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TABLE OF CONTENTS

CLACKAMAS RIVER SUBBASIN

Abundance, behavior, and habitat utilization by coho salmon and Steelhead trout in Fish Creek, Oregon, as influenced by habitat enhancement - USFS PNW Forest and Range Experiment Station — Separate Supplement

Collawash River Habitat Improvement - Mt. Hood National Forest (NF) Project No. 84-11 — 1

Collawash Falls Fish Passage Project - Mt. Hood NF Project No. 84-11 — 39

HOOD RIVER SUBBASIN

Lake Branch Rearing Habitat Improvement - Mt. Hood NF Project No. 84-11 — 103

FIFTEENMILE CREEK SUBBASIN

Fifteenmile Creek Basin Habitat Improvement Project Project No. 84-11 — 1 3 5

JOHN DAY RIVER SUBBASIN

John Day River Habitat Enhancement - Oregon Department of Fish and Wildlife Project No. 84-21 — 211

North Fork John Day River Habitat Improvement - Umatilla NF Project No. 84-8 — 222

Upper Mainstem John Day River Habitat Improvement Project - Malheur NF Project No. 84-22 — 261

UMATILLA RIVER SUBBASIN

Fish Passage improvements at Three Mile Falls Diversion Dam, Umatilla River, Oregon - Bureau of Reclamation Project No. 83-436 — 267

Habitat Quality and Anadromous Production Potentials on the Warm Springs Indian Reservation - Warm Springs Tribe Project No. 8lS-8 — 461

GRANDE RONDE RIVER SUBBASIN

Grande Ronde Habitat Improvement Project Joseph Creek and Upper Grand Ronde River - Oregon Department of Fish and Wildlife Project No. 84-25 — 359

Grand Ronde River Habitat Enhancement - Wallowa-Whitman NF Project No. 84-9 — 397

Collawash River Habitat Improvement Project

Annual Report FY 1985

by

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Division of Fish and Wildlife

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TABLE OF CONTENTS

INTRODUCTION 7

DESCRIPTION OF STUDY AREA 7

METHODS AND MATERIALS 8

RESULTS AND DISCUSSION 11

SUMMARY OF EXPENDITURES 13

APPENDIX A - PROJECT AREA MAPS 14

APPENDIX B - PROJECT PHOTOS 16

APPENDIX C - PRE-PROJECT MONITORING MAP (PANSY CR.) 30

LIST OF FIGURES

FIGURE 1 - DRILL AND DELAY PATTERN FOR HOLDING POOLS ON FALLS #3 (NOHORN CREEK)

FIGURE 2 - DRILL AND DRAY PATTERN FOR JUMP POOLS ON FALLS #3 (NOHORN CREEK)

LIST OF PHOTOGRAPHS

PANSY CREEK

LOGJAM BEFORE PARTIAL REMOVAL

LOGJAM AFTER PARTIAL REMOVAL

LOGJAM BEFORE BLASTING

LOGJAM AFTER BLASTING

MODIFIED WATERFALL

BOULDER/RIFFLE HABITAT

BOULDER BERMS DURING HIGH FLOWS

UPPER LOG SILL BEFORE INSTALLATION

UPPER LOG SILL AFTER INSTALLATION

ALCOVE SITE BEFORE EXCAVATION

ALCOVE DURING HIGH FLOWS

POOL #5 BEFORE BLASTING

POOL #5 AFTER BLASTING

NOHORN CREEK

WATERFALL #3

LOWER HOLDING POOL BEFORE BLASTING

UPPER PORTION OF WATERFALL #3

HOLDING POOLS IN UPPER PORTION OF FALLS

LOWER PORTION OF WATERFALL BEFORE BLASTING

FALLS UPON COMPLETION OF WORK

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Abstract

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

In the first year of a multi-year effort to improve fish habitat in the Hot Springs Fork drainage, passage enhancement on two tributaries and channel rehabilitation on one of those tributaries was completed. Three waterfalls on Nohorn Creek were evaluated and passage improved on the upper most waterfall to provide Steelhead full access to 2.4 miles of good quality habitat. The work was completed in October 1985 and involved blasting three Jump pools and two holding pools into the waterfall. On Pansy Creek, four potential passage barriers were evaluated and passage improvement work conducted on two logjams and one waterfall. Partial removal of wood on one logjam was performed with a six person crew usi ng handtool s. The second logjam was partially removed by blasting with dynamite. Minor modifications were made to a waterfall to increase flow into a side channel which allows passage around the waterfall. The work was completed with a two person crew using handtools. Channel rehabil itation efforts on Pansy Creek (RM 0.0 - 0.3) to Increase low flow pool rearing habitat and spawning habitat included blasting five pools into areas of bedrock substrate and using a track-mounted backhoe to construct instream structures. On site materials were used to construct three log sills, three boulder berms, a boulder flow deflector, and five log and boulder structures. Also, an alcove was excavated to provide over-winter rearing habitat. Prior to project implementation pre-proJect monitoring consisting of physical and biological data collection was completed In the project area. Project work on Pansy Creek was initiated in August 1985 and compl eted in September 1985.

Introduction

The Hot Springs Fork is a fourth order tributary to the Collawash River, entering the mainstem at RM 4.0. Mainstem length is 14.6 miles and the basin area is 60 square miles. The entire watershed is on National Forest System lands. The Hot Springs Fork supports natural production of spring chinook, coho salmon, and winter Steelhead. In addition, the Oregon Department of Fish and Wildllfe (ODFW) annually outplant summer Steelhead to provide a summer sport fishery. Major tributaries to the Hot Spings Fork Include Pansy, Nohorn, Alice, and Whetstone Creeks. Migration barriers on the mainstem and tributaries and reductions in rearing habitat complexity limit anadromous fish productton in the drainage.

In 1985, the first year of a multi-year habitat improvement program in the Hot Springs Fork sub-drainage, passage enhancement on Pansy and Nohorn Creeks and channel rehabilitation on Pansy Creek was conducted to improve steel head production on these two tributaries (see Appendix A: Project Area Maps and Appendix 8: Project Photos). Two barrier logjams and one waterfall were modified on Pansy Creek to allow Steelhead access to three miles of good quality habitat. Channel rehabilitation from RM 0.0 to 0.3 on Pansy Creek included constructing logsills, boulder berms, excavating an alcove, and blasting pools into bedrock substrates to improve spawning and rearing habitat. On Nohorn Creek three falls were evaluated for fish passage conditions and the uppermost waterfall was modified to Improve passage conditions. This will help Steelhead fully seed and utilize 2.4 miles of good quality habitat above the falls.

BPA funded the projects under the Clackamas/Hood River Habitat Enhancement, Project 84-11 agreement. A combined total of $27,197 was budgeted for project planning and implementation of the two projects in 1985. Expenditures for completion of the two projects totalled $27.027.24. Benefits derived from the projects include Improved anadromous fish access to over four miles of habitat and the creation of approximately 437 M^2 of low flow pool rearing habitat.

Description of Study Area

Pansy Creek is a third order tributary which enters the Hot Springs Fork at RM 5.1. It supports populations of Steelhead and resident trout. Flood events have greatly impacted the habitat on Pansy Creek. Two logjams (RM 0.75 and 0.8), apparently set up by floods, acted as migration barriers preventing steel head access to two miles of good habitat. In addition to these passage obstructions, two waterfalls (RM 0.6 and 0.65) 'were reviewed for possible assage problems. Minor modifications were necessary on the upper waterfall and partial removal of wood from the logjams to Improve passage in Pansy Creek. Floods also scoured large portions of the channel, from the mouth to RM 0.3, to bedrock. As a result, in-channel structure was limited and little spawning and pool rearing habitat remained. This section of Pansy Creek is typified by areas of boulder/riffles interspersed with reaches of bedrock. The gradient varies from l-3%, but an incised channel with limited floodplain development makes it *a* high energy system in the project area.

Nohorn Creek Is a fourth order tributary which enters the mainstem at RM 6.6. it also supports Steelhead and resident trout. The mainstem Is 6.8 miles long with 4.5 miles suitable for anadranous utilization. Three waterfalls In the first mile of Nohorn Creek (RM 0.3, 0.7, and 0.8) were identified as partial passage barriers. In 1980 a project funded and Implemented by the Forest Service used explosives to modify the three fal Is to Improve passage. Passage was improved at the lower two falls but passage was still marginal at the third fal Is. The waterfall rises a total of 18 feet over a 100 foot distance. The steep lower portion of the falls is a series of three Jumps (4, 3, and 2.5 feet high) followed by a slot of fast water. The upper portion *of* the fal I s Is a broad (40 feet wide) bedrock chute with shallow, laminar flows across the width. A series of pools were blasted in 1980 to improve the Jump conditions in the lower portion of the falls and to provide holding water in the upper portion. The pools created were too smal I and sal low to significantly improve passage. Additional work was needed to enlarge and deepen the existing pools to improve passage over the fails at a broader range of flows.

Methods and Materials

An evaluation of all the potential passage obstructions in the first mile of both tributaries (3 waterfalls on Nohorn and 2 waterfalls and 2 logjams on Pansy) and solutions to Improve passage were completed by Glyn Steiner of Construction Consulting Services in July 1985. He Identified the need to alter the two logJams and one waterfall on Pansy Creek and one waterfall on Nohorn Creek. A Forest Service geologist examined the bedrock type and rook competency In the areas to be blasted and provided recommendations for drilling and blasting strategies based on the condition of the bedrock.

Passage enhancement on Pansy Creek centered on creating passage at the second waterfall and the total barrier logjams. Partial removal of the logjam at RM 0.75 was accomplished with a six person crew using chain saws. Wood was removed from the head of the Jam where a nine foot high waterfall dropped through a tangle of logs. Selective removal of wood redirected the flow away from the nine foot drop to an area with a five foot drop and clear passage. The second logJam (RM 0.8) set up between two large boulders with the stream f I I ter ing through the wood. Partial removal of the Jam was required to al low upstream passage of steel head. Rather than using a crew with hand tool s, a case of 40% gel dynamite was used to remove the Jam. Sticks of dynamite were attached to key structural components of the jam to ensure its bred<-up. Minor work was also performed on a waterfall at RM 0.65. A boulder plug was removed from the head of a h igh f I ow channel that prov ided passage around the waterfall. This allows more water into the channel so passage is possible during a broader range of flows.

Channel rehabilitation on Pansy Creek involved treating the boulder/riffles and bedrock areas from RM 0.0 to 0.3. The primary objective was to increase low flow pool rearing habitat with secondary benefits of improving spawning habitat. Prior to implementation, pre-project monitoring was conducted in the project area to measure and map the existing habitat conditons (Appendix CL Fish sampling in one control and four treatment (2 bedrock, 2 boulder/riffle) sites was also conducted at this time to measure pre-project densities of salmonids. Post-project monitoring in subsequent years w I I help to determinethe projects effectiveness in meeting the habitat objectives and any corresponding change in fish densities.

Rearing and spawning habitat improvements In the boulder/riffle areas involved the use of a large track-mounted backhoe to construct three log sills, three boulder berms, a boulder flow deflector, and the excavation of an off-channel rearing area (alcove). Selected logs and boulders along the banks were also pulled Into the stream to Increase the amount of channel structure and to provide cover. Access for the the backhoe was from the north across the Hot Springs Fork to the mouth of Pansy Creek. The machine was walked up the channel to the head of the project area and worked downstream. On site materials (boulders and downed woody debris) were utilized in the construction of instream structures. Two cedars were felled and bucked for use In two of the log sills.

The log sills were designed to increase rearing habitat by impounding water upstream and by scouring pools in the plunge immediately downstream. The lower two log sills were located in an area where the left bank was *a* bedrock wail. Originally, expansion bolts and cable were going to be used to anchor the sills to this bank but the bedrock was weathered and breaking. Instead, the sills were keyed into the right bank 13-15 feet and ballasted with large boulders. The upper log sill was keyed into both banks and the keys backfilled with boulders.

Spawning habitat in the project area is expected to increase at the log sills with gravel deposition in the upstream pools, and with the construction of three bould der berms. 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. Boulders for the berms were col lected from the immediate area and arranged in a "V" shape with the vertex poi nti ng downstream. The vertex is the lowest point in the structure, providing a slot to improve the scouring action bel ow each berm. The accumul ation of boul ders that form the berms should also provide overwintering habitat for Juvenile Steelhead and resident trout. Additional overwintering habitat was created by excavating an alcove along the stream margin. The alcove wil I provide protected, quiet water habitat during periods of high flows in the main channel. A boulder flow deflector was constructed to help divert flows into the alcove and to Increase the water velocity by the mouth of the alcove to minimize the chance of bedload deposition sealing it off.

Rearing habitat was also created by blasting pools in the bedrock reaches. Five pool s were created in this manner. Pool sites were chosen where a slight increase in the stream gradient existed. This was done to take advantage of the streams f I ush ing capacity In these areas to hel p keep the created pool s clear of excessive bedload deposition. Two portable rock drills (a Pionjar and Cobra) were used during the drilling for each site. Dynamite (40% gel) and instantaneous blasting caps were used for the demoliton. Rock debris which remained in a pool after the initial blast was removed with subsequent blasts. Even after these clearing blasts, a significant amount of smaller material remained In the pools. This material was left to flush out with high flows.

Work on the Nohorn Creek waterfalls was originally scheduled for September but was delayed due to rain. The project was rescheduled and work began on the third falls in October. The plan for the third falls involved enlarging and deepening the three Jump pool s in the lower portion of the falls and creating two holding pools to provide a fishway in the upper portion. Materials and labor were provided by the Forest Service and Steiner was contracted to do the drilling layout, loading, and detonation of the pools. The project area is fairly remote so two portable rock drills were used. Prior to drilling, each site was dewatered by using sandbags to divert flows. Work began on the two holding pools in the upper portion. These were located to take advantage of existing pools. The upper holding pool was drilled 10 feet long, 3 feet wide, and 2.5 feet deep. The lower pool in the fishway enlarged and deepened the existing pool to a length of 12 feet, width of 3 feet, and a depth of 2 feet. A similar drill and delay explosive pattern (Fig. 1) were used on the two holding pools.

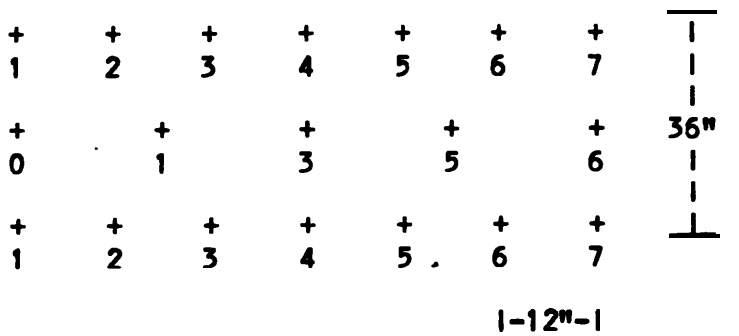


Figure 1. Drill and delay pattern for holding pools on Falls #3.

Dynamite (40% gel) and delay blasting caps were used for the demolition and the holding pools were lifted in two shots. The rock debris which remained from the shots was left to be flushed from the pools during high flows. The procedure was similar for blasting the three Jump pools in the lower portion of the falls. Working on three existing pools, the plan was to deepen than so they provided steps up the face of the falls. The pools were located In a braid of the falls which created a narrow slot. To keep the energy of the explosion from blowing out and greatly enlarging rather than deepening the pools, a tighter drill pattern was used and the delays layed in a spiral fashion (Fig. 2). The holes were drilled to a depth of 2 feet.

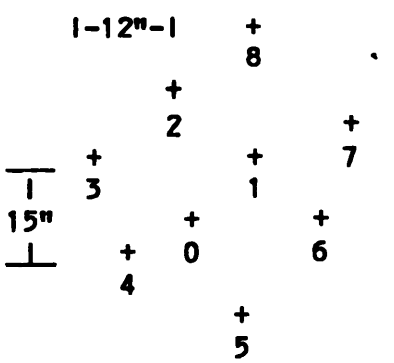


Figure 2. Drill and delay pattern for Jump pools on Falls #3.

The spiral design of the delays helped bore holes into the rock while working in a confined space. Again, the rock debris was left to wash out with high flows.

Results and Discussion

All work items scheduled were completed within the time and budget estimates in the contract between the Forest and BPA. Passage conditions on Pansy Creek were improved at the two logjams and one waterfall. Different methods of removing wood at the logjams were used. The use of explosives to clear the one Jam proved to be very quick and effective and saved on labor. A drawback of blasting logjams though is the loss of the ability to selectively remove wood to provide passage while maintaining the habitat complexity and sediment storing capabilities of the Jam. By blasting the logjam the sediment plain above the Jam was lost. At this particular logjam the loss was not significant and blasting was the preferred method. Selective removal on the lower logjam *was* necessary due to the larger sediment plain upstream of the Jam and the deposits of gravels that were suitable for spawning habitat.

The construction of eight structures in Pansy Creek using a large track-mounted backhoe was completed in August 1985. immediate gains in rearing habitat were made with the instal lation of the log sills. Large pools were created upstream of the structures and plunge pools began to form downstream. Approximate1 y 316 M^2 of pool habitat was created by the log sills.

The creation of overwinter quiet-water habitat also appeared successful upon review of the alcove during mean high water. The alcove provides approximately 28 M^2 of new overwinter habitat.

The effectiveness of the structures on increasing and improving spawning conditions was greater then anticipated for the first winter after implementation. initial observations indicate that the structures were fully seeded with gravel.

The creation of five pools by blasting into bedrock was completed in September 1985. Approximate1 y 93 M^2 of pool area was created with depths ranging from 2 to 4 feet. This phase of the Pansy Creek project was the most labor intensive and time consuming. The blasting site is fairly remote so two portable rook drills were used for the drilling. These proved to be slow and cumbersome to use. A high rate of fatigue was experienced during the drilling so a relatively large crew was used to keep people fresh and the drills operati ng constantl y.

The demolition of the pools was done with 40% gel dynamite and instantaneous blasting caps. While this proved to be effective, it was felt that a better product could have been achieved by using delay blasting caps, as were used on the Nohorn Creek waterfall. The instantaneous blasts tended to blow out the edges of the pools reducing the definition of the pool boundary and eliminating any lip at the head of the pools which would assist In pool scour. By controlling the direction of the blasts delay explosives would have given us sharper edges and a better plunge at the head of the pools.

The Nohorn Creek project was completed in October 1985. A total of three Jump pool s and two hoi ding pool s were bl asted Into the fal I s. The use of del ay explosives were essential in controlling the force and direction of the blasts to achieve the desired results. The project was successful in improving the Jump and holding conditions over the falls and it appears that passage will be possible over a broader range of stream flows.

Post-project monitoring in following years on Pansy Creek will map the physical habitat changes associated with the project as well as measure biological changes (salmonid densities) in the project area. Review of spawning areas upstream of modified passage barriers will help to determine the success of the passage Improvement work on Pansy and Nohorn Creeks.

In February 1986 a flood estimated as a l0-15 year event occurred in the Hot Springs Fork drainage. A review of the two project areas was made to determine the level of damage incurred during the flood. In additon to high flows in Pansy Creek, a landslide slid into the channel from RM 0.75 to 0.85. The introduction of landslide material coupled with the high flows re-established the logjam at RM 0.75 as a migration barrier. Additional removal of this Jam will be necessary to provide passage. In the area of the second Jam (RM 0.8) the stream had regraded and passage conditons are excellent. An evaluation of I andslide material that has clogged the channel between the two Jams w I I I be needed to determine if a new barrier was created. Debris had al so collected at the waterfall (RM 0.65) and sealed off the boulder side channel that cl rcumvents the fal I s. This material was removed by hand and water re-established into the channel at the time of review. Additional work coul d be conducted to prevent debris from depositing in the head of the side channel.

Damage to the channel rehabilitation efforts includes movement of boulders from two of the berms and boulder flow deflector, the alcove filling with sediments, movement of individually placed logs and boulders, and one of the blasted pool s f ll I ing with bedload. Bedload deposition was also greater than anticipated in the upstream pools created by the log sil Is resulting in a reduction of pool habitat. The energy of the flow scoured large pools below the sills and one berm, and al so cleaned four of the blasted pools of rock debris that remained following the project

No damage was noticed on Nohorn Creek. The project appeared In good shape and ail the rock debris which was left after blasting had flushed out.

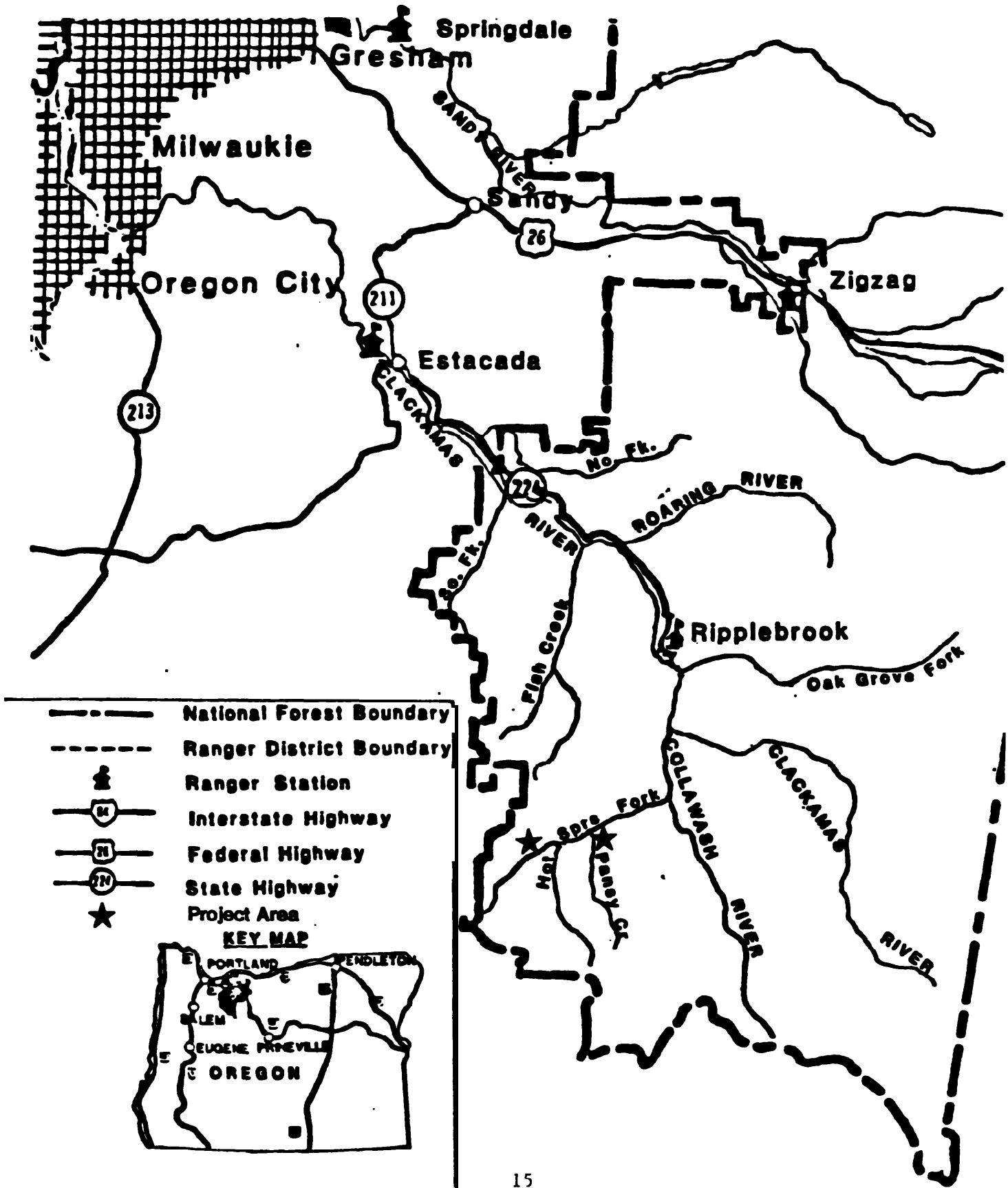
Summary of Expenditures

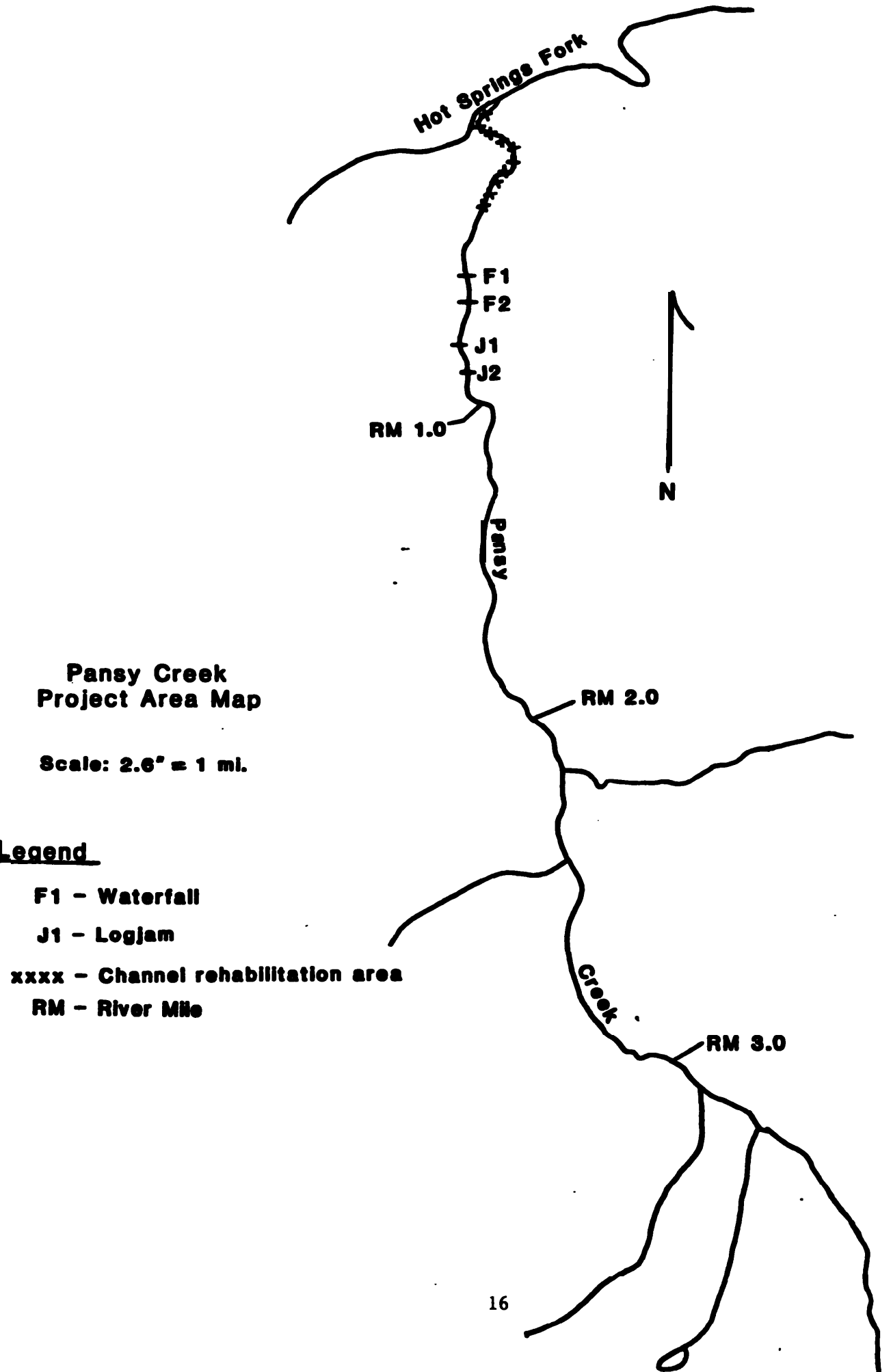
1.	Personnel	17.687.99
3.	Travel	521.03
5.	**Expendable equipment**	**1,218.80**
8.	Sub-contracts	**5,150.00**
9.	General Serv ices	105.45
10.	G&A Overhead (12%)	2.343.97
14.	Total Cost	$27.027.24

APPENDIX A:

PROJECT AREA MAPS

VICINITY MAP
HOT SPRINGS FORK SUB-DRAINAGE





Pansy Creek
Project Area Map

Scale: 2.6" = 1 mi.

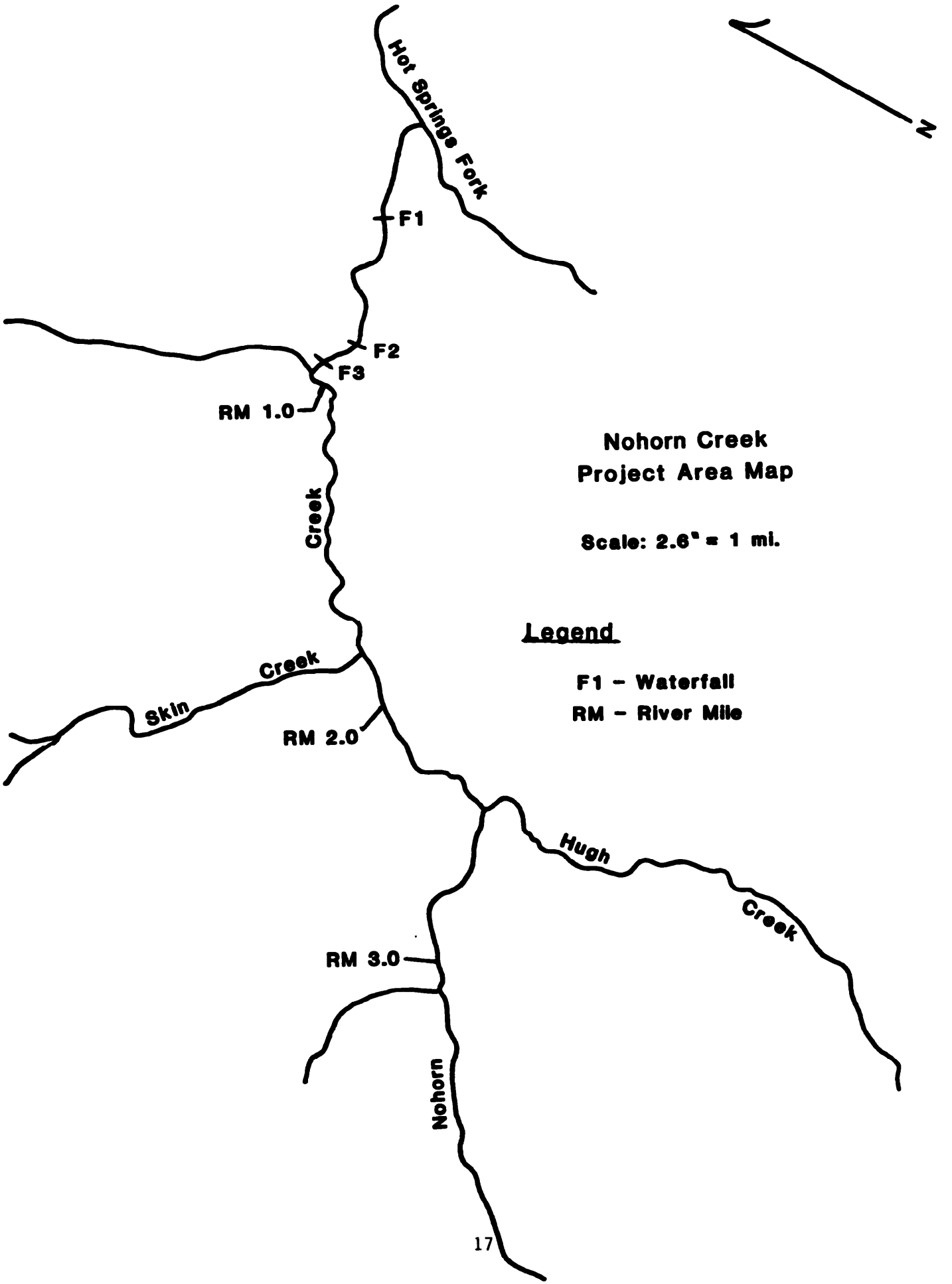
Legend

F1 – Waterfall

J1 – Logjam

xxxx – Channel rehabilitation area

RM – River Mile


Hot Springs Fork
N
F1
F2
F3
RM 1.0
Creek
Nohorn Creek
Project Area Map
Scale: 2.6" = 1 mi.
Legend
F1 - Waterfall
RM - River Mile
Skin
Creek
RM 2.0
Hugh
Creek
RM 3.0
Nohorn

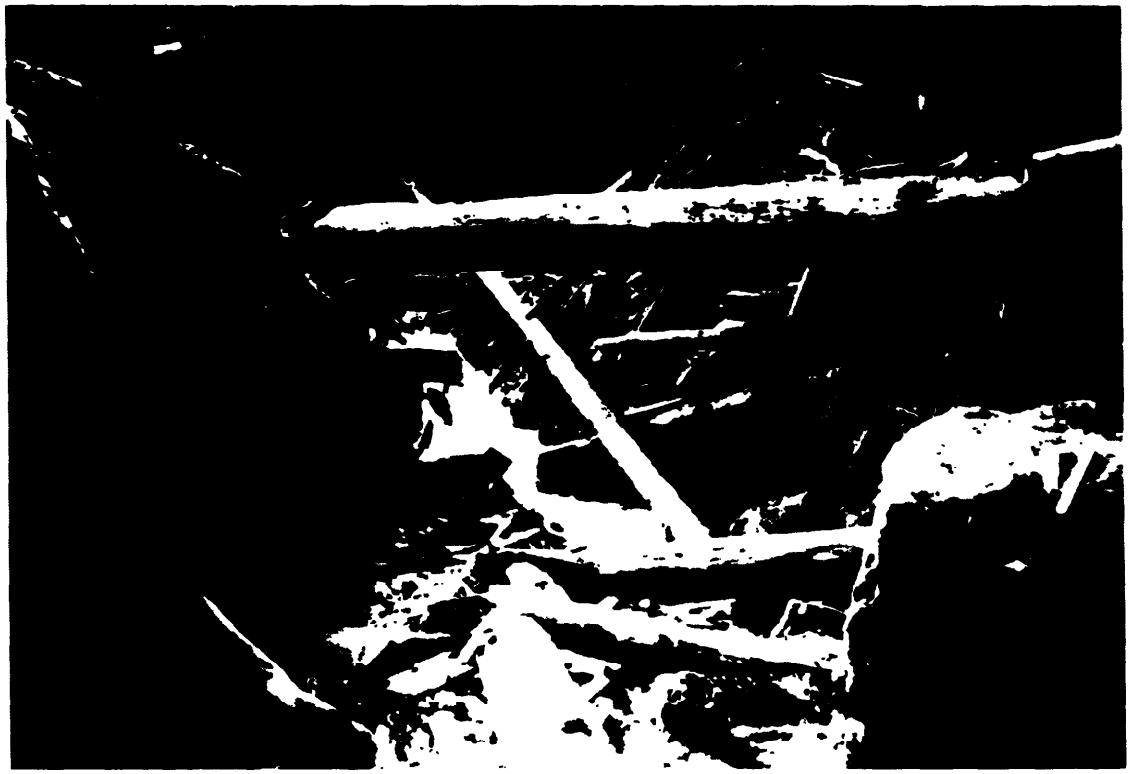
APPENDIX B:

PROJECT PHOTOS

This barrier logjam (RM 0.75) was partially removed to allow upstream passage for steelhead. The work was done by a six person crew using hand tools.

The logjam upon completion of the work.

Another barrier logjam (RM 0.8) was removed with explosives.



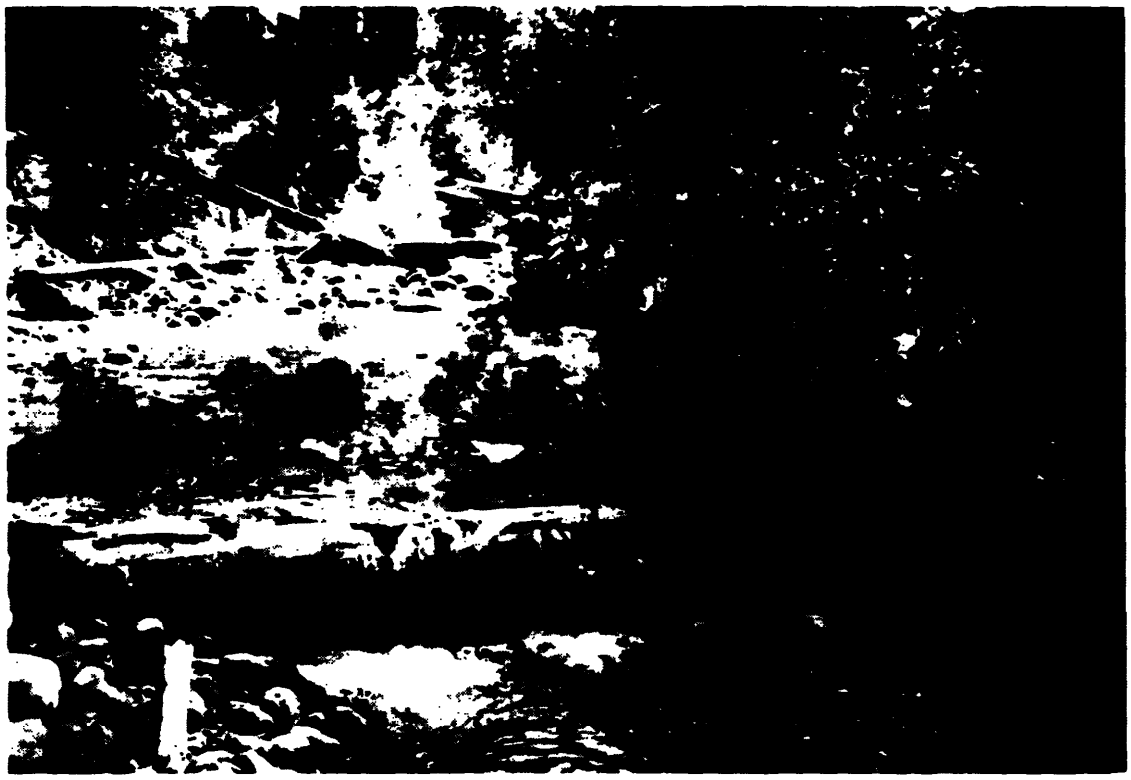
The logjam following the blast. Dynamite was attatched to key structural elements to insure the break-up of the jam.

The boulder channel (right side of photo) allows passage around this waterfall at RM 0.6 of Pansy Creek. A boulder plug was removed from the head of the channel, allowing more flow for improved passage.

Portions of the Pansy Creek project area are boulder/riffles that provide limited spawning and pool rearing habitat. Rehabilitation efforts using a backhoe were concentrated in these areas. This is a site prior to the construction of boulder berms.

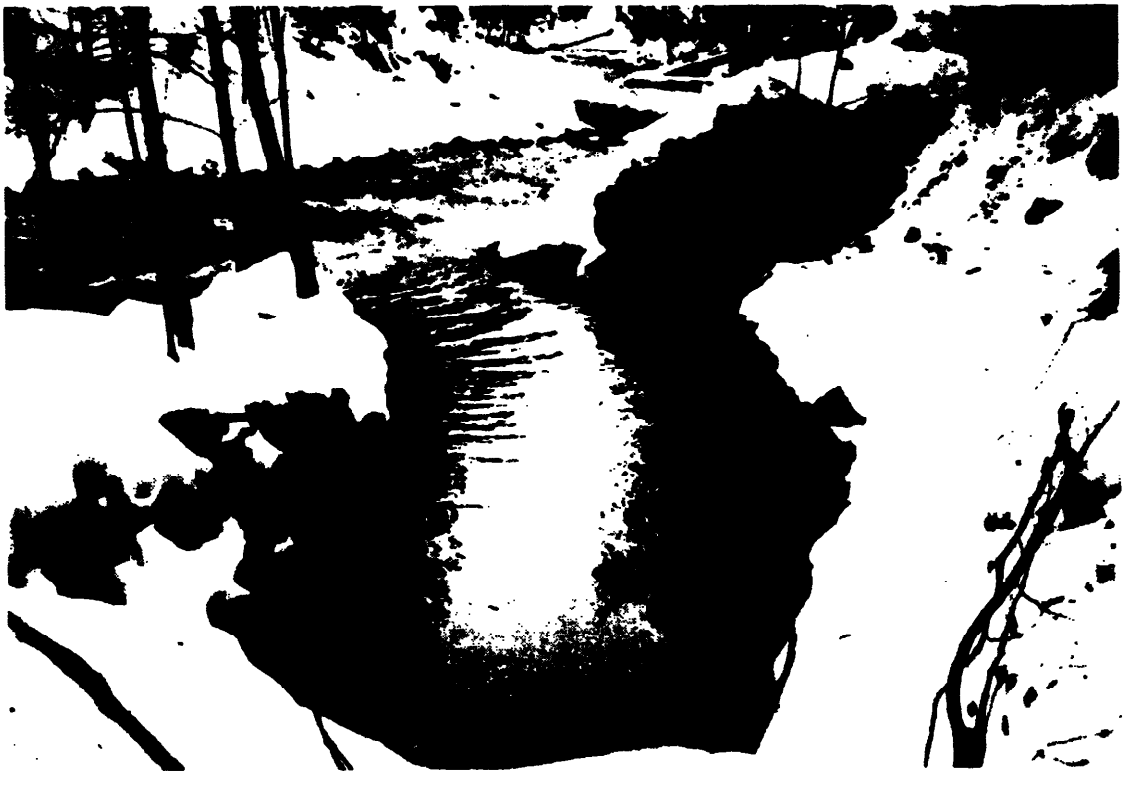
Two boulder berms during winter flows. The berms were designed to increase and improve spawning habitat by trapping gravels. These berms are located in the reach shown in the previous photograph.

On site materials were used in the construction of the boulder berms and the log sills. This downed tree was used for the upper log sill.



The log sills were designed to increase low flow pool rearing habitat. Gravel deposition in these pools should also improve spawning habitat. This is the upper log sill immediately after installation.

The backhoe moving into position to excavate an off-channel rearing area (alcove).



The alcove provides quiet water rearing habitat during periods of high flows.

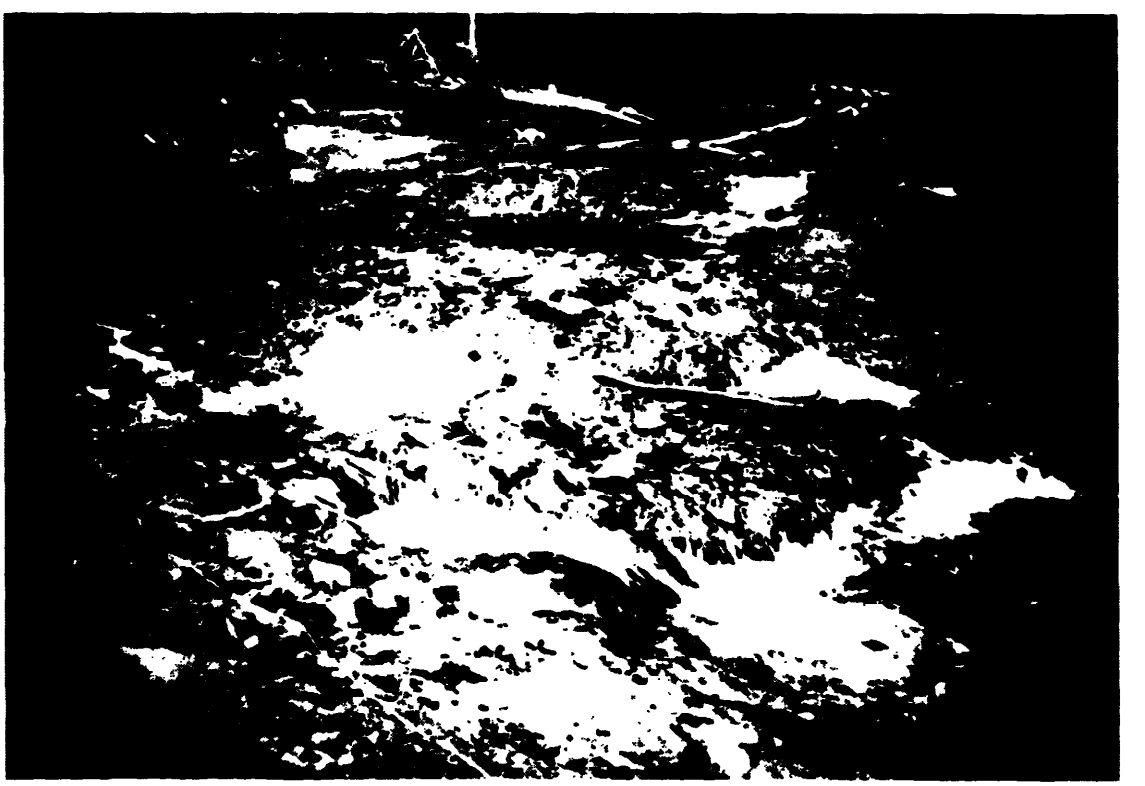
Large sections of the Pansy Creek channel have been scoured to bedrock. These areas are typically shallow with poor pool development. Note the water is only a few inches deep prior to blasting Pool #5.

Pool #5 immediately after being shot. Five pools were blasted into the bedrock substrate to increase low flow pool area. The person at left is standing on the original substrate. The rock debris remaining was cleared with another shot.

Waterfall #3 (RM 0.8) required additional work to improve passage. Two holding pools and three jump pools were blasted into the falls in October, 1985. This photo was taken in May, 1985.

The lower holding pool site prior to blasting. Shallows flows in the upper portion of the waterfall impaired fish passage.

Preparing the lower holding pool for the second shot. Workers in background are preparing the upper holding pool for the first shot.



The completed holding pools (upper two pools in photo) provide a fishway through the upper portion of the waterfall. Rock debris in the pools should be flushed out during high flows.

Looking down the steep lower portion of the falls prior to blasting jump pools into the narrow, dewatered slot.

A total of three jump pools were blasted into the middle braid (center of photo) to improve passage. Picture taken upon completion of work.

APPENDIX C:

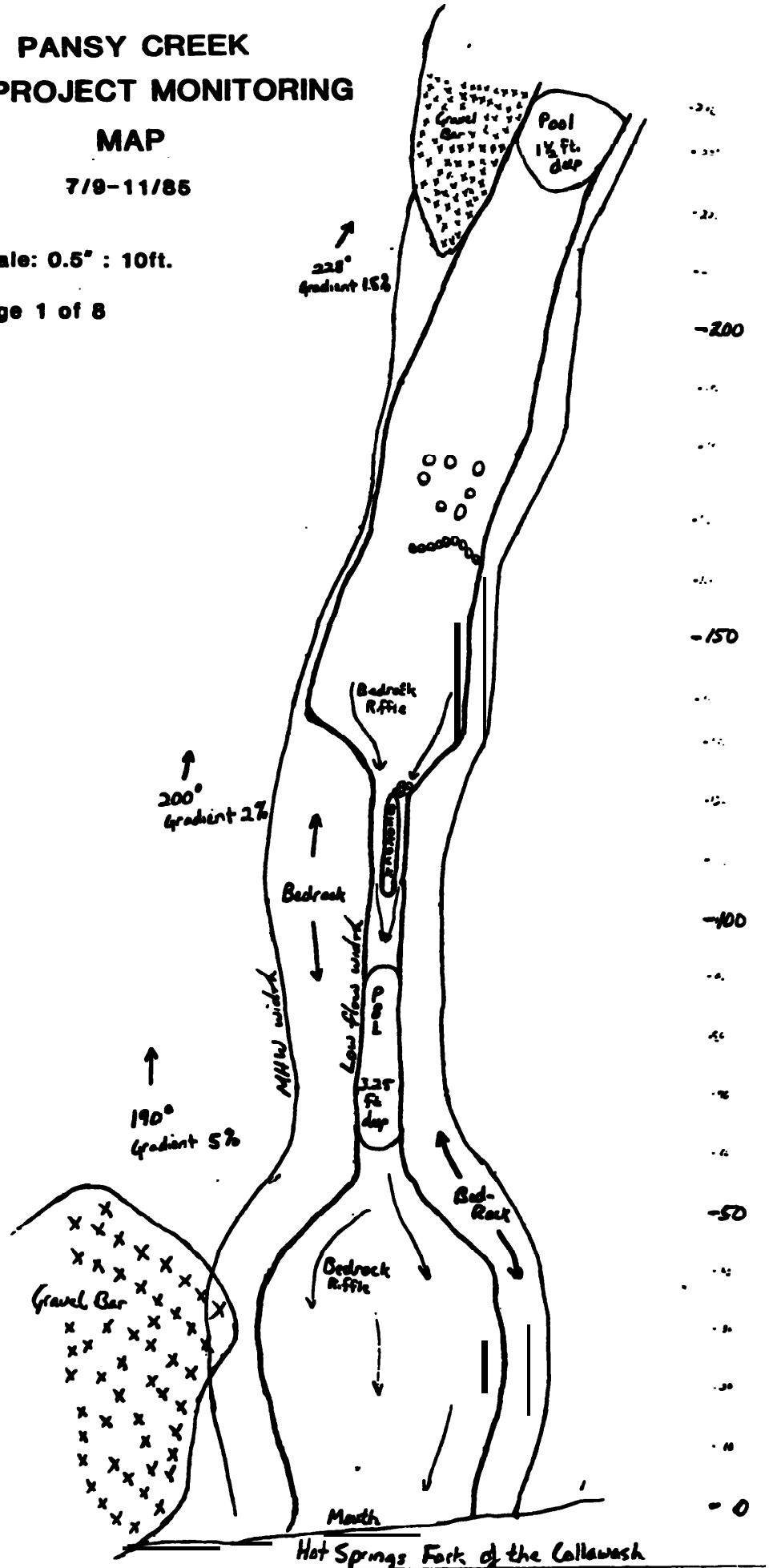
PRE-PROJECT MONITORING MAP

(PANSY CREEK)

PANSY CREEK
PRE-PROJECT MONITORING
MAP

7/9-11/85

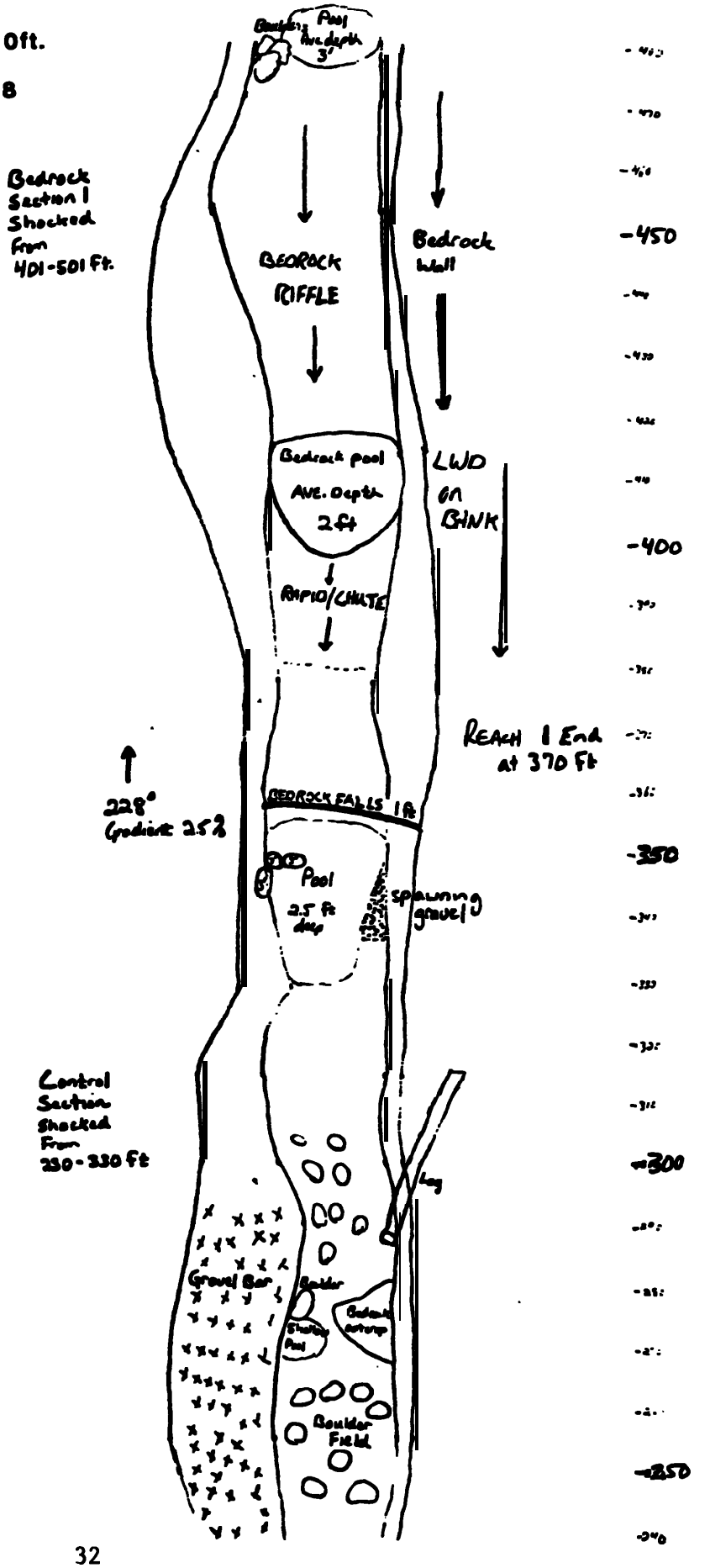
Scale: 0.5" : 10ft.



PANSY CREEK

Scale: 0.5" : 10ft.

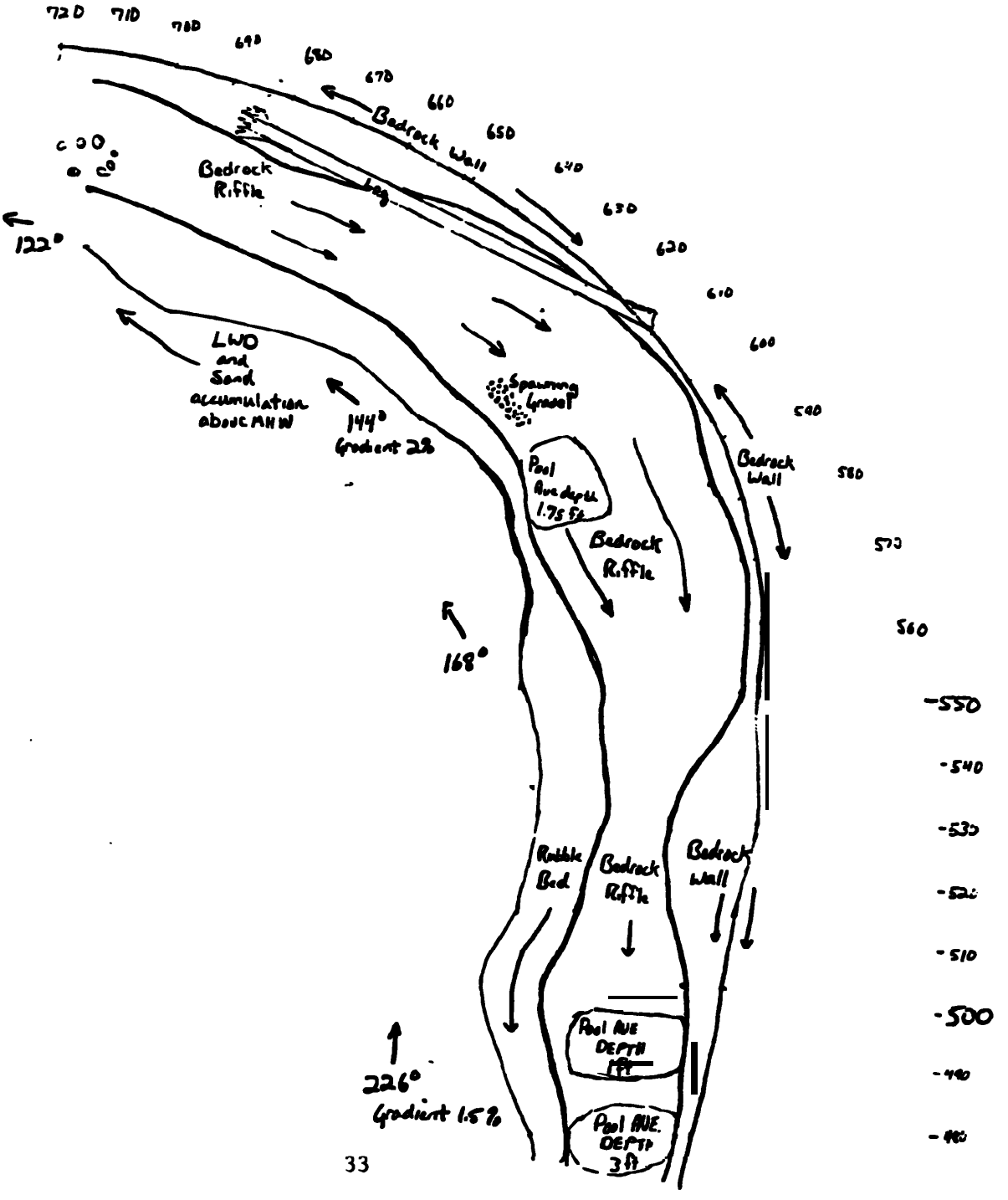
Page 2 of 8



PANSY CREEK

Scale: 0.5" : 10ft.

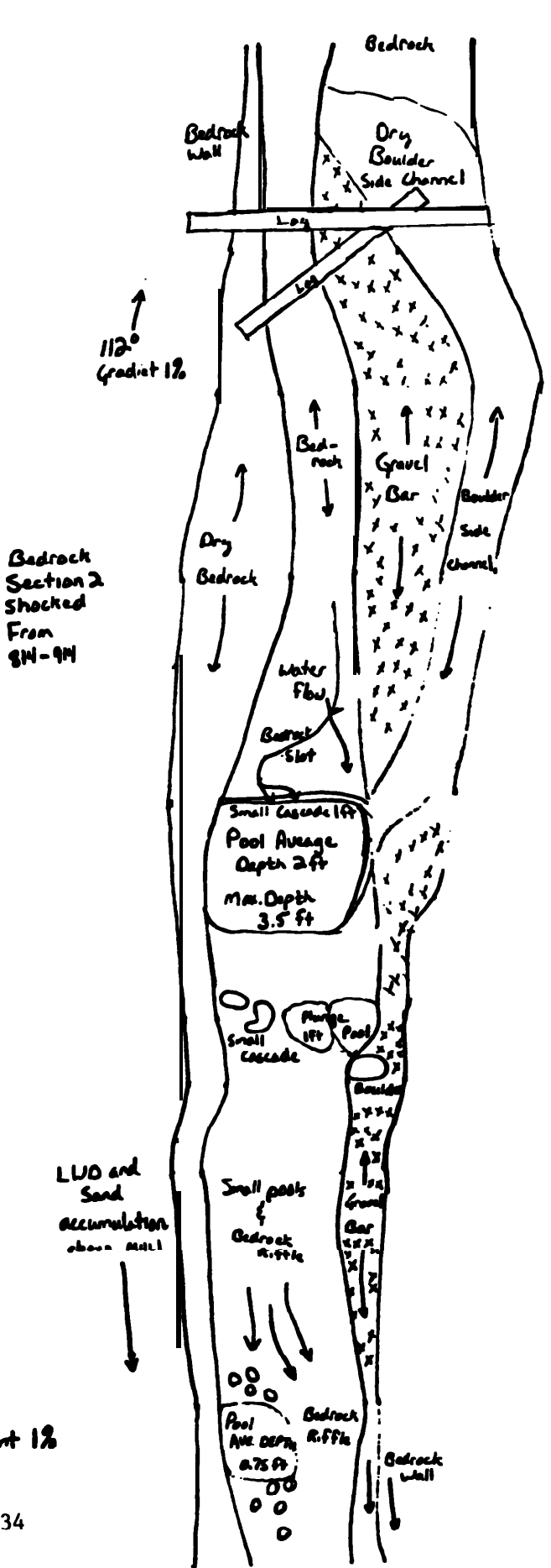
Page 3 of 8



PANSY CREEK

Scale: 0.5" : 10ft.

Page 4 of 8



PANSY CREEK

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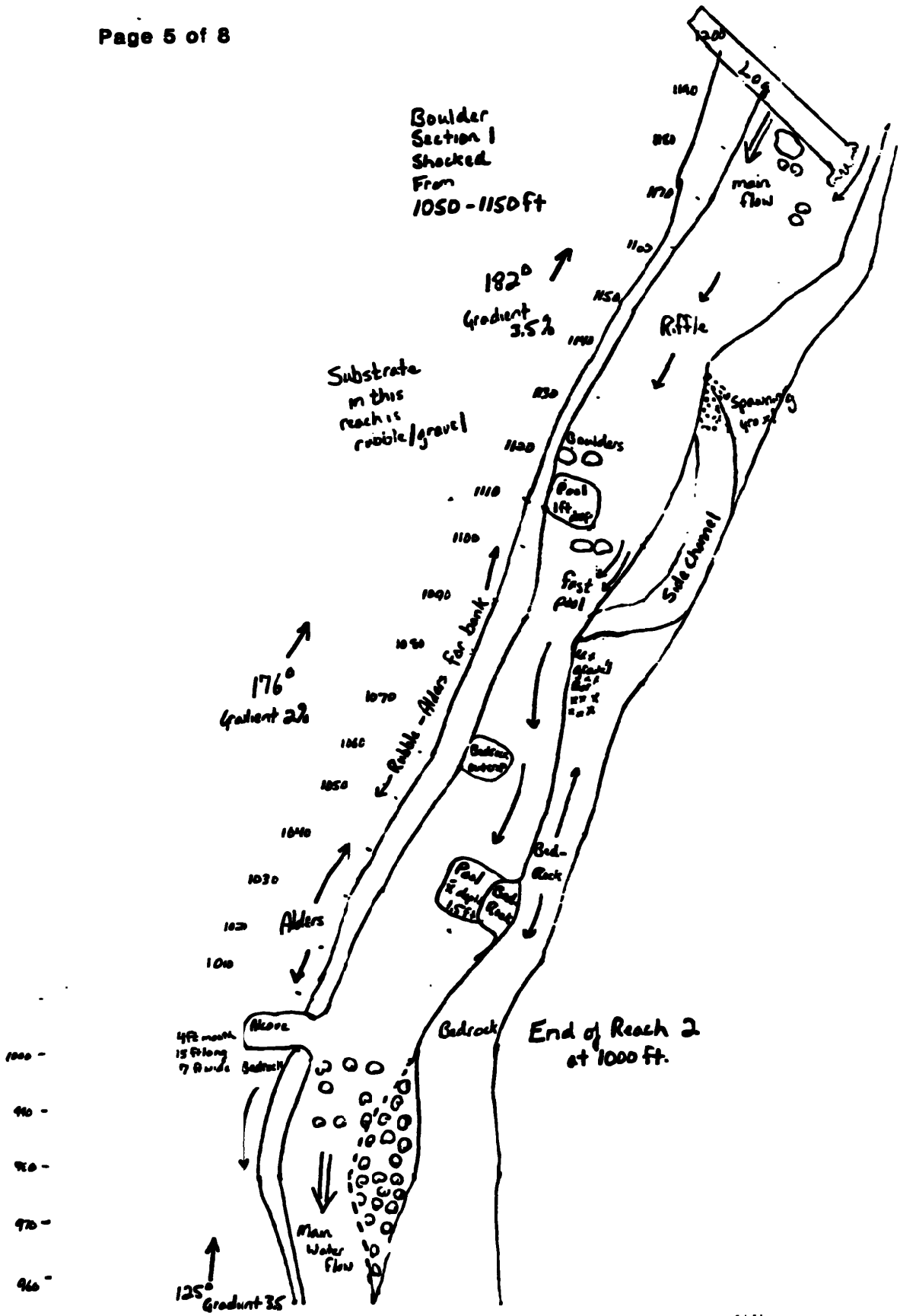
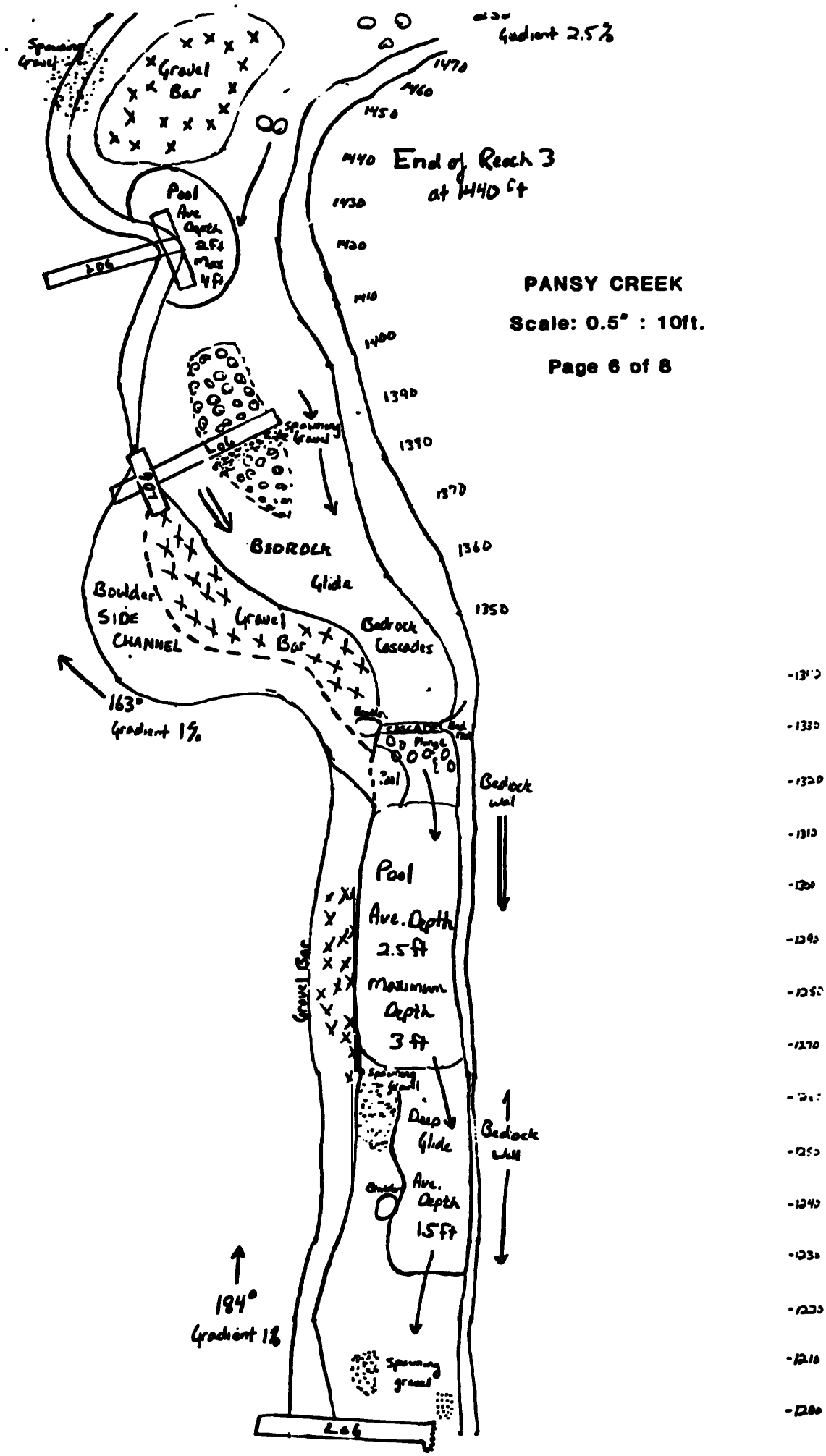
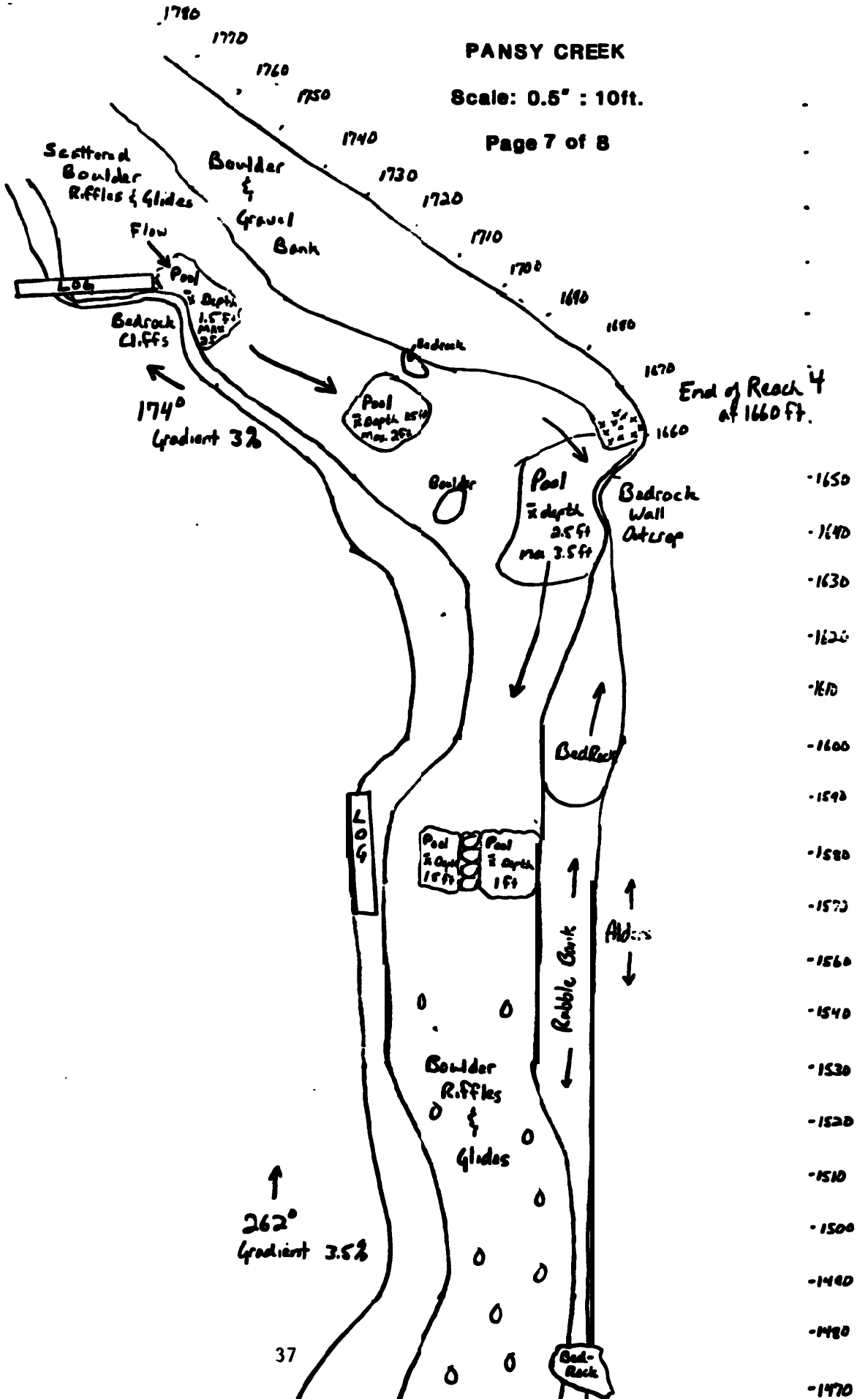



Gradient 2.5%
Spawning Gravel
Gravel Bar
1470
1460
1450
1440
End of Reach 3
at 1440 ft
1430
1420
1410
1400
1390
1380
1370
1360
1350
Pool
Ave Depth 2.5ft
Max 4ft
Log
Log
Log
Spawning Gravel
BEDROCK
Glide
Boulder
SIDE
CHANNEL
Gravel Bar
Bedrock Cascades
163°
Gradient 1%
Cascade
Plunge
Pool
Bedrock wall
Pool
Ave. Depth
2.5ft
Maximum
Depth
3 ft
Gravel Bar
Spawning gravel
Deep Glide
Bedrock wall
Ave. Depth
1.5ft
184°
Gradient 1%
Spawning gravel
Log
PANSY CREEK
Scale: 0.5" : 10ft.
Page 6 of 8


PANSY CREEK
Scale: 0.5" : 10ft.
Page 7 of 8
Scattered Boulder Riffles & Glides
Boulder & Gravel Bank
Flow
Pool
Log
Bedrock Cliffs
174°
Gradient 3%
Bedrock
Pool
Boulder
Pool
x̄ depth 2.5 ft
max 3.5 ft
Bedrock Wall Outcrop
End of Reach 4 at 1660 ft.
BedRock
Log
Pool
x̄ depth 1 ft
Pool
x̄ depth 1 ft
Rubble Bank
Alders
Boulder Riffles & Glides
262°
Gradient 3.5%
Bed-Rock
1790
1770
1760
1750
1740
1730
1720
1710
1700
1690
1680
1670
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1640
1630
1620
1610
1600
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1500
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1480
1470

PANSY CREEK

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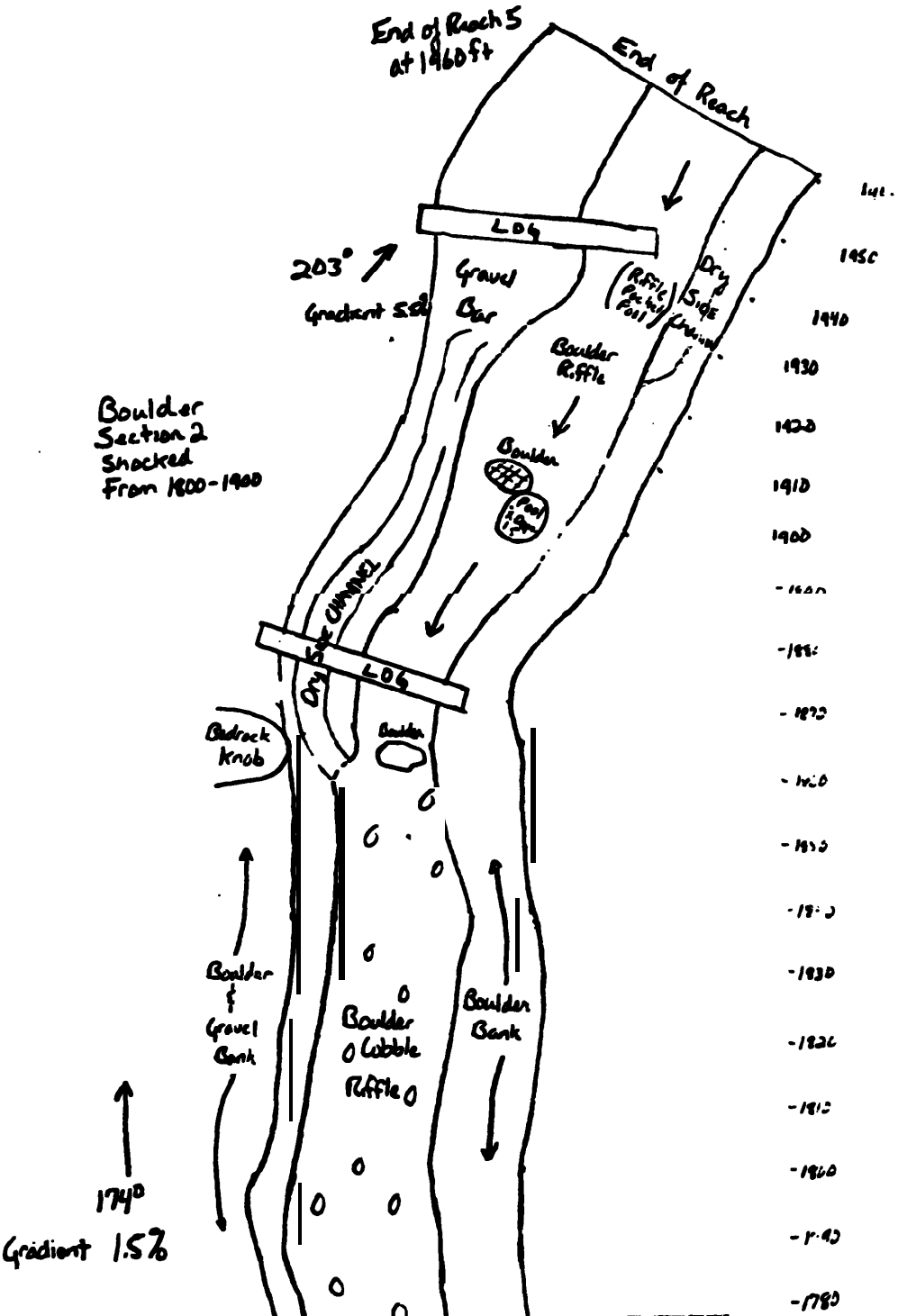

Collawash Falls Fish Passage Project

Final Report

by

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Bonneville Power Administration
Division of Fish and Wildlife
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September, 1985

TABLE OF CONTENTS

CHAPTER		PAGE
1	SUMMARY	44
	Purpose of the Project	44
	Description of the Work Accomplished	44
	Discussion of Passage Alternatives	45
	INTRODUCTION	47
	Authority	47
	Subcontract&H	47
	Scope of Work	47
3	EXISTING CONDITIONS	49
	Fish	54
	Topography	55
	Geology	55
	Hydrology	63
4	OPPORTUNITIES AND CONSTRAINTS	68
	Fish	68
	Hydraulics and Hydrology	68
	Geology	69
	Hydrology	71
	Construction	72
5	PASSAGE ALTERNATIVES	74
	Passage Alternatives Considered	74
	Passage Alternatives Selected	74
	Alternative 1 - Raising Tailwater	74
	Layout	74
	Operation	77
	Diversion and Care of Water	77
	Materials of Construction	78
	Methods of Construction	78
	Safety During Construction	79
	Longevity	79
	Likelihood of Successfully Passing Fish	81
	Alternative 2 - Pool Excavation	82
	Layout	82
	Operation	84
	Diversion and Care of Water	84
	Materials of Construction	84
	Methods of Construction	85
	Safety During Construction	85
	Longevity	86
	Likelihood of Successfully Passing Fish	86

CHAPTER		PAGE

Alternative 3 - Vertical Slotted Fishway . . 86
Layout..... 88
Operation 88
Diversion and Care of Water 88
Materials of Construction 89
Methods of Construction 89
Safety During Construction 90
Longevity . 90
Likelihood of Successfully Passing Fish . 90
Alternative 4 - Blasting Lower Falls 91
Blasting Plan 91
Safety During Construction 92
Problems Anticipated 92
Longevity . 92
Likelihood of Successfully Passing Fish . 93.

6 COST ESTIMATES 94
Project Life 94
Capital Costs 94
Annual Costs 96

LIST OF FIGURES

FIGURE		PAGE
1	Location Maps	50
2	Site Topography	51
3	Geologic Cross Section	58
4	Site Geologic Map	60
5	Mean Monthly Hydrograph for Flows at Collawash Falls	65
6	Annual Flow Duration for Flow at Collawash Falls	66
7	Flood Frequency Curve	67
8	Migration Periods of Salmon and Steelhead	70
9	Profile Through Cascade and Lower Falls	71
10	Alternative 1 - Raised Tailwater	75
11	Alternative 1 - Section	76
12	Alternative 2 - Pool Excavation	83
13	Alternative 3 - Vertical Slotted Fishway	87
14	Alternative 4 - Blasting Lower Falls	92

LIST OF PHOTOS

PHOTO		PAGE
1	Upper Falls	51
2	Cascade Area.	52
3	Lower Falls	53
4	1974.	80
5	1984	80

LIST OF TABLES

TABLE		PAGE
1	Comparison of Selected Alternatives.	146
2	Alternative 1 - Raising Tailwater, Estimate of Capital and Annual Costs	98
3	Alternative 2 - Pool Excavation, Estimate of Capital and Annual Costs	99
4	Alternative 3 - Vertical Slotted Fishway, Estimate of Capital and Annual Costs	100
5	Alternative 4 - Blasting Lower Falls, Estimate of Capital and Annual Costs.	101

CHAPTER 1
SUMMARY

This report was prepared for the Collawash Falls Fish Passage Project. Collawash Falls is located in Northwest Oregon on the Collawash River about 60 miles south of Portland, Oregon.

PURPOSE OF THE PROJECT

The purpose of the project is to determine the technical and economic feasibility of improving upstream passage for adult salmon and Steelhead at a natural barrier to migration. The project is included in the Northwest Power Planning Council's Fish and Wildlife Program of 1982. Project efforts are being directed by the U.S.D.A., Forest Service, Mt. Hood National Forest, and funded by the Bonneville Power Administration.

DESCRIPTION OF WORK ACCOMPLISHED

The principal objective of the project is to develop preliminary designs and costs for upstream passage alternatives. Data were gathered and developed on the site geology, hydrology, and topography to accomplish this objective. This work included:

- Geologic mapping, investigation, and report preparation,
- Development of detailed hydrology for the site, and
- Preparation of a topographic map of the site.

Three site visits were made to identify, collect, and verify field information.

A number of passage alternatives were considered. The most promising alternatives were selected for further study.

Preliminary designs and cost estimates were prepared for four selected passage alternatives. These are summarized in the next sect ion.

DESCRIPTION OF PASSAGE ALTERNATIVES

Passage alternatives were developed to improve migration past a natural falls about twelve feet high. The right and left banks in the area of the falls present a design challenge because the right bank is an active landslide and the left 'bank is a nearly vertical, spalling, rock face.

Alternative 1 consists of a series of three weirs constructed of gabions and located immediately downstream of the falls. The weirs would raise the tailwater at the falls in three steps, thereby "drowning" the falls. Fish would then be required to pass from pool to pool in jumps of three feet.

Alternative 2 involves the excavation of pools into the rock which forms the base of the falls. In this alternative, three pools would be excavated by blasting. The jump between pools would be approximately three feet.

Alternative 3 consists of a conventional vertical slotted fishway that begins at the base of the falls near the left bank. The fishway would have eleven pools, each six feet wide by eight feet long. The drop in head between pools would be approximately one foot.

Alternative 4 involves blasting the rock at the base of the falls so as to increase roughness by leaving large material in the stream and reduce velocities so that fish can pass upstream.

Table 1 compares the advantages, disadvantages, and costs of of the alternatives.

TABLE 1. COMPARISON OF SELECTED ALTERNATIVES

	PRESENT VALUE OF CAPITAL COST & ANNUAL COST[1]	LIKELIHOOD OF SUCCESSFULLY PASSING FISH[2]	LONGEVITY	ADVANTAGES	DISADVANTAGES
Alternative 1, Raising Tailwater	$195,000	o Good at high flows, o May be poor at low flows	o 10 years + with proper maintenance	o Blasting not necessary	o High Cost o Low flow passage o 3 ft jumps per pool
Alternative 2, Pool Excavation	$ 73,000	o Good at low flows o May be poor at high flows	o 10 years + with proper maintenance	o Low cost	o High flow passage o 3 ft jumps per pool
Alternative 3, Vertical Slotted Fishway	$270,000	o Excellent at all flows	o 10 years + with proper maintenance	o 1 ft head drop per pool o Proven design	o High cost o Extensive blasting required
Alternative 4, Blasting Lower Falls	$ 54,000	o Improvement likely but difficult to predict	o 10 years +	o Low cost o Low O & M	o Questionable results

1 Detailed cost estimates are presented in Tables 2 to 5.

2 Run timing is shown on Figure 8. Late run spring chinook and peak run summer steelhead would be limited by poor, low-flow passage. Coho and possibly winter steelhead would be limited by poor, high-flow passage. Spring chinook, coho, and winter steelhead are target runs for improved passage.

CHAPTER 2
INTRODUCTION

AUTHORITY

The U.S.D.A. Forest Service, Mt. Hood National Forest, retained Ott Water Engineers, Inc. (OTT) on October 5, 1984 to perform a feasibility study for upstream fish passage at the Collawash Falls, Oregon.

SUBCONTRACTORS

OTT used the services of two subcontractors for the project: Mr. Kim de Rubertis and Mr. Milo C. Bell. Mr. de Rubertis served as project geotechnical engineer and senior consultant; he prepared the geologic report and contributed to the alternative development. Mr. Bell served as senior consultant and provided advice on the design and utility of passage alternatives.

SCOPE OF WORK

The purpose of the project is to determine the technical and economic feasibility of improving upstream passage for salmon and Steelhead at Collawash Falls. OTT was required to develop at least three passage alternatives and present the advantages and disadvantages of each with regard to:

1. cost
2. Competency of the bedrock
3. Maintenance requirements
4. Life of the project
5. Equipment needed and access to site
6. Operation/Safety constraints

In developing the alternatives, the following six tasks were performed:

- Task 1 - Fisheries Data
- Task 2 - Existing Site Data
- Task 3 - Hydrology and Hydraulics
- Task 4 - Alternative Formulation
- Task 5 - Preliminary Designs
- Task 6 - Cost 'Estimates

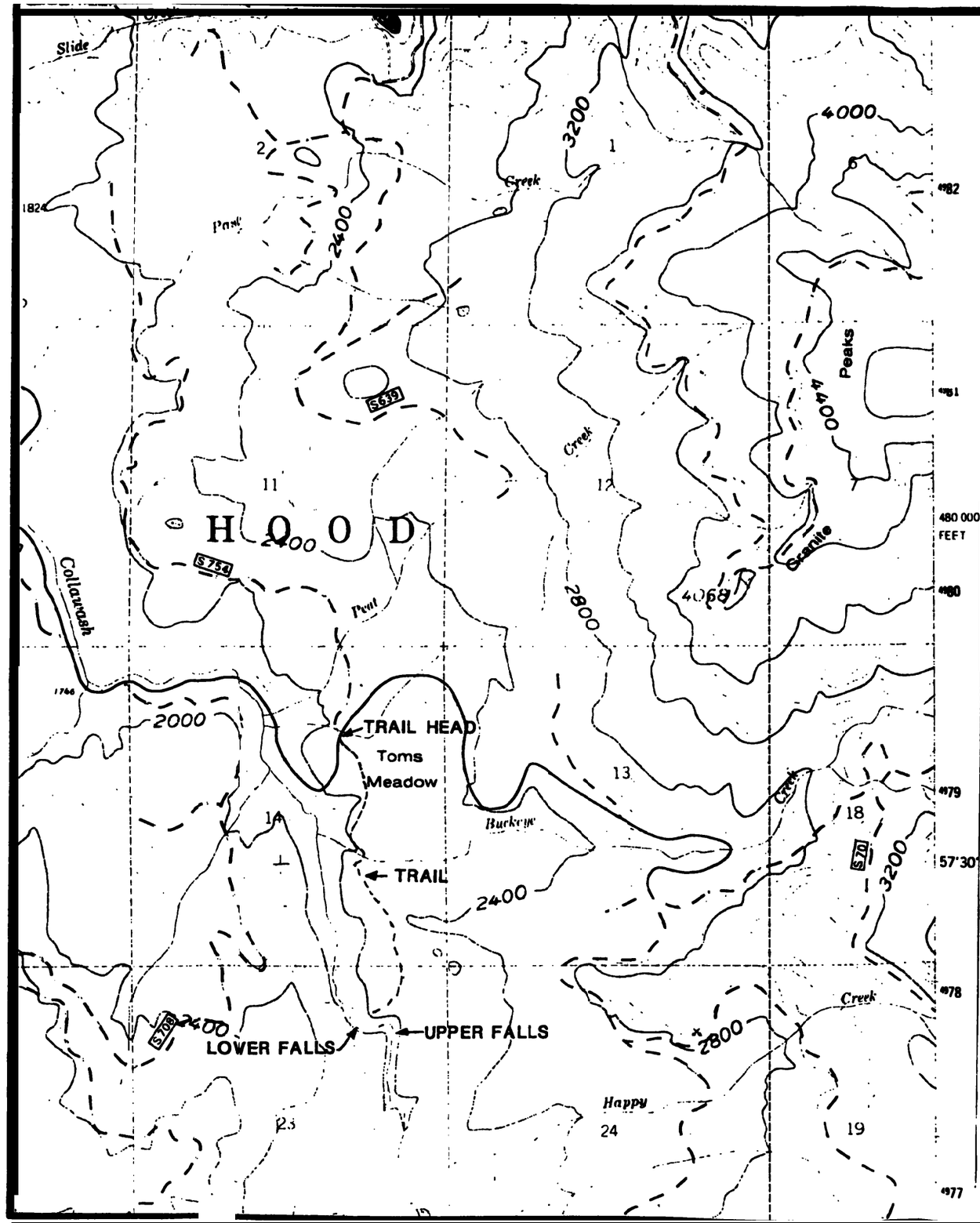
Tasks 1 through 3 consisted of the acquisition and review of existing information on fish, geology, topography, and hydrology. A geologic report, hydrology of the site, and a topographic map were produced in these tasks. Tasks 4 through 6 involved the formulation of upstream passage alternatives and the preliminary design and cost estimates for them.

CHAPTER 3
EXISTING CONDITIONS

Callawash Falls is located on the Collawash River about six miles south of its confluence with the Clackamas River. The Falls occur in a deep canyon cut through volcanic rocks (Figures 1 and 2). Average elevation at the site is about 2,000 feet. The River runs along the east flank of an anticline and then cuts through the anticline forming two distinct series of falls, Upper and Lower. The Upper Falls (Photo 1) is a series of cascades formed over landslide blocks lying on the upstream flank of the anticline. The total fall is about 12 feet; however, this fall is divided more or less equally between a number of cascades (Photo 2), the highest of which presents a 3- to 4-foot obstacle to fish passage. The Upper Falls is not considered by the Mt. Hood National Forest staff to represent an insurmountable barrier for anadromous fish.

The Lower Falls (Photo 3) occur within the breached portion of the anticline. They also consist of a series of cascades with a total fall of about 20 feet. The lowest cascade presents the most difficult obstacle to fish - a hurdle of about 12 feet.

Passage alternatives are directed at improving passage over the Lower Falls. The Lower Falls is a barrier to passage at most flows though some Steelhead are able to pass at lower flows. As shown in Figure 2 and Photo 3, the Lower Falls consists of a chute that was blasted in the rock mass and a channel which is formed in bedrock and alluvial material It is not certain whether fish pass through the main channel or the chute at low flows, though passage is expected to be through the main channel.



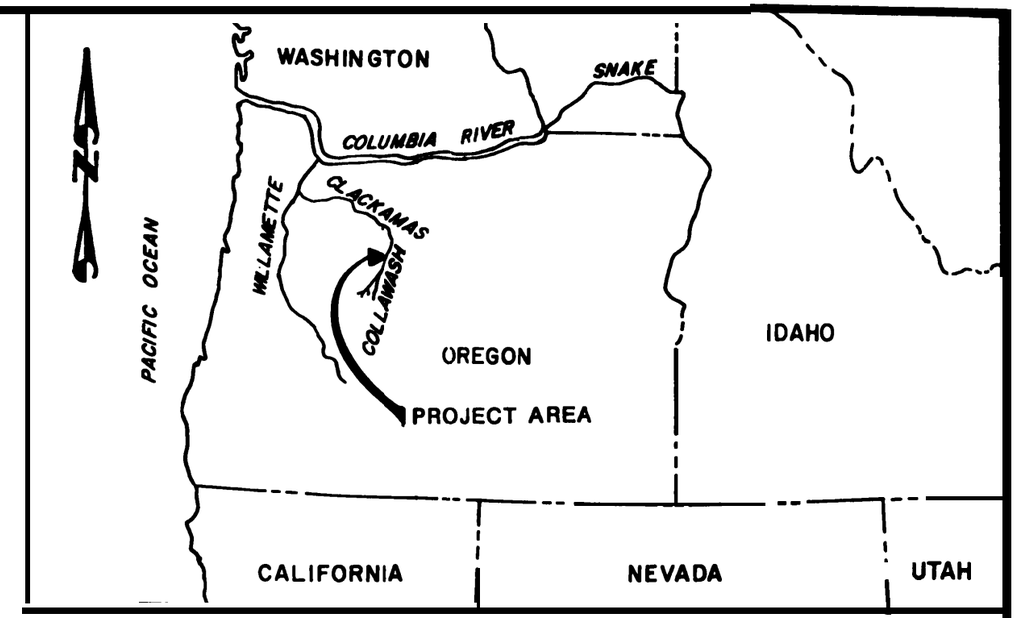


FIGURE 1

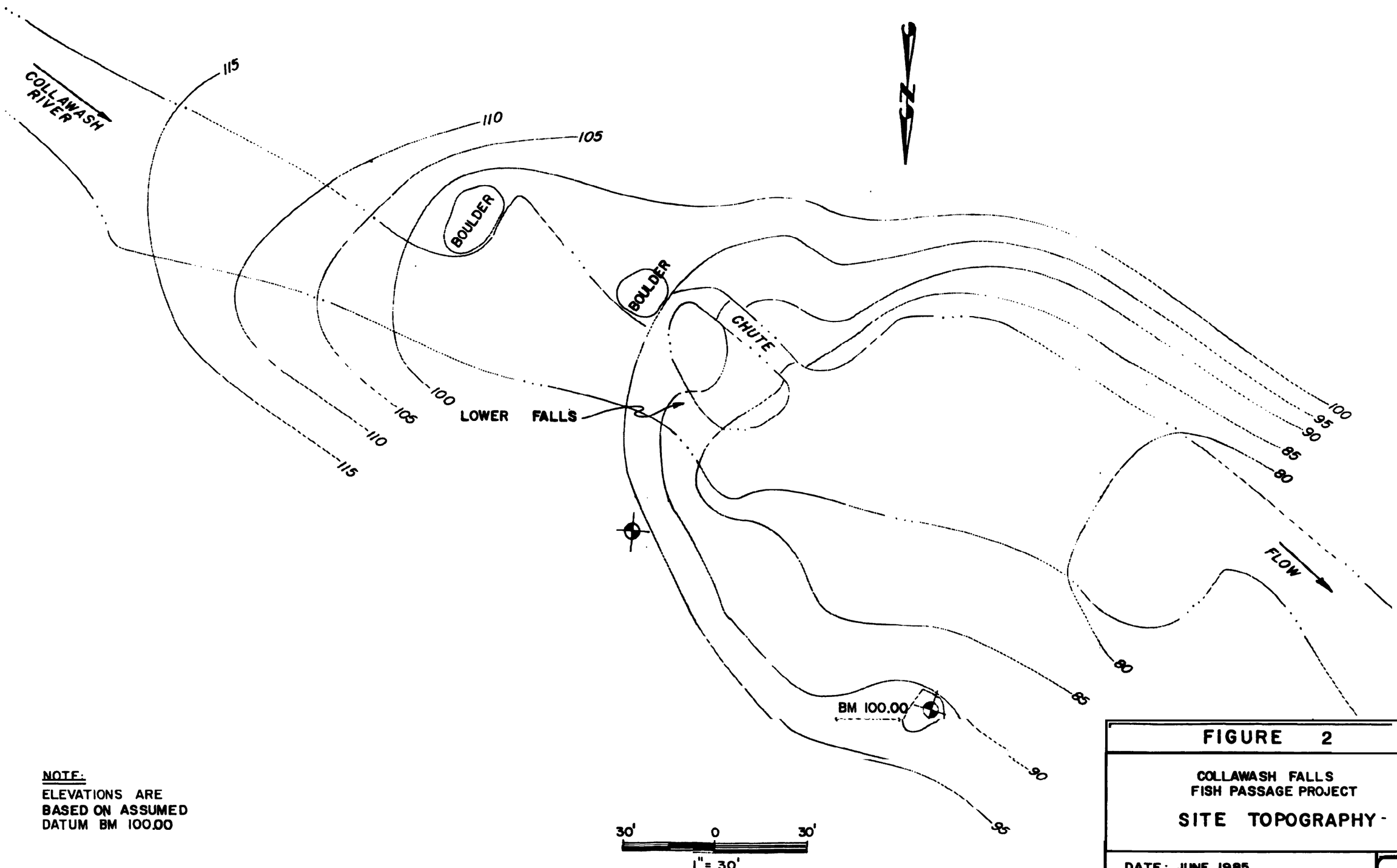
COLLAWASH FALLS
FISH PASSAGE PROJECT

LOCATION MAPS

DATE: AUGUST 1985

JOB NUMBER: S1029.01

OTT



NOTE:
ELEVATIONS ARE BASED ON ASSUMED DATUM BM 100.00

FIGURE 2

COLLAWASH FALLS
FISH PASSAGE PROJECT

SITE TOPOGRAPHY

DATE: JUNE 1985

PROJECT NUMBER: S1029.01

OTT

Photo 1 - Upper Falls

Photo 2 - Cascade Area

Photo 3 - Lower Falls

The existing conditions bearing on improved fish passage are fish, topography, geology, and hydrology.

FISH

SPECIES COMPOSITION

Collawash River salmon and Steelhead reared in the ocean return as adults migrating up the Columbia River to the Willamette River, then into the Clackamas River, and ultimately into the Collawash River (see Figure 1). Target stocks identified by the Mt. Hood National Forest staff for improved passage at the falls, are winter Steelhead trout, spring chinook, and coho salmon. These runs are targeted because they originate from native stocks. Summer Steelhead have been observed above the falls in limited numbers, 12 to 15 fish, (pers. comm., Jay Massey, ODFW, and Dave Heller, USFS). There is also a population of resident rainbow and cutthroat trout above the falls. Little is known about numbers of winter Steelhead, coho, and chinook, if any, above Collawash Falls.

RUN TIMING

Run timing of target anadromous fish species for the project was determined by John Sanchez (pers. comm.) of the Mt. Hood National Forest. Typically, adult summer Steelhead will attempt to pass the falls between April and November; their peak upstream migration will occur in May and July. Winter Steelhead will migrate between March and June with peaks in April and May. Adult spring chinook migrate past the falls from May through October with peaks in May and September. Coho are expected to migrate past the falls between September and March- There are two separate coho runs with peaks in October and January.

Considering all species, fish may attempt to pass the Collawash Falls throughout the year. Sanchez noted, however, that fish are not expected to move during extreme high or low flow events. This means that fish are not expected to migrate in flows above 700 cfs or below 50 cfs.

TOPOGRAPHY

The dominant vegetation in the area of the falls is coniferous with some broad leaf evergreens. Ground cover is composed mainly of grasses and moss. The falls occur in a steep-sided canyon cut into bedrock. The left bank is very steep (1H:3V) from the river to a point about 150 feet above the river. Above 150 feet, forested slopes are about 2H:1V. Slopes on the right bank from the river to a point about 100 feet above the river are approximately 1H:1V. Above 100 feet, fores ted slopes are about 2-1/2H:1V.

Access to the site is available by an unmarked trail to the right bank of the site. The trail is approximately one mile long.

The area was mapped in 1956 by the USGS (Battle Ax, Oregon 15-minute series) with an 80-foot contour interval. OTT mapped the immediate area of the falls by stadia methods with a five-foot contour interval. Mapping by OTT is referenced to an assumed datum, rather than mean sea level (see Figure 2). The most recent available aerial photographs of the site are USDA #616065 dated 7/16/79.

GEOLOGY

The falls lie within the Western Cascade physiographic province. The area is underlain by a thick sequence of volcanic rocks believed to be of Miocene age, about 20 million years old. The

Western Cascades are Cut by numerous NW to N-trending faults. Fault traces commonly extend for many miles. Above the Alder Shelter, the Collawash River follows the regional trend of NW-SE faults.

The region does not appear to have been intensely folded. In late Cenozoic time (less than 1 million years ago), the region was uplifted as much as 1,500 feet (Hammond and others). At least two episodes of alpine glaciation and a long period of stream erosion followed. The landforms which have developed are ridges with steep-sided and deeply incised valleys generally following the regional NW to N structural trend.

Rock units in the project area have been mapped by Hammond and others (1982) as belonging to the Middle Western Cascade Group. Most of the formations comprising the group contain some beds formed by volcanic debris flows and mudflows. Reflecting their heritage, these rocks are susceptible to landsliding and the region is rich with active landslide terrain.

Other typical constituents of the general stratigraphic column are' lava flows, tuffs, breccias, and volcaniclastic sandstones and conglomerates. Alteration is common and zeolites are prominent alteration products.

SITE GEOLOGY

The stratigraphy, structure, and history of the site contribute to an understanding of the alternatives for fish passage.

Stratigraphy

Six distinct stratigraphic units occur at the site. Two of these are bedrock units and four are surficial deposits. The bedrock units are the Andesite of Nohorn Creek and the Beds of

Bull Creek (Hammond and others). The four surficial deposits are landslide debris, alluvium, talus, and colluvium.

The andesites of Nohorn Creek (Tn) crop out along the left bank and expose a sequence of interbedded flow breccias, thin lava flows, and tuffs, all capped by a massive andesite flow (Figure 3). The flows are porphyritic and probably have compositions ranging from trachyite to andesite. Color ranges from green to tan to black. Alteration is common. The black flow breccia at the base of the cliff is altered with carbonate minerals and traces of chyrsocolla (copper silicate) were seen, The-bluish, greenish rocks in the valley bottom are altered with chlorite and clay minerals. Black, silicified wood is common in all of the flow breccias. One prominent yellowish tuff occurs at the top of the black flow breccia. The exposed stratigraphic thickness of the Nohorn is about 135 feet.

The Beds of Bull Creek (Tbc) crop out along the right bank from Dickey Creek to a point about 1,000 feet below the Lower Falls. The outcrops are disturbed because the beds occur in an active landslide. Intact, undisturbed rock was not observed. The beds are gray to brown to reddish, lithified, volcanic mudflow (lahar) debris consisting of subangular to -round gravel to boulder-sized fragments of gray prophyritic andesite in a fine grained, tan to brown matrix of earthy, pulverized, volcanic rock. The matrix is often strong, and the rock breaks through the embedded fragments rather than through the matrix. On the right bank between the Upper and Lower Falls, reddish outcrops appear to have been baked along joint surfaces. Alteration by zeolites is common.

Landslide debris (Qls) occurs all along the right bank and is mixed with the alluvium in the river. The debris is broken-up Bull Creek material. Landslide debris, probably resting on bedrock, forms the Lower Falls.

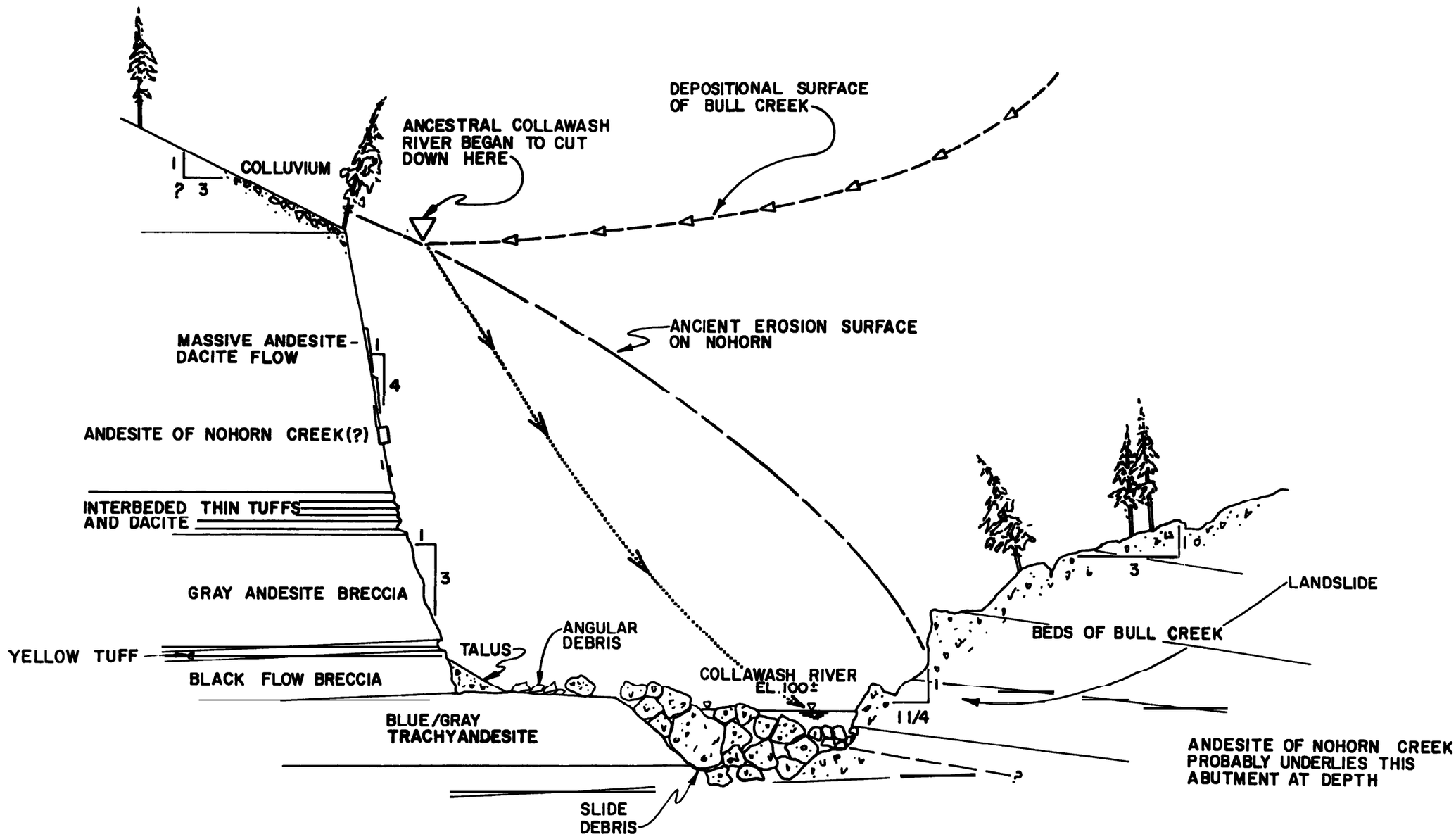


FIGURE 3

COLLAWASH FALLS
FISH PASSAGE PROJECT

GEOLOGIC CROSS SECTION

DATE JUNE 1985

PROJECT NUMBER S1029.01

OTT

Alluvium (Qal) is exposed in the pool just above the Lower Falls. It consists mainly of tan to brown sand which has been transported by the river and deposited in quiet reaches. Most of the coarser material in the river has been derived locally from the banks and has not been transported by the river.

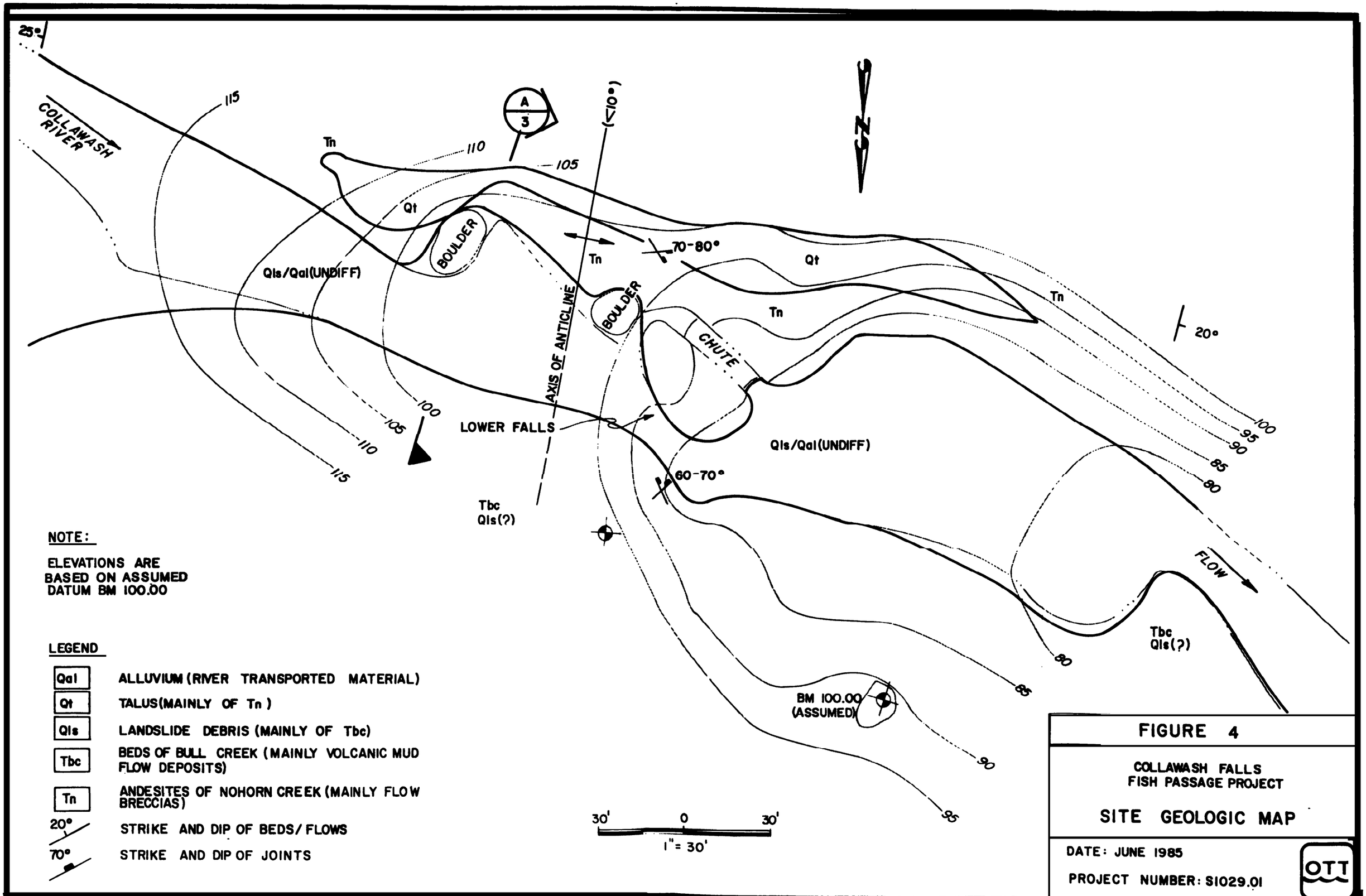
Talus (Qt) occurs at the base of the outcrop of Nohorn in the canyon and is composed, mostly of angular, joint-bounded blocks which have fallen from the cliff. Size of the talus ranges from gravel to boulders.

Collumium (not mapped) mantles the Nohorn and consists of a thin (<5 feet thick), tan, stony soil. Figure 4 illustrates the area1 distribution of the stratigraphic units.

Structure

Totally different structures are expressed by the two bedrock units. The Nohorn is folded into an asymmetrical anticline which strikes about N15E and appears to plunge slightly south. Dips on the west flank are 15-20W. On the east flank, they are 25-30E. The river flows along the east flank of the anticline from a point near Dickey Creek until it breaches the anticline at Collawash Falls. The river appears to flow on the west flank of the anticline from the island (about 1,000 feet downstream from the Lower Falls) to Buckeye Creek. A remnant of the axial portion of the anticline is believed to support the steep ridge on the right bank downstream from the obvious landslide terrain and just above the island.

Old erosion surfaces are evident in the Norhorn. On the left bank, about 300 feet downstream from the Lower Falls, an old valley in the Norhorn is filled with a tan to brownish gray, well indurated, pebble to boulder agglomerate. It is interesting to


25°
COLLAWASH RIVER
115
110
105
100
95
90
85
80
A
3
Tn
Qt
BOULDER
Qls/Qal(UNDIFF)
AXIS OF ANTICLINE
(<10°)
70-80°
CHUTE
LOWER FALLS
60-70°
Tbc
Qls(?)
20°
FLOW
BM 100.00
(ASSUMED)
30'
0
30'
1" = 30'
NOTE:
ELEVATIONS ARE BASED ON ASSUMED DATUM BM 100.00
LEGEND
Qal ALLUVIUM (RIVER TRANSPORTED MATERIAL)
Qt TALUS (MAINLY OF Tn)
Qls LANDSLIDE DEBRIS (MAINLY OF Tbc)
Tbc BEDS OF BULL CREEK (MAINLY VOLCANIC MUD FLOW DEPOSITS)
Tn ANDESITES OF NOHORN CREEK (MAINLY FLOW BRECCIAS)
20° STRIKE AND DIP OF BEDS/FLOWS
70° STRIKE AND DIP OF JOINTS
FIGURE 4
COLLAWASH FALLS
FISH PASSAGE PROJECT
SITE GEOLOGIC MAP
DATE: JUNE 1985
PROJECT NUMBER: S1029.01
OTT

note that the filled valley appears to dip to the northeast. Two sets of prominent joints in the Nohorn have strikes and dips of N40-50W, 70-80N, and N40-50E, 70-80N. These joints probably formed in response to stresses during folding.

Structure on the Bull Creek beds is a jumble of chaotic blocks of landslide debris. Movement has produced the telltale signs of instability - hummocky terrain, leaning trees, and closed depressions. The anticlinal structure of the Nohorn is not reflected in the Bull Creek. The airphotos (1979) clearly reveal a scarp which appears to be the limit of -present movement. The scarp strikes NW-SE and is about 4,000 feet long. It intersects the river just upstream from' the island, and it may have formed along a bedrock fault. Where the scarp meets the river, a recent, large slide can be seen in the airphotos. A pair of ponds, possibly sag ponds, above and near the active landslide area, may contribute to its instability by providing a source of seepage. Jointing is evident in the Bull Creek with two sets oriented NW and NE. Both sets dip steeply toward the river, compounding problems of stability.

Collawash Falls is formed by landslide debris which has choked and constricted flow in the valley bottom. At the Upper Falls, the debris can be observed to rest on the thick, andesite flow which forms the east flank of the anticline. The pool just upstream from the Lower Falls appears to be formed on bedrock of the Nohorn because its floor is relatively. At the pool just below the Lower Falls, bedrock of the Nohorn outcrops halfway across the river. This is the rock through which the chute was partially excavated. It is believed that the Nohorn continuously underlies the landslide debris in the river bottom throughout the falls. Because of the alternate soft and hard layers in the bedrock, it is likely that falls formed on the bedrock surface before the landslide debris reached the river.

For example, the black flow breccia is soft and would quickly erode leaving a "step" or falls between the top of the underlying flow and the top of the overlying flow.

History

The exact history of the formation of the falls is not known but may be inferred on the basis of the geologic evidence observed in the field and from the airphotos. The most likely sequence of events appears to be as follows:

Step 1 - The andesites of Nohorn Creek were deposited during a wide variety of volcanic episodes.

Step 2 - The Nohorn was folded to form the anticline and faulted along regional trends. Major joint sets formed in response to the compression of folding.

Step 3 - The folded surface was eroded and valleys were cut into its surface. The general land surface sloped steeply to the north.

Step 4 - Younger volcanic rocks were deposited into the eroded valleys. similar to those seen in the left bank downstream from the Lower Falls. Erosion continued.

Step 5 - The beds of Bull Creek were deposited against the erosional surface of the Nohorn.

Step 6 - The ancestral Collawash River, flowing along the east flank of the anticline, breached the anticline at the contact between the Nohorn and the Bull Creek.

Step 7 - Erosion continued, and the river cut down to its present level. During this process, the river undercut the toe of the' Bull Creek and caused landsliding which has contributed to the present morphology of the falls (Figure 3). It is believed that landsliding may have been initiated along the line of an old bedrock fault (Step 2) because the scarp at the head of the active landslide wedge is quite linear. It is aligned with the north edge of the island, and it fits the regional trend.

Summary

Material at the right bank of the Falls, beds of Bull Creek, is volcanic mudflow debris disturbed by an active landslide. Material at the left bank, the Nohorn, is andesite, also of volcanic origin, but much more stable. Only surf icial spalling occurs at the left bank. The stream morphology has been and will continue to be controlled by the landslide in the Bull Creek material, and to a lesser extent by the talus contributed by the spalling of andesites at the left bank.

HYDROLOGY

The elevation of the Collawash River at the falls is approximately 2,000 feet. The river has a drainage area of 68 square miles above the falls. Average monthly flows in the river are highest in the winter with storm runoff and in the spring with snowmelt. The low flow period is typically July through September.

Three USGS gages were used to develop the hydrology for the Collawash River at the falls:

- Molalla River above Pine Creek, USGS #1985, record from 1935 to 1982, records rated excellent;

- Clackamas River at Big Bottom, USGS #2080, record from 1920 to 1970, records rated good;

- Collawash River near Breitenbush, USGS #2083, record from 1966 to 1968, records rated excellent.

