March 1990

YAKIMA/KLICKITAT PRODUCTION PROJECT PRELIMINARY DESIGN REPORT

APPENDIX C: YAKIMA AND KLICKITAT PRELIMINARY ENGINEERING REPORTS

DOE/BP-00245-4

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YAKIMA/KLICKITAT PRODUCTION PROJECT PRELIMINARY DESIGN REPORT

APPENDIX C:

YAKIMA AND KLICKITAT PRELIMINARY ENGINEERING REPORTS

**Yakima River Basin
Salmon and Steelhead Facilities
Preliminary Design Report**

BY
CH2M Hill

**Klickitat Salmon and Steethead Hatchery
Preliminary Design Report**

By
R. W. Beck and Associates

Prepared for:

**Tom Clune, COTR
Bonneville Power Administration
Division of Fish and Wildlife
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Portland, Oregon 97208-3621**

March 1990

YAKIMA RIVER BASIN

SALMON AND STEELHEAD FACILITIES

PRELIMINARY DESIGN REPORT

Prepared for

BONNEVILLE POWER ADMINISTRATION

by

CH2M HILL
February 1990

CONTENTS

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Chapter 1
INTRODUCTION

AUTHORIZATION

This preliminary design report was prepared by CH2M HILL Northwest, Inc. for the Bonneville Power Administration (BPA) under contract DE-AC79-89BP96455 dated December 1988. The broad scope of the contract was to provide engineering services for studies and preliminary designs for salmon and steelhead facilities in the Yakima River Basin in South Central Washington.

PURPOSE

The purpose of the predesign was to finalize the nature and location of various fish-production facilities in the Yakima Basin in a coordinated fashion that is consistent with the Yakima and Klickitat Rivers Central Outplanting Facility Master Plan (FMC, 1987) and the Report on Refined Project Goals and Management Plan for the Yakima/Klickitat Production Project (May 1989). In essence, this predesign report is intended to form a bridge between the extensive study and planning done on the project prior to 1989 and the final detailed design, which is planned to start in mid-1990.

The majority of this report is devoted to the production component of the Yakima Basin program. Fish culture programming and vessel requirements are followed by detailed descriptions of individual fish culture facilities. The production goals and rearing vessel size were developed with specific input from the Experimental Design Work Group (EDWG), which deals exclusively with the experimental requirements of the program.

This report will be periodically updated and expanded during the final design process. At this point, there are still several water supply-related issues which remain unresolved. None of these, however, will result in a change in location of the selected sites or the production goals. As these and other unresolved issues, such as flood plain boundaries at some sites, are resolved during final design, they will be incorporated into this document, which will then take the form of the project design memorandum.

ACKNOWLEDGMENTS

We would like to acknowledge the assistance of the BPA project team, staff of the Yakima Indian Nation, members of the Hatchery Technical Work **Group,** EDWG, and the Bureau of Reclamation (USBR). We also acknowledge the invaluable contribution of our consultant, Mr. Harry Senn, of Fish Management Consultants (FMC) for his development of the fish culture program and the hatchery management plan for the Yakima Basin.

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Chapter 2

FISH CULTURE REQUIREMENTS

INTRODUCTION

This chapter describes the biological and physical fish culture requirements of the hatchery system from which the concepts for the design are formulated. It includes a discussion of the program goals for fish production in the Yakima Basin followed by a brief summary of selected sites. The biological criteria are presented for the water system, adult holding, incubation, rearing, and finally transportation and release. The biological criteria address the water and space requirements, the number and type of vessels, and the related support requirements. To be assured that the components of the system meet all program demands, each life phase from adult capture to the juvenile or smolt transfer into the acclimation sites is analyzed.

PROGRAM GOALS

PRODUCTION GOALS

The goal of the Yakima Basin production program is to produce high quality smolts in the required number and at the required locations to meet the objectives of supplementation within the guidelines of the experimental design. The agreed-to production goals by species, subbasin, and numbers of experimental groups are as shown in Table 2-1.

Table 2-1
YAKIMA RIVER BASIN
PRODUCTION GOALS

Species	Number	Size	Pounds of Production	Number of Experimental Groups
Upper Yakima Spring Chinook	1,150,000	151b	76,667	15
Naches Spring Chinook	450,000	15/lb	30,000	6
Naches Summer Chinook	200,000	15/lb	13,333	N/A
Naches Summer Steelhead	400,000	7/lb	57,143	12
Fall Chinook	3,600,OOO	65flb	55,385	18
Lower Yakima Coho	1,550,000	15flb	103,333	3
Naches Coho	450.000	15nb	30,000	6
Total	7,800,OOO		365,861	

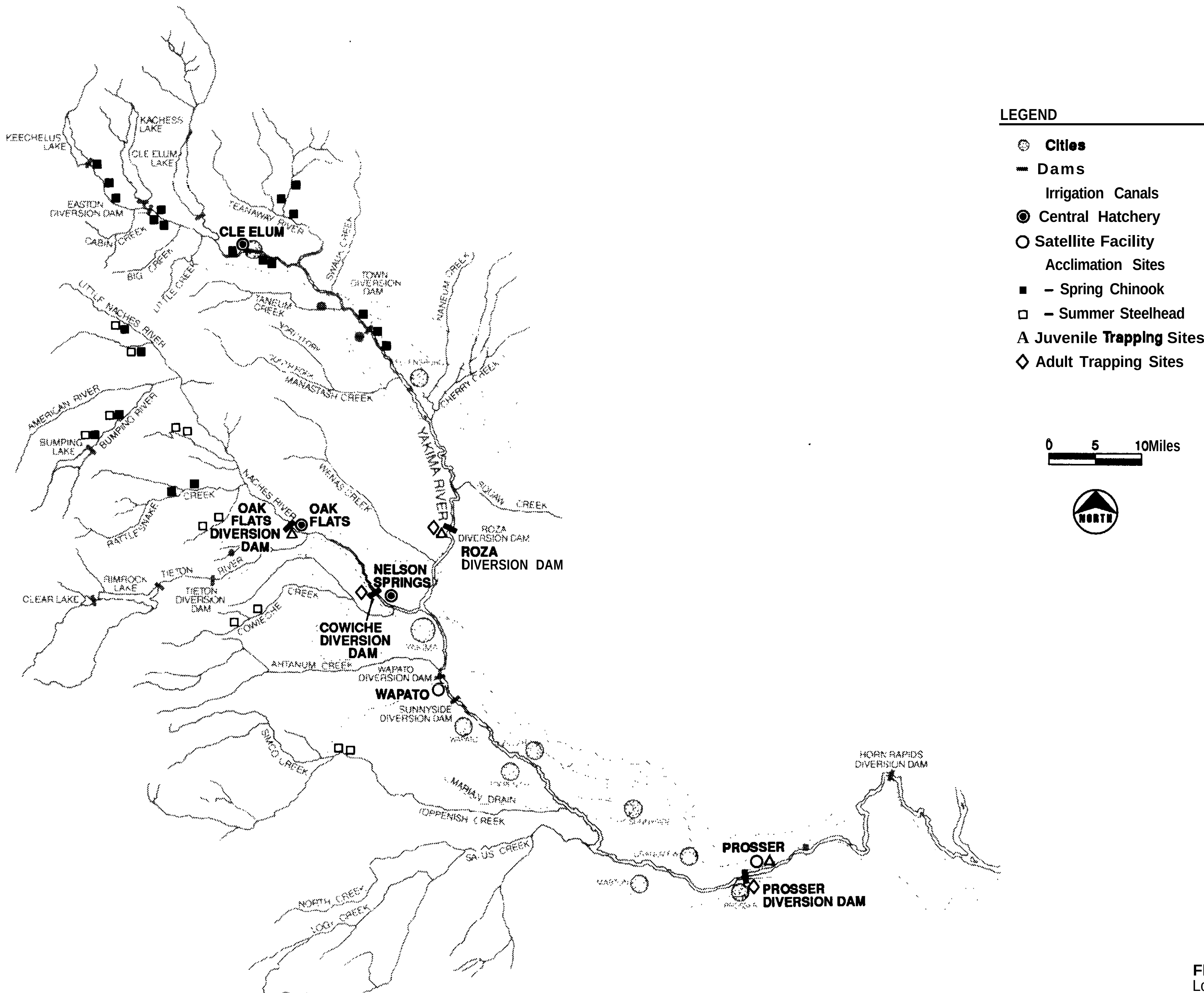

FIGURE 2-1
Location Map
Yakima Basin
Enhancement Facilities

The data presented in Table 2-1 are slightly different than shown in previous reports but are generally consistent with the Master Plan and reflect EDWG's most recent requirements for production and experimental design. These production goals are equivalent to what was referred to in the Master Plan as Year 10 goals. EDWG is preparing a separate report that will explain the rate at which the program will develop to meet these ultimate Year 10 goals. For the purposes of this report, facilities will be designed and constructed to accommodate smolt production at the Year 10 levels shown in Table 2-l.

FACILITY SITING

The Draft Environmental Assessment (EA) prepared by BPA in 1989 explains all of the facilities and alternative sites considered in the Yakima Basin. This report will concentrate on those sites finally selected for use in the Yakima Basin program. Table 2-2 lists the various facilities required for the program.

The adult and juvenile trapping facilities are the subject of a separate predesign report being prepared by the Yakima Basin Passage Work Group. Figure 2-l was taken from the EA and modified to show the locations of the above-listed facilities. At this time, the specific locations of the acclimation sites have not been finalized but the locations shown on Figure 2-l represent EDWG's most recent plan for the respective stream reaches for acclimation and release.

Table 2-2
YAKIMA RIVER BASIN
FISH FACILITIES

Central Hatcheries

Oak Flats
Cle Elum
Nelson Springs

Satellite Facilities

Wapato
Prosser

Acclimation Sites

12-Summer Steelhead
15-Upper Yakima Spring Chinook
6-Naches Spring Chinook

Adult Trapping Sites

Roza Dam
Cowiche Diversion
Prosser Dam

Juvenile Trapping Sites

Roza Dam
Oak Flats Division
Prosser Dam

FISH CULTURAL CRITERIA

WATER QUALITY AND QUANTITY

The most important criteria for the fish culture program are water quality and quantity. A brief discussion of water quality and quantity is presented below. A companion document prepared by the USBR contains detailed information on the suitability of the selected sites to meet these criteria.

Water Quality

The general water quality guidelines for fish culture facilities is taken from the Alaska Department of Fish and Game (1983). The USBR water supply report will compare the recorded water quality at each site with the Alaska criteria. Several criteria have been agreed upon in the hatchery design that relate to disease control. These include:

- The initial incubation of all eggs will be on disease-free water, e.g., spring or well water. Isolation in bucket incubators is suggested initially for steelhead and may be expanded for further use for chinook at a later time.

- Rearing will be conducted only with first pass water with the exception of coho and only in the event that site water supply constraints require it.

- Second or third pass water can be used for holding adults if site specific water supply constraints require it.

- To reduce stress and potential disease outbreaks, dissolved oxygen gas in the water shall remain 7.0 mg/l or above. Thus, inflowing water or second pass water should be returned to near saturation.

- The rearing of steelhead in raceways or troughs shall be physically isolated from chinook to reduce the chance of disease-bearing water from being easily transferred, e.g., raceways should not have common walls between steelhead and chinook.

Water temperature is a critical parameter for the programming of fish culture. If the desired water temperature cannot be reached from existing sources, water chilling may be required. The water temperature which was assumed to be available at each site is documented in the computer output in Appendix A. These data were taken from existing records and in some cases specific onsite measurements by the USBR. The USBR water supply report presents all available temperature data.

Water Quantity

Based on available temperature data and the program goals at each site, the desired maximum flow rate for fish culture at each site was calculated and is shown in Table 2-3. Appendix A shows calculated flow and space requirements by species and the desired practical flow rates for normal hatchery operations. These desired flow rates will be compared with the actual available flow rates in the USBR water supply report.

Table 2-3
YAKIMA RIVER BASIN
FISH CULTURE FACILITIES
DESIRED FLOW RATES

Site	Flow (in CFS) Surface Water	Well Water	Total
Central Hatcheries			
Oak Flats	44	5	49
Cle Elum	17	7	24
Nelson Springs	10	1	11
Satellite Facilities			
Wapato	60	0	60
Prosser	14	1	15
Acclimation Sites			
Each Pond	1.2	0	1.2

FISH PROGRAMMING

The programming of each fish species by subbasin and facility in the Yakima River Basin was accomplished by FMC using a computer program which they specifically developed for this purpose. The computer program yields space, flow, and food requirements, as well as estimated pollution levels generated by fish culture activities. The detailed computer output is contained in Appendix A. This section deals with the schedule of fish by species, subbasin, and site.

SCHEDULES

Figure 2-2 shows the schedule of fish production by species for a single generation of fish. For clarity, the second generation was not shown. Figure 2-3 shows the same information presented in Figure 2-2 but rearranged by site. Again, no attempt was made to show the second generation of fish. Study of Figures 2-1, 2-2, and 2-3 should make it very clear that this is a complex fish culture program requiring a substantial amount of central control and management, and a significant amount of fish-transfer logistics. This will be discussed later in this chapter.

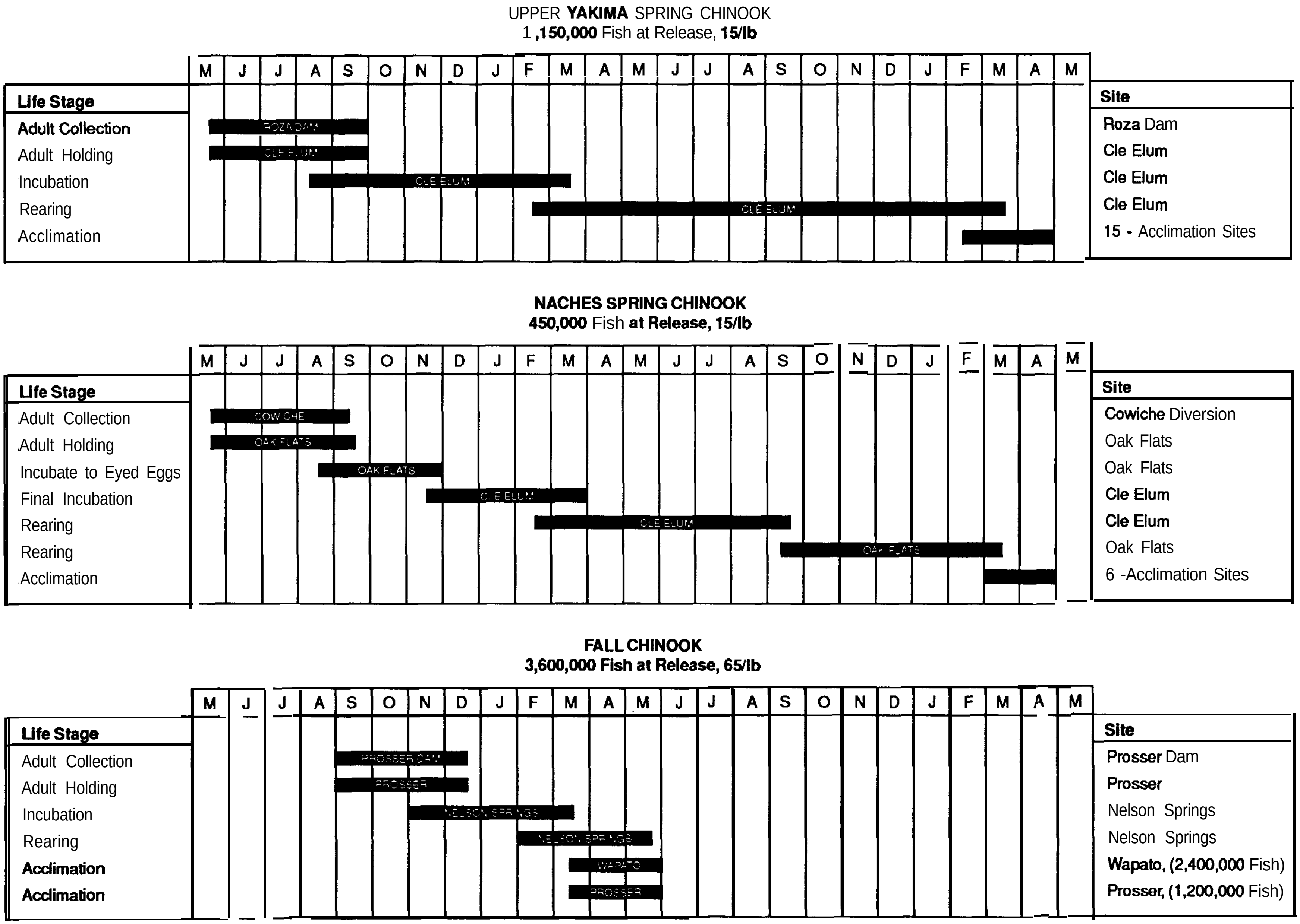

FIGURE 2-2
Yakima Basin
Fish Culture Schedule
by Species

NACHES SUMMER CHINOOK
200,000 Fish at Release, 15/lb

M J J A S O N D J F M A M J J A S O N D J F M A M

Life Stage	Site
Adult Collection	Cowiche Diversion
Adult Holding	Oak Flats
Incubation	Oak Flats
Rearing/Acclimation	Oak Flats

COHO
2,000,000 Fish at Release, 15/lb

M J J A S O N D J F M A M J J A S O N D J F M A M

Life Stage	Site
Adult Collection	Prosser Dam
Adult Holding	Prosser
Incubation	Oak Flats
Rearing	Oak Flats
Acclimation	Oak Flats (450,000 Fish)
Acclimation	Wapato (1,550,000 Fish)

SUMMER STEELHEAD
400,000 Fish at Release, 7/lb

M J J A S O N D J F M A M J J A S O N D J F M A M

Life Stage	Site
Adult Collection	Cowiche Diversion
Adult Holding	Nelson Springs
Incubation	Nelson Springs
Early Rearing (Inside)	Nelson Springs
Rearing	Nelson Springs
Acclimation	6 -Acclimation Sites (200,000 Fish)
Rearing	Nelson Springs
Acclimation	Oak Flats
	6 -Acclimation Sites (200,000 Fish)

FIGURE 2-2 (Continued)
Yakima Basin
Fish Culture Schedule
by Species

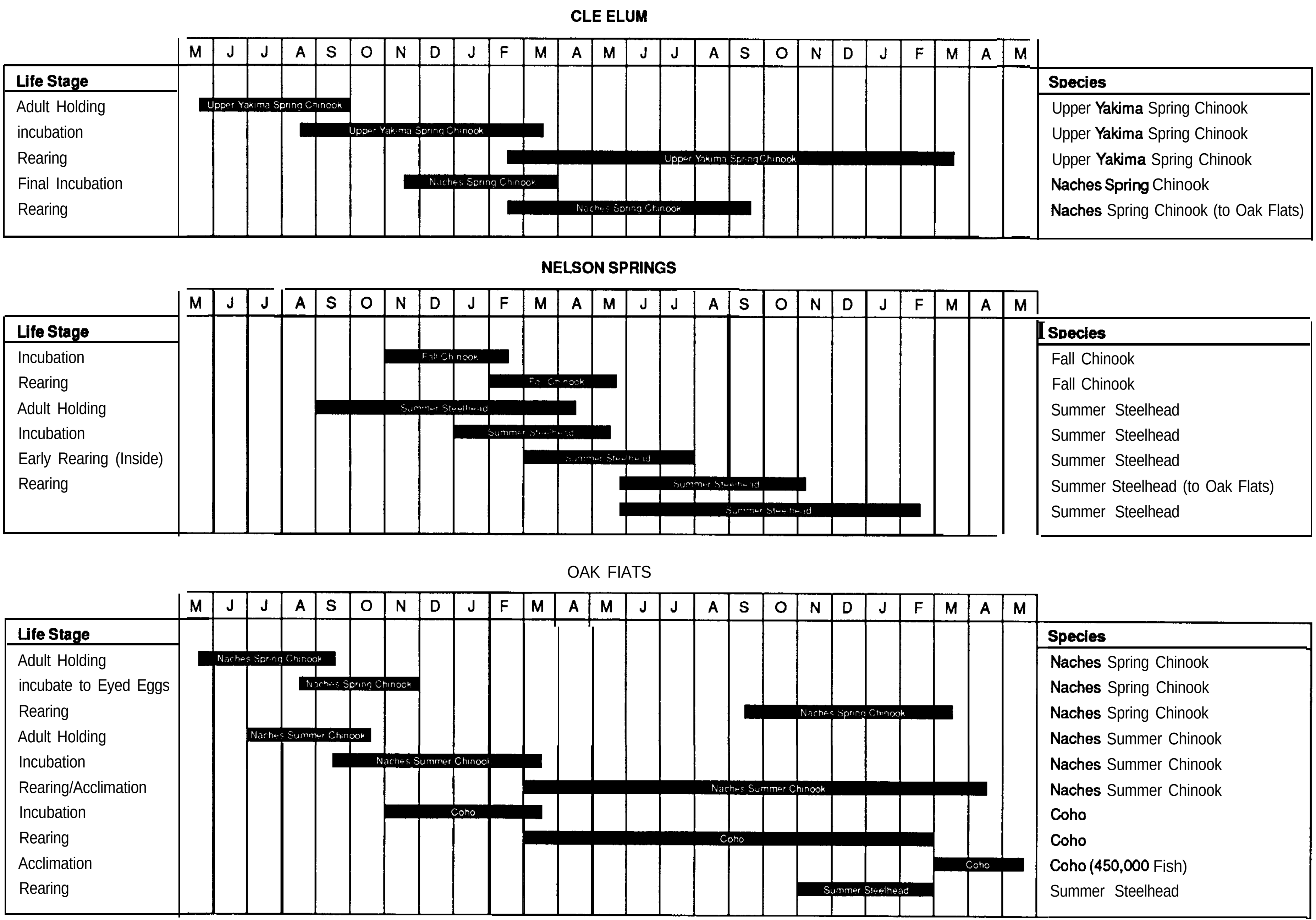

FIGURE **2-3**
Yakima Basin
Fish Culture Schedule
by Site

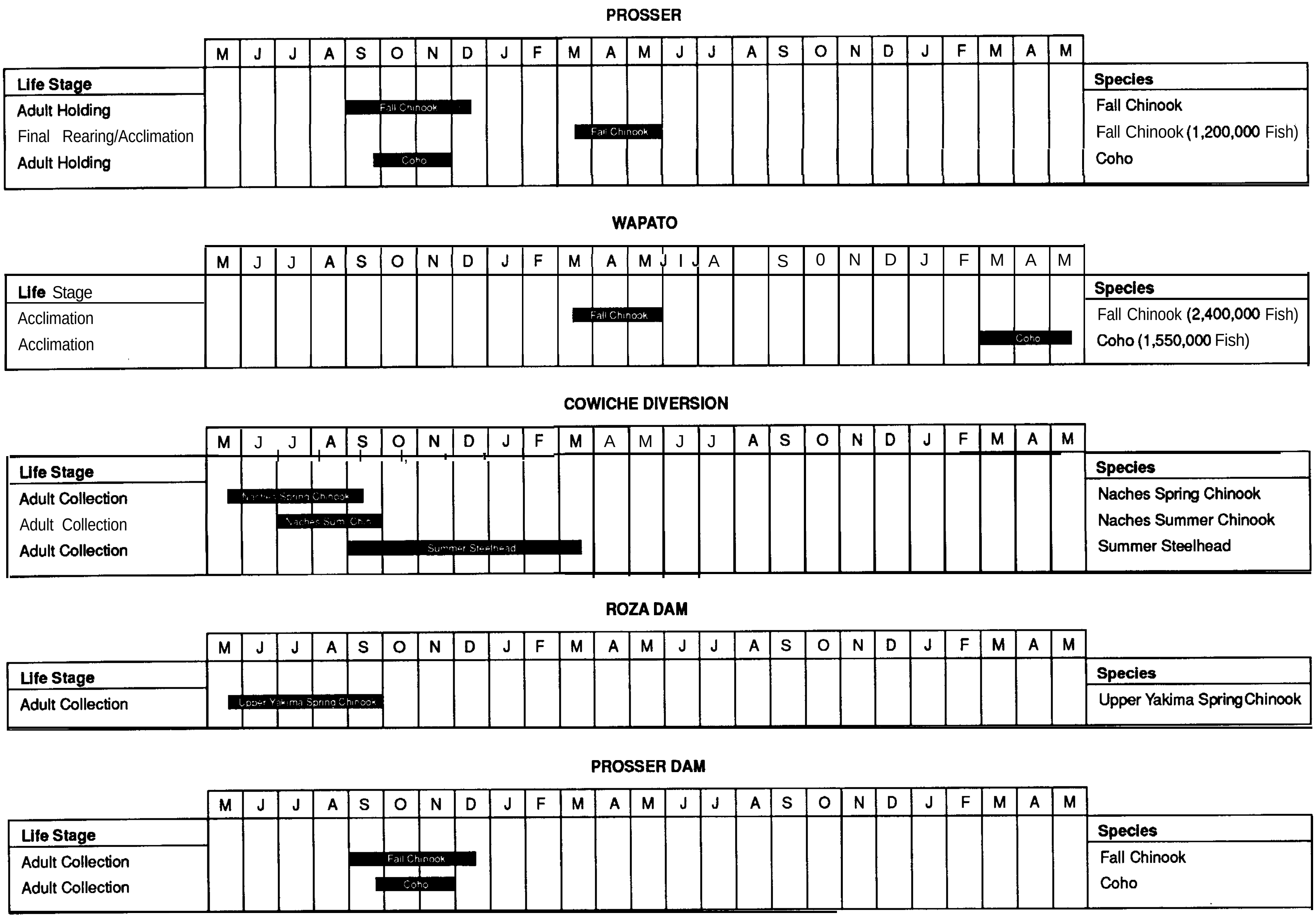

FIGURE 2-3 (Continued)
Yakima Basin
Fish Culture Schedule
by Site

VESSELS

The programming was based on a discrete number of experimental groups within each stock of fish. Standardized vessels are used throughout the Yakima Basin to allow for the handling of these discrete experimental groups. The details of these vessel requirements and vessel design are presented later in this chapter. As an overview of the programming, however, we have prepared Figures 2-4 through 2-11 to show the vessel and flow usage for both rearing and incubation by station. These schedules include the second generation fish because of the potential for overlapping space and flow requirements.

Figures 2-2 through 2-11 summarize the essence of programming for the Yakima Basin and have received careful review by all concerned parties. The remainder of this chapter is devoted to the details which lead to the development of these figures.

LIFE-STAGE CRITERIA

The programming of the fish from adult capture to smolt release is presented in this section, Table 2-4 presents a summary of the numbers of fish at each life stage for the Yakima River Basin program. Additional details on adult holding and spawning, incubation and rearing are presented in the following sections.

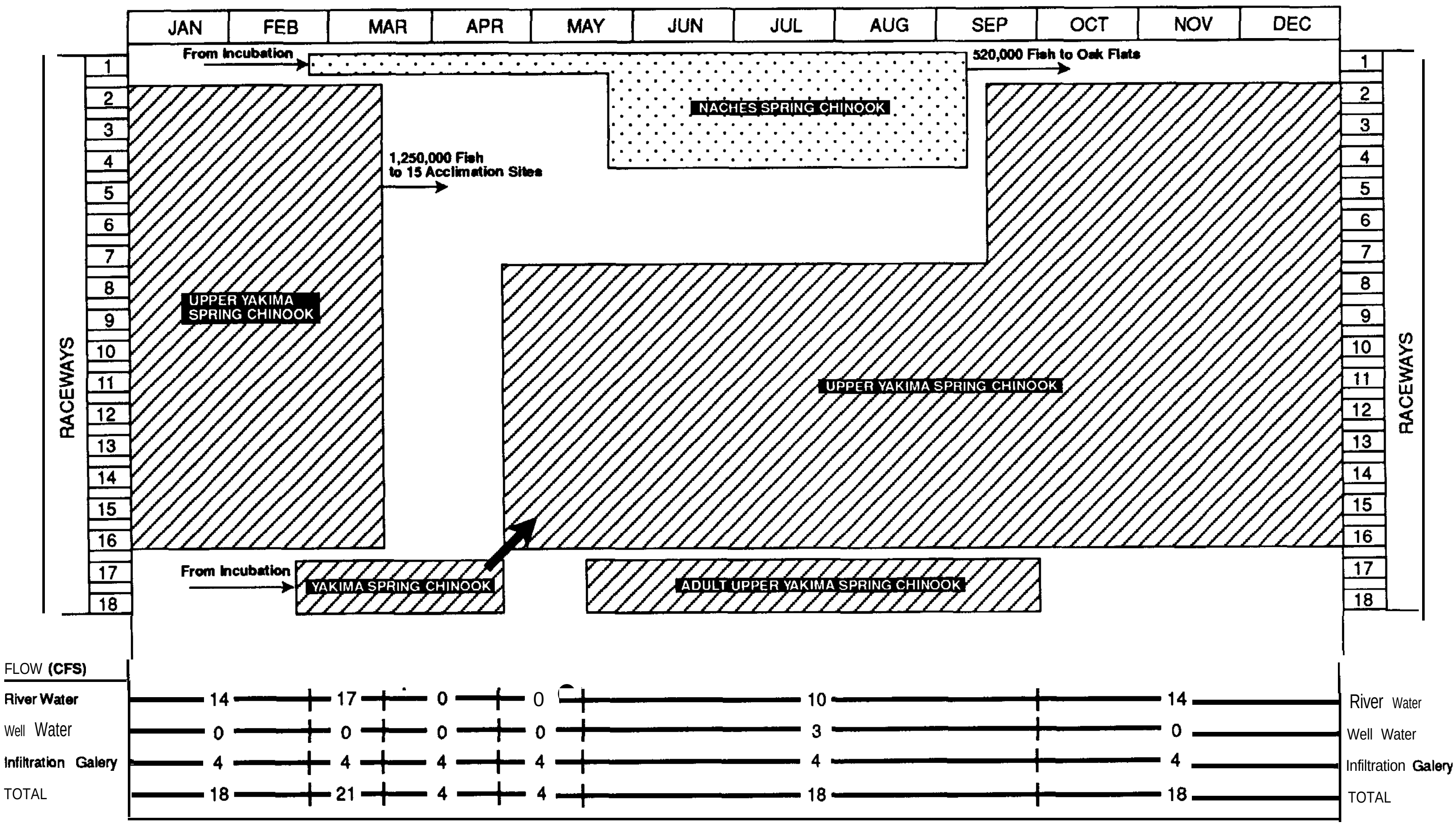

FIGURE **2-4**
Cle Eium Central Hatchery
Upper Yakima and Naches Spring Chinnok
Rearing

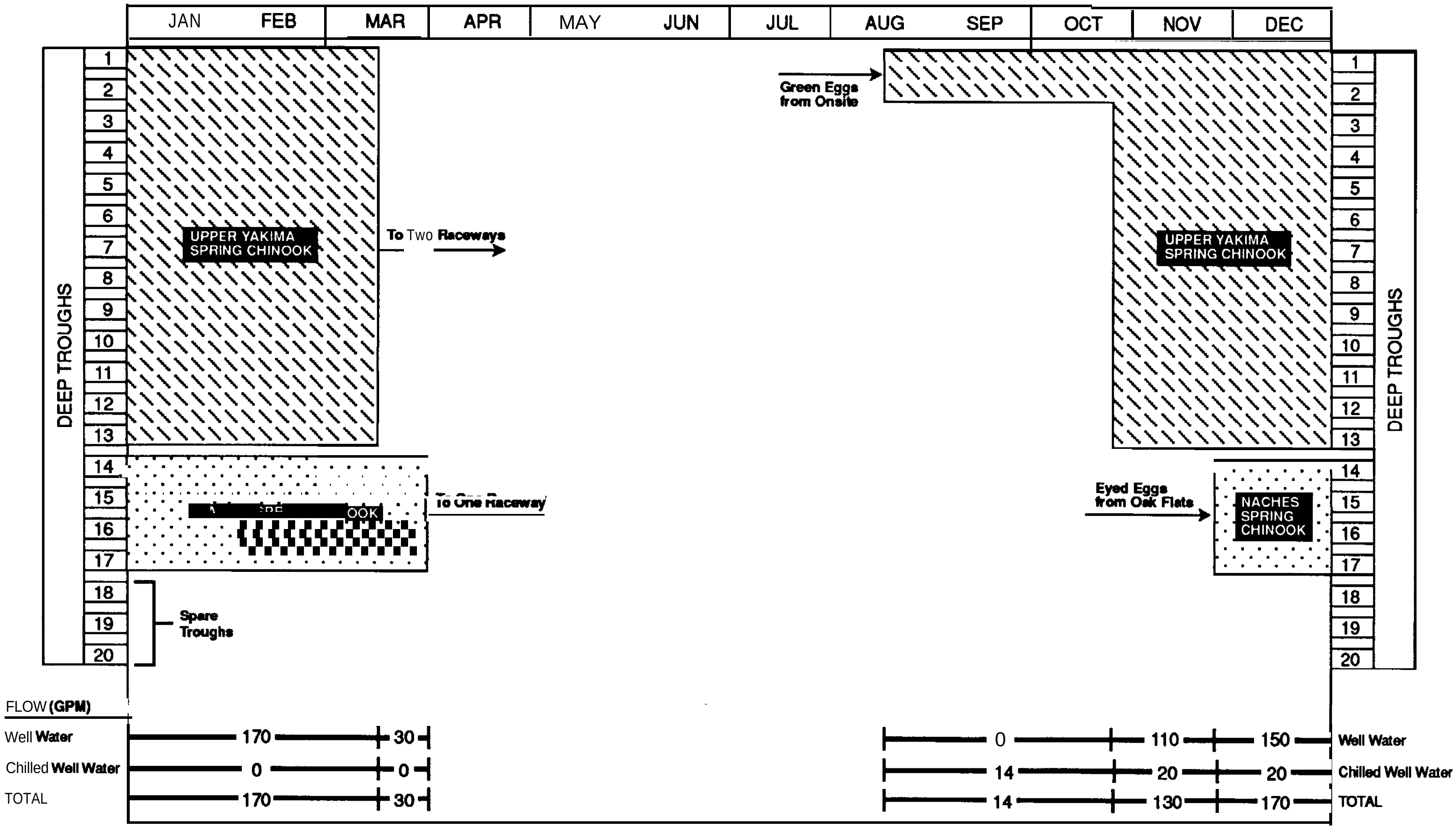

FIGURE 2-5
Cle Elum Central Hatchery
Upper Yakima and Naches Spring Chinook Incubation

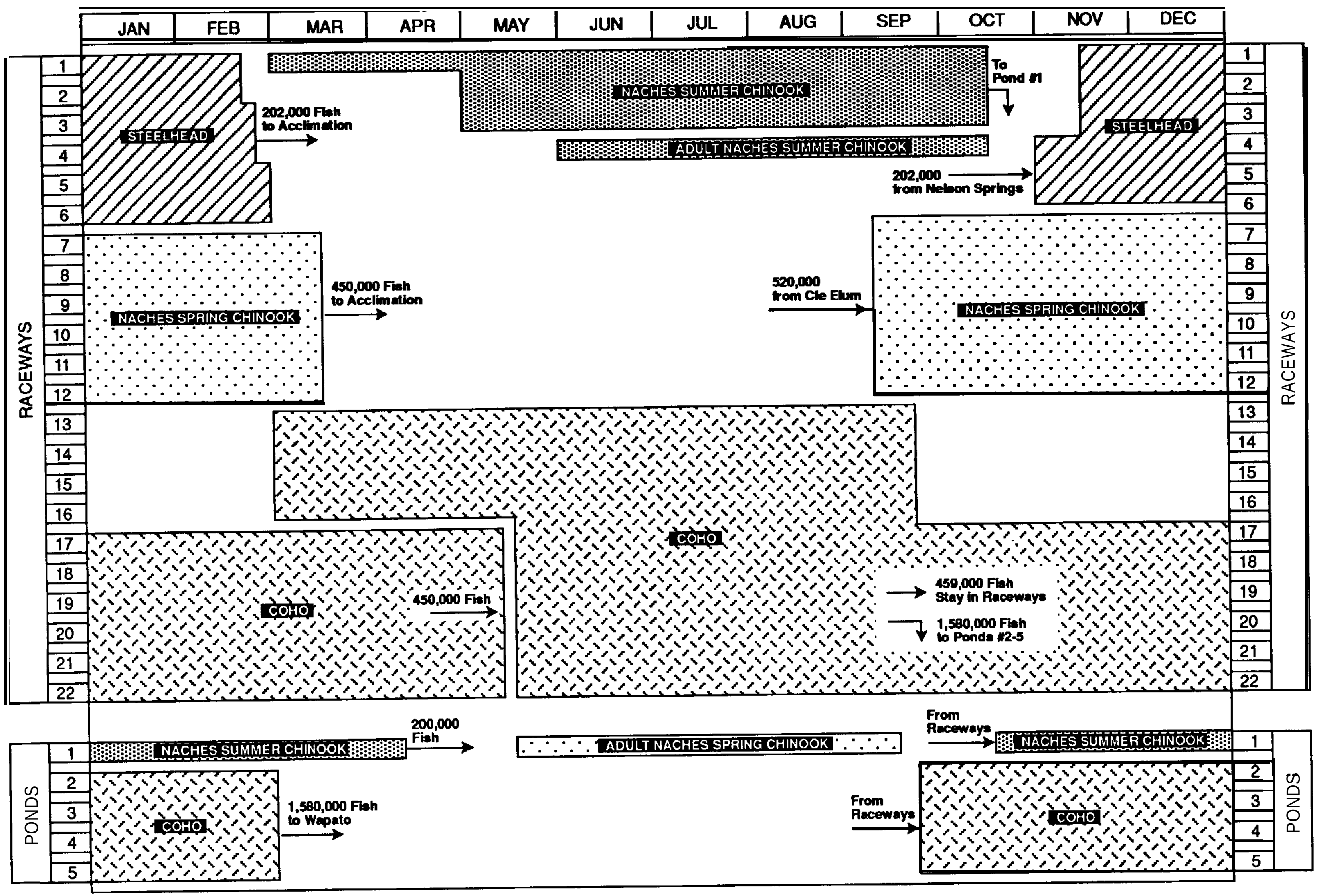

FIGURE 2-6
Oak Flats Central Hatchery
Naches Spring and Summer Chinook
Coho and Summer Steelhead
Rearing

FLOW (CFS)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
well water	0	0	0	0	0	5	5	5	5	0	0	0	Well Water
River water	38	40	36	15	15	19	19	23	31	44	38	38	River Water
Returned to River	38	40	36	0	0	0	0	0	0	0	38	38	Returned to River
Returned to Canal	0	0	0	15	15	24	24	28	36	44	0	0	Returned to Canal
Naches-Selah I.D.	0	0	0	130	132	134	136	136	115	108	0	0	Naches-Selah I.D.
River Diversion	38	40	36	130	132	129	131	131	110	108	38	38	River Diversion

FIGURE 2-6 (Continued)
Oak Flats Flow Summary

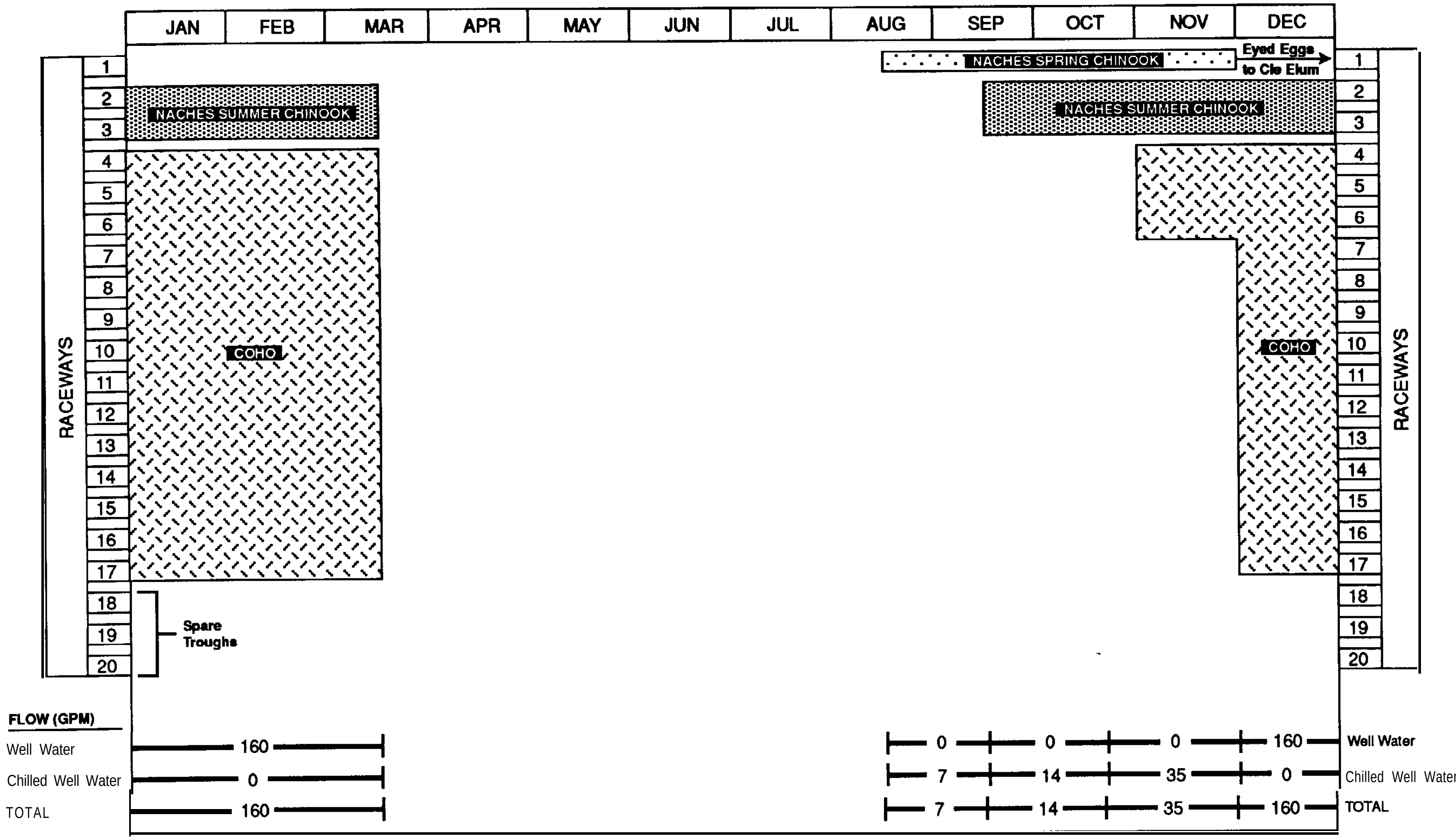

FIGURE 2-7
Oak Flats Central Hatchery
Naches Spring and Summer Chinook and Coho Incubation

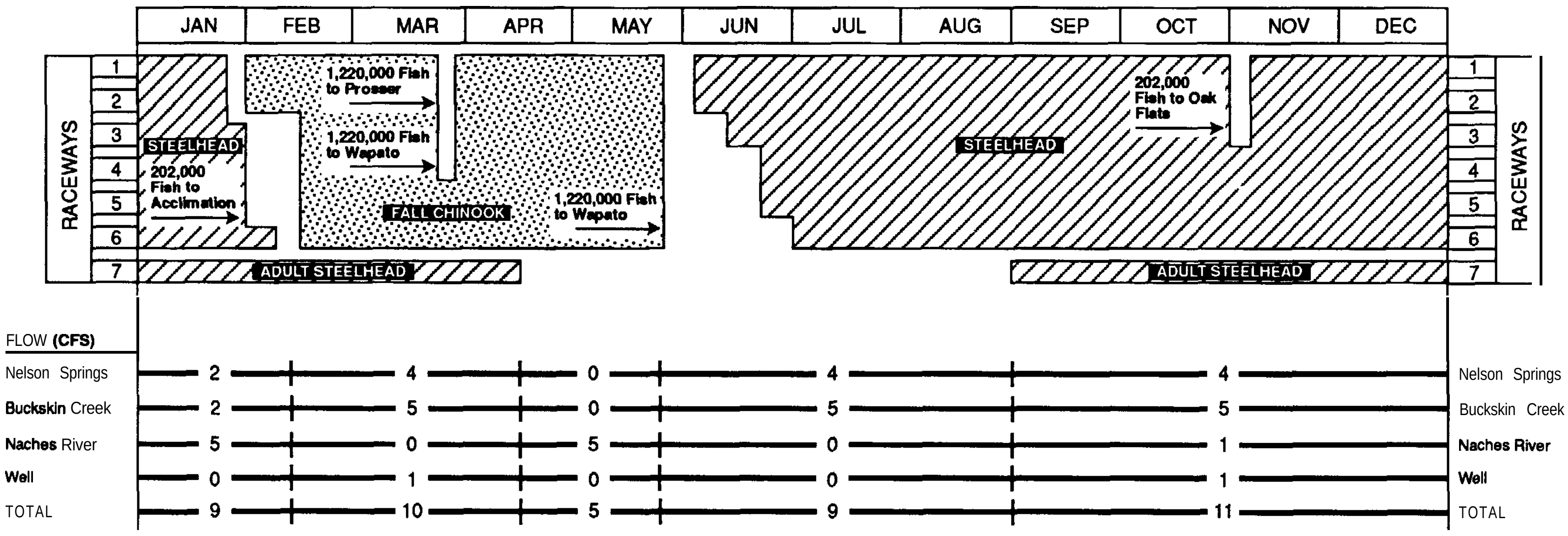

FIGURE 2-8
Nelson Springs Central Hatchery
Fall Chinook and Steelhead
Rearing

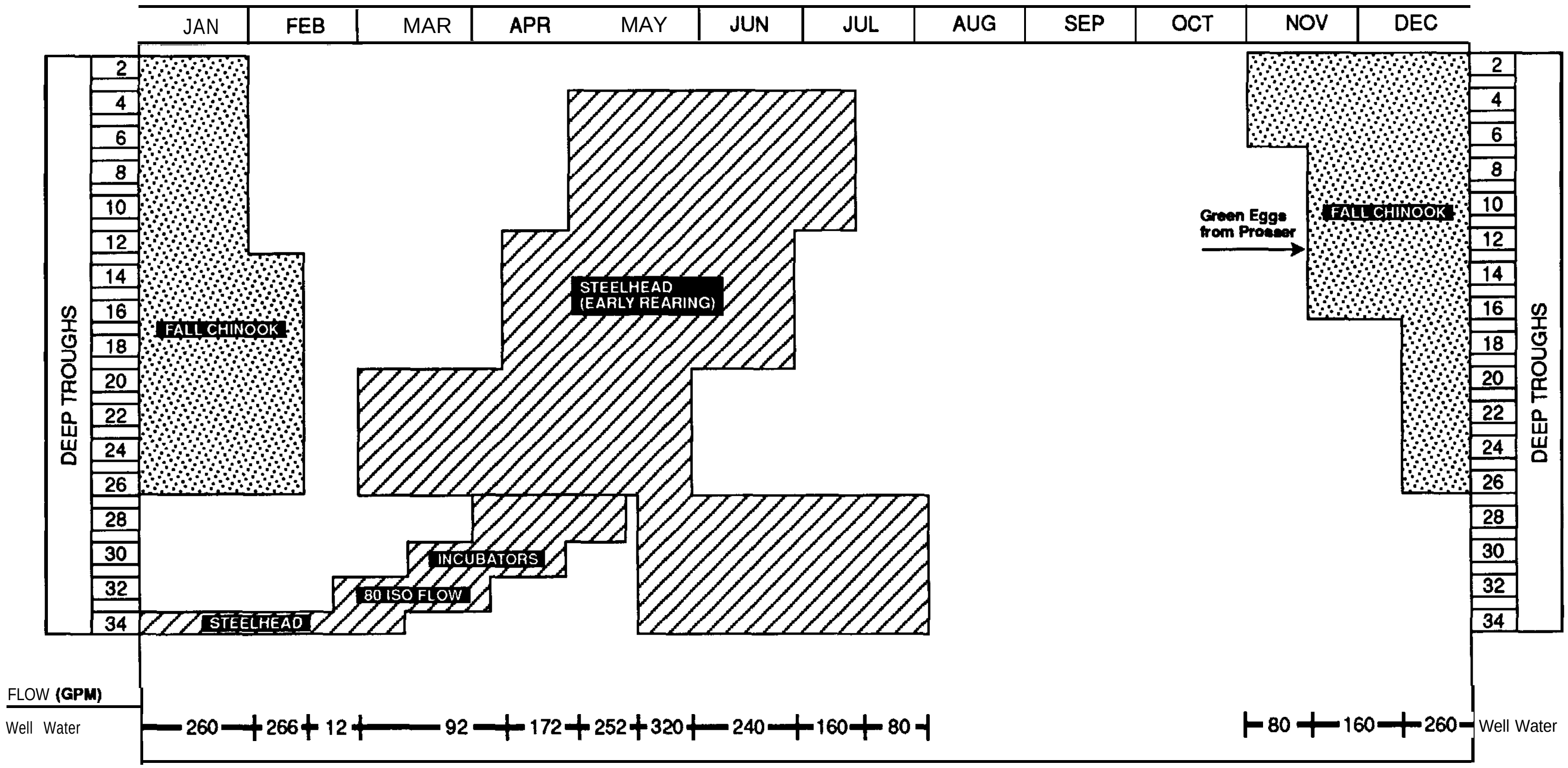

FIGURE 2-9
Nelson Springs Central Hatchery
Fall Chinook and Steelhead
Incubation

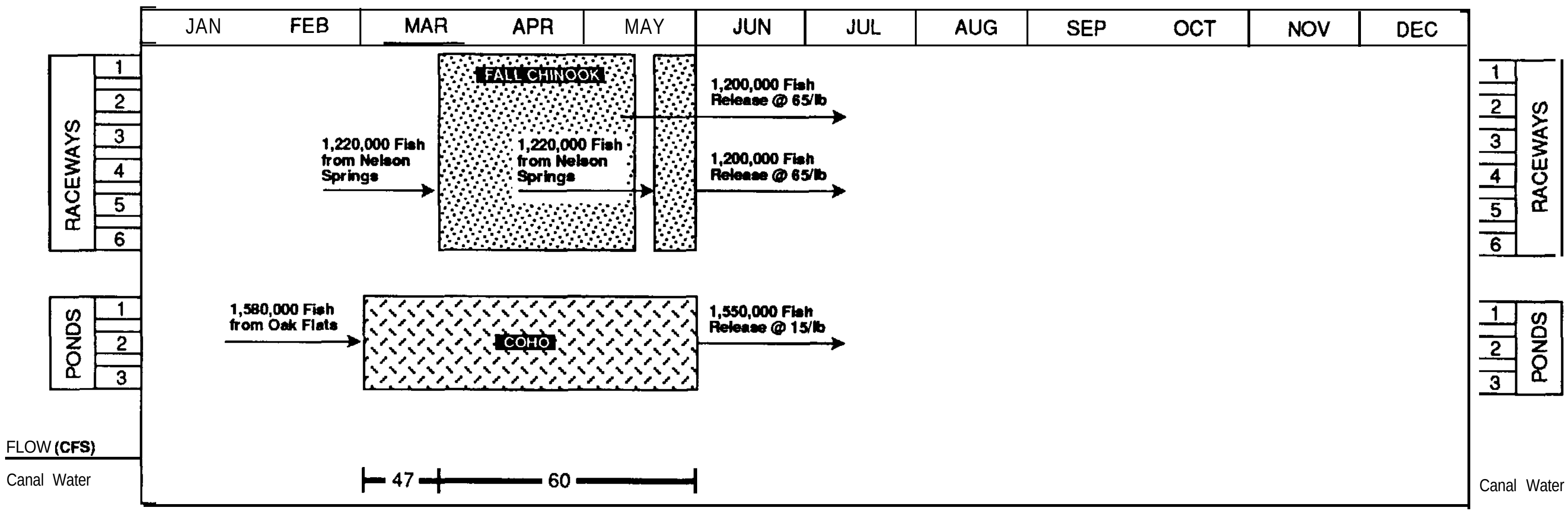

FIGURE 2-10
Wapato Satellite Site
Fall Chinook and Coho
Acclimation

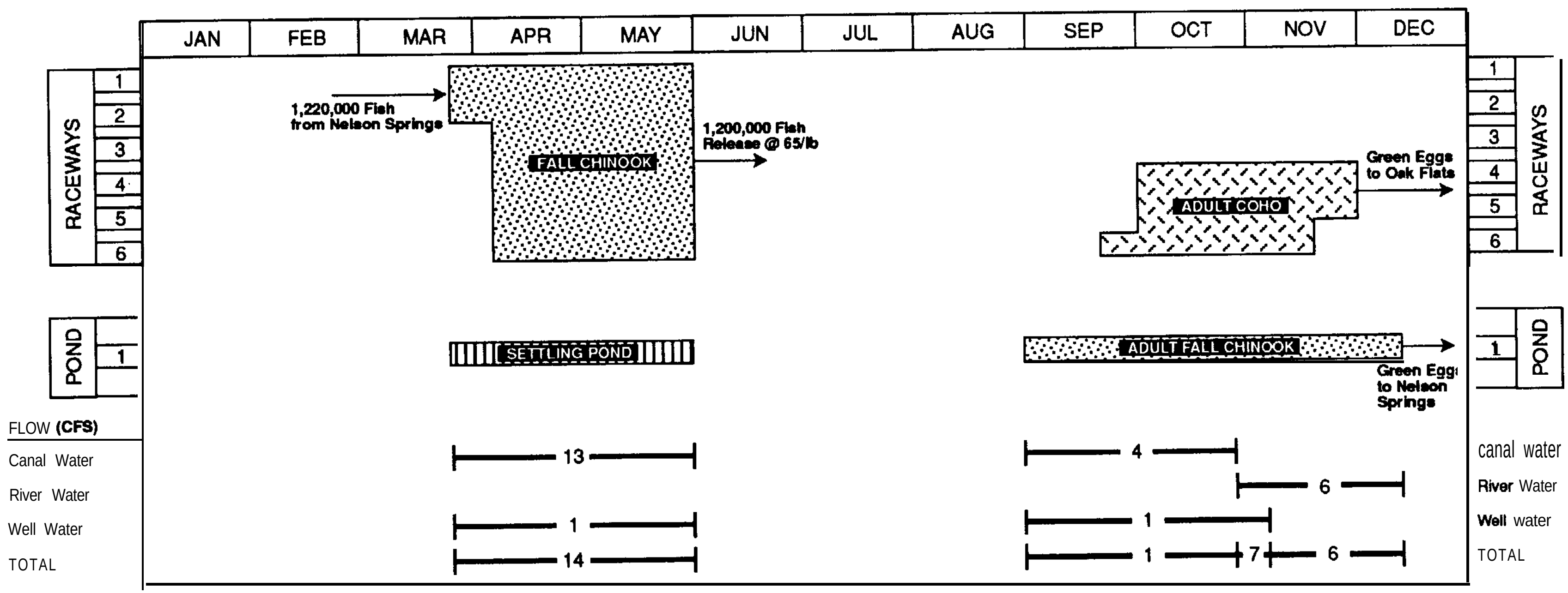

FIGURE 2-11
Prosser Satellite Site
Fall Chinook Adult Holding and Acclimation
Coho Adult Holding

Table 2-4
YAKIMA RIVER BASIN
LIFE-STAGE SUMMARY

Life Stage	Upper Yakima Spring Chinook	Naches Spring Chinook	Naches Summer Chinook	Fall Chinook	Coho	Summer Steelhead
Adults trapped	1,289	508	243	2,815	2,648	306
Females spawned	412	162	77	1,013	1,191	137
Eggs taken	1,769,000	693,000	308,000	4,557,000	2,857,000	615,000
Eyed eggs	1,627,000	638,000	283,000	3,965,000	2,486,000	566,000
(%)	(92)	(92)	(92)	(87)	(87)	(92)
Survive to first feeding	1,592,000	623,000	277,000	3,737,000	2,343,000	554,000
(%)	(90)	(90)	(90)	(82)	(82)	(90)
Survive to release	1,150,000	450,000	200,000	3,600,000	2,000,000	400,000
(%)	(65)	(65)	(65)	(79)	(70)	(65)

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Adult Criteria

Adult brood stock will be trapped at the Prosser, Cowiche and Roza trapping sites. Only short-term holding (one or two days) will be available at these sites. Long-term adult holding and spawning will occur at the central hatcheries and the Prosser satellite facility. The flow criteria for holding adults is 1 gpm/fish for chinook and ½ gpm/fish for coho and 2 gpm/fish for steelhead. The volume criteria is 8 $foot^3$/fish for' chinook, 4 $foot^3$/fish for coho and 2.5 $foot^3$/fish for steelhead.

Table 2-5 shows the adult holding criteria for the Yakima Basin. All adult holding vessels will also be used for juvenile rearing with the exception of the fall chinook holding pond at Prosser which will serve as a settling pond.

Incubation Criteria

The general strategy for incubation is to use deep trough incubators (Senn, et al, 1984, pp. 89-93) for all salmon and Isoflow buckets for steelhead. Deep troughs will also be used for steelhead early rearing. The incubation strategy will be to extend with the development rate of all salmon that are to be reared for 12 months or more to a period in time when their first feeding matches closely

Table 2-5
YAKIMA RIVER BASIN
ADULT HOLDING CRITERIA

	Upper Yakima Spring Chinook	Naches Spring Chinook	Naches Summer Chinook	Fall Chinook	Coho	Summer Steelhead
Eggs required	1,769,000	693,000	308,000	4,557,000	2,857,000	615,000
Eggs per female	4,300	4,300	4,000	4,500	2,400	3,000
Females required	412	162	77	1,013	1,191	205
Pre-spawn mortality (%)	20	20	20	10	10	10
Females taken	515	203	97	1,126	1,324	228
Male to female ratio	1.5:1	1.5:1	1.5:1	1.5:1	1:1	1:1
Adults taken	1,289	508	243	2,815	2,648	456
Adults held at one time	1,289	508	243	2,252	2,119	456
Volume required (ft^3)	10,312	4,064	1,944	18,016	8,476	1,139
Flow required (gpm)	1,289	508	243	2,250	1,059	912
Raceway	2		1		2	1
Ponds		1		1		

the emergence of fry from the naturally spawning population. Fall chinook and summer steelhead will be incubated on spring water at Neson Springs.

All salmon incubation will include substrate as determined by the hatchery manager. Table 2-6 provides a summary of criteria to be used in the design for incubation. The recommended number of incubation units for each facility is as follows is shown as well as the required flow rate.

Rearing Criteria

The application of the following rearing criteria to the available water supply at each site is detailed in Appendix A. The following density indexes were used for the three types of rearing vessels.

- Raceways 0.175 $lbs/ft^3/inch$
- Ponds 0.150 $lbs/ft^3/inch$
- Acclimation Ponds 0.110 $lbs/ft^3/inch$

Flow loading rates were designed according to the following formula for raceway and pond loadings.

$$\text{gpm/lb} = \frac{(\%\ \text{food fed})}{(4)(\text{available oxygen, ppm})}$$

Table 2-6

YAKMA RIVER BASIN

INCUBATIONREQUIREMENTS

	Upper Yakima Spring Chinook	Naches Spring Chinook	Naches Summer Chinook	Fall Chinook	Coho	Summer Steelhead
Eggs spawned	1,769,000	693,000	308,000	4,557,000	2,857,000	615,000
Troughs for eyeing	2	1	1	4	3	82 (buckets)
Flow required (gpm)	14	7	7	28	21	27
Eggs after eyeing	1,627,000	638,000	283,000	3,965,000	2,486,000	566,000
Density after eyeing	180,000	180,000	180,000	152,000	180,000	180,000
Troughs for hatching	9	4	2	26	14	3
Flow required (gpm)	90	40	20	260	140	30
Early rearing	--		--	--	_	450,000
Troughs for rearing	--	--	--	--	_	32
Flow required (gpm)	--		--	_		320

Where the available oxygen equals the influent concentration minus effluent concentration. As an example, with available oxygen equal to 4.0 ppm and percentage food fed equal to 2.0, the flow loading rate used for rearing is 0.13 gpm/lb of fish or 8 lbs/gpm. The actual flow rates needed by the fish at each stage of rearing are shown in the computer output in Appendix A.

Based on these criteria and the need for individual experimental groups, it was decided that standard 5,000-ft^3 concrete raceways of a design similar to that currently used by WDF would be used for rearing. These would be 10 feet wide and 100 feet long (wall to screen) and average 5 feet deep with no kettel.

Rearing ponds will be standardized at 20,000 ft^3 and will be designed in keeping with current WDF criteria. The three 45,000-ft^3 ponds at Wapato are the **only** exception to this standardization of vessels. These ponds for final acclimation of coho will be similar to those used for spring chinook at Chelan PUDs Chiwawa acclimation site. The required rearing vessels for the Yakima Basin are shown in Table 2-7.

Table 2-7
YAKIMA RIVER BASIN
REARING VESSELS

	Number of Vessels		
	$5,000\text{-ft}^3$ Raceways	$20,000\text{-ft}^3$ Ponds	$45,000\text{-ft}^3$ Ponds
Cle Elum	18	0	0
Oak Flats	22	5	0
Nelson Springs	7	0	0
Wapato	6	0	3
Prosser	6	1	0

FISH CULTURE SUPPORT

FOOD CONSUMPTION

Food consumption was calculated for each station and each stock is documented in Appendix A. Table 2-8 shows a summary of food requirements by station by month. The food requirements shown for Oak Flats, Cle Elum, and Nelson Springs include the food which would be needed at the associated acclimation sites for spring chinook and steelhead. Three 70,000-lb capacity freezer buildings of a type similar to WDF's Klickitat freezer will be provided for the Yakima Basin. One of these buildings will be provided at Oak Flats, Cle Elum, and Wapato. In final design a semitrailer will be considered for the Wapato site to reduce cost. All required food will be delivered by commercial suppliers to these three main freezer buildings. Hatchery staff will move the required food to walk-in freezers at Nelson Springs, and Prosser Food for acclimation sites will be transported each day to the sites by the fish culturist responsible for these facilities. Two feedings per day are anticipated at the acclimation sites.

Table 2-8
YAKIMA RIVER BASIN
MONTHLY FOOD REQUIREMENTS
BY STATION

Month	Upper Yakima Basin	Naches Basin		Lower Yakima Basin		Total
	Cle Elum	Oak Flats	Nelson Springs	Wapato	Prosser	
January	6,139	7,945	9,568			23,652
February	10,852	30,109	17,609			58,570
March	20,362	28,969	4,630	34,755	1,675	90,391
April	2,638	17,729	675	70,536	10,294	101,872
May	5,619	4,535	1,475	12,736	6,203	30,568
June	8,711	9,427	2,969			21,107
July	12,620	15,514	4,944			33,078
August	28,106	32,939	11,814			72,859
September	18,586	31,919	10,184			60,689
October	11,323	29,660	4,727			45,710
November	7,344	8,129	5,610			21,083
December	3.940	7.108	7.169			18,217
Total	136,240	223,983	81,374	118,207	18,172	577,796

TRANSPORTATION OF FISH

As explained earlier in this chapter, there will be a substantial movement of fish at various life stages between the facilities in the Yakima Basin. To ensure success of the overall program, these logistical efforts must be carefully designed and managed. There will be two 2,000-gallon tanker trucks, and two 300-gallon tanker trailers to be pulled by 3/4-ton pickups. Eggs will be transported in standard hatchery pickup trucks with canopies. Table 2-9 shows the truck trips and estimated miles per trip required for and estimated miles per trip required for transporting fish in the Yakima program. A total of 321 truck days (one truck day = 8 hours) are estimated for the Yakima Basin program.

STAFFING REQUIREMENTS

An estimate of the staffing requirements for the Yakima Basin was prepared by FMC based on current WDF practice. Table 2-10 shows the estimated staff requirements. This estimate does not include staff required for marking fish and other experimental data collection needs as required by EDWG.

Table 2-9
YAKIMA RIVER BASIN
FISH TRANSPORTATION REQUIREMENTS

Stock/ Life Stage	From	To	Start	Finish	Total Number To he Moved	Vehicle	Total Number of Trips	Round Trip Mileage	Total Miles
Upper Yakima Spring Chinook/ Adults	Roza Dam	Cle Elum	5/20	9/30	1,030	Tanker	45	96	4,320
Upper Yakima Spring Chinook/ Adults	Roza Dam	Cle Elum	5/20	9/30	258	Trailer	40	%	3,840
Upper Yakima Spring Chinook/ Presmolts	Cle Elum	Acclimation	2/15	3/15	1,200,000	Tanker	45	40	1,800
Naches Spring and summer Chinook/Adults	Cowiche Diversion	Oak Flats	5/20	9/30	751	Trailer	140	30	4,200
Naches Spring Chinook/Eyed Eggs	Oak Flats	Cle Elum	11/15	11/30	638,000	Pickup	3	150	450
Naches Spring Chinook/Fry	Cle Elum	Oak Flats	9/10	9/18	500,000	Tanker	18	150	2,700
Naches Spring Chinook! Presmolts	Oak Flats	Acclimation	3/1	3/15	460,000	Tanker	18	50	900
Fall Chinook/ Adults	Prosser Dam	Prosser	9/1	12/15	2,252	Tanker	26	2	52
Fall Chinook! Adults	Prosser Dam	Prosser	9/1	12/15	563	Trailer	60	2	120
Fall Chinook/ Green Eggs	Prosser	Nelson Springs	2/1	3/15	4,557,000	Pickup	20	110	2,220
Fall Chinook/ Fry	Nelson Springs	Wapato	3/20	3/30	1,250,000	Tanker	12	24	288

Table 2-9
(Continued)

Stock/ Life Stage	From'	To	Start	Finish	Total Number To be Moved	Vehicle	Total Number of Trips	Round Trip Mileage	Total Miles
Fall Chinook/ Fry	Nelson Springs	Wapato	5/15	5/20	1,250,000	Tanker	18	24	432
Fall Chinook! Fry	Nelson Springs	Prosser	3/15	5/20	1,300,000	Tanker	12	110	1,320
Coho/Adults	Prosser Dam	Prosser	9/20	11/30	2,118	Tanker	16	2	32
Coho/Adults	Prosser Dam	Prosser	9/20	11/30	530	Trailer	16	2	32
Coho/ Green Eggs	Prosser	Oak Flats	9/1	9/30	2,857,000	Pickup	20	140	2,800
Coho/Presmolts	Oak Flats	Wapato	2/28	3/10	1,600,000	Tanker	30	56	1,680
Summer Steelhead/ Adults	Cowiche Diversion	Nelson Springs	9/1	3/15	306	Trailer	40	2	80
Summer Steelhead/ Presmolts	Nelson Springs	Acclimation	2/14	2/16	210,000	Tanker	18	60	1,080
Summer Steelhead/ Fry	Nelson Springs	Oak Flats	11/1	11/4	220,000	Tanker	18	30	540
Summer Steelhead/ Presmolts	Oak Flats	Acclimation	2/20	2/28	210,000	Tanker	18	50	900

Table 2-10
YAKIMA RIVER BASIN
ESTIMATED STAFF REQUIREMENTS
(person months)

	Manager	Assistant Manager	Culturist	Temp.	Security	Truck Driver	Pathologist	Maintenance
Cle Elum	12	2	4	6	6	--		--
Oak Flats	12	12	36	10	6	12	12	12
Nelson Springs	12	12	--	6	3	--	--	--
Wapato	--	--	--	8	--	--		--
Prosser	--	--	10	3	3	--		
Upper Yakima Acclimation		--		30				
Naches Acclimation	--	--		36	--	--	--	
Total	36	36	70	99	18	12	12	12

Chapter 3
CLE ELUM FACILITY DESIGN

GENERAL SITE DESCRIPTION

The Cle Elum site was chosen as the central hatchery facility for Upper Yakima Spring Chinook. In addition, Naches Spring Chinook will be incubated and reared at this site prior to their return to the Naches basin central hatchery at Oak Flats. The Cle Elum site is located 0.9 mile west of the bridge between Cle Elum and South Cle Elum.

The 5-acre site is situated near the bank of the old Yakima River channel in an undeveloped 140-acre site. The construction of the Northern Pacific Railroad forced the realignment of the Yakima River channel and left the old river channel as a series of ox bow lakes. The railroad embankment acts as a levee to protect the site from floods. The site is approximately at River Mile 184.0 on the Yakima River. An aerial photo of the Cle Elum site is shown on Figure 3-1.

ALTERNATIVE SITES

Two sites near the town of Thorp were investigated as alternatives to Cle Elum. The Thorp site was at the existing City of Ellensburg water supply facility near the Town Diversion Dam. The Newman site was located across the river from the Thorp site on a 250-acre parcel of land. It was understood that the City of Ellensburg would be willing to sell their facilities including an infiltration pond and a large productive well field. When this option did not develop, the nearby Newman site was investigated. Groundwater which was important to the development of either site did not materialize after geophysical studies and drilling at test wells on the Newman property. As a result, the Thorp and Newman sites were dropped from further consideration and Cle Elum was selected as the site for the Upper Yakima Basin central hatchery.

FACILITY SIZE

Relative to the available space on the site, the hatchery is very small. Ample room is available for the required 18 raceways as well as support facilities. The hatchery site proper will encompass 5 acres. Smaller offsite parcels will be required for a river pump station and well heads (see Figure 3-2). Easements will be required for the short powerline and the 0.5 mile access road. An easement will also be required for the river pump station and its access road.

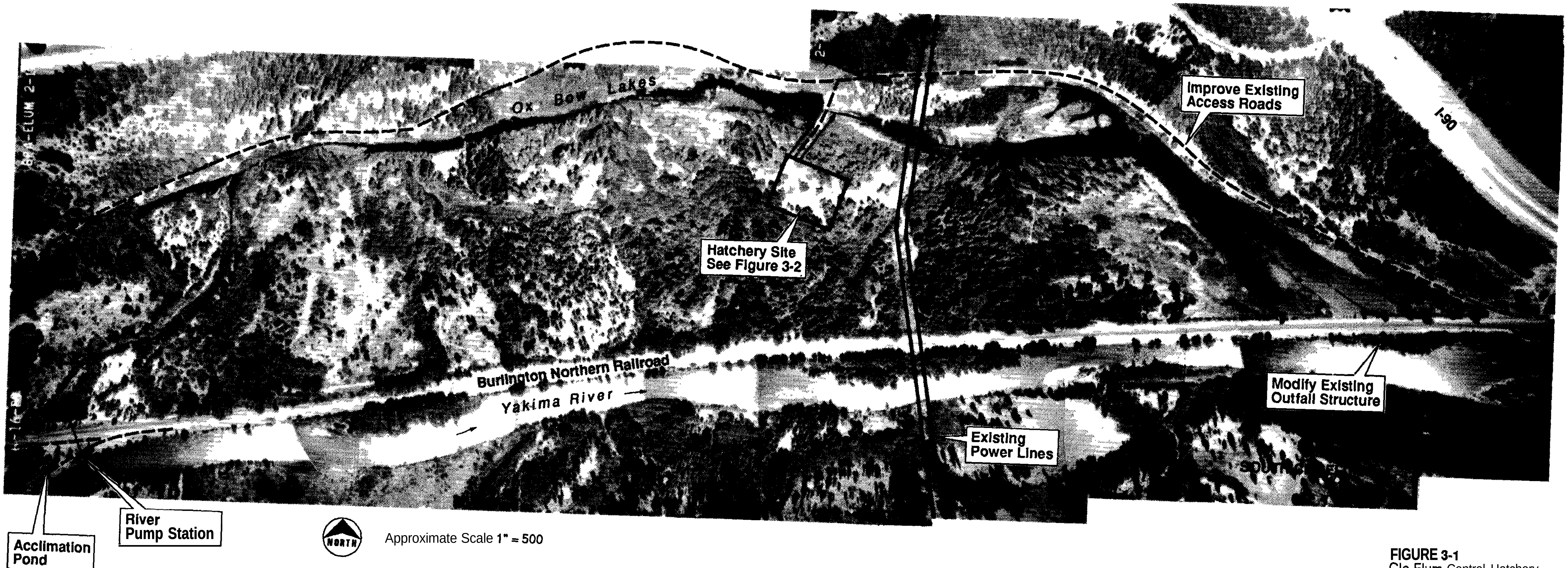
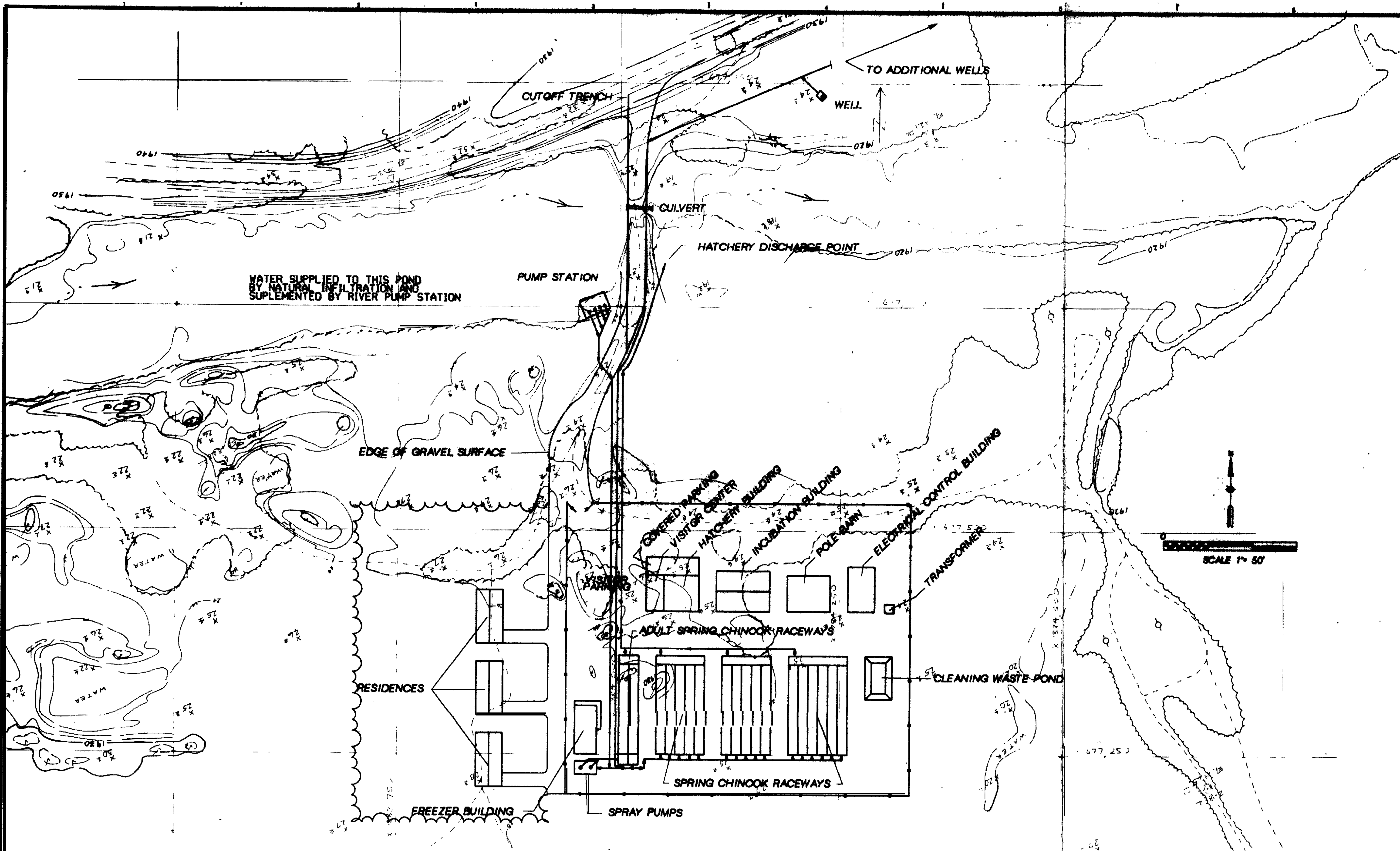


FIGURE 3-1
Cle Elum Central Hatchery
General Site Plan



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YAKIMA RIVER BASIN
SALMON AND STEELHEAD FