Ponderosa pine and Douglas fir were not determined in 1986.

In preparation for the 1987 field season approximately sixty white willow (Salix alba) cuttings were taken and a seedling bed was prepared for excess shrubs and conifers. More white willow cuttings will be taken prior to the 1987 field season.

4. Fencing

A total of 1.9 miles of fence were constructed in 1986; 1.4 miles of five-strand barbed wire and 0.5 miles of six-strand high tensile smooth wire fence. The barbed wire fence was constructed along 0.6 miles of Elk Creek (Figure 4a) and protects 7.7 acres of riparian habitat and all plantings and instream structures which have been placed in and along the creek.

Prior to 1986 only two types of BPA-funded fencing had been used to protect leased riparian habitat areas in northeast Oregon: 1) conventional barbed wire, and 2) powered (electric) smooth wire fences. Neither of these fence types, however, has proven totally acceptable. Often our riparian fences need to be built on very uneven or steep terrain; often in timbered areas and/or areas with moderate to high big game utilization. We decided, therefore, to find a more acceptable type of fence for our purpose. In searching for a new type of riparian fence our objectives were to find a fence type that: 1) was comparable in cost to our presently used fence types, 2) would require less maintenance, and 3) would be more acceptable to highly utilized big game areas. With these objectives in mind project personnel attended a high tensile smooth wire fence construction seminar, and met with ranchers, contractors, and fencing materials suppliers; all to help determine the feasibility and practicality of non-powered high tensile smooth wire fences for riparian protection.

If properly designed and constructed, project personnel now feel that non-powered high tensile smooth wire fences will meet all of our objectives. Therefore, the 0.5 miles of high tensile smooth wire fence which was constructed along Chesnimnus Creek (Figure 4b)

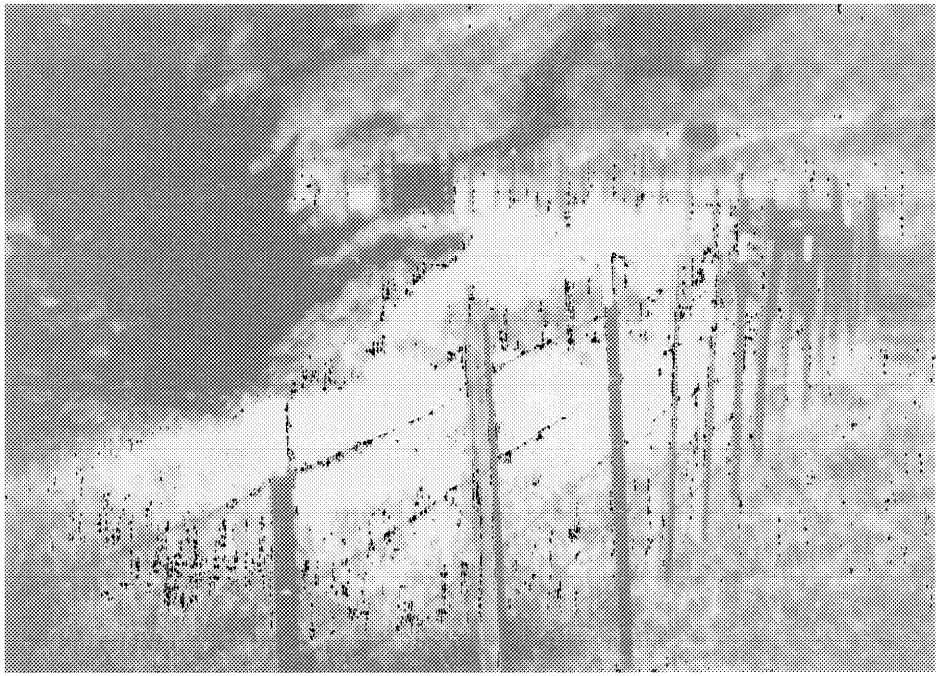


Figure 4a. Riparian fences constructed in 1986: Elk Creek barbed wire fence,

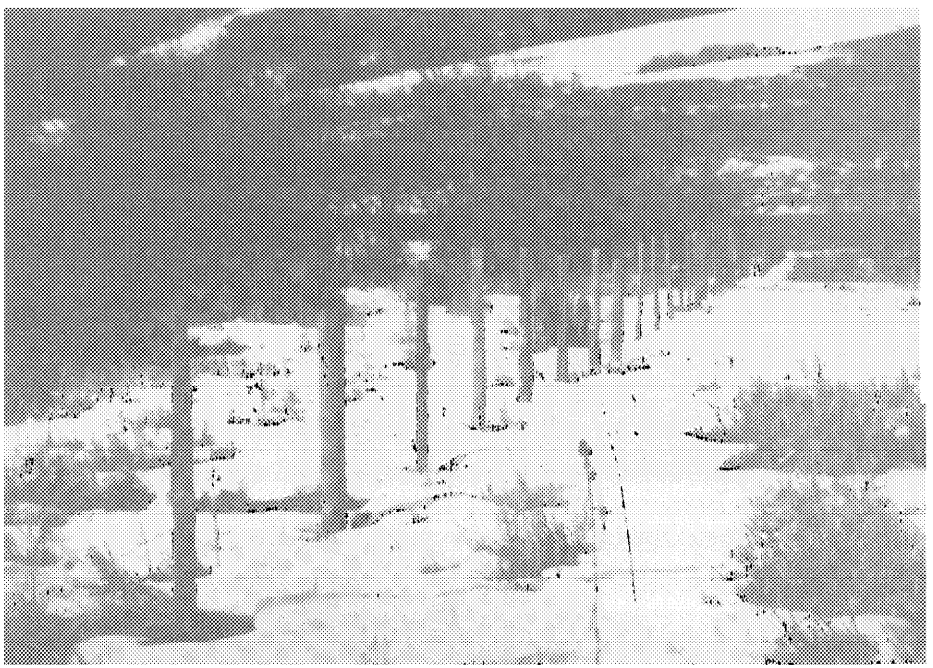


Figure 4b. Riparian fences constructed in 1986: Chesnimnus Creek high tensile smooth wire fence.

is only the first part of a 5.4 mile fence which will be completed in 1987. When completed this fence will protect 3.0 miles of Chesnimnus Creek, 41.8 acres of riparian habitat and all of the associated plantings and instream structures. The purpose of beginning construction of this fence in 1986 was fourfold:

1) to provide riparian protection,
2) to serve as an example that can be shown to prospective fencing contractors during prebid tours,
3) to serve as an example to show landowners, and
4) to aid in developing high tensile smooth wire fence construction specifications.

Maintenance was also done to 4.4 miles of barbed wire fence along Swamp Creek (See POSTWORK: Maintenance).

5. Miscellaneous Field Activities

Following completion of all planting, fencing, and instream structure installation operations, disturbed areas were seeded at a rate of 21 pounds per acre with a seed mixture developed, by SCS personnel[1]. These areas were then fertilized with a 27-12-0-4 commercial fertilizer. Reseeding of the Elk Creek project area was also done following severe flooding in February 1986.

Eight transects were set up within the Chesnimnus Creek project area for the purpose of monitoring the effects of recently installed instream structures on the location and depth of the stream channel and rearing pools associated with the structures.

Seven photopoints were established along Chesnimnus Creek and permanent photopoint markers were placed at previously established photopoints along Elk and Swamp creeks.

Twelve bank erosion monitoring points were established at severely eroded cut banks along McCoy Creek in the upper Grande Ronde drainage. All monitoring points were measured, photographed, and indexed on 8½ x 11 inch maps for future reference.

---

1 The custom seed mixture consisted of (pounds per acre in parentheses): intermediate wheat grass (4), smooth brome (4), Durar hard fescue (2) sweet clover (1), red clover (1), white clover (1), alsike clover (2): alfalfa (1), Timothy (2), and orchard grass (3).

POSTWORK

1. Maintenance

Creeks in the Joseph Creek drainage, including Elk and Swamp creeks, experienced an estimated 15 to 20 year flood between February 22 and 24, 1986. On February 27 and 28, all BPA-funded work on Elk and Swamp creeks was inspected and the damage assessed.

Damage to 4.4 miles of fence along Swamp Creek was minimal, with most damage occurring to creek cross-fences. It was decided, however, that some additional work needed to be done to the fence to insure future structural integrity. Consequently, a contract was awarded, all flood damage repaired and additional structures added to the fence: 671 steel posts added, twelve fence stiles realigned, three rock cribs installed, on H-brace repaired, cross-fences repaired and flood-deposited woody debris removed from the fence.

Following assessment of flood damage on Elk Creek structures, a contract was awarded to repair damaged structures and place additional habitat structures where needed. Additionally, minor modifications were made to several existing structures to insure upstream passage of juvenile and/or adult fish (See IMPLEMENTATION: Instream Structures).

2. Monitoring and Evaluation

During May of this year planting along Elk Creek was completed (See IMPLEMENTATION: Planting), and 117 (17.9%) of the redosier dogwood were marked with flourescent surveyor's tape to facilitate future evaluation of planting success. Initial monitoring of these marked dogwoods in August indicated only 38 (32.5%) had survived. These results, however, did not appear to be indicative of the survival throughout the Elk Creek project site; survival in most areas appeared to be considerably higher, perhaps 75%. Survival seemed to be moisture dependent and almost totally independent of soil quality; most dogwoods planted in gravel bars adjacent to the creek survived while those planted in loamy soil on higher creek banks had a very low survival rate.

During June 1986, willow plantings made along Elk Creek in 1985 were trimmed and the tops painted to prevent dehydration and checking. A total of 128 willows were trimmed; 38 (29.7%) were alive and 90 (70.3%) were dead. It is felt most dead willows died due to:

a. fall planting which did not allow the trees adequate time to develop roots prior to winter freezing, and

b. severe dehydration due to the size of stock used and therefore the large cut surface area that was exposed.

During May 1986, plantings made along Swamp Creek one year earlier, were randomly inspected and planting success evaluated (Table 10).

Table 10. Results of the 1986 evaluation of riparian plantings made along Swamp Creek in 1985.

Species (Stock type)	No. Planted	No. Examined	No. Alive	% Alive
White Willow: *Salix alba* (stake)	550	200	159	79.5[1/]
Wavey leaf alder: *Alnus sinuata* (stake)	767	170	11	6.5
Crabapple, Siberian, and midwest: *Malus spp.* (rooted)	1,000	72	71	98.6
Redosier dogwood: *Cornus stolonifera* (rooted)	800	3	3	2/
River birch: *Betula occidentalis* (bareroot)	400	46	4	8.7

1/ Inspection of willow stakes during late summer indicated many stakes which were classifed as "dead" during the May survey were actually alive and had two to four foot sprouts growing from their bases. Survival, therefore was probably in excess of 90.0%.

2/ Most redosier dogwood plants were obscured by high grasses and therefore we were unable to adequately evaluate their survival.

Pictures were taken from all photopoints during the spring and fall, and photo-documentation of all field projects was done throughout the year (Figure 5a-d).

Figure 5a. Photopoint documentation of riparian project areas: Swamp Creek, November 1984

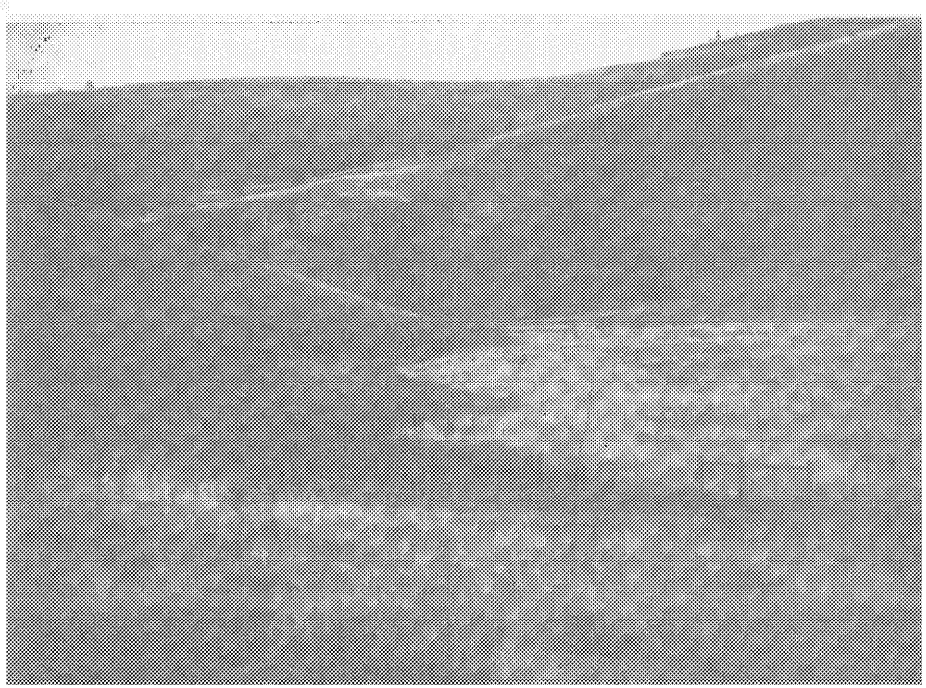


Figure 5b. Photopoint documentation of riparian project areas: Swamp Creek, October 1985.

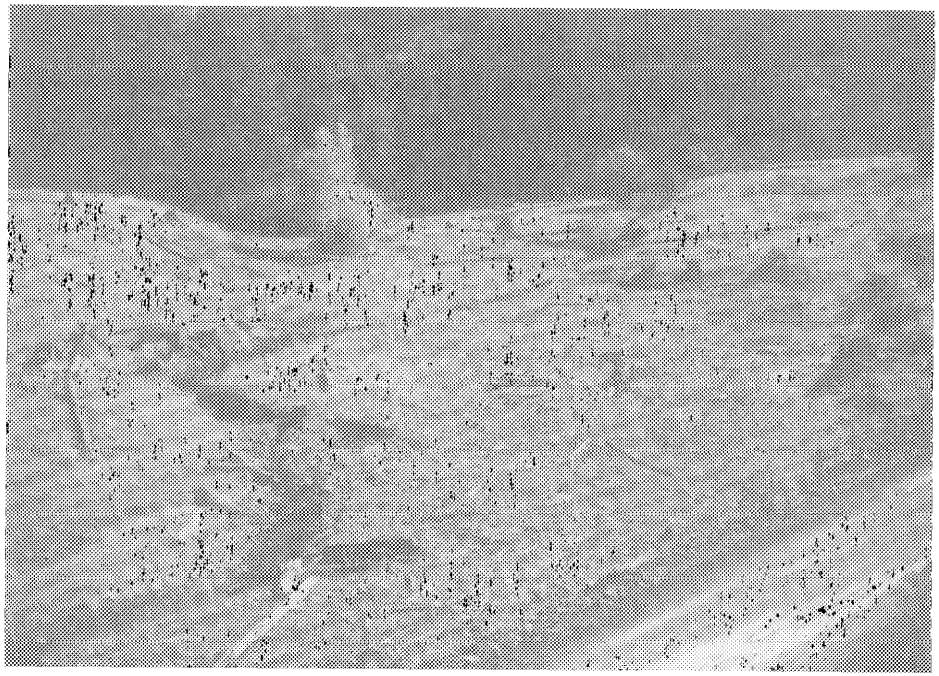


Figure 5c. Photopoint documentation of riparian project areas: Elk Creek, October 1984

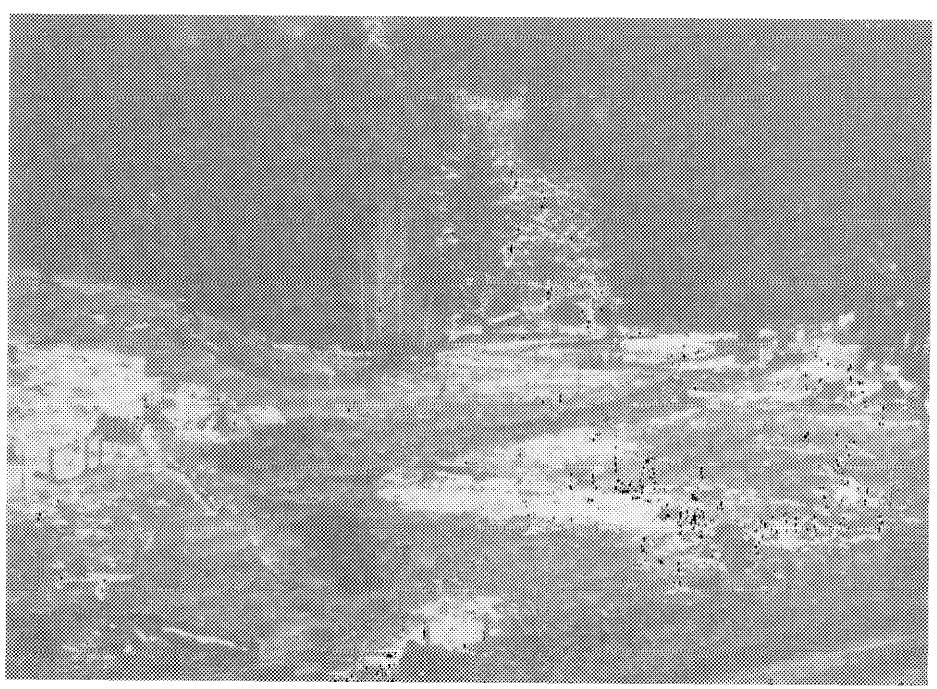


Figure 5d. Photopoint documentation of riparian project areas: Elk Creek, November, 1986.

II. ADMINISTRATIVE AND INTERAGENCY COORDINATION/EDUCATION

ADMINISTRATIVE

Administrative activities during 1986 included preparation of reports and budgets, and supervision of personnel.

1. Reports

Monthly and annual progress reports for the Joseph Creek and upper Grande Ronde River drainages were submitted as per contract agreements with BPA during 1986.

A write-up on BPA-funded riparian enhancement projects was completed and submitted to the Union County Soil and Water Conservation District (SWCD) for inclusion in their annual report (Appendix C).

Analysis of data and writing of a report on plant propogation techniques used with riparian vegetation by Vocational-Agricultural students from Joseph and Enterprise high schools was completed (Appendix D).

2. Budgets

Project area maps, narratives and mini-budgets were prepared and submitted for inclusion in the April 1, 1987 - March 31, 1988 budget package.

3. Personnel

Four temporary employees (Tim Bailey, Mark Kirsch, Shawn Robertson, and Lisa Wakefield) were hired for a total of thirteen person-months. These employees began work on July 1, 1986 and were terminated between September 15 and November 15, 1986. While employed they were resonsible for collection and summarization of riparian habitat inventories in the Joseph Creek and upper Grande Ronde drainages, and to a lesser degree, with mapping, installation of instream structures, and construction and repair of riparian fences.

INTERAGENCY COORDINATION

Monthly Wallowa County SWCD meetings and Coordinated Interagency Resource Council (CIRC) meetings were regularly attended throughout the year to keep these resource groups informed of riparian habitat enhancement activities.

A coordinated presentation between ODFW and USFS personnel was given at the annual BPA Project Presentations in March.

Numerous contacts were made and meetings held with personnel from the USFS and BLM to develop habitat inventory and habitat monitoring methods.

Several tours of project areas were given to personnel from ODFW, USFS, and the SCS/SWCD to discuss and critique various aspects of our projects.

Blue and white plastic signs (10" x 10") were designed and manufactured for use along BPA funded riparian enhancement projects. These signs explain the objectives of the program and identify the cooperators in the program as the private landowner, BPA, and ODFW (Figure 6).

EDUCATION

Considerable work was done with Enterprise and Joseph high schools' Vocational-Agricultural classes on riparian planting and management. Students from the Joseph high school class were given a slide talk on fish habitat requirements and proper management of riparian zones; both high school classes were also taken on separate field trips to plant riparian vegetation which they had propogated, as well as some commercially grown stock.

Slide talks on restoring riparian areas and properly managing riparian habitat were given to the Wallowa Chapter of the Future Farmers of America (FFA) and an Enterprise 4-H club. The 4-H club was subsequently taken on a field trip during which they planted 220 trees within the Elk Creek project site.

An all day presentation on riparian zones and their benefits was given to four sixth-grade classes as part of the annual Wallowa County Sixth Grande Conservation Tour. Prior to the tour, materials were developed on riparian management and submitted for inclusion in the sixth grade conservation tour handbook.

A riparian habitat display was developed to be used as part of an ODFW display at the annual SCS sponsored Wallowa County "Landfest".

A one-half hour radio talk was presented on various types of vegetation used for developing fish and wildlife habitats.

The "Riparian Habitat Enhancement Evaluation Workshop" was attended in October.

2-20

Figure 6. Sign designed for use along BPA-funded riparian enhancement projects.

APPENDIX A

Riparian Habitat Inventory Methods

STREAM INVENTORY INSTRUCTIONS

INVENTORY SECTION NO. - This is to correlate the location of the inventory section on the ground with the inventory sheet. Fill in the boxes in consecutive order. Sections may be identified on the ground with 3-foot lath marked with grease pencil and flagged (usually blue ribbon). On private land, section numbers and locations will be marked on an aerial photo or topographical map. An inventory section number will be placed on the map at the beginning of that inventory section.

DIRECTION OF INVENTORY - Check the appropriate box. Once the inventory begins on a reach of a main stream or tributary, inventory direction will remain the same.

INVENTORY INTENSITY AND SECTION LENGTH - Check the appropriate boxes. A section is a reach of stream 50,100, or 150 paces. Normally a section length of 50 paces will be inventoried at 100%. A 100 pace section will be inventoried at 50%' (every other 50 pace reach will be inventoried), and a 150 pace section at 33% (randomly select one of three 50 pace reaches to inventory). A pace is two full steps calibrated at approximately five feet. Line of pacing follows the edge of the waterflow (the thalweg).

INVENTORY SHEET USE - Check the appropriate box.

Main Sheet - This will be the most common use of the form.

Braided Channel - A separate inventory sheet will be used for each group of braided channels. See instructions below for braided channels.

Continuation Sheet - If all columns on the main sheet are used, continue data collection on a continuation sheet.

PERMANENT IDENTIFYING FEATURE - This will normally be-filled out at the beginning and end of the inventory and transferred to a map. Periodic identifiers can also be noted by description and pace location within sections and transferred to reference map and aerial photos. Examples of some identifiers might be: road crossings, side streams, ditch diversions, fences, forest service boundaries, etc.

PACED SUBSECTION - Distances from the beginning point of the section to an identifiable change in flow feature or channel configuration (straight or curve). All sub-section lengths will add to 50 paces (250 feet). Sub-section distance is recorded when a change occurs from:

- a single flow feature to another single flow feature.
- a single flow feature to a multiple flow feature and vice versa
- a multiple flow feature to another set of multiple flow features where 1) there is an obvious different percentage mix, 2) when site distance is too great to get a good percentage mix for remaining area.
- a dominant channel type change, i.e., straight to curve and vice versa.

DEFINITIONS:

Single Flow Feature - at least 90% of the sub-section is a single flow feature. (The remaining percent is still recorded.)

Multiple Flow Feature - more than one flow feature - no feature accounts for 90% or more of the sub-sections.-

Flow Features

Pools are portions of the stream that are deeper and of lower velocity than main current (Arnette, 1976).

Glide/Run are sections where the water surface is not broken but is shallow and has a fast or faster velocity (Duff & Cooper, 1976).

Riffles are faster, shallower areas with the water surface broken into waves by wholly or partly submerged obstructions.

Different flow features within a pace distance will be recorded as a percentage, in 5° increments based on a visual estimate.

ORGANIC DEBRIS INDEX

Frequency

0 - none
1 - Debris covering* less than 10% of channel area
2 - Debris covering 11-30% of channel area
3 - Debris covering 31-50% of channel area
4 - Debris covering over 50% of channel area
5 - Extensive debris jams which force water onto flood plain even with moderate flows. Generally presents a fish migration blockage.

*covering means floating, submerged or overhead within 16" of the water's surface.

Size

A - Small, floatable organic debris
B - Mixture of small (l-6" diameter) to medium (7-12" diameter) size debris
C - Mixture of medium (7-12" diameter) to large (>12" diameter) size debris
D - Predominately large debris (>12" diameter)

Debris Class

Combine the number from the frequency and the letter from the size class to determine the debris class (e.g., Frequency = 1; Size = B; Debris Class = 1B) If frequency = 0, record 0 for Debris class.

POOL CHARACTERISTICS

Depth Cl ass

Average present stream width <20 feet		Average present stream width >20 feet	
Depth at deepest point	Depth Class	Depth at Deepest point	Depth Class
0-1/2 (feet)	1/2	0-1½ (feet)	1
1/2-1½	1	1½-3	2
1½-2½	2	3-6	4
>2½	3	6-9	7

Perimeter Cover - Using increments of 0, 5, 10, 20, 30, . . . 100%, record the % perimeter with usable cover. (Perimeter cover is usually within l-2 feet of the shore, depending on the pool. size.)

Surface Cover - Using increments of 0, 5, 10, 20, 30, . . . 100%, record the % of the interior surface of pool having cover.

Cover that extends from the perimeter to the interior surface of the pool can be divided between perimeter and surface cover. (Do not count any portion of the cover twice.)

DEFINITION: Pool Cover - any material or condition that provides protection to fish such as logs, other organic debris, overhanging vegetation within 1 foot of the water surface, cobble, boulders, undercut banks or water depth.

SUBSTRATE - Record by visual estimates within the riffles and glide/runs only, the substrate types by percentage in each of the following size classes (measured across longest axis):

Boulders - >10 inches; Cobbles 3-10 inches; Gravel 0.2-3 inches; Fines <0.2 inches; Hard Surface includes hardpan, bedrock, etc. (Silt load over the substrate should be noted in the "Notes" Section).

RIPARIAN VEGETATION DENSITY CLASS

Conifers and deciduous trees or shrubs less than 5 feet tall within 10 feet of the water edge are to be recorded by density class, averaging left and right banks within a paced sub-section. Conifer and deciduous groups will be recorded separately.

Conifers and deciduous trees or shrubs greater than 5 feet tall within 20 feet of the channel edge will be recorded in the same manner.

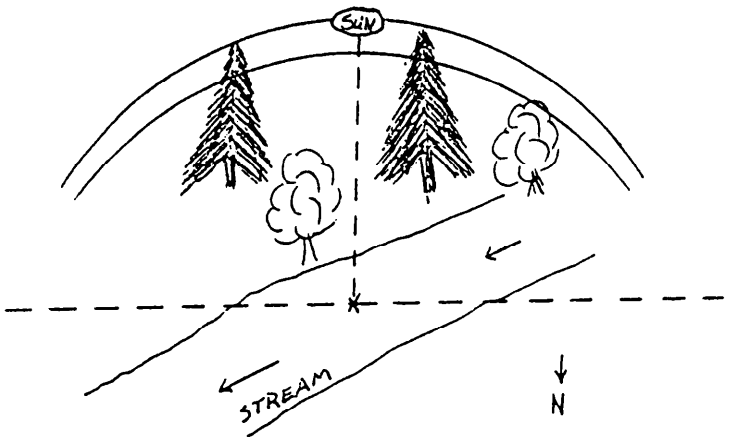
The density classes corresponding to percentage of canopy cover are as follows:

Percent Cover	0	1-10	11-20	21-40	41-60	61-80	81-100
Density Class Recorded	0	5	15	30	50	70	90

SHADE DENSITY CLASS

An estimate of the overhead shade is made at one or more locations within the section (e.g., once at the end of each paced sub-section). Face in the general direction of the path of the sun relative to a point in the middle of the channel (usually south) and divide the view into two 90" quadrants. In each quadrant estimate the percentage of the overhead canopy which would provide shade at the heating period of the day at roughly a window between a 50° and 66° angle overhead. Add the percentage in each quadrant, divide by 2 and record the appropriate shade density class using the following table:

Percent Shade	0	1-10	11-30	31-50	51-70	71-90	91-100
Shade Density Class	0	5	20	40	60	80	90



CHANNEL

Width - An estimation (± 2 feet) of the bank full (flood) width and the present width in feet.

Curve/Straight - record by using first letters of the word straight or curve for the condition by pace distance.

Excavation ease - insert the letter which best describes the sub-section in terms of ease of excavation (A)lluvium (meadow), (B)edrock, (T)ight trees/roots, large (R)ocks, (S)oil with no impediments (other than alluvium).

Vertical Bank Heights - For curved sections record in feet the average height on the outside of the curve. For straight sections record by percent the number of bank pairs with one or more banks having heights less than 2 feet.

BRAIDED CHANNEL PROCEDURE - Proceed with the inventory using the main inventory sheet until a braided channel is reached. Begin a new sub-section at the top of the braided section. Enter the pace value on a new inventory sheet marked ✓ braided channel. Proceed using normal standard inventory methods, except that inventory information from each braid (of that braided reach) is recorded on the same "braided channel" sheet. Separate data from each braid with a solid line. When all braids are recorded, return to the "main" inventory sheet. Enter the last pace value from the dominant braid or if all braids are about equal, enter the last pace value from the longest braid. Leave the column below this pace value blank. The data from the separate braids will be averaged and entered into this blank column at a later date.

✓ Main Sheet

CED SUB-SECTIONS		0→10	35	40	50	Section weighted averages
FLOW FEATURES	Pool %	100	50	—		//
	Glide/Run %	—	50	40		//
	Riffle %	—	—	60		//

leave blank

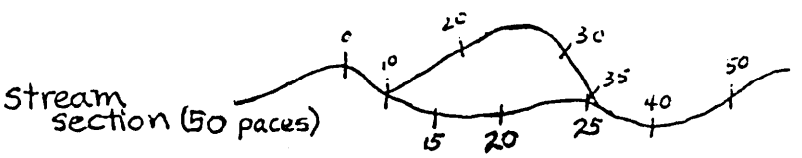
✓ Braided Channel Sheet

0→10	15	20	25	0→10	20	30	35
—	100	10			50	—	100
80	—	40			25	60	—
20	—	90			25	40	—

leave blank

draw solid line to separate braids

NOTES: Anything of relative importance can be inserted in this space which will add information to the inventory. The following is a list of items which may or may not be included. On braided channel sheets always sketch the braided channels and insert appropriate pace distances as illustrated below:



Cutbanks - stability, appropriateness for structures
Livestock effects - browsing, trampling, etc.
Degree of activity - i.e., roads, timber, recreation, mining, etc.
Equipment access
Beaver (Active) (Abandon)
High water table
Planting difficulty
Fish observed, not observed, identification
Bank undercut
Vegetation - species, general condition (browsed, regenerating), potential for regrowth

When making notes, footnote the paced subsections where possible, e.g.:

(subsection)
0-6 Major cattle crossing at pace 5
6-18 - good undercut banks on right - lots of willow regeneration on left gravel bar.

Arnett, J.L. 1976. Nomenclature for instream assessments. Pages 9-15 in C.B. Steinaker and J.L. Arnette, eds. Methodlologies for the determination of stream resource flow requirements: an assessment. U.S. Fish Wildl. Serv., Logan, Utah.

Duff, B.A., and J.L. Cooper. 1976. Techniques for conducting a stream habitat survey on National Resource Land. U.S. Bur. Land Manage. Tech. Note 283. 72 pp.

FISH HABITAT STREAM INVENTORY PACE TRANSECTS

STREAM NAME _____ PAGE _ O F _

OBSERVERS _____ DATE _____

INVENTORY SECTION NO. _____ INVENTORY PROCEEDED _ _UPSTREAM _____ DOWNSTREAM

INVENTORY INTENSITY 100% 50% 33% SECTION LENGTH (PACES) _ % _ 100 _ 150 __ OTHER

INVENTORY SHEET USE _____ MAIN SHEET _____ BRAIDED CHANNEL _____ CONTINUATION SHEET

PERMANENT IDENTIFYING FEATURE WITHIN REACH _____

LEFT AND RIGHT IS RELATIVE TO LOOKING DOWNSTREAM.

	PACED SUB-SECTIONS 0 →													Section weighted averages
FLOW FEATURES	Pool%													
	Glide Run %													
	Riffle %													
ORGANIC DEBRIS INDEX	Frequency (0-5)													
	Size (A-F)													
	Debris Class													
POOL CHARAC-TERISTICS	Depth Class													
	Perimeter Cover													
	Surface Cover													
SUBSTRATE RIFFLE-GLIDE/RUN	Boulders % (>10")													
	Cobbles % (3-10")													
	Gravel % (.2-3")													
	Fines % (<.2")													
	Hardpan %													
RIPARIAN VEGETATION DENSITY CLASS	Deciduous <5' tall (0-10')													
	Conifer <5' tall (0-10')													
	Deciduous >5' tall (0-20')													
	Conifer >5' tall (0-20')													
	SHADE DENSITY CLASS													
CHANNEL	WIDTH Flood													
	WIDTH Present													
	Straight/Curve													
	Excavation Ease													
	Vertical Bank Height													

NOTES:

A P P E N D I X B

Swamp Creek Breeding Bird Survey

SWAMP CREEK BREEDING BIRD SURVEY

A breeding bird survey was conducted on 1 July, 1986 on upper Swamp Creek. The route started at the upper end of the riparian habitat improvement project on the Faye Olson property.

The technique used was identical to the breeding bird surveys employed by the U.S. Fish & Wildlife Service. Routes start one-half hour before sunrise (Approx. 0430 hrs .) .

All birds seen or heard during a three minute period are recorded.

Stops #1 and #2 were on the west side of the creek. Stop #3 was at the new culvert crossing the creek. Stops #4, #5, and #6 were on the east side of the creek. Stop #6 was extended downstream below the lower fence of the improvement project.

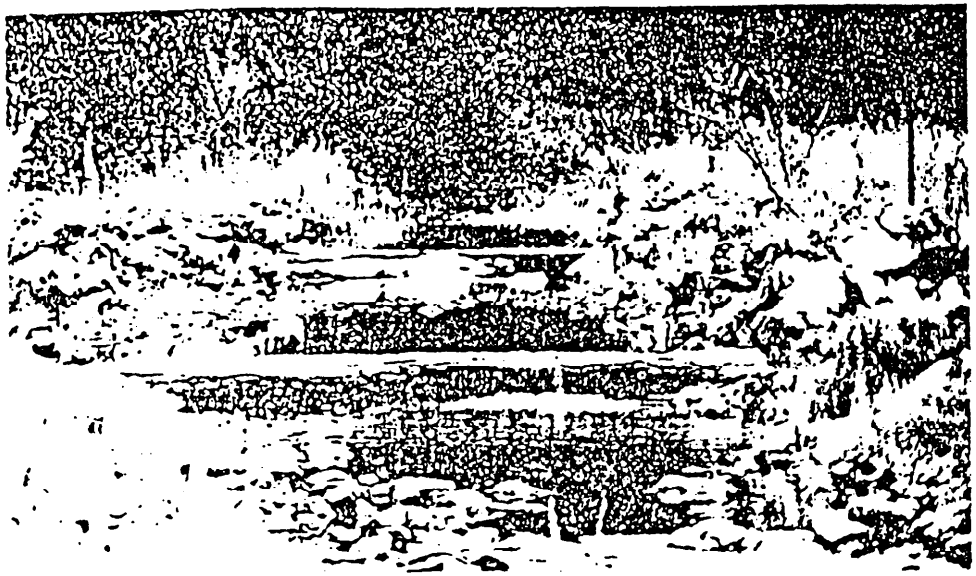
Results are as follows:

SPECIES	# INDIVIDUALS	# STOPS/SPECIES
Ring-necked Pheasant	2	2
Common Snipe	4	3
Mourning Dove	4	4
Common Nighthawk	1	1
Willow Flycatcher	5	4
Dusky/Hammonds Flycatcher	1	1
Western Wood Pewee	4	3
Barn Swallow	3	2
House Wren	1	1
Rock Wren	5	3
American Robin	30	6
MacGillivray's Warbler	1	1
Common Yellowthroat	1	1
Western Meadowlark	4	3
Red-winged Blackbird	16	2
Brewer's Blackbird	40	4
Brown-headed Cowbird	9	2
Vesper Sparrow	6	3
Dark-eyed Junco	2	1
Chipping Sparrow	1	1
Song Sparrow	1	1
American Coot	1	1
Nashville Warbler	1	1
23 Species total	143 Individuals total	

APPENDIX C

BPA-Funded Fish Habitat Projects
from
Union County SWCD 1986 Annual Report

BPA Funded Fish Habitat Projects - Oregon Dept. of Fish & Wildlife



In July of 1985. Bonneville Power Administration and Oregon Department of Fish and Wildlife entered into an agreement to initiate fish habitat enhancement work on private lands in the Upper Grande Ronde Drainage Basin (UGRDB). There are 33 tributaries and part of the mainstream of the upper Grande Ronde River included in this project area.

Observations in the UGRDB indicate that optimum habitat for summer steelhead and spring chinook is limited in large portions of the drainage by degradation of riparian (streamside) and instream areas.

The primary objective of the Habitat Improvement Project is to provide additional spawning and rearing habitat. At the same time. providing benefits to the landowner. such as improved bank stabilization. increased summer flows. and improved water quality. Typical projects include instream structure work. fencing and streamside plantings. Landowner participation in the habitat improvement projects is voluntary.

Oregon Department of Fish and Wildlife is now in the process of contacting landowners to describe the program. Presentations explaining the objectives and goals of the program and landowner participation are available for individuals or groups. If you are interested in one of these presentations. or would like to learn more about the program. please contact Ann Kratz or Steve Williams at Oregon Department of Fish and Wildlife, 201 20th St.. LaGrande. OR (963-2138).

APPENDIX D

Plant Propogation Techniques Used With Riparian Vegetation -- A Report

VOCATIONAL AGRICULTURE PLANT PROPAGATION PROJECT

Ann Reece and Randy Reeve
1986

Preface

This project was set up with vocational agriculture classes to establish hardwood cutting propagation techniques for seven native plant species and to introduce high school students to the concept of riparian restoration and protection.

The project had a specific experimental design and data was collected on the presence or absence of root primordia development, bud break and callus formation. Following the data collection by the students, it became apparent that the students were not uniform in their criteria for determining the presence or absence of the above features. Those reading this report should keep in mind that discrepencies in the data collection did exist, which may effect the end results, and thus the conclusions of this project.

Introduction and Objectives

A plant propagation project was set up with Vocational Agriculture classes at Joseph and Enterprise High Schools in Wallowa County, Oregon.The objectives of this project were two-fold.

A low cost method for producing seedlings of native shrubs and trees is needed for developing planting stock for use along streamsides in riparian re-vegetation programs. We elected to propagate plants from dormant hardwood cuttings rather than from softwood cuttings, leaf cuttings, seeds, tissue culture, etc., because less specialized equipment is required, and the length of time required to reach planting stock size is probably shorter. Due to the limited amount of information available from nurserymen, lack of current literature on methods for propagating hardwood cuttings of native species, and limited local knowledge on management of riparian areas two objectives were established for this project: 1) to establish dormant hardwood cutting propagation techniques for several local native shrubs and trees for use in riparian vegetation restoration [the local shrub and tree species that we wished to propagate were: willow (*Salix* spp.) red-osier dogwood (Cornus *stolonifera*), cottonwood (*Populus trichocarpa*), alder (*Alnus* spp.), aspen (*Populus tremuloides*), black hawthorn (*Crataegus douqlasii*), and birch (*Betula occidentalis*)] and 2) to introduce high school students to the concept of riparian restoration and protection.

The project was set up with a specific experimental design to maximize the usefulness of the information obtained.

Methods and Materials

Collection of Whips

On November 20, 1985, ODFW personnel, Ann Baker, Randy Reeve and William Nell, made collections of whips (shoots) from mostly one year old wood (last seasons growth) from the seven species listed above. The location of the source and numbers of whips collected are listed in Table 1.

Table 1. Location and Numbers of Dormant Hardwood Whips Collected for Plant Propagation Purposes.

Species	# Whips	Source	Landowner
dogwood	300	Chesnimnus Creek	Yost
willow	300	Chesnimnus Creek	Yost
cottonwood	300	Beaver Creek & Enterprise	
alder	100	Elk Creek	Birkmaier
hawthorn	100	Elk Creek & Chesnimnus Cr.	Birkmaier/Dawson
aspen	100		
birch*	100	Grande Ronde River (Un.Co.)	USFS

*(collected 12/6/86)

These whips were packed in plastic bags filled with damp peatmoss, and placed into cold storage within one day of collection.

Rooting Cuttings

The vo-ag students from Enterprise and Joseph High Schools were given the opportunity to do the actual propagating of dormant hardwood cuttings made from the seven species listed above. The students were to then plant the rooted cuttings onto a pre-selected riparian site in need of additional trees and shrubs. This was to be done in conjunction with a field trip highlighting the importance and functions of riparian zones for anadromous fish production. On December 11-13, 1985, the whips were taken to Enterprise and Joseph High School Vo-ag classes. The students made cuttings from the whips using the following procedure:

1. The top cut was made just above a bud.
2. The lower cut was made 6,8 or 12" below the top bud (depending on the species) - this was to ensure that three buds were included in each cutting.
3. The cuttings were taken from the basal end of the whips - wood from the lower portion has better regeneration capacity than wood nearer the tip.

The cuttings were bundled into groups of ten and "heeled-in" into two warm-bottom beds. These beds are used to promote warm bottom callousing, a method of propagation that has been successful for difficult-to-root species. To achieve warm bottom callousing, cuttings are placed upright for about four weeks in damp packing material

over bottom heat at 65-70°F with the top portion of the cuttings left exposed to cool temperatures (Hartman and Kester, 1983)[1]. In this project, beds approximately 72" x 18" x 14" were filled with a rooting medium of two parts sand: two parts peatmoss: 1 part vermiculite. A soil warming mat was placed beneath the rooting medium to provide the necessary constant bottom temperature of approximately 68-70°F. The top of the rooting beds were kept at approximately 40°F. The cuttings were buried in the rooting medium deep enough to expose only the top bud. This is to inhibit development of the lower buds and to encourage growth of a single stemmed plant. A common reason why cuttings fail is they may fail to develop roots because they are allowed to dry out. To avoid water loss, as little of the cutting as possible should be exposed above the ground. For most plants only an inch or so of the cutting needs to be above the ground. Up to 2 or 3 buds can be exposed if a branched plant is desired (Browse, 1979)[2].

Bundles of cuttings were rooted for four weeks on the warm bottom bed, then broken apart and individual cuttings transplanted to either a growth chamber (Enterprise High School) or back into the warm-bottom beds (Joseph High School). The bundles were broken apart and transplanted to allow more space for growth between individual cuttings.

These cuttings were to be grown to planting stock size and planted on-site in the spring.

Hormone Treatments

Enterprise high school students dipped the bases of their cuttings in Woods Rooting Compound? (one part hormone: 5 parts water, mixed according to label directions) prior to being heeled-in into the warm-bottom bed.

Joseph High School students did not dip their cuttings prior to being heeled-in. Rather they dipped the bases of their cuttings after they were on the warm-bottom bed for a month, and they dipped only the bases of the cuttings which did not yet show any signs of rooting. This dipping was done to attempt to have as many successful cuttings as possible for planting in the field at the end of the experiment.

q Hartman, H. and D. Kester, 1983. Plant Propagation, chapter 9, Prentice-Hall, Inc. New Jersey. 727 pp.

2 Browse, Philip McMillian, 1979. Plant Propagation, The Simon and Schuster Step-By-Step Encyclopedia of Practical Gardening, Simon and Schuster, New York. 96 pp.

3 Woods Rooting Compound consists of 10,000 ppm IBA, 5000 ppm NAA in approximately 20% Dimethyl formamide and 80% Ethyl alcohol.

Fungicide Treatment

On January 30, 1986, the cuttings were treated with Captan SO-W to reduce fungi populations. They were treated at a rate of approximately 4 lb./acre (9 grams/gallon water; 6 gallons applied at Joseph High School, 4 gallons applied at Enterprise High School. The difference in amounts applied was due to differences in the spacing of the cuttings and overall bed size. The cuttings were treated after fungi were found growing on the cuttings.

Experimental Design

The experimental design consisted of the different hormone treatments (Joseph High School versus Enterprise High School) as described above. There were five replications within each of the two treatments and ten cuttings per replication for each of the seven native species.

Data Collection

At the same time the cuttings were transplanted, the students collected data. This was on January 20, 1986, a month after the cuttings were heeled-in into the warm-bottom bed. They recorded the presence or absence of budbreak, callus formation and root primordia for each of the ten cuttings within the five replications for the seven species.

Results

The numbers of cuttings out of ten showing bud break, callus formation and root primordia development are shown in Table 1. The data was collected for each high school after the cuttings were on the warm-bottom bed for four weeks.

Only two significant differences were found between the treatment means using a pooled estimate of variance for the student's "t-test" (see Table 1). Alder having no hormone treatment prior to data collection showed significantly more budbreak than those treated with a hormone (8.4 compared to 4.8). And, birch having no hormone treatment prior to data collection showed significantly more root primordia development than those treated with a hormone (4.6 compared to 2.2).

A comparison of means between treatments without regard to significant differences shows that for all species (excluding willow and cottonwood which only had one treatment - no hormone), cuttings which received no hormone treatment prior to data collection showed more bud break than those receiving a hormone treatment. Delayed bud break is preferred because cuttings without a well-developed root system may dessicate more quickly after bud break.

In the same type of comparison, all species (again, excluding willow and cottonwood) treated with a hormone prior to data collection, except alder and birch, showed more callus formation.

And, all species (excluding willow and cottonwood) treated with a hormone prior to data collection, except alder and birch, showed more root primordia development.

A regression analysis (averaged over all species) was made using callus formation as the independent variable and root primordia development as the dependent variable to determine if root primordia formation is dependent on callus formation. The results from this experiment indicate that there is no relationship between these two variables. This supports the statement in Hartmann and Kester[4], pages 234-240, that "the formation of callus and formation of roots [in cuttings] are independent of each other; that they often occur simultaneously is due to their dependence upon similiar internal and environmental conditions". Hartmann and Kester also say that in some species callus formation is a precursor of root development in cuttings.

When averaging the two treatments (see Table 2), the three species with the highest amount of root primordia development are willow, dogwood, and cottonwood (7.3, 6.7, 6.7, respectively). This was expected as these three species are considered to be the easiest of all seven species to root.

About 50% of the alder cuttings showed root primordia development. This was encouraging, because this specie is considered difficult to root from hardwood, dormant cuttings.

About 24 to 37% of the aspen, birch, and hawthorn cuttings showed root primordia development. These low percentages were expected because these species are considered difficult to root from hardwood, dormant cuttings, and very little information on rooting techniques of these species is available. However, even the low percentage that showed root primordia development is encouraging because it demonstrates the potential of these three species to root from hardwood cuttings.

The project was brought to a close sooner than expected. The cuttings died shortly after the Captan fungicide application, but the cause of failure is not known for sure.

Discussion

This project has shown that it is possible to root, with at least limited success, each of the seven native shrub and tree species used in this project using techniques similiar to those outlined in this report.

4 Hartmann, H. and D. Kester, 1983. Plant Propagation, Chapter 9, Prentice-Hall, Inc. New Jersey. 727 pp.

Table 2. A comparison of budbreak, callus formation, and root primordia development between two treatments applied to seven native plant species.

Species	Bud Break (Number Out of 10)		Callus Formation (Number Out of 10)		With Root Primordia (Number Out of 10)		
	JHS[1]	EHS[2]	JHS[1]	EHS[2]	JHS[1]	EHS[2]	Average
Willow[3]	6.8[4]	6.8	6.0	8.6	6.0	8.6	7.3
Dogwood	7.6	6.4	8.2	8.8	6.6	6.8	6.7
Cottonwood 3	7.4	5.8	7.8	8.8	6.6	6.8	6.7
Alder	8.4*	4.8"	5.4	4.4	5.4	5.2	5.3
Aspen	4.6	2.8	6.4	8.8	2.2	2.8	2.5
Black Hawthorn	5.0	3.0	6.8	8.8	3.0	4.4	3.7
Birch	8.2	6.2	9.4	9.2	4.6*	2.2*	3.4

* Numbers within a row followed by an asterisk (*) are significantly different at the 0.05% level using student's "t-test".

[1] Joseph High School - cuttings were not dipped in rooting hormone prior to data collection.

[2] Enterprise High School - cuttings were dipped in rooting hormone four weeks prior to data collection.

[3] Cuttings of willow and cottonwood were not dipped in rooting hormone.

[4] These numbers are averaged over five replications, with ten cuttings in each replication.

This project has not clearly shown if the use of a rooting hormone (Wood's Rooting Compound) promotes root development in dogwood, alder, aspen, or black hawthorn. However, it has shown that the hormone had a negative effect on the rooting of birch cuttings.

The design of this experiment may have been inadequately designed to encompass the experimental error due to discrepencies between observers and due to natural variation between replications. (A look at the raw data or standard deviation shows a large amount of variation between replications.) A stronger design could be implemented in one of two ways.

1. Each replication could be considered a single observation (the ten cuttings given a rating of presence or absence best become grouped into a single observation for statistical analysis purposes). Thus there could be five observations (each consisting of a group of ten cuttings) per replication. Any desired number of additional replications could be added to the experimental design. The drawback to this method is that it would increase the total number of cuttings used in the project by five (assuming five replications were added). However, to compensate for the additional cuttings, fewer species could be tested.

2. Another way to improve the strength of the design would be to use the same existing design, but change the method of data collection. Rather than recording the presence or absence of root primordia, the data collection could begin a few weeks later and record actual average root lengths per ten cuttings per replication. Actual numbers make a stronger statistical test than recording a "+" or "-". The disadvantage of this method is that it would take considerably longer to collect the data and it may be harder on the survival of the cuttings due to increased handling. The advantage is that the project could be conducting using the same number of cuttings as outlined in the Methods and Materials section.

The method of data collection used in this experiment (number of ten cuttings showing the characteristic in question - or absence or presence type data) does not show any qualitative differences. For example, the roots of dogwood cuttings without a hormone treatments prior to data collection were far more robust and healthy looking than those receiving an initial hormone treatment. Such differences do not show up in Table 1. Use of the data collection method as outlined in the above paragraph may be desirable to show this type of difference.

Recommendations

1. If this project is ever repeated, I recommend using the data collection method and experimental design outlined in the fifth paragraph of the Discussion section in this report.

2. I recommend rooting willow, dogwood, cottonwood and birch without the use of rooting hormones. Of these, willow, dogwood and

cottonwood could be rooted on a large scale using techniques similiar to those outlined in this report. Another pilot project using these three species may determine if the techniques outlined in this report can be further streamlined (for example, eliminate the use of the warm-bottom bed).

3. I recommend further testing of alder, aspen and black hawthorn to determine the effects of rooting hormones on root development.

4. I recommend additional pilot projects to re-test the rooting potential of alder, aspen, black hawthorn and birch from dormant hardwood cuttings. With the exception of alder, I do not recommend large scale production of these species using techniques outlined in this paper without further testing.

Some example pilot projects would be to vary the concentrations of hormones (for example, perhaps birch is very sensitive to rooting hormones, and a lower rate would induce more rooting than a higher rate). Other variables could be altered as well. For example, the length of time the cuttings are on the warm-bottom bed, the time of year the cuttings are made, using different parent stock plants, etc.

Summary

Dormant hardwood cuttings were made from seven native shrub and tree species. These were cottonwood, willow, dogwood, aspen, black hawthorn, birch and alder.

Half of the cuttings were treated with Wood's Rooting Compound (one part hormone: five parts water) prior to data collection, and half did not receive a hormone treatment prior to data collection. The cuttings were placed on a warm-bottom bed for a month (lower temperature approximately 68°F, upper temperature approximately 40°F). Cottonwood, willow and dogwood rooted the best. Aspen, black hawthorn and birch rooted, but poorly. Alder was intermediate in its ability to root. Birch responded negatively to the use of the rooting compound. Cottonwood, dogwood and willow rooted well without the hormone. The results of using a rooting hormone were not conclusive for alder, aspen or black hawthorn.

cd/C-26

JUN 22 1987

GRANDE RONDE RIVER HABITAT ENHANCEMENT

ON THE WALLOWA-WHITMAN NATIONAL FOREST

During Work Period
July 1, 1986 to March 31, 1987

ANNUAL REPORT

Prepared by:

Sylvan Thomas - Upper Grande Ronde Sub-basin
Mike Leonard - Joseph Creek Sub-basin
Rod Miller - Upper North Fork John Day River Sub-basin
Rich Uberuaga - Compiling for all Sub-basins

For Forest Supervisor — Date 6/19/87

Table of Contents

Preface 450

Upper Grande Ronde Sub-Basin 451

Abstract 451

Introduction 451

Description of Study Area 451
Meadow Creek Sub-Basin 451
Fly Creek 454
Mainstream Upper Grande Ronde River 454
Sheep Creek 455

Methods and Materials 455

Results and Discussion 456

Summary and Conclusions 459

Summary of Expenditures 460

Joseph Creek Sub-Basin 461

Abstract 461

Introduction 461

Description of Study Area 463

Elk Creek 463
Chesnimnus Creek 463
Swamp Creek 464
Davis Creek 464
Alder Creek 465

Methods and Materials 465

Implementation 466

Results and Discussion 467

Summary and Conclusions 469

Summary of Expenditures 470

Upper North Fork John Day Sub-Basin 471

Abstract, Results, Discussion and Summary 471

Appendix 473

PREFACE

This annual report on anadromous fish habitat enhancement work on the Wallowa-Whitman National Forest deals with three sub-basins in two major watersheds of the Columbia River Basin. The Grande Ronde Drainage contains two major sub-basins with streams on the Forest -- the Upper Grande Ronde and Joseph Creek. The Upper North Fork John Day sub-basin lies up-drainage from the Umatilla National Forest where habitat enhancement work has been on-going for several years.

Habitat enhancement work is reported by each of the three sub-basins.

UPPER GRANDE RONDE SUB-BASIN HABITAT ENHANCEMENT

7/l/86 THROUGH 3/31/87

I. ABSTRACT

Fisheries habitat inventory was completed along 23.1 miles of stream in the Meadow Creek sub-basin. Instream structure enhancement design was also completed along 7.6 miles of Fly Creek. Instream structure installation along the mainstem Grande Ronde River was deferred until the 1987 field season due to extreme summer fire activity. Riparian fencing along Sheep Creek was 90 percent complete by the field season's end. One hundred and one instream structures along Sheep Creek (1985) received minor maintenance during this field season.

II. INTRODUCTION

The Upper Grande Ronde River basin (Figures 1 and 2) historically produced large natural runs of chinook salmon and steelhead trout. The decline in returning numbers of adult fish in the past decade has been well documented and is attributable to many interacting factors. This dramatic decrease in fish numbers has prompted fisheries management agencies throughout the northwest to aggressively develop and implement rehabilitation and enhancement improvement measures necessary for restoring fish runs to historical levels. Cooperative planning and implementation efforts now underway between the Forest Service (FS), Oregon Department of Fish and Wildlife (ODF&W), Bonneville Power Administration (BPA), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and various public interest groups will insure a major improvement in fisheries production from Columbia River basin streams.

This section describes current fish habitat restoration and enhancement activities on National Forest lands within the Upper Grande Ronde River and tributaries for the work period April 1, 1986 through March 31, 1987. Specific tasks include the following: 1) stream inventory of Meadow Creek sub-basin (23.1 miles), (2) Fly Creek habitat improvement design (7.6 miles), (3) Upper Grande Ronde migration barrier removal feasibility, (4) Upper Grande Ronde structure installation, (5) Sheep Creek fencing, and (6) Sheep Creek instream structure maintenance and monitoring.

III. DESCRIPTION OF STUDY AREA

Meadow Creek Sub-basin

Meadow Creek enters the Grande Ronde River at river mile (RM) 180 and drains an area of 177 square miles. There are about 70 miles of stream within the drainage basin that are used by steelhead for spawning and/or rearing, Historical records indicate that at least

FIGURE 1

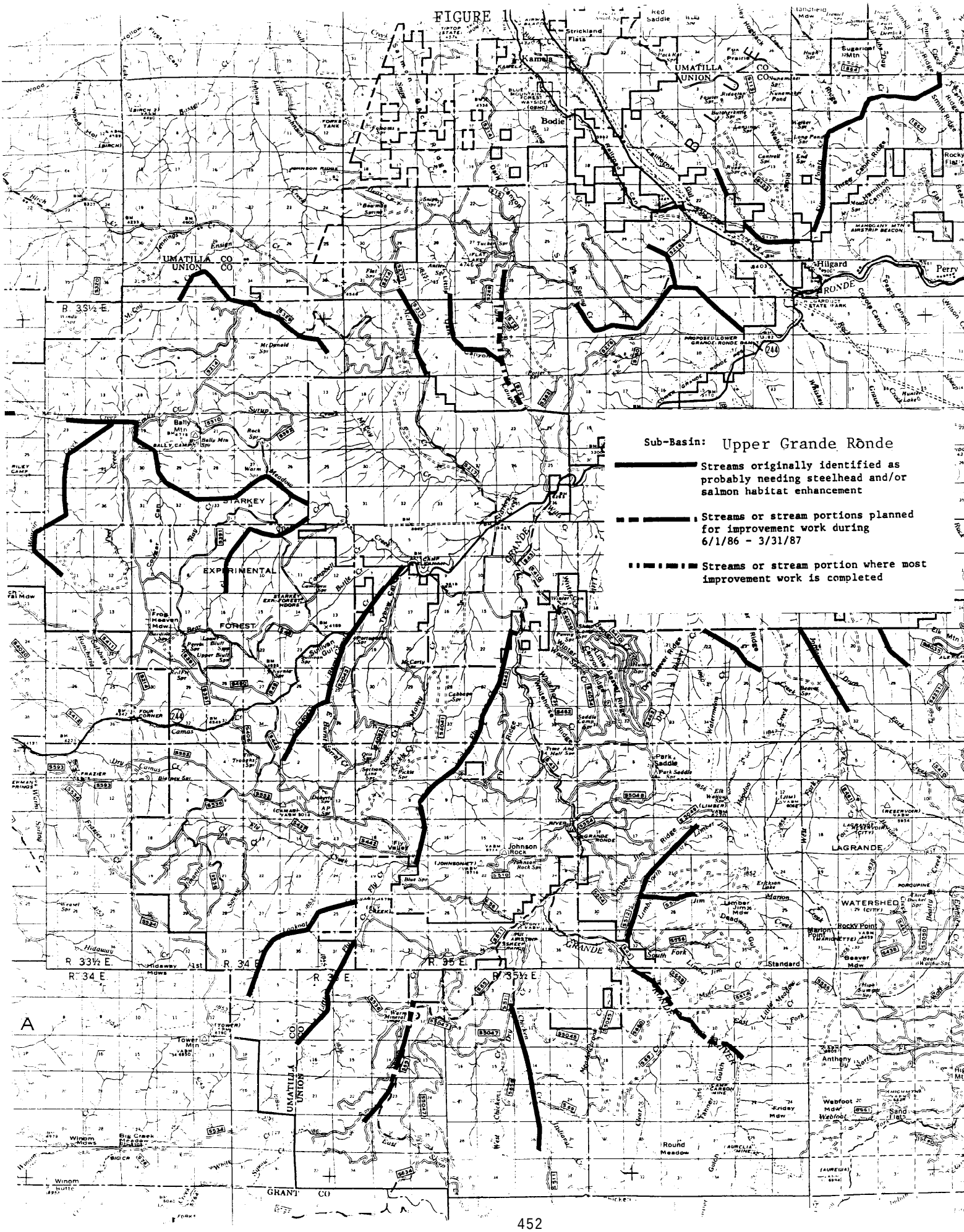
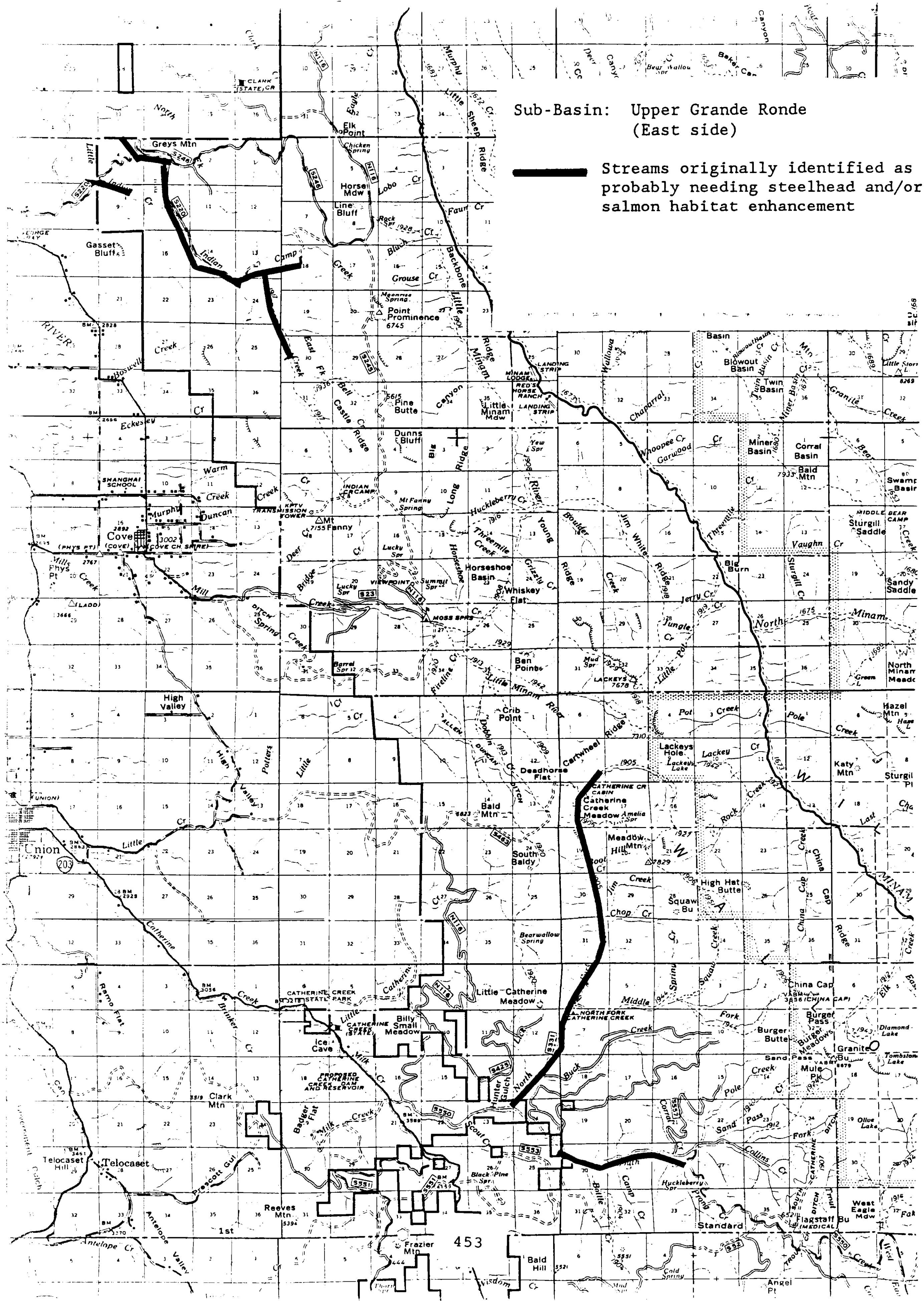

Sub-Basin: Upper Grande Ronde
Streams originally identified as probably needing steelhead and/or salmon habitat enhancement
Streams or stream portions planned for improvement work during 6/1/86 - 3/31/87
Streams or stream portion where most improvement work is completed
UMATILLA CO
UNION CO
STARKEY
EXPERIMENTAL
FOREST
GRANDE
RONDE
LAGRANDE
WATERSHED
Hilgard
Perry
Kamela
Bodie
Camas
Johnson Rock
Park Saddle
Standard
Winom
GRANT CO
R 33½ E.
R 34 E.
R 35 E.
R 35½ E.
A

FIGURE 2


Sub-Basin: Upper Grande Ronde
(East side)
Streams originally identified as probably needing steelhead and/or salmon habitat enhancement
Greys Mtn
Elk Point
Gasset Bluff
Point Prominence 6745
Cove
Union
Telocaset
High Valley
Catherine Creek Meadow
Little Catherine Meadow
Catherine Creek State Park
Proposed Catherine Creek Dam and Reservoir
Clark Mtn
Reeves Mtn
Frazier Mtn
Bald Hill
Standard
Granite
China Cap
Burger Pass
Sand Pass
Big Burn
Twin Basin
Blowout Basin
Miner Basin
Corral Basin
Bald Mtn
Ben Point
Crib Point
Deadhorse Flat
Lackeys Hole
Katy Mtn
Hazel Mtn
High Hat Butte
Squaw Bu
South Baldy
Meadow Mtn

the mainstem of Meadow Creek was also used for spawning and rearing of chinook salmon. Approximately 23 miles of stream lies on private land, the remainder is on National Forest land. The drainage is heavily roaded and has been intensively managed for timber and livestock production. Meadow Creek also contains the 27,000-acre Starkey Experimental Forest.

Anadromous fish producing streams tributary to Meadow Creek include Dark Canyon Creek, McCoy Creek, Burnt Corral Creek, Battle Creek, Bear Creek, Cougar Canyon Creek, Peet Creek, and Waucup Creek. The primary limiting factors are the lack of streamside vegetation, instream structure and quality pools. Each of the streams except Waucup, Battle and Cougar Canyon are listed in "Grande Ronde River Basin Recommended Salmon and Steelhead Habitat Improvement Measures" - January 1984 - Confederated Tribes of the Umatilla Indian Reservation. These three streams were identified for feasibility studies after the aforementioned document's publication.

Fly Creek

Fly Creek is tributary to the Grande Ronde River at RM 184.5. The drainage area comprises 52 square miles. Approximately 16 miles of this stream provide spawning and rearing habitat for steelhead. Little specific information exists regarding adult or juvenile salmonid distribution within the stream. Fly Creek is characterized by two general reaches. The upper 8-mile reach of stream lies on private land and is a low gradient, meandering meadow-dominated reach that has been heavily impacted by livestock grazing. The lower 8-mile reach lies on NF land, is a low-moderate gradient stream, and is moderately forested in a narrow valley bottom. Impacts in the lower reach are primarily from past roading and logging. Inventory was completed on NF land in 1985 and indicated a pool/riffle ratio of 20/80 and low quality pools.

Mainstem Upper Grande Ronde River

The Upper Grande Ronde River and its numerous tributaries drain an area of approximately 600 square miles. The mainstem portion of the river provides steelhead and chinook salmon spawning and rearing habitat over 80 percent of its length. For descriptive purposes, the mainstem river can be divided into 4 general reaches. Proceeding from highest in the drainage downstream they are:

The first reach (9 mi.) on NF land is a moderate-high gradient stream, heavily forested, and except for a primitive mining road, has not been significantly impacted. Roading and logging, however, are planned for this area. Inventory completed in 1985 indicated a pool/riffle ratio of 50/50 along with high quality pools. Habitat is near optimum; however, barriers may impede adult anadromous fish passage to upstream areas.

The second reach (3 mi.) is also on NF land and is a low-moderate gradient stream, moderately forested and has incurred heavy impact from placer mining activities conducted in the 1930's. Much of the river valley in this section is occupied by dredge tailings and a heavy shrub/grass plant community. A forest road parallels this section. Inventory completed in 1984 indicated a pool/riffle ratio of 3/97 along with low quality pools.

The third reach (7 mi.) lies on private land and meanders through a wide meadow dominated valley bottom. A forest road parallels the entire section. Heavy impacts from livestock grazing have occurred.

The fourth reach (28 mi.) is a low-moderate gradient section, moderately forested, and is paralleled by a paved highway. Approximately 10 miles of this section lies on disjunct portions of NF land. The remainder is on private land.

To date, project activities have been confined to the upper two reaches.

Sheep Creek

Sheep Creek is tributary to the Grande Ronde River at RM 197. The drainage area comprises approximately 58 square miles. Eleven miles of stream have been identified as containing spawning and/or rearing for chinook salmon. The upper two miles of stream lie on NF land and is characterized by a moderate gradient, narrow valley floor, which is heavily timbered. The middle three miles also lie on NF land and are characterized by a low gradient, meadow/timber complex with a high degree of meander. The remaining six miles of the stream are low gradient, meadow dominant and lie on private land. Watershed uses and impacts include roading, logging, livestock grazing, and severe damage to lodgepole pine stands from insect epidemics.

There were 101 structures installed in 1985 on two miles of the middle reach. The total amount of created pool and cover area was 10,489 sq. ft. and 3,228 sq. ft., respectively, which closely approximates objectives for enhancing pool/riffle ratio and pool quality for this stream.

IV. METHODS AND MATERIALS

A. INVENTORY

Habitat assessment methods currently in use on all fishery inventory projects are adapted from Platts' 1/ research procedures.

1/ Platts, William S., et al. 1983 Methods for evaluating stream, riparian, and biotic conditions. CTR INT-138 Forest Service

B. DESIGN

The design techniques used on Fly Creek involved traversing the project area, locating and staking sites for reference and developing site-specific prescriptions for each stream section that address the limiting factors described during inventory.

Procedures for analyzing the feasibility of removing barriers in the mainstem Upper Grande Ronde River involved establishing survey tag-lines at barrier sites. A section of stream above the barriers was electro-shocked by ODF&W and Forest Service employees and representative fish samples were collected. Portions of the collection were preserved in formaldehyde for dissections and identification. The remainder was frozen for later verification.

C. IMPLEMENTATION

Preparatory work for installation of structures in the mainstem Upper Grande Ronde River included setting up an equipment rental agreement consisting of a Case backhoe (Model 580-C) with operator and the acquisition of hardware cloth, filter fabric, cable and rebar. Logs and boulders were located from on-site sources.

A contract for a basic 4-wire, rock jack-type of livestock fence was prepared for Sheep Creek. Water access points were located at a frequency sufficient to allow livestock watering and provide access for equipment. The construction contract was 90 percent completed during the work period.

D. MAINTENANCE

Maintenance of structures consisted of minor hand-tool repair, and reseeding of bank keys where needed.

E. MONITORING

Established monitoring stations were resampled and structures photographed on Sheep Creek.

V. RESULTS AND DISCUSSION

A. HABITAT INVENTORY

The following table summarizes the miles of habitat inventory accomplished for this work period.

Meadow Creek Sub-basin	Accomplished (1986)	Planned (1987)
- Meadow Creek	15.10	
- Dark Canyon Creek		5.0

Meadow Creek Sub-basin	Accomplished (1986)	Planned (1987)
- McCoy Creek		9.0
- Burnt Corral Creek		6.0
- Battle Creek		2.0
- Bear Creek		4.0
- Cougar Canyon Creek	.75	
- Peet Creek		3.0
- Waucup Creek	7.25	
Total	23.10	29.00

Twenty-three miles out of the planned 29 miles of stream were inventoried. Inventory work was interrupted due to the extensive fire season on the Wallowa-Whitman National Forest. Consequently, inventory was not started until October. Several streams were deferred until next year because of extreme low flows.

B. DESIGN

Implementation design was completed for 7.6 miles of the lower reach of Fly Creek. Inventory indicated a deficiency in juvenile rearing habitat. Structure design planned for about 190 instream structures. The following table provides a breakdown of structure type by stream reach.

Section (Mi.)	Whole trees Single	- Double	Double Log Weirs	Single Log Weirs	Totals
A (4.12)	31		73	4	108
B (2.84)	13		43	7	63
c (.66)	11	a	1	1	19
7.62	61		117	12	190

Whole trees are cabled to boulders or streambanks and provide instream and overhead cover for juveniles and adult fish. Single and double log weirs stabilize and collect stream gravels along with forming upstream and downstream pools. Average structure cost was estimated at $244.

Engineering consultation and barrier reconnaissance indicated that debris dam and falls in the lower section of the Upper Grande Ronde River reach could be removed for an estimated cost of $7,500. This particular site lies on an unstable geologic fault line which would probably result in high maintenance costs. Because of severely limited access and the additional number of upstream barriers, it was determined removal would not

be practical or cost efficient. Fish collection above the barriers identified populations of eastern brook, rainbow trout and dolly varden. Preliminary identification of the rainbow trout indicated they are native redband trout. This identification is preliminary. Follow-up verification is being sought. This stream reach probably has a long history of isolation due to barriers. Steelhead may partially ascend the stream depending on flows; however, chinook salmon were not present in the collection. The consensus recommendation for this reach of stream is to maintain natural conditions.

C. IMPLEMENTATION

1. Upper Grande Ronde Instream Structures

Approximately 4 miles of stream on the mainstem Upper Grande Ronde River was targeted for structural enhancement during the low flow period in August. Preparation work involving acquisition of boulders, logs, materials and equipment rental contracting was started. A decision was made to defer excavation and placement of structures this season due to the heavy fire activity on the Forest and the priority commitment of personnel and equipment for suppression and rehabilitation work. During the interim, the design on some of the structures has been modified to angle log/boulder structures rather than the typical digger log structure used on Sheep Creek. This modification should prove more cost efficient by reducing excavation time and risk to the more unconsolidated streambanks that occur throughout the mine tailings on the Grande Ronde River. Stream morphology and hydrology appear more suited to this heavier type of structure and should better meet objectives. There should be no significant change in project costs by deferring this project to the 1987 field season.

2. Sheep Creek Fencing

The original riparian fence along Sheep Creek was designed for a total exclosure of livestock and big game. Because of physical and chemical (netting and sprays) alternatives available to deter the low numbers of big game, a decision was made to proceed with a fence designed to exclude livestock only at a significant cost savings. A construction contract package was prepared, advertised, and awarded on 2/28/87. Fence construction was 90 percent complete at the end of the contract period.

D. MAINTENANCE

Spring flows in Sheep Creek were high intensity - short duration in nature. Most of the out-of-bank flow occurred while the snow

cover was still in place. Minor hand maintenance was required on a few structures at a point where the structures were keyed into the streambanks. These margins were reinforced and reseeded.

E. MONITORING

The permanent monitoring stations on Sheep Creek were resampled. No significant changes were apparent. Monitoring procedures are currently being standardized in cooperation with ODF&W biologists. This should help work out some of the procedural problems and errors. Photo points were re-read. Heavy cattle grazing occurred in the riparian zone after monitoring stations were sampled. Exclosure fencing will provide for riparian recovery; however, evidence of unstable streambanks will be apparent for several years. This situation will test to our monitoring procedure and its ability to detect changes in stream morphology.

VI. SUMMARY AND CONCLUSIONS

Major interruptions in planned work resulted from an extensive fire season on the Wallowa-Whitman National Forest. Personnel and equipment were committed for emergency suppression and rehabilitation on fires during the preferred instream construction work period.

Twenty-three out of the planned twenty-eight stream miles in Meadow Creek were inventoried. The remainder of streams to be inventoried in this basin are scheduled for the 1987 field season. Design tasks for Fly Creek were completed as planned. Implementation of instream structures on the Upper Grande Ronde River was deferred to the 1987 field season and fencing of Sheep Creek will be complete by May 1987. Development of standardized monitoring procedures in cooperation with ODF&W will increase efficiency and accuracy.

VII. SUMMARY OF EXPENDITURES

Sub-Project	$ Used or Obligated
1. Sheep Creek	
Fencing	$ 2,489.43
Monitoring & Maintenance	$ 1,001.47
2. Fly Creek	
Design	$ 1779.55
3. Meadow Creek	
Inventory	$ 3,126.79
4. UGGR	
Feasibility	$ 617.79
Structures	$ 9,320.22
TOTALS For La Grande	$18,335.25
OVERHEAD 10%	$ 1,833.53
Grand Total	$20,168.78

JOSEPH CREEK SUB-BASIN HABITAT ENHANCEMENT
April 1, 1986 through March 31, 1987

I. ABSTRACT

The Joseph Creek sub-basin of the Grande Ronde River Drainage has been determined (by the ODF&W) to be a primary producer of wild and native steelhead trout within the Columbia River Basin. There are 80 miles of anadromous spawning and rearing streams on National Forest land within this sub-basin.

During this work period, the following was accomplished in cooperation with Bonneville Power Administration:

1. 25.5 miles of stream habitat inventory completed.

2. 33.7 miles of habitat improvement design was completed.

3. Deciduous vegetation planting stock was acquired for planting during the next work period.

4. Supplemental planting was completed on Elk Creek.

5. Seventy-five instream structures were installed for improving quantity and quality of pools on Chesnimnus Creek.

6. Preliminary design for 5.75 stream miles of protection fencing was completed.

7. Habitat monitoring and evaluation was completed on 4.5 miles of previous improvement work.

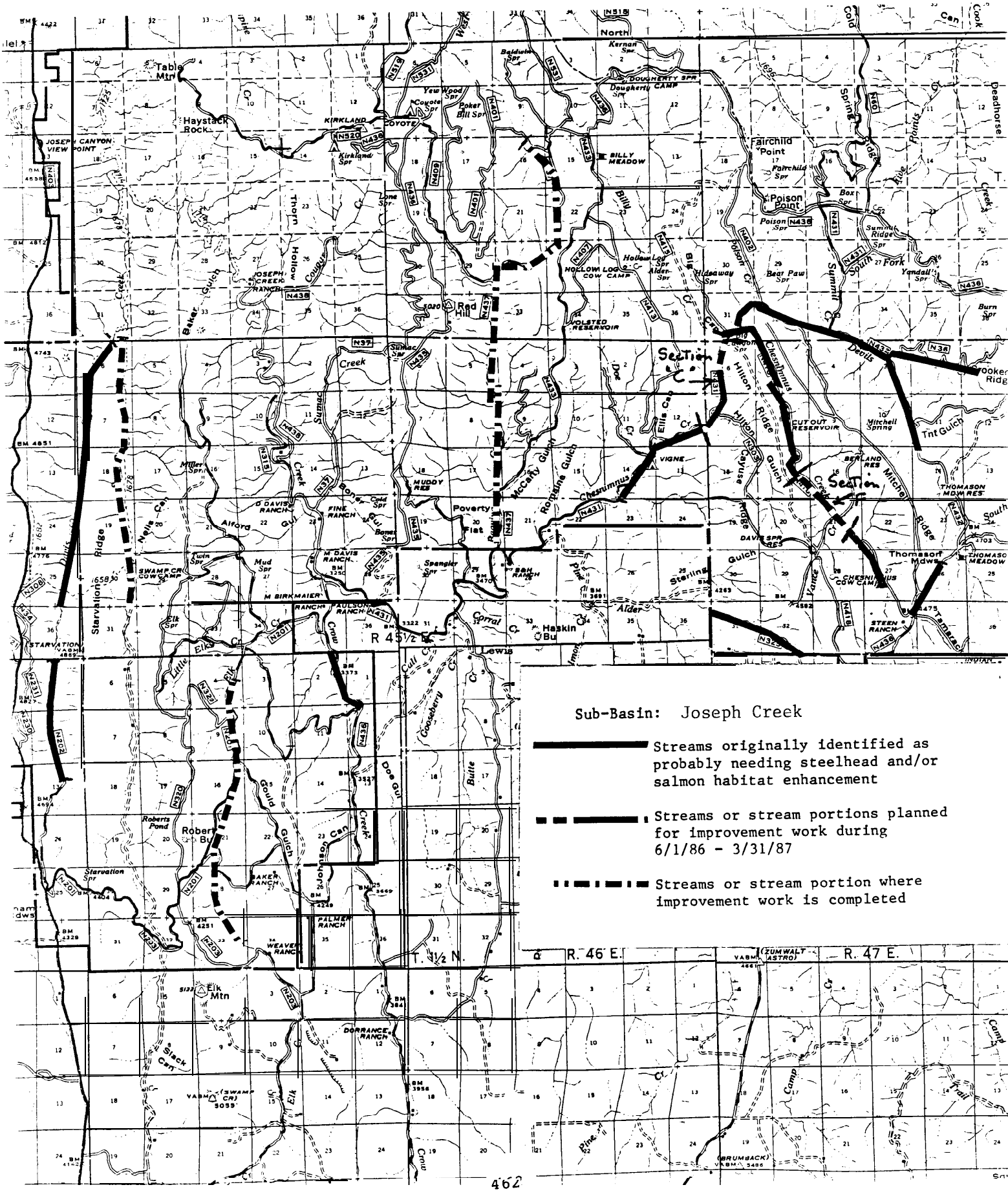
8. Maintenance was completed on 25 instream structures and 11.2 miles of protection fence.

II. INTRODUCTION

The Joseph Creek drainage is a major sub-basin of the Grande Ronde River (Figure 3). Cumulative impacts over time from logging and grazing have degraded aquatic habitats in the drainage resulting in a level of fish production far below full potential. Most tributary streams within the Joseph Creek sub-basin have been identified as needing habitat rehabilitation. 2/

2/ Northwest Power Planning Council Columbia River Basin Fish and Wildlife Program Final Amendment Document. Portland, Oregon. 1987

FIGURE 3


Sub-Basin: Joseph Creek
Streams originally identified as probably needing steelhead and/or salmon habitat enhancement
Streams or stream portions planned for improvement work during 6/1/86 - 3/31/87
Streams or stream portion where improvement work is completed
Section C
Section F
R 45½ E.
R. 46 E.
R. 47 E.
T. 1½ N.
Table Mtn
Haystack Rock
Fairchild Point
Poison Point
Red Hill
Elk Mtn
Haskin
Lewis
Roberts
Starvation
Poverty Flat
Thomasoff Mdws
Thomason Mdw Res
Cutout Reservoir
Holsted Reservoir
Hollow Log Cow Camp
Billy Meadow
Doughertty Camp
Joseph Canyon View Point
Joseph Creek Ranch
Muddy Res
Davis Spr Res
Berland Res
Steen Ranch
Palmer Ranch
Weaver Ranch
Dorrance Ranch
Baker Ranch
Paulson Ranch
Swamp Cr Cow Camp
Chesnimnus Cow Camp
Vigne
Kirkland
Coyote
Starvation Ridge
Chesnimnus Ridge
Hilton Ridge
Summit Ridge
Billy Ridge
Poison Cr
Big Cr
Doe Gul
Johnson Can
Gould Gulch
Butte
Alford Gul
Bonner Gul
Sumac Creek
Thorn Hollow
Cougar
Baker Gulch
Nelis Cr
Little Elk
Elk Cr
Crow Creek
Cull Cr
Gooseberry Cr
Slack Can
Pine Cr
Camp Cr
Trail
Devils
Tnt Gulch
Mitchell Mitche
Tamarack
Vance
Sterling Gulch
Alder
Spring Ridge
Deadhorse
Cook Can
Cold
Burn Spr
Dooker Ridge
Mud Spr
Twin Spr
Spangler Spr
Miller Spr
Elk Spr
Starvation Spr
Roberts Pond
Sumac Spr
Cold Spr
Bonner Spr
Yew Wood Spr
Poker Bill Spr
Kirkland Spr
Lone Spr
Baldwin Spr
Kernan Spr
Doughertty Spr
Fairchild Spr
Poison Spr
Box Spr
Summit Ridge Spr
Bear Paw Spr
Hideaway Spr
Alder Spr
Yandall Spr
Mitchell Spring
Burn Spr
Doe Cr
Ellis Cr
Romaine Gulch
McCarty Gulch
Pine Cr
Sprrat Cr
Cull Cr
Gooseberry Cr
Butte
Doe Gul
Johnson Can
Gould Gulch
Crow Creek
Elk Cr
Little Elk
Slack Can
Pine Cr
Camp Cr
Trail
Devils
Tnt Gulch
Mitchell Mitche
Tamarack
Vance
Sterling Gulch
Alder
Spring Ridge
Deadhorse
Cook Can
Cold
Burn Spr
Dooker Ridge
Mud Spr
Twin Spr
Spangler Spr
Miller Spr
Elk Spr
Starvation Spr
Roberts Pond
Sumac Spr
Cold Spr
Bonner Spr
Yew Wood Spr
Poker Bill Spr
Kirkland Spr
Lone Spr
Baldwin Spr
Kernan Spr
Doughertty Spr
Fairchild Spr
Poison Spr
Box Spr
Summit Ridge Spr
Bear Paw Spr
Hideaway Spr
Alder Spr
Yandall Spr
Mitchell Spring
Burn Spr
Doe Cr
Ellis Cr
Romaine Gulch
McCarty Gulch
Pine Cr
Sprrat Cr
Cull Cr
Gooseberry Cr
Butte
Doe Gul
Johnson Can
Gould Gulch
Crow Creek
Elk Cr
Little Elk
Slack Can
Pine Cr
Camp Cr
Trail
Devils
Tnt Gulch
Mitchell Mitche
Tamarack
Vance
Sterling Gulch
Alder
Spring Ridge
Deadhorse
Cook Can
Cold
Burn Spr
Dooker Ridge

The primary factors limiting anadromous production are high summer water temperatures and degraded rearing habitat. Plans are in various stages of development that will offset these factors by installing in-stream structures as well as planting and protecting deciduous and coniferous vegetation stream shade.

This portion of the report describes current fish habitat restoration and enhancement activities on National Forest lands within the Joseph Creek sub-basin for the work period April 1, 1986 through March 31, 1987. Specific tasks include the following: 1) Stream habitat inventory (25.5 miles), 2) habitat improvement design (30 miles), 3) instream structure installation (75 structures), 4) planting stock preparation, and 5) habitat improvement maintenance and monitoring.

III. DESCRIPTION OF STUDY AREA

Elk Creek

Elk Creek has a drainage of about 25 square miles, of which about 16 square miles are National Forest lands. Approximately 12 miles of spawning and rearing stream occur within the drainage.

The headwater of the system lies entirely within privately-owned farm land, timber and grazing lands. Runoff and sediment contributions from this large area contribute to degraded condition in Elk Creek on National Forest lands. As opportunities develop on these private land portions of Elk Creek, the ODF&W will work with landowners to improve fisheries habitat. Activities affecting water quality and stream-flows include past and current practices on National Forest and private land of logging, road construction, grazing and farming.

The National Forest project area falls within two grazing allotments: Davis Creek and Swamp Creek. At this time the National Forest segment of Elk Creek within the Davis Creek Allotment is almost totally protected from livestock grazing through exclosure fencing. Grazing in the Swamp Creek Allotment on Elk Creek is being controlled by a combination of exclosures and pasture fencing.

The Elk Creek drainage is heavily roaded. Railroad logging during the early part of this century was responsible for constructing a railroad grade down the bottom of the stream. This resulted in channelizing of large segments of stream.

Chesnimnus Creek

Chesnimnus Creek is tributary to Joseph Creek at the confluence with Crow Creek. The drainage area is approximately 190 square miles; about 108 square miles are on National Forest land. There are 12 miles of Chesnimnus Creek on National Forest land and about 8 miles on private land that require improvement for steelhead spawning and/or rearing. Chesnimnus Creek is characterized by low gradient, with short stretches of moderate gradient in the middle reaches. Narrow

bluegrass meadows dominate the upper reaches, with scattered lodgepole pine overstory. The middle reaches are rocky, narrow ravines for a short distance, which open up into broader U-shaped canyon bottoms of logged-over mixed conifer stands on the remainder of National Forest ground. The private land area is dominated by wider canyon bottoms consisting predominately of hayfields and pastures.

Watershed uses and impacts include roading, logging, livestock grazing and farming. There are numerous reaches on both National Forest and private ground that have been channelized in order to accommodate road construction and hay field development. Intensive logging is continuing on the forested ground throughout the drainage.

The ODF&W is currently developing riparian and aquatic habitat improvement projects on private land downstream from the National Forest. The primary investments being planned and implemented are instream structures (log weirs, boulder clusters); protective riparian fencing; and planting of vegetation.

Swamp Creek

Swamp Creek is a tributary to Joseph Creek. It encompasses a drainage area of about 55 square miles. About 23 square miles of the lower portion of the drainage is on National Forest land. The upper one-half of the drainage encompasses mostly private land. The lower one-half encompasses National Forest land, although one-half of the actual riparian stream bottom is privately owned . Throughout the Forest Service portion of the drainage, the stream is in a narrow U-shaped canyon, surrounded by alternating grassland and forested slopes. The riparian zone is a mixture of about 50 percent conifer communities which have been converted to grasslands, along with still intact conifer communities, and 50 percent shrubland or grass-moist meadow which has been converted to Kentucky bluegrass.

In 1986 a large complex of fires burned through the lower one-third of the Swamp Creek drainage, almost exclusively on National Forest land. Significant damage to the watershed has occurred, particularly the timbered north-facing slopes. A possibility exists that runoff patterns will be altered in this area for years to come. Although rehabilitative measures were implemented (seeding, rest from grazing), the impacts to the riparian and aquatic habitats may be substantial. Sedimentation and channel instability will likely be increased by this event.

Davis Creek

Davis Creek is a tributary stream of Swamp Creek. It encompasses a drainage area of 14 square miles and is approximately 71 percent Forest Service and 29 percent private. The anadromous fish spawning and rearing portions of this stream is about 11.25 miles long (7.5 miles Forest Service: 3.75 miles private).

This stream has been heavily impacted in the early decades of this century by railroad logging, which removed the forested canopy and physically rearranged the stream channel. Subsequent logging, road building and moderate to heavy grazing in the drainage has maintained the poor conditions of the riparian and aquatic habitats.

Davis Creek falls within two Forest Service grazing allotments: Davis Creek Allotment and Swamp Creek Allotment. Landownership patterns in this stream drainage make comprehensive grazing plans difficult to implement.

Alder Creek

Alder Creek, tributary to Pine Creek, contains about 4.5 miles of steelhead spawning/rearing streams of which 2 miles are on National Forest land. This small drainage encompasses about 20 square miles of land; only about 3 square miles are on National Forest land.

Alder Creek runs through two grazing allotments, Chesnimnus Creek and Doe Creek. The riparian zone is very heavily used by livestock and big game. It becomes intermittent in late summer, although there are several springs present.

The stream channel and bank conditions indicate a high flow volume and velocity during spring runoff. The majority of the stream exhibits unstable streambanks and large amounts of soil movement. Stream shade is lacking, as is vegetative diversity. This stream also exhibits a large degree of stream cutting. It is severely lacking in flow feature diversity.

IV. METHODS AND MATERIALS

A. INVENTORY

Habitat assessment methods currently in use on all fishery inventory projects are adapted from Platts' research procedures (footnoted earlier). Personnel from the Wallowa Valley Ranger District and the ODF&W implemented the inventory phase of these projects.

B. DESIGN

Thirty (30) miles of stream were assessed and implementation design developed. Mike Leonard, District Wildlife Biologist, developed the implementation designs for all projects work on the Wallowa Valley Ranger District. Techniques included walking the project areas and developing prescriptions based on integrating inventories, observations and use of large scale (1:2,000) color IR photo imagery.

C. IMPLEMENTATION

The following five tasks were completed:

1. Acquisition of planting stock

The standard procedure which has been adopted is that of pruning and collecting local willow and cottonwood trees within the Wallowa Valley. Forest Service personnel worked with crews from Pacific Power and Light Company to collect materials resulting from their annual powerline right-of-way maintenance. Another source has been from local people who provide trees for direct pruning by Forest Service personnel. Acquisition of planting stock utilized Forest Service funding sources.

The type of materials used are pole cuttings, 1 1/2 to 3 inches in diameter and 12 to 18 feet long. It is also desirable that the pieces are young growth, typically with green, smooth bark. Another size class material acquired is "peg" material, which is smaller in diameter and cut to approximately 18 inches in length. This material is acquired as it becomes available when collecting the larger materials. Additional rooted stock material was planned for purchase this winter.

2. Planting

Stream shade will be increased through extensive planting of deciduous vegetation. This task is planned to consist of supplemental planting on Elk Creek, Swamp Creek, and Peavine Creek in April/May 1987.

3. Instream Structures

Stream reaches deficient in pools and structural cover will be enhanced through construction of in-stream structures. Generally, these consist of log weirs; log deflectors, boulder clusters and rock deflectors.

Seventy-five structures were installed in Section C and F of Chesnimnus Creek during July-October 1986.

4. Fencing

Growth of deciduous vegetation plantings and healing of streambanks will be increased with fencing to exclude livestock. Examination and siting of fence locations for Sections A, B, C and F on Chesnimnus Creek were prepared for contracting during the next work year.

Streamside log barrier placement designed to restrict ungulate grazing on vegetation along Chesnimnus Creek, Section F, was deemed infeasible.

D. MAINTENANCE

Minor maintenance was performed on both powered and conventional fences and also on 25 instream structures.

E. MONITORING

Monitoring and evaluation tasks consisted of those activities described in Appendix A (BPA/FS Anadromous Fish Habitat Monitoring Plan).

This phase also included establishment of baseline habitat monitoring transects and photo points on 12 miles of Chesnimnus Creek and 5 miles of Swamp Creek. Twenty randomly selected monitoring points were installed on each stream.

V. RESULTS AND DISCUSSION

A. HABITAT INVENTORY

All 25 1/2 miles of stream were inventoried as planned. Major interruptions in the accomplishment of the inventories were caused by the very extensive forest fires on the Wallowa-Whitman National Forest this field season. Consequently, several streams were not inventoried until late October.

B. DESIGN

Implementation design was planned for completion during this work year on Chesnimnus Creek, Swamp Creek, Davis Creek, Devil's Run Creek, Crow Creek, TNT Gulch and Alder Gulch. Two events occurred which impaired total accomplishment of these designs: 1) the extensive forest fires on the Wallowa-Whitman NF and particularly the Wallowa Valley Ranger District disrupted all planned activities by involved personnel for over three months; 2) loss of key personnel from the District impacted workloads. Thus, implementation design is incomplete at this time for Crow Creek, Devil's Run Creek, and TNT Gulch. These projects are in progress; their incomplete status does not impair out-year planning at this time. Inventories were completed, and preliminary analyses initiated. The other four streams, Chesnimnus Creek, Swamp Creek, Davis Creek, and Alder Creek have completed design plans. Additionally, a design plan for Elk Creek was also completed. Design was completed on 33.7 miles of stream.

C. IMPLEMENTATION

1. Acquisition of Planting Stock

During this work period planting stock was gathered for work to be accomplished in the next work year (spring of 1987). Acquisition has included gathering cutting materials of cottonwood and willow species, and through purchase of rooted stock. The cuttings target is 7,200 poles. Rooted stock which is being purchased will consist of: 1) 2,000 bare root seedlings of *Populus* spp.; 2) 220 potted *Sorbus* spp.; 1,000 root-balled *Populus* sp. 2' - 5' tall.

All of these materials have been secured using Forest Service funds.

2. Planting

Supplemental planting of deciduous vegetation (approximately 1,000 pegs of *Populus* and *Salix*) was implemented on Elk Creek. This project was funded from Forest Service funds.

3. Structures

Installation of 75 structures in Sections C and F of Chesnimnus Creek was accomplished as planned. This project was also interrupted by the forest fire outbreak. A delay over almost two months occurred between completion of work on Section C and the resumption of the project in Section F. Because of the cooperation from the equipment operators and excellent fall weather, these tasks were completed in 1986.

4. Fencing

Preliminary design and contract preparation for 5 3/4 miles (5.75) of riparian exclosure fencing for Sections A, B, C and F on Chesnimnus Creek has been initiated. This initial work has been completed using Forest Service funds. The majority of this task will be completed in the next work year.

D. MAINTENANCE

Maintenance was concluded as planned on all fences Maintenance on the six miles of conventional fence on Elk Creek was relatively easy compared to the maintenance and checking required to maintain the 6.5 miles of powered fence on Peavine creek. It was accomplished without significant problems. About 25 structures on Elk Creek required minor maintenance. All structures in Peavine creek were sound and required no maintenance.

E. MONITORING

Three thermographs were installed on Peavine Creek, turbidity samples were taken, and supplemental temperature readings were taken as planned. Additionally, camera points were rephotographed. Planted vegetation has not responded quite as well as other planted areas, such as Elk Creek, because of use by big game, fence failures and poorer planting stock quality. However, some areas are responding very well due to the decrease in overall ungulate pressure, and will improve rapidly with additional rest. Herbaceous vegetation and native shrub species are starting to show increased vigor.

All monitoring transects were established as planned. Twenty randomly selected monitoring plots with photo series were established on both Chesnimnus Creek and Swamp Creek (i.e., 40 plots total were installed).

VI. SUMMARY AND CONCLUSIONS

Although the riparian and aquatic habitat rehabilitation projects described here are in initial stages of planning, design and implementation, it appears that significant progress is being made toward recovery of these resources. As inventory and planning progresses, experience and interagency communication are evolving into sound practices for evaluation, planning and implementation. Designs have been successfully implemented, and costs are being reduced.

Initial observations indicate that predictions in achieving habitat goals and objectives are realistic. Survival on plantings are high, instream structures are providing effective habitat, and protected areas are recovering.

Additionally, more individuals in the Forest Service from diverse disciplines are becoming involved; this is also true of traditional user groups on the Forest. This is creating benefits to the riparian and aquatic habitat resources, even beyond the project areas, because of heightened awareness and commitments to better management practices.

VI. SUMMARY OF EXPENDITURES

	Sub-Projec	$ Used or Obligated
1.	Joseph Creek	
	Habitat Inventory	$ 3,496.61
	Improvement Design	$ 8,127.30
	Maintenance	$ 221.80
2.	Chesnimnus Creek	
	Planting	$ 1,063.33
	Instream Placement Structure	$29,035.24
	Maintenance of Improvements	$ 1,117.04
	Evaluation & Monitoring of Habitat Change	$ 819.94
3.	Elk Creek	
	Fencing	$ 97.02
4.	Swamp Creek	
	Planting	$ 467.18
	TOTALS FOR Wallowa Valley	$44,445.46
	OVERHEAD 10%	$ 4.444.55
	Grand Total	$48,890.01

JOHN DAY DRAINAGE

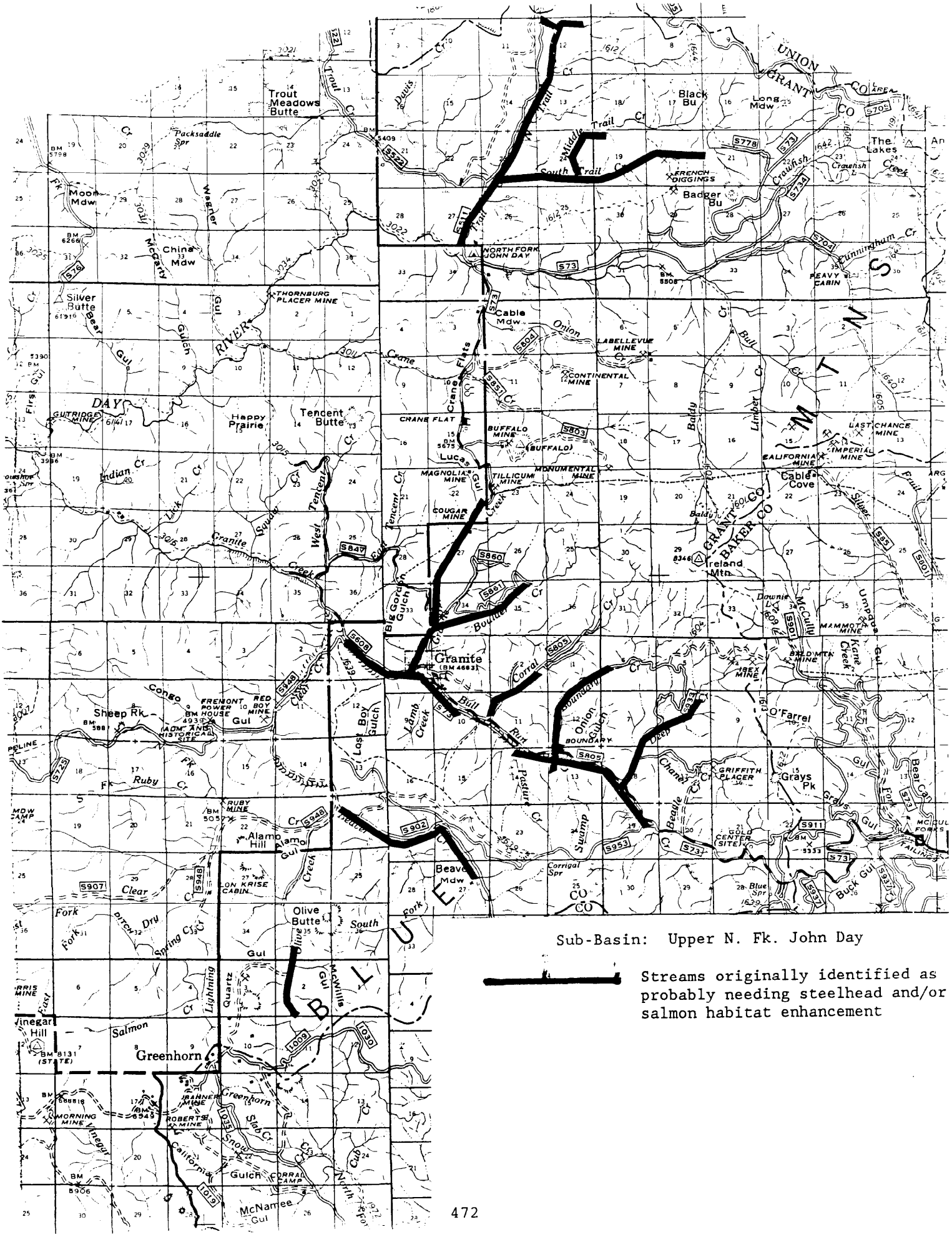
UPPER NORTH FORK JOHN DAY SUB-BASIN

ABSTRACT RESULTS, DISCUSSION AND SUMMARY

The Upper North Fork John Day sub-basin is the uppermost in the North Fork drainage (Figure 4). It lies upstream from the Umatilla National Forest where habitat enhancement work has been ongoing for several years. There are about 50 miles of salmon and/or steelhead spawning or rearing streams within sub-basin on the Wallowa-Whitman National Forest.

During this work period habitat inventory was initiated on Beaver Creek. Seven and four tenths (7.4) total stream miles were surveyed.

Beaver Creek below the mouth of the South Fork has a wet meadow margin that has had little recent cattle grazing pressure. Overhanging sedges give excellent fish cover; undercut banks are numerous and the width/depth ratio is good. The limiting factor to anadromous fish production appears to be the lack of quality spawning gravel and excessive water temperatures. Sections of Beaver Creek will greatly benefit from riparian vegetation plantings. Implementation design for Beaver Creek is scheduled for 1987. This design will address site-specific additions of primarily large, woody debris to improve instream and overhead rearing and spawning habitat.



Sub-Basin: Upper N. Fk. John Day

Streams originally identified as probably needing steelhead and/or salmon habitat enhancement

BPA/FS Anadromous Fish Habitat Monitoring Plan

This document outlines the habitat parameters which the Forest Service will monitor prior to and on a long-term basis as part of the BPA/FS/ODF&W and Tribal Anadromous Fish Stream Improvement Projects on the Wallowa-Whitman National Forest. Baseline and future monitoring of future popu- lations will be conducted under the leadership of the ODF&W. Parameters, methods and frequency for doing such are presently being determined by that agency. They will become part of the monitoring plan upon completion.

Project Areas: Joseph Creek Drainage and Upper Grande Ronde River, Wallowa-Whitman National Forest.

Project Objectives: Within 10 years of the completion of each project implementation, the water temperature, pool/riffle ratio, and streambank cover components of the habitat within the project areas is planned to be in near optimum spawning and rearing conditions for summer steelhead and/or spring chinook salmon.

Primary Habitat Monitoring and Evaluation Parameters

1. Water Temperature
2. Stream shade
3. Pool quality
4. Channel bottom sedimentation and compositions
5. Streambank stability
6. Riparian/floodplain vegetation
7. Pools associated with structures

Methods

A. 1. Recording thermographs will be installed instream immediate- ly above and below each entire project area (FS), or in a similar manner above and below isolated major segments of project areas.

2. Temperature data will be supplemented by on-site measure- ments taken with hand-held thermometers when reading transects.

B. Channel and Banks

Permanent cross-channel transects will be randomly installed which will monitor instream changes. When appropriate, sets of transects (one set equals one monitoring project) will be set up to isolate different types of treatment improvements or initial stream conditions - such as different cattle grazing systems or

significantly different stream gradients. These transects will be installed at a rate that insures statistical reliability at the 90% confidence level for all parameters in the treated areas.

Confidence intervals (controlled by number of sample points) will be small enough to identify changes that are expected to take place by the end of ten years. All transect data will be collected during the summer months, and reread at the same time thereafter (preferably July-August). All parameters will be summarized by mean values, variance, standard error and confidence.

1. Stream shade will be indexed by spherical densiometer measurements of brushed and combined brush and tree. this will be done at each transect mid-stream point.

2. Flow depth will be measured at 1/4, 1/2 and 3/4 intervals on the cross sectional transect. Flow width will also be measured.

3. Pool/riffle ratios will be established by classifying stream surface flow characteristics of each cross sectional transect.

   Pool quality will be evaluated on the basis of the largest pool intercepted by each transect, and rated using Platts et al 1/ (1983, p. 9) technique of rating pool quality (modified for small streams).

4. Sediment will be evaluated as a component of the stream substrate, and rated using Platts et al classification system (1983 p. 16) for stream substrate.

5. Streambank stability will be evaluated at each transect site by use of similar scheme developed by Platts et al (1983, p. 13) using five categories (very poor to excellent) in combination with vertical bank height measurements.

C. Riparian/floodplain vegetation

Changes in vegetation structure, canopy closure, and composition will be monitored using two systems of photo imagery.

1. Fixed camera points will be established at each stream transect site. Pictures will be taken (color transparencies) across stream (both directions), up and down-

---

1/ Platts, William S., et al 1983 Methods for evaluating stream, riparian and biotic conditions. CTR INT-138. Forest Service

stream from the transect "zero-point", using a meter scale in all photos. This will give a ground level view of vegetation change.

2. Color IR aerial imagery (scale 1:2000) will be flown before project implementation (or as early as can be scheduled) of all Forest Service stream project areas. These will be reflown at about 5-year intervals. Percentage change in vegetation canopy cover and vegetation composition will be determined from this imagery.

D. Pools associated with structures

1. Fixed camera points will be established at each site. Pictures will be taken viewing upstream with a reference scale positions in the deepest part of the pool.

2. Measurements will be taken of pool depth, width, length, and quality.

Schedule

1. Recording thermographs where needed to supplement existing equipment, will be installed at the initiation of project implementation. They will be maintained continuously during the field season (June 1 - Sept. 30).

2. Transects and photo points will be monitored biennially after installation for at least ten years.

3. Aerial imagery will be reflown at 5-year intervals.

Middle Fork John Day River and Tributaries
Habitat Improvement

1986 Annual Report

Prepared by
Richard Gritz, Project Coordinator

USDA Forest Service
Malheur National Forest
139 NE Dayton Street
John Day, Oregon 97845

Funded by

Bonneville Power Administration

Division of Fish and Wildlife

PO Box 3621

Portland OR 97208

Kathy Anderson, Project Manager

Contract No. DE-AI79-84BP16064
Project Number 84-22

Columbia River Basin Fish and Wildlife Program Measure 704(d)(l)

March 1987

Table of Contents

Summary 477

Appendix - Efficiency Analysis 484

SUMMARY

Project work on the Malheur National Forest in 1986 was a continuation of the Middle Fork John Day River and Tributaries Project identified in Section 700, Table 2, of the 1984 Columbia River Basin Fish and Wildlife Program. Two projects were completed in 1986. Project 1, involved structural fish habitat improvement work on five tributaries of the Middle Fork John Day River. The work included the installation of log and rock weirs, log and rock deflectors, riprap blankets, and boulders, as well as relocating" the stream back into its natural channel in two locations. Maintenance of existing structures on other tributaries was also accomplished. Total cost for the project was approximately $141,000. Project 2, was the survey, environmental analysis, and preliminary design work for future projects on remaining tributaries to the Middle Fork. The cost for this project was approximately $12,000.

The primary objective of the structural work this year was to increase the quantity and improve the quality of steelhead rearing habitat in Beaver Creek, Big Boulder Creek, Davis Creek, Vincent Creek, and Vinegar Creek. Chinook rearing potential will also be increased, since chinook move from the Middle Fork up into these tributaries during summer low flow and warm water conditions. Pools of sufficient size and depth to provide good rearing habitat during summer low flow and winter icing conditions are limited in these streams.

Barriers to fish movement during low flow conditions are also a concern in Vincent Creek and Vinegar Creek. In some of the old mine tailing areas, all of the flow has been subsurface in some years during summer low flow conditions. This has resulted in a loss of the potential rearing area within these reaches and has also blocked access to upstream areas. This subsurface flow condition is the result of repeated depositing of bedload in these areas, which in turn, has caused repeated channel changes. In the spring, several small poorly defined channels were present, but none of these channels were able to maintain flow through the summers of dry years. Structural work in these areas was to help the stream define and maintain a main channel with enough size and depth to maintain surface flow during low flow conditions.

Two changes were made to the 1986 program of work during final layout. First, Beaver Creek was substituted for the tributaries of Big Boulder Creek. The reasons for deferring work in the Big Boulder tributaries is discussed in the section of this report describing the work done in Big Boulder Creek. Second, Vinegar Creek was substituted for Deerhorn Creek. We felt the need of a little more time for detailed layout of the work to provide passage at the mouth of Deerhorn Creek, and the priority treatment reach of Vinegar Creek was acquired in a land exchange. The substitutions were made with minimal changes to contracts and workload.

In related Forest Service projects, the resource survey of the South Fork John Day River and tributaries on the Malheur National Forest, which was started in 1985, was completed. Maintenance of existing fish habitat and passage structures was also accomplished.

Table 1: Summary of Structural Work Accomplished in 1986

Stream	Length Treated (Miles)	Log/Rock Weirs	Log/Rock Deflectors	Riprap Blankets	Boulders
Beaver Creek	2	37	4		30
Big Boulder Creek	0.3				40
Davis Creek	1.5	4	15	4	110
Vincent Creek 2 "channel changes"	3	67	20	6	190
Vinegar Creek	0.5	2	9	2	30
Total 2 "channel changes"	7.3	110	48	12	400

Project 1: Structural Habitat Improvement Work on Five Tributaries of the Middle Fork John Day River

Implementation of structural habitat improvement in tributaries of the Middle Fork John Day River. This is work covered in Modification A003 of Agreement DE-AI79-84BP16064, Project 84-22. Numbers and types of structures are summarized in Table 1. Project areas are shown in Appendix 2 (map).

Beaver Creek T. 10 S., R. 34 E., sections 30 and 31

Riparian vegetation and channel stability are good along most of Beaver Creek, with fair to poor conditions being localized. The overall condition of the Beaver Creek drainage appears to be reflected in fairly stable water temperature and flow conditions during the summer. Instream structure was limited, however, with less than 20 percent of the stream area as pools. Emphasis for treatment in Beaver Creek was to increase this pool/riffle ratio. Most of the structures were log weirs and boulders. Nearly 2 miles of stream were treated, which is all of the work needing done within steelhead distribution on National Forest land.

Remaining work to be done on this stream is on private land downstream from the Forest boundary. Because of the land ownership pattern, this work would logically be done concurrent with work in the main Middle Fork. Also, the physical condition of the stream changes as it goes onto private land, so that a different set of rehabilitation measures will probably be employed here, subject to landowner approval. Implementation of work in the main Middle Fork has not yet been approved, so negotiations with the landowner have not been completed. ODFW has primary responsibility for this work.

Big Boulder Creek T. 10 S., R. 33 E., section 23

Within the boundary of the Malheur NF, Big Boulder Creek is a relatively steep, high energy stream. Equipment access to the stream is limited, and the riparian vegetation and rearing habitat conditions are generally good, for steelhead and resident trout. Rearing habitat quality for chinook fry is fair, limited by a general lack of side channel and backwater areas, but economically viable opportunities to provide more of these types of habitat are not available. Some of the tributaries to Big Boulder Creek have potential for fish habitat improvement. Myrtle Creek, Badger Creek, and Wray Creek were included in the proposed 1986 Work Statement. It would be necessary to reopen old roads to accomplish this work, so it has been deferred at this time. In Wray Creek, for example, it should be possible to accomplish most of the needed work with K-V funding, with the next entry for timber harvest in the area. The next timber sale scheduled in a portion of this area is in 1989.

Habitat improvement work in Big Boulder Creek was limited to a short reach with access where pools were limited, approximately one-half mile upstream from the Forest boundary. Boulders were used to create pools with cover. The hydraulic energy in the stream at this site would have made other types of structures quite expensive. There is little opportunity at this time for more work in Big Boulder Creek within the National Forest boundary. The work done was similar to what was done in other project areas and fit in well as part of the contract package for 1986.

There is a need/opportunity for fish habitat improvement work in the lower reaches of Big Boulder Creek, on private land, but as for Beaver Creek, the physical condition of the stream changes as it goes onto private land, so that a different set of rehabilitation measures will probably be employed here, subject to landowner approval.

Davis-Creek T. 11 S., R. 35 E., sections 20 and 30
In the upper stream reach of Davis Creek within the project area, the stream has been channelized as a part of past mining operations. Pools were very limited in this reach. Log weirs and boulders were installed to provide high quality rearing pools with cover. In lower reaches, the creek has been affected by road building, loss of riparian lodgepole pine stands to beetle infestations, timber harvest and livestock grazing. Riparian vegetation condition is generally in an upward trend, but the effects of all of this historical activity are still obvious. The stream was characterized by unstable banks, with accelerated channel movement (scour and deposition). Total pool frequency was limited and high quality pools with depth and cover were very limited. The emphasis here was to use deflectors, riprap blankets and boulders to help stabilize the banks, while providing pool habitat adjacent to the structures. More than 1 1/2 miles of stream were treated, within the first 2 1/2 miles of stream on the Forest. It was not practical, or economically efficient, to treat "every foot of the whole stream." Additional followup work may be needed in a few years.

Additional work is also needed downstream on private land, but this work will need to be done concurrent with and as part of treatment of this reach of the main Middle Fork.

Vincent Creek T. 11 S., R. 35 E., sections 6, 7, and 18

As with Davis Creek, Vincent Creek has been affected by a variety of past management activities. Parts of the stream have been dredged. Some mining activity continues near the stream. There is an old road that closely parallels the stream in several places. Timber harvest has occurred along the stream and livestock grazing continues in the riparian area. Vegetative cover is still limited along much of the stream, but changes in livestock management in recent years have resulted in an overall upward trend for riparian vegetation. Fencing was not included as part of the project. Current Forest policy states: *Normally, riparian corridor fencing will only be used when other management strategies will not bring the riparian condition into an upward trend."

A variety of structures were used to achieve site specific objectives along three miles of stream. In areas with adequate stable stream banks, but with limited pools, log weirs were generally suitable to achieve the greatest increase in pool rearing area. Boulders were used between the weirs to add diversity to the channel morphology and fish habitat. In areas with unstable banks and accelerated erosion, deflectors and riprap blankets were used to stabilize the banks and give the stream a deeper, narrower channel. Again, boulders were used in conjunction with these structures to add structural diversity to the instream habitat.

Some of the old dredge mining areas posed more difficulty in designing structures to accomplish the objectives. In two areas, this dredging occurred in natural depositional areas, where the channel gradient flattens out. Annual deposit of gravel in these areas during spring high flows resulted in multiple poorly-defined channels, which changed frequently. With the flow being dispersed across a fairly wide area and the high permeability of the unconsolidated substrate material, all of the flow would go subsurface during low flow periods. This resulted in a loss of rearing habitat in these areas. It also created barriers to fish movement and isolated rearing fish during receding flow conditions.

The deflector type structures installed here are designed to intercept some of the subsurface flow and concentrate flow, so that the stream can maintain a defined channel with surface flow. They also provide hard points where scour pools can be maintained to provide rearing habitat. We tried to achieve this with a minimum number of structures, so the area will need to be monitored to determine if any additional work may be needed after a few spring high flow periods.

In two locations, Vincent Creek had changed channel location into the roadbed of the old road paralleling the stream. Shade was totally lacking in these reaches and the limited pool area was mostly shallow and exposed. A spot check of water temperature one afternoon showed an increase of about 4 degrees F. from the top to the bottom of one of these reaches. Deflectors and riprap were used to divert the stream back into the existing “natural” channel. These two reaches total about 1/4 of a mile. Existing riparian vegetation condition is fair to good, with stream surface shading greater than 50 percent.

Vinegar Creek T. 11 S., R. 35 E., section 20

Only a portion of Vinegar Creek needing treatment was treated in 1986. Parts of the stream have been identified for treatment with K-V funding. Other parts of the stream which do not now have adequate access for equipment will be accessible within the next few years, as roads are reconstructed for the next timber sale entry into this area. Rock weirs were installed in one short upstream reach this year, but the emphasis for treatment at this time was near the mouth of the stream, just upstream from County Road 20, in an area recently acquired in a land exchange. This is the highest priority area for treatment on this stream.

In this area, riparian vegetation is responding positively to a change in livestock management along the stream, but the area has the typical appearance of an old dredge mine area which has been leveled. The channel was wide and shallow, and bedload deposition and scour was evident. A combination of deflectors, riprap and boulders was used to help narrow and define the channel, stabilize the banks, and provide rearing pools. In addition to increasing and improving rearing habitat, this structural work will also improve fish passage during low flow conditions from the Middle Fork to Vinegar Creek. These stabilizing structures should also help to accelerate the vegetative recovery in the adjacent riparian area.

Summary

In summary, a total of 172 structures and 400 boulders were placed in 7.3 miles of stream. The benefits to anadromous fish production, through improved low flow passage and water temperature regulation will extend beyond the stream distance actually treated. The primary species to benefit from this work will be steelhead trout. The estimated increase in production is 4,500 smolts. Chinook rearing potential will also be increased. We know that juvenile chinook are moving up into these tributaries during summer warm water conditions in the Middle Fork, but we do not have much quantifiable information on how many and for how long, or what the potential increase will be. Therefore, the estimated increase in steelhead production was just inflated by 500 for the purpose of the economic efficiency analysis. That analysis is shown in Appendix A.

Project 2: Environmental analysis and preliminary design for future projects in tributaries of the Middle Fork John Day River

This is the work covered under Modification A004 of Agreement DE-AI79-84BP16064, Project 84-22. The scope of this project was revised during the year due to a decision by BPA to consolidate "survey and design" for all land ownership in the main Middle Fork. The project agreement was signed for environmental analysis and preliminary design for the Middle Fork and tributaries on the Malheur National Forest. With the decision to consolidate the survey and design for all of the area of mixed ownership along the main Middle Fork, and to contract that work to a third party, it was necessary to revise our analysis area to just include the tributaries. This environmental analysis was completed. With the reduced scope of the project, only about one-half of the $24,465 agreed to in Modification A004 of the Work Agreement was used this year. The remaining $12,000 will be carried over as Project 2 in the 1987 Work Statement.

Within the tributaries analyzed for future potential projects, the structures proposed to accomplish this work are of standard design and the procedures to install them have been successfully used in the past on similar projects. These include instream and streamside structures such as weirs, deflectors, riprap blankets and boulder placements. In conjunction with this structural habitat work, range management practices to reduce the existing impact of livestock grazing in the riparian areas may also be included. The decision announcement to categorically exclude this action from documentation in an environmental assessment or an environmental impact statement was signed by the Forest Supervisor on December 3, 1986. As a part of this analysis, opportunities for funding of fish habitat improvement work with K-V funds (Knudtson-Vandenberg Act) from timber sale receipts were identified. Thus, priority for requests for funding from BPA can go to streams with limited opportunity for K-V funding. Also, having this analysis done should reduce, if not eliminate, the need for changes to annual project work statements, as was done in 1986 for Deerhorn Creek and the tributaries of Big Boulder Creek.

Append ix A

EFFICIENCY ANALYSIS

Fish Analysis A

Malheur NF
so

Prepared by:
RG/PFB

March 9, 1987

This report generated by 'EFFICIENCY'
VERSION 2.101086
'EFFICIENCY' was developed by
Jerry Haugen
Operations Research Analyst
Kootenai National Forest (RO1F14A)

SUMMARY
MEASURES OF EFFICIENCY

Total UNDISCOUNTED (31 year) costs amount to	$ 151,000.00
Total UNDISCOUNTED (31 year) returns amount to	$1,431,642.00
Net UNDISCOUNTED (31 year) returns amount to	$1,280,642.00

The discount rate that was used is 4 percent (REAL).

The present value of all costs in 1986 dollars is	$144,473.75
The present value of all returns in 1986 dollars is	$783,065.38

The PRESENT NET VALUE of all activities and outputs in this analysis is $638,591.63 in 1986 dollars discounted at 4.000 percent

The BENEFIT-COST RATIO is 5.42012

The internal rate of return is 29 percent

The equivalent annual income (average net annual benefit) is $36,307.30

INTRODUCTION

This analysis begins in 1986 and runs 31 years into the future. All costs and returns were input in 1986 dollars and are discounted to 1986 at 4.000 percent. All costs and returns are discounted from the end of the year in which they accrue.

ACTIVITIES AND COSTS USED IN THIS ANALYSIS

ACTIVITY	TOTAL QUANTITY	L OR A	UNITS	START YR	END YR	UNIT COST
Habitat Imp	1.00	L	Job	1	1	141000.00
Maint	1.00	L	Job	2	2	5000.00
Maint	1.00	L	Job	4	4	5000.00

OUTPUTS AND RETURNS USED IN THIS ANALYSIS

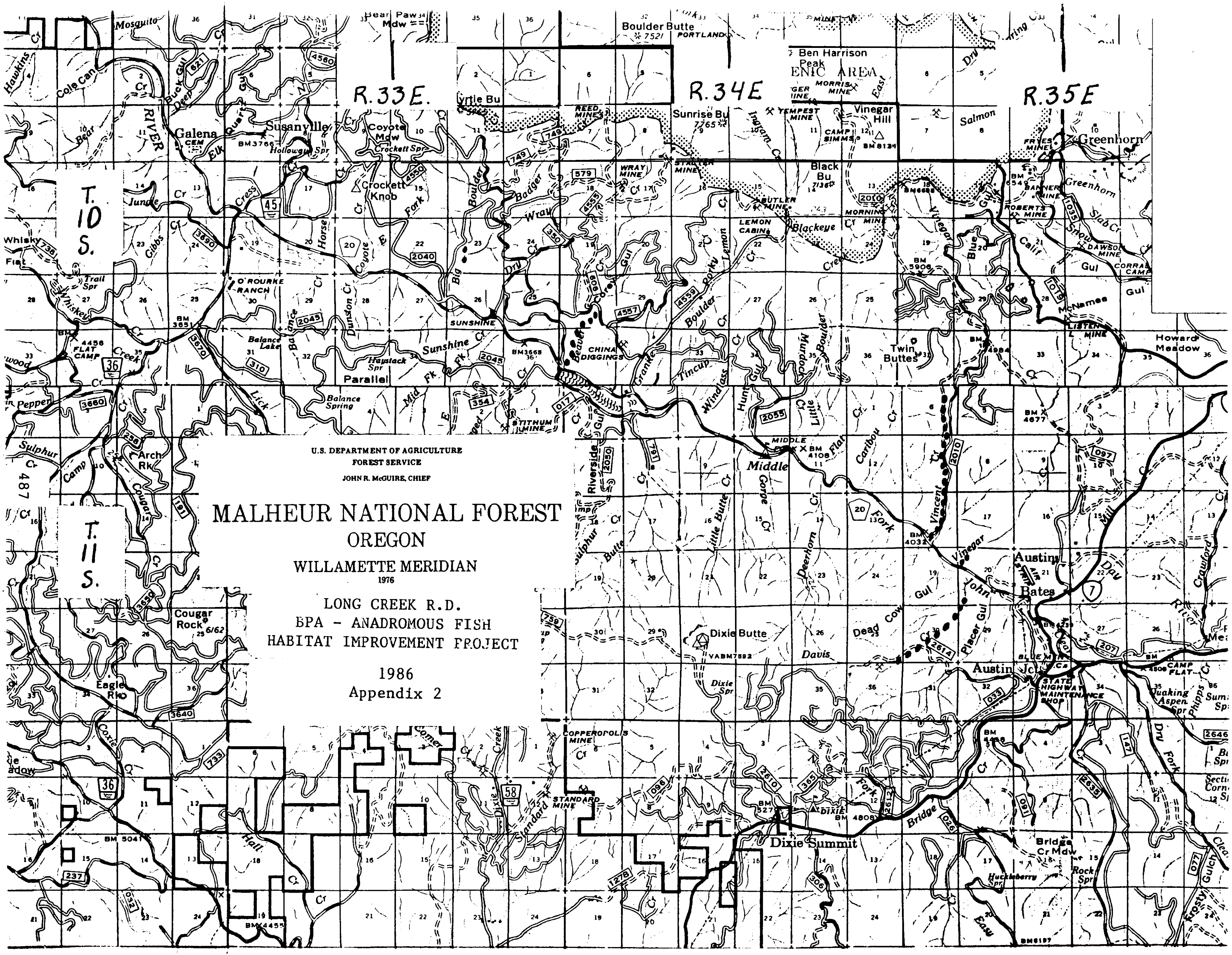
OUTPUT NAME	OUTPUT AMOUNT	L/A	UNITS	STRT YEAR	END YEAR	FUT YR UNIT RET
Benefits	82.00	L	Spwnrs	2	2	358.00
Benefits	109.00	L	Spwnrs	3	3	358.00
Benefits	136.00	A	Spwnrs	4	31	358.00

TOTAL ECONOMIC ACTIVITY BY YEAR

YEAR NO.	YEAR	COSTS	RETURNS	NET RETURNS	PRESENT VALUE COSTS	PRESENT. VALUE RETURNS	CONTRB TO PRES NET VALUE
1	1986	141000.00	.00	-141000.00	135576.94	.00	-135576.94
2	1987	5000.00	29356.00	24356.00	4622.78	27141.27	22518.49
3	1988	.00	39022.00	39022.00	.00	34690.40	34690.40
4	1989	5000.00	48688.00	43688.00	4274.02	41618.69	37344.67
5	1990	.00	48688.00	48688.00	.00	40017.99	40017.99
6	1991	.00	48688.00	48688.00	.00	38478.81	38478.81
7	1992	.00	48688.00	48688.00	.00	36998.84	36998.84
8	1993	.00	48688.00	48688.00	.00	35575.81	35575.81
9	1994	.00	48688.00	48688.00	.00	34207.51	34207.51
10	1995	.00	48688.00	48688.00	.00	32891.84	32891.84
II	1996	.00	48688.00	48688.00	.00	31626.75	31626.75
12	1997	.00	48688.00	48688.00	.00	30410.34	30410.34
13	1998	.00	48688.00	48688.00	.00	29240.72	29240.72
14	1999	.00	48688.00	48688.00	.00	28116.07	28116.07
15	2000	.00	48688.00	48688.00	.00	27034.66	27034.66
16	2001	.00	48688.00	48688.00	.00	25994.87	25994.87
17	2002	.00	48688.00	48688.00	.00	24995.07	24995.07
18	2003	.00	48688.00	48688.00	.00	24033.71	24033.71
19	2004	.00	48688.00	48688.00	.00	23109.33	23109.33
20	2005	.00	48688.00	48688.00	.00	22220.52	22220.52
21	2006	.00	48688.00	48688.00	.00	21365.89	21365.89
22	2007	.00	48688.00	48688.00	.00	20544.11	20544.11
23	2008	.00	48688.00	48688.00	.00	19753.95	19753.95
24	2009	.00	48688.00	48688.00	.00	18994.18	18994.18
25	2010	.00	48688.00	48688.00	.00	18263.64	18263.64
26	2011	.00	48688.00	48688.00	.00	17561.19	17561.19
27	2012	.00	48688.00	48688.00	.00	16885.75	16885.75
28	2013	.00	48688.00	48688.00	.00	16236.30	16236.30
29	2014	.00	48688.00	48688.00	.00	15611.83	15611.83
30	2015	.00	48688.00	48688.00	.00	15011.37	15011.37
31	2016	.00	48688.00	48688.00	.00	14434.00	14434.00

COST = 151000.00
RETURNS = 1431642.00
NET RETURNS = 1280642.00
PRESENT VALUE COSTS = 144473.75
PRESENT VALUE RETURNS = 783065.38
PRESENT NET VALUE = 638591.63

The lines for 'COST', 'RETURNS and 'NET RETURNS' are not discounted!


U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
JOHN R. McGUIRE, CHIEF
MALHEUR NATIONAL FOREST
OREGON
WILLAMETTE MERIDIAN
1976
LONG CREEK R.D.
BPA - ANADROMOUS FISH
HABITAT IMPROVEMENT PROJECT
1986
Appendix 2
R.33E.
R.34E
R.35E
T. 10 S.
T. 11 S.
Galena
Susanville
Greenhorn
Vinegar Hill
Austin
Bates
Austin Jc
Dixie Summit
Dixie Butte
Middle
Twin Buttes
Cougar Rock
Crockett Knob
Boulder Butte
Ben Harrison Peak
Sunrise Bu
Black Bu
Parallel
China Diggings
Howard Meadow

John Day River Fish Habitat Enhancement

Annual Progress Report

by

Amy Stuart, Project Leader

Mark Lacy, Project Assistant

Steve Williams, Northeast Region Program Leader

Oregon Department of Fish & Wildlife

P.O. Box 9

John Day, Oregon 97845

Funded by

Kathy Anderson

Bonneville Power Administration

Division of Fish and Wildlife

P.O. Box 3621

Portland, Oregon 97208

Contract No. DE-A179-84 B017460

Columbia River Basin Fish and Wildlife Program Measure Measure 704(d)(1)

December 1986

Table of Contents

Abstract 489

Introduction 490

Description of Project Area 494

Methods and Materials 494

Results and Discussion 501

Summary and Conclusions 503

References 504

Appendix 505

ABSTRACT

This project, initiated July 1, 1984, under Bonneville Power Administration (BPA) contract number DE A179-84 BP17460, provides initital landowner contacts agreement development, project design, budgeting, and implementation for an anadramous fish habitat improvement program on privately owned lands within the John Day Basin. The purpose of the project is to provide offsite mitigation for spring chinook and summer steelhead adult and juvenile losses from hydroelectric dams on the Columbia River. Implementation of the major segment of improvement work in 1986 occured after July 1. Activities under the first phase of the contract period (January 1, 1986 through June 30, 1986, state FY 86) included landowner contacts and agreement development, personnel training, equipment purchase, physical habitat inventory, planning and design, and construction contract development. Activities in the second phase (July 1, 1986 through December 31, 1986, state FY 87) included layout of contract work and contract implementation, physical habitat inventory and photopoints, construction of instream structures and riparian fence, budget development, annual report, and landowner contacts for 1987 work.

Because of the agreement and association between the Bonneville Power Administration (BPA), Grant Soil and Water Conservation District (GSWCD), the Soil Conservation Service (SCS) and the Oregon Department of Fish and Wildlife (ODFW), lease agreements were signed with 7 landowners on 8 properties in 1986.

Instream habitat improvement was completed on 4 miles of the mainstem John Day River and included construction of 3.5 miles of riparian exclosure fence. Approximately 2.8 miles of fence was completed on 1.7 miles of stream on 2 reaches of the mainstem where rock work was completed in 1985. Construction included completion of 5 miles of instream habitat improvement and 11.4 miles of barbwire exclosure fence on Fox Creek. A passage improvement project for steelhead was partially completed on an 8′ waterfall barrier on Deer Creek.

INTRODUCTION

The John Day River system (Figure 1) supports the largest remaining totally wild runs of spring chinook and summer steelhead in Northeast Oregon. The genetic component of these runs must be maintained to reserve the option for future rebuilding of runs in other Columbia tributary systems and for effective utilization of habitat in the John Day system.

ODFW personnel first surveyed the John Day system for spring chinook and summer steelhead in 1959. Few chinook redds were found. Gradually over the next 14 years, counts of redds in the basin increased and by 1974, there were 8.2 redds per mile. Since 1978, however, John Day chinook returns have declined (Table 1). Sport fishing for chinook salmon has been closed in the John Day basin since 1978.

During the 1960's and early 1970's, summer steelhead redd counts remained fairly stable (six-eight redds per mile) with a peak of 16 redds per mile in 1966 (Table 2). Index counts for steelhead then declined to a low of one redd per mile in 1979. Some improvement has occurred since then. Sport catch of steelhead varied in recent years and a reduced annual bag limit is currently in effect on the system.

A variety of man's activities have impacted salmon and steelhead habitat in the John Day system. Placer mining in the late 1800's left many streams with little or no shade, high silt load, and diverted flows. Later, dredging overturned the stream channels in the larger streams changing stream course, silting gravel, and destroying stream cover. In the more recent past, overgrazing, road building, logging, landowner clearing, increased water withdrawals, and channelization created further fish habitat problems by disturbing or destroying riparian vegetation and destabilizing streambanks and watersheds. The results are wide, shallow channels; low, warm summer flows: high, turbid spring flows; and decreased fish production. This situation is improving with proper management on many streams, but much remains to be done to return the John Day system to its once productive state. In addition to the in-basin problems, the Columbia River hydroelectric complex, particularly the John Day Dam, is taking its toll on wild smolts migrating from, and adults returning to, the John Day River system, further compounding in-basin *problems.

The purpose of the in-stream and riparian restoration work is to maintain wild gene pools and enhance production of smolts and adults to offset losses incurred at the dams. By mitigating for these losses, we hope to rebuild runs in the system to pre-dam numbers.

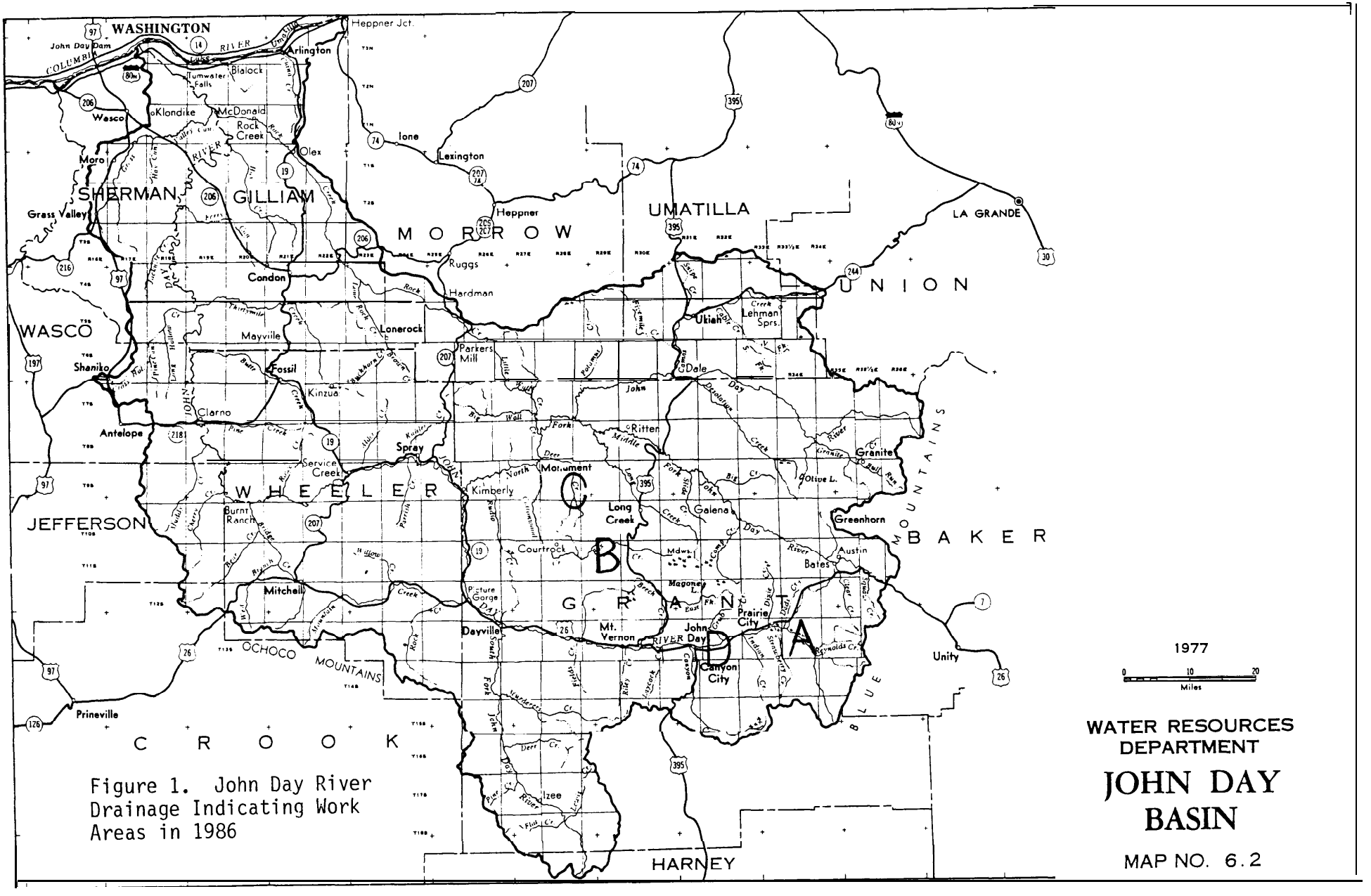


Figure 1. John Day River Drainage Indicating Work Areas in 1986

Table 1. *Twenty-Seven Year Summary of Chinook Salmon Spawning Density*

John Day District 1959 Through 1985

Year	Bull Run Creek	Clear Creek	Granite Creek	John Day River	Middle Fork John Day River	North Fork John Day River	Average
1959	*	4.3	6.0	0.3	0.0	*	2.6
1960	*	16.3	10.0	0.7	3.2	*	7.5
1961	*	3.3	5.3	3.0	1.1	*	3.2
1962	2.0	49.7	44.2	12.2	2.8	*	22.2
1963	7.0	29.2	26.4	0.8	0.4	*	12.7
1964	10.0	49.7	34.8	1.3	3.6	7.8	17.8
1965	7.5	16.7	24.4	5.8	3.7	8.1	11.0
1966	0.3	43.5	31.0	9.3	6.5	10.3	16.8
1967	6.0	38.5	19.4	7.4	1.7	5.5	13.0
1968	6.4	60.5	50.2	0.7	0.4	8.8	14.4
1969	15.6	13.7	16.8	9.3	4.8	20.5	13.3
1970	26.4	18.7	33.6	8.3	7.6	16.8	14.1
1971	11.6	18.8	31.2	7.0	4.1	11.8	11.5
1972	24.4	39.5	43.5	3.9**	5.1	10.5	14.2
1973	7.2	27.0	36.0	8.9	4.3	19.4	15.7
1974	7.6	8.0	25.5	2.5	8.1	7.2	8.2
1975	18.8	11.5	24.7	7.1	8.9	11.7	11.7
1976	9.2	7.0	20.2	4.6	6.6	6.2	7.5
1977	11.6	12.8	23.1	4.9	5.8	16.4	11.1
19.78	12.4	6.3	19.8	4.5	10.7	5.9	8.3
1979	6.4	7.0	15.6	5.2	11.8	11.1	9.7
1980	1.2	7.0	8.5	1.2	5.8	4.3	4.3
1981	2.8	11.3	10.6	3.9	2.6	7.7	6.1
1982	5.2	10.8	12.0	3.8	6.2	5.5	6.4
1983	0.8	1.0	7.3	10.2	5.1	4.2	5.8
1984	3.2	2.0	5.8	5.6	6.7	3.5	4.4
1985	6.4	8.2	15.1	8.9	4.0	6.1	7.5
1986	2.4	11.5	20.2	12.2	6.3	14.3	5.9

*No survey.

**Count low due to rain and increased river flows which delayed survey and caused poor counting conditions.

Table 2. *Steelhead Spawning Ground Summary*

Twenty-Eight Year Periods

Year	Number of Streams Surveyed	Miles Surveyed	Steelhead	Redds	Per Mile
1959	6	14.5	30	108	7.4
1960	10	22.0	60	194	8.8
1961	8	24.5	56	166	6.8
1962	10	26.5	56	184	6.9
1963	11	30.5	47	216	7.1
1964	13	43.5	51	266	6.1
1965	19	45.0	88	344	7.6
1966	23	69.0	141	1,103	16.0
1967	25	78.0	61	905	11.6
1968*	23	74.5	19	358	4.8
1969	27	91.5	76	806	8.9
1970	21	65.0	58	530	8.1
1971	8	22.5	18	181	8.0
1972	16	53.5	41	409	7.6
1973	25	76.4	22	402	5.3
1974**	14	38.0	4	167	4.4
1975**	14	34.0	21	302	8.9
1976	21	59.8	8	308	5.2
1977	30	75.5	69	535	7.1
1978	35	102.7	21	438	4.3
1979	29	78.7	4	81	1.0
1980	34	90.1	11	305	3.4
1981	33	86.1	12	319	3.7
1982	32	71.8	34	301	4.2
1983	31	89.3	39	438	4.9
1984	29	76.7	33	299	3.9
1985	39	120.3	88	1,016	8.5
1986	42	117.6	127	1,286	10.9
Totals and Averages	560	1,580.5	1,154	10,653	6.8

*Nineteen hundred and sixty eight was low water with an absence of spring runoff. Irrigation took entire stream flows on several tributaries causing steelhead spawning escapement to be nil1 in some areas. The poor count is reflected in redd/mile figure for that season.

**Counts low due to high water in spring which smoothed out early redds and caused poor counting conditions.

Funds provided to ODFW by the BPA contract number DE A179-84 BP17460 are for landowner contacts and agreements, physical habitat inventory, planning and design work, contract development, budgeting, in-stream habitat work, riparian enhancement, and post construction review and maintenance for anadramous fish habitat improvement on private lands within the John Day Basin. The program will compliment ongoing BPA habitat programs on Forest Service and BLM lands in the basin.

DESCRIPTION OF PROJECT AREA

The John Day drainage contains 8,010 square miles in east central Oregon and is the third largest drainage in the state (Figure 1). The basin includes a major part of Gilliam, Grant, and Wheeler Counties and portions of Crook, Harney, Jefferson, Morrow, Sherman, Umatilla, Union, and Wasco Counties.

The mainstem John Day River flows 284 miles from its source in the Strawberry Mountains into the Columbia River just above the John Day Dam. The largest tributary, the North Fork, enters the John Day at Kimberly (RM 184) and extends 112 miles to its headwaters in the Elkhorn Mountains at elevations near 7,500 feet. The Middle Fork John Day River originates just south of the headwaters of the North Fork and flows roughly parallel to it for 75 miles until they merge at RM 31 of the North Fork. The South Fork originates from Snow Mountain, elevation 7,163 feet, and drains the south side of the Aldrich Mountains.

Salmon and steelhead runs in the John Day River consist entirely of wild stocks. Spring chinook salmon spawn in the mainstem John Day River above Indian Creek (Figure 2), in the North Fork above Dale including Granite Creek and its tributaries Clear and Bull Run Creeks, and in the Middle Fork above Mosquito Creek. Summer steelhead utilize virtually all accessible tributaries in the basin (Lindsey, et al. 1981) (Figure 3). Summer steelhead spawn and rear in the South Fork up to RM 28 at South Fork Falls, an impassable barrier.

Specific areas included in the project during FY 1986 are: a) the mainstem John Day River above the town of Prairie City, RM 260-274 and b) Fox Creek, RM 3-12, c) Deer Creek Falls at RM 8, and d) repair work on the mainstem John Day, RM 247-250 (Figure 1).

METHODS AND MATERIALS

Work continued with the assistance of the GSWCD and SCS on landowner contacts and 15 year lease agreements, planning and designing habitat treatments, procuring equipment and materials, hiring seasonal personnel, budgeting, and contract development and administration.

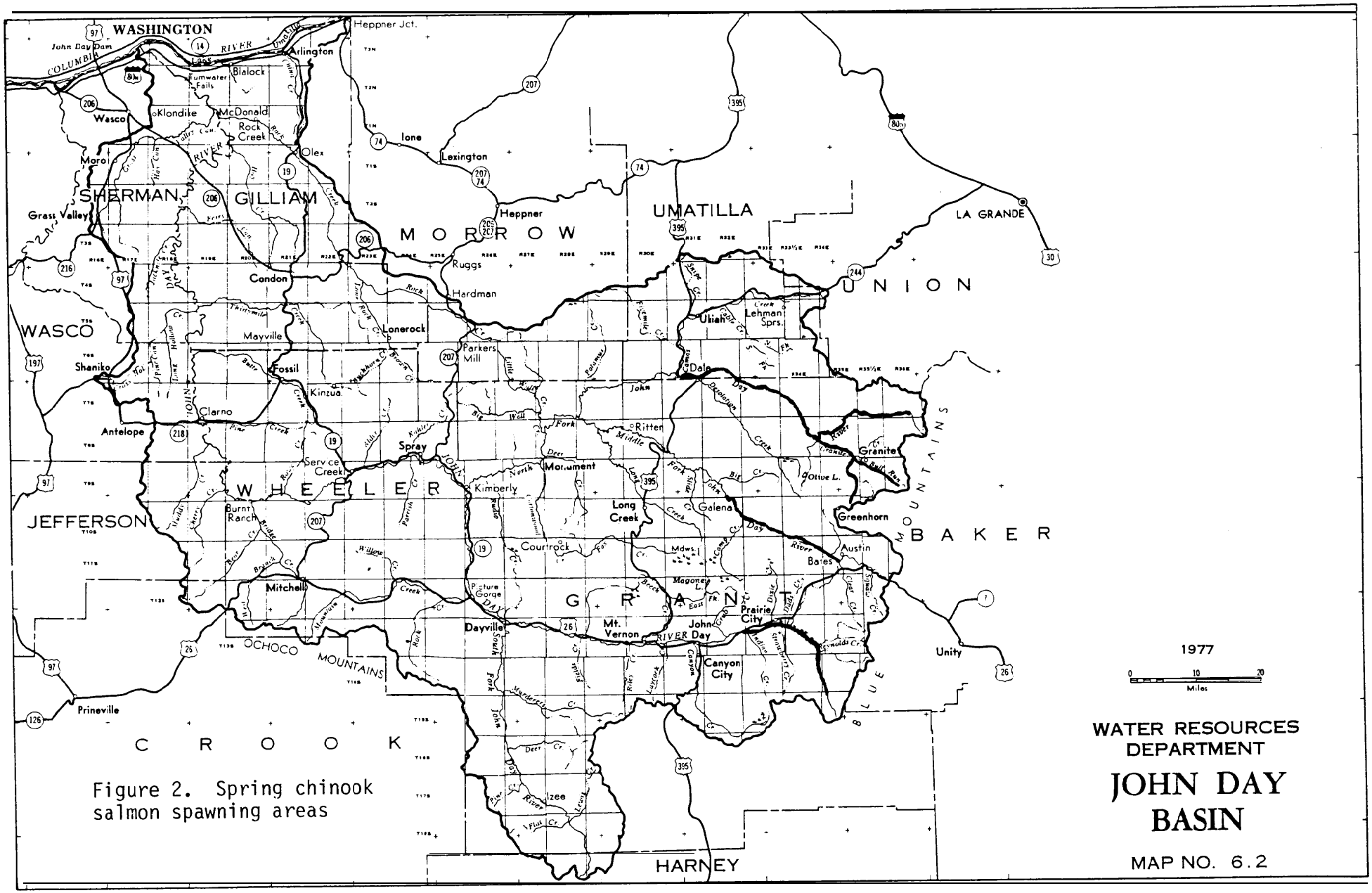


Figure 2. Spring chinook salmon spawning areas

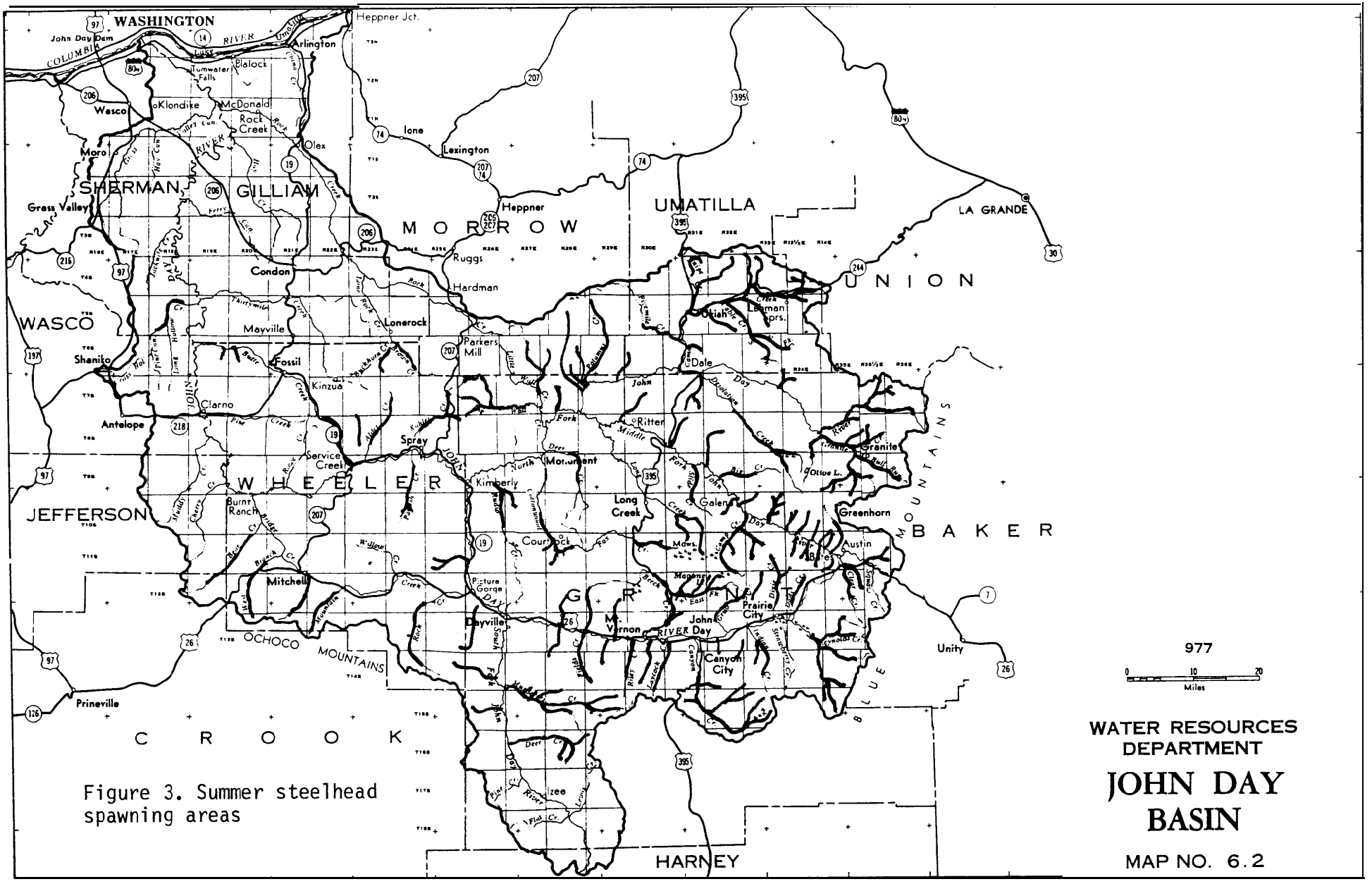


Figure 3. Summer steelhead spawning areas

Baseline physical stream measurements were taken on FY 87 properties and included stream width, depth, cover area, length of bank vegetative cover, and pool/riffle ratio following Platts, et. al. 1983 for comparison to post treatment conditions. Stream width and depth were measured on transects located at 50 pace (150 feet) intervals, using wetted width, with estimates for undercut banks and maximum depth. Cover area, bank vegetation, and pool/riffle ratio were quantified for all reaches. Cover criteria included any submerged or overhanging material providing in-stream cover in an area of water where velocities would allow a fingerling fish to hold. Woody vegetative cover providing shade to any portion of stream was measured in lineal feet. Pool area was determined to be an area of stream with reduced velocities allowing a fingerling fish to hold and including at least one half of the stream width.

Stream reaches planned for work in FY 87 were surveyed to identify areas of poor instream habitat and riparian cover, and subsequently determine quantities and types of instream structures and riparian fencing. Engineering support personnel from GSWCD made measurements to determine bank stabilization needs and locations for weirs, jetties, riprap, and check dams. Measurements included length of bank, average bank height, and stream gradient, and were subsequently used to calculate quantity of rock and juniper riprap required for construction, and estimate contract costs.

Jetties, rock riprap, and juniper riprap were implemented to stabilize actively eroding banks and reduce stream channel erosion, as well as provide more “edge effect” for rearing juvenile salmonids. Weirs and boulders were placed instream to provide more pool area, particularly for rearing juveniles. Check dams and livestock crossings were located to raise the water table and promote riparian vegetation as well as provide pool for rearing juveniles. Spring developments were constructed to provide additional watering sites for cattle as well as attract cattle away from the riparian area. Fencing was constructed to exclude cattle and allow full recovery of the riparian area (see Appendix A for photographs and Appendix B for technical specifications on instream structures and fencing).

Quantities were determined for fencing, number of jetties, boulders, weirs, length of riprap, check dams, spring developments, livestock watergaps, and crossings. Maps and technical specifications were developed for specific stream reaches. Rock sources meeting minimum weight and size gradation specifications were located by GSWCD personnel. This information was submitted to the ODFW engineering section for contract review, advertisement, and award. Pre-bid tours were conducted for prospective contractors by personnel from the John Day ODFW office, contracts were opened for bidding, and construction began in late June.

Following surveys that identified sites needing instream work, jetty, boulder, weir, and riprap locations were staked. The contractor excavated these locations, and rock and juniper was placed and shaped under the supervision of ODFW or GSWCD personnel.

Mainstem John Day River

Based on information from stream habitat surveys and the John Day spring chinook research study, limiting factors on the mainstem river include holding pools for spring chinook adults, and rearing for juvenile chinook and steelhead. Present rearing conditions are less than optimum for juveniles due to low pool:riffle ratios, little instream cover, limited riparian vegetation, shading, and instream diversity, and high summer stream temperatures. In addition, unstable, eroded banks add to sedimentation problems, reducing egg and juvenile survival, and reducing chance of vegetative recovery.

Jetties, rock riprap, and juniper riprap were implemented to stabilize actively eroding banks and reduce stream channel erosion, as well as provide more “edge effect” for rearing juvenile salmonids. Jetties develop scour holes off the tip, providng cover and edge effect. Sediment accumulates on the downstream side and allows regrowth of vegetation. Riprap stabilizes severely eroded banks from continued erosion. Large rock at the toe of the riprap blanket increases channel roughness and edge effect.

Weirs were placed instream to provide more pool area, particularly for rearing juveniles. Plunge pools below weirs provide excellent fish habitat and downstream gravel at the tailout of the pool may provide spawning beds for adults. Rock weirs were excavated and constructed with riprap grade rock and boulder sills placed to produce a central concentration of water flow. Associated adult holding pools were excavated downstream of the weir boulder sills to a depth of 7 feet.

Boulders were placed instream to develop scour holes and small rearing pools for resting cover for fish, increase edge effect, deflect flow away from eroded banks, and increase channel roughness. They were individually placed in the stream by the contractor under the direct supervision of John Day ODFW or GSWCD personnel. Boulders were located in clusters or singly, in the thalweg of the channel or against banks to provide maximum fish benefits.

Downed logs and root wads with sound wood found along the bank were used to provide additional instream cover, habitat diversity, and nutrient cycling. Woody debris was placed using contract equipment rental time, and later cabled into the bank with 1/4 inch steel cable by ODFW personnel.

Fox Creek

Fox Creek provides spawning and rearing for summer steelhead and resident trout. Based on stream habitat surveys and discussions with the ODFW district biologist (Errol Claire, personal communication), present conditions on private lands are less than optimum for fish. Riparian cover is almost non-existent and unstable banks exist along major segments. High summer temperatures and sedimentation are major problems within the stream reach.

Check dams and livestock crossings were constructed to raise the water table to enhance riparian vegetation, increase pool area for juvenile rearing, and control erosion by decrease in stream slope and velocity. Check dams were located at shallow, narrow sites to provide maximum hydraulic effect and minimize rock volumes. Check dam sites were excavated and riprap grade rock was placed and shaped to provide an increase in upstream water depth of no greater than 18 inches to ensure passage for juveniles. Livestock crossings were constructed to provide multiple benefits of livestock watering and crossing in combination with stream corridor fencing. These were constructed similarly to 2 check dams parallel with each other, with additional rock riprap, a riprap "apron" below each rock structure and a let-down fence built to gate specifications to discourage cattle passage into the riparian area.

Spring developments were constructed to provide alternate watering sites for cattle with their exclusion from traditional watering sites and to attract cattle away from the riparian zones. They were constructed similar to SCS technical specifications to develop approximately one gallon per minute outflow with perforated pipe laid in gravel trenches to intercept spring flow, a collection box, and a series of troughs to water livestock. Spring areas and collection boxes were fenced to protect the development from livestock damage or trampling.

A major portion of the juniper riprap constructed in 1986 was installed on a reach of Fox Creek to substantially reduce stream channel erosion, and protect the riparian fence from potentially being undercut before riparian vegetation had a chance to re-establish itself. Juniper riprap provides multiple benefits of bank protection, cover for juvenile salmonids, and increased nutrient cycling. Additionally, juniper riprap limbs trap sediment, aiding in bank stabilization bank and riparian enhancement. Trees were placed in a shingled, overlapping pattern from downstream and working upstream and secured with number 9 smooth wire and steel posts sunk flush with the ground.

Fence

Riparian corridor fencing was constructed on all mainstem river and Fox Creek properties to restrict or eliminate livestock grazing and allow vegetation to rebuild along streambanks. Riparian recovery will provide benefits to salmonids from increased shading and reduced summer stream temperatures, increased woody debris for cover, improved nutrient cycling, and increased bank storage of water.

Livestock watergap, gate, and fence locations were staked and located with the participation of landowners to assist meeting the needs of normal ranch operations and assure longterm cooperation with the program. Watergaps were constructed to furnish water to livestock, and fenced to keep cattle outside the riparian area. Watergap locations were excavated to a depth below the streambed and then partially filled with a small grade of animal access rock where livestock water, and with a facing of rock riprap along the stream for protection from high water. A railroad tie double H-brace and set post jack, steel post, wood stay, 4 strand barbwire riparian exclosure fence was constructed on all Mainstem River and Fox Creek properties.

The Fox Creek contractor has not completed all fencing and spring development projects and has been granted an extension for project completion to June 30, 1987 by ODFW.

Riparian grass seed mix was planted by GSWCD personnel along the streambank on areas disturbed by heavy equipment and construction activities. SCS personnel recommended a mixture of 6 grass species, and application rates. The mix included hard fescue (Festuca ovina duriuscula) and pubescent wheatgrass (Agropyron trichophorum) both sod-forming species that develop a good root stucture; ladak alfalfa (Medicago falcata ladak), white dutch clover (Trifolium repens), and sweet clover (Melilotus officinalis), nitrogen-fixing species that provide rapid establishment of good cover and high quality wildlife food: and tall wheatgrass (Agropyron elongatum), which produces large amounts of foliage and cover for surface stabilization, good nesting cover for birds, and fawning cover for deer.

Deer Creek Falls

Deer Creek has considerable potential for steelhead spawning and rearing habitat that has been largely unavailable to anadramous species due to a partially impassable waterfalls. Passage improvement was partially constructed over the 8 foot waterfall barrier. Four out of a total of five cement weirs were completed to create a series of jump pools to improve passage for summer steelhead. An estimated 10 miles of spawning and rearing habitat will become available with completion of the project. This work will compliment a riparian pasture system enclosed with electric fence designed to improve riparian vegetation.

RESULTS AND DISCUSSION

Field Activities

With the assistance of the GSWCD, 15 year lease agreements were made with 3 additional landowners, and addendums with 3 landowners from 1985 projects to continue habitat improvement work on additional areas (Table 3). Instream and fencing habitat work was cooperated with by 3 landowners on 4 properties on the Mainstem John Day River and with 3 landowners on 4 properties on Fox Creek in FY 87. A 25 year easement was also obtained for construction of the passage project on Deer Creek. This project will compliment habitat work constructed in 1985 of a 13 mile electric riparian pasture fence enclosing approximately 6 miles of Deer Creek.

Habitat improvement work was completed on 4 reaches of the mainstem John Day River for a total of approximately 4.25 stream miles (Table 3). On these 4 reaches, 27 jetties, 10 weirs and their associated holding pools, 563 boulders, 170 feet of juniper riprap, 189 feet of rock riprap, 13 watergaps, and several pieces of woody debris were installed for fish habitat and bank stabilization purposes. Approximately 3.5 miles of riparian fence were completed on these properties. In addition, 1.7 miles of riparian fence were constructed on 2 properties where rock work was completed in 1985.

Habitat improvement work was completed on 3 reaches of Fox Creek for a total of approximately 5 stream miles (Table 3). Instream structures completed include 12 check dams, 13 livestock watergaps, 7 livestock crossings, and 800 feet of juniper riprap. Approximately 11.4 miles of riparian fence was completed to exclude cattle from the riparian area. In addition, 3 spring developments were partially completed.

The construction of the Deer Creek Falls passage improvement project for steelhead was partially completed in FY 87 (Table 3). Completion of the project will be incorporated into FY 88 construction projects.

Administrative

Monthly and annual progress reports for the John Day Basin habitat improvement project were submitted to BPA during 1986. The John Day program hired 1 seasonal technician from June to September 1986 to assist with physical inventory transects, contract oversite, and construction and repair of miscellaneous sections of fence not included under contract work.

Interagency Coordination/Education

Considerable time was spent giving presentations, touring or meeting with other resource organizations. A slide presentation was given to Wallowa-Whitman National Forest on types of habitat projects conducted with BPA funds in the John Day Basin. The annual slide presentation was given in March to update habitat project activities to BPA staff.

Table 3
Work Completed for the John Day Basin in 1986
Private Lands Habitat Improvement Project

Landowner	Stream Length	Habitat Improvement a/										
		Fence	Boulder	Jetty	Weir	Rock Riprap b/	Juniper Riprap b/	Livestock Crossing	Check Dam	Spring Develop c/	Water Gap	Passage Project d/
MAINSTEM												
Coombs Upper	0.6	0.7	97	3	3	57	**	**	**	**	2	RR
Coombs Island	0.6	0.4	94	8	2	50	110	**	**	**	**	**
Stephansky	2.0	1.7	68	5	3	82	**	**	**	**	11	**
Field	1.0	0.6	303	11	2	**	60	**	**	**	**	**
Coombs-Depoe Park	0.4	0.4	**	**	**	**	**	**	**	**	**	**
Emmel	1.2	2.4	**	**	**	**	**	**	**	**	**	**
Total	5.8	6.2	562	27	10	189	170	0	0	0	13	**
FOX CREEK												
Johns	5.0	8.6	**	**	**	**	**	6	7	3	10	**
McGirr, B	0.7	1.4	**	**	**	**	**	1	2	**	1	**
McGirr, L	0.7	1.4	**	**	**	**	**	**	3	**	2	**
Total	6.4	11.4	*	**	**	*	**	7	12	3	13	**
DEER CREEK												
Bentley Ranch	**	**	**	**	**	**	**	**	**	**	**	1
Grand Total	12.2	17.6	562	27	10	189	170	7	12	3	26	1

a/ available woody debris installed with cable by ODFW personnel
b/ riprap in lineal feet
c/ fencing and spring developments at Fox have contract extension to June 30, 1987 for completion from ODFW Engineering Section
d/ passage project will be completed in 1987

Consultation and review was provided to personnel of Malheur National Forest on instream construction project on tributaries of the middle Fork John Day River.

A four county Oregon Association of Conservation Districts meeting was attended in John Day. A tour was provided of fish habitat and bank stabilization structures, and fencing methods to agency, conservation district, and ranching members of the meeting.

Monthly Grant Soil and Water Conservation District meetings were attended to participate in local issues and keep board members infomed of the progress of the BPA habitat project.

A joint tour of Malheur and Umatilla National Forests, and John Day basin private lands BPA habitat programs for BPA and Confederated Tribes of the Umatilla Indian Reservation staff was attended. Information was presented at the tour on types and benefits of fencing and instream structures implemented on private lands in the John Day basin.

A demonstration tour was given to ODFW Northeast Region staff during active construction on instream rock work. A tour was given by ODFW staff in Enterprise to John Day personnel of habitat projects installed on the Joseph Creek drainage.

SUMMARY AND CONCLUSIONS

Activities under the first half of 1986 included landowner contacts and lease agreements, personnel hiring and training, physical habitat inventory, procurement to of equipment and materials, planning and design of stream treatments, and contract development. Fifteen year lease agreements were obtained with 3 landowners and addendums with 3 landowners from 1985 construction projects to do habitat work on additional properties in 1986. Activities during the second half of 1986 were contract layout and administration, physical habitat inventory, transects and photopoints, construction of instream habitat and bank stabilization structures and riparian fencing, 1987-88 budget development, annual report, and landowner contacts for the 1987 construction season. Contacts have been made with 8 prospective landowner cooperators for habitat in 1987 and 1988.

REFERENCES

Gibbons, D.R., W.R. Meehan, M.D. Bryant, M.L. Murphy, and S.T.Elliot. 1986. Fish in the Forest: Large woody debris in streams, a new management approach to fish habitat. U.S.D.A. Forest Service, Alaska Region. 22pp.

Lindsay, R.B., B.J. Smith, and E.A. Olsen. 1981. Spring Chinook Studies in the John Day River. Federal Aid Progress Report-Fisheries. Oregon Department of Fish and Wildlife, Corvallis. 48pp.

Oregon Department of Fish and Wildlife, unpublished report. 1985. Draft Report, John Day River Basin: Spring Chinook Production Plan. Portland, Oregon. 22pp.

Oregon Department of Fish and Wildlife, unpublished report. 1985. Draft Report, John Day River Basin: Summer Steelhead Production Plan. Portland, Oregon. 18pp.

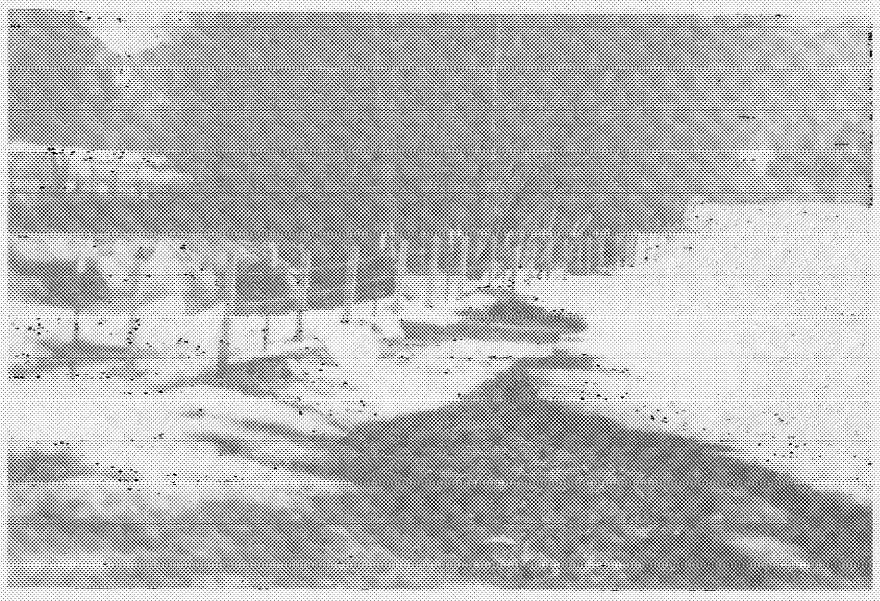
Platts, W.S., and R.L. Nelson. 1985. Impacts of rest rotation grazing on streambanks in forested watersheds in Idaho. North American Journal of Fisheries Management 5:547-556.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods of evaluating stream, riparian and biotic conditions. Ogden, Utah: U.S.D.A. Forest Service, Intermountain Region. Gen. Tech. Rep. INT-138. 7Opp.

U.S. Department of Agriculture. 1979. Restoration of Fish Habitat in Relocated Streams. Federal Highway Administration. FHWA-lP-70-3. 63pp.

U.S. Department of Agriculture. 1984. North Fork of the John Day River Sub-basin Anadramous Fish Habitat Improvement, Umatilla National Forest. 31pp.

Appendix A - Photographs

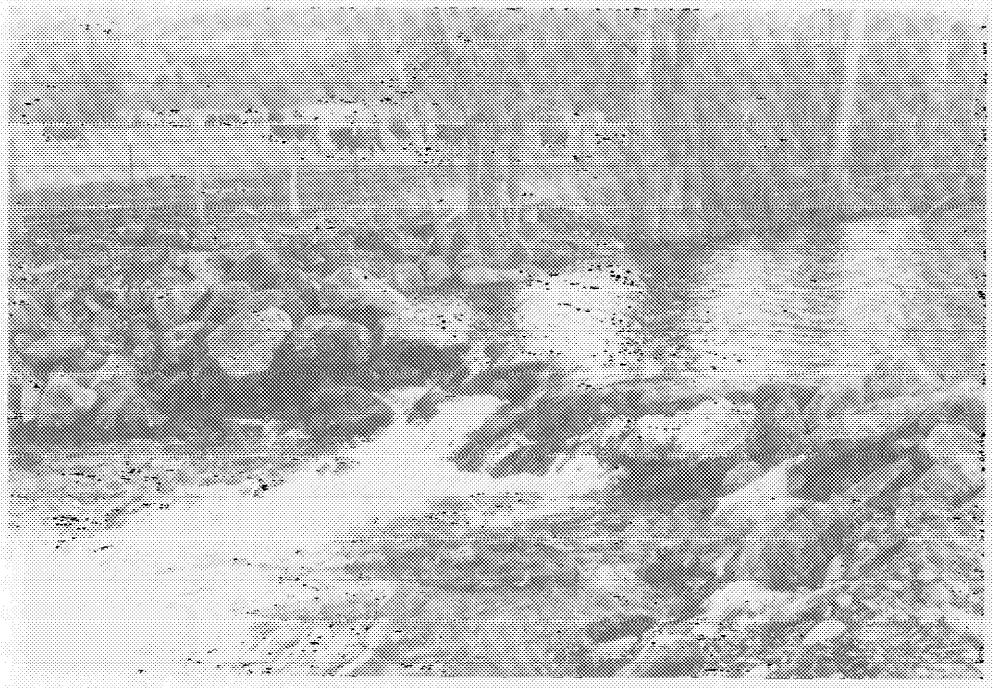


Mainstem John Day River - 4 strand barbwire riparian exclosure fence

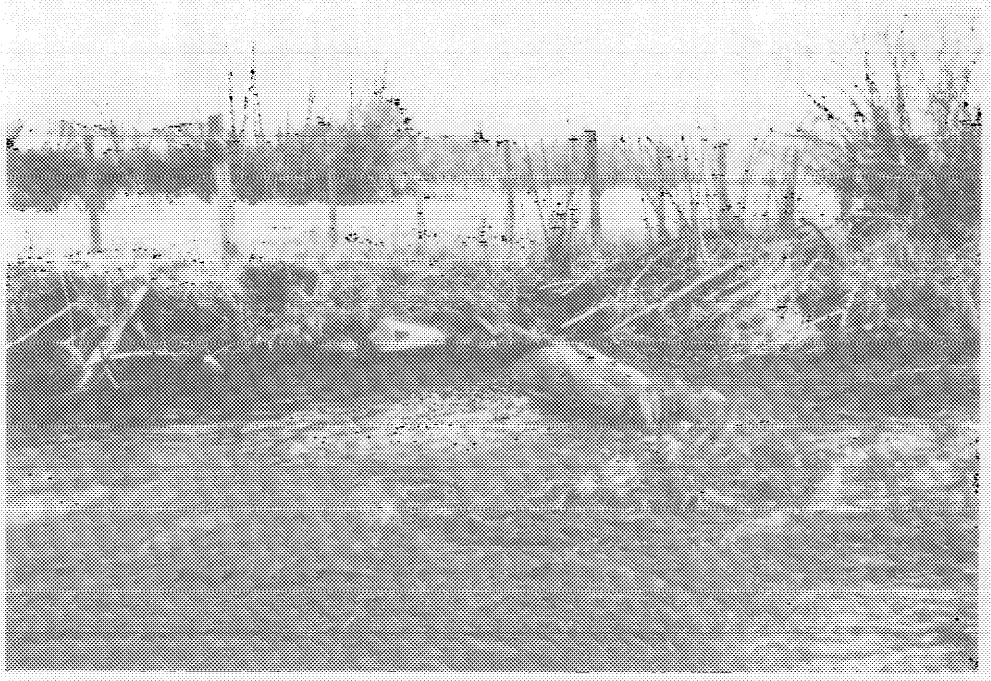
Mainstem John Day River - cul-de-sac watering gap for livestock access to water

Mainstem John Day River - Upstream view of 2 weirs with adult holding pools

Mainstem John Day River - juniper riprap with exclosure riparian fence to protect eroded bank

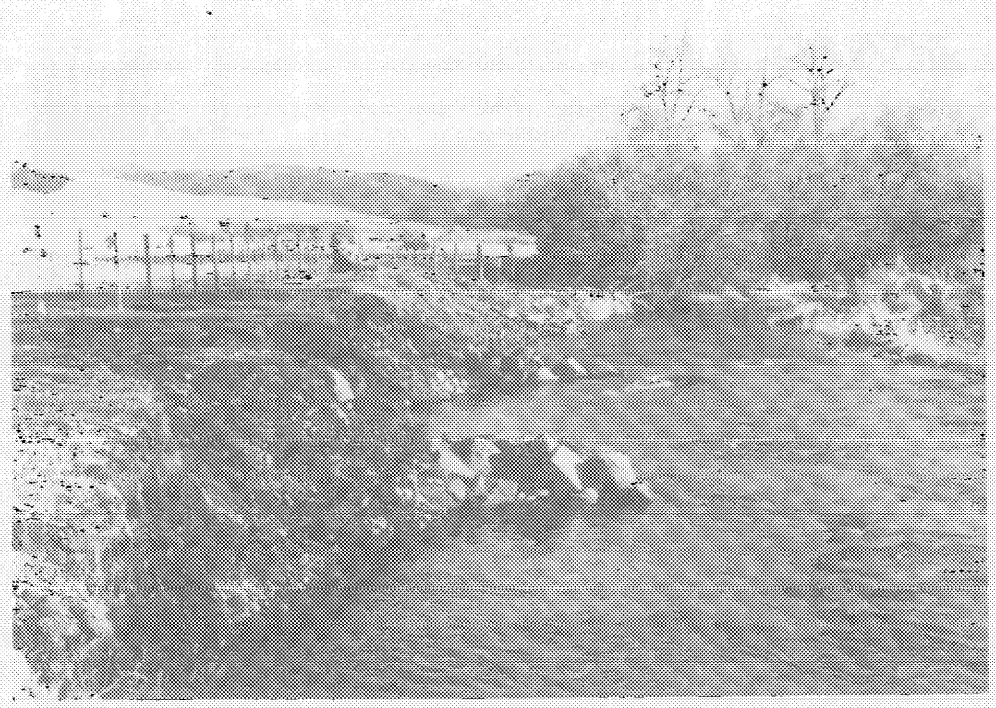


Mainstem John Day River - Upstream view of rock weir
Note central flow of water

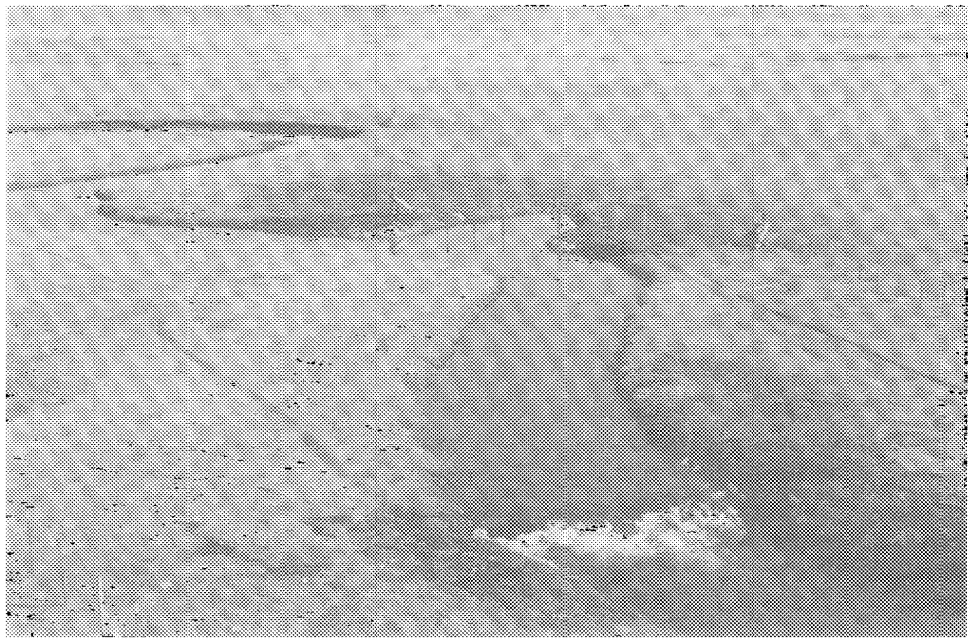


Mainstem John Day River - Boulder placements in cluster against bank, and single boulder in thalweg of river

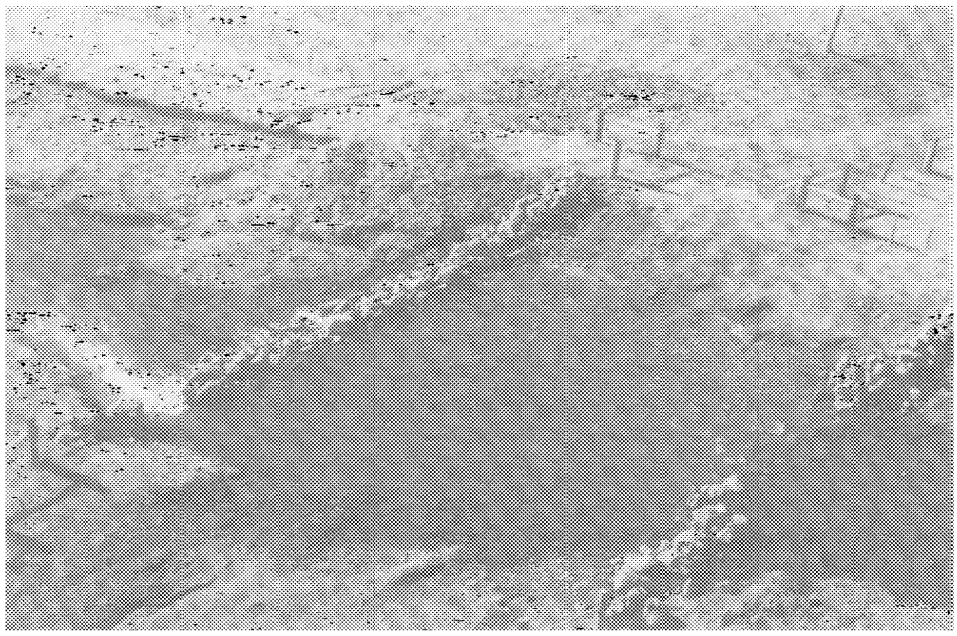
Mainstem John Day River - Rock riprap blanket on sharp river corner. Note: large boulders along toe of riprap for edge effect



Mainstem John Day River - series of rock jetties on severely eroded bank with riparian exclosure fence in the background



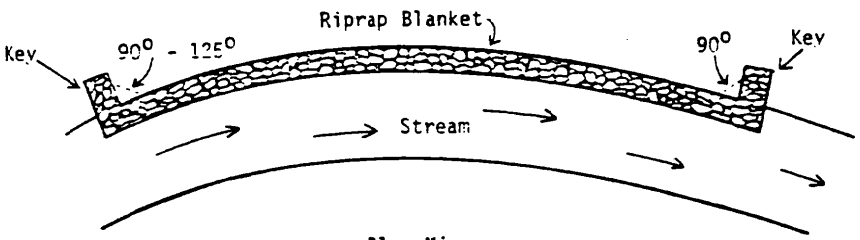
Fox Creek - aerial view of check dam and cul-de-sac watering gap



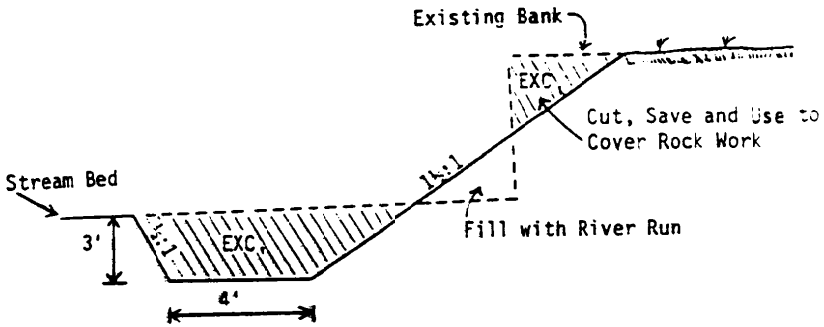
Fox Creek - aerial view of livestock crossing

Appendix B - Technical Specifications

RIPRAP BLANKET TYPICALS

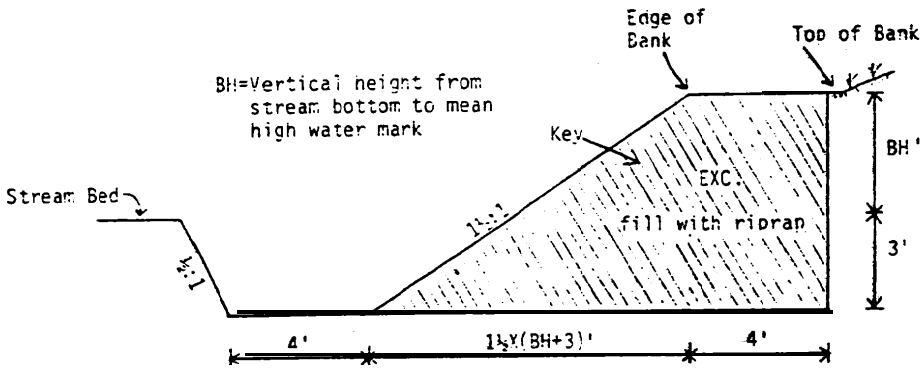


Plan View

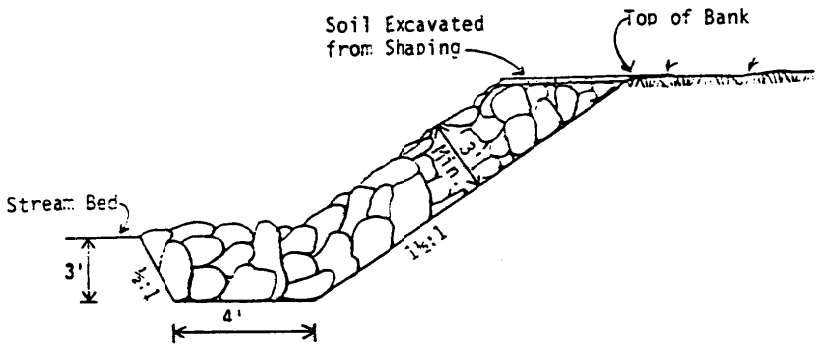


Shaping

Bank and Toe Trench Excavation



Key



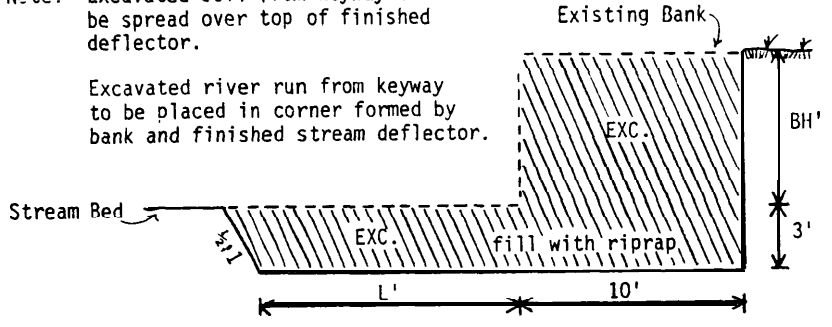
Riprap Blanket

NOT DRAWN TO SCALE

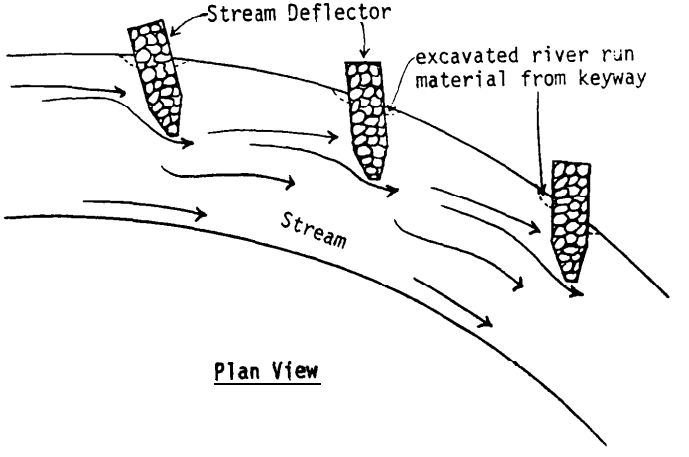
STREAM DEFLECTOR TYPICALS

Note: Excavated soil from keyway to be spread over top of finished deflector.

Excavated river run from keyway to be placed in corner formed by bank and finished stream deflector.



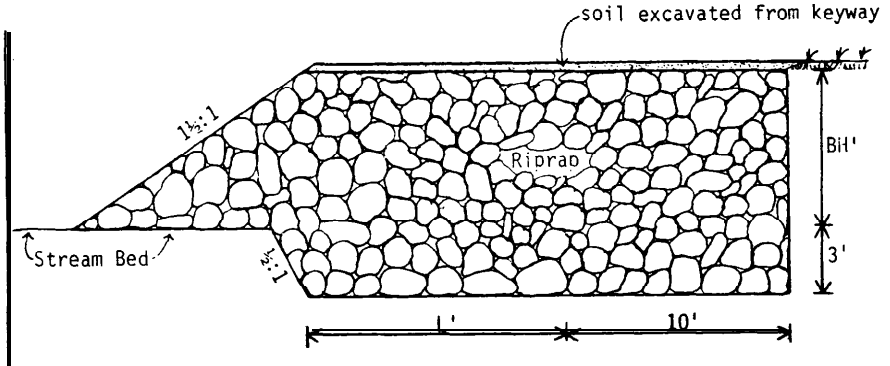
Keyway Excavation



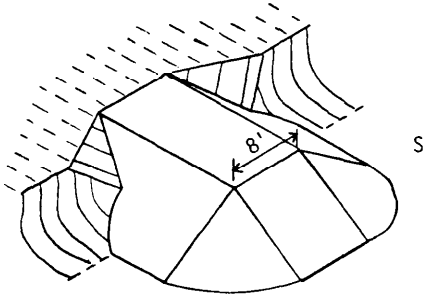
Plan View

BH=Vertical height from stream bottom to mean high water mark

L =Deflector length to be determined by COR to achieve the desired hydraulic effect.



Riprap Stream Deflector & Keyway

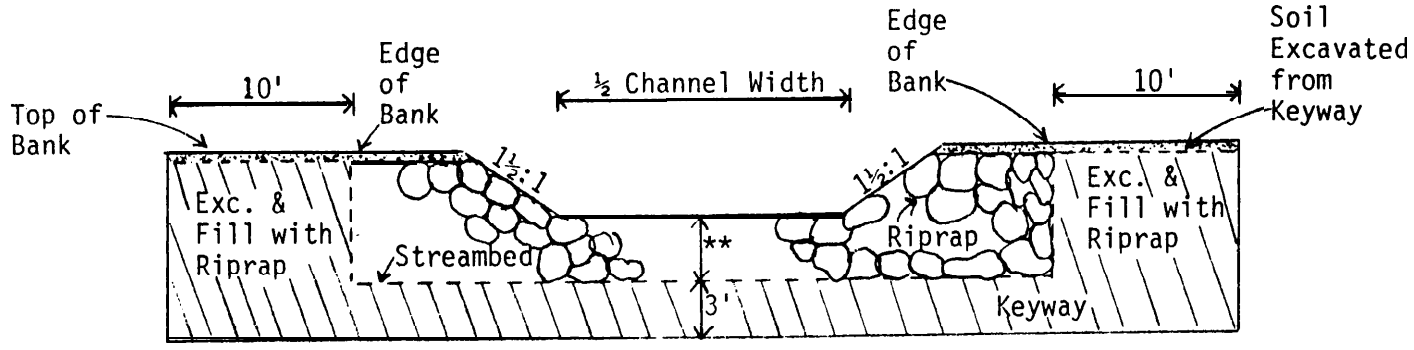


Slopes = 1½:1

Isometric View

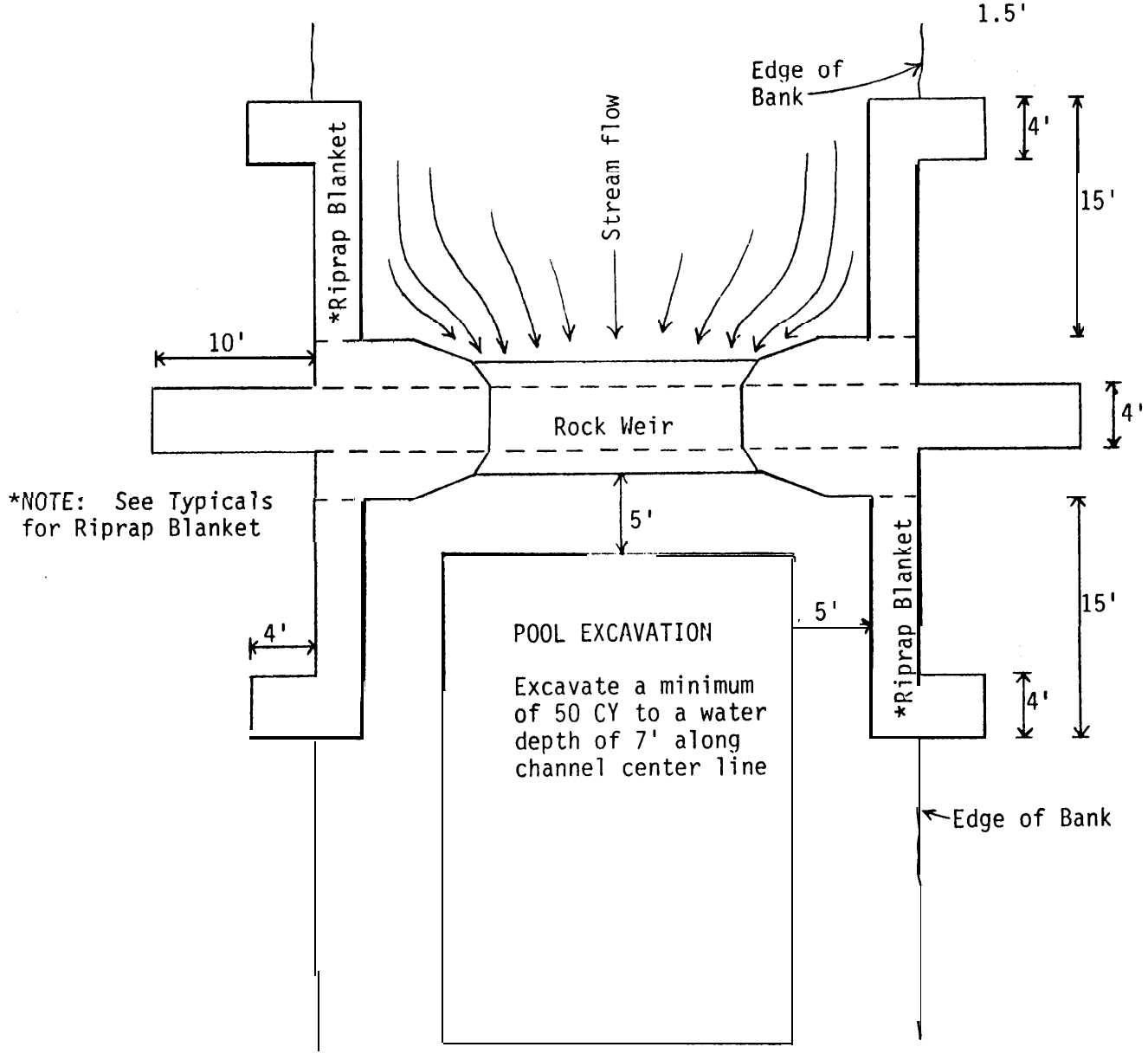
NOT DRAWN TO SCALE

ROCK WEIR TYPICALS



X-Section View
Rock Weir

**Weir Height = Stream depth + a minimum of 1.5'

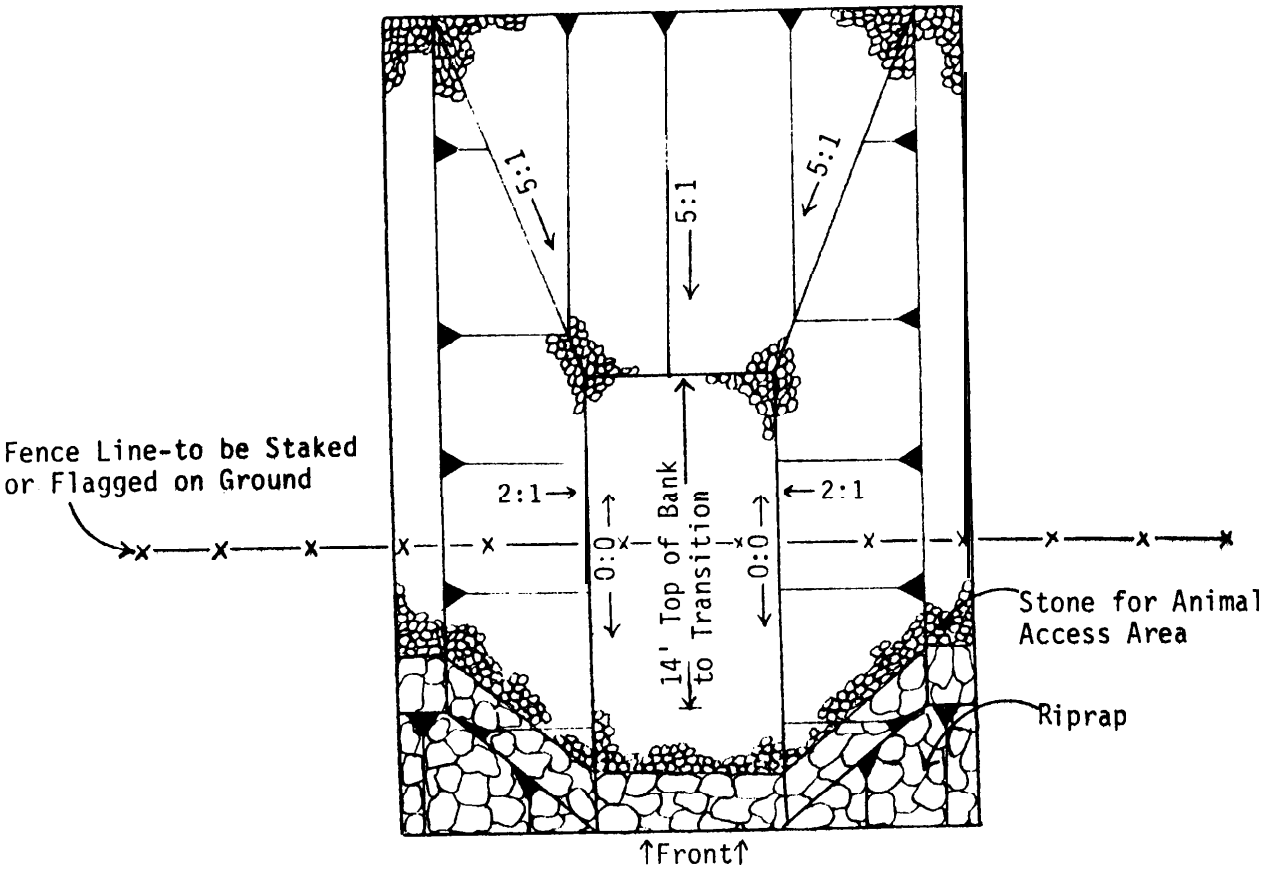


*NOTE: See Typicals for Riprap Blanket

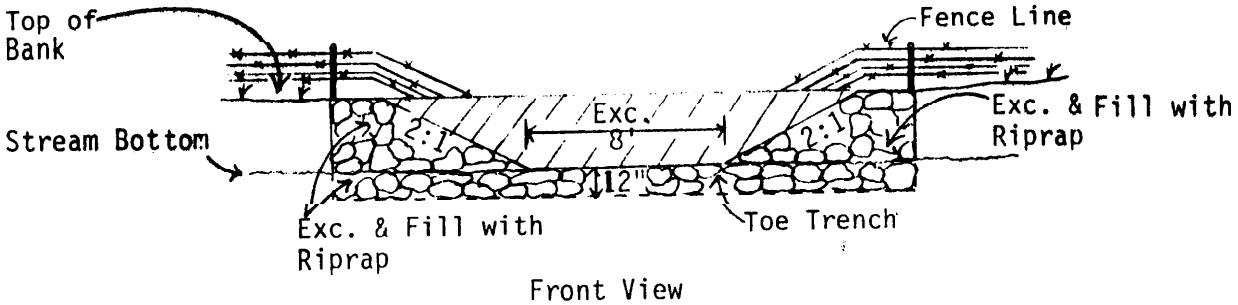
Plan View

NOT DRAWN TO SCALE

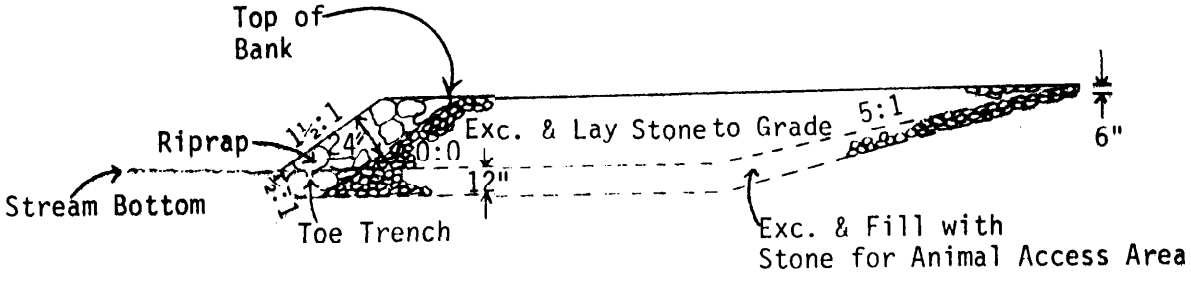
WATER GAP TYPICALS



Plan View



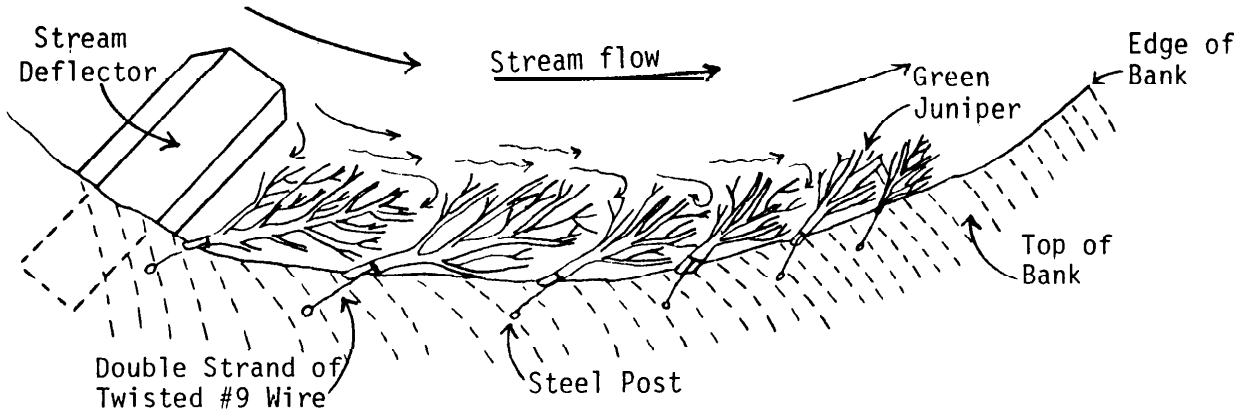
Front View

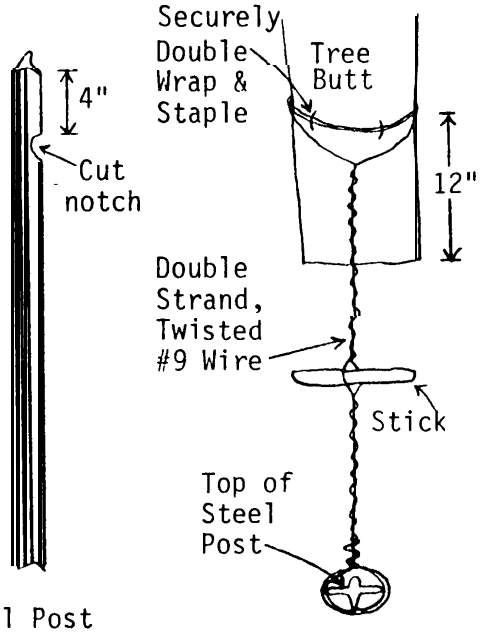


Side View

NOT DRAWN TO SCALE

JUNIPER RIPRAP TYPICAL





Steel Post

3' Min. Length
1.33 lb./ft.

Wiring

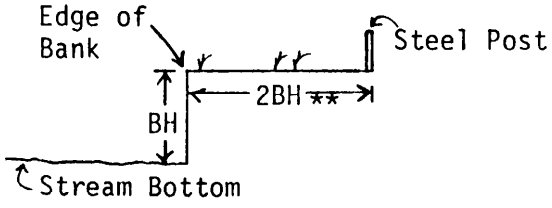
NOTES

1. **Place juniper trees in a shingled, overlapping pattern, tightly packed, beginning downstream. Use green, full limbed trees.**
   Min. Size: Butt Dia. 6", Length *
   Max. Size: Butt Dia.18", Length *

2. **Double wrap and staple #9 smooth wire around butt end of tree and double wrap opposite end of #9 wire around steel post in cut notch. Twist #9 wire until tree is tight against bank.**

3. **Drive steel posts a min. of 2BH back from edge of bank in undisturbed soil. Drive flush with ground. Place notch away from stream.**

4. **Location of juniper riprap shall be staked or flagged.**

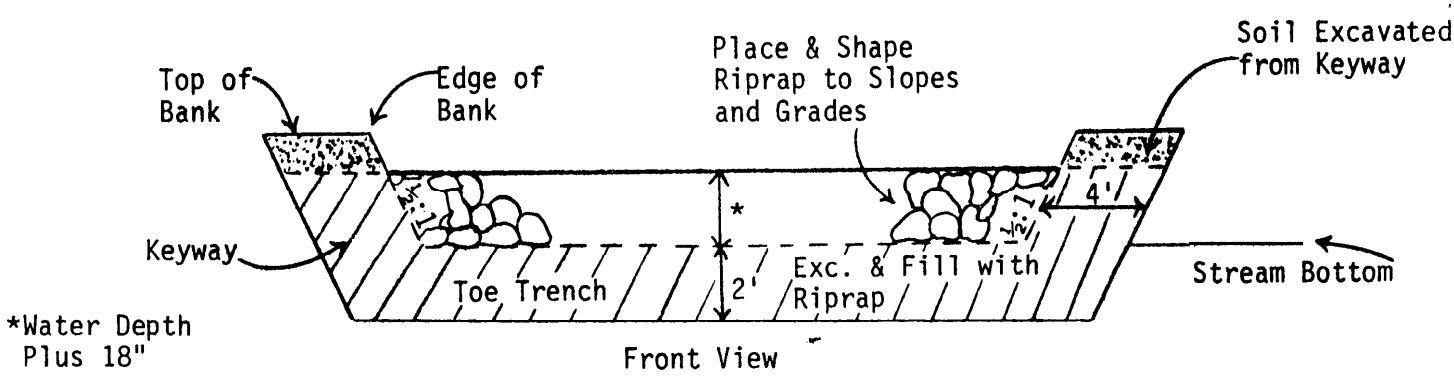


***TREE LENGTH shall be adequate to allow 1' - 3' of the butt end to rest on the bank while deflecting stream current 6' - 8' away from the bank.**

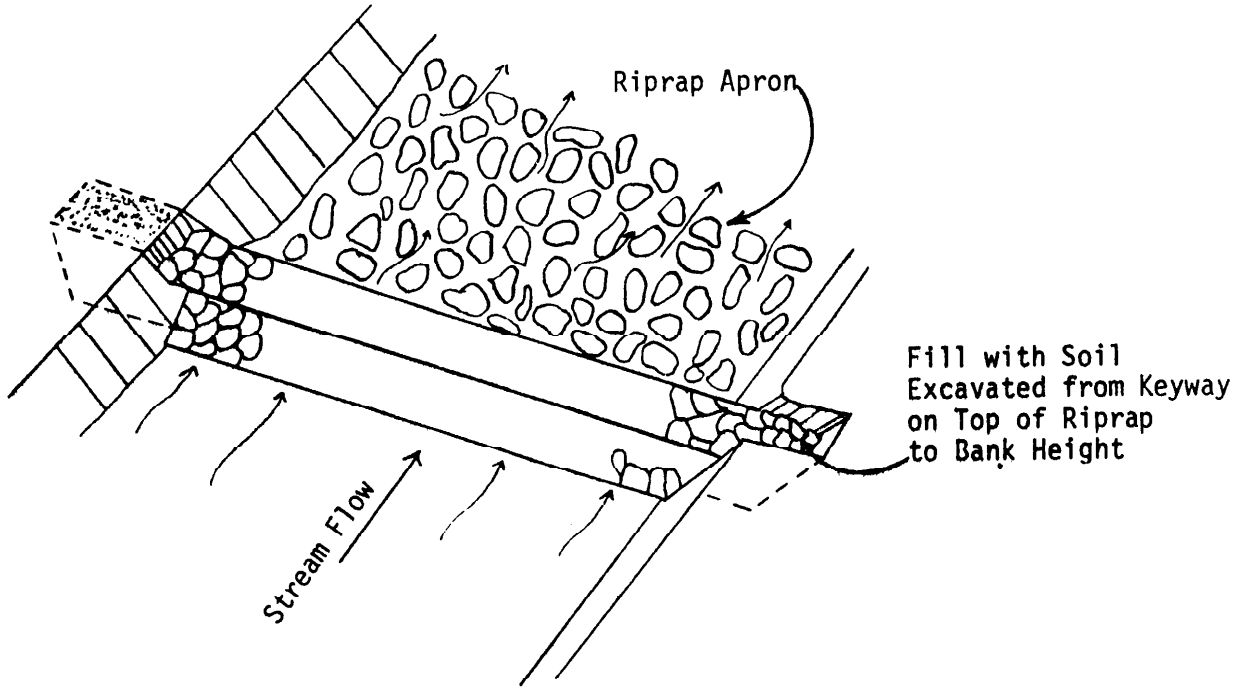
****Not to exceed 16'**

NOT DRAWN TO SCALE

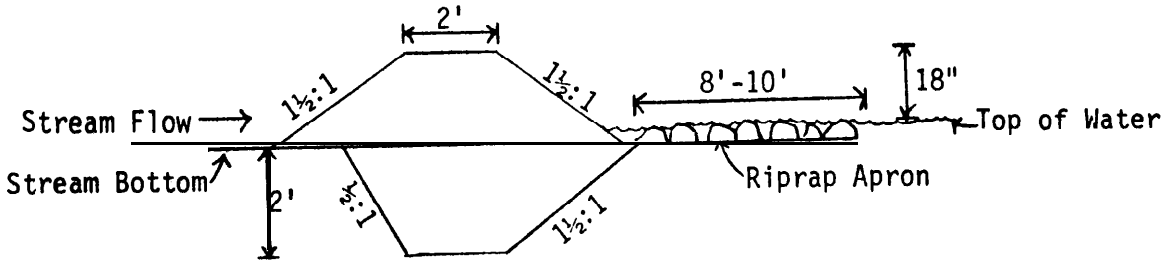
CHECK DAM TYPICALS



Front View



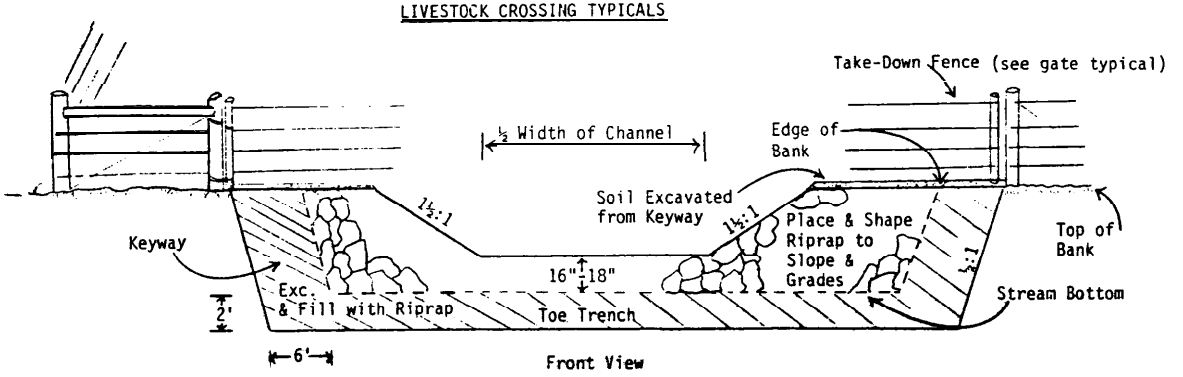
Isometric View



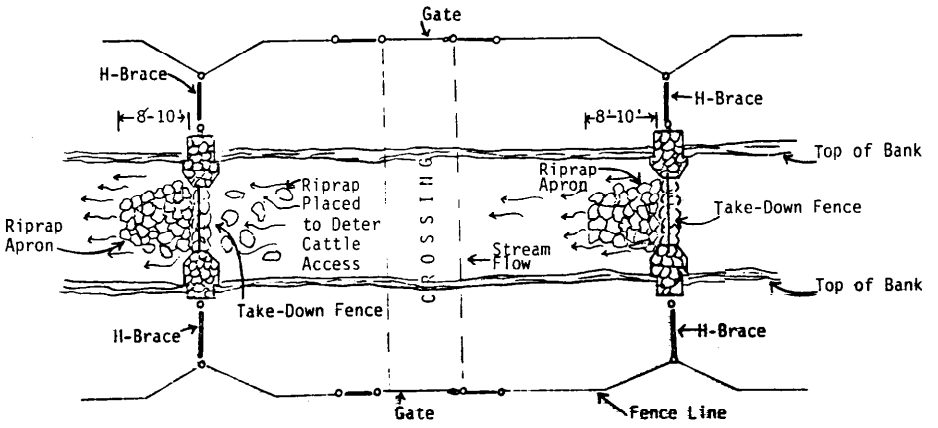
Side View

NOT DRAWN TO SCALE

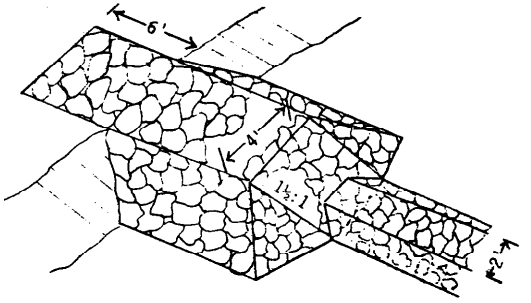
LIVESTOCK CROSSING TYPICALS



Front View

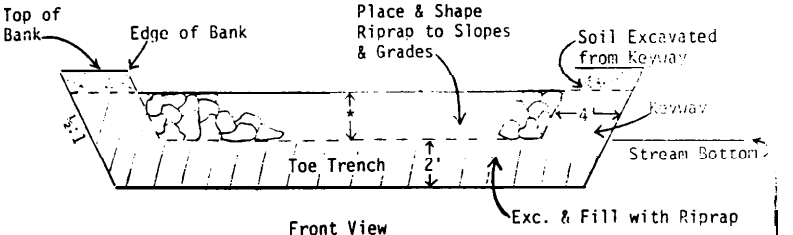


Plan View



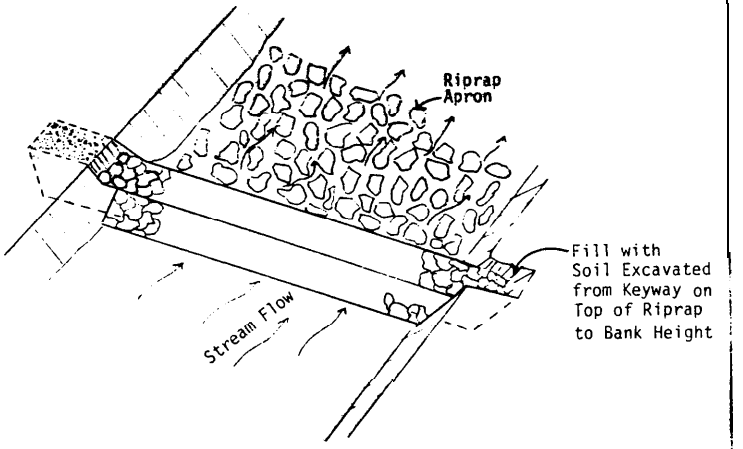
Isometric View

CHECK DAM TYPICALS

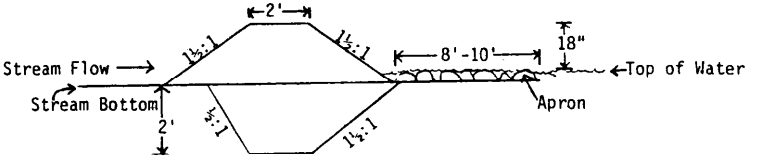


Front View

*Water Depth Plus 18"



Isometric View

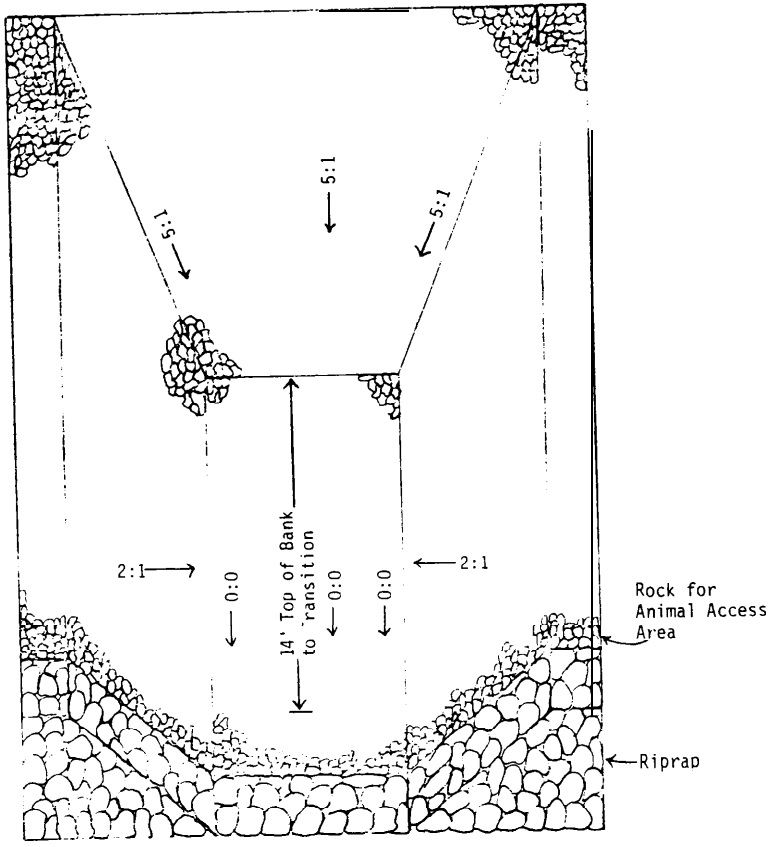


Side View

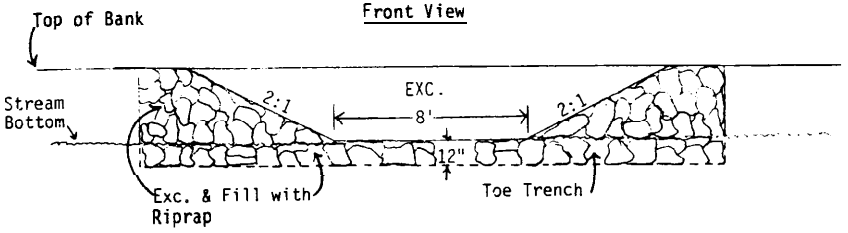
NOT DRAWN TO SCALE

WATER GAP TYPICALS

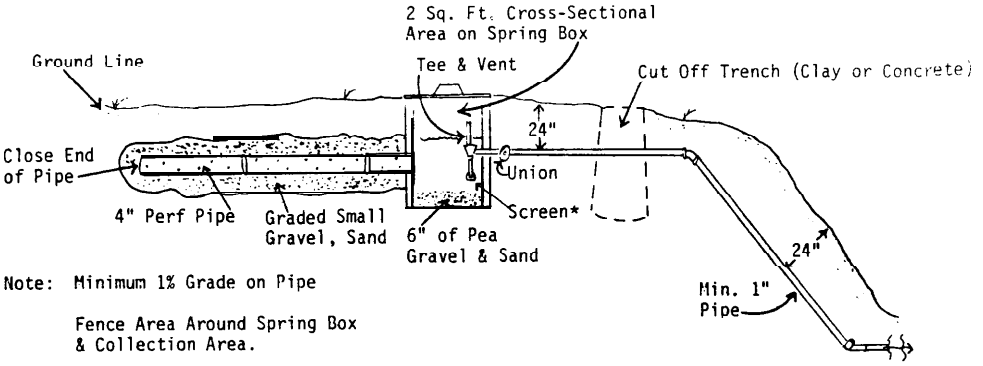
Plan View



Front View



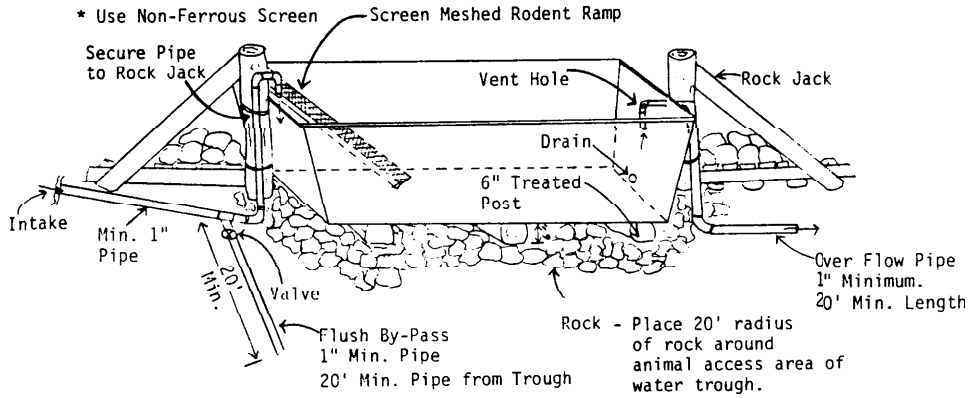
SPRING DEVELOPMENT TYPICALS



Note: Minimum 1% Grade on Pipe

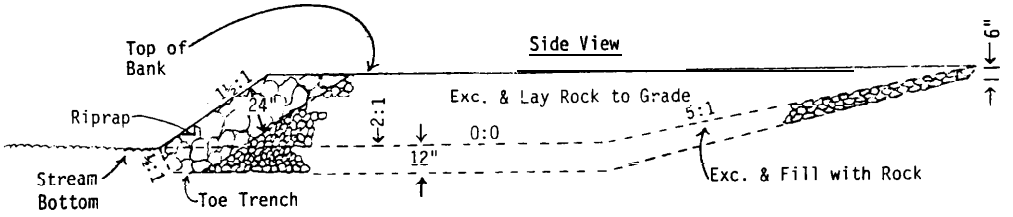
Fence Area Around Spring Box & Collection Area.

* Use Non-Ferrous Screen



NOT DRAWN TO SCALE

Side View



NOT DRAWN TO SCALE

North Fork John Day River Habitat Improvement

Annual Report

Prepared by

Brent D. Frazier, Interim Project Leader

and

Earl Fishburn,
Project Coordinator
and Robin Metz

Umatilla National Forest
2517 S. W. Hailey Avenue
Pendleton, Oregon 97801

Funded by

Kathy Anderson, Project Manager

Bonneville Power Administration

Divison of Fish and Wildlife

Contract No. DE-A179-84BP16725

Project Number 84-8

January 1987

Table of Contents

Tables 522

Sub-Project I - North Fork John Day River Side Channels 524

Sub-Project II - North Fork John Day Tributaries 528

Subproject IIa - Desolation Creek 528

Subproject IIb - Lower North Fork John Day Tributaries 531

Wilson Creek 531

Little Wall Creek 534

Subproject IIc - Fivemile Creek System 537

Subproject IId - Camas Creek System 538

North Hidaway Creek 538

Project Monitoring 540

Project Costs 540

References 541

Appendices 542

A Project Location Maps 542

B Smolt Productin and Cost Derivation Procedure 549

C Photographs 566

D Stream Survey Summaries 576

List of Tables

Summary of the North Fork John Day River Side Channel Project to Date . 527

Increase in Smolt Production, North Fork Side Channels 527

Summary of Desolation Creek Project to Date 530

Increase in Smolt Production in Desolation Creek 530

Summary of the Wilson Creek Project to Date 533

Increase in Smolt Production in Wilson Creek 534

Summary of the Little Wall Creek Project to Date 536

Increase in Smolt Production in Little Wall Creek 536

Summary of the North Hidaway Creek Project to Date 539

Increase in Smolt Production in North Hidaway Creek 539

Project Costs, April 1, 1986 to March 31, 1987 540

ABSTRACT

In 1986, the Umatilla National Forest constructed fish habitat improvement3 on the North Fork of the John Day River and aide channels, Desolation Creek, Wilson Creek, Little Wall Creek, and North Hidaway Creek.

Work in the North Fork John Day River and side channel3 consisted of opening 1 new side channel, constructing 46 side channel and 9 mainstem rock weirs, constructing 52 rock deflectors to direct flow in side channel3 and control bank erosion, planting 672 cuttings, and placing 160 large boulders and 26 logs in side channels and in the main river to provide instream cover.

Work on Desolation Creek created an estimated 5,500 square meters of quality rearing pool habitat by constructing 72 rock and 7 log weirs and 7 rock and log deflectors in 0.8 miles of the stream. Four of the pools that were created are of the size and depth for adult chinook resting or holding pool. In addition, 0.6 miles of side channels were constructed and 191 boulders and 40 logs were placed in the stream and 38 hardwood cuttings were planted.

in Wilson Creek during 1986, we constructed 103 rock weirs, sills and berms, and 9 log weirs for a total of 111 major pool creating structures for juvenile rearing. Fish passage was improved by some stream channel construction. We also placed 183 boulders, 18 logs, and 53 root wads, constructed 24 deflectors, enhanced 14 natural rock weirs by rearranging rocks and digging deeper pools; planted 192 hardwoods and 4 sedge clumps to establish a sedge seed source.

In Little Wall Creek during 1986, 1 rock weir, 22 log weirs, and one rock sill were constructed; and 5 root wads, one log deflector and 2 rock deflectors were placed. Some stream channel reconstruction was also completed. The project was funded cooperatively, with approximatly one-half BPA funds and one-half Forest KV funds.

The Forest constructed 20 pool-creating log and rock weirs, placing woody material in each, and placed 20 boulders and logs in North Hidaway Creek. Some stream channel reconstruction was completed. The project was funded cooperatively, approximately one-half BPA funds and one-half Forest KV funds.

Stream surveys were completed by contract for over 65 miles of streams, including the project area of the North Fork John Day River and side channels, Wilson Creek, Little Wall Creek, North Hidaway Creek, Clear Creek, and the Fivemile Creek system. Forest personnel surveyed the 1985 and 1986 project reaches of Desolation Creek.

INTRODUCTION

The commercial and recreational values of Oregon's anadromous salmon and steelhead fisheries are well known. The John Day River and its tributaries are important areas for natural anadromous salmonid reproduction . The North Fork John Day River is a major contributor to this production.

The project area is located in northern Grant County on the North Fork John Day Ranger District) Umatilla National Forest in T.6S., R.32E., and T.6 & 7S., R.33E. (see vicinity nap, Appendix A).

The 1984 estimate of spring chinook salmon (Oncorhynchus tshawytscha) production for the 14 miles of mainstem of the North Fork John Day River on the Umatilla National Forest outside of the North Fork John Day Wilderness was 108,000 smolt annually . There is an estimated potential of producing 190,500 smolt annually if habitat conditions are brought to optimum levels.

Beginning in 1939 and ending in 1950, gold dredging activities changed the natural course and hydrology of the North Fork John Day River. High flow channels were created which dried up during annual low flow periods and trapped and killed spring chinook parr or presmolt annually, resulting in an estimated loss to the system of 26,000 pre-smolt spring chinook salmon.

Fourteen miles of the North Fork John Day River offer the opportunity to significantly increase smolt production at relatively low cost. Twenty-six of thirty-two aide channels trapped rearing chinook parr or pre-smolt annually. During August 1971, the Oregon Department of Fish and Wildlife (ODFW) in cooperation with the U.S. Forest Service increased the juvenile spring chinook rearing area by pushing dredge tailings into the river, This forced a portion of the streamflow down several secondary channels that were left dry by the dredging. From 1979-1986, the Umatilla National Forest rebuilt these two side channels and reopened 25 additional side channels from river mile 63 to river mile 76. The Forest also constructed numerous structures in the river and side channels to increase juvenile spring chinook rearing habitat.

The work has been cooperative involving the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and ODFW in the planning stages. The Louisiana-Pacific Corporation made a source of boulders available for the project, and in 1986 a local mining claimant provided insight into the construction of an unplanned side channel on one of his mining claims. The Bonneville Power Administration has provided major financing since 1963 through the Northwest Power Act. The USFS has been responsible for the planning and administration of the project.

The overall project goal hasbeen to increase the production of spring chinook salmon by meeting the following objectives:

1. Decrease the hazard of juvenile salmon being trapped in the side channels during low flow periods. This has been accomplished by constructing structures at the channel entrances to provide a year-round streamflow through the channels.

2. Increase juvenile salmon rearing habitat in the mainstem river and side channels. Constructed pools below weirs and boulder placements are contributing to meeting this objective.

3. Improve bank stabilization. Rock deflectors and riprap were used to control erosion from unstable banks.

4. Increase adult salmon resting areas. The constructed pools below the main-stem sills are being used by adult salmon for resting prior to spawning.

5. Restore riparian vegetation. Shrub cuttings and the placement of entire shrubs are being used to establish riparian vegetation along the barren dredge tailings.

Due to the use of streams by steelhead and spring chinook salmon, the only period available for instream work is July 15 to August 31. Remaining work on the project consists of additional weir construction, boulder placement, bank stabilization, shrub establishment and fertilization, and maintenance in approximately the lower five mile stretch of the project area.

PROJECT DESCRIPTION

Project activities consisted of preparing and administering a contract to: (1) haul boulders and riprap from the rock pit to the construction sites on the river, (2) reopen side channels to the North Fork John Day River, (3) construct flow control deflectors at the entrances, (4) place boulders, woody material, rock weirs, and rock deflectors in the side channels and in the main liver, and (5) plant hardwood cuttings to restore riparian vegetation along the barren dredge piles.

The contractor began work on June 27, 1986, and construction was completed on August 29, 1986. Boulders and riprap were hauled from a pit at the lower end of the project and stockpiled at the construction sites.

An excavator was used to load the trucks that hauled the boulders and riprap and to place 160 boulders and 26 logs in several side channels and in the North Fork John Day River between river miles 63 and 76 (Table 1). The excavator was used to dig a key and rearing pool and place the boulder in the key. The boulders provide physical cover for rearing juvenile salmon and also as create turbulence and pools which provide additional cover. Many natural and previously placed boulders in the river were repositioned to increase their effectiveness. The logs, some with root wads attached, were placed in the larger excavated pools and either held down with large boulders or cabled in place. A crawler-loader backhoe was used to pack boulders and riprap at several sites.

One new side channel was excavated to grade and a flow control structure constructed at the entrance to divert between 20 and 30 percent of the main river flow into it. Flow control was improved to aeven side channels, three of which required in-channel maintenance. Thirteen weirs, 4 sills, and 13 rock deflectors were modified by changing their design to improve their effectiveness. Riprap was used to protect unstable banks and to construct rock deflectors for increased juvenile fish rearing.

ACHIEVEMENTS

Anadromous fish in the North Fork John Day sub-basin are maintaining themselves at very low population levels. It is anticipated that the increased rearing area associated with the boulders, rock weirs, and aide channels will result in increased anadromous fish survival from egg to smolt (see Appendix B). Assuming the increased rearing area equates to a proportional increase in fish production, this increase is estimated at 3,048 spring chinook and 1,098 summer steelhead smolt annually and will require at least one generation of five years before results become readily apparent. Appendix B contains an appendix from an Environmental Assessment for Fisheries Habitat Enhancement work in the North Fork John Day Sub-basin. The appendix describes the method used to estimate the number of structures needed to improve percent pool to the objective for anadromous fish, describes the assumptions and method used to estimate the number of chinook and steelhead smolt and spawners for the existing situation (1984) and as a result of enhancement, and a description of assumptions and the method of economic analysis used in the E.A. Using these assumptions, modified by the results of the Value Analysis conducted on Desolation Creek in 1986 which indicated an error in calculation due to the ommission of a pre-smolt to smolt mortality factor of 30%, a tabular summary of expected fish production per structure was generated and is also included in this appendix.

These smolt would provide 19 additional escaping chinook and 7 additional escaping steelhead adults which would have an estimated annual net value of $12,991, using National Marine Fisheries Service Economic Values (Table 2).

Table 1. Summary of the North Fork John Day River Side Channel Project to Data

Structure	1979	1980	1981	1982	1983	1984	1985	1986	TOTAL
Side Channels	1	8	1	1	6	3	6	1	27
Alcoves and Blind Channels							2	0	2
Boulders Placed	63	50	60	80	492	250	283	160	1438
Log Weirs						2		0	2
Rock Weirs					16	8	16	46	88
Main Stem Rock Sills							22	9	31
Rock Deflectors	14	3		14		7	23	50	102
Adult Holding Pool3						1		0	1
Instream Logs Placed						1	35	26	62
Erosion Structures					4	1		2	7
Shrubs Planted							8	0	8
Cuttings Planted							182	672	852

Table 2. Increase in Smolt Production, North Fork Side Channels

	ChS	St
Estimated increase in numbers of smolts	3,048	1,098
@ 0.625 percent spawning escapement 1/	x.00625	x.00625
Estimated increased numbers of adult spawners	19	7
Net value per escaping adult 1/	x$550	$359
Estimated annual value 1986 BPA project	$10,478	$2,513

1/ As per conversation with Errol Clair 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.

SUBPROJECT II - North Fork John Day Tributaries

Subproject IIa - Desolation Creek

INTRODUCTION

The project area is located in the northern edge of Grant County in the North Fork John Day Ranger District, Umatilla National Forest in T.8S., R.33E. and T.9S., R.33E (see vicinity map in Appendix A). Desolation Creek is tributary to the North Fork John Day River from the south, 0.5 miles upstream from the Highway 395 bridge.

Forest Service employees that were in the area in the 1930's observed spring chinook salmon spawning in Desolation Creek. Several barriers in the lower portions of the stream apparently had blocked salmon passage since that time. Louisiana-Pacific Corporation, landowner in the blockage area, removed the barriers in the 1970's.

Presently, spring chinook salmon, Summer steelhead, and resident trout use Desolation Creek. The spring chinook spawning population is at a low level; Oregon Department of Fish and Wildlife estimates that 20 adults or less spawn in the stream annually. Steelhead are estimated at 140 spawners.

Each spring, trout anglers report catching late migrating spring chinook smolts in lower portions of the stream. An August 1982 pre-work stream inventory of Desolation Creek fish habitat conditions tallied one spring chinook adult at stream mile 20.5. In September 1986 three spring chinook salmon redds and four live adult spring chinook were observed in the project area by CTUIR biologists during a cooperative spawning survey coordinated by ODFW.

An evaluation of the 1982 stream inventory data indicated that existing pool habitat for both adult holding and juvenile rearing is naturally limiting anadromous fish production. Presently the pool/riffle ratio is in unworked areas averages 11% percent pool and 89 percent riffle as opposed to the 60:40 pool/riffle ratio which is considered optimum for rearing juvenile salmon and steelhead. The opportunity exists to increase the pool percentage from 11% toward 60%. All of the pools will be designed to increase juvenile rearing while several pools will be designed to provide the depth and size required for adult holding. The opportunity also exists to add gravel catching structures to Desolation Creek to increase anadromous fish spawning areas.

The overall project objective is to increase the production potential of spring chinook salmon by:

1. Changing the pool/riffle ratio from the present 11:89 tp 60:40 and improving the quality of the existing pools by adding cover and increasing depth.

2. Contructing at least one adult anadromous fish resting pool per mile.

3. Increasing the amount of woody material in the stream to improve instream cover, and the diversity and complexity of the stream.

4. Increasing anadromous fish spawning areas in both size and quality by constructing rock weirs that will retain bedload gravels.

5. Designing and installing fish habitat structures that control bank erosion.

PROJECT DESCRIPTION

Project activities consisted of preparing and administering a contract to place rock structures, boulders and riprap in Desolation Creek. The contractor began work on June 8, 1986 by hauling rock, and construction was completed on September 23, 1986.

In 1986 the Forest constructed three new side channels, 72 rock weirs and pools of which 4 were constructed for use by adults, 4 log weirs, installed 191 large boulders, placed 40 logs, constructed 7 deflectors and planted 68 cottonwood and willow cuttings to provide shade and improve juvenile anadromous fish rearing habitat in Desolation Creek.

Instream work began with the modification of 10 rock weirs that had been constructed in 1985 by improving their design and by adding rock weirs and woody material to the last side channel constructed in 1985.

‘Work then progressed downstream approximately 1.5 miles, from approximately stream mile 20.0 to stream mile 18.5, to a point just upstream of Howard Creek. The new aide channels provide 0.6 miles of additional stream habitat with surface area of quality pool of 32 percent. A physical stream survey of this and last year% project area (see Table 3) was conducted by Forest personnel and results indicate that previous estimates of pool area constructed were too high. We had estimated the 1985 main channel at 50 percent pool after construction, but the survey indicates the pool:riffle ratio for the main channel project area to be 36:64. However, the pools that were constructed average 2.6 feet in depth where unworked stream pool depth averaged less than one foot. The survey also indicated that in the 1985 project area spawning gravel increased from none prior to work to 503 square meters in mainstream and side channel. In general, gravel collects upstream of rock weirs. The 1986 main channel pool:riffle ratio in the project area after construction was increased from 11:89 to 27:73.

Photographs in Appendix C illustrate side channel construction, gravel collection, access difficulties in Desolation Creek, rock weir construction, "K" weir construction, and an adult holding pool.

A Forest Value Analysis (a technique to review benefit:cost and suggest alternatives to improve coat effectiveness) was conducted in 1986 for the Desolation Creek Project and evaluated work proposed for 1987. The result of the analysis indicated a benefit cost ratio of 1.6 : 1 by continuing as we have been in the past. Many recommendations made by the Value Analysis Team, such as increasing woody material, will be incorporated into the project.

ACHIEVEMENTS

Table 3 summarizes the Desolation Creek Project to date. The increase in total anadromous fish habitat capability from the project is estimated at 4,572 spring chinook smolt and 1,230 summer steelhead smolt (see Appendix B). Table 4 summarizes the estimated value of the project.

Table 3: Summary of the Desolation Creek Project to Date

Structure	1985	1986	TOTAL
Rock Weirs	52	68	120
Adult Holding Pools	1	4	5
Boulders Placed	97	191	288
Instream Logs Placed	11	40	51
Side Channels	2	3	5
Side Channel Length (ft.)	1,584	3,167	1,584
Alcoves and Blind Channels	5	0	5
Alcoves and Blind Channel Length (ft.)	550	0	550
Debris Jam Bypass	1	0	1
Cuttings Planted	18	68	86

Table 4. Increase in Smolt Production in Desolation Creek

	ChS	St
Estimated increase in numbers of smolts	4,572	1,230
@ 0.625 percent spawning escapement 1/	x.00625	x.00625
Estimated increase in numbers of adult spawners	29	8
Net value per escaping adult 2/	x$550	x$359
Estimated annual value 1986 BPA project	$15,716	$2,872

1/ As per conversation with Errol Claire, 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.

Subproject IIb - Lower North Fork John Day Tributaries

Wilson Creek

INTRODUCTION

Wilson Creek is located on the Umatilla National Forest in T6S, R27E (see vicinity map in Appendix A). It is within the Wall Creek watershed which is tributary to the North Fork John Day River. The stream produces summer steelhead and resident trout but a lack of adequate pool has limited the stream's production potential. The sub-project objective is to improve rearing habitat for juvenile summer steelhead in Wilson Creek.

An evaluation of the 1985 stream inventory data indicated that the quantity and quality of pool habitat was limiting production. The reaches within the project area averaged only 27% pool which is considerably less than the 50% pool which is considered optimum for rearing juvenile summer steelhead. Compounding the problem, the average pool depth was only 0.9 feet, too shallow to be effective. In addition to the need for good pool habitat, there are opportunities to increase the amount of spawning gravel, add more cover, and correct some unstable streambank conditions.

Nearly ten years ago, several small enhancement projects were completed in the stream. The projects installed pool-creating structures which are still some of the best steelhead rearing habitat in the stream. The current program builds upon this experience.

The overall project objective is to increase the production potential of summer steelhead by:

1. Increasing the pool:riffle ratio from the present 27:73 to 50:50 and improving the quality of the existing pools by adding cover and increasing depth.

2. Constructing at least one adult steelhead resting pool per mile.

3. Increasing both size and quality of anadromous fish spawning area by constructing the rock weirs so that they will retain bedload gravels.

4. Designing and installing fish habitat structures that control bank erosion.

5. Planting willow cuttings and entire shrubs along barren streambanks to increase the amount of riparian vegetation.

PROJECT DESCRIPTION

Project activities in Wilson Creek consisted of preparing and administering a contract to place rock structures and boulders in 1.6 miles of the stream.

After analysis of the stream survey data, work priorities were set and the scope of the Wilson Creek project was defined. District personnel along with the Forest Fish Biologist and the Forest Hydrologist evaluated the portion of the creek to be included in the 1986 project. Deficiencies and opportunities were studied before habitat enhancing structures were designed. Pre-work documentation of stream conditions was completed and project plans were finalized before the contract was prepared. Construction started on July 21, 1986 and was completed on September 12, 1986.

The main emphasis was to increase the number and depth of pools. Thirty nine rock weirs and nine log weirs were installed (Table 5). In addition, 14 natural weir arrangements were reconstructed or strengthened and 63 smaller natural pools were enlarged and deepened to improve their quality. A total of 125 pools were either constructed or enhanced. Upon completion of the project pool/riffle measurements were taken along the three reaches included in the project. The pool/riffle ratio had increased from 27/73 to 54/46. Pool volume had increased by 300 percent.

The weir structures were designed to use the streams scouring effect to maintain the pool depth and to retain bedload gravels for spawning habitat. To increase the pool effectiveness, 53 root wads, 16 logs, and 183 boulders were placed in the pools. This greatly increased available hiding cover. The material will also catch spawning gravels which are often deposited around debris along the stream margins.

In conjunction with the pool construction, problems with unstable stream courses were corrected. Fifteen side channels were closed in areas of excessive braiding. This stabilized the stream channel and reduced the loss of juvenile salmonids due to stranding in side pools when water levels drop after spring high flow. Deflectors and rip-rap were used to control unstable streambank conditions.

To complete the stream enhancement work, riparian vegetation was planted to increase the amount of shade and to stabilize stream banks. Sixty two deciduous trees were planted to shade the new pools. In addition, 130 shrubs were planted and all disturbed soils were grass seeded.

Near the beginning of the project, a migratory barrier was reconstructed to allow fish passage to five miles of headwater stream. The barrier was a short stretch of stream which flowed through a boulder field on to a bedrock shelf. The shelf was a wide, flat bench which lacked any pool. Fish had difficulty making the jump from the shallow water on the shelf up into the small pools interspersed among the boulders. It blocked steelhead passage four out of five years. Only in years of extremely high flows were fish able to get over the barrier. To solve the problem, the lower portion of the barrier area was reconstructed by building up the stream bed over the bedrock shelf to allow the formation of pools and to lessen the gradient, permitting easier passage.

ACHIEVEMENTS

It is anticipated that the increased rearing areas associated with the boulders, rock weirs and large woody material will result in increased steelhead survival from egg to smolt. Assuming the increased rearing area equates to a proportional increase in fish production (see Appendix B), this increase is estimated at 2,468 smolt annually and will require at least one generation before results become apparent (Table 6).

Table 5. Summary of the Wilson Creek Project to Date.

Structure	1986	Total
Rock Weirs 1/	39	39
Log Weirs	9	9
Sills & Berms	63	63
Deflectors	24	24
Boulders Placed	183	183
Instream Logs Placed	18	18
Root Wads Placed	53	53
Fish Passage Improvement 2/	1	1
Hardwood Cuttings Planted	192	192
Sedge Clumps Planted 3/	4	4

1/ Fourteen natural weirs were enhanced.
2/ Fifteen side channels were closed to prevent juvenile stranding.
3/ Sedge clumps were planted to establish an upstream sedge seed source.

Table 6. Increase in Smolt Production in Wilson Creek.

	St
Estimated increase in numbers of smolt	2,468
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increase in numbers of adult spawners	15
Net value per escaping adult 2/	x$359
Estimated annual value 1986 BPA project	$ 5,538

1/ As per conversation with Errol Claire, 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.

Little Wall Creek

INTRODUCTION

Little Wall Creek is a headwater stream of Wall Creek which is tributary to the North Fork John Day River four miles above Monument, Oregon. The stream is located on the Heppner Ranger District in T6S, R27E and T7S, R27E (see vicinity map in Appendix A).

An evaluation of 1985 stream inventory data indicates that both the quantity and quality of pool habitat and the lack of spawning gravel are limiting summer steelhead production. Pool habitat is only 24%, much lower than the 50% pool considered to be optimum for summer steelhead. Stream enhancement work was first planned as a timber sale area improvement project to be funded by Forest Service KV funds. These plans were later expanded into a joint BPA-Forest Service project to increase summer steelhead production.

The overall project objective is to increase the production potential of summer steelhead by:

1. Increasing the pool:riffle ratio to approach 50:50.

2. Constructing at least one adult steelhead resting pool per mile.

3. Increasing both size and quality of anadromous fish spawning area by constructing the rock weirs so that they will retain bedload gravels.

4. Controlling bank erosion.

PROJECT DESCRIPTION

Project activities consisted of preparing and administering a contract to place rock structures, log structures, boulders, large woody material, and hardwood plantings in Little Wall Creek.

During 1986, 1 rock weir, 22 log weirs, and one rock sill were constructed; and 5 root wads, one log deflector and 2 rock deflectors were placed (Table 7). Some stream channel reconstruction was also completed. The weir structures were designed not only to maintain good pool habitat but also to trap and accumulate spawning gravels both above the weir and at the foot of the pools. To add diversity, the large root wads were placed in five of the pools.

This project was done in late summer when water levels were lowest to minimize siltation of spawning gravels downstream. During this low flow period the log weirs intercepted underground flows and brought them to the surface. This increased the amount of water in the stream at a critical time.

Photographs in Appendix C illustrate upstream "V" weir placement in Little Wall Creek. Of particular interest are the photographs illustrating high water, low water, and low water after construction work. Other photographs show large woody material and root wad placement, and the construction of a boulder weir and a completed boulder weir.

ACHIEVEMENTS

It is anticipated that the increased rearing areas associated with the boulders, rock weirs and large woody material will result in increased steelhead survival from egg to smolt. Assuming the increased rearing area equates to a proportional increase in fish production (see Appendix B), this increase is estimated at 414 summer steelhead smolt annually and will require at least one generation before results become apparent (Table 8).

Table 7. Summary of the Little Wall Creek Project to Date.

Structure	1986	Total
Rock Weirs	1	1
Log Weirs	22	22
Sills & Berms	1	1
Deflectors	3	3
Boulders Placed	0	0
Instream Logs Placed	0	0
Root Wads Placed	5	5
Hardwood Cuttings Planted	0	0

Table 8. Increase in Smolt Production in Little Wall Creek.

	St
Estimated increase in numbers of smolt	1114
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increase in numbers of adult spawners	3
Net value per escaping adults 2/	x$359
Estimated annual value 1986 BPA project	$ 1,077

1/ As per conversation with Errol Claire, 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.

Subproject IIc - Fivemile Creek System

INTRODUCTION

The Fivemile Creek System is located on the Umatilla National Forest in T4 & 5S, R29 & 30E and is tributary to Camas Creek which is tributary fo the North Fork of the John Day River (see vicinity map in Appendix A). Fivenile Creek and its tributaries have historically been used for spawning and rearing by summer steelhead. Within the last twenty years a falls has formed one mile from the mouth of Fivemile Creek. This falls, which is on private land, has become a partial barrier to steelhead adult migration. The Oregon Department of Fish and Wildlife plans to improve passage at the falls in 1987.

In 1986 a physical stream survey was conducted for Fivemile Creek and its tributaries (see Appendix B) . An evaluation of survey data indicates that the quantity of pool sufficient to provide adequate rearing is very low, approximately eleven percent of the surface area. The survey also indicated heavy past grazing impacts on the streams and some subsurface flow. The past year was one of the driest recorded and several streams in the Fivemile Creek system that had always had flow were dry. Spawning gravel and riparian vegetation were also limited along some reaches of the stream.

No instream work has been previously done in the Fivemile system.

Past grazing has adversely impacted the riparian resources in portions of the system. In 1985, an allotment management plan for the F.G. Whitney Livestock Allotment was planned and approved. A major objective of the allotment management plan was to improve the riparian area and associated fisheries resource. Implementation of the plan occurred in 1986 with the completion of a riparian pasture which encompasses approximately 4000 acres around Fivemile Creek. The pasture fence is out of the riparian area so that the pasture includes upland areas. The pasture is being rested in 1986, 1987, and 1988 with grazing to begin in 1989. The grazing objective is to use the pasture for no more than 10 days by the 650 cow/calf pairs on the allotment to achieve the Forest standard of approximately 40% utilization. The pasture will be grazed in different seasons in different years and will be rested every third year thereafter . The occurance of fisheries habitat projects occurring In the system is recognized in the plan and associated Environmental Assessment. Forest dollars funded the construction of the pasture fence.

From the survey evaluation the overall project objective will be to increase the production potential of summer steelhead by:

1. Increasing the ratio of quality pool (0.7 foot or greater) to riffle ratio from 11:89 to approaching 50:50.

2. Constructing at least one large pool per mile of stream.

3. Increasing both amount and quantity of spawning gravel by constructing weirs to retain bedload gravels.

4. Controlling bank erosion.

5. Increasing and protecting vegetation in the riparian area.

PROJECT DESCRIPTION

Project activities in 1986 consisted of preparing and administering a contract to survey Fivemile Creek and tributaries in conjunction with several other streams.

A total of 27.88 miles of stream were surveyed. The survey recorded pool, spawning gravel, impacts on the streams system, stream channel stability, gradient and several other data. Pool greater than 0.7 feet in depth is very low at 11 percent of the surface area. Spawning gravel quantity is low and riparian vegetation condition is poor.

ACHIEVEMENTS

Nearly 28 mile of stream in the Fivemile Creek system were surveyed for physical characteristics to provide pre-construction data for.

Subproject IId - Camas Creek System

North Hidaway Creek

INTRODUCTION

North Hidaway Creek is a tributary in the Camas Creek system which is tributary to the North Fork John Day River. The location of the project is T.5S., R.33E and R.33-1/2E. (see vicinity map in Appendix A).

Summer steelhead and resident trout habitat improvement in North Hidaway Creek was initially proposed as a KV project associated with timber sale improvement. These plans were expanded into a joint BPA-Forest Service project to increase summer steelhead production. Surveys of the stream indicated that quality pool habitat is naturally limiting steelhead production.

PROJECT DESCRIPTION

In North Hidaway Creek in 1986 the Forest constructed 20 pool-creating log and rock weirs, placing woody material in each, and placed 20 boulders and logs in the stream (Table 9). We also did some stream channel reconstruction. The 1986 project was funded cooperatively, approximately one-half BPA funds and one-half Forest KV funds.

The overall project objective is to increase the production potential of summer steelhead by:

1. Increasing the pool:riffle ratio to approach 50:50.

2. Constructing at least one adult steelhead resting pool per mile.

3. Increasing both size and quality of anadromous fish spawning area by constructing the rock weirs to that they will retain bedload gravels.

4. Controlling bank erosion.

ACHIEVEMENTS

It is anticipated that the increased rearing areas associated with the boulders, rock weirs and large woody material will result in increased steelhead survival from egg to smolt. Assuming the increased rearing area equates to a proportional increase in fish production (see Appendix B), this increase is estimated at 520 smolt annually and will require at least one generation before results become apparent (Table 10).

Table 9. Summary of the North Hidaway Creek Project to Date.

Structure	1986	Total
Weirs	20	20
Boulders Placed	20	20
Instream Logs Placed	20	20

Table 10. Increase in Smolt Production in North Hidaway Creek.

	St
Estimated increase in numbers of smolt	520
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increase in numbers of adult spawners	3
Net value per escaping adults 2/	x$359
Estimated annual value 1986 BPA project	$ 1,077

1/ As per conversation with Errol Claire, 3/5/84.
2/ Meyers 1982. Wet Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.

PROJECT MONITORING

Monitoring of the project results in the North Fork John Day Sub-basin has been coordinated with the Oregon Department of Fish and Wildlife; however, no on-the-ground smolt monitoring occurred in 1985 or 1986. ODFW conducted spawning ground counts on the North Fork of the John Day River, Clear and Granite Creeks, and Desolation Creek.

A physical stream survey for project streams was conducted in 1986 to monitor the physical habitat changes that have occurred since the inititation of project work in 1984 and for pre-work purposes on streams proposed for 1987 project work. Appendix D contains summaries of the stream survey information prefaced by a pool/riffle summary adjusted to reflect inadequate pool quality.

PROJECT COSTS

Table 11. Project Costs, April 1, 1986 to March 30, 1987

Bonneville Power Administration Funda:

a.	Salaries	$69,440
b.	Transportation and travel	7,500
c.	Materials and supplies 1/	9,800
d.	Equipment rental contracts	162,753
e.	Overhead @ 10.7%	26,695
	Total	$276,188

1/ No major property purchased.

Umatilla Forest Appropriated Funds:

a.	Salaries	$12,244
b.	Transportation and travel	1,050
c.	Materials and supplies	5,300
d.	Equipment rental contracts	22,961
	Total	$41,285

REFERENCES

Claire, Errol, 1984. Personal communication on March 5, 1984.

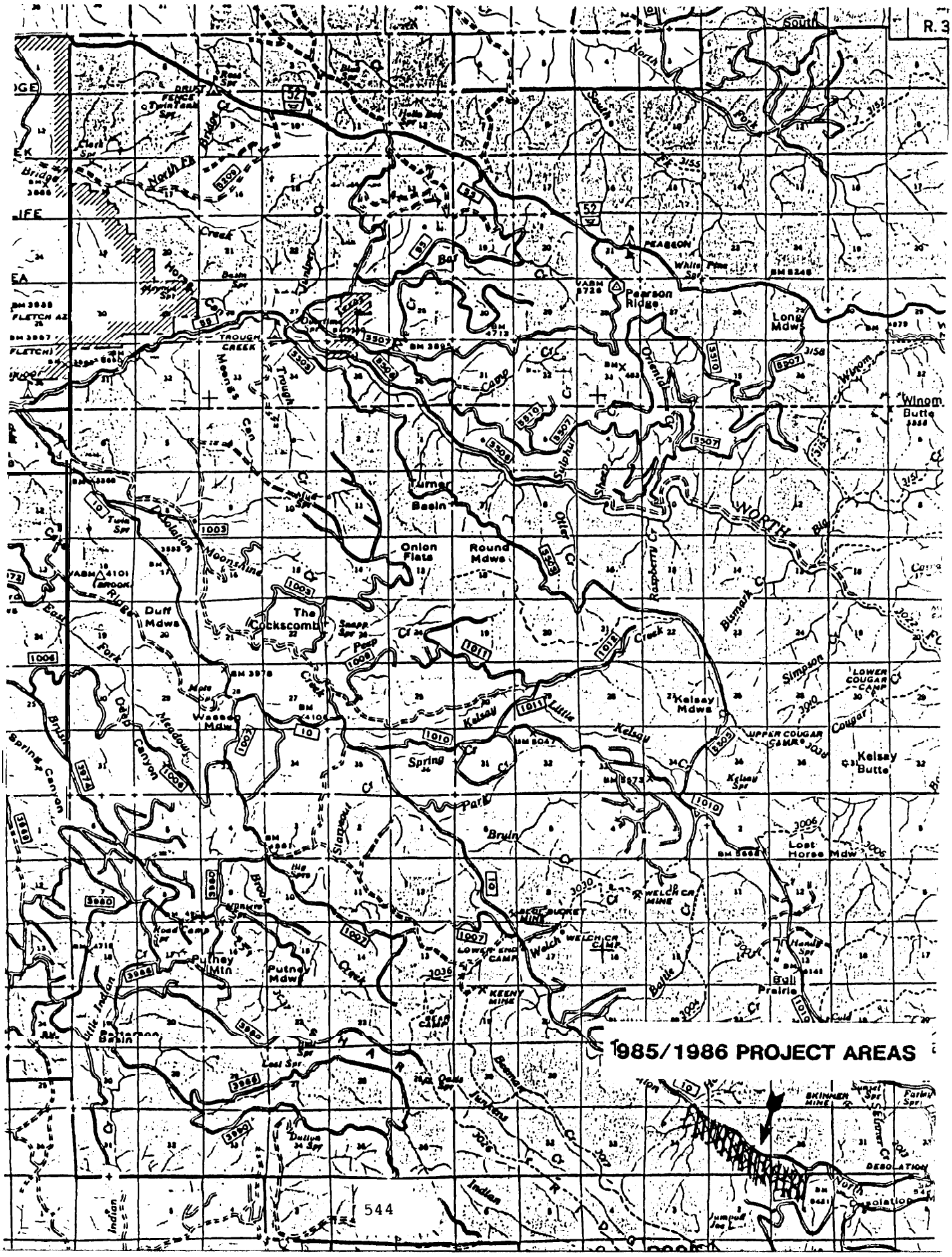
Meyers, Philip A., 1982. "Net Economic Values for Salmon and Steelhead from the Columbia River System," U.S. Department of Commerce, 23 pages, June 1982.

Oregon State Game Commission, 1959. "Fishery Division 1958 Annual Report", June 1959, page 182.

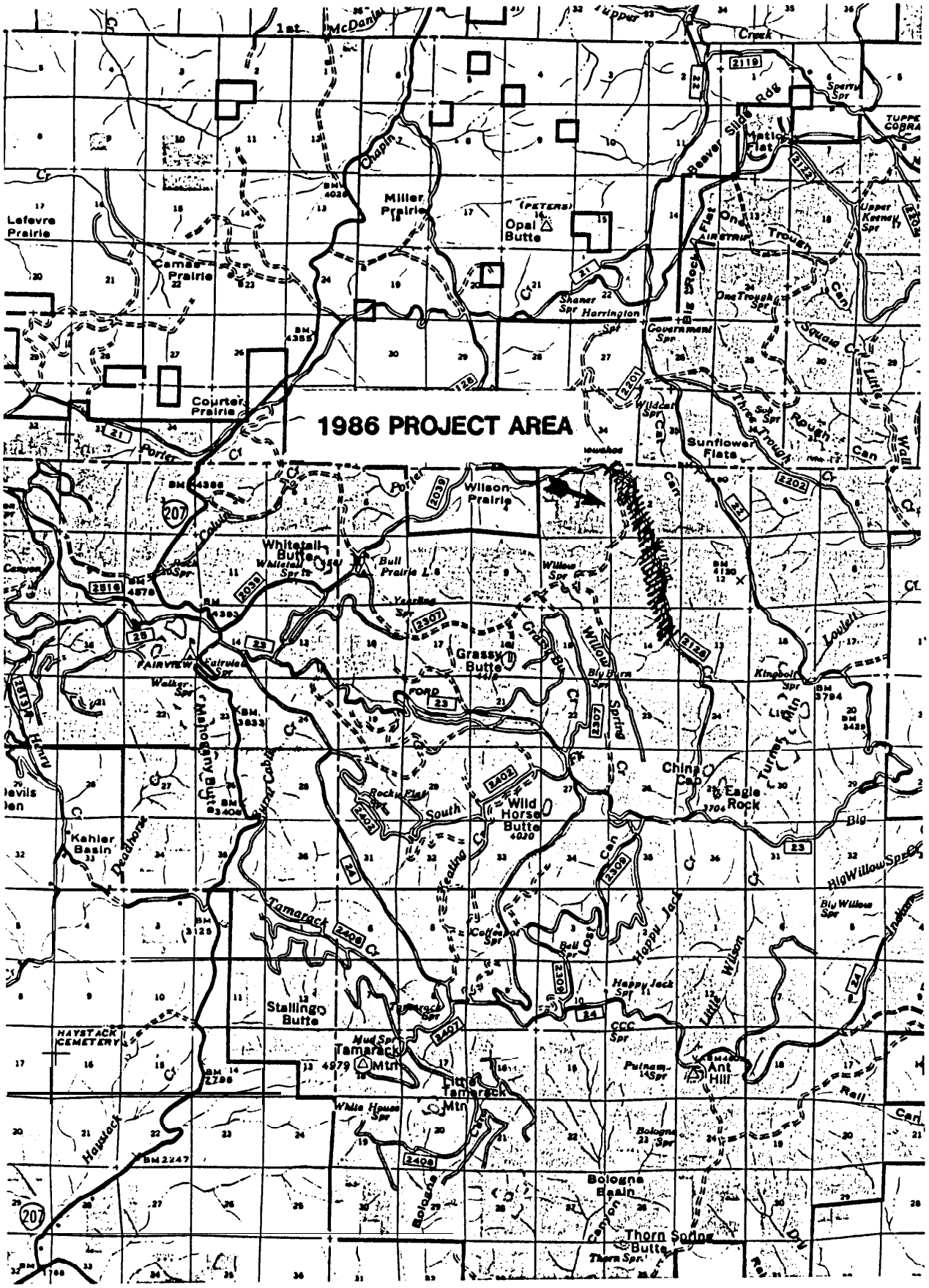
Appendix A: Project Location Maps

I. NORTH FORK JOHN DAY RIVER

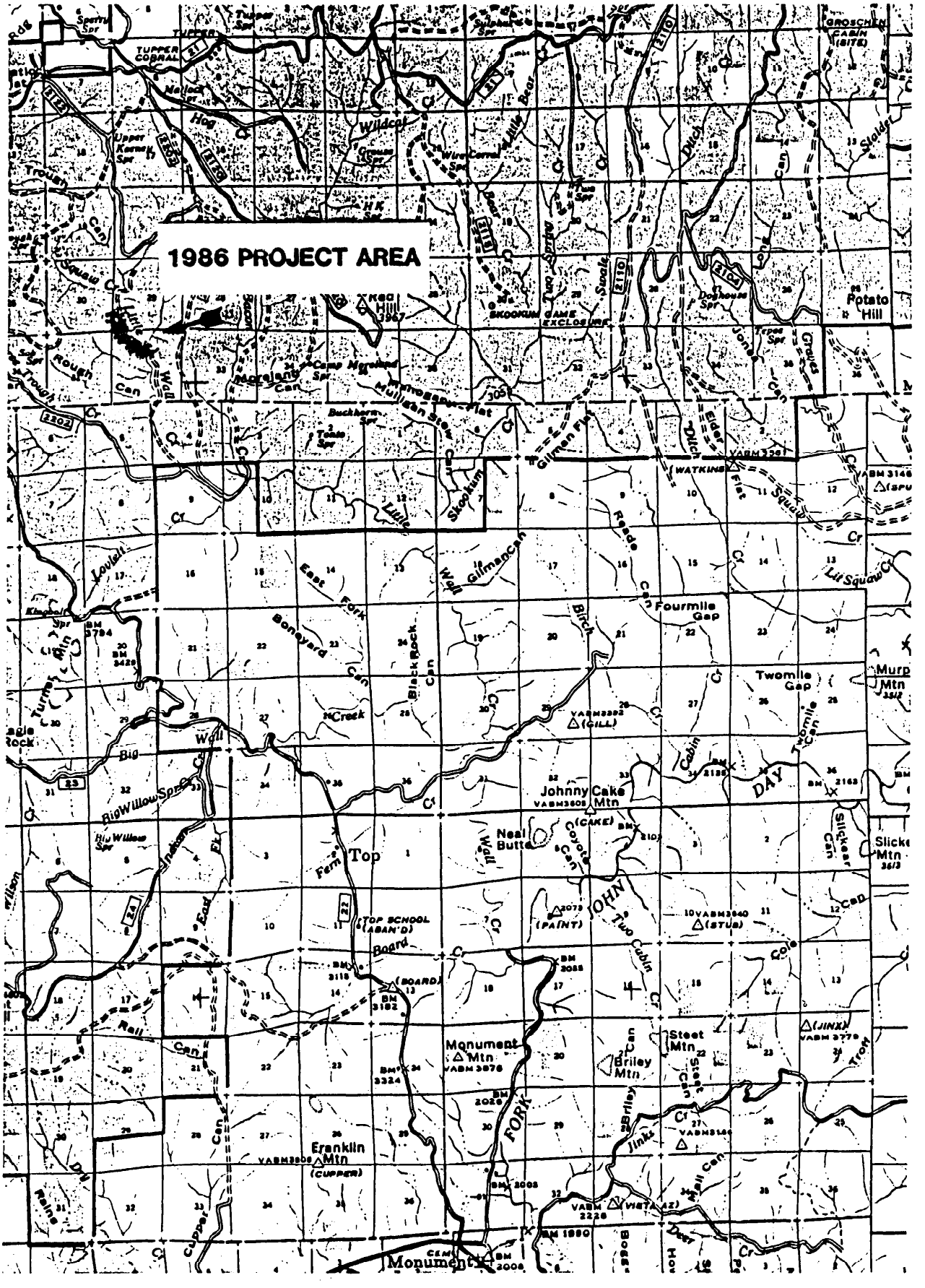
IIa. DESOLATION CREEK



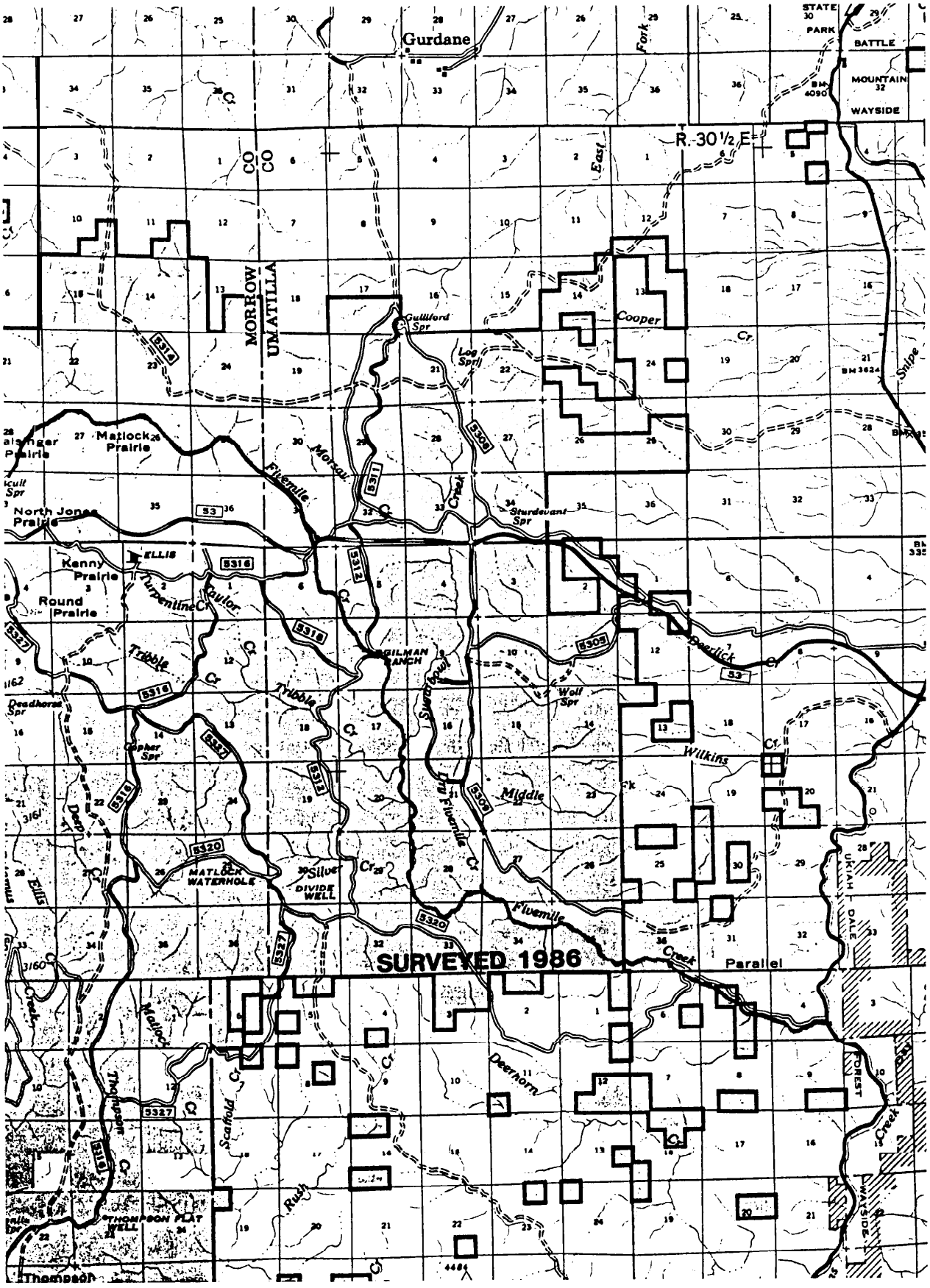
11b. WILSON CREEK



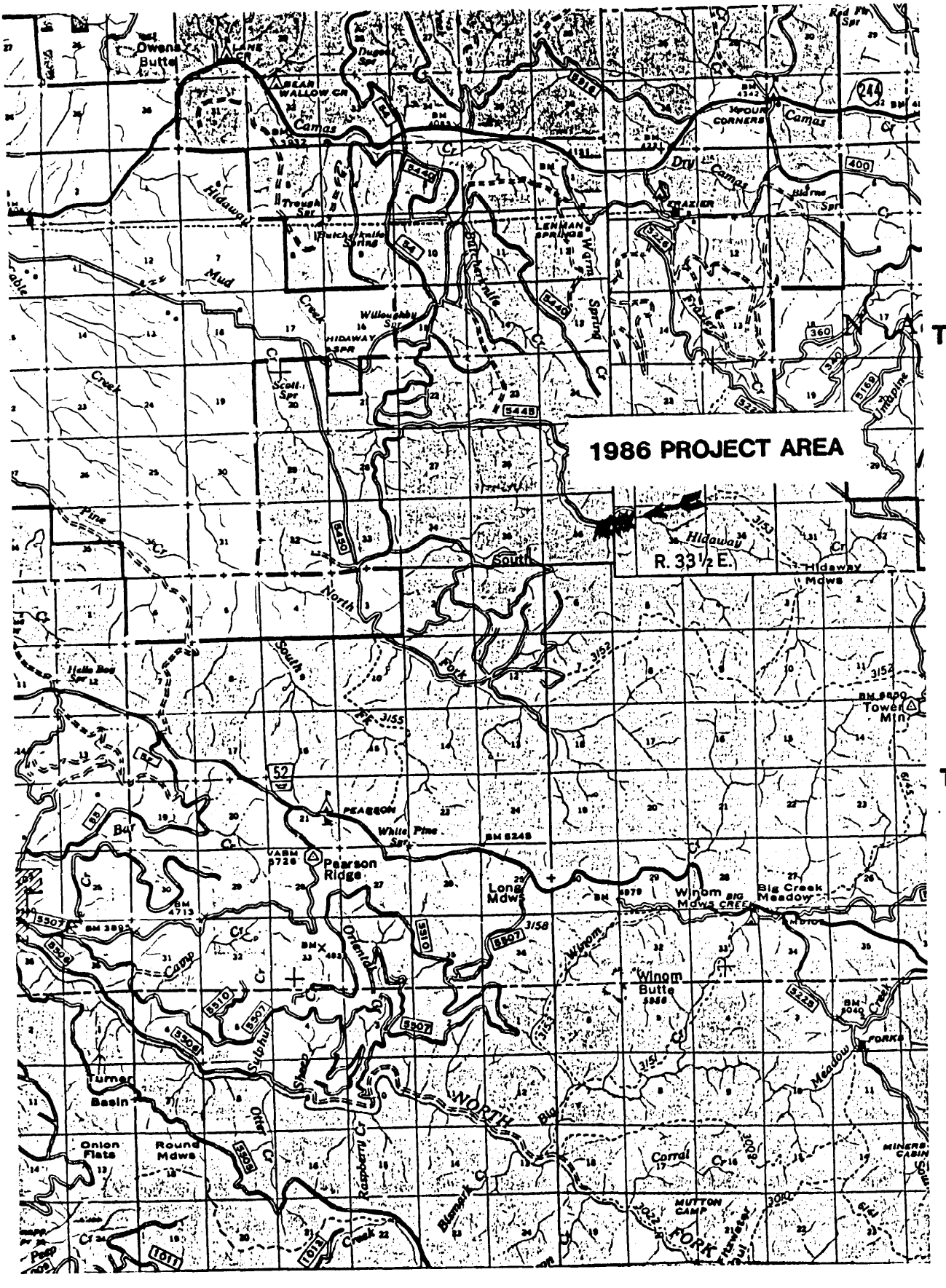
11b. LITTLE WALL CREEK



11c FIVEMILE CREEK



11d. NORTH HIDAWAY CREEK



Appendix B: Smolt Production and Cost Derivation Procedure

APPENDIX 1: ANALYSIS

DESCRIPTION OF THE METHOD USED TO ESTIMATE THE NUMBER OF STRUCTURES HEEDED TO IMPROVE PERCENT POOL TO TEE OBJECTIVE FOR ANADROMOUS FISH

The existing percent pool has been estimated from stream inventory and observation. The width of the stream is an estimated average for the stream. The objective percent pool is 60 percent for chinook streams and 50 percent for steelhead streams. From experiences previous stream improvement projects, the effective number of boulders that should be placed is a function of stream size. It is estimated that 200 boulders/mile will be most effective for the North Fork of the John Day River; 150 boulders/mile for Desolation Cr., Clear Cr. and Granite Cr.; and 100 boulders/rile for all other streams. Boulders are rocks three feet or greater in diameter, From work done on other streams on the Forest, it is estimated that a boulder creates 15 square feet of pool and that an average structure other that a boulder creates 410 square feet of pool. Using this information and assumptions one can calculate the number of structures needed to improve the percent pool to the objective percent pool using the General procedure that follows:

1. The number of boulders to be placed is the length of stream in miles multiplied by the boulders per mile assigned for the particular stream.

2. Multiply the length of stream in miles by 5280 feet/mile by the stream width in feet to obtain the total stream surface area in feet.

3. Multiply the total surface area by the objective percent pool to obtain the surface area needed to be pool to meet the objective.

4. Multiply the total surface area by the average existing percent pool to obtain existing surface area that is pool.

5. Subtract existing area of pool from the objective surface area to obtain the surface area of pool to be created to achieve the objective.

6. Multiply the number of boulders needed by 15 sq. ft. per boulder to obtain the surface area of pool created by boulders.

7. Subtract the surface area of pool created by boulders from the surface area of pool to be created to achieve objective to obtain the surface area of pool that is to be created by other structures.

8. Finally; divide the surface area of pool to be created by other structures by 410 sq. ft. per structure to obtain the number of other structures to be constructed to achieve objective pool.

There are exceptions to the general method:

North Fork John Day River and Desolation Creek

Because of the size of these streams in terns of width and water volume, larger and fewer effective structures are necessary to achieve the objectives. The number of structures on the North Fork is estimated to from past work and includes 24 side channels. The number of structures on Desolation Creek was estimated by assuming 1000 sq. ft. per other structure rather than 410 sq. ft.

Big Wall and Bear Wallow Creeks, Salsbury Tributary "B"

The percent pool on thesecreeks approaches the objective if one considers quantity only. Approximately half of the existing pool of these creeks is too shallow to be effective habitat. 'Therefore half the existing pool is used to calculate the number of structures using the general method,

All calculations are an estimate of the maximum number of instream structures that could be needed to improve anadromous fish habitat to the objective levels of each stream.

Table 1 of this Appendix summarizes the estimated number of structures needed to enhance streams for anadromous fish.

APPENDIX 1 TABLE 1. ESTIMATED MAXIMUM NUMBER OF STRUCTURES NEEDED TO ENHANCE ANADROMOUS STREAMS

STREAM	Total Miles of Potential Anadromous Streams in Forest Boundry	Mi. Pot'l Anadromous Streams Within Forest Boundary Excluding Wilderness	Mi. Pot'l Anadromous Streams Within Forest Boundary Excluding Wilderness and Private	Ave Pool	Ave Width to Nearest 5 feet	Within Forest Boundary: Miles of Riparian Improvement: Protection	Within Forest Boundary: Miles of Riparian Improvement: Erosion Control 1/	Excluding Wilderness: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool:Riffle: Boulders	Excluding Wilderness: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool:Riffle: Other	Miles of Riparian Improvement: Protection	U.S.F.S. Only: Miles of Riparian Improvement: Erosion Control 1/	U.S.F.S. Only: Estimated Maximum Number of Instream Structures Needed to Improve Existing Pool:Riffle: Boulders	U.S.F.S. Only: Estimated Maximum Number of Instream Structures Needed to Improve Existing Pool:Riffle: Other
North Fork John Day	14.0	18.0	16.0	12	50	0	0	3600	276 3/	0	0	3500	249
Wall Creek	—	—	—	—	—	—	—	—	—	—	—	—	—
Big Wall Creek 4/	8.5	8.5	6.0	49	15	3.0	0	850	377	3.0	0	600	269
Indian Creek	2.8	2.8	2.8	31	10	0	0	280	66	0	0	280	66
Wilson Creek	10.0	10.0	8.0	45	10	3.0	0	1000	28	3.0	0	800	22
Porter Creek	.25	.05	.05	45	5	0	0	50	1	0	0	50	1
Cannon Creek	1.25	1.25	1.25	12	5	0	0	125	26	0	0	125	26
South Fork	1.25	1.25	1.25	15	5	0	0	125	21	0	0	125	21
Little Wall Creek	4.5	4.5	4.25	24	10	1.0	0	450	134	1.0	0	425	127
Skookum Creek	7.5	7.5	7.5	38	5	0	0	750	31	0	0	750	31
Swale Creek	6.5	6.5	6.5	11	5	0.2	0	650	138	0.2	0	650	138
Bear Creek	1.5	1.5	1.5	27	5	0	0	150	17	0	0	150	17
Alder Creek	1.5	1.5	1.5	27	5	0	0	150	17	0	0	150	17
Bacon Creek	1.25	1.25	1.2	33	5	0	0	125	9	0	0	100	7
Rough Canyon	0.6	0.6	0.6	10	5	0	0	60	13	0	0	60	13
Ditch Creek	14.0	14.0	12.5	14	10	3.0	0	1400	598	3.0	0	1250	534
Mallory Creek	8.25	8.25	8.25	23	10	1.0	0	825	256	1.0	0	825	256
Potamus Creek	13.5	13.5	13.5	20	15	4.0	0	1350	733	4.0	0	350	733
Little Potamus Creek	2.0	2.0	2.0	19	5	0	0	200	33	0	0	200	33
Wilson Creek	.25	.25	.25	28	5	0.2	0.5	25	3	0.2	0.2	25	3
Stony Creek	0.3	0.3	0.3	38	5	0	0	30	1	0	0	30	1
Camas Creek	11.5	11.5	6.0	19	15	0	0	1150	647	0	0	600	338
Fivemile Creek 5/	16.0	16.0	15.0	27	10	6.0	0	1600	415	6.0	0	1500	389
Dry Fivemile Creek	1.6	1.6	1.6	17	5	0	0	160	12	0	0	160	12
Silver Creek	1.7	1.7	1.7	11	5	0	0	170	30	0	0	110	30
Tribble Creek	4.2	4.2	4.2	17	5	6.0	0	420	74	6.0	0	420	74
Taylor Creek	0.4	0.4	0.4	17	5	1.0	0	40	7	1.0	0	40	7
Sugarbowl Creek	1.8	1.8	1.1	17	5	0	0	180	32	0	0	110	20
Owens Creek	5.0	5.0	5.0	19	5	0	0	500	82	0	0	500	82
Totals	1.5	1.5	1.5	15	5	0	0	150	28	0	0	150	28

Footnotes:

1/ ALL STREAMS HAVE SHORT SECTIONS OF UNSTABLE BANKS WHICH NEED IMPROVEMENT.

2/ TWENTYFOUR SIDE CHANNELS, TWO HUNDRED FIFTY TWO OTHER STRUCTURES.

3/ TWENTYFOUR SIDE CHANNELS, TWO HUNDRED TWENTY-FOUR OTHER STRUCTURES.

4/ EXISTING POOL IS TOO SHALLOW TO BE EFFECTIVE. ESTIMATE ONE-HALF OF EXISTING POOL NEEDS IMPROVEMENT

5/ FIVEMILE CREEK SYSTEM BARRIER REMOVAL BY ODFW IN 1985 or 1986 WILL MAKE THESE STREAMS AVAILABLE.

APPENDIX 1. TABLE 1.

Continued:

STREAM	Total Miles of Potential Anadromous Streams in Forest Boundry	Mi. Tot'l Anadromous Streams Within Forest Boundary Excluding Wilderness	Mi. Tot'l Anadromous Streams Within Forest Boundary Excluding Wilderness and Private	Ave. Pool	Ave. Width to Nearest 5 feet	Within Forest Boundary Excluding Wilderness: Miles of Riparian Improvement: Protection	Erosion 1/ Control	Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool:Riffle: Boulders	Other	Miles of Riparian Improvement: Protection	Erosion 1/ Control	Estimated Maximum N of Instream Structu Needed to Optimize Improve Existing P Riffle: Boulders	Other
Cable Creek	—	—	—	—	—	—	—	—	—	—	—	—	—
South Fork	6.0	6.0	6.0	19	5	0	0	600	98	0	0	600	98
North Fork	6.8	6.8	6.8	36	5	0	0	680	39	0	0	680	39
Trib. E	0.5	0.5	0.5	14	5	0	0	50	10	0	0	50	10
Hidaway Creek	6.8	6.8	6.8	31	10	0	0	680	133	0	0	680	133
Line Creek	1.0	1.0	1.0	20	5	0	0	100	16	0	0	100	16
Lane Creek	5.5	5.5	5.5	25	5	0	0	550	68	0	0	550	68
Trib. A	1.5	1.5	1.5	16	5	0	0	150	24	0	0	150	24
Bear Wallow Creek 4/	6.0	6.0	5.5	50	10	0	0	600	171	0	0	550	157
Bowman Creek	3.25	3.25	3.0	5	10	0	0	325	176	0	0	300	162
Frazier Creek	4.25	4.25	4.25	25	5	0	0	425	53	0	0	425	53
Dry Camas Creek	3.0	3.0	3.0	25	5	0	0	300	37	0	0	300	37
Rancheria Creek	3.0	3.0	3.0	34	5	0	0	300	20	0	0	300	20
Salsbury Creek	1.0	1.0	1.0	40	5	0	0	100	3	0	0	100	3
Trib. B	0.75	0.75	0.75	45	5	0	0	75	11	0	0	75	11
Trib. C	0.5	0.5	0.5	27	5	0	0	50	6	0	0	50	6
Hinton Creek	0.5	0.5	0.5	15	5	0	0	50	9	0	0	50	9
Meadowbrook Creek	1.3	1.3	1.3	37	10	0	0	130	17	0	0	130	17
W. Meadowbrook Creek	1.5	1.5	1.5	32	10	0	0	150	29	0	0	150	29
Smith Creek	0.75	0.75	0.75	21	5	0	0	75	11	0	0	75	11
Desolation Creek	21.5	21.5	12.0	12	30	18.0	0	3225	1290	12.0	0	180	720
Kelsay Creek	3.5	3.5	3.5	5	10	0	0	350	190	0	0	350	190
Bruin Creek	1.0	1.0	1.0	7	5	0	0	100	24	0	0	100	24
Junkens Creek	0.4	0.4	0.4	10	5	0	0	40	9	0	0	40	9
Beaman Creek	0.3	0.3	0.3	12	5	0	0	30	6	0	0	30	6
Battle Creek	2.0	2.0	2.0	13	5	0	0	200	40	0	0	200	40
Sponge Creek	1.0	1.0	1.0	17	5	0	0	100	18	0	0	100	18
Howard Creek	0.5	0.5	0.5	15	5	0	0	50	9	0	0	50	9
North Fork	5.0	5.0	5.0	29	10	0	0	500	117	0	0	500	117
South Fork	2.5	2.5	2.5	23	15	0	0	250	121	0	0	250	121

Footnotes:

1/ ALL STREAMS HAVE SHORT SECTIONS OF UNSTABLE BANKS WHICH NEED IMPROVEMENT.

2/ TWENTYFOUR SIDE CHANNELS, TWO HUNDRED FIFTY TWO OTHER STRUCTURES.

3/ TWENTYFOUR SIDE CHANNELS, TWO HUNDRED TWENTY FOUR OTHER STRUCTURES.

4/ EXISTING POOL IS TOO SHALLOW TO BE EFFECTIVE. ESTIMATE ONE-HALF OF EXISTING POOL NEEDS IMPROVEMENT.

5/ FIVEMILE CREEK SYSTEM BARRIER REMOVAL BY ODFW IN 1985 or 1986 WILL MAKE THESE STREAMS AVAILABLE.

APPENDIX 1 TABLE 1. Continued:

STREAM	Total Miles of Potential Anadromous Streams in Forest Boundry	Mi. Pot'l Anadromous Streams Within Forest Boundary Excluding Wilderness	Mi. Pot'l Anadromous Streams Within Forest Boundary Excluding Wildnerness and Private	Avg. % Pool	Avg. Width, to Nearest S. feet	Within Forest Boundary Excluding Wilderness: Miles of Riparian Improvement: Protection	Within Forest Boundary Excluding Wilderness: Miles of Riparian Improvement: Erosion 1/ Control	Within Forest Boundary Excluding Wilderness: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool: Boulders	Within Forest Boundary Excluding Wilderness: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool: Other	Miles of Riparian Improvement: Protection	U.S.F.S. Only: Miles of Riparian Improvement: Erosion 1/ Control	U.S.F.S. Only: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool: Riffle: Boulders	U.S.F.S. Only: Estimated Maximum Number of Instream Structures Needed to Optimize or Improve Existing Pool: Other
Texas Bar Creek	3.0	3.0	1.0	15	10	0	0	300	124	0	0	100	41
Big Creek	3.0	0.25	0.25	9	20	0	0	25	25	0	0	25	25
Winom Creek	0.25	0	0	13	10	0	0	0	0	0	0	0	0
Basin Creek	1.5	0	0	20	5	0	0	0	0	0	0	0	0
Paradise Creek	0.5	0	0	30	5	0	0	0	0	0	0	0	0
Glade Creek	0.2	0	0	20	5	0	0	0	0	0	0	0	0
Silver Creek	1.0	0	0	30	5	0	0	0	0	0	0	0	0
Granite Creek	8.0	5.0	2.0	35	30	0	4.0	750	262	0	2.0	300	105
Lake Creek	2.5	0	0	20	10	0	0	0	0	0	0	0	0
Tencent Creek	0.5	0.5	0.5	15	10	0	0	50	21	0	0	50	21
Clear Creek 6/	8.0 (4.0)	7.0 (3.0)	6.0 (2.0)	38	25	0	0	450	195	0	0	300	130
Ruby Creek	1.0	1.0	1.0	13	5	0	0	100	20	0	0	100	20
South Fork	1.0	0	0	15	5	0	0	0	0	0	0	0	0
Lightning Creek	1.3	1.3	1.3	13	5	0	0	130	26	0	0	130	26
Warner Gul.	1.5	0	0	17	5	0	0	0	0	0	0	0	0
Crane Creek	1.5	0	0	12	10	0	0	0	0	0	0	0	0
Trout Creek	20	0	0	70	10	0	0	0	0	0	0	0	0
Middle Fork John Day	—	—	—	—	—	—	—	—	—	—	—	—	—
Indian Creek	2.0	2.0	2.0	20	10	2.0	0	200	70	2.0	0	200	70
TOTAL:	306.5 (302.5)	259.8 (255.1)	226.8 (222.8)	—	—	48.4	4.5	2880.5	762	42.4	2.2	2473.5	613.4

Footnotes:

1/ ALL STREAMS HAVE SHORT SECTIONS OF UNSTABLE BANKS WHICH NEED IMPROVEMENT.

2/ TWENTYFOUR SIDE CHANNELS, TWO HUNDRED FIFTY TWO OTHER STRUCTURES.

3/ ~~TWENTYFOUR SIDE CHANNELS, TWO HUNDRED TWENTY FOUR OTHER STRUCTURES.~~

4/ EXISTING POOL IS TOO SHALLOW TO BE EFFECTIVE. ESTIMATE ONE-HALF OF EXISTING POOL NEEDS IMPROVEMENT.

5/ FIVEMILE CREEK SYSTEM BARRIER REMOVAL BY ODFW IN 1985 or 1986 WILL MAKE THESE STREAMS AVAILABLE.

6/ FOUR MILES OF CLEAR CREEK HAVE BEEN COMPLETED. FIGURE IN PARENTHESIS IS THE REMAINDER.

APPENDIX 1. TABLE 2. ESTIMATED ANADROMOUS FISH PRODUCTION WITHIN FOREST BOUNDARY EXCLUDING WILDERNESS

STREAM	ESTIMATED CURRENT PRODUCTION				ESTIMATED INCREASE DUE TO ENHANCEMENT				TOTAL		
	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Adult
North Fork John Day	576	288	92160	43200	29040	12312	182	82	121200	55512	758
Wall Creek											
Big Wall Creek	0	36	0	5400	0	13346	0	89	0	18746	0
Indian Creek	0	20	0	3000	0	2840	0	19	0	5840	0
Wilson Creek	0	70	0	10500	0	5672	0	38	0	16172	0
Porter Creek	0	0	0	0	0	274	0	2	0	274	0
Cannon Creek	0	10	0	1500	0	1249	0	8	0	2749	0
South Fork	0	10	0	1500	0	1201	0	8	0	2701	0
Little Wall Creek	0	40	0	6000	0	5466	0	36	0	11466	0
Skookum Creek	0	60	0	9000	0	4494	0	30	0	13494	0
Swale Creek	0	16	0	2400	0	6562	0	44	0	8962	0
Bear Creek	0	12	0	1800	0	1158	0	8	0	2958	0
Alder Creek	0	6	0	900	0	1158	0	8	0	2058	0
Bacon Creek	0	10	0	1500	0	841	0	6	0	2341	0
Bough Canyon	0	10	0	1500	0	612	0	4	0	2112	0
Ditch Creek	0	84	0	12600	0	21352	0	142	0	33952	0
Mallory Creek	0	42	0	6300	0	10262	0	68	0	16569	0
Potamus Creek	0	90	0	13500	0	24342	0	162	0	37842	0
Little Potamus Creek	0	11	0	1650	0	1792	0	12	0	3442	0
Wilson Creek	0	1	0	150	0	197	0	1	0	347	0
Stony Creek	0	4	0	600	0	174	0	1	0	774	0
Camas Creek	0	58	0	8700	0	21278	0	142	0	29978	0
Fivemile Creek	0	135	0	20250	0	17960	0	120	0	38210	0
Dry Fivemile Creek	0	14	0	2100	0	1088	0	7	0	3188	0
Silver Creek	0	15	0	2250	0	1570	0	10	0	3820	0
Tribble Creek	0	38	0	5700	0	3876	0	26	0	9576	0
Taylor Creek	0	4	0	600	0	368	0	2	0	968	0
Sugarbowl Creek	0	10	0	1500	0	1668	0	11	0	3168	0
Owens Creek	0	100	0	15000	0	4468	0	30	0	19468	0
Trib. B.	0	15	0	2250	0	1422	0	9	0	3672	0

APPENDIX 1. TABLE 2. Continued:

STREAM	ESTIMATED CURRENT PRODUCTION				ESTIMATED INCREASE DUE TO ENHANCEMENT				TOTAL			
	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Adult	Steelhead Adult
Cable Creek	0	43	0	6450	0	5352	0	36	0	11802	0	79
South Fork	0	68	0	10200	0	4336	0	29	0	14536	0	97
North Fork	0	5	0	750	0	490	0	3	0	1240	0	8
Trib. E	0	109	0	16350	0	6592	0	44	0	22952	0	153
Hidaway Creek	0	6	0	900	0	884	0	6	0	1784	0	12
Line Creek	0	40	0	6000	0	4382	0	29	0	10382	0	69
Lane Creek	0	11	0	1650	0	1326	0	8	0	2976	0	19
Trib. A	0	50	0	7500	0	7104	0	47	0	14604	0	97
Bear Wallow Creek	0	30	0	4500	0	5849	0	39	0	10349	0	69
Bowman Creek	0	64	0	9600	0	3397	0	23	0	12997	0	87
Frazier Creek	0	29	0	4350	0	2388	0	16	0	6738	0	45
Dry Camas Creek	0	32	0	4800	0	1980	0	13	0	6780	0	45
Rancheria Creek	0	6	0	900	0	572	0	4	0	1472	0	10
Salsbury Creek	0	4	0	600	0	639	0	4	0	1239	0	8
Trib. B	0	3	0	450	0	394	0	3	0	844	0	6
Trib. C	0	6	0	900	0	466	0	3	0	1366	0	9
Hinton Creek	0	13	0	1950	0	1058	0	7	0	3008	0	20
Meadowbrook Creek	0	23	0	3450	0	1446	0	10	0	4896	0	33
W. Meadowbrook Creek	0	36	0	5400	0	639	0	4	0	6039	0	40
Smith Creek	20	140	3200	21000	67725	23542	423	157	70925	44542	443	297
Desolation Creek	0	6	0	900	0	6310	0	42	0	7210	0	48
Kelsay Creek	0	12	0	1800	0	1076	0	7	0	2876	0	19
Bruin Creek	0	2	0	300	0	416	0	3	0	716	0	5
Junkens Creek	0	4	0	600	0	294	0	2	0	894	0	6
Beeman Creek	0	20	0	3000	0	1960	0	13	0	4960	0	33
Battle Creek	0	12	0	1800	0	932	0	6	0	2732	0	18
Sponge Creek	0	6	0	900	0	466	0	3	0	1366	0	9
Howard Creek	0	50	0	7500	0	5308	0	35	0	12808	0	85
North Fork	0	50	0	7500	0	4154	0	28	0	11654	0	78
South Fork												

APPENDIX 1. TABLE 2. Continued:

STREAM	ESTIMATED CURRENT PRODUCTION				ESTIMATED INCREASE DUE TO ENHANCEMENT				TOTAL			
	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Adult	Steelhead Adult
Texas Bar Creek	0	10	0	1500	0	4476	0	30	0	5976	0	40
Big Creek	0	2	0	300	0	725	0	5	0	1025	0	7
Minam Creek	0	0	0	0	0	0	0	0	0	0	0	0
Basin Creek	0	0	0	0	0	0	0	0	0	0	0	0
Paradise Creek	0	0	0	0	0	0	0	0	0	0	0	0
Glade Creek	0	0	0	0	0	0	0	0	0	0	0	0
Silver Creek	0	0	0	0	0	0	0	0	0	0	0	0
Granite Creek	155	85	24800	12750	14230	5019	89	33	39030	17769	244	118
Lake Creek	0	0	0	0	0	0	0	0	0	0	0	0
Tencent Creek	0	6	0	900	0	754	0	5	0	1654	0	11
Clear Creek	45	46	7200	6900	10050	3465	63	23	17250	10365	108	69
Ruby Creek	0	12	0	1800	0	980	0	7	0	2780	0	19
South Fork	0	0	0	0	0	0	0	0	0	0	0	0
Lightning Creek	0	20	0	3000	0	1274	0	8	0	4274	0	28
Wagner Gul.	0	0	0	0	0	0	0	0	0	0	0	0
Crane Creek	0	0	0	0	0	0	0	0	0	0	0	0
Trout Creek	0	0	0	0	0	0	0	0	0	0	0	0
Middle Fork John Day	—	—	—	—	—	—	—	—	—	—	—	—
Indian Creek	0	20	0	3000	0	2680	0	18	0	5680	0	38
TOTAL	796	2290	127360	34350	121045	523745	757	1880	248405	867245	1553	4170

APPENDIX 1 TABLE 3. ESTIMATED ANADROMOUS FISH PRODUCTION U.S.F.S. ONLY EXCLUDING WILDERNESS

STREAM	ESTIMATED CURRENT PRODUCTION				ESTIMATED INCREASE DUE TO ENHANCEMENT				TOTAL			
	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	Chinook Adult	Steelhead Adult
North Fork John Day	512	256	81920	38400	25813	10944	162	73	107733	49344	674	329
Wall Creek	—	—	—	—	—	—	—	—	—	—	—	—
Big Wall Creek	0	33	0	4950	0	9425	0	63	0	14375	0	96
Indian Creek	0	20	0	3000	0	2840	0	19	0	5840	0	29
Wilson Creek	0	70	0	10500	0	4528	0	30	0	15028	0	100
Porter Creek	0	0	0	0		274	0	2	0	274	0	2
Cannon Creek	0	10	0	1500	0	1249	0	8	0	2749	0	18
South Fork	0	10	0	1500	0	1201	0	8	0	2701	0	18
Little Wall Creek	0	38	0	5100	0	5162	0	34	0	10262	0	72
Skookum Creek	0	60	0	9000	0	4494	0	30	0	13494	0	90
Swale Creek	0	16	0	2400	0	6564	0	44	0	8962	0	60
Bear Creek	0	12	0	1800	0	1158	0	8	0	2958	0	20
Alder Creek	0	6	0	900	0	1158	0	8	0	10158	0	14
Bacon Creek	0	8	0	1200	0	673	0	4	0	1873	0	12
Rough Canyon	0	10	0	1500	0	612	0	4	0	2112	0	14
Ditch Creek	0	80	0	12000	0	19066	0	127	0	31066	0	207
Mallory Creek	0	42	0	6300	0	10269	0	68	0	16569	0	110
Potamus Creek	0	83	0	12450	0	24342	0	162	0	36792	0	245
Little Potamus Creek	0	11	0	1650	0	1792	0	12	0	3442	0	23
Wilson Creek	0	1	0	150	0	197	0	1	0	347	0	2
Stony Creek	0	1	0	150	0	174	0	1	0	324	0	2
Camas Creek	0	30	0	4500	0	11102	0	74	0	15602	0	104
Fivemile Creek	0	127	0	19050	0	16838	0	112	0	35888	0	239
Dry Fivemile Creek	0	14	0	2100	0	1088	0	7	0	3188	0	21
Silver Creek	0	15	0	2250	0	1570	0	10	0	3820	0	25
Tribble Creek	0	38	0	5700	0	3876	0	26	0	9576	0	64
Taylor Creek	0	4	0	600	0	368	0	2	0	968	0	6
Sugarbowl Creek	0	10	0	1500	0	1019	0	7	0	2519	0	17
Owens Creek	0	100	0	15000	0	4468	0	30	0	19468	0	130
Trib. B.	0	15	0	2250	0	1422	0	9	0	3672	0	24

APPENDIX 1. TABLE 3. Continued:

STREAM	ESTIMATED CURRENT PRODUCTION Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	ESTIMATED INCREASE DUE TO ENHANCEMENT Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	TOTAL Chinook Smolt	Steelhead Smolt	Chinook Adult	Steelhead Adult
Cable Creek												
South Fork	0	43	0	6450	0	5352	0	36		11802	0	79
North Fork	0	68	0	10200	0	4336	0	29		14536	0	97
Trib. E	0	5	0	750	0	490	0	3		1240	0	8
Hidaway Creek	0	109	0	16350	0	6592	0	44		22942	0	153
Line Creek	0	6	0	900	0	884	0	6		1784	0	12
Lane Creek	0	40	0	6000	0	4382	0	29		10382	0	69
Trib. A	0	11	0	1650	0	1326	0	8		2976	0	19
Bear Wallow Creek	0	46	0	6900	0	6512	0	43		13412	0	89
Bowman Creek	0	28	0	4200	0	5399	0	36		9599	0	64
Frazier Creek	0	64	0	9600	0	3397	0	23		12997	0	87
Dry Camas Creek		29	0	4350	0	2388	0	16		6738	0	45
Rancheria Creek		32	0	4800	0	1980	0	13		6780	0	45
Salsbury Creek		6	0	900	0	572	0	4		1472	0	10
Trib. B		4	0	600	0	639	0	4		1239	0	8
Trib. C		3	0	450	0	394	0	3		844	0	6
Hinton Creek		6	0	900	0	466	0	3		1366	0	9
Meadowbrook Creek		13	0	1950	0	1058	0	7		3008	0	20
W. Meadowbrook Creek		23	0	3450	0	1446	0	10		4896	0	33
Smith Creek	0	36	0	5400	0	639	0	4		6039	0	40
Desolation Creek	20	140	3200	21000	67725	23542	423	157	709.5	44542	443	297
Kelsay Creek	0	6	0	900	0	630	0	42		7210	0	48
Bruin Creek	0	12	0	1800	0	1076	0	7		2876	0	19
Junkens Creek	0	2	0	300	0	416	0	3		716	0	5
Beeman Creek	0	4	0	600	0	294	0	2		894	0	6
Battle Creek	0	20	0	3000	0	1960	0	13		4960	0	33
Sponge Creek	0	12	0	1800	0	932	0	6		2732	0	18
Howard Creek	0	6	0	900	0	466	0	3		1366	0	9
North Fork	0	5	0	7500	0	5308	0	35		12808	0	85
South Fork	0	50	0	7500	0	4154	0	28		11654	0	78

APPENDIX 1. TABLE 3. Continued:

STREAM	ESTIMATED CURRENT PRODUCTION Chinook Spawners	Steelhead Spawners	Chinook Smolt	Steelhead Smolt	ESTIMATED INCREASE DUE TO ENHANCEMENT Chinook Smolt	Steelhead Smolt	Chinook Spawners	Steelhead Spawners	TOTAL Chinook Smolt	Steelhead Smolt	Chinook Adult	Steelhead Adult
Texas Bar Creek	0	3	0	1500	0	1492	0	10	0	2992	0	13
Big Creek	0	1	0	300	0	60	0	1	0	360	0	2
Winom Creek	0	0	0	0	0	0	0	0	0	0	0	0
Basin Creek	0	0	0	0	0	0	0	0	0	0	0	0
Paradise Creek	0	0	0	0	0	0	0	0	0	0	0	0
Glade Creek	0	0	0	0	0	0	0	0	0	0	0	0
Silver Creek	0	0	0	0	0	0	0	0	0	0	0	0
Granite Creek	62	34	9920	5100	5692	2008	36	13	15612	7108	98	47
Lake Creek	0	0	0	0	0	0	0	0	0	0	0	0
Tencent Creek	0	6	0	900	0	754	0	5	0	1654	0	11
Clear Creek	30	31	4800	4650	6700	2310	42	15	11500	6960	72	46
Ruby Creek	0	12	0	1800	0	980	0	7	0	2780	0	19
South Fork	0	0	0	0	0	0	0	0	0	0	0	0
Lightning Creek	0	20	0	3000	0	1274	0	8	0	4274	0	28
Wagner Gul.	0	0	0	0	0	0	0	0	0	0	0	0
Crane Creek	0	0	0	0	0	0	0	0	0	0	0	0
Trout Creek	0	0	0	0	0	0	0	0	0	0	0	0
Middle Fork John Day	—	—	—	—	—	—	—	—	—	—	—	—
Indian Creek	0	20	0	3000	0	2680	0	18	0	5680	0	38
TOTAL	624	2121	99840	317250	105930	252139	663	1667	205770	569389	1287	3788

DESCRIPTION OF ASSUMPTIONS AND METHOD OF ECONOMIC ANALYSIS

Costs

The cost of structures is estimated using the average cost of constructing structures in previous projects. The estimates for the various structures are:

1. Boulder placement.....$100
2. Other structure $1000
3. Fence . . . .$3000/mile of fence
4. Erosion problem control.....$53,000/mile of stream

Table 3 of this Appendix contains the calculated costs per stream of the project.

Fish Vale

The values used for the economic analysis are:

Chinook Salmon Spawner.....$550
Steelhead Spawner.....$359

These values are from Meyer (1982).

Present Net Value and Benefit:&&

Assumptions made in the calculation of present net value and benefit:cost are that the project will be accomplished over 30 years, has a 30 year life span and that the discount rate is 4 percent. The following table illustrates the analysis for the project area within the Forest boundary excluding wilderness.

Year Group	Mid-point	Dis-count 1/	Cost	Discounted Cost	Benefit	Discounted Benefit	Discounted Net
1-10	5	.82	3,574,467	2,931,063	10,912,700	8,948,414	6,017,351
11-20	15	.56	3,574,467	2,001,702	21,825,400	12,222,224	10,220,522
21-30	25	.38	3,574,467	1,358,298	32,738,100	12,440,478	11,082,180
31-40	35	.25	-	-	21,825,400	5,456,350	4,098,052
41-50	45	.17	-	-	10,912,700	1,855,159	1,855,159
Totals			10,723,400	6,291,063	98,214,300	40,922,625	33,273,264

Present Net Value: 33,273,264 Benefit:Cost: 6.5:1

1/ The discounting formula is $\frac{1}{(1.04)^n}$ where n =midpoint of the year group.

APPENDIX I. TABLE 4. ESTIMATED COSTS IN THOUSANDS OF DOLLARS

STREAM	WITHIN FOREST BOUNDARY EXCLUDING WILDERNESS					U.S.F.S ONLY EXCLUDING WILDERNESS				
	Protection	Erosion Control	Boulders	Other	Total	Protection	Erosion Control	Boulders	Other	Total
North Fork John Day	0	0	360	324	684	0	0	320	296	616
Wall Creek	—	—	—			—	—	—		—
Big Wall Creek	9	0	85	379	473	9	0	60	268	337
Indian Creek	0	0	28	60	88	0	0	28	60	88
Wilson Creek	9	0	100	28	137	9	0	80	22	111
Porter Creek	0	0	5	1	6	0	0	5	1	6
Cannon Creek	0	0	125	26	38.5	0	0	125	26	38.5
South Fork	0	0	12.5	24	36.5	0	0	12.5	24	36.5
Little Wall Creek	3	0	45	134	182	3	0	42.5	127	172.5
Skookum Creek	0	0	75	31	106	0.6	0	75	31	106
Swale Creek	0.6	0	65	138	203.6	0	0	65	138	203.6
Bear Creek	0	0	15	17	32	0	0	15	17	32
Alder Creek	0	0	15	17	32	0	0	15	17	32
Bacon Creek	0	0	12.5	9	21.5	0	0	10	7	17
Rough Canyon	0	0	6	13	19	0	0	6	13	19
Ditch Creek	9	0	140	598	747	9	0	125	534	668
Mallory Creek	3	0	82.5	256	341.5	3	0	82.5	256	341.5
Potamus Creek	12	0	135	733	880	12	0	135	733	880
Little Potamus Creek	0	0	20	33	53	0	0	20	33	55
Wilson Creek	0.6	26.5	2.5	3	32.6	0.6	10.6	2.5	3	16.7
Stony Creek	0	0	3	1	4	0	0	3	1	4
Camas Creek	0	0	115	647	762	0	0	60	238	398
Fivemile Creek	18	0	160	415	593	18	0	150	389	557
Dry Fivemile Creek	0	0	16	12	28	0	0	16	12	28
Silver Creek	0	0	17	30	47	0	0	17	30	47
Tribble Creek	18	0	42	74	134	18	0	42	74	134
Taylor Creek	3	0	4	7	14	3	0	4	7	14
Sugarbowl Creek	0	0	18	32	50	0	0	11	20	31
Owens Creek	0	0	50	82	132	0	0	50	82	132
Trib. B.	0	0	15	28	43	0	0	15	28	43

APPENDIX 1. TABLE 4. Continued:

STREAM	WITHIN FOREST BOUNDARY EXCLUDING WILDERNESS					U.S.F.S ONLY EXCLUDING WILDERNESS				
	Protection	Erosion Control	Boulders	Other	Total	Protection	Erosion Control	Boulders	Other	Total
Cable Creek										
South Fork	0	0	60	98	158	0	0	60	98	158
North Fork	0	0	68	39	107	0	0	68	39	107
Trib. E	0	0	5	10	15	0	0	5	10	15
Hidaway Creek	0	0	68	133	201	0	0	68	133	201
Line Creek	0	0	10	16	26	0	0	10	16	26
Lane Creek	0	0	55	68	123	0	0	55	68	123
Trib. A	0	0	15	24	39	0	0	15	24	39
Bear Wallow Creek	0	0	60	171	231	0	0	55	157	212
Bowman Creek	0	0	32.5	176	208.5	0	0	30	162	192
Frazier Creek	0	0	42.5	53	95.5	0	0	42.5	53	47.5
Dry Camas Creek	0	0	30	37	67	0	0	30	37	67
Rancheria Creek	0	0	30	20	50	0	0	30	20	50
Salsbury Creek	0	0	10	3	13	0	0	10	3	13
Trib. B	0	0	7.5	11	18.5	0	0	7.5	11	18.5
Trib. C	0	0	5	6	11	0	0	5	6	11
Hinton Creek	0	0	5	9	14	0	0	5	9	14
Meadowbrook Creek	0	0	13	17	30	0	0	13	17	30
W. Meadowbrook Creek	0	0	15	29	44	0	0	15	29	44
Smith Creek	0	0	7.5	11	18.5	0	0	7.5	11	18.5
Desolation Creek	54	0	322.5	1290	1666.5	36	0	180	720	936
Kelsay Creek	0	0	35	190	225	0	0	35	190	225
Bruin Creek	0	0	10	24	34	0	0	10	24	34
Junkens Creek	0	0	4	9	13	0	0	4	9	13
Beeman Creek	0	0	3	6	9	0	0	3	6	9
Battle Creek	0	0	20	40	60	0	0	20	40	60
Sponge Creek	0	0	10	18	28	0	0	10	18	28
Howard Creek	0	0	5	9	14	0	0	5	9	14
North Fork	0	0	50	117	167	0	0	50	117	167
South Fork	0	0	25	121	146	0	0	25	121	146

APPENDIX 1, TABLE 4. Continued:

STREAM	WITHIN FOREST BOUNDARY EXCLUDING WILDERNESS					U.S.F.S ONLY EXCLUDING WILDERNESS				
	Protection	Erosion Control	Boulders	Other	Total	Protection	Erosion Control	Boulders	Other	Total
Texas Bar Creek	0	0	30	124	154	0	0	10	41	51
Big Creek	0	0	25	25	27.5	0	0	2.5	25	27.5
Winom Creek	0	0	0	0	0	0	0	0	0	0
Basin Creek	0	0	0	0	0	0	0	0	0	0
Paradise Creek	0	0	0	0	0	0	0	0	0	0
Glade Creek	0	0	0	0	0	0	0	0	0	0
Silver Creek	0	0	0	0	0	0	0	0	0	0
Granite Creek	0	21.2	75	262	358.2	0	10.6	30	105	145.6
Lake Creek	0	0	0	0	0	0	0	0	0	0
Tencent Creek	0	0	5	21	26	0	0	5	21	26
Clear Creek	0	0	45	195	240	0	0	30	130	160
Ruby Creek	0	0	10	20	30	0	0	10	20	30
South Fork	0	0	0	0	0	0	0	0	0	0
Lightning Creek	0	0	13	26	39	0	0	13	26	39
Wagner Gul.	0	0	0	0	0	0	0	0	0	0
Crane Creek	0	0	0	0	0	0	0	0	0	0
Trout Creek	0	0	0	0	0	0	0	0	0	0
Middle Fork John Day										
Indian Creek	60	0	20	70	96	60	0	20	70	96
TOTAL	145.2	47.7	2840.5	7650	10723.4	127.2	21.2	2473.5	6182	8803.9

1-17

Estimated Production by Structure.

Structure	Annual Smolt output
Side channel	448Chs - 140Sts
Boulders placed	4Chs - 2Sts
Log or Rock Weirs	28Chs - 8Sts
Alcove	28Chs - 8Sts
Rock Sills	14Chs - 4Sts
Log in pool	7Chs - 3Sts
Deflectors	7Chs - 3Sts
Adult Holding Pools	70Chs - 21Sts
Instream Logs	7Chs - 3 Sts

Assumptions

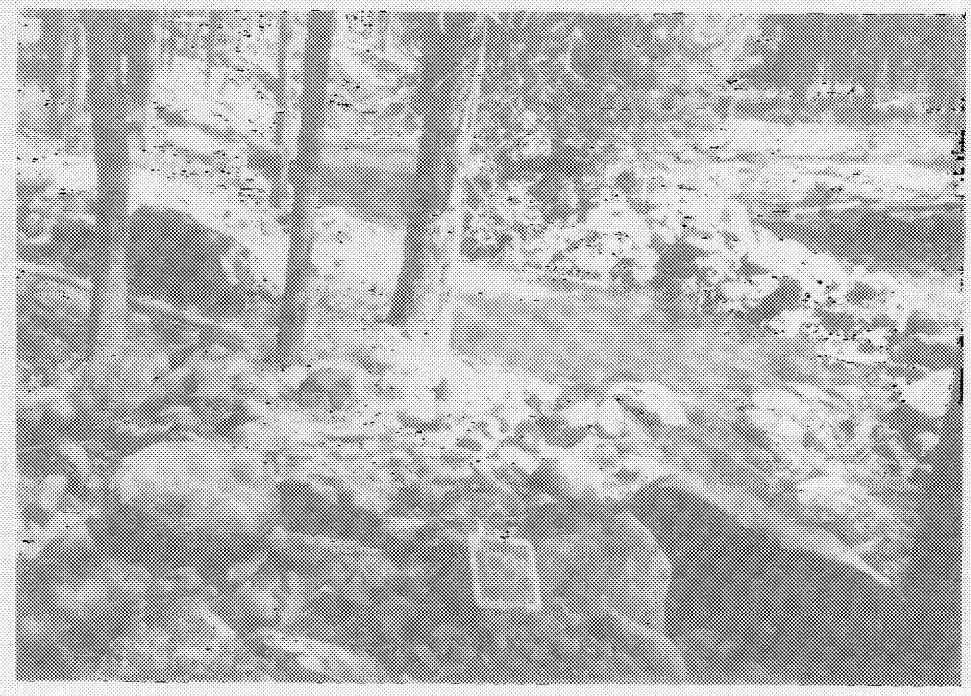
1. If one is not planning from spring chinook, then steelhead smolt output doubles.

2. One large adult holding pool per mile is necessary to gain full benefit from the rest of the project.

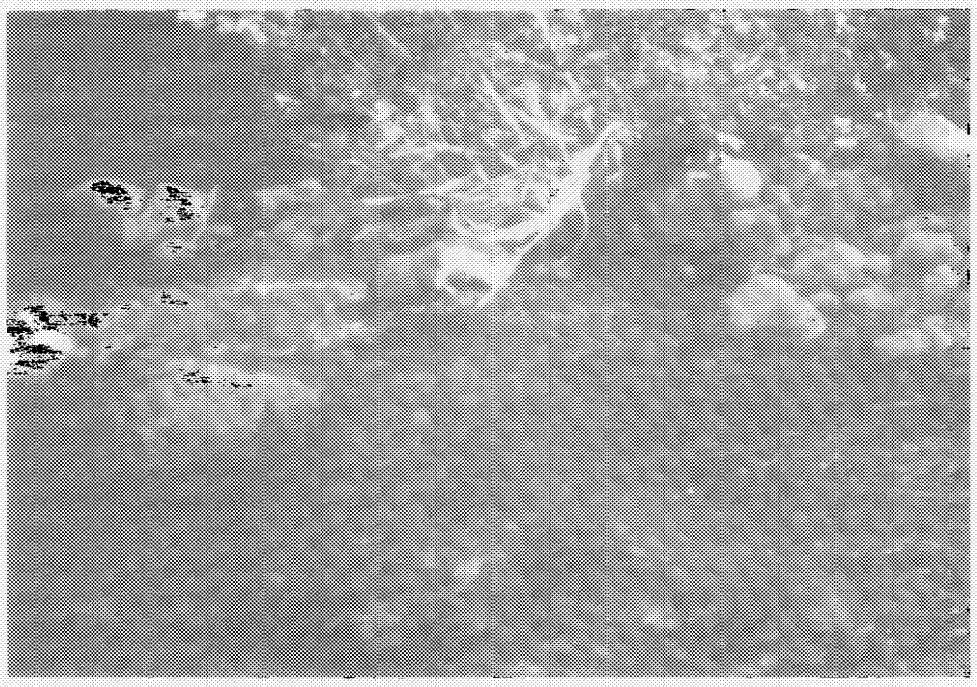
3* Output numbers derived by Andrews and ODFW representatives and account for an assumed 30% presmolt mortality.

Appendix C : Photographs

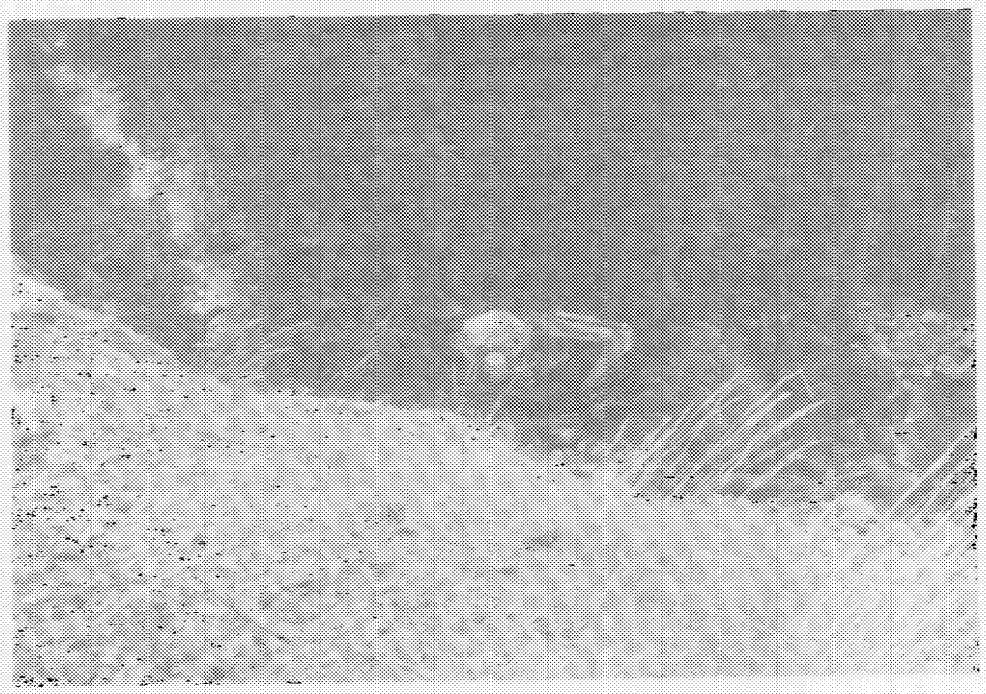
Side channel site in Desolation Creek prior to construction.



The same side channel after construction.

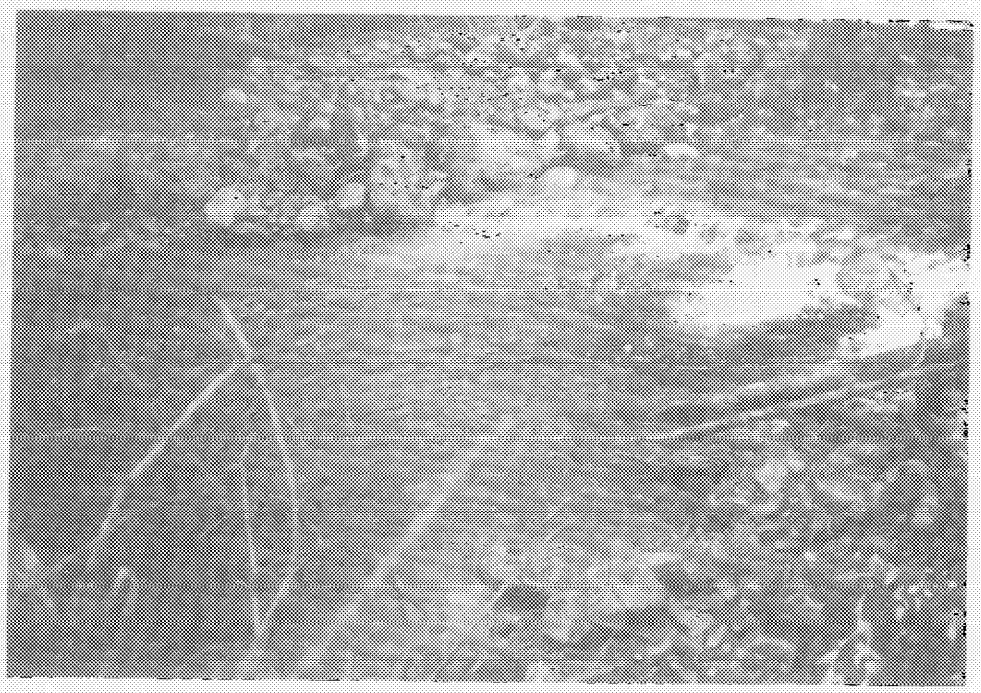


"Pocket" gravel collected in the 1985 Desolation Creek project area.

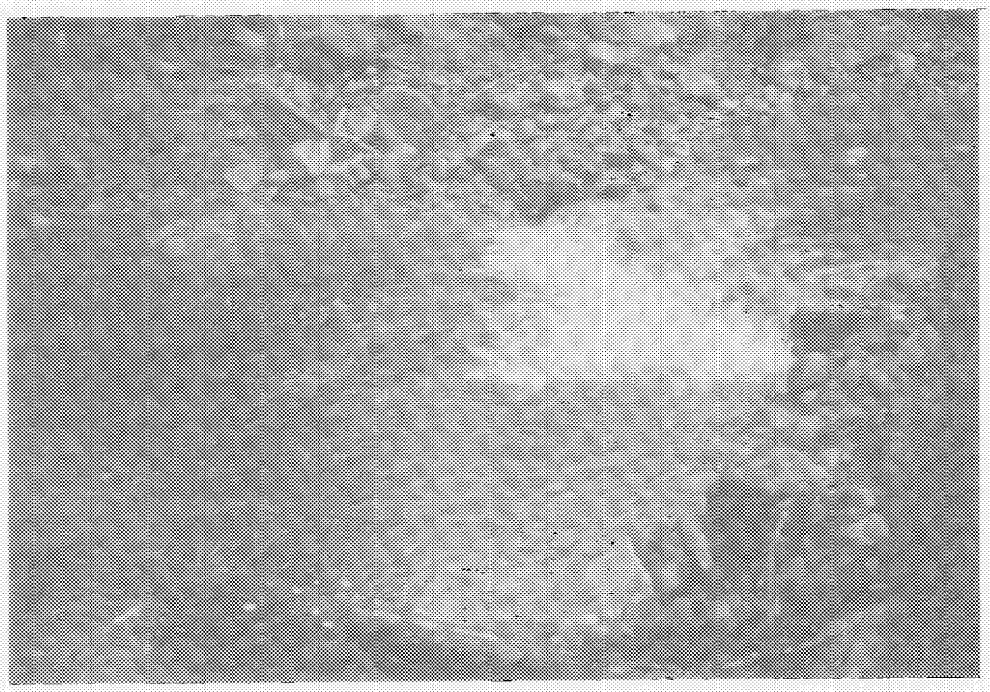


Excavator in Desolation Creek illustrating access difficulties.

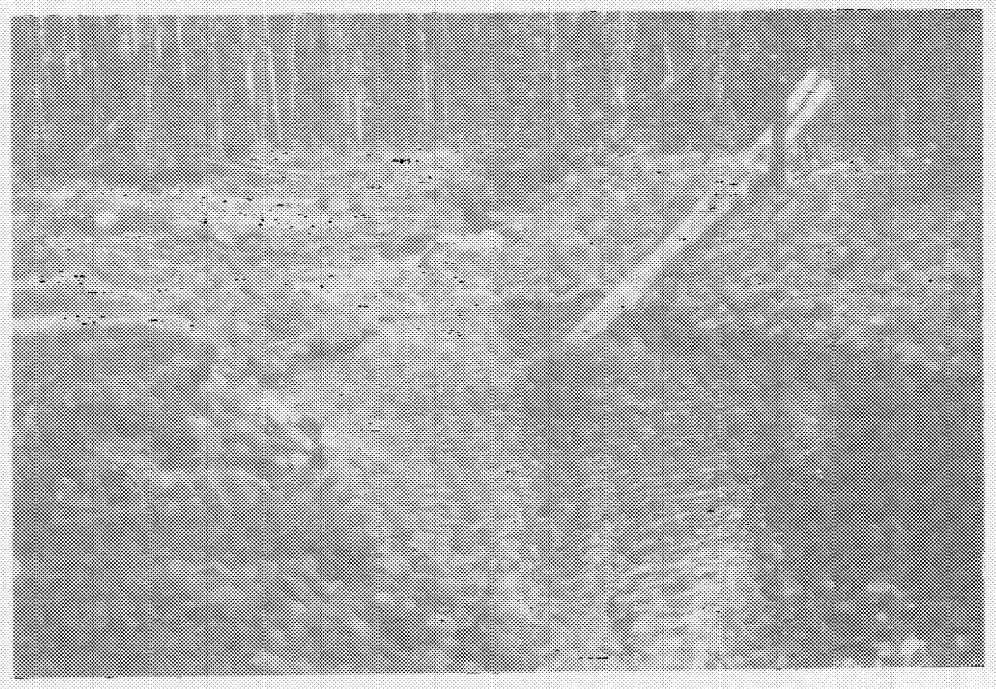
Rock weir and pool illustrating the fitting together of the rocks of the weir keyway.



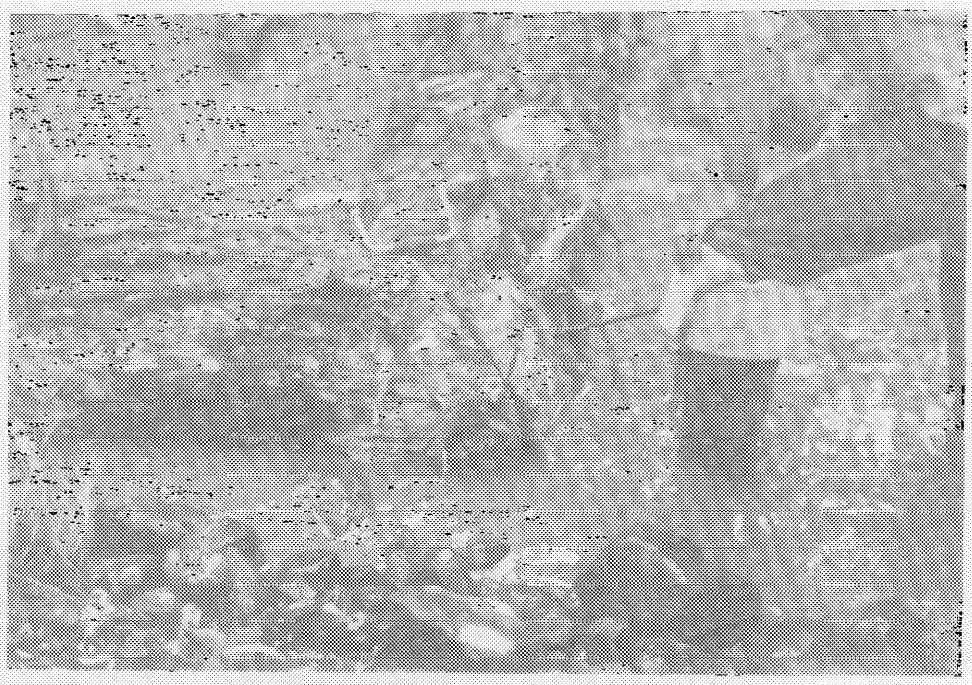
A sill constructed in Desolation Creek illustrating the lack of a keyway. Sills are constructed when boulder numbers or boulder size are insufficient to construct a keyway type of weir.



"K" log weir in Desolation Creek.



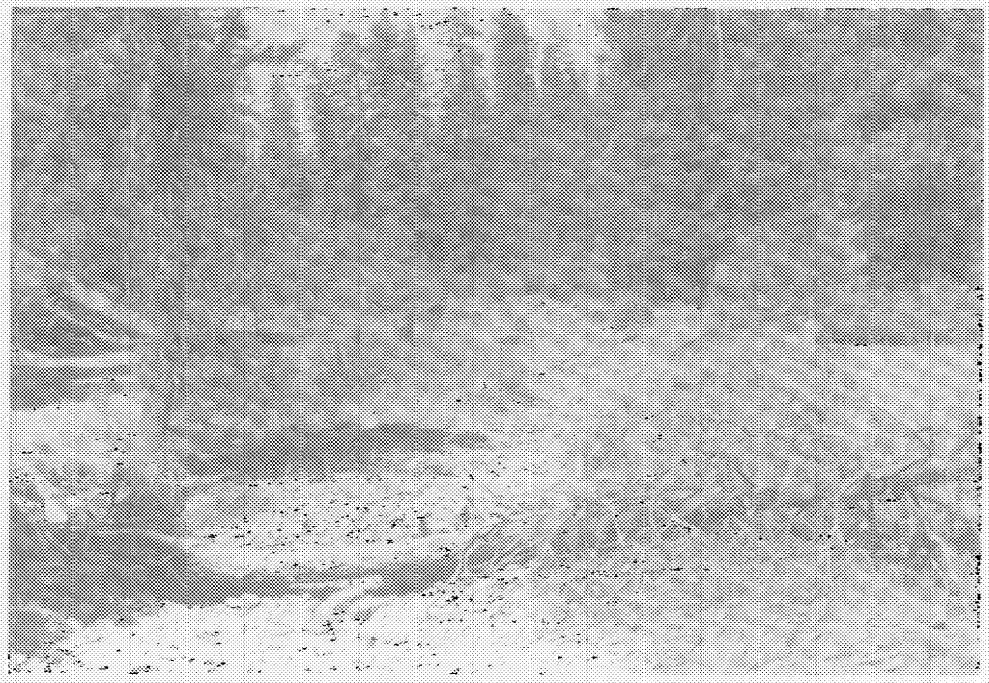
Large adult holding pool constructed below a boulder weir in Desolation Creek.



Upstream "V" log weir construction in Little Wall Creek.

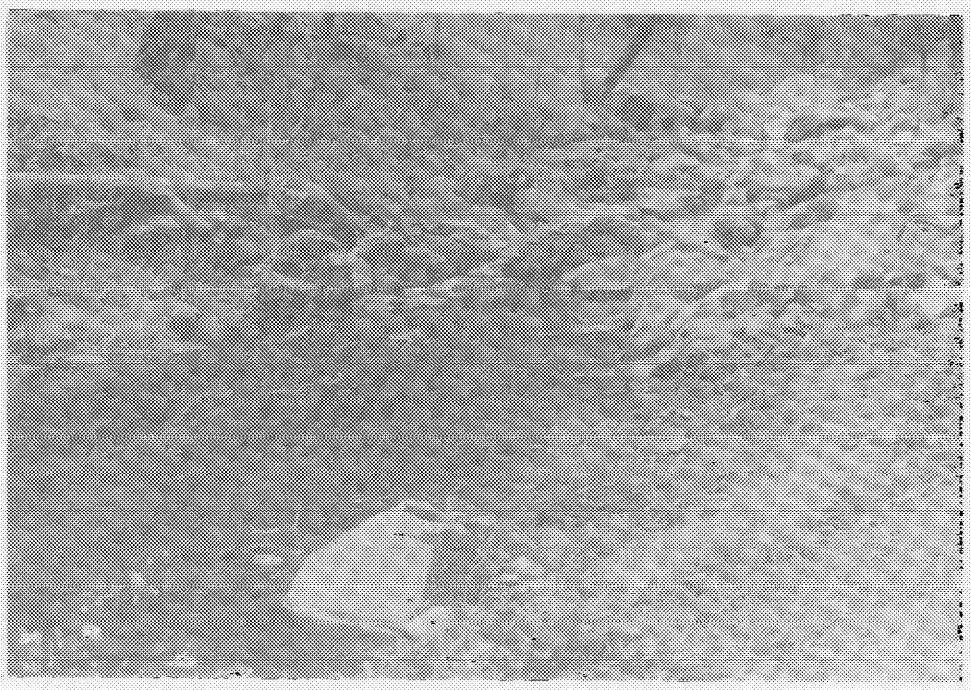
Completed "V" log weir and pool.

Little Wall Creek at photopoint # 5, high water, 1986.

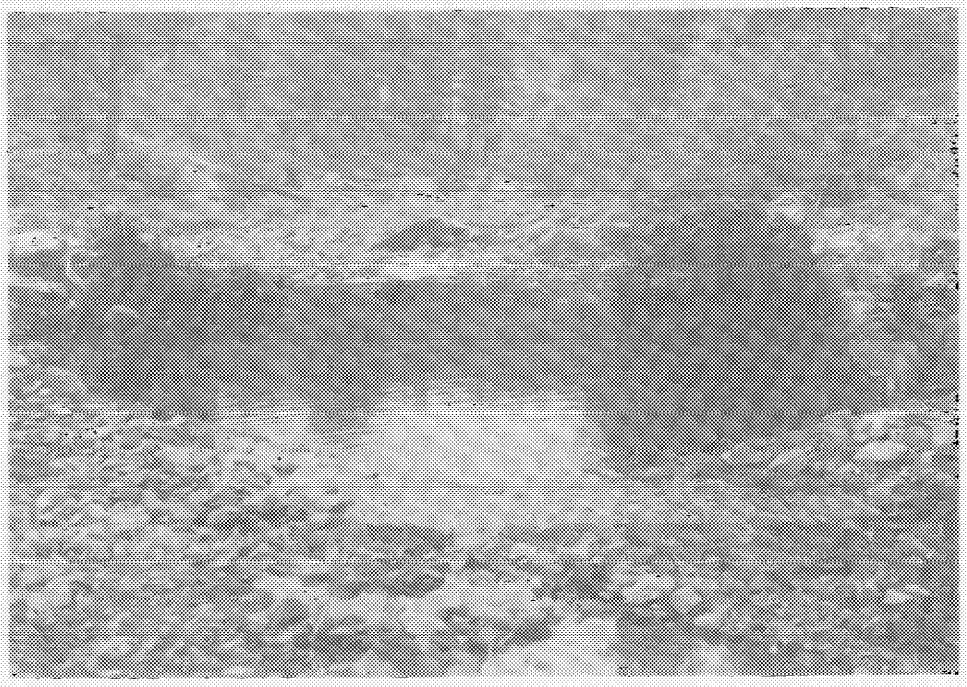


Little Wall Creek at photopoint #5 immediately prior to construction.

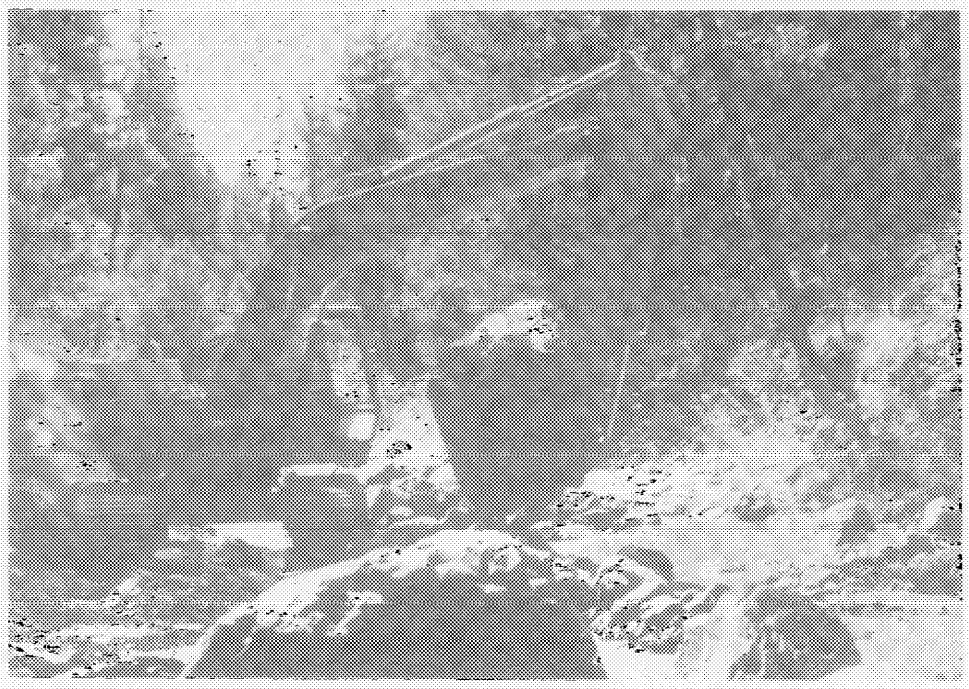
Little Wall Creek at photpoint #5 after construction.



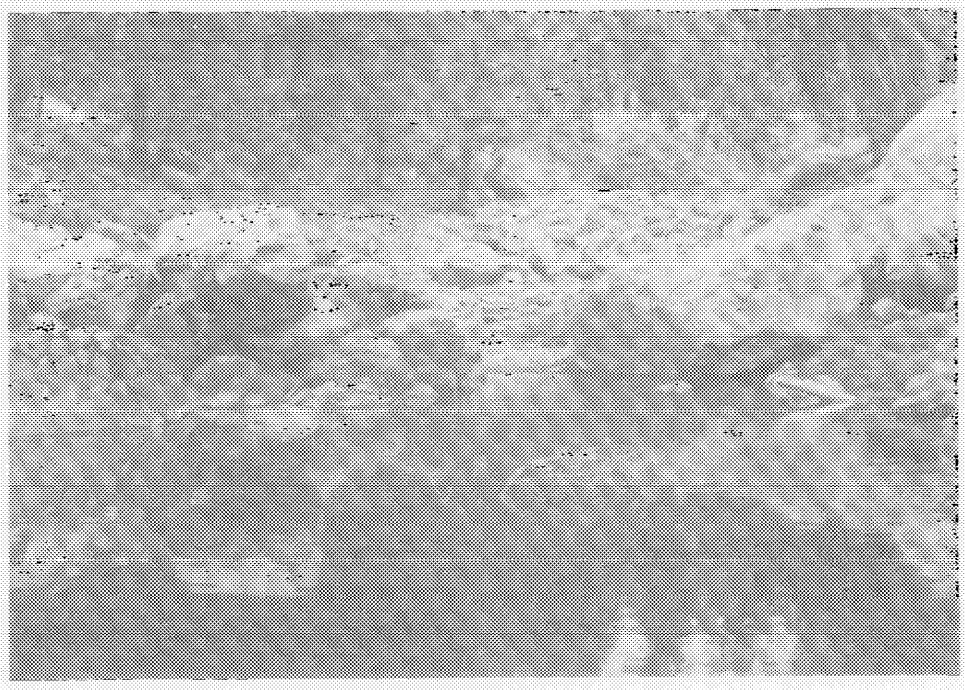
Large woody material placed in Little Wall Creek.



Rootwad placement in Little Wall Creek.



Excavator constructing boulder weir.



Boulder weir and large pool with large woody material in Little Wall Creek.

Appendix D: Stream Survey Summaries

Summary of Pool/Riffle Ratio and Spawning Gravel from the 1986 Stream Survey

Stream	Total Area (sq.ft.)	Pool Area* (sq.ft.)	Riffle Area (sq.ft.)	P/R %	Spawning Gravek (sq.ft.)
Clear Cr.	644,325	430,655	303,165	53/47	77,500
Desolation 1985					
Side channels	11,540	4,966	6,574	43/57	1,220
Main channel	65,763	23,739	42,024	36/64	1,780
Desolation 1986					
Side channels	33,075	10,748	22,327	33/67	1,074
Main channel	222,573	59,451	163,122	27/73	4,334
Fivemile & Trib.	972,832	111,050	861,782	11/89	147,500
Hidaway & Trib.	743,113	140,863	602,250	19/81	146,010
Wilson Cr.	343,300	93,060	250,240	27/73	5,020
NFJD River					
Side channels	1,057,398	815,424	241,974	77/23	242,700
Main channel	5,674,145	3,240,294	2,433,851	43/57	761,750

* Pool area was calcualted based on pools of 0.7 foot depth or greater. All other pools were added to the riffle area because they were considered to be less than adequate for successful juvenile rearing.

NORTH FORK JOHN DAY RIVER

	REACH LENGTH		AVE. REACH WIDTH	TOTAL SURFACE AREA	POOL AREA LENGTH		AVE. WIDTH	SURFACE AREA	RIFFLE AREA LENGTH		AVE. WIDTH	SURFACE AREA	P/R RATIO	AVE. GRAD.	SPAWNIN GRAVEL	
	FT.	MI.	FT.	SQ. FT.	TOTAL FT.	AVE. FT.	FT.	SQ. FT.	TOTAL FT.	AVE. FT.	FT.	SQ. FT.		%	SQ. FT.	COMMENTS
A	7330	1.39	55	403150	2350	235.0	60.7	159925	4010	334.2	58.9	184535	46/54	0	21600	shallow pools, grazing
B	5980	1.13	67	400660	1490	248.3	65.8	164450	2680	297.8	68.9	178302	47/53	0	5600	gravel mixed with rubble
C	3615	0.68	55	198102	1475	166.1	51.3	117025	645	92.1	45.4	68600	57/43	1	4250	cutbanks up to 20' high
D	4920	0.93	80	393600	2340	292.5	90.0	251300	1600	177.8	78.3	174200	59/41	0	284500	rock placement, many redds
E	6390	1.21	93	594270	1910	212.2	95.6	257000	2550	318.8	97.5	341800	43/57	0	140100	rock deflectors, redds
F	3330	0.63	99	329670	920	184.0	108.0	134000	1470	245.0	101.7	196300	41/59	0	60000	suction dredging
G	7185	1.36	63	452655	3800	345.5	61.8	254225	2185	242.8	64.4	137858	65/35	0	53070	silt,tailings,2'cutbanks
H	3955	0.75	47	185855	1500	300.0	41.0	74265	2005	286.4	45.7	116975	39/61	0	800	rock placement,deflectors
I	3065	0.58	48	147120	1315	328.8	50.0	121950	1450	241.7	48.3	72900	63/37	0	2000	structures, bank cutting
J	3405	0.64	50	170250	2060	294.3	51.4	165980	745	149.0	44.0	49200	77/23	0	33800	start of side channels
K	1600	0.30	69	110400	665	221.7	83.3	114360	190	63.3	40.0	42920	73/27	1	14800	bank up to 11' high
L	2405	0.46	64	153920	1420	284.0	59.0	175905	255	85.0	50.0	39690	82/18	1	70000	roc weirs,sills,deflectors
M	4835	0.92	67	323945	3135	285.0	67.3	248190	1020	145.7	60.0	99100	73/27	0	7300	cutbank up to 30' high
N	2665	0.50	61	162565	1960	217.8	64.4	217570	60	40.0	62.5	28470	88/12	0	34400	leaking side channel
O	3275	0.62	45	148275	1770	295.0	42.5	87815	1690	281.7	47.5	83700	51/49	1	0	structures,willows planted
P	4720	0.89	38	179360	2210	313.7	36.4	115925	1835	305.8	38.3	90575	56/44	1	2300	more structures, plantings
Q	2955	0.56	45	132975	1055	131.9	41.9	68660	1300	216.7	47.5	80655	46/54	1	1000	beaver dam in side channel
R								44486				26123	63/37	1	15000	side channel #13
S	1875	0.36	65	121875	1210	172.9	81.4	175045	270	135.0	50.0	31960	85/15	1	24400	rock structures, redds
T	1090	0.21	66	71940	730	182.5	61.3	72705	30	30.0	75.0	13480	84/16	1	99200	rock placement, weirs, sill
U	1970	0.37	56	110320	1140	228.0	75.0	164750	270	135.0	62.5	46850	77/23	1	34600	many rock & log deflectors
V	4190	0.79	64	268160	1310	218.3	68.3	161090	370	185.0	55.0	112050	59/41	1	26500	excellent poo , redds
W								251500				414250	38/62	0	59900	side channels #17A, 18, 19
X	3130	0.59	63	197190	2040	226.7	67.6	172950	215	53.8	50.0	44550	80/20	1	24500	right bank stabilizing
Y								97615				9560	91/9	1	20800	side channel #19
Z	3350	0.73	57	219450	770	154.0	51.0	38570	1280	213.3	45.8	129550	41/59	1	500	two leaks into side channel
AA	3215	0.61	34	109310	1130	226.0	42.0	91075	1460	208.6	33.6	62170	59/41	1	9000	side channels leak
AB	1885	0.36	37	69745	700	175.0	32.5	54789	715	178.8	42.5	51976	51/49	1	10000	side channels end
T.	92855	17.57	53	5654762	40425	228.4	59.6	4103120	30320	172.7	54.4	2950299	63/37	1	1067220	

WILSON CREEK

	REACH LENGTH FT.	MI.	AVE. REACH WIDTH FT.	TOTAL SURFACE AREA SQ. FT.	POOL AREA LENGTH TOTAL FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	RIFFLE AREA LENGTH TOTAL FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	P/R RATIO	AVE. GRAD. %	SPAWNING GRAVEL SQ. FT.	COMMENTS
A	1385	0.26	18.3	25346	940	104.4	18.3	24070	115	28.8	14.3	8480	97/3	1	1100	grazing damage, no good gravel
B	1725	0.33	16.8	28980	770	70.0	17.7	44730	95	31.7	15.7	10900	80/20	2	750	many rainbow, less bank damage
C	1960	0.37	17.6	34496	730	56.2	16.0	25900	90	45.0	17.0	9940	72/28	2	500	rainbow & suckers common
D	1675	0.32	17.5	29313	695	58.0	18.9	22030	120	60.0	12.5	11120	66/34	1	400	start of numerous structures
E	1785	0.34	19.7	35165	680	52.3	20.5	24080	40	13.3	18.3	9865	71/29	2	200	log,stump & boulder placements
F	1530	0.30	16.1	25438	765	47.8	18.4	21060	135	33.8	11.3	10540	67/33	2	0	deflectors & weirs continue
G	1340	0.25	15.1	20234	490	32.7	15.7	15060	15	7.5	16.0	4805	76/24	2	20	side channel blocked
H	1165	0.22	15.3	18131	485	32.3	17.4	14940	25	12.5	6.0	4250	78/22	2	250	more structures,7'high cutbank
I	1250	0.24	16.5	21120	625	37.1	17.5	16820	45	15.0	11.0	4570	79/21	2	300	pools excavated, more weirs
J	1755	0.33	13.5	23693	755	44.4	15.8	18820	50	16.7	8.3	4865	79/21	4	950	much rock & log placement
K	1990	0.38	12.6	23880	545	32.1	14.4	15695	45	22.5	7.0	2365	87/13	5	300	cascade; passage difficult
L	1315	0.25	12.6	16569	775	45.6	16.1	16035	70	14.0	4.6	2360	87/13	3	250	more pools dug, rock weirs
T	18975	3.59	16.0	302365	8255	51.2	17.2	259240	845	25.0	11.8	84060	78/22	2	5020	

CLEAR CREEK

	REACH LENGTH FT.	MI.	AVE. REACH WIDTH FT.	TOTAL SURFACE AREA SQ. FT.	POOL AREA LENGTH TOTAL FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	RIFFLE AREA LENGTH TOTAL FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	P/R RATIO	AVE. GRAD. %	SPAWNING GRAVEL SQ. FT.	COMMENTS
A	1945	0.37	22	42790	715	59.6	22.8	16160	1230	94.6	21.7	28365	36/64	1	2350	four redds, 2 dead chinook
B	2015	0.38	26	52390	1215	86.8	26.2	32095	590	59.0	25.5	16820	66/34	1	3250	boulder placement,weirs
C	1405	0.27	29	40745	705	50.4	29.3	24150	530	66.3	26.1	18580	57/43	1	3250	rock placement, weirs, redds
D	2395	0.45	26	62270	1475	105.4	25.3	45065	660	73.3	25.8	29900	68/32	1	19300	deeper pools than downstream
E	1872	0.35	30	56160	1040	80.0	30.1	35545	707	64.3	28.9	27495	57/43	1	5800	yellow-boy from mine on left
F	1580	0.30	30	47400	735	66.8	30.9	26400	845	93.9	27.8	24210	64/36	1	1900	bank cutting
G	2285	0.43	26	59410	1155	88.8	28.6	40585	605	75.6	22.8	21545	59/41	1	12450	pollution from Congo Gulch
H	2125	0.40	25	53125	1435	95.7	26.3	41460	485	69.3	20.4	13950	79/21	1	5300	rock placement, sills, riprap
I	1620	0.34	27	49140	1090	77.7	27.4	36800	340	68.0	24.0	13360	73/27	2	3350	Blackjack Mine effluent enters
J	1435	0.27	22	31570	1230	111.8	21.3	29830	195	48.8	18.8	7685	80/20	1	13300	between series of log weirs
K	1285	0.24	27	34695	1075	59.7	28.2	32055	210	30.0	25.6	5930	84/16	2	2250	rock placement, 15 log weirs
L	1300	0.25	26	33800	1025	56.9	26.7	37215	105	53.0	23.5	3240	92/8	2	1500	riprap entire reach, 14 wiers
M	880	0.17	28	24640	880	46.3	28.3	24115	0			0	100/0	3	1300	weir staircase, no riffles
BEAVER CREEK																
A	1095	0.21	13	14235	720	48.0	13.1	8880	190	23.8	12.3	2590	77/23	1	2200	willows, 6 log weirs, riprap
T	23437	4.43	25.5	602370	14495	73.9	26.0	430655	6692	63.1	23.3	213670	71/29	1	77500	

FIVEMILE CREEK

	REACH LENGTH FT.	MI.	AVE. REACH WIDTH FT.	TOTAL SURFACE AREA SQ. FT.	POOL AREA TOTAL LENGTH FT.	AVE. LENGTH FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	RIFFLE AREA TOTAL LENGTH FT.	AVE. LENGTH FT.	AVE. WIDTH FT.	SURFACE AREA SQ. FT.	P/R RATIO	AVE. GRAD. %	SPANNING GRAVEL SQ. FT.	COMMENTS
A	1569	0.30	13	20397	537	53.7	17.8	17512	0	0.0	0.0	2615	87/13	3	2050	abundant 1-2" trout, dace
B	1381	0.26	12	16572	351	35.1	15.7	14609	10	10.0	3.0	2930	83/17	5	1250	cascade; passage difficult
C	2157	0.41	13	28041	557	55.7	17.1	23095	0	0.0	0.0	5090	82/18	3	850	increasing gradient
D	945	0.18	12	11340	410	41.0	16.5	10520	50	16.7	7.3	1415	88/12	4	50	ends with chute barrier
E	2633	0.50	12	31596	568	51.6	16.3	26102	15	15.0	10.0	3660	88/12	6	650	gradients up to 10%,willow
F	2250	0.43	18	40500	535	44.6	22.3	30625	0	0.0	0.0	6980	82/18	4	800	cattle reduce sedge cover
G	2190	0.42	16	35040	645	49.6	19.3	29825	10	10.0	2.0	8305	78/22	4	800	wide,shallow, more rainbow
H	1737	0.33	15	26055	342	50.3	16.6	20028	0	0.0	0.0	7110	74/26	2	100	algae choked shallow pools
I	1882	0.36	13	24466	502	41.8	15.6	22095	10	10.0	4.0	4215	84/16	5	950	ends above rd. 140 bridge
J	2110	0.40	16	33760	600	50.0	19.5	28240	15	15.0	12.0	5170	85/15	4	550	decreasing gradient
K	1440	0.27	15	21600	515	46.8	21.3	18740	0	0.0	0.0	4770	80/20	4	600	less algae than downstream
L	1673	0.32	16	26768	475	43.2	22.5	19585	18	9.0	6.5	4828	80/20	6	500	increasing gradient
M	2065	0.39	13	26845	520	40.0	17.5	20370	88	44.0	6.5	6734	75/25	4	200	cascades have passage
N	2095	0.40	14	29330	520	43.3	16.8	19435	90	45.0	13.5	11020	64/36	5	1400	variable gradient & width
O	1230	0.23	13	15990	565	47.1	17.6	14705	90	18.0	7.4	3400	81/19	6	1950	cascade has passage
P	1785	0.34	15	26775	655	54.6	19.8	22380	185	92.5	10.0	5795	79/21	4	650	decreasing gradient
Q	1885	0.36	16	30160	445	44.5	16.9	21990	115	57.5	21.0	10345	68/32	3	350	poor gravel, grazing
R	2685	0.51	9	24165	275	39.3	9.6	13315	35	17.5	8.0	11910	53/47	2	1700	begin subsurface flow
S	2645	0.50	14	37030	615	51.3	18.2	24805	15	15.0	12.0	9320	73/27	3	300	narrow canyon, big pools
T	2750	0.52	13	35750	430	47.8	16.0	15990	15	15.0	10.0	6450	71/29	3	350	begin streamside logging
U	2443	0.46	13	31759	398	49.8	16.4	12740	195	97.5	3.5	9400	58/42	2	1600	gradient decreases
V	2665	0.50	7	18655	425	60.7	12.9	12215	20	20.0	10.0	8055	60/40	1	6700	grazing damage lower reach
W	962	0.18	11	10582	210	30.0	12.9	8640	32	10.7	8.0	2140	80/20	1	500	only a few 1-9" rainbow
X	1961	0.37	11	21571	557	50.6	13.3	15505	35	11.7	7.0	9865	61/39	1	4400	heavy grazing continues
Y	2275	0.43	9	20475	240	40.0	11.8	10685	0	0.0	0.0	12200	46/54	1	11900	severe grazing impacts
Z	2155	0.41	8	17240	485	69.3	12.3	12005	190	63.3	5.3	8850	58/42	1	5300	all pools <5" mean depth
AA	3130	0.59	8	25040	230	57.5	12.5	9170	0	0.0	0.0	19050	36/64	1	3950	many shallow riffle/pools
AB	3135	0.59	8	25080	540	67.5	11.1	11650	105	35.0	3.7	13845	46/54	2	2950	shallow pools, few rainbow
AC	2730	0.52	5	13650	435	39.5	8.6	9480	20	20.0	1.0	2385	80/20	1	6250	only one pool >4" deep
AD	1787	0.34	5	8935	282	23.5	9.4	3989	145	36.3	2.5	2075	66/34	2	1300	much lodgepole deadfall
AE	2720	0.52	6	16320	345	43.1	8.6	3625	200	50.0	3.5	1510	71/29	2	6600	upper half all subsurface
AF	2517	0.48	4	10068	282	31.3	5.7	2277	100	20.0	1.8	355	87/13	1	4600	heavily grazed floodplain
AG	2075	0.39	6	12450	510	42.5	7.1	5500	130	32.5	3.0	1965	74/26	1	2600	private land, grazing
AH	1550	0.29	6	9300	715	47.7	8.7	8255	225	32.1	3.0	1700	83/17	1	590	Gilman Ranch fenced off
AI	2647	0.50	6	15882	257	36.7	7.4	2644	170	34.0	4.0	1505	64/36	1	2450	severe logging damage
AJ	1892	0.36	6	11352	512	46.5	7.8	6078	180	30.0	4.2	1875	76/24	1	2550	improved channel & veg.
AK	1320	0.25	8	10560	605	50.4	10.2	6855	165	23.6	5.0	1510	82/18	1	1000	poor gravel continues
AL	1520	0.29	9	13680	830	55.3	12.9	11255	150	25.0	4.7	2190	84/16	1	150	much logging debris, silt
AM	1425	0.27	8	11400	1045	69.7	11.5	13305	165	16.5	5.5	1410	90/10	1	400	heavy elk use, logging
AN	1500	0.28	10	15000	745	49.7	13.5	12890	45	11.3	7.3	2365	84/16	1	350	deeper pools, more trout
AO	1790	0.34	6	10740	605	50.4	7.5	6510	100	25.0	3.3	890	88/12	1	1650	more logging debris, silt
AP	1550	0.30	7	10850	945	63.0	8.3	8475	95	13.6	3.3	765	92/8	1	250	good riparian veg. & banks
AQ	1515	0.29	5	7575	1030	68.7	7.3	8250	75	9.4	2.4	625	93/7	1	100	good habitat, no fish seen
AR	1620	0.31	5	8100	725	55.8	6.1	6425	120	15.0	3.1	1480	81/19	1	60	no gravel, becomes marshy
t	87991	16.69	10	896444	23015	48.4	13.6	622389	3423	23.2	5.2	230072	75/25	2	84250	

SILVER CREEK															
A	2239	0.42	3	6717	124	15.5	8.0	1958	35	35.0	1.0	495	78/22	7	1050 gradient 6-9%, few fish
B	3572	0.68	1	3572	52	13.0	7.5	706	0	0.0	0.0	370	66/34	4	1000 decreasing gradient
t	5811	1.1	2	10289	176	14.25	7.75	2664	35	17.5	0.5	865	72/28	6	2050
TAYLOR CREEK															
A	3080	0.58	6	18480	420	46.7	9.8	6730	55	27.5	4.0	7540	47/53	2	2000 heavy algae growth
B	3000	0.57	3	9000	145	36.3	9.0	3290	0	0.0	0.0	2965	53/47	2	1300 logging, grazing, dogwood
C	3655	0.69	9	32895	490	70.0	14.4	6940	0	0.0	0.0	920	88/12	1	3200 severe logging & grazing
D	4015	0.76	5	20075	90	30.0	7.3	1540	0	0.0	0.0	950	62/38	1	6800 logging impacts severe
E	1650	0.31		0	0			0	0			0		0	6500 all subsurface, no shade
F	2535	0.48	4	10140	280	35.0	6.6	2245	55	27.5	2.5	735	75/25	1	4400 water temperature 25 C
G	1452	0.28	6	8712	657	46.9	8.6	6440	270	33.8	2.8	2250	74/26	1	550 severe cattle damage
H	3372	0.64	6	20232	397	44.1	7.0	3566	85	42.5	2.0	510	87/13	1	16450 eroded cutbanks trampled
t	22759	4.31	5	119534	2479	38.6	7.8	30751	465	16.4	1.4	15870	69/31	1	41200
TRIBBLE CREEK															
A	4034	0.76	3	12102	44	14.7	4.0	342	0	0.0	0.0	50	87/13	1	3400 mostly subsurface, logging
B	1900	0.36	5	9500	815	58.2	7.1	8360	80	20.0	4.5	2595	76/24	1	600 gravel is silted, 1 trout
C	2030	0.38	5	10150	845	65.0	7.0	9075	35	17.5	3.0	1710	84/16	1	250 cattle damage, more trout
D	3490	0.66	5	17450	945	78.8	7.8	13400	0	0.0	0.0	2830	83/17	1	100 severe cattle damage
t	11454	2.16	5	49202	2649	54.2	6.5	31177	115	9.37	1.9	7185	83/17	1	4350
SUGARBOWL CREEK															
A	1835	0.35	4	7340	290	29.0	7.8	5305	125	41.7	3.0	2115	71/29	1	750 logging debris, silt
B	1840	0.35	6	11040	440	48.9	10.6	6825	135	45.0	5.3	3300	67/34	1	250 poor rd. design, logging
C	2970	0.56	8	23760	280	46.7	13.2	4755	115	28.8	4.5	1545	75/25	1	2550 logging, goes subsurface
D	3005	0.57	6	18030	315	52.5	7.3	2565	240	48.0	3.4	940	73/27	1	5050 grazing & logging damage
E	2856	0.54	6	17136	271	33.9	7.6	2568	130	32.5	4.5	745	78/22	1	1700 severe grazing damage
F	3785	0.72	6	22710	35	35.0	6.0	210	0	0.0	0.0	0	100/0	1	4300 more bank destruction
G	2792	0.53	7	19544	107	21.4	8.6	966	20	20.0	1.0	20	98/2	1	1050 many logjams, cutbanks 4'
t	19083	3.62	6	119560	1738	38.2	8.7	23194	765	30.8	3.1	8665	80/20	1	15650
T	147098	27.88	6	1197029	30057	38.7	8.9	710175	4803	19.4	2.4	262657	75/25	2	147500

HIDAWAY CREEK

	REACH LENGTH		AVE. REACH WIDTH	TOTAL SURFACE AREA	POOL AREA				RIFFLE AREA						
					LENGTH		AVE. WIDTH	SURFACE AREA	LENGTH		AVE. WIDTH	SURFACE AREA	P/R RATIO	AVE. GRAD. %	SPAWNING GRAVEL
	FT.	MI.	FT.	SQ. FT.	TOTAL FT.	AVE. FT.	FT.	SQ. FT.	TOTAL FT.	AVE. FT.	FT.	SQ. FT.			SQ. FT. COMMENTS
A	750	0.14	15	11250	320	64.0	19.2	6990	430	71.7	6.0	6730	51/49	1	3150 much good spawning gravel
B	471	0.09	16	7536	187	46.8	27.5	5395	284	56.8	10.0	3464	61/39	1	4750 abundant rainbow trout 1, 2-6"
C	792	0.15	14	11088	265	44.2	17.8	8170	347	49.6	13.0	6620	55/45	2	4620 natural log weirs, good gravel
D	1197	0.23	16	19152	550	50.0	18.7	12153	597	54.3	12.8	8960	58/42	1	3425 braided channel, low gradient
E	1364	0.26	16	21824	342	38.0	17.1	9957	162	40.5	16.3	10257	49/51	1	3095 lots of large woody material
F	707	0.13	16	11312	512	64.0	18.4	10206	185	30.8	13.5	3015	77/23	0	6500 much good spawning gravel
G	814	0.15	14	11396	523	58.1	19.3	10697	216	30.9	8.3	2373	82/18	0	3400 rainbow and dace abundant
H	729	0.14	12	8748	505	63.1	17.1	10580	107	17.8	9.3	2072	84/16	0	4650 braiding, some marsh,log weirs
I	577	0.11	17	9809	365	73.0	23.4	11960	67	16.8	8.0	3430	78/22	1	4750 two dead 5" rainbow trout
J	1338	0.25	14	18732	481	43.8	13.5	6836	857	85.7	13.4	12537	35/65	2	1230 increasing gradient, logjam
K	656	0.12	11	7216	384	38.4	14.5	6391	262	26.2	7.7	2094	75/25	1	2780 floodplain widens, gradient 1%
L	1104	0.21	15	16560	740	61.7	20.2	17510	209	23.2	10.6	4075	81/19	1	3050 ungulates reduced bank cover
M	1434	0.27	15	21510	1003	66.9	15.7	17651	281	25.5	13.3	5026	78/22	1	4650 potential logjam barriers
N	445	0.08	18	8010	240	80.0	16.7	4050	205	68.3	19.0	4530	47/53	0	450 dry meadow, grazing impacts
O	797	0.15	12	9564	473	36.4	14.6	7067	324	27.0	10.2	3155	69/31	1	2300 algae remains abundant
P	498	0.09	14	6972	305	76.3	17.5	6450	93	23.3	10.0	1575	80/20	1	2050 logging to stream edge begins
Q	989	0.19	12	12264	477	59.6	17.7	13003	172	34.4	9.4	3615	78/22	1	3560 trees felled accross stream
R	913	0.17	14	12782	426	53.5	18.1	9491	160	22.9	10.9	3244	75/25	2	2900 debris, high logjam potential
S	1019	0.19	13	13247	516	51.6	16.2	12601	388	55.4	10.1	5184	71/29	1	2400 logging ends, logjams continue
T	1253	0.24	12	15036	620	44.3	14.6	10860	233	29.1	7.9	4114	73/27	1	2325 windthrow, logjams continue
U	973	0.18	15	14595	565	56.5	18.3	13351	340	42.5	11.5	4935	73/27	2	2950 long side channel near camp
V	1166	0.22	14	16324	741	57.0	16.1	14379	330	36.7	10.8	4263	77/23	3	2225 increasing gradient
W	910	0.17	12	10920	382	38.2	16.2	8967	163	23.3	6.9	3416	72/28	2	1200 decreasing gradient, braiding
X	1157	0.22	11	12727	673	48.1	12.1	10168	354	32.2	9.6	6042	63/37	3	1220 dry meadow,gradient +
Y	1199	0.23	13	15587	424	32.6	16.3	6815	640	33.0	10.3	8160	46/54	3	900 dense timber, grazing impacts
Z	1045	0.20	12	12540	355	44.4	13.6	7680	215	35.8	12.5	5565	58/42	3	2800 ends where Line Cr. enters
AA	1312	0.25	12	15744	247	30.9	14.9	7488	240	48.0	12.6	9560	44/56	2	2000 logjams, spur road ford
AB	965	0.18	14	13510	180	30.0	16.3	6265	50	50.0	15.0	7890	44/56	5	550 gradient increase,logjam
AC	2104	0.40	14	29456	335	27.9	16.3	12380	12	12.0	12.0	14729	46/54	5	550 logjams & falls have passage
AD	2292	0.43	11	25212	177	29.5	14.0	11256	75	75.0	14.0	12385	48/52	3	2600 more logjams have passage
AE	545	0.10	12	6540	175	35.0	14.0	3920	0	0.0	0.0	2255	63/55	3	550 logjam may be a barrier
AF	1985	0.38	11	21438	220	31.4	15.1	10680	65	32.5	7.0	12395	46/54	3	3650 spruce still dominant
AG	1019	0.19	13	13247	314	34.9	16.7	8165	90	40.5	6.5	3760	68/32	2	1150 valley narrows, 1-8" rainbow
AH	1657	0.31	10	16570	317	35.2	15.3	10080	150	37.5	4.8	7400	58/42	3	1350 first weir stakes seen
AI	1077	0.20	12	12924	147	36.8	17.3	7064	0	0.0	0.0	5785	55/45	5	500 gradient increases 3 to 7%
AJ	2195	0.42	10	21950	110	27.5	11.0	10300	0	0.0	0.0	12780	45/55	6	450 pumping sampler station
AK	1780	0.34	9	16020	160	80.0	10.0	8475	30	30.0	4.0	10865	44/56	6	750 natural log weirs, logjams
AL	2243	0.42	11	24673	323	46.1	13.9	10021	0	0.0	0.0	11655	46/54	2	3480 big slide, log weirs, meadows
AM	1813	0.34	8	14504	266	53.2	9.4	5090	122	61.0	8.5	7507	40/60	3	2900 logjams have passage, falcon
AN	1485	0.28	9	13365	225	75.0	9.0	5220	0	0.0	0.0	7695	40/60	5	1950 gradient decreases to 1%
AO	2165	0.41	10	21434	605	50.4	14.2	15010	85	21.3	4.8	4445	77/23	2	8300 log wiers, more shading
AP	1470	0.28	9	13230	775	51.7	11.2	10430	260	28.9	4.8	2540	80/20	1	7400 enters meadows,bank cutting
AQ	1985	0.38	10	19850	950	63.3	13.1	15360	155	38.8	6.8	4335	78/22	1	9800 much ungulate damage to banks
AR	2010	0.38	9	17085	895	74.6	10.3	14280	165	33.0	7.4	4430	76/24	1	7200 cutbanks up to 5'high
AS	2685	0.51	6	16110	545	49.5	7.2	10725	20	10.0	6.0	3630	75/25	1	6650 meandering through meadow
AT	2145	0.41	5	10725	320	80.0	7.0	8895	0	0.0	0.0	2570	76/24	1	6900 lodgepole pine dominant
t	59229	11.19	12	680288	19662	50.7	15.4	450482	9140	32.9	8.6	277062	63/37	2	146010

LINE CREEK															
A	855	0.16	4	3420	0	0.0	0.0	930	110	110.0	6.0	2710	26/74	8	75 steep, no spawning gravel
UNNAMED CREEK															
A	2516	0.48	5	12580	145	36.3	7.3	9290	0	0.0	0.0	2374	80/20	1	5550 elk meadows, many rainbows
B	1125	0.21	4	4500	50	50.0	8.0	2860	0	0.0	0.0	1045	73/27	1	1650 heavy algae growth
t	3641	0.69	5	17080	195	43.2	7.7	12150	0	0.0	0.0	3419	77/23	1	7200
T	62870	11.88	8	697368	19857	46.9	11.5	462632	9140	16.4	4.3	280481	63/37	2	153210