The site lies between basins monitored by the Molalla and Clackamas gages and displays characteristics of both,. The partial record at the Collawash gage was compared to the Molalla and Clackamas gages. It was determined that the Molalla gage was the best indicator of Collawash flows because it showed the best correspondence for the period of record at the Collawash gage. Mean monthly flows and flow exceedence at Molalla were adjusted to the Collawash gage by corresponding monthly flows. A significant number of tributary streams enter the Collawash River downstream of the falls and upstream of the Collawash gage. To account for these tributaries, the flow at the falls was determined by multiplying the flow at the Collawash gage by the ratio of area above the falls to the area above the gage. This model is believed to be sufficiently accurate for this study. A flood frequency curve was developed for the Collawash River at the falls by comparison of flood frequency curves for the Molalla and Clackamas gages and the contributing areas above the gages and the falls.

Figures 5, 6, and 7 are a mean monthly hydrograph, annual flow-duration curve, and flood-frequency curve for the river at the falls. The average annual flow at the falls is approximately 350 cfs. The lo-year flood is roughly 9,000 cfs, and the 100-year flood is roughly 15,000 cfs.

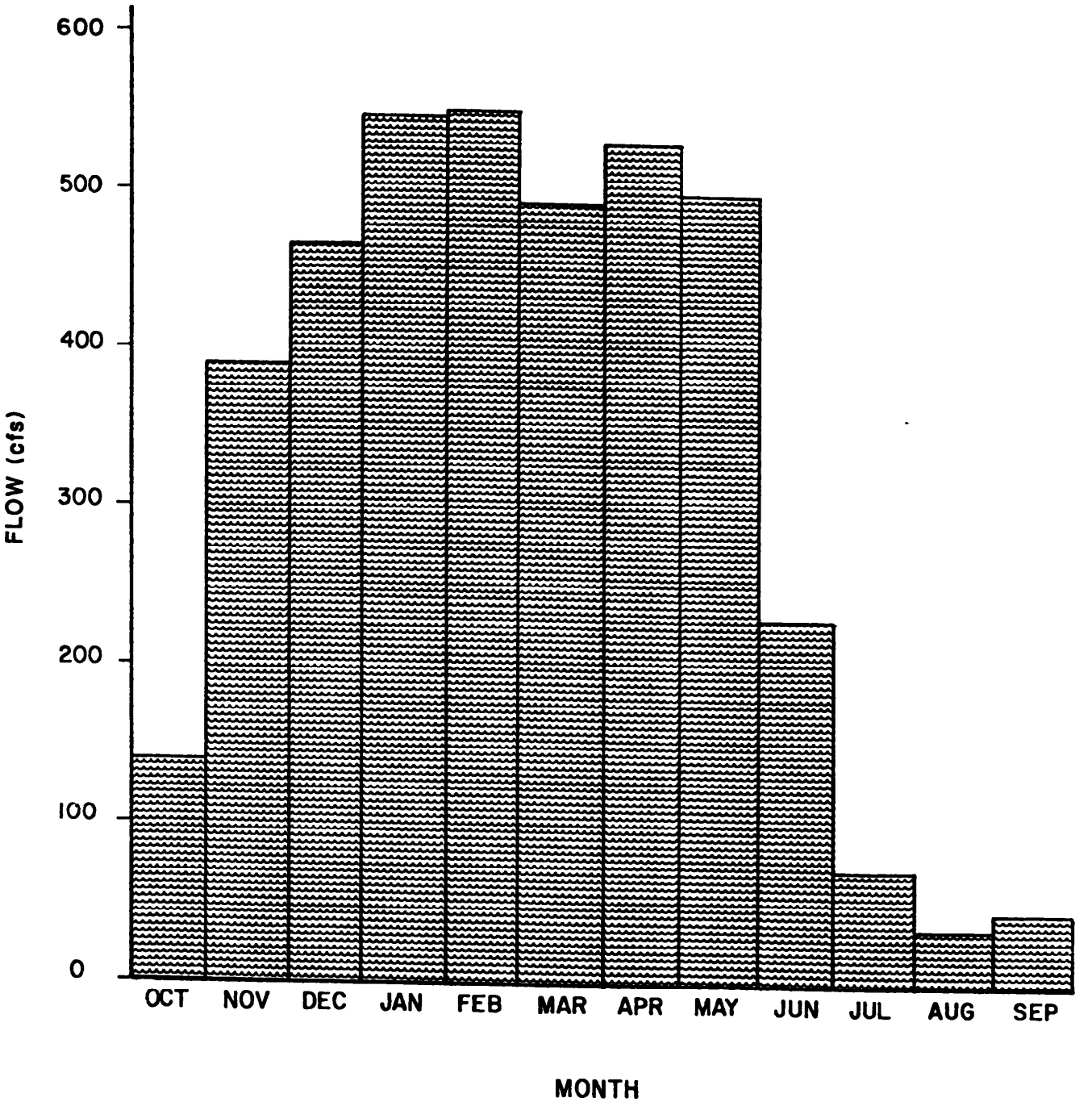


FIGURE 5

COLLAWASH FALLS
FISH PASSAGE PROJECT-
MEAN MONTHLY HYDROGRAPH
AT COLLAWASH FALLS

DATE: AUGUST 1985
JOB NUMBER S1029.01

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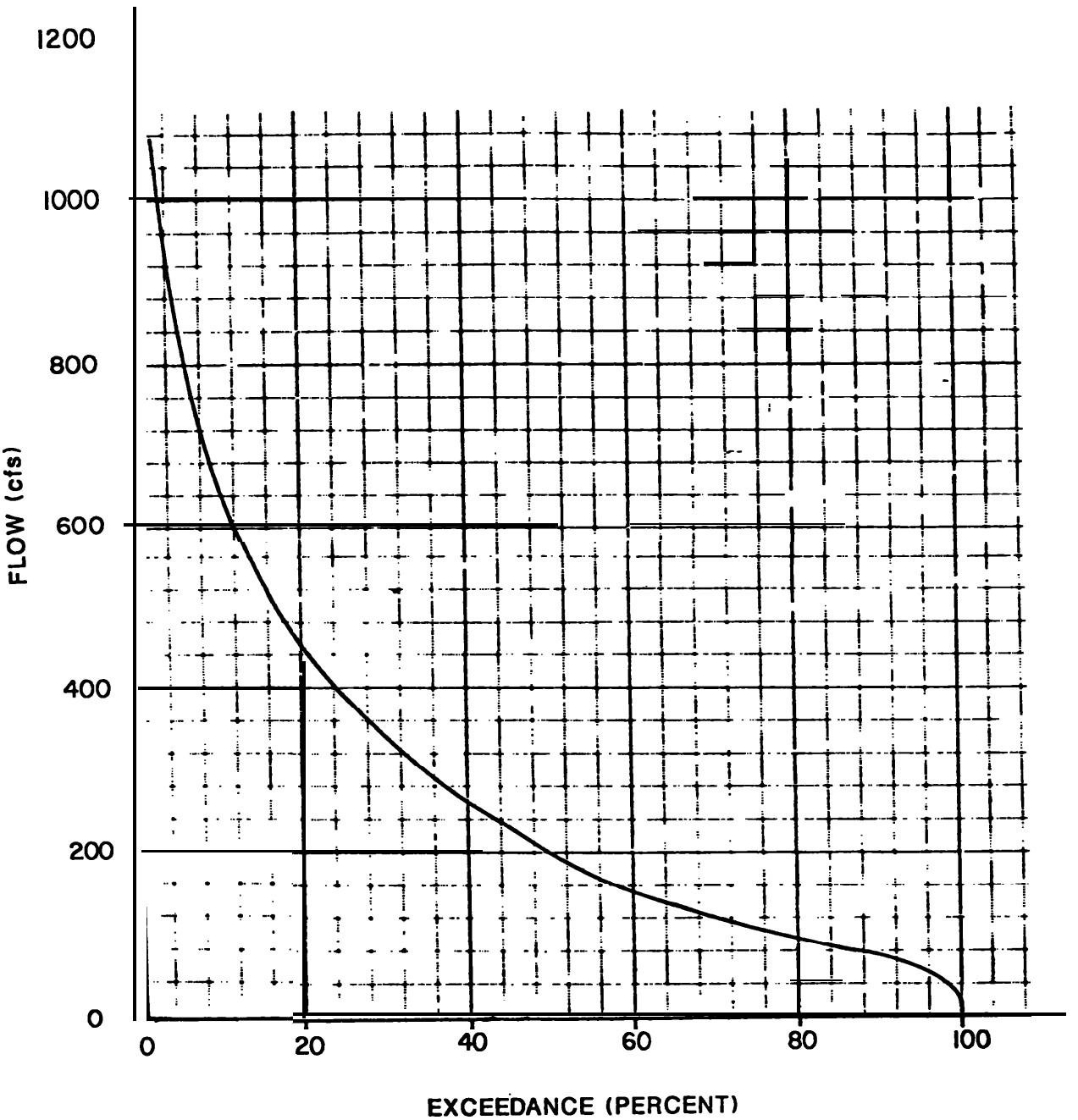

FIGURE 6

COLLAWASH FALLS
FISH PASSAGE PROJECT

ANNUAL FLOW DURATION
AT COLLAWASH FALLS

DATE: AUGUST 1985
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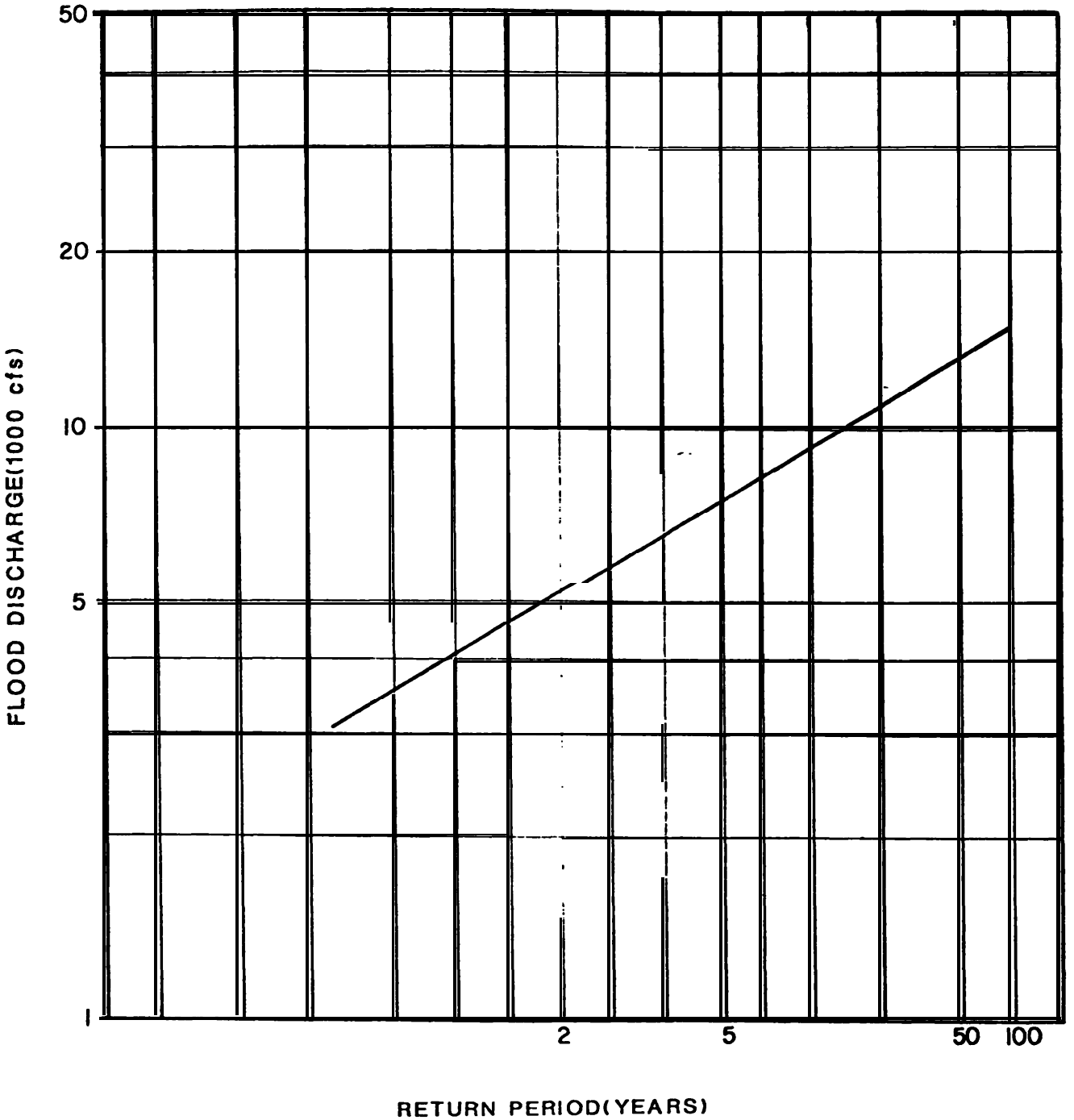

FIGURE 7

COLLAWASH FALLS
FISH PASSAGE PROJECT

FLOOD FREQUENCY CURVE

DATE: AUGUST 1985
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CHAPTER 4
OPPORTUNITIES AND CONSTRAINTS

In the previous chapter, the existing conditions of the site and the species of fish were described. These provide opportunities for, and impose constraints on, the development of passage alternatives at the falls. This chapter discusses these opportunities and constraints in the context of fish, hydraulics and hydrology, geology, and construction.

FISH

The swimming and jumping abilities of Steelhead, spring chinook, and coho are exceptional. Orsborn (1982) reports darting velocities of 26.5 fps, 22.4 fps, and 21.5 fps for Steelhead, chinook, and coho, respectively. Mt. Hood National Forest staff suggest that: 1) Summer Steelhead be required to jump no more than six feet, 2) Winter Steelhead be required to jump no more than four feet, 3) Spring chinook be required to jump no more that six feet, and 4) Coho be required to jump no more than four feet (pers. comm., Dave Hohler). It should be noted that fish do not have the stamina to perform repetitive jumps without being provided adequate jumping pools and resting areas. As a result, the passage alternatives should provide pools for jumping and resting and should limit jumps to approximately three vertical feet. The limitation of three feet provides a less selective passage, thereby passing more than just "athletes".

HYDRAULICS AND HYDROLOGY

Design of any passage alternative must consider the flow in the river at the time fish are expected to arrive. In Chapter 3, it was noted that fish may arrive throughout the water year with

the exception of extreme high or low flows. Figure 8 shows the upstream migration period, by species, plotted on the average monthly hydrograph.

If designed and maintained properly, any fish passage scheme could be operated through low flows. Flood flows, however, are an important consideration in providing and maintaining passage. Two major effects of flood flows are:

- Failure of engineered structures through scour and impact by debris and/or bedload, and

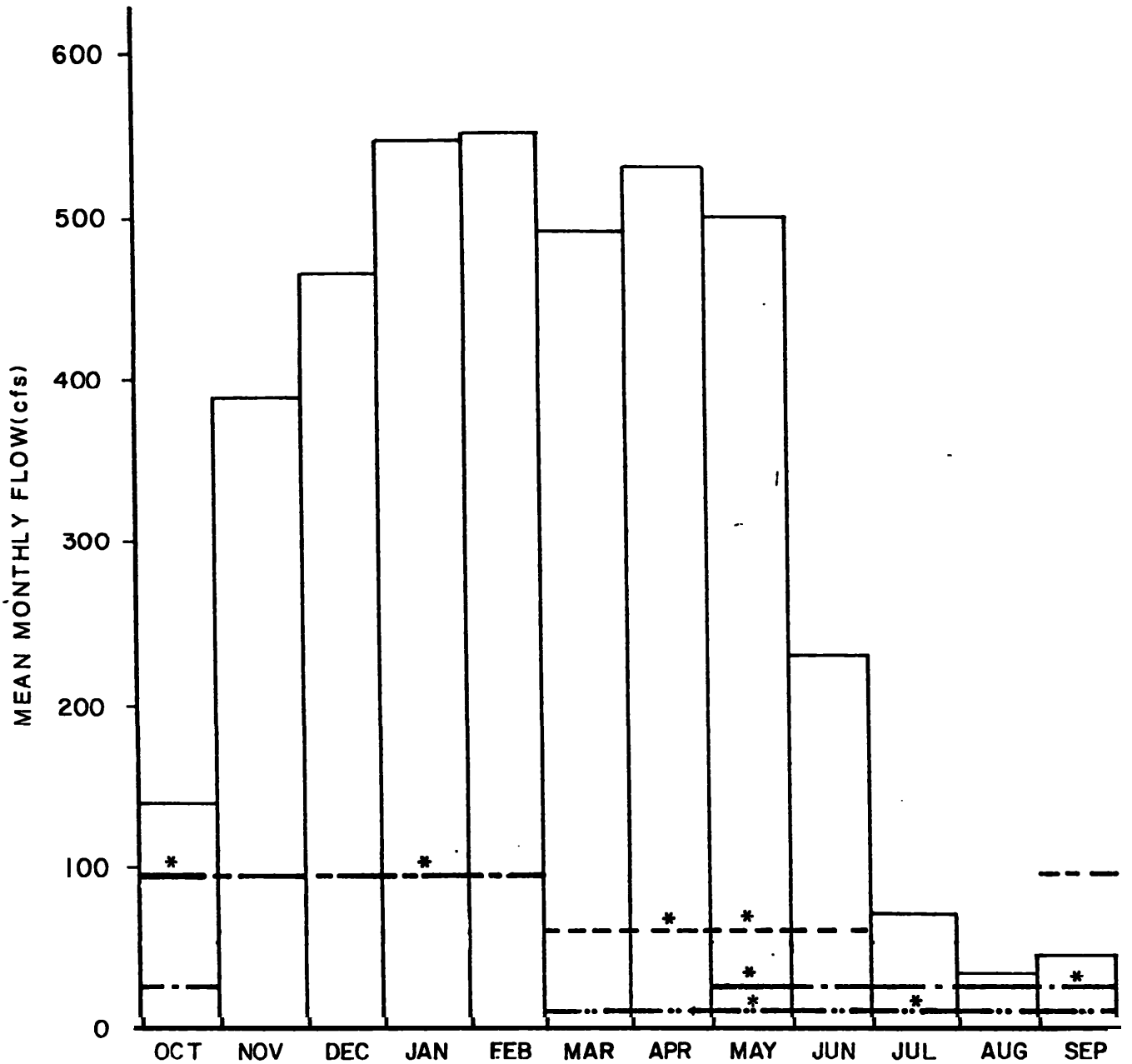
- Landslides initiated by scour at the toe of slopes.

Structures can and should be designed, to the extent practical and economical, to prevent failures. It does not appear to be practical, however, to prevent landslides.

GEOLOGY

Both river banks in the area of the lower falls have a continuing effect on the morphology of the stream. They influence size and composition of the alluvium, as well as the gradient at which it rests.

Accumulated talus from the Nohorn does not significantly affect river bed stability. Accumulated landslide debris from the Bull Creek dominates river bed stability. Figure 9 is a river profile through the Lower Falls. The gradient through the falls is about 17 percent. It is believed that both the top and bottom of the falls are near bedrock of the Nohorn. It is impossible to improve on this gradient without cutting at the top, filling at the base, or both.



LEGEND

COHO
SPRING CHINOOK
SUMMER STEELHEAD
WINTER STEELHEAD

* PEAK MIGRATION PERIODS

FIGURE 8

COLLAWASH FALLS
FISH PASSAGE PROJECT

MIGRATION PERIODS OF
SALMON AND STEELHEAD

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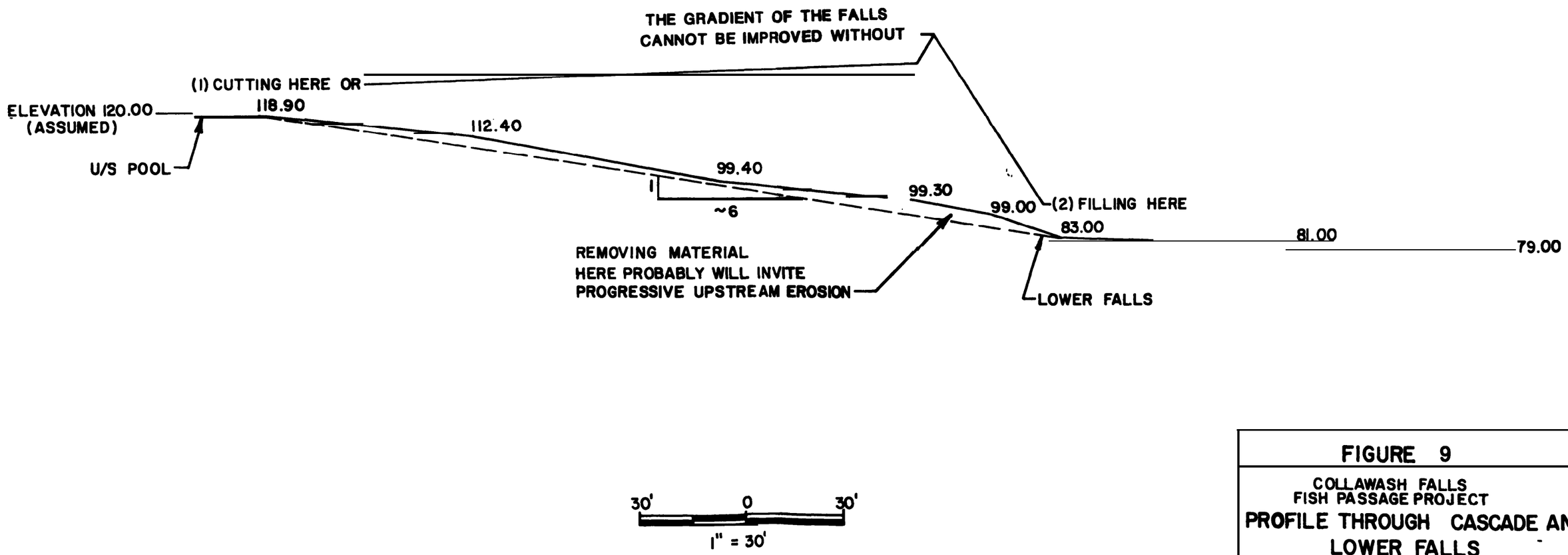

FIGURE 9

COLLAWASH FALLS
FISH PASSAGE PROJECT

PROFILE THROUGH CASCADE AND LOWER FALLS

DATE: JUNE 1985

PROJECT NUMBER: S1029.01

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The Lower Falls forms a 12-foot drop and has been identified as the key passage problem. It may be possible to modify the Lower Falls and provide passage. However, there is a high risk that modifications by blasting or machinery excavation will promote progressive upstream erosion - simply moving the problem upstream and, perhaps, complicating it.

Any structure(s) in the area of the Lower Falls will be subject to rockfalls from the left bank and landslides from the right bank. Such events may result in the need for continued maintenance and repair. The more complex the structure, the more costly will be the maintenance and repair. Continued slope failures may relocate the problem upstream or downstream, or may solve the problem by depositing material in a location that will improve the gradient through the obstacle.

CONSTRUCTION

ACCESS

Three methods of construction access could be used to construct the project. Labor, equipment, and materials could be transported to and from the site by foot, air, or road. Access by foot would require the use of pack animals. Access by air would require the use of a helicopter which has been done before. Access by either of these methods will limit the type and quantity of materials used for construction. Road access to the site is preferred since it will allow Greater flexibility in materials and equipment.

Adverse terrain in the area will make road construction difficult and portions of the road would likely be founded in the stream bed. Tracked equipment would probably be required to skid all materials into the site. This will increase unit cost

for all construction i terns well beyond what is typically encountered for similar work.

SEASON

The construction season is dictated principally by weather and flow in the river. Fire prevention considerations may also restrict construction during dry summer months. As shown in Figure 5, the low flow period is usually July through September. Any work within the stream should be planned for this period. Work not performed within the stream should also be planned for this period to avoid snow and rain.

CHAPTER 5
PASSAGE ALTERNATIVES

PASSAGE ALTERNATIVES CONSIDERED

Two approaches for providing passage at the Lower Falls were considered: 1) Raising tailwater at the Lower Falls, and 2) Modifications to the Lower Falls by structural and nonstructural means. Raising tailwater involves construction of a series of small weirs that "backup" water on the Lower Falls. The upstream weir is the highest with progressively lower weirs located dowstream. Three types of construction (concrete, rockfill, and gabion weirs) were investigated for this alternative. Gabion weirs were determined to be the most economical because they make maximum use of construction materials available at the site. The volume of concrete or large rock necessary for the other types of construction are not easily transported to the site and would be expensive. Structural and non-structural modifications to the Lower Falls include excavation of pools, construction of a slotted fishway, and blasting of the Lower Falls.

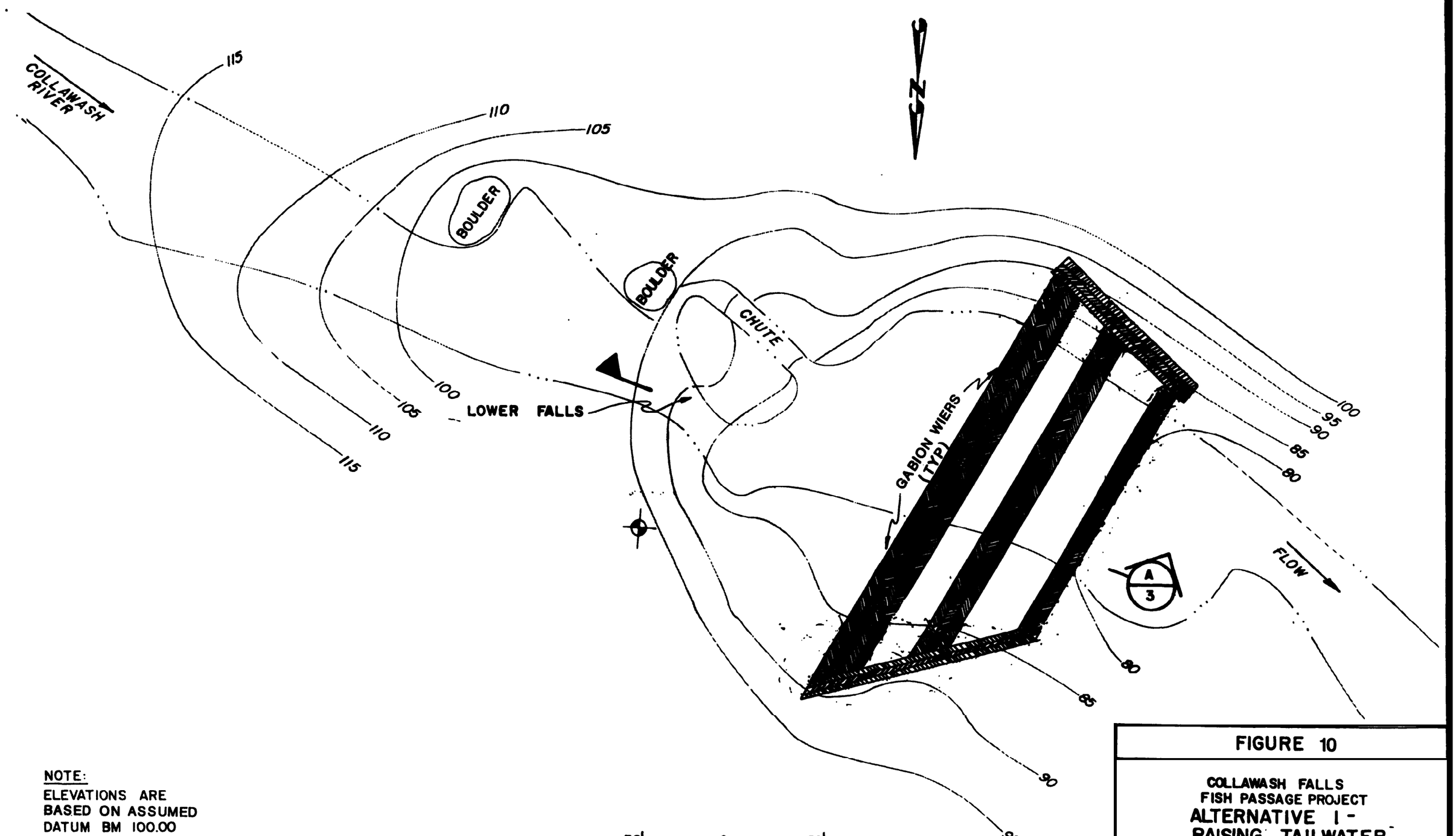
The next sections describe the four passage alternatives selected.

PASSAGE ALTERNATIVES SELECTED

ALTERNATIVE 1 - RAISING TAILWATER

Layout

Figures 10 and 11 show Alternative 1 in plan and section. Raising tailwater requires three low weirs placed below the Lower Falls with heights of approximately 12 feet, 9 feet, and 6 feet.



NOTE:
ELEVATIONS ARE BASED ON ASSUMED DATUM BM 100.00

FIGURE 10

COLLAWASH FALLS
FISH PASSAGE PROJECT
ALTERNATIVE 1 - RAISING TAILWATER

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PROJECT NUMBER: S1029.01

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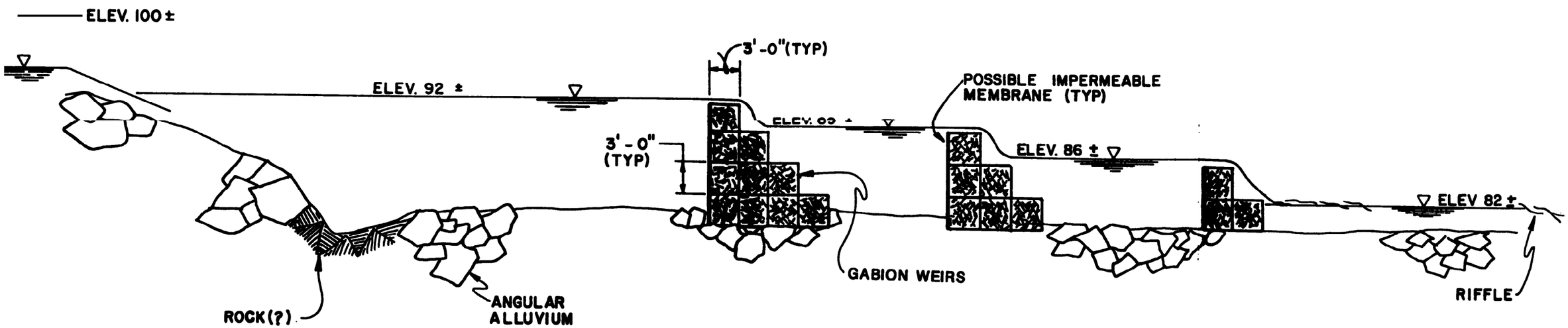

SECTION A/2
1"=10'

FIGURE 11

COLLAWASH FALLS
FISH PASSAGE PROJECT

ALTERNATIVE 1 – SECTION

DATE: JUNE 1985

PROJECT NUMBER S1029.01

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The weirs are of gabion construction and oriented normal to the stream flow. Both abutments are reinforced with gabions placed roughly normal to the axes of the weirs. The weirs would be founded on alluvium and operate as gravity structures to resist shear at the base and overturning. An impermeable membrane using geotextiles could be placed at the upstream face of the structure to lessen seepage through the structures. Gunite could also be used to reduce seepage and improve durability; however, the cost of gunite will be at least an order of magnitude higher than geotextile. The crest of each weir should slope from each abutment toward the center to concentrate low flows for fish. Alternatively, the center gabion in the top course could be decreased from three feet to two feet in height, thereby providing a notch to concentrate low flows.

Operation

The head at the Lower Falls is approximately 12 feet. The three weirs will distribute the 12 feet of head between four jumps approximately 3 feet each. Pools between weirs and between the upstream weir and the falls will function as resting areas and jumping pools and will provide a volume of water for energy dissipation. Pools in front of the weirs are expected to fill with bedload to a point of seasonal equilibrium. During high flows, the pool volumes will increase over the low flow volumes. At no time are they expected to completely fill. The configuration shown requires the least amount of materials. If selected for design, consideration should be given to geometry of the jumping pools to ensure that they have the proper configuration. This may require the use of more materials.

Diversion and Care of Water

Construction should be planned for the low flow season, July through September, when diversion and care of water will

probably be easy- If the weirs are constructed from upstream to downstream and gabions are filled in-place or set with equipment, working "in the wet" should be possible.

Materials of Construction

Weirs and abutments would be constructed. of galvanized wire gabions. Two strands of light gauge galvanized wire should be used for lacing selvage. This will provide the necessary strength while increasing productivity. Gabions are available in a variety of lengths and cross-sections., In general, 12 x 3 x 3 feet baskets are anticipated with other sizes used as required.

Gabions should be filled with clean, hard rock ranging from three to eight inches in the greatest dimension. Fill may be placed either by hand or machine. Some fill is available at the Lower Falls; the remainder could be borrowed from the braided reach below the falls.

Methods of Construction

A construction access road could be constructed from near the trailhead and continue roughly along the river to the Lower Falls. A D7 tractor, or equivalent, would be adequate to construct the road. The road would provide limited access for construction equipment and materials. Construction equipment may include a tracked loader, such as a 963 Cat, for borrowing gabion fill material and filling and placing gabions. It may be possible to transport the gabions and construction materials, other than fill, by helicopter. This may save some expense in constructing the access road.

Foundations and abutments for weirs must be cleared of all loose material, leveled, and graded before gabions are placed. Weirs

at the right bank should be keyed into the slope by extending them a distance of one-half a basket (about six feet) into the slope. This could be accomplished with a tracked backhoe. Gabion fill borrowed from downstream could be skidded to the falls with a tracked loader. The tracked loader could also be used to excavate fill material and to fill and set gabions.

Safety During Construction

Rockfalls from the left bank and landslides from the right bank are the principal hazards during construction. The slope at the left bank could be scaled and/or netted to reduce hazards from rockfalls and the right bank could be 'cleared of obviously unstable material. These measures will be costly and it should probably be left to the discretion of the contractor to take necessary safety precautions.

It is advised, however, to avoid work during conditions of high water, rain, freezing or thawing, and high winds. These natural agents provoke the rock falls and landslides at the site.

Longevity

The series of gabion weirs can be designed and constructed to withstand the forces of annual flood events and floods with return periods of 100 years. Extensive slope failures at the right bank, however, can not reasonably be designed for and their occurrence cannot be accurately predicted. Comparision of photographs from 1974 (Photo 4) and 1984 (Photo 5) show that slope failures have occurred in the past ten years. These failures probably would not have caused a complete failure of the proposed alternative. It is reasonable to assume that, with regular maintenance, gabion weirs will last as much as ten years and longer.

Photo 4 - Lower Falls 1974

Photo 5 - Lower Falls 1984

It should be planned to reinforce or replace wire mesh and place additional riprap at the weirs and their abutments on an annual basis. Inspection of the structures should follow every major runoff event. Inspection and early repair of damage will be the key to long-term viability of this alternative.

Likelihood of Successfully Passing Fish

Fishway success typically depends upon four key items:

- Placement of entrance,
- Attraction flow,
- Head loss per pool, and
- Flow regulation

Since the scheme uses the entire stream for a fishway, the first two items are easily satisfied. Head loss per pool in this alternative is approximately three feet. Though three feet is within the jumping capabilities of the target species (Steelhead, chinook, and coho) it is well over the one-foot head loss per pool used in conventional fishway design. As a result, some delay in upstream migration should be expected, and some fish may he unable to pass.

Fishway flow must be regulated to provide a minimum flow to allow passage during low flow periods and a maximum flow that will not create a barrier in the fishway during high flows. The weir- lengths coupled with the pool volumes in this alternative should be adequate to handle the upper design flow of 700 cfs, though no regulation is available. At the lowest design flow of 50 cfs, seepage through or beneath the gabion weirs may reduce

flows for passage. It is believed that seepage can be limited by the use of a membrane. In any event, silting will reduce seepage in time.

The relatively high jumps that fish are required to negotiate and the potential low-flow passage problems may tend to limit upstream migration for all species, but will certainly improve present conditions.

ALTERNATIVE 2 - POOL EXCAVATION

Layout

Figure 12 shows the pool excavation in plan and section. This alternative consists of three pools excavated in the rock that forms the base of the Lower Falls. It would occupy the chute that was excavated during 1974 and extend upstream of the chute.

The pools are roughly 10 feet in width by 15 feet in length. Nominal depth of the pools is approximately three feet. The head loss per pool is approximately three feet. The "lip" of each pool, . should be reinforced with fiber concrete. Reinforcing steel should be placed in the fiber concrete. The reinforcing steel placed in the direction of flow should be embedded in hard rock (drilled and grouted). The rock/concrete interface should be smooth with no feathered edges.

Either the pools and lips can be sloped normal to the flow or the lips of pools can be formed with concrete to slope normal to the flow. This will regulate flow in the ladder by "drying up" the high side of the ladder during low flow. As stream. flows increase and the headwater elevation increases, flow will begin to enter the high side of the ladder. The slope of lips is determined from the design range of flow and the variation in headwater elevation.

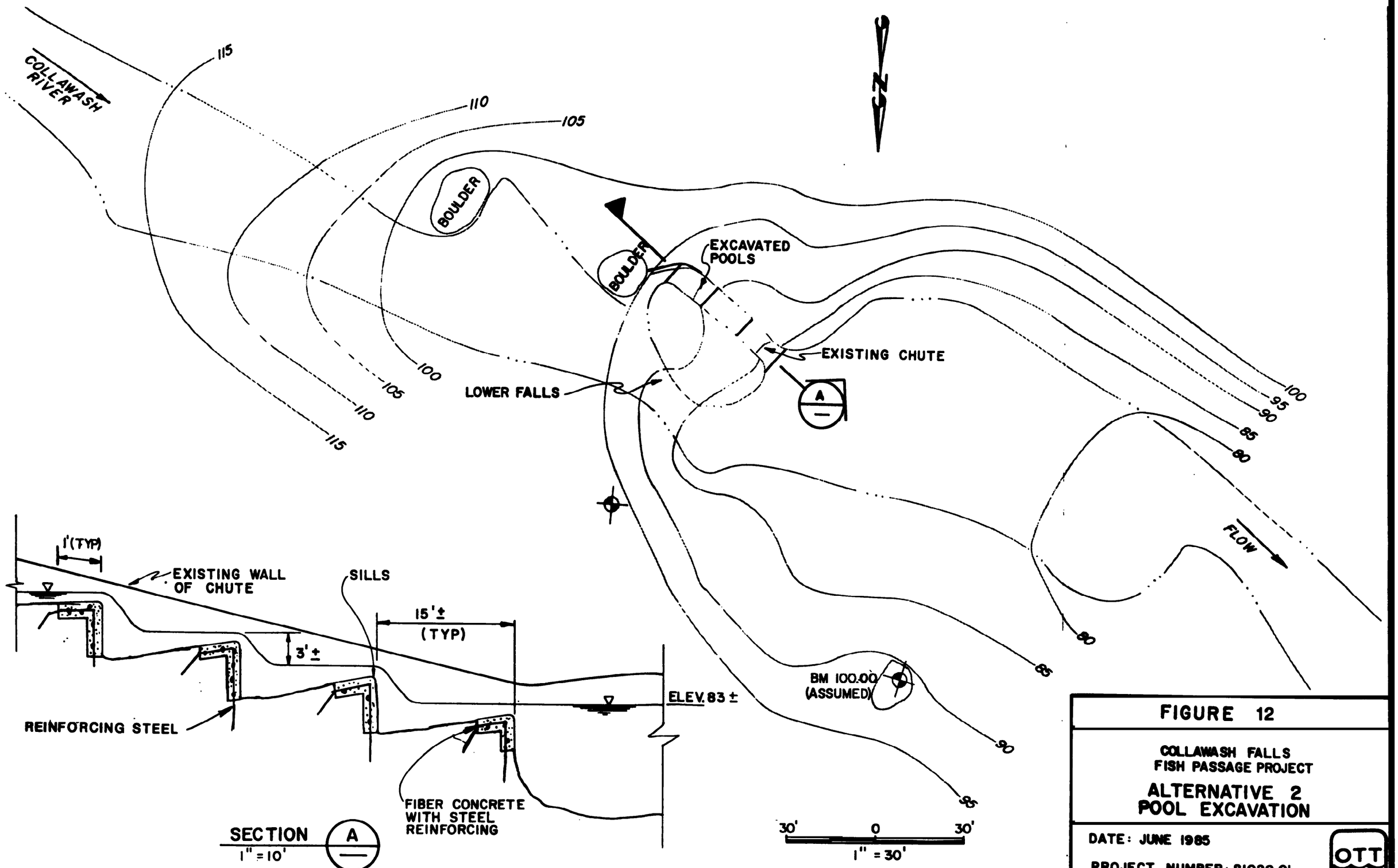

FIGURE 12

COLLAWASH FALLS
FISH PASSAGE PROJECT

ALTERNATIVE 2
POOL EXCAVATION

DATE: JUNE 1985

PROJECT NUMBER: S1029.01

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Operation

Fish approaching the Lower Falls would enter the ladder from the pool at the base of the falls. After passing the three excavated pools fish would enter the cascade area above the falls. A channel would have to be cleared between the head of the ladder and the main flow of the stream.

The excavated pools will provide a sufficient volume for energy dissipation up to an "in-ladder" flow of approximately 50 cfs. If a greater in-ladder flow is desired, the pools should be proportionately wider. A guide for the required volume for energy dissipation is four ft-lb/set of power per cubic foot of pool volume.

Diversion and Care of Water

There is little flow in the area of the chute during the July through September period. If construction is planned for this period, diversion and care of water could probably be accomplished by sandbagging. The sand could be borrowed from the pool at the head of the cascade area at the Lower Falls.

Materials of Construction

Materials of construction are primarily reinforcing steel and concrete used to armor the lips of pools. ASTM grade 60 reinforcing steel is readily available and adequate for steel requirements. Concrete can be additionally reinforced with steel, glass, synthetic, or natural fibers. This will improve the concrete strength and reduce wear caused by impact and abrasion. Fiber types should be selected during final design based on properties and cost.

Methods of Construction

Pool excavation will require carefully controlled, very light blasting. The first step will be to clean the bedrock surface of loose rocks and talus so that the surface is cleanly exposed along and adjacent to the alignment. Second, the layout should be marked on the rock. The third step will be to select a test pool and line drill the perimeter to neat lines of the excavation, to grade, at one-foot centers. Then, a trial blast should be made with production holes spaced two feet on centers and loaded with not more than the equivalent of .35 lb of 60-percent dynamite/cu yd of rock. Production holes should be drilled six inches below grade and stemmed to six inches above grade with tamped, moist, fine soil. Hole collars also should be stemmed to confine the blast. Production holes in a single pool may be fired instantaneously because the volumes of rock and explosive are small. Perimeter holes should be left unloaded. Results should be observed and the blasting pattern adjusted as required. If inadequate breakage occurs, consideration should be given to increasing the spacing of perimeter holes to 18 inches and loading every other hole. Also, the powder factor may have to be adjusted. Remaining pools could be excavated with a single blast using 25 millisecond (ms) delays between pools, thereby limiting the total number of blasts to two. Cleaning and trimming to final grade may be done by hand.

Safety During Construction

The safety considerations mentioned in Alternative 1 should be observed here. Precautions for blasting are discussed in Alternative 4 and should be observed here as well.

Longevity

Pool excavation will require regular inspection and maintenance. Under typical flood events and bedload movement, repairs should not be difficult to perform. The greatest hazard to this alternative is a massive slide from the right bank covering the work or moving the barrier to passage downstream. As it is impossible to predict the occurrence of a slide, it is impossible to predict a project life. It is believed that pools will have a good chance of surviving ten years provided that a major slide does not occur and conscientious annual maintenance is performed.

Likelihood of Successfully Passing Fish

The location of the passage entrance is optimum, i.e., it is placed at the base of the barrier in a confined area. Fish attraction flows are adequate for this alternative as well. The three-foot height of jumps may cause delay, as mentioned under Alternative 1, but should be negotiable by most fish.

Regulation of flow in the fish ladder is critical in this alternative. Once a design range of flow is selected, the exit sill and successive pools must be carefully designed to regulate in-ladder flows. With proper design, this alternative will successfully pass fish.

ALTERNATIVE 3 VERTICAL SLOTTED FISHWAY

Layout

Alternative 3 consists of a vertical slotted fishway at the left bank of the Lower Falls. This is shown in plan and section in Figure 13. The fishway entrance is located at the base of the Lower Falls; its lower section occupies the chute. The fishway

exits at the left bank in the cascade area. Pools of the fishway are six feet x eight feet with a minimum depth of three feet. The slope of the fishway is approximately 1V:8H. Head loss between pools is one foot.

The fishway entrance would be a vertical slot approximately one-foot wide. Baffles between pools would be the vertical slot type with nominal one-foot slot widths. The exit trashrack should be sloped 60 degrees from horizontal and bar spacing should be 10 inches. Ice is not expected to control trashrack design. The entire fishway should be covered by a galvanized grating to protect the structure from rockfalls and to help prevent poaching.

Operation

Slotted fishways are designed to regulate in-ladder flows under changing tailwater and headwater conditions. The f ishway flow will increase as headwater rises. As flows increase, the depth in pools will also increase and the hydraulic characteristics (velocity and flow patterns) remain essentially constant over the high to low flow design range.

Fish approaching the Lower Falls will encounter approximately 20 cfs fishway flow during low flows and up to 40 cfs during high flows. Velocity of the entrance jet will be approximately eight fps.

Diversion and Care of Water

Construction should be planned for the low flow season. Because of the location, dewatering during construction could be accomplished with sandbags with the exception of the fishway entrance. A contractor would probably excavate the entire ladder route but leave a minimum amout of intact rock at the

entrance thereby providing a downstream cofferdam. Concrete could then be placed in the dry. The remaining rock would be removed after the entrance concrete is placed and forms are stripped.

Materials of Construction

Fishway walls, slabs, and baffles would be cast-in-place reinforced concrete: 3,000 psi concrete and ASTM grade 60 steel would be adequate. Grating should be galvanized steel fastened to the walls of the fishway. Trashracks should be galvanized steel adequate to withstand impact of floating debris and a large bed load.

Methods of Construction

The slot in which the fishway will be constructed will require blasting to excavate the bedrock. It is likely that a contractor would make the excavation and it would be important to allow the contractor to choose. the blasting methods he considers appropriate. The best method will be the one which minimizes overbreak (because concrete is expensive) but which adequately breaks the rock (because cleanup is expensive). A plan for blasting might include the following:

The bedrock surface should be cleaned and the neat lines of the excavation marked. Next, the perimeter lines should be drilled at 18-inch centers. Production holes on three-foot centers (approximating a ditching pattern) should be drilled to six inches below grade and stemmed to six inches above grade. Hole collars should be stemmed. The equivalent of about .50 lb of 60 percent dynamite/cu yd of rock should be used in the production holes. Only alternate perimeter holes should be loaded. Along the length, roughly each six rows of holes should be delayed at least 25 ms. If the excavation is 120 feet long,

6 delays would be needed. Delays should be planned to provide relief for the deepest holes which probably will mean that the blast should be initiated from upstream to downstream. Hand cleaning to final grade will be required.

Materials and equipment for construction would be skidded to the site from a staging area near the existing trailhead. Concrete will be batched at the site, as close to the fish ladder as possible. Since work will be accomplished mainly with hand equipment, material dimensions and quantities should be kept to a minimum.

Safety During Construction

Safety precautions discussed earlier should be observed for this alternative. Rockfalls from the left bank pose the greatest hazard during construction. Location of the work will probably require the left bank to be scaled of loose material, and/or a safety net placed over the rock face.

Longevity

A number of conventional fishways have been in operation for 50 years or more. Projecting the life for a fishway at Collawash Falls must recognize the risk of damage arising from slope failure and extreme high flows. Of all of the alternatives considered, the slotted fishway is the most vulnerable to damage because it is the most complex alternative. Damage, if it occurs, may be difficult and costly to repair, relative to the other alternatives. It is believed that a regularly inspected and properly maintained slotted fishway will survive ten years.

Likelihood of Successfully Passing Fish

The design, construction and operation of slotted fishways is well understood, and there are many successful examples.

Passage can be further enhanced if trashracks are routinely cleaned. Auxiliary attraction flow is not a necessity, but it would further improve the likelihood of passage.

ALTERNATIVE 4 - BLASTING LOWER FALLS

Blasting Plan

Blasting the bedrock ledge at the base of and to the left of the Lower Falls has the objectives of producing a quantity of large rock which will increase roughness, and of reducing the velocity of sheet flow which traverses the ledge and is directed at the base of the falls. To accomplish these objectives, the ledge must be blasted into large, separated pieces. The pieces should be large enough to resist erosion and sufficiently separated to invite substantial flow between adjacent pieces.

Joints will control the size of pieces which can be produced. The northeast set of joints controlled the right side of the previously excavated chute and can be expected to control breakage in the ledge. Prominent northeast joints are spaced about six feet on centers. The northwest set of joints is not as well developed and is spaced about four feet between prominent joints. These orientations and spacing suggest that pieces up to four feet x six feet x depth of cut might be produced. Rocks about this size can be observed in the cascade above the falls, and it seems likely that pieces this size would resist movement downstream.

Achieving enough separation to invite substantial flow between adjacent blasted pieces suggests using long delays and a fairly high powder factor. However, a high powder factor may work against the objective of producing large pieces. It is believed that satisfactory results could be obtained using the equivalent of .75 lb of 60 percent dynamite/cu yd of rock with at least

200 ms between successive rows. Holes should be at least 1-3/4 inches in diameter (to provide sufficient volume for the required charge of explosives), 10 feet deep (or deeper if the adjacent pool is deeper), and on 6-foot centers (following prominent joints as much as possible). Figure 14 shows a possible layout for the blast. The blast would choke the present plunge pool of the falls.

Safety During Construction

The safety considerations mentioned above should be observed. The use of long delays increases the risk of misfire. To reduce the risk, non-electric delays should be used in a dually-initiated, detonating cord circuit.

Problems Anticipated

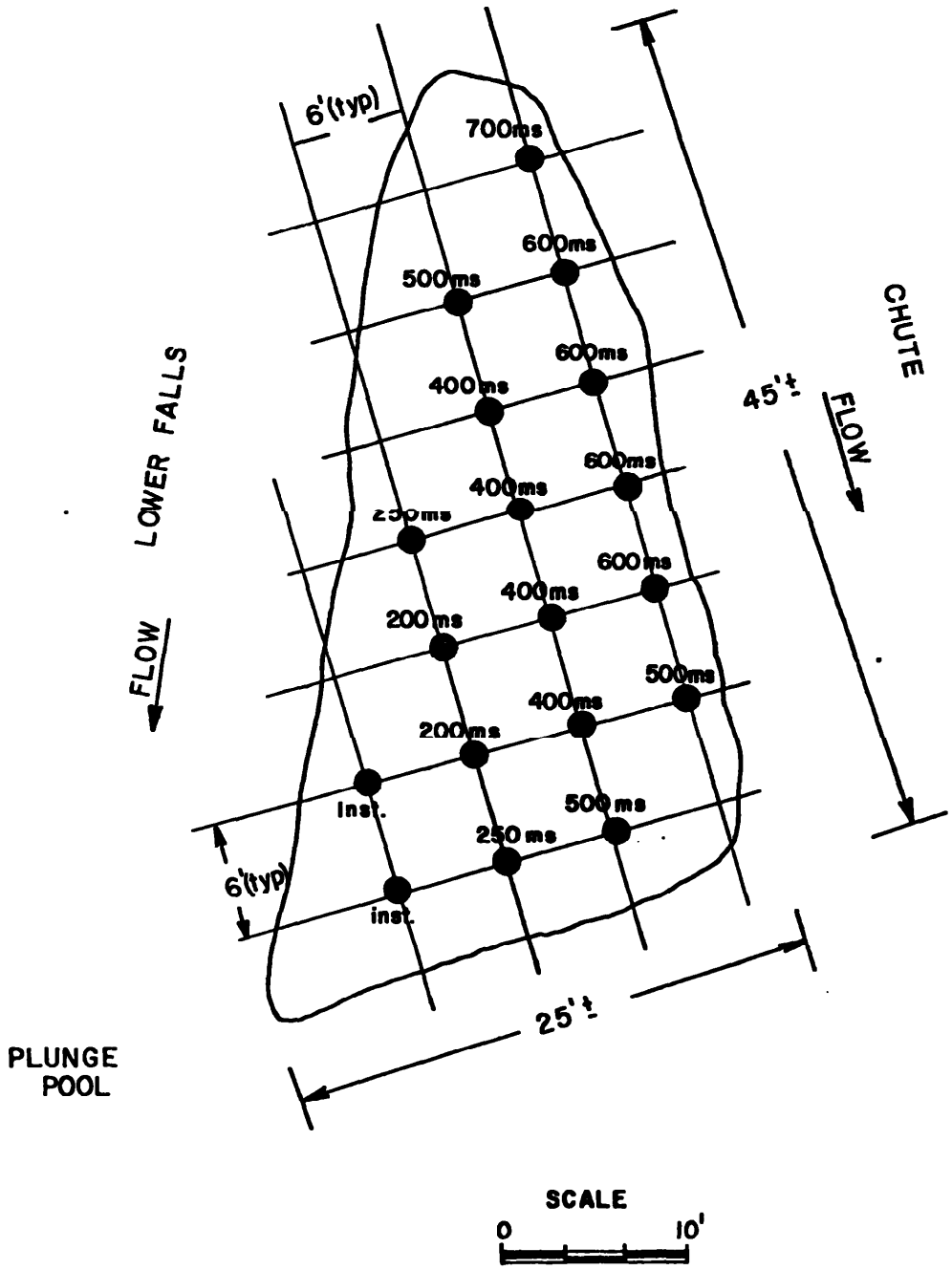
The blast may cause the landslide debris in the Lower Falls to fail. Progressive upstream erosion would ensue, thereby exacerbating the existing problem, at least temporarily.

The blast may cause material on the right bank to fail into the river. The result could be positive or negative.

Low flows may not reach the blasted area. Low flow now favors the right bank, and blasting the bedrock ledge will not change the low flow pattern unless the landslide debris in the falls fails.

Longevity

The result is uncertain, as is its potential longevity. If initial results are encouraging, a few key boulders might he moved annually , after high flows, to further improve very local



NOTES:

Drill 1 3/4 inch dia.(min) holes, 10 ft. or depth of plunge pool, whichever is greater.

Load not greater than .75 lb. per cubic yard.

Use nonelectric delays in approximate sequence shown.

FIGURE 14

COLLAWASH FALLS
FISH PASSAGE PROJECT

ALTERNATIVE 4
BLASTING LOWER FALLS

DATE: AUGUST 1985
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OTT

conditions. Judging from observed ten-year changes, it seems likely that further blasting will be required at about five-year intervals.

Likelihood of Successfully Passing Fish

The success of this alternative depends upon the interstices developed between blasted pieces of rock. If the interstices are narrow, say less than six inches, fish may not be able to swim between rocks and low-flow passage could be difficult. High-flow passage should be improved somewhat, however. If the interstices are wide enough to allow fish to pass and a clear path is made available, low-flow passage may be improved substantially. This should improve high-flow passage as well.

CHAPTER 6

COST ESTIMATES

This chapter presents the results of a cost estimate analysis performed on the four alternatives investigated. Considered in this chapter are project life, capital costs, and operation and maintenance costs.

PROJECT LIFE

The expected project lives of the four alternatives cannot be determined accurately, but are believed to be at least ten years. To determine the present value of annual costs of each alternative, a ten-year life was assumed for each.

CAPITAL COSTS

Capital costs have been estimated for each of the four alternatives. The uncertainty of preparing estimates for a site as remote as Collawash Falls should be recognized. Many decisions and assumptions have been made on the basis of engineering judgment. Alternatives 1 and 3 have contingencies of 30 percent. Alternatives 2 and 4 have contingencies of 20 percent. These contingencies reflect the degree of uncertainty in the estimates.

ASSUMPTIONS

The assumptions made for each of the four alternatives are as follows:

Alternative 1 - Raising Tailwater

1. Heavy equipment required for excavation and moving materials will be able to reach the site via a temporary access road.

2. Sufficient rock suitable for gabion construction can be found within approximately one quarter mile downstream of the falls.

3. An access road to the location of the rock for gabion construction can be constructed and used to skid rock from the borrow area to the gabion construction site.

4. Construction will take place during the usual low flow period so that construction can occur without extensive. provisions for dewatering.

Alternative 2 - Pool Excavation

1. Material and equipment will be brought to the site by helicopter.

2. Blasting of the rock to form pools will be performed in such a way that the remaining rock structure following blasting is adequate for forming and placing the concrete without undue overbreak.

Alternative 3 - Vertical Slotted Fishway

1. Heavy equipment for excavating and moving materials will be able to reach the site via a temporary access road.

2. Materials required to construct the fishway can be brought to the site via the access road.

3. Blasting of the rock to form the fishway will be performed in such a way that the remaining rock structure following blasting is adequate for forming and placing the slab and walls of the fishway without undue overbreak.

Alternative 4

1. Material and equipment will be brought to the site by helicopter.

ANNUAL COSTS

Annual costs will be incurred for labor and materials required for the operation and maintenance of the passage alternatives. Labor costs include employee time for periodic inspection and repairs as needed. Material costs are for materials needed to make minor repairs to the passage structures. The estimates include only costs for minor repairs and routine maintenance, and do not include allowances for catastrophic damage or failure.

Annual labor required for Alternative 1 is 14 man-days. This includes two inspections by a two-man crew and a two man-week allowance for repairs. The total labor cost is $1,610 per year, at a rate of $115 per man-day. Annual cost for miscellaneous materials is $500.

Labor for Alternative 2 is estimated at 14 man-days per year for inspection and repairs. This includes two inspections by a two-man crew and a two man-week allowance for repairs. The total labor cost for this alternative is $1,610 per year. Annual cost for miscellaneous materials is $500. This includes items such as concrete, reinforcing steel, and hand tools.

For Alternative 3 the estimated time requirement for inspection and repairs is 20 man-days at a cost of $2,300 per year. This alternative will require routine visits by a two-man crew during heavy migration periods to clean trashracks. An allowance is also provided for minor repair to the fishway. Miscellaneous materials for repairs are estimated at $200 annually.

Alternative 4, blasting, does not provide for any permanent structures, and therefore no annual costs will be incurred. It is estimated, however, that the falls would have to be blasted again in 5 years at a cost of 2/3 the initial cost.

An economic analysis was performed to adjust the annual costs for labor and materials to a present value. A ten-year project life and three percent discount rate are used in the analysis. The three percent discount rate is the rate currently used by the Bonneville Power Administration for evaluating fish and wildlife projects. Tables 2 through 5 show detailed cost summaries for the alternatives.

TABLE 2
ALTERNATIVE 1

RAISING TAILWATER
ESTIMATE OF CAPITAL AND ANNUAL COSTS

ITEM	UNIT	QUANTITY	COSTS UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 10,000	$ 10,000
DEWATERING	N/A	---	---	---
EARTHWORK				11,000
Excavation, Common	CY	1,000	10	10,000
Backfill	CY	250	3	1,000
Riprap	CY	---		
REINFORCED CONCRETE	N/A	---	---	---
GABIONS 3'x 3'x 12' each	CY	850	65	55,000
CIVIL SITE WORK	LS	---	10,000	10,000
ACCESS TO SITE	LS	---	16,000	16,000
SUBTOTAL				$102,000
30% CONTINGENCY				31,000
ENGINEERING SERVICES				44,000
NEPA Compliance				5,000
Permits				2,000
Design (@ 20%)				27,000
Surveying				5,000
Inspection				5,000
TOTAL CAPITAL COST				$177,000
PRESENT VALUE OF ANNUAL COSTS ($2110/YR., 3%, 10 YRS)				18,000
TOTAL PROJECT COST				$195,000

TABLE 3
ALTERNATIVE 2

POOL EXCAVATION
ESTIMATE OF CAPITAL AND **ANNUAL** COSTS

ITEM	UNIT	QUANTITY	COSTS UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 10,000	**$ 10,000**
DEWATERING	LS	---	1,000	1,000
EARTHWORK				5,000
Blasting	CY	27	150	4,000
Cleaning	CY	27	22	1,000
CONCRETE	LS	---	---	3,000
DEBRIS NET	LS	---	6,000	6,000
SITE ACCESS (AIR)	LS	---	10,000	10,000
SUBTOTAL				$ 35,000
20% CONTINGENCY				7,000
ENGINEERING SERVICES				13,000
NEPA Compliance				2,000
Permits				1,000
Design (@ 20%)				8,000
Surveying				1,000
Inspection				1,000
TOTAL CAPITAL COST				$ 55,000
PRESENT VALUE OF ANNUAL COSIS ($2110/YR., 3%, 10 YRS.)				**18,000**
TOTAL PROJECT COST				**$ 73,000**

TABLE 4
ALTERNATIVE 3

VERTICAL S-D FISHWAY
ESTIMATE OF CAPITAL AND ANNUAL COSTS

ITEM	UNIT	COSTS QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 20,000	$ 20,000
DEWATERING	LS	---		1,000
EARTHWORK				31,000
Blasting	CY	180	150	27,000
Cleaning	CY	180	20	4,000
CONSTRUCTION OF FISHWAY	LS	---	---	60,000
ACCESS TO SITE	LS	---	16,000	16,000
DEBRIS NET	LS	---	16,000	16,000.
SUBTOTAL				$144,000
30% CONTINGENCY				43,000
ENGINEERING SERVICES				62,000
NEPA Compliance				10,000
Permits				5,000
Design (@ 20%)				37,000
Surveying				5,000
Inspection				5,000
TOTAL CAPITAL COST				$249,000
PRESENT VALUE OF ANNUAL COSTS ($2500/YR, 3%, 10YRS)				21,000
TOTAL PROJECT COST				$270,000

TABLE 5
ALTERNATIVE 4

BLASTING LOWER FALLS
ESTIMATE OF CAPITAL AND ANNUAL COSTS

ITEM	UNIT	COSTS QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 2,000	$ 2,000
DRILL & BLAST	LS	---	5,000	5,000
DEBRIS NET	LS	---	6,000	6,000
SITE ACCES (AIR)	LS	---	10,000	10,000
SUBTOTAL				$ 23,000
20% CONTINGENCY				5,000
ENGINEERING SERVICES				6,000
NEPA Compliance				2,000
Permits				1,000
Design				2,000
Surveying				500
Inspection				500
TOTAL CAPITAL COST				$ 34,000
PRESENT VALUE OF REPLACEMENT COSTS (66% of Capital Cost at Year 5, 3%)				20,000
TOTAL PROJECT COST				$ 54,000

TABLE S
ALTERNATIVE 4

BLASTING LOWER FALLS
ESTIMATE OF CAPITAL AND ANNUAL COSTS

ITEM	UNIT	COSTS QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	**LS**	---	$ 2,000	**$** 2,000
DRILL & BLAST	**LS**	---	5,000	5,000
DEBRIS NET	**LS**	---	6,000	6,000
SITE **ACCES** (AIR)	**LS**	---	10,000	10,000
SUBTOTAL				$ 23,000
20% CONTINGENCY				5,000
ENGINEERING SERVICES				6,000
NEPA Compliance				**2,000**
Permits				**1,000**
Design				2,000
Surveying				500
Inspection				500
TOTAL CAPITAL COST		I		$ 34,000
PRESENT VALUE OF REPLACEMENT COSTS **(66% of Capital Cost at Year 5, 3%)**				20,000
TOTAL PROJECT COST		II		$ 54,000

LAKE BRANCH REARING HABITAT IMPROVEMENT

1985

by

Ken MacDonald - Fishery Biologist

Richard Ragan - Hydrology Technician

Mt. Hood National Forest

Hood River Ranger District

Mt. Hood, Oregon

Funded by

Bonneville Power Administration

Division of Fish and Wildlife

Agreement Number: DE-AI79-84BP16726

Project Number: 84-11

LIST OF FIGURES

		PAGE
FIGURE 1	REACH A PROJECT AREA	111
FIGURE 2	BOULDER PLACEMENT	113
FIGURE 3	SIDE CHANNEL PLAN VIEW .	114
FIGURE 4	SIDE CHANNEL INLET	116
FIGURE 5	LOG SILL DETAIL	117
FIGURE 6	DIGGER LOG DETAIL	118
FIGURE 7	REACH B SITE DETAIL	119

LIST OF PHOTOGRAPHS

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Boulder Placement

Boulder Placement Reach - Before

Boulder Placement Reach - After

Reach A Side Channel - Before

Reach A Side Channel - After

Side Channel Construction

Side Channel - "Ship Prow"

Side Channel Structures - Downstream View

Side Channel Inlet Control - Upstream View

Upper Portion of Completed Side Channel

Lower Portion of Completed Side Channel

Side Channel Enters Existing Backwater Pool

Confluence of Side Channel and Lake Branch

Reach B Structures

1984 Side Channel Before Maintenance

1984 Side Channel After Maintenance

1984 Side Channel Structures

ACKNOWLEDGEMENTS

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DAVE FORWARD	Engineer Mt. Hood National Forest Eastside Technical Center

ABSTRACT

Lake Branch of the West Fork Hood River is an important producer of summer steel head trout. Anadromous fish habitat is generally good, but is locally limited by poor low flow rearing habitat, marginal spawning habitat, a lack of instream diversity and possibly overwintering habitat. Lake Branch Steelhead probably smolt as 1+, 2+ and 3+ fish making quality rearing habitat an important habitat component.

The 1985 project represents the third phase of a planned five year anadromous fish enhancement program on Lake Branch. The objectives of the project were to improve low flow rearing habitat for 1+ and older Juvenile steel head trout and increase habitat diversity. Expected secondary benefits include improved over winter habitat and creation of additional spawning habitat.

Programmed activities for FY'85 were:

1. Develop a detailed enhancement plan for the West Fork Hood River.
2. Develop 15 rock berm structures in Lower Lake Branch.
3. Develop two side channels.
4. Monitor/evaluate the FY1983 and FY1984 project work.
5. Maintenance of the FY1984 work, especially the side channel.
6. Baseline monitoring of the FY1985 work.

All proposed work was completed, with sane minor modification, within the programmed budget.

Accomplishment included:

1. An initial draft Hood River Basin fish and fish habitat management/enhancement framework was formulated. This framework includes limiting factors, possible management actions, and monitoring plans for the West Fork of Hood River.
2. Four boulder clusters were placed in a riffle/glide reach to improve instream cover. Twelve rock structures were constructed to improve low flow rearing habitat in lower Lake Branch.
3. Two side channels were built. One was completed and seven log structures installed. The second had a soft mud bottom and will overwinter before completion.
4. Habitat and population monitoring/evaluation activities were continued in the 1983 and 1984 project area.
5. Deepening of the 1984 side channel and placement of five rock and one log structure within the side channel.
6. Baseline population and habitat data was gathered in the 1985 project area.

Introduction

Lake Branch is an important anadromous fish producing tributary of the West Fork Hood River (refer to Vicinity Map). Summer Steelhead trout and spring chinook are the management emphasis species. Some winter Steelhead trout may utilize the stream and spring chinook salmon are being introduced through an active Salmon Trout Enhancement Program (STEP) hatch box project. The Oregon Department of Fish and Wildlife (ODF&W) annually supplements natural summer steelhead production with smolt outplants.

Fish habitat in Lake Branch is generally rated as good (Uebel et al, 1981). Habitat quality is diminished by locally poor rearing habitat, poor distribution of spawning habitat and a lack of habitat diversity. Past managment activities, especially stream cleanout and salvage logging of log Jams has locally reduced diversity and lessened the habitat quality. Rearing habitat is especially important in Lake Branch, as Hood River system Steelhead smolt not only as 1+ fish but also 2+ and 3+ (Holer, Kinzey, and Hutchinson, 1986). it is assumed that low flow rrearing habitat for 1+ and older Juveniles is the factor most limiting anadromous habitat capability.

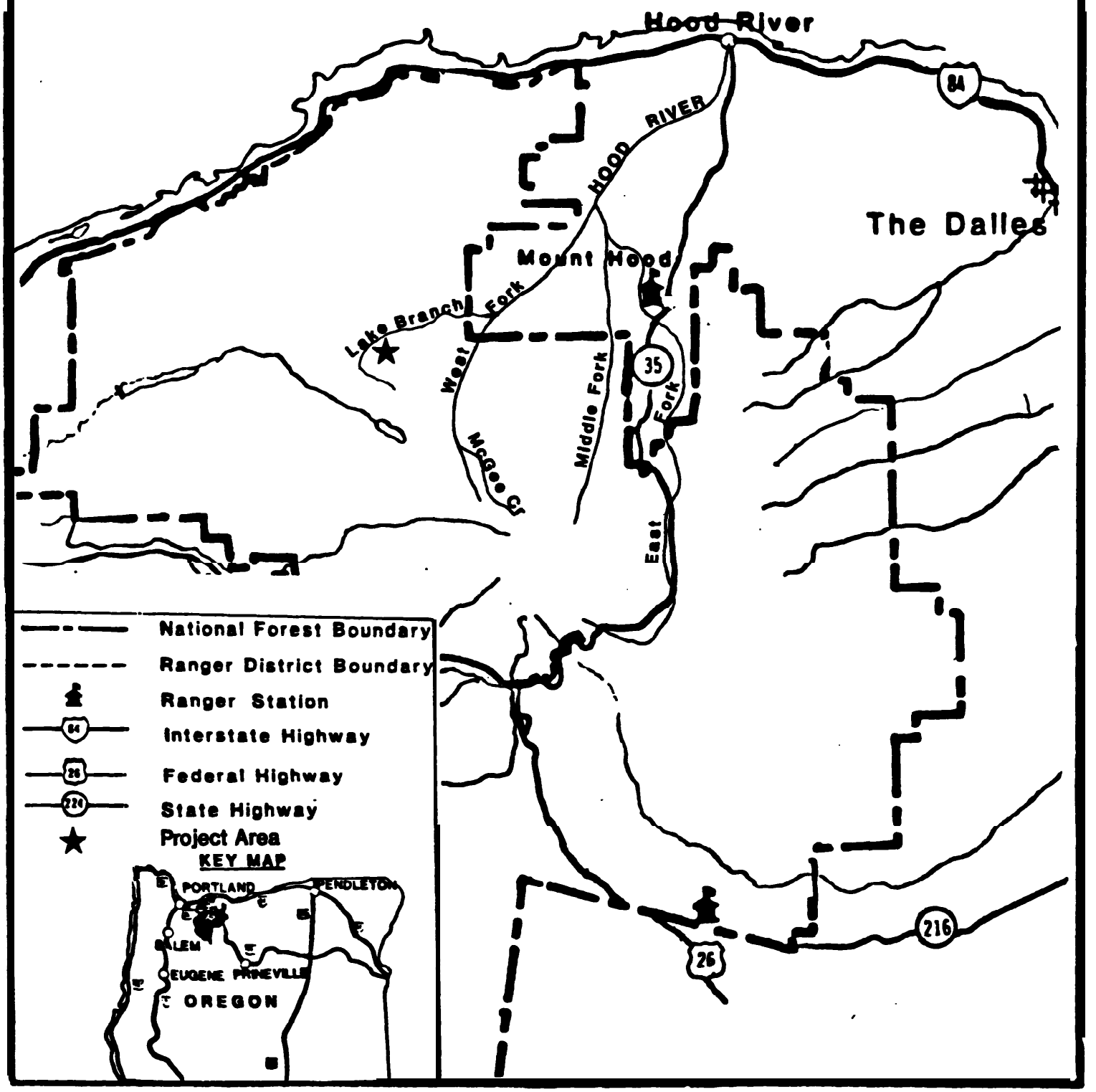
The 1985 Lake Branch Project was the third year of a multi-year enhancement effort in the West Fork Hood River Drainage. The enhancement program is coordinated between the USDA Forest Service, Mt. Hood National Forest (Forest Service) and the Oregon Department of Fish & Wildlife, in consultation with the Confederated Tribes of Warm Springs. Forest Service work has included rehabilitation of roads within the drainage to reduce sediment input and instream enhancement projects in 1983 and 1984 funded by the Bonneville Power Administration (BPA) through the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (Heller, 1984), (MacDonald and Ragan, 1985). The Forest Service, using Knutson-Vandenberg funds in 1985 constructed four rock berms to increase low flow pool and glide habitat in lower Lake Branch. The ODF&W has concentrated on improving passage in the lower watershed. A BPA funded ODF&W project in 1985 completed a passage facility at a fails on the West Fork Hood River and STEP volunteers improved passage at a boulder chute at RM 2.8 of Lake Branch.

The Lake Branch enhancement project has been divided into two subprojects; rearing habitat improvement below river mile (RM) 7.8 and channel rehabilitation between RM 7.8 and 9.0. The 1983 and 1984 projects were prototype projects, testing several different improvement techniques for their applicability in a high gradient stream such as Lake Branch. The objectives of the 1985 project were to apply proven techniques from in the 1983 and 1984 projects to improve low flow rearing habitat for 1+ and older juvenile Steelhead trout, and increase habitat diversity. Secondary benefits expected to be produced are improved overwinter habitat and spawning habitat.

A monitoring program has been established to determine the extent to which project objectives are met and measure the effectiveness of various structures in improving fish habitat and production. The monitoring in the lower reach includes pre and post project population sampling and habitat measurements at structure locations. A control reach has also been established. in the Channel Rehab reach, monitoring includes a topographic map of the channel, pre and post project implementation, and the fish population sampling. The topographic map will produce a record of channel and habitat changes due to the structures over time.

VICINITY MAP

HOOD RIVER DRAINAGE



Future fish and fish habitat management in the West Fork Hood River and Hood River Basin will be guided by the Hood River Basin Fish and Fish Habitat Management Framework. This document is a cooperative effort between ODF&W and the Forest Service to promote effective management of the fish resources and associated habitat in the basin. initially enhancement planning was to focus on the West Fork drainage but the agencies involved in the planning felt that a basin approach would be most effective.

The "Framework" wi I I summarize current information, identify information needs, target species and stocks by subdrainage, identify and formalize cooperative management objectives, establish an overall basin enhancement strategy and prioritize rehab/enhancement work.

The preliminary planning completed to date emphasizes the production of spring chinook and summer Steelhead and recognizes the need for instream project work to Increase habitat complexity and channel structure in the West Fork and Its tributaries. Index streams were identified and monitoring to assess habitat use will begin in the spring of 1986. The highest priority for new work is considered to be the construction of a counting facility at Powerdale Dam to assess the strength of anadromous fish runs into and out of the drainage.

Methods and Materials

Two stream reaches were selected for enhancement under the project; Reach A (approximately RM 7.4 -7.5) and Reach B (approximately RM 5.4). Selection of reaches was based upon heavy equipment access, opportunities for improvement work and areas where it is unlikely timber sales in the near future will al Ion expenditure of KV funds for fisheries enhancement. Equipment access is an important factor in Lake Branch as the size of the stream, steep gradient and magnitude of flows necessitates the instream structures be large and well anchored to be effective.

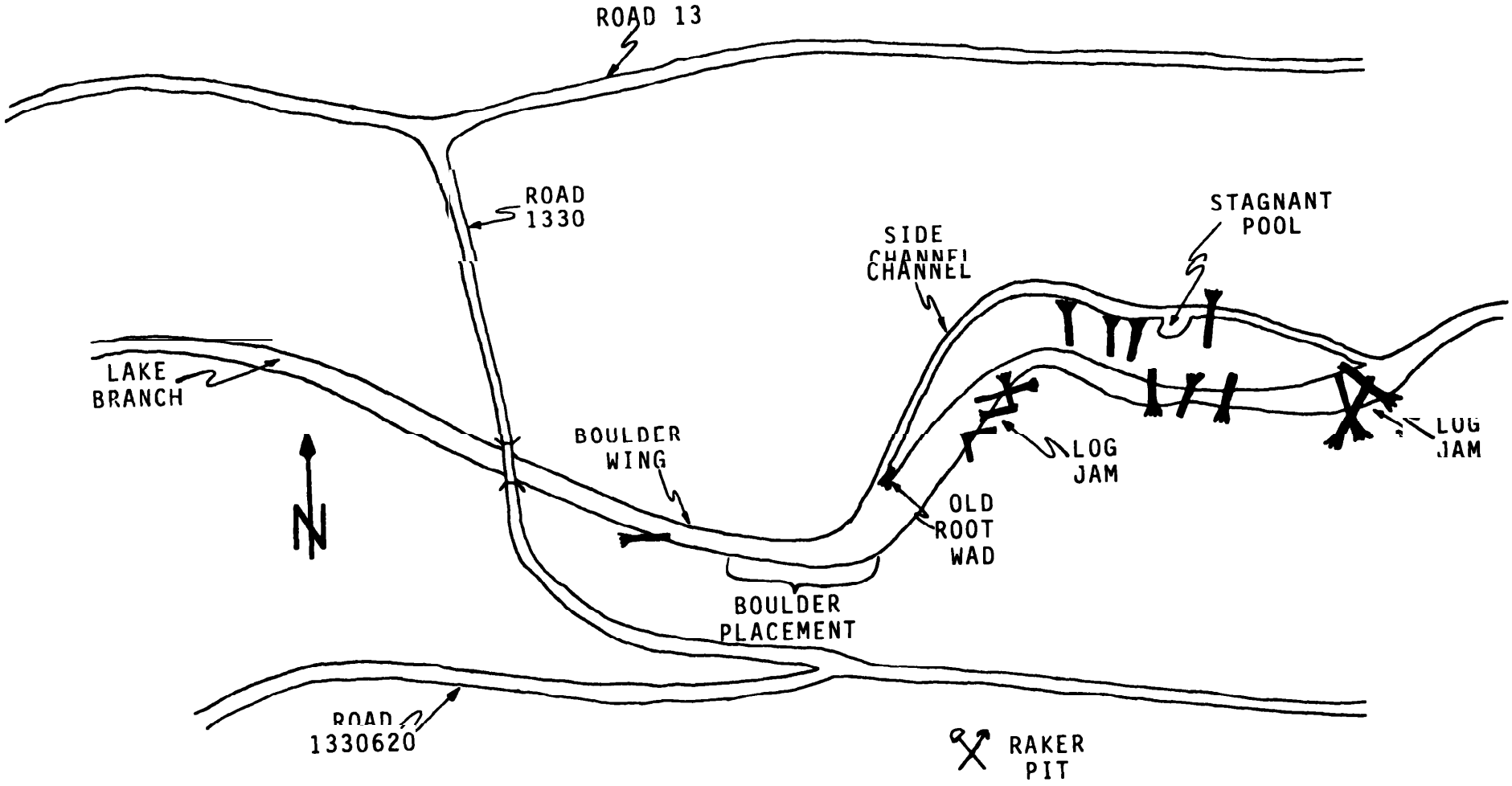
Four boulder groupings were placed in Reach A and an overflow channel developed into a perrenial side channel (Figure). A second side channel was to be constructed but the excavation with the backhoe was aborted due to a muddy, unstable substrate. The excavation was continued by hand to connect the Inlet. The sidechannel will be watched over the winter and a decision made about the feasibility to complete the excavation. I n Reach B, bou I der structures were used to increase pool volume and cover and the control at the mouth of a natural side channel was lowered to increase volume during low flow.

Reach A

The boulder groupings were placed in a low flow glide between two riffles. During medium to high flows, the riffle/glide complex becomes a continusus riffle. Three of the groupings were placed in either a diamond or a paired cluster and one of the goupings was arranged In a wing formation (Figure 2). The objective of the wing was to direct flows toward the right hand side (RHS) enhancing scour associated with a natural log wing. The boulders were arranged in a berm extending from the vegetation out at a 45 degree angle to one third channel width. The boulder wing will force more flow and energy against the RHS, increasing the scour. The boulders that remain within the low flow netted perimeter will also provide instream cover.

F I G U R E 1

REACH A PROJECT AREA



NOT TO SCALE

The thalweg within the glide lays along the right hand de, therefore the deepest portion of the glide is against the right hand bank. Cover in the glide is limited to depth provided In the thalweg and scattered alcoves and overhanging roots along the right hand bank.

The objective of the clusters is to increase cover within the glide and not alter the thalweg, thus maintaining habitat along the right hand bank. The clusters were arranged so that the outside edge of the boulders adjacent to the deepest portion of the channel were placed at the edge of the thalweg (Figure 2). The placement should maintain flow through the thalweg, provide additional cover to the habitat associated with the low flow channel and Increase cover in the glide as a whole.

Downstream of the boulder clusters, a series of log Jams and lown trees form a diverse, high quality fish habitat. The first Jam in the series has caused a gravel bar to form on the left hand side with an overflow channel al ong the I ef t hand bank. During medium stage, water flows down the overflow channel and In high flow events, water flows over the bar and down the overflow channel. The overflow channel was excavated to create a year around side channel. The bjective of the side channel was to increase habitat diversity and rearing habitat, while protecting the log Jams and associated habitat. The side channel should also provide spawning and overw Inter hab i tat.

At the I ower end of the side channel Is a I arge pool that connects to the main channel. During the summer months, this pool becomes stagnant. The side channel now flows into the pool and will maintain flows through the pool into the main channel at all flows. The log Jams and gravel bar did create a somewhat unstabl e channel condi tion and it was necessary to take measures to prevent a channel shift or capture of the main flow.

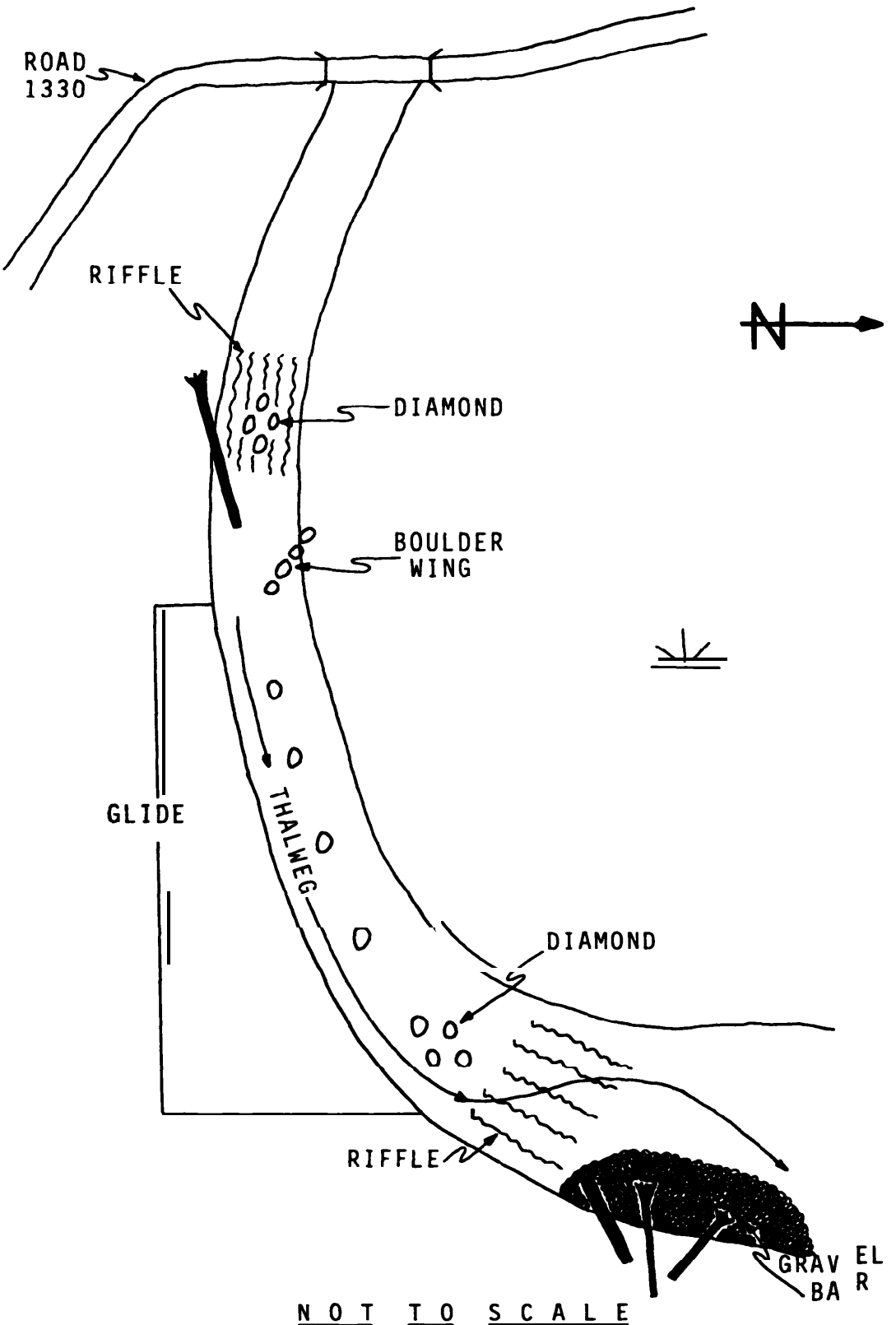
Excavation started at the stagnant pool and proceeded up stream. Care was exercised during excavation to not disturb the left hand bank because high flows had cut the bank to what appears to be afairly stable condition. The channel was excavated until ground water was captured but no deeper than one foot below the elevation of the main channel. Excavation proceeded to a point upstream of an intermittent tributary draining a swampl The tributary was blocked so that it will flow down the side channel. Spoils, to this point, were put on the right hand side of the side channel to form a protect i ve berm. Logs were placed, before excavation, in a wagon wheel configuration (Figure 3) to provide a stable base for the berm. The logs were anchored,, using one half Inch aircraft cable, at each end to buried 55 gal ion drums filled with concrete. SpoiIs were pl aced over the logs.

Where the major excavation ended, Just upstream of the intermittent tributary, a boulder deflector shaped like a ship's prow, was constructed at the head of the spoi Is berm. The prow is designed to dissipate the energy and deflect high flows crossing the gravel bar (Figure 3 and 4).

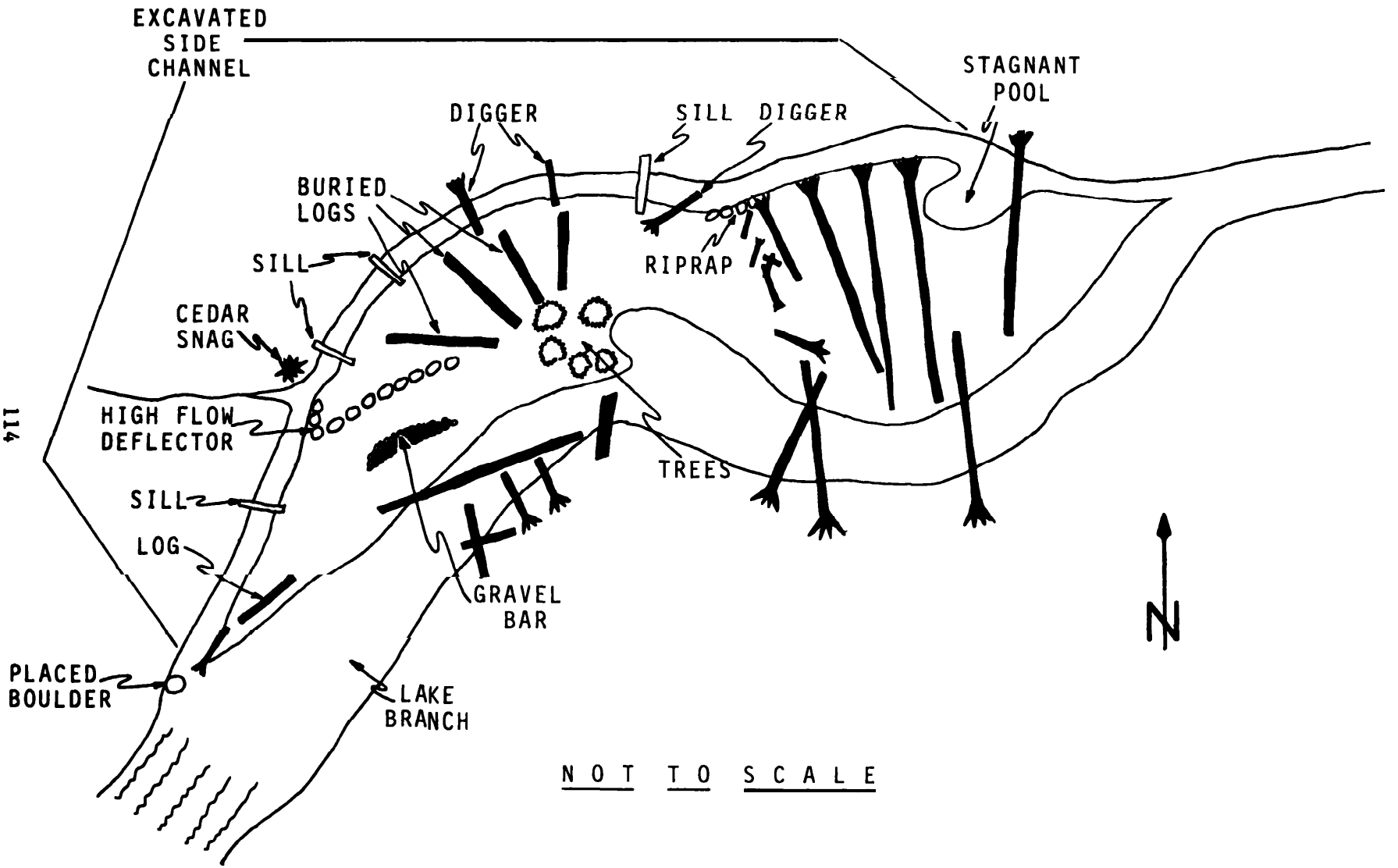
Above the ships prow excavation consisted only of clearing the channel and lowering the bed Just enough to allow flows into the side channel from the main channel during low flow periods. The side channel mouth was control led by a I arge root wad.

F I G U R E 2

BOULDER PLACEMENT



SIDE CHANNEL PLAN VIEW



The control was further protected by placing a large boulder across from the root wad (Figure 4) and a deflector log was placed to divert high flow energy and protect the inlet. The log was anchored to a buried 55 gallon drums.

Once excavation was complete, log structures were placed to provide structural components necessary for habitat diversity. Four log sills were installed to collect gravel and create plunge pools and two log diggers were placed to create scour pools. The target species is summer Steelhead, therefore the structures are designed so that the velocity is maintained (avoiding backwater pools) and the channel will hoefully mimick a riffle gradient with incorporated woody debris.

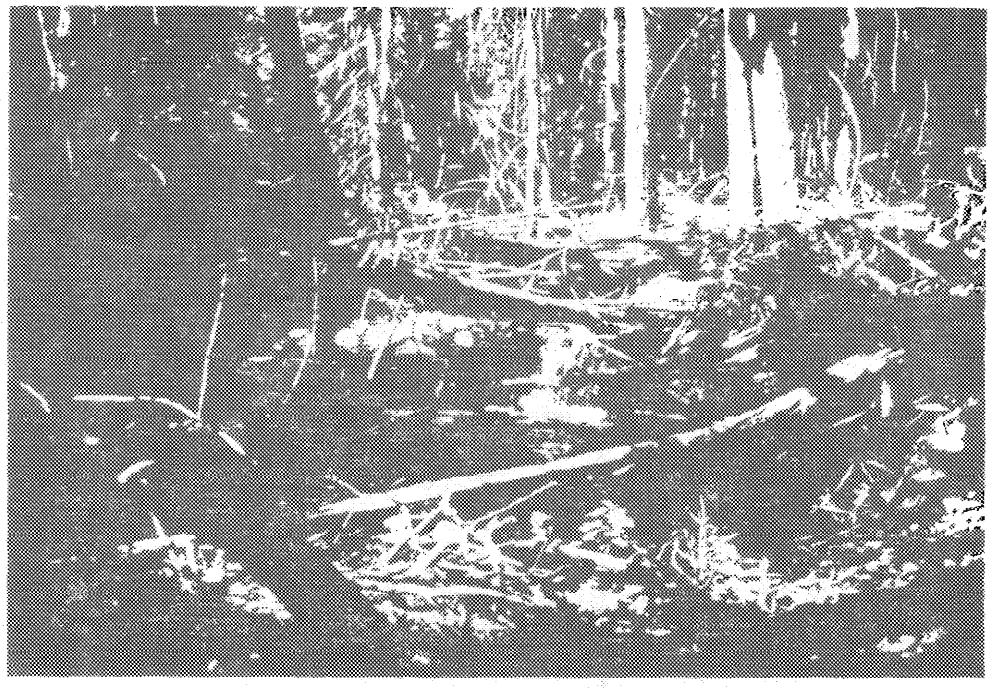
The ends of sill logs were excavated into the banks and ballasted with large boulders. filter and hardware cloth was placed on the upstream faces of the logs to prevent undercutting (Figure 5). Digger logs were placed perpendicular to the flow above the low flow water level. High flows should be forced under the logs causing formation of a scour pool The ends of the digger logs were also excavated Into the banks and ballasted with large rocks (Figure 6). Boulders were placed along the channel margins and in the channel to provide cover.

Reach B

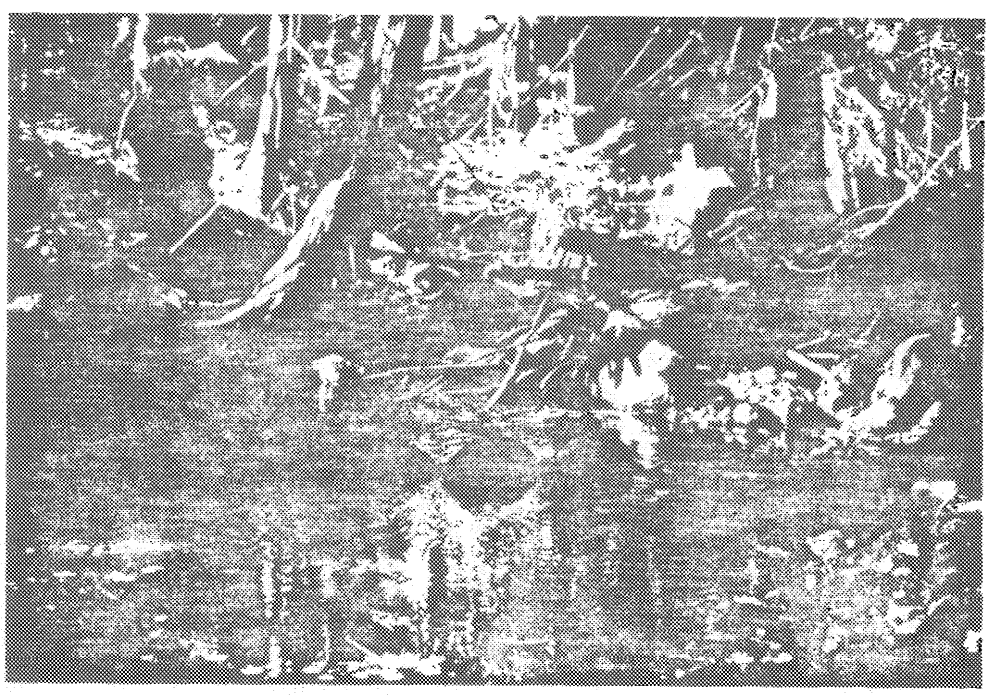
The objective in Reach B was to improve low flow rearing habitat through the use of boulder structures. The channel in Reach B is up to 150 feet wide with a boulder/cobble substrate. The upper portion of the reach is a depositional plain that probably formed as a result of a log Jam. Due to removal of the Jam, the hydraulic control that shaped the channel is missing and the wetted perimeter appears broader than it may have been historically. Water depths are very shallow in the summer and as such little rearing habitat is available for older age class Juveniles. A mid channel berm divides the flow in the upper half of Reach B. Most flow is concentrated down the wider left hand side of the berm. Several rock berms were constructed in the right hand channel and the channnel was deepened. A small low flow channel along the left hand bank was deepened to increase rearing volume. Boulders were placed to provide cover (Figure 7) and a rock wing constructed to force some additional low flow towards the left hand side. Rock structures were planned for the depositional area but upon further review it was decided that excavation may destabilize the deposited material causing a migration of the material downstream.

Below the depositions! plan more boulder structures were placed to enhance low flow habitat. The structures included rearranging boulders to concentrate the low flow thalweg and six berms were constructed to form pools. Rock was maintained in all the pools to provide cover.

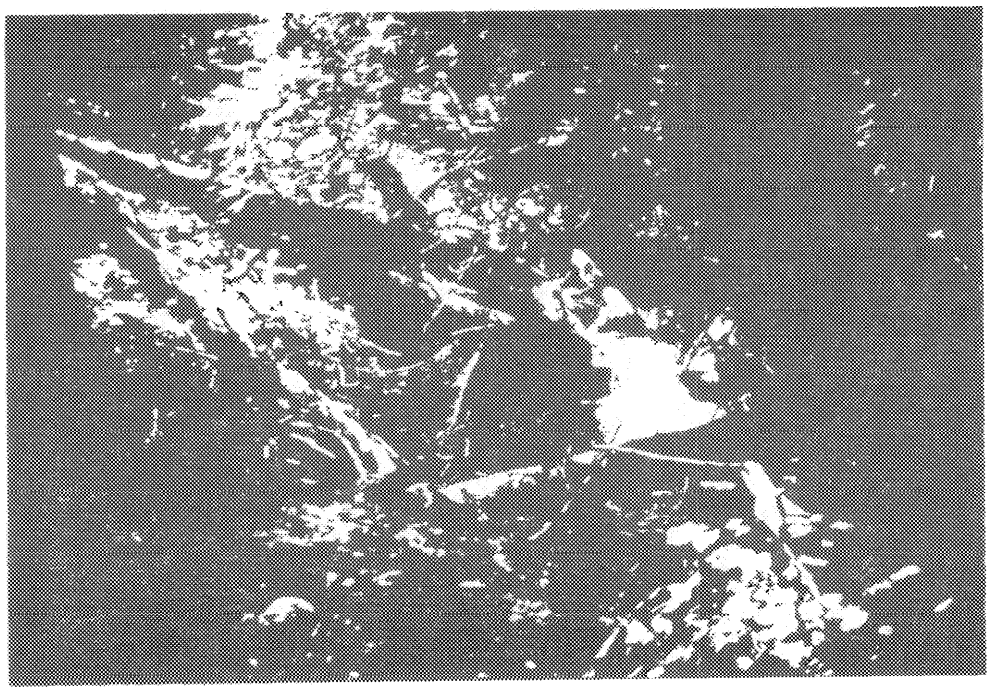
A natural side channel is being formed in Reach B. This side channel provides high quality spawning habitat although rearing habitat was diminished by low summer flow. Rocks were hand removed from the mouth of the side channel to lower the control, thus increasing flow and the volume of rearing habitat.



About 50 partial barrier logjams from RM 24.5 to 29.0 reduce fish access through this potential habitat. Enhancement options include partial debris removal and jump pool construction at these locations.

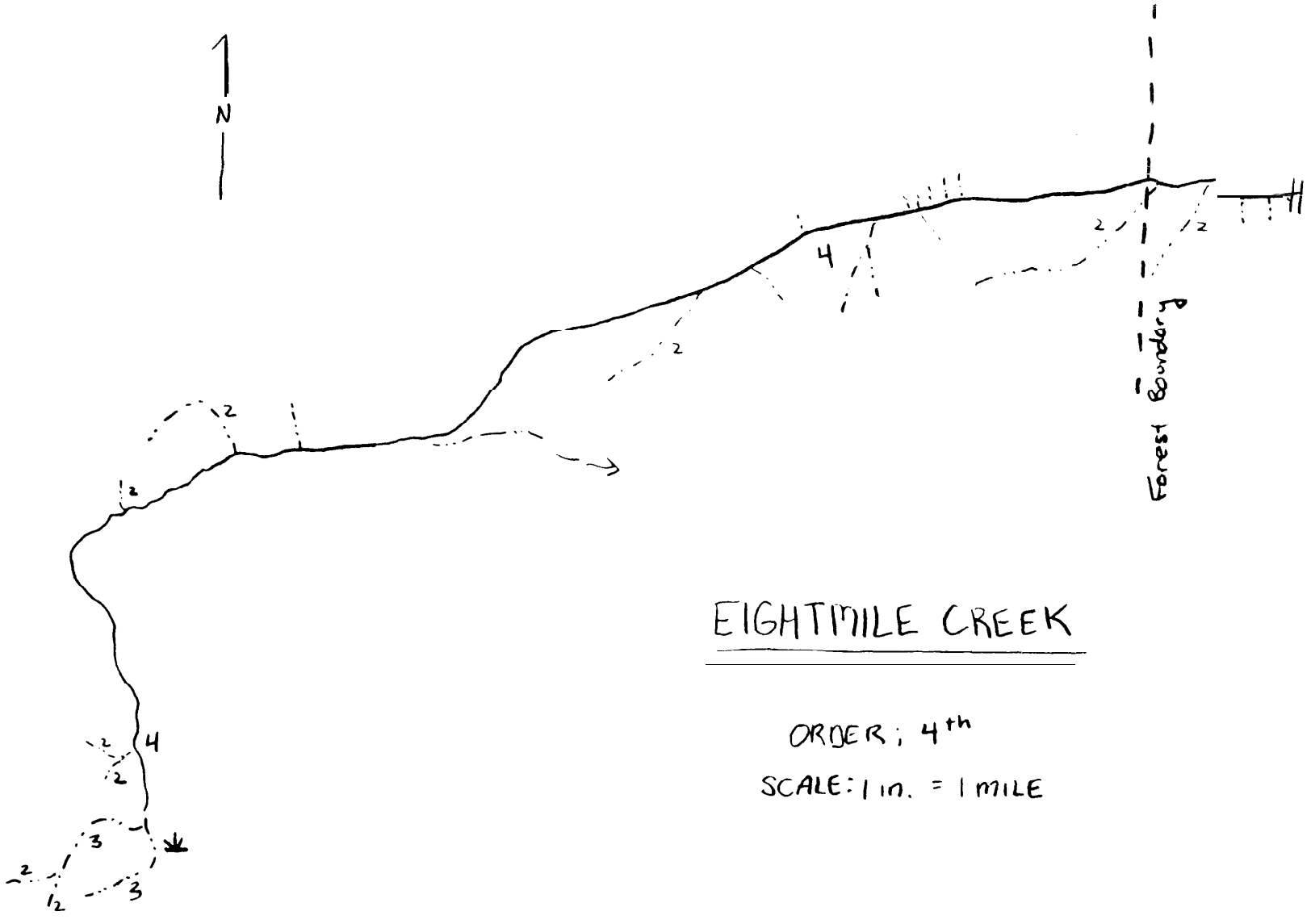


Three fish sample sites, including this section near the Forest Boundary, were electroshocked on Eightmile to develop baseline information on existing fish populations. An average of 20 trout per 200' sample section (0.1 trout/M^2) was obtained.



The Habitat Condition Rating for Eightmile is good (HCR = 7.4). Large woody debris loading, stream stability, pool development, and canopy appear to be in original condition over most of the stream length surveyed.

Localized removal of instream woody structure in the Upper Eightmile Campground (RM 29.5-29.7) has likely decreased pool habitat in this area. Rehabilitation project options in the campground include log sill/boulder berm construction and streamside planting to reestablish structure and bank strength.


N
Forest Boundary
EIGHTMILE CREEK
ORDER; 4th
SCALE: 1 in. = 1 MILE

- STREAM SURVEY MAP SYMBOLS -

CLEAR CUT BOUNDARY

PARTIAL CUT BOUNDARY

$R_{I,II,III}$ REACH # and SECTION

T_1 | 1.0 TRANSECT # and RIVERMILE

OBSTRUCTION

BARRIER

J1,2,3 JAM and #
F( )1,2,3 FALLS, HEIGHT, and #
C1,2,3 CULVERT and #
B1,2,3 CHUTE and #

MONITOR SITE

STRUCTURE

BRIDGE

LANDSLIDE, SLUMP

DEBRIS TORRENT TRACK

SPRING

UPPER LIMIT OF FISH PRESENT

BANK EROSION (EXTENSIVE/SEVERE)

1,2,3, MISCELLANEOUS

WETLAND HABITAT

ROAD AND ID NUMBER

EARTHFLOW

FIVEMILE CREEK
BARLOW RANGER DISTRICT

Surveyors: Doug Kinzey
Corey Hutchinson

Dates Surveyed:

August 8, 13, 14, 22, 1985

Tributary to: Eightmile Creek

TRI Compartments: FIVEMILE 1201
PERRY 1103

Game Fish: Cutthroat trout
Rainbow trout

Anadromous Species:
Steelhead

County: Wasco

Mouth Location: T1N, R.14E, Sec. 4

Watershed Area: 2 sq. miles
13400 acres
(within National Forest)

Stream Length:
18.4 miles mainstem
8 miles S. Fork
8 miles M. Fork

Distance Surveyed:
0.2 miles mainstem
2 miles S. Fork
7 miles M. Fork

Stream Order: IV

Average Fish Habitat Condition Rating: 4.1 (poor to fair)

Average Riparian Habitat Condition Rating: 5.5 (moderate)

FIVEMILE CREEK

Survey Summary

A. Stream Summary

Fivemile Creek is the northernmost tributary of the Fifteenmile system. It is a fourth order stream at the Forest boundary. The lower 18.2 miles are on private I and. Fivemile drains into Eight-mile Creek approximately 1.5 miles above its confluence with Fifteenmile Creek.

The confluence of the Middle Fork and the South Fork Fivemile is just above the Forest boundary, at rivermile (RM) 18.4. The North Fork FIvemIle enters Fivemile below the Forest boundary, is intermittent on Forest lands, and was not included in the survey.

A total of 9.2 miles of the Fivemile system were surveyed during August 1985, including 0.2 miles of mainstem (RM 18.2-18.41, 2.0 miles of the South Fork (RM 0.0-2.01, and 7.0 miles of the Middle Fork (RM 0.0-7.0). The mainstem and Middle Fork are accessible from the 4421 spur, paralleling them to the north for about three miles. The 4431 road crosses the Middle Fork at RM 6.3. A non-system spur road from the 4431-160 crossing at RM 0.4 runs up the South Fork floodplain for about a mile.

Irrigation withdrawals completely dewater the stream channel about two miles below the Forest Boundary for most of the summer. The uppermost diversion structure is located on Forest I and at RM 18.3.

8. Watershed Characteristics and Geomorphology

Fivemile appears to possess a more flashy flow regime than the other Fifteenmile tributaries surveyed on Forest I and. Mainstem discharge estimates range from 1.5 cfs (above diversions) in late summer to 20+ cfs in spring. Low f I ows on the South Fork sect ion surveyed consist of standing water potholes and subsurface areas over about half the stream length. Upper South Fork flows at the 4430 road crossing (RM 6.2, above area surveyed) are perennial .

Floodplain widths are moderate (70 - 100 feet) on the mainstem and on the lower South (RM 0.0-2.0) and Middle (RM 0.0-1.5) Fork reaches. The Middle Fork above RM 1.5 has a narrow (less than 70 ft.) floodplain width.

The lower reaches of Fivemile carry a high suspended sediment load in spring and early summer yielding a characteristic “milky” color during these months. Above the 4430 road crossing, about six miles above their confluence, both the Middle and South Forks run clear throughout the year.

C. Reach Description

Seven reaches are identified, one each on the mainstem and South Fork, and five or the Middle Fork Fivemile. Reaches are delineated primarily on the basis of gradient, overstory, and inchannel structural characteristics.

Gradient in the mainstem reach surveyed (RM 18.2-18.4) is 3%. Canopy is a mix of deciduous and coniferous species. Boulder structure appears more important in pool formation in this reach than in the others on Fivemile. Fifty percent of the high quality low flow pools are boulder controlled.

South Fork (RM 0.0-2.0) gradient is 3%. Overstory is mixed to RM 0.5, and predominantly coniferouis above this point. Large woody debris is responsible for 90% of high quality pools.

Middle Fork Reach I (RM 0.0-1.5) gradient is 1%. Canopy is primarily deciduous. LWD structure accounts for 65% of high quality pools in this reach. Wood structure is commonly provided by log jams composed of small material, and appears relatively unstable.

Middle Fork Reach ii (RM 1.5-2.7) gradient increases to 2%. Canopy is coniferous. LWD structure Is associated with 95% of high quality pools. Structure in this reach is typically composed of large incorporated cedar logs, and appears the most stable of any reach.

Middle Fork Reach iii (RM 2.7-4.0) begins at the bottom of an older clearcut (about 20 years) which replaced an originally coniferous floodplain canopy with nearly 100% red alder from RM 2.7-3.0. Gradient increases to 3%. Beaver activity is common, with numerous dams and ponds. LWD is associated with 90% of the high quality pools. This reach has the highest percentage of small substrate material (40% <l") of those surveyed on Fivemile.

Middle Fork Reach IV (RM 4.0-6.31, is dominated by a coniferous overstory. Gradient increases to 4%. This reach was corridor-logged by the Knebal Timber Sale (closed 19791, which reduced future sources of large woody debris.

Middle Fork Reach V (RM 6.3-7.0) gradient remains 4%, and overstory continues to be coniferous. Reduced flows (0.5 cfs), narrow valley bottom (30 ft. wide), and apparent lack of anadromous potential, characterize this reach.

D. Fisheries

The Habitat Cond tion Rating on Fivemile is poor to fair (HCR = 4.1). Major factors reducing the rating include low summer discharge, poor pool quality (shallow depth, low cover), and low spawning gravel counts. The highest ratings were ass gned to the mainstem (HCR = 5.4), and to Middle Fork Reach II (RM 1.5-2.7, HCR = 4.7).

The lower 1.5 miles of the South Fork may be suitable for anadromous spawning, but low summer discharge limits potential South' Fork rearing habitat to isolated pool s. About six miles of the Middle Fork appear to have anadromous potential.

Electroshocking results in 1985 produced an average of 102 trout per 200 ft. sample section (0.65 trout/M^2). Most trout examined appeared to be resident cutthroat. Varying degrees of rainbow characteristics appeared in some individuals, particularly in the upper sample sites.

E. Riparian Area

The overall Riparian Condition Rating is moderate (RCR = 5.5). A high number of habitat units, good overstory diversity, and numerous small seeps and wetlands are positive aspects increasing the score. A narrow valley bottom in reaches II - V of the Middle Fork lowers the score.

FIVEMILE CREEK
Reach Summary

Mainstem; RM 18.2-18.4

1. The valley bottom is a moderate (100' wide), flat bottom V.

2. Gradient is 3%.

3. Riffle substrate Is dominated by rubble (40%) and boulders (35%).

4. Low flow stream area is pool dominated (P:R = 7:3).

5. Stream shading is 80%, provided by a mixed coniferous and deciduous canopy.

South Fork RM 0.0-2.0

1. The valley bottom is a moderately wide, flat bottom V, ranging from 40-100' wide.

2. Gradient is 3%.

3. Riffle substrate is dominated by rubble (50%) and gravel (30%).

4. Low flow wetted stream area is pool dominated (P:R = 9:1). Standing water pools alternate with sections of dry streambed. About half of the total stream length of the South Fork was dry during the time of survey.

5. Stream shading is 90%, and is primarily coniferous.

M. Fork I; RM 0.0-1.5

1. The valley bottom is a moderately wide (75 feet), flat bottom V.

2. Gradient is low (1%).

3. Riffle substrate is dominated by gravel (35%) and boulders (30%).

4. Low flow stream area is slightly pool dominated P:R = 6:4. Structure is provided by transported debris jams and appears unstable.

50 Stream shading is 80%, provided by a primarily deciduous canopy.

M. Fork II; RM 1.5-2.7

1. The floodplain width decreases slightly to a narrow (average 60'; ranging from 40 to 75' wide), flat bottom V.

2. Gradient increases to 2%.

3. Riffle substrate remain dominated by gravel (45%) and boulders (35%).

4. Low flow stream area is an even mix of pools and riffles (P:R = 5:5). Stucture in this reach is commonly provided by single log sills, and appears more stable than in Reach I.

5. Stream shading is 70%, provided by a coniferous canopy.

M. Fork III: RM 2.7-4.0

1. The floodplain width remains narrow (average 55; ranging from 50 to 60 wide).

2. Gradient increases to 3%.

3. Riffle substrate decreases in size, dominated by gravel (50%) and coarse sand (30%).

4. Low flow stream area is slightly pool dominated (P:R = 6:4). Beaver activity is common in this reach, with cross channel dams often providing structure.

5. Shading is the lowest of any reach (50%) provided by a mix of coniferous and deciduous species. Small openings in the canopy are common above RM 3.0.

M. Fork IV: RM 4.0-6.3

1. The valley configuration remains a flat bottom V, with a narrow (50' wide) floodplain.

2. Gradient increases to 4%.

3. Riffle substrate remains gravel dominated (50%) but has more large substrate (30% rubble-boulder).

4. Pool to riffle ratio is even (P:R = 5:5). Localized reduction in structure occurs in logging corridors of the Knebal Timber Sale.

5. Shading increases to 80%, provided by a coniferous overstory. Localized reductions in shading occur in logging corridors.

Reach V: RM 6.3-7.0)

1. Valley configuration narrows to a V-notch, averaging 20' wide.

2. Gradient remains 4%.

3. Riffle substrate size decreases (80% gravel-coarse sand).

4. Pools increase slightly (P:R = 6:4).

5. Shading Is the highest of any reach (95%). Shade will likely be reduced in this reach following partial harvest of the floodplain by the Knestat Timber Sale (uncut at time of survey).

FIVEMILE CREEK
Fish Habitat Summary

Mainstem: RM 18.2-18.4

1. The Habitat Condition Rating is fair (HCR = 5.4).

2. Pool rearing habitat is shallow (1 foot deep), averageing 3 square yards in area. Moderate effective cover is provided by boulders, which provide about half the high quality pool habitat in this reach.

3. Five square yards of potential steelhead spawning gravel were counted. One hundred percent of spawing gravels are associated with LWD structure.

4. An irrigation diversion structure at RM 18.3, and a logjam at RM 18.35 may restrict trout movement at low flow, but appear passable under higher flows.

S. Fork: RM 0.0-2.0

1. The Habitat Condition Rating is poor (HCR = 2.7). Low numbers of trout were observed in isolated pools from RM 0.0 to 0.3.

2. Pool rearing habitat is limited. Low flow stream discharge is a mix of subsurface sections, short riffles, and standing water pools. Pool to riffle ratios over the wetted portion of the stream are 9:1. Pools average 6 square yards, and are shallow (12"), with low effective cover. About half the streambed length was dry during the survey. While only 15% of all pools appear associated with wood structure, 90% of the high quality pools appear dependant on LWD for their formation.

3. Eight square yards of gravel suitable for anadromous fish were counted. Boulders and channel meanders appear responsible for gravel retention. Fifteen percent of all gravels are associated with LWD.

4. The 4431 road culvert at RM 0.4 is a partial barrier to fish migration (see 1984 Mt. Hood Culvert Inventory).

M. Fork 1: RM 0.0-1.5

1. The habitat is rated poor to fair (HCR = 4.2).

2. Although pool to riffle ratios are good (P:R = 6:4), pool habitat is only fair due to shallow depth (12") and low effective cover. Average size is four square yards. LWD appears responsible for 50% of all pools.

3. Twenty five square yards of spawning gravel suitable for anadromous use were counted. Forty-five percent of all gravel is rated marginal due to channel placement. Sixty-five percent is dependent on LWD.

4. No passage barriers were observed.

M. Fork II: RM 1.5-2.7

1. Fish habitat rates poor to fair (HCR = 4.7).

2. Pool to riffle ratios are excellent (P:R = 5:5), although rearing habitat quality is reduced due to shallow depths (12"), Effective cover is moderate. Average size Is 3 square yards. The importance of LWD increases In this reach. Seventy percent of all pools, and 95% of high quality pools are dependent on LWD. Cedar rootwads and local source log sill structure is common,

3. Twenty-five square yards of spawning gravel suitable for anadromous use wet-e counted. of which 42% are considered marginal quality due to channel placement. Sixty percent of spawning gravels are associated with LWD.

4. No passage barriers were observed.

Middle Fork III: RM 2.7-4.0

1. Fish habitat rates poor to fair (HCR = 4.5).

2. Pool to riffle ratios are good (P:R = 6:4), depth is low (12"), and effective cover Is moderate. Average size remains 3 square yards. Beaver dams and transported debris Jams are the typical structure in this reach. LWD is associated with 35% of all pools.

3. Twenty two square yards of anadromous sized spawning gravels were counted. Thirty seven percent are rated marginal. Sixty five percent of all spawning gravels are associated with LWD.

4. Numerous beaver dams throughout this reach may be passage barriers at low flow for resident trout but are likely passable under higher flows.

M. Fork IV: RM 4.0-6.3

1. The habitat rating remains poor to fair (HCR = 4.6).

2. Pool to riffle ratio is excellent (P:R= 5:5). Pools are shallow (12"), and small (1 square yard), with low effective cover.

3. Thirty nine square yards of potential anadromous spawning gravel were counted. Thirty nine percent are rated marginal. Eighty percent are dependent on LWD,

4. The road 4430 culvert at the end of the reach (RM 6.3) is a total passage barrier, preventing access to about 0.2 miles of marginal trout habitat.

M. Fork V; RM 6.3-7.0

1. The HCR is rated poor, with the lowest rating of the Middle Fork reaches (HCR = 4.0). Trout were observed to RM 6.5.

2. The stream is slightly pool dominated (P:R = 6:4). Pools are small (0.5 square yards) and shallow (< 12% Moderate effective cover is provided by abundant inchannel wood debris. One hundred percent of all pools are associated with LWD.

3. All spawning gravels counted are in the resident trout size class. Seventy percent are dependent on LWD.

4. No passage barriers were noted.

FIVEMILE CREEK

Riparian Habitat Summary

Mainstem: RM 18.2-18.4

1. The riparian condition rates moderate (RCR = 5:6.
2. Floodplain width is moderate (l00ft. wide). Forest Service road 4421 constricts valley bottom width along the northern floodplain.
3. Al I five habitat units are present, although large saw timber is sparse.
4. The overstory is dominated by deciduous species (red alder and cottonwood). Douglas-fir is a coniferous component.
5. No special habitats were noted in the riparian zone. Rocky bluffs are present on the north sideslope above the road.

South Fork: RM 0.0-2.0

1. The riparian condition rates moderate (RCR = 5.3).
2. The floodplain width remains moderate overall (75ft.).
3. Four habitat units are present with moderate balance.
4. The overstory is a mix of deciduous (alder, cottonwood) and coniferous (Douglas-fir) species from RM 0.0-0.5, and predominantly coniferous (cedar, Douglas-fir, Ponderosa and grand fir) above this point.
5. No special habitats were observed.

Middle Fork I; 0.0-1.5

1. The riparian condition rates moderate (PCR = 5.5).
2. Floodplain width remains moderate (75ft.).
3. Four habitat units are present with moderate balance.
4. The overstory is a mix of coniferous and deciduous species. Abundant red alder provides a deciduous component.
5. Small side channel/wetlands over 10% of stream length are a special habitat for this reach,

Middle Fork II; RM 1.5 - 2.7

1. The riparian condition rating continues to be moderate (RCR = 4.6).

2. Floodplain width narrows from the previous reach to 60ft.

3. All five habitat units are present although the grass-forb unit is scarce?.

4. The overstory is coniferous. An average of two species, cedar and Douglas-fir, with lesser abundance of Grand fir, are present.

5. No special habitats were observed.

Midd e Fork III: RM 2.7-4.0

1. The riparian condition rating increases to high (HCR = 6.91, with the highest score of any reach.

2. Floodplain width remains narrow (55 ft.). Braiding is common in this reach.

3. An average of four habitat units are present in moderate balance. Large saw timber is generally absent.

4. Overstory composition is variable. From RM 2.7-3.0, the stream runs through the bottom of an old plantation with nearly 100% alder canopy in the riparian zone. Above RM 3.0, an average of two coniferous species per transect are present. Cedar, Douglas-fir, and Grand fir play on increasing role in canopy structure. Cedar dominates the riparian canopy by the end of the reach.

5. Three special habitats - snag patches, beaver ponds, and small wetlands - were noted. Small braids and overflow channels around and between beaver ponds create small wetlands along 60% of the reach length.

Middle Fork IV; RM 4.0-6.3

1. The riparian condition rating drops to moderate (RCR = 5.6).

2. Floodplain width remains narrow (50 ft.).

3. All five habitat units are present in moderate to high balance.

4. Cedar and Douglas-fir dominate the canopy with hemlock gaining importance at the upper end of the reach. Red alder is, present in low numbers at the lower end of the reach.

5. Small wetlands along 20% of the stream length are a special habitat for this reach.

Middle Fork V: RM 6.3-7.0

1. The riparian condition rating is poor (HCR = 4.0), due in part to a reduced, stream class rating (Class IV).

2. The valley bottom width is very narrow (20 ft.).

3. Five habitat units are present in moderate balance.

4. The overstory is coniferous, dominated by Douglas-fir and hemlock. Cedar Is also present, Alder was noted only at the start of the reach.

5. Small spring/wetlands over 10% of reach length are noted as a special habitat.

TABLE I - HABITAT DATA SURVEY

REACH (R.M.)	STREAM				POOLS				RIFFLES (%)			
	HCR	S	P:R	G	d	A	EC	BR	1'+	6-12"	1-6"	.1-1"
Mainstem (18.218.4)	5.4	80	7:3	3	L	3	M	-	35	40	20	5
S. Fork (0.0-2.0)	2.7	90	9:1	3	L	6	L	-	5	50	30	15
M. Fork I (0.0-1.5)	4.2	80	6:4	1	L	4	L	*	15	30	35	10
II (1.5-2.7)	4.7	70	5:5	2	L	3	M	-	5	35	45	15
III (2.7-4.0)	4.5	50	6:4	3	L	3	M	-	*	10	50	30
IV (4.0-6.3)	4.6	80	5:5	4	L	1	L	-	10	20	50	15
V (6.3-7.0)	4	95	6:4	4	L	0.5	M	-	*	15	40	40

LEGEND:
- HCR: Habitat Condition Rating
- S: Percent of stream shaded
- P:R: Ratio of pool length: riffle length
- G: Average gradient (%)
- d: Average maximum depth (L _ 12", M = 12 - 29", H _ 30")
- A: Average pool area (sq. yards)
- EC: Effective cover (L _ 40%, M = 40-60%, H _ 60%)
- BR: Bedrock
- SD: Sand
- D: Average depth (inches)
- *: Present, but less than 5%

FIVEMILE CREEK

TABLE II - FISH SPECIES OBSERVED AND RELATIVE ABUNDANCE/100 FT.

Species	REACH					TRIBUTARIES	
	Mainstem	S. Fork	I	II	III	IV	V
Salmo sp.	M	M	M	M	M	M	M

LEGEND: L = Low (0-5); M = Moderate (6-50); H = High (50+)
a = adult, j = juvenile

* = habitat suitable; presence reported but not observed.
( )= habitat suitable; may not be present.

TABLE III - SPAWNING GRAVEL (SQUARE YARDS)

Reach (R.M.)	Spawning Gravel (Sq. Yds.) Total	Good	Marginal
Mainstem (18.2-18.4)	10	0	10
S. Fork (0.0-2.0)	42	14	28
M. Fork I (0.0-1.5)	82	45	37
II (1.5-2.7)	97	56	41
III (2.7-4.0)	101	64	37
IV (4.0-6.3)	148	91	57
V (6.3-7.0)	25	12	13
TOTAL	505	282	223

FIVEMILE CREEK

TABLE IV - FISH MIGRATION OBSTRUCTIONS

STREAM (R.M.)	TYPE	ID#	PASSABLE	RECOMMENDATIONS*
Mainstem (18.3)	Irrigation Diversion		F	None
South Fork (0.4)	Culvert		P	Baffle
Middle Fork (4.8)	Culvert		N	Removed 1985

LEGEND: F = full passage
P = partial passage
N = no pssage

*Refer to special case form for barrier characteristics.

TABLE V - ANADROMOUS HABITAT SUMMARY

REACH (RM)	Miles Avail.	Miles Pot.	P:R	Rearing Area	Rearing Depth	Spawning 1"-3"	Spawning 3"-6"	Comments
Mainstem (18.2-18.4)	0.2	0.2	7:3	3	1	5	0	
S. Fork (0.0-2.0)	0.5	1.0	9:1	6	1	8	0	
M. Fork I (0.0-1.5)	1.5	1.5	6:4	4	1	25	0	
II (1.5-2.7)	1.2	1.2	5:5	3	1	25	0	
III (2.7-4.0)	1.3	1.3	6:4	3	1	22	0	
IV (4.0-6.3)	2.3	2.3	5:5	1	1	39	0	
V (6.3-7.0)	0	0	-	-	-	-	-	
TOTAL	7.0	7.5				124	0	

LEGEND:
- Avail.: Miles of habitat presently accessible to anadromous fish if introduced.
- Pot.: Additional miles of habitat potentially available with complete passsage enhancement.
- P:R: Ratio of pool length: riffle length.
- Area: Average pool area (sq. yds.).
- Depth: Average pool depth (feet).
- Spawning: Number of Sq. Yards of gravels observed in the 1"-3" and 3"-6"size classes.

FIVEMILE CREEK

TABLE VI - LWD HABITAT QUALITY INFLUENCE

	SP. GRAVELS		POOL		LWD CHARACTERISTICS				
Reach (R.M.)	Total (%)	HQ (%)	Total (%)	HQ (%)	OR	#	L	Dia	Source
Mainstem (18.2-18.4)	100	100	50	50	Perp	M	1-2	1	M
S. Fork (0.0-2.0)	15	20	15	90	Perp	SM	1-2	1	L
M. Fork I (0.0-1.5)	65	65	50	65	Perp	M	<ch	1	M
II (1.5-2.7)	60	65	70	95	Perp	S	1-2	1-2	L
III (2.7-4.0)	65	75	95	90	Var	SM	1	1-2	L, M
IV (4.0-6.3)	50	65	80	95	Perp,Var	SM	1-2	1-2	L, M
V (6.3-7.0)	70	75	95	100	Var	M	2	1-2	L

LEGEND:
- Total: Percent of total habitat area dependent on LWD.
- HQ: Percent of high quality habitat area dependent on LWD.
- OR: Angle of orientation to flow; Perp = perpendicular, Var = variable.
- #: Number of logs/structure; S = single log, M = multi-log.
- L: Average length of logs, expressed in channel widths.
- Dia: Diameter of average logs in feet.
- Source: L = local
  T = transported
  M = mixture of local and transported

TABLE VII - HABITAT AND HYDROLOGICAL FEATURES FOR SUMMER AND BANKFULL CONDITIONS

	SUMMER				BANKFULL		
Reach (R.M.)	w	d	v	Q	W	D	Floodplain Width (Ft.)
Mainstem (18.2-18.4)	6	0.5	0.5	1.5	10	1.5	100
S. Fork (0.0-2.0)	3	0.3	0.5	0.5	5	1	75
M. Fork I (0.0-1.5)	4	0.3	0.6	0.7	8	1	75
II (1.5-2.7)	4	0.1	2	0.8	8	1	60
III (2.7-4.0)	5	0.3	1	1.5	8	1	55
IV (4.0-6.3)	4	0.3	1	1.2	7	0.8	50
V (6.3-7.0)	2	0.25	1	0.5	4	0.5	30

LEGEND:
- W,w: Stream width (ft)
- D,d: Stream depth (ft)
- v: Velocity (feet/second)
- Q: Average reach flow in cubic feet/second

FIVEMILE CREEK

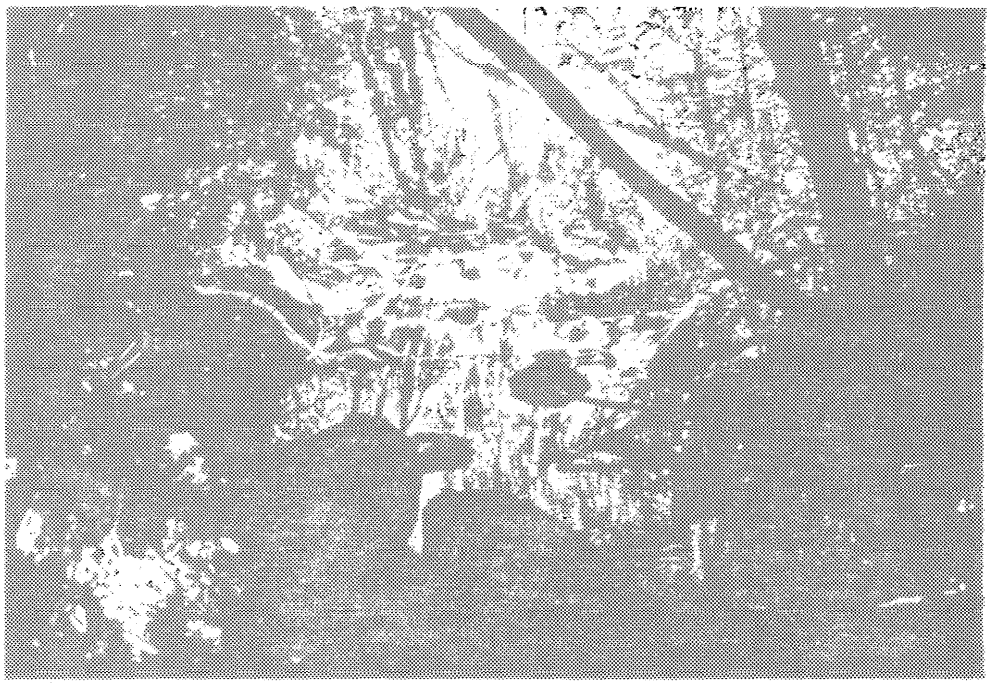
TABLE VIII - TEMPERATURE AND SHADE RELATIONSHIP

REACH (R.M.)	DATE	FLOW (cfs)	% SHADE	ASPECT	AIR/WATER TEMP. °F A/W	A/W	TIME
Mainstem							
(18.2-18.4)	8/8/85	1.5	80	NE	57/54		1000
S. Fork							
(0.0-2.0)	8/8/85	0.5	90	NE	58/51-65/52		1200-1400
M. Fork I							
(0.0-1.5)	8/13/85	0.7	80	NE	62/55-70/56		1030-1300
II (1.5-2.7)	8/13/85	0.8	70	NE	66/55-70/55		1300-1515
III (2.7-4.0)	8/14/85	1.5	50	NE	68/52-73/53		1145-1400
IV (4.0-6.3)	8/14,22/85	1.2	80	NE	55/46-74/54		0930-1500
V (6.3-7.0)	8/22/85	0.5	95	NE	56/46-58/46		1300-1400

TABLE IX - RIPARIAN HABITAT SUMMARY

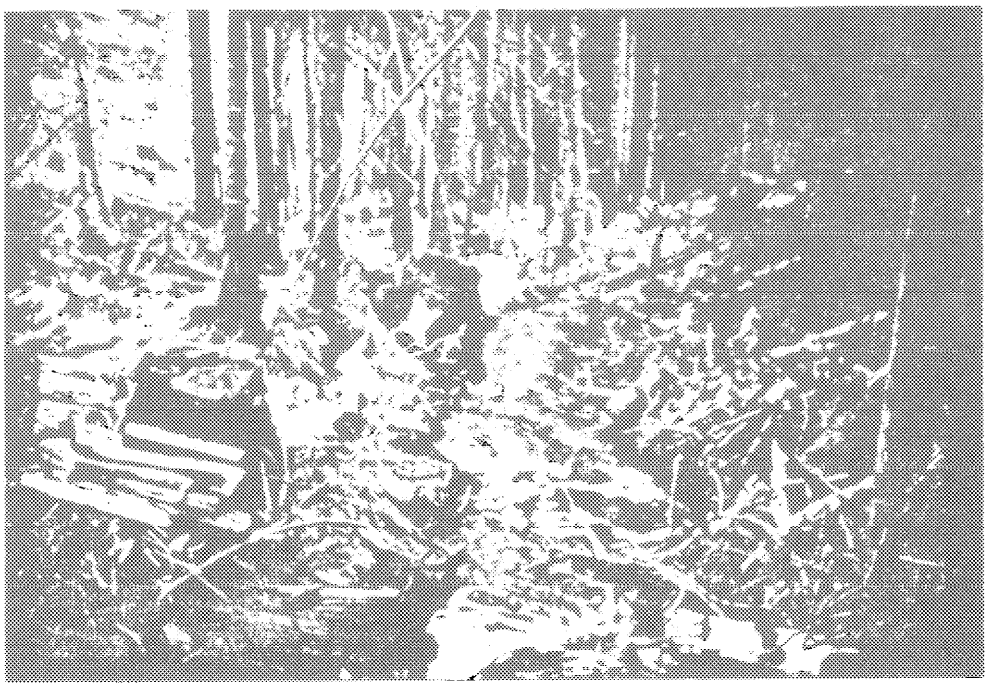
REACH (RM)	RCR	VALLEY F.P. (ft.)	VEGETATION H.U.	Overstory Con.	Dec.	AQUATIC Streamclass	Wetland%	Size	Speci Habita
Mainstem									
(18.2-18.4)	5.6	100	H	1	2	1			
S. Fork (0.0-2.0)	5.3	75	H	3	2	1			
M. ForK									
I (0.0-1.5	5.5	75	H	2	1	1	10%	S	
II (1.5-.2.7)	4.6	60	H	2	0	1	-	-	
III (2.7-4.0)	6.9	55	H	2	1	1	60%	S	
IV (4.0-6.3)	5.8	50	H	3	1	1	15%	S	
V (6.3-7.0)	4.0	20	H	3	1	2	10%	S	

LEGEND:
- PCR: Riparian Condition Rating
- F.P.: Floodplain width in feet
- H.U.: # Habitat units (H _ 4; M = 2-3; L _ 1)
- Con: # Conifer species
- Dec: # Deciduous species
- Wetland: Percent of stream length with adjacent wetlands: (H 50%; M = 25-50%; L 25%)
- Size: Size of wetlands
  - S = small (less than 1 acre)
  - L = large (greater than 1 acre)

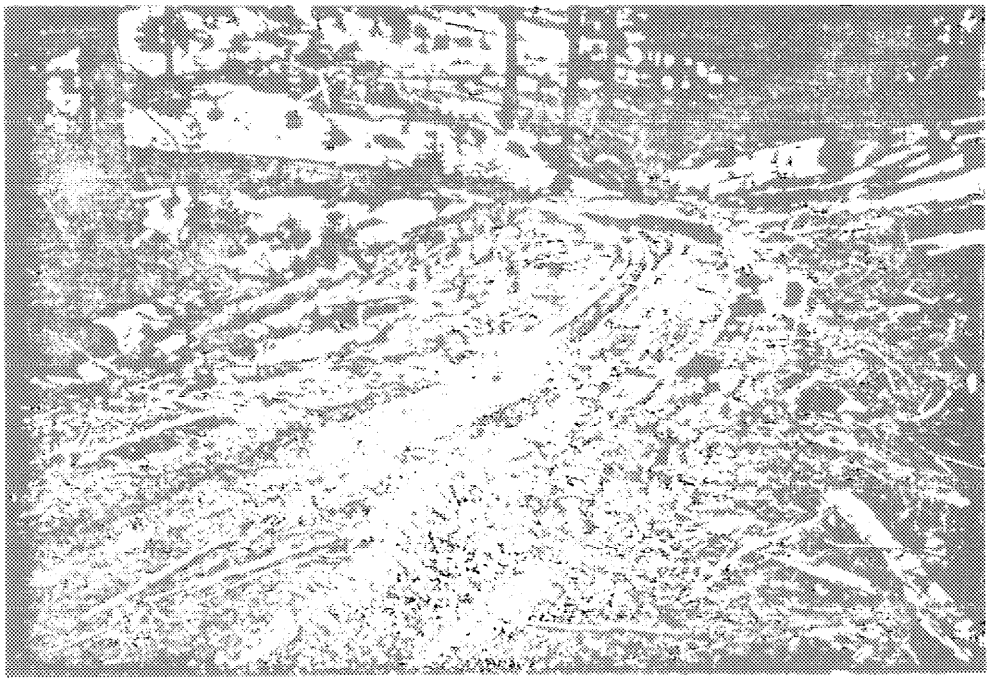


Mainstem RM 18.3 - Boulder structure is an important component of Fivemile Creek pool formation. Stream cleanout, salvage logging and floodplain road construction have likely reduced historic levels of wood structure in the Fivemile system.

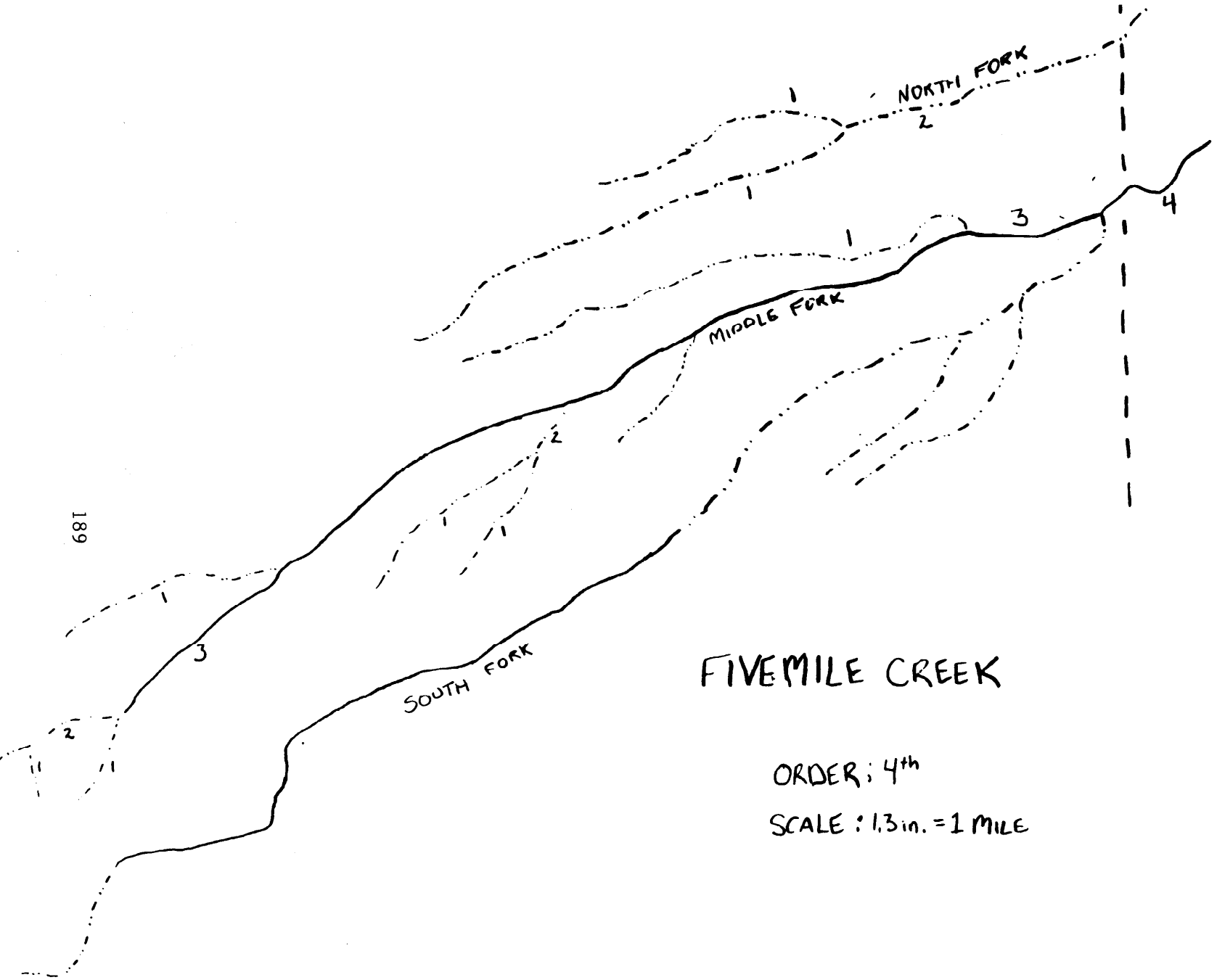
Middle Fork RM 3.0 - High quality rearing pool habitat on Fivemile is being provided by beaver ponds, particularly in Reach III of the Middle Fork. Electroschocking at this beaver pond produced an estimate of 244 trout over the 200' sample section (0.65 trout/M^2). The average of all three fish sample sites on Fivemile was 102 trout per 200' long section (0.65 trout/M^2).



Replacement of channel structure and canopy where they have been reduced on the South Fork Fivemile could reduce downstream temperatures and sediment loading. Football Timber Sale Unit 23 is pictured here.



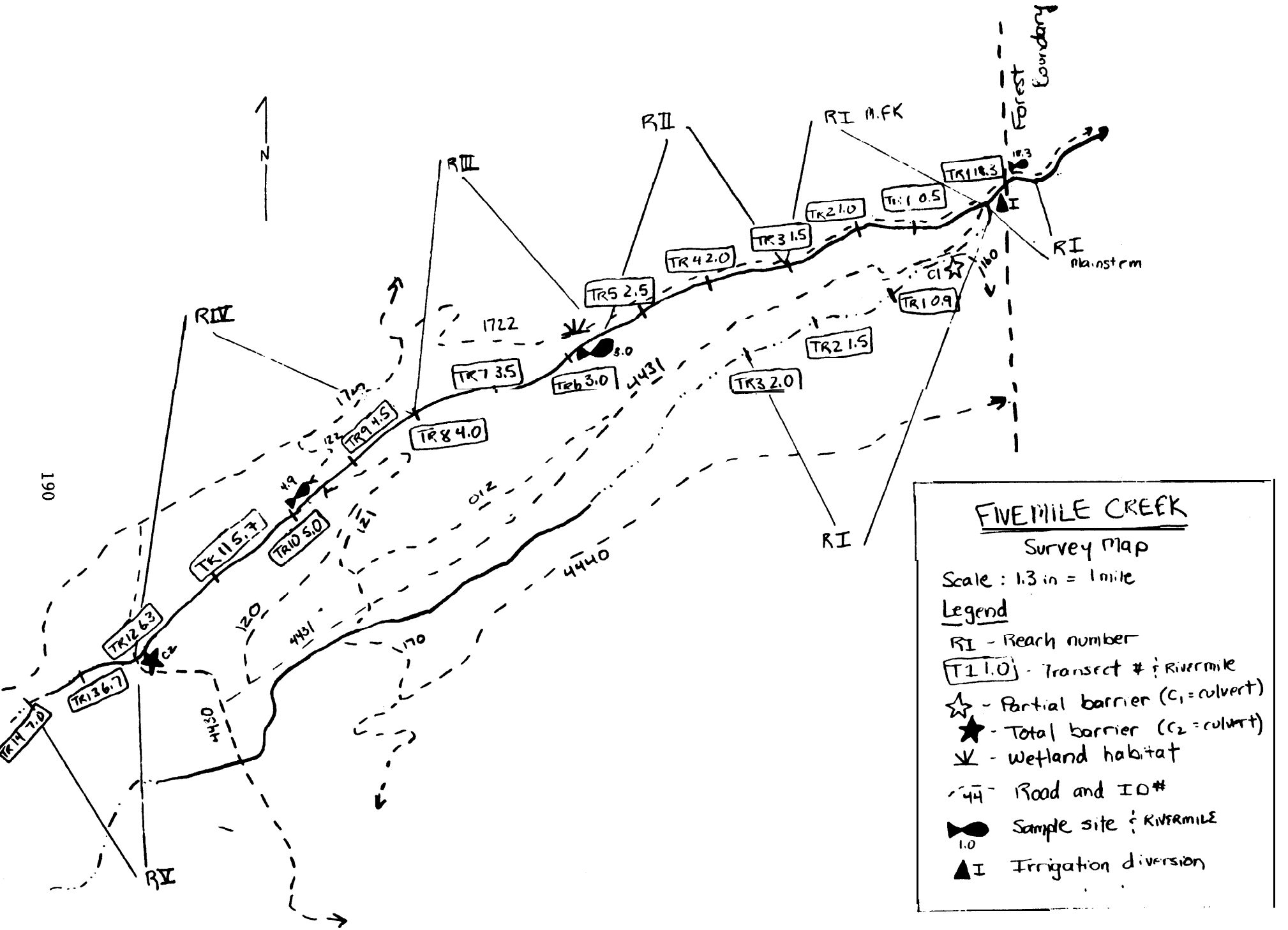
Road drainage improvements at several sites in the Fivemile Watershed could reduce downstream sediment loading. The 4430-014 spur, crossing the South Fork Fivemile (photo background) captures an intermittent tributary for about 200' stream length. This spur fords another South Fork tributary without a culvert north of this location.



FIVEMILE CREEK

ORDER: 4th

SCALE: 1.3 in. = 1 MILE


FIVEMILE CREEK
Survey Map
Scale : 1.3 in = 1 mile
Legend
RI - Reach number
T1 1.0 - Transect # & Rivermile
- Partial barrier (C1 = culvert)
- Total barrier (C2 = culvert)
- Wetland habitat
44 Road and ID#
1.0 Sample site & RIVERMILE
I Irrigation diversion
N
RI
RI M.FK
RI Mainstem
RII
RIII
RIV
RV
Forest Boundary
TR1 18.3
TR1 0.5
TR2 1.0
TR3 1.5
TR4 2.0
TR5 2.5
TR6 3.0
TR7 3.5
TR8 4.0
TR9 4.5
TR10 5.0
TR11 5.7
TR12 6.3
TR13 6.7
TR14 7.0
TR1 0.9
TR2 1.5
TR3 2.0
1722
4431
4440
4430
1160
C1
C2
I

- STREAM SURVEY MAP SYMBOLS -

CLEAR CUT BOUNDARY

PARTIAL CUT BOUNDARY

$R_{I,II,III}$ REACH # and SECTION

T_1 | 1.0 TRANSECT # and RIVERMILE

OBSTRUCTION

BARRIER

J1,2,3 JAM and #
F( )1,2,3 FALLS, HEIGHT, and #
C1,2,3 CULVERT and #
B1,2,3 CHUTE and #

MONITOR SITE

STRUCTURE

BRIDGE

LANDSLIDE, SLUMP

DEBRIS TORRENT TRACK

SPRING

UPPER LIMIT OF FISH PRESENT

BANK EROSION (EXTENSIVE/SEVERE)

1,2,3, MISCELLANEOUS

WETLAND HABITAT

S-737 ROAD AND ID NUMBER

EARTHFLOW

RAMSEY CREEK

BARLOW RANGER DISTRICT

Surveyors: Doug Kinzey, Corey Hutchinson

County: Wasco

Dates Surveyd: August 15-19, 1985

Mouth Location: T1S, R12E, Sec. 31

Tributary to Fifteenmile Creek

Watershed Area: 4 sq.mi. 2560 acres

Stream length: 14 miles

Drainage: Fifteenmile

Distance Surveyed: 5.0 miles

TRI Compartments: BALDWIN 1202
BULO 1302

Low flow width (avg.): 7 feet

Stream Order: III

Game Fish: Rainbow trout
Cutthroat trout

Anadromous Species:
Steelhead

Average Fish Habitat Condition Rating: 6.1 (fair to moderate)

Average Riparian Condition Rating: 5.2 (moderate)

RAMSEY CREEK

Survey Summary

A. Stream Summary

Ramsey Creek Is a third order tributary to Fifteenmile Creek. The mouth is 7.5 miles below the Forest boundary. Forest Road 44 crosses the creek about a mile above the confluence. The stream survey started just below the Forest boundary at RM 7.5, and ended at RM 12.0. Forest Service road 44 parallels Ramsey Creek on the north and 4450 crosses at approximately RM 10.8. The Forest Road 4400-190 crossing at RM 8.4 was closed and the culvert removed to provide fish passage in Fall, 1983. Forest Roads 4400-l 40, 130 and 132 access the headwater area. The stream section from RM 11.3 to 11.7 is privately owned (Camp Baldwin - BSA). Development of this area along Ramsey Creek includes the construction of a concrete dam and a one acre pond at RM 11.4.

B. Watershed and Geomorphology

Ramsey Creek heads in the Puma spring area at approximately RM 14.5. The flow regime appears well regulated. Floodplain width is narrow, ranging from 35 to 100 feet. In the uppermost mile, average width narrows to 45 feet. Valley walls are typically moderate to steep. Logging has occurred throughout the drainage, heavily in the headwater/spring area. The role of large woody debris (LWD) in providing stream structure increases heading upstream (see reach descriptions below).

C. Reach Descriptions

Three reaches were identified along the surveyed section. Reach I (RM 7.5-8.4) is high gradient (5%) and riffle dominated (P:R = 3:7), with abundant cobble-rubble substrate. LWD is associated with 60% of all pools. Spawning gravel abundance is low.

Reach II (RM 8.4-11.4) constitutes approximately 70% of the surveyed stream length. The average gradient is 3.5%. Pools are more frequent (P:R = 4:6) than in Reach I. The role of LWD increases to affect 70% of all pools. Quantity and quality of spawning gravels also increases.

In Reach III (RM 11.4-12.01, the gradient steepens to 5% and the channel narrows. LWD plays a greater role than in the previous reaches, associated with 85% of pool structure. Cascades are common in the upper end of this reach (12%).

D. Fisheries

The overall fish habitat rating for Ramsey Creek is fair (HCR = 6.0). Factors contributing positively to the rating include moderate pool to riffle ratios in Reaches II and Ill (P:R = 4:6) and pool quality (> 12″ deep with moderate cover). Eighty percent of the 100 square yards/mile of spawning gravels counted are in the resident trout size class.

Major negative factors include low summer flows in all reaches (average 4 cfs) and poor spawning habitat quantity in Reaches I and Ill, (about 30 square yards/mile with 40% of anadromous size). Salmonids were observed throughout the survey area. Electroshocking results in October 1985 produced an average estimate of 44 salmonids/200ft section sampled (0.27 salmonids/m^2). Individuals obtained displayed varying degrees of Steelhead, rainbow, and cutthroat characteristics.

E. Riparian Area

Riparian quality is rated moderate overall (RCR = 4:8). Positive aspects include the Class 1 rating and the high number of habitat units, including a pond, rock outcrops and small wetlands in Reach I I. A narrow valley and floodplain, and general lack of deciduous overstory species, lower the rating.

RAMSEY CREEK

Reach Summary

Reach I: RM 7.5 - 8.4

1. The valley configuration is a flat-bottomed V, with 40-60% slopes. The average floodplain width is 70 feet (range is 50 - 80').

2. The gradient is moderate (5%).

3. Riffle substrate is dominanted by large gravels and cobbles (85%) with about 10% boulder material. Smal I gravel is scarce (5%).

4. Riffles dominate this reach (P:R = 3:7).

5. Stream shading is moderate (70%).

Reach II, RM 8.4-11.4

1. Floodplain width and valley configuration are similar to Reach I. Average width is 60 feet, ranging from 30 feet at RM 9.5 to 100 feet at RM 10.0.

2. The gradient decreases to an average of 3.5%.

3. Substrate composition includes an increased proportion of small gravels and sand (30% of substrate). Cobble-large gravel material is less dominant (65%) than in Reach I.

4. The pool-riffle ratio increases from Reach I (P:R = 4:6).

5. Shading remains 70%.

Reach III: RM 11.4-12.0

1. Floodplain width becomes very narrow (average of 45 feet). Sideslope gradient decreases to less than 40%.

2. The stream gradient increases to an average of 5%, with localized areas up to 12%.

3. Substrate composition is predominantly large gravel and cobble (55%). Boulder material increases to 15%.

4. Pool-riffle ratio is similar to Reach II (P:R = 4:6).

5. Shading increases to 80%.

RAMSEY CREEK

Fish Habitat Summary

Reach · RM 7.5-8.4

1. The fish habitat rating Is fair to poor (HCR = 4.7).

2. Riffles dominate the stream area (P:R = 3:7). Average pool depth is 1.5 feet and average area I s three square yards. Ef fect ive cover is I ow. LWD is associated with about 60% of all pools.

3. Spawning habitat is sparce Only 30% of the 20 square yards are rated good quality, due primarily to channel placement. Seventy five percent of the gravel appears to be of a suitable size for anadromous spawning.

4. No migration barriers were noted.

Reach II, RM 8.4-11.4

1. The habitat rating increases from fair to good (HCR = 6.7).

2. Pool to riffle ratio increases to 4:6. Average depth is 1.3 feet, and average area remains 3 square yards. Effective cover increases from Reach I, to moderate. The influence of LWD Increases to 70% of all pools, and 80% of high quality pools.

3. Spawning gravels greatly increase from Reach I. Of the 320 yards counted, 72% are rated good qual ity. Twenty percent of the total gravels are of a size class suitable for anadromous spawning. Eighty five percent of al I gravels are dependent on LWD.

4. Four partial passage barriers (3 log jams, 1 falls/chute) could inhibit fish migration. They are located at RM 8.8, 10.3, 10.7 an 11.1. Jump-pool enhancement (see rehab./enhancement summary) could improve passage at these obstructions. A concrete dam for the Camp Baldwin pond at the upper end of this reach (RM 11.4) is a total barrier to fish passage (5 foot jump, no jump pool).

Reach III: RM 11.4-12.0

1. The fish habitat rating drops from Reach II,, to fair (HCR = 4.9).

2. Pool size and depth decreases, with an average area of 2 square yards, and 1 foot depth. Effective cover Is moderate. Eighty-f ive percent of al I pools are dependent on LWD.

3. Spawning gravel decreases substantially from Reach II. Twenty seven square yards were counted, of which 77% was rated good quality. Four square yards appear to be of anadromous spawn ing size.

4. Cascades of 12% gradient at the top end of this Reach (RM 12.01, appear to be the upper I imit of potential anadromous habitat.

RAMSEY CREEK

Riparian Summary

Reach I: RM 7.5-8.4

1. The riparian condition rating is moderate (RCR = 4.8).

2. Floodplain width is moderate (70′ average), within a flat-bottom valley.

3. All 5 habitat units are present (grass-forb, shrub-seedling-sapling, pole, small saw, large saw). Large saw comprises a small proportion of the balance.

4. Cedar and Douglas-fir are the predominant overstory species. Cottonwood provides a deciduous component to the canopy.

5. No special habitats were noted.

Reach II: RM 8.4-11.4

1. The riparian condition remains moderate. The RCR (5.6) increases from Reach I.

2. Average floodplain width narrows slightly (60′ average).

3. All 5 habitat units are present, In moderate balance.

4. The overstory is coniferous, including Douglas-fir, ponderosa, cedar, grand fir, hemlock, spruce and Pacific silver fir. No deciduous overstory was observed.

5. Three special habitats are present, a pond, small wetlands, and rock outcrops. They comprise less than 25% of the reach length but contribute to an increased RCR. The pond (RM 11.4) is a development of Camp Baldwin.

Reach III: RM 11.4-12.0

1. The riparian condition rating decreases from Reach I (PCR = 4.1).

2. Floodplain width Is narrow (45′ average).

3. All 5 habitat units were noted with moderate balance.

4. The overstory remains coniferous. Species present Include Douglas-fir, cedar, spruce, hemlock and ponderosa pine.

5. No special habitats were observed.

RAMSEY CREEK

TABLE I - HABITAT DATA SURVEY

REACH (R.M.)	STREAM				POOLS				RIFFLES (%)			
	HCR	S	P:R	G	d	A	EC	BR	1'+	6-12"	1-6"	.1-1
I (7.5-8.4)	4.7	70	3:7	5	M	3	L	*	10	45	40	5
II (8.4-11.4)	6.7	70	4:6	3.5	L-M	3	M	*	5	30	35	25
III (11.4-12.0)	4.9	80	4:6	5.0	L	2	M	*	15	20	35	25

LEGEND:
- HCR: Habitat Condition Rating
- S: Percent of stream shaded
- P:R: Ratio of pool length: riffle length
- G: Average gradient (%)
- d: Average maximum depth (L _ 12", M = 12 - 29", H _ 30")
- A: Average pool area (sq. yards)
- EC: Effective cover (L _ 40%, M = 40-60%, H _ 60%)
- BR: Bedrock
- SD: Sand
- D: Average depth (inches)
- *: Present, but less than 5%

RAMSEY CREEK

TABLE II - FISH SPECIES OBSERVED AND RELATIVE ABUNDANCE/100 FT. 1/

Species	REACH I	REACH II	REACH III	TRIBUTARIES
Rainbow	L-M	L	L	
Cutthroat				

LEGEND: L = Low (0-5); M = Moderate (6-50); H = High (50+)
a = adult, j = juvenile

* = habitat suitable; presence reported but not observed.
( )= habitat suitable; may not be present.

TABLE III - SPAWNING GRAVEL (SQUARE YARDS)

Reach (R.M.)	Spawning Gravel (Sq. Yds.) Total	Good	Marginal
I (7.5 - 8.4)	20	6	14
II (8.4 - 11.4)	320	231	89
III (11.4 - 12.0)	27	21	6
TOTAL	367	258	109

RAMSEY CREEK

TABLE IV - FISH MIGRATION OBSTRUCTIONS

STREAM (R.M.)	TYPE	ID#	PASSABLE	RECOMMENDATIONS*
8.8	Logjam	J1	P	Build up jump pool.
10.3	Logjam	J2	P	Remove some material build up pool.
10.7	Logjam	J3	P	Partial removal of material.
11.1	falls/chute	F1	P	Remove material, build up pool.
11.4	Concrete dam	F2	N	Private land

LEGEND: F = full passage
P = partial passage
N = no passage

*Refer to special case form for barrier characteristics.

TABLE V - ANADROMOUS HABITAT SUMMARY

REACH (RM)	Miles Avail.	Miles Pot.	P:R	Rearing Area	Rearing Depth	Spawning 1"-3"	Spawning 3"-6"	Comments
I (7.5-8.4)	0.9	0.9	3:7	3	1.5'	15	0	
II (8.4-11.4)	2.8	3.0	4:6	3	1.3'	64	0	Concrete d at RM 11.4
III (11.4-12.0)	0	0.6	4:6	2	< 1.0'	4	0	
TOTAL	3.7	4.5				88	0	

LEGEND:
- Avail.: Miles of habitat presently accessible to anadromous fish if introduced.
- Pot.: Additional miles of habitat potentially available with complete passsage enhancement.
- P:R: Ratio of pool length: riffle length.
- Area: Average pool area (sq. yds.).
- Depth: Average pool depth (feet).
- Spawning: Number of Sq. Yards of gravels observed in the 1"-3" and 3"-6"size classes.

RAMSEY CREEK

TABLE VI - LWD HABITAT QUALITY INFLUENCE

	SP. GRAVELS		POOL		LWD CHARACTERISTICS				
Reach (R.M.)	Total (%)	HO (%)	Total (%)	HO (%)	OR	#	L	Dia	Source
I (7.5-8.4)	40	50	60	55	Var	M	1-2	1-2	T
II (8.4-11.4)	65	60	70	80	perp/var	M	1-2	1-2	L,T
III (11.4-12.0)	85	80	85	80	perp/var	M	1-2	1-2	L

LEGEND:
- Total: Percent of total habitat area dependent on LWD.
- HO: Percent of high quality habitat area dependent on LWD.
- OR: Angle of orientation to flow; Perp = perpendicular, Var = variable.
- #: Number of logs/structure; S = single log, M = multi-log.
- L: Average length of logs, expressed in channel widths.
- Dia: Diameter of average logs in feet.
- Source: L = local
  T = transported
  M = mixture of local and transported

TABLE VII - HABITAT AND HYDROLOGICAL FEATURES FOR SUMMER AND BANKFULL CONDITIONS

	SUMMER				BANKFULL		
Reach (R.M.)	w	d	v	Q	W	D	Floodplain Width (Ft.)
I (7.5-8.4)	8	0.5	1	4	10	1.3	70
II (8.4-11.4)	7	0.3	2	4.2	8	1.0	60
III (11.4-12.0)	5	0.4	1.5	3	7	1.0	45

LEGEND:
- W,w: Stream width (ft)
- D,d: Stream depth (ft)
- v: Velocity (feet/second)
- Q: Average reach flow in cubic feet/second

RAMSEY CREEK

TABLE VIII - TEMPERATURE AND SHADE RELATIONSHIP

REACH (R.M.)	DATE	FLOW (cfs)	% SHADE	ASPECT	AIR/WATER TEMP. °F A/W	A/W	TIME
I (7.5-8.4)	8/15/85	4.0	45	NE	76/54	78/55	1200-1300
II (8.4-11.4)	8/15,19/85	4.2	68	E	58/48	78/54	1030-1415
III (11.4-12.0)	8/19/85	3.0	80	E	62/48	66/48	1330-1415

TABLE IX - RIPARIAN HABITAT SUMMARY

REACH (RM)	RCR	VALLEY F.P. (ft.)	VEGETATION H.U.	Overstory Con.	Dec.	AQUATIC Streamclass	Wetland%	Size	Spec Habita
I (7.5-8.4)	4.8	70	H	2	1	I	*	-	
II (8.4-11.4)	5.6	60	H	4	0	I	L	S	
III (11.4-12.0)	4.1	45	H	3	0	I	*	-	

LEGEND:
- PCR: Riparian Condition Rating
- F.P.: Floodplain width in feet
- H.U.: # Habitat units (H _ 4; M = 2-3; L _ 1)
- Con: # Conifer species
- Dec: # Deciduous species
- Wetland: Percent of stream length with adjacent wetlands: (H 50%; M = 25-50%; L 25%)
- Size: Size of wetlands
  - S = small (less than 1 acre)
  - L = large (greater than 1 acre)

RM 11.8 - Ramsey Creek appears to have anadromous potential through Reach III. The role of wood in providing stream structure on Ramsey Creek generally increases heading upstream. In Reach III, large woody debris is associated with 85% of all pool formation.

RM 11.0 - Fish populations were sampled at three sites on Ramsey Creek. Electroshocking at this uppermost site produced 29 trout over the 200' long stream section sampled (0.7 trout/M^2). The average of all three sites sampled on Ramsey Creek was 44 trout/200' long sample section (0.27trout/M^2).

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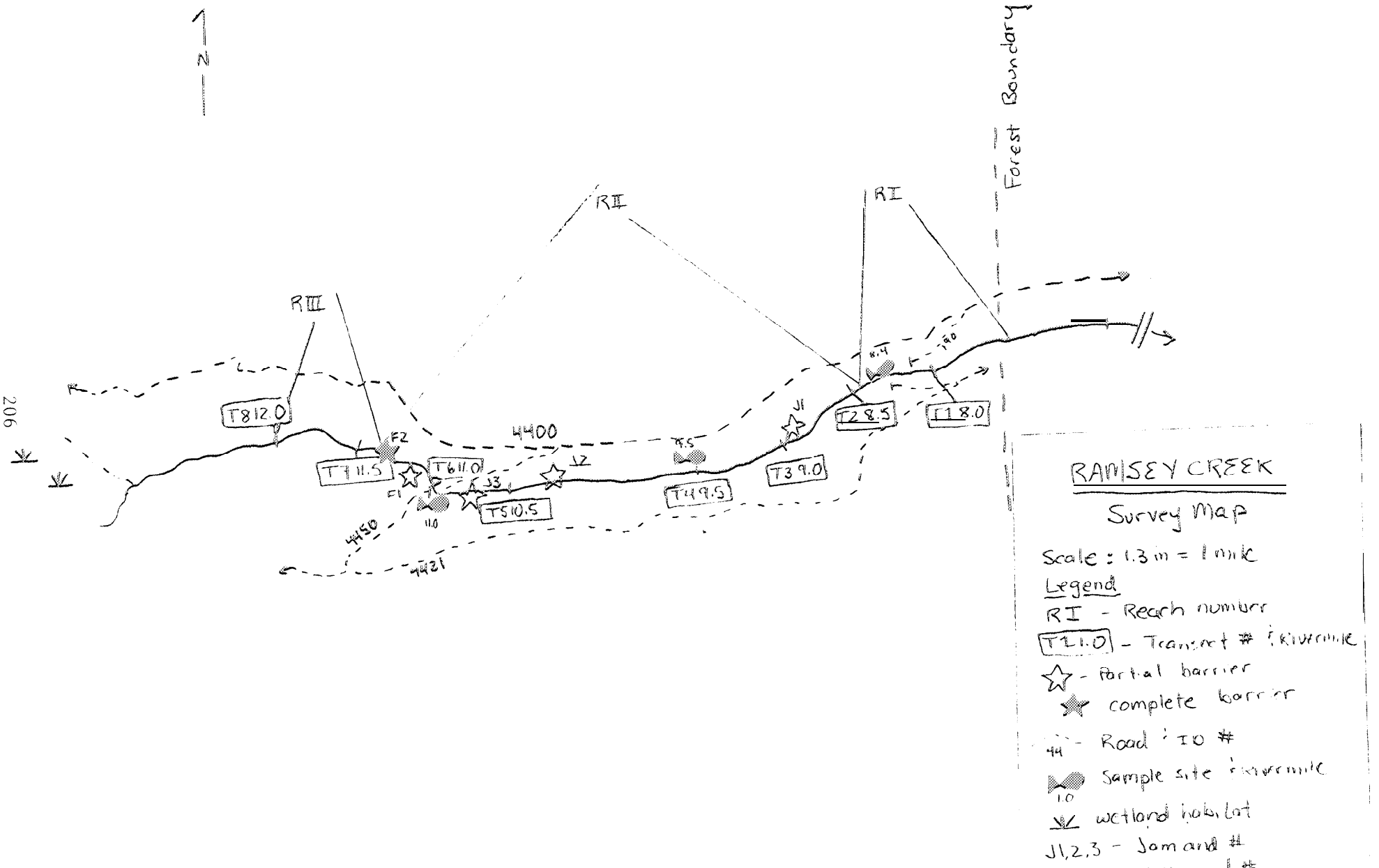
RAMSEY CREEK

ORDER : 3RD

SCALE : 1.3in = 1 MILE


N
Forest Boundary
RI
RII
RIII
T812.0
T711.5
T611.0
T510.5
T49.5
T39.0
T28.5
T18.0
F1
F2
J1
J2
J3
4400
4450
4421
RAMSEY CREEK
Survey Map
Scale : 1.3 in = 1 mile
Legend
RI - Reach number
T11.0 - Transect # & Rivermile
- Partial barrier
complete barrier
44 - Road & ID #
1.0 Sample site & Rivermile
wetland habitat
J1,2,3 - Jam and #

- STREAM SURVEY MAP SYMBOLS -

CLEAR CUT BOUNDARY

PARTIAL CUT BOUNDARY

•R I,II,III REACH # and SECTION

[T1 | 1.0] TRANSECT # and RIVERMILE

OBSTRUCTION

BARRIER

J1,2,3 JAM and #
F( )1,2,3 FALLS, HEIGHT, and #
C1,2,3 CULVERT and #
B1,2,3 CHUTE and #

MONITOR SITE

STRUCTURE

BRIDGE

LANDSLIDE, SLUMP

DEBRIS TORRENT TRACK

SPRING

UPPER LIMIT OF FISH PRESENT

BANK EROSION (EXTENSIVE/SEVERE)

1,2,3, MISCELLANEOUS

WETLAND HABITAT

S-737 ROAD AND ID NUMBER

EARTHFLOW

Log Jam # 1 Stream Ramsey Date 8-15

Location: T.____ R.____ S.____ Stream Survey Mile 8.8

Barrier ____ Partial Barrier ✓ No Barrier ____

Woody Material: L 5' x W 15' x H 5' = Volume ____ cu. ft.

Sediment Plain: L 100' x W 8' x D 3' = Volume ____ cu. ft.

Washout Potential: Appears Stable ✓ Does Not Appear Stable ____

Comments: Build up - jump pool w/material available at site. Could be ok at higher flows.

Log Jam # 2 Stream Ramsey Date 8-19-85

Location: T.____ R.____ S.____ Stream Survey Mile 10.3

Barrier ____ Partial Barrier ✓ No Barrier ____

Woody Material: L 6' x W 20' x H 4' = Volume ____ cu. ft.

Sediment Plain: L 20' x W 10' x D 3' = Volume ____ cu. ft.

Washout Potential: Appears Stable ✓ Does Not Appear Stable ____

Comments: Barrier may not exist at high flows. Partial removal may help passage. Sediment plain is mostly pea gravel.

Log Jam # 3 Stream Ramsey Date 8-19-85

Location: T.____ R.____ S.____ Stream Survey Mile 10.7

Barrier ____ Partial Barrier ✓ No Barrier ____

Woody Material: L 2' x W 25' x H 4' = Volume ____ cu. ft.

Sediment Plain: L 40' x W 15' x D 2' = Volume ____ cu. ft.

Washout Potential: Appears Stable ✓ Does Not Appear Stable ____

Comments: Passage may be possible through jam. Partial removal may help passage. Jam is located 200' below trail x-ing

Log Jam # ____ Stream ____ Date ____

Location: T.____ R.____ S.____ Stream Survey Mile ____

Barrier ____ Partial Barrier ____ No Barrier ____

Woody Material: L____' x W____' x H____' = Volume ____ cu. ft.

Sediment Plain: L____' x W____' x D____' = Volume ____ cu. ft.

Washout Potential: Appears Stable ____ Does Not Appear Stable ____

Comments: ____

Log Jam # ____ Stream ____ Date ____

Location: T.____ R.____ S.____ Stream Survey Mile ____

Barrier ____ Partial Barrier ____ No Barrier ____

Woody Material: L____' x W____' x H____' = Volume ____ cu. ft.

Sediment Plain: L____' x W____' x D____' = Volume ____ cu. ft.

Washout Potential: Appears Stable ____ Does Not Appear Stable ____

Comments: ____

Log Jam # ____ Stream ____ Date ____

Location: T.____ R.____ S.____ Stream Survey Mile ____

Barrier ____ Partial Barrier ____ No Barrier ____

Woody Material: L____' x W____' x H____' = Volume ____ cu. ft.

Sediment Plain: L____' x W____' x D____' = Volume ____ cu. ft.

Washout Potential: Appears Stable ____ Does Not Appear Stable ____

Comments: ____

Falls/Chute # 1 Stream [illegible] Date 8/19

Location: T. ____ R. ____ S. ____ Stream Survey Mile 11.1

Size: W 20', H 4', L 10' Gradient ____ Barrier: Yes Partial No ____

Is pool present below the falls? Yes ✓ No ____

Length 10', width 2', depth 4'

Other comments: Not a jumping flow steelhead barrier
Build up jump pool depth w/ logs and remove
logging debris from top, possibly blast steps,
Hand pile & bank plant.

Falls/Chute # 2 Stream Ramsey Date 8/19 am

Location: T. ____ R. ____ S. ____ Stream Survey Mile 11.4

Size: W 10', H 5', L <' Gradient ____ Barrier: Yes ✓ No ____

Is pool present below the falls? Yes ____ No ✓

Length ____', width ____', depth ____'

Other comments: Camp Baldwin ownership, Complete
barrier. No jump pool due to rock & wood debris below structure
Concrete dam creating pond.
Private ownership.

Falls/Chute # ____ Stream ____ Date ____

Location: T. ____ R. ____ S. ____ Stream Survey Mile ____

Size: W ___', H ___', L ___' Gradient ____ Barrier: Yes ___ No ___

Is pool present below the falls? Yes ____ No ____

Length ____', width ____', depth ____'

Other comments: ____

Falls/Chute # ____ Stream ____ Date ____

Location: T. ____ R. ____ S. ____ Stream Survey Mile ____

Size: W ___', H ___', L ___' Gradient ____ Barrier: Yes ___ No ___

Is pool present below the falls? Yes ____ No ____

Length ____', width ____', depth ____'

Other comments: ____

Falls/Chute # ____ Stream ____ Date ____

Location: T. ____ R. ____ S. ____ Stream Survey Mile ____

Size: W ___', H ___', L ___' Gradient ____ Barrier: Yes ___ No ___

Is pool present below the falls? Yes ____ No ____

Length ____', width ____', depth ____'

Other comments: ____

Falls/Chute # ____ Stream ____ Date ____

Location: T. ____ R. ____ S. ____ Stream Survey Mile ____

Size: W ___', H ___', L ___' Gradient ____ Barrier: Yes ___ No ___

Is pool present below the falls? Yes ____ No ____

Length ____', width ____', depth ____'

Other comments: ____

RM 9.2

I.D. A Stream Ramsey Date 8-15-85 | TRIB I.D. ___ Stream ___ Date ___

L Int ___ Gradient 30 % | Per ___ Int ___ Gradient ___ %

H ___ ft. x̄ Depth 0.1 ft x̄ VEL 4 ft/s | WIDTH ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s

0.8 c.f.s. M.H.W. WIDTH 2 ft | Q ___ c.f.s. M.H.W. WIDTH ___ ft

Steep; cobble bottomed trench. ═══

[illegible] North.

I.D. ___ Stream ___ Date ═══ | TRIB I.D. ___ Stream ___ Date ___

Int ═══ Gradient ___ % | Per ___ Int ___ Gradient ___ %

H ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s | WIDTH ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s

___ c.f.s. M.H.W. WIDTH ___ ft | Q ___ c.f.s. M.H.W. WIDTH ___ ft

I.D. ___ Stream ___ Date ___ | TRIB I.D. ___ Stream ___ Date ___

Int ___ Gradient ___ % | Per ___ Int ═══ Gradient ___ %

H ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s | WIDTH ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s

___ c.f.s. M.H.W. WIDTH ___ ft | Q ___ c.f.s. M.H.W. WIDTH ___ ft

I.D. ___ Stream ___ Date ___ | TRIB I.D. ___ Stream ___ Date ___

Int ___ Gradient ___ % | Per ___ Int ___ Gradient ___ %

H ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s | WIDTH ___ ft x̄ Depth ___ ft x̄ VEL ___ ft/s

___ c.f.s. M.H.W. ___ ft | Q ___ c.f.s. M.H.W. WIDTH ___ ft

John Day River Habitat Enhancement

Annual Progress Report

by

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Project No. 84-21
Contract No. DE-AI79-85BP17460

January 1 to December 31, 1985

Abstract

This project, inititated July 1, 1984 under Bonneville Power Administration (BPA) contract number DE A179-84 BP17460, provides initial landowner contacts agreement development, project design, budgeting, and implementation for an anadromous fish habitat improvement program on privately owned lands within the John Day Basin. Implementation of the major segment of improvement work under this project occurred after July 1, 1985. Activities under the first phase of the contract period (January 1, 1985 through June 30, 1985) included landowner contacts and agreement development, personnel training, equipment purchase and project inventory, planning and design work.

Because of our agreement and association with the Grant Soil and Water Conservation District (GSWCD) and our cooperative (GSWCD, SCS, and ODFW) working relationship, we had agreements with 6 landowners on 7 properties in 1985.

We completed instream habitat improvement on 3 miles of the main-stem John Day and have constructed 1.7 miles of riparian exclosure fence on this section. We completed 13 miles of electric riparian/pasture fence on Deer Creek and 2.4 miles of electric riparian exclosure fence on Fox Creek. We also constructed 3.0 miles of barbwire exclosure fence on Fox 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 restoration of runs in other Columbia tributary systems and for effective utilization of habitat in the John Day system.

Oregon Department of Fish and Wildlife (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.

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. 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 restore runs in the system to pre-dam numbers.

Funds provided to the ODFW by the BPA contract number DE A179-84 BP17460 provides for landowner contact and agreements, project inventory, plan and design work, contract development, budgeting, in-stream habitat work, riparian restoration, and post construction review for anadromous 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 John Day River originates from Snow Mountain, elevation 7,163 ft., 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 Prairie City (Figure l), 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 a77 accessable tributaries in the basin (Lindsey, et.al. 1981). In the South Fork up to RM 28 at South Fork Falls, summer Steelhead spawn and rear.

Specific areas included in the project during FY 1985 include; (A) the John Day River above the town of John Day, between RM 247 and 250 and (B) between RM 260 and 272, (C) Fox Creek (Cottonwood Creek drainage, North Fork tributary) between RM 1 and 15, and (D) Deer Creek (North-Fork tributary) between RM 4 and 12 (Figure 1).

Methods and Materials

We continued work on landowner agreements for FY 1985, implemented and established time frames, equipment procurement, hiring personnel, budgeting, and contract development.

We continued collection of baseline physical stream measurements, 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. We measured stream width and depth on transects located at 50 pace (150 feet) intervals. We used wetted width, with estimates for undercut banks and maximum depth as our measurements. Cover area, bank vegetation, and pool/riffle ratio were quantified for the entire reach. 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 the 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.

We also walked the stream reaches planned for instream work in state FY 1985 and determined the amount and types of in-stream habitat improvement and riparian fencing needed by identifying areas of poor habitat, ie. areas lacking pools or cover, and poor riparian cover respectively.

Our engineering support personnel from GSWCD made measurements to determine bank stabilization needs within planned project areas. We implemented stabilization of actively eroding banks with rock riprap and jetties in conjunction with streambank fencing to allow full recovery of the riparian area. Measurements included length of bank and average bank height. These measurements were subsequently used to calculate quantity of rock required to estimate costs, and for contracting. We estimated fencing quantities, number of jetties and boulders, length of riprap and other conditions, and submitted this information to the ODFW engineering section for contracts. Pre-bid tours were conducted and the contracts were then opened for bidding and construction began in mid September.

We determined jetty, boulder, riprap, and water gap locations by walking the mainstem stream reaches and staking these areas. The contractor then excavated these locations and rock was placed under supervision by ODFW personnel. Boulders were individually placed in the stream by the contractor under direct supervision of ODFW personnel. Woody debris was cabled into the bank with ¼ inch steel cable by ODFW personnel. Side channels were excavated by the contractor under the direction of ODFW and boulders were placed within these channels. Rock weirs were excavated and constructed with jetty structures, boulder placement, and associated holding pools. A railroad tie corner post, steel post, wood stay, 5-strand barbwire riparian enclosure fence was constructed on one side of the river on the Coombs property (.5 mile). A rock jack, steel post, wood stay, 5-strand barbwire riparian enclosure fence was constructed on the Holmstrom property (1.2 miles). Riparian grass seed was planted on 3.4 miles of streambank on the Coombs and Emmel properties. Several pieces of woody debris, (ie. logs and branches) were placed within the jetties and left projecting into the channel for fish habitat. These will be evaluated for icing and performance throughout the year.

A 14.5 mile long, electric, 4-strand (2 hot wires), wood corner post, steel post and fiberglass stay riparian pasture fence was constructed on Deer Creek (North Fork tributary) for 6.6 stream miles. Associated structures included switches placed every ½ miles on the fence for maintenance, 2 flood gate controllers were placed at the beginning and end of the project site, numerour hog wire gully crossings, and 6 gates for ingress and egress. A total riparian exclosure electric fence was constructed within the above fence along a 400 feet corridor of the stream and 20 feet wide on each side of the creek to monitor plant community, growth, and development in the riaprian zone for a comparison between total and partial cattle exclusion. The electric riparian pasture system is a grazing strategy that will allow equitable use of available forage, with carefully managed levels of stocking, and timing and intensity of grazing (Platts and Nelson 1985).

A rock jack, steel post, wood stay, 5-strand barbwire riparian exclosure fence was also constructed on Fox Creek (Cottonwood Creek, North Fork tributary). The 3 mile long fence will allow riparian recovery on 1.5 miles of stream.

An electric 4-strand (2 hot wires), wood corner post, steel post, and fiberglass stay riparian exclosure fence was also constructed along 1.2 stream miles (2.4 fence miles) on a portion of Fox Creek. Three water gaps and 11 gates were also installed.

Fencing projects not completed in 1985 will be incorporated into the 1986 construction contracts. A major portion of this fencing will be coordinated with instream habitat structure work in 1986.

Results and Discussion

We obtained 7 signed riparian lease agreements and worked on 6 properties in FY 1985 (Table 1). We have contacted several more landowners and plan to implement habitat improvement on 10 separate projects in FY 1986 which includes 5 of the 7 landowners from FY 1985. These priority areas include the upper mainstem John Day, the upper Middle Fork John Day, Fox Creek, Deer Creek Falls, and Fivemile Creek Falls. This work will treat approximately 18.6 miles of stream and open up spawning and rearing areas above the 2 falls for 38 additional miles.

We completed instream habitat improvement work in the mainstem John Day on 3 properties for a total of 2.9 stream miles. In these 3 reaches, we placed 751 boulders, 2 rock weirs and associated holding pools, 146 rock jetties, 2 side channels for juvenile rearing and overwintering,1725 feet of rock riprap for bank stabilization, 7 water gap developments, and installed several pieces of woody debris with cables or in association with jetties for fish cover (Table 1). We completed 1.7 miles of riparian barbwire exclosure fence on 2 properties.

We completed approximately 3.0 miles of riparian barbwire exclosure fence and began construction on one spring development on Fox Creek (North Fork tributary). On a second property, we completed approximately 2.4 miles of riparian electric exclosure fence on Fox Creek.

We completed approximately 13.0 miles of riparian pasture electric fence and a riparian exclosure electric fence on a 400 feet by 20 feet section of stream for riparian monitoring on Deer Creek (North Fork tributary).

Summary and Conclusions

Activities under the first half of the contract period (January 1 through July 31, 1985) included landowner contact and agreements, personnel training, project inventory, equipment aquisition, planning, and design work. We obtained agreements with 7 landowners for FY 1985 and have contacted 9 landowners for FY 1986 projects. We have been working with the USFS,. Malheur NF to develop a project on the Middle Fork John Day River in 1986 or 1987 on USFS land. Activities in the second half of the contract period (August 1 through December 31, 1985) included the above activities and the following: contracts, pre-bid tours, instream habitat improvement projects, riparian fence construction, budgeting (Table 3) and working on the annual report.

Fish benefits from the instream habitat structures (Table 2) are estimated based on calculations by the USFS (USDA, Umatilla NF 1984). Total number of additional anadromous fish derived from habitat enhancement work is estimated at 7171 smolts and 107.56 adults of spring chinook and 2796 smolts and 111.60 adults of summer Steelhead (Oregon Dept. of Fish and Wildlife, unpublished report 1985).

Our agreement with GSWCD for them to provide the ODFW with engineering support, construction, riparian planting, and landowner agreements has worked well. The John Day project has benefited greatly in terms of landowner acceptance and cooperation from our association working with the GSWCD and SCS (Soil Conservation Service). The GSWCD is a group of landowners set up to deal with local problems and issues related to soil and water. Landowners have been very receptive to being approached through GSWCD about fish habitat improvement projects. SCS personnel have also assisted with landowner contacts, and strategies for management changes and streambank fencing. Landowner contacts have continued to be positive and our staff has projects lined up for FY 1986.

John Day River Drainage Indicating Work Areas in 1985

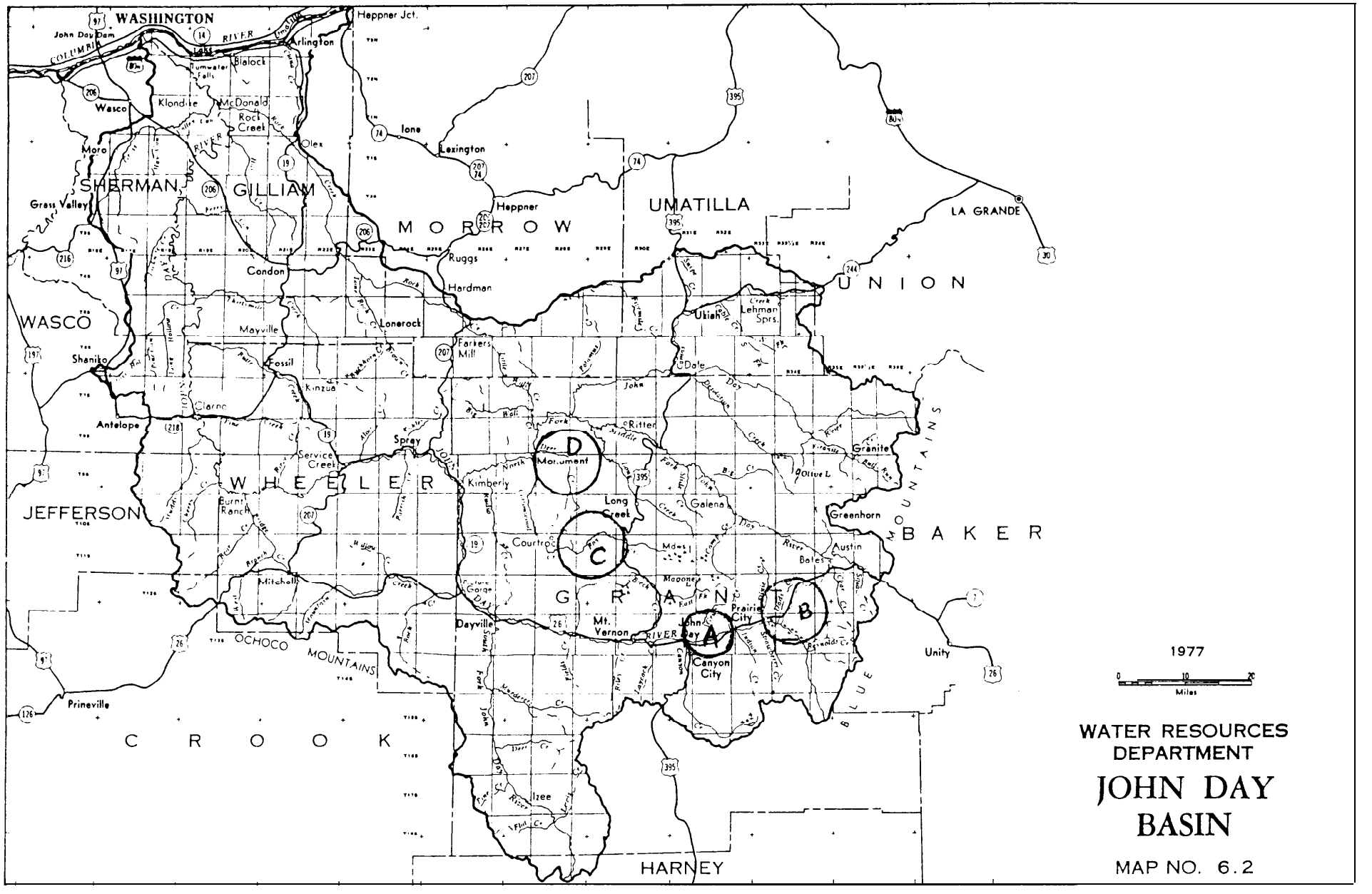

TABLE 1

Work Completed for the John Day Basin in 1985
Private Lands Habitat Improvement Project, State FY 1986

LANDOWNER	AREA	LENGTH OF STREAM (MILE)	Habitat Improvements a/							PHYSICAL INVENTORY DATA
			BOULDERS	JETTIES	WEIRS	RIPRAP	SIDE CHANNEL	H_2O DEV	FENCING (MILE)	
Coombs	Upper Mainstem	0.4	117	25 a/	-	25'	-	1	0.5 b/	yes
Emmel	Upper Mainstem	1.2	323	62 a/	2	925'	1	2	b/	yes
Holmstrom	Upper Mainstem	1.2	311	59 a/	-	775'	1	-	1.2	yes
Johns	Fox Creek	5.0	-	-	-	-	-	1 c/	2.0 d/	yes
Bentley Ranch	Fox Creek	1.2	-	-	-	-	-	3	2.4	yes
Bentley Ranch	Deer Creek	6.5	-	-	-	-	-	-	13.0	yes
McGirrs	Fox Creek	1.5	-	-	-	-	-	-	1.0 d/	yes
TOTAL		17.0	751	146	2	1725'	2	7	19.6	

a/ Woody debris installed with cables or in association with some jetties on mainstem projects

b/ Fencing incomplete as of January 1986

c/ 1 spring development begun in 1985; 2 more planned for 1986

d/ Fencing incomplete; major portion of fencing will be included with instream habitat structure work in 1986

TABLE 2

Estimated Fish Benefits from Instream Habitat Structures
in 1985 on the Mainstem John Day River a/ b/

STRUCTURE TYPE	# STRUCTURES	#CHINOOK SMOLTS	#STEELHEAD SMOLTS
Boulder	751	3,755	1,502
Jetty	146	2,920	876
Weir	2	120	36
Sidechannel	2	376	376
Total Smolts		7,171	2,796
Total Adults		107.56	111060

a/ Assumptions for calculations:

1. Chinook spawner produces 160 viable smolts
2. Steelhead spawner produces 150 viable smolts
3. A placed boulder produces rearing habitat for 5 salmon and 2 Steelhead smolt, or 5 Steelhead smolt if in a Steelhead only stream.
4. A side channel produces habitat for 1800 chinook and 540 Steelhead smolt.
5. Other structures produce habitat for 40 chinook and 12 Steelhead smolt or 24 Steelhead smolt if in a Steelhead only stream.

b/ Assumptions from USDA U.S. Forest Service, Umatilla National Forest Environmental Assessment, September 1984.

TABLE 3
BUDGET SUMMARY FORM

Project Title: John Day River Habitat Enhancement
Project Number: 84-21
Contract: DE A179-84 BP 17460
Agency: OR Dept. of Fish & Wildlife
Agreement Period: 7/1/85 - 3/31/86

July 1 - Nov. 30 Expenditures a/

	ITEM	CONTRACT 659	CONTRACT 660	TOTAL
1.	Personnel Salaries	35,760.27	23,158.84	58,919.11
2.	Labor Overhead 36%	12,605.03	8,194.01	20,799.04
3.	Travel/Per diem	3,387.28	5,336.78	8,724.06
4.	Training	--	--	--
5.	Expendable Equipment	4,360.12	26,578.34	30,938.46
6.	Non-Expendable Equipment	2,008.78	1,017.55	3,026.33
7.	Rent	--	--	--
8.	General Services	6,441.18	1,788.19	8,229.33
9.	Indirect Overhead 23%	14,387.39	14,962.92	29,350.31
10.	Subtotal	78,950.05	81,036.36	159,986.41
11.	Subcontracts	56,213.19	193,514.86	249,728.05
12.	Total Expenditures	135,163.24	274,551.22	409,714.46
13.	Budget	263,970.00	263,970.00	527,940.00

a/ Expenditures available through February 1986

References

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. 48 pp.

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North Fork John Day River Habitat Improvement

Annual Report

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Divison of Fish and Wildlife

Contract No. DE-A179-84BP16725

Project Number 84-8

January 1985

CONTENTS

	Page
ABSTRACT	225
SUBPROJECT I - NORTH FORK JOHN DAY RIVER SIDE CHANNELS.	226
Introduction	226
Project Description.	227
Achievements	229
SUBPROJECT II - DESOLATION CREEK.	231
Introduction	231
Project Description.	232
Achievements	232
SUBPROJECT III - LOWER NORTH FORK JOHN DAY SUB-BASIN.	234
Introduction	234
Stream Survey Methods and Results.	234
SUBPROJECT IV - UMATILLA BASIN.	236
Introduction	236
Achievements	236
PROJECT MONITORING.	237
PROJECT COSTS	237
LITERATURE CITED.	239
APPENDIX A: PROJECT PHOTOGRAPHS	240
APPENDIX B: LOWER NORTH FORK JOHN DAY SUB-BASIN STREAM SURVEYS.	241
APPENDIX C: PROJECT LOCATION MAPS	242

TABLES

Table		page
1.	Summary of the North Fork John Day River Side Channel Project to Date.	229
2.	Increase in Smolt Production, North Fork John River Side Channels, 1985.	230
3.	Summary of the Desolation Creek Project to Date.	233
4.	Increase in Smolt Production, Desolation Creek, 1985 . . .	233
5.	Project Costs, April 1985 to March 1986	238

ABSTRACT

Personnel from the Umatilla National Forest completed all construction work planned for 1985. Work on the North Fork John Day River consisted of opening six side channels, constructing two alcove or blind channels, constructing 16 side channel and 22 main stem rock weirs, placing six rock deflectors at side channel entrances for flow control, constructing 17 rock deflectors to direct flow in side channels, planting eight shrubs and 182 cuttings, and placing 283 large boulders and 35 logs in side channels and in the main river to provide instream cover.

Work on Desolation Creek last year created an estimated 18,664 square feet of rearing pool habitat by constructing 52 rock weirs, 1 adult holding pool, and five alcove or blind channels in 0.8 miles of Desolation Creek. In addition, 2 side channels, 0.3 miles in length were constructed, 97 boulders and 11 logs were placed in the stream, and 18 cottonwood cuttings were planted to provide shade and improve juvenile anadromous fish rearing habitat.

A detailed stream survey of anadromous fish habitat covering 70.5 miles of stream in the lower North Fork John Day Sub-basin was completed and an anadromous fish habitat improvement project planned for Wilson Creek.

An environmental assessment that discusses anadromous fish habitat improvement within the Umatilla Basin was completed during the spring of 1985. This report was prepared with interdisciplinary input from soils, watershed and wildlife specialists as well as participation by Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Oregon Department of Fish and Wildlife (ODFW).

SUBPROJECT I - North Fork John Day River Side Channels

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 8 7S., R.33E. (Figure 1).

The 1984 estimate of spring chinook salmon (Oncorhynchus tshawytscha) production for the 14 miles of main stem of the North Fork John Day River on the Umatilla National Forest outside of the North Fork John Day Wilderness was 108,000 smolts annually. There is an estimated potential of producing 190,500 smolts annually if habitat conditions are brought to optimum levels.

Degradation by gold dredging in this area began in 1939 and ended in 1950. Dredging activities changed the natural course and hydrology of the North Fork John Day River. High flow channels were created by the gold dredging. To date, the anadromous fish rearing habitat in this portion of the river has not recovered from the impacts of this dredging.

Fourteen miles of the North Fork John Day River offers the opportunity to significantly increase smolt production at relatively low cost. Twenty-six of thirty-two side channels trapped rearing chinook parrs or pre-smolts annually. During low flow periods, the channels dried up and the trapped fish died which resulted in an estimated loss to the system of 26,000 pre-smolt spring chinook salmon.

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 1979-1985, the Umatilla National Forest rebuilt these two side channels and reopened an additional 24 side channels. The Forest also constructed structures in the river and side channels to increase juvenile spring chinook rearing habitat.

This has been a cooperative venture. CTUIR and ODFW has been heavily involved in the planning stages. The Louisiana-Pacific Corporation has made a source of boulders available to the project. Bonneville Power Administration has provided major financing since 1983 through the Northwest Power Act. The USDA Forest Service has been responsible for the planning and administration of the project.

The overall project goal has been 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 Stability. 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. Restoration of 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, and shrub establishment and fertilization in the thirteen-mile stretch of the river previously worked.

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 river.

The contractor began work on June 10, 1985, and construction was completed on August 31, 1985. 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 place 283 boulders and 35 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 wired in place.

Six side channels were excavated to grade, and 16 rock weirs were constructed in the channels prior to opening the entrance and allowing the water to flow through them. A flow control structure was constructed at the entrance of each side channel to divert between 20 and 30 percent of the main river flow into the side channel. Riprap was used to protect unstable banks and to construct rock deflectors for increased juvenile fish rearing.

The alcoves or blind channels were constructed by excavating a channel from the river at a upstream angle while holding the grade to that of the stream bottom at the lowest end of the channel. In addition to the rearing habitat provided, the resulting off-channel pool provides refuge for juvenile fish during flood events.

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 side channels will result in increased anadromous fish survival from egg to smolt. Assuming the increased rearing area equates to a porportional increase in fish production, this increase is estimated at 7,260 smolts annually and will require at least one generation of five years before results become readily apparent. These smolts would provide 45 additional escaping adults which would have an estimated annual net value of $24,750 using National Marine Fisheries Service Economic Values (Table 2).

Table 1. Summary of the North Fork John Day River Side Channel Project to Date.

Structure	1979	1980	1981	1982	1983	1984	1985	TOTAL
Side Channels	1	8	1	1	6	3	6	26
Alcoves and Blind Channels							2	2
Boulders Placed	63	50	60	80	492	250	283	1278
Log Weirs						2		2
Rock Weirs			2		16	8	16	42
Main Stem Rock Sills							22	22
Rock Deflectors	14	3		1	4	7	23	52
Adult Holding Pools						1		1
Instream Logs Placed						1	35	36
Erosion Control Structures					4	1		5
Shrubs Planted							8	8
Cuttings Planted							182	182

Table 2. Increase in Smolt Production, North Fork John Day River Side Channels.

	ChS
Estimated increase in numbers of smolts	7,260
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increased numbers of adult spawners	45
Net value per escaping chinook 2/	x$550
Estimated annual value 1985 BPA project	$24,750
Benefit-Cost Ratio 3/	2.6:1

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.
3/ Based on 4% interest for a 20-year project life.

SUBPROJECT II - Desolation Creek Habitat Improvement

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. 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 numerous spring chinnok salmon spawning in Desolation Creek. Several barriers in the lower portions of the stream apparently blocked salmon passage since that time. Louisiana-Pacific Corporation, landowner in the blockage area, removed the barriers during last three years.

Presently, spring chinook salmon, summer Steelhead, and resident trout utilize 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.

Each spring, trout anglers report catching late migrating spring chinook smolts in lower portions of the stream, and an August 1982 pre-work stream inventory of Desolation Creek fish habitat conditions tallied one spring chinook adult at stream mile 20.5.

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 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 goal is to increase the production potential of spring chinook salmon by meeting the following objectives:

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.

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.

PROJECTDESCRIPTION

Project activities consisted of preparing and administering a contract to place rock structures, boulders and riprap in Desolation Creek from stream miles 20.7 to 21.5 (Table 3). The contractor began work on September 3, 1985, and construction was completed on September 29, 1985.

The 1985 Desolation Creek project began with the construction of approximately one-half mile of access to the creek. The equipment used for access construction, which consisted of clearing fallen lodgepole from an existing trail, and instream construction was a tracklayer hoe with street pads and a l-yard bucket on a boom that would reach 30-feet. Instream work began at the conjuction of the North and South Forks of Desolation Creek and progressed for 0.8 of a mile downstream. Within this section of stream we constructed 2 side channels totaling 0.3 of a mile of additional stream habitat, 38 weirs and large pools in the main channel, 1 large resting pool in the main channel, 4 blind channels, one bypass around a potential barrier, 14 weirs and pools in the side channels, and 1 side channel alcove. As work progessed downstream, we also placed 14 boulders in the channel, 59 boulders in the newly constructed pools, dug 24 small pools behind boulders already in the stream, placed and tied in 11 trees as woody debris, and planted 18 cottonwoods along the longest of the side channels.

The rock weirs were designed to catch moving bedload gravel. The pools that were constructed below the weirs were generally 10 to 12 feet wide, 15 to 20 feet in length and a depth of 4 to 6 feet. Boulders were placed in the pools to increase structure and cover in the pool. Boulders excess to the needs of weir and resting pool construction were placed in the stream in scattered groups to provide additional instream cover. Blind channels were dug to approximately 4 feet in depth and 8 feet in width, and ranged in length from 50 feet to 150 feet. Woody debris was tied in with #9 wire to trees on the bank. All ground scarified by equipment was seeded with streamside grass. Access roads were blocked by trees or boulders to prevent more access that than which existed before the project and to prevent resource damage from vehicle use in the wet areas that exist along the streamside.

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 side channels will result in increased anadromous fish survival from egg to smolt. Assuming the increased rearing area equates to a porportional increase in fish production, this increase is estimated at 1,600 smolts annually and will require at least one generation of five years before results become readily apparent. These smolts would provide 29 additional escaping adults which would have an estimated annual net value of $15,950 using National Marine Fisheries Service Economic Values (Table 4).

Table 3. Summary of the Desolation Creek Project to Date.

Structure	1985	TOTAL
Rock Weirs	52	52
Adult Holding Pools	1	1
Boulders Placed	97	97
Instream Logs Placed	11	11
Side Channels	2	2
Side Channel Length (ft.)	1,584	1,584
Alcove and Blind Channels	5	5
Alcove and Blind Channel Length (ft.)	550	550
Debris Jam Bypass	1	1
Cuttings Planted	18	18

Table 4. Increase in Smolt Production, Desolation Creek, 1985.

	Spring Chinook
Estimated increase in numbers of smolts	1,600
Multiplied by: percent spawning escapement 1/	x.00625
Estimated increase in numbers of adult spawners	29
Net value per escaping chinook 2/	x$550
Estimated annual value 1985 BPA project	$15,950
Benefit-Cost Ratio 3/	8.6:1

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.
3/ Based on 4% interest for a 20-year project life and project cost @ 25M.

SUB-PROJECT III - Lower North Fork John Day Sub-basin

INTRODUCTION

A detailed stream survey of anadromous fish habitat covering 70.5 miles of streams in the lower North Fork John Day Sub-basin was completed and an anadromous fish habitat improvement project planned for Wilson Creek. An evaluation of the 1985 physical stream inventory data indicates that both the quality and quantity of pool habitat for adult and juvenile anadromous fish is naturally limiting production. In addition, many of the pools are shallow and not have sufficient volume for good fish production. In Wilson Creek, the opportunity exists to increase the pool percentage, as well as, increase the maximum depths in the pools from under two feet to over three feet. All of the pools will be designed to increase juvenile rearing while several pools will be designed to provide the additional depth and size required for adult holding.

STREAM SURVEY METHODS AND RESULTS

The survey was a basic on-the-ground inventory of anadromous and potentially anadromous streams. Each stream was walked during the low flow period to collect data on biological and hydrological conditions. The result was a combination of stream reach inventory, channel stability evaluation and fishery habitat survey for each stream. Survey methods were derived from previous experience and procedures developed by the Forest Service in Region 1 (Stream Reach Inventory & Channel Stability Evaluation, Dale Pfankuck, 1975). These methods have proven reliable and effective for inventorying habitat conditions for northwest salmonids.

The survey method relies on both measurements and observations. A minimum of equipment was necessary. The equipment included: a thermometer, for water and air temperature; a compass, for stream orientation; a clinometer, for gradient and slope; a spherical densiometer for cover determinations and a camera. These were readily available and didn't require special purchase. Length and area determinations were made by pacing. The parameters that couldn't be quantitatively measured, such as stability or stream morphology, were rated using a set of evaluation criteria. Results were surprisingly uniform between surveyors and produced an accurate account of stream conditions.

Each stream was divided into reaches. They were generally about l/2 mile in length and usually delineated by changes in gradient *or* when a tributary entered a larger stream. The physical and biological parameters of each reach were recorded to provide the information summarized below:

Fishery Habitat:	Estimated flow, water quality, water & air temperature, gradient, channel depth profile and fish species present.
Riparian Vegetation:	Cover, size composition, riparian zone cross-section, dominant species, percent overhanging vegetation and stream surface shade.

Channel Stability:	Upper bank-land form, slope, mass wasting hazard, debris jam potential and vegetation bank protection. Lower bank-channel capacity, bank rock content, flow deflectors/obstructions, bank cutting and point-bar deposition. Channel bottom-rock anaularity, brightness, particle packing, percent stable material & size distribution, scour and deposition, and the amount of clinging aquatic vegetation.

This data proved a comprehensive description of each reach. In addition within each reach, every pool and riffle was measured. There areas were determined and tabulated to provide an accurate pool/riffle ratio. Spawning gravel areas were also inventoried along with notes on gravel size, quality and factors causing quality degradation.

Photography was used extensivily to document the conditions of each reach. Beginning and ending photos were taken on each reach. Pictures were also taken of major hydrological features such as barriers, characteristic features such as typical pool or riffle stretches, and examples of past management activities. These photos provide good documentation of the present ecosystem and will be used to evaluate long term changes in trend.

An evaluation of the data collected from the 70.5 miles of stream surveyed during 1985 indicates that both the quality and quantity of pool habitat for adult and juvenile anadromous fish is naturally limiting production. This data was used to design a habitat improvement project and prepare a work statement for three miles of Wilson Creek, a tributary to Wall Creek.

SUB-PROJECT IV - Umatilla Basin

INTRODUCTION

The completion of the comprehensive plan for the rehabilitation of anadromous fish stocks in the Umatilla River Basin, the improvement of passage in the lower Umatilla River, and the recent adoption of minimum streamflows by the State of Oregon coupled with results of the Umatilla National Forest's physical survey of anadromous streams which indicates that rearing habitat for juvenile anadromous is at a low level points to the need for an anadromous fish habitat improvement project in the Umatilla Basin. This work will be coordinated with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Oregon Department of Fish and Wildlife (ODFW) and a work statement is being prepared for a habitat improvement project in FY 1986.

ACHIEVEMENTS

The stream survey conducted on Forest streams in the upper Umatilla River drainage during the summer of 1984 indicated a significant lack of adult holding and rearing pool habitat. Pool:riffle ratios in the range of 5:95 were common. Using this stream survey data as a basis, the Forest proposed that anadromous fish habitat values in the various stream reaches be enhanced through construction of log and rock weir structures. In line with this proposal, the Forest conducted an environmental analysis of the impact of this type of project proposal on various resource issues and concerns. A report, Environmental Assessment for Anadromous Fish Habitat Enhancement on the Umatilla National Forest Portion of the Umatilla River Drainage, was prepared by the Walla Walla Ranger District to document this analysis process. The Umatilla Forest Supervisor signed a Decision Notice and Finding of No Significant Impact for the proposed project work on June 7, 1985.

During July, August, and September of this year 365 log and rock pool creating weir structures were located, inventoried, and designed in the Thomas Creek stream reach (tributary to the South Fork of the Umatilla River). In addition, access for equipment to place the structures was located and designated along the reach.

Placement of the weir structures in the channel will accomplish the following:

1. Improve Steelhead access to the reach.

   The summer crew noted a dead adult Steelhead 100 yards below the culvert under Forest Road 32 (T. 2 N., R. 37, Section 13). While it is documented that spawning adults have access to the reach it is very difficult and many more do not make it than do. Improvement of this access will therefor increase the number of spawning adults reaching the available habitat.

2. Dramatically improve the abilitv of the stream to produce downstream Steelhead outmigrant smolts.

   This will result primarily from the creation of mid-summer low flow holding pool habitat. The summer crew noted almost complete mortality of native

trout and anadromous Steelhead along the reach due to lack of holding pools during low flow periods.

3. Stabilize channel bedload movement.

This bedload stabilization should increase Steelhead redd success and may be enough to permit future runs of chinook salmon to become established in the lower mile or so of the reach.

PROJECT MONITORING

Biological monitoring of the project results in the North Fork John Day Sub-basin has and will be coordinated with the Oregon Department of Fish and Wildlife; however, no on-the-ground monitoring occurred in 1985. The use of the created rearing areas by salmonids will be tallied for different types of structures during the 1986 field season by Forest Service personnel. --

Physical monitoring of all BPA anadromous fish improvement project start with a comprehensive pre-project physical survey. All projects in this year's program had this survey prior to 1985. Physical monitoring of the North Fork John Day River Side Channel sub-project will consist of a physical stream survey which is scheduled for September 1986. The survey will monitor the physical habitat changes that have occured since the pre-work survey of 1982.

Physical monitoring of the Desolation sub-project has consisted of preliminary measurements of constructed pool area (18,644 square feet). Physical monitoring next year will consist of resurveying the portion of Desolation Creek where habitat improvement work was completed in 1985 and 1986 with emphasis on measuring the surface area and volume of constructed pools and comparing this data with that obtained in the 1982 survey.

PROJECT COSTS

Incurred and anticipated expenses from April 1, 1985 to March 31, 1986 are shown in table four. These costs are broken out to show both Bonneville Power Administration costs and USDA Forest Service costs.

USDA Forest Service appropriated funds spent for fish habitat improvement on the Umatilla National Forest totaled $64,254 of which $11,590 was associated with this project and $42,244 was spent installing 32 log weirs, 6 rock weirs, 1 adult anadromous fish holding pool,and 740 cubic yards of riprap in Tucannon River, Touchet River, Mottet Creek, Mallory Creek and Indian Creek (streams included in the Northwest Power Planning Council's 1984 Columbia River Basin Fish and Wildlife Program). In addition, the Forest spent $10,400 installing 27 log weirs in Jarboe Creek (a resident trout stream not in the NWPPC program).

Table 5. Project Costs, April 1985 to March 1986.

Bonneville Power Administration Funds: 1/		
a. Salaries		$47,500
b. Transportation and travel		7,500
c. Materials and supplies 2/		1,200
d. Equipment rental contracts		66,500
	Subtotal	$122,700
e. Overhead @ 10.7%		13,100
	Total	$135,800

1/ Estimated Costs.
2/ No major property purchased.

Umatilla Forest Appropriated Funds:		
a. Salaries		$19,712
b. Transportation and travel		2,030
c. Materials and supplies		5,750
d. Equipment rental contracts		$36,662
	Total	$64,254

Literature Cited

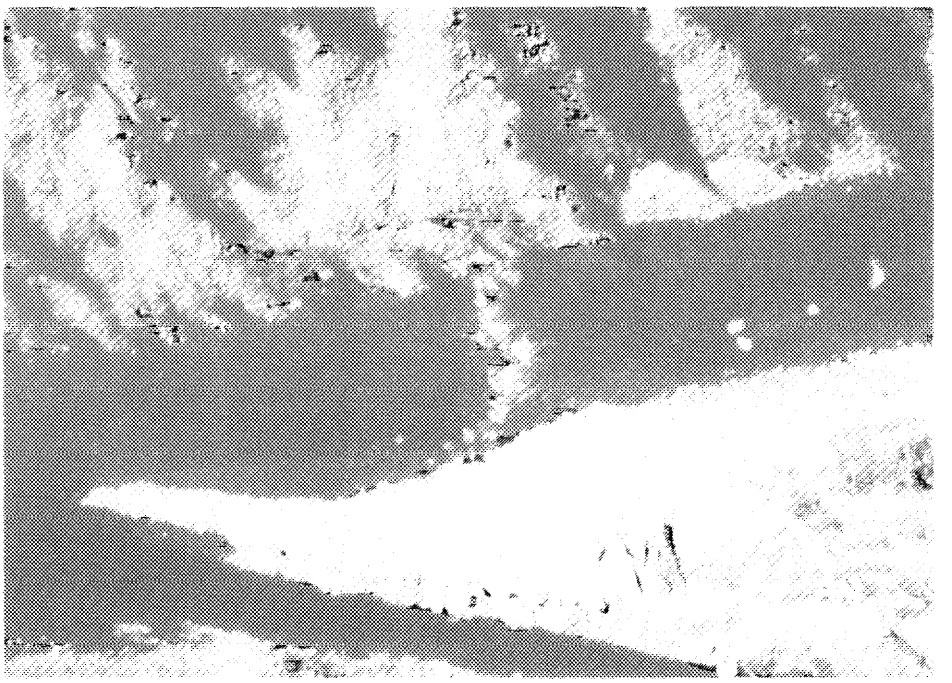
Claire, Errol. 1984. Personal communication on March 5, 1984.

Meyers, Philip A. 1982. Net Economic Values for Salmon and Steelhead from the Columbia River System. U.S. Department of Commerce. 23 pages.

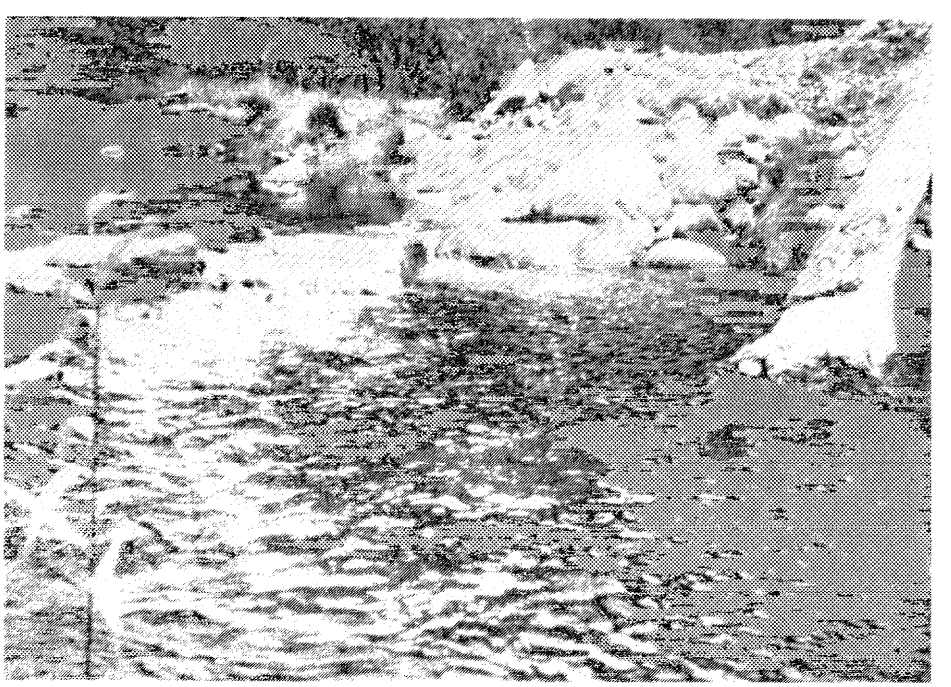
Oregon State Game Commission. 1959. Fishery Division 1958 Annual Report. page 182.

Pfankuck, Dale. 1975 l Stream Reach Inventory and Channel Stability Evaluation. USDA, Forest Service, Northern Region. 26 pages.

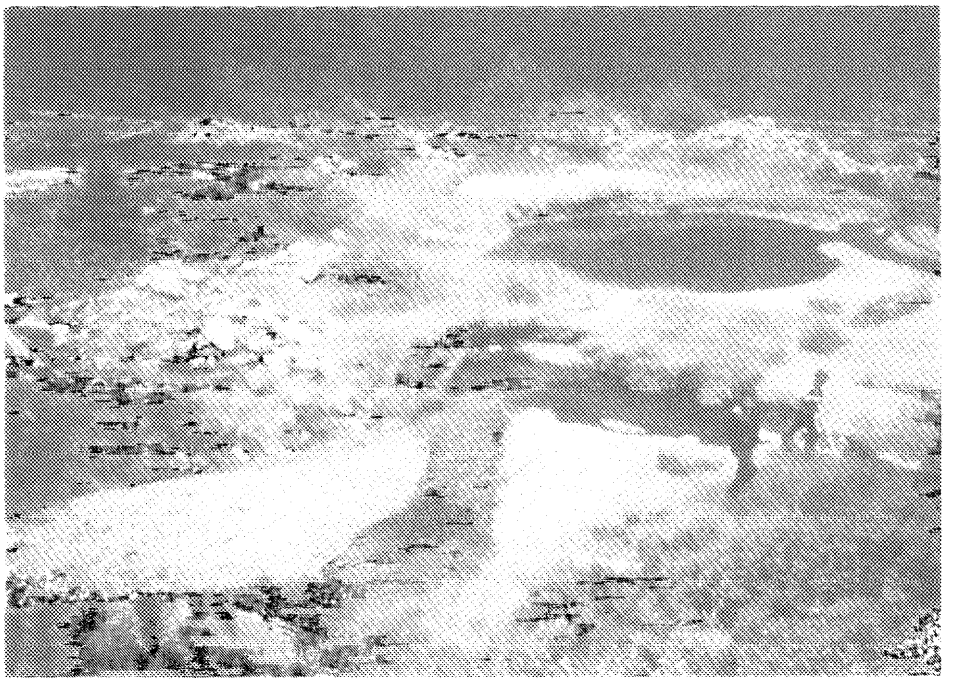
Appendix A: Photographs



Rock weir, boulder placement, and entrance to side channel at the lower end of the project area,

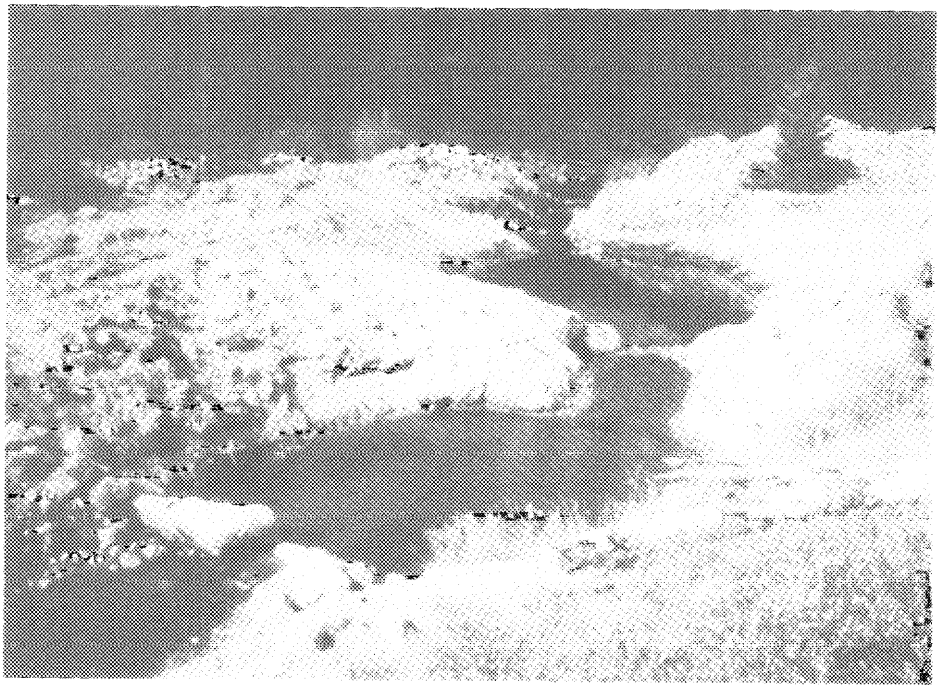


The rock weir, boulder and large log combine to provide complexity.

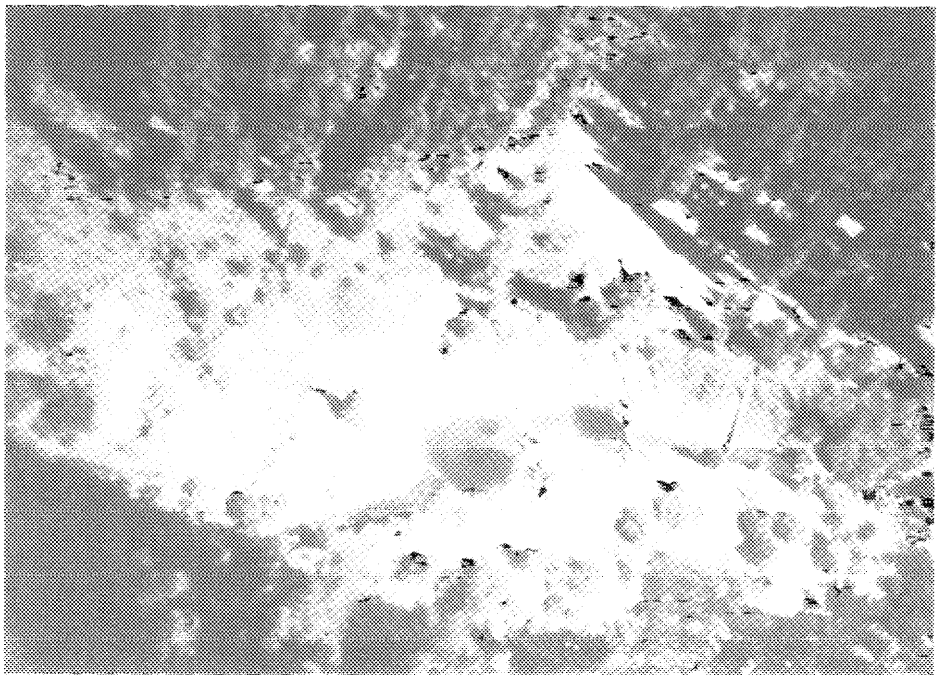


Side channel in June with adequate flow.

Side channel in August. Notice the damp spot in the large hole where Chinook fry were trapped.

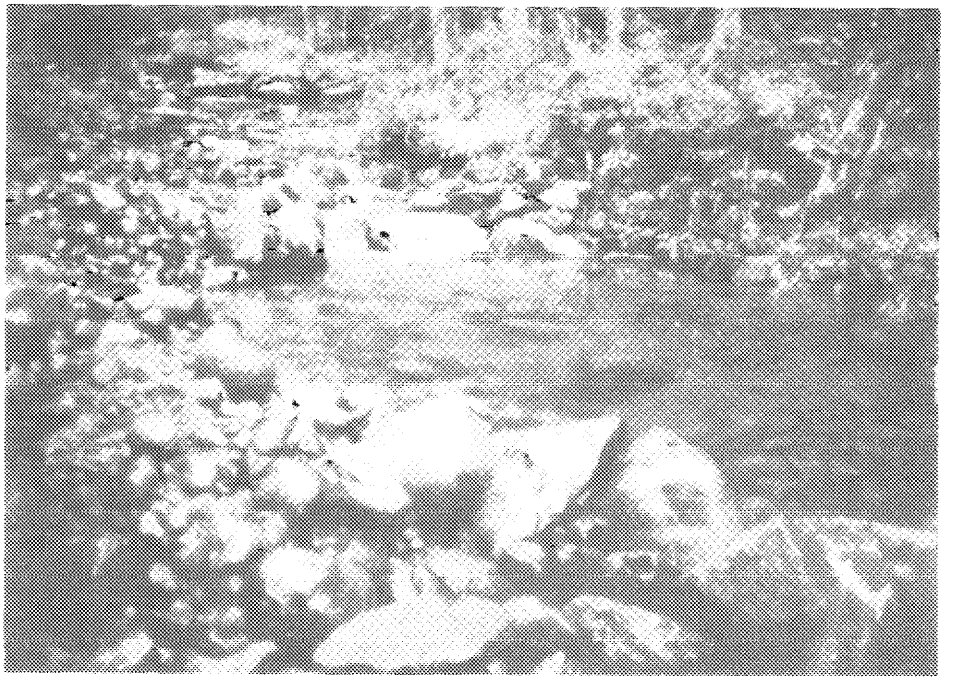


Side channel in September after construction.

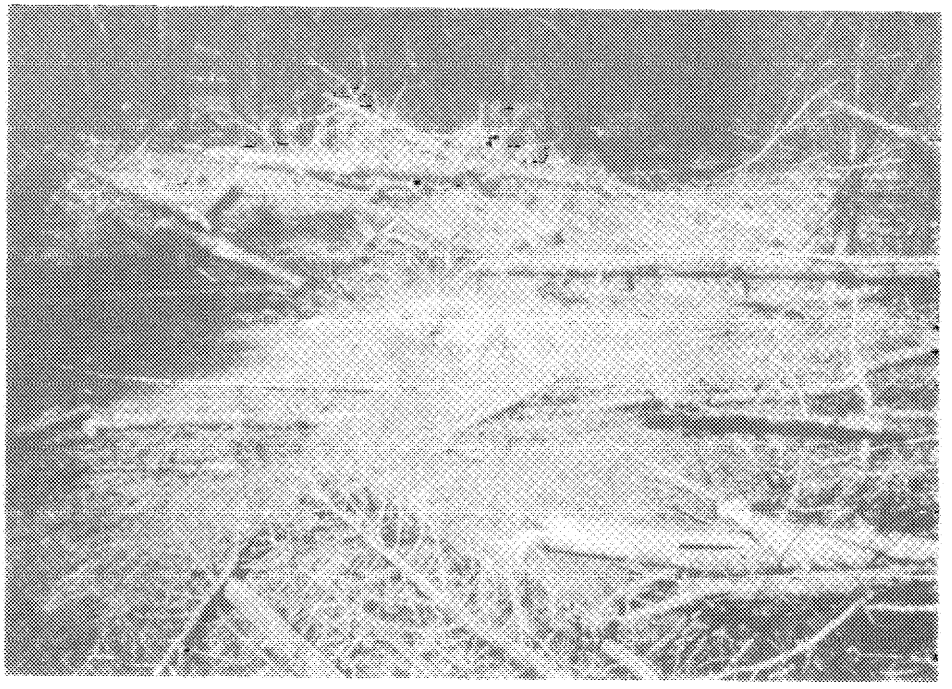


Aerial view of side channel in September.

The upper end of the main stem of Desolation Creek prior to construction,

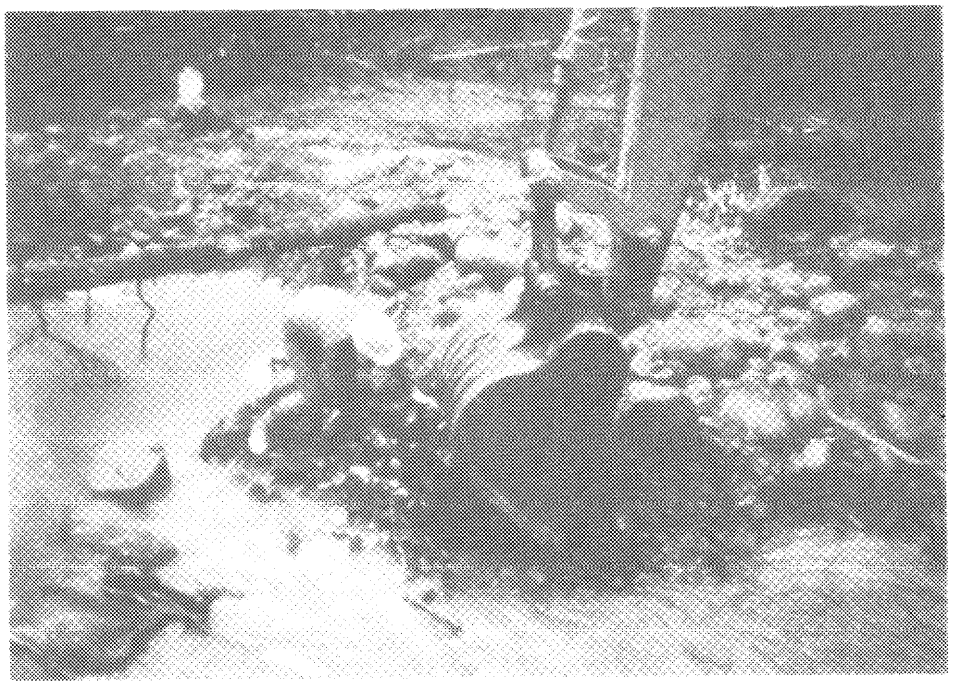


Same view as above after pool construction.



Desolation Creek side channel prior to construction.

The same side channel after construction.



Planting cottonwood cuttings in a Desolation Creek side channel.

A blind channel at the lower end of the Desolation Creek project.

Appendix B: Lower North Fork John Day Sub-basin Survey Summaries

LOWER NORTH FORK JOHN DAY HABITAT ANADROMOUS FISH SURVEY, 1985.

STREAM SUMMARIES	REACH LENGTH (FT.)	REACH LENGTH (MI.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA TOTAL LENGTH (FT.)	POOL AREA SURFACE AREA SQ. FT.)	RIFFLE AREA TOTAL LENGTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	SPAWNING GRAVEL (SQ. FT.
Wall Creek	45,402	8.6	326,054	11,062	89,813	34,340	236,241	28:72	3,342
Indian Creek	2,356	.4	7,936	444	2,132	1,912	5,804	27:73	0
Wilson Creek	34,037	6.4	368,435	11,141	114,967	24,771	253,468	31:69	275
Bull Creek	5,361	1.0	20,956	389	2,421	4,972	18,535	12:88	0
Porter Creek	2,021	.4	12,605	456	5,240	1,565	7,365	41:59	0
Little Wall Creek	26,443	5.0	186,507	9,724	55,502	16,719	131,005	30:70	30
Skookum Creek	48,767	9.2	369,890	10,702	81,917	38,065	287,973	22:78	63
Swale Creek	47,896	9.1	257,855	4,573	35,209	43,323	222,646	14:86	110
Little Bear Creek	2,900	.5	11,724	241	1,862	2,659	9,862	15:85	0
Alder & East Alder Creeks	15,950	3.0	66,261	4,066	20,350	11,884	45,911	12:88	94
Hog Creek	4,198	.8	19,651	209	1,455	3,989	18,196	07:93	0
Bacon Creek	12,060	2.3	37,008	1,137	5,791	10,923	31,217	16:84	150
Three Trough Creek	2,383	0.5	12,328	283	1,998	2,100	10,330	16:19	0
Ditch Creek	51,807	9.8	272,510	5,573	35,705	46,234	236,805	13:87	300
Martin Creek	3,051	.6	9,697	127	3,934	2,924	5,763	40:59	0
Mallory Creek	15,752	3.0	59,269	1,459	11,227	14,293	48,042	19:81	0
Potamus Creek	29,034	5.5	171,038	2,133	27,650	26,901	143,388	16:84	60
Ellis Creek	13,952	2.6	69,484	1,000	6,917	12,952	62,567	10:90	0
Pole Creek	9,345	1.8	31,080	502	2,776	8,843	28,304	09:91	0
Survey Totals	374,590	70.5	2,310,238	69,287	506,866	309,369	1,803,372	22:78	4,424

INDIAN CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,356	.45	3.37	7,936	444	10	4.80	2,132	1,912	39	3.04	5,804	27:73	5		Flows over bedrock w/angular boulders, 2-3' log jams
T.	2,356	.45		7,936	444			2,132	1,912			5,804	27:73			Flows over bedrock w/angular boulders, 2-3' log jams

WALL CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,919	.36	12.7	24,323	452	50.2	16.0	7,238	1,467	122.2	11.6	17,085	28:70	2	0	Algae greater in #16, veg. change also
2	3,350	.63	13.3	44,724	976	48.8	20.3	19,796	2,374	103.2	10.5	24,928	44:56	1	3,300	Bedrock, good fish, gradient changes
3	2,790	.53	12.6	35,052	646	24.8	12.2	7,873	2,144	82.4	12.7	27,179	22:77	4	42	Lots of debris & mass wasting, large log jam
4	1,557	.29	14.4	22,376	467	20.3	11.1	5,193	1,090	49.5	15.8	17,183	23:77	3	0	Shallow slow moving; numerous dace
5	1,115	.21	8.4	9,386.5	377	15.7	8.0	3,020	738.5	30.7	8.6	6,366.5	32:68	3	0	Bedrock, lrg. boulders, pools w/short riffles
6	1,992	.37	14.6	29,201	697	34.8	10.1	7,075	1,295	68.1	17.0	22,126	24:76	1-2	0	Parts of creek on N.F. portions on pvt. land
7	3,655	.69	8.1	29,629	995	18.4	6.4	6,319	2,660	45.1	8.8	23,310	21:78	4-6	0	Little shrubs at begin, picking up more logs
8	7,822	1.5	7.4	57,713	2,088	32.6	8.2	17,191	5,734	85.6	7.1	40,522	30:70	3	0	Starts old bridge, Dark Canyon, dry stretch
9	1,450	2.7	5.5	8,021	349	18.4	8.8	3,071	1,101	55.0	4.5	4,950	38:62	4	0	Begins w/popr on sides, cutting on outside banks
10	1,520	.29	4.1	6,317	205	12.0	5.4	1,118	1,315	65.7	4.0	5,199	18:82	4	0	Creek reduced, fewer large fish, bank cutting
11	8,541	1.6	4.0	34,173	1,387	11.6	5.1	7,079	7,154	56.7	3.8	27,094	20:79	5	0	Start has less algae, larger rocks, steeper grad
12	3,496	.66	4.1	14,315	531	10.2	5.1	2,718	2,965	55.0	4.0	11,597	19:81	5	0	Log jams, diverted stream caused by jams
13	6,195	1.2	1.7	10,824	1,892	47.3	1.1	2,122	4,303	100.0	2.0	8,702	20:80	5	0	Begins at log jam, above jam stream narrower
T.	45,402	11.0	8.5	326,054.5	11,062	19.0	9.0	89,813	34,340	70.7	8.5	236,241.5	28:72		3,342	

WILSON

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	5,120	.97	11.97	61,277	1,298	35	13.51	17,532	3,822	98	11.45	43,745	29:71	2	40	Fish plentiful, bedrock, log jam ideal hiding
2	2,646	.50	11.14	29,484	616	56	15.03	9,256	2,030	203	9.96	20,228	31:69	4	85	Big bank spawning gravel contains fish
3	6,879	1.3	11.88	81,699	1,955	59	13.11	25,633	4,969	138	11.28	56,066	31:69	+5	78	Deepest pool island has evidence of hi flow
4	2,382	.45	13.23	31,522	2,744	171	4.57	12,533	1,468	98	12.94	18,989	40:60	+5	0	Big boulders cutting of bank, fallen tree
5	7,058	1.34	11.16	73,025	2,064	25	12.54	25,877	4,994	92	9.44	47,148	36:66	5	10	Culvert here, channel is bedrock
6	5,212	.99	9.16	47,734	1,155	32	9.25	10,687	4,057	94	9.13	37,047	22:78	4	50	Culvert - extensive bank erosion rocks in water
7	3,357	.64	9.88	33,152	1,016	23	10.40	10,562	2,341	50	9.65	22,590	32:68	6	12	Large boulders
8	1,383	.26	7.62	10,542	293	37	9.85	2,887	1,090	121	7.02	7,655	27:73	+3	0	Bedrock channel creates small water fall
T.	34,037	6.4		366,896	11,141			114,967	24,771			253,468	31:69		275	

LOWER NORTH FORK JOHN DAY HABITAT ANADROMOUS FISH SURVEY, 1985.

BULL CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	5,361	1.02	3.91	20,956	389	13	6.22	2,421	4,972	151	3.73	18,535	12:88	4		Few fish, few pools-open meadow area, rocky channel bot.
T.	5,361	1.02		20,956	389			2,421	4,972			18,535	12:88			Few fish, few pools-open meadow area, rocky channel bot.

PORTER CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	322	.06	14.1	4,541	70	14	24.16	1,691	252	50	11.31	2,850	37:63	5	0	Steep chan. bot. boulders, falls barriers 7-10'
2	1,699	.32	4.46	8,064	386	24	9.19	3,549	1,313	82	3.44	4,515	44:56	3	0	Fish above sect. where water flows underground
T.	2,021	.38		12,605	456			5,240	1,565			7,365	41:59		0	

LITTLE WALL CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,231	.61	8.8	28,378	571	22.8	8.6	4,917	2,660	85.8	8.9	23,461	17:82	3-4	0	Many boulders, narrow canyon at end of reach
2	1,604	.30	7.7	12,296	607	30.3	10.4	6,322	997	41.5	6.0	5,974	51:49	3	0	3' deep hole near large boulders
3	4,775	.90	9.0	42,780	1,631	25.8	10.4	17,040	3,144	49.1	8.1	25,740	40:60	4	24	Alternating of cover, lots of shrubs, sedge
4	3,288	.62	5.5	18,052	1,909	53.0	3.4	6,554	1,379	47.6	8.3	11,498	36:64	4	0	Lots of 4% gradient, good poold, large boulders
5	829	.16	14.4	11,958	189	21.0	11.5	2,167	640	58.2	15.2	9,791	18:82	2	0	
6	4,647	.88	11.5	53,388	1,145	26.6	12.1	13,883	3,502	68.7	11.3	39,505	26:74	2-4	0	Bedrock bottom, narrow chute at the top
7	3,971	.75	1.8	7,245	2,050	89.1	1.2	2,394	1,921	96.0	2.5	4,851	33:67	3	0	Mostly underground flow, fed by unnamed spring
8	4,098	.78	3.0	12,410	1,622	62.3	1.3	2,225	2,476	124.0	4.1	10,185	17:82	3	6	Little water, stagnant
T.	26,443	5.0		186,507	9,724			55,502	16,719			131,005	30:70		30	

SKOOKUM CK.

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	935	.18	4.76	4,455	190	12	5.3	1,025	745	46	4.6	3,430	23:77	2	0	Shallow, 2 deep holes, fair amount of jam debris
2	1,244	.24	3.12	7,102	251	17	5.3	1,346	993	71	5.8	5,756	19:81	2	0	Shallow w/few 1' deep holes, 6" fish, jam debris
3	2,901	.55	14.67	14,539	550	34	5.2	2,870	2,351	145	4.9	11,669	20:80	1	0	Lower half is open area, debris, cranefish
4	350	.07	6.27	2,195	70	18	7	495	280	56	6	1,700	22:77	1	0	Douglas dominant, lots grass, fence parallel ck.
5	1,645	.31	8.09	13,305	410	34	5.9	2,415	1,235	112	8.8	10,890	18:82	1	0	Shallow, lots of 8" fish, bank cutting, grass
6	1,053	.20	9.02	9,496	260	20	8.1	2,120	793	66	9.3	7,376	22:78	1	0	Shallow, lots grass, some debris
7	2,641	.50	9.91	26,173	900	30	9.4	8,475	1,741	58	10.1	17,698	32:68	1	0	2' high bank cutting, lots grass, fence east
8	908	.17	8.58	7,791	331	27.5	9.7	3,226	577	48	7.9	4,565	41:59	1	0	Next to canyon, canyon getting narrower
9	1,836	.35	9.45	17,352	446	29.7	8.9	3,972	1,390	92.6	9.6	13,380	23:77	1	0	1" fish, lots of dry streambed, debris log jams
10	945	.18	10.11	9,552	396	33	10.4	4,148	549	49.9	9.8	5,404	43:56	1	0	Large logs across ck., some debris
11	1,319	.25	9.51	11,495	455	28.4	8.9	4,070	864	54	8.6	7,425	35:65	1	0	Ck. next to canyon west slope, some bank cutting
12	2,176	.41	9.29	20,205	846	52.8	10.1	8,580	1,330	83.1	8.7	11,625	42:57	1	0	Lot debris w/7 big log jams, wide stream bed
13	1,668	.32	9.94	16,580	296	26.9	10.9	3,230	1,372	124.7	9.7	13,350	19:80	1	0	Lot of 1" fish, lot of creek bed, less debris
14	1,536	.29	10.92	16,775	466	33.2	11.1	5,215	1,070	71.3	10.8	11,560	31:69	1	0	Canyon beds are dry, banks good shape, debris
15	1,054	.20	10.62	10,892	259	23.5	9.2	2,382	795	66.2	10.7	8,510	22:77	1	0	Lots debris, lot creek bed, 6-10" fish
16	1,217	.23	3.94	4,793	302	10.0	4.2	1,288	915	29.5	3.08	3,505	27:73	1	0	Lots debris, shallow, some fish, good banks
17	1,897	.36	3.24	6,305	264	8.8	3.7	983	1,633	54.4	3.2	5,322	16:84	2	0	Shallow, few fish, lot debris in lower half
18	465	.09	3.20	1,486	164	16.4	3.7	614	301	33.4	2.9	872	41:59	2	0	Rear is shallow, 1" fish, fair amount debris
19	1,754	.33	2.2	5,394	231	6.4	3.0	690	1,523	351	3.0	4,659	13:87	3	0	Blockage by roadbed, meadow-type veg.
20	3,138	.59	2.3	7,324	500	8	3.2	1,613	2,638	43	2.2	5,711	22:78	4	0	Meadow type to forest type, culvert barrier
21	1,098	.20	3.1	3,434	167	12	4.0	652	931	62	3.0	2,782	19:81	3	6	Channel overgrown marshy, logs could impede pass
22	970	.18	4.15	4,023	221	15	5.5	1,210	749	50	3.7	2,813	30:70	4	6	Large increase of debri causing halt of fish
23	656	.12	4.02	2,638	222	17	5.3	1,188	434	33	3.3	1,450	45:55	8	30	Large amount of debri; narrow canyon trees to
24	2,789	.53	8.80	24,495	324	36	10	3,170	2,465	247	8.6	21,325	13:87	3	0	Some boulders, patches of gravel, woody debris
25	3,010	.57	9.79	25,260	655	66	4.4	2,885	2,355	236	9.5	22,375	11:89	7	0	Swale Ck. runs into Skookum
26	2,369	.44	8.23	20,978	196	15	9.0	1,763	2,173	155	8.8	19,215	08:92	3	0	Bedrock, good flow, falls at pool #27
27	1,795	.34	2.94	14,102	357	22	9.3	3,327	1,438	76	7.5	10,775	24:76	5	0	Constricts around bedrock, boulders block pass
28	2,270	.43	9.26	21,022	417	20	9.3	3,880	1,853	77	9.2	17,142	18:82	4	0	Steeper gradient, falls, boulders, major barrier
29	1,025	.19	7.76	8,110	180	30	11.0	1,972	845	106	7.3	6,138	24:76	2	0	Decrease gradient, boulders end, channel widens
30	1,731	.33	7.64	30,301	339	23	8.3	2,830	1,392	19.7	19.7	27,471	9:91	3	21	Boulders occur, veg. change, lose sedge, narrow
31	372	.07	7.96	2,363	37	19	7.6	283	335	168	12.3	2,080	12:88	3	0	Mass wasting of bank, boulders, spotty sedges
T.	48,767	9.24	7.2	369,890	10,702	24	676	81,917	38,065	93.0	9.0	287,973	22:78		63	

SWALE CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,886	.36	8.41	15,818	329	24	11	3,740	1,557	11.1	8	12,078	24:76	4	45	Lots willows, big boulders & trees
2	1,670	.32	8.64	14,425	355	30	10	3,590	1,315	101	8	10,835	25:75	5	0	Shrubs thinned
3	2,082	.39	5.46	12,622	327	20	9	2,922	1,755	110	6	9,700	23:77	4	65	Increase of debris in Little Bear & Swale Ck.
4	1,018	.19	5.39	5,490	158	14	8	1,340	860	61	5	4,150	24:76	5	0	
5	1,544	.29	6.41	9,896	126	11	10	1,313	1,418	109	6	8,583	13:87	4	0	Small cobbles w/big cobbe in middle of ck.
6	1,580	.30	5.89	11,424	227	17	8	1,744	1,353	104	7	9,680	15:85	5	0	Increased debris, log jams frequent
7	1,536	.29	6.83	10,484	296	17	7	2,149	1,240	73	7	8,335	21:80	4	0	Large boulders creating nice pools & falls
8	2,456	.47	6.01	14,749	224	14	7	1,564	2,232	140	6	13,185	11:89	7	0	Steep canyon, over hanging shrubs
9	2,182	.41	5.92	12,922	242	13	8	1,880	1,940	97	6	11,042	15:85	6	0	Meets Rd. 2110, heavy debris, tree growth
10	2,328	.44	6.62	15,411	259	14	10	2,568	2,069	99	6	12,843	17:83	7	0	Large rock capped hill to east, willow dominance
11	2,649	.50	6.35	17,215	231	14	10	2,316	2,418	134	6	14,899	13:87	9	0	Mixed stretches of flatter areas
12	2,428	.46	7.47	18,134	283	13	10	2,833	2,145	93	7	15,301	16:84	15	0	Drainage from west, huge boulders create falls
13	2,420	.46	5.91	14,305	20	10	5	100	2,400	240	6	14,205	01:99	5	0	Drainage on west bank, bottom channel widened
14	2,911	.55	3.98	11,577	35	7	4	123	2,876	180	4	11,454	01:99	2-3	0	Stream meanders thru "dry meadow"
15	3,479	.66	3.17	11,044	110	12	6	701	3,369	187	3	10,343	06:94	2	0	Stream w/good overhang of sadges & grasses
16	5,881	1.11	4.03	23,786	128	6	4	555	5,753	164	4	23,231	02:98	3	0	Flows over roadbed rock, culverts barriers
17	980	.19	4.85	3,780				-	980	490	4	3,780	0:100	2	0	Crisscrossed w/lodgepole, serious barrier
18	4,720	.89	3.68	17,318	540	17	5	2,568	4,180	131	4	14,750	15:85	.5-1	0	Bank cutting, major briad, 1/2% gradient
19	4,146	.79	4.48	17,455	683	18	5	3,203	3,463	94	4	14,252	18:82	.5-1	0	4' bank cutting and mass wasting, clay & milky
	47,896	9.1		257,855	4,573			35,209	43,323			222,646	14:86		110	

LITTLE BEAR CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,724	.33	4.21	7,259	136	10	7.50	1,020	1,588	106	3.93	6,239	14:86	6	0	Few fish, stagnant shallow pools
2	1,176	.22	4.14	4,465	105	12	8.02	842	1,071	134	3.38	3,623	17:74	6	0	Flow seems to come from spring on east side
T.	2,900	.55		11,724	241			1,862	2,659			9,862	15:85		0	

ALDER & EAST ALDER

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,715	.32	3.03	5,202	742	46.3	3.3	2,496	973	60.8	2.7	2,706	48:52	1	0	Culvert 3' high 35' long - creek crosses.
2	1,791	.34	3.55	6,360	791	24.7	4.2	3,340	1,000	31.2	3.0	3,020	52:47	1	0	Slope on side hills beg. to steep.
3	1,993	.38	5.46	10,881	478	18.3	6.2	2,986	1,515	56.1	5.2	7,895	27:72	M	0	Canyon, cast banks, slopes steep.
4	1,874	.35	8.11	8,277	386	14.3	4.9	1,914	1,488	53.1	4.2	6,363	23:77	2	0	Alder & Skookum Creeks cross, same size.
5	1,207	.23	5.37	6,486	384	23	7.34	2,820	823	41	4.45	3,666	43:57	2	94	Log creates pool possible barrier to fish.
6	4,469	.85	4.63	20,704	740	21	6.55	4,848	3,729	104	4.25	15,856	23:77	3	0	Alder shaded, culvert w/3 ft. drop barrier
7	1,416	.27	3.02	4,271	325	9	3.79	1,233	1,091	29	2.78	3,038	29:71	2-3	0	Few fish barriers 20' apart culvert collapsed
8	1,485	.28	2.75	4,080	220	8	3.24	713	1,265	45	2.66	3,367	17:83	2-3	0	No fish survey discontinued
T.	15,950	3.02	4.5	66,261	4,066	164.6	5.0	20,350	11,884	52.5	3.86	45,911	12:88		94	

HOG CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,325	.44	4.30	10,005	151	15.10	7.17	1,082	2,174	181.17	4.10	8,923	11:89	6	0	Reach on side of fence separating Hog & Skookum
2	1,873	.35	5.15	9,646	58	11.60	6.43	373	1,815	363	5.11	9,273	03:96	9	0	Logs w/stacked rocks creating 3' wall
T.	4,198	.80		19,651	209			1,455	3,989			18,196	07:93		0	

BACON

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,276	.62	3.6	11,830	315	12	5.27	1,659	2,961	110	3.44	10,171	14:86	3	0	Pools formed by log jams, bedrock & boulders
2	2,082	.39	2.22	4,632	167	9	4.36	728	1,915	96	2.04	3,904	16:84	5	0	Numerous boulders, small steelhead & crayfish
2A	4,337	.82	3.51	15,205	515	17	5.01	2,578	3,822	123	3.30	12,627	17:83	6	150	Begin. w/gravel bar in small pond grad. increase
3	204	.04	3.86	787	50	17	5.9	295	154	51	3.19	492	37:63	4	0	Starts w/meadow type ends w/increased gradient
4	2,161	.41	2.11	4,554	90	15	5.9	531	2,071	207	1.94	4,023	12:88	4	0	Deep channel, bank of soil & exposed roots
T.	12,060	2.3		37,008	1,137			5,791	10,923			31,217			150	

THREE TROUGH

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,383	.45	5.17	12,328	283	18	7.06	1,998	2,100	124	4.92	10,330	16:19	4	0	
T.	2,383	.45		12,328	283			1,998	2,100			10,330	16:19		0	

DITCH CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,329	.25	7.8	10,319	219	16.8	9.7	2,114	1,110	79.2	7.4	8,205	80:20	+4	0	Riparian used by animals, loose soil
2	3,229	.61	6.6	21,178	529	17.6	9.5	5,013	2,700	84.4	6.0	16,165	24:76	6	0	Coverage on side slopes, large debris throughout
3	2,246	.43	7.6	17,162	386	20.3	9.4	3,627	1,860	93.0	7.6	13,535	21:79	4	0	Decreased steepness, less debris, wider riparian
4	1,935	.37	6.0	11,585	135	19.2	6.9	930	1,800	257.1	5.9	10,655	08:92	3	0	Level stream, less debri, more grassy bench
5	3,175	.60	5.8	18,357	280	15.5	7.8	2,182	2,895	152.4	5.6	16,175	12:88	3	0	Available boulders for const., large water flow
6	2,028	.38	5.1	10,348	33	11.0	5.5	183	1,995	399.0	5.0	10,165	01:98	1-2	0	Poor bottom, flat, few pools, needs work
7	3,786	.72	5.6	21,454	211	11.7	7.6	1,599	3,575	143.0	5.5	19,855	07:93	2	0	Begins at end of flat meadow
8	4,347	.82	4.5	19,545	376	9.0	6.4	2,396	3,971	88.2	4.3	17,149	12:88	3	0	Narrow canyon walls, steep slopes, bedrock
9	1,669	.32	4.8	8,085	155	10.3	5.8	907	1,514	94.6	4.7	7,178	11:89	2	300	Boulders, jams with bralds, falls
10	4,157	.78	6.6	22,338	1,200	42.9	3.2	3,857	2,957	98.5	6.2	18,481	17:83	5	0	Bedrock walls at start, wider at bottom
11	1,898	.36	7.6	14,397	93	15.5	8.2	762	1,805	225.6	7.5	13,635	05:95	8	0	Boulders scattered on bottom, increased gradient
12	8,527	1.61	4.6	37,378	894	27.0	6.4	5,752	7,633	272.6	4.1	31,626	15:85	3	0	Canyon opens into meadow, dece thick in bottom
13	9,792	1.85	4.7	45,803	578	18.0	6.5	3,762	9,214	236.2	4.5	42,041	08:91	4	0	Meadows with tall, thick grass, higher banks
14	3,241	.61	4.1	13,545	366	12.2	6.2	2,265	2,875	130.7	3.9	11,280	17:83	.5-1	0	Meanders through meadow, slow water, some bluish
15	448	.08	2.3	1,016	118	7.3	3.0	356	330	55.0	2.0	660	35:65	.5-1	0	Mostly dry, deep holes have water, blue, murky
T.	51,807	9.81		272,510	5,573			35,705	46,234			236,805	13:87		300	

MARTIN CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,051	0.58	3.18	9,697	127	15.88	30.98	3,934	2,924	209	1.98	5,763	40:59	1	0	Outlet at superpond inadequate, no outflow
T.	3,051	0.58		9,697	127			3,934	2,924			5,763	40:59		0	Outlet at superpond inadequate, no outflow

MALLORY CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	4,418	.84	3.52	15,545	388	9	6.00	2,327	4,030	92	3.28	13,218	15:85	3-5+	0	Reach begins @ F.S. boundary gradient 40%+
2	3,286	.62	3.12	10,238	361	8	5.67	2,047	2,925	71	2.80	8,191	20:80	3-5	0	Cascades prevent fish passage large boulders
3	477	.09	3.30	1,576	27	7	6.15	166	450	90	3.13	1,410	11:89	3	0	Boulders - impossible to get machinery in
4	563	.11	3.66	2,061	77	7	7.06	544	486	44	3.12	1,517	26:74	5	0	Majority of reach is on bedrock
5	968	.18	4.81	4,657	43	6	5.40	232	925	132	4.78	4,425	20:01	2	0	Reach begins where large boulders begin
6	1,093	.21	3.13	3,421	276	46	.60	165	817	136	3.99	3,256	21:01	2	0	Accessible w/equipment, needs pools
7	1,806	.34	4.26	7,700	106	12	12.08	1,280	1,700	142	3.78	6,420	17:83	1	0	Mass waste of banks, brown trout, rainbows
8	3,141	.59	4.48	14,071	181	12	24.67	4,466	2,960	211	3.24	9,605	32:68	2	0	Reach ends south of Goshen Cabin
T.	15,752	2.98		59,269	1,459			11,227	14,293			48,042	19:81		0	

POTAMUS CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	AVE. (FT.)	AVE. WIDTH (FT.)	SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,955	.37	8.2	15,946	425	16.3	10.3	4,398	1,530	56.7	7.5	11,548	28:72	10	0	Steep & rocky with several waterfalls
2	3,189	.60	7.7	24,398	397	17.3	23.0	9,131	2,792	111.7	5.5	15,267	37:63	8	0	Leveling out, canyon narrows
3	2,815	.53	7.4	20,808	200	18.2	10.5	2,103	2,615	261.5	7.2	18,705	10:90	4	0	Number of pools drastically reduced
4	500	.09	10.0	5,000	0			0	500	500	10.0	5,000	0:100	1-2	0	Debris piling up @ mouth of culvert, bar forma.
5	1,970	.37	7.2	14,240	30	15.0	6.7	200	1,940	485	7.2	14,040	1:99	2	0	Needs work - good access off 2105
6	3,524	.67	5.9	20,800	152	11.7	7.2	1,088	3,372	198.4	5.8	19,712	5:95	3	0	Banks need work not many pools
7	4,264	.81	4.9	20,960	76	7.6	9.3	708	4,188	322.2	4.8	20,252	3:97	2	0	Too few pools falls are barrier for fish passage
8	1,376	.26	5.1	7,071	41	8.2	5.4	221	1,335	222.5	5.1	6,850	3:97	3	0	2 seeps putting out water into creek
9	1,973	.37	6.4	12,660	123	30.8	33.7	4,140	1,850	308.3	4.6	8,520	33:67	1	0	Mass wasting common & sloughing too
10	2,357	.45	5.0	11,863	277	19.8	12.2	3,373	2,080	138.7	4.1	8,490	28:72	1	0	Superpond
11	434	.08	3.3	1,437	15	5.0	.21	70	419	104.8	3.3	1,367	05:95	3	0	Meadow type, narrow channel, steep walls
12	1,817	.34	4.0	7,222	104	6.9	.15	714	1,713	142.8	3.8	6,508	10:90	2	60	Partly stable log jams, dams need work, check
13	1,899	.36	3.2	6,097	267	5.2	.19	1,408	1,632	102	2.9	4,689	23:77	1	0	Large loops, numerous rainbow, deep slow water
14	961	.18	2.6	2,536	26	3.7	.27	96	935	187	2.6	2,440	03:96	.5	0	No definite channels, marshy, culverts
T.	29,034	5.48		171,038	2,133			27,650	26,901			143,388	16:84		60	

LOWER NORTH FORK JOHN DAY HABITAT ANADROMOUS FISH SURVEY, 1985.

ELLIS CREEK

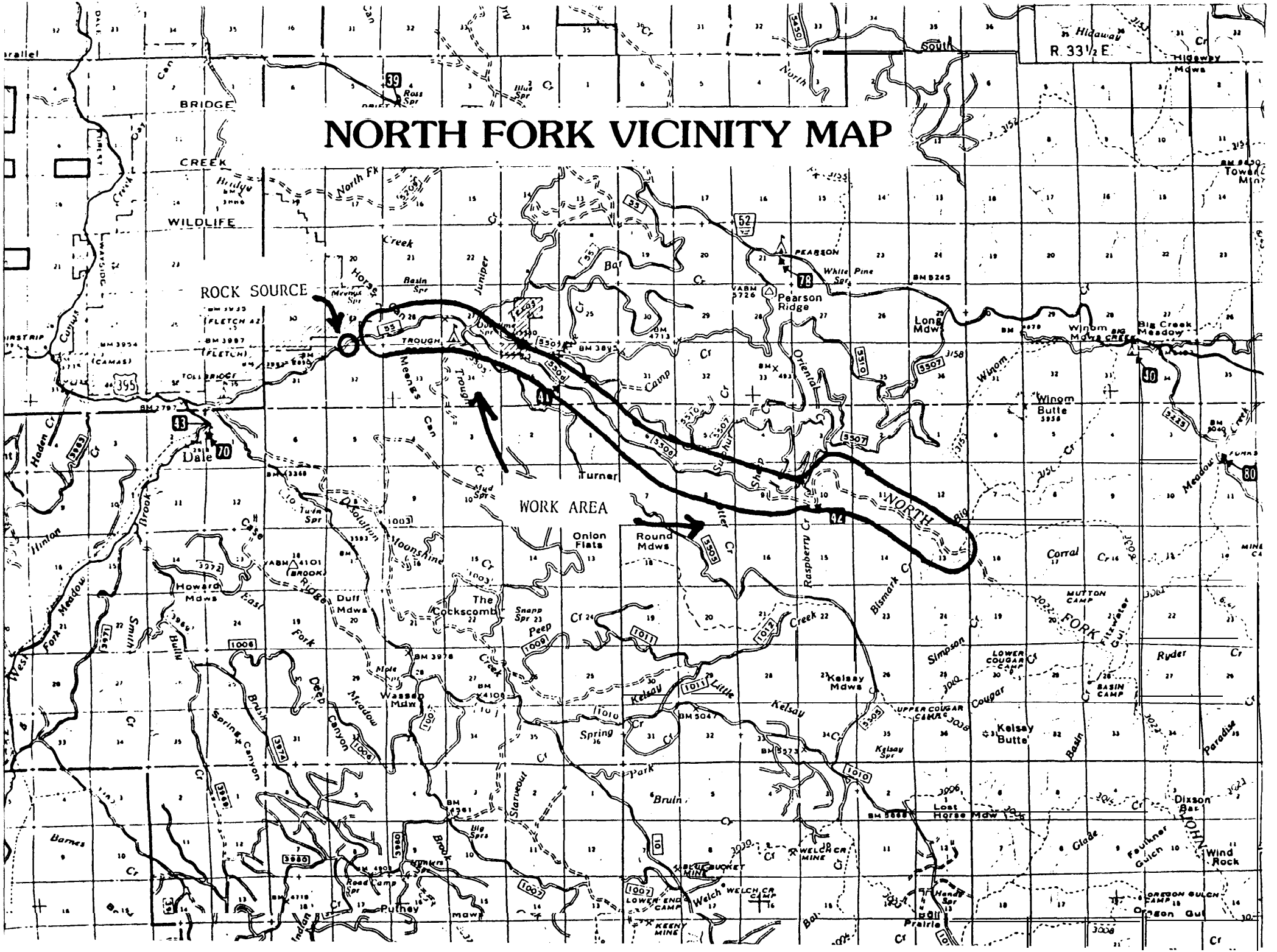
REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	4,036	.76	7.2	29,160	548	16.6	6.0	3,337	3,488	96.9	7.4	25,823	11:89	12	0	Large pools & boulders, waterfalls
2	2,998	.57	5.2	15,600	218	11.5	11.9	2,595	2,780	174.0	4.7	13,005	17:83	5	0	Starts above deep canyon, widened bottom
3	2,293	.43	4.7	10,746	73	10.4	4.5	331	2,220	246.6	4.7	10,415	03:97	1-2	0	Culvert N. side Rd. 2105, channel unstable
4	4,625	.88	3.0	13,978	161	7.6	4.0	654	4,464	148.8	3.0	13,324	04:95	2	0	Underground flow, steep upper banks, seeps
T.	13,952	2.6		69,484	1,000			6,917	12,952			62,567	10:90			

POLE CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,714	.70	3.63	13,472	182	12.13	5.32	969	3,532	177	3.54	12,503	07:09	4	0	Reach in Potamus in meadow with aspen stand
2	4,601	.87	2.72	12,527	186	11.63	5.36	997	4,415	597	2.61	11,530	08:92	7	0	Reach at drainage on E. side, sporadic flow
3	1,030	.20	4.93	5,081	134	12.18	6.04	810	896	69	4.77	4,271	16:84	4	0	Reach in timbered area, eroded banks (12' high)
T.	9,345	1.77		31,080	502			2,776	8,843			28,304	09:91			

Appendix C: Project Location Maps

NORTH FORK VICINITY MAP



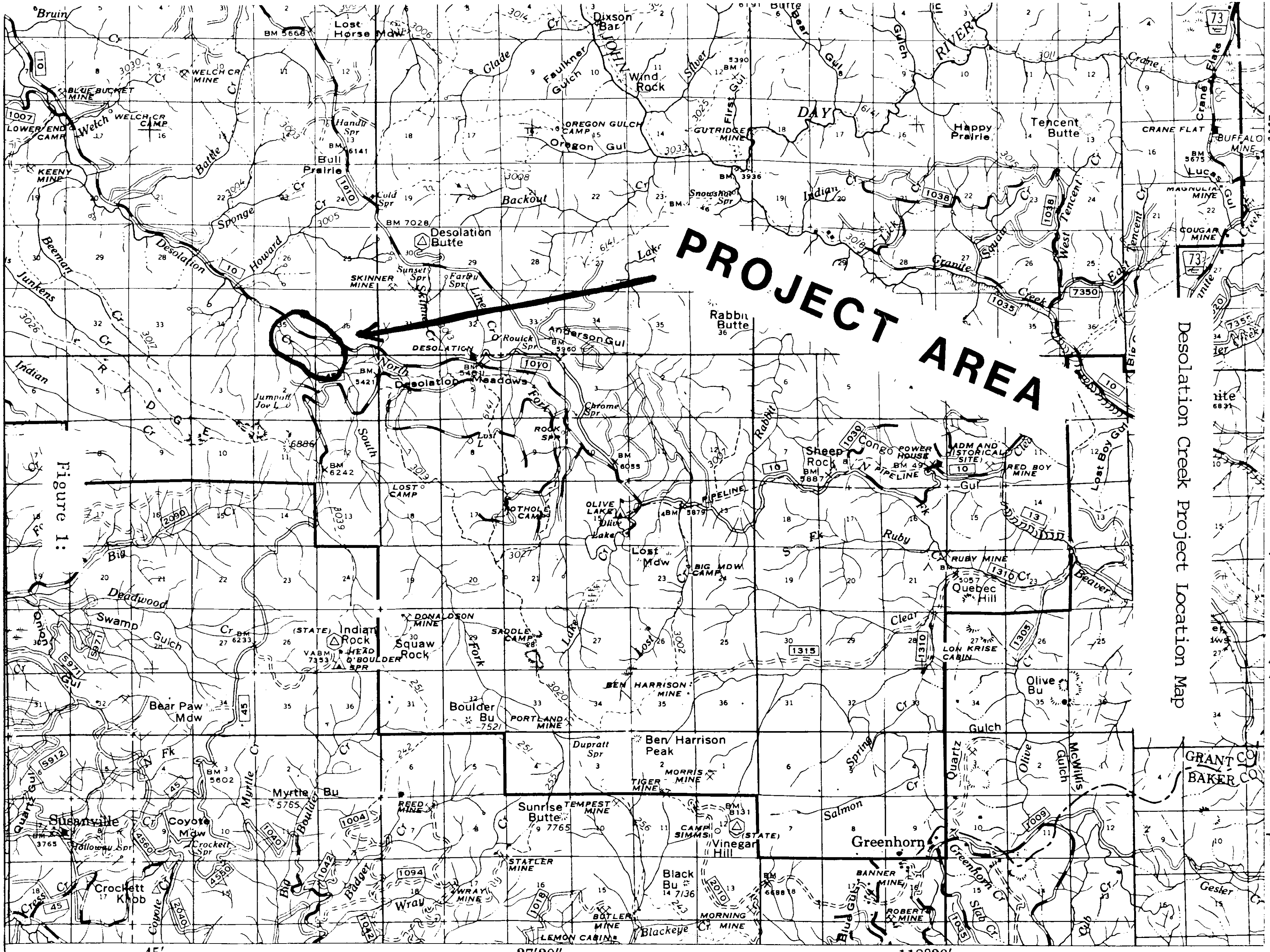
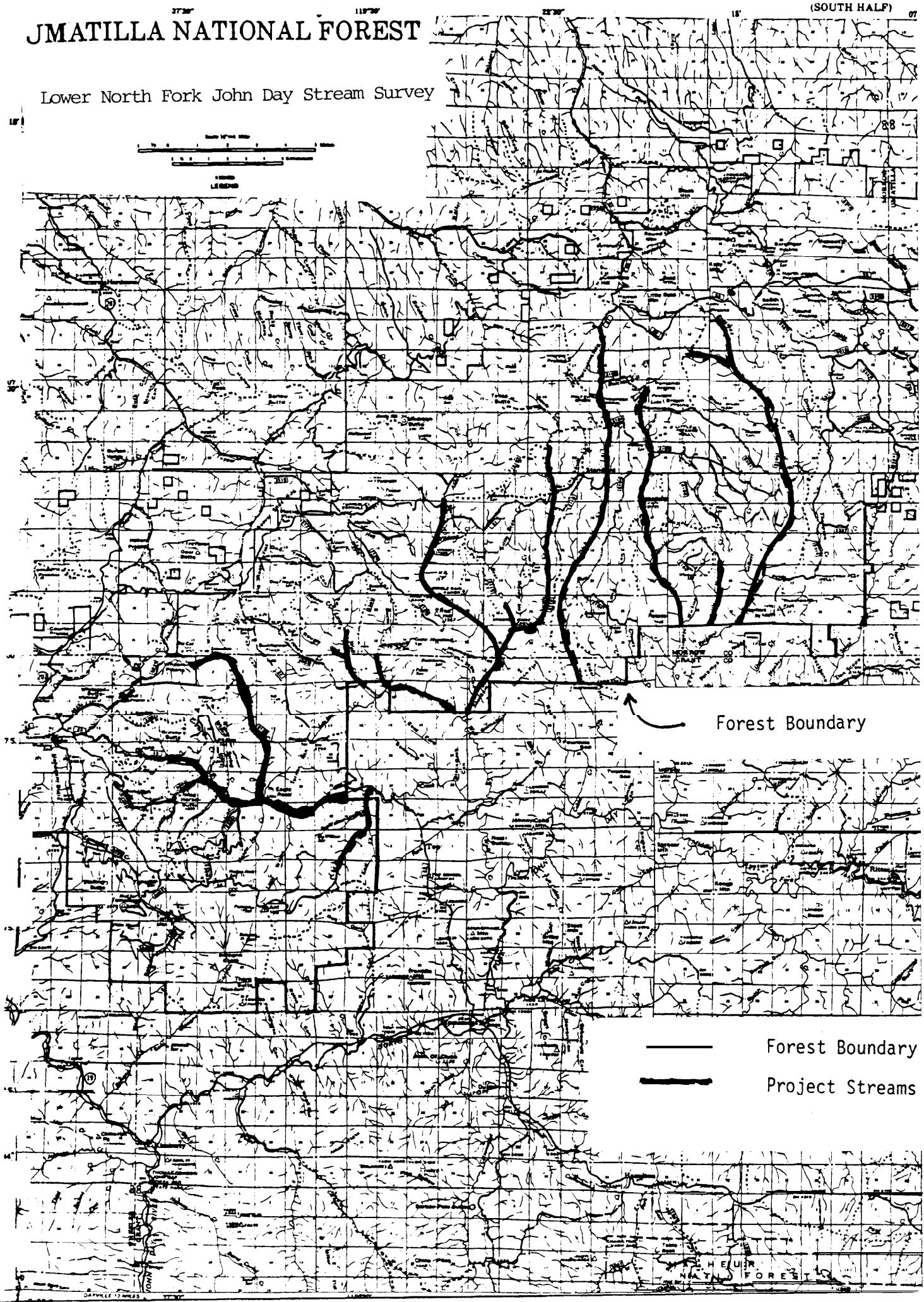


Figure 1: Desolation Creek Project Location Map

JMATILLA NATIONAL FOREST

Lower North Fork John Day Stream Survey



FINAL REPORT TO THE
BONNEVILLE POWER ADMINISTRATION (BPA)

USDA - Forest Service
Malheur National Forest
139 NE Dayton Street
John Day, Oregon 97845

Upper Mainstem John Day River Habitat Improvement Project 84-22

CONTRACT NUMBER DE-AI79-85BP16064

Prepared by: Richard Gritz
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Approved by: Kenneth L. Evans
Kenneth L. Evans
Forest Supervisor

SUMMARY

During the summer of 1985, 40 single log weirs and 67 boulders were placed by the USDA - Forest Service, Malheur National Forest. These structures were placed along 2 miles of the upper John Day River and 1 mile of Roberts Creek (map attached). A total of 30 log weirs and 67 boulders were placed in the John Day River from Trout Farm Campground up to Crescent Campground. Ten weirs were installed in Roberts Creek in the lower 1 mile of the stream within the Forest boundary. Total project cost was $28,000. This is about 10 percent under the estimated cost in the work statement.

Some additional opportunities still exist for more work in these streams. On National Forest lands, the remaining work can be completed with K-V funding, over time. Additional opportunities also exist for habitat improvement in stream reaches on intermingled sections of privately owned (Crown Zellerbach) land. It may be possible to coordinate this work with future K-V projects on the Forest.

In related work, the USDA - Forest Service spent about $1,800 to correct a fish passage problem for Steelhead on Hall Creek and about $1,100 for maintenance of existing habitat improvement structures. This work was accomplished with Forest Service funding.

The primary objective of this project was to increase the quantity and improve the quality of pool habitat in these streams, thereby increasing the juvenile rearing capacity for summer Steelhead trout. Side benefits include spawning gravels collected above and below the weirs. Rearing habitat for resident trout is also improved.

Log weirs create high quality, self cleaning pools which are ideal for rearing juvenile Steelhead. Cover is provided by the log itself, and by the surface turbulence created by water spilling over the log. By careful site selection, we were also able to take advantage of streamside cover, such as overhanging shrubs to improve the quality of the resulting pool habitat at many sites.

At sites where log weir construction was not feasible, large boulders were placed in the stream to create scour pools with cover. Boulders do not provide as much pool habitat as log weirs on a per structure basis, but they greatly increase the amount of stream that can be treated, thus making it possible to achieve better overall habitat conditions in more of the stream. These boulder placements are also very natural in appearance.

DESCRIPTION OF PROJECT AREA

This is an area of mixed ownership. Within the external boundaries of the Malheur National Forest, about 50 percent of the Steelhead habitat is on National Forest lands. Forest and ODFW surveys have shown that the low quantity and quality of pool habitat are limiting rearing potential for

juvenile salmonids in this area. The estimated number of Steelhead spawning annually on Forest within the project area is 87. Chinook spawning extends about 3 miles inside the Forest boundary in the mainstem, but within this area, only about l/2 mile of the river is on National Forest land. The remainder of the area is in private ownership. Therefore, steelhead trout was the primary target species for this project. Lesser benefits would also apply to rearing chinook salmon fry, but these were not included in the calculations of PNV and benefit/cost.

DESCRIPTION OF ACTIVITIES

The project required two contracts: 1) hauling of riprap and boulders - this included development of a rock source, preparation, loading and hauling of riprap and boulders to the project sites; 2) equipment rental with operator - a backhoe with operator installed log weirs and placed boulders at selected sites in the project area. A Forest Service crew assisted the backhoe with the construction portion of the project. Trees for the log weirs were felled near the project sites and moved to the sites with the backhoe. Sites were selected beforehand, using a combination of hydrologic and fisheries criteria. All disturbed areas were seeded for erosion control.

ECONOMIC ANALYSIS

Project costs:

a. Salaries	$8,625
b. Travel and Transportation	990
c. Equipment and Materials	4,060
d. Contracts	
Riprap and Boulders	5,363
Equipment Rental	6,262
subtotal	25,300
e. General Administration @ 10.7%	2,700
Total	$28,000

Project Benefits:

a. It is estimated that this project increased pool habitat by 17,340 square feet and will result in an increased annual Steelhead smolt production of about 1,150 (Table 1). These are based on Steelhead production and smolt habitat capability indices developed cooperatively with ODFW and the Malheur National Forest.

b. Annual adult Steelhead production is estimated to increase by 23. This is estimated to result in 8 additional Steelhead escaping to spawn on the Forest annually.*

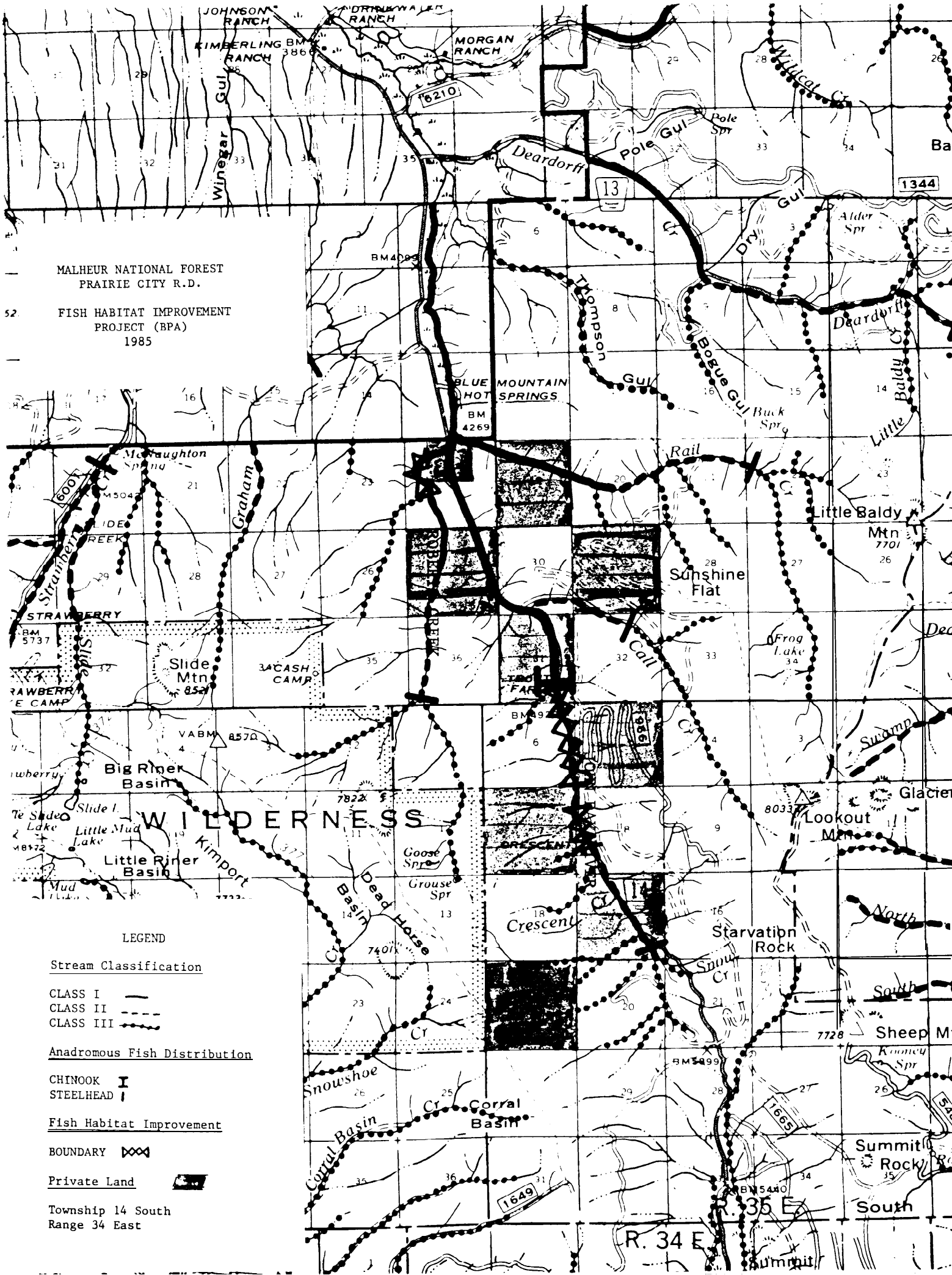
c. Total estimated annual Steelhead benefit is $2,872. For a project life of 30 years, discounted at 4 percent, the PNV for this project is calculated to be $8,876. The benefit/cost ratio is calculated to be 1.32/l.**

* Based on survival coefficients agreed on for Forest planning for east-side Oregon Forests.

** Based on figures for escaping Columbia River Steelhead trout in "Net Economic Values for Salmon and Steelhead from the Columbia River System," by Philip A Meyer, NOAA Tech. Memo, NMFS F/NWR-3, 1982.

TABLE 1

Miles of Stream Improved	3
No. Weirs Constructed	40
Area Pool Created/Weir	400 sq.ft.
Total Area Pool Created with Weirs	16,000 sq.ft.
No. Boulders Placed	67
Area Pool Created/Boulder	20
Total Area Pool Created with Boulders	1,340
Total Area Pool Created with Project	17,340
Annual Estimated Smolt Cain with Project	1,156


MALHEUR NATIONAL FOREST
PRAIRIE CITY R.D.
FISH HABITAT IMPROVEMENT
PROJECT (BPA)
1985
JOHNSON RANCH
KIMBERLING RANCH
MORGAN RANCH
Winegar Gul
Deardorff
Pole Gul
Pole Spr
Wildcat Cr
Dry Gul
Alder Spr
Thompson Gul
Bogue Gul
Buck Spr
Little Baldy Cr
Little Baldy Mtn
BLUE MOUNTAIN HOT SPRINGS
BM 4269
Rail Cr
McLaughton Spring
Graham
Strawberry Cr
STRAWBERRY
Slide Mtn
CASH CAMP
Sunshine Flat
Call Cr
Frog Lake
Swamp
Big River Basin
WILDERNESS
Little Mud Lake
Little River Basin
Kimport
Goose Spr
Grouse Spr
Dead Horse Basin
Crescent
Starvation Rock
Snow Cr
Lookout Mtn
Glacier
North
South
Sheep Mt
Kooney Spr
Snowshoe Cr
Corral Basin
Summit Rock
R. 35 E.
R. 34 E.
LEGEND
Stream Classification
CLASS I
CLASS II
CLASS III
Anadromous Fish Distribution
CHINOOK
STEELHEAD
Fish Habitat Improvement
BOUNDARY
Private Land
Township 14 South
Range 34 East

Final Completion Report

To

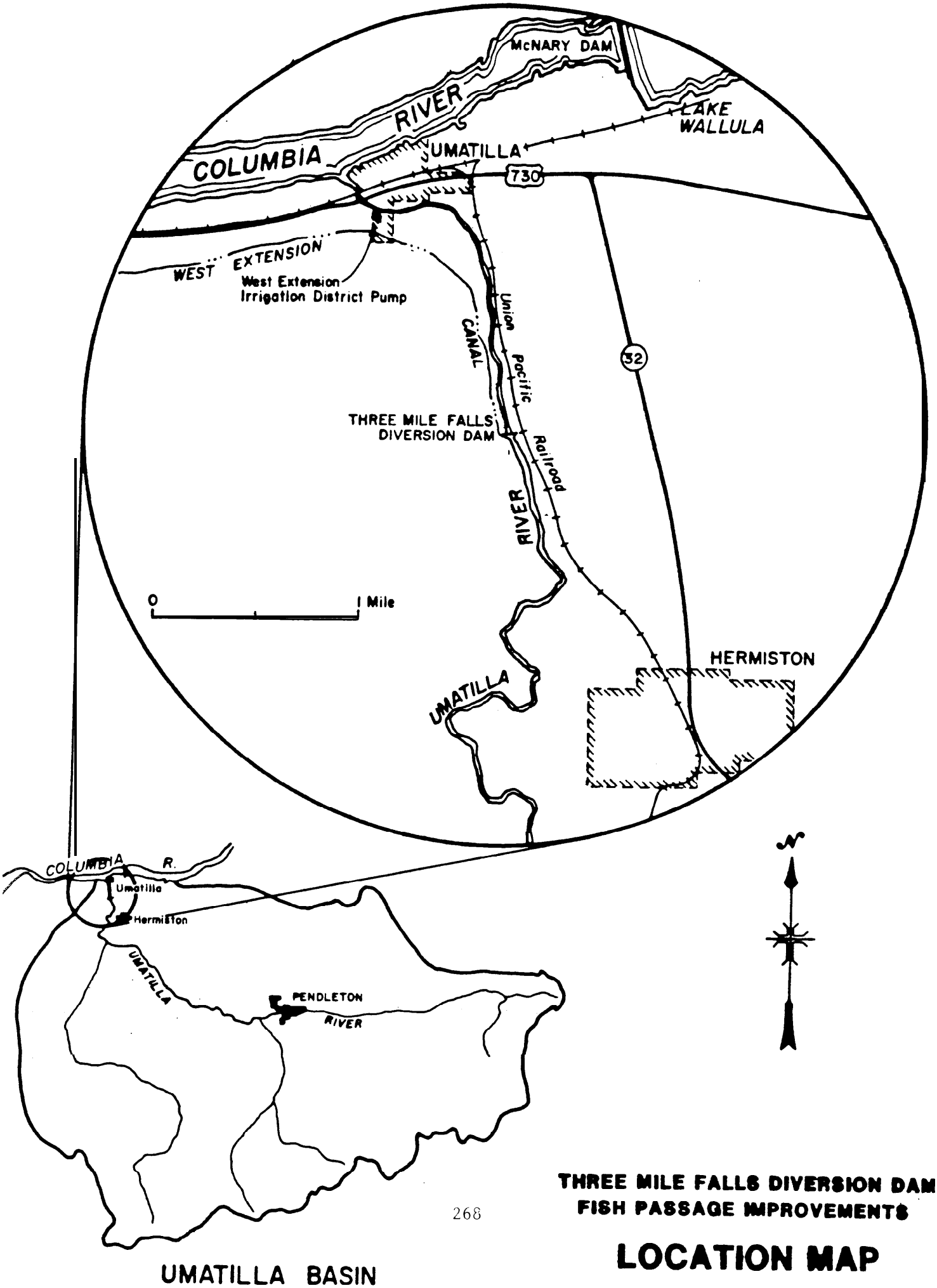
Bonneville Power Administration

FISH PASSAGE IMPROVEMENTS AT THREE MILE FALLS DIVERSION DAM, UMATILLA RIVER, OREGON

Project Number 83-436
Contract Number DE-AI79-85BP17463

Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

May 1985



UMATILLA BASIN

THREE MILE FALLS DIVERSION DAM
FISH PASSAGE IMPROVEMENTS

LOCATION MAP

SUMMARY

In June 1984 an interagency agreement between Bonneville Power Administration (BPA) and the Bureau of Reclamation was signed which directed Reclamation to (I) coordinate a thorough biological assessment of fish passage problems and needs at Three Mile Falls Diversion Dam, located on the lower Umatilla River, among the fishery agencies and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and (2) conduct a feasibility study of alternative plans to meet these needs.

This report contains the results and conclusions from the biological assessment and outlines several alternative plans for solving fish passage problems at the dam. A recommended plan, based on consensus of the fisheries agencies and the tribes, is described, and the rationale for that decision is discussed. Data needs for final designs, a tentative construction schedule, and a discussion of operation and maintenance needs are presented.

Historically, the Umatilla River produced large numbers of summer Steelhead and fall and spring chinook salmon. The construction of Three Mile Falls Diversion Dam, in combination with other upstream irrigation project development, eliminated all chinook salmon and-drastically reduced runs of summer Steelhead. Steelhead runs-have averaged less than 2,000 returning adults for the past 14 years.

The provision of improved fish passage facilities under existing flow levels would significantly reduce or eliminate losses of adult salmon and Steelhead below the dam and reduce delays in adult passage. The inclusion of trapping and counting facilities would permit the selection of adults for brood stock without severely delaying or excessive handling of fish, enhance the trapping of adults to be hauled to suitable spawning areas, and provide for total counts by species to and in the evaluation of all other fish enhancement projects. [This would be a valuable tool in the evaluation of program success and would allow proper crediting to ratepayers for projects accomplished under section 4(h) of Public Law 96-501.] Passage efficiency for juvenile fish would be improved.

Three Mile Falls Diversion Dam was constructed in 1914 by the Bureau of Reclamation as an integral part of the Umatilla Project. The dam is owned by Reclamation, with operation and maintenance responsibilities being handled primarily by the West Extension Irrigation District (WEID). The dam is a concrete buttress dam with a maximum height of 24 feet and a crest length of 915 feet.

Existing fish passage facilities include East Ladder, West Ladder, and. louver screen. The East Ladder was built during the initial construction in 1914. Additional weirs were constructed at the toe of the dam as part of the ladder in 1963. This ladder is an overflow weir type. It was taken out of service in 1964 by backfilling it with earth but was reopened in 1984. Successful passage of Steelhead has occurred when riverflows exceed 500 cubic feet per second (ft^3/s). Primary problems associated with the East Ladder include false attraction flows along the face of the dam just west of the ladder entrance, obstructions in the channel below the entrance to the ladder, and sedimentation along the upstream face of the dam near the exit (upstream end) of the ladder. Also, the ladder does not contain trapping, holding, or

counting facilities. No additional attraction water is provided to the ladder entrance.

The West Ladder on the left abutment of the dam Is a vertical slot-type structure which was completed in August 1964. It has twenty-one 8-foot by 10-foot rectangular concrete pools. The floor slopes and the slots in the pools extend to the floor. The ladder is operated during periods of upstream anadromous fish migrations and uses about 20 to 40 ft^3/s for ladder operation depending upon forebay depths. When there is a difference of 20 feet between the forebay and tailwater, the ladder will operate with about l-foot difference in water level between pools. A l&inch-diameter pipe routes water from inside the upper pool through a diffuser in the lower pool to provide about 15 ft^3/s of additional attraction flows for adult anadromous fish.

The ladder is not designed for trapping, counting, and holding of adult anadromous fish. An electronic counter operated at the head of the West Ladder for several years but has not been used recently. This counter was difficult to calibrate and gave inconsistent results. Consequently, a temporary conduit fyke-type trap is used in the upper four pools of the ladder for annual counting of summer Steelhead. The pools are then partially dewatered, and the fish are individually dip-netted, counted, and passed over the dam. Steelhead brood stock selection (for the juvenile supplemental outplanting program) also occurs in this manner. Downstream juvenile migrants are passed either over the crest of the dam or through a bypass pipe that collects those fish which have been screened from the canal entrance.

The louver is mounted at the intake of the WEID Canal at the left abutment of the dam. It is approximately 30 feet long and consists of a series of fixed metal slats spaced about 1 to 2 inches apart. It prevents most Steelhead smolts from entering the canal and directs them to the entrance of the bypass pipe.

During 1984, modifications were made to the Umatilla River channel below Three Mile Falls Diversion Dam to improve upstream fish passage. This work, overseen by the Corps of Engineers and Oregon Department of Fish and Wildlife (ODFW), was about 90 percent complete at the end of the construction season in late 1984. A research project will be conducted in 1985 to monitor the success of this project over a range of flows. According to ODFW, the river channel below the dam was observed to be a barrier to upstream passage of adult Salmon and Steelhead at flows less than 200 ft^3/s, and flows up to 300 ft /s were assumed to limit passage. With channel work near completion, a flow of 100 ft^3/s was assumed to be the minimum flow needed for adult passage. However, even with channel work, it is estimated that flows up to 150 ft^3/s will limit passage. Fish passage studies to be conducted in late 1985 should yield information on appropriate passage flow levels.

Adult Steelhead use the lower main stem Umatilla River primarily as a migration corridor, Upstream migration begins as early as October, depending on flows, with the peak occurring between November and March. Most spawning occurs in April and May in the upper Umatilla River and its tributaries.

Egg incubation occurs from April through July. Most rearing takes place in the same tributary streams where spawning occurs. The juveniles typically spend 2 years in freshwater before migrating to sea as smolts. The estimated

annual outmigration of summer Steelhead smolts is 50,000 to 100,000 native fish. This occurs during the period April through June. The ODFW began supplemental hatchery outplanting of juvenile Steelhead in 1980. Since the program began, ODFW released about 17,500 Steelhead smolts in 1981, 59,500 in 1982, 60,500 in 1983, 58,000 in 1984, and 60,000 in 1985. The outplanted smolts are progenies of native adult fish trapped at Three Mile Falls Diversion Dam.

A self-sustaining run of fall chinook has not existed in the Umatilla River since shortly after the construction of Three Mile Falls Diversion Dam. However, an abundance of potential spawning habitat is found throughout the main stem Umatilla River and in Meacham Creek.

Under a fish release program developed by CTUIR and ODFW, juvenile fall chinook have been liberated in the Umatilla River since 1982.

Once established, adult fall chinook will enter the Umatilla River in October through December, with most spawning expected to occur in November and December. Egg incubation takes place from December to mid-March, with rearing between February and the end of May. Fingerlings are expected to migrate downstream to the Columbia River in March through June.

Large numbers of spring chinook salmon existed in the Umatilla basin prior to construction of Three Mile Falls Diversion Dam. The ODFW reported small numbers of spring chinook in the system into the 1960's, but none have been observed since.

An implementation plan for enhancement of Umatilla River salmon and Steelhead has been developed by the CTUIR. Long-term escapement goals presented in this plan are 5,400 hatchery-produced and 5,000 naturally produced adult summer Steelhead, 10,000 hatchery-produced and 12,000 naturally produced adult fall chinook salmon, and 10,000 hatchery-produced and 1,000 naturally produced adult spring chinook salmon.

The Bureau of Reclamation recently completed a Planning Report/Environmental Statement on the Umatilla Project. This project emphasizes fishery flow measures to restore chinook runs and enhance Steelhead runs in the Umatilla River basin. The plan's major feature and recommended plan of development is that of improving streamflows by "importing" water from the neighboring Columbia River. Water would be pumped from the Columbia River into Cold Springs Reservoir for distribution to irrigators. Use of this imported water by irrigators would permit Umatilla River water which is now diverted or stored for irrigation use to remain in the Umatilla River to improve flow conditions in the lower basin. Other measures would include fish passage improvements at four diversion points on the Umatilla River and a postproject fishery study.

Three Mile Falls Diversion Dam presents a major obstacle to both upstream and downstream migrating salmon and Steelhead. As runoff increases to medium to high flows (about 500 ft^3/s or greater), a higher percentage of water spills over the crest of the dam, and attraction flows at both ladders become a smaller portion of the total flow. This creates a false attraction problem in the tailrace area. The resulting migration delay creates increased stress and mortality when fish jump and become trapped in the open bays beneath the

dam. An estimated 20 percent of 1982-83 Steelhead return was lost because of these conditions at Three Mile Falls Diversion Dam. Migration delays for fall chinook would be even more harmful than for Steelhead due to the relatively short period of time between migration and spawning.

The West Ladder is well designed for salmon and Steelhead passage but lacks adequate attraction flows at the entrance during medium to high flows. The East Ladder is not adequately designed by today's standards. It has poor entrance conditions, poor turn pool conditions, poor exit conditions, and is not self-regulating. It also lacks adequate attraction water at all flow levels. Sediment naturally accumulates above the east side of the dam and restricts flow into the East Ladder, thus impeding fish passage. There are no trapping or counting facilities at the East Ladder and only marginal opportunities at the West Ladder.

Debris hanging over the dam crest and accumulating in the tailrace area impedes lateral movement of adult salmon and Steelhead along the base of the dam, This situation, combined with insufficient attraction flows at the ladder entrances, also creates migration delay and stress. Accumulation of debris above the east side of the dam restricts-the amount of flow entering the East Ladder. Failure to maintain control of debris above and below the East Ladder may cause stranding of adult fish.

Juvenile steel head migrate downstream past Three Mile Falls Diversion Dam by passing over the crest, through the fish ladders, or through the smolt bypass pipe on the west side. The bypass pipe drops fish 20 feet into the tailrace area below the dam. This may cause injury, stress, and possible mortality to smolts, especially during low flow conditions when the bedrock area below the pipe does not contain adequate pool depths. This condition is even worse for those smolts passing over the crest of the dam. Smolts encounter the louver system at the intake of WEID Canal. Passage efficiency of this type louver system for Steelhead smolts under ideal flow conditions is 70 to 95 percent. Passage conditions at Three Mile Falls Diversion Dam are probably near the low end of this range because of problems with the approach velocities, nonlaminar flows, and bypass slot velocities. This efficiency does not meet National Marine Fisheries Service (NMFS) criteria for screening facility design, which requires successful passage of all fish.

Passage efficiency of louvers for fall chinook migrants under ideal conditions would range from 40 to 90 percent and for spring chinook 60 to 90 percent. The larger-sized yearling fall chinook smolt presently being released would likely be near the upper end of the range. However, future outmigrations of natural and hatchery fry and fingerlings of both fall and spring chinook would likely experience passage efficiencies near the lower end of this range.

This study considered several potential measures for fish passage improvement, including two fish ladders, a concrete apron plus improvements to the existing left bank ladder, a cap on the crest of the dam plus improvements to the left bank ladder, and dam removal..

The main feature of the two-fish ladder plan would be the construction of a new right bank ladder to improve fish passage. In addition, this alternative includes modifications to the existing left bank ladder and the

installation of rotary drum fish screens and related structures in the WEID Canal. Total construction costs and annual operation and maintenance costs would be $3,475,000 and $66,000, respectively.[1/]

The concrete apron plus West Ladder alternative would consist of a training wall (barrier) and apron constructed downstream of the dam and the same modifications to the left bank ladder and new screens and related structures in the WEID Canal. Total construction costs would be $3,560,000, while annual operation and maintenance costs would total $55,000.

The cap-on-crest plus west ladder alternative would feature a concrete cap on the east and center portions of the dam along with the modifications to the left bank ladder and the new screens and related structures in the WEID Canal. Construction costs would total an estimated $2,985,000, while annual operation and maintenance costs would be $55,000.

The dam removal alternative would require the construction of a new pumping plant at the mouth of the Umatilla River to supply water to the WEID Canal. Fish passage in the river would be improved by restoring the river channel to predam conditions. This would require the removal of a portion of the dam and bedrock and/or silt removal behind the dam. No fish ladders would be required, and the canal headworks would be abandoned. Water normally diverted at the dam for irrigation would be allowed to pass downstream for improved fish flows, particularly during low flow conditions and high fish migration. Water for the WEID Canal would be supplied by the pumping plant.

The construction costs for the pumping plant and dam removal are estimated to be $8,280,000. Annual operation and maintenance costs were not calculated for this alternative.

The two-ladder plan was selected as the recommended plan by the fisheries agencies and the Umatilla Indian tribes.

Three other alternatives were considered in the earlier stages of this study but were eliminated for various reasons. These alternatives were (1) East Ladder only; (2) ladder at new location (i.e., middle of dam); and (3) center cap-on-crest with sill-type ladder on east side. The East Ladder only alternative was eliminated because it would abandon the best (left bank) existing ladder, and it was thought that a single ladder was not sufficient to meet fish passage problems. The middle ladder alternative was eliminated because of access and maintenance difficulties, particularly when trapping and counting fish. A middle ladder would require more water to operate and would be more costly than a bank ladder due to additional heights and strength requirements. The sill-type ladder was omitted because it would be more difficult to regulate flow, debris in the ladder would be a major problem, and trapping and sampling facilities would not be available.

Present operation and maintenance responsibilities are shared between WEID, ODFW, and NMFS. Estimated annual operation and maintenance expenses borne by WEID are $10,500, which is used for minor and ordinary maintenance and repair on gates, the louvers, and other structures.

1/ All costs cited in this report are based on January 1985 price levels.

The right bank ladder was reopened in 1984 after being out of service for 20 years. The left bank ladder is used to trap and count fish by partially dewatering it and dip-netting individual fish and passing them over the dam. The ODFW has responsibility for this activity, which requires about 50 man-days per year to accomplish.

The louvers were constructed by the Bureau of Commerical Fisheries (now NMFS) in 1961. Funding for annual maintenance and repair is passed to ODFW from NMFS in a program that includes fish screens throughout the Columbia Basin. No funding estimates are available for operation and maintenance on the louvers.

Specific operation and maintenance responsibilities and funding sources have not been identified at this phase of the project. Estimated annual operation and maintenance costs for the facilities outlined in the recommended plan are about $66,000. The Bureau of Reclamation has no authority to provide operation and maintenance funding for fish facilities at the dam and has asked BPA to pursue the possibility of their funding operation and maintenance of new fish passage facilities at Three Mile Falls Diversion Dam. It is assumed that Reclamation would be responsible for overseeing operation and maintenance activities. One possibility under consideration is to include the operation and maintenance function in the Yakima fish passage facilities program since Three Mile Falls Diversion Dam is reasonably close to the Yakima Project.

Resolution of the various questions regarding operation and maintenance of fish passage facilities at Three Mile Falls Diverson Dam should be a top priority as this project moves into the final design phase.

A variety of data must be collected and analyzed before final designs can be prepared and construction begun. Additional control surveys and topographical mapping are needed at each ladder and fish screen structure. Surveys are needed to establish river cross sections above and below the dam and canal cross sections and profiles above and below the screen site, Geological investigations are needed to explore foundation conditions at each structure to locate possible borrow sources and to locate sites for disposal of waste materials. Hydrologic records and analyses are needed to develop water surface profiles above and below the dam and the screen site. Also, a flood frequency analysis needs to be prepared for the site, and operational data needs to be analyzed before final designs and specifications can be determined.

Records of all construction at and within the construction area of the ladders and screens need to be examined to determine how new construction should tie into existing facilities, to locate possible utilities, to establish access routes, and to locate rights-of-way.

Stream maintenance requirements during construction of the fishways need to be determined.

TABLE OF CONTENTS

	Page
SUMMARY	
INTRODUCTION	278
Study Purpose	279
Study Scope	279
Need for Action	280
Potential Results of Actions	280
Coordination with Others	281
DESCRIPTION OF STUDY AREA	281
Three Mile Falls Diversion Dam	281
Purpose and Function of Dam'	281
Ownership, Operation, and Maintenance Responsibility	281
Dam Design and Flow Characteristics	282
Existing Fish Passage Facilities	282
Right Bank Ladder	282
Left Bank Ladder	284
Louver	284
Downstream Channel Improvements	284
EXISTING FISHERY RESOURCES OF THE UMATILLA BASIN	285
Steelhead	285
Fall Chinook	286
Spring Chinook'	287
POTENTIAL FUTURE FISHERY RESOURCES OF THE UMATILLA BASIN	287
Steelhead	287
Fall Chinook	287
Spring Chinook	288
Umatilla Basin Project	288
PRESENT AND POTENTIAL FUTURE FISHERY PROBLEMS ASSOCIATED WITH THREE MILE FALLS DIVERSION DAM	289
Steelhead	289
Adults	289
Juveniles	289
Fall Chinook	290
Adults	290
Juveniles	290
Spring Chinook	291
Adults	291
Juveniles	291
ALTERNATIVE IMPROVEMENT MEASURES	292
Two Fish Ladders	292
Description of Facilities	292
Right Bank Ladder	292
Left Bank Ladder Modifications	293
West Extension Irrigation District Canal Fish Screens	293
Operating Plan	294
costs	294
Concrete Apron Plus West Ladder	295
Description of Facilities	295
Operating Plan	295
Costs	296

Table of Contents

Page

Cap-on-crest Plus West Ladder 296
Description of Facilities 296
Operating Plan 297
costs 297
Dam Removal 297
Description of Facilities 297
Operating Plan 298
costs . 298
DEVELOPMENT OF ALTERNATIVES AND SELECTION OF RECOMMENDED PLAN . . . . l 299
OTHER PLANS CONSIDERED 300
DATA NEEDS FOR FINAL DESIGNS AND CONSTRUCTION . l 300
IMPLEMENTATION AND OPERATION AND MAINTENANCE . . : : : : : : : : : : : l 301
Permits and Clearances 301
Construction Schedule 301
Operation and Maintenance Costs and Responsibilities 302
ENVIRONMENTAL CONSIDERATION AND NEPA COMPLIANCE 302
Environmental Considerations 302
NEPA Compliance 303
COSTS DEVELOPMENT l 303
CONCLUSIONS AND RECOMMENDATIONS 304
Conclusions 304
Recommendations 304
LITERATURE CITED
APPENDED MATERIAL
BIOLOGICAL ASSESSMENT
CONSTRUCTION COST ESTIMATE SHEETS FOR RECOMMENDED PLAN
AGENCY CONCURRENCE LETTERS

TABLES

Table No. Page

1 Average Monthly Flows Expressed in Cubic Feet Per Second Below Three Mile Falls Diversion Dam for 44 Years of Record, 1935-78 283
2 Assumed Passage Conditions (Expressed as Percentage of Fish Passing Three Mile Falls Diversion Dam) 290
3 Comparative Summary of Plans 299

MAPS

Location Map . . . . . Frontispiece

Table of Contents

DRAWINGS

	Follows Page
Existing Facilities	281
Right Bank Fish Ladder	292
Left Bank Fish Ladder	293
Fish Screens	293
Fish Barrier and Apron	295
Cap On Crest	296
Construction Schedule	301

FISH PASSAGE IMPROVEMENTS AT THREE MILE FALLS DIVERSION DAM UMATILLA RIVER, OREGON

INTRODUCTION

On December 5, 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501). The act created a council charged with the responsibility to prepare a Northwest Conservation and Electric Power Plan and to develop a program to protect, mitigate, and enhance fish and wildlife including related spawning grounds and habitat on the Columbia River and its tributaries.

The council adopted its Fish and Wildlife Program on November 15, 1982. Section 700 of the program deals with measures to enhance the natural propagation of salmon and Steelhead as well as to improve facilities and techniques used for hatchery propagation. The primary objectives of the recommendations to improve natural propagation are:

1. Provision of suitable flows for spawning, incubation, emergence, and rearing in the Columbia River and its tributaries

2. Improvement of anadromous fish spawning, incubation, rearing, and migration habitat which were affected by hydroelectric development and enhancement of habitat at other locations to compensate for direct effects

3. Provision of and restoration of passage to habitats which became unavailable to migratory fish primarily as a result of hydroelectric development (I)[1/]

Much of the anadromous fish habitat in the Columbia River system has been lost as a result of hydroelectric development. However, many tributary streams have good spawning and rearing habitat and could be brought to full potential through habitat improvement measures and improved fish passage. The proposed passage improvement measures at Three Mile Falls Diversion Dam are in concert with goal 3 above,

Two projects have been requested by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in cooperation with the Oregon Department of Fish and Wildlife (ODFW) to restore chinook salmon and improve Steelhead passage at and below the dam. The first of these was essentially completed in October 1984 and involved the excavation of a channel from the mouth of the Umatilla River to within about 1,000 feet of Three Mile Falls Diversion Dam. Upstream migrating salmon and Steelhead now have much improved passage conditions to the dam. Before the channel work, upstream passage was virtually impossible at low flows.

1/ A number in parentheses refers to the number of the reference in the "Literature Cited" section.

A proposal was developed jointly in 1983 by fishery agencies, CTUIR, and Bureau of Reclamation to improve fish passage at the dam. The plan included construction of a fish barrier immediately below the dam to help fish locate the entrance to the fish ladder. Also included were modifications to counting and trapping facilities in the existing vertical slot fish ladder located on the west end of the dam. Reclamation prepared feasibility plans and estimates for the fish barrier in October 1983.

After reviewing these plans and estimates, Bonneville Power Administration (BPA) concluded that it could not commit funds for the final design and construction of the proposed fish barrier because:

1. Information presented did not fully demonstrate that construction of the fish barrier was independent of other required passage improvements at the dam

2. The independent utility of the project from other Umatilla River fish enhancement activities was not established (2)

Consequently, BPA requested that Reclamation (1) coordinate a thorough biological assessment by the various fishery agencies and the CTUIR to clarify fish passage problems and needs and (2) conduct a feasibility study of alternative plans to meet needs. An interagency agreement providing for this work was signed by the agencies in June 1984,

Study Purpose

The Reclamation study has two purposes:

1. To coordinate the completion of and report on a biological assessment of fish passage problems and needs at Three Mile Falls Diversion Dam by several interested fishery agencies and the CTUIR

2. To apply information from the biological assessment in developing alternative plans for solving fish passage problems which can be used by the fisheries agencies, CTUIR, and BPA to recommend a course of action

Study Scope

'Included in this study are:

1. Results and conclusions of the biological assessment'

2. Preliminary engineering data delineating general configuration and layout of facilities; general flow requirements to operate facilities: data requirements for preparation of final plans, designs, and specifications; and cost estimates for construction and operation and maintenance

3. Identification of Federal, State, and local government permits which' may be required before construction can be initiated

4. Estimated schedules for final plans and designs, specifications, and construction

5. Identification of potential arrangements for operation and maintenance of the new facilities

6. Analysis and preparation of information to satisfy National Environmental Policy Act (NEPA) requirements

Need for Action

Historically, the Umatilla River produced large numbers of summer Steelhead and fall and spring chinook salmon. No actual population estimates are available prior to the construction of Three Mile Falls Diversion Dam in 1914, but reports of "thousands and thousands" of salmon being caught from spring to fall in the lower Umatilla River by both Indians and non-Indians are documented (3).

The construction of Three Mile Falls Diversion Dam eliminated all chinook salmon and drastically reduced runs of summer Steelhead. Present runs of Steelhead have averaged less than 2,000 returning adults for the past 14 years.

The Umatilla River basin has an abundance of spawning gravel and potential habitat for both Steelhead and spring and fall chinook. Primary factors limiting populations in the basin are low flows exacerbated by irrigation withdrawals and inadequate passage over irrigation diversion dams. The provision of adequate fish passage and protective facilities at Three Mile Falls Diversion Dam would be a very important step in reestablishing chinook salmon runs and enhancing Steelhead runs in the Umatilla basin.

Potential Results of Actions

The provision of improved fish passage facilities under existing flow levels would significantly reduce or eliminate losses of adult salmon and Steelhead below the dam and reduce delays in adult passage. The inclusion of trapping and counting facilities would permit the selection of adults for brood stock without severely delaying or excessive handling of fish, enhance the trapping of adults to be hauled to suitable spawning areas, and provide for total counts by species to and in the evaluation of all other fish enhancement projects. [This would be a valuable tool in the evaluation of program success and would allow proper crediting to ratepayers for projects accomplished under section 4(h) of Public Law 96-501.] Passage efficiency for juvenile fish would be improved.

Coordination with Others

The Bureau of Reclamation appreciates the assistance of the following entities who provided information or otherwise participated in the study:

Confederated Tribes of the Umatilla Indian Reservation
Oregon Department of Fish and Wildlife
U.S. Fish and Wildlife Service
National Marine Fisheries Service
Columbia River Intertribal Fish Commission
Bureau of Indian Affairs
Corps of Engineers
West Extension Irrigation District
Bonneville Power Administration

The biological assessment was prepared by an interagency team comprised of the U.S. Fish and Wildlife Service, National Marine Fisheries Service (NMFS), ODFW, CTUIR, and the Columbia River Intertribal Fish Commission. Designs for fish ladders and screens were developed by Reclamation in close consultation with the NMFS and ODFW,

DESCRIPTION OF STUDY AREA

Three Mile Falls Diversion Dam

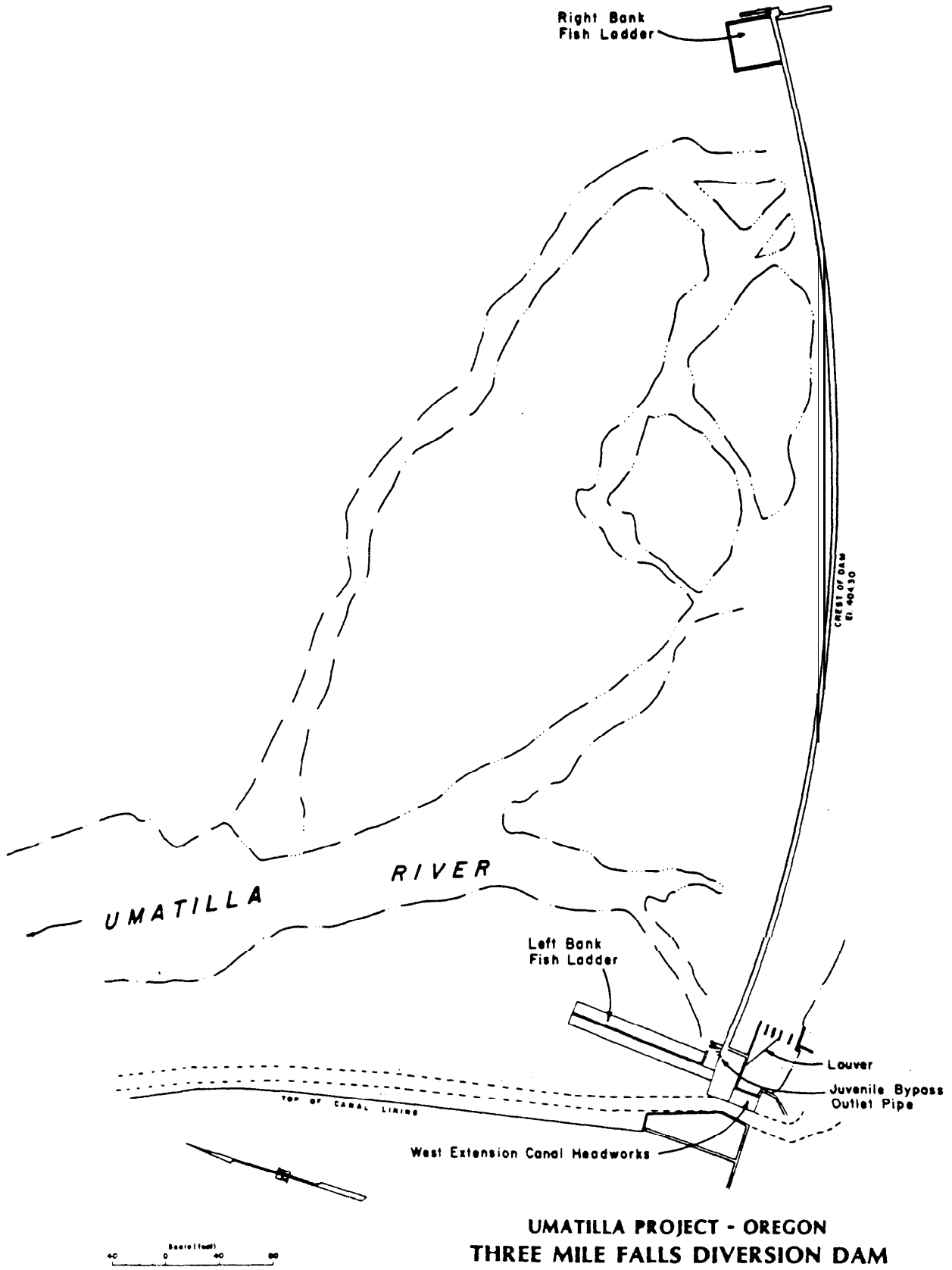
Purpose and Function of Dam

Three Mile Falls Diversion Dam is located on the Umatilla River approximately 3 miles south of Umatilla, Oregon. The dam, headworks, and right bank fish ladder were constructed by the Bureau of Reclamation in 1914 as an integral part of the Umatilla Project under authority of the original Reclamation Act, section 4 (32 Stat. 388) and approved by the President on January 5, 1911. It diverts water to the service area of the West Extension Irrigation District (WEID) through a 27-mile-long main canal (see drawing). The diverted water is used to irrigate about 7,000 acres of farmland.

Ownership, Operation, and Maintenance Responsibility

Title to Three Mile Falls Diversion Dam is held by the United States. The Bureau of Reclamation initially operated and maintained the works until April 27, 1926, when the WEID assumed operation, maintenance, and replacement responsibility for the structure under contract with the. Bureau of Reclamation.

Existing fish passage facilities at Three Mile Falls Diversion Dam include the original pool -and-weir ladder on the right bank (which was reopened in 1984 after being out of service for 20 years). a vertical slot ladder on the left bank, and a louver screen mounted at the intake of the WEID Canal. The left bank ladder is used to trap and count fish by partially dewatering it and dip-netting individual fish and passing them over the dam.



UMATILLA PROJECT - OREGON

THREE MILE FALLS DIVERSION DAM
FISH PASSAGE & PROTECTION FACILITIES
EXISTING FACILITIES

U.S. Bureau of Reclamation | May 1985 | 30-100-5576

The ODFW has responsibility for this activity, and about 50 man-days a year are expended in its accomplishment. The WEID is responsible for debris removal along the face of the dam and from the louvers. The district has no responsibility for operation and maintenance activities at the right bank ladder. Estimated annual operation and maintenance expenses borne by WEID are $10,500, which includes $9,000 per year for labor (wages) and $1,500 for minor and ordinary maintenance and repairs on gates, louver screens, and other structures. About once every 8 to 10 years the district removes silt from just upstream of the east abutment and snags from the dam crest at an estimated cost of $4,000. The louvers were constructed by the Bureau of Commercial Fisheries (now NMFS). Funding for annual maintenance and repair is passed to ODFW from NMFS in a program that includes fish screens throughout the Columbia Basin. No funding estimates are available specifically for Three Mile Falls Diversion Dam louvers.

Dam Design and Flow Characteristics

Three Mile Falls Diversion Dam is a concrete buttress dam with a maximum height of 24 feet and a crest length of 915 feet. The canal headworks at the diversion dam has a capacity of 375 cubic feet per second (ft^3/s). The canal capacity is 310 ft^3/s, and the historic peak diversion is 305 ft^3/s. Actual average monthly diversions for the period 1935-78 are 145 to 170 ft^3/s between April and September.

The buttress dam was designed to function as an overflow weir along its entire crest. During the normal irrigation season, (April-October), the WEID diverts available river water to meet its demands and passes any remainder over the dam crest. During periods of low flow, all the available water is diverted (up to the canal capacity) except for about 20 ft^3/s released through the downstream migrant pipe. The fish ladder is operated during periods of upstream Steelhead migrations and requires about 20 to 40 ft^3/s for ladder operation.

During the nonirrigation season, all the riverflows in excess of the fish ladder and bypass pipe capacity are passed over the dam. As the flows increase over the dam, the proportion of total flow at the ladder entrance decreases. Table 1 depicts the average flow conditions in the Umatilla River below the dam over the 44-year period 1935-78.

Existing Fish Passage Facilities

Right Bank Ladder.--During its initial construction, the dam was equipped with a low fish ladder on the right abutment (east bank). Additional weirs were constructed at the toe of the dam as part of the ladder in 1963. The right bank ladder is an overflow weir type containing 13 concrete pools, each 6 feet by 8 feet by 6 feet in size. This series of pools contain vertical drops ranging from 6 inches to 1 foot. This ladder was taken out of service in 1964 by backfilling it with earth. It was replaced by a new ladder on the left bank. However, in 1984 the right bank ladder was reopened by a group of volunteers, and successful passage of Steelhead occurred when riverflows exceeded about 500 ft^3/s. Primary problems associated with the right bank ladder include false attraction flows along the face of the dam just west of the ladder entrance, obstructions in the channel below the entrance to the ladder, and sedimentation along the upstream face of the dam near the exit (upstream end) of the ladder. Also, the ladder does not contain trapping,

Table 1.--Average Monthly Flows Expressed in Cubic Feet Per Second Below Three Mile Falls Diversion Dam for 44 Years of Record, 1935-78

Year	Oct	Nov 15	Nov 30	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 15	Sep 30	Average
1935	5.	5.	13.	390.	322.	316.	188.	974.	109.	11.	15.	14.	9.	18.	195.6
1936	4.	84.	106.	88.	365.	289.	1082.	1513.	176.	13.	12.	10.	8.	13.	303.8
1937	9.	31.	84.	79.	51.	198.	578.	1206.	375.	50.	10.	26.	48.	28.	222.2
1938	33.	110.	161.	291.	275.	393.	1041.	1181.	95.	29.	25.	15.	27.	13.	293.2
1939	16.	79.	137.	174.	168.	283.	1560.	692.	48.	18.	38.	14.	5.	21.	261.3
1940	17.	105.	100.	110.	105.	987.	1391.	774.	17.	15.	22.	13.	13.	16.	292.5
1941	13.	128.	268.	484.	319.	117.	321.	11.	36.	211.	15.	41.	49.	68.	152.7
1942	210.	250.	867.	733.	545.	892.	739.	992.	855.	445.	148.	28.	81.	35.	514.0
1943	14.	138.	356.	1280.	1273.	1663.	1181.	2023.	957.	295.	54.	63.	52.	51.	752.1
1944	98.	188.	115.	122.	95.	202.	743.	1037.	148.	26.	22.	21.	40.	14.	223.7
1945	80.	101.	138.	115.	332.	946.	1000.	1267.	855.	91.	26.	32.	58.	42.	405.4
1946	43.	135.	618.	803.	749.	488.	1457.	1409.	535.	99.	48.	45.	151.	97.	515.0
1947	130.	163.	637.	1571.	820.	779.	832.	588.	15.	66.	35.	24.	32.	51.	440.7
1948	76.	645.	1030.	974.	888.	1066.	991.	2120.	3360.	551.	41.	56.	141.	77.	921.6
1949	138.	128.	217.	450.	226.	1584.	1963.	1872.	652.	31.	19.	35.	31.	43.	590.9
1950	44.	113.	157.	171.	521.	1462.	1490.	1363.	797.	804.	11.	51.	65.	45.	568.0
1951	140.	358.	325.	795.	1207.	1815.	1429.	1054.	217.	140.	32.	21.	33.	19.	593.7
1952	171.	181.	258.	344.	371.	882.	829.	1501.	430.	22.	26.	19.	37.	25.	399.6
1953	36.	72.	128.	117.	1007.	1369.	1123.	1481.	726.	417.	26.	68.	80.	71.	538.8
1954	92.	129.	167.	562.	436.	689.	456.	560.	13.	220.	24.	35.	46.	67.	271.1
1955	40.	207.	126.	131.	132.	189.	122.	737.	1478.	116.	27.	45.	52.	34.	269.6
1956	39.	184.	536.	1215.	1309.	742.	1703.	1376.	1107.	44.	14.	44.	28.	19.	666.4
1957	69.	221.	165.	583.	116.	833.	1499.	1407.	914.	39.	12.	36.	24.	12.	474.4
1958	161.	176.	210.	635.	715.	1875.	688.	3055.	980.	11.	8.	45.	47.	11.	688.6
1959	51.	262.	362.	948.	1378.	910.	894.	981.	318.	35.	19.	25.	111.	123.	497.1
1960	311.	192.	567.	160.	306.	587.	1132.	640.	726.	34.	17.	66.	65.	26.	366.2
1961	14.	152.	629.	215.	205.	1477.	1338.	405.	218.	24.	12.	25.	46.	17.	355.4
1962	15.	118.	176.	274.	513.	298.	699.	891.	441.	33.	19.	10.	27.	17.	280.1
1963	127.	146.	282.	452.	221.	1367.	440.	941.	332.	7.	8.	19.	11.	4.	336.9
1964	31.	155.	164.	165.	252.	331.	423.	936.	378.	66.	8.	15.	4.	12.	229.7
1965	26.	62.	116.	1887.	2316.	2254.	559.	1167.	176.	52.	34.	12.	5.	5.	706.2
1966	39.	73.	103.	103.	131.	139.	584.	289.	6.	6.	10.	6.	3.	3.	117.0
1967	11.	155.	48.	489.	810.	610.	241.	188.	619.	9.	5.	7.	7.	3.	257.0
1968	50.	122.	107.	502.	260.	1074.	164.	5.	4.	2.	4.	4.	3.	4.	176.5
1969	74.	256.	413.	456.	1331.	591.	854.	2188.	604.	54.	26.	12.	17.	50.	545.0
1970	127.	145.	115.	147.	1931.	1051.	1106.	942.	839.	25.	4.	5.	71.	19.	527.7
1971	118.	172.	286.	241.	1141.	916.	628.	602.	250.	198.	24.	18.	85.	35.	365.4
1972	85.	209.	307.	775.	866.	1636.	3677.	1023.	795.	42.	17.	16.	22.	24.	765.4
1973	108.	151.	120.	486.	548.	160.	208.	8.	7.	7.	5.	6.	7.	5.	141.3
1974	16.	466.	640.	1898.	2010.	1301.	1388.	2800.	1255.	296.	21.	12.	17.	25.	961.8
1975	66.	138.	153.	225.	1580.	842.	1324.	996.	1271.	59.	15.	12.	10.	14.	546.0
1976	99.	196.	208.	1392.	1492.	763.	751.	1922.	645.	12.	10.	17.	7.	4.	608.8
1977	36.	107.	97.	96.	109.	77.	134.	268.	2.	2.	3.	3.	2.	2.	69.1
1978	4.	164.	448.	1177.	757.	727.	1031.	784.	344.	10.	24.	33.	15.	13.	433.6
AVG	70.	168.	279.	552.	693.	845.	954.	1095.	548.	108.	23.	26.	39.	29.	428.2

holding, or counting facilities. No additional attraction water is provided to the ladder entrance.

Left Bank Ladder.--The left bank ladder on the west abutment of the dam is a vertical slot-type structure which was completed in August 1964. It was built by the State of Oregon under contract with the Bureau of Reclamation and the WEID. It has twenty-one 8-foot by lo-foot rectangular concrete pools. The floor slopes and the slots in the pools extend to the floor. The ladder is operated during periods of upstream anadromous fish migrations and uses about 20 to 40 ft^3/s for ladder operation depending upon forebay depths. When there is a difference of 20 feet between the forebay and tailwater, the ladder will operate with about l-foot difference in water level between pools. A 12 inch-diameter pipe routes water from inside the upper pool through a diffuser in the lower pool to provide about 15 ft^3/s of additional attraction flows for adult anadromous fish.

The ladder is not designed for trapping, counting, and holding of adult anadromous fish. An electronic counter operated at the head of this ladder for several years but has not been used recently. This counter was difficult to calibrate and gave inconsistent results. Consequently, a temporary conduit fyke-type trap is used in the upper four pools of the ladder for annual counting of summer Steelhead. The pools are then partially dewatered, and the fish are individually dip-netted, counted, and passed over the dam. Steelhead broodstock selection (for the juvenile supplemental outplanting program) also occurs in this manner. Downstream juvenile migrants are passed either over the crest of the dam or through a bypass pipe that collects those fish which have been screened from the canal entrance.

Louver.--The louver screen is mounted at the intake of the WEID Canal at the left abutment of the dam. It was constructed by the Bureau of Commercial Fisheries in 1961 under contract with the Bureau of Reclamation and the WEID. It is approximately 30 feet long and consists of a series of fixed metal slats spaced about 1 to 2 inches apart. It prevents most Steelhead smolts from entering the canal and directs them to the entrance of the bypass pipe.

Downstream Channel Improvements.--During 1984, modifications were made to the Umatilla River channel below Three Mile Falls Diversion Dam to improve upstream fish passage. This work, overseen by the Corps of Engineers and ODFW, was about 90-percent complete at the end of the construction season in 1 ate 1984. A research project will be conducted in 1985 to monitor the success of this project over a range of flows. According to ODFW (6), the river channel below the dam was observed to be a barrier to upstream passage of adult salmon and Steelhead at flows less than 200 ft^3/s, and flows up to . 300 ft^3/s were assumed to limit passage. With channel, work near completion, .a flow of 100 ft^3/s was assumed to be the minimum flow needed for adult passage. However, even with channel work, it is estimated that flows up to 150 ft^3/s will limit passage. Fish passage studies to be conducted in late 1985 should yield information on appropriate passage flow levels.

EXISTING FISHERY RESOURCES OF THE UMATILLA BASIN

Steelhead

Summer Steelhead is the only anadromous species that inhabits the Umatilla system. These fish have adapted to a number of limiting habitat conditions in the basin. Run sizes in recent years have averaged about 1,880, ranging from 700 to 2,500 returning adult spawners. Numbers of returning adults appear to be directly related to riverflow conditions during the winter migration period; higher flows allow for greater numbers of fish to pass upstream to spawning areas.

Adult Steelhead use the lower main stem Umatilla River primarily as a migration corridor. Upstream migration begins as early as October, depending on flows, with the peak occurring between November and March. Most spawning occurs in April and May in the upper Umatilla River and its tributaries. Estimated distribution of Umatilla summer Steelhead spawning is as follows:

Stream	Percent
Meacham Creek	40.0
South Fork Umatilla River	17.0
North Fork Umatilla River	10.0
Main stem Umatilla River	10.0
Squaw Creek	5.0
Birch Creek	15.0
Other tributaries	3.0

Egg incubation occurs from April through July. Most rearing takes place in the same tributary streams where spawning occurs. The juveniles typically spend 2 years in freshwater before migrating to sea as smolts. The estimated annual outmigration of summer Steelhead smolts is 50,000 to 100,000 native fish. This occurs during the period April through June. Major periods of summer Steelhead use of the Umatilla River basin are as follows:

Upstream adult migration	October-May
Spawning	April-May
Egg incubation	April-July
Rearing	All year
Downstream smolt migration	April-June

The ODFW began supplemental hatchery outplanting of juvenile Steelhead in 1980. Since the program began, ODFW released about 17,500 Steelhead smolts in 1981, 59,500 in 1982, 60,500 in 1983, 58,000 in 1984, and 60,000 in 1985. The outplanted smolts are progenies of native adult fish trapped at Three Mile Falls Diversion Dam.

Fall Chinook

A self-sustaining run of fall chinook has not existed in the Umatilla River since shortly after the construction of Three Mile Falls Diversion Dam. However, an abundance of potential spawning habitat is found throughout the main stem Umatilla River, In addition, Meacham Creek up to the North Fork also has potential for fall chinook spawning.

Under a fish release program developed by the CTUIR and ODFW, juvenile fall chinook have been liberated in the Umatilla River since 1982 at the following rates:

Year of Release	Approximate Number of Fish	Size	Stock
1982	3.83 million	Fingerlings	Tule
1983	100,500	Yearlings	Upriver bright
1984	223,600	Yearlings	Upriver bright
1985	225,000	Yearlings	Upriver bright

.Approximately 20,000, 50,000, and 140,000 fall chinook yearlings were acclimated and released at Bonifer Pond in 1983, 1984, and 1985, respectively. The remaining smolts were released in upper Meacham Creek. A few 2-year-old jacks (probably fewer than 100) from the 1983 release returned to the Umatilla River in the fall of 1983. During the fall of 1984, adult tule and upriver bright fall chinook returned to the mouth of the Umatilla River from the 1982 and 1983 hatchery releases. These fish had spent two to three growth seasons in the ocean environment. The tule fish were 10 to 15 pounds and were mature spawners. The upriver brights were immature males (jacks) of 20-24 inches in length. Due to Umatilla River channel modification work underway below Three Mile Falls Diversion Dam, none of these fish were able to move above the river mouth.

When established, adult fall chinook will enter the Umatilla River in October through December, with most spawning expected to occur in November and December. Egg incubation takes place from December to mid-March, with rearing between February and the end of May. Fingerlings will migrate downstream to the Columbia River in March through June.

The major time periods that fall chinook are expected to utilize Umatilla River basin waters are as follows:

Upstream adult migration	October-December
Spawning	November-December
Egg incubation	November-March
Rearing	February-May
Downstream smolt migration	March-July

Spring Chinook

Large numbers of spring chinook salmon existed in the Umatilla basin prior to construction of Three Mile Falls Diversion Dam. The ODFW reported small numbers of spring chinook in the system into the 1960's, but none have been observed since.

Projected time periods of spring chinook use of the Umatilla River basin are as follows:

Upstream adult migration	April-June
Spawning	August-September
Egg incubation	August-December
Rearing	November-April
Downstream smolt migration	April-June

POTENTIAL FUTURE FISHERY RESOURCES OF THE UMATILLA BASIN

. Steelhead

An implementation plan for enhancement of Umatilla River Steelhead has been developed by the CTUIR (4). Long-term escapement goals presented in this plan for summer Steelhead in the basin are 5,400 hatchery-produced adult fish and 5,000 naturally produced adult fish.

Hatchery production goals will be achieved through annual releases of 200,000 Steelhead smolts at the existing Bonifer facility and the Minthorn acclimation facility currently in final design phase. The proposed Umatilla hatchery near Irrigon (in the predesign phase) will produce these fish. The 60,000 smolts that are currently being reared at existing ODFW facilities and released at Bonifer will continue at least until the Umatilla hatchery comes online. Any excess broodstock returning to the Bonifer and Minthorn facilities will be used for enhancement of natural production by reseeding (adult or egg outplanting) in underutilized habitat.

Riparian and instream habitat improvement needs were identified in the CTUIR Umatilla River basin report of January 1984 (4). These projects were submitted to the Northwest Power Planning Council in November 1983 as proposed amendments to the Fish and Wildlife Program of the Northwest Power Planning and Conservation Act of 1980. There is an excellent opportunity to vastly improve the natural production of anadromous fish habitat throughout the Umatilla basin.

Fall Chinook

The Umatilla Basin Implementation Plan (4) cites long-term escapement goals of 10,000 hatchery-produced and 12,000 naturally produced fall chinook salmon. Approximately 225,000 yearlings are programmed for acclimation and release at the Bonifer and Minthorn facilities through 1987. Based upon the results of ongoing studies at Bonneville hatchery, the most cost-effective

program for juvenile releases will be used. This may include yearling releases, fall reared smolts, or fingerlings. Based upon available data, a return of about 2,500 adult fish would result from either program. Returning adult fall chinook will be used as broodstock for hatchery production and to foster natural production in the system.

Spring Chinook

Potential spring chinook spawning habitat exists in the upper main stem, lower North Fork, and South Fork Umatilla River and in Meacham Creek. The CTUIR and ODFW have plans for reestablishment of spring chinook in the Umatilla basin. Escapement goals are 10,000 hatchery-produced fish and 1,000 naturally produced fish. However, poor spring passage conditions and lack of deep holding pools for adults could limit the production of these fish. To avoid or reduce potential passage problems, broodstock would be selected for early arrival of adults to avoid low streamflows. When introduced, adults would enter the Umatilla River in April and May and migrate to upstream resting pools near spawning grounds. Adults would hold over in these pools until spawning commenced in late August and September. Most juveniles would rear for a year prior to migration in April, May, and June.

Umatilla Basin Project

The Bureau of Reclamation recently completed a Planning Report/Environmental Statement on the Umatilla Project, This project emphasizes flow enhancement to help restore chinook runs and enhance Steelhead runs in the Umatilla River basin. The plan's major feature and recommended plan of development is that of improving streamflows by "importing" water from the neighboring Columbia River.

The recommended plan includes a program to pump water from the Columbia into Cold Springs Reservoir for distribution to irrigators. Use of this imported water by irrigators would permit Umatilla River water which is now diverted or stored for irrigation use to remain in the Umatilla River to improve flow conditions in the lower basin. Structural features include a major pumping plant on the Columbia River (Lake Wallula), a relift pumping station, and carriage facilities. Increased streamflow in the lower Umatilla River in conjunction with improved fish passage at Three Mile Falls Diversion Dam would optimize passage conditions at the dam,

In addition to the pumping feature, the plan proposes improvements to fish passage facilities and installation of protective screens at some existing irrigation diversions. A significant plan feature is a postconstruction monitoring program which would "fine tune"' flow improvements and other measures in meeting fishery enhancement objectives. This monitoring program, new expected to extend over a 12-year period would aid project operators and fishery experts in adjusting operations or proposing addi tional measures to meet fishery restoration goals.

PRESENT AND POTENTIAL FUTURE FISHERY PROBLEMS ASSOCIATED WITH THREE MILE FALLS DIVERSION DAM

Steelhead

Adults

Adult Steelhead enter the Umatilla River in the late fall when the irrigation season has ended and natural flows begin increasing (table 1). As runoff increases to medium to high flows (about 500 ft^3/s or greater), a higher percentage of water spills over the crest of the dam, and attraction flows at both ladders become a smaller portion of the total flow. This creates a false attraction problem for Steelhead in the tailrace area. The resulting migration delay creates increased stress and mortality when fish jump and become trapped in the open bays beneath the dam. An estimated 20 percent of the 1982-83 Steelhead return was lost because of these conditions at Three Mile Falls Diversion Dam.

The left bank ladder is well designed for steelhead passage but lacks adequate attraction flows at the entrance during medium to high flows. The right bank ladder is not adequately designed by today's standards. It has poor entrance conditions, poor turn pool conditions, poor exit conditions, and is not self-regulating. It also lacks adequate attraction water at all flow levels. Sediment naturally accumulates above the east side of the dam and restricts flow into the right bank ladder, thus impeding fish passage. There are no trapping or counting facilities at the right bank ladder and only marginal opportunities at the left bank ladder.

Debris hanging over the dam crest and accumulating in the tai lrace area impedes lateral movement of Steelhead along the base of the dam. This situation, combined with insufficient attraction flows at the ladder entrances, also creates migration delay and stress. Accumulation of debris above the east side of the dam restricts the amount of flow entering the right bank ladder. Failure to maintain control of debris above and below the right bank ladder may cause stranding of adult Steelhead.

Juveniles

Juvenile Steelhead migrate downstream past Three Mile Falls Diversion Dam by passing over the crest, through the fish ladders, or through the smolt bypass pipe on the west side. The bypass pipe drops fish 20 feet into the tailrace area below the dam. This may cause injury, stress, and possible mortality to smolts, especially during low flow conditions when the bedrock area below the pipe does not contain adequate pool depths. This condition is even worse for those smolts passing over the crest of the dam. Smolts encounter the louver system at the intake of WEID Canal. A NMFS study (5) indicates that the passage efficiency of this type louver system for Steelhead smolts under ideal flow conditions is 70 to 95 percent. Passage conditions at Three Mile Falls Diversion Dam are probably near the low end of this range because of problems with the approach velocities, nonlaminar flows, and bypass slot velocities. This efficiency does not meet NMFS criteria for screening facility design, which requires successful passage of all fish.

A summary of the current passage conditions for Steelhead, expressed as a percentage of adult and juvenile fish passing Three Mile Falls Diversion Dam, is provided in table 2. Future Steelhead passage conditions, again assuming no flow enhancement with the present facilities at Three Mile Falls Diversion Dam, *would* not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized (table 2).

Fall Chinook

Adults

As indicated in table 1, adequate flows (assumed to be 200 ft^3/s or greater) for adult fish passage to Three Mile Falls Diversion Dam can occur during the October through December migration period. During this period, all the passage problems listed for adult Steelhead would be common to fall chinook. These include (1) false attraction flows below the dam, (2) lack of adequate attraction to the ladder entrances, and (3) debris and/or sediment above and below the dam. In addition to these problems, the overflow weir design of the right bank ladder does not promote chinook passage as would the vertical slot design. A submerged orifice or vertical slot is especially important for the ladder entrance.

Table 2.--Assumed Existing Passage Conditions
(Expressed as Percentage of Fish Passing Three Mile Falls Diversion Dam)

Passage Condition	Steelhead		Fall Chinook		Spring Chinook	
	Adults	Juveniles	Adults	Juveniles	Adults	Juveniles
Without flow enhancement	75	75	38	50	48	60
With Reclamation flow enhancement	80	75	90	50	80	75

Migration delays for fall chinook are generally more harmful than for Steelhead due to the relatively short period of time between migration and spawning.

During flow periods that could provide adequate fish passage, movement through the left bank ladder could be satisfactory. However, counting, trapping, and holding facilities are poor. During periods of extreme low flows, passage would be reduced or eliminated. Water temperature and swimming duration are not expected to cause passage problems.

Juveniles

The NMFS study (5) indicates that the passage efficiency of louvers for fall chinook migrants under ideal flow conditions varies from 40 to 90 percent. The larger-sized yearling chinook smolt presently being released would likely be near the upper end of this range. Future outmigrations of natural

and hatchery fry and fingerlings would likely experience efficiencies near the lower end of this range. The same problems with velocities and nonlami nar flows affecting louver efficiency for Steelhead would be more of a problem for the smaller fall chinook. NMFS policy has been to pass 100 percent of the fish, thus passage criteria would not be met in either case. Chinook downstream migrants would also experience the same problems with injury, stress, and possible mortality from the juvenile bypass system as discussed for Steelhead.

A summary of the current passage conditions for fall chinook, expressed as a percentage of adult and juvenile fish passing Three Mile Falls Diversion Dam, is provided in table 2. Future fall chinook passage conditions, again assuming no flow enhancementwith the present facilities at Three Mile Falls Diversion Dam, would not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized (table 2).

Spring Chinook

Adults

Medium to high flows often occur during the April and early May migration period. With these conditions, problems listed for Steelhead and fall chinook at Three Mile Falls Diversion Dam would also be common for spring chinook. These include (1) false attraction flows below the dam, (2) lack of adequate attraction to the ladder entrances, and (3) debris and/or sediment obstruction above and below the dam. In addition to these problems, the overflow weir design of the right bank ladder does not promote chinook passage as would a vertical slot design. A submerged orifice or vertical slot is especially important for the ladder entrance.

In late May and into June, flows can rapidly decrease to very low flow conditions because of irrigation diversions (table 1). Passage during these periods could be significantly reduced or even eliminated. Migration delays for spring chinook would have very serious implications because upstream passage to holding and spawning areas would be impossible later in the spring and into summer. This would especially be a problem during late May and early June for late arriving adults. During periods of adequate flows, movement through the left bank ladder could be satisfactory. However, existing counting, trapping, and holding facilities are inadequate. Temperature conditions and/or swimming duration are not expected to cause passage problems.

Juveniles

Spring chinook downstream migrants are expected to be yearling smolts. The NMFS study (5) indicates that the passage efficiency of louvers for spring chinook smolts under ideal flow conditions varies from 60 to 90 percent. The previously discussed problems with velocities and nonlaminar flows affecting louver efficiency for Steelhead would also affect spring chinook. NMFS policy has been to pass all of the fish. Therefore, NMFS passage criteria would not be met. Spring chinook downstream migrants would also experience the same problems from injury, stress, and mortality with the juvenile bypass system as those listed earlier for Steelhead and fall chinook.

A summary of the current passage conditions for spring chinook, expressed as a percentage of adult and juvenile fish passing Three Mile Falls Diversion Dam, is provided in table 2. Future spring chinook passage conditions, again assuming no flow enhancement with the present facilities at Three Mile Falls Diversion Dam, would not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized (table 2).

ALTERNATIVE IMPROVEMENT MEASURES

The study considered several potential measures which are discussed below. These include two fish ladders, a concrete apron plus improvements to the existing left bank ladder, a cap on the crest of the dam plus improvements to the left bank ladder, and dam removal.

Two Fish Ladders

Description of Facilities

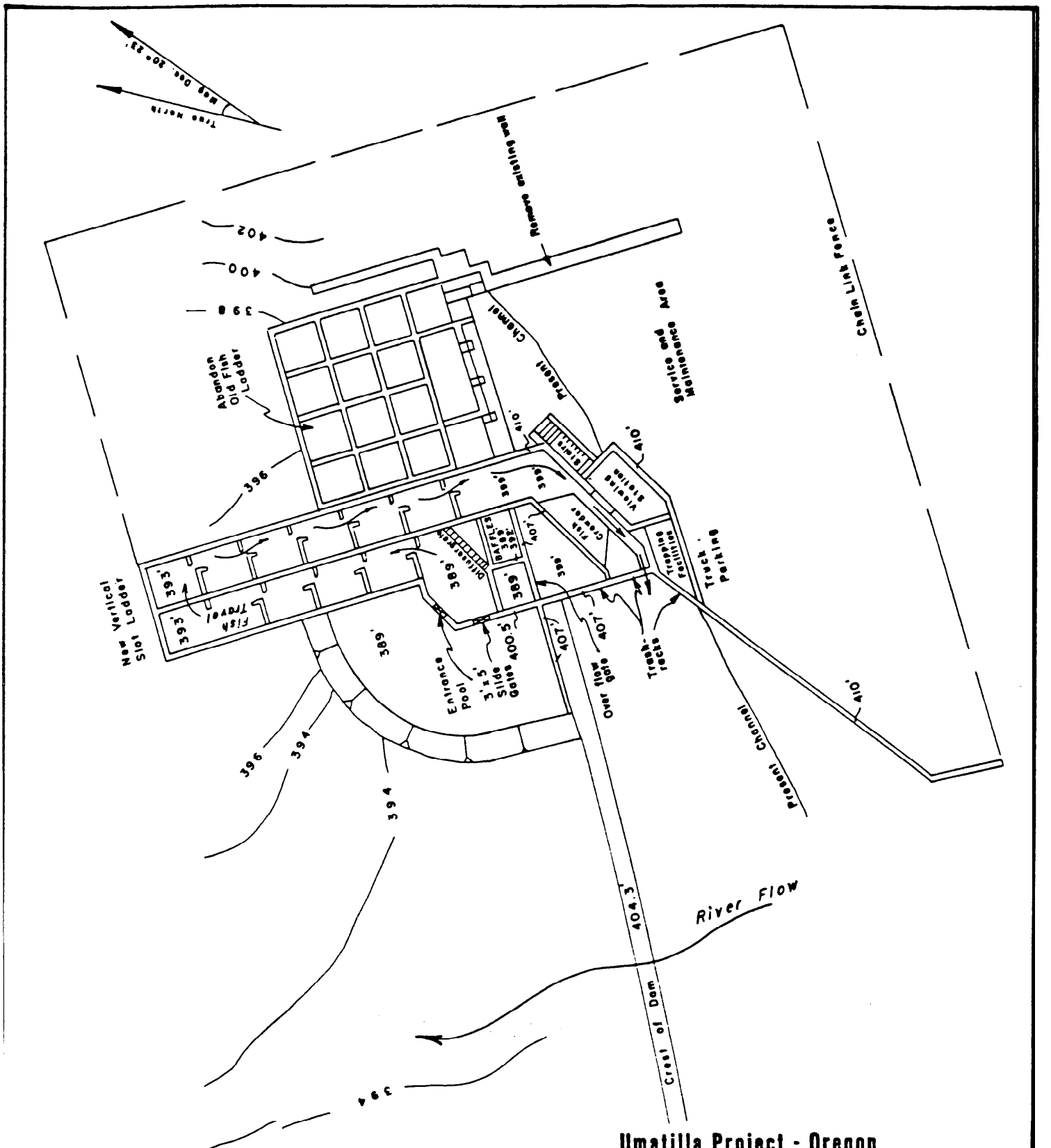
Right Bank Ladder.--The main feature of this alternative would be the construction of a new right bank ladder to improve fish passage. In addition, this alternative includes modifications to the existing left bank ladder and the installation of rotary drum fish screens and related structures in the WEID Canal.

The right bank fish ladder would be located just left of the existing pool-and-weir fish ladder (which is inadequately designed by today's standards and would become inoperable), A second ladder of adequate design at the dam would prevent stranding and delay of adult migrants that would make their way to the right side due to attraction flows over the dam. The new ladder would be a vertical slot design with a 15-inch-slot opening and a 10:1 sloping floor. Ten pools would be needed, with pools being 8 feet wide and 10 feet long. The overall length of the structure would be about 100 feet, with about 75 feet extending downstream from the crest of the dam (see design drawing).

An entrance pool would be excavated in the rock in front of the entrance structure. The entrance structure would have two gates, one for low flow conditions and one for high flow conditions. However, only one gate would be operated at any one time. Improved channels would be excavated downstream and along the toe of the dam leading to the two entrance gates, and secondary channels and potholes would be capped to facilitate better access to the entrance structure.

Auxiliary water to the entrance structure would be supplied by an overflow gate. The water would spill over the gate into a separate pool, through a baffle structure, and then through a diffuser grate before entering the entrance structure,

The exit structure would have a viewing station for viewing and counting fish, a fish crowder, and a trapping and sampling facility. The exit would be approximately 60 feet left of the exit for the existing pool-and-weir ladder which will help minimize the amount of silt accumulation, A retaining wall



Umatilla Project - Oregon

THREE MILE FALLS DIVERSION DAM

FISH PASSAGE & PROTECTION FACILITIES RIGHT BANK FISH LADDER

U.S. Bureau of Reclamation March 1985 30-100-5568

would extend upstream of the exit structure for ease of maintaining an open exit channel. Silt removal in the exit channel and debris removal from the dam crest and channels immediately downstream are essential maintenance tasks necessary to keep the fish ladder functional.

Adult fish could be trapped as they pass through the exit channel just beyond the viewing station. Fish would be diverted into a separate holding pool instead of being allowed to pass into the river. This would be done by controlling a set of hydraulically operated slide gates. Once in the holding pool the fish would be moved into a portable tank by a crowding mechanism. The tank would then be lifted from the holding pool by an elevator system and raised high enough to sluice the fish from the portable tank into fish transport trucks.

Grating over the structures as well as chain link fence around the entire facility would be provided to prevent poaching and vandalism.

Left Bank Ladder Modifications.--The left bank ladder modifications would include a new entrance structure, Improved auxiliary water supply, a viewing and counting station, a fish crowder, and a trapping and sampling facility. The vertical slot ladder itself would not be changed, since it meets current state-of-the-art design criteria. .

In order to modify the existing fishway exit and entrance, the top of one of the arch buttresses would be removed. The old auxiliary water supply pipe and existing bypass pipe would be removed as well. Much of the existing entrance and exit would be renovated. Trashracks would be required across the exit to the fishway and the entrance to the auxiliary water supply. New trashracks would replace existing ones across the canal entrance.(see design drawing).

The trapping and sampling facility would operate in a similar manner as the facility on the right bank ladder. However, tank trucks would not be able to park adjacent to the structure. Tank trucks would load from a location just downstream of the gatehouse, which avoids the use of the canal bridge. A long sluice system would be used to transfer fish from the elevated portable tank to the trucks.

Grating would be placed across open structures to prevent poaching. Access is limited to this side by existing locked gates on the canal access road, so additional chain link fence is not required.

Silt removal would be required to keep the fish ladder operational as well as debris removal from the exit, entrance, and immediate channels downstream.

WEID Canal Fish Screens.--A new fish screen structure would be located on the WEID Canal just downstream of the existing gatehouse. The existing louver screens in the canal entrance would be removed since they would no longer be needed. The new facility would include seven rotary drum fish screens, each 10 feet in diameter and 12.5 feet long, oriented at an angle of 25" to the canal flows (see design drawings). The total length of the fish screen structure would be 110 feet. The screens are designed to handle flows of

Umatilla Project - Oregon

THREE MILE FALLS DIVERSION DAM

FISH PASSAGE & PROTECTION FACILITIES

LEFT BANK FISH LADDER MODIFICATION

Umatilla Project - Oregon

THREE MILE FALLS DIVERSION DAM

FISH PASSAGE & PROTECTION FACILITIES

FISH SCREENS

10 0 10 20

SCALE IN FEET

310 ft^3/s (which is the design capacity of the canal). Since actual usage averages only 210 ft^3/s during the peak month of the irrigation season and the existing capacity is only 270 ft^3/s due to settlement of the canal, a new lower design flow may be chosen before the final design stage.

The screening facilities include a single entrance bypass structure with a pump-back system to return a large portion of the bypass water back to the canal. This is needed especially during low flows to optimize water usage. A juvenile sampling structure would be located between the bypass structure and the Umatilla River.

The WEID has been issued a preliminary permit by the Federal Energy Regulatory Commission to study the feasibility of installing a powerplant in the town of Umatilla. Water to run the new generator would be diverted at Three Mile Falls Diversion Dam through the WEID Canal. Since the powerplant would primarily be operated during the winter and spring months, some concern has been raised over potential conflicts between operation of the powerplant and winter operation of the new screens, which would be subject to the formation of frazil ice during periods of cold weather.

The possibility of using an advanced louver system, methods of operating the drum screen during cold weather, and winter operating constraints and responsibilities will be addressed during preparation of final designs and specifications.

Operating Plan

The ideal operating flow for each ladder is 85 ft^3/s. This condition provides the desired attraction velocities through the entrance gate to attract the fish. This flow is made up of 45-60 ft^3/s from the ladder (depending on flows over the crest), with the remaining flow being made up from the auxiliary water supply system. The ladders are designed to operate at flows up to 6,000 ft^3/s passing the dam. During low flows over the crest (when not enough water is available to operate two ladders satisfactorily), only the right bank ladder would be in operation. If no flows are going over the crest, then only the left bank ladder would be operational, provided there would be enough water to attract the fish and pass them up to the dam from downstream. Both ladders would successfully pass fish at flows of less than 85 ft^3/s.

The fish screen structure will handle 310 ft^3/s at velocities of 0.5 feet per second (ft^3/s); however, historical irrigation usage has been an average of 210 ft^3/s in any month. The bypass structure will take approximately 65 ft^3/s under normal conditions; however, the pump-back system is capable of pumping 62 ft^3/s back into the canal if needed. Only 4 or 5 ft^3/s are required to operate the sampling structure and to pass juveniles to the river. However, additional water from the dam or ladders is needed to safely carry the juveniles downstream unless they are trapped and hauled by truck.

costs

The construction costs for the new right bank ladder, the left bank ladder modifications, and the fish screen facilities are estimated to be $3,475,000. This includes $1,060,000 for the right bank fish ladder,

$605,000 for the left bank ladder modifications, and $1,810,000 for the fish screen facilities.

Annual operation and maintenance costs would be $21,000 for the right bank ladder, $25,000 for the left bank ladder, and $20,000 for the fish screen facilities--a total of $66,000.

Construction and annual operation and maintenance costs are based on an October 1984 price level.

Concrete Apron Plus West Ladder

Description of Facilities

This alternative would consist of a training wall (barrier) and apron constructed downstream of the dam, modifications to the left bank ladder, and new screens and related structures in the WEID Canal (see design drawing).

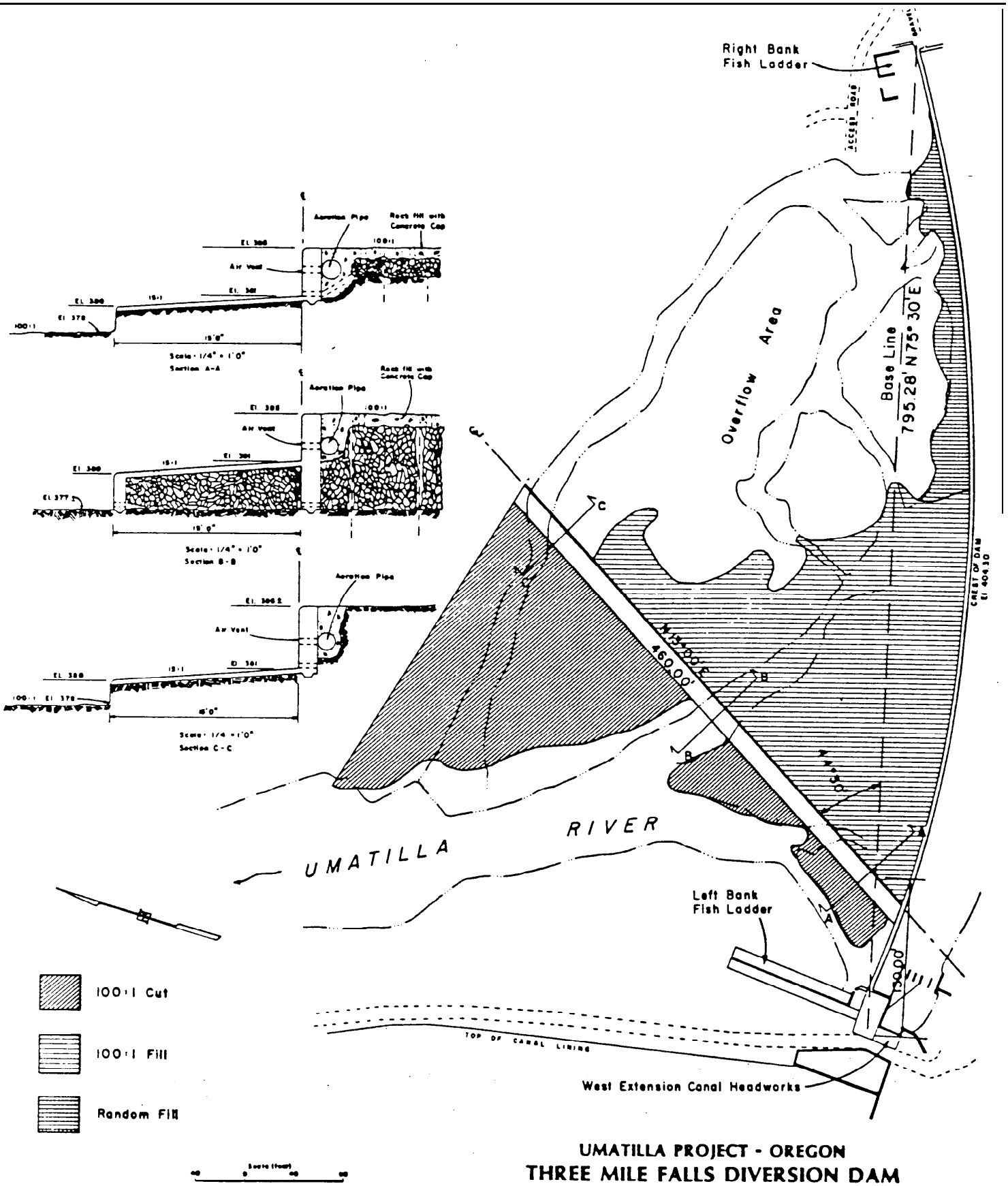
The barrier would consist of a 460-foot-long, 4-foot-high concrete wall with a 15-foot-wide concrete apron, constructed along the interface of the river channel and the overflow area downstream of the dam. The barrier would train upstream migrating adult fish toward the entrance to the fish ladder on the left bank and would prevent fish from reaching the east side of the dam where they are subject to injury, stranding, and poaching. The upstream area would be filled with rock and capped with concrete to eliminate fish resting areas and to reduce trash accumulation. In order for the barrier to function properly, the barrier, fill, and cut areas must be kept clear of debris.

The concrete barrier wall would be equipped with an aeration piping system. This would reduce the differential pressure created beneath the overflowing nappe. The fill area would have drain pipes to reduce uplift pressures and steel anchors to reduce erosion of the fill rock.

The left bank ladder modifications and the fish screen structures would be the same as described under the two-ladder alternative.

Operating Plan

The barrier and apron would operate effectively under a range of flow conditions. However, the structure was designed such that velocities on the apron would be about 16 ft/s at a flow of 3,000 ft^3/s. This velocity would make it difficult for fish to get on the apron. Those fish that did get on the apron would have to continue to swim against the high velocity to the upstream end of the apron. Here they would find it difficult to jump the 4-foot-high wall since flow depth on the apron would be too shallow for them to obtain vertical acceleration. At any time, if a fish would turn broadside to the flow, it would be swept off the apron. Any fish which would manage to pass the barrier would eventually be swept back into the main river channel since the area between the barrier and the toe of the dam would be filled to eliminate holes and pools where a fish could rest.



UMATILLA PROJECT - OREGON
THREE MILE FALLS DIVERSION DAM
FISH PASSAGE & PROTECTION FACILITIES
FISH BARRIER AND APRON

U.S. Bureau of Reclamation April 1985 30-100-5569

Only the left bank ladder would be operational under this scenario. The operation of the left bank ladder and fish screens would be the same as described under the two-ladder alternative.

costs

The construction costs for the fish barrier and apron, the left bank ladder modifications, and the fish screen facilities are estimated to be $3,560,000. This includes $1,145,000 for the barrier and apron, $605,000 for the left bank modifications, and $1,810,000 for the fish screen facilities.

Annual operation and maintenance costs would be $7,000 for the barrier and apron, $25,000 for the left bank ladder, and $20,000 for the fish screen facilities--a total of $52,000.

Construction and annual operation and maintenance costs are based on an October 1984 price level.

Cap-on-crest Plus West Ladder

Description of Facilities

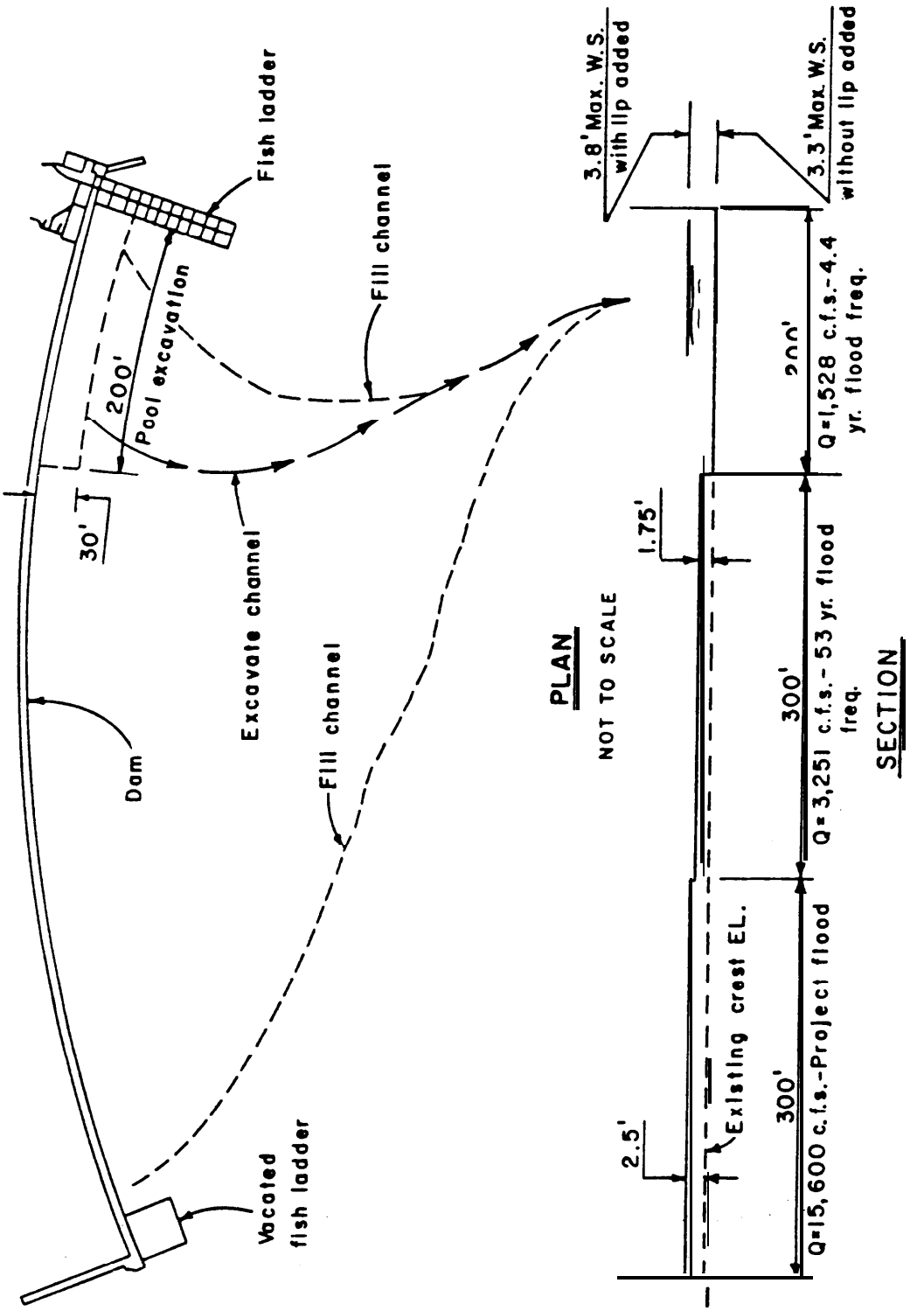
A cap on the east and center portions of the dam would be the key features in this alternative. Other features would include modifications to the left bank ladder and new fish screens and related structures in the WEID Canal (see design drawing).

A 2.5 foot-high cap would be constructed on the dam crest for a 300-foot length starting from the east (right) side. A center section would have a 1.75-foot cap for another 300 feet. The west 200 feet of the dam would be left without a cap, During low flow conditions (generally from July through February), fish attraction waters would be directed to the left bank fish ladder, Water cresting the dam would spill into an entrance pool which would be constructed along the face of the dam for the entire 200 feet of the uncapped section. A new channel would be constructed from the east end of the pool. Old channels would be filled in and capped with concrete to prevent stranding and delaying of upstream migrants.

Debris removal from the dam crest, left bank fish ladder entrance and exit, and the canal entrance would be essential for proper operation of all facilities,

The operation of the left bank ladder and fish screens would be the same as described under the two-ladder alternative. The existing right bank pool-and-weir ladder would be inoperable under this alternative.

The cap-on-crest alternative would present a number of problems that would require further investigation. This alternative would result in an approximate l/2-foot increase in the maximum pool elevation behind the dam, which would require flow routing studies to determine whether the WEID Canal headworks and left fish ladder exit would need to be raised. The weight of the proposed cap may affect the structural stability of the dam. Core samples



Umatilla Project - Oregon
THREE MILE FALLS DIVERSION DAM
FISH PASSAGE & PROTECTION FACILITIES

CAP ON CREST

from the dam would be taken to determine any need for additional structural support to the dam.

Operating Plan

With the cap on the crest, flows would be directed to the west portion of the dam during low flow conditions.3 The noncapped section of the dam would be able to handle flows up to 1,528 ft^3/s, and with the middle section, flows could increase to 3,251 ft^3/s. Above 3,251 ft^3/s flows would start cresting the east- capped section of the dam as well. At 15,600 ft^3/s, the cap would raise the water surface behind the dam by 0.5 feet over current conditions.

The left bank fish ladder and bypass structures would. require up to 85 ft^3/s and 65 ft^3/s, respectively, as described under the two-ladder alternative.

costs

The construction cost for the cap-on-crest, the left bank fish ladder modifications, and the fish screen facilities are estimated to be $2,985,000. This includes $570,000 for the cap on the dam, $605,000 for the left bank modifications, and $1,810,000 for the fish screen facilities.

Annual operation and maintenance costs would be $10,000 for the cap-on-crest, $25,000 for the left bank ladder, and $20,000 for the fish screen facilities--a total of $55,000.

Construction and annual operation and maintenance costs are based on an October 1984 price level.

Dam Removal

Description of Facilities

This alternative would require the construction of a new pumping plant at the mouth of the Umatilla River to supply water to the WEID Canal. Fish passage in the river would be improved by restoring the river channel to predam conditions. This would require the removal of a portion of the dam and bedrock and/or silt removal behind the dam. No fish ladders would be required, and the canal headworks would be abandoned. Water normally diverted at the dam for irrigation would be allowed to pass downstream for improved fish flows, particularly during low flow conditions and high fish migration.. Water for the WEID Canal would be supplied by the pumping plant.

A new pumping plant would be constructed near the mouth of the Umatilla River at the present pumping site. Existing features are obsolete and would be entirely replaced. The new plant would have a capacity of 6,500 horsepower and would be able to lift 270 ft^3/s (present canal capacity) 150 feet to the existing canal structure. The forebay channel would need to be deepened, discharge lines replaced, and a new outlet structure built.

Approximately one-third of the dam would have to be removed to restore the channel to predam conditions. The other portions of the dam and related

structures would be left in place and abandoned. Some of the silt behind the reservoir would be removed to prevent environmental problems downstream. The quantity of silt that would be removed and the amount left to flush downstream are not known at this time.

Operating Plan

WEID would obtain all its water supply from pumping from the mouth of the Umatilla River. A portion of this supply would have to be pumped back toward Three Mile Falls Diversion Dam. However, most of the needs are downstream from this point. The maximum capacity of the pumping plant is 270 ft^3/s, which is more than current supply (however, less than existing water rights).

Water normally diverted for irrigation at Three Mile Falls Diversion Dam would be allowed to pass downstream to improve fish passage flows in the river.

costs

The construction costs for the pumping plant and dam removal are estimated to be $8,280,000. This includes $7,900,000 for the pumping plant and related structures and $380,000 for removal of a portion of Three Mile Falls Diversion Dam. This includes a limited amount of silt removal.

Annual operation and maintenance costs were not calculated for this alternative. Construction costs are based on an October 1984 price level.

A comparative summary of plans is found in table 3.

Table 3.--Comparative Summary of Plans

Item	Two Fish Ladders	Concrete Apron Plus West Ladder	Cap-on-crest Plus West Ladder	Dam Removal
Advantages	Technology proven on ladder design Reduces stranding of fish Offers most versatility for operation, trapping, and counting Improved attraction water to both ladders Improved passage to and through left bank ladder Canal screens included	Facilitates debris removal from face of dam Would only require operation and maintenance on one ladder Addition of counting/ trapping facilities in right bank ladder Canal screens included	Least costly alternative Would only require operation and maintenance on one ladder Improved attraction to right bank ladder Addition of counting/ trapping facilities in right bank ladder Canal screens included	Would provide most natural conditions for fish passage which would cause, least stress on fish (assuming adequate flows in river and channelization in reservoir area if needed)
Disadvantages	High operation and maintenance (debris and silt) potential on left bank ladder	Hydraulics of barrier unknown without model testing Debris or unfavorable hydraulics may create pockets of false attraction flows, resulting in adult migration delay	Potential for excessive debris problem at canal headworks Possible safety of dams problem Canal headworks would need to be raised due to raise in maximum reservoir water surface	Most expensive alternative Pumping costs may increase in future Loss of trapping/ counting opportunities at Three Mile Falls Diversion Dam Environmental impacts more severe than other alternatives
Total construction costs	$3,475,000	$3,560,000	$2,985,000	$8,280,000
Operation, maintenance, replacement, and power costs	$66,000	$52,000	$55,000	Not calculated

DEVELOPMENT OF ALTERNATIVES AND SELECTION OF RECOMMENDED PLAN

The various fishery agencies, the Umatilla Indian tribes, and the WEID were involved in the selection of the recommended plan.

During the preparation of the biological assessment in mid-1984, seven conceptual alternatives were defined by the agencies and Indians. Three of these alternatives were eliminated early in the planning stage; a discussion of this process is found in the following section. More detailed engineering designs and cost estimates were done on the remaining four alternatives just discussed. Preliminary designs and cost estimates were presented to the WEID in mid-February 1985 and to the fishery agencies and Indians in late February.

The representative from the WEID (Mr. Darrell Dick) favored the Concrete Apron Plus West Ladder alternative because it was felt that the apron would facilitate debris removal from the face of the dam and would be somewhat self-cleaning. The representative also expressed that the Cap-on-crest Plus

West Ladder alternative would be undesirable because of significantly increased debris problems at the canal headworks. Also, since this plan would result in a slightly higher reservoir pool level during high flows due to reduced spillway width, the canal headworks would probably have to be raised. The WEID's main concern with the two-ladder plan is the question of operation and maintenance funding and responsibility. The construction of a new ladder on the right bank could cause difficulty in access along the face of the dam for maintenance work.

The fishery agencies and Indians have unanimously endorsed the two-ladder plan. However, the U.S. Fish and Wildlife Service, CTUIR, and Columbia River Intertribal Fish Commission initially indicated a preference for dam removal. Since this alternative is much more costly than the other alternatives, they chose the two-ladder plan as their recommended plan. Within the ODFW, some people initially indicated a preference for the concrete apron plan because there would be less effort involved in counting and trapping fish with only one ladder. However, several people expressed concern over the effectiveness of the barrier. It was felt that there was high potential for the creation of pockets of high flows along the face of the barrier, which would attract fish and create delays in upstream migration. Conversely, the technology and effectiveness of the fish ladders are proven.

No preference was shown for the Cap-on-crest alternative.

Based on the above, the two-ladder plan has been chosen as the recommended plan. WEID's concern for a means of access to the face of the dam will be addressed during final design work.

Copies of letters from the various agencies and Indians summarizing their positions on the alternative items are found in the appended material.

OTHER PLANS CONSIDERED

Three other alternatives were considered in the earlier stages of this study but were eliminated for various reasons. These alternatives were (1) right bank ladder only; (2) ladder at new location (i.e., middle of dam); and (3) center cap-on-crest with sill-type ladder on east side. The East Ladder only alternative was eliminated because it would abandon the best (left bank) existing ladder, and it was thought that a single ladder was not sufficient to meet fish passage problems. The middle ladder alternative was eliminated because of access and maintenance difficulties, particularly when trapping and counting fish. A middle ladder would require more water to operate and would be more costly than a bank ladder due to additional height and strength requirements. The sill-type ladder was omitted because it would be more difficult to regulate flow, debris in the ladder would be a major problem, and trapping and sampling facilities would not be available.

DATA NEEDS FOR FINAL DESIGNS AND CONSTRUCTION

A variety of data must be collected and analyzed before final designs can be prepared and construction begun. Additional control surveys and topographical mapping are needed at each ladder and fish screen structure. Surveys are

needed to establish river cross sections above and below the darn and canal cross-sections and profiles above and below the screen site. Geological investigations are needed to explore foundation conditions at each structure to locate possible borrow sources and to locate sites for disposal of waste materials. Hydrologic records and analyses are needed to develop water surface profiles above and below the dam and the screen site. Also, a flood frequency analysis needs to be prepared for the site, and operational data needs to be analyzed before final designs and specifications can be determined.

Records of all construction at and within the construction area of the ladders and screens need to be examined to determine how new construction should tie into existing facilities, to locate possible utilities, to establish access routes, and to locate rights-of-way.

Stream maintenance requirements during construction of the fishways need to he determined.

IMPLEMENTATION AND OPERATION AND MAINTENANCE

Permits and Clearances

Prior to any construction, Reclamation will submit a joint Application for Permit to both the Army Corps of Engineers and State of Oregon, Division of Lands. This will comply with both section 404 of the Clean Water Act and appropriate State regulations for removal or filling of materials in waterways.

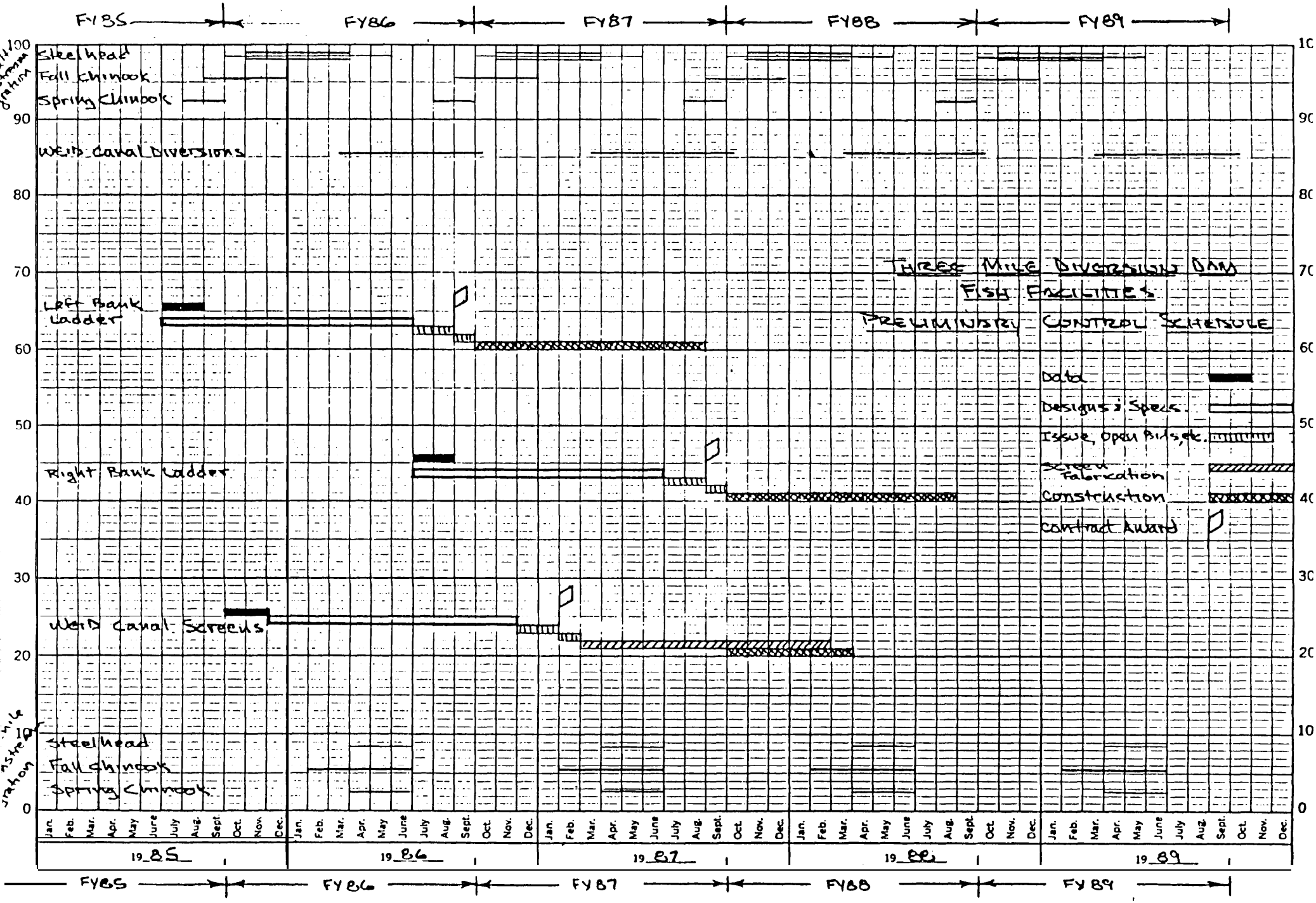
As part of this process, Reclamation will also comply with any local regulations governing alterations and/or development within a flood plain..

Construction Schedule

BPA proposes to fund construction of fish passage and protective facilities at Three Mile Falls Diversion Dam. The construction schedule (on the following page) was developed to provide continued operation of at least one ladder at all times. Design data for the left bank ladder modifications would be collected in July. and August of 1985, and preparation of final designs and specifications would begin at the same time. The construction contract would be awarded in September 1986, and the modifications would be complete by September 1987. The schedule for the right bank ladder would be the same as the left bank ladder except that it would be 1 year later, with completion in September 1988. Some trapping and hauling of fish during construction may be required to supplement passage through whichever ladder is operating at the time. Both ladders would be fully operational for the fall and winter 1988 upstream migration period.

This construction schedule is contingent upon securing funds for construction and upon input and review from appropriate fishery agencies and the CTUIR in a timely manner to complete the designs.

Design data for the WEID Canal screens would be collected in October and November 1985. Preparation of final designs and specifications would start in


FY85
FY86
FY87
FY88
FY89
Steelhead
Fall Chinook
Spring Chinook
Weir Canal Diversions
Left Bank Ladder
Right Bank Ladder
Weir Canal Screens
Steelhead
Fall Chinook
Spring Chinook
THREE MILE DIVERSION DAM
FISH FACILITIES
PRELIMINARY CONTROL SCHEDULE
Data
Designs & Specs.
Issue, Open Bids, etc.
Screen Fabrication
Construction
Contract Award
100
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December 1985. The construction contract would be awarded in February 1987. Fabrication of screens would begin at that time. Construction of the screen structure would start in October 1987 and would be complete by March 1988.

Operation and Maintenance Costs and Responsibilities

Present operation and maintenance responsibilities are shared between WEID, ODFW, and NMFS. The WEID is responsible for debris removal along the face of the dam and from the louvers. The district has no responsibility for operation and maintenance activities on the right bank ladder. Estimated annual operation and maintenance expenses borne by WEID are $10,500, which includes $9,000 per year for labor (wages) and $1,500 for minor and ordinary maintenance and repair on gates, the louvers, and other structures. About once every 8 to 10 years the district removes silt from just upstream of the east abutment and snags and other debris from the dam crest at an estimated cost of $4,000.

The right bank ladder was reopened in 1984 after being out of service for 20 years, The left bank ladder is used to trap and count fish by partially dewatering it and dip-netting individual fish and passing them over the dam, The ODFW has responsibility for this activity, which requires about 50 man-days per year to accomplish.

The louvers were constructed by NMFS in 1961. Funding for annual maintenance and repair is passed to ODFW from NMFS in a program that includes fish screens throughout the Columbia Basin, No funding estimates are available for operation and maintenance on the louvers.

BPA will fund design and construction of fish passage and protective facilities at the dam, and informal indications are that they will provide operation and maintenance funds perpetually. Specific operation and maintenance responsibilities have not been identified at this phase of the project. Estimated annual operation and maintenance costs for the facilities outlined in the recommended plan are about $66,000. It is assumed that Reclamation would be responsible for overseeing operation and maintenance activities. One possibility under consideration is to include the operation and maintenance function in the Yakima fish passage facilities program since Three Mile Falls Diversion Dam is reasonably close to the Yakima Project.

Resolution of the various questions regarding operation and maintenance of fish passage facilities at Three Mile Falls Diversion Dam should be a top priority as this project moves into the final design phase.

ENVIRONMENTAL CONSIDERATION AND NEPA COMPLIANCE

Environmental Considerations

Constructing fish ladders and fish screening structures at Three Mile Falls Diversion Dam would be classed as a minor construction activity and would have only minor, short-term, and localized negative environmental

effects. None of these effects would be considered significant. The effects of the proposed construction would be limited to four environmental parameters --air quality, water quality, noise, and fish and wildlife.

Increases in dust and exhaust emissions at all sites would be minor during construction and would result from operation of equipment. These increases would be limited to the immediate area near the construction sites and would be insignificant.

Construction of the fish ladders and fish screens would require constructing cofferdams or other type barriers to dewater the construction sites. This activity would cause short-term and minor increases in turbidity downstream. However, the increase in turbidity would disappear within a few hours after completion of the activity as the natural streamflow cleansed the area.

A minor and short-term increase in noise levels would occur in the immediate area of the construction site. There are no residential areas in the immediate vicinity of the dam, and noise levels are already somewhat high from falling water and traffic on a nearby highway. The increased noise levels during construction would not be significant.

Noise and human activity in the immediate area of construction at each site may cause the temporary displacement of a few animals sensitive to this activity. Construction of the ladders and screens would correct existing passage problems which now result in substantial mortality and delay of fish as they attempt to pass Three Mile Falls Diversion Dam. This action would help rebuild the severely depleted anadromous fish runs in the Umatilla River basin.

Construction of the fish ladders and screens would not change the existing land use which is diversion of water for agricultural purposes. The proposed action would not have any effect on any wild and scenic river, national trail, designated or proposed wilderness area, or threatened or endangered species.

NEPA Compliance

The Bureau of Reclamation and BPA are coordinating the preparation of an environmental assessment, which wi 11 be ready for public review during late summer 1985. If this environmental assessment supports a Finding of No Significant Impact (FONSI), the FONSI document will be completed by late October 1985.

COSTS DEVELOPMENT

Construction costs shown in this report are total construction costs based on an October 1984 price level and include allowances for contingencies, engineering, and supervision during construction. These costs were developed by applying unit prices to quantity estimates developed from preliminary layouts and designs. Ladder and screen layouts and designs were developed in cooperation with ODFW and NMFS. Ladder and screen layouts and designs were

also based on Reclamation fish passage and protective facilities being constructed on the Yakima River Basin Project, Washington. Designs reflect the current state-of-the-art for fish passage and protection for this size of project. Quantities for rotary screen and pumpback estimates in this report are based on the specification drawings for the Sunnyside screen facility and adjusted as necessary for site-specific conditions.

The costs developed in this report are the best available at the present time and should provide an adequate cost estimate for project construction. Some items that may be required in final designs were not evaluated in this study. Among other things, these could include a check structure downstream of the fish screens to help regulate the flows in the canal, filling in the bays of the dam to prevent stranding if fish should still be inclined to "jump" the dam, and repair of seepage problems to the canal downstream of the fish screen structure.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The provision of adequate fish passage and protective facilities at Three Mile Falls Diversion Dam would be a highly important step in the process of enhancing Steelhead runs and reestablishing chinook salmon runs in the Umatilla basin.

Recommendations

It is recommended that final designs and specifications on the recommended plan and NEPA compliance requirements be completed as outlined in the enclosed schedule and construction be initiated as proposed. This objective is in keeping with the recommendations of the Northwest Power Planning Council in its Fish and Wildlife Program and with the goals of the ODFW and Columbia River Intertribal Fish Commission in reestablishing chinook salmon runs in the Umatilla basin.

LITERATURE CITED

1. Northwest Power Planning Council, Columbia River Basin Fish and Wildlife Program. Adopted pursuant to Section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501). November 15, 1982.

2. Bonneville Power Administration. Letter to Bureau of Reclamation dated January 13, 1984.

3. Van Cleve, R. and R. Ting. 1960. The Condition of Salmon Stocks in the John Day, Umatilla, Walla Walla, Grande Ronde, and Imnaha Rivers.

4. Confederated Tribes of the Umatilla Indian Reservation. 1984. Umatilla River Basin Recommended Salmon and Steelhead Habitat Improvement Measures.

5. National Marine Fisheries Service, Portland, Oregon. 1981. Use of Louvers for Downstream Migrant Protection. Unpublished Draft Paper.

6. Oregon Department of Fish and Wildlife. January 1985. Umatilla Rehabilitation Plan Review (Draft).

APPENDED MATERIAL

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference RG:mm

July 6, 1984

Recipient:

This is the final biological assessment of anadromous fish passage problems at Three Mile Falls Diversion Dam, Umatilla River, Umatilla County, Oregon. The assessment describes: 1) existing and future anadromous fish resources of the Umatilla Basin; 2) current fish passage facilities and passage problems at Three Mile Dam; and, 3) eight alternative actions under two flow conditions (present and future). Future flow conditions are those that would exist with two potential flow enhancement projects--one by the Corps of Engineers and one by the Bureau of Reclamation. These projects are briefly described as they relate to flow-conditions at Three Mile Dam.

The purpose of the assessment is to provide the biological aspects of fish passage problems under the above conditions. This information is being provided to the Bureau of Reclamation for its use in development of a structural feasibility/preliminary design study of passage problems and solutions at Three Mile Dam. The study will also include engineering and economic information and will be submitted to the Bonneville Power Administration for possible funding under the Northwest Power Planning and Conservation Act. The assessment is in outline form to assist the Bureau in preparation of its study.

Both written and/or verbal comments were received from the Oregon Department of Fish and Wildlife, National Marine Fisheries Service, Confederated Tribes of the Umatilla Indian Reservation, and the Bureau of Reclamation. The final assessment has been refined and updated as a result of internal review and comments on the draft assessment.

We look forward to your continued interest and cooperation in protecting and restoring anadromous fish resources in the Umatilla River Basin.

Sincerely,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

BIOLOGICAL ASSESSMENT

BIOLOGICAL ASSESSMENT, FISH PASSAGE AT THREE MILE FALLS DIVERSION DAM, UMATILLA RIVER

I. Three Mile Falls Diversion Dam

A. Purpose and Function of Dam

Three Mile Falls Diversion Dam is located on the Umatilla River approximately 3 miles south of Umatilla, Oregon. The structure is a concrete buttress dam with a maximum height of 24 feet, hydraulic height of 23 feet, and a crest length of 915 feet. The dam was constructed by the U.S. Bureau of Reclamation (BR) in 1914 as an integral part of the Umatilla Project. It diverts water to the service area of the West Extension Irrigation District (WEID) through a 27-mile-long main canal. The canal headworks capacity is 375 cubic feet per second (cfs) and the canal -capacity is 310 cfs. The historic peak diversion has been 305 cfs with maximum canal flows averaging about '210 cfs over the past 50 years. The diverted water is used to irrigate about 7,000 acres of farmland.

B. Ownership, Operation, and Maintenance Responsibility

The dam is owned by the BR with operation and maintenance responsibilities being handled by the WEID. Provisions for operation and maintenance are handled under contract between the two agencies.

c. Diversion Dam Design and Flow Characteristics

The dam was designed to function as an overflow weir along its entire crest. During the normal irrigation season (April through October) the WEID 'diverts available river water to meet their demand, and passes the remainder over the dam crest. During periods of low flow, all the available water is diverted (up to the canal capacity), except for about 15 to 20 cfs released through the downstream migrant bypass pipe for downstream diversion at the Brownell site. When river flow is inadequate to meet irrigation requirements, additional water can be pumped into the canal from the Columbia River. This has not been done in the last few years because of the pumping costs.

During the non-irrigation season, all river flow in excess of fish ladder and bypass pipe capacity is passed over the dam. As the flows increase over the dam, the proportion of total

flow at the ladder entrance decreases. Figure 1 depicts the average flow conditions in the Umatilla River below Three Mile Dam over the 44-year period, 1935 to 1978. The photo on page 4 shows the design and operation of the diversion dam, with flows overtopping the crest along most of its length.

D. Existing Fish Passage Facilities

1. West Ladder, Trap, and Counting Facilities

The West Ladder on the left abutment of the dam is a vertical-slot type structure which was completed in August, 1964, It has 21, 8 foot by 10 foot rectangular concrete pools. The floor slopes and the slots in the pools go clear to the floor. The ladder is operated during periods of upstream anadromous fish migrations and utilizes about 20 to 40 cfs for ladder operation, depending upon forebay depths. When there is a difference of 20 feet between the forebay and tailwater, the ladder will operate with about 1 foot difference in water level between pools. A 12-inch diameter pipe routes water from inside the upper pool through a diffuser in the lower pool to provide additional attraction flows (about 15 cfs) for adult anadromous fish.

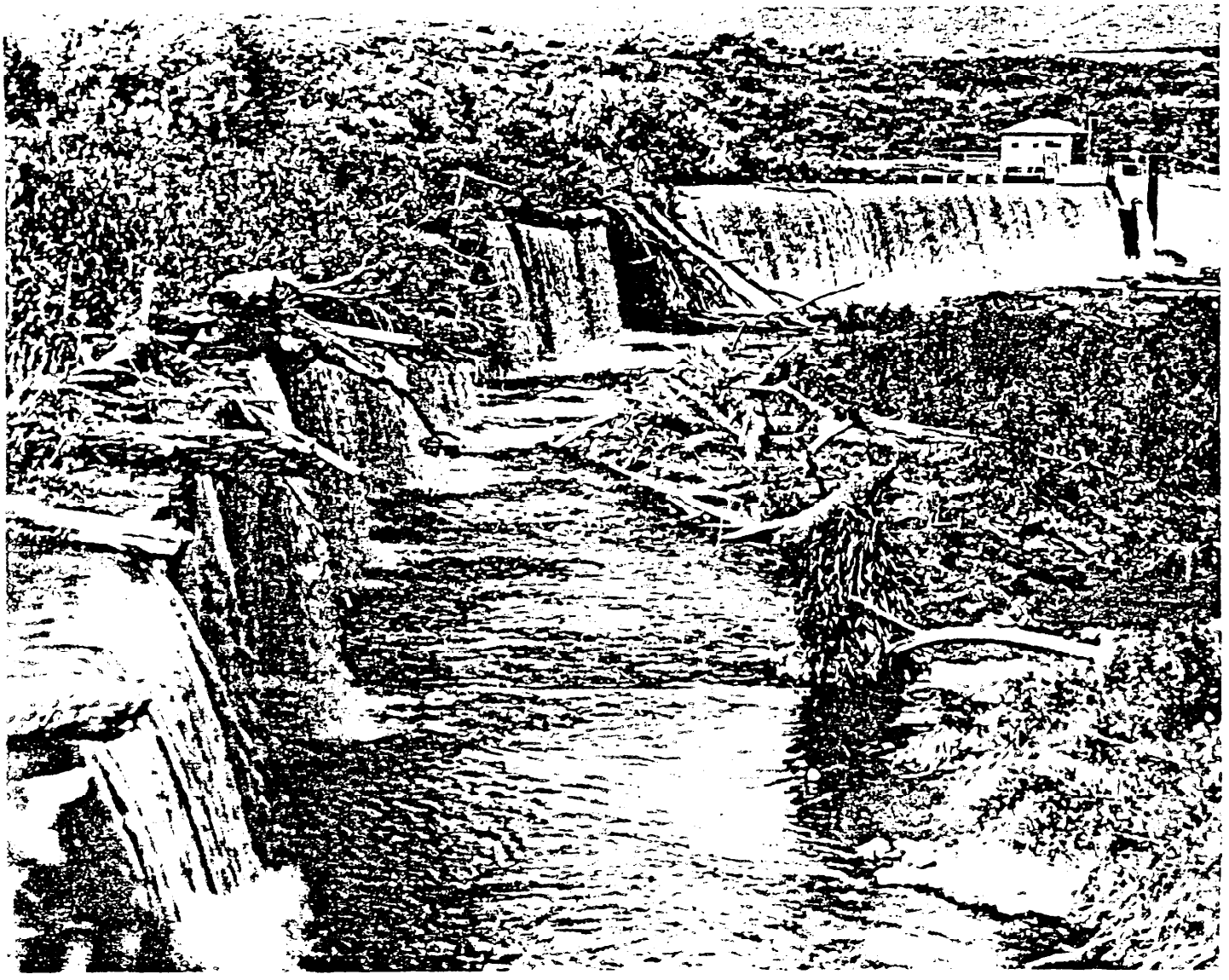
The ladder is not designed for trapping, counting, and holding adult anadromous fish. An electronic counter operated at the head of the West Ladder for several years but has nott been used recently This counter was difficult to calibrate and gave inconsistent results. Consequently, a temporary conduit, fyke-type trap is used in the upper four pools of the ladder for annual counting of summer Steelhead. The pools are then partially dewatered and the fish are individually dip-netted, counted, and passed over the dam, Steelhead broodstock selection (for the juvenile supplemental outplanting program) also occurs in this manner. Downstream juvenile migrants are passed either over the crest of the dam or through a bypass pipe that collects those fish which have been "screened" from the canal entrance. The bottom photo on page 5 shows the juvenile bypass pipe existing in the tailrace, and the West Ladder entrance.

i. West Extension Irrigation District Louver

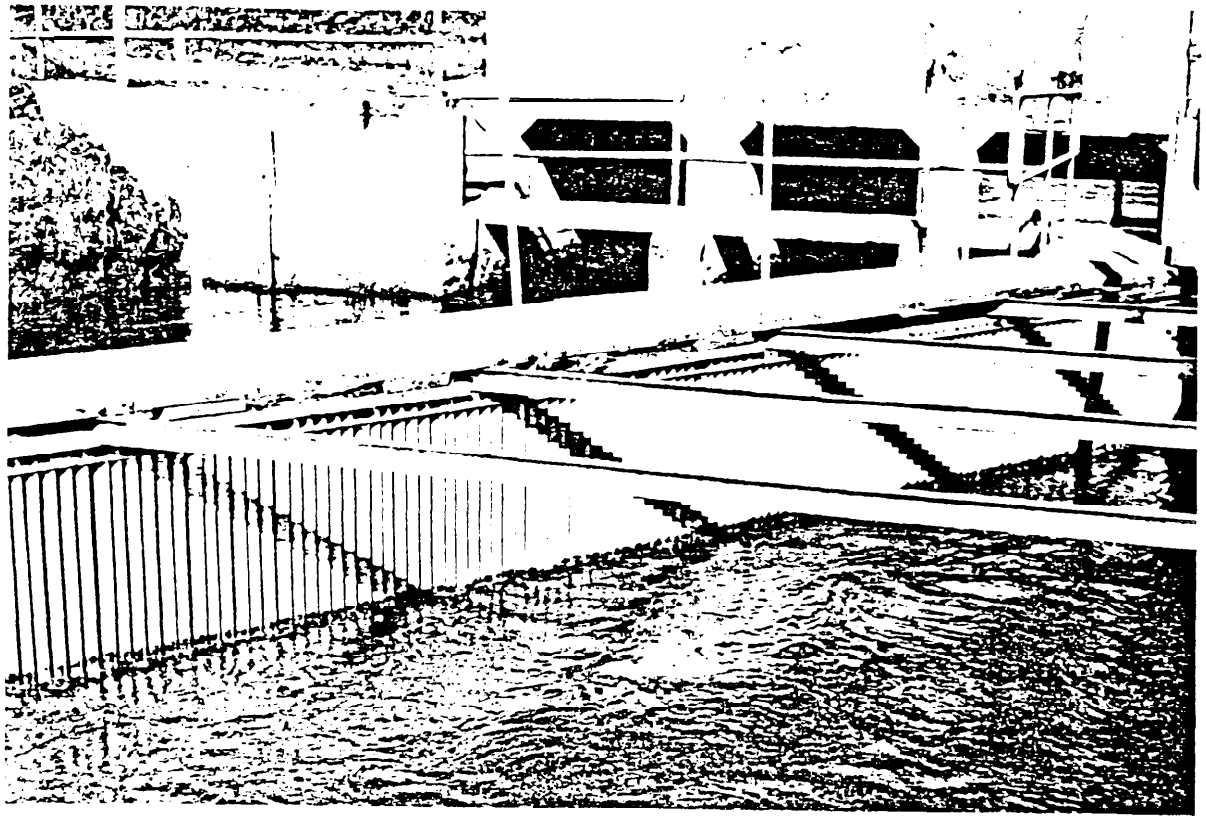
The louver is mounted at the intake of the WEID Canal at the west end of Three Mile Dam. It is approximately 30 feet long and consists of a series of fixed metal slats spaced about 1 to 2 inches apart. It prevents most Steelhead smolts from entering the canal and directs them to the entrance of the bypass pipe. The top photo on page 5 shows the louver system.

Figure 1. Average Monthly Flows Expressed in cfs Below Three Mile Dam for 44 Years of Record, 19341978

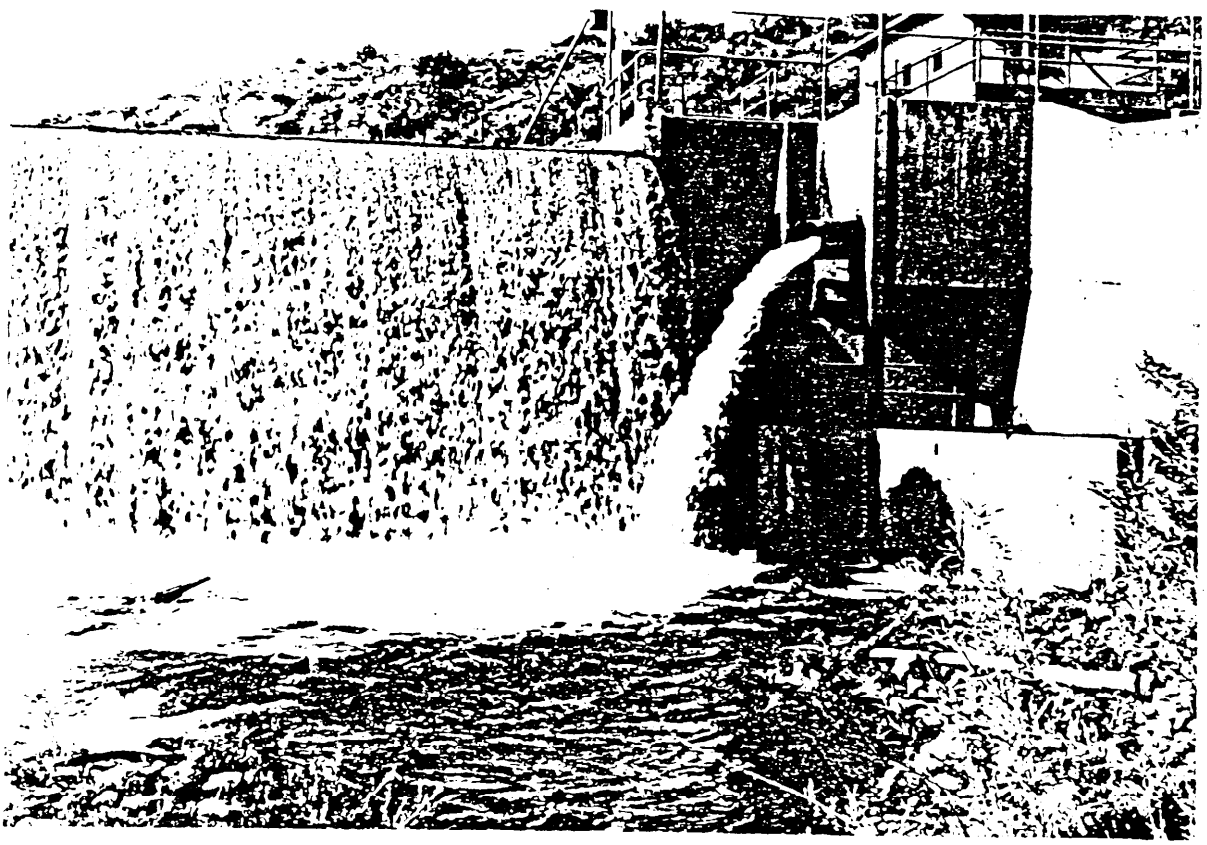
Year	Oct	Nov 15	Nov 30	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 15	Sep 30	Average
1935	5.	5.	13.	390.	322.	316.	188.	974.	109.	11.	15.	14.	9.	18.	195.6
1936	4.	84.	106.	88.	365.	289.	1082.	1513.	176.	13.	12.	10.	8.	13.	303.8
1937	9.	31.	84.	79.	51.	198.	578.	1206.	375.	50.	10.	26.	48.	28.	222.2
1938	33.	110.	161.	291.	275.	393.	1041.	1181.	95.	29.	25.	15.	27.	13.	293.2
1939	16.	79.	137.	174.	168.	283.	1560.	692.	48.	18.	38.	14.	5.	21.	261.3
1940	17.	105.	100.	110.	105.	987.	1391.	774.	17.	15.	22.	13.	13.	16.	292.5
1941	13.	128.	268.	484.	319.	117.	321.	11.	36.	211.	15.	41.	49.	68.	152.7
1942	210.	250.	867.	733.	545.	892.	739.	992.	855.	445.	148.	28.	81.	35.	514.0
1943	14.	138.	356.	1280.	1273.	1663.	1181.	2023.	957.	295.	54.	63.	52.	51.	752.1
1944	98.	188.	115.	122.	95.	202.	743.	1037.	148.	26.	22.	21.	40.	14.	223.7
1945	80.	101.	138.	115.	332.	946.	1000.	1267.	855.	91.	26.	32.	58.	42.	405.4
1946	43.	135.	618.	803.	749.	488.	1457.	1409.	535.	99.	48.	45.	151.	97.	515.0
1947	130.	163.	637.	1571.	820.	779.	832.	588.	15.	66.	35.	24.	32.	51.	440.7
1948	76.	645.	1030.	974.	888.	1066.	991.	2120.	3360.	551.	41.	56.	141.	77.	921.6
1949	138.	128.	217.	450.	226.	1584.	1963.	1872.	652.	31.	19.	35.	31.	43.	590.9
1950	44.	113.	157.	171.	521.	1462.	1490.	1363.	797.	804.	11.	51.	65.	45.	568.0
1951	140.	358.	325.	795.	1207.	1815.	1429.	1054.	217.	140.	32.	21.	33.	19.	593.7
1952	171.	181.	258.	344.	371.	882.	829.	1501.	430.	22.	26.	19.	37.	25.	399.6
1953	36.	72.	128.	117.	1007.	1369.	1123.	1481.	726.	417.	26.	68.	80.	71.	538.8
1954	92.	129.	167.	562.	436.	689.	456.	560.	13.	220.	24.	35.	46.	67.	271.1
1955	40.	207.	126.	131.	132.	189.	122.	737.	1478.	116.	27.	45.	52.	34.	269.6
1956	39.	184.	536.	1215.	1309.	742.	1703.	1376.	1107.	44.	14.	44.	28.	19.	666.4
1957	69.	221.	165.	583.	116.	833.	1499.	1407.	914.	39.	12.	36.	24.	12.	474.4
1958	161.	176.	210.	635.	715.	1875.	688.	3055.	980.	11.	8.	45.	47.	11.	688.6
1959	51.	262.	362.	948.	1378.	910.	894.	981.	318.	35.	19.	25.	111.	123.	497.1
1960	311.	192.	567.	160.	306.	587.	1132.	640.	726.	34.	17.	66.	65.	26.	366.2
1961	14.	152.	629.	215.	205.	1477.	1338.	405.	218.	24.	12.	25.	46.	17.	355.4
1962	15.	118.	176.	274.	513.	298.	699.	891.	441.	33.	19.	10.	27.	17.	280.1
1963	127.	146.	282.	452.	221.	1367.	440.	941.	332.	7.	8.	19.	11.	4.	336.9
1964	31.	155.	164.	165.	252.	331.	423.	936.	378.	66.	8.	15.	4.	12.	229.7
1965	26.	62.	116.	1887.	2316.	2254.	559.	1167.	176.	52.	34.	12.	5.	5.	706.2
1966	39.	73.	103.	103.	131.	139.	584.	289.	6.	6.	10.	6.	3.	3.	117.0
1967	11.	155.	48.	489.	810.	610.	241.	188.	619.	9.	5.	7.	7.	3.	257.0
1968	50.	122.	107.	502.	260.	1074.	164.	5.	4.	2.	4.	4.	3.	4.	176.5
1969	74.	256.	413.	456.	1331.	591.	854.	2188.	604.	54.	26.	12.	17.	50.	545.0
1970	127.	145.	115.	147.	1931.	1051.	1106.	942.	839.	25.	4.	5.	71.	19.	527.7
1971	118.	172.	286.	241.	1141.	916.	628.	602.	250.	198.	24.	18.	85.	35.	365.4
1972	85.	209.	307.	775.	866.	1636.	3677.	1023.	795.	42.	17.	16.	22.	24.	765.4
1973	108.	151.	120.	486.	548.	160.	208.	8.	7.	7.	5.	6.	7.	5.	141.3
1974	16.	466.	640.	1898.	2010.	1301.	1388.	2800.	1255.	296.	21.	12.	17.	25.	961.8
1975	66.	138.	153.	225.	1580.	842.	1324.	996.	1271.	59.	15.	12.	10.	14.	546.0
1976	99.	196.	208.	1392.	1492.	763.	751.	1922.	645.	12.	10.	17.	7.	4.	608.8
1977	36.	107.	97.	96.	109.	77.	134.	268.	2.	2.	3.	3.	2.	2.	69.1
1978	4.	164.	448.	1177.	757.	727.	1031.	784.	344.	10.	24.	33.	15.	13.	433.6
AVG	70.	168.	279.	552.	693.	845.	954.	1095.	548.	108.	23.	26.	39.	29.	428.2



View of Threemile Dam from above east ladder looking west. Note: Attraction flows over the dam and debris accumulation.



West - Existing louver system used to bypass the downstream juvenile migrants (WEID Canal headgate in background)



West - Juvenile bypass outlet pipe and entrance to fish ladder on west end of Threemile Dam

3. East Ladder

The East Ladder on the right abutment of the dam was constructed in 1914 in conjunction with Three Mile Dam. Additional weirs were constructed at the toe of the dam as part of this ladder in 1963. The ladder is an overflow weir type containing 13 concrete pools, each 6 foot by 8 foot by 6 foot in size. This series of pools contain vertical drops ranging from 6 inches to 1 foot. Because of sedimention problems and access difficulties, this ladder has been used only recently since the West Ladder was completed in 1964. These access problems are the result of sediment buildups and obstructions in the river near the ladder entrance. In 1984 the ladder was reopened and successful passage of Steelhead occurred when river flows exceeded about 500 cfs. The ladder does not contain trapping, holding, or counting facilities. No additional attraction water is provided to the ladder entrance. The photos on page 7 show this ladder in operation from both the upstream and downstream side.

II. Existing and Future Fishery Resources

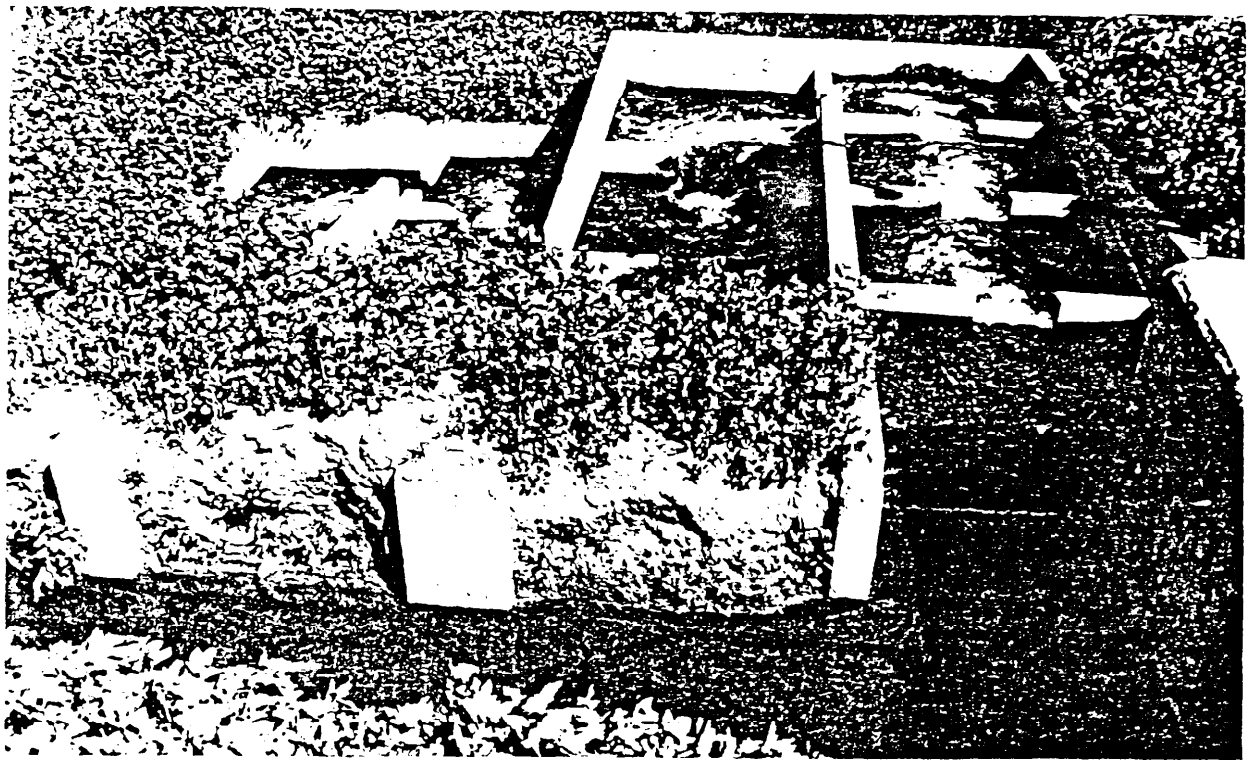
Historically, the Umatilla River System produced large numbers of summer Steelhead and fall and spring chinook salmon. The largest run of chinook salmon within the memory of white man occurred in 1914 (Van Cleve and Ting, 1960). In that year, Indians and non-Indians caught "thousands upon thousands of salmon from spring to fall at the site of West Extension Canal and Hermiston Light and Power Company Dams." It was reported that significant declines in the numbers of salmon and steelhead followed that year with the completion of Three Mile Dam.

A. Steelhead

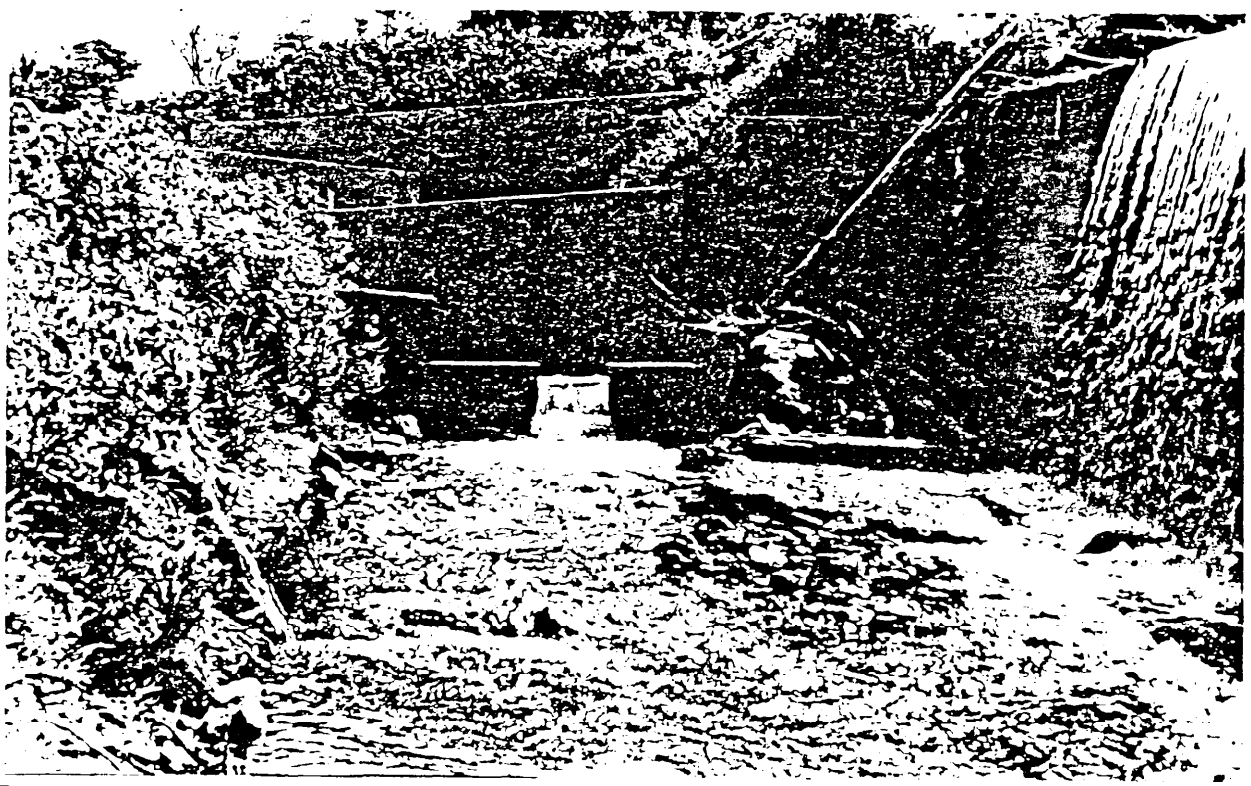
1. Present Situation

The average number of native Umatilla River summer steelhead (based on long-term electronic counts and recent manual counts) passing over Three Mile Dam for the last 14 years has been 1,886 fish.

Adult Steelhead use the lower mainstem Umatilla River primarily as a migration corridor. Upstream migration begins as early as October, depending on flows, with the peak occurring between November and March. Most spawning occurs in April and May in the upper Umatilla River and its tributaries. Estimated distribution of Umatilla summer Steelhead spawning is as follows:



East - East ladder looking from upstream side showing overflow weir design



East - Entrance to east side fish ladder Note: lack of well-defined channel

Stream	Percent [1]
Meacham Creek	40.0
South Fork Umatilla River	17.0
North Fork Umatilla River	10.0
Mainstem Umatilla River	10.0
Squaw Creek	5.0
Birch Creek	15.0
Other Tributaries	3.0

Egg incubation occurs from April through July. Most rearing takes place in the same tributary streams where spawning occurs. The juveniles typically spend 2 years in freshwater before migrating to sea as smolts. The estimated annual outmigration of summer Steelhead smolts is 50,000 to 100,000 native fish. This occurs during the period of April through June. Major periods of summer Steelhead use of the Umatilla River Basin are as follows:

Upstream Adult Migration	October - May
Spawning	April - May
Egg Incubation	April - July
Rearing	January - December
Downstream Smolt Migration	April - June

The Oregon Department of Fish and Wildlife (ODFW) began supplemental hatchery outplanting of juvenile Steelhead in 1980. Since the program began ODFW has released 19,000 Steelhead smolts in 1981, 50,000 in 1982, and 60,000 in both 1983 and 1984. The outplanted smolts are progeny of native adult fish trapped at Three Mile Dam.

2. Future Enhancement

An implementation plan for enhancement of Umatilla River Steelhead has been developed by ODFW and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The elements of this plan are presented in their joint Umatilla River Basin Report (1984). Long-term escapement goals' for summer Steelhead in the Basin are 4,000 hatchery produced adult fish and 5,000 naturally produced adult fish.

Hatchery production goals will be achieved through annual releases of 200,000 Steelhead smolts at the existing Bonifer facility and the Minthorn acclimation facility

currently in final design phase. The proposed Umatilla Hatchery near Irrigon (in the predesign phase) will produce these fish. The 60,000 smolts that are currently being reared at existing ODFW facilities and released at Bonifer will continue at least until the Umatilla Hatchery comes online. Any excess broodstock returning to the Bonifer and Minthorn facilities will be used for enhancement of natural production by reseeding (adult or egg outplanting) in under-utilized habitat.

Riparian and instream habitat improvement needs were identified in the Umatilla River Basin Report of January 1984. These projects were submitted to the Power Planning Council in November, 1983 as proposed amendments to the Fish and Wildlife Program of the Northwest Power Planning and Conservation Act (NPPCA) of 1980. Some of these improvements are being implemented in Squaw and Meacham Creek with Bureau of Indian Affairs and Union Pacific Railroad funds. There is an excellent opportunity to vastly improve the natural production of anadromous fish habitat throughout the Umatilla Basin.

Fall Chinook

1. Present Situation

A self-sustaining run of fall chinook has not existed in the Umatilla River since shortly after the construction of Three Mile Dam. However, an abundance of potential spawning habitat is found throughout the Mainstem Umatilla River. In addition, Meacham Creek up to the North Fork also has potential for fall chinook spawning.

Under a fish release program developed by CTUIR and ODFW, juvenile fall chinook have been liberated in the Umatilla River since 1982 at the following rates:

Year of Release	No. of Fish	Size	Stock
1982	4 million	90/lb	Tule stock
1983	100,000	9/lb	Upriver bright stock
1984	225,000	9/lb	Upriver bright stock

Approximately 20,000 and 50,000 fall chinook yearlings were acclimated and released at Bonifer Pond in 1983 and

1984, respectively. The remaining smolts were released in upper Meacham Creek. A few 2 year old mini-jacks, (probably fewer than 100) from the 1983 release returned to the Umatilla River in the fall of 1983. Jacks are also expected to arrive in the fall of 1984.

Adult fall chinook will enter the Umatilla River in October through December, with most spawning expected to occur in November and December. Egg incubation will take place from December to mid-March, with rearing between February and the end of May. Fingerlings will migrate downstream to the Columbia River in March through June.

The major time periods that fall chinook are expected to utilize Umatilla River Basin waters are as follows:

Upstream Adult Migration	October - December
Spawning	November - December
Egg Incubation	November - March
Rearing	February - May
Downstream Smolt Migration	March - June

2. Future Enhancement

The Umatilla Basin Implementation Plan (1984) cites long-term escapement goals of 10,000 hatchery produced and 12,000 naturally produced fall chinook salmon. Approximately 225,000 yearling are programed for acclimation and release at the Bonifer and Minthorn facilities through 1987. Based upon the results of ongoing studies at Bonneville Hatchery, the most cost effective program for juvenile releases will be used. This may include yearling releases, fall reared smolts, or 90/lb. fish. Based upon available data a return of about 2,500 adult fish would result from either program. Returning adult fall chinook will be used as brood stock for hatchery production, and to foster natural production in the system.

The capability of present flows in the Umatilla River to support a self-sustaining run of naturally produced fall chinook is doubtful., The Fish and Wildlife Service (FWS, 1984) evaluated the potential benefits of flow enhancement as part of a Corps of Engineers project to provide flows for anadromous fish. from Three Mile Dam downstream to the mouth of the Umatilla River. Channel improvement below Three Mile Dam was also a part of that project.

The channel work is scheduled for completion this year by the Corps with funding from the Bonneville Power Administration (BPA) under the NPPCA. The Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and ODFW are currently analyzing a potential flow enhancement project being planned by the BR to improve flows for anadroums. fish in the Umatilla River Basin. The effect of these two flow projects as they relate to passage at Three Mile Dam are discussed in the last section (Item IV, B and C) of this report.

Future fisheries projects identified in the Umatilla River Basin Report (1984) t and included in the Fish and Wildlife Program, will also enhance fall chinook runs. These projects include the acquisition of 6,000 acre-feet of McKay Reservoir storage for fish flows, modification or replacement of Umatilla River irrigation screens, and adult passage improvement at Maxwell and Cold Springs diversions.

c. Spring Chinook

1. Present Situation

Large numbers of spring chinook salmon existed in the Umatilla Basin prior to construction of Three Mile Dam. The ODFW reported small numbers of spring chinook in the System into the 1960's, but none have been observed since.

2. Future

Potential spring chinook spawning habitat exists in the upper Mainstem, lower North Fork, and South Fork Umatilla River, and in Meacham Creek. The CTUIR and ODFW have plans for reestablishment of spring chinook in the Umatilla Basin. Escapement goals are 10,000 hatchery produced fish and 1,000 naturally produced fish. However, poor spring passage conditions and lack of deep holding pools for adults could limit the production of these fish. To avoid or reduce potential passage problems, broodstock would be selected for early arrival of adults to avoid low stream flows. When, introduced, adults would enter the Umatilla River in April and May and 'migrate to upstream resting pools near spawning grounds. Adults would hold over in these pools until spawning commenced in late August and September. Most juveniles would rear for a year prior to migration in April, May and June.

Projected time periods of spring chinook use of the Umatilla River Basin are as follows:

Upstream Adult Migration	April - June
Spawning	August - September
Egg Incubation	August - December
Rearing	November - April
Downstream Smolt Migration	April - June

III. Fish Passage Problems 'Caused by Three Mile Falls Diversion Dam

A. Steelhead

1. Upstream (Adult)

Adult Steelhead enter the Umatilla River in the late fall when the irrigation season has ended and natural flows begin increasing (Figure 1, page 13). As runoff increases to medium to high flows (about 500 cfs or greater), a higher percentage of water spills over the crest of the dam and attraction flows at both ladders become a smaller portion of the total flow. This creates a false attraction problem for Steelhead in the tailrace area. The resulting migration delay creates increased stress and mortality when fish jump and become trapped in the open bays beneath the dam. An estimated 20 percent of the 1982-83 Steelhead return was lost because of these conditions at Three Mile Dam.

The West Ladder is well designed for Steelhead passage but lacks adequate attraction flows at the entrance during medium to high flows. The East Ladder is not adequately designed by today's standards. It has poor entrance conditions, poor turn pool conditions, poor exit conditions, and is not self regulating. It also lacks adequate attraction water at all flow levels. Sediment naturally accumulates above the east side of the dam and restricts flow into the East Ladder, thus impeding fish passage. There are no trapping or counting facilities at the East Ladder and only marginal opportunities at the West Ladder.

Debris hanging Over the dam crest and accumulating in the tailrace area impedes lateral movement of Steelhead along the base of the dam (see photo on page 4). This situation, combined with insufficient attraction flows at the ladder entrances, also creates migration delay and stress. Accumulation of debris above the east side of

the dam restricts the amount of flow entering the East Ladder. Failure to maintain control of debris above and below the East Ladder may cause stranding of adult Steelhead.

2. Downstream (Juveniles)

Juvenile Steelhead migrate past Three Mile Dam by passing over the crest, through the fish ladders, or through the smolt bypass pipe on the west side. The bypass pipe drops fish 20 feet into the tailrace area below the dam. This may cause injury, stress and possible mortality to smolts, especially during low flow conditions when the bedrock area below the pipe does not contain adequate pool depths. This condition is even worse for those smolts passing over the crest of the dam. Smolts encounter the louver system at the intake of WEID Canal. A NMFS study (1981) indicates that the passage efficency of this type louver system for Steelhead smolts under ideal flow conditions is 70 to 95 percent. Passage conditions at Three Mile Dam are probably near the low end of this range because of problems with the approach velocities, nonlaminar flows, and bypass slot velocities. This efficiency does not meet NMFS criteria for screening facility design, which requires successful passage of all fish.

A summary of the current passage conditions for steelhead, expressed as' a percentage of adult and juvenile fish passing Three Mile Dam, is provided in Table 1. This information is listed under the No Action Plan, assuming no flow improvements. Future Steelhead passage conditions, again assuming no flow enhancement with the present facilities at Three Mile Dam, would not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized.

B. Fall Chinook

1. Upstream (Adult)

AS indicated in Figure 1 (Page 3), adequate flows (200 cfs or greater) for adult fish passage to Three Mile Dam can occur during the October through December migration period. During these periods all the passage problems listed for adult Steelhead would be common to fall chinook. These include: 1) false attraction flows below the dam; 2) lack of adequate attraction to the ladder entrances; and, 3) debris and/or sediment

Table 1. Assumed Passage Conditions (Expressed as Percentage of Fish Passing) Three Mile Diversion Dam

Alternative	Without Flow Enhancement						With Reclamation Flow Enhancement1/					
	Steelhead		Fall Chinook		Spring Chinook		Steelhead		Fall Chinook		Spring Chinook	
	Adults	Juvenile	Adult	Juvenile	Adults	Juvenile	Adults	Juvenile	Adults	Juvenile	Adults	Juvenile
Alternative A. No Action	75	75	38	50	48	60	80	75	90	50	80	75
Alternative B. Dam Removal	95	95	50	95	65	95	100	100	100	100	100	100
Alternative C. East Side Ladder Only	95	90	45	90	60	90	95	95	95	95	95	95
Alternative D. Two Ladders No Apron	95	90	45	90	60	90	95	95	95	95	95	95
Alternative E. Cap on Crest West Ladder	95	90	45	90	60	90	95	95	95	95	95	95
Alternative F. Ladder in Middle	95	90	45	90	60	90	95	95	95	95	95	95
Alternative G. Concrete Apron Plus West Ladder	95	90	45	90	60	90	95	95	95	95	95	95
Alternative H. Center Cap East Side Ladder	95	90	45	90	60	90	95	95	95	95	95	95

1/ The Corps flow enhancement would produce passage conditions to Three Mile Dam for steelhead and fall chinook adults equal to those listed under "Reclamation Flow Enhancement," and for spring chinook adults and juveniles of all species, the conditions would be equal to those listed under "Without Flow Enhancement."

above and below the dam. In addition to these problems, the overflow weir design of the East Ladder does not promote chinook passage as would the vertical slot design. A submerged orifice or vertical slot is especially important for the ladder entrance.

Migration delays for fall chinook are generally more harmful than for Steelhead, due to the relatively short period of time between migration and spawning.

During flow periods that could provide adequate fish passage, movement through the West Ladder could be satisfactory. However, counting, trapping, and holding facilities are poor. During periods of extreme low flows, passage would be reduced or eliminated. Temperature and swimming duration are not expected to cause passage problems.

2. Downstream (Juveniles)

The NMFS study (1981) indicates that the passage efficiency of louvers for fall chinook migrants under ideal flow conditions varies from 40 to 90 percent. The larger sized yearling chinook smolt presently being released would likely be near the upper end of this range. Future outmigrations of natural and hatchery fry and fingerling would likely experience efficiencies near the lower end of this range. The same problems with velocities and nonlaminar flows affecting louver efficiency for Steelhead would be more of a problem for the smaller fall chinook. NMFS policy has been to pass 100 percent of the fish, thus passage criteria would not be met in either case. Chinook downstream migrants would also experience the same problem with injury, stress, and possible mortality from the juvenile bypass system as discussed for Steelhead.

A summary of the current passage conditions for fall chinook, expressed as a percentage of adult and juvenile fish passing Three Mile Dam, is provided in Table 1 (Page 14). This information is listed under the No Action Plan, assuming no flow improvements. Future fall chinook passage conditions, again assuming. no flow enhancement with the present facilities at Three Mile Dam, would not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized.

c. Spring Chinook

1. Upstream (Adult)

Medium to high flows often occur during April and early May of the migration period. With these conditions, problems listed for Steelhead and fall chinook at Three Mile Dam would also be common for spring chinook. These include: 1) false attraction flows below the dam; 2) lack of adequate attraction to the ladder entrances; and 3) debris and/or sediment obstruction above and below the dam. In addition to these problems, the overflow weir design of the East Ladder does not promote chinook passage as would a vertical slot design. A submerged orifice or vertical slot is especially important for the ladder entrance.

In late May and into June, flows can rapidly decrease to very low flow conditions because of irrigation diversions (Figure 1, Page 3). Passage during these periods could be significantly reduced *or* even eliminated. Migration delays for spring chinook would have very serious implications because upstream passage to holding and spawning areas would be impossible later in the spring and into summer. This would especially be a problem during late May and early June for late arriving adults. During periods of adequate flows, movement through the West Ladder could be satisfactory. However, counting, trapping and holding facilities are poor. Temperature conditions and/or swimming duration are' not expected to cause passage problems.

2. Downstream (Juvenile)

Spring chinook downstream migrants are expected to be yearling smolts. The NMFS study (1981) indicates that the passage efficiency of louvers for spring chinook smolts under ideal flow conditions varies from 60 to 90 percent. The previously discussed problems with velocities and nonlaminar flows affecting louver efficiency for Steelhead would also affect spring chinook. NMFS policy has been to pass all of the fish. Therefore, NMFS passage criteria would not be met. Spring chinook downstream migrants would also experience the same problems from injury, stress, and mortality with the juvenile bypass system as those listed earlier for Steelhead and fall chinook.

A summary of the current passage conditions for spring chinook, expressed as a percentage of adult and juvenile fish passing Three Mile Dam, is provided in Table 1

This information is listed under the No Action Plan, assuming no flow improvements. Future spring chinook passage conditions, again assuming no flow enhancement with the present facilities at Three Mile Dam, would not change. However, greater numbers of fish would be impacted as the benefits of the combined CTUIR/ODFW enhancement program are realized.

IV Conceptual Actions

A. No Action

This alternative would maintain the existing passage facilities at Three Mile Dam. Existing management and operations would continue as in the past. Passage conditions would not change at Three Mile Dam. It is assumed that passage conditions below Three Mile Dam would improve. This would be the result of channel improvements planned at several locations in the three miles of river below the dam. This work is scheduled for completion this year (1984) by the Corps of Engineers. The downstream channel improvement work is assumed to be a condition of all the conceptual actions discussed herein.

B. Dam Removal

This concept would involve three major features. These are: 1) removal of the dam: 2) bedrock and/or silt removal if required; and, 3) construction of a new screen facility and bypass system at the future location of the WEID Canal entrance.

Under this concept the dam would be removed down to bedrock to allow the river to pass unimpeded at all flow levels. Specific flow characteristics, (velocities, depth), channel characteristics (drops), and sediment conditions that would exist with this action need additional engineering study. The specific channel design through the area should provide passage conditions consistent with accepted adult salmon and Steelhead passage criteria. The opportunity for trapping and counting at this location would be foregone with this plan.

The need to replace flows to the WEID Canal with this plan also should be considered. It is unlikely that adequate conditions would exist to provide for this need at Three Mile Dam. Alternatives include pumping water from the Columbia River or providing a new, low head diversion futher upstream in the Umatilla River. A new diversion dam should have appropriate passage facilities to insure that existing problems are

not just being moved upstream. Any new source of water should be screened to insure safe passage of juvenile fish.

c. East Ladder Only

This concept would involve six major features. These are: 1) improve or rebuild the East Ladder with vertical slots or other state-of-the-art facilities; 2) addition of trapping and counting facilities; 3) improved attraction water; 4) improved fish access to the ladder; 5) maintenance of the forebay and tailrace-; and, 6) construction of a new screen and bypass facility at the WEID Canal.

To improve passage through the East Ladder the overflow weir design of the steps would be changed to submerged orifice, vertical slots, or other more acceptable design. Construction of trapping and counting facilities at the ladder would be required. The West Ladder would be nonfunctional under this concept.

With this plan, additional attraction water would be provided at the ladder. During periods of higher flows (500+ cfs) this would be achieved by removal of debris upstream from the point of inflow, allowing greater volumes of flow to enter the ladder. During low flows appropriate features would be designed to assure that a sufficient amount of water for attraction flows could be diverted through the ladder.

An improved channel would have to be constructed through the bedrock at the face of the dam. At higher flows this would induce fish attracted by spill to cross the channel and enter the ladder.

To assure access to the ladder the forebay and tailrace would have to be maintained. This would include removal of debris and sediment which could physically block or hinder fish movement.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria,

D. Two Ladders, No Apron

This concept would involve seven major features. These are:. 1) improved attraction water to the West and East Ladders; 2) addition of trapping and counting facilities at both ladders; 3) convert the overflow type ,design in the East Ladder to a

type that would improve passage of Steelhead and chinook salmon; 4) improved fish access to the East Ladder (but not to the West Ladder); 5) maintenance of the forebay and tail-race at the East Ladder; 6) modify both ladders so they can be shut off to prevent any flow-through; and, 7) construction of a new screen and bypass facility at the WEID Canal.

Under this concept additional attraction water would be provided at both ladders. During. periods of higher flows (500+ cfs) this would be achieved by removal of debris up-stream from the point of inflow. This would allow greater volumes of flow to enter the ladders. During low flows one of the ladders could be shut off and flow would go through the other ladder.

To improve chinook passage through the East Ladder the overflow weir design of the steps would be changed to sub-merged orifice, vertical slots, or other more acceptable design. Construction of trapping and counting facilities at both ladders would be required.

An improved channel would have to be constructed through the bedrock at the face of the dam leading to the East Ladder, At higher flows this would induce fish attracted by spill to cross the channel and enter the ladder.

To assure access to the East Ladder the forebay and tailrace' would have to be maintained. This would include removal of debris and sediment which could physically block or hinder fish movement.

During low flow periods there may be insufficient water to keep both ladders operational. To maximize the potential for upstream migration one of the ladders may have to be shut off at the upstream end. This would result in all passage flows entering the other ladder and would improve passage conditions. Associated features would be designed to assure that the water would be diverted efficiently, and that the "shut off" ladder and approaches would be completely drained, This would prevent stranding of fish.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria.

E. Cap on Crest - West Ladder

This concept would involve four major features. These are: 1) improved attraction water to the West Ladder; 2) addition of trapping and counting facilities; 3) addition of a cap on the crest of the dam beginning at the east bank: and, 4) construction of a new screen and bypass facility at the WEID Canal.

Under this concept additional attraction water would be provided at the West Ladder. During periods of higher flows (500+ cfs) this would be achieved by removal of debris upstream from the point of inflow. Also, the cap would allow greater volumes of water to enter the ladder during low flows. The cap would be designed to assure that a sufficient amount of water for adequate attraction flows could be provided at the ladder entrance. The East Ladder would be nonfunctional with this plan. In addition, construction of trapping and counting facilities at the West Ladder would be required'.

The addition of a cap on the existing facility would help direct flows near the west bank and eliminate the false attraction flows over the crest of the dam. This flow concentration would also likely reduce the debris problem which exists upstream of the dam.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria,

F. Ladder At New Location (i.e. Middle of Dam)

This concept would involve four major features. These are: 1) construct a new ladder at an optimum location; 2) insure adequate attraction water to the ladder; 3) addition of trapping and counting facilities; and, 4) construct a new screen and bypass facility at the WEID Canal.

The construction of a new fish ladder located approximately in the middle of the existing facility could be used alone, or in conjunction with the West Ladder. It would be designed with a submerged orif ice, vertical slots, or other acceptable state-of-the--art features.

Under this concept additional attraction water would be provided at the ladder. During periods of higher flows (500+ cfs) this would be achieved by removal of debris upstream from the point of inflow. During low flows appropriate features

would be designed to assure that a sufficient amount of water for adequate attraction flows could be provided at the ladder entrances.

Construction of trapping and counting facilities at the new ladder would be required. Access to the ladder must also be provided.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria.

G. Concrete Apron Plus West Ladder

This concept would involve four major features. These are: 1) improved attraction water to the West Ladder; 2) addition of trapping and counting facilities at both ladders; 3) a concrete apron in the tailrace of the dam (east side only); and, 4) construction of a new screen and bypass facility at the WEID Canal.

Under this concept additional attraction water would be provided at the West Ladder. The East Ladder would be accessible and useable only during high flows. This would be achieved by the concrete apron acting as a velocity barrier to direct both fish and flows in the tailrace to the West Ladder. Flows across the apron would be shallow and swift, thus sweeping any fish off the apron, while at the same 'time directing them towards the West Ladder. At high flows 'fish could negotiate the apron and use the East Ladder in its existing condition. The concrete apron would have to be constructed through and on the bedrock at the east face of the dam over to the existing main channel below the west side of the dam. Construction of trapping and counting facilities at the West Ladder would be required.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria.

H. Center Cap On Crest with Sill-Type Ladder on East Side.

This concept would involve six major features. These are: 1) construct a small cap across the center crest of the dam; 2) construct a sill-ladder; 3) improved attraction water to the sill-ladder: 4) improved fish access to the sill-ladder; 5) addition of trapping and counting facilities; and, 6) construct a new screen and bypass facility at the WEID Canal.

Under this concept a small cap would be constructed across the center section of the dam, with lower portions remaining on both sides. The gap on the west side would be slightly higher than the east side gap. This would be designed to direct low flows *over* the east side of the dam.

A sill-type ladder with several large steps would be constructed on the east side where the present ladder is now located. These would act as a ladder, with vertical drops between each sill. The sills would create resting pools and would be deep enough for fish to negotiate vertical jumps,

Under this concept additional attraction water would be provided at the sills by concentrating all low flows at one location, Moderate flows would also pass through the existing West Ladder or over the crest on the west side as a result of the gap on the west side of the dam. Thus, low to medium flows would pass only over each end of the dam but not over the center. The peak high could pass over the center section of the dam, however, this would be an infrequent occurrence and spread a smaller portion of the total flows over a large enough area, that false attraction flows should not be a problem.

An improved channel would have to be constructed through the bedrock at the face of the dam to the sill-ladder. At lower flows this would induce fish attracted by the spill to cross the channel and enter the East Ladder.

The forebay and tailrac would have to be maintained to assure access to the East Ladder, This would include removal of debris and sediment which could physically block fish movement. Construction of trapping and counting facilities at the West Ladder would be required.

To increase smolt survival it would be necessary to replace the louver and bypass pipe at the WEID Canal headgate. The new screens and bypass facility would comply with ODFW, NMFS, and FWS criteria,

V.3 Summary

A. Effect of Conceptual Actions Under Present Flow Conditions

Adult and juvenile anadromous fish that reach Three Mile Dam during upstream and downstream migration are confronted with a variety of passage problems. These include: 1) outdated facility design; 2) inadequate attraction flows at the

ladders; 3) inadequate flow through the East Ladder at certain times; 4) sediment and/or debris barriers; and, 5) channel conditions which prevent access to the ladders at some flows. These problems would persist under the No Action Plan. A detailed description of these existing problems is provided in Section III above.

The structural improvements for ladder design and for location, dam modification or removal, and upstream or downstream channel improvements would increase upstream passage of adult fish by about 10 to 20 percent. It is assumed that the dam removal alternative would increase adult passage when compared to the other alternatives because of a small percentage of fish which would not negotiate the structure, even with state-of-the-art designed passage facilities. The opportunity for trapping and counting would be improved with all plans (except for dam removal) and broodstock selection would be available at the dam. Trapping and counting facilities would also allow for a CTUIR terminal fishery at Three *Mile* Dam; total counts by species to evaluate the habitat improvement measures of the ODFW/CTUIR implementation plan; and trapping and hauling of adult salmon to other areas in the basin where suitable spawning habitat may exist. The lack of these facilities without the dam is not considered to be as important as the improved passage that would result from this alternative. Dam removal would also eliminate expenditures of time and funds required to operate and maintain facilities installed at the dam. With improved design of the juvenile bypass system and more efficient screening, downstream migrant survival would increase by about 15 to 40 percent. A comparison of each plans improvements, for both adult and juvenile fish, is provided in Table 1 (Page 14).

Lack of adequate flows at certain critical times would continue to be the major passage problem for all three anadromous fish species (Table 2). Fall chinook adults would be the most seriously affected because of low flow conditions in September, October and November. Spring chinook passage would be similarly affected, but to a lesser degree, because of low flow periods in May and June. Both early and late returning adult Steelhead could experience passage problems during these low flow periods; but the biggest percentage of these fish return during the December through March period when flows are normally adequate. Downstream migrants of all species could experience passage problems because of low flows in May and June. This would require trucking of these smolts during periods of extreme low flow, as is presently done during such periods at the Westland Diversion Dam (river mile 27 on the Mainstem Umatilla River).

Table 2. Present Flow Conditions at Three Mile Dam[1]

Flow Conditions (cfs)	Sept 16-30	Oct	Nov 1-15	Nov 16-30	May	June
Average Flow	29	70	168	279	548	108
Median Flow	24	44	145	176	378	33
Number of Years Flows Equal or Exceed 200 cfs[2]	0/44	2/44	9/44	21/44	30/44	8/44

1/ Number of years flows equal or exceed 200 cfs downstream of Three Mile Dam, based on 44 years of record (1935 to 1978) from Figure 1.

2/ The minimum flow for adequate fish passage below Three Mile Dam was considered to be 200 cfs with planned channel improvement (FWS, 1984).

B. Effect of Conceptual Actions Under Reclamation Flow Enhancement

The BR plan (BR, 1982) basically entails a pumping facility to exchange water from the Columbia River for some natural flow rights in the Umatilla River and some McKay Reservoir storage presently diverted for irrigation. Also included is a water storage reservoir on Bear Creek, a tributary to Meacham Creek. This plan would significantly improve streamflow and water quality conditions in Meacham Creek and 79 miles of the Mainstem Umatilla River. Steelhead productivity would be enhanced and salmon runs would be restored on a sustained basis.

The plan provides the following minimum streamflows (cfs) for Steelhead trout and chinook salmon in the Umatilla River downstream from the Three Mile Dam.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
								l-15/16-30		l-15/16-30	
250	250	250	250	250	250	0	0	O/250	300	300/250	250

Flow enhancement without structural modifications would not eliminate passage problems associated with: 1) false attraction below the dam; 2) lack of adequate attraction flows at ladder entrances; 3) debris and/or sediment obstructions; and, 4) channel problems in the tail-race. However, with the flow improvements shortages during critical periods would be eliminated, and passage conditions would improve. The combination of structural improvements (plans C to H) plus flows, would eliminate all major passage problems. The dam removal alternative with flows provides for 100 percent passage of anadromous fish, while the structural plans are assumed to impact a small percentage of fish that would not successfully pass the structure. Compared to the existing passage problems without flow enhancement, improvements would range from about 20 to 55 percent for adult fish, to about 25 to 45 percent for juvenile fish. A comparison of each plans improvements with BR flows, for both adult and juvenile fish, is provided in Table 1 (Page 14).

C. Effect of Conceptual Actions Under Corps Flow Enhancement

The Corps of Engineers plan (Corps, 1981) entails use of an existing pumping plant to transport water from near the mouth of the Umatilla River up to Three Mile Diversion Dam.

The pumped water would be added to the WEID Canal to ensure adequate water for irrigation uses. This would allow Umatilla River water to be bypassed as the minimum flows for fishery enhancement. This proposal only provides flows from Three Mile Dam downstream, and has no provisions for flow related improvements upstream from the dam.

The Corps' plan would provide the following minimum stream- , flows (cfs) for Steelhead trout and chinook salmon in the Umatilla River downstream from Three Mile Dam.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
200	200	200	200	100	100	0	0	20	200	200	200

Flow enhancement without structural modifications would not eliminate passage problems associated with: 1) false attraction below the dam; 2) lack of adequate attraction flows at ladder entrances; 3) debris and/or sediment obstructions; and, 4) channel problems in the tailrace. However, with the flow improvements, shortages during some critical periods would be eliminated, and passage conditions would improve.

In comparing the Corps flow enhancement project with the BR project the two major differences are: 1) the amount of water provided during the months of September, May and June; and, 2) water with the Corps project would be provided only at Three Mile Dam, while the BR project provides water upstream from Three Mile Dam. In terms of fish passage, the May and June flows with the Corps project (100 cfs versus 250 cfs with BR) are not considered adequate for upstream passage of adult spring chinook. Also, because May and June do have periods of low to no flows as a result of irrigation withdrawals, water provided at Three Mile Dam would not eliminate the need to truck outmigrating smolts that would otherwise be stranded at upstream diversions. The flow differences in September would impact early returning adult fall chinook. However, this should be a very small portion of the run when compared to adults that would return during the October through December period. A comparison of each plan's improvements with the Corps flow enhancement, for both adult and juvenile fish, is provided in Table 1 (Page 14).

CONSTRUCTION COST ESTIMATE SHEETS

FOR RECOMMENDED PLAN

7-1412 (1-84)
Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 1 OF 7

PROJECT: UMATILLA
DIVISION:
UNIT:
FEATURE: 3-MILE DIVERSION DAM

PREPARED BY: PN REGION 720
ESTIMATE DATE: JANUARY, 1985
ESTIMATE TYPE: FEASIBILITY
PRICE LEVEL: OCTOBER, 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				GENERAL PROPERTY								
	05			3-MILE DIVERSION DAM								
		151		DAMS								
				(1) RIGHT BANK FISH LADDER					$840,000		$220,000	$1,060,000
			1.	MOBILIZATION AND PREPARATORY WORK	LUMP SUM	LS	LS	32,000				
			2.	DIVERSION AND CARE OF RIVER	LUMP SUM	LS	LS	50,000				
			3.	REMOVAL OF EXISTING CONCRETE	30	CY	200.00	6,000				
			4.	EXCAVATION, COMMON, STRUCTURE	1430	CY	8.00	11,500				
			5.	EXCAVATION ROCK, STRUCTURE	830	CY	60.00	50,000				
			6.	EXCAVATION, ROCK, STRUCTURE	320	CY	20.00	6,400				
			7.	GRADATION AND PLACING ROCK FILL	650	CY	3.00	1950				
			8.	STRUCTURAL BACKFILL	2310	CY	5.00	11,500				
			9	COMPACTING BACKFILL	2310	CY	10.00	23,000				
			10.	CONCRETE IN ROCK CAP	330	CY	235.00	77,550				
			11.	STEEL ANCHORS	1200	LB	4.50	5,400				
			12	WELDED WIRE FABRIC REINFORCEMENT	13,000	SF	0.65	8,500				
			13.	CONCRETE, STRUCTURAL	380	CY	385.00	145,000				
			14.	REINFORCEMENT	57,000	LB	0.65	37,000				
			15.	CHAIN LINK FENCE	370	LF	25.00	9,300				
			16.	GRATING OVER STRUCTURES	21,000	SF	40.00	84,000				
			17.	DIFFUSER GRATES, 1-INCH OPENINGS	40	SF	50.00	2,000				
			18	FURNISH AND INSTALL BAFFLE STRUCTURE	LUMP SUM	LS	LS	7,000				
			19.	TRASHRACKS, 10-INCH OPENINGS	64	SF	40.00	2,550				
			20.	TRASHRACKS, 1/8-INCH OPENINGS	30	SF	70.00	2,100				
			21	FURNISH AND INSTALL 3X5 SLIDE GATE	2	EA	4000.00	8,000				
			22	FURNISH AND INSTALL 3X5 TELESCOPING GATE	1	EA	3500.00	3,500				
			23	FURNISH AND INSTALL FISH CROWDER	LUMP SUM	LS	LS	8,000				
			24	FURNISH AND INSTALL TRAPPING FACILITIES	LUMP SUM	LS	LS	50,000				
			25	POWER SUPPLY	LUMP SUM	LS	LS	5,000				
			26	ALLOWANCE FOR UNLISTED ITEMS	LUMP SUM	LS	LS	33,500				
				SUBTOTAL				$700,000				
				CONTINGENCIES (20%±)				140,000				
				FIELD COST 15.05.151 (1)				$840,000				
				DESIGN AND SPECIFICATIONS							($220,000)	
				CONSTRUCTION SUPERVISION								

7 1432 (1-84)
Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 2 OF 7

PROJECT: UMATILLA
PREPARED BY: PN - REGION 720
DIVISION:
ESTIMATE DATE: JANUARY, 1985
UNIT:
ESTIMATE TYPE: FEASIBILITY
FEATURE: 3-MILE DIVERSION DAM - FISH PASSAGE IMPROVEMENT
PRICE LEVEL: OCTOBER, 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				GENERAL PROPERTY								
	05			3-MILE DIVERSION DAM								
		151		DAMS								
				(3) LEFT BANK FISH LADDER MODIFICATION					$480,000		$125,000	$605,000
			1	MOBILIZATION AND PREPARATORY WORK	LUMP SUM	LS	LS	18,000				
			2	DIVERSION AND CARE OF WATER	LUMP SUM	LS	LS	50,000				
			3	REMOVAL OF EXISTING STRUCTURES	LUMP SUM	LS	LS	15,000				
			4	EXCAVATION, ROCK	120	CY	60.00	7,200				
			5	GRAVEL FILL	23	CY	30.00	690				
			6	CONCRETE, STRUCTURAL	155	CY	385.00	60,000				
			7	REINFORCEMENT	23,000	LB	0.65	15,000				
			8	GRATING OVER STRUCTURES	3,000	SF	40.00	120,000				
			9	UNDERSIDE GRATES, 1 INCH OPENINGS	40	SF	50.00	2,000				
			10	FURNISH AND INSTALL BAFFLE STRUCTURE	LUMP SUM	LS	LS	7,000				
			11	TRASHRACKS, 10-INCH OPENINGS	350	SF	40.00	14,000				
			12	TRASHRACKS, 7/8-INCH OPENINGS	30	SF	70.00	2,100				
			13	FURNISH AND INSTALL 3'x5' SLUICE GATE	1	EA	4,000.00	4,000				
			14	FURNISH AND INSTALL 3'x5' TELESCOPING GATE	1	EA	3,500.00	3,500				
			15	FURNISH AND INSTALL FISH COUNTER	LUMP SUM	LS	LS	8,000				
			16	FURNISH AND INSTALL TRAPPING FACILITIES	LUMP SUM	LS	LS	50,000				
			17	POWER SUPPLY	LUMP SUM	LS	LS	5,000				
			18	ALLOWANCE FOR UNLISTED ITEMS	LUMP SUM	LS	LS	17,000				
				SUBTOTAL				400,000				
				CONTINGENCIES (20%)				80,000				
				FIELD COSTS (CONTRACT)	(2)			$480,000				
				DESIGN AND SUPERVISION							($125,000)	
				ADMINISTRATION COSTS								

7-1411 (1-81)
Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 3 OF 7

PROJECT: Umatilla	PREPARED BY: PN - R[illegible]
DIVISION:	ESTIMATE DATE: January, 1995
UNIT:	ESTIMATE TYPE: Feasibility
FEATURE: 3-Mile Diversion Dam - Fish Passage Improvement	PRICE LEVEL: October, 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				General Property								
	05			3-Mile Diversion Dam								
		151		Dams								
				(3) Fish screens 7 - 10 foot					$1,440,000		$370,000	1,810,000
				Diameter x 12.5 foot long								
				Rotating Drum Screens								
			1	Mobilization and Preparatory Work	Lump Sum	LS	LS	54,000				
			2	Removal of Existing Concrete	120	CY	120.00	14,500				
			3	Excavation, Cofferdam, Structure	7700	CY	8.00	63,000				
			4	Structural Backfill	2000	CY	5.00	10,000				
			5	Compacting Backfill	2000	CY	10.00	20,000				
			6	Concrete, Structural	1,160	CY	395.00	450,000				
			7	Reinforcement	174,000	lb	0.65	115,000				
				Furnish and Install the Following:								
			8	Rotating Drum Fish Screens	Lump Sum	LS	LS	125,000				
			9	Traveling Belt Fish Screens	Lump Sum	LS	LS	45,000				
			10	Pumpback System	Lump Sum	LS	LS	72,000				
			11	Hoist System	Lump Sum	LS	LS	60,000				
			12	Sample Structure Facilities	Lump Sum	LS	LS	50,000				
			13	24" Ø PVC Pipe	280	lf	50.00	14,000				
			14	Grating	410	SF	40.00	16,500				
			15	Catwalk	660	SF	11.50	7,600				
			16	Handrail	220	lf	36.00	7,900				
			17	24" Ø Slide Gates	2	ea	1800.00	3,600				
			18	Power Supply	Lump Sum	LS	LS	10,000				
			19	Allowance for unlisted items				57,000				
				Subtotal				1,200,000				
				Contingencies (20%)				240,000				
				Field Costs 15,05.1 (3)				$1,440,000				
				Design and Specifications							($370,000)	
				Construction Supervision								

7143-2 (1-84)
Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 4 OF 7

PROJECT: UMATILLA
PREPARED BY: PN REGION 720
DIVISION:
ESTIMATE DATE: JANUARY 1985
UNIT:
ESTIMATE TYPE: FEASIBILITY
FEATURE: 3-MILE DIVERSION DAM - FISH PASSAGE IMPROVEMENT
PRICE LEVEL: OCTOBER, 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				GENERAL PROPERTY								
	05			3-MILE DIVERSION DAM								
		151		DAMS								
				(4) DOWNSTREAM FISH BARRIER					$910,000		$235,000	$1,145,000
			1	MOBILIZATION AND PREPARATORY WORK	Lump Sum	ls	ls	34,000				
			2	CLEARING BRUSH AND DEBRIS	Lump Sum	ls	ls	10,000				
			3	CONTROLLING WATER	Lump Sum	ls	ls	2,000				
			4	ROCK EXCAVATION	4130	cy	20.00	83,000				
			5	FURNISHING LARGE ROCK FROM QUARRY	1,500	cy	7.00	11,500				
			6	EXCAVATION AND PLACING ROCKFILL	7,400	cy	3.00	22,000				
			7	CONCRETE IN ROCK CAP	1710	cy	200.00	342,000				
			8	WELDED WIRE FABRIC REINFORCEMENT	39,500	sf	0.65	26,000				
			9	STEEL ANCHORS IN FILL AREA	1900	lb	4.50	8,600				
			10	CONCRETE STRUCTURAL	220	cy	275.00	60,500				
			11	REINFORCEMENT	61,200	lb	0.65	40,000				
			12	FURNISHING AND HANDLING CEMENT	10,890	cwt	6.00	65,000				
				FURNISHING & INSTALLING AERATION PIPING:								
			13	6-INCH PVC	31	lf	8.00	250				
			14	18-INCH PVC	430	lf	30.00	13,000				
			15	FURNISHING AND INSTALLING 4-INCH DRAIN PIPE	70	lf	6.00	400				
			16	PLACING AND COMPACTING ROAD FILL	400	cy	8.50	3400				
			17	FURNISHING & PLACING GRAVEL FOR ROAD SURFACE	120	cy	10.00	1200				
			18	ALLOWANCE FOR UNLISTED ITEMS	Lump Sum	ls	ls	36,000				
				SUBTOTAL				760,000				
				CONTINGENCIES (20%±)				150,000				
				FIELD COST 15.05.151(4)				$910,000				
				DESIGN AND SUPERVISION							(235,000)	
				CONSTRUCTION								

Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 5 OF 7

PROJECT: Yakima

DIVISION:

UNIT:

FEATURE: 3-Mile Diversion Dam

PREPARED BY: PN Region 720

ESTIMATE DATE: January 1995

ESTIMATE TYPE: Feasibility

PRICE LEVEL: October, 1994

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				General Property								
	05			3-Mile Diversion Dam								
		151		Dams								
				(5) Cap on Dam Crest					$450,000		$120,000	$570,000
			1	Mobilization and Preparatory Work	Lump Sum	LS	LS	17,000				
			2.	Diversion and Care of River	Lump Sum	LS	LS	5,000				
			3.	Excavation, Rock, Structure	600	CY	60.00	36,000				
			4	Excavation, Rock, Structure	100	CY	20.00	2,000				
			5.	Grading and Placing Rock Fill	2225	CY	3.00	6,700				
			6.	Concrete in Rock Cap	865	CY	235.00	200,000				
			7	Welded Wire Fabric Reinforcement	34,400	SF	0.65	22,500				
			8.	Steel Anchors in Fill	3130	lb	4.50	14,000				
			9.	30" Concrete Cap	68	CY	408.50	28,000				
			10	21" Concrete Cap	57	CY	408.50	23,000				
			11	Trash Boom	1	EA	800.00	800				
			12.	Trash Boom Guides	2	EA	900.00	1,800				
			13.	Allowance for Unlisted Items	Lump Sum	LS	LS	18,000				
				Subtotal				375,000				
				Contingencies (20%±)				75,000				
				Field Cost 15.05.151(5)				450,000				
				Design and Specifications							($120,000)	
				Construction Supervision								

Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 6 OF 7

PROJECT: Umatilla

DIVISION:

UNIT:

FEATURE: 3-Mile Diversion Dam

PREPARED BY: Pil Regional 770

ESTIMATE DATE: January 1985

ESTIMATE TYPE: Feasibility

PRICE LEVEL: October 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				General Property								
	05			3-Mile Diversion Dam								
		151		Dams								
				(6) Pumping Pl					$5,770,000		$2,130,000	$7,900,000
			1.	Pumping Plant Structure (Includes 20% for Mobilization and Unlisted Items)	Lump Sum	ls	ls	5,150,000				
			2.	Discharge Line	Lump Sum	ls	ls	420,000				
			3.	Forebay Excav.	Lump Sum	ls	ls	200,000				
				Subtotal				5,770,000				
				Field Costs				5,770,000				
				Indirects (36%)							(2,130,000)	

Bureau of Reclamation

CONSTRUCTION COST ESTIMATE

SHEET 7 OF 7

PROJECT: UMATILLA	PREPARED BY: PN REGION 120
DIVISION:	ESTIMATE DATE: JANUARY 1985
UNIT:	ESTIMATE TYPE: FEASIBILITY
FEATURE: 3-MILE DIVERSION DAM	PRICE LEVEL: OCTOBER 1984

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	ITEM	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT	FIELD COST	TOTAL FIELD COST	NONCONTRACT COST	CONSTRUCTION COST
15				GENERAL PROPERTY								
	05			3-MILE DIVERSION DAM								
		151		DAMS								
				(7) DAM REMOVAL					$300,000		$80,000	$380,000
			1	MOBILIZATION	LUMP SUM	1s	1s	$11,000				
			2	DAM REMOVAL	LUMP SUM	1s	1s	225,000				
			3	UNLISTED ITEMS	LUMP SUM	1s	1s	13,000				
				SUBTOTAL				250,000				
				CONTINGENCIES (20%)				50,000				
				FIELD COSTS 15.05.151 (7)				$300,000				
				DESIGN AND SPECIFICATIONS							$80,000	
				CONSTRUCTION SUPERVISION								

AGENCY CONCURRENCE LETTERS

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife

506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

BUREAU OF RECLAMATION
OFFICIAL FILE COPY
MAR 11 1985

TO	INIT	DATE
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FILE		

ACTION MADE BY

March 6, 1985

Mr. Larry W. Wolf
Bureau of Reclamation
PO Box 043, U.S. Courthouse
550 W Fort St
Boise, ID 83724

Dear Larry:

We have reviewed the two preferred options for-improving adult salmonid passage at Three Mile Falls Dam on the Umatilla River, which were discussed at the coordination meeting held at our headquarters on February 25, 1985, and have concluded that our preference is for a two-fishway system rather than the single fishway and velocity barrier.

In coming to this conclusion, however, we identified several aspects of the systems's operation which were of concern to us. We want to be sure that design and operational criteria will address these concerns, which we list below.

1. Design criteria for the fishways should allow fish to pass through them under any flow condition. However, it is possible that when flow at Three Mile Falls Dam falls below a certain level, there will be an insufficient volume of water passing through a fishway to attract fish to its entrance. Yet, because some water would flow through the channel leading to the base of the fishway, fish may be attracted into the lower end of this channel. This could result in delay and injury to fish attempting to reach the fishway. Likewise, dividing flows between the east and west bank fishways below a certain flow level may result in inadequate attraction flows for both fishways. Therefore, it may be necessary to identify minimum flow levels above Three Mile Falls Dam at which both fishways would be operated. When flows fall below that needed to operate both fishways, the east ladder should be shut down and all flows should be diverted down or in close proximity to the west fishway. At higher flows water should not be spilled over the crest of the dam while one of the fishways (the east bank fishway) is not operating. This could result in uncontrolled attraction of fish into the channel leading to the closed fishway and result in further delay or mortality. Therefore, when flow above Three Mile Falls Dam is at or falls below the combined capacities of the two fishways, all flow should be passed through the fishways.

2. Both fishways should include a capability for counting and trapping since we cannot predict with certainty that most fish will use a fishway of our choosing. However, the renovation should be designed so that at higher flows when both fishways are operational attraction is strongest to the west fishway. It will be more convenient and less expensive operationally if fish can be mainly trapped in one fishway.

3. When flow through the east fishway is shut off, the channel leading to that fishway should drain in such a fashion as to prevent the entrapment of fish in remaining pools. A pool at the lower end of the channel which extends for some distance into the channel and results in a "blind-alley" situation should, likewise, be avoided as this situation could contribute to-delays in fish passage. On the other hand, the grade of the channels leading to the base of the fishways should not be so steep and uniform as to result in a velocity barrier under relatively high flow conditions.

We look forward to the continuing opportunity to review and comment on plans for improving fish passage at Three Mile Falls Dam, and are appreciative of this opportunity to comment regarding the preliminary design options. If you need additional information regarding these comments, please let us know.

Sincerely,

Harry

Harry Wagner
Chief of Fisheries

cc T. Vogel (BPA)
Esch (NMFS)
Garst (USFWS)
James (CTUIR)
Marsh (CRITFC)
Prange (BR)
Chaney
Smelcer/Barila (USACE)
Andrews (USFS)
Schneider (NPPC)
Chrisman (NPPC)

GENERAL COUNCIL
and
BOARD of TRUSTEES

CONFEDERATED TRIBES
of the
Umatilla Indian Reservation

P.O. Box 638
PENDLETON, OREGON 97801
Area Code (503) Phone 276-3165

BUREAU OF RECLAMATION
MAR 25 1985
700

March 15, 1985

.arry Vinsonhaler
Regional Planning Officer
Bureau of Reclamation
PO Box 043, US Courthouse
550 W Fort St
Boise ID 83724

RE: Preferred Alternative for Modification of Three Mile Falls Dam

Dear Larry:

The Umatilla Tribe has long recognized the anadromous fish passage problems associated with Three Mile Falls Dam on the Umatilla River. We have been excited about the recent cooperative efforts and the funding outlook for finally correcting this problem and many others which have impacted anadromous fish runs in the basin since the early 1900's.

The Tribe has always favored a dam modification plan that would result in the best fish passage conditions. Recent reports stated that dam removal would provide the best juvenile and adult passage. However, the cost of this alternative is more than double any other option, as was noted at the February 25, 1985 coordination meeting. Although cost by itself should not be an overriding factor in determining the preferred alternative, there are other issues which are potential problems with the dam removal option. The cost of pumping water into the WEID canal raises several unanswered questions, and the lack of irrigator support for this alternative would no doubt be detrimental to other critical ongoing flow coordination efforts with irrigation districts.

The Tribe also has problems with the velocity barrier option. We are not convinced that this additional structure would result in acceptable levels of false attraction, fish stress, and migration delay.

For the above reasons, the Tribe supports the two-ladder fish passage alternative at Three Mile Falls Dam. We feel that providing passage at both ends of the 900-foot-wide dam is critically important during medium to high flows. The two-fishway system must be versatile so that low flows can be concentrated through either ladder. This alternative should also include a rotary drum fish screening system in WEID canal with juvenile sampling capabilities, fish counting and trapping capabilities in both

fishways, and some channel work immediately below the dam to create pool areas at the ladder entrances and facilitate passage to these areas.

The Umatilla Tribe appreciates the opportunity to comment on the preliminary design options for improved fish passage at Three Mile Falls Dam. We look forward to continued coordination with your agency during the final design phase. We hope that the project can move ahead expediently since upriver brigh fall chinook will begin to return annually to the Umatilla River in the Fall of 1985.

Sincerely,

BOARD OF TRUSTEES

Elwood H. Patawa

Elwood H. Patawa
Chairman

cc: Fish and Wildlife Committee
Vogel (BPA)
Esch (NMFS)
Garst (USFWS)
Burchfield (CTITFC)
Prange (BOR)
Chaney
Korn (ODFW)
Phelps (ODFW)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
847 NE 19th AVENUE, SUITE 350
PORTLAND, OREGON 97232-2279
(503) 230-5400

MAR 2 5 1985
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March 21, 1985

Mr. Larry Vinsonhaler
Regional Planning Officer
Bureau of Reclamation
Federal Building and U.S. Courthouse
Box 043-550 West Fort Street
Boise, Idaho 83724

Dear Mr. Vinsonhaler:

In accordance with a request by Mr. Bill Mullins of your staff, we have reviewed the alternatives for proposed fish passage improvements at Three-Mile Dam. We favor both a right bank and left bank fish ladder in addition to fish screens in the West Extension Irrigation District Canal.

We believe fish ladders on both banks will provide the optimum passage conditions for adult salmon and Steelhead approaching the project. Additionally, two ladders will provide greater operational flexibility through a full range of flows and site conditions.

Thank you for the opportunity to comment on this project. Please direct further comments or questions to Steve Rainey at FTS 429-5418 or Randy Lee at FTS 429-5411.

Sincerely,

Dale R. Evans
Division Chief

cc: Jim Phelps, ODFW, Pendleton
Gary James, CTUIR

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

BUREAU OF
OFFICE COPY
MAR 28 1985

Reference RG:mm

730 RR

March 25, 1985

MEMORANDUM

739

To : Regional Planning Officer, U.S. Bureau of Reclamation, Boise, ID 03724

From : Field Supervisor, ES, Portland Field Office

Subject: Fish Passage Alternatives for Three Mile Falls Diversion Dam

This is a follow-up to the February 25,1985 meeting on the subject. Preliminary designs and cost estimates were discussed for the alternatives currently under consideration. It is our understanding that the Bureau's assessment of fish passage problems and potential solutions at Three Mile Dam will discuss four alternatives. These will involve a combination of: two ladders; downstream fish barrier,: cap on crest; and dam removal. In recent discussions with your staff, we have been asked to identify our preferred alternative.

Based simply on the biological issue of fish passage, it is our opinion that the dam removal option is the best alternative. We realize, however, that there are other considerations (engineering. economics, politics, etc.) which will be weighed in the final selection of a plan. In any event, the Bureau's analysis should include a fair and equal assessment of this alternative as a possible solution to the fish passage problems at Three Mile Dam. This analysis might include other (possibly more economical) means of supplying water to the West Extention Irrigation District **(WEID)**, besides pumping.

The second best alternative from a biological standpoint appears to be the two ladder alternative. This would involve renovating the left bank (west side) ladder and adding a ladder at a new location on the right bank (east side) of the dam. Both ladders would have counting and trapping facilities and a new fish screen and juvenile bypass system would be added on the left bank. As discussed at the meeting, there are Several design considerations that still need to be resolved for this option--particularly for the screening facility.

The other two alternatives, while likely improving fish passage compared to the present situation, have many unanswered questions considering the debris, sedimentation, and flow problems at the dam. Without some hydrologic modeling to test these alternatives, we feel the two ladder option can be designed and operated in conjunction with good maintenance at the dam, -to satisfactorily allow for fish passage.

These comments should be considered preliminary. We will make final comments on a preferred alternative when detailed plans and specifications are available for review. Thank you for the opportunity to provide early input on this matter.

Ronald L Hart
for Russell D. Peterson

cc:
ODFW, Portland
NMFS, Portland
ODFW, Pendleton
CTUIR, Pendleton
CRITFC, Portland

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION

2705 East Burnside Street, Suite 114, Portland, Oregon 97214 Telephone (503) 238-0667

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26 March, 1985

Larry Vinsonhaler
Regional Planning Officer
Bureau of Reclamation
P.O. Box 043,U.S. Courthouse
550 W. Fort Street
Boise, ID 83724

Dear Larry,

The Columbia River Inter-Tribal Fish Commission has reviewed the options for fish passage facilities at Three Mile Falls Dam on the Umatilla River. While we consider dam removal as an attractive option, we are aware that a pumping station on the Columbia River would merely transfer the fish passage problem to another site. Substantial changes in water policies are necessary before dam removal can be a suitable solution to fish passage problems at Three Mile Dam. Since it appears water policies are unlikely to change drastically within the next few years, we support the Umatilla Tribes' endorsement (by letter of March 15) of the two-fishway system. Flexibility to operate one or both ladders must be built into the design. The approach channel must be designed to minimize stranding of adults if one ladder is inoperable during low flows. Fish counting and trapping facilities should be designed for both ladders. Additionally, this option should include juvenile screening of WEID canal and juvenile sampling capabilities.

We appreciate the opportunity to provide input to you during these early stages of the design process. We are eager for construction to begin, and we urge you to avoid delays whenever possible.

Sincerely,

S. Timothy Wapato

S. Timothy Wapato
Executive Director

STW:SB:mrm

missioners:

NEZ PERCE Melvin S. Joye • Henry W. Penney • Allen Pinkham • Charles H. Hayes • Wilfred Scott
UMATILLA Roderick Cowapoo • N. Kathryn Brigham • Elzie Farrow • Robert Williams
WARM SPRINGS Harold Culpus • Delbert Frank, Sr. • Nathan Jim, Sr. • Claude H. Smith, Sr. • Eugene Greene, Sr.
YAKIMA Bill Yallup • Levi George, Sr. • Wilferd Yallup • Tom Eli

Grande Ronde Habitat Improvement Project: Joseph Creek and Upper Grande Ronde River Drainages

Annual Report

by

William T. Noll, Project Leader
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 1986

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS.....36 2

ABSTRACT.....36 3

INTRODUCTION.....36 4

DESCRIPTION OF STUDY AREA

Joseph Creek Drainage.....37 1
Upper Grande Ronde River Drainage.....37 1

METHODS AND MATERIALS

Prework 374
Project planning 374
Onsite preparation 374
Easement procurement 374

Implementation 374
Instream structures 374
Planting 374
Fencing 375

Postwork 375

RESULTS AND DISCUSSION: I. FIELD ACTIVITIES

Prework 375
Project planning 375
Design and layout 375
Landowner coordination 376
Development of contracts and contract specifications 376
Onsite preparation 376
Riparian lease procurement 377

Implementation 377
Planting 377
Fencing 377
Instream structures 377
Miscellaneous field activities 378

Postwork 380

RESULTS AND DISCUSSION: II. ADMINISTRATIVE AND INTERAGENCY COORDINATION/EDUCATION

Administrative.....380
Reports.....380
Budgets.....380
Personnel.....380

Interagency Coordination/Education.....380

APPENDICIES

A. Results of Elk Creek electrofishing - A memorandum.....382

B. Leased riparian habitat area on Swamp Creek fenced in 1985.....384

C. Instream structures installed on Elk Creek in 1985.....389

D. Suggested Elk Creek instream structure modifications - A memorandum.....394

LIST OF ILLUSTRATIONS

TABLES PAGE

1. The estimated amount of riparian and instream habitat work needed within the Joseph Creek Drainage by stream, and in priority order. 365

2. The estimated amount of riparian and instream habitat work needed within the Upper Grande Ronde River Drainage by stream, and in priority order. 366

3. Summer Steelhead spawning ground counts in the Joseph Creek Drainage, 1966 through 1985. 368

4. Spring chinook spawning ground counts in the Upper Grande Ronde River Drainage, 1967 through 1985. 369

5. Counts of returning adult spring chinook and summer Steelhead over Lower Granite Dam on the Lower Snake River, 1975 through 1985. 370

FIGURES

1. The Joseph Creek Drainage as it relates to the Grande Ronde River Basin of Northeastern Oregon and Southeastern Washington. 372

2. The Upper Grande Ronde River Drainage as it relates to the Grande Ronde River Basin of Northeastern Oregon. 373

3. Comparison of diagonal and horizontal slot designs for use with instream log sills. 379

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 this contract (Contract No. DE-AI79-84BP16614) was renewed with the addition of the Upper Grande Ronde River and 33 of its tributaries. 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)(l) 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.

During the first nine months of this year, major emphasis was placed on developing work contracts and implementing projects within the Joseph Creek Drainage. Major emphasis during the last three months of the year was placed on promotion of Upper Grande Ronde River Drainage landowner awareness and acceptance of the program, and preparation of riparian lease agreements with landowners within the Joseph Creek Drainage.

All work being done by the Oregon Department of Fish and Wildlife is on private lands and therefore requires that considerable time be spent developing landowner rapport to insure their acceptance of, and cooperation with, the program.

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 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: 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 mainstem dam passage problems and controlling ocean and river harvest of these stocks. There are now indications that 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).

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: Fencing		Miles of Riparian Work: Planting		Instream Structures	
			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. 1983. 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: Fencing		Miles of Riparian Work: Planting		Instream Structures	
			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 1985.

	YEARS																			
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Redds Observed	780	611	234	357	267	148	209	103	113	17	29	34	40	9	93	103	87	75	76	463
Miles Surveyed	56	52	51	63	47	53	55	60	54	34	50	30	51	58	59	59	45	58	49	49
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

[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.

[2] Since the Joseph Creek and Upper Grande Ronde River drainages are both within the Grande Ronde River Basin, it is felt that spawning ground trends within the Joseph Creek Drainage are also representative of those within the Upper Grande Ronde River Drainage.

Table 4. Spring Chinook spawning ground counts in the Upper Grande Ronde River Drainage[1], 1967 through 1985.

	YEARS																		
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Redds Observed	310	390	447	198	422	323	295	186	106	205	102	122	48	106	68	110	112	72	132
Miles Surveyed	40.5	38	27	27	27	27	27	27	27	27	19	21	27	27	27	28	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

[1] Streams in the Upper Grande Ronde River Drainage spring chinook spawning ground counts include North Fork, South Fork and mainstem of Catherine Creek, mainstem Grande Ronde River, and Sheep Creek.

Table 5. Counts of returning Adult Spring Chinook and Summer Steelhead over Lower Granite Dam on the Lower Snake River, 1975 through 1985.

	Annual Counts[1]	
Year	Summer Steelhead	Spring Chinook
1975	13,523	17,639
1976	20,020	20,475
1977	48,037	38,770
1978	23,565	41,006
1979	20,281 [2]	7,539
1980	32,677	6,758
1981	33,234	13,642
1982	63,070	12,746
1983	76,673 [2]	10,026
1984	86,448 [2]	7,921
1985	102,104 [2]	27,737 [2]

[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 figures were obtained through personal communication with Howard Jensen, Oregon Department of Fish and Wildlife, Clackamas, Oregon, January 17, 1986.

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 degradation 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 that 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 70 percent; a 250 percent increase over present shade cover. installation of instream structures can restore pool/riffle ratios to an acceptable 50:50 ratio. Therefore through an agressive habitat enhancement program optimum habitats for returning adults and their progeny may be realized.

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 River and Snake rivers (Figure 1). Approximately 75 percent of the Jodeh 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).

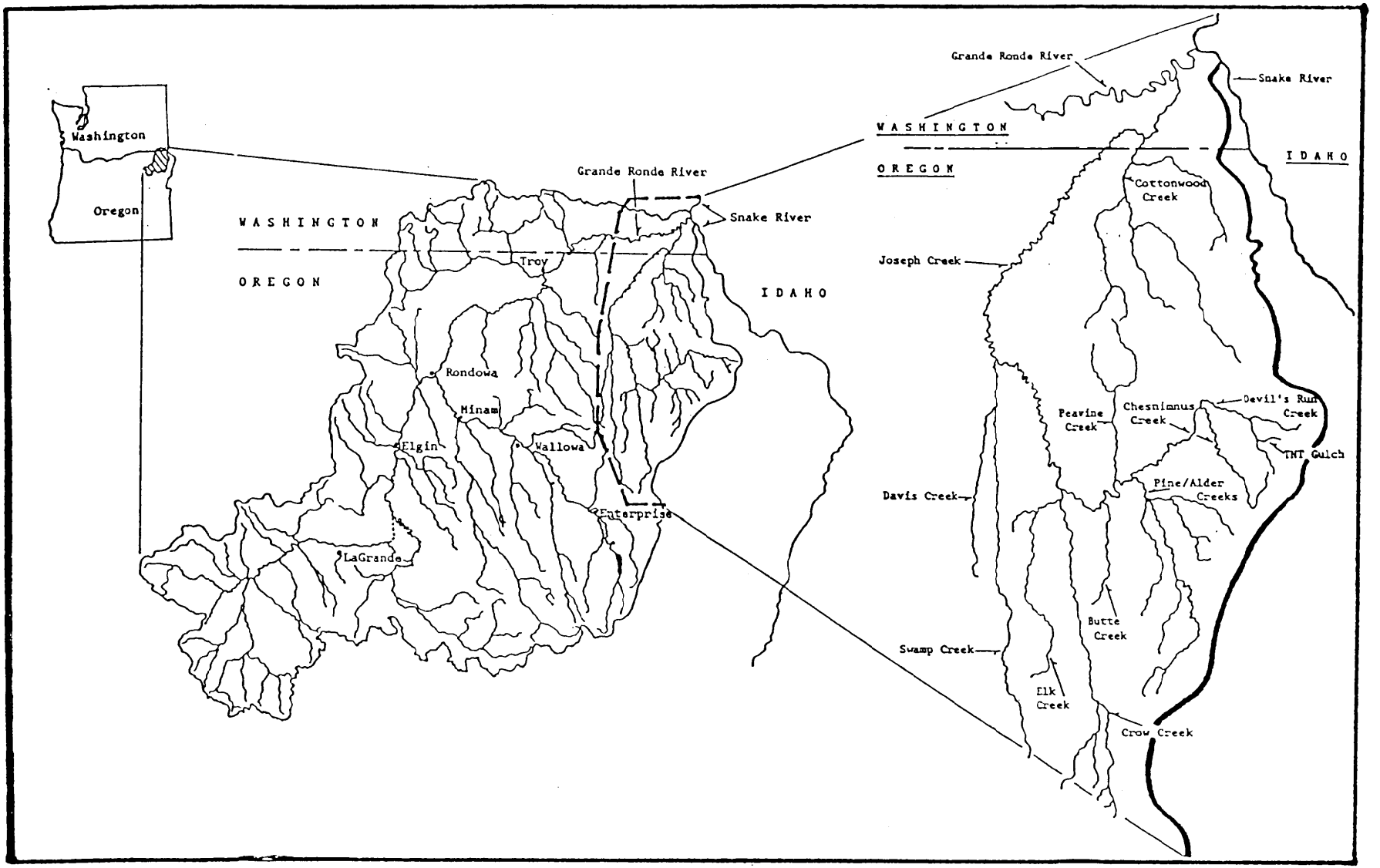

Figure 1. The Joseph Creek Drainage as it relates to the Grande Ronde River Basin of northeast Oregon and southeast Washington.

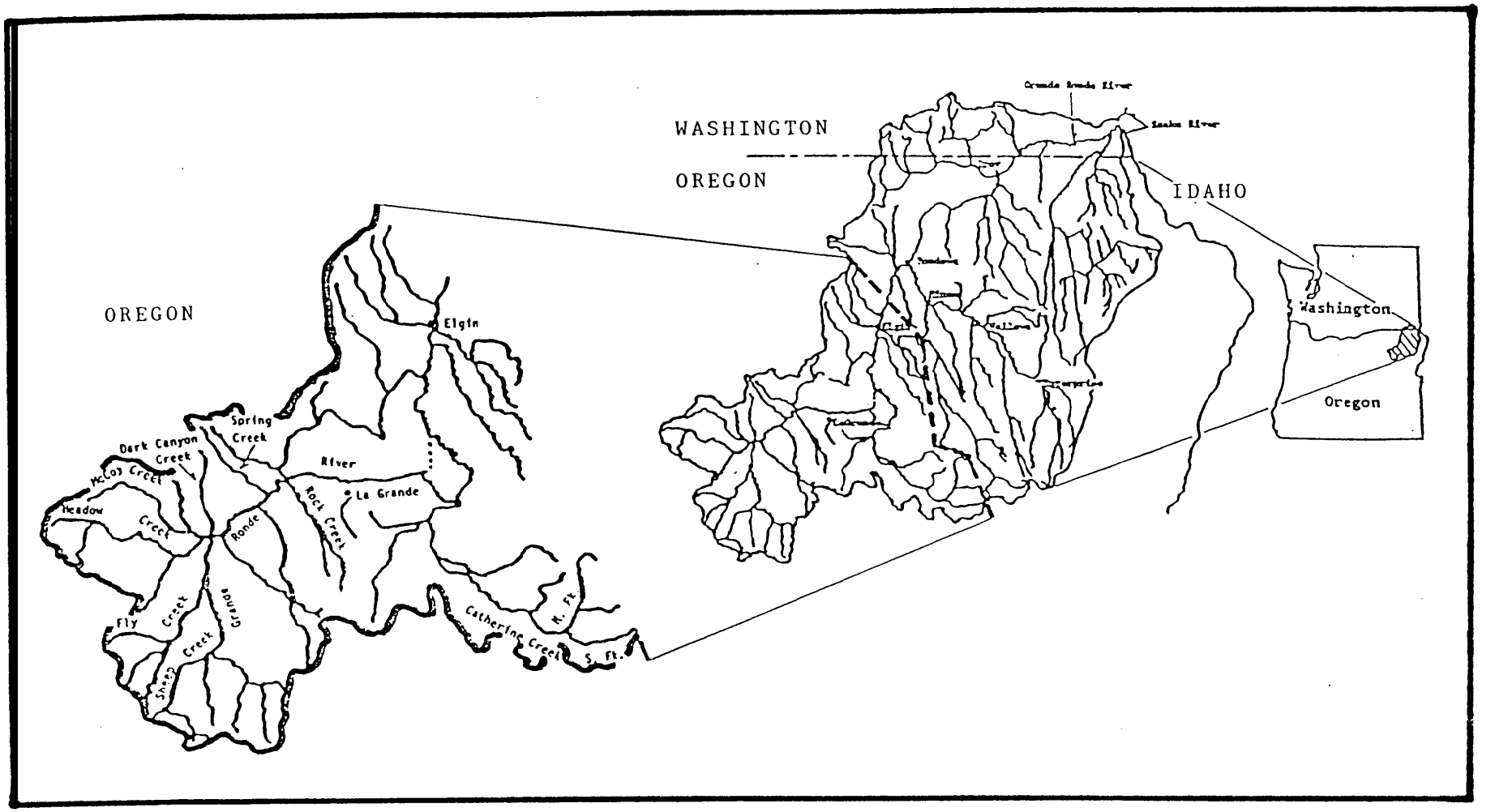

Figure 2. The Upper Grande Ronde River Drainage as it relates to the Grande Ronde River Basin of northeast Oregon

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. Easement 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.

4. Physical stream survey: Preliminary surveys of the physical characteristics of each proposed subproject area will be undertaken, in some cases, as a joint effort with the U.S. Forest Service.

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. Instram 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.

2. Plantings: During the early spring vegetation will be planted at preselected locations along streams within the project areas. Since high summer water temperatures are considered to be the drainage's 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 80 percent. The objective of this phase of the project is to reach a minimum of 70 percent shade and have water temperatures of no more than 68°F within ten years of project implementation.

3. 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.

Postwork

Postwork will entail all 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) palnning and preparation (prework), 2) implementation, and 3) maintenance and evaluation (postwork). Activities undertaken during this year were within all three 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.

1. Project Planning

Work done in the project planning stage included: a) design and layout of onsite work, b) landowner coordination, and c) development of contract specifications.

a. Design and Layout County ownership maps were obtained for all private lands in the Joseph Creek Drainage and along the top ten priority streams in the Upper Grande Ronde River Drainage. Once these maps were obtained, and land ownerships identified, aerial photographs were obtained for these streams from U.S. Department of Agriculture-Agricultural Stabilization and Conservation Service (USDA-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 to 89 x 11 inch segments and reproduced for use in on-the-ground planning activities, as descriptive parts of riparian lease agreements, and as parts of contract specifications for contracted riparian enhancement work.

Maps for Chesnimnus, Crow, Joseph, and Swamp creeks in the Joseph Creek Drainage, and the mainstem Grande Ronde River, Fly, and Sheep creeks in the Upper Grande Ronde River Drainage were completed to the 8½ x 11 inch stage. Mapping of Butte Creek in the Joseph Creek Drainage was completed to the ozalid stage.

Maps of proposed project areas within Joseph Creek and Upper Grande Ronde River drainages were also developed for budgeting purposes.

Meetings with ODFW District Fish Biologists and Soil Conservation Service (SCS) personnel were conducted, and proposed project areas inspected in the Upper Grande Ronde River Drainage in preparation for the 1986 field season.

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, and slide presentations. During these meetings emphasis was placed on meeting needs of the fishery resource while, at the same time, benefiting landowners. Contacts were made with five landowners in the Joseph Creek Drainage and six landowners in the Upper Grande Ronde River Drainage.

c. Development of Contracts and Contract Specifications Considerable time-during this year was devoted to development of work contract specifications for fence construction, riparian planting, materials procurement, and instream structure construction.

2. Onsite Preparation

Preliminary staking of fencelines along 4.5 miles of Chesnimnus Creek and 4.2 miles of Crow Creek in the Joseph Creek Drainage were completed during 1985. Additionally, 32 sites on Elk Creek were identified and staked in preparation for installation of instream structures.

Approximately 5.0 miles of Chesnimnus Creek were surveyed in cooperation with SCS personnel to develop a Cooperative Resource Management Plan for that creek. Following the initial survey, about 4.0 miles were resurveyed and potential sites for instream and streambank stabilization structures identified.

Prior to installation of instream structures 1.2 miles of Elk , e k a tributary to Joseph Creek, were surveyed with the aid of n elect shocker (Appendix A).

Habitat inventories, done in cooperation with the USFS, were completed on private lands along Swamp and Elk Creeks in the Joseph Creek Drainage and along Fly and Sheep creeks, and the mainstem Grande Ronde River in the Upper Grande Ronde River Drainage.

3. Riparian Lease Procurement

Riparian leases were signed with two landowners in the Joseph Creek Drainage during 1985. The first lease will protect approximately 16.2 acres of riparian habitat along 2.4 miles of Swamp Creek for a period of ten years. The second lease will protect approximately 17.3 acres of riparian habitat along 0.9 miles of Elk Creek for a period of twelve years.

Tentative agreements were reached with two landowners on Chesnimnus Creek. If leases for these two pieces of property are signed during 1986 they will protect approximately 5.0 miles of creek for 15 years.

No lease agreements have been signed with landowners in the Upper Grande Ronde River Drainage because we were not able to initiate landowner contacts in that area prior to November 1985.

IMPLEMENTATION

Implementation activities undertaken during this year were in the planting, fencing, instream structure, and miscellaneous field activity categories.

1. Planting

Planting of 3,530 trees and shrubs along 2.4 miles of Swamp Creek was completed during this year; 550 white willow (*Salix alba*), 500 each of Siberian crabapple (*Malus baccata*) and Midwest crabapple (*Malus Selkirk*), 767 Wavey leafed alder (*Alnus sinuata*), 400 river birch (*Betula occidentalis*), and 800 Redosier dogwood (*Cornus stolonfiera*).

Although implementation of planting was not anticipated for Elk Creek during this year, favorable conditions enabled us to initiate planting activities. A total of 280 trees and shrubs were planted: 145 White willow, 44 Wavey leafed alder, 98 Siberian crabapple, and 4 Redosier dogwood. These initial plantings were made along two short sections totaling 0.9 miles of creek. Planting in these sections will be completed during the spring of 1986 and protective fencing constructed immediately following this planting.

2. Fencing

Following planting of Swamp Creek, 4.44 miles of five strand barbed wire fence were constructed to protect 2.4 miles of creek, 3,530 planted trees and shrubs, and 16.2 acres of riparian habitat (Appendix B).

Fencing of leased riparian areas along Elk Creek will be done during 1986.

3. Instream Structures

Installation of 30 instream structures on 1.2 miles of Elk Creek was completed in 1985. Of these structures, five were log sills, nine were digger logs, and 16 were deflector logs or digger wings (Appendix C).

The passage slot in log sills was redesigned so as to minimize juvenile salmonid upstream passage problems and increase the life expectancy of the sill. The standard slot which is commonly used in log sills is square when viewed from overhead, and horizontal or parallel to the water's surface when viewed from the side: the new design is "V" shaped when viewed from overhead, and diagonal, or angled down towards the downstream edge of the log, when viewed from the side (Figure 3). This new design accomplishes four things: 1) it reduces the vertical distance that fish must jump, 2) its angled surface allows fish to swim over the log, 3) it concentrates water during periods of low flow thereby allowing easier fish passage, and 4) it directs flow away from the log thereby reducing log undercutting and increasing life expectancy of the structure.

4. 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] and then fertilized with a 27-12-0-4 commercial fertilizer.

Considerable photo documentation of implementation activities, completed work and photopoints was undertaken in 1985.

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[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).

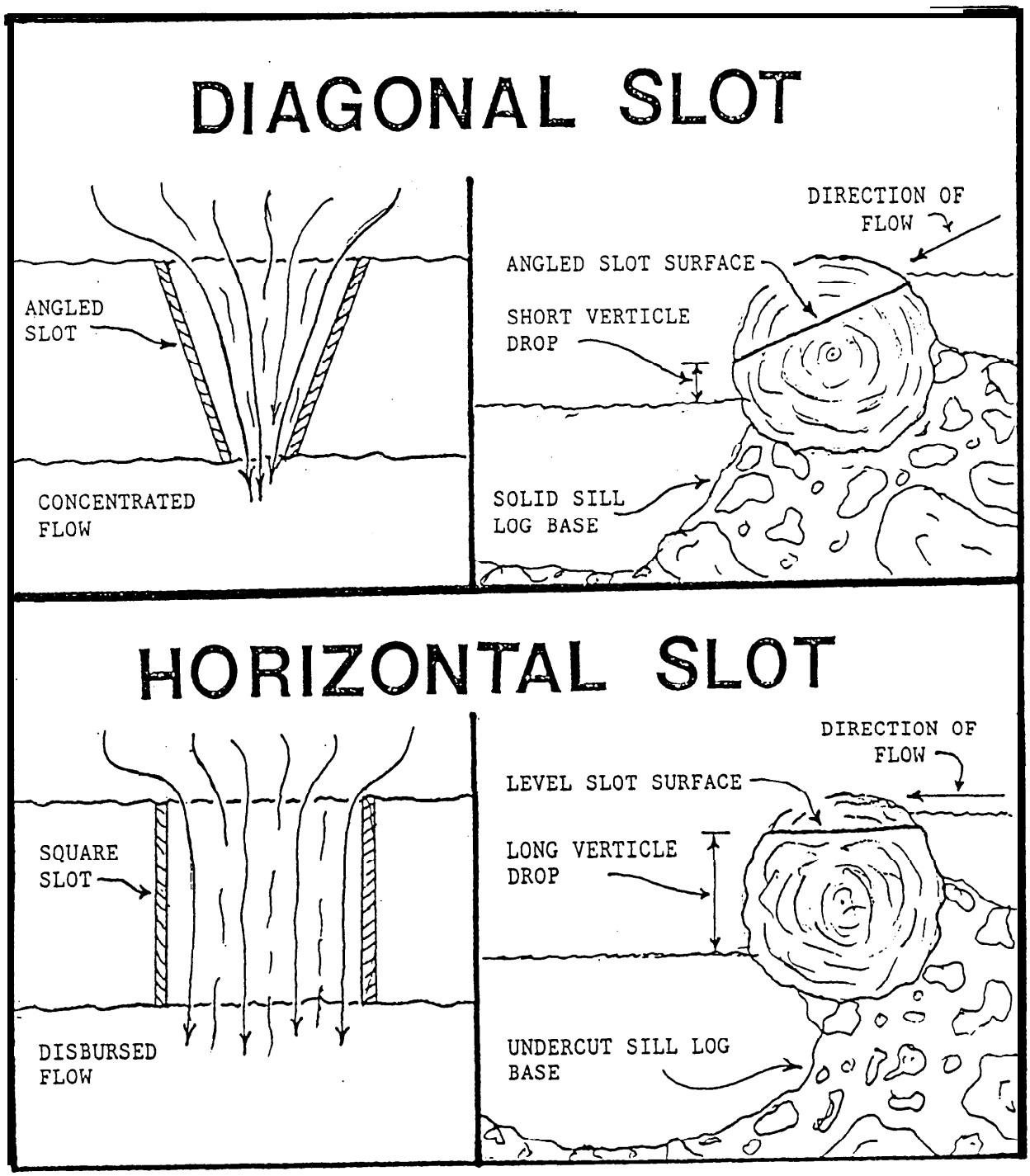


Figure 3. Comparison of diagonal and horizontal slot designs for use with instream log sills.

POSTWORK

One day was spent with U.S. Forest Service personnel evaluating log and gabion instream structures constructed in Elk Creek by the USFS. Deficiencies and modification needs were identified and discussed (Appendix 0).

RESULTS AND DISCUSSION

II. ADMINISTRATIVE AND INTERAGENCY COORDINATION/EDUCATION

ADMINISTRATIVE

Administrative activities during 1985 included preparation of reports and budgets, and orientation of new personnel.

1. Reports

Monthly, quarterly and annual progress reports for the Joseph Creek and Upper Grande Ronde River drainages were submitted as per contract agreements with BPA during 1985.

2. Budgets

During 1985 the decision was made to change the annual budgeting dates from July 1 - June 30 to April 1 - March 31 for all BPA projects in northeast Oregon thereby better facilitating implementation of field work. As a result, two separate packets containing budgets, work proposals, and five year budget projections for the Joseph Creek and Upper Grande Ronde River drainages were submitted in 1985. One packet to cover the July 1, 1985 - March 31, 1986 period, and the second to cover the next full year of budgeting under the new budgeting period starting on April 1, 1986.

3. Personnel

In September 1985 two new Fishery Technicians (Ann B. Kratz and Randal N. Reeve) were hired to facilitate planning and implementation of BPA projects in the Upper Grande Ronde River and Joseph Creek drainages, respectively.

INTERAGENCY COORDINATION/EDUCATION

In addition to meeting with private landowners to inform them of BPA-funded riparian habitat enhancement projects, considerable time was spent meeting with and/or giving presentations to various resource organizations. Slide programs were shown to resource agency personnel on six occasions. Presentations were given to Wallowa and Union County SCS's and Soil and Water Conservation Districts (SWCD); the Area Eight SWCD's and corresponding SCS Districts and the state directors from both agencies; and the State Vocational-Agricultural Teacher's Conference. Several of these meetings were also attended by personnel from other resource agencies (USFS, ASCS, County Planning, Extension Service).

A talk on "Riparian Habitat Projects and How They Relate to Ongoing Fish Management Programs in Northeast Oregon" was also given at an interagency coordination meeting between Umatilla National Forest and ODFW personnel.

Monthly Wallowa County SWCD meetings and Coordinated Interagency Resource Council meetings were regularly attended throughout the year to keep these resource groups informed of riparian habitat enhancement activities.

A meeting was attended in John Day to discuss interagency coordination between personnel from ODFW, SCS, and SWCD's.

A tour of BPA-funded riparian habitat enhancement projects in the Upper Grande Ronde River and Joseph Creek drainages was conducted for personnel from BPA, USFS, and ODFW. A similar tour of the Joseph Creek projects was given to fish biologists and technicians from the Nez Perce Tribe.

An inspection tour of riparian habitat projects in the John Day Project areas was attended as a part of the orientation for all new fishery technicians working on BPA projects in northeast Oregon.

A riparian habitat display was developed to be used as part of an ODFW display at the annual SCS-sponsored Wallowa County "Landfest".

Curriculum and lecture materials on propogation of native riparian vegetation were developed, and then presented over a two day period to students from Enterprise and Joseph Vocational-Agricultural classes. These classes will be followed-up in the spring of 1986 with in-the-field planting of riparian vegetation and a tour of areas where riparian habitats are being restored through BPA-funded projects.

The ASCS was contacted regarding the Agricultural Conservation Program (ACP) cost-sharing program and the possibility of doing riparian habitat projects on a cost-sharing basis with private landowners. Under the ACP a landowner may receive cost-sharing from the ASCS for up to fifty percent of the cost on approved projects (i.e. streambank stabilization). Therefore, if an approved streambank stabilization project on private land was needed, and it was also felt that this work would benefit fisheries, BPA funds could be used in conjunction with ACP and landowner funds rather than BPA or the landowner paying for 100 percent of the project costs. For example, if a project was going to cost BPA $5,000.00 but it was felt that the primary benefit was to the landowner for streambank stabilization rather than to fisheries, then the landowner could apply for ACP cost-sharing funds. This would reduce the amount that BPA would pay into the project and at the same time greatly decrease his own costs he would otherwise have to pay for the project himself. BPA may decide to fund $2,000.00 of the project, therefore leaving $1,500.00 each for the landowner and ACP to pay. Though not practical where most benefits are fisheries related, this may be a valuable tool in areas where no fisheries benefits would be realized and most benefits from the project would be directly to the landowner.

APPENDIX A

RESULTS OF ELK CREEK ELECTROFISHING

- A MEMORANDUM -

DEPARTMENT **FISH AND WILDLIFE**

MEMORANDUM

DATE: August 9, 1985

TO: Ken Witty

FROM: Willie Noll

SUBJECT: Elk Creek electroshocking

Ken,

During the past four days (August 6-9,1985) Mark Fritsch, Wes Bickerstaff and I electroshocked approximately 1.2 miles of Elk Creek which we have leased from Mack Birkmaier for BPA habitat enhancement purposes. The Steelhead numbers are pretty accurate, but the nonsalmonid numbers are probably quite low due to the difficulty of collecting and counting them.

For ease of classification we broke Steelhead into three size groups: 0-3.0", 3.1-6.0" and 6.1-9.0". The electroshocking results were as follows:

Steelhead:		Cottids	= 746
0.0 - 3.0"	= 1,788	Suckers	= 22
3.1 - 6.0"	= 590	Dace	= 413
6.1 - 9.0"	= 21	Squawfish	= 3
Totals	= 2,399	Totals	= 1,184

We also observed innumerable juvenile suckers or dace which were impossible to collect due to their size and stream conditions.

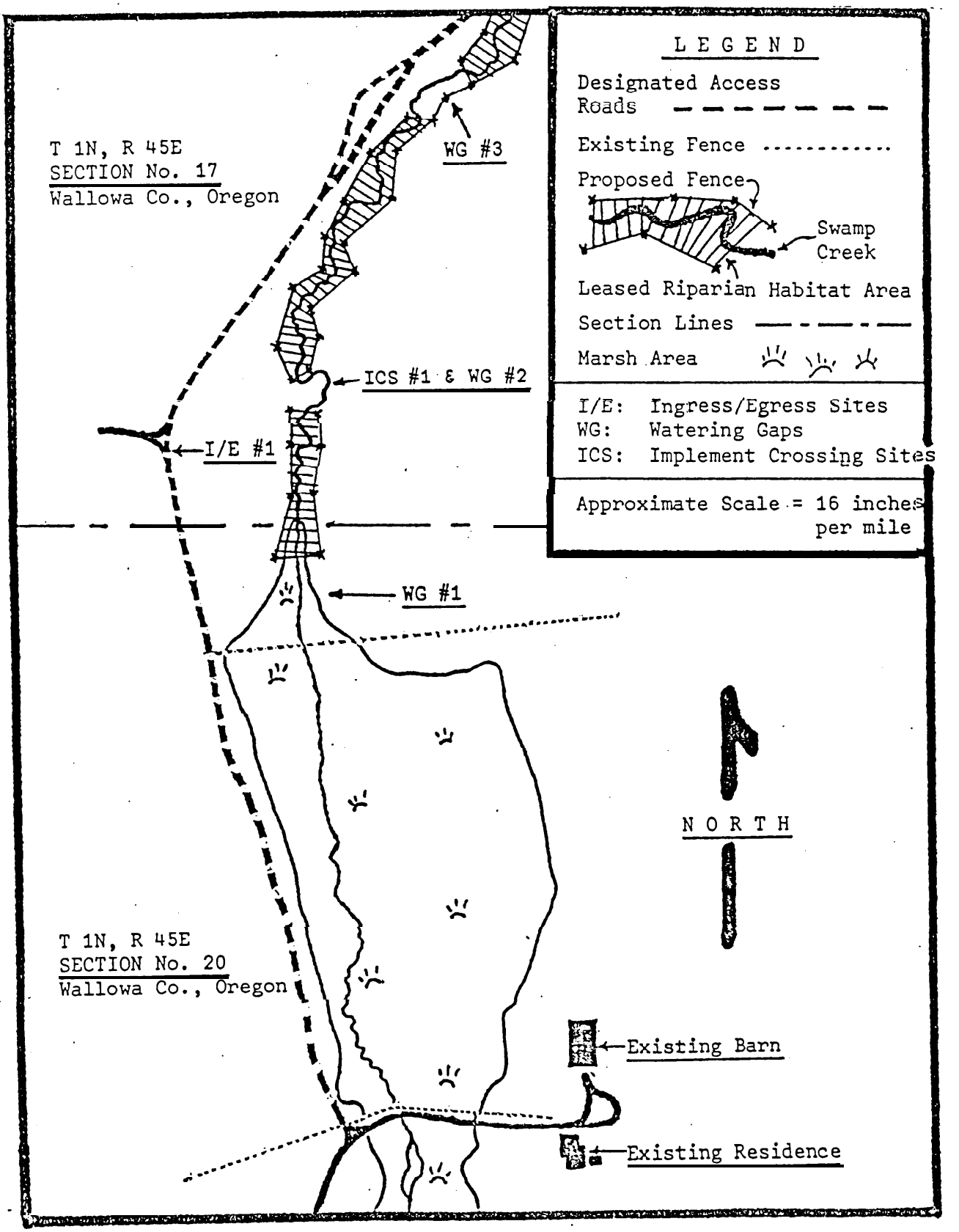
Willie

APPENDIX B

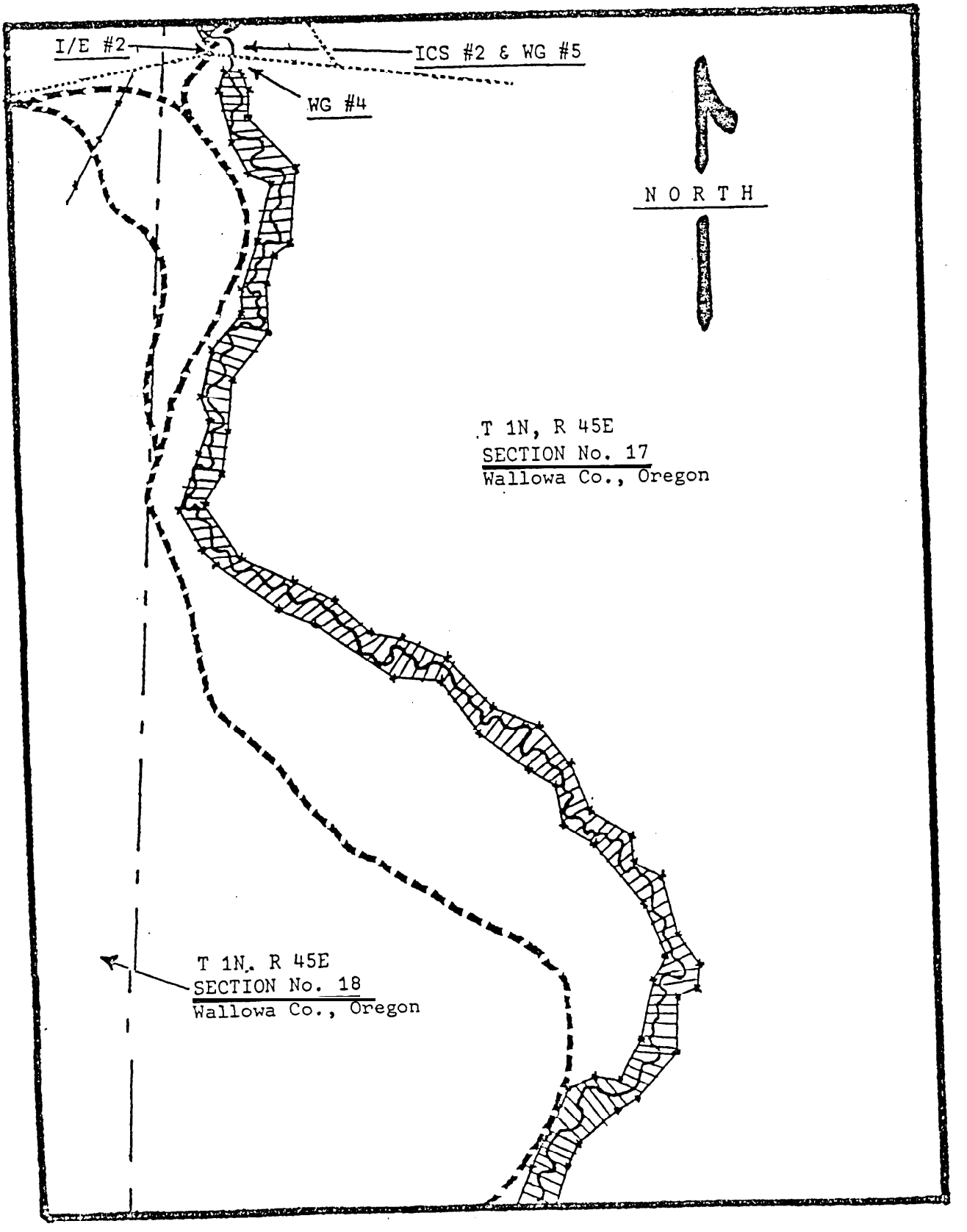
LEASED RIPARIAN HABITAT AREA ON SWAMP CREEK FENCED IN 1985

- A MAP -

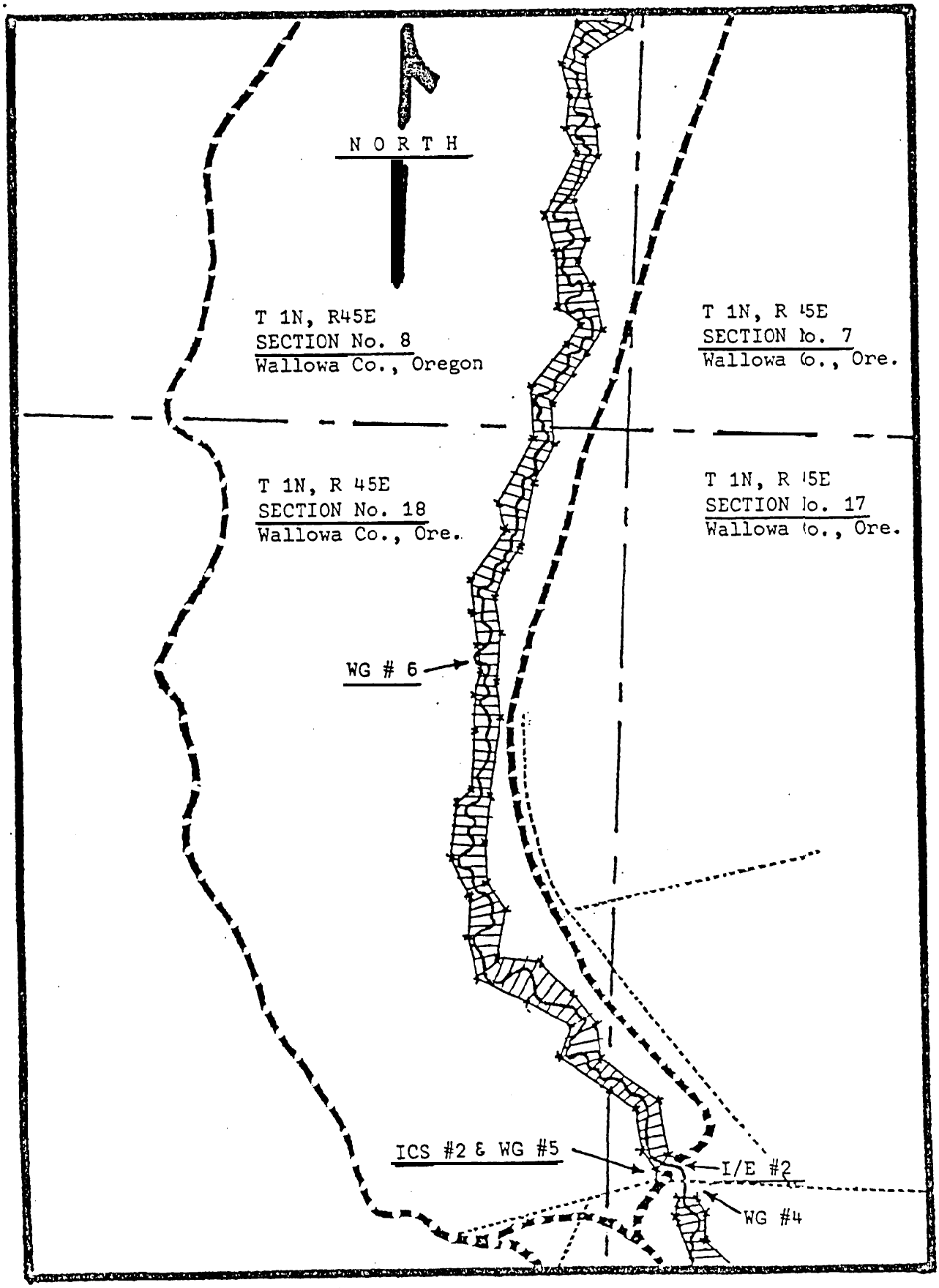
APPENDIX B-1


LEGEND
Designated Access Roads
Existing Fence
Proposed Fence
Swamp Creek
Leased Riparian Habitat Area
Section Lines
Marsh Area
I/E: Ingress/Egress Sites
WG: Watering Gaps
ICS: Implement Crossing Sites
Approximate Scale = 16 inches per mile
T 1N, R 45E
SECTION No. 17
Wallowa Co., Oregon
WG #3
ICS #1 & WG #2
I/E #1
WG #1
NORTH
T 1N, R 45E
SECTION No. 20
Wallowa Co., Oregon
Existing Barn
Existing Residence

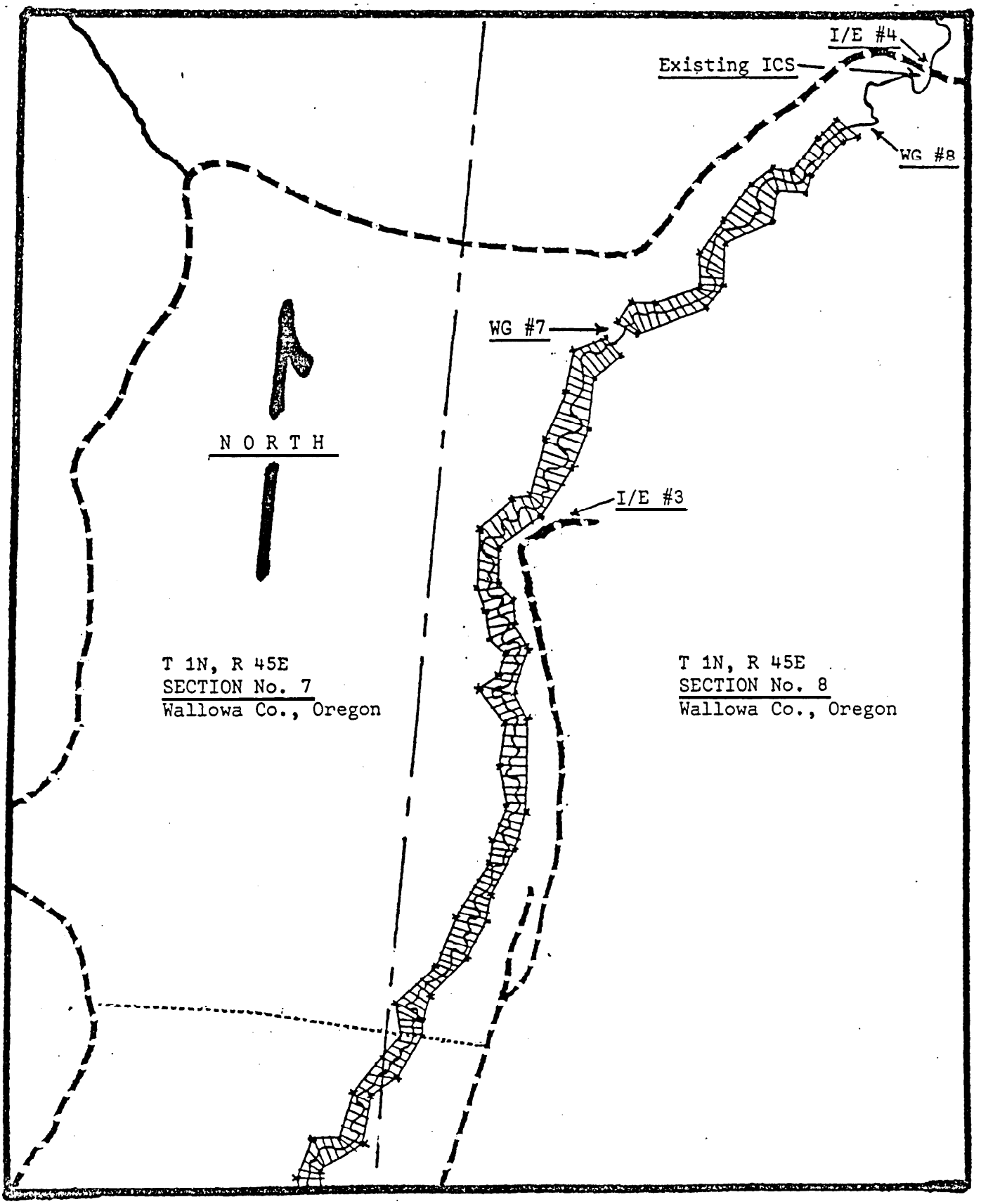
APPENDIX B - 3


I/E #2
ICS #2 & WG #5
WG #4
NORTH
T 1N, R 45E
SECTION No. 17
Wallowa Co., Oregon
T 1N, R 45E
SECTION No. 18
Wallowa Co., Oregon

APPENDIX B-3


NORTH
T 1N, R45E
SECTION No. 8
Wallowa Co., Oregon
T 1N, R 45E
SECTION No. 7
Wallowa Co., Ore.
T 1N, R 45E
SECTION No. 18
Wallowa Co., Ore.
T 1N, R 45E
SECTION No. 17
Wallowa Co., Ore.
WG # 6
ICS #2 & WG #5
I/E #2
WG #4

APPENDIX B-4


I/E #4
Existing ICS
WG #8
WG #7
NORTH
I/E #3
T 1N, R 45E
SECTION No. 7
Wallowa Co., Oregon
T 1N, R 45E
SECTION No. 8
Wallowa Co., Oregon

APPENDIX C

INSTREAM STRUCTURES INSTALLED ON ELK CREEK IN 1985

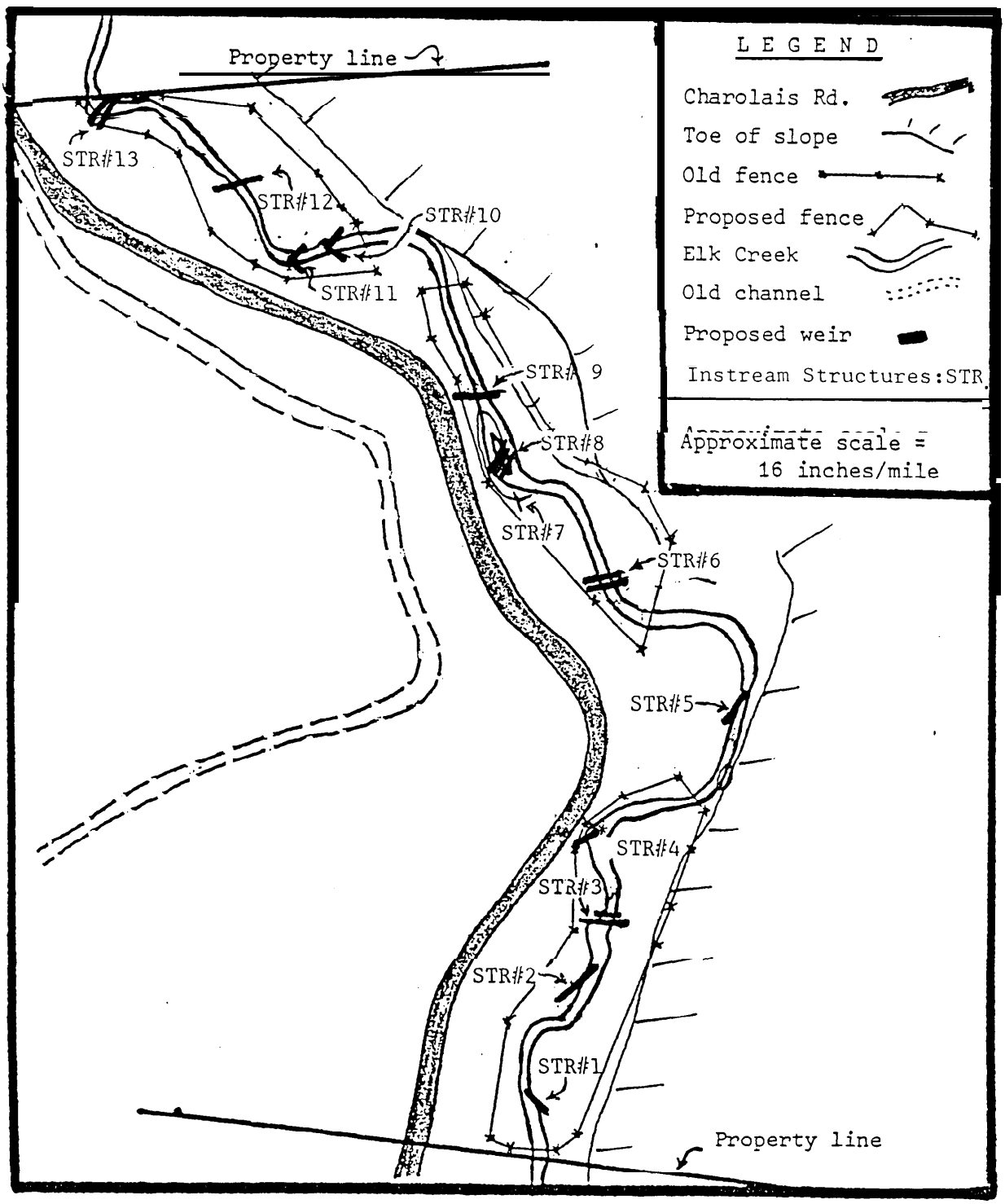
- A MAP -

APPENDIX C-l

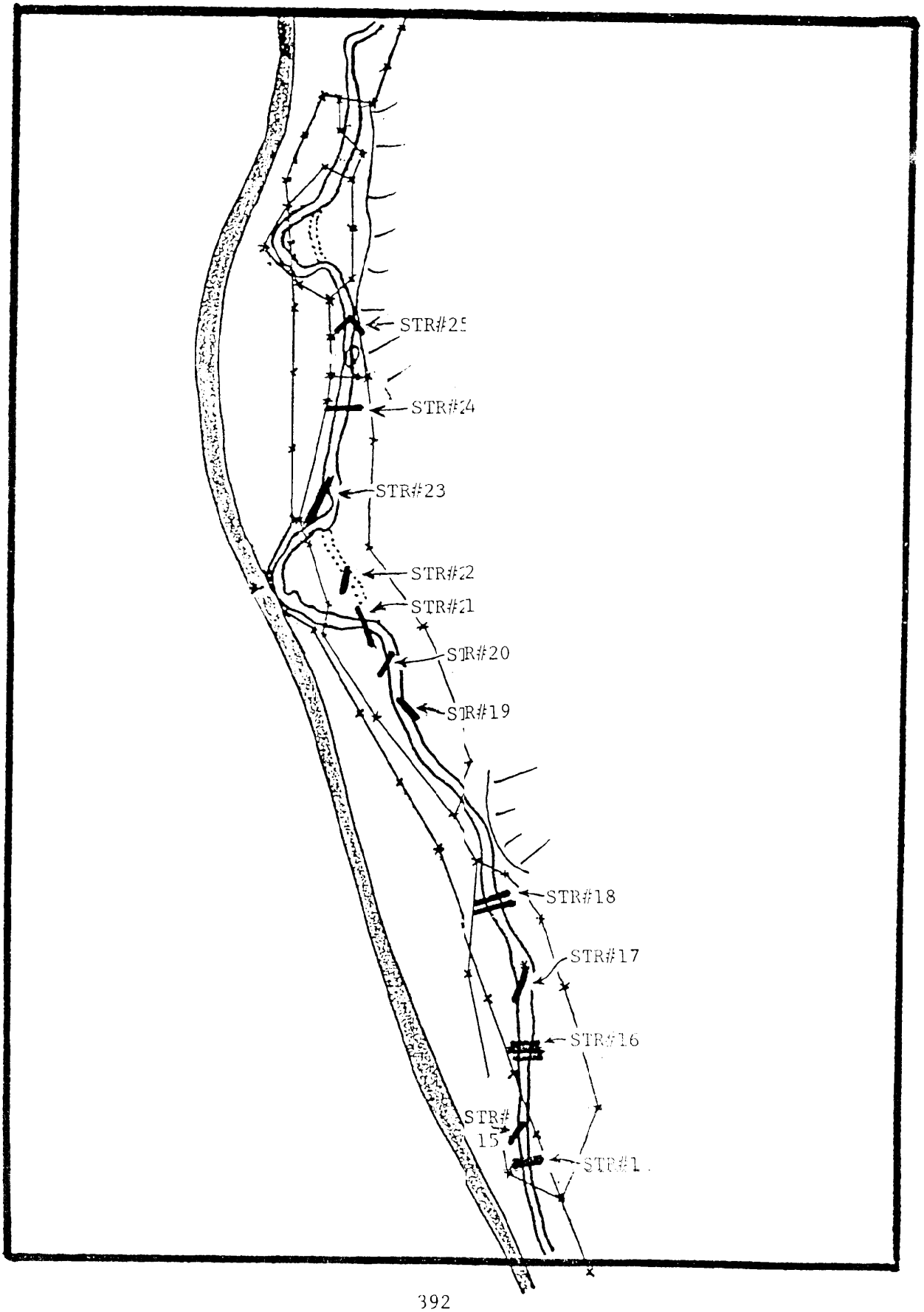
INSTREAM STRUCTURES INSTALLED ON ELK CREEK IN 1985

Structure Number	Structure Type
1	Digger wing, enlarged the existing pool
2	Digger wing, excavated a new pool
3	Double digger log, excavated new pool
4	Deflector log and root wad, enlarged existing pool
5	Digger wing, excavated a new pool
6	Double digger log, excavated a new pool, wood structure
7	Deflector log placed in pool
8	Digger wings, enlarged existing pool
9	Digger log, excavated a new pool, boulder placed
10	Deflector log and digger root wad, excavated a new pool, boulder placed
11	Deflector log and digger root wad, excavated a new pool
12	Digger log, boulder placed, new pool excavated
13	Double digger log and deflector, excavated a new pool
14	Digger log, excavated a new pool
15	Digger wing, excavated a small pool
16	Triple digger log, excavated a new pool
17	Digger Wing
18	Double digger log, excavated a new pool, root wad placed
19	Digger wing, excavated a small new pool
20	Digger wing, excavated a small new pool
21	Dviersion log, excavated a new pool
22	Digger wing, excavated a small new pool
23	Digger wing and deflector, enlarged an existing pool
24	Digger log, excavated a new pool
25	"V", double digger wing, enlarged existing pool
26	Log sill, excavated new pool, large rocks placed
27	Log sill, excavated new pool
28	Log sill, excavated new pool
29	Log sill, excavated a new pool, wood and rock structure added to pool
30	Log sill, excavated a new pool

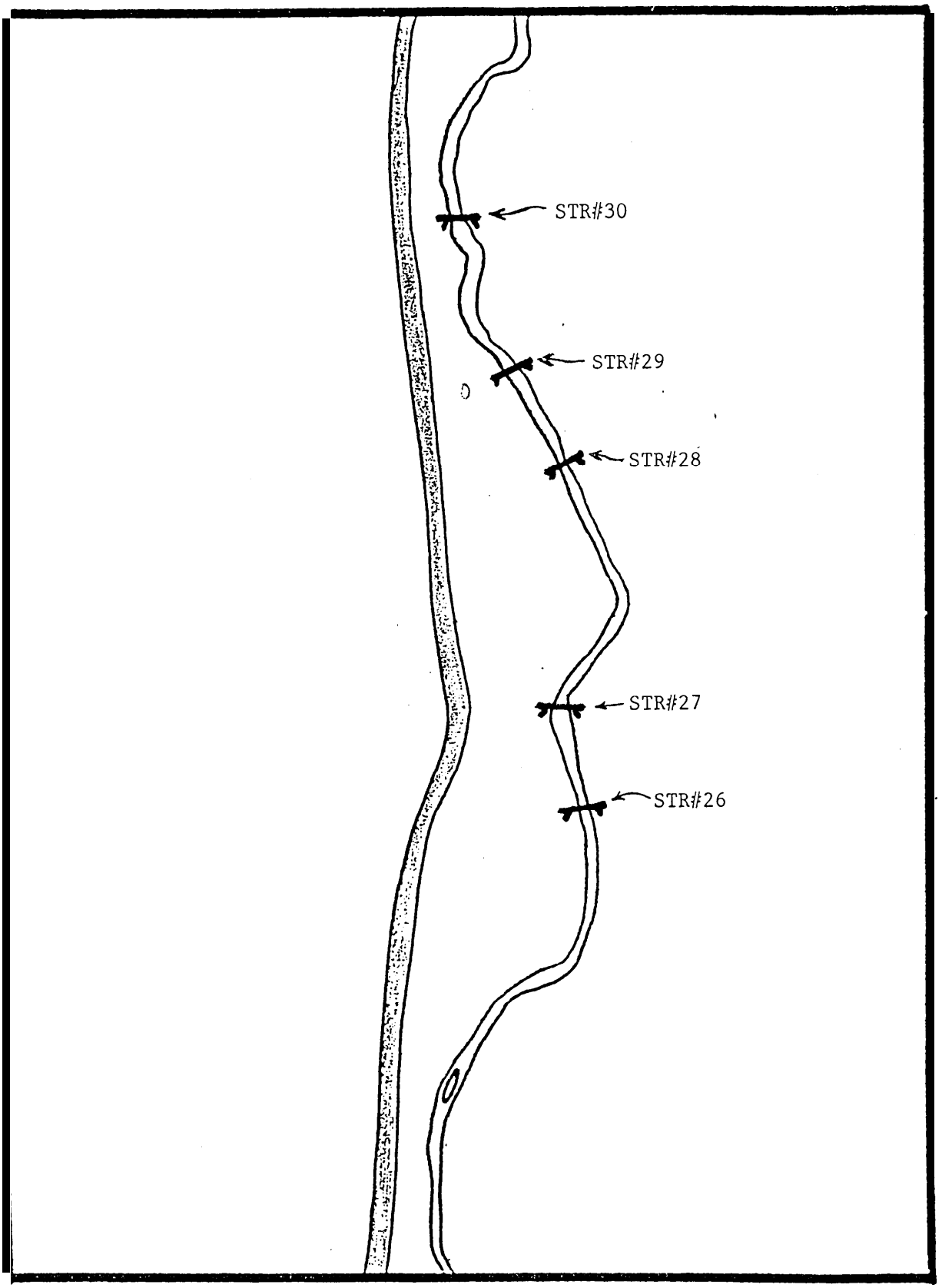
APPENDIX C-2


LEGEND
Charolais Rd.
Toe of slope
Old fence
Proposed fence
Elk Creek
Old channel
Proposed weir
Instream Structures:STR
Approximate scale =
16 inches/mile
Property line
STR#13
STR#12
STR#11
STR#10
STR# 9
STR#8
STR#7
STR#6
STR#5
STR#4
STR#3
STR#2
STR#1
Property line

APPENDIX C-3


STR#25
STR#24
STR#23
STR#22
STR#21
STR#20
STR#19
STR#18
STR#17
STR#16
STR#
15
STR#1

APPENDIX C-4



APPENDIX D

SUGGESTED ELK CREEK INSTREAM STRUCTURE MODIFICATIONS

- A MEMORANDUM -

DEPARTMENT FISH AND WILDLIFE

MEMORANDUM

DATE: May 25, 1985

TO: Frank Olsen

FROM: Willie Noll

SUBJECT: May 24, 1985 survey of Elk Creek, weirs and fish abundance

Frank:

On Friday, May 24, 1985 Jim Olivarez of your District and I surveyed Elk Creek just upstream from Gould Gulch with two objectives in mind: 1) to obtain information on abundance and distribution of juvenile salmonids within the area, particularly in conjunction with the instream structures which your personnel have placed in Elk Creek, and 2) to evaluate the condition and function of instream structures within the area.

Jim and I electroshocked the pools immediately below 21 weirs and collected 39 juvenile salmonids ranging from approximately 2 - 6 inches in length. We also electroshocked four natural rearing areas (undercut banks, root mass overhangs, and natural log weirs) and collected 14 juvenile salmonids within the same size range. One juvenile sucker and two juvenile cottids were also collected, No Steelhead smolts were collected and it is assumed that they had already moved out of lower Elk Creek. Had visibility been better we may have seen more fish, but I feel that we did see the majority of fish that were turned up with the electroshocker. Water temperature was 57 °F.

When Jim and I evaluated the instream structures we found, as in any evaluation, some very positive features and some areas that need improvement. I have broken our evaluation down into four basic areas as listed below:

1. Structure types. There were three structure types that Jim and I evaluated on Elk Creek: 1) log weirs, 2) gabion weirs, and 3) digger logs. Of the two weir types I believe that the log weirs are superior to the gabion weirs (e.g. if a sealing problem developes with a gabion weir there is a much greater chance that it could prove detremental to juvenile fish since they could get washed into the interior of the weir itself and be killed. If a log weir, on the other hand, developes a sealing problem, the water flow will either go around or under the log thereby still providing safe passage for fish). Should a log weir develope a wash-out under the structure then it has essentially turned into a digger log rather than a weir and, from our preliminary observations, that may be one of the most beneficial structures that we can provide. There was only one digger log to evaluate and it appeared to have functioned quite well in that a good pool (about 18 inches deep) was already being formed. A major advantage of the digger log is that it shouldn't pose any problem to movement of fish up or down the stream whereas log or gabion weirs prove to be more of a problem in this area.

2. Weir Construction: All structures seemed to have withstood the high spring runoff fairly well. It may prove advantageous in the future, however, to key the weirs further into the banks to prevent high spring flows from washing around the ends of the weirs and possibly creating new channels within a few years.

When gabion weirs were constructed a flap of geotextile material was laid over the primary weir spillway. This seems to be working quite well as it prevents the water from flowing through the weir, thereby passing fish over the weir rather than causing mortalities as they try to pass through the weir with the water flows.

Some log weirs were quite high and may need to have the top log notched very deeply or removed so as not to impede upstream movement of juvenile salmonids.

3. Weir spacing: During our evaluation time Jim and I also discussed pool/riffle ratios, why they were important, and how a good pool/riffle area should be structured. With this in mind, Jim and I agreed that some of the existing log weirs should either be removed or modified in such a way so as to develope a more desireable pool/riffle ratio and thereby provide more favorable rearing conditions for juvenile salmonids.

4. Pool development: Though only shallow pools were excavated below most weirs at the time of weir construction, the spring flows appear to have scoured out some reasonably good rearing pools in these areas. Pool depths below weirs ranged from 10 to 42 inches and averaged about 18 inches.

It may be advantageous in the future, however, to excavate deeper (18 to 24 inch deep) rearing pools below the weirs at the time of weir cnstruction. This would provide more immediately useable rearing areas.

Another obserbvation which Jim and I made was that deeper, more well defined poolsexisted below weirs where a notch had been cut into the top log so that flows passing over the log weir were concentrated into a central point, thereby digging deeper pools.

I really appreciated Jim's help with this preliminary evaluation Frank, and find his apparent interest in, and concern for the fishery resource very encouraging and refreshing.

Sincerely,

William T. Noll
Fish Biologist

XC: Ken Witty

Grande Ronde River Habitat Enhancement
Project 84-9
Annual Report
April 1, 1985 to June 20, 1986
Contract No. DE-AI-85BP

ABSTRACT

Two detailed reports are enclosed for work done in the (1) Upper Grande Ronde Sub-basin and (2) Joseph Creek Sub-basin. Both sub-basins are combined under the same agreement with BPA.

The primary objective for the entire Grande Ronde River drainage is to improve spawning and rearing habitat for summer Steelhead and spring chinook salmon. Such improvement work is mostly in the form of increasing the amount of shade and the streambank cover, and increasing the quality and quantity of rearing water for young fish. Such objectives are similar for entire streams, whether on National Forest or private lands. The Umatilla Confederated Tribes, Nez Perce Indian tribes and particularly the ODF&W have continued their close cooperation with the Forest on the planning for and implementation of improvement work.

During the work period the following was completed:

1. Habitat inventory completed on 57 miles of stream.

2. Detailed habitat improvement design for 8 miles of stream.

3. Shrub/tree planting along 2.3 miles of stream.

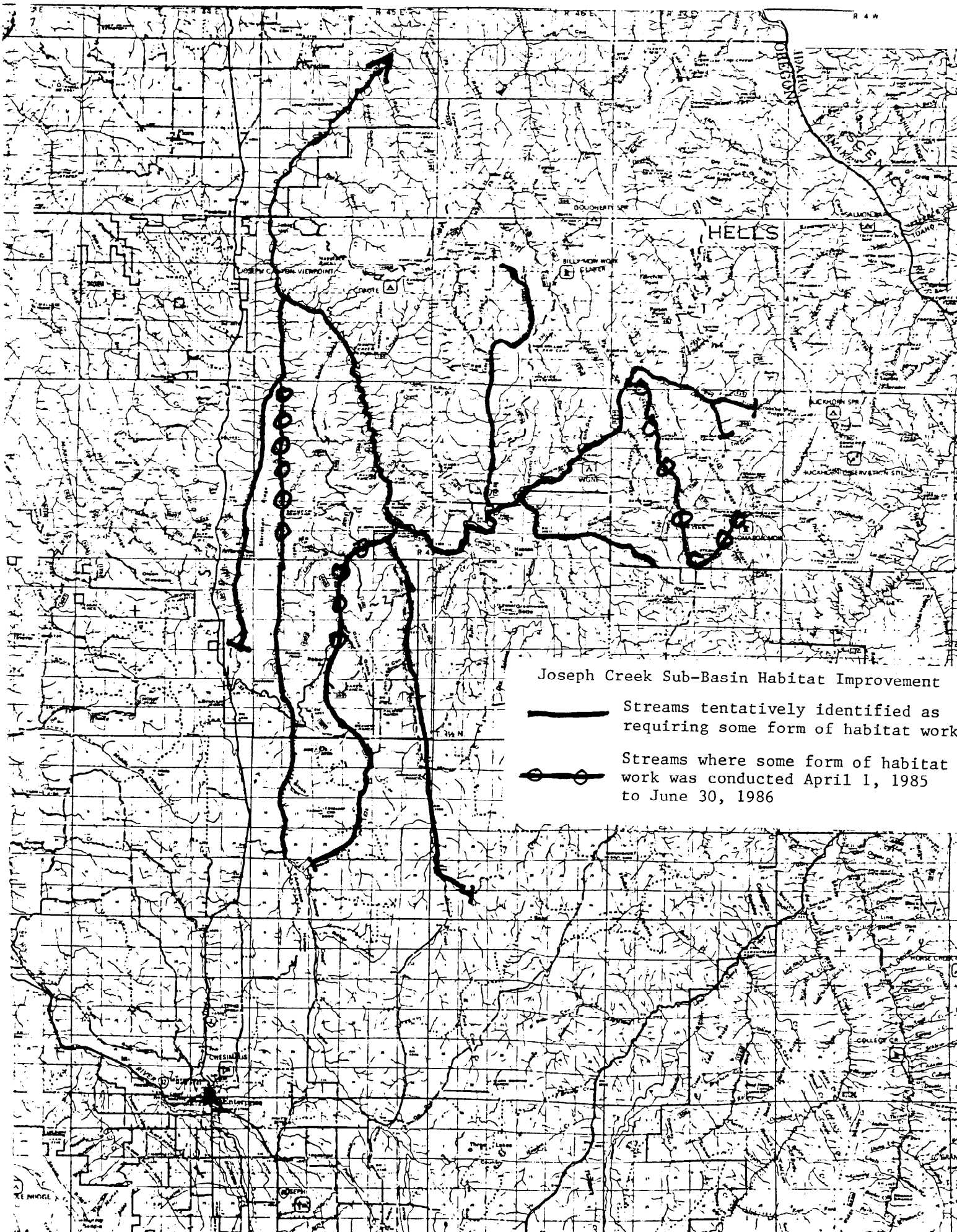
4. 2.8 miles of stream fenced to promote vegetative growth (5.8 miles of fence).

5. 101 insteam structures installed on 2 miles of stream.

6. All previously constructed structures were maintained to assure their planned functioning.

7. Permanent habitat monitoring points were installed.

Due primarily to the shortage of qualified people to conduct or supervise the on-the-ground work (all phases) along with other high priority work, the Forest was unable to complete all planned work. Uncompleted jobs have been rescheduled for completion this year (7/1/86 to 3/31/87). We are planning some organization changes that will correct this problem this coming winter.


HELLS
IDAHO
OREGON
Joseph Creek Sub-Basin Habitat Improvement
Streams tentatively identified as requiring some form of habitat work
Streams where some form of habitat work was conducted April 1, 1985 to June 30, 1986

JOSEPH CREEK DRAINAGE

OFF-SITE ENHANCEMENT PROJECT

ANNUAL REPORT FY 1985
(July 1, 1985 through June 30, 1986)

BY

ROD MILLER, PROJECT LEADER

WALLOWA-WHITMAN NATIONAL FOREST

PREPARED BY

JAMES P. OLIVAREZ, RANGE CONSERVATIONIST

WALLOWA VALLEY RANGER DISTRICT

Measure 7.4 (d)(l), Table 4e

Agreement
De-A179-83BP11898

TABLE OF CONTENTS

		PAGE
I.	Acknowledgements	**401**
11.	Introduction	**402**
III.	Methods and Materials	**402**
IV.	Results and Discussion	**404**
V.	Appendices	**408**

ACKNOWLEDGEMENTS

The Wallowa-Whitman National Forest wishes to express its appreciation to Northwest Power Planning Council for its foresight and initiative in incorporating National Forest System lands within its off-site enhancement program.

Also, the Bonneville Power Administration for their funding efforts, project review and consultation throughout the project.

The Wallowa-Whitman National Forest gratefully acknowledges the important contributions and assistance of the following individuals and organizations:

Gary James - Umatilla Confederated Tribes

Nez Perce Indian Tribe - Lapwai, Idaho

Ken Witty - Oregon Department of Fish and Wildlife

Willie Noll - Oregon Department of Fish and Wildlife

John Andrus - Umatilla National Forest

II. INTRODUCTION

This annual report shall display the work accomplished during the work period of July 1, 1985 through June 30, 1986.

The Joseph Creek Drainage Off-Site Enhancement Program was developed to enhance and improve anadromous fisheries habitat that had been identified as deteriorated and having significant potential.

The Joseph Creek system is a sub-drainage of the Grande Ronde System. The Projects upon Elk Creek, Swamp Creek and Chesnimnus Creek have all been identified as high priorities for treatment within the Grande Ronde System as displayed in the Columbia River Basin Fish and Wildlife Program.

The primary concerns are lack of quality pools and high summer water temperatures. These critical limiting factors affected rearing habitat during the summer months of July and August.

The plan was to offset these factors by installing in-stream structures as well as planting and protecting deciduous and coniferous vegetation from domestic livestock.

This report depicts a variety of different project phases within several tributaries of the Joseph Creek Drainage. We display project phases such as planting of deciduous vegetation along Elk Creek and Swamp Creek, Collections of planting stock for Chesnimnus Creek; installation of fencing for Elk Creek; Habitat Inventory and Determination of Potential for Elk Creek, Swamp Creek and Chesnimnus Creek; Implementation Design for Swamp Creek and Chesnimnus Creek; as well as Maintenance and Evaluation of in-stream structures and plantings for Peavine Creek and Elk Creek.

III. METHODS AND MATERIALS

During the project period several phases of project work occurred. The methods and materials used are displayed by phases where applicable:

Phase One: Habitat Inventory and Determination of Potential

A Habitat Inventory Procedure was developed by Mr. Michael Collette in 1984. It was adapted for management project use from Platts[1] research inventory procedures. (See Appendix I).

The instructions and procedures involved with the Inventory Technique are displayed upon the inventory form. Additional hands-on field workshops occurred with Oregon Department of Fish and Wildlife personnel.

[1] Platts, William S., et.al. 1983 Methods for evaluating stream, riparian and biotic conditions. CTR INT-138 Forest Service

The inventory was to be conducted on forty-six and four tenths (46.4) miles of stream. Of this, twenty-three and four tenths (23.4) were on National Forest Lands and twenty-three miles were on private Lands.

The inventory was to be accomplished by personnel from the Wallowa Valley Ranger District.

Initially an inventory of 100% of streams involved was scheduled. The months of August and September were the scheduled months of accomplishment.

Phase Two. Implementation Design

There is no formalized procedure for this phase.

Seventeen miles (17), of stream were to be assessed and Implementation Designs developed.

Michael Leonard, District Wildlife Biologist, has developed the Implementation Designs for all project work on the Wallowa Valley Ranger District.

The field style used is that of walking the project area and making on-the-&round prescriptions. The use of low-elevation infared photographs, (scale: 1:2000), has been critical for pre-field assessments and as a mapping and design display tool.

Prescription notes and a narrative with table displays are developed for each project area. (See Appendix II)

Phase Three Project Implementation

These were three distinct types of project implementation to occur as follows:

1. Acquisition and propogation of planting stock.

The standard procedure adopted is that of pruning local willow and cottonwood trees within the Wallowa Valley. Typically sources have been working with the Pacific Power and Light Company to collect pieces that result from their annual powerline right-of-way maintenance. Another source is local residents that have available and suitable trees for pruning. A final source has been on lands owned by the State of Oregon and managed by the Oregon Department of Fish and Wildlife.

The type of material sought has been pole material, 1 l/2 to 3 inches in diameter and 12 to 16 feet Long. It is also desirable that the pieces be young growth, typically with green, smooth bark.

Another size class material acquired is "peg" material. This is material that may be smaller in diameter and is cut to approximately 18 inches in length.

There were four exclosure segments in which an off-set hot (electric) wire was to be installed to deter elk passage. The target areas for off-set wires were where timber stands were adjacent to the exclosure. The fencing is to be accomplished by contract and Force Account personnel.

IV. RESULTS AND DISCUSSION:

The results of the pro&ram ending on June 30, 1986 were as follows:

Phase One: Of the forty-six miles of stream to be inventoried, eleven miles of Chesnimnus Creek were inventoried on federal lands. Another five and eight tenths miles of Swamp Creek were inventoried that are within private land. The remainder of the inventory and baseline monitoring is rescheduled for the next operating period.

The problems that occurred were primarily with personnel being subject to project work in other areas as a result of unexpected problems arising. Another occurance was that scheduled assignments were not completed by the employee.

Phase Two: An Implementation Design Packet was completed for Chesnimnus Creek. (See Appendix II>. This packet included site specific prescriptions for approximately four miles of Chesnimnus Creek. An overview was displayed for the remainin,; eight miles.

An intensive implementation Design Packet for the remaining eight miles of Chesnimnus Creek and the 5 miles of Swamp Creek has been rescheduled for the next work period. The Baseline Permanent Transects will also be installed in the next work period.

Phase Three: Project Implementation

1. Acquisition and propagation of planting stock.

During this work period planting stock was acquired for the Elk Creek planting preject, the Swamp Creek planting project and for the forthcoming Chesnimnus Planting Project.

In total for the Elk Creek and Swamp Creek Projects, approximately 4042 pieces of pole material, 6150 pieces of peg material and 1245 pieces of root stock shrubs and trees were acquired and planted.

The new propagation and acquisition efforts initiated for the Chesnimnus Piant in;; Project were conducted in the fail and winter of 1985/86.

The timing is restricted to dormant winter seasons for acquisition of cuttings for rooting in a growth medium.

This project is still in a state of refinement and development l In March of 1986 a re-grouping was in order

and a shift occurred in reference to collection and propogating of planting material. This shift was ~~done~~ due to higher than expected nursery costs and our inability to collect the targeted numbers during the collection period of December through February, (see Appendix III).

The present situation is that this project phase will need to be another carryover into the next work period. There is $5000.00 left in this fund that will need to be carried over.

2. Planting

The planting of Elk Creek was executed on schedule and by the prescribed method and material. A daily log was kept by the inspector, Susan Burton. This log is included in Appendix IV.

The Swamp Creek Planting Project was completed as prescribed. In April of the year the planted stock was air-lifted into Swamp Creek. In May, a backhoe was used to plant Swamp Creek down to the confluence of Davis Creek.

The following amounts and species of planting stock are in place.

Cottonwood and Willows	2200 poles
Potted Plants	400

3. Fencing

The protection fences prescribed were constructed during calendar year 1985. This was accomplished by both contract and Force Account. There were 5.8 miles of fence constructed. These fences were all of standard barb-wire construction with an off-set hot wire (electric) installation completed in the spring of 1986.

The fences were constructed within nine (9) segments throughout the project area.

The fencing that occurred was all standardized four-strand barb-wire with selected areas receiving an additional off-set hot wire to discourage elk crossing from adjacent timber stands.

The District has chosen to not utilize the complete New Zealand type electric fencing for the following reasons:

1. We have experienced elk getting into the charged exclosures in Peavine Creek and becoming trapped within. In 1985 approximately (8) eight head of elk

stayed trapped in an exclosure and consumed all existing annual growth on shrubs. We had to shut down the electric fence and herd the elk out of the exc

2. The electric fence system we have used in the past is subject to complete shut down if a problem occurs. During the shut-down periods the exclosures are vulnerable and livestock impacts can easily occur.

3. The standard barb-wire fence is a universal style that can be maintained by a vast majority of our personnel. The electric fence requires a trained technician with the appropriate specialized equipment.

4. The off-set hot wire is a simpler system and very easily maintained. It is also less susceptable to show-down if a malfunction occurs.

SUMMARY OF EXPENDITURES

Elk Creek Project (Completed)

1. Salaries	$35,953.00
2. Equipment Rental	$ 6,356.00
3. Construction/Services	$ 8,500.00
4. Material/Supplies	$17,825.00
5. Travel	$ 3,000.00
6. Overhead	----------
7. Approved Budget	$73,832.00
8. Expenditures to date 6/30/86	$71,634.00

The expenditures for all other project work shall be compiled and included in the final report each respective project.

APPENDIX I

HABITAT INVENTORY PROCEDURE

STREAM INVENTORY INSTRUCTIONS

Section - A reach of stream 50 paces long. A pace is two full steps calibrated to approximately five feet. Section lengths are about 250 feet. In remote areas, sections may be expanded to 100 paces. Line of pacing follows upper bank contours.

Inventory Section - This is to identify the location on-the-ground correlated with the inventory sheet. Fill in the boxes starting with the previous stake proceeding to the next station (e.g., 0 to 1 or Al to AZ, etc.). Sections will be identified on-the-ground with three-foot lath marked with grease pencil and flagged (usually blue ribbon). Inventory on private land may require another method unless approved by the landowner.

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.

Permanent Identifying Feature - This will normally be filled out at the beginning and end of the inventory and transferred to a four-inch to one mile 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 entering from the west, ditch diversion, etc.

Sub-section - Distances from the beginning point of the section to an identifiable change in flow feature or channel. All sub-section lengths will add to 50 paces (250 feet) for the section (100 paces remote sections). 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;

multiple flow features to another set of multiple flow features where (1) there is an obvious different percentage mix, and (2) when site distance is too great to get a good percentage mix for remaining area; and

dominant channel type change (i.e., straight to curve and vice versa).

Definitions:

<u>Single flow feature</u> - At least 90% of the sub-section is a single flow feature, although the remaining percent is still recorded.

<u>Multiple flow feature</u> - More than one flow feature - no feature accounts for 90% or more of the sub-section.

<u>Flow Features</u>: Pools, riffles, glide/runs.

Pools are portions of the stream that are deeper and of lower velocity than the main current (Arnette, 1976).

Riffles are faster, shallower areas with the water surface broken into waves by wholly or partly submerged obstructions.

Glides and runs are sections where the water surface is not broken, but is shallow and has a fast or faster velocity (Duff and Cooper, 1976).

Different flow features within a pace distance will be recorded as a percentage based on a visual estimate.

Organic Debris Indix

1 None
2 Infrequent debris, what's present consists of small, floatable organic debris.
3. Moderate frequency, mixture of small to medium size debris affecting less than 10% of channel area.
4. Numerous debris mixture of medium to large sizes affecting 11 to 302 of channel area.
5. Debris dams of predominantly large material affecting 31 to 50% of channel area and often occupying the total width of the channel.
6. Extensive, large debris dams either continuous or influencing over 50% of the channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage (Rosgen 1985).

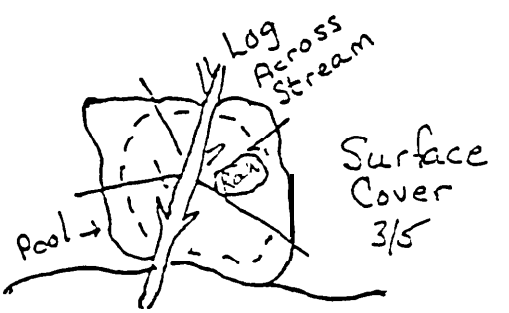
Pool Quality -

Depth. If the average present stream width for the sub-section is less than 20 feet, record depth by the following class: 1, 1-2, 2 feet. If stream width is greater than 20 feet, use Class 2, 2-3, 3 feet.

Diameter class. If the maximum pool diameter (measure by longest axis) is within 10% of the average present stream width of the sub-section, record 1A; if the maximum pool diameter exceeds the average present stream width by 10%) record 1B; if the maximum pool diameter is less than the average present stream width of the sub-section, record 1C.

Perimeter cover by 1/5 -- mentally divide the perimeter into 1/5, record the number of 1/5 which have cover (defined below).

Surface cover by 1/5. Similarly break the interior surface area of pool into 1/5 and record the number of 1/5 having cover.



Cover Class - the total number of 1/5th recorded as having cover for both perimeter and surface are combined as follows:

0-3	0-4	7-10
(P)oor	(F)air	(G)ood

Above schematic
3/5 + 3/5 = 6/5 = FAIR

Composite Pool Quality - Referring to the publication "Field Methods and Statistcal Analysis for Monitoring Small Salmonid Streams", by C. Armour and W. Platts, rating from Table 7.

Definition: Pool cover - Any material or condition that provides protection to fish such as logs, other organic debris, overhanging vegetation within one foot of the water surface, rubble, boulders, undercut banks, or water depth.

Substrate

Record by visual estimates within the riffles and glide/runs only substrate types by percentage in each of the following size classes:

Boulders - 10 inches; cobbles - 3 to 10 inches; large grave?. - 1 to 3 inches ; small gravel .2 to I inch; all other fines - 0.2 inch.

Riparian Vegetation Density -

Brush greater than or equal to three feet tall and within six feet of the stream edge is to be recorded by density class along each side of the stream within the pace distance. The density classes corresponding to percentage of canopy cover are as follows:

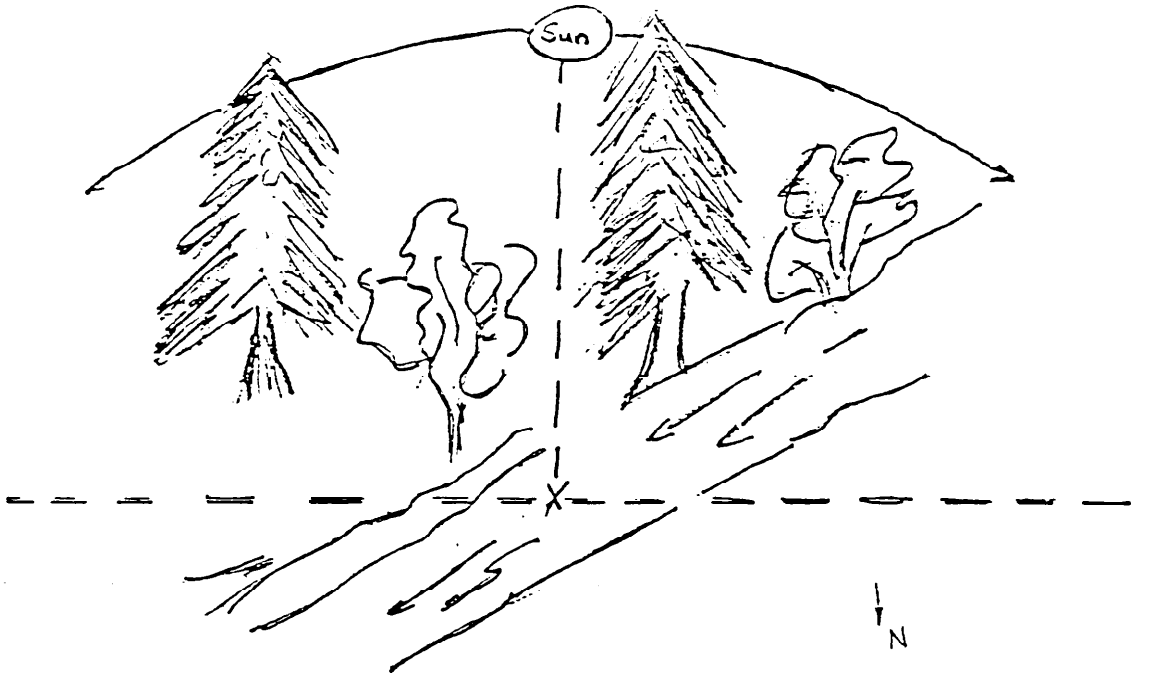
% Cover	0	1-10	11-20	21-40	41-60	61-80	81-100
Density Class Recorded	0	5	15	30	50	70	90

Trees within 25 feet of the stream edge are to be recorded by density class on each side within the pace distance.

% Cover	0	1-20	21-40	41-60	61-80	81-100
Density Class Recorded	0	15	20	50	70	90

Shade

An estimate of the overhead shade is made at one or more Locations within the section. Face in the general direction of the path of the sun relative to a point in the middle of the channel and divide the view into two 90 degree 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 50 to 66 degree angle overhead. Add the percentages in each quadrant, divide by two, and record.



Channel

Width - An estimation (± 2 feet) of the bank full 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)lluvian (meadow), (B)edrock, (T)ight trees/roots, large (R)ocks, (S)od cover.

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.

NOTES: Anything of relative importance can be inserted in this space which will add infroamtion to the inventory. The following is a list of items which may or may not be included.

Cutbanks - stability, appropriateness for structures
Livestock effects - browsing, trampling, etc.
Degree of human activity (i.e., roads, timber, recreation, mining, etc.)
Equipment access
Beaver (Active)(Abanson)
High water table
Planting difficulty
Fish observed, not observed, identification
Bank undercut

Arnett. J. L. 1976. Nonenclature for instream assessments. Pages 9-15 in C. B. Stalnaker and J. L. Arnette, eds. Methodologies for the determination of stream resource flow requirements: an assessment. U. S. Fish Wildl. Serv., Logan, UT.

Duff, D. A., and J. L. Cooper. 1976. Techniques for conducting a stream habitat survey on National Resource Land. U. S. Bur. Land Manage. Tech. Note 233. 72 pp.

Rosgen, David L. Paper presented at the symposium, Riparian Ecosystems and Their Management: Reconciling conflicting Uses, April 16-18, 1985, Tucson, AZ.

FISH HABITAT STREAM INVENTORY
PACE TRANSECTS

STREAM NAME _____ PAGE ___ OF ___

OBSERVER(S) _____ DATE Y M D

INVENTORY SECTION ☐ TO ☐ INVENTORY PROCEEDED ☐ UPSTREAM ☐ DOWNSTREAM

PERMANENT IDENTIFYING FEATURE WITHIN REACH _____

			SUB-SECTION										SECTION WEIGHTED AVERAGES
	BEGIN SECTION		• →										
FLOW FEATURES	POOL %												
	GLIDE/RUN %												
	RIFFLE %												
ORGANIC	INDEX												
POOL QUALITY	DEPTH (FT)												
	POOL DIAMETER CLASS												
	PERIMETER COVER FIFTHS												
	SURFACE COVER FIFTHS												
	COVER CLASS												
	POOL QUALITY COMPOSITE CLASS												
SUBSTRATE RIFFLE - GLIDE/RUN	BOULDERS %												
	COBBLES %												
	GRAVEL 1"-3" %												
	GRAVEL .2"-1"%												
	FINES <.2"%												
RIPARIAN VEGETATION DENSITY	BRUSH DENSITY CLASS	RIGHT											
		LEFT											
	TREE DENSITY CLASS	RIGHT											
		LEFT											
	PERCENT SHADE												
CHANNEL	WIDTH	FLOOD											
		PRESNT											
	STRAIGHT/CURVE												
	EXCAVATION EASE												
	VERTICAL BANK HEIGHTS												

NOTES:

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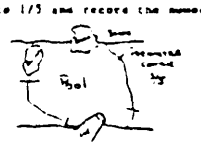

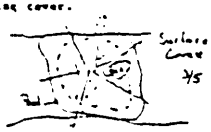

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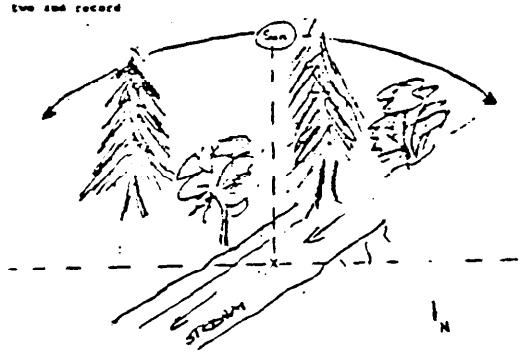

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Excavation case - insert the letter which best describes the sub-section in terms of case of excavation (A)lluvium (meadow), (B)edrock, (T)ight trees/roots, large (R)ocks, (B)ed cover.

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.

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.

Cutbanks - stability, appropriateness for structures
Livestock effects - browsing, trampling, etc.
Degree of human activity, i.e. roads, timber, recreation, mining, etc.
Equipment access
Beaver (Active)(Abandoned)
High water table
Planting difficulty
Fish observed, not observed, identification
Bank undercut

Armantrout, J.L. 1976. Nomenclature for instream assessments. Pages 9-15 in C.B. Stalnaker and J.L. Arnette, eds. Methodologies for the determination of stream resource flow requirements: an assessment. U.S. Fish Wildl. Serv., Logan. Ut.

Duff, D.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.

Reagan, David L. Paper presented at the symposium, Riparian Ecosystems and Their Management: Reconciling Conflicting Uses. April 16-18 1985, Tucson, Arizona.

CONTINUATION SHEET

STREAM

SECTION [ ] TO [ ] DATE — — — PAGE — —

SUB-SECTION

		BEGIN SECTION 0 →										SECTION WEIGHTED AVERAGES
FLOW FEATURES	POOL %											
	GLIDE/RUN %											
	RIFFLE %											
ORGANIC	INDEX											
POOL QUALITY	DEPTH (FT)											
	POOL DIAMETER CLASS											
	PERIMETER COVER FIFTHS											
	SURFACE COVER FIFTHS											
	COVER CLASS											
	POOL QUALITY COMPOSITE CLASS											
SUBSTRATE RIFFLE - GLIDE/RUN	BOULDERS %											
	COBBLES %											
	GRAVEL 1"-3" %											
	GRAVEL .2"-1" %											
	FINES < .2" %											
RIPARIAN VEGETATION DENSITY	BRUSH DENSITY CLASS RIGHT											
	BRUSH DENSITY CLASS LEFT											
	TREE DENSITY CLASS RIGHT											
	TREE DENSITY CLASS LEFT											
	PERCENT SHADE											
CHANNEL	WIDTH FLOOD											
	WIDTH PRESNT											
	STRAIGHT/CURVE											
	EXCAVATION EASE											
	VERTICAL BANK HEIGHTS											

NOTES:

STREAM INVENTORY INSTRUCTIONS

Section - A reach of stream 50 paces long. A pace is two full steps calibrated to approximately five feet. Section lengths are about 250 feet. In remote areas, sections may be expanded to 100 paces. Line of pacing follows upper bank contours.

Inventory section - This is to identify the location on the ground correlated with the inventory sheet. Fill in the boxes starting with the previous state proceeding to the next station. E.g. 0 to 1 or A1 to A2 , etc. Sections will be identified on the ground with three-foot lath marked with grease pencil and flagged (usually blue ribbon). Inventory on private land may required another method unless approved by landowner.

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.

Permanent Identifying Feature - This will normally be filled out at the beginning and end of the inventory and transferred to a four-inch to mile 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 entering from the west; ditch diversion; etc...

Sub-section Distances from the beginning point of the section to an identifiable change in flow feature or channel. All sub-section lengths will add to 50 paces (250 feet) for the section (100 paces remote sections). 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.

multiple flow features 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.

dominant channel type change, i.e. straight to curve and vice versa.

Definitions: Single flow feature - at least 90 percent of the sub-section is a single flow feature. The remaining percent is still recorded though.

Multiple flow feature - More than one flow feature - no feature accounts for 90 percent or more of the sub-section.

Flow Features: Pools, riffles, glide/runs.

Pools are portions of the stream that are deeper and of lower velocity than the main current (Arnette, 1976).

Riffles are faster, smaller areas with the water surface broken into waves by wholly or partly submerged constructions.

Glides and runs are sections where the water surface is not broken but is shallow and has a fast or faster velocity (Duff and Cooper, 1976).

Different flow features within a pace distance will be recorded as a percentage based on a visual estimate.

Organic Debris Index

1 None

2 Infrequent debris, what's present consists of small, floatable organic debris.
3 Moderate frequency, mixture of small to medium size debris affecting less than 10% of channel area.
4 Numerous debris mixture of medium to large sizes affecting 11 to 30% of channel area.
5 Debris jams of predominantly large material affecting 31 to 50% of channel area and often occupying the total width of the channel.
6 Extreme or large uproots dams either continuous or influencing over 50% of the channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage. (Roegan 1985)

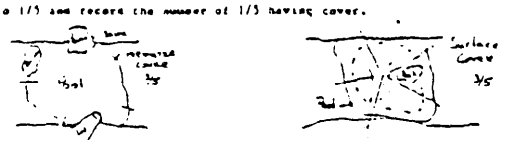
Pool Quality -

Depth. If the average present stream width for the sub-sections is less than 20 feet, record depth by the following class: < 1, 1-1, > 2 feet. If stream width is greater than 20 feet, use class < 2, 2-3, > 3 feet.

Diameter class. If the maximum pool diameter (measure by longest axis) is within 10 percent of the average present stream width of the sub-section, record LL. If the maximum pool diameter exceeds the average present stream width by 10 percent, record LR, if the maximum pool diameter is less than the average present stream width of the sub-section, record LC.

Perimeter cover by 1/5ths—mentally divide the perimeter into 1/5, record the number of 1/5 which have cover (defined below).

Surface cover by 1/5ths. Similarly break the interior surface area of pool into 1/5 and record the number of 1/5 having cover.



Cover Class - the total number of 1/5th recorded as having cover for both perimeter and surface are combined as follows:

0-3	4-6	7-10
(P)oor	(F)air	(G)ood

Above Schemmbs
1/6 + 1/6 = 1/3 (FAIR)

Composite Pool Quality - referring to the publication "Field Methods and Statistical Analysis for Monitoring Small Salmonid Streams", by C.Armour and W. Platts, rating from Table 7.

Definition: Pool Cover - any material or condition that provides protection to fish such as logs, other organic debris, overhanging vegetation within one foot of the water surface, rubble, boulders, undercut banks or water depth.

Substrate

Record by visual estimates within the riffles and glide/runs only substrate types by percentage in each of the following size classes:

Boulders 10 inches, cobbles 3 inches to 10 inches, large gravel 1 inch to 3 inches, small gravel .2 inche to 1 inch, all other fines < 0.2 inch.

Riparian Vegetation Density -

Brush greater than or equal to three feet tall and within six feet of the stream edge is to be recorded by density class along each side of the stream within the pace distance. The density class corresponding to percentage of canopy cover are as follows:

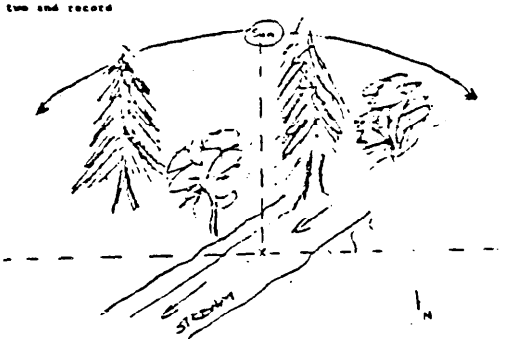
% Cover	0	1-10	11-20	21-40	41-60	61-70	81-100
Density Class Recorded	0	5	15	30	50	70	90

Trees within 25 feet of the stream edge are to be recorded by density class on each side within the pace distance.

% Cover	0	1-20	21-40	41-60	61-70	81-100
Density Class Recorded	0	15	30	50	70	90

Shade

An estimate of the overhead shade is made at one or more locations within the section. Face in the general direction of the path of the sun relative to a point in the middle of the channel and divide the view into two 90 degree quadrants. In each quadrant estimate the percentage of the overhead canopy which would provide shade at the heating period of the day, roughly a 50 to 66 degree angle overhead. Add the percentages in each quadrant , divide by two and record



Channel

Width - An estimation (± 2 feet) of the bank full 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 roots/roots, large (R)ocks, (S)od cover.

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.

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.

Cutbanks - stability, appropriateness for structures
Livestock effects - browsing, trampling, ecc.
Degree of game activity, i.e. roads, timber, recreation, mining, ecc.
Equipment access
Beaver (Active)(Abandon)
High water tools
Planting difficulty
Fish observed, not observed, identification
Bank undercut

Arnette. J.L. 1976. Nomenclature for instream assessments. Pages 9-13 in C.B. Stalnaker and J.L. Arnette,eds. Methodologies for the determination of stream resource flow requirements: an assessment. U.S. Fish Wildl. Serv., Logan. Ut.

Duff, D.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.

Roegan, David L. Paper presented at the symposium, Riparian Ecosystems and Their Management: Reconciling Conflicting Uses, April 16-18 1985, Tucson, Arizona.

Table 7. Rating of pool quality in streams between 20 and 60 feet wide (Platts et al. 1983).[a]

	Description	Pool rating
1A	If the maximum pool diameter is within 10% of the average stream width of the study site	Go to 2A, 2B
1B	If the maximum pool diameter exceeds the average stream width of the study site by at least 10%	Go to 3A, 3B
1C	If the maximum pool diameter is less than the average stream width of the study site by 10% or more	Go to 4A, 4B, 4C
2A	If the pool is less than 2 ft in depth ...	Go to 5A, 5B
2B	If the pool is more than 2 ft in depth ...	Go to 3A, 3B
3A	If the pool is over 3 ft in depth or the pool is over 2 ft in depth and has abundant fish cover[b]	Rate 5
3B	If the pool is less than 2 ft in depth or if the pool is between 2 and 3 ft deep and lacks fish cover	Rate 4
4A	If the pool is over 2 ft deep with intermediate[c] or better cover	Rate 3
4B	If the pool is less than 2 ft in depth but pool cover for fish is intermediate or better	Rate 2
4C	If the pool is less than 2 ft in depth and pool cover is classified as exposed[d]	Rate 1
5A	If the pool has intermediate to abundant cover	Rate 3
5B	If the pool has exposed cover conditions	Rate 2

[a]For streams less than 20 ft wide, deduct 1 ft from all entries with foot values and add 1 ft to the values for streams wider than 60 ft.

[b]If cover is abundant, the pool has excellent instream cover and most of the perimeter of the pool has a fish cover.

[c]If cover is intermediate, the pool has moderate instream cover and one-half of the pool perimeter has fish cover.

[d]If cover is exposed, the pool has poor instream cover and less than one-fourth of the pool perimeter has any fish cover.

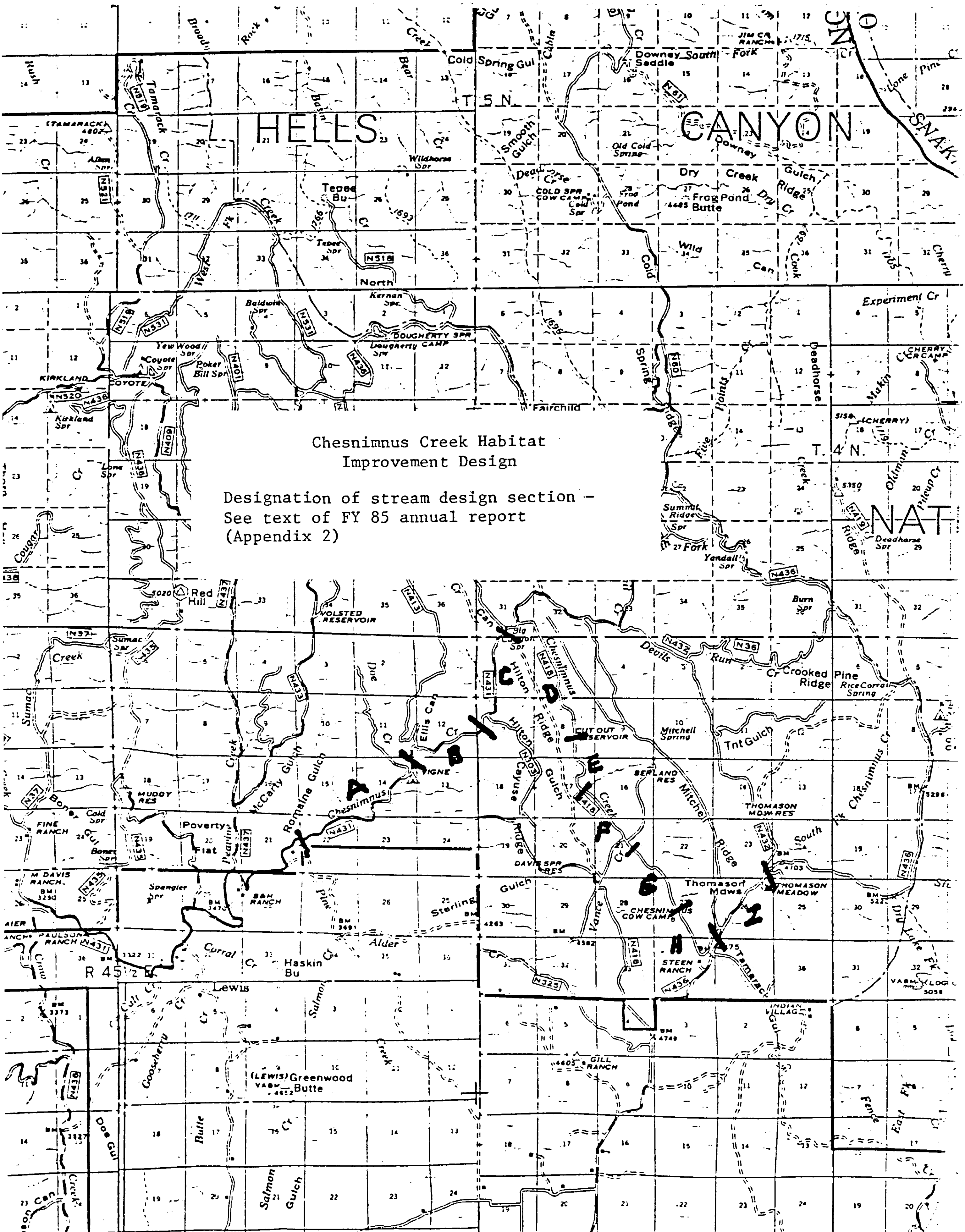
APPENDIX II

IMPLEMENTATION DESIGN

Chesnimnus Creek

The following; documentation is the implementation design packet developed for the Chesnimnus Creek Off-Site Enhancement Project.

It displays a map depictin, the project area by stream section. ALSO displayed are noted habitat deficiencies and appropriate treatment prescriptions. Another dimension of this packet is a narrative on what was actually done in the field and developed conclusions. Estimates of projected equipment, material needs and costs are included.



Chesnimnus Creek Habitat Improvement Design

Designation of stream design section - See text of FY 85 annual report (Appendix 2)

Anadromous Fish Habitat
Chesnimnus Creek

SECTION	A	B	C	D	E	F	G	H	I
100% SURVEY COMPLETE	NO	1/2	YES	NO	NO	YES	NO	NO	NO
DEFICIENCIES									
SHADE	YES	10%	31%	15%	YES	13%	YES	YES	?
POOLS	YES	10%	6%	5%	YES	34%	NO	?	NO
SILTED GRAVELS	NO	NO	NO	NO	?	YES	YES	YES	?
COVER	YES	YES	YES	YES	?	YES	NO	?	?
WATER DEPTH	NO	NO	NO	YES	YES	NO	NO	YES	?
STABILITY	YES	1/2	NO	NO	YES	YES	YES	?	YES
PRIORITY FOR FISH HABITAT WORK ONLY	6	4	1	7	3	2	5	8	9
PROJECTS (PLANNED)									
DIGGER LOGS		15	11		45	14			
BANK DIGGERS		3	30		?	21			
LOG WEIRS			3			1			
LOG DEFLECTORS		3	2			3			
PLACE BOULDERS DIG POOLS		3	13		20	16			
ARRANGE TREES & LOGS FOR COVER				YES	YES	YES	YES	YES	YES
NEEDS FURTHER EVALUATION	YES	PART		YES	YES		YES	YES	YES
ROOM FOR MORE STRUCTURES	YES 24	YES 60	YES	65	YES 50				
PLANTING	YES	YES	YES		YES	YES	MINIMAL		
FENCING	YES	SOME	NO	NO	YES	YES	YES	?	?
CAT TIME (DAYS)	?5	5	11					DAYS TOTAL 15 OR	
BACK HOE TIME (DAYS)	?5	5.5	13	3	10	12		DAYS TOTAL 47	

47 DAYS BACKHOE TIME AT $35/HR +200 LABOR ($600/DAY) = $28,000
20 DAYS CAT TIME AT $35/HOUR ($350/DAY) = $35,000

This machinery and GS-11 and GS-7 wages for the whole shooting match will use up about $35,000. Best Guess.

Section A. Forest Boundary to Vigne Campground

I did not run a formal inventory here. I walked through it briefly. This section exhibits much instability, and has wide, shallow channels. Several areas are multichanneled and need hydrologic controls. It would be possible to provide fish habitat enhancement, but I feel that hydrologic control work should be the highest priority here. The Hilton, McCarty and Alder timber sales should be examined as a source of K.V. funds to work in these areas. Overgrazing appears to be a problem. This stretch of stream tends to be dominated by unshaded riffles. Plant heavily with pole size material.

Section B: Doe Creek to Hilton Ridge Bridge

I completed a 100% survey for about one-half of this section. There are few quality pools; the total percentage of pools in the reach survey is less than 10% (10:90 pool to riffle ratio). The timbered sites have been logged, and there is evidence of landings, channelization and bank destruction due to old logging. Very few banks are stable, and pools occur primarily in association with rock ledges, debris jams and trees which have fallen into the creek. It appears that the primary objective in this section should concentrate on pool enhancement, bank protection and shade development.

Section C: From the Hilton Ridge Bridge to Big Canyon Creek

This section was surveyed in two parts. The lower part (from the bridge to a few hundred feet above Billy Creek.) is less heavily impacted by past logging and road building practices than that piece upstream from it. Nevertheless, pools are few (less than 6%), and it is dominated by riffles and little shade. As in Section B, most pools occur around debris jams, and can be temporary in nature. A few sub-sections also have rocky stretches with pools. These are infrequent. Overgrazing does not appear to be a problem here now, as there is evidence of brush sprouting (willows, cottonwood and alder) in several sub-sections. I feel that with key hydrologic controls and continued reduction of grazing pressure. Shade could slowly return to this section. More livestock control (reduced pressure) may be needed.

There are a lot of small fish in this section, although of mixed species. Objectives for management here should focus on pool enhancement and development. Hydrologic control structures are needed in conjunction with pool enhancement on debris jams. Digger logs to create pools could be useful in a few places.

Shade is definitely needed, but its absence at this time may be due more to hydrologic instability than to overgrazing. I would suggest that several sites in this section (and the lower section) be set aside as test areas to determine the most efficient means of cultivating shade species, i.e: 1) build fenced exclosures on several sites, 2) or cut and arrange big trees in a jig-saw fashion along stream bank to barricade seedlings from ungulate access.

It may be possible to obtain all log materials for structures from adjacent forest stands. This should be looked at before ordering up any imported logs for work in this section.

KEY PIECES

The upper portion of this reach is 90% channelized, and it almost entirely riffle and unshaded. Not much good can be said about it except that because of the straight, high banks and excellent access, it has good potential for rehabilitation work.

Objectives for this section should stress intensive development of pools, cover and shade , and should be the highest priority for work on Chesnimnus Creek,

Logs will have to be imported. I have designed a conservative structure installation plan. This is because I feel we need to be somewhat cautious about the type of structure we use here. There is littie debris present in these channels, except in the lower section on curves. Thus, my guess is that large volumes of water sluice through this section each spring, and that we should approach our stream improvement methods incrementally, until we are comfortable with the appropriate structures. Thus , I have proposed a variety of structures, to be alternated throughout this section.

This stretch is very rocky; digging will be slow, and the log pieces will be long (12-18" dbh, SO-60 feet long). Specialized equipment may be needed.

Planting along this stretch will also be a challenge. I recommend that very long poles of cottonwood and willows be planted in trenches along the west bank for Its entire length, and on both sides on key gravel bars. Big job for 1987. About 2,500 poles.

Section D: Big Canyon to the beginning of the bluegrass meadows 2.4 miles above Devil's Run Creek Bridge

No survey was done by me here. It can be subdivided into 2 to 3 subsections, which should be determined before surveying. (i.e., in order to stratify the data).

The first sub-section should be from Big Canyon Creek to the junction of Devil's Run Creek. This piece appears to be in fairly good shape, and also appears to be difficult to work in. I saw a couple of places that could use some pool enhancement work, but they would be of low priority compared to the rest of the Creek's needs.

About the Devil's Run Creek confluence, Chesnimnus Creek becomes narrow, steep and rocky. There are very few pools, and some stretches still appear to be receiving heavy lives tack use l Because of the narrowness of this stretch, it appears that cattle overuse these it appears that cattle over use these stretches even more than the more gentle bottoms further upstream in the same pasture. Flows are very low, almost sub-surface.

At this time, it appears to me that the best action in this section would be to get: vegetation growing back on the creek. This would provide shade and woody debris to create pool formation. I suggest that we hire someone with a chainsaw and a tractor) and drop trees across the creek alternative every 50-100 feet all through the upper part of this section. This would restrict ungulate movement,

provide shade and cover for fish, and lead to pool formation. In the meantime, desiduous vegetation could take hold in the protection of the tree carcasses.

The lower section (Big Canyon to Devil's Run Creek) should be left alone, exception for a digger log and some bank diggers.

Surveys need to be completed.

Section E: From the beginning of the bluegrass meadows to the Cut Out Res. Road.

This has not been intensively surveyed. I reluctantly considered this to be a lower priority at this time for two reasons: 1) the stream banks are low to non-existent, and 2) flows here are very low in late summer. In of need it is high priority. This section totally lacks structure. As in Section D., there are few pools, and those that exist are poor quality. This stretch needs all the help it can get, and it appears that ungulate pressure is still very heavy throughout. Reducing grazing, pressure should be the number one priority here in order to: 1) increase shade, and cover) and 2) encourage healing of raw banks. We should program time in the project to move trees and logs into place for cover.

Section F: Cut Out Res. Road to the Burland Res. Road.

I ran an intensive survey here. This section has a shallow gradient, thus, many pools (34:66) pool:riffle ratio). These are bluegrass/LPP bottoms, with heavy alleuvial soils.

Pools are poor quality; sedimentation and lack of shade and cover are a problem. Gravels and riffle areas are heavily sealed with sediments.

This is a high priority section for rehabilitation work, because of several factors:

1. There is plenty of water here in late summer.
2. Remnant vegetation is such that with proper management, shade and bank stability could be quickly restored.
3. Minimal structural. work will greatly improve pool, cover, shade and gravel deficiencies.
4. Salmonid populations seem to be higher here than in sections immediately above or below.

Objectives for this section are many.

1. Improve quality of pools with digger logs and bank diggers.
2. Improve spawning gravel with digger logs.
3. Improve cover and shade by:
   a. moving LPP debris over stream and banks.
   b, planting vegetation (willows, cottonwood)
   c. fencing and/or piling of trees to block ungulate use.

Sections G-I: From the Berland Res. Road to Thomason Meadows

The gradient varies from flat to very shallow throughout. I didn't survey these sections, but walked through most of it. The primary need in sections G and H is shade. These areas are still overgrazed and need protection. They are also heavily silted. My guess is that the best thing that can be done is to reduce grazing pressure, and let the LPP fall into the creek. Where pressure has been reduced, as is the case above the Steen Ranch, the creek is looking good.

Materials Required:

Materials Required:

1. NO rock has to be imported; all will be taken on-site.
2. Log materials for Sections #B,C.I and #F can be taken from adjacent timber stands.
3. Log materials for section #C.II (straight piece above Billy Creek) all must be imported. This will require hauling in and distributing about 50 logs, 18-20 inches dbh and 60 feet long, larch or ponderosa pine.
4. 250 feet of hardware cloth (1/4")
5. 250 feet of poly-filter cloth
6. 80-100 18" spikes

Equipment Requirements:

1. A. Machinery to distribute logs for work in section #C.II.
   B. Machinery to retrieve large logs adjacent to stream. (12-18" dbh, 40-50 feet long) in sections #B and C.I, for however many structures are used.
   C. Machinery to excavate sites, and place logs in stream (large logs) in sections #B and #C.I and #C.II.
   D. Machinery to retrieve, handle, excavate and place primarily LPP logs in stream and along stream in section #F. These logs will be 8-12 inches LPP (primarily), about 30-45 feet long.
   E. Machinery capable of moving boulders, and excavating pools amoung large rocks.

Fencing:

It appears to me that the highest priority candidate areas for protective fencing, needed to protect planted stock and native brush vegetation (to produce shade) will be in Sections A, E, F and G. Small pieces may need to be fenced in Section C.

I am not advocating fencing for total exclusion of livestock. I do feel, however, that positive control on livestock is needed in total or in part to give the vegetativon a headstart for a period of several years. Ultimately, I think that we will have opportunity to graze the riparian zones for the advantage of all resources equally.

Time Requirements: Guesstimates a = total planned b= priority only

A. Digger Logs = 4 per day (a) 40 = 10 days
(b) 29 = 7 days
B. Log Weirs = 1 per day (a&b) 4 = 4 days

(conservative ???)

C. Bank Digger = 6 per day (a) 54 = 9 days
(b) 41 = 7 days

D. Log Deflectors = 6 per day (a)11 = 2 days
(b) 9 = 2 days

So: A = 109 Structures B = 81 structures

If all total structures are installed, (listed as A) then estimated total days of work = 25 days.

If (b) only priority structures are installed, then total days of work = 20 days.

Thus is machine time costs $35/hour @ 10 hour days, and manpower (1 GS-11 and 1 GS-7) cost $200 per day, and throw in $50 miscellaneous cost per day, then daily costs are going to be $600.

The agreement states that BPA allocate $58,500 for 60 structurs. $600 per day = 97 days of work. The max plan (illustrated above) will cost $15,000 for labor and machinery. So, this gives us $83,500 of flexibility. We should consider more projects than just these. Moreover, even if costs are up to $40-45 per hour, there is still room to wiggle.

A possible format for developing the contract would be to plan on using two pieces of equipment in sections B and C (such as a backhoe and a cat), and then require use of only the backhoe for work in sections E and F, and to keep going until the money runs out. This will require keeping good books as we go, but I think it is the way to go. We are developing efficiency in both our design and methods, and should try to use this opportunity to get as much structure as possible into Chesnimnus Creek.

STREAM REACH (FOREST SERVICE)	PHOTO SERIES	INVENTORY SERIES	POOL TO RIFFLE	SHADE	STRUCTURES DIGGER LOG	LOG WEIR	BANK DIGGER	LOG DEFLECT	BOULDER PLACEMENT AND PLACEMENT POOL SITE EXCAVATION
#B DOE CREEK to one mile upstream	8250-195	195-01 to	10% POOL	10%	15	0	3	3	6
	8250-177	195-20	90% RIFFLE						

NOTES: 2 VISIBLE SITES should be tended to as priority between PTS 195-03 to 195-07. And between 195.11 to 195.14. Both sites could be easily rehabilitated with digger logs, planting and protection. They are highly visible, but are also degraded sites that need attention. Because

Distance:1MI			Priority:		6			2	3
#C I. Hilton Bridge Bridge to Beginning	8250-185	185-01 to	6% POOL	31%	3	0	14	2	8
	8250-187	185-20	94% RIFFLE						

' Part CII (.5 mile of stream) above Billy Creek 8250-79 to 825043

NOTES: Priority segment between PTS 185-07 to 185-08 channelized, appears to be an old landing. Could be quickly rehabilitated with a digger log, 2 bank diggers; dig pools, place boulders, beciduous plantings and protection. Access may a problem. Native material close by. Is a visible site from road. At beginning of segment 185-15, a log jam creating excellent habitat needs reinforcement and development . High Priority

			Priority:		1		4	1	

OBJECTIVES:
1. Maintain and improve pool quality and cover with bank digger logs.
2. Increase pool quantity and cover quality through the use of digger logs .(increase percentage of pools)
3. Increase shade by planting vegetation and protecting vegetation plantings from overgrazing, on key sites along the stream.

STREAM REACH (FOREST SERVICE)	PHOTO SERIES	INVENTORY SERIES	POOL TO RIFFLE	SHADE	STRUCTURES DIGGER LOG	LOG WEIR	BANK DIGGER	LOG DEFLECT	BOULDER PLACEMENT AND PLACEMENT POOL SITE EXCAVATION
#C.II Begins approx. 250 yards up-	8250-85to	85-01 to	5% pool	15%	8	3	16	3	5
stream from Billy Creek to the meadow below Big Canyon. This is a channelized reach, 1 mile long.	8250-91	85-20	95%riffle	24	6	16	3		
	8251-4 to 8251-6								

NOTE: This reach is the highest priority its entirety. I have designed what I feel is a modest number of structures to increase pools, am3 to enhance places that provide bank cover. This is straight riffle, with very few pools. Although channelized it is stable for construction purposes. I think that we may be able to place more digger log and log weir structures here eventually, but that the level I have proposed should be tried initially to see how the stream responds. We may throw in a couple of extra structures if we have time and money during the initial construction.

OBJECTIVES:
1. Increase the number of pools by installing digger logs and log weirs, and digging pools in which to place boulders.
2. the existing pools and cover with use of bank digger logs.
3. Plant vegetation on key sites to create shade and cover.

STREAM REACH (FOREST SERVICE)	PHOTO SERIES	INVENTORY SERIES	POOL TO RIFFLE	SHADE	STRUCTURES DIGGER LOG	LOG WEIR	BANK DIGGER	LOG DEFLECT	BOULDER PLACEMENT AND PLACEMENT POOL SITE EXCAVATION
#F.From meadow at Cutout Res. Road intersection with Ches. Cr. to 200 yds above Vance Draw Exclosure	8250-7 8250-19	19-01 to 19-30	34% 66%Riffle	13%	14	1	21	3	

(*Begins at 8250-19 and runs in decreasing order)

NOTE: This entire reach is a priority for project rehabilitation. In Chesnimnus Creek above Devil's Run Creek and below Chesnimnus Cow Camp, this has the best standing depth of moving water, and pools and riffle habitat. However, pool quality is poor, and overall cover is poor. There are numerous instability problems and shade is poor. But, this reach offers the greatest opportunity to efficiently increase rearing (and spawning) habitat in upper Chesnimnus Creek.

OBJECTIVES:

1. Improve pool quality(depth and cover), and increase spawning gravel quantity by installing digger logs and bank diggers primarily at existing pool sites.
2. Increase cover, and improve pool quality by excavating pools to a greater depth, and by placing boulders in pool "slots" and existing glide/runs.
3. Increase cover, improve bank stability, and provide shade by gragging LPP trees onto banks, and along stream.
4. Increase cover, stability, and provide shade by planting vegetation.
5. Provide vegetation and bank protection with fencing and barriers.

TOTAL PLANNED STRUCTURES:	Digger Log	Log Weir	Bank Digger		Log Deflector	Boulder Placement and pool excavate
	40	4	54	11	35	
Logs Per Structure(Total)	3(120)	2(8)	1(54)	1(11)		
Only Priority Structures:	29	4	41	9	24	
Logs per Structure(Total)	3(87)	2(8)	1(41)	1(9)		

MICHAEL LEONARD
Wildlife Biologist

APPENDIX III

PLANTING STOCK ACQUISITION - NARRATIVE

Chesnimnus Creek - Planting Stock

Project Methods (13 March 86):

We have made 21 cutting collections April 5 through September 26, 1985, totaling 1,966 pieces of species of deciduous hardwoods, and one seed/fruit collection 2 lbs. of black hawthorn. This material was delivered directly to Randy Sinker of Alder Slope Nursery for handling, bedding and growing. Survival of this stock has been variable and low.

February and March 1986 - we have collected approximately 2,000 2-3 foot cuttings of a variety of deciduous species. The plan is to set up rooting beds for this cutting material in unused stock troughs at both the Wallowa Valley R.D. office location and at Thomason Meadow Guard Station which is on Chesnimnus Creek itself. We have also accumulated nearly 1,000 6-14 foot long 1" to 4" top cutting matterial which we are not currently stockpiling but Bull Pasture pond which is within a wildlife habitat enclosure , on the lower reaches of Chesnimnus Creek.

Planting beds in currently unused stock troughs will be developed by piacing them on blocks, laying 3-4 lengths of 4-6" PVC drain pipe in the bottoms and filling them 18" deep with a rooting/growing medium consistin of 1 part Chesnimnus Creek soils, 2 parts horticultural vermiculite (grade 2) and 2 parts peat.

We will maintain monitoring controls on all rooting beds permitting us to realize production modei surviveability, and make adjustments against future projects. We anticipate installing, a framework and polyethelene covers on the rootink beds, and winterizing the beds with baled straw.

Integral and raised rootins beds will facilitate planting, permitting us to pull as much stock as we can &et in the ground on a daily basis. Also, particularly with the Thomason G.S. beds, we can maximize efforts to propagate tile limited phenotypically native, genotypes of cottonwood, willow, and red-osier do&wood - a point our F.S. R-6 Piant Ecologist has made repeatedly on field inspections of our riparian zone projects0

Progress, success and shortcoming of this project will be continually monitored and assessed in order to make appropriate adjustments resultin, in our achieving at least minimum objectives.

APPENDIX IV

PROJECT IMPLEMENTATION DOCUMENT

ELK CREEK RIPARIAN AREA PLANTING
(Segments 8,9,12 & 6)

and

DAILY LOG

Wallowa Valley Ranger District
Rt. 1 Box 83; Joseph, Ore&on 97846

2630/6520 July 3, 1985

Elk Creek Planting - FY 85

Whom it May Concern

BPA FUNDED RIPARIAN REHABILITATlON

ELK CREEK RIPARIAN AREA PLANTING
(SEGMENTS 8,9,12 & 6)

EQUIPMENT RENTAL CONTRACT #04M3-5-0419

Three equipment rental bids were received for the Elk Creek riparian area planting before April 1, 1985. Schock Excavating, Harold Schock, owner/operator, was awarded the bid for 115 hours of backhoe time at $30.00 per hour, plus a move in cost of $200.000 The Contractin Officer's Representative (COR) was to be the sole planter.

On May 6, 1985, at 0600 hours) the prework equipment inspection was conducted at Gould Gulch by Sue Burton and Chuck Anderson. The equipment was then moved to start work at the Lower end of Segment #12, on the private iand boundary. There appeared to be discrepancies in maps and markers as to the Location of the private Land boundary. The confusion was promptly cleared up by Chuck Anderson and later confirmed.

May 6:

Planting was started at approximately 0730 on May 6 at the lower (North) end of Segment #12. On this day, one hundred fifty-five (155) willow cuttings were planted, approximately eight of these cuttings were hand planted due to the small size. Several cuttings were planted on the East side of Elk Creek on an aid road bed near a cutbank. It was uncertain if these trees were planted deep enough to reach the water table. It was felt that the benefits frown this risk would outweigh the efforts. On this day it was evidence that the contractor's wife, Bernice Schock, was very interested in assisting in the project. She was allowed to assist , but a concern for her safety was discussed l She agreed to wear a hard hat (if one could be supplied) and be more conscious about on the job safety.

The willow cache on this day was suite close, therefore travel time to fill the front-end loader with cuttings was minimai, probably no more than 20 minutes round trip. The caches, however, could have been distributed further up s Cream to save on backhoe travel time. The caches had been distributed according to the map boundaries which included the private iand, therefore two caches not tapped into this day were further downstream and would have to be moved a such Greater distance, as the project was all upstream.

May 7:

Work started at 0600 in Segment #12 and by 1200, one hundred three (103) cuttings had been planted. A half load had been left the previous day where work ended. One hundred seventy three (173) willow cut&in&s were planted on this day and a load of cuttings was distributed through the remainder of the sediment depleting the first cutting cache.

On this day Bernice assisted for haif the day. The hard hat had been forgotton in the office.

A later discussion on this day with Jim Olivarez and Ralph Anderson concluded what Bernice would wear a hard hat or not be on the site and if any injuries were incurred the Liability would probably be shared.

May 8:

Chuck Anderson replaced Sue Burton as COR on this date. Segment #12 was £ and planting began near the middle of Segment #9. Approximately seventy (70) cut&in&s were planted in each segment. On hundred thirty nine (139) cuttings were planted. A total of 398 willows were planted in Segment #12.

May 9:

On May 9 a total of one hundred seventy nine (179) willows and fifteen (15) aspen were planted in Segment #9. The willow cache was fairly close and easily accessible on this day. The aspen were planted in groups of threes and fours and barriers of logs and debris were placed around them to avoid their being grazed. The aspen were planted in shallow trenches, one to three inches above the root collar.

May 10:

One hundred forty four (144) willow cuttings were planted in Segment #9 on this day. Planting was somewhat slower due to the accessability of the willow cache. The backhoe had problems getting out of the area the cache was in, thus some soil displacement occured on this hillside. The operator did a very nice job covering his impacts, however, larger pieces were planted, thus making for longer handling time (loading, unloading, planting). Stream bank accessability was also difficult and slow on this day.

Nay 11:

There were no more caches in Segment #9, therefore, the caches below Segment #12 had to be traveled to by backhoe, costing about an hour round trip time. Streambank accessability was also a littie difficult on this day. One hundred sixty two (162) cuttings were planted in Segment #9 on this day and a backhoe load of cuttings was hauled and distributed in Segment #8. Segment #9 was completed. A total of 554 willows and 15 aspen were planted in Segment #9.

May 13:

Chuck Anderson replaced Sue Burton as Contractin& Officer's Representative for this day. One hundred seventy seven (177) willows were planted and five (5) aspen in Segment #8. Planting was slow in places due to the swampy condition of the riparian area. The backhoe was stuck on one occasion.

May 14:

It snowed and rained all day. The willow caches were close and easily accessible. On this day one hundred ninety eight (198) willows and ten (10) aspen were planted. A large cutbank sluffed off into the stream muddying the water on this safternoon. Planting was slow in one swampy area.

May 15:

Planting in Segment #8 was completed this morning with fifty seven (57) willows planted and five (5) aspen making the total trees in Segment #8 427 willow and 20 aspen. A backhoe load of willows was moved to Segment #6 from Segment #8 alon, with two pickup loads from below Segment #12. These were distributed throughout Segment #6. (A crew of three extras moved the pickup loads of willows so planting would not have to stop. This worked much better than paying backhoe time to ferry the cuttings>) Frank Olson, the District Ranger, visited Segment 86 on this day. He gave no comments on his observations. Part of the stream bank collapsed while working in the afternoon. One hundred thirty six (136) willows were planted in Segment 96 along with four (4) aspen. No debris was satirered to protect the aspen planted on this day. Travel time into Segment #6 is approximately one half hour to forty five minutes greater than the previous segements.

May 16:

Stream bank collapsed on this morning, causing muddy water down stream. Large cuttings were planted and some were very hard to handle. Jim Olivarez visited the site before lunch and observed until noon. A total of 170 willows and 6 aspen were planted on this day.

May 17:

On May 17, 1985 one hundred seventeen (117) willows were planted. No more cuttings were available to be planted. At this time accumulated backhoe hours was 114 hours, one hour short of the estimated 115 hours. A total of 423 willows and 10 aspen were planted in Segment #6. Approximately one haif of this segment remains to be planted.

SUMMARY :

Backhoe	14 hours @ $30.00/hour	$3,420.00
	Move in cost	200.00
		$3,620.00
COR and Planter (GS-9)		
	Planning & reconnaissance 20 hours	240.00
	Planting i contract administration (47 hours overtime, 86 hours regular)	1,830.00
	Closing Contract & Summary, 29 hours (approximately)	348.00
		2,418.00
		$6,038.00

The backhoe planting portion of the project included the activities related to above plus the costs of collectin;, transportin and stockpiling cutting material, supplies and equipment support. In conjunction with this machine planting exercise we also hand planted smaller cuttings and a variety of rooted stock.

The taily of stock planted includes:

Backhoe planted cuttings of willow and cottonwood	2042 pieces
Hand planted cuttings of willow and cottonwood	2150 pieces
Backhoe planted rooted stock	45 aspen
Rand plantad rooted stock	150 apple
	300 water birch
	300 service berry
	200 AMerican plum
TOTAL	5187 pieces planted

Total costs associated with this planting project included:

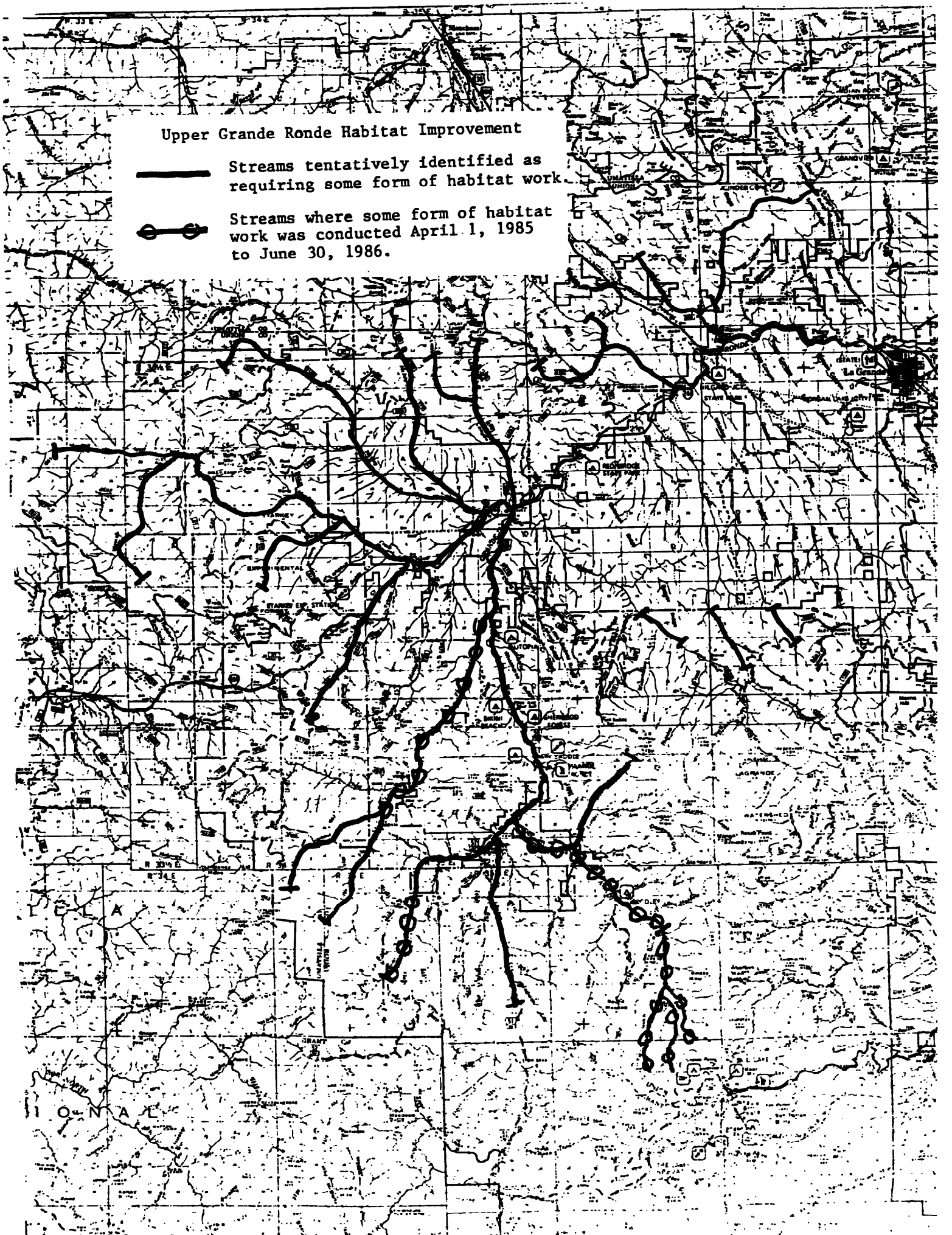
J. Olivarez (48 hours - $720), S. Burton (133 hours - $2418), C. Anderson (112.5 hours - $1463)) R. Anderson (205 hours - $2465) , GS-5 Labor (456 hours - $3377)) GS-4 labor (133 hours - $949), vehicle use and mileage ($200), backhoe rental ($3620)) purchased planting stock ($1930), rootone ($781, hand tools, hip boots, film, etc. ($713), for a total expenditure of $17,933 ($1985 less than originally planned).

Accomplishment summary includes: 5,167 pieces planted on 2.3 miles of stream for a cost of $3.457 per piece planted of $7797 per mile of stream planted. Our original projections were for planting 5,000 pieces on 2.3 miles of stream for $19,918.

We have notes that local sources of planting material are becoming increasingly difficult to come by, particularly now that ODF&W is engaged in similar planting projects.

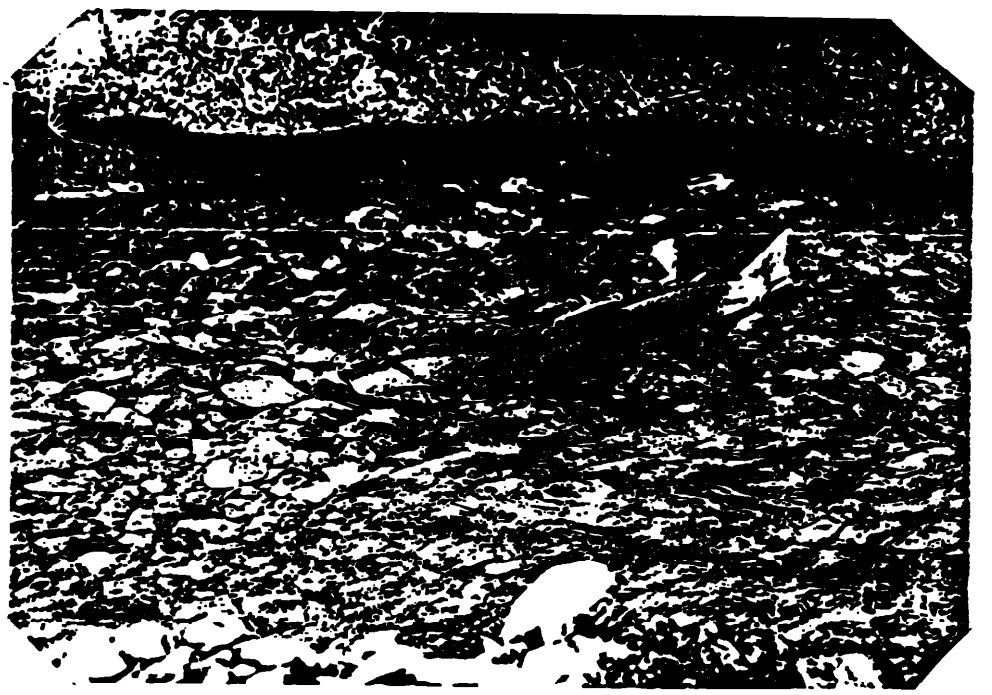
SUSAN L. BURTON, COR
Range Conservationist

RALPH ANDERSON
Biological Technician


Upper Grande Ronde Habitat Improvement
Streams tentatively identified as requiring some form of habitat work.
Streams where some form of habitat work was conducted April 1, 1985 to June 30, 1986.
La Grande
UTOPIA
GRANT

BPA Project 84-9: Grande Ronde River Habitat Enhancement

Effective Period: April 1, 1985 to June 30, 1986



Prepared by: Tom Thomas
Michael Collette

La Grande Ranger District, Wallowa-Whitman National Forest

Abstract

Inventory was conducted on 40.3 miles of stream. Inventory data indicated a deficiency in pool/riffle ratios and pool quality. Design for enhancement was completed on 4 miles of stream. One hundred one structures were installed on 2 miles of stream at a cost of $137 per structure.

INTRODUCTION

The Grande Ronde River system above the City of La Grande has historically provided habitat for natural runs of spring chinook and summer steelhead, The decline in numbers of returning fish in recent years is well documented. Existing spawning and rearing is marginal throughout a large portion of available habitat. Action to increase propagation potential through habitat enhancement is underway on selected reaches of priority streams.

This report describes on-going enhancement activities conducted on the mainstem Grande Ronde River and selected tributary streams (Figure 1) for the work period April 1, 1985 to June 30, 1986. Project goals included three tasks: (1) inventory of 38.25 miles of stream on the mainstem Grande Ronde River, Fly Creek and Sheep Creek, (2) design on 22.25 miles of stream for enhancement on National Forest land and (3) implementation of enhancement work on 2 miles of Sheep Creek.

DESCRIPTION OF STUDY AREA

Upper Grande Ronde River Mainstem

The upper Grande Ronde River (RM 194-212) drains an area of approximately 69 square miles and is characterized by three district reaches.

The upper reach is a high gradient stream, heavily forested and, except for a primitive mining road with on-going mining activity, has not been significantly impacted.

The middle reach is a low to moderate gradient stream, moderately forested and has incurred heavy impacts from placer mining. Much of the river valley is occupied by dredge tailings and a heavy shrub/sedge/grass plant community is dominant in the riparian zone. A forest road parallels the entire length.

The lower reach is a low gradient stream that meanders through a wide meadow-dominated valley bottom. A forest road also parallels the entire length. Heavy impacts from livestock grazing have occurred, particularly on the private land portion.

Fly Creek

Fly Creek is tributary to the Grande Ronde River at river mile 184.5. Drainage area comprises approximately 52 square miles.

Fly Creek is characterized by two distinct reaches. The upper half of the stream length is a low gradient reach and meanders through a wide meadow-dominated valley that has been heavily impacted by livestock grazing primarily on privately owned land. The lower reach on National Forest land is a low - moderate gradient stream, moderately forested, that courses through a narrow valley bottom. Impacts in the lower reach include roading and logging.

Sheep Creek

Sheep Creek is tributary to the Grande Ronde at river mile 194. Drainage area comprises approximately 58 square miles. It is characterized as low gradient, meadow-dominant with a high degree of meander. The history of impacts include roading, logging and livestock use.

METHODS AND MATERIALS

Procedures developed in 1984 were used for stream inventory and establishment of permanent monitory stations. A sample copy is enclosed in Appendix 1. The inventory process was also adapted for use by Oregon Department of Fish and Wildlife personnel this field season. Major habitat descriptions derived from the inventory include pool/riffle and glide/run quantity, pool quality, riffle and glide/run substrate, shrub and tree density, shade, large organic debri and channel morphology.

Preparatory work for installation of structures included falling and yarding 16-20 inch diameter trees to the site. An equipment rental agreement consisting of a Case backhoe (Model 580-C) with operator was used for excavation and placement of structures. Appendix 2 provides detailed drawings of the four basic log structures that were planned.

Other material used included rootwads cabled in place, boulder groups where rock sources were nearby and placement of cover along bends and deep pools. One inch hardware cloth, polypropylene filter fabric and rebar were used to seal the structures according to design criteria.

RESULTS AND DISCUSSION

Inventory

The following table summarizes inventory accomplishments for this work period.

	Planned		Accomplished	
	NF	PVT	NF	PVT
Upper Grande Ronde Basin streams (not itemized in work plan)	22.25	16.0		
Mainstem Upper Grande Ronde			11.9	6.0
Sheep Creek				6.0
Fly Creek	____	____	7.5	8.9
Total	22.25	16.0 (38.25)	19.4	20.9 (40.3)

Actual inventory accomplishment exceeded what was planned by 5 percent. The additional 2 miles are probably accounted for by the relatively high degree of stream meander that was encountered.

Fifty-two percent of the stream miles inventoried were on privately owned land. This was accomplished for Oregon Department of Fish and Wildlife by agreement.

Once field biologists were trained, we found that one person could adequately survey up to 1.5 miles of stream per day. Evaluation of the inventory data for all streams indicated a significant lack of pools for rearing and low pool quality.

Design

Design for project implementation was planned for approximately 22.25 miles of stream on National Forest land.

After completing the inventory, it was learned that about 12 miles of the upper Grande Ronde River may be either partially or wholely inaccessible to steelhead and salmon due to a series of waterfalls and occasional heavy debri jams. Low numbers of fish, possibly native trout, were observed in disjunct headwater reaches. Design for enhancement was postponed pending further physical and biological evaluation. Design work was completed on about 4 miles of stream that prescribed approximately 130 structures similar to those used on Sheep Creek (Appendix 2). Log weirs, whole log placement and boulder placement will be the predominant type of structures used for enhancement.

Design work on about (miles of Fly Creek was rescheduled to the 7/l/86 to 3/31/87 work period due to a reduction in personnel.

Implementation

Two miles of Sheep Creek on National Forest land were targeted for enhancement. The work plan prescribed for 136 structures. There were 101 high priority structures actually installed. Appendix 3 provides pictures and narration.

The total amount of created pool and cover area was 10,489 sq. ft. and 3228 sq. ft., respectively, which closely approximates objectives for enhancing pool/riffle ratio and pool quality for this stream.

Total project costs for structure installation were summarized as follows:

Trees felled and bucked	-	236.14
Rubber tired skidder	-	493.00
Horse logging	-	700.00
Misc. equip & supplies	-	1,184.46
Vehicles	-	527.73
Backhoe ($34/hr.)	-	5,706.42
Wages	-	4,989.95
Total	-	$13,837.70
Total cost/structure		$ 137.01
Total cost/mile		$ 6,918.85

Stream shade planting on Sheep Creek was rescheduled for 1988 due to unpredictable ungulate use and the need for additional protection fencing. Protection fencing is scheduled for the 86-87 work period.

1/ - Includes only overhead. Trees provided by Forest Service
Felling and bucking provided through training.

Monitoring

Twelve permanent monitoring stations were installed in the mainstem Grande Ronde River.

Maintenance

No maintenance of improvements was done during this work period. Recent evaluation on Sheep Creek after high spring flows indicated all structures were intact and had only minor maintenance needs.

SUMMARY AND CONCLUSIONS

Stream inventory procedures are working quite well. They provide a consistent approach for both U. S. Forest Service and Oregon Department of Fish and Wildlife personnel. Limiting factors as well as priority reaches that can be efficiently modified are made visible. Instream work is being designed and implemented in a cost effective manner to meet established objectives.

Changes in the work plan due to a reduction in personnel were negotiated and work was completed as revised.

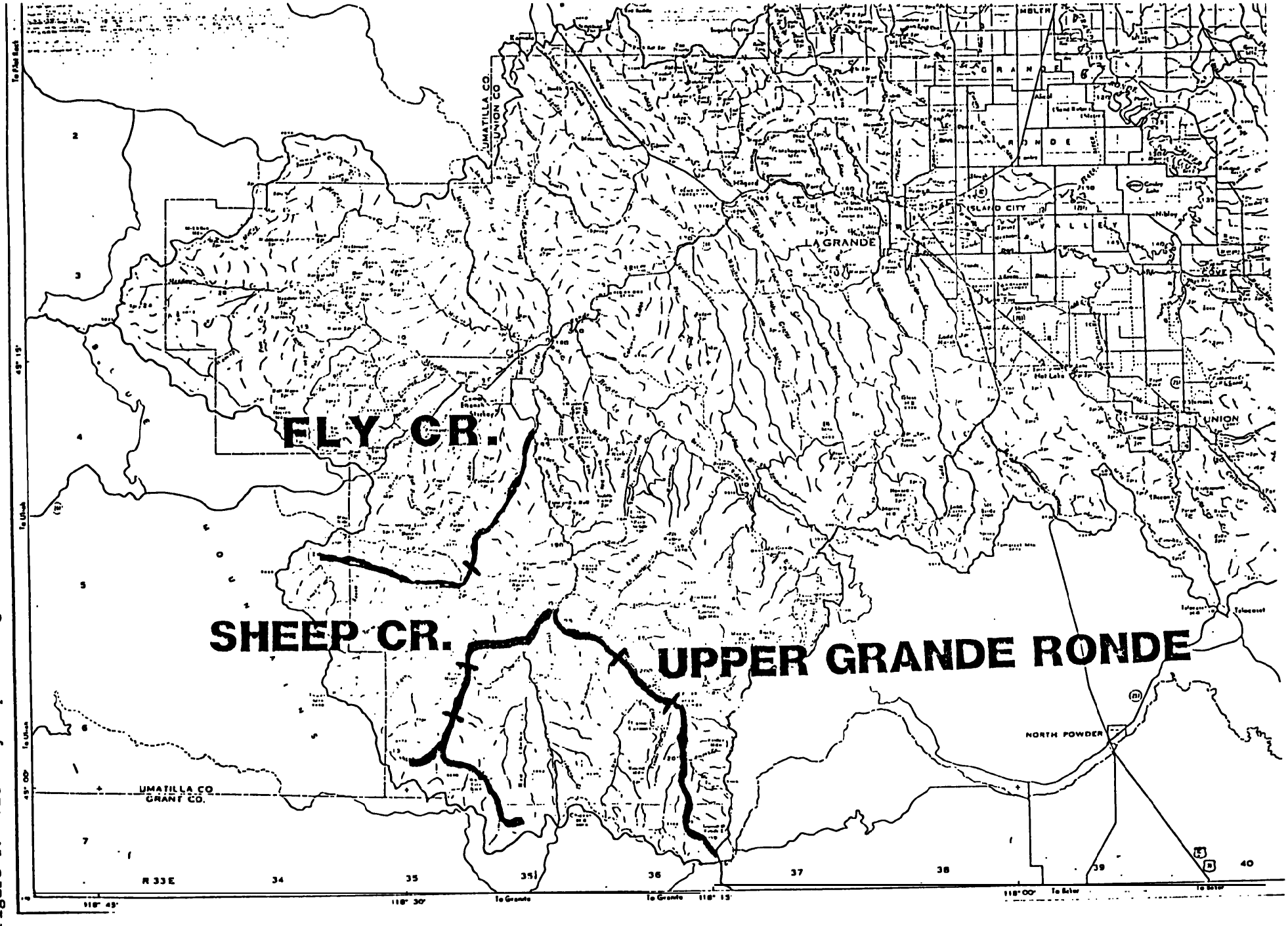


Figure 1. Vicinity map of targeted streams and reaches.

Appendix 1

Inventory Procedures

FISH HABITAT STREAM INVENTORY
PACE TRANSECTS

STREAM NAME FLY CREEK

OBSERVER(S) Collette

PAGE 1 OF ___

DATE Y M D 85-8-13

INVENTORY SECTION 0 TO 1

INVENTORY PROCEEDED ☒ UPSTREAM ☐ DOWNSTREAM

PERMANENT IDENTIFYING FEATURE WITHIN REACH At Fence 60 yrds up from mouth of Fly at Grande Ronde Stake on Left Bank

SUB-SECTION

	BEGIN SECTION	0	18	26	34	46	50						SECTION WEIGHTED AVERAGES
FLOW FEATURES	POOL %		80	100	75								47%
	GLIDE/RUN %	60			10	50							28%
	RIFFLE %	40	20		15	50							25%
ORGANIC	INDEX	1	1	1	3	2							
POOL QUALITY	DEPTH (FT)		<1	1-2	1-2								
	POOL DIAMETER CLASS		1B	1B	1B								
	PERIMETER COVER FIFTHS		1	3	3								
	SURFACE COVER FIFTHS		0	0	2								
	COVER CLASS		P	P	F								
	POOL QUALITY COMPOSITE CLASS		4	4	4								x 4
SUBSTRATE RIFFLE - GLIDE/RUN	BOULDERS %	<1	0	0	0	1							
	COBBLES %	70	60	50	60	49							61
	GRAVEL 1"-3" %	25	25	30	30	40							32
	GRAVEL .2"-1"%	5	15	15	10	10							10
	FINES <.2"%	—	-	5	—	-							.1
RIPARIAN VEGETATION DENSITY	BRUSH DENSITY CLASS RIGHT	90	50	5	5	15							44
	BRUSH DENSITY CLASS LEFT	70	90	90	50	70							72
	TREE DENSITY CLASS RIGHT	0	15	70	0	0							14
	TREE DENSITY CLASS LEFT	0	0	15	0	0							2
	PERCENT SHADE	15	30	70	30	5							x 30
CHANNEL	WIDTH FLOOD	30	30	40	40	45							
	WIDTH PRESNT	12	12	9	10	8							
	STRAIGHT/CURVE	S	S	C	C	C							
	EXCAVATION EASE	B	B	B	T/R	T/R							
	VERTICAL BANK HEIGHTS	0	0	0	0	0							

NOTES:

Section very difficult to work. Has good LWD good pools. Some bedrock out crop on right banks good riparian shrubs. Did not see any fish.

STREAM INVENTORY INSTRUCTIONS

Section - A reach of stream 10 paces long. A pace is two full steps calibrated to approximately five feet. Section lengths are about 250 feet. In remote areas, sections may be expanded to 100 paces. Line of pacing follows upper bank contours.

Inventory section This is to identify the location on the ground correlated with the inventory sheet. Fill in the boxes starting with the previous stake proceeding to the next station. E.g. 0 to 1 or A1 to A2 , etc. Sections will be identified on the ground with three-foot lath marked with grease pencil and flagged (usually blue ribbon). Inventory on private land may required another method unless approved by landowner.

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.

Permanent identifying feature - This will normally be filled out at the beginning and end of the inventory and transferred to a four-inch to mile 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 entering from the west, ditch diversions, etc...

Sub-section Distances from the beginning point of the section to an identifiable change in flow feature or channel. All sub-section lengths will add to 50 paces (250 feet) for the section (100 paces remote sections). 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.
- multiple flow features to another set of multiple flow features where 1) there is an obvious different percentage mix. 2) when mix distance is too great to get a good percentage mix for remaining area.
- dominant channel type change, i.e. straight to curve and vice versa.

Definitions: Single flow feature - at least 90 percent of the sub-section is a single flow feature. The remaining percent is still recorded though.

Multiple flow feature - More than one flow feature - no feature segments for 90 percent or more of the sub-section.

Flow features: Pools, riffles, glide/runs.

Pools are portions of the stream that are deeper and of lower velocity than the main current (Armotte, 1976).

Riffles are faster, shallower areas with the water surface broken into waves by wholly or partly submerged obstructions.

Glides and runs are sections where the water surface is not broken but is shallow and has a fast or faster velocity (Duff and Cooper, 1976).

Different flow features within a pace distance will be recorded as a percentage based on a visual estimate.

Organic Debris Index

1 None

2 Infrequent debris, what's present consists of small, floatable organic debris.
3 Moderate frequency, mixture of small to medium size debris affecting less than 13% of channel area.
4 Numerous debris mixture of medium to large size affecting 11 to 30% of channel area.
5 Debris dams of predominantly large material affecting 31 to 50% of channel area and often occupying the total width of the channel.
6 Extensive, large debris dams either continuous or influencing over 50% of the channel area. Forces water onto floodplain even with moderate flows. Generally permanent & fish migration blockage. (Keegan 1981)

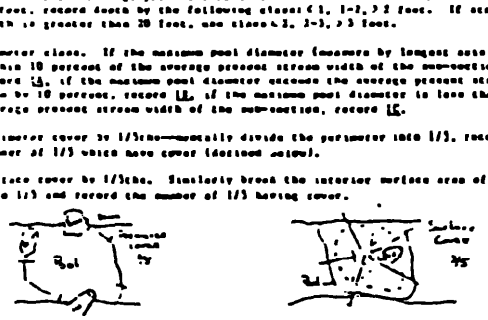
Pool Quality -

Depth. If the average present stream width for the sub-sections is less than 20 feet, record depth by the following classes: < 1, 1-2, > 2 feet. If stream width is greater than 20 feet, use class < 2, 2-3, > 3 feet.

Diameter class. If the maximum pool diameter (measure by longest axis) is within 10 percent of the average present stream width of the sub-section, record LS, if the maximum pool diameter exceeds the average present stream width by 10 percent, record LE, if the maximum pool diameter is less than the average present stream width of the sub-section, record LE.

Perimeter cover by 1/3ths—mentally divide the perimeter into 1/3, record the number of 1/3 which have cover (defined below).

Surface cover by 1/3ths. Similarly break the interior surface area of pool into 1/3 and record the number of 1/3 having cover.



Cover Class - the total number of 1/3ths recorded as having cover for both perimeter and surface are combined as follows:

0-1	2-4	5-10
(P)oor	(F)air	(G)ood

Steve Schmanke

1/6 + 1/6 = 2/6 FAIR

Composite Pool Quality - referring to the publication "Field Methods and Statistical Analysis for Monitoring Small Salmonid Streams", by C.Armour & W. Platts, rating from Table 7.

Definitions: Pool Cover - any material or condition that provides protection to fish such as logs, other organic debris, overhanging vegetation within one foot of the water surface, rubble, boulders, undercut banks or water depth.

Substrate

Record by visual estimation within the riffles and glide/runs only substrate types by percentage in each of the following size classes:

Boulders 10 inches, cobbles 3 inches to 10 inches, large gravel 1 inch to 3 inches, small gravel .2 inches to 1 inch, all other fines < 0.2 inch.

Riparian Vegetation Density -

Brush greater than or equal to three feet tall and within six feet of the stream edge is to be recorded by density class along each side of the stream within the pace distance. The density class corresponding to percentage of canopy cover are as follows:

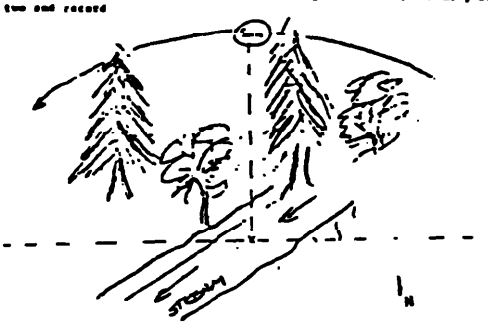
% Cover	0	1-10	11-19	21-40	41-60	61-80	81-100
Density Class Recorded	0	5	15	30	50	70	90

Trees within 25 feet of the stream edge are to be recorded by density class on each side within the pace distance.

% Cover	0	1-20	21-40	41-60	61-80	81-100
Density Class Recorded	0	15	30	50	70	90

Shade

An estimate of the overhead shade is made at one or more locations within the sections. Face in the general direction of the path of the sun relative to a point in the middle of the channel and divide the view into two 90 degree quadrants. In each quadrant estimate the percentage of the overhead canopy which would provide shade at the heating period of the day, roughly a 30 to 45 degree angle overhead. Add the percentages in each quadrant , divide by two and record



Channel

Width - An estimation (± 2 feet) of the bank full 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 zone - insert the letter which best describes the sub-section in terms of zone of excavation (A)llluvium (sandbar), (B)edrock, (T)ight trees/roots, large (R)ocks, (S)ed cover.

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.

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.

Catbanks - stability, appropriateness for structures
Livestock effects - browsing, trampling, etc.
Degree of man activity, i.e. roads, timber, recreation, mining, etc.
Equipment access
Beaver (Active)(Abandon)
High water table
Planting difficulty
Fish observed, and observed, identification
Bank cover

Armotte, J.L. 1976. Nomenclature for instream assessments. Pages 9-13 in C.B. Stalnaker and J.L. Arnette,eds. Methodologies for the determination of stream resource flow requirements: an assessment. U.S. Fish Wildl. Serv., Logan. Ut.

Duff, D.A., and J.L. Cooper. 1976. Techniques for conducting a stream habitat survey on National Resource Land. U.S. Bur. Land Manag. Tech. Note 283. 22 pp.

Keegan, David L. Paper presented at the symposium, Riparian Ecosystems and Their Management: Reconciling Conflicting Uses, April 16-18 1985, Tucson, Arizona.

CONTINUATION SHEET

STREAM 1 LT CREEK SECTION 1 TO 2 DATE 8 13 85 PAGE 2

SUB-SECTION

	BEGIN SECTION	10	26	36	50							SECTION WEIGHTED AVERAGES
FLOW FEATURES	POOL %	10	5	90	50							3[illegible]
	GLIDE/RUN %		65	10	50							37
	RIFFLE %	90	30	—								[illegible]
ORGANIC	INDEX	1	1	1	1							
	[illegible]	<1	<1	<1	<2							
	[illegible]	1B	1C	1B	1B							
	[illegible]		2	2								
	[illegible]	0	0	0	1							
	[illegible]	P	P	P	P							
	[illegible] CLASS	4	1	4	4							3.25
SUBSTRATE RIFFLE	BOULDERS %	2	0	0	1							<1
	COBBLES %	30	20	25	30							26
	GRAVEL 1"-3" %	60	60	70	59							62
	GRAVEL .2"-1" %	8	20	5	10							12
	FINES < .2" %	-	-	-								
[illegible]	BRUSH DENSITY CLASS RIGHT	90	90	90	30							.73
	BRUSH DENSITY CLASS LEFT	30	30	50	5							.27
	TREE DENSITY CLASS RIGHT	0	15	0	0							.05
	TREE DENSITY CLASS LEFT	0	15	0	0							.05
	PERCENT SHADE	2	8	15	15							10
CHANNEL	WIDTH FLOOD	55	35	30	45							36
	WIDTH PRESNT	8	12	25	12							14
	STRAIGHT/CURVE	S	S	S	S							
	EXCAVATION EASE	Poor	Poor	Poor	Poor							
	VERTICAL BANK HEIGHTS	0	0	0	0							

NOTES:

10-26 at low & channel split flow
@ 36 Trib enters at left

End of section is just below private land fence.

Reach exibits Poor condition characteristics other than good Rip Shrubs. Stream is weak braiding type.
Cattle have been grazing intensely pretty low. Fish still absent suspect water temp.

@ 1053 temp 14°C

STREAM INVENTORY INSTRUCTIONS

Pace – A reach of stream 50 paces long. A pace is two full steps calculated to approximately five feet. Section lengths are about 250 feet. In remote areas, sections may be expanded to 100 paces. Line of pacing follows upper bank contours.

Inventory Section – This is to identify the location on-the-ground correlated with the inventory sheet. Fill in the space starting with the previous stake proceeding to the next station (e.g., 0 to 1 or 41 to 42 etc.). Sections will be identified on-the-ground with three-foot lath marked with grease pencil and flagged (usually blue ribbon). Inventory on private land may require another method unless approved by the landowner.

Direction of Inventory – Check the appropriate box. When the inventory begins on a reach of a main stream or tributary, inventory direction will remain the same.

Permanent Identifying Feature – This will normally be filled out at the beginning and end of the inventory and transferred to a [illegible] to [illegible] [illegible] features identifiers can also be noted as description and pace location within sections and transferred to reference map and aerial photos. [illegible] [illegible] identifiers might be [illegible] crossings, [illegible] [illegible] [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible] flow [illegible] [illegible] velocity (Duff and Cooper, 1976).

Different flow features within a pace distance will be recorded in percentages based on a visual estimate.

[illegible] Debris Index

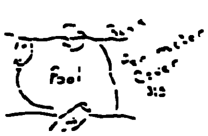
- None
1. Infrequent debris, small, a present consists of small, floatable organic debris.
2. Moderate frequency, mixture of small to medium size debris affecting less than 10% of channel area.
3. Numerous debris mixture of medium to large sizes affecting 11 to 30% of channel area.
4. Debris dams of predominantly large material affecting 31 to 50% of channel area and often occupying the total width of the channel.
5. Extensive, large debris dams either continuous or influencing over 50% of the channel area. Forces water into floodplain even with moderate flows. Generally presents a fish migration blockage (Hodges 1985).

[illegible] the average present stream width for the subsection [illegible] following class [illegible] stream width is greater than 20 feet, use Class [illegible]

[illegible] the maximum [illegible] diameter [illegible] the average present stream width [illegible] the maximum [illegible] diameter is less than the average present stream width of the subsection, record [illegible].

[illegible] perimeter [illegible] have cover [illegible]

[illegible] surface area of pool [illegible] having cover



Cover Class – the total number of 1/5th recorded as having cover for both perimeter and surface are combined as follows.

0-3	4-6	7-10
(Poor)	(Fair)	(Good)

Above example
3/5 + 3/5 = 6/5 = FAIR

Comments Fish Quality – Referring to the publication "Field Methods and Statistical Analyses for Monitoring Small Salmonid Streams", by [illegible] and W. Platts, rating from Table 7.

Definition Pool cover – Any material or condition that provides protection to fish such as logs, other organic debris, overhanging vegetation within one foot of the water surface, rubble, boulders, undercut banks, or water depth.

Substrate

Record by visual estimates within the riffles and glides/runs main substrate types by percentage in each of the following size classes

Boulders = 12 inches, rubble = 3 to 12 inches, large gravel = 1 to 3 inches, small gravel .2 to 1 inch, all other fines = 0.2 inch.

Riparian Vegetation Density –

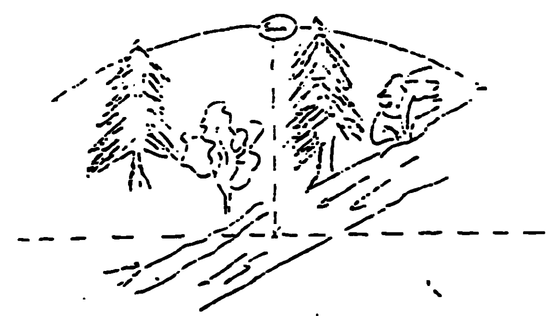
Brush greater than or equal to three feet tall and within six feet of the stream edge is to be recorded as density class along each side of the stream within the pace distance. The density classes corresponding to percentage of canopy cover are as follows

[illegible]
Density Class
Vegetation

[illegible]

[illegible]

[illegible]



Channel

Width – An estimation (in feet) of the bank full width and the present width in feet.

Curve/Straight – Record by using first letters of the word straight or curve for the condition of pace distance.

Excavation Zone – Insert the letter which best describes the sub-section in terms of zone of excavation [illegible] [illegible] [illegible] [illegible] [illegible] large [illegible] cover

Vertical Bank Heights – For curved sections [illegible] in feet the average height on the outside of the curve. For straight sections record the percent the number of bank pairs with one or more banks having heights [illegible] than [illegible] feet.

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.

Culverts – structure appropriateness for structures
Livestock effects – browsing, trampling, etc.
Degree of human activity (i.e., roads, timber, recreation, mining, etc.)
Equipment access
Beaver (active/abandoned)
High water table
Planting difficulty
Fish observed, not observed, identification
Bank undercut

Arnett, J. L. 1976. Nomenclature for instream assessments. Pages 9-15 in C. B. Stalnaker and J. L. Arnette, eds. Methodologies for the determination of stream resource flow requirements: an assessment. U. S. Fish Wildl. Serv., Logan, UT.

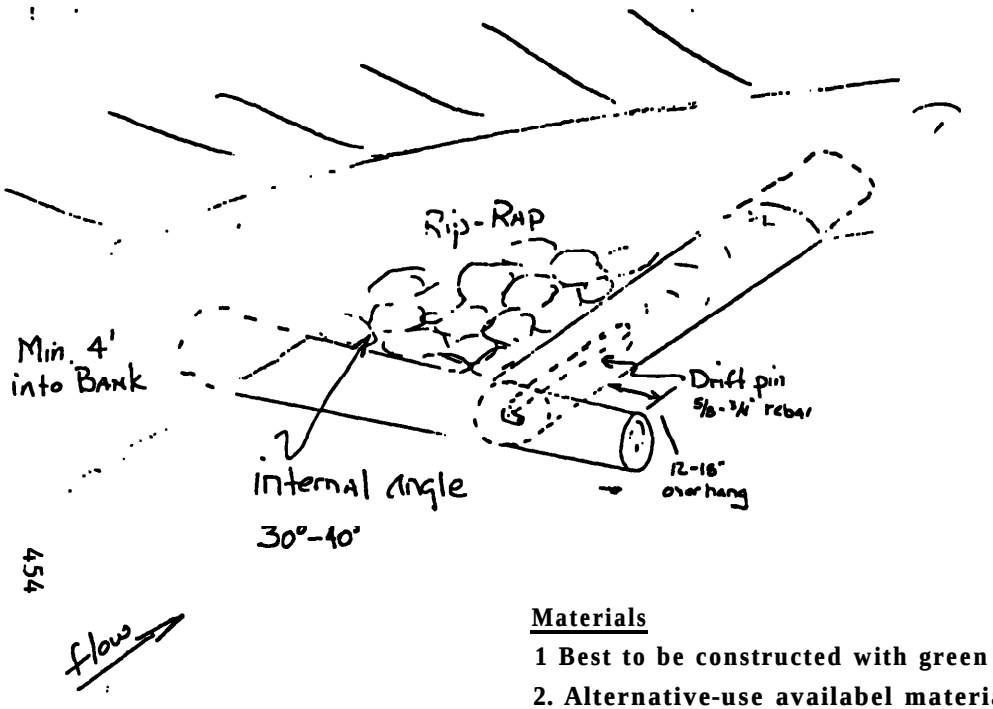
Duff, D. A., and J. L. Cooper. 1976. Techniques for conducting a stream habitat survey on National Resource Land. U. S. Bur. Land Manage. Tech. Note 283. 73 pp.

Hodges, David L. Paper presented at the symposium, Riparian Ecosystems and Their Management: Reconciling Conflicting Uses. April 16-18, 1985. Tucson, AZ.

Appendix 2

Structure Design

WINGS (FLOW DEFLECTORS)



Objectives: 1. Provide bank protection down stream from structures.

2. Create rearing areas from scour pool expected to develope at the down-stream ends.

Materials

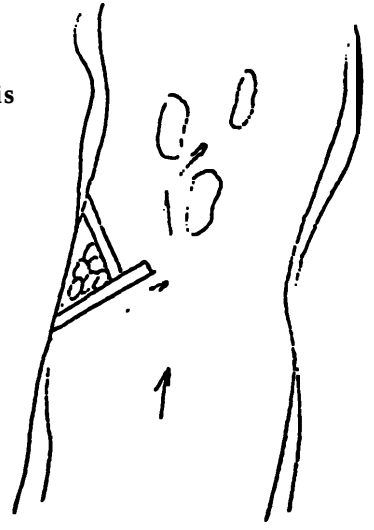
1 Best to be constructed with green larch.

2. Alternative-use availabel material near site.

Reabr-5/8 to 3/4" drift pins.

Rock balast fro center of structure usually this will consist of local stream material.

;



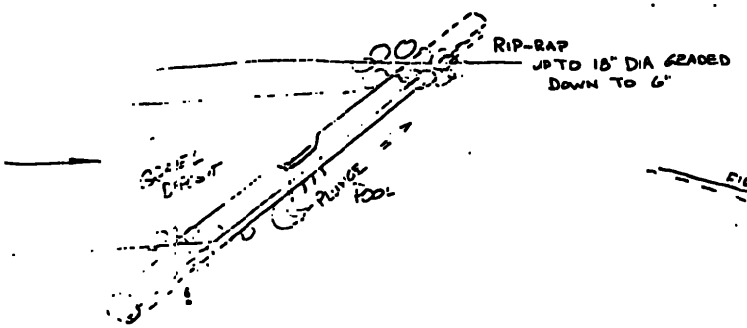
On curves these will work well to protect banks on straight stretches. They will also work well in connection with other habitat items such as boulder groups or root wads.

LOG SILL OR WEIR

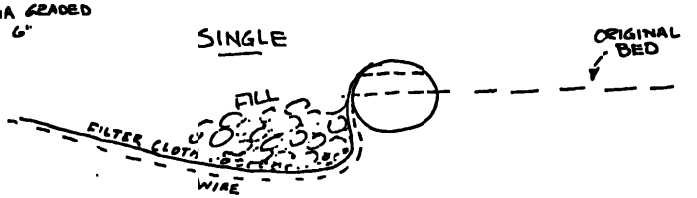
OBJECTIVES: 1. TO CREATE PLUNGE POOLS OF HIGH QUALITY TO REAR FISH

2. CREATE deposit AREAS FOR GRAVEL FOR SPAWNING.

TWO TYPES: SINGLE, DOUBLE

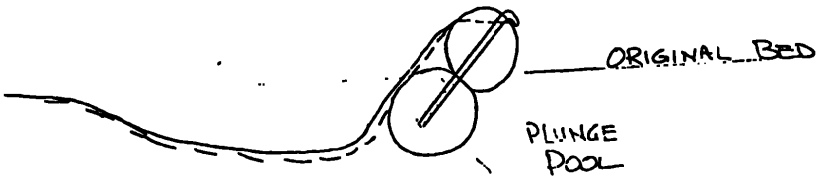


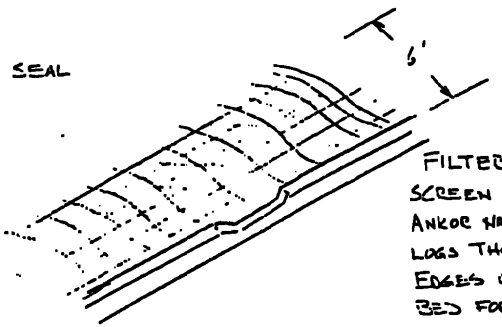
SINGLE



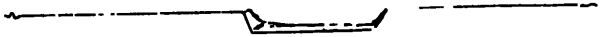
PROFILE

DOUBLE





FILTER BLANKET & WIRE MESH SCREEN ATTACHED TO TOP LOG BY ANKOR NAILS: EXCAVATE A DEPRESSION ABOVE LOGS THEN LAY BLANKETS AGAINST UPSTREAM EDGES OF LOGS, THEN ALONG THE CHANNEL BED FOR A DISTANCE OF SIX FEET UPSTREAM FROM THE STRUCTURE. FEATHER INTO BANKS.
HOG MESH 3"X2"



NOTCH to FOCUS LOW FLOWS PROVIDES PLACE FOR FISH TO HAVE SLIGHTLY LESS HEIGHT TO JUMP GENERALLY DESIGNED TO HANDLE Q_{90} N 4" X 2-3'

MATERIALS

- LOGS DIA. 14-20" GREEN LARCH
  FOR DOUBLE LOG STRUCTURES USE SMALLER LOGS
- DRIFT PINS 5/8-3/4" REBAR HOLES IN LOGS MUST BE AUGERED. PINS DRIVEN 2/3 INTO BOTTOM LOG. BEND TOP 3" OVER LOG FACING DOWNSTREAM.

BANKS

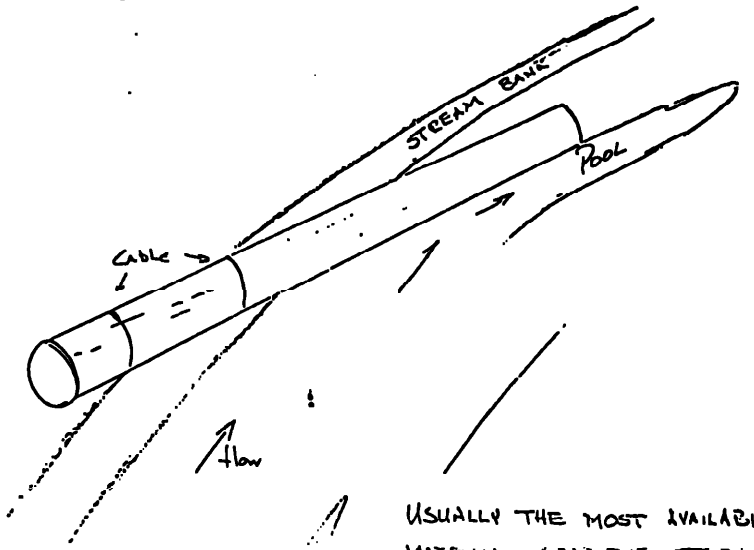
LOCATION OF SILLS IN CHANNEL BANKS. SHOULD BE HIGH ENOUGH SO THAT THE NEW GEOMETRIC/HYDRAULIC CONDITIONS SATISFY WATERSHED HYDROLOGY DEMANDS FOR 30-YR FLOOD 50% SURVIVAL

WHOLE TREE

Purpose: 1. OFFER PROTECTION TO RAW OUTSIDE BANKS ON CURVES.

2. PROVIDE THE NECESSARY RESISTANCE TO CAUSE SOME UNDER AND DOWNSTREAM DIGGING.

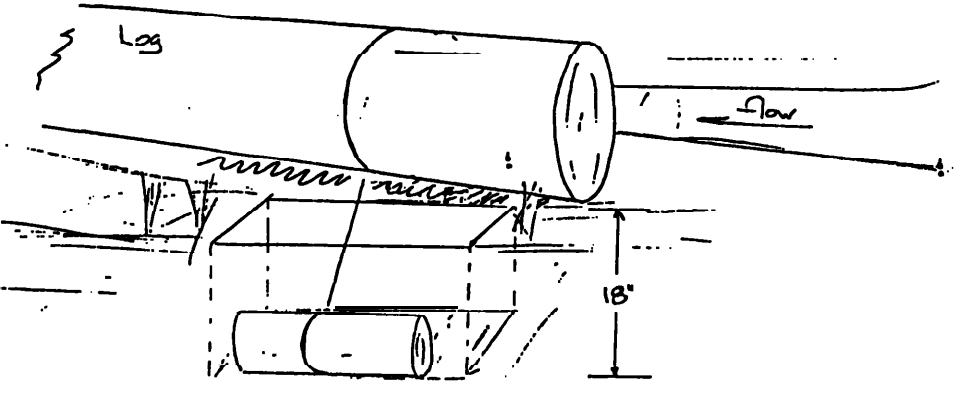
3. PROVIDE COVER & POOL QUALITY ENHANCEMENT.



USUALLY THE MOST AVAILABLE MATERIAL NEAR THE STREAM WILL BE OK. LOOK FOR TREES WITH NO ROT. SIZE 14-20". PLACE LARGE END ON THE BANK.

SOME MINOR EXCAVATION MAY BE NECESSARY TO CORRECTLY POSITION THE LOG ON THE BANK & INTO THE STREAM. SMALL END SHOULD WETTED AT ALL TIMES. TREE SHOULD ANGLE DOWNWARD INTO WATER

WHEN POSSIBLE USE A PIVOT TREE TO ANKOR LOG AGAINST.



DEADMAN ANKOR

CABLE STRECHER NEEDED

USE 1/4 - 3/8" CABLE (WIRE ROPE) W/ CLAMPS

DEADMAN CAN BE A LARGE ROCK OR LARGE ≥ 14" DOIT OF WOOD PLACED IN THE GROUND ≥ 18" DEEP. IF AVAILABLE THE ROCK WOULD LAST LONGER

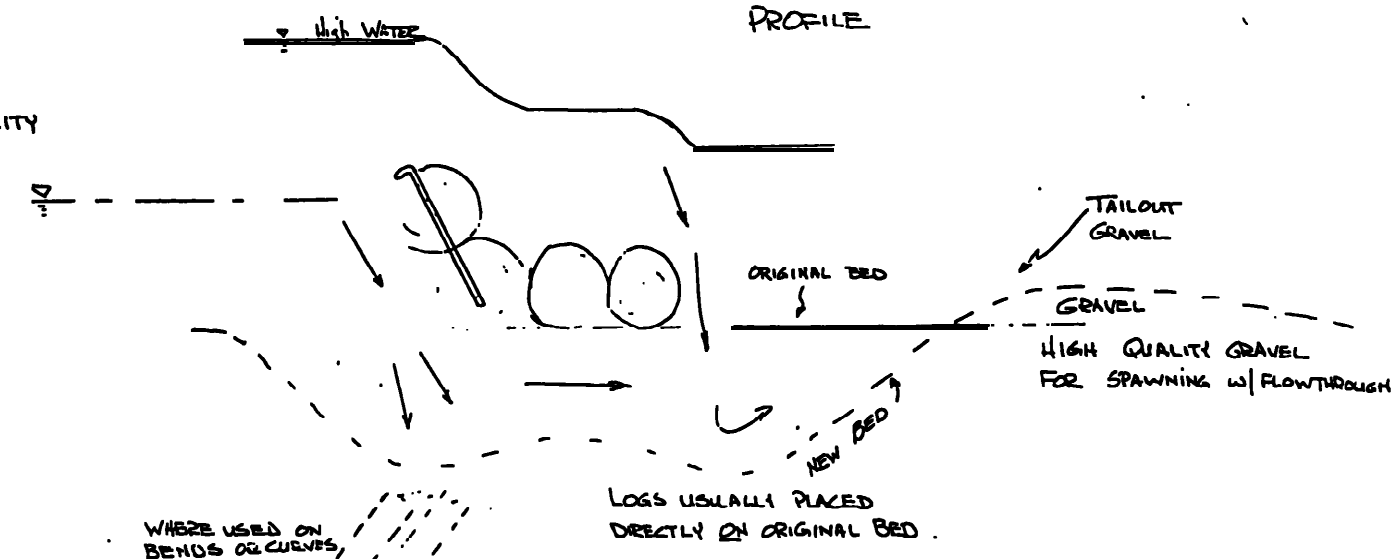
USUALLY TWO DEADMAN ANKORS WILL BE REQUIRED. ONE NEAR THE LOG BUTT END THE OTHER UP THE LOG NO NEAREZ THAN 5' from the BUTT ANKOR.

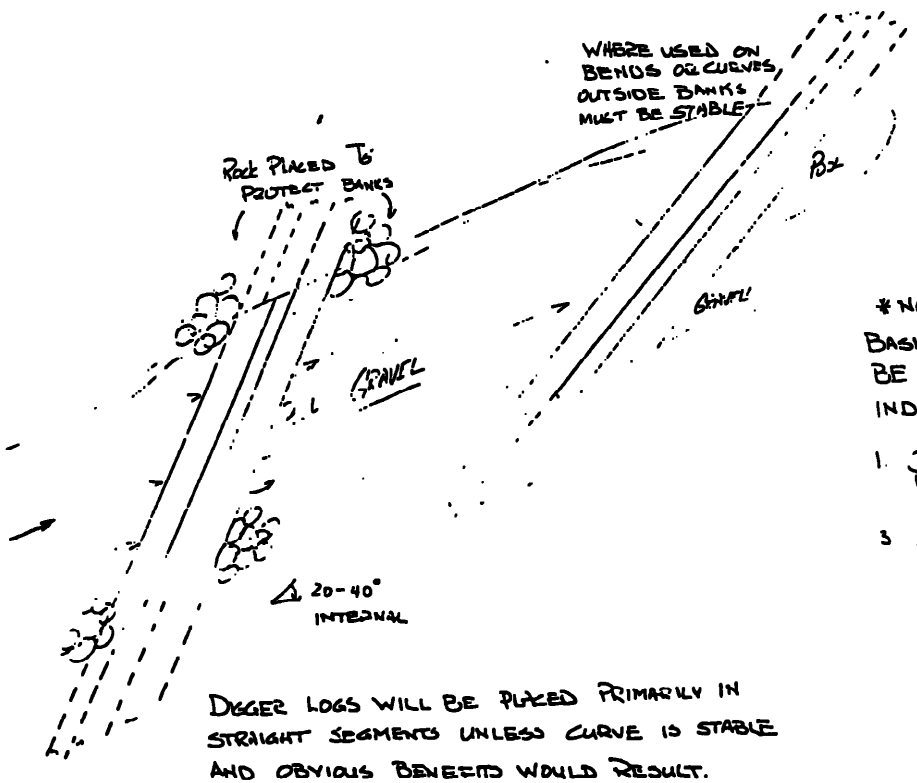
DIGGER LOGS

PRIMARY OBJECTIVES

1. TO IMPROVE THE EXISTING POOL QUALITY BY PROVIDING COVER & DEEPER POOL WHERE THEY ALREADY EXIST.

2. TO CREATE HIGH QUALITY POOLS IN REACHES OF STREAMS LACKING POOL STRUCTURE



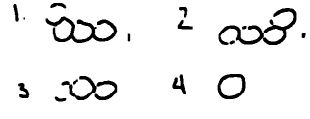


DIGGER LOGS WILL BE PLACED PRIMARILY IN STRAIGHT SEGMENTS UNLESS CURVE IS STABLE AND OBVIOUS BENEFITS WOULD RESULT.

ESTIMATED COST PER STRUCTURE $80

* NOTE.

BASICALLY 4 DESIGNS WILL BE USED. ONE WILL BE INDICATED ON GROUND STAKE



MATERIALS

Logs: GENERALLY 12-14" GREEN LARCH

DRIFT PINS: REBAR 5/8" to 3/4"

BORE HOLE 1/2 INTO BOTTOM LOG THEN DRIVE THE REST OF THE WAY TO SEAT 2/3 OF THE WAY INTO BOTTOM LOG AUGER HOLE SHOULD BE SLIGHTLY SMALLER THAN REBAR.

DIGGER LOG WILL REQUIRE A BACK HOE TO EXCAVATE KEYS FOR ENDS OF LOGS.

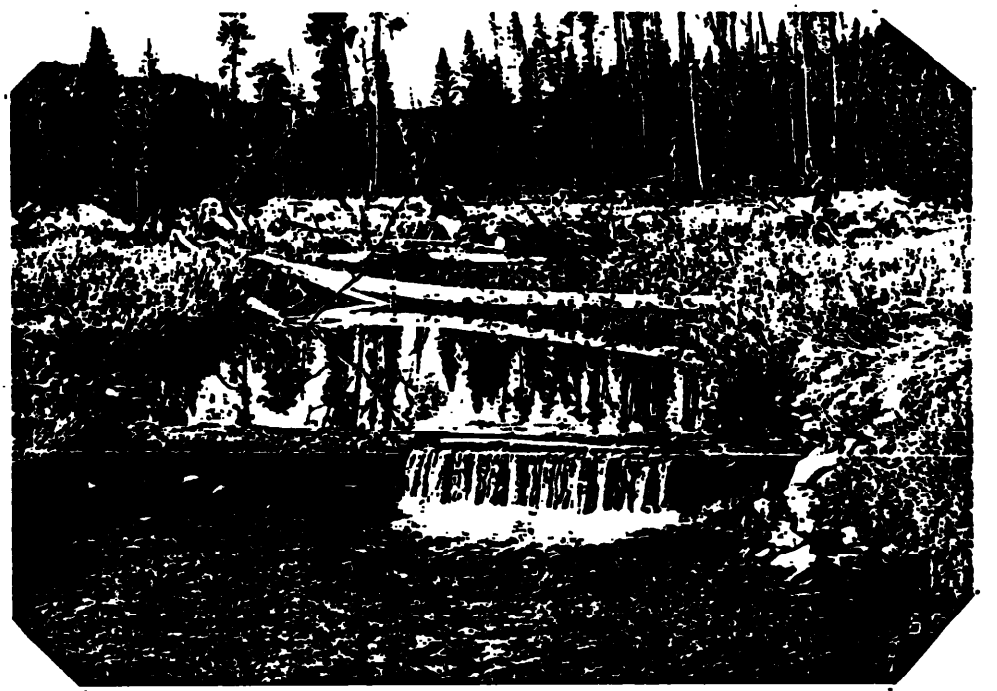
Appendix 3

Photo Display

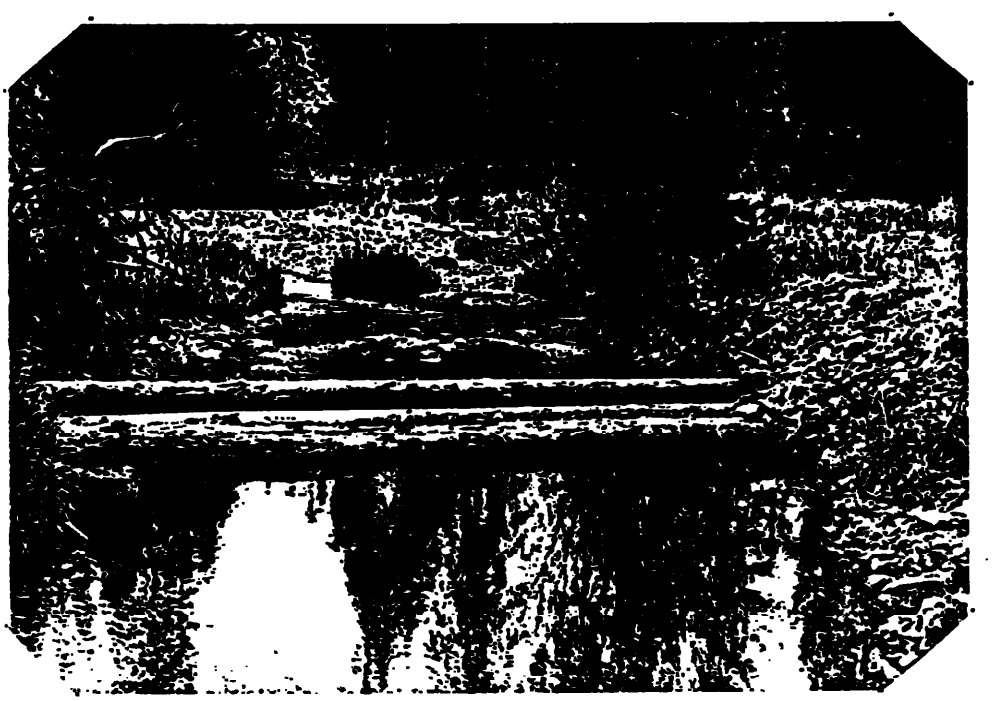
Sheep Creek Structures

The designs were:

Log wiers, either single log or multi-log structure sealed upsstream with filter cloth, keyed well into the bank. Objectives were usually to raise water table, create plunge pools, elevate water to make contact with large woody debris and to slow water on the outside of sensitive streambanks.

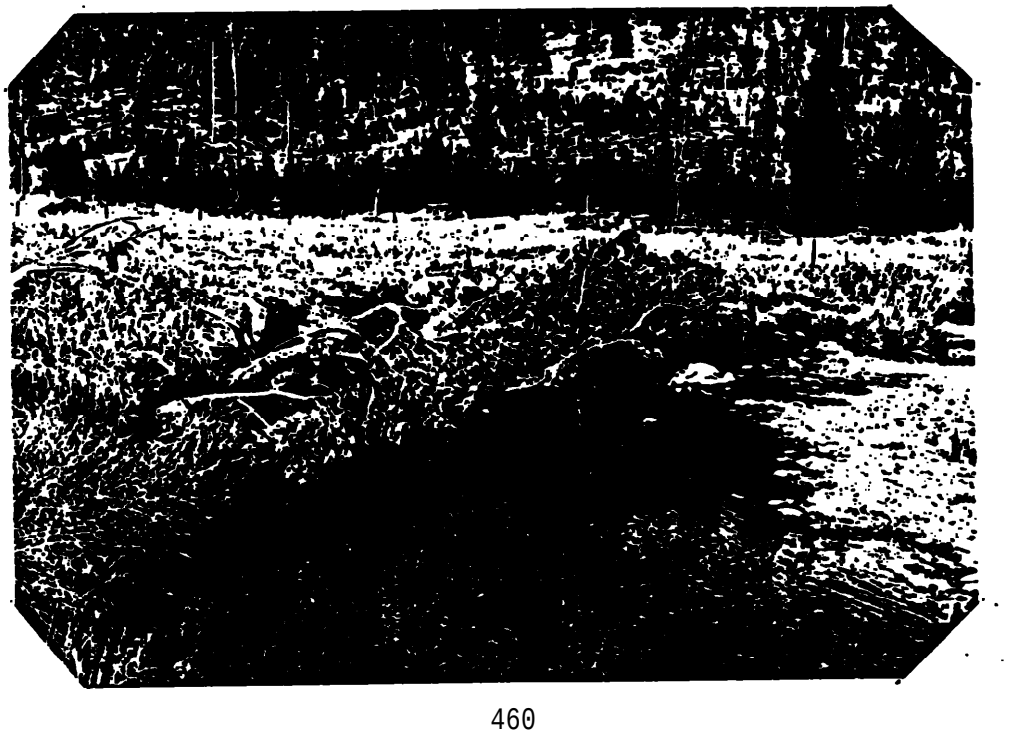


Digger logs : The basic design was for two to three logs placed side by side with a piggyback log opposed at 45 degrees on the upstream log. Angle of logs was usually 90 degrees to the direction to flow. On occasion a digger group was angled 30-40 degrees to the inside bank. These types of diggers were keyed well into the banks. Objective: to improve the quality of existing pools by providing cover, to create and maintain a deep covered pool where none existed before.



Wing deflectors: These are log structures of various geometric shapes designed to create or maintain pools under, around and on the downstream side of each structure. Each is keyed well into the bank, most are double log usually piggyback, some were set side by side. Their angle to the inside bank is between 30 and 45 degrees. A variety of lenghts into the stream were tried and succes of each method will be evaluated.

Whole tree: Usually these were set on the outside of meander bends to utilize hydraulic forces to create or maintain undercuts and cover. These were not used extensively but those installed will be evaluated for later treatment.



Habitat Quality and Baseline Data

Annual Report 1985

by

Cris Stainbrook
Terry A. Luther
and
Fisheries Technician
Lewis E. Pitt, Jr.

Research by

The Confederated Tribes of the
Warm Springs Indian Reservation
Warm Springs, Oregon

Prepared for

Bonneville Power Administration
Division of Fish and Wildlife
Project No. 81S-8
Contract No. DE-AI79-85BP13047

HABITAT QUALITY AND ANADROMOUS FISH PRODUCTION
POTENTIALS ON THE WARM SPRINGS INDIAN RESERVATION

Project Leader: Terry A. Luther
Confederated Tribea of Warm springa
BPA Project Officer: Jeff Gislason
BPA Project Number: 81S-8
Program Measure Number: 704(d) (1)

elationship to Program Measure: The Warm Spring8 Indian Reservation's
nadromous fish habitat and production project is determining anadromous fish
-oduction potentials of reservation streams and improving habitat to
rcrease spring chinook salmon and steelhead trout populations.
re rivers and streams of the Warn Springs Indian Reservation provide over
re hundred miles of spawning and rearing habitat for naturally produced
Bring chinook salmon and summer steelhead trout. Salmonid production levels
-e being measured and evaluated to determine what factore are limiting
-oduction. Insufficient Juvenile rearing and over wintering habitat are
rought to be major factore limiting potential fish production.

echnical Results: In 1985, the fourth year of this project, established
mitering sites were field sampled to determine fish biomass levels and
ater quality and quantity parameters on the Warm Springs River system and
nitike Creek. The 1983 brood spring chinook salmon were fin marked at the
arm Springs National Fish Hatchery. A Humphrey scoop trap was operated near
-e mouth of the Warm Springa River to estimate spring and fall anadromous
sh out migration from the Warn Spring6 River system. Habitat
assification surveys were conducted in a channelized reach of Beaver Creek.
.e Beaver Creek survey data was analyzed and a habitat improvement plan to
.crease the amount Juvenile rearing area was developed. The Beaver Creek
an will be implemented in the summer and fall of 1986. Redd count surveys
re conducted to determine chinook and steelhead stream seeding level8 and
aluate previous BPA and tribally funded improvement projects.

chnical Review: Biologists of the U.S. Fish and Wildlife Service. U.S.
rest Service, Oregon Department of Fish and Wildlife and other individual8
o are specialists in design of instream structures and barrier removal have
en consulted and assisted with reservation projects.

fectiveness: Improvement projects on the Warm Springs Indian Reservation
e being evaluated through a multi-year project funded by BPA and the
nfederated Tribes of Warm Springs. Twenty-eight miles of stream have been
ened up to spring chinook salmon and steelhead trout production. Juvenile
oduction is projected to increase by 300% au a result of
bitat improvement in the Beaver Creek enhancement project.

gree of Program Measure Fulfillment: This was the fourth year of the
heduled eleven year Warn Springs Indian Reservation Anadromous fish production
d habitat improvement program. Since the rivers of the Warm Springa Indian
servation represent only a ems11 amount of the Columbia River Basin, a
gnificant portion of Program Measure 704(d)(l) will need to be accomplished
on completion of this project.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ACKNOWLEDGMENTS

INTRODUCTION 466

STUDY AREA 468

METHODS 470

RESULTS 477

STREAM INVENTORY 477

ANADROMOUS FISH PRODUCTION 480

Redd Counts 480

Site Specific Juvenile Production 487

Strawberry Falls Byparr Evaluation 488

Beaver Creek Rehabilitation end Enhancement Project ... 488

Discussion 489

Habitat Evaluation 490

HABITAT SUMMARY AND RECOMMENDATIONS 492

FISH PRODUCTION EVALUATION 494

STRAWBERRY FALLS PASSAGE 500

REFERENCES 502

APPENDIX A Species Conposition, Biomass, Redd Data & Migrant Trap Data

APPENDIX B Beaver Creek Enhancement Project EXPENDITURES

LIST OF TABLES

Table Number

1. Stream sampling sites on the Warm Springs Indian Reservation.

2. Water quality measurements (monthly average) for stream monitoring sites on the Warm Springs Indian Reservation, 1984 to 1985.

3. Bank and stability rating system.

4. Steelhead redds by reach for Shitike Creek.

5. Spring chinook redds by reach for Shitike Creek.

6. Spring Chinook redd counts by index area in the Warm Springs river system.

7. Spring Chinook escapement, redd counts and out-migration estimates for Warm Springs river system. 1975-1985.

8. Summary of Humphrey Scoop Trap Spring 1985.

9. Summary of Humphrey Scoop Trap Fall 1984.

10. Summary of Humphrey Scoop Trap Spring 1985.

11. The percentage of out-migrating chinook juveniles in the Humphrey Scoop trap. 1979-1985 Spring.

12. Number of redds, eggs deposited, total out-migrants and percent survival from egg to out-migrant by brood year, 1975 to 1983.

13. Fish species composition (X) at sampling sites on the Warm Springs Indian Reservation, 1983 to 1985.

14. Spring Chinook population and biomass estimates for twenty sampling sites on the Warm Springs Indian Reservation, 1984 to 1985.

15. Rainbow Trout population and biomass estimates for twenty sampling sites on the Warm Springs Indian Reservation, 1984 to 1985.

16. Humphrey Scoop Trap data, Spring 1984.

17. Humphrey Scoop Trap data, Fall 1984.

18. Humphrey Scoop Trap data, Spring 1985.

FIGURES

Figure 1. Map of Warm Springs Indian Reservation with BPA monitoring sites.

Figure 2. Relationship between number of redds and percent survival to outmigrants in Warm Springs River system, 1975 to 1983.

Figure 3. Relationship between per adult returns and spring smolts passing the migrant trap in the Warm Springs River system, (B. Cates).

ACKNOWLEDGMENTS

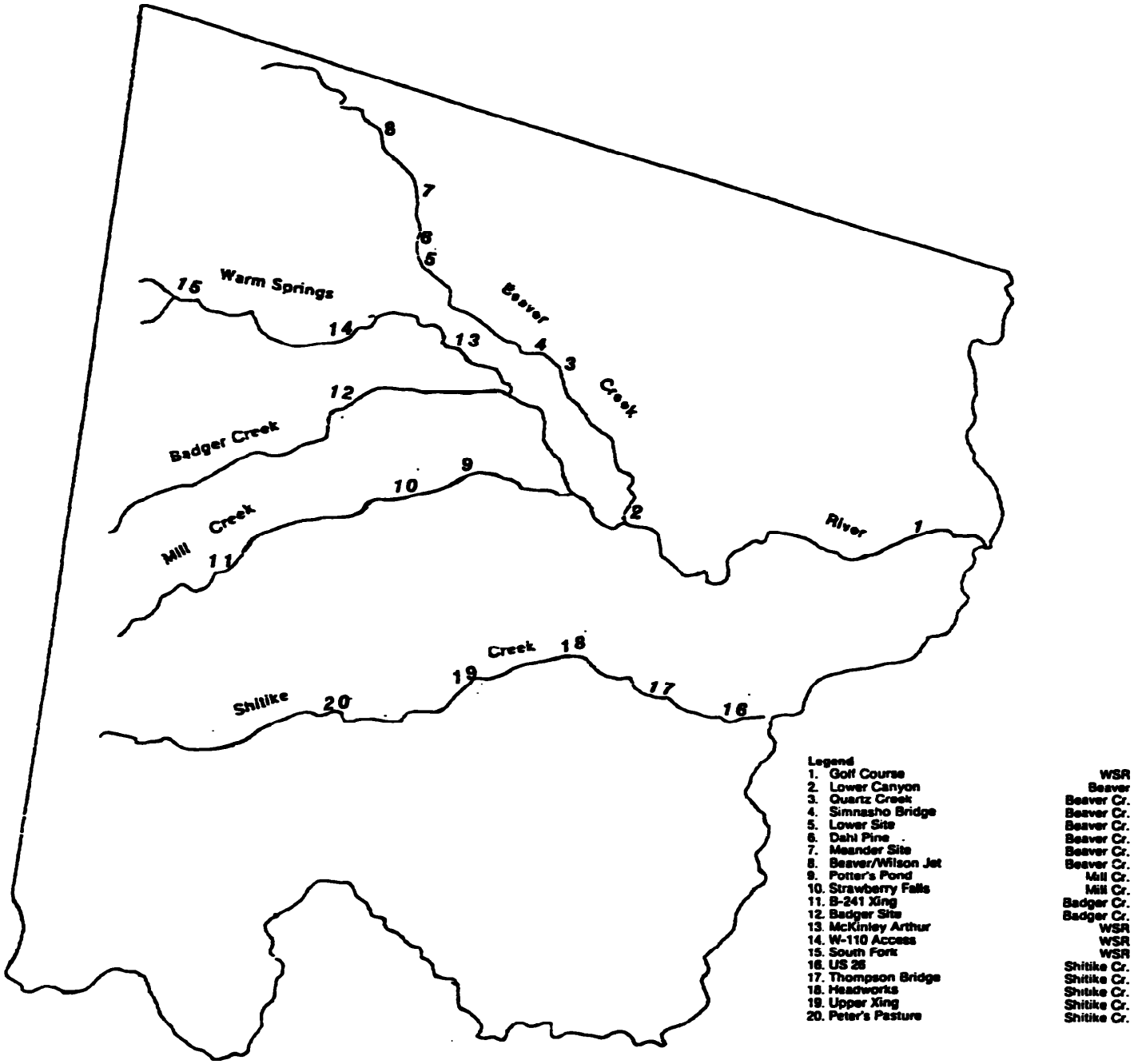
Individuals from the Oregon Department of Fish and Wildlife and United States Fish and Wildlife Service assisted greatly in formulating this document. Specifically thanks go to Kirk Schroeder, Bob Lindsay and Brian Jonasson, ODFW Biologists and Brian Cates, USFW Biologist. A special thanks to the Warm Springs Natural Resources BPA Crew: Keith Moody, David Crowe, Cassie Clements and William Patt.

We would also like to thank out BPA project coordinator, Jeff Gislason, for his help and patience with the development of this report.

INTRODUCTION

The Confederated Tribes of the Warm Springs Indian Reservation of Oregon are conducting fisheries sampling aimed at determining the existing and potential anadromous fisheries resources of reservation streams. In conJunction with that sampling, habitat rehabilitation and enhancement projects have been proposed and implemented. Funding for this effort has been provided by Bonneville Power Administration.

The project consists of three phases. Phase I was a compilation of information of the salmonid resources of the reservation streams. This phase was completed by the contractor, CH2W-Hill, in January 1982. The second phase of the project, which began in June 1983, la intended to determine the habitat potential, identify habitat problems and possible corrective actions and determine the potential benefits of each project. Phase II is scheduled for completion in December 1986. Phase III of the project is implementation and evaluation of the habitat rehabilitation or enhancement projects identified in Phase II. This phase began in 1984 and will conclude no later than fiscal year 1992. The work completed during FY-85 involved Phases II and III.



THE WARM SPRINGS INDIAN RESERVATION

Figure 7.

Study Area

The Warn Springs Indian Reservation <Fig. 11, located in north-central Oregon, is bordered on the south by the Metolius River and on the east by the Deschutes River. Anadromous fish runs in reservation streams are now limited to those streams which have a confluence with the Deschutes River downstream of the Pelton Reregulating Dam (approx. river mile 100). The 1985 field sampling was conducted in Shitike Creek, the Warn Springs River its tributaries, Beaver Creek, Badger Creek and Mill Creek.

Shitike Creek, which Joins the Deschutes River at approximately RR 93, is the second largest drainage on the reservation <272 square kilometers). Principally fed by springs and snow melt, Shitike Creek has an average annual discharge of 108 cfs. The minimum and maximum recorded flows were 17 cfs and 5600 cfs, respectively. Naturally spawning runs of summer steelhead (Salmo gairdneri) and spring chinook (Oncorhynchus tshawytscha) occur in Shitike Creek. Inadequate passage facilities at a defunct community water intake dam <RR 6) have impeded the upstream migration of both steelhead and spring chinook in past years. The Tribes removed the dam in August 1983, making an additional 39 km of stream more accessible to anadromous fish.
Beaver Creek, Mill Creek and Badger Creek Join with the Warm Springs River at RM 19, 21 and 27, respectively. Mill Creek originates in east slope, high Cascade lakes and is the largest tributary to the Warm Springs River, draining 150 square kilometers and contributing approximately 30% of the flow to the river. The mean annual recorded flow was 62 cfs. The minimum and maximum recorded flows were 38 cfs and

159 cfs, respectively.

Beaver Creek is the second largest tributary to the Warm Springs River and drains 298 square kilometer8 of the northwest part of the reservation. Water sources for Beaver Creek are principally snow melt and springs. The mean annual recorded flow for Beaver Creek wan 85 cfs and and minimum and maximum flow8 were 26 cfs and 839 cfs, respectively. Portion8 of Beaver Creek were channelized during the construction of Highway 26 which now parallels the stream from RR 12.5 to RR 22.

Badger Creek is the third largest tributary to the Warm Spring8 River. Approximately 30 km long, it draina 93 square kilometer8 of the central reservation lands It8 primary source of water is mow melt and flows are quite variable, with an estimated average annual flow of 28 cfs and a minimum flow of 5 cfs. No maxinun flow estimates have been made for Badger Creek.

The rainstem of the Warm Springs River originates at approximately 3,775 feet elevation and flows in a southeasterly direction for approximately 92 km to its confluence with the Deschutes River. The flow of the Warn Springs River is very stable as it primarily originates from ground water sources.

The average annual discharge is 440 cfs and the minimum and maximum recorded flour were 232 cfs and 6,350 cfs, respectively. Springs chinook and summer steelhead spawn and rear in the mainstem and tributaries of the Warm Springs River. Coho salmon (0. kisutch) were heavily planted in the Warm Springs system for a number of year8 during

the 1960's, but only a remnant run, if any, now return.

Methods

Existing fish populations and several habitat parameters were measured at 20 sites throughout the Warm Springs River system and Shitike Creek.

Habitat evaluation of each rite included an estimation of pool-to-riffle ratios, bottom substrate analysis, streambed profiles, establishment of photo points and a bank stability rating. The bank stability rating was calculated using the methodology an developed in the Warn Springs Streamside Management Plan (Sehgal and Heckman 1982).

Existing fish populations were sampled at each site to establish species composition and densities. Sample areas, which varied in length from 45.7 meters to 91.4 meters, were blocked at both upstream and downstream ends with 3.1 mm stretch me&h seine and then electrofished with a Type VII, Smith-Root electroshocker unit. Densities of fish abundance were estimated using the two-pare removal method of Seber and LeCren (19671. Biomass estimates were then calculated from densities and mean weight8 of both age class O+ and l+ fish.

Water quality sampling at each site included temperature, dissolved oxygen, pH, conductivity and turbidity. All parameters were measured using the appropriate portable Hach meters.

The floating, Humphrey scoop trap wan again operated at the mouth of the Warm Springs River to monitor the downstream migration of Juvenile salmonids. The trap operated 4.8 days per week from September 17 to

December 19, 1984, and from March 12 to Juno 21, 1985. The efficiency of the trap, with a 1.9 meter mouth opening, was measured monthly during the sampling period. This involved marking the caudal fin of a sub-sample of downstream migrants, transporting the marked fish 2.0 km upstream for relearn and recapturing the marked fish at the trap. Sub-samples of each species of fish captured at the trap were measured for length to the nearest millimeter and salmonids for weight to the nearest one-tenth of a gram. Sub-sample nunberm ranging from 20 to 200 depending on the abundance of fish in the trap.

The total out-rigration of spring chinook juveniles war calculated from the total catch expanded by the trap efficiency. A Juvenile index warn calculated using the method devised by the Oregon Department of Fish and Wildlife (Aho et al 1979).

Spawning ground surveys for summer steelhead and spring chinook salmon were conducted in 1985. Two index area redd counts were made for steelhead in Shitike Creek. Sample redd counts for steelhead were made in Mill Creek above Strawberry Falls to check for adult passage. Two surveys for spring chinook spawning were made in index areas throughout the Wara Springs River system and Shitike Creek. It is believed that spawning ground index areas account for over 95 percent of the total spring chinook redds found in Reservation stream, as determined by previous surveys which included the ontire area accessible to anadromous fish.

Adult returns to the Warn Springs River are routinely monitored by the

Table 1 - Stream sampling sites on the Warm Springs Indian Reservation, pool-to-riffle ratio, bottom substrate composition and bank stability rating at each site.

Site	Legal Descriptions	Pool:Riffle Ratio	Boulder	Cobble	Gravel	Sand	Mud	Bank Stability
Shitike Creek								
U.S. Highway 26 (RM 1)								
	NW½ NW¼ Sec 25, T9S-R12E	.01:1		80%	20%			107
Thompsons Bridge (RM3)								
	NW¼, SE¼, Sec 2, T9S R12E	.80:1		60%	20%	10%	10%	101
Headworks (RM 5)								
	NW¼, SW¼, Sec 17, T8S R11E	.43:1	10%	80%	10%			69
Upper Xing (RM 10)								
	NE¼, SW¼, Sec 16, T8S R10E	.67:1	55%	35%	10%			65
Peter's Pasture (RM24)								
	SE¼, NE¼, Sec 34, T9S R9E	.36:1	10%	15%	70%	5%		64
Warm Springs River								
Golf Course (RM 6.5)								
	NE¼, NW¼, Sec 27, T8S R13E	.36:1	30%	50%	10%	10%		73
McKinley Arthur (RM 28.5)								
	NW¼, SE¼, Sec 17, T6S R10E	.20:1	5%	20%	70%			70
W-110 Access (RM 34)								
	SW¼, NW¼, Sec 9, T6S R9E	.10:1	10%	40%	40%	10%		73
South Fork (RM 40.5)								
	NE¼ SE¼ Sec 24, T7S R9E	4.0:1	8%	79%	15%	6%		61
Beaver Creek								
Lower Site (RM 1)								
	SE¼, NE¼, Sec 18, T7s R1-E	2.3:1	5%	65%	15%	15%		121
U.S.G.S. (RM 7)								
	SE¼, SW¼ Sec 14, T6S R11E	4.0:1	40%	25%	5%	30%		88
Simnasho Bridge (RM 8)								
	NE¼, NW¼, Sec 14, T6S R11E	4.0:1	80%	10%	2%		8%	57
Lower Canyon Site (RM 12)								
	NW¼ SW¼, Sec 6, T6S R10E	2.3:1	45%	20%	10%		25%	53
Dahl Pine Bridge (RM 15)								
	NW¼, SE¼, Sec 36, T6S R10E ,	.06:1	2%	70%	20%	1%	7%	63
Meander (RM 16)								
	NE¼, NW¼, Sec 36, T6S R10E	.67:1	1%	4%	90%	5%		
Beaver/Wilson								
	SW¼, NE¼, Sec 33, T5S R9E	.67:1	18%	58%	20%	2%	2%	77

Site	Legal Descriptions	Pool:Riffle Ratio	Boulder	Cobble	Gravel	Sand	Mud	Bank Stability
Mill Creek								
Potter's Pond (RM 5.5)								
	NE¼, SE¼, Sec 19, T8S R10E	.43:1	30%	60%	10%			85
Strawberry Falls (RM 7.5)								
	SW¼, NE¼, Sec 14, T7S R10E	.53:1	80%	4%	4%		12%	67
B-241 X-ing (RM 16.5)								
	SW¼, NW¼, Sec 6, T8S R10E	.42:1	2%	18%	80%			79
Badger Creek								
Badger Creek (RM 6.5)								
	NW¼, NE¼, Sec 28, T7S R9E	1.9:1	1%	10%	70%	5%	14%	66
	Average		22%	40%	30%	5%	4%	
	Range		0-80	4-80	2-90	0-30	0-25	

Table 2 Water quality measurements (monthly average) for stream monitoring sites on the Warm Springs Indian Reservation 1984 to 1985

Year	Month	Water-shed	Site	H20 Temp Celsius Range RANGE---,0 to 27	Dissolved Oxygen(ppm) Range 5 to 15 Mg/L	pH Range 6.5 to 8.5	Conductive Micromhos Range 20 to 200 Mh	Turbidi NTU Range 1 to 10
1984	Aug	Badg	Badger	8.4			40.0	2.00
1984	Nov	Badg	Badger	0.5	11.6	7.53	60.0	4.20
1984	Dec	Badg	Badger	0.3	13.6	7.92	60.0	2.20
1985	Jan	Badg	Badger	1.2	12.3		42.0	2.90
1985	Mar	Badg	Badger	6.0	11.9	8.12	55.0	4.70
1985	June	Badg	Badger	16.5	10.1		55.0	3.20
1984	Aug	Beav	Below D.P	15.0	10.4		78.0	
1985	Jan	Beav	Below D.P	0.0	12.8	8.13	62.0	0.58
1985	Feb	Beav	Below D.P	2.2	14.0	6.99	80.0	6.20
1985	Aug	Beav	Below D.P	21.5	9.5		29.5	
1984	Aug	Beav	Dahl Pine	12.6	11.5	7.69	60.0	2.10
1984	Nov	Beav	Dahl Pine	4.4		8.04	60.0	
1984	Dec	Beav	Dahl Pine				79.0	
1985	Dec	Beav	Dahl Pine	4.1	13.4	6.90	74.0	
1985	Feb	Beav	Dahl Pine		13.8	6.99	80.0	
1985	Aug	Beav	Dahl Pine	11.5	10.6	7.90	84.5	3.10
1984	Aug	Beav	Lower	16.5	11.4	7.07	74.5	2.70
1985	April	Beav	Lower	10.0	11.7	7.80	58.0	11.00
1985	July	Beav	Lower	16.0	11.7	8.17		1.50
1985	Feb	Beav	Meander	2.2	14.0	6.98		6.20
1985	March	Beav	Meander	5.0	12.7		54.0	3.10
1985	Aug	Beav	Meander	21.5	9.8		85.0	
1984	Aug	Beav	Quartz	19.2	7.4	8.20	72.0	3.30
1984	Nov	Beav	Quartz	6.2	16.0	8.20	90.0	2.60
1984	Dee	Beav	Quartz	3.7		8.15	80.0	3.50
1985	Jan	Beav	Quartz	3.0	12.5	8.10		
1985	Feb	Beav	Quartz	1.0	12.6	6.75	90.0	
1985	Mar	Beav	Quartz	11.5	13.0	7.90	65.5	5.10
1985	July	Beav	Quartz	17.0	9.4			4.50
1985	Aug	Beav	Quartz	10.9	12.0		80.0	2.50
1984	Aug	Beav	Simnasho	17.9	12.4	7.07	75.0	2.70
1984	Dee	Beav	Simnasho	3.9	13.3	7.99	67.0	4.70
1985	Feb	Beav	Simnasho	2.0	13.2	6.80	80.0	4.40
1985	June	Beav	Simnasho	18.0	10.5	8.20	70.0	2.20
1985	Aug	Beav	Simnasho	11.0	10.0			
1984	Nov	Beav	Wilson	2.8	10.4		50.0	
1984	Dee	Beav	Wilson	2.9		7.40	78.0	3.20
1985	Jan	Beav	Wilson	6.0	13.5		60.0	
1985	Feb	Beav	Wilson	1.7	12.2	6.87	80.0	
1985	July	Beav	Wilson	11.1		7.74		0.60
1985	Aug	Beav	Wilson	11.0	9.5		55.0	

 Water Qualities

Year	Month	Water-shed	**Site**	HZ0 Temp Celsius	Dissolved Oxygen(ppm)	pH	Conductiv Micromhos	Turbid NTU
1084	Aug	Mill	B-241	11.6			**35.0**	0.20
1985	July	Mill	B-241	17.4	12.0	8.20		2.10
1985	Aug	Mill	B-241	9.5	11.4		60.0	
1984	July	Mill	Potters	15.0	10.9	7.34	**55.0**	**2.5**
1984	Dec	Mill	Potters	4.1	14.6	7.75	**73.0**	**4.5**
1985	Feb	Mill	Potters	1.0	13.2	6.74	**53.0**	**1.7**
1985	June	Mill	Potters	17.0	10.0	7.63	**45.0**	**2.1**
1985	July	Mill	Potters	17.0	9.9	7.97	**75.0**	
1984	July	Mill	Strawberry		8.6	7.40	56.0	**3.3**
1985	Feb	Mill	Strawberry	0.0	12.2	7.10	39.0	**5.0**
1984	Aug	Shi	Headworks	16.5		7.23	24.0	**1.4**
1985	Jan	Shi	Headworks	2.0	12.5	7.77	45.0	**1.5**
1985	Fob	Shi	Headworks	4.5	12.5	7.58	61.5	**3.9**
1985	July	Shi	Headworks	14.0	9.8		45.0	**1.2**
1985	Aug	Shi	Headworks	12.0	10.4		49.0	
1984	July	Shi	Peters	10.0	10.1			
1984	Aug	Shi	Peters		10.2	7.90	28.0	0.61
1985	July	Shi	Peters	11.0	12.0	7.33		1.71
1985	Aug	Shi	Peters	7.2	11.2		**35.0**	
1984	Nov	Shi	Thompson	3.6	11.7	7.86	65.0	4.5,
1985	Jan	Shi	Thompson	1.0	11.9	7.30	64.0	6.1
1985	Feb	Shi	Thompson	2.0	12.1	7.10	61.0	1.5
1985	Aug	Shi	Thompson	10.4	10.8		45.0	
1985	Dee	Shi	Thompson	4.0	13.2	6.22	55.0	6.9
1984	Aug	Shi	U.S.26	15.8	10.8		18.0	
1984	Nov	Shi	U.S.26	4.0	12.5	8.02	60.0	
1984	Dot	Shi	U.S.26	0.4	14.3	7.80	24.0	
1985	Jan	Shi	U.S.26	is.0	13.0	7.53	39.0	6.8
1985	Feb	Shi	U.S.26	4.3	12.0	6.79	60.5	3.0
1985	June	Shi	U.S.26	17.5	9.8	8.14	41.0	
1985	July	Shi	U.S.26	14.0	9.7			
1984	Aug	Shi	UpperXing	11.1			39.0	1.5
1985	July	Shi	UpperXing				24.0	
1985	Aug	Shi	UpperXing	12.0	11.5		45.0	
1985	Jan	W.S.R.	G.Course	4.0	11.4	8.02	60.0	1.7
1985	Feb	W.S.R.	G.Course	7.0	12.0			
1985	Feb	W.S.R.	Hehe	9.0				2.4
1985	Jan	W.S.R.	McKinley	3.0	12.8	8.00	80.0	1.3
1985	Jan	W.S.R.	Mouth	8.0		6.96		41.0
1984	Aug	W.S.R.	S. Fork	14.0				
1985	Jan	W.S.R.	S. Fork	2.0	11.8	7.96	60.0	2.2
1985	April	W.S.R.	S. Fork	6.0	12.1	7.61	42.0	1.9
1985	June	W.S.R.	S. Fork	13.0	9.5	7.40	40.0	2.1
1984	Aug	W.S.R.	Schoolie	10.3			55.0	1.0
1985	Jan	W.S.R.	Schoolie	3.8	11.4	7.82	70.0	1.9
1985	Mar	W.S.R.	Schoolie	4.0	12.3		65.0	2.4
1985	July	W.S.R.	W-110	14.7	12.0	7.99		

Badg=Badger Creek Beav=Beaver CreekShi=Shitike Creek

Filename: **Qualfeb4**

Item Rated	Stability Indicator Classes							
UPPER BANKS	A		B		C		D	
Landform Slope	Bank slope gradient <30%.	(2)	Bank slope gradient 30-40%.	(4)	Bank slope gradient 40-60%.	(6)	Bank slope gradient 60%+.	(8)
Mass Wasting (Existing or Potential)	No evidence of past or potential for future mass wasting into channels.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	(12)
Debris Jam Potential (Floatable Objects)	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Bank Protection from Vegetation	90%+ plant density. Vigor and variety suggests a deep, dense root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
	COLUMN TOTALS →							

ZONE II SCORE =

LOWER BANKS								
Channel Capacity	ample for present plus some increases. Peak flows contained. W/D ratio < 7.	(1)	Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8-15.	(2)	Barely contains present peaks. Ocassional overbank floods. W/D ratio 15-25.	(3)	Inadequate. Overbank flows common. W/D ratio > 25.	(4)
Bank Rock Content	65%+ with large, angular boulders 12"+ numerous.	(2)	40-65%, mostly small boulders to cobbles 6-12".	(4)	20-40%, with most in the 3-6" diameter class.	(6)	< 20% rock fragments of gravel sizes, 1-3" or less.	(8)
Obstructions Flow Deflectors	Rocks, old logs firmly embedded. Flow pattern of pools & riffles stable without cutting or deposition.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(6)	Frequent obstructions and deflectors cause bank erosion yearlong.	(8)
Cutting	Little or none evident. Infrequent raw banks.	(4)	Some intermittently at outcurves and constrictions.	(8)	Significant. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts. Failure of overhangs frequent.	(16)
Deposition	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
BOTTOM								
Rock Angularity	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners and edges, surfaces smooth and flat.	(2)	Corners & edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surfaces smooth.	(4)
Consolidation of Particle Packing	Assorted sized tightly packed and/or overlapping.	(2)	Moderately packed with some overlapping.	(4)	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
Bottom Size Distribution & Precent Stable Materials	Stable materials 80-100%.	(4)	Stable materials 50-80%.	(8)	Stable materials 20-50%.	(12)	Stable materials < 20%.	(16)
Deposition /Scour	< 5% of the bottom affected by deposition. and Scouring	(6)	5-30% affected. Some deposition in pools. Scour at constrictions and where grade steepens	(12)	30-50% affected. Deposits at obstructions, constrictions, and bends. Some filling of pools.	(18)	> 50% of the bottom in a state of flux or change nearly yearlong.	(24)
Clinging Aquatic Vegetation (Moss & Algae)	Abundant. Growth largely moss like, dark green, perennial. In swift water too.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
	COLUMN TOTALS →							

EVALUATION SCORE: EXCELLENT (<38) GOOD (39-76) FAIR (77-114) POOR (>115)

ZONE I SCORE = ZONE I + ZONE II TOTAL =

Size Composition of Bottom Materials (Total to 100%)

Exposed bedrock..... ___% 5. Small rubble, 3-6"..... ___%

Large boulders, 3"+ Dia.... ___% 6. Coarse gravel, 1-3"..... ___%

U.S. Fish and Wildlife Service at the Warm Springs National Fish Hatchery. A total blockage of the Warn Springa River at the hatchery allows up&ream migrants to be enumerated.

All 1984 brood year spring chinook Juveniles at the Warn Springs National Fish Hatchery were fin-marked to allow differentiation of hatchery and wild chinook as out migrants at the scoop trap, and as returning adults.

Results

The results of field sampling during FY85 are tabulated in Appendix A. Where pertinent, these resulta have been combined with data from previous year8 for comparative purposes.

STREAM INVENTORY

The habitat characteristics and water quality trampling result8 are summarized in Tables 1 and 2.

The pool-to-riffle ratio showed substantial differencea between sampling sites. In 14 of the 20 sites there is leas pool habitat than riffle (Table 1). Some areas such as lower Shitike Creek <US 26 site) and the highway impacted areas of Beaver Creek (Dahl Pine Bridge site) contain negligible amounts of pool habitat. The other sampling sites have P:R rationo varying from 0.10:1 to 4.00:1.

A bank and channel atability rating bared on the criteria listed in Table 3 was assigned to each sampling cite in an attempt to identify

TABLE 4
STEELHEAD REDDS BY REACH FOR SHITIKE CREEK
1979 TO 1985

Stretch	1978	1979	1980	1981	1982	1983	1984	1985
Mouth-CommCntr		17	7	10	8	1	9	10
ConnCntHeadworkskds		43	21	25	43	8	13	17
Headworks-Bennet		18	5	5	1	4	13	7
Bennet-UpperXing		12	7	7	12	2	4	19
		90	40	47	64	15	39	53

TABLE 5
SPRING CHINOOK REDDS BY REACH FOR SHITIKE
1978 TO 1985

Stretch	1978	1979	1980	1981	1982	1983	1984	1985
Mouth-CommCntr	n.a.		1	0	0	1	3	2
CommCntHeadworks	3	2	13	6	16	8	2	13
Headworks-Bennet	2	1	0	0	n.a.	4	6	4
Bennet-UpperXing	n.a.		0	0	n.a.	2	10	3
	5	3	14	6	16	15	21	22

Table 6, Spring chinook redd counts by index area in the Warm Springs River system 1983-1985,

Warm Springs River System	1983	1984	1985
Beaver Creek:			
Robinson Park to Canyon	83	98	59
Old Bridge to Simnasho Bridge	7	0	5
Simnahso Bridge to Lower Beaver Creek	14	48	30
Mill Creek:			
B-241 road bridge area	3	16	17
Old Mill to Strawberry Falls		0	1
Strawberry Falls to Boulder Creek	27	14	15
Warm Springs River:			
Bunchgrass to Schoolie	112	93	123
Schoolie to Badger Creek	188	146	127
Hatchery to Culpus Bridge	5	14	21
TOTAL FOR WARM SPRINGS SYSTEM --	439	429	398
Adults arriving at W.S.N.F.H.	1878	1981	2202
Jacks arriving at W.S.N.F.H.	34	301	62
TOTAL	1912	2282	2264
Adults sent upstream	1251	1322	1264
Jacks sent upstream	34	164	56
TOTAL	1285	1486	1320
Redds in index areas above W.S.N.F.H.	434	415	377
Total fish per index area redd	3	3.6	3.5
Adult fish per index area redd	2.9	3.2	3.4

pointa of instability and erosion. The majority of alter fell within the moderately stable and moderately unstable categories. The only rite that rated as unstable was Lower Beaver Canyon, where erosive bank cutting has been occurring for several years.

Water quality sampling (Table 2) was completed at each sampling site as close to the time of fishery sampling as possible. Water quality parameters were generally within ranges acceptable for salmonid production. There are occasional high turbidity readings, and one site (USGS Beaver Creek) experienced high water temperatures (exceeding 18 degrees Celsius) during the summer months.

ANADROMOUS FISH PRODUCTION

Redd Counts

Spawning ground surveys for summer steelhead were conducted in index areas of Shitike Creek and Mill Creek in May 1985. The number of redds in Shitike Creek was 36% higher than in 1984 <Table 4). Steelhead redd counts conducted in Hill Creek were for the purposes of evaluating the Strawberry Falls bypass Channel <see below).

Index areas were surveyed for spring chinook redds in September in the Warn Springa River, its tributaries and Shitike Creek (Tables 5 & 6). The number of redds observed in Shitike Creek was similar to 1984, but the redds were more concentrated in the lower reaches of the creek.

The number of spring chinook redds in the index areas of the Warm

Table 7. SPRING CHINOOK ESCAPEMENT, REDD COUNTS AND OUT-MIGRATION ESTIMATES FOR WARM SPRINGS RIVER SYSTEM.
1975 TO 1985

BROOD YEAR	ADULTS TOTAL # RELEASED ABOVE WSNFH	TOTAL # REDDS ABOVE WSNFH	TOTAL # ADULTS PER REDD ABOVE WSNFH	TOTAL # REDDS IN WSR SYSTEM	DAYS IN SAMPLING	FALL # OUT-MIGRANTS	DAYS IN SAMPLING	SPRING # OUT-MIGRANTS	TOTAL # OUT-MIGRANTS
1975	N/A	N/A	N/A	808	n.a.	25795	58	43250	69045
1976	N/A	N/A	N/A	1066	212	47041	143	26043	73084
1977	1505	498	3	699	195	25125	64	25204	50329
1978	1808	768	2.4	796	198	74727	131	57216	131943
1979	906	357	2.5	359	182	24930	122	25628	50558
1980	651	109	6	112	193	20579	112	14656	35235
1981	1014	147	6.9	157	174	29238	94	14647	43885
1982	1587	421	3.8	433	79	70227	94	28915	99142
1983	1251	434	2.9	439	94	72929	101	28143	101072
1984	1322	415	3.2	429		N/A		N/A	N/A
1985	1264	377	3.4	398		N/A		N/A	N/A

Table 8 Summary of Humphrey Scoop Trap Swing 1984
March 28 to April 15

DATE From	To	Water Level	Water Temp	Total Chinook	Average Chk/Day	Average Length
Mar 28	Mar 30	2.44	46.67	76	25.33	94.02
April 2	April 5	2.25	49. cm	49	12.25	101.04
April 8	April 13	2.20	47.33	51	8.50	102.11
April 26	April 30	2.01	51.00	119	39.67	105.17
May 1	May 3	2.05	50.67	180	60. 00	110.75
May 5	May 11	2.02	51.40	218	36.33	113.11
May 14	May 17	2.20	51.75	207	51.75	113.56
May 21	May 25	2.16	52.75	170	42.50	109.76
May 29	April 1	2.22	58.25	126	31.50	97.97
April 4	April 8	2. 18	54. cm	32	6.40	104.56
April 11	April 15	1.95	57.00	44	8.80	100.27
	MIN	1.95	46.67	32.00	6.40	94. 02
	MAX	2. 44	58.25	218.00	60.00	113.96
	AVG	2.15	51.80	115.64	29.37	104. 79

Table 9. 1984 Fall

Warn Springs River Sept 17 to Dec 19 1984

Humphrey Scoop Trap Mouth of River

Weekly Average

From	To	Water Level	Water Temp	Total Chk	Chk Avg No./Day	Average Length
Sept 17	Sept 22	1.49	55.8	8	13	71.2
act 1	Ott s	1.48	49	106	21.2	92.2
Ott 8	Ott 12	1.58	51.2	S	1	4
Ott 22	Ott 26	1.54	42.4	415	83	95.3
Ott 28	Nov 2	1.64	41.8	439	73.2	85.1
Nov 4	Nov 9	2.12	40.2	754	12.7	90.1
Nov 15	Nov 21	1.83	40.6	325	54.2	95
Nov 24	Nov 30	1.98	40.4	119	17	96.9
Dec 1	Dee S	1.9	39	55	13.8	98.7
Dec 6	Dee 11	1.81	36.3	so	8.3	100.7
Dee 12	Dee 19	1.86	38.4	44	5.5	94.2
	MIN	1.48	36.3	S	1	4
	MAX	2.12	55.8	754	83	100.7
	AVG	1.748	43.191	210.909	27.536	83.945

Table 10. Sunnary of Humphrey Scoop Trap
Warm Springs River March 12 to June 21

DATE From	To	Water Level	Water Temp	Total Chinook	Average Chk/Day	Average Length
Mar 12	Mar 15	1.94	41.60	129	43.00	98.00
Mar 18	Mar 22	2.03	45.80	255	51.00	98.00
Mar 24	Mar 27	2.07	43.30	153	51.00	99.30
April 4	April 8	2.30	47.00	69	17.25	114.10
April 19	April 26	2.25	48.10	362	51.71	103.10
April 29	May 2	2.06	54.00	120	40.00	114.68
May 6	May 10	2.08	SO.30	65	16.30	116.84
May 11	May 17	2.01	53.90	187	23.70	115.70
May 20	May 24	2.15	58.60	93	18.60	114.58
May 26	May 31	2.08	54.30	38	7.60	112.46
June 2	June 7	2.00	57.30	15	3.00	112.79
June 8	June 14	2.06	52.6	67	9.57	84.39
June 17	June 21	1.67	64.2	3	0.6	87.3
	MIN	1.67	41.60	3.00	0.60	84.39
	MAX	2.30	64.20	362.00	51.71	116.84
	AVG	2.05	51.62	119.69	25.64	105.48

Table 11. The percentage of out-migrating chinook juvenilea in the Humphrey scoop trap at the mouth of the Warn Springs River. by sampling period 1976 to 1985.

Trap Efficiency

YEAR	SPRING	FALL
1979		15.8
1980	11.1	22.3
1981	16.8	18.3
1982	9	12.6
1983	15	11.1
1984	7.7	5.5
1985	9.1	

Table 12. Number of redds. eggs deposited, total out-migrants and percent survival from egg to out-migrant by brood year for the Warm Springs River system, 1975 to 1983.

Brood Year	Number of Redds	Number of eggs deposited (x1000)	Total-out migrants	X Survival egg-to-out-migranta
1975	808	2798	69045	2.5
1976	1066	3692	73084	2
1977	699	2421	50329	2.1
1978	796	2675	131943	4.9
1979	359	1243	50558	4.1
1980	112	388	35235	9.1
1981	157	534	43885	8.2
1982	433	1499	99142	6.6
1983	439	1520	101072	6.6

Springs system was approximately 10% lower in 1985 than in the two previous years. Escapement above the Warn Springs National Fish Hatchery was intermediate compared to 1983 and 1984.

Data from the Humphrey scoop trap is summarized in Tables 7, 8 and 9. Sampling of the 1983 brood year out migrants was completed with the spring sampling. The total out-migrant estimate for the brood year was estimated at 101,072; 72,929 and 28,143 in the fall and spring, respectively. The 1983 brood year estimated out-migration is approximately 24% higher than the 1982 brood year when the number of redds in the index areas was similar.

The efficiency of the scoop trap was 5.5% and 9.1% during fall and springs sampling periods, respectively. While the efficiency of both sampling periods was low, it is within the range of pad sampling (Table 10).

Site Specific Juvenile Production

The results of fisheries sampling at the 20 monitoring sites are summarized in Table 11, 12 and 13 (Appendix A) Sculpin (*Cottus ID.*) were the most abundant fish in reservation stream. Rainbow trout were second most abundant. The density and biomass estimates for spring chinook were highly variable from cite to cite and from one sampling period to the next. Density estimates ranged from 0 to 0.53 fish per square meter and biomass from 0 to 0.336 gram per square meter. Possible reasona for the variability are reviewed in the discussion section of this report. Five sites did not have chinook present during any time when the site was sampled. Those rites are Badger Creek, B-241

on Hill Creek, the South Fork and Golf Course sites of the Warn Springa River and Peter's Pasture on Shitike Creek.

Rainbow/steelhead trout was the most abundant salmonid during sampling timer at moat miter. Densities ranged from 0 to 0.775 fish/square meter and biomass from 0 to 3.17 g/square meter.

Strawberry Falls Bypass Evaluation

Strawberry Falls was a cataract formed by bedrock at approximately RM 7 of Mill Creek. Upstream parsage of summer steelhead was impeded and pareage of spring chinook adults was completely blocked. In 1984 a byparr channel opening an additional 17 km of habitat war constructed under Phase III of this contract.

Evaluation of the Strawberry Falls bypass channel will be based on documented passage of summer steelhead and spring chinook adulta to the area above the Falls. In 1985 redd counts for both species were conducted and indicated fish are using the channel. In Hay, a steelhead carcam and two redds were located in the B-241 road bridge area, 12 km upstream of the bypass channel. The survey for spring chinook apawning revealed one redd and one live chinook above the channel.

Beaver Creek Rehabilitation and Enhancement Protect

Channelized reacher, comprising 6.02 km of Beaver Creek have been identified as aream where rehabilitation work in Phase III could produce substantial results. A proporal for the placement of instream

structures and fencing of a section of the riparian area was developed during 1985 (Appendix A).

Discussion

In 1983, overall Reservation project goala and objectives were outlined in a work statement prepared for BPA. A major element of the work statement was to determine the number of redds needed to produce the optimum number of smolts and returning adults in the Warm Springs River System. Excess eggs to pre-spawning adults from the Warm Springs National Fish Hatchery were to be used to supplement natural spawning to reach an equivalent total escapement representing 1000 redds. Discussion concerning alteration of the genetic integrity of the spring chinook stock led to several meetings involving the U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife and tribal personnel. The meetings resulted in a commitment and written agreement between the Confederated Tribes and U.S. Fish and Wildlife Service to protect the genetic integrity of the spring chinook stock. This agreement did not allow the scheduled work element to proceed, since hatchery supplementation of the system would require deliberate stocking of hatchery fish in areas of naturally producing "wild" stock. However, the agreement does allow hatchery supplementation in unutilized areas as agreed upon by the Tribe and U.S. Fish and Wildlife Service.

Recognizing a need to change program direction due to the Interagency agreement and a failure of the Binns Model, twenty sampling sites were established to obtain baseline habitat and production data of existing fish resources in the five study streams. Some sites were located in areas where habitat problems are thought to exist. Other sites were

located in areas of known salmonid fish production.

In general, potential problem rites held few fish. However, in some sites such as those in lower Beaver Creek (USGS/Quartz and Lower Site), significant numbers of spring chinook were sampled only during October, suggesting they were actively migrating fish.

HABITAT EVALUATION

The results of habitat sampling have shown an abundance of spawning habitat in reservation streams for summer steelhead and spring chinook as was indicated in the Phase I Report (CH2M-Hill,1982). That report puts the ambient gravel capacity of the Warm Springs River system at more than 10,500 and 7,700 redds for spring chinook and summer steelhead, respectively. For Shitike Creek, the report lists gravel resources sufficient to handle more than 863 summer steelhead redds and 768 spring chinook redds. Since the observed numbers of redds in the reservation streams have never approached this level and rarely exceed 10% of these numbers, spawning habitat is clearly not the limiting factor in reservation streams. Rearing habitat, particularly over wintering habitat, is the apparent limiting factor in anadromous salmonid production. Pool habitat, which is a critical component of rearing and over wintering habitat, is found in lesser quantities than riffle-type habitat in the streams. Pool habitat averages less than 40% of the area at the 20 sampling sites. It is commonly recognized by fisheries biologists that optimum juvenile rearing areas should approximate 50% pool to 50% riffle for steelhead and 60% pool to 40%

riffle for spring chinook.

The lack of pool habitat in many reaches of the streams stems from the small amount of large rock and woody debris found in the stream. While the amount of pool habitat associated with large rocka has remained relatively constant, pools formed in association with large woody debris have probably varied a good deal in the past. Until the institution of the "Streamside Management Plan" in 1982, logging practices allowed cutting of all merchantable timber within sale boundaries including trees in the riparian area. All woody material was removed from the stream as well. Recruitment of large wood structure to the stream was minimal while these practices were allowed. Recruitment of woody debris will continue to increase in the future, as those areas which were treated in the past, recover and contribute woody structure to the stream. A corresponding increase in pool habitat should result. In the interim, enhancement and rehabilitation projects emphasizing pool development would be desirable.

The bank and channel stability rating was initially applied during implementation of the "Streamside Management Plan" as a method to classify the riparian area tolerance to disturbance. The application of this bank and channel stability rating during the project was intended to identify areas in need of riparian area rehabilitation work or in danger of becoming unstable due to land use practices.

Lower Beaver Creek Canyon, the only site which was rated as unstable, was the site of bank stabilization efforts in 1984. The results of those efforts are just beginning to become apparent with vegetation

becoming established on previously eroding streambanks.

Other sites which rated relatively high in bank and channel instability were the two sites lowest on Shitike Creek. This area suffered extensive danage from the 1964 and 1972 floods. The lower Shitike Creek area is scheduled for a more thorough examination during FY86.

Water quality sampling conducted at each site did not reveal any major differences between sites or any major problems at any specific site. Summer water temperatures at some mites on Beaver Creek are indicative of the openess of the riparian zone vegetation. The riparian area vegetation should provide more shading of all reservation streams in the future as implementation of the "Streamside Management plan" begins to show affect.

HABITAT SUMMARY AND RECOMMENDATIONS

Habitat investigations should continue in the areas listed below:

Beaver Creek - High Sumner temperatures nay be limiting salmonid rearing in lower Beaver Creek. A thermograph placed in the creek during August and September revealed temperatures within tolerable levels for salmonid production. A thermograph should be placed at the same cite and

operated during July and August in 1986. Some reaches below the Simnasho Bridge, RM 7.3, might be enhanced by increased riparian vegetation. The areas listed as relatively unstable should alno be monitored closely. Upriver areas with poor pool to riffle ratios have been identified and habitat improvements will be made in FY 86 through implementation of the Beaver Creek Enhancement project.

Shitike Creek - Stream channel degradation caused by the 1964 flood and subsequent channelization projects may present problems to anadromous fish production. Riparian vegetation is lacking in some lower reaches, RM 10 to the mouth. Water temperatures taken during electrofishing activities did not exceed fish tolerance levels. A thermograph should be placed near the mouth during the months of July and August to obtain daily temperature information.

Badger Creek - Adult passage barrier(s) at the mouth during low flows may be limiting the production of this creek. Pool to riffle ratios and a spawning gravel assessment should be conducted in Badger Creek, A thermograph should be placed in the lower reacher of Badger Creek to determine daily temperature information during the mummer months.

Mill Creek - Adult passage may be impeded in the Potters Pond area, RM 6, due to stream braiding. This area should be evaluated for instream modification which would improve adult passage and Juvenile rearing. Riparian vegetation is lacking in the Potters Pond area and improvement may help stabilize the river channel. Mill Creek should be investigated for pool to riffle ratios from the mouth to RM 16.5.

Warn Springs River - Pool to riffle ratios should be calculated between RM 28.5 and RM 37.5. High temperatures have been reported from the Warm Springs Fish Hatchery in past years. A thermograph should be placed in the lower Warm Springs River, to determine summer temperature data.

FISH PRODUCTION EVALUATION

The summer steelhead spawning ground surveys conducted in Shitike Creek showed both an increase in the number of redds and a distribution of redds more heavily weighted to upstream reaches. This distribution is the apparent result of the removal of the Headworks Dam by the Tribes in 1983. Increased production should continue in the future an more area is now available for spawning and juvenile rearing.

Spawning ground surveys conducted in September for spring chinook, showed the distribution of redds in Shitike Creek to be lower in the system than 1984. The low water flow conditions which prevailed during late summer and fall probably limited upstream migration of adult chinook. This may have occurred in the Warm Springs River system to some extent, as 21 redds we counted below the Warm Springs National Fish Hatchery, compared with 5 in 1983 and 14 in 1984.

The Humphrey scoop trap data collected during FY1985 provided some interesting comparisons to previous years. The total out-migrant estimate is the second largest since the trapping operation began with

the 1975 brood year. This also represents the third consecutive brood year to increase in out-migrant numbers. Also, the survival of Juveniles from egg-to-out-migrant was the second highest since 1975. The survival from egg-to-out-migrant may provide some insight into the production capabilities of the system through a direct correlation of redds constructed, eggs deposited and resulting number of out migrants tabulated at the trap (Table 12).

Analysis using a model developed by Oregon Department of Fish and Wildlife (1979) shows an inverse linear relation&hip exists between the number of redds and survival from egg-to-out-migrant (Fig. 2). While an inverse type of relationship is expected because of increased intra-specific competition, pant environrental conditions have probably magnified the decrease in survival at higher redd numbers. Also, the linear nature of the relationship in probably the effect of limited data points.

The two major events which affected spring chinook production in the river system between 1975 and 1981 were, the severe drought in 1977 and an epizootic of bacterial kidney disease in 1980 and 1981. The extent to which there events affected each brood year is unknown. The lowest survival rates of Juveniles were in 1976 (2.1%) and 1977 (2.2%), the two brood years definitely affected by the drought conditions. The 1977 brood year wan particularly impacted, as 201 redds occurred below the Warm Springs National Fish Hatchery. Thin area, approximately 11 km, usually contains less than 15 redds.

The effect of the BKD outbreak was documented in pre-spawning adult

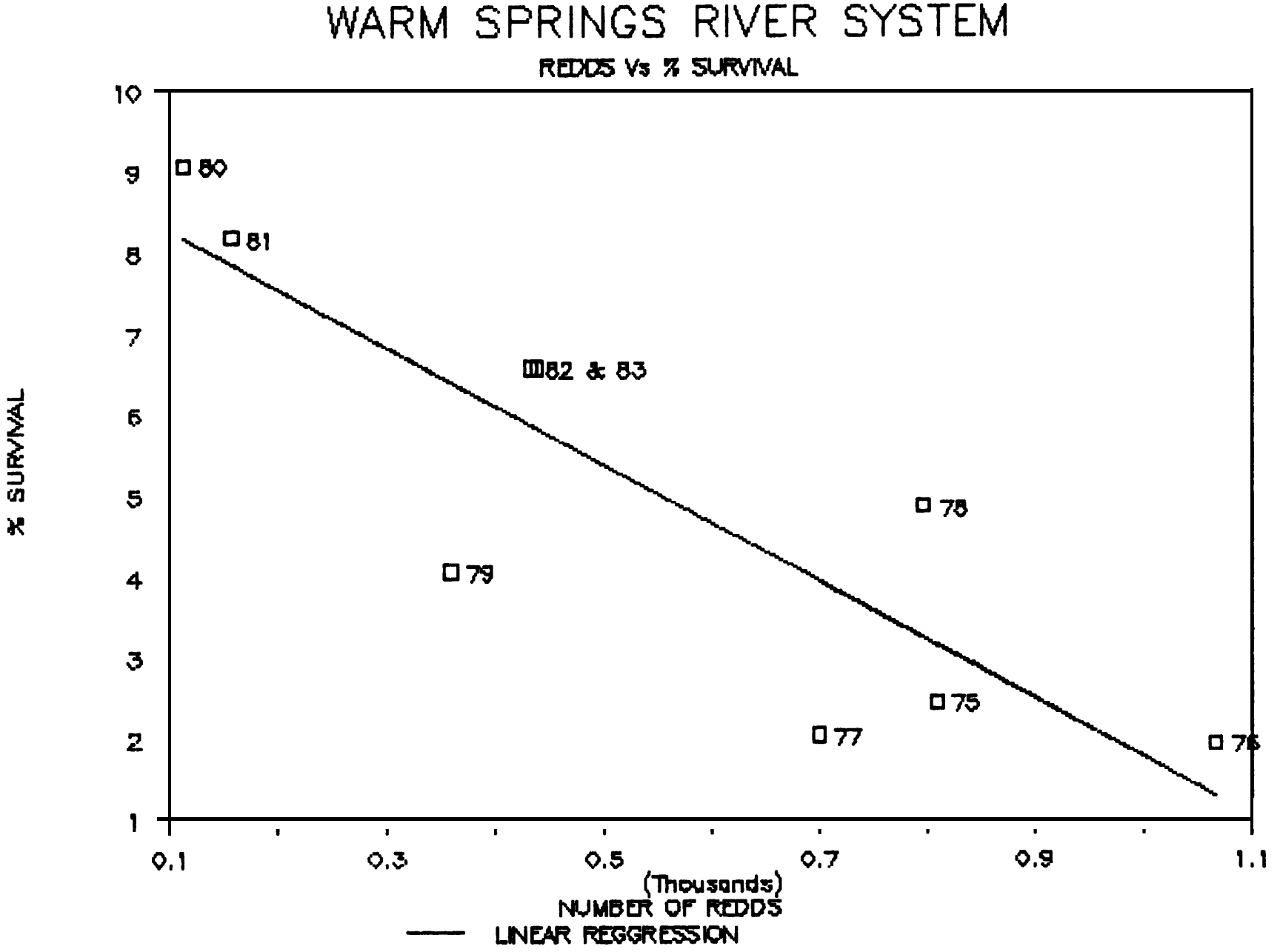


Figure 2. Relationship between the number of redds and % survival to out-migrant in the Warm Springs River system. 1975-1983.

mortalities at the Warn Springs National Fish Hatchery. In the wild population the adult to redd ratio was more than double the average of other years. It is felt that BKD severely impacted the wild fish also, since the percent loss of wild adults was conparable to the adult loss at the Warm Springs National Fish Hatchery.

The out-migrant trapping operation should continue as scheduled. There appears to be a close correlation between juvenile spring chinook out-migration, especially spring outmigrants and returning adults (Figure 3). Out-migrant information will provide a more reliable data base and will be used in combination with adult returns to develop a complete model of system production capabilities. The outmigrant trap may also provide an important tool for measuring habitat improvement projects in the Warm Springs River system, since an increase in out migrants should result from habitat modification.

Beginning with brood year 1982, all juvenile chinook reared and released from the Warm Springs National Fish Hatchery were fin-marked under Phase II of this program. The purpose of this marking program was to allow for identification of hatchery and naturally-produced chinook juveniles at the out-migrant trap, and as returning adults at the Warm Springs National Fish Hatchery. Hatchery adults will also be identifiable in the in-river creel sampling conducted at Sherar's, Falls on the Deschutes River (RM 44). In 1985, 3-year old fish were separable and in 1986, the majority of the run will be distinguishable as to the fish's origin. Combining the adult return information with out-migrant information should allow for development of escapement and production goals.

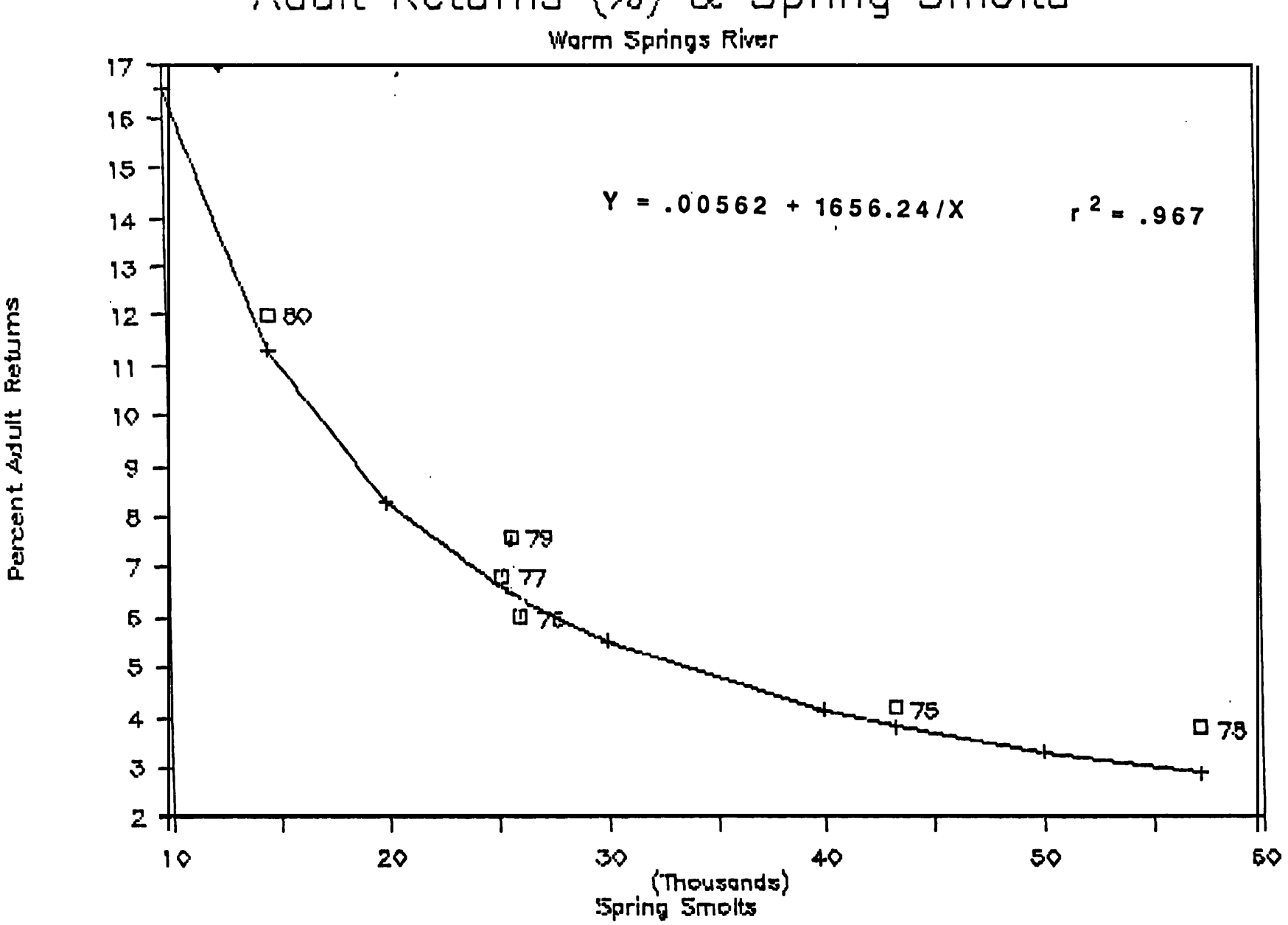


Figure 3. Warm Springs River. Per cent adult returns and spring smolts passing the Migrant Trap on the Warm Springs River. The dates are brood years. (Source: B. Cates 1986 United States Fish and Wildlife Service, Unpublished)

Fish population and biomass sampling conducted during FY85 had variable results. The potential sources of bias in this study were:

1. Some sample sites were located on the fringe, or beyond, known production areas.
2. In some areas we were unable to capture enough fish to make a statistically valid population estimate.
3. The catchability of juvenile fish is different depending on their size and behavior.
4. Population and biomass estimates say be deceiving in late fall as a result of migration.

It is recommended that future sampling be conducted just prior to the expected migration period, typically the month of October.

The utility of the electrofishing and monitoring rite formation may be highest when considering rite specific concerna or projects. An example of this is the Beaver Creek area where pretreatment data was a by-product of the monitoring site work.

Population sampling should be limited to there established sites. numberr 2,4,6,8,9,10,11,14,16,18,19 (see Figure 1.1. where future habitat improvement projects may be warranted. Sampling of other sites will be discontinued. Future population sampling will include a change from the two-pass method to the multiple pare method of Zippen (1958).

This change is necessary to reduce error in the estimates.

The low rearing densities in most areas may indicate a heavy reliance on the mainsten of the Warm Springs River for rearing and over wintering. However, this area, especially the lower reaches, is very difficult to sample with the gear on hand. Future sampling of the mainstem will have to be modified if densities and biomass estimates, are to be made of this area. A migrant trap located in a tributary may be a more practical way of determining out-migration and juvenile rearing contribution of the mainstem. Tributary out migrants could be marked and tabulated when sampled again at the scoop trap near the mouth of the Warm Springs River. Expansion of tributary out-migration and mainstem rearing would be calculated using the mark and recapture method currently utilized at the lower mainstem trap. This procedure would also be useful in evaluating tributary habitat projects as juvenile fish over wintering would be expected to increase.

Strawberry Falls Passage

The results of redd counts conducted above Strawberry Falls in 1985 indicate the bypass channel is providing fish passage successfully. The redd production above the falls was limited, but increases should occur in the near future. Adult out-plants of spring chinook began in an area approximately 10 km above the falls in 1982. The first returns from this program were expected in 1985, but the bulk of the production should begin to return in 1986 as 4-year olds. Steelhead production from the area above the falls should increase, but at a such slower rate, as there is currently

no supplementation of that run.

Evaluation of this project should continue for one more year to ascertain that passage is occurring and is not impeded.

The channel itself has maintained it8 integrity with only minor scouring c loose sediments and gravel& A gravel bar has formed at the downstream e1 of the channel and across the former channel. No modification of the bypass channel is recommended at this time.

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APPENDIX A

SPECIES COMPOSITION
BIOMASS
REDD DATA
HUMPHREY SCOOP TRAP DATA

Table 13. Fish species composition (%) at sampling sites on the Warm Springs Indian Reservation, 1983 to 1985

Date	Watershed	Site	Chk	Rbt	Sculpin	Dace	PER CENT E Brook Trout	Suckers	Dolly Varden	Redside Shiner	White Fish
850724	W.S.R.	Golf Course		19.05	66.67	14.29					
841023	W.S.R.	Arthur Place									
850814	W.S.R.	Arthur Place		7.41	81.48	11.11					
850314	W.S.R.	W-110		33.33	66.67						
850722	W.S.R.	W-110	4.55	18.18	63.64	13.64					
850313	W.S.R.	Schoolie		3.85	96.15						
840822	W.S.R.	South Fork		11.76	51.96		36.27				
850616	W.S.R.	South Fork		1.02	88.78		10.20				
850620	W.S.R.	South Fork		4.90	77.45		17.65				
850717	W.S.R.	South Fork			51.28		48.72				
830823	Beaver	Lower Site		100.00							
840412	Beaver	Lower Site	23.08	30.77	30.77	15.38					
841004	Beaver	Lower Site	15.38	5.13	41.03	38.46					
850617	Beaver	Lower Site	21.43		78.57						
850709	Beaver	Lower Site		27.12	42.37	1.69		13.56		15.25	
841002	Beaver	Quartz	29.23	10.77	4.62	4.62		50.77			
850710	Beaver	Quartz		17.14	71.43					11.43	
850722	Beaver	Quartz		20.59	73.53	5.88					
850801	Beaver	Quartz		4.55	11.36	84.09					
850816	Beaver	Quartz		13.79	75.86	10.34					
830822	Beaver	Simnasho	70.21	29.79							
841002	Beaver	Simnasho	27.87	21.31	21.31	19.67					9.84
850718	Beaver	Simnasho	11.11	22.22	66.67						
841023	Beaver	Below D.P.	24.72	24.72	40.45	10.11					
850128	Beaver	Below D.P.	34.29	22.86	42.86						
850725	Beaver	Below D.P.	16.67	16.67	61.11			5.56			
850614	Beaver	Below D.P.	17.78	11.11	62.22	8.89					
840820	Beaver	Dahl Pine	5.93	21.48	72.59						
850122	Beaver	Dahl Pine	8.82	8.82	82.35						
850123	Beaver	Dahl Pine	23.08		76.92						
850306	Beaver	Dahl Pine	5.56	5.56	88.89						
850607	Beaver	Dahl Pine	6.67	42.22	48.89	2.22					
850717	Beaver	Dahl Pine	8.16	7.14	80.61	4.08					
850729	Beaver	Dahl Pine		29.17	66.67			4.17			
850801	Beaver	Dahl Pine	3.85	30.77	65.38						
850815	Beaver	Dahl Pine		4.35	95.65						
830727	Beaver	Meander	45.45	54.55							
850514	Beaver	Meander	16.07	3.57	76.79	3.57					
850716	Beaver	Meander	7.14		92.86						
850815	Beaver	Meander	4.76		90.48	4.76					
830823	Beaver	Impact	1.79	98.21							
830824	Beaver	Non-impact	8.70	91.30							
850125	Beaver	Wilson		11.76	88.24						
850618	Beaver	Wilson		8.51	91.49						
850731	Beaver	Wilson		43.59	56.41						
850808	Beaver	Wilson	4.35	43.48	52.17						
830902	Mill	Canyon	15.05	84.95							
841017	Badger	Badger		25.86	72.41	1.72					
850220	Badger	Badger		7.89	92.11						
850621	Badger	Badger		3.39	91.53	3.39		1.69			
850718	Badger	Badger		17.65	82.35						
850206	Badger	Badger		20.00	66.67			13.33			

Page 2. Species Composition

Date	Watershed	Site	Chk	Rbt	Sculpin	Dace	E Brook Trout	Suckers	Dolly Varden	Redside Shiner	White Fish
830829	Mill	Below Potter	30.59	69.41							
830825	Mill	Potters	23.33	76.67							
850215	Mill	Potters		41.67	58.33						
850306	Mill	Potters	2.17	47.83	45.65	4.35					
850715	Mill	Potters	4.55	10.23	65.91	12.50		6.82			
850731	Mill	Potters		10.71	67.86	14.29		7.14			
850823	Mill	Potters	5.48	45.21	46.58	2.74					
830830	Mill	Above Potter	32.10	67.90							
850715	Mill	Strawberry	4.94	2.47	85.19	6.17		1.23			
850822	Mill	Strawberry		29.41	70.59						
830901	Mill	Old Mill	17.78	82.22							
830901	Mill	B-241	15.79	47.37			36.84				
850723	Mill	B-241		10.94	78.13		4.69		6.25		
850724	Mill	B-241		23.53	58.82	5.88	11.76				
850821	Mill	B-241		16.67	66.67		16.67				
840821	Shitike	U.S.26		61.71	25.65	12.64					
850305	Shitike	U.S.26		23.71	67.01	9.28					
850625	Shitike	U.S.26		37.50	44.85	17.65					
830908	Shitike	W.S.Cornunit	5.76	94.24							
830906	Shitike	Thompson	6.75	93.25							
850226	Shitike	Thompson	4.00	45.00	50.00						
850814	Shitike	Thompson		27.59	58.62	13.79					
840822	Shitike	Headworks	2.73	27.27	62.73	7.27					
850708	Shitike	Headworks	0.83	8.26	79.34	8.26		3.31			
830907	Shitike	Upper Xing	11.46	88.54							
841016	Shitike	Upper Xing	14.86	74.32	9.46				1.35		
850719	Shitike	Upper Xing	8.33	31.94	59.72						
850819	Shitike	Upper Xing	11.48	57.38	27.87				3.26		
830907	Shitike	Peters Pasture		85.35			4.55		9.09		
850722	Shitike	Peters Pasture		10.00	73.33			6.67	10.00		
850820	Shitike	Peters Pasture		40.00	50.00				10.00		
SAMPLE SITES											
850805	Badger	Near mouth	29.41		70.59						
841005	W.S.R.	Golf Course									
841024	W.S.R.	Schoolie			100.00						
850624	Beaver	Simmasho									
850725	Beaver	Meander	26.67	13.33	60.00						
841022	W.S.R.	Schoolie									
841010	Beaver	Wilson									
841018	Mill	Potters									
841023	Mill	Strawberry									
841016	Mill	B-241									
841003	Shitike	Peters Pasture									

Table 14. Spring chinook population and biomass estimates for twenty sampling sites on the Warm Springs Indian Reservation.

1984 to 1985

Stream	Site	Date Sampled	N	SE	N/m	Average Length mm	Average Weight grams	BIOMASS g/m	BIOMASS C.S.
BADGER CREEK									?
	BADGER	850320	0	0	0	0	0	0.000	0.000
	BADGER	850621	0	0	0	0	0	0.000	0.000
	BADGER	850718	0	0	0	0	0	0.000	0.000
	* BADGER	850805	2	0	0.005	70	4.3	0.022	0.022
	BADGER	850806	0	0	0	0	0	0.000	0.000
									ERR
	BEAV./WILSON	850125	0	0	0	0	0	0.000	0.000
	BEAV./WILSON	850730	0	0	0	0	0	0.000	0.000
	BEAV./WILSON	850806	1	0	0.004	53	1.5	0.006	0.006
	BEAV./WILSON	850618	0	0	0	0	0	0.000	0.000
	MEANDER	850123	4	3.4	0.005	83.7	4	0.020	0.022
	MEANDER	850614	25	60	0.034	45.1	0.9	0.030	0.030
	MEANDER	850716	1	0	0.001	70	4.3	0.004	0.006
	MEANDER	850725	4	0	0.005	61.8	1	0.005	0.005
	MEANDER	850826	1	0	0.001	64	3.3	0.003	0.004
	DAHL PINE	850122	4	3.5	0.002	60.3	2.5	0.005	0.022
	DAHL PINE	850306	1	0	0.002	75	4	0.008	0.009
	DAHL PINE	850607	2	0	0.004	53	1.5	0.006	0.006
	DAHL PINE	850717	13	10.6	0.027	53.1	1.5	0.040	0.042
	DAHL PINE	850729	0	0	0	0	0	0.000	0.000
	DAHL PINE	850801	1	0	0.002	53	1	0.002	0.002
	DAHL PINE	850826	0	0	0	0	0	0.000	0.000
	BELOW D.P	850128	12	6	0.019	74.8	5	0.095	0.097
	BELOW D.P	850725	3	0	0.005	66.7	3.3	0.017	0.016
	BELOW D.P	850814	16	31.8	0.026	70.2	3.9	0.102	0.101
	* OLD SIM. BR.	850624	2	0	0.003	75	5.1	0.153	0.016
	OLD SIM. BR.	850718	1	0	0.004	77	5.4	0.021	0.009
	USGS QUARTZ	850710	0	0	0	0	0	0.000	0.000
	USGS QUARTZ	850722	0	0	0	0	0	0.000	0.000
	USGS QUARTZ	850731	0	0	0	0	0	0.000	0.000
	USGS QUARTZ	850801	0	0	0	0	0	0.000	0.000
	USGS QUARTZ	850816	0	0	0	0	0	0.000	0.000
	LOWER SITE	850412	3	0	0.005	41.7	0.5	0.002	0.003
	LOWER SITE	850617	3	0	0.005	52	1.8	0.009	0.009
	LOWER SITE	850709	0	0	0	0	0	0.000	0.000

Biomass estimates

Stream	Site	Date Sampled	N	SE	N/m	Average Length mm	Average Weight grams	BIOMASS g/m
MILL CREEK								
	B-241	850723	0	0	0	0	0	0.000
	STR. FALLS	850715	9	21.4	0.021	75	4.3	0.091
	STR. FALLS	850822	0	0	0	0	0	0.000
	POTTERS POND	850215	0	0	0	0	0	0.000
	POTTERS POND	850306	1	0	0.002	80	5.9	0.011
	POTTERS POND	850715	0	0	0	0	0	0.000
	POTTERS POND	850731	0	0	0	0	0	0.000
	POTTERS POND	850823	4	3.5	0.008	71.3	4.1	0.033
RIVER	McK.AR.PL.	850814	0	0	0	0	0	0.000
	SOUTHFORK	850618	0	0	0	0	0	0.000
	SOUTHFORK	850620	0	0	0	0	0	0.000
	SOUTHFORK	850717	0	0	0	0	0	0.000
	SCH. CAMP	850313	0	0	0	0	0	0.000
	SCH. CAMP	850314	0	0	0	0	0	0.000
	SCH. CAMP	850722	1	0	0.001	68	3.9	0.004
	W-110	850314	0	0	0	0	0	0.000
	W-110	850722	1	0	0.001	68	3.9	0.004
	GOLF COURSE	850724	0	0	0	0	0	0.000
	PETERS PAS.	850723	0	0	0	0	0	0.000
	PETERS PAS.	850820	0	0	0	0	0	0.000
	UPPER X-ING	850719	4	3.5	0.005	58	4.9	0.024
	UPPER X-ING	850819	8	2.9	0.01	74.3	7.4	0.050
	HEADWORKS	850708	1	0	0.001	65	3.4	0.003
	HEADWORKS	850227	2	0	0.003	73.5	7.3	0.022
	THOMPSON BR.	850226	1	0	0.001	96	11.1	0.011
	THOMPSON BR.	850814	0	0	0	0	0	0.000
	US 26	850305	0	0	0	0	0	0.000
	US 26	850625	0	0	0	0	0	0.000

Table 15. Rainbow Trout Population and biomass estimates for twenty sampling sites on the Warm Springs Indian Reservation.

From 1984 to 1985

Stream	Site	Date Sampled	N	SE	N/m	Average Length mm	Average Weight g.	BIOMASS g/m
BADGER CREEK	BADGER	841017	64	216.9	0.164	94.0	11.6	1.907
	BADGER	850320	4	3.5	0.003	62.3	3.3	0.010
	BADGER	850621	2	0.0	0.005	30.5	0.1	0.001
	BADGER	850718	4	3.5	0.010	43.0	0.4	0.004
	BADGER	850805	0	0.0	0.000	0.0	0.0	0
	BADGER	850806	3	0.0	0.008	112.6	16.5	0.132
BEAVER CREEK	BEAV./WILSON	841010	0	0.0	0.000	0.0	0.0	0
	BEAV./WILSON	850125	2	0.0	0.008	45.3	0.4	0.003
	BEAV./WILSON	850618	4	0.0	0.017	97.0	12.4	0.211
	BEAV./WILSON	850730	17	0.0	0.072	51.0	0.3	0.020
	BEAV./WILSON	850806	10	0.0	0.042	57.9	2.1	0.088
	MEANDER	850123	0	0.0	0.000	0.0	0.0	0
	MEANDER	850614	2	0.0	0.003	45.1	0.5	0.002
	MEANDER	850716	0	0.0	0.000	0.0	0.0	0
	MEANDER	850725	2	0.0	0.003	46.0	0.6	0.002
	MEANDER	850826	0	0.0	0.000	0.0	0.0	0
	DAHL PINE	840820	85	124.5	0.180	62.9	3.4	0.615
	DAHL PINE	850122	4	3.5	0.002	60.3	2.7	0.005
	DAHL PINE	850306	1	0.0	0.002	51.0	0.3	0.001
	DAHL PINE	850607	25	5.9	0.053	53.0	0.8	0.043
	DAHL PINE	850717	8	4.9	0.017	63.4	3.5	0.060
	DAHL PINE	850729	16	31.7	0.035	42.1	0.4	0.014
	DAHL PINE	850801	8	0.0	0.017	48.1	0.7	0.012
	DAHL PINE	850826	2	0.0	0.004	46.5	0.6	0.002
	BELOW D.P	841023	23	1.7	0.037	62.3	3.3	0.121
	BELOW D.P	850128	9	2.1	0.015	75.3	6.7	0.100
	BELOW D.P	850725	3	0.0	0.005	45.0	0.5	0.003
	BELOW D.P	850814	9	13.4	0.015	71.6	5.7	0.086
	OLD SIM. BR.	841002	13	0.1	0.002	73.5	6.2	0.012
	OLD SIM. BR.	850624	0	0.0	0.000	0.0	0.0	0
	OLD SIM. BR.	850718	2	0.0	0.003	98.0	12.7	0.038
	USGS QUARTZ	841002	16	31.7	0.025	73.0	6.1	0.152
	USGS QUARTZ	850710	18	19.0	0.028	45.2	0.5	0.014
	USGS QUARTZ	850722	7	0.6	0.011	51.7	0.5	0.005
	USGS QUARTZ	850731	1	0.0	0.002	43.0	0.4	0.001
	USGS QUARTZ	850801	2	0.0	0.003	27.5	0.3	0.001
	USGS QUARTZ	850816	5	2.3	0.007	55.8	1.5	0.011
	LOWER SITE	840412	0	0.0	0.000	0.0	0.0	0
	LOWER SITE	841004	1	0.0	0.002	68.5	4.9	0.010
	LOWER SITE	850412	4	3.5	0.007	102.3	13.8	0.097
	LOWER SITE	850617	0	0.0	0.000	0.0	0.0	0
	LOWER SITE	850709	13	10.6	0.022	42.8	0.3	0.007

Rainbow Trout Biomass continued

Page 2 Stream	Site	Date Sampled	N	SE	N/m	Average Length mm	Average Weight g.	BIOMASS g/m
MILL CREEK	B-241	850821	4	3.5	0.009	95.0	11.9	0.107
	B-241	850723	16	31.7	0.035	70.3	5.4	0.188
	B-241	850724	4	0.0	0.009	40.8	0.1	0.001
	STR. FALLS	841023	0	0.0	0.000	0.0	0.0	0
	STR. FALLS	850715	1	0.0	0.002	58.0	2.1	0.004
	STR. FALLS	850822	11	2.0	0.025	44.7	0.9	0.023
	POTTERS POND	841018	0	0.0	0.000	0.0	0.0	0
	POTTERS POND	850215	5	1.0	0.010	48.8	3.9	0.039
	POTTERS POND	850306	33	14.6	0.063	85.8	9.5	0.596
	POTTERS POND	850715	25	60.0	0.048	55.0	1.3	0.064
	POTTERS POND	850731	3	0.0	0.005	55.7	1.5	0.008
	POTTERS POND	850823	44	10.2	0.085	59.0	2.4	0.203
WARM SPRINGS RIVER	McKArt.	841023	0	0	0.0	0.000	0.0	0
	McKart.	850814	1	0	0.001	61.50	3.0	0.003
	SOUTHFORK	840822	6	6.90	0.053	125.20	19.90	1.05
	SOUTHFORK	850618	1	0.00	0.003	58.00	2.10	0.006
	SOUTHFORK	850620	5	0.0	0.017	90.6	10.7	0.182
	SOUTHFORK	850717	0	0.0	0.000	0.0	0.0	0
	SCH. CAMP	841024	0	0.0	0.000	0.0	0.0	0
	SCH. CAMP	850313	1	0.0	0.001	227.0	46.7	0.047
	SCH. CAMP	850314	4	0.0	0.005	56.8	1.8	0.009
	SCH. CAMP	850722	0	0.0	0.000	0.0	0.0	0
	W-110	850314	4	0.0	0.006	56.7	1.8	0.011
	W-110	850722	5	1.5	0.007	53.8	1.0	0.007
	GOLF COURSE	840510	0	0.0	0.000	0.0	0.0	0
	GOLF COURSE	850724	4	0.0	0.004	45.3	0.5	0.002
SMITHE CREEK	PETERS PAS.	841003	0	0.0	0.000	0.0	0.0	0
	PETERS PAS.	850723	4	3.5	0.008	60.7	4.1	0.033
	PETERS PAS.	850820	16	31.7	0.031	63.1	4.9	0.152
	UPPER X-ING	841016	392	1337.4	0.467	58.9	4.2	1.961
	UPPER X-ING	850719	20	6.1	0.024	55.9	3.7	0.089
	UPPER X-ING	850819	55	24.9	0.065	57.9	3.9	0.254
	HEADWORKS	840822	65	52.1	0.093	69.8	6.0	0.558
	HEADWORKS	850708	11	1.4	0.015	92.4	7.1	0.107
	HEADWORKS	850227	10	0.0	0.014	57.8	5.4	0.076
	THOMPSON BR.	850226	26	4.5	0.032	61.0	3.9	0.125
	THOMPSON BR.	850814	13	10.6	0.013	60.6	4.4	0.057
	US 26	840821	377	172.0	0.540	51.3	3.2	1.728
	US 26	850305	45	30.0	0.064	58.0	3.5	0.224
	US 26	850625	61	6.4	0.087	35.9	1.8	0.157

Table 16. Summary of Humphrey Scooo Trap
Warm Springs River, March 28 - June 15, 1984

Date	H20 Level	Temp	Wild Chk	Hatchery	CRainbow	AllSpecie Total	Wild Chk Length
840328	2.48	48	35		3	38	93.34
840329	2.46	46	17		1	18	96.24
840330	2.37	46	24		0	29	92.5
840402	2.3	48	15		4	20	99.4
840403	2.24	50	12		3	16	101.08
840404	2.22	49	13		4	18	101
840405	2.22	49	9		0	10	102.66
840408	2.2	48	6		1	10	98.5
840409	2.14	46	5		2	7	102.6
840410	2.18	46	12		0	12	108.33
840411	2.2	48	17		2	21	109.06
840412	2.22	46			0	0	*
840413	2.24	50	11		1	12	106.63
840426	2.04	50	47	3	11	66	105.94
840427			42	9	13	65	99.44
840430	1.98	52	30	8	10	50	110.13
840501	2	50	43	4	5	58	108.63
840502	2.08	50	72	11	30	120	112.43
840503	2.08	52	65	11	36	115	111.18
840505	2.1	50	25	10	9	47	108.24
840507	2	50	45	8	14	74	113.24
840508	1.98	54	59	11	7	1	111.71
840509	2.02	52	24	7	3	34	112.88
840510	2	51	36	3	9	52	115.25
840511	2		29		9	43	117.31
840514	2.2	53	46	22	2	96	110.85
840515	2.22	50	45	5	24	78	115.04
840516	2.18	50	54	4	20	89	117.56
840517		54	62	10	7	79	112.37
840521	2.1	54	59	14	19	124	109.39
840523	2.18	52	38	3	56	112	114.71
840524	2.22	52	54	16	20	111	106.57
840525	2.14	53	19	10	20	66	108.37
840529	2.18	60	36	36	33	152	101.21
840530	2.2	61	47	0	15	64	89.7
840531	2.23	58	29	9	25	77	102.18
840601	2.25	54	14	1	14	42	98.79
840604	2.4	56	12	1	11	25	106.66
840605	2.12	56	3	1	6	21	98
840606	2.13	52	3	1	7	28	106
840607	2.16	52	4	0	4	10	108.75
840608	2.08	54	10		5	24	103.4
840611	1.96	56	8		8	27	103.38
840612	1.93	56	12		3	33	101.3
840613	1.96	56	11	1	1	39	100
840614	1.96	57	9		1	34	91.66
840615		60	4			23	105

Table 17. Summary of Humphrey Scoop Tran

Warm springs River, Sept. 17 to Dec. 19 1984

Date	Water Level	Water Level	Wild Chinook	Hatchery Chinook	RBT	ALL SPECIES	WildChino Length
840917	1.48	61	Put in			Put in	
840919	1.48	59	1			8	
840921	1.49	49	4		1	16	70
840922	1.52	48	3		1	11	66.7
841002	1.48	50	26		1	34	96
841003	1.48	50	30		3	44	90.6
841004	1.48	49	35			44	91.5
841005	1.46	50	15			22	90.6
841009	1.48	52	3		2	12	96.7
841010	1.48	51	0			5	
841011	1.48	51	2			7	90
841012	1.95	48	0			3	
841023	1.52	42	298	527		827	88
841024	1.52	39	117	665	14	802	102.6
841025	1.52	41	Mal	6	1	7	
841029	1.62	44	49	54	2	113	87.5
841030	1.58	43	53	63	5	129	90.2
841031	1.56	44	118	219	3	347	64.7
841101	1.52	38	118	136	1	261	85.5
841102	1.9	40	101	53	9	176	97.8
841105	2.3	40	70	47	19	149	87.4
841106	2.1	43	313	59	34	415	92.7
841107	2.05	40	281	24	19	335	95.3
841108	1.94	39	35	7	5	47	97.2
841109	1.96	41	55	10	11	83	98
841116	2.16	40	152	287	9	467	94
841117	2.1	40	37	24	5	77	78.1
841118	2.08	39	45	11	1	68	93.7
841119	2.01	39	39	13	2	59	92
841120	2.2	43	21	4	1	31	91
841121	2.2	42	31	15	0	58	94.9
841125	1.88	41	27	35	4	72	93.9
841126	1.82	41	16	56	2	76	93.8
841127	1.82	40	15	55	2	79	99.5
841128	2.06	40	4	20	3	30	93.5
841129	2.2		36	174	2	218	99.2
841130	2.1	40	21	194	1	217	101.4
841202		43	19	48	5	82	104.7
841203	1.9	37	17	271	8	308	99.3
841204	1.82	37	14	146	4	165	97
841205	1.76	39	5	57	3	66	93.8
841206	1.74	33	16	58	4	85	99.06
841207	1.74	34	15	26	1	44	98.4
841208	1.78	37	4	20	1	32	108
841209	1.78	39	5	12	2	27	100.2
841210	1.88	38	3	8	0	12	98.3
841211	1.92	37	7	4	0	17	100
841212	1.9	37	2	2	1	12	104
841213	1.88	40	4	3	0	14	94
841214	1.84	39	11	2	0	15	92.6
841215	1.9	41	4	0	0	6	95.3
841216	1.78	42	8	1	0	14	90.3
841217	1.84	36	4	0	0	6	89.3
841218	1.85	34	6	1	0	11	95.3
841219			5	0	0	6	92.4

Table 18. Data of Humphrey Scoop Trap Spring 1985
March 3 to June 21

Date	H2O Level	Temperature Celsius	Wild Chinook	Hatchery Chinook	RBT All Species Numbers	Chinook Total	Length mm.
850312	1.92		17	0	0	17	
850313	1.91		11	0	1	14	101.8
850314	1.90	8	82	0	0	82	97.4
850315	2.00	8	36	0	0	39	94.8
850318	1.98	8	26	0	1	27	97.58
850319	2.00	8	57	0	0	57	98.54
850320	2.00	9	55	0	1	57	98.31
850321	2.08	8	48	0	1	49	98.21
850322	2.08	6	69	0	3	72	97.36
850325	2.06	8	26	0	3	29	99.5
850326	2.06	5	63	0	3	66	98.86
850327	2.11	6	64	0	5	69	99.5
850405	2.19	7	18	0	0	18	116.11
850406	2.32	7	18	0	0	18	107.77
850407	2.33	8	9	0	4	13	121.66
850408	2.34	11	24	0	2	26	111
850420	2.42	11	27	1	11	39	87.26
850421	2.32	7	50	0	9	59	103.56
850422	2.28	8	123	0	36	159	96.98
850423	2.24	10	36	6	4	47	106.75
850424	2.22	9	26	12	5	43	107.65
850425	2.18	9	15	6	5	26	106.33
850426	2.12	9	85	1	17	104	113.15
850430	2.04	14	37	24	5	70	114.68
850502	2.06	13	83	65	0	155	53.55
850507	2.12		10	5	3	18	114.9
850508	2.09	9	28	6	11	49	116.96
850509	2.07	10	20	15	6	44	117.5
850510	2.07	12	7	5	7	21	7.12
850511	2.06	10	24	12	3	39	114.54
850512	2.07	11	16	8	6	31	114.06
850513	1.95	12	31	11	8	55	117.16
850514	1.95	10	8	12	2	26	120.75
850515	1.94	14	42	33	10	94	118.1
850516	1.95	14	7	10	4	21	115.86
850517	2.04	14	59	24	6	90	109.42
850520	2.14	15	28	48	12	88	112.89
850521	2.16	13	23	9	8	55	115.26
850522	2.16	16	14	8	3	38	117.7
850523	2.10	16.5	1	2	5	8	113
850524	2.18	14	27	30	5	96	114.03
850527	2.12		3	4	5	24	102.3
850528	2.06	15	8	5	0	30	108.88
850529	2.04	11	5	0	8	38	106.8
850530	2.03	11	14	6	5	29	112.14
850531	1.95	13	8	5	0	15	120.13
850603	1.95	11	1	6	1	9	130
850605	1.86	16	6	15	0	56	102.17
850606	1.92	15	0	2	0	5	
850607	2.25	14	8	1	21	33	103
850608	2.46	12	4	13	9	27	102.5
850609	2.38	12	4	13	6	25	101.8
850610	2.06	15	20	58	12	101	96.2
850611	1.96		7	29	1	50	93.14
850612	1.89	17	15	23	1	55	100.2
850613	1.85	19	17	65	3	122	97
850614	1.82	18	0	4	0	6	0
850617	1.74	16	0	1	0	8	0
850618	1.69	17	0	0	0	3	0
850619	1.68	20	3	0	0	9	87.3
850620	1.64	19	0	0	0	12	0

Major Expenditures Bonneville Power Administration

1985 BPA Expenditures of 1985 over $1,000.00

Peabody Ryan (thermographs)	1,070.00
Peabody Ryan (thermographs)	1,072.77
Total	2,142.77

APPENDIX B

BEAVER CREEK ENHANCEMENT PROJECT

FISH HABITAT REHABILITATION AND

ENHANCEMENT OF THE CHANNELIZED SECTIONS

OF BEAVER CREEK (WARM SPRINGS RIVER DRAINAGE)

Prepared by Cris Stainbrook 9/13/85
Cris E. Stainbrook, Fisheries Biologist

Lewis Pitt 9/17/85
Lewis Pitt, Jr., Fisheries Technician

INTRODUCTION

The Confederated Tribes of Warm Springs began a three-phase evaluation and fisheries enhancement program for reservation streams in 1981. Funding for this program and associated enhancement projects is through the Bonneville Power Administration (BPA). Phase I of this effort was a compilation of existing information on the anadromous fisheries resources and habitat. Phase I was completed by the contractor, CH2M-Hill, in January of 1982. In 1983, the Confederated Tribes contracted with BPA to carry out Phases II and III of the program. The purpose of Phase II was to determine the existing production potential of reservation streams, identify habitat problems that limit the production of anadromous fish and propose corrective enhancement measures which could be implemented in Phase III. The Phase II effort is on-going.

The third phase of the program began in 1984 when a bypass channel around Strawberry Falls was constructed. This proposal addresses another habitat problem and rehabilitation project identified in Phase II, the alteration of Beaver Creek during construction of U.S. Highway 26.

PROPOSED WORK SITE

Beaver Creek is a fourth order tributary to the Warm Springs River (Figure 1). Originating in the timbered areas (elevation 795m) on the east slope of the Cascade Mountains, Beaver Creek flows in a south-southeasterly course for approximately 40 km to its confluence with the Warm Springs River (RM 19). The creek drains approxmiately 288 km^2 in the northwest corner of the Warm Springs Indian Reservation and contributes up to 15% of the annual flow of the Warm Springs River. Beaver Creek is characterized by relatively stable streamflows. Low flows, at the USGS guaging station (RM 7), average approximately 1.1 m^3/s and annual high flows rarely

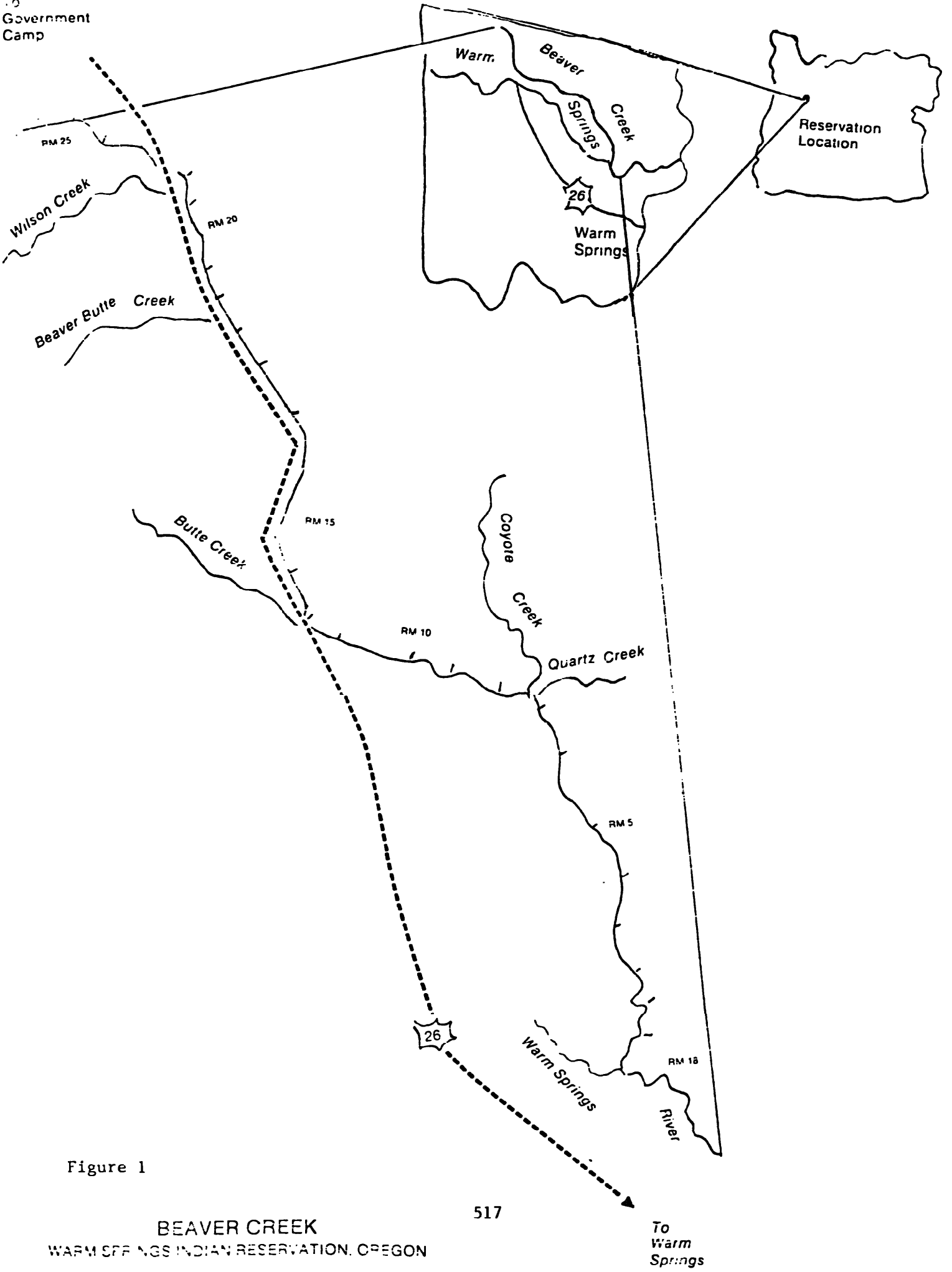


Figure 1

BEAVER CREEK
WARM SPRINGS INDIAN RESERVATION, OREGON

exceed 2.9 m^3/s. Water quality and temperature are considered good to excellent throughout most of the stream. High water temperatures during summer low flows, due to excessive solar exposure, may limit salmonid production in lower Beaver Creek between RM 1.3 and RM 3.0. Prior to major rehabilitation work by the Confederated Tribes, large amounts of sediment entered Beaver Creek from Coyote Creek (RM 7.6) and Quartz Creek (RM 7.4). The amount of sediment now entering Beaver Creek from these two tributaries is markedly reduced and further improvement is expected with time. Further water quality and quantity information is available in Appendix A.

Beaver Creek is an important spawning and rearing stream for two species of anadromous salmonids - spring chinook (Oncorhynchus tshawytscha) and summer steelhead (Salmo gairdneri). Virtually all of the remaining, naturally-produced, spring chinook stock in the Deschutes River system spawn and rear in reservation streams; Beaver Creek accounts for an average of 18X of that annual chinook production based on redd counts (Table 1). Spring chinook redd counts of Beaver Creek generally reflect a trend similar to that of the entire Warm Springs River system (Figure 2). Summer steelhead are known to use Beaver Creek, but historical information and data is very sketchy.

There is approximately 31 to 32 km of potential anadromous fish habitat in Beaver Creek, most of which is in fair to good condition. Several correctable habitat problems do exist in the Beaver Creek system. As mentioned above, water temperatures in a lower reach of the creek (RM 1.3-3.0) may limit salmonid production in that area at summer low flows. The excessive solar radiation the stream incurs is a result of a degraded riparian area. The riparian vegetation and stream channel were heavily impacted by the 1964 flood.

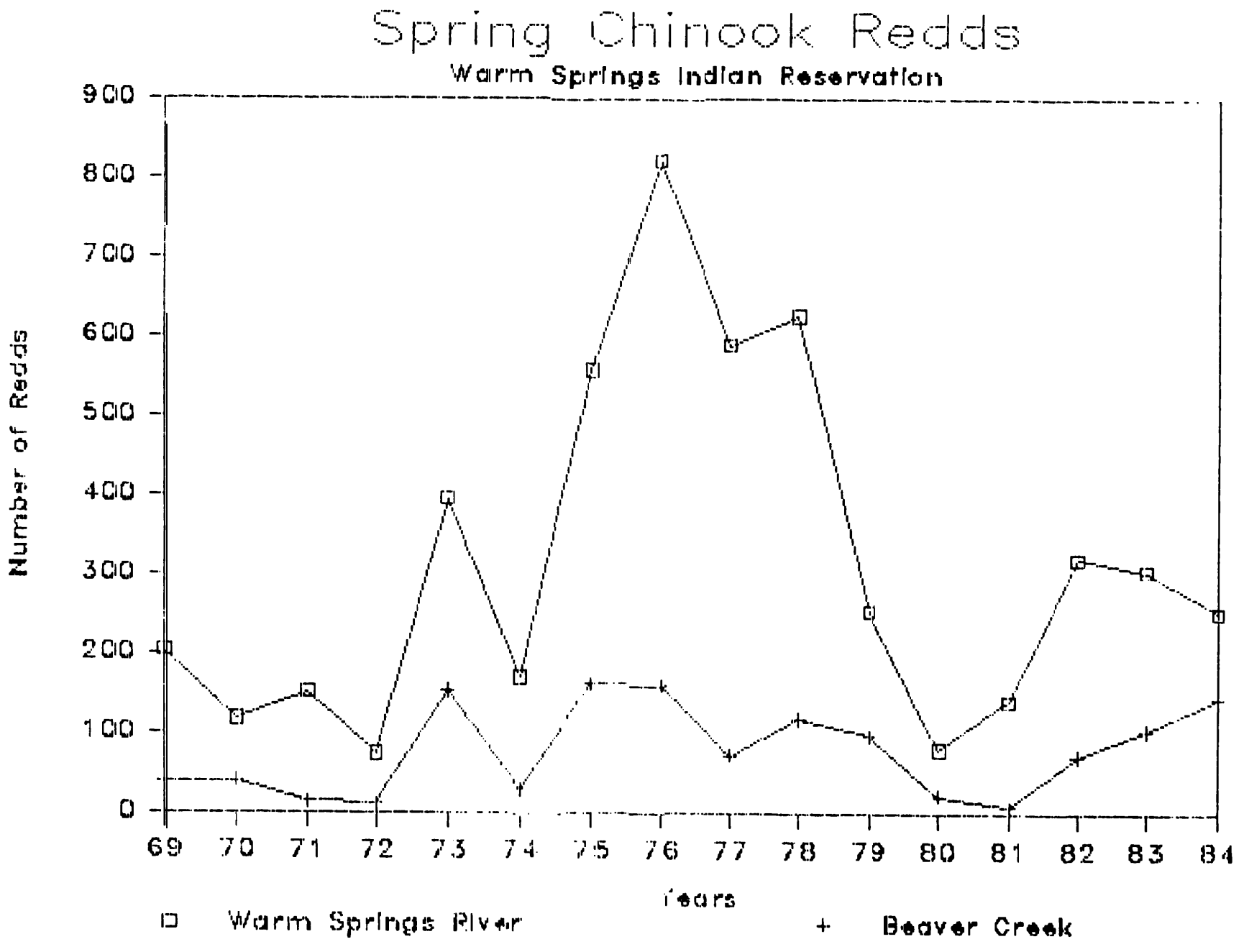
Although the stream channel has stabilized, the riparian vegetation has been

Table 1. Spring Chinook redd counts for streams on the Warm Springs Indian Reservation 1969-1984

Year	W.S. River	Beaver Creek	Mill Creek	Shitike	Totals
1969	205	39	20		264
1970	119	41	12		172
1971	152	15	6		173
1972	75	12	0		87
1573	396	154	34		584
1474	172	31	13		216
1975	560	162	86	0	808
1976	823	161	77	29	1090
1977	591	73	35	0	699
1478	628	119	49	5	801
1979	255	97	7	3	362
1980	81	22	6	14	123
1981	141	9	7	6	163
1982	321	72	25	16	434
1983	305	104	30	15	454
1984	253	146	30	21	450
Avg.	317	79	27	11	430
Min	75	9	0	0	87
Max	823	162	86	29	1090

Table 2. - Channelized reaches of Beaver Creek for rehabilitation.

Channelized Reach	River Milage	Total Kilometers	Gradient	Pool to Riffle ratio
A	12.0 to 14.0	3.33	1.16%	0:1
B	17.3 to 18.0	1.2	2.11%	.01:1
C	18.3 to 18.7	.66	1.65%	.2 :1
D	18.9 to 19.4	.83	1.2%	.06:1


Spring Chinook Redds
Warm Springs Indian Reservation
Number of Redds
900
800
700
600
500
400
300
200
100
0
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
Years
Warm Springs River
Beaver Creek

slow to recover due to heavy seasonal grazing of livestock in the area. The initial attempts at correcting this problem were made in 1984 when summer youth crews armored the eroding streambanks with cut juniper trees. The results of these efforts are not yet apparent. Further rehabilitative work, such as fencing, may be needed in the future.

Damage to the riparian area vegetation from livestock grazing is becoming a matter of concern in the upper watershed as well. The stream corridor from approximately RM 12 to RM 22 is fenced along the highway right-of-way, but is not fenced on the opposite side of the riparian zone. Cattle use in the area is high during late summer and early fall. Eroding banks are becoming more numerous and severe. The problem of livestock grazing and possible measures to rectify it will be discussed in greater detail under separate cover to be issued later.

The major habitat problem in Beaver Creek to be dealt with in this project will be the impact of the construction of U.S. Highway 26 (Hwy 26). In 1949, Hwy 26 was constructed through reservation lands. A portion of the highway parallels Beaver Creek and as a result, 14.5 km of the stream lie in close proximity to the road grade. The highway construction also involved channelization of about 5 km of of Beaver Creek between RM 12 and RM 22. The construction of the highway has changed this upper section of Beaver Creek from a meandering stream with considerable instream structure, to a stream which alternates between natural meandering and straight channels with little or no instream structure.

NEED FOR ACTION

The channelization of four stretches of Beaver Creek during the construction of Hwy 26 altered the stream in such a way that lower anadromous fish production has resulted. There are several factors which may be contributing to lower

production including lack of instream structure, lack of pool area, shallow water depths at low flow, and insufficient gravel depths for spawning.

The four channelized reaches are in a low gradient area of Beaver Creek, extending from RM 12 to RM 22 (Table 2). The streambanks adjacent to the highway have, for the most part, been rip-rapped where the existing substrate was insufficient to assure road bed stability. Despite the rip-rap and large rock content, banks on both sides of Beaver Creek are thickly lined with woody vegetation; alder species predominate, but some sections do have a conifer overstory (see accompanying photographs). The vegetative canopy does provide the stream with summertime shading and high water temperature is not a problem.

The streambed morphology which was altered during the channelization has not recovered to a "natural" state. In changing the streams course, a large bulldozer was used to scrape the new channel down to bedrock. In doing this, the large woody debris and rocks were removed leaving the reaches with little or no instream structure. Natural recruitment of structure into these stretches has been minimal as the photographs show. Structure, and the associated cover it provides juvenile fish, is an important factor in fish rearing habitat. The lack of structure also accounts for a lack of pool area which is a very important rearing habitat for l+ steelhead and yearling spring chinook.

Pools are formed in a stream by several methods. In streams like Beaver Creek, pool formation most commonly occurs from bedrock deformation or instream structures (logs, rocks, beaver dams, etc.). There are very few bedrock protrusions or depressions in the channelized reaches of Beaver Creek and as discussed above, no instream structures. The results are very low pool-to-riffle ratios in these areas (Table 2). Pool-to-riffle ratios in the non-channelized reaches of Beaver Creek are typically around 20 to 1.

Fisheries sampling has been conducted in channelized and non-channelized reaches of Beaver Creek since 1983. This sampling was expanded in 1984 and 1985 in anticipation of it being used as pre-treatment data. The results of that sampling show that the non-channelized reaches, where natural instream structures exist, have a higher biomass of juvenile salmonids than channelized reaches (Table 3). All areas are below what is considered the full-seeding rate for spring chinook (0.8 g/m^2) in similar streams on the Mt. Hood National Forest (David Heller, USFS, personal communication).

The morphology of the channelized streambed may be impeding adult spring chinook migration into the upper watershed as well. Channelization left the stream channel wide and relatively level (Figure 3). The flow is spread evenly accross the channel and during low flow, water depths are very shallow throughout the impacted reaches (Appendix B). As an example, Reach A in the Dahl Pine area is the longest channelized reach and also the lowest reach in the system. Water depths in Reach A average 160 mm during flows that approach low flow levels. It is generally considered that a minimum water depth of approximately 250 mm is needed for spring chinook passage. At water depths less than this, energy is expended in burst swimming speeds. Depending on water velocities, chinook may only be able to maintain full burst speed for 50 to 100 meters (Dr. John Orsborne, Washington State University, personal communication). The timing of low flow conditions in Beaver Creek corresponds with the upstream spawning migration of spring chinook.

The substrate in each channelized reach is characterized by gravel of suitable size for spring chinook and summer steelhead spawning. However, spring chinook redd count surveys of Beaver Creek have shown that very little spawning activity occurs in the straightened reaches. Spring chinook test digs are fairly common

Table 3. - Biomass estimates (grams/m2) of spring chinook and summer **steelhead/rainbow** trout in highway impacted and non-impacted sites in Beaver Creek.

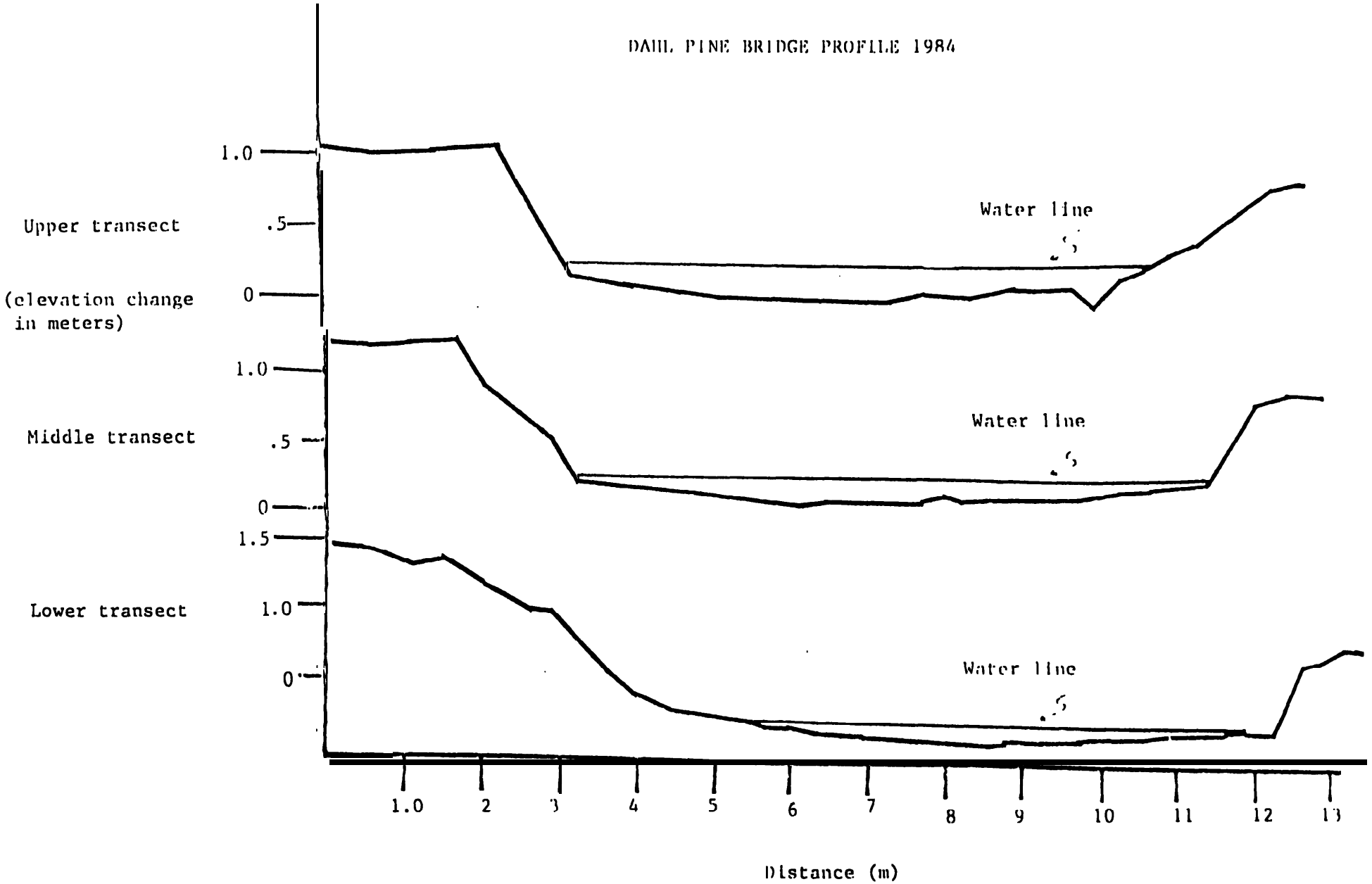
Chinook

Date	Above Robison Park(RM 18.01	Above Robison* Park(RM 18.5)	Meander above Dahl Pine(RM 14.5)	Dahl Pine Bridge(RM 12.5)	Below Dahl Pine(RM 11.5)
August '83	0.051	0.019	0.172	--	--
October '83	--	--	--	0.00	0.083
January '85	--	--	--	0.019	0.046
June '85	--	--	0.012	0.009	--
July '85	--	--	0.018	0.000	0.009
August '85	--	--	0.005	0.000	0.030
Rainbow Trout					
August '83	0.253	0.070	**	--	--
October '84			--	0.023	0.067
January '85	--	--	--	0.034	0.034
June '85	--	--	0.003	0.060	--
July '85	--	--	0.005	0.042	0.005
August '85	--	--	0.000	0.004	**

* Highway channelized

** Rainhow Trout present, biomass estimate not available

Figure 3. Example of streambed profile in the channelized reaches of Beaver Creek. Dahl Pine Bridge sampling site; three transects.



in Reach A, but there are few completed redds annually. The uniformity and relative shallowness (approximately 253 mm) of the gravel layer may account for the lack of spawning in these areas. In Beaver Creek, areas of high spawning activity are generally in gravelled riffles at the head of pools where gravel depths often exceed 500 mm.

PROPOSED ACTION

The Confederated Tribes wish to restore Beaver Creek to its full anadromous fish production level. In order to accomplish this goal in an expediant manner, the Tribes propose to construct a series of instream structures in channelized reaches of the stream. This work would be similar to that undertaken by the Forest Service on Camp Creek of the John Day River drainage (BPA project No. 82-9). The placement of instream structures in the channelized reaches of Beaver Creek will accomplish the following:

1) pool-to-riffle ratios will be increased from 0:1 to approximately 5:1;
2) provide instream cover;
3) narrow the stream channel providing a greater water depth; and
4) create gravel bars that are suitable for spawning.

Instream structures to be installed include log sills, rock wiers and boulder placements. These items were chosen for several reasons including longevity, ease of construction, low maintenance costs and esthetics.

Log sills - Logs of suitable size and quality are available within a short distance of the work sites. Downed trees within the riparian area could be skidded into the stream and cull logs from nearby timber sales are decked and could, with appropriate approvals, be hauled to the sites. Additionally, the Oregon State Highway Department periodically removes trees which are endangering highway traffic from the highway right-of-way. Through coordination with the Highway

Department, these trees could be identified and utilized as sills.

The sills will be keyed into the bank opposite the highway and, where possible, into the adjacent bank as well. Where the highway lays in very close proximity or the bank is rip-rapped, the end of the log will be secured with large rock. The streambed will be scraped of small rock prior to the placement of the log (Figure 4). Log sills will be limited to 0.6 - 0.8 m above the streambed so that upstream migration of salmonids will not be impeded. This will also lower resistance to high flows. Properly installed log sills have a life expectancy of 15 to 20 years and very low maintence requirements.

Rock wiers and boulder placements - Large rocks are available from several sources Road construction in the Beaver Creek area left numerous large boulders in piles along the logging roads; those rocks which are not needed for roadbed stability could, with appropriate approval, be available. An old quarry is located along Hwy 26 at milepost 78 and a quantity of suitably sized rock is readily available. If mere rock is required, limited blasting could be done, with Tribal Council's approval, to obtain more.

The rock wiers will be placed in the stream in such a way as to direct the flow into a more defined channel along the bank opposite the highway (Figure 5). Boulders will be placed within the water flow to create velocity breaks, smaller pools and cover.

The rock structures will last indefinately in the stream although some shifting may occur. There should be no maintenance costs associated with these structures.

The log sills and rock placements have the added benefit of appearing to be natural stream structure. The visual impact on travelers of Hwy 26 of unnatural structures, such as gabions, was a concern raised by several tribal members. Every attempt will be made to make the structures appear as natural as possible

Figure 4 - Example of log sill to be placed in Heaver Creek (Side View).
Note - not all sills may be placed on bedrock, but hardware
and road cloth will prevent undercutting.

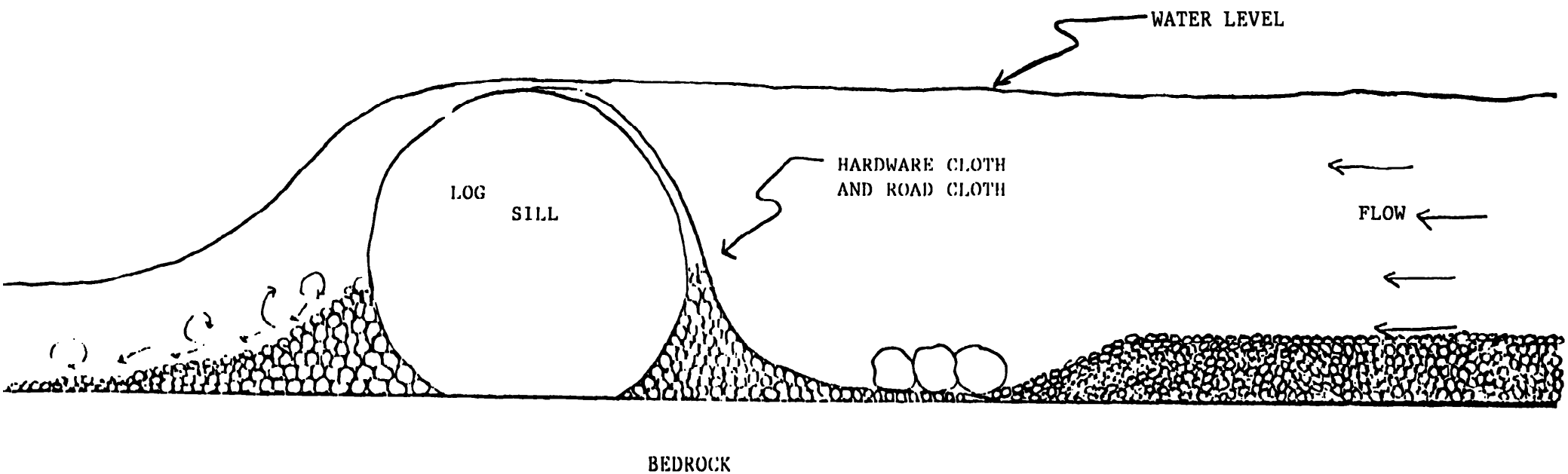
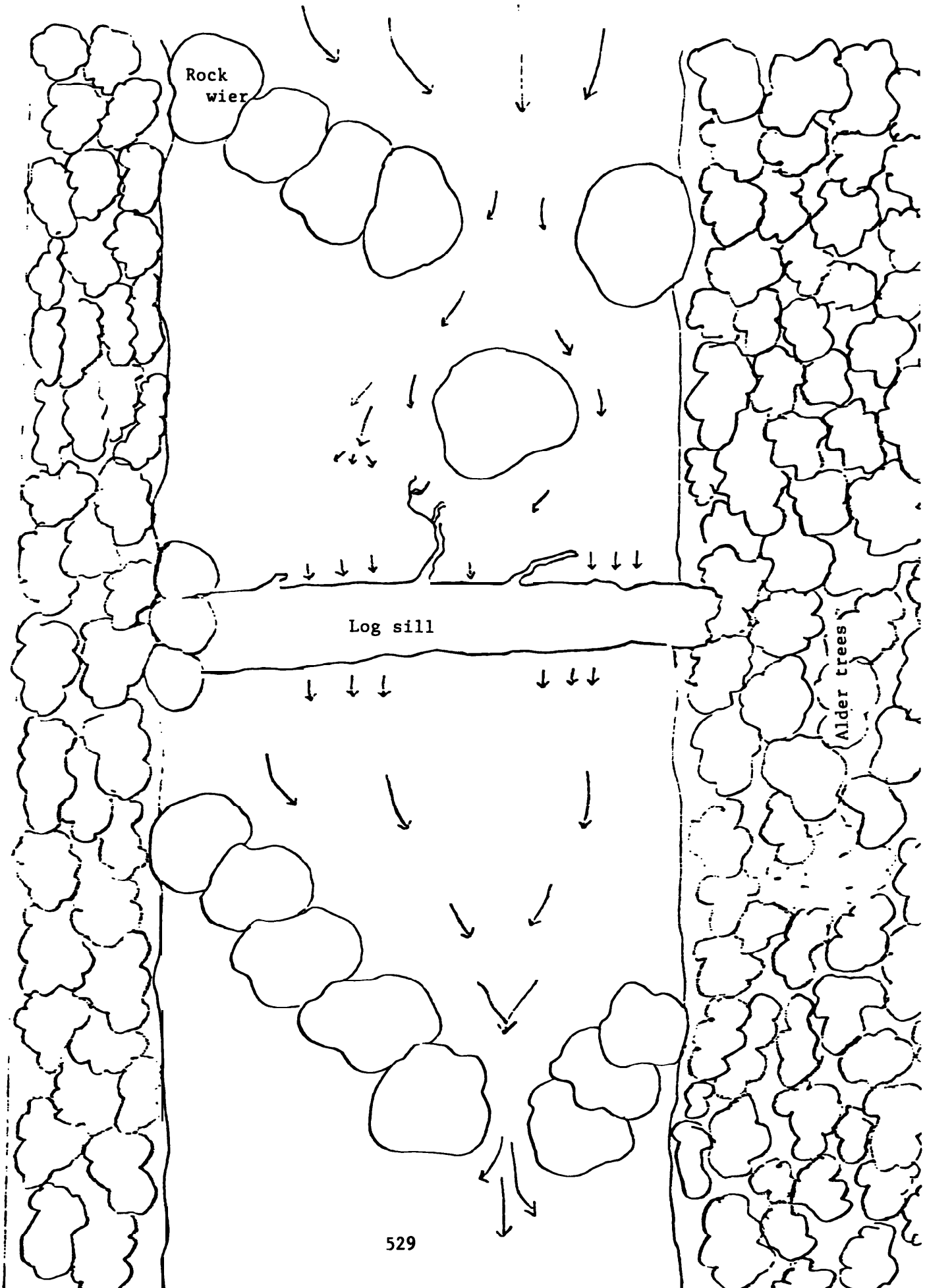


Figure 5. Example of intended placements for log sills and rock wiers in Beaver Creek.



while maintaining the function.

The number of structures to be installed is yet unknown. Recommendations from a number of biologists and hydrologists vary from 12 to 20 per stream mile for a stream of this gradient. Most individuals suggested at least 15 structures per stream mile, but qualified the statement and recommended flexibility during implementation. Based on 15 structures per stream mile, 30 structures will be placed in Reach A, 11 in Reach B, 6 in Reach C and 8 in Reach D for a total of 55 structures. Structures will not be placed in any area where State Highway Department engineers feel the roadbed will be adversely impacted.

There will be short-term disturbance of riparian vegetation and the streambed. A small amount of siltation will occur, but will be minimal. There are no lasting, adverse environmental impacts expected as a result of this project.

BENEFITS/COST

There is approximately 46,960 m^2 of spawning gravel that is currently under or unutilized in the four channelized reaches. At the completion of this project, it is expected that spawning habitat will be improved and provide enough quality habitat for 584 spawning pairs of spring chinook and 400 pairs of spawning summer steelhead.

The main intent of the project, however, is to increase rearing habitat, particularly over-wintering habitat, for salmonids. Ongoing fisheries sampling in the Warm Springs River system indicates thatthis habitat is virtually non-existant in the channelized reaches, it is unlikely that significant gains in salmonids production from these reaches would be realized, even at higher seeding levels. With modification of the stream, and the resultant pool development, an increase of approximately 6,500 to 7,000 spring chinook smolts per year could be expected at full-seeding levels. At current survival and harvest levels, this would result in an adult return to the Deschutes River of between 163 and 175 spring chinook annually.

Increases in summer steelhead production are more difficult to project. Recent fisheries sampling of the instream structures of Camp Creek showed 14 to 17 l+ steelhead

directly associated with each structure (Errol Claire, Oregon Department of Fish and Wildlife, personal communication). This represents an increase of approximately four-fold for that stream, which is considered to be under-seeded. Similar increases could certainly be expected in Beaver Creek.

The cost of instream structures appears to be dependent upon the materials used and the availability of those materials to the work site. Recently completed work of a similar nature on the Mt. Hood National Forest ranged from $50.00 per single boulder placement to $1,000.00 for top-of-the-line log sills. The average heavy equipment time spent per log sill or rock wier was approximately 2 hours when material was readily available (Dave Hohler, U.S.F.S., personal communication). These costs and time expenditures are similar to those encountered in the Camp Creek project (Rich Grietz, Malhuer National Forest, personal communication).

Monitoring of the projects effectiveness will be conducted for the next several years and will involve both water and fisheries parameters. Fisheries sampling will include quarterly biomass estimates at 5 sites throughout the project area and redd count surveys for spring chinook and summer steelhead. Water quality and quantity will be checked concurrently with fisheries sampling. An estimated 60 man-days will be necessary to conduct this sampling.

The anticipated costs for 55 instream structures (30 log sills, 25 rock wiers) and associated monitoring are attached on a budget page.

APPENDIX A

WATER QUALITY INFORMATION ON BEAVER CREEK

FEB Fish and Water Quality Bonneville Power Administration
Beaver Creek Warm Springs Indian Reservation

Date	Watershed	Site	H20Temp	DO2	pH	Conduct	Turbid
841119	Beaver	Wilson	2.8	10.4	8.27	50	
841211	Beaver	Wilson			7.4		3.2
841212	Beaver	Wilson	2.9			78	
850102	Beaver	Wilson	6	**13.5**	8.61	60	
850212	Beaver	Wilson	1.6	**11**	6.76	80	
850221	Beaver	Wilson	1.7	**13.4**	6.98		
850711	Beaver	Wilson	11.1		7.74		0.6
850802	Beaver	Wilson	11	**9.5**		55	
850221	Beever	Meander	2.2	14	6.98		6.2
850301	Beaver	Meander	5	12.7		54	3.1
850802	Beaver	Meander	21.5	9.8		85	
840807	Beaver	Dahl Pine	12.6	**11.5**	7.69	60	2.1
841120	Beaver	Dahl Pine	4.4		8.04	60	10.1
841211	Beaver	Dahl Pine					1.8
841212	Beaver	Dahl Pine				79	
850212	Beaver	Dahl Pine	2	13	6.81	68	
850221	Beaver	Dahl Pine	6.2	13.8	6.99	80	
850801	Beaver	Dahl Pine	12	10.6	8.39	85	3.1
850802	Beaver	Dahl Pine	11		7.9	84	
840108	Beaver	BelowD.P.	**15**	10.4		78	
840801	Beaver	BelowD.P.	**15**	10.4		78	
850103	Beaver	BelowD.P.	**0**	12.8	8.13	62	0 .58
840806	Beaver	Simnasho	17.9	12.4	7.07	75	2.7
841212	Beaver	Simnasho	3.9	13.3	7.99	67	4.7
850213	Beaver	Simnasho	2	13.2	6.8	80	4.4
850621	Beaver	Simnasho	18	10.5	8.2	70	2.2
850621	Beaver	Simnasho	18	10.5	8.2	70	2.2
850802	Beaver	Simnasho	11	10			
840808	Beaver	Quartz	19.2	7.4	8.2	72	3.3
841112	Beaver	Quartz	6.2	16	8.2	90	2.6
841120	Beaver	Quartz	8	16	8.2	90	2.6
841212	Beaver	Quartz	3.7		8.15	80	3.5
850102	Beaver	Quartz	3	12.5	8.1		
850213	Beaver	Quartz	1	12.6	6.75	90	
650301	Beaver	Quartz	5			61	5.1
850319	Beaver	Quartz	18	13	7.9	70	15
850710	Beaver	Quartz	17	9.4			4.5
850502	Beaver	Quartz	10	10		80	
850816	Beaver	Quartz	11.7	14	8.32	80	2.5
840801	Beaver	Lower	15	10.4		74	
840806	Beaver	Lower	18	12.4	7.07	75	2.7
850412	Beaver	Lower	10	11.7	7.8	58	11
850701	Beaver	Lower	16	10.2	8.17		1.5
850709	Beaver	Lower		11.2			

DATUM OF GAGE

DISCHARGE, IN CUBIC … WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975

MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
1–31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	2725	[illegible]	1372	---
MEAN	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	135	[illegible]	[illegible]	[illegible]	---
MAX	[illegible]	[illegible]			241	[illegible]	[illegible]	103	[illegible]	[illegible]	---
MIN	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	77	[illegible]	43	---
AC-FT	[illegible]	[illegible]		[illegible]	[illegible]	7470	[illegible]	[illegible]	[illegible]	2720	---

CAL YR 1974 TOTAL [illegible] MEAN [illegible] MAX [illegible] MIN [illegible] AC-FT [illegible]

534

LAT 465732 LONG 1212035 STATE 41 COUNTY 065 DATUM OF GAGE: DRAINAGE AREA: 145

PROVISIONAL DATA DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1								---	81	54	42	38
2								---	78	53	42	39
3								---	77	53	42	39
4								---	82	51	42	39
5								---	85	51	42	39
6								---	84	50	42	44
7								---	85	50	40	42
8								---	79	50	40	41
9								---	75	49	40	40
10								---	74	49	40	40
11								---	71	49	40	39
12								---	70	47	40	39
13								---	73	47	40	39
14								---	75	47	40	39
15								---	71	46	40	39
16								---	67	46	40	39
17								---	66	46	40	39
18								---	64	46	40	39
19								---	63	45	40	39
20								---	63	45	40	39
21								---	64	45	40	39
22								---	64	45	40	40
23								---	61	45	40	42
24								---	59	44	39	40
25								---	58	43	40	40
26								---	56	42	39	40
27								---	56	42	39	39
28								---	55	42	39	39
29								---	55	42	39	39
30								---	55	42	39	39
31								85	---	42	39	---
TOTAL								---	2070	1448	1245	1157
MEAN								---	69.0	46.7	40.2	38.6
MAX								---	85	54	42	44
MIN								---	55	42	39	38
AC-FT								---	4110	2870	2470	2350

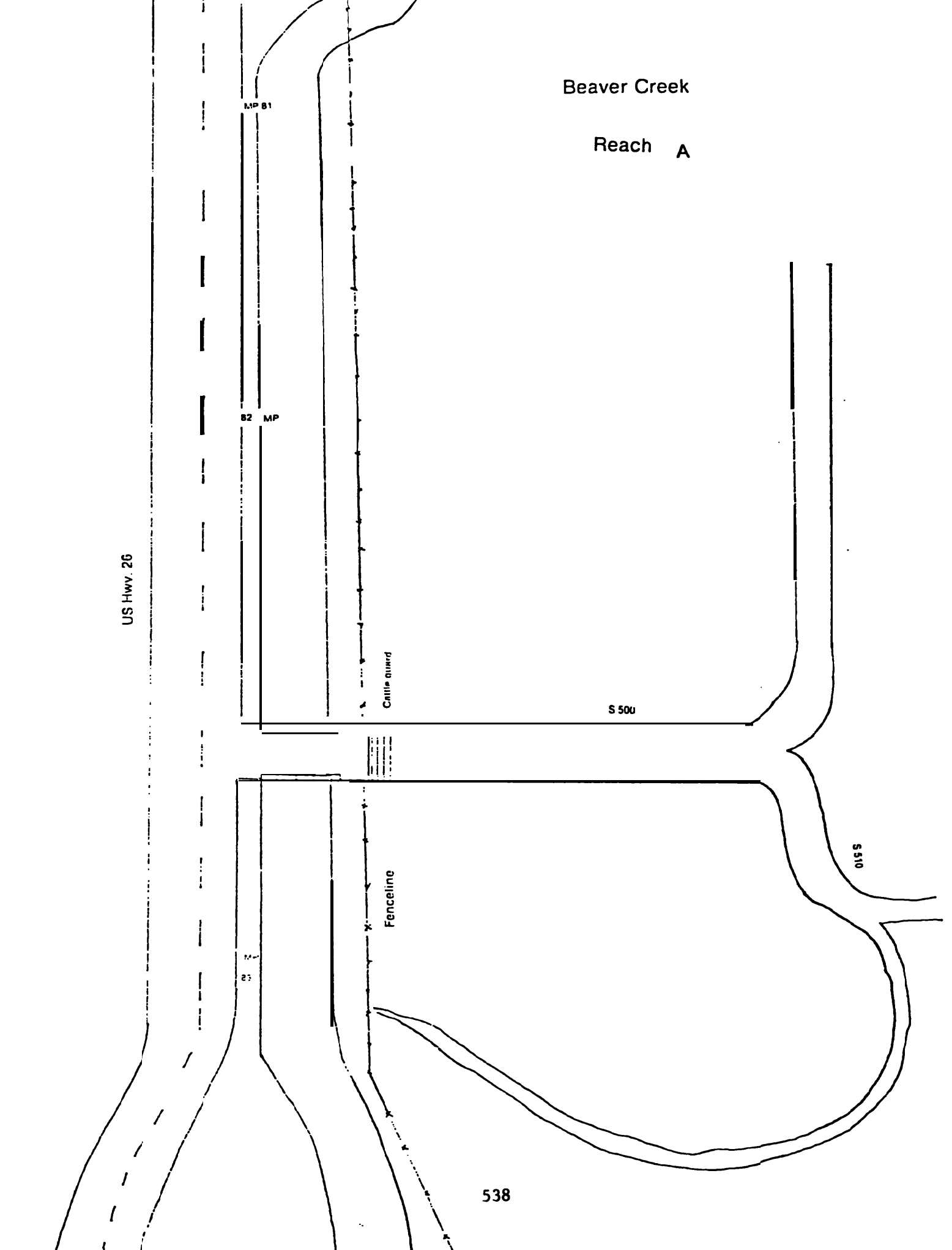
UNPUBLISHED RECORDS
SUBJECT TO REVISION

APPENDIX B

INDIVIDUAL CHANNELIZED REACH INFORMATION

REACH A BEAVER CREEK ENHANCEMENT

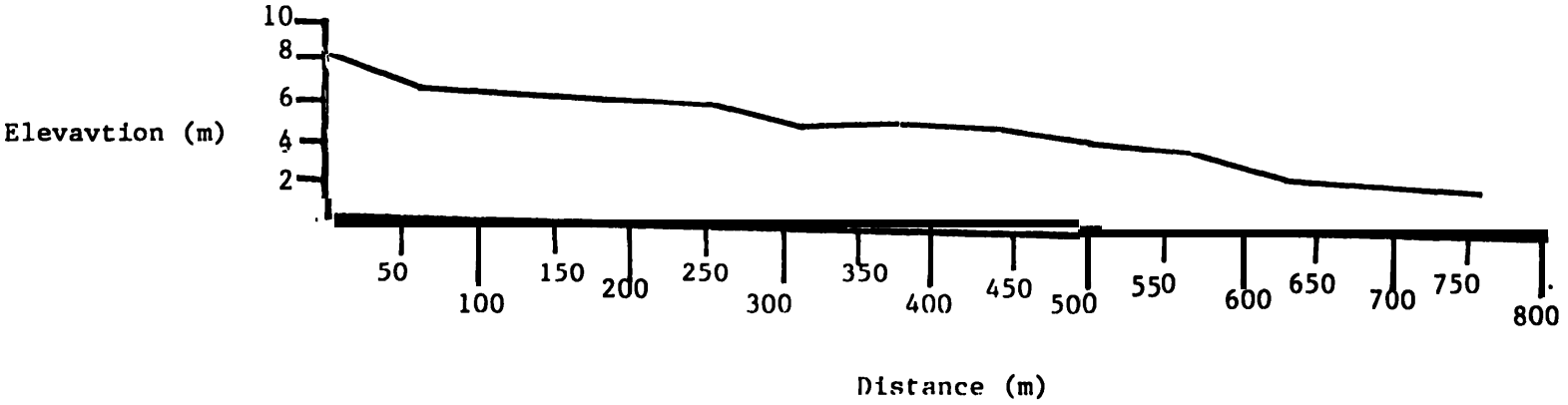
Legal Description	T7S, R10E, 1A; T6S, R10E, 36BC
River Mile	12.0 to 14.0
Length	2 miles
Gradient	1.16%
Average Channel Width	10.0 meters
Average Water Depth at Low Flow	0.16 meters
Average Gravel Depth	0.27 meters
Pool: Riffle ratio	0:1

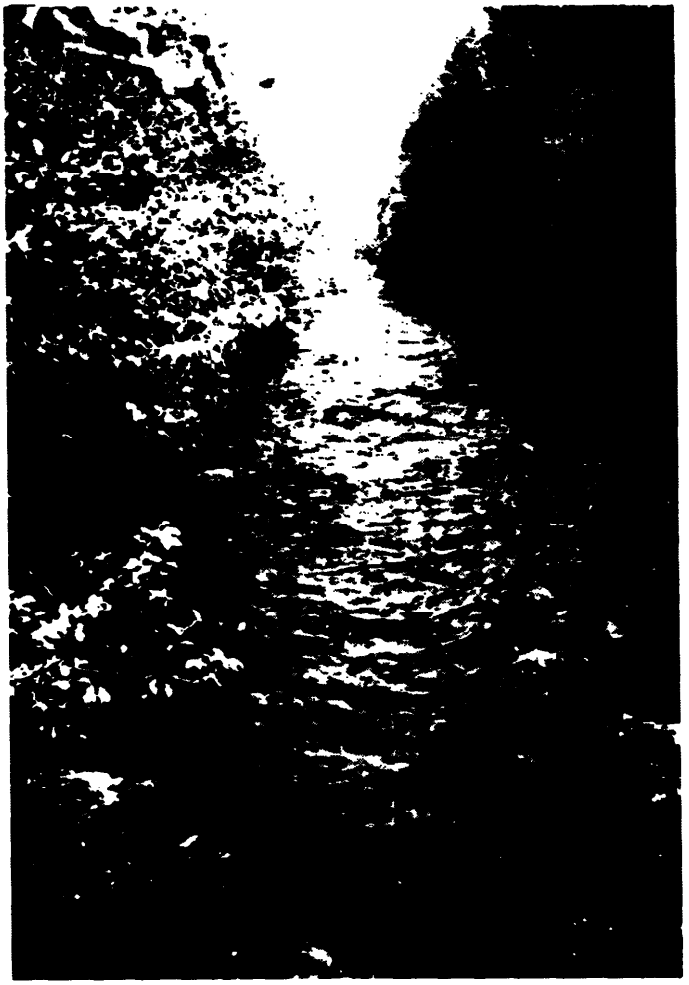

Beaver Creek
Reach A
MP 81
82 MP
US Hwy. 26
Cattle guard
S 500
S 510
Fenceline
538

Beaver Creek

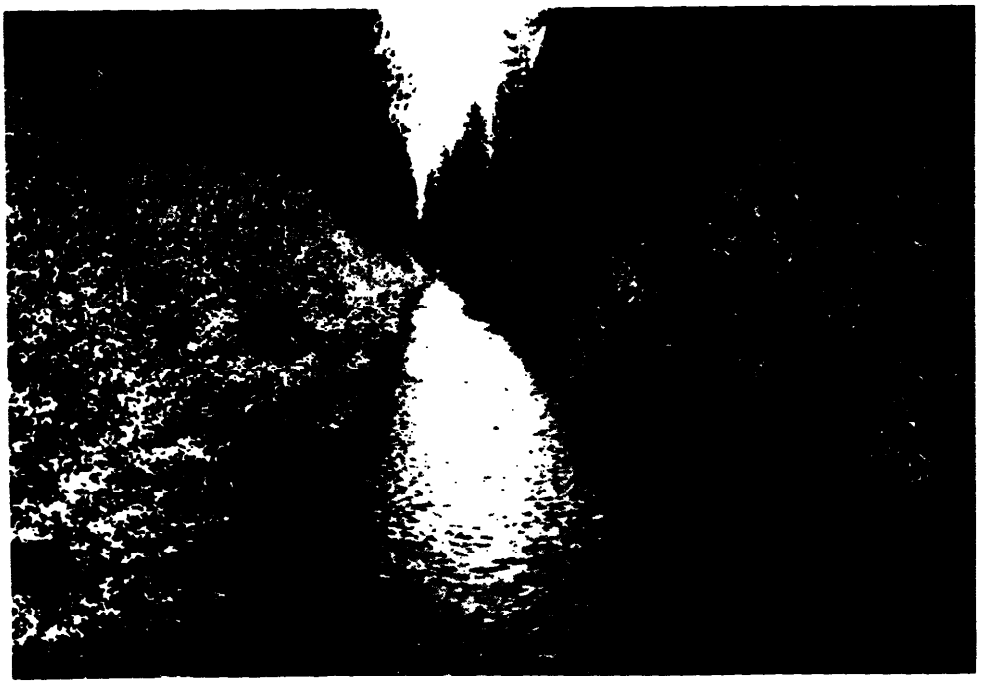
REACH (section) A

Length 731.52m
Drop 8.49m
Gradient 1.16%





Reach A - Note shallow water depth, abundant gravel substrate and lack of instream structure.

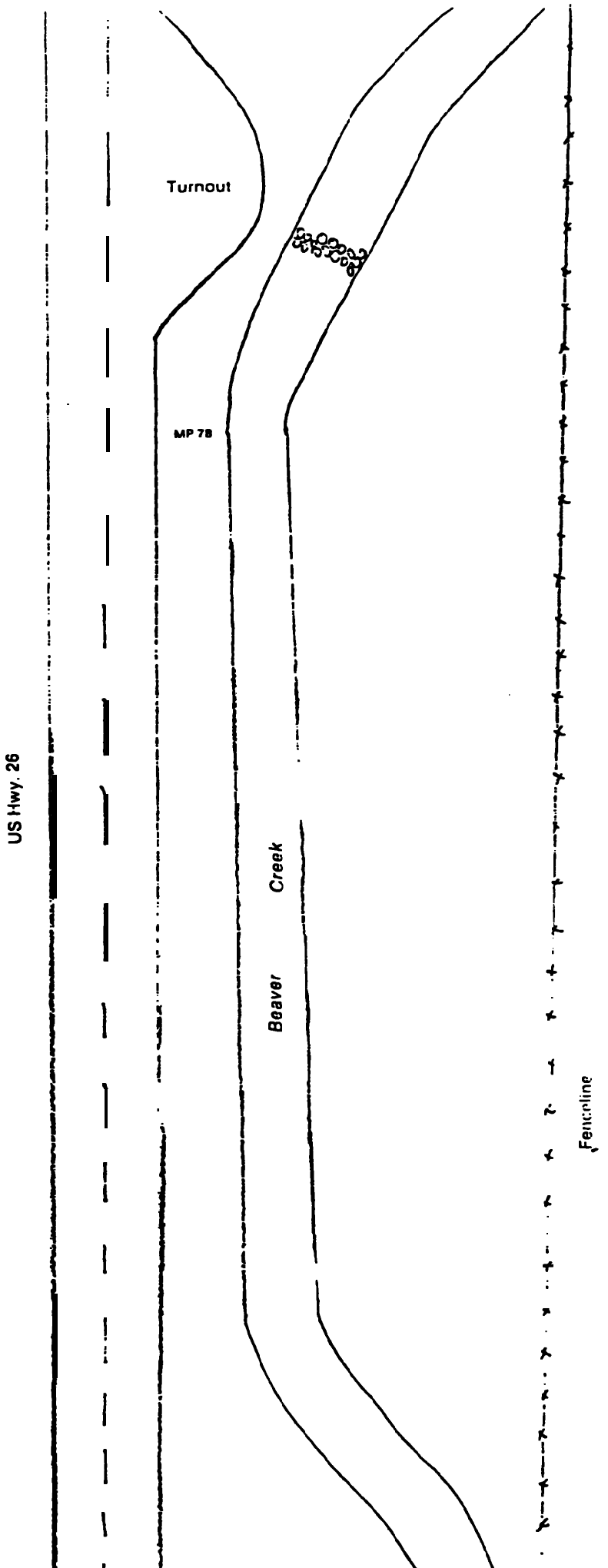


REACH B BEAVER CREEK ENHANCEMENT

Legal Description	T6S, R10E,10A; T6S, R10E, 11C
River Mile	17.3 to 18.0
Length	0.7 miles
Gradient	2.11%
Average Channel Width	9.35 meters
Average Water Depth	0.16 meters
Average Gravel Depth	0.21 meters
Pool: riffle ratio	.01:1

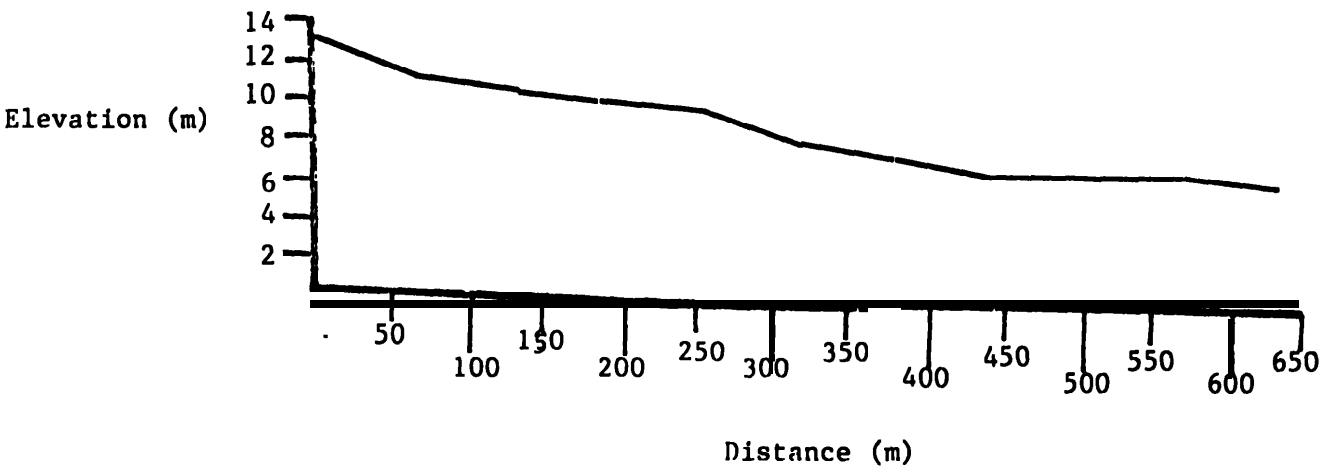
Beaver Creek

Reach B



SECTION B

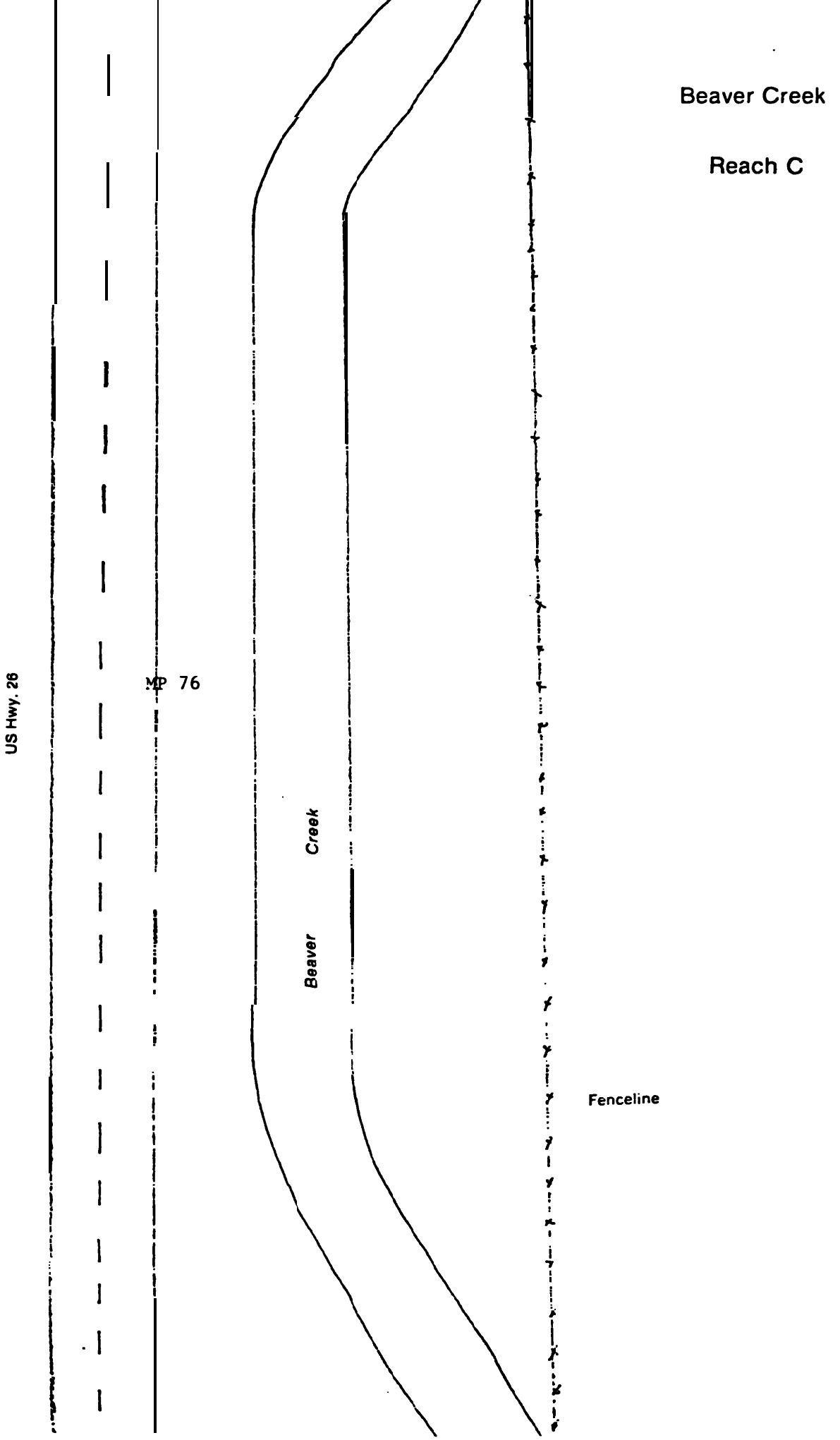
Length 609.6m
Drop 12.67m
Gradient 2.07%



Reach B - Above is the remnant of a rock weir built by travelers of Hwy 26. Below note the wide channel and extremely shallow water depth.

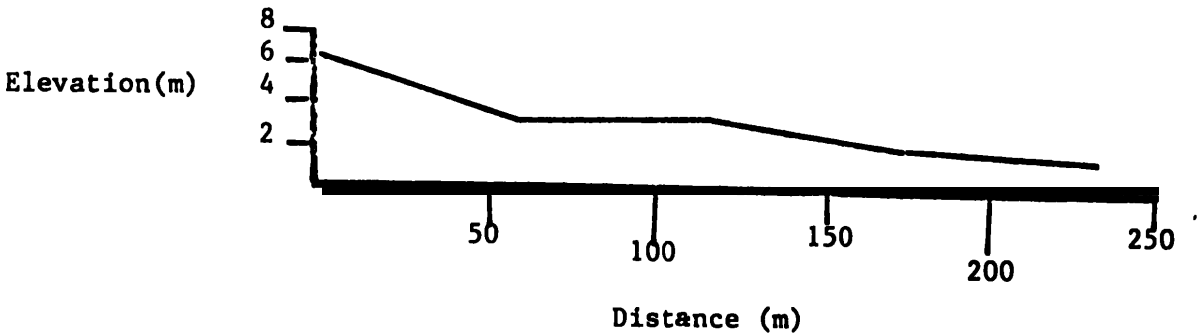
REACH C BEAVER CREEK ENHANCEMENT

Legal Description	T6S, R10E, 3C
River Mile	18.3 to 18.7
Length	0.4 miles
Gradient	1.65%
Average Channel Width	8 meters
Average Water Depth	0.16 meters
Average Gravel Depth	0.24 meters
Pool: riffle ratio	.2:1


Beaver Creek
Reach C
US Hwy. 26
MP 76
Beaver Creek
Fenceline

SECTION C

Length 243.84m
Drop 6.43m
Gradient 2.6%



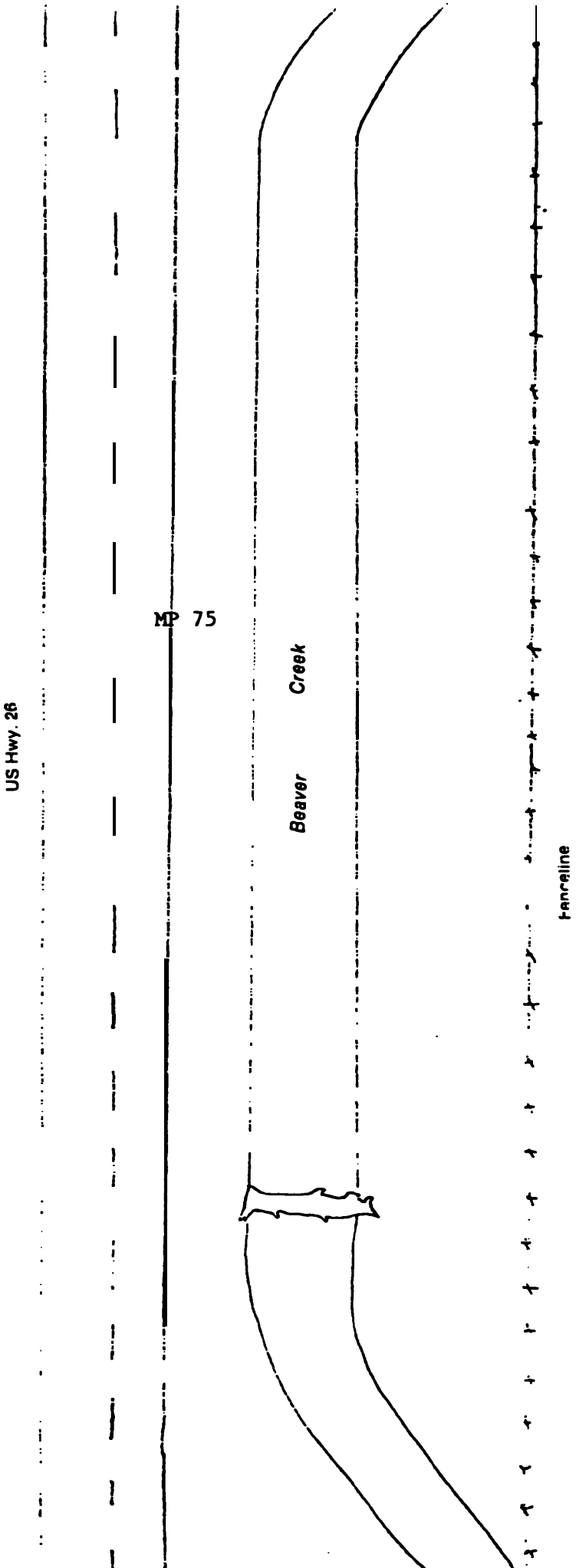
Reach C - Note alder growth despite heavily rip-rapped banks. Slightly more instream structure than other reaches.

REACH D BEAVER CREEK ENHANCEMENT

Legal Descrition	T6S, RlOE, 3B
River Mile	18.9 to 19.4
Length	0.5 miles
Gradient	1.2%
Average Channel Width	6 meters
Average Water Depth	0.15 meters
Average Gravel Depth	0.25 meters
Pool: riffle ratio	.06:1

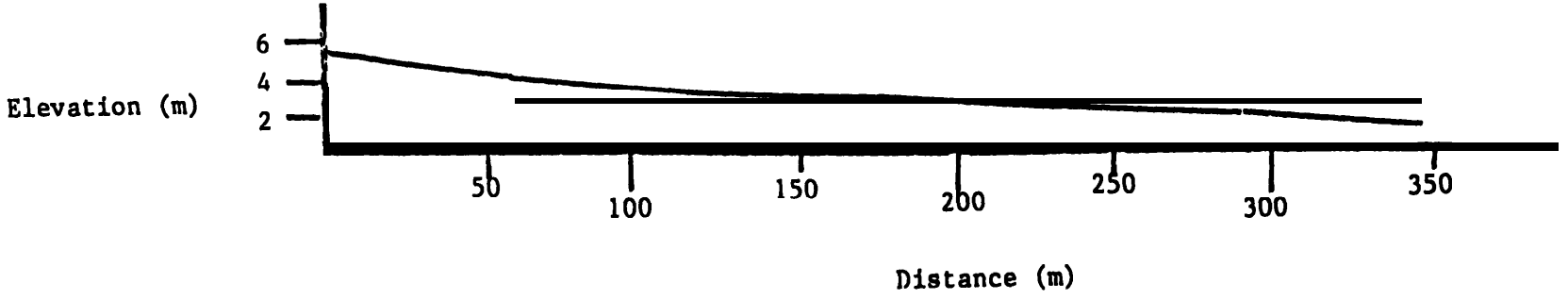
Beaver Creek

Reach D



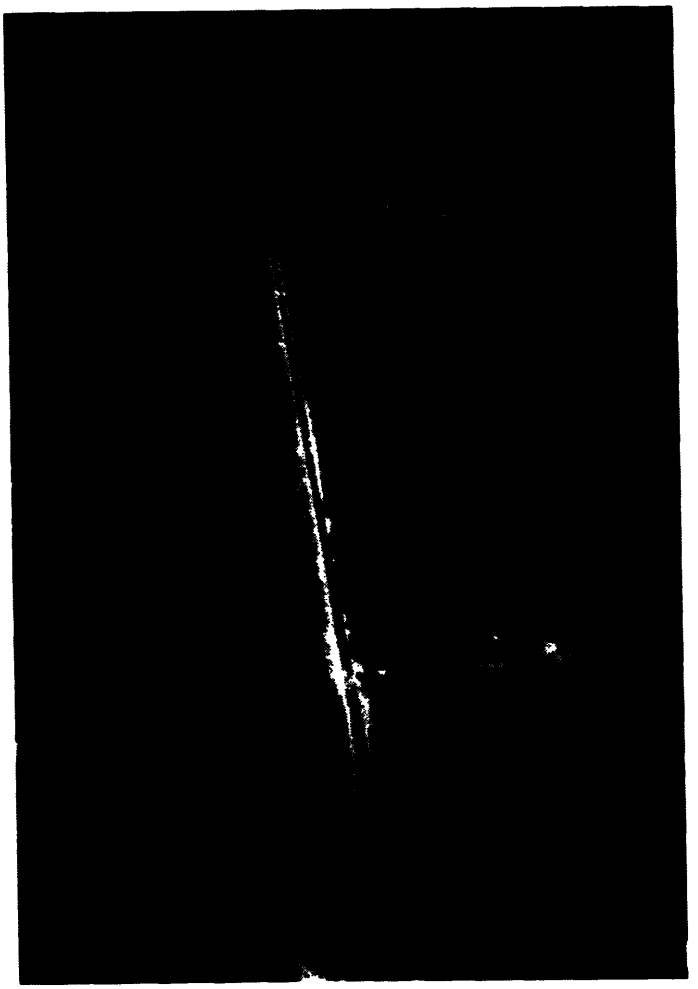
SECTION D

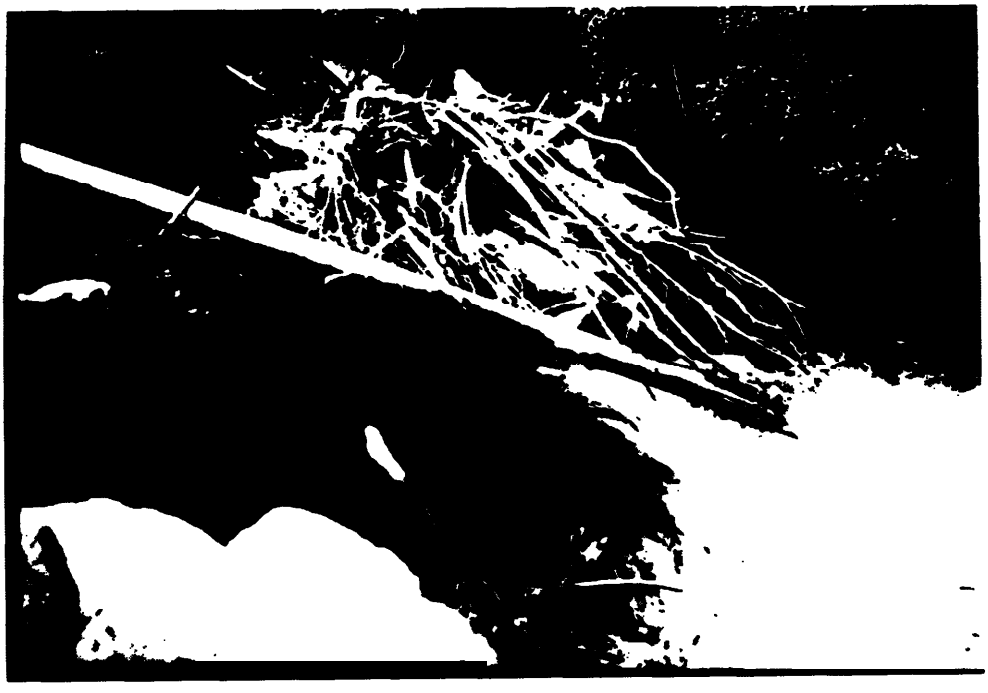
Length 365.76m
Drop 4.38m
Gradient 1.2%



Reach D - Note lack of structure. The highest channelized reach in the system to be worked **on,** the channel is narrower and the banks extremely rocky.

Aerial views of U.S. Highway 26 and Beaver Creek. Dahl Pine Area (River Mile 12.0 to 14.0)

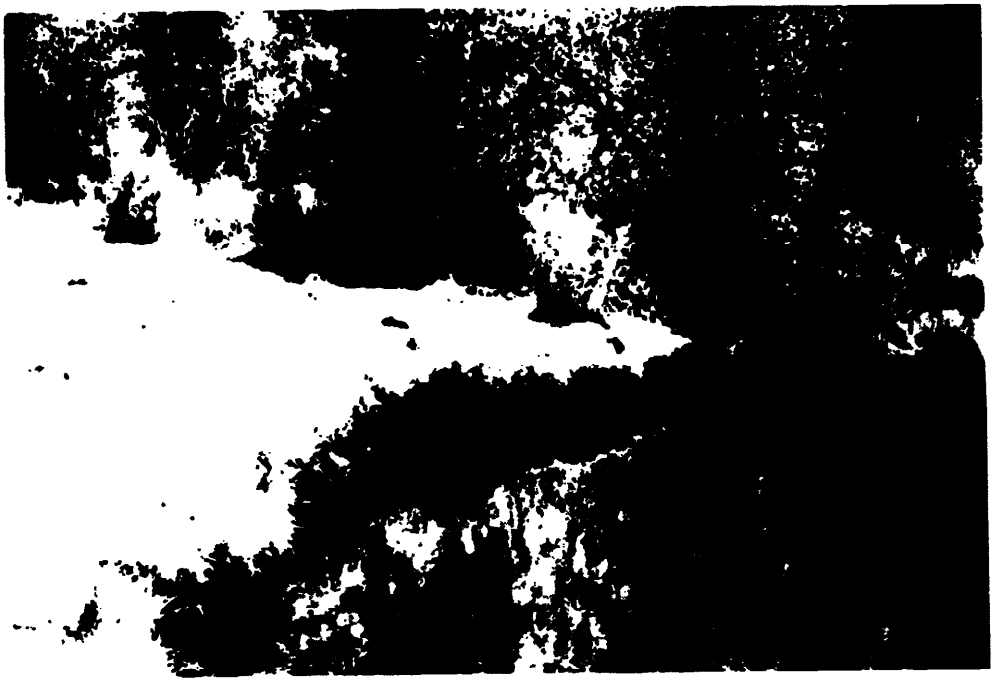




Naturally occurring instream structures in non-channelized reaches of Beaver Creek. Note the cover and pool habitat.

Above is an example of the eroding banks in lower Beaver Creek. Approximately 2.5 km of stream bank was armoured with juniper trees in 1984 (below).

Above and below are examples of the impact of cattle on the riparian vegetation of Beaver Creek. Note the raw streambanks and cropped-off woody vegetation.



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