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SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT

ANNUAL REPORT, 1991
Monitoring Phase - Years 3 and 4

BY

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TITLE: Project 85-71 - South Fork John Day River Habitat Enhancement Project Evaluation

ANNUAL REPORT, 1991 - Monitoring Phase

AGREEMENT No.: DE-AI79-85BP25385

PROJECT PERIOD: September 1, 1985 to March 31, 1991

EXECUTIVE SUMMARY: A study to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was continued during the month of September in 1988 and 1989.

ABSTRACT: Between 1987 and 1989, a S-year study was established in 1986 to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was continued. Stream discharge, water velocity, bottom profile, depth, width, thalweg, pool:riffle ratio, substrate composition, streambank erosion, riparian cover and instream cover were measured and compared to pre-project conditions measured in 1986. In general, quantity and quality of rearing area for summer steelhead improved. Almost all improvements were the result of the boulder placement project.

INTRODUCTION

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During September 1986, 1,500 boulders were placed in 14 reaches of the South Fork of the John Day River (SFJDR), between RM 14 and RM 25 (Figures 1 and 2). Each boulder was three feet or greater in at least one dimension. The boulders were placed in a variety of configurations, for example, V's, diamonds, double V's, jetty-like groups, in lines perpendicular to the flow, and randomly distributed in existing pools. Each configuration was best fitted to specific site features (i.e. depth, flow, velocity, bank condition, riparian cover, substrate, channel morphology and existing instream objects).

The purpose of the project was to increase rearing area for summer steelhead smolt by providing instream cover. For the purposes of this report, the terms rearing area and instream cover are equivalent. During field measurements, instream cover was defined as the stream area that functioned as the rearing area.

An increase in rearing cover (i.e. pools, boulders, undercut banks, etc.) can be expected to produce an increase in the number of juvenile summer steelhead reared to smolt. Previous electroshocking studies (BLM, unpublished data), of earlier boulder placements in the SFJDR show that an average of five juveniles use each boulder. This is expected to hold true for this project as well. When the improvements have stabilized, it is estimated that an additional 7,500 Smolts will be produced. A habitat evaluation study carried out by ODF&W in 1983 (Lindsay, 1983) on Deer Creek, a tributary of the SFJDR. showed a 119 percent increase in age one and older fish one year after boulder placement. Using this assumption, it is expected that an additional 5.000 age

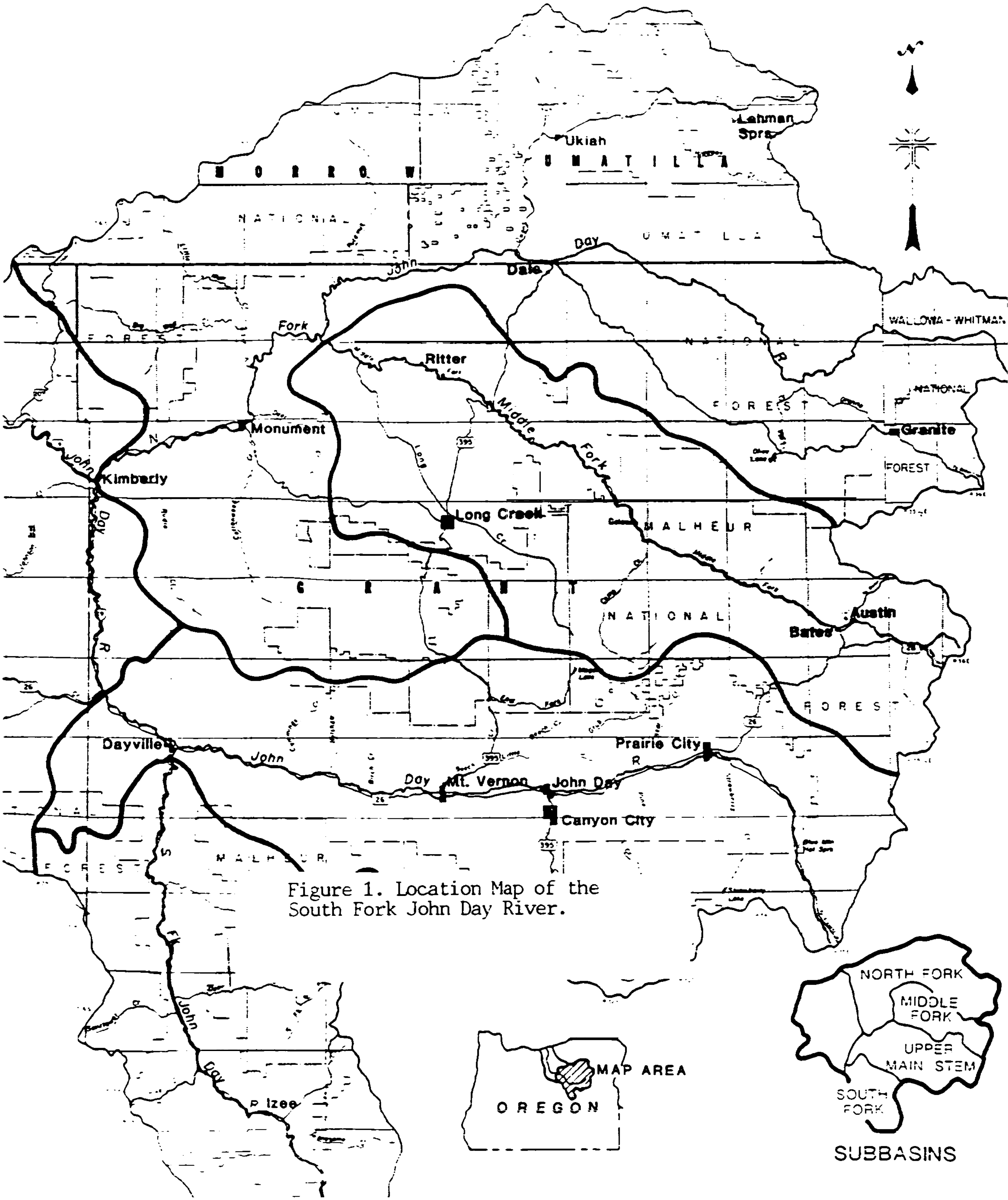

Figure 1. Location Map of the South Fork John Day River.

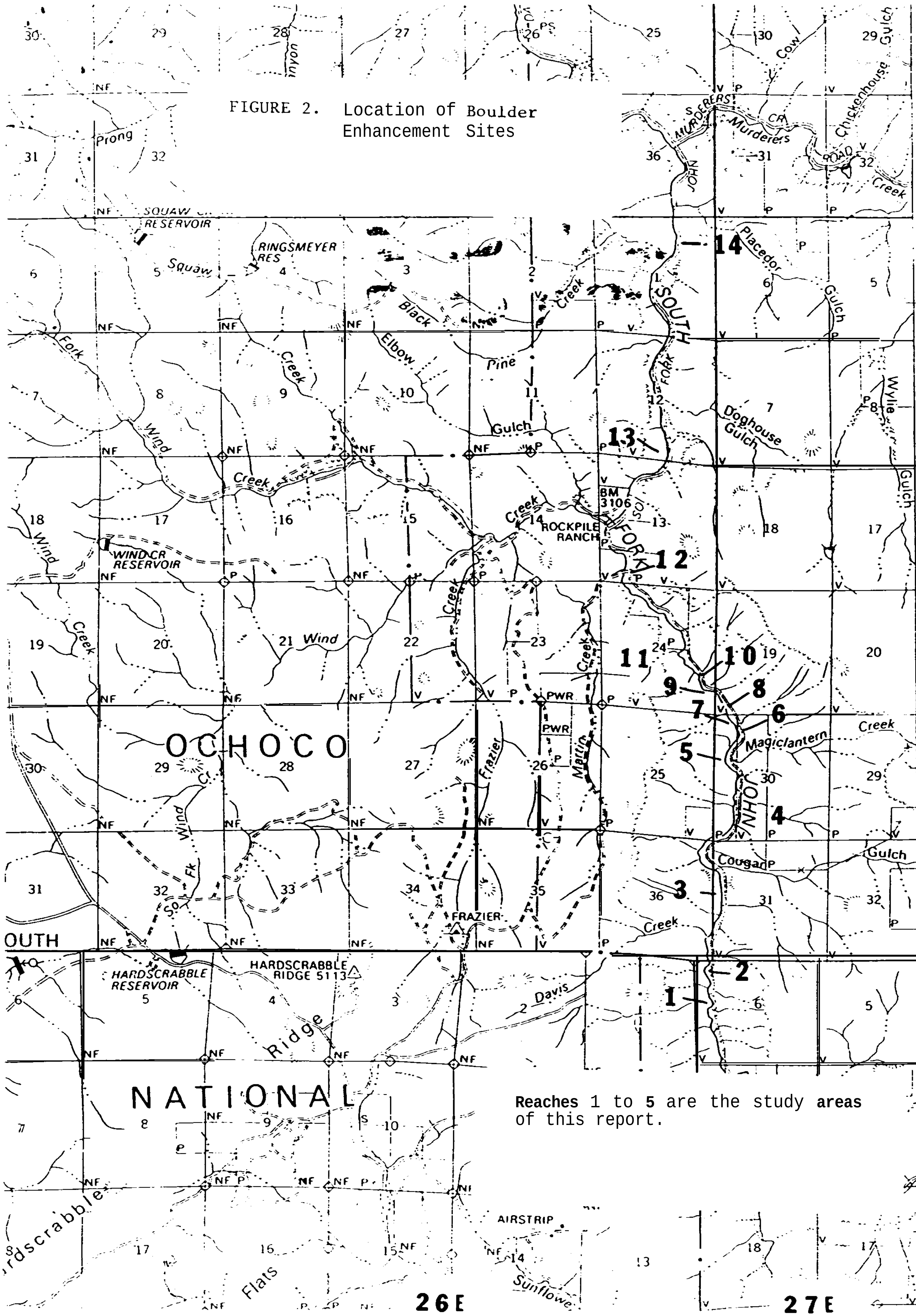

FIGURE 2. Location of Boulder Enhancement Sites

Reaches 1 to **5** are the study **areas** of this report.

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one and older fish will use the treated reaches the first year after the post-project years. After full pool development, this figure could rise over the next three to five years. Therefore, the projected increase of the 7,500 smolts may be conservative.

In order to document the effectiveness of the project in accomplishing planned objectives, a S-year habitat monitoring study was set up. The goal of this study was to measure physical changes in habitat of improved stream reaches.

OBJECTIVES

The objectives of this study are as follows:

1. Monitor changes in bottom profile, depth, width, flow (volume and velocity), thalweg, pool/riffle ratio, substrate composition, streambank erosion, riparian cover and cover as a result of boulder treatment.

2. Evaluate the effectiveness of boulder treatment as a fish habitat improvement technique.

MATERIALS AND METHODS

Station Selection and Layout

Five reaches were selected as permanent monitoring stations (Figure 2). Selection criteria included: 1) streambank access and 2) representativeness of the reaches to the total project area. Stream characteristics varied through the project area. Therefore, the locations were selected to portray variation rather than homogeneity.

Each station is 100 yards long as measured along the mid-channel line. A permanent marker was placed at the head of each station (upstream> to mark the station and to serve as head stakes for bottom profile measurements. Additionally, nearby trees were marked with paint to help relocate the station. A total of three transects were established at each station, one at the upstream end, one in the center and one at the downstream end of each station. Both ends were marked with a permanent marker.

Parameters Measured and Methods Used

At each transect, a measuring tape was stretched across the channel cross section. Measurements using automatic level and rod and standard surveying techniques were made. Depth was taken at each point where there was a change in bottom profile caused by changes in substrate or the presence of a major object (i.e. boulder or debris>. In the latter case, a reading was taken on the object and immediately to each side of it. A water surface elevation was taken with each bottom profile reading.

1 Width. Stream width was measured at each transect across the wetted channel.

2 Depth. Depth was calculated as the difference between water surface elevation and bottom.

3 Water velocity Flows were measured using a pygmy meter at each point along the transects and thalweg where depth measurements were made.

4 Thalwea Length. The thalweg length was surveyed using rod and level from the upstream transect (number 1) and downstream transect (number 3).

5. Thalweg Depth. Depth was determined from water surface elevation and bottom profile measurements taken along the thalweg.

6. Thalweg Velocity. Velocity was measured along the thalweg whenever substrate data was collected.

7. Bottom Profile. Bottom profile was measured at all three transects per reach using standard surveying techniques.

8. Substrate Composition. Substrate composition was recorded from the bottom profile at each transect and along the thalweg for the length of each reach, percent of silt, gravel, cobble and boulders was then calculated.

9. Pool/Riffle Ratio. The pool/riffle ratio was calculated from data gathered while mapping instream cover.

10 Instream Cover. Instream cover was measured for the entire station length. Each separate component was measured individually and mapped to facilitate future comparisons.

11. Streambank Erosion. Streambank erosion was measured along both sides for a total length of eroded bank in the station.

12. Riparian Cover. The total length of streambank with riparian cover was measured between a point five feet above the high water mark to water's edge. A percentage of the water area covered was visually estimated.

RESULTS

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Stream Width.

Table 1 displays stream width for each reach and transect by year. Width varied considerably during the course of the study, both between transects of a single reach during the same year and from year to year. For example, width at Reach 1 varied from 30.3 feet at Transect 2 to 7.9 feet at Transect 3 in 1988 while Transect 3 varied from 7.9 feet in 1988 to 14.0 feet in 1989.

Reach 1, Transect 3, was consistently the narrowest reach with a four-year average of 11.5 feet and a one-time width of 7.9 feet. Reach 2, Transect 2, was the most stable reach, ranging from 34.6 feet to 36.2 feet, a 4.6 percent difference. Reach 5, Transect 3, was the widest reach with a 4-year average of 57.1 feet and a one-time width of 61.9 feet.

Beaverdams were present at five out of 15 transects (33.3%). Stream width may have been influenced by these structures. An asterisk identifies these transects in Table 1 and the year the dams were first observed and recorded in field notes. Transects were originally established in localized areas where there were no beaverdams. Over the course of the study, beaver activity increased.

Overall stream width varied from 7.9 feet (Reach 1, Transect 3) to 62.3 feet (Reach 5, Transect 3), with both measurements made on the same day in 1988. Average overall four-year stream width for all reaches is 31.9 feet. There is a slight trend toward an increase in channel confinement in three out of five reaches (60 percent). This is reflected in Table 1A where post-project stream widths are contrasted to pre-project widths. Although post-project years were drier than average, it would be expected that the trend toward narrower channel widths would be common to all five reaches.

TABLE 1
Measurements of Stream Width
(in feet) of South Fork of the John Dav River

Year & Reach No.	Transect Width1/ #1	#2	#3		Avg Reach Width1/
Reach 1					
1986	27.7	30.0	12.6		23.4
1987	27.1	30.1*	11.6		23.2
1988	26.6	30.3	7.9		21.6
1989	29.0	26.3	14.0		23.1
4-Year Transect Avg	27.6	29.2	11.5	4-Yr Reach Avg	22.8
Reach 2					
1986	35.0	MD	30.5		32.7
1987	26.3	36.2	24.7		29.1
1988	52.7*	34.6	31.3		39.5
1989	38 l*	34.6	31.7		34.8
4-Year Transect Avg	38.0	35.1	29.5	4-Yr Reach Avg	
Reach 3					
1986	19.8	26.8	32.0		26.2
1987	17.0	19.0*	30.3		22.1
1988	15.5	26.4	19.4		20.4
1989	29.3	24 9	33.4		20 9
4-Year Transect Avg	20.4	24.3	28.8	4-Yr Reach Avg	22.4
Reach 4					
1986	28.5	28.3	31.3		29.4
1987	40.0	29.1*	30.5		33.2
1988	22.3	28.5*	26.5		25.8
1989	28.6	28 9	36.2		A-31
4-Year Transect Avg	29.9	28.7	31.1	4-Yr Reach Avg	29.9
Reach 5					
1986	46.8	44.8	61.5		51.0
1987	43.3	45.0	42.8		43.7
1988	47.2	54.0*	62.3		54.5
1989	47 9	48.5	57.1	4-Yr Reach Avg	50.5
4-Year Transect Avg	46.3	48.1			
				Overall Average =	31.9

*Indicates measurements that may be influenced by beaverdams.

MD = missing data
I/ = in feet

TABLE 1A
Pre- and Posst-Project Stream Width Contrast

Reach No.	Pre-Project Width*	Post-Project Avg Width*	Percent Difference
1	23.4	22.6	-3.4
2	32.7	34.5	5.5
3	26.2	21.1	-19.5
4	29.4	30.0	2.0
5	51.0	50.3	-13.7

*in feet

It is unknown if the boulder placement caused the stream width to change. In three of five reaches, the average post-project width was narrower than the pre-project width but a cause and effect relationship cannot be determined due to the variability of stream width measurements. For example, at nine out of 15 transects, the width was narrower the first year following treatment (1987) and six out of the same nine transects were wider a year later in 1988.

Although stream width was scheduled to be measured and reported annually, the first progress report in 1987 summarizes no such data from 1986 and 1987 field seasons.

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Water Depth.

Depth throughout the study was less variable than width. Measurements ranged from an average depth of 0.2 foot at Reach 1, Transect 1 (Table 2) to 2.0 feet at Reach 2, Transect 1 in 1988 respectively. Overall average reach depth was greater in post treatment than in pre-treatment reaches. The four-year average depth was 0.7 foot, modal depth was 0.5 foot. Average optimum depth for juvenile salmonids ranges from 1.5 to 2.5 feet and it occurred only at three transects during the study. This represents only 5.0 percent occurrence. However, this is up from 0.9 percent of optimum depth of pre-project conditions. Figures 1 through 5 display cross channel profiles for 1987 and 1989. In 12 out of 15 transects, there is an increase in depth and channel complexity. This is attributed to the boulder placement.

A more useful data element that should be measured is pool depth.

TABLE 2
Water Denth (in feet) bv Reach and Year
of the South Fork of the John Dav Basin

Year & Reach No.		Transect Depth1/ #1	#2	#3		Avg Reach Depth1/
Reach 1						
1986		0.2	0.7	0.6		0.5
1987		0.3	1.4*	0.5		0.7
1988		0.2	0.9	0.3		0.4
1989		0.5	1.3	0.6		0.8
	4-Yr Transect Avg	0.3	1.1	0.5	4-Yr Reach Avg	0.6
Reach 2						
1986		0.8	0.6	0.7		0.7
1987		0.7	0.4	0.8		0.6
1988		2.0*	0.4	0.8		1.1
1989		1.0	0.6	0.7		0.7
	4-Yr Transect Avg	1.1	0.4	0.8	4-Yr Reach Avg	0.8
Reach 3						
1986		0.4	1.1	0.4		0.6
1987		1.6	0.8*	0.4		0.6
1988		0.4	1.0	MD		0.7
1989		0.5	1.2	0.5		0.7
	4-Yr Transect Avg	0.7	1.0	0.4	4-Yr Reach Avg	0.7
Reach 4						
1986		0.7	0.9	0.7		0.8
1987		1.0	1.5*	1.4		1.3
1988		0.5	1.0*	1.0		0.8
1989		0.9	0.7	0.7		0.8
	4-Yr Transect Avg	0.8	1.0	0.7	4-Yr Reach Avg	0.8
Reach 5						
1986		0.4	0.6	.0.5		0.5
1987		0.5	0.6	0.5		0.5
1988		0.7	0.8*	0.5		0.7
1989		0.6	1.1	0.7		0.8
	4-Yr Transect Avg	0.6	0.8	0.6	4-Yr Reach Avg	0.6
					Overall Average	0.7

* indicates beaverdam present in transect

MD = missing data
1/ = in feet

Velocity.

Average water velocities ranged from a low of 0.1 foot per second (Table 3) to 2.7 feet per second. Highest average velocities for all three transects occurred during 1986, the pre-project year. The beginning of the current 4-year drought is first evident during the 1987 Yearly Average Velocities for all reaches except Reach 5 in years 1986 and 1987. However, beaverdams were constructed at five transect locations (33 percent) during the period of the study. All five dams decreased the flow as measured at transect stations below the dam.

Three out of 15 pre-treatment transects (33%) had average velocities within the 0.8 to 1.6 fps velocity range that is optimum for juveniles, while 15 out of 42 (36%) post-treatment transect velocities were within optimum, with virtually no difference between pre- and post-project.

TABLE 3
Velocity (feet per second)
Measurements of South Fork of the John Dav River

Year & Reach No.	Transect Velocity1/ #1	#2	A 3	Yearly Avg Reach Velocity1/
Reach 1				
1986	2.7	0.4	2.6	1.9
1987	1.4	0.2*	1.5	1.0
1988	1.2	--	1.3	1.12
1989	1.3	4 A		
4-Yr Transect Avg	1.7	0.3	1.8	4-Yr Reach Avg 1.3
Reach 2				
1986	1.1	1.9	0.9	1.3
1987	0.1	0.3	0.1	0.1
1988	MD	0.6	0.1	0.2
1989	0.4	0.6	0.4	0.4
4-Yr Transect Avg	0.5	0.9	0.4	4-Yr Reach Avg 0.5
Reach 3				
1986	2.4	0.7	2.3	1.8
1987	0.9	0.5*	0.8	0.8
1988	2.4	0.5	1.3	1.4
1989	1.6	0.3	1.2	
4-Yr Transect Avg	1.8	0.5	1.4	4-Yr Reach Avg 1.3
Reach 4				
1986	2.3	1.1	0.8	1.4
1987	0.4	0.1*	0.1	0.2
1988	1.1	0.2*	MD	0.7
1989	0.6	0.8	0.6	0.7
4-Yr Transect Avg	1.1	0.6	0.5	4-Yr Reach Avg 0.8
Reach 5				
1986	1.1	0.8	0.7	0.9
1987	1.1	0.1	1.2	0.8
	0.6	0.1*	0.4	0.4
1988/1989	0.5	0.4	1.0	0.6
4-Yr Transect Avg	0.8	0.4	0.8	4-Yr Reach Avg 0.7
				Overall Average 0.9

*indicates beaverdam present in transect

MD = missing data
1/ = in feet

Thalweg Length. DRAFT

Thalweg lengths are summarized in Table 4. Four-year averages ranged from 299 feet to 354 feet. Greatest variability occurred in Reach 1 which ranged from a high of 379 feet in 1987 to a low of 331 feet in 1989, a decrease of 48 feet.

There is a discrepancy in data at Reaches 3 and 4. In 1986, 1988 and 1989, thalweg lengths under 300 feet were reported. Since each reach is 300 feet long, any smaller measurement is an error. It is possible that the upper and lower boundaries of these reaches may have been erroneously located during these field surveys, or due to a change in personnel, there may have been errors in technique. Field work that is scheduled in 1991 will attempt to identify these errors.

Thalweg Deoth.

Average depths along the thalweg ranged from a low of 0.5 foot in 1986 at Reach 1 to a high of 1.7 feet at Reach 4 in 1987 (Table 4). Greatest average depth of 1.4 feet occurred at Reach 5 in 1986, shallowest depth of 0.5 foot was measured at Reach 1 in 1986. Through all reaches in 1986, the average depth was 0.74 foot; by 1989 the average was 1.2 feet, an increase of 0.46 foot or 62 percent. The overall four-year average for all reaches is 1.1 feet. The trend toward an increase in depth is occurring despite low water years and drought conditions in the John Day River Basin. The scouring action of boulder placement in the river is credited with changing this habitat component. Further field studies will monitor this component. Hopefully, this trend will continue and the goal of establishing optimum depths for juveniles will be achieved.

Thalweg Velocity.

Average thalweg velocities ranged from a high of 3.0 feet per second (fps) at Reach 3 in 1986 to a low of 0.8 foot at Reaches 1 and 5 in 1988 and 1989 respectively. Pre-project combined average velocity was 2.2 fps; post-project combined average velocity (1987 to 1989) was 1.2 fps, a 54.5% decrease. This could be attributed to below average flows and drought conditions. The post-project combined average was within the desired range of 1.0 to 3.0 fps as reported by Binns (1982). Only in 1988 was thalweg velocity consistently below the desired range at all five reaches, and only twice did this occur, once in Reach 4 (1987) and in Reach 5 (1989).

TABLE 4
Thalweg Length, Depth and Velocity of the South Fork of the John Dav Basin

Year & Reach #		Thalweg Length*	Thalweg Death*	Thalweg Velocity/
Reach 1				
1986		337	0.5	2.6
1987		379	1.2	1.7
1988		367	0.9	0.8
1989		331	1.2	1.3
	4-Yr Average	354	1.0	1.6
Reach 2				
1986		316	0.7	2.2
1987		319	0.7	1.7
1988		324	0.9	0.7
1989		327	1.1	1.3
	4-Yr Average	322	0.9	1.5
Reach 3				
1986		297	1.1	3.0
1987		310	1.1	1.7
1988		295	0.7	1.5
1989		295	1.2	1.4
	4-Yr Average	299	1.0	1.9
Reach 4				
1986		296	1.1	1.9
1987		321	1.7	0.7
1988		298	0.9	0.8
1989		303	1.2	1.4
	4-Yr Average	305	1.2	1.2
Reach 5				
1986		317	1.4	1.4
1987		320	1.3	1.4
1988		324	1.3	0.8
1989		320	1.3	0.8
	4-Yr Average	320	1.3	1.1

*feet

1/ fps

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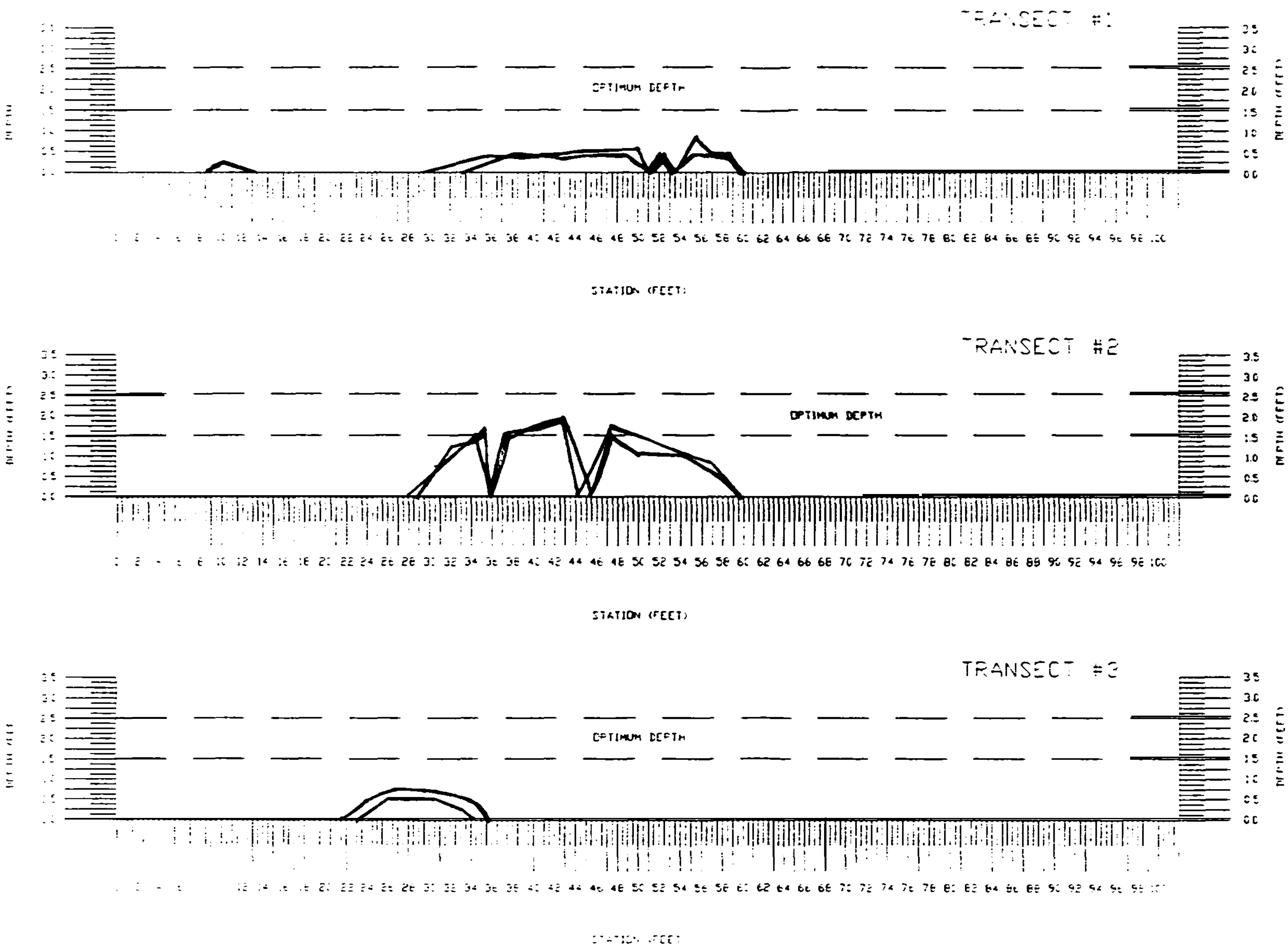
Bottom Profile

This data element was not reported or discussed in the 1986 or 1987 reports. However, the data for 1987 and 1989 is available and has been drawn in Figures 3-7 as an inverse channel. This was done to compare channel trends toward an increase in depth. The range of optimal depths for juvenile steelhead ranges from 1.5 to 2.5 feet and as can be seen, there is a positive trend in depth in 11 out of 15 transects.

Only Reach 4 illustrates the process of aggrading or filling of the stream channel. This is probably the normal hydrologic function of the river at this segment. Transect 2, Reach 1, appears to be stable between the two sample dates. Interestingly, the inverse spikes betwen 1987 and 1989 are nearly identical. These spikes portray the presence of large bolders and their similarity indicates that these bolders have not moved since 1987. This pattern of superimposing spikes reappears in all reaches.

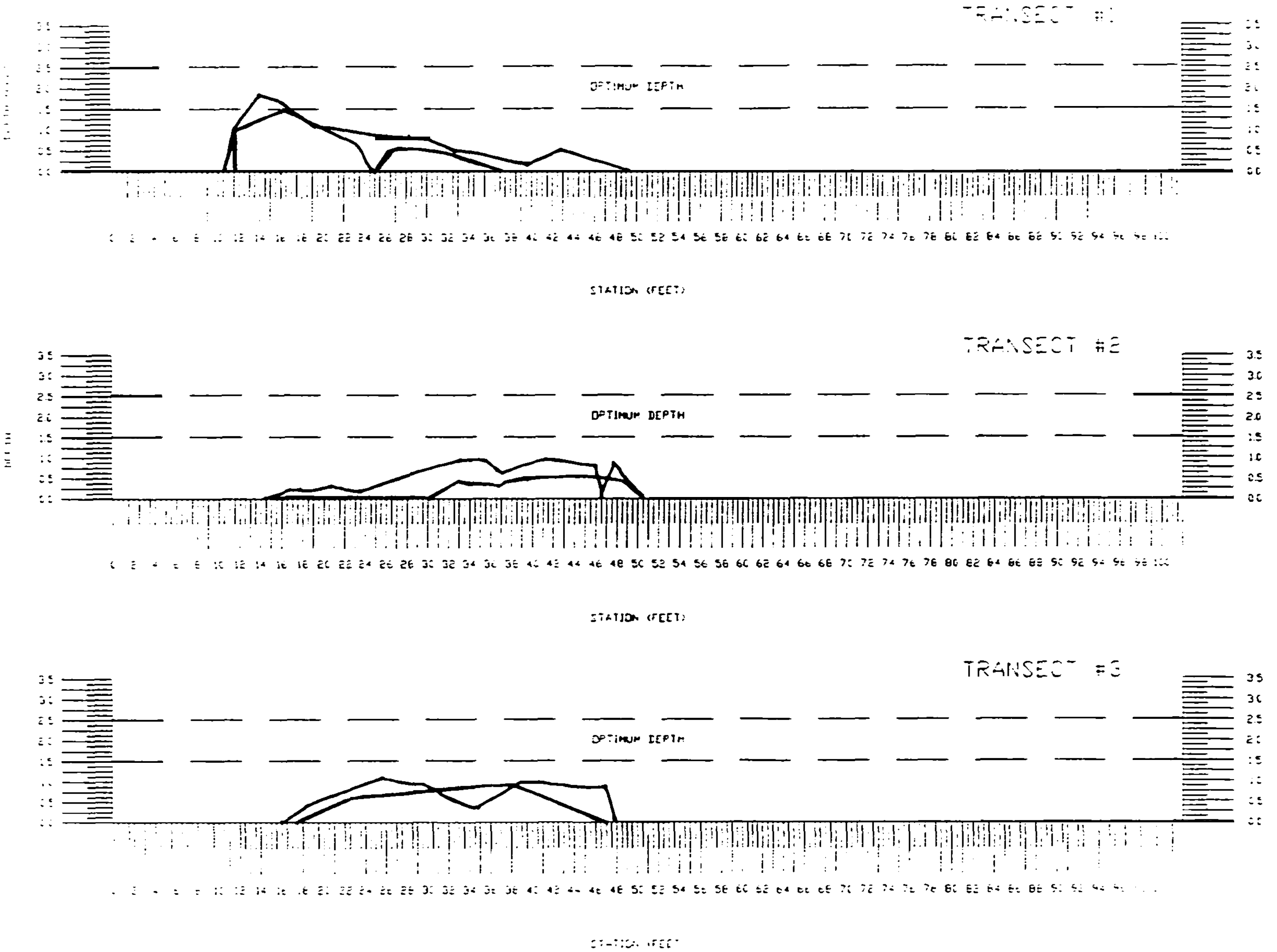
Overall, there is an increase in the complexity of the stream bottom which has increased the amount of instream cover for steelhead.

FIGURE 3. Bottom Profile of Reach 1
South Fork John Day River
1986-1989



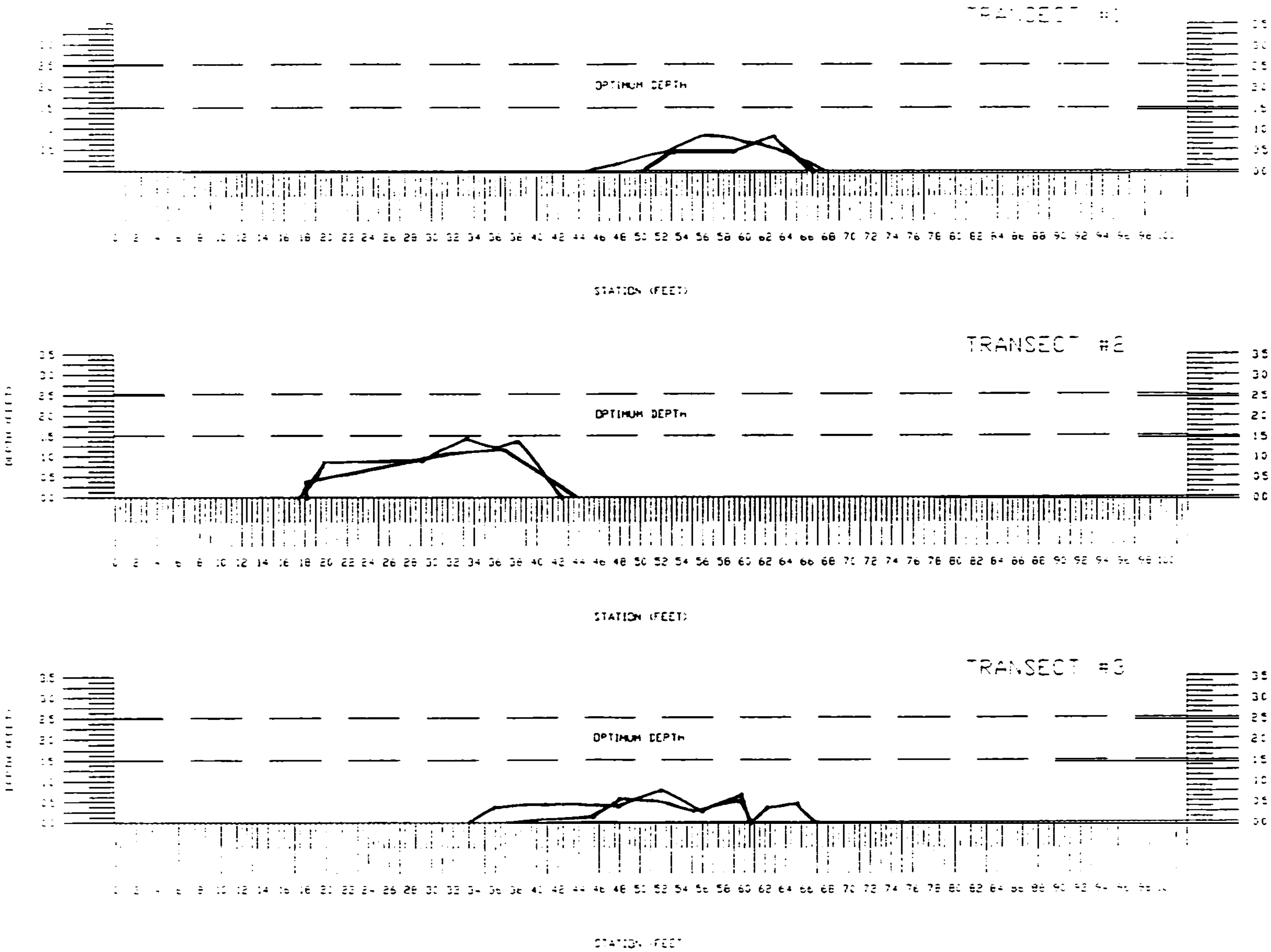
Red line = 1989
Green line = 1987

FIGURE 4. Bottom Profile of Reach 2
South Fork John Day River
1986-1989



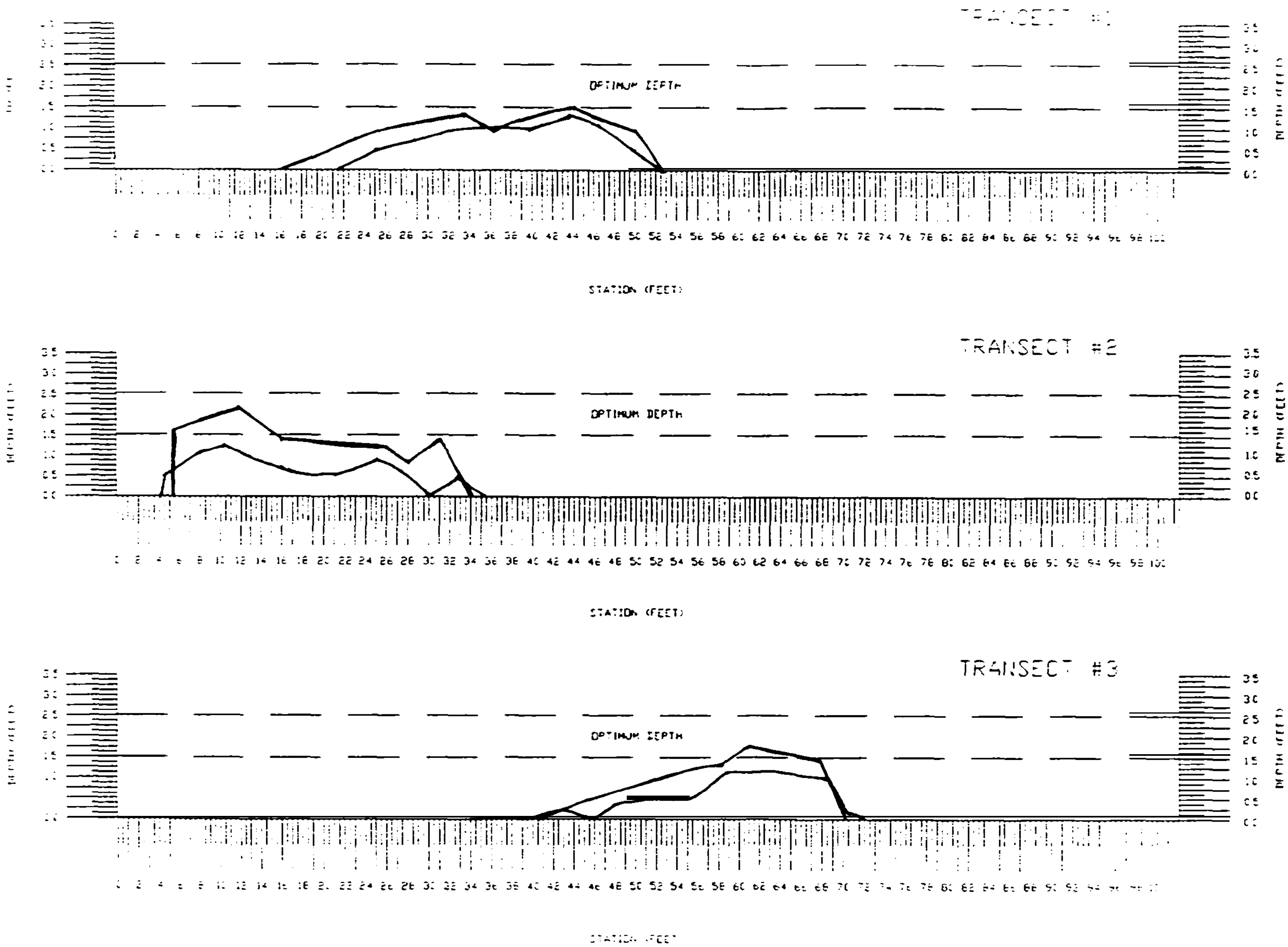
Red line = 1989
Green line = 1987

FIGURE 5. Bottom Profile of Reach 3
South Fork John Day River
1986-1989



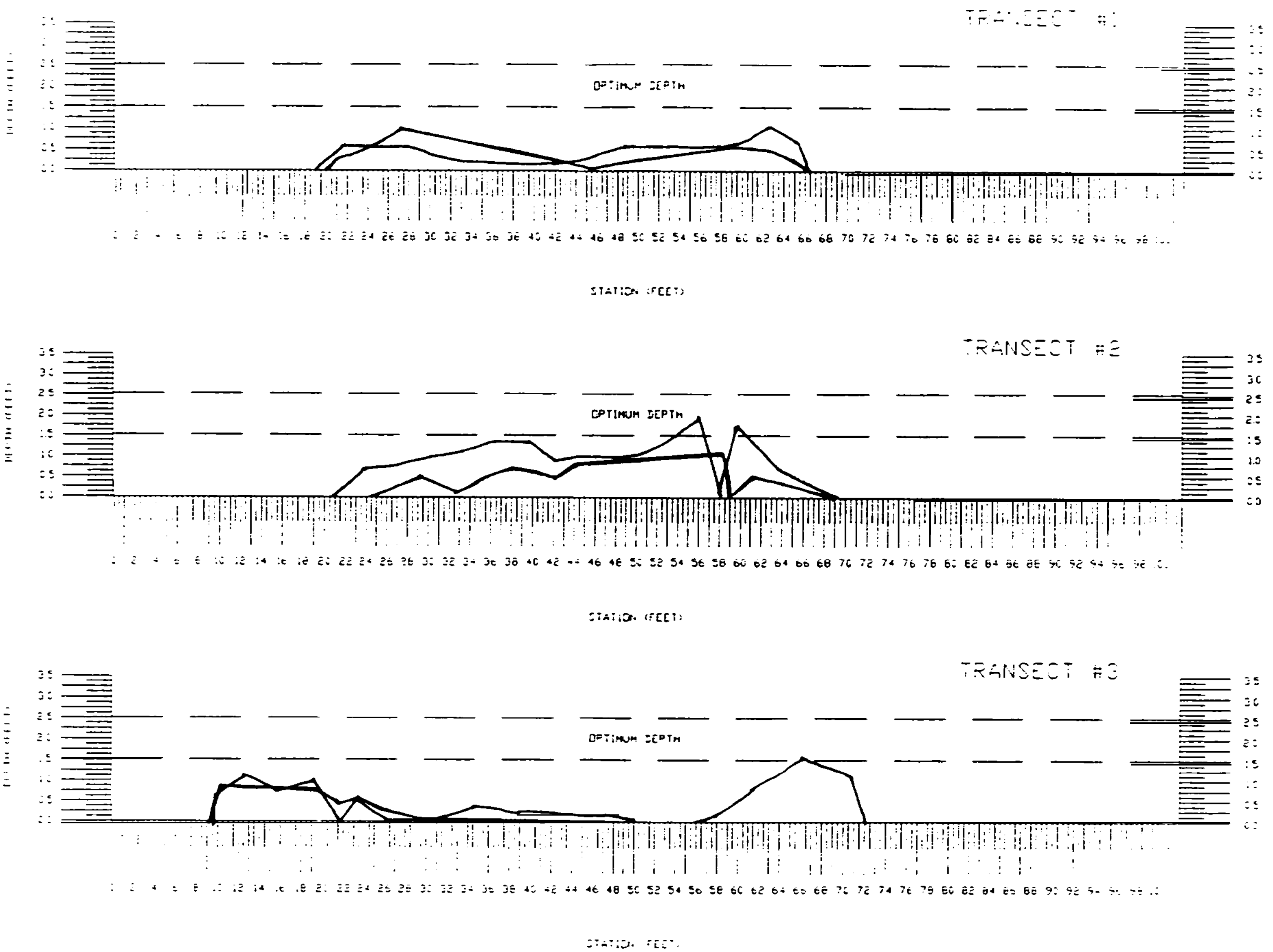
Red line = 1989
Green line = 1987

FIGURE 6. Bottom Profile of Reach 4
South Fork John Day River
1986-1989



Red line = 1989
Green line = 1987

FIGURE 7. Bottom Profile of Reach 5
South Fork John Day River
1986-1989



Red line = 1989
Green line = 1987

Substrate

Substrates in all sample reaches were composed of cobble, sand/silt and gravel. Four years of substrate composition monitoring are summarized in Table 5. It is very difficult to discern a specific trend. This is due to changes in field personnel during the four-year study and some differences in definition of the various substrate components. Rather than interpret the historical field records, the following definitions are provided and should serve as the basis for future data analysis and acquisition.

Type	Size
Large Boulders,	3 feet or greater
Small Boulders,	1 to 3 feet
Large Cobble,	6 to 12 inches
Small Cobble,	3 to 6 inches
Course Gravel,	1 to 3 inches
Fine Gravel,	0.1 to 1 inch
Sand/Silt,	less than 0.1 inch

TABLE 5
Transect Substrate Composition by Percent

Year & Reach No.	Transect 1 S	G	C	B	Transect 2 S	G	C	B	Transect 3 S	G	C	B	Average S	G	C	B
Reach 1																
1986	20	0	80	0	17	0	83	0	0	0	100	0	12	0	88	0
1987	20	20	40	20	33	0	44	23	34	0	66	0	29	7	50	14
1988	18	0	72	9	13	0	63	25	0	0	100	0	10	0	78	11
1989	6	56	25	13	50	0	30	20	0	40	60	0	2	32	38	11
Reach 2																
1986	0	0	100	0	0	0	100	0	67	0	33	0	22	0	78	0
1987	14	0	71	14	8	17	67	8	67	0	33	0	30	6	57	7
1988	100	0	0	0	12	88	0	0	75	0	25	0	62	30	8	0
1989	25	17	50	8	0	21	57	21	43	14	43	0	23	17	50	10
Reach 3																
1986	0	0	100	0	88	0	12	0	10	0	90	0	33	0	67	0
1987	0	0	100	0	66	0	33	0	0	0	83	17	22	0	72	6
1988	0	0	100	0	100	0	0	0	0	0	75	25	33	0	58	9
1989	0	0	100	0	40	20	40	0	11	33	44	33	17	18	19	11
Reach 4																
1986	37	0	63	0	67	0	33	0	89	0	11	0	64	0	36	0
1987	43	0	43	14	83	0	17	0	75	0	25	0	67	0	28	5
1988	25	75	0	0	50	0	50	0	71	29	0	0	49	35	16	0
1989	25	38	25	12	66	17	17	0	36	50	14	0	42	35	19	4
Reach 5																
1986	60	0	40	0	100	0	0	0	63	0	37	0	74	0	26	0
1987	37	0	63	0	18	9	64	9	43	0	57	0	33	3	61	3
1988	20	80	0	0	45	18	27	9	44	44	0	12	36	47	9	7
1989	0	100	0	0	57	36	0	7	52	24	18	6	36	53	6	4

S - Sand
G - Gravel
C - Cobble
B - Boulder

Pool/Riffle Ratio.

Table 6 summarizes pool/riffle ratios by reach and by year. Pre-project pool/riffle ratios exceeded the ideal 50:50 in Reaches 1, 3 and 4. Reach 3 and 5 were predominantly riffle habitat with ratios of 3:97 and 31:69 respectively. Only Reach 2 showed a significant change in 1987 from 3:97 to 20:80. In 1988, no data was reported. In 1989, ratios approached the 50:50 goal at Reaches 1, 2, 4 and 5. Only Reach 3 showed a trend toward increasing pool habitat as evidenced by a 72:38 ratio. This was caused in part by the project coupled with the construction of a beaverdam. Beaverdams also were present and presumably influential in establishing pool habitat in Reaches 1, 2 and 4.

TABLE 6
Pool Riffle Ratio by Stream Reach and Year for South Fork of the John Dav River

Reach No. & Year	Pool Riffle Ratio[1]
Reach 1	
1986	64:36
1987	64:36
1988	MD
1989	53:47
Reach 2	
1986	3:97
1987	20:80
1988	MD
1989	47:53
Reach 3	
1986	63:37
1987	63:37
1988	MD
1989	72:28
Reach 4	
1986	76:24
1987	76:24
1988	MD
1989	54:46
Reach 5	
1986	31:69
1987	31:69
1988	MD
1989	66:34

1/Data based on qualitative visual estimates.

MD = missing data

cutbank differently and considered it to be eroding.

DRAFT

Instream Cover.

Instream cover was visually estimated in 1986 and again in 1987. In 1987, cover ranged from 9.1 to 11.5 percent of the total surface area. All five study reaches combined exhibited an overall average of 10.2 percent cover to total surface area. This is approximately 68 percent of the minimum of 15 percent considered to be adequate for juveniles (Raleigh, 1984). This represents an increase over 1986 conditions ranging from 58 percent in Reach 1 to 30 percent in Reach 2 with an overall increase of 122 percent for all study reaches combined. This increase was almost entirely due to bolders placed in the river in 1986. No data is available for 1988 and 1989.

Streambank Erosion.

Pre-project streambank erosion ranged from a low of 8.5 percent (Table 7) at Reach 3 to 50 percent at Reach 4. Healthy stream systems are characterized by a limited range of erosion, less than ten percent. Only Reaches 3 and 5 were indicative of a healthy system, although Reach 1 with only 23.8 percent showed immediate potential for improvement. The first year following the project, three out of five reaches had demonstrated a trend toward streambank improvement as erosion dropped below 20 percent.

Bank erosion at Reach 4 ranged from 50 feet in 1986 to 0 foot in 1987, and back to 71.3 feet in 1989. No data was collected in 1988. The reason for this difference is probably due to changes in field personnel. In the 1987 report, the west bank was described as "actively eroding a 4 to 6-foot high cutbank". Along this reach, boulders were placed in groups next to this cutbank in an attempt to protect the bank as well as provide instream cover. The cutbank started to heal in 1987. This was probably the basis for not measuring it as an eroded bank. However, a different field crew viewed that

TABLE 7
Bank Erosion by Stream Reach and Year
for South Fork of the John Day River

Reach No. & Year	Eroding Bank Feet	Eroding Bank A - -
Reach 1		
1986	143	23.8
1987	105	17.5
1988	MD	MD
1989	59	9.8
Reach 2		
1986	199	33.2
1987	189	31.5
1988	MD	MD
1989	71	11.8
Reach 3		
1986	51	8.5
1987	39	6.5
1988	MD	MD
1989	27	4.5
Reach 4		
1986	300	50
1987	0	0
1988	MD	MD
1989	428	71.3
Reach 5		
1986	0	0
1987	0	0
1988	MD	MD
1989	0	0

MD = missing data

Recommendations

The following recommendations are made in order to improve monitoring efficacy.

1. Conduct a microhabitat evaluation (Hankin and Reeves 1988) and correlate data with transect data currently being obtained.

2. Classify reaches according to Rosgen's, 1985, nomenclature.

3. Conduct snorkeling inventories to document habitat uses by steelhead in the project area and random sites along the South Fork. Compare and contrast habitat use areas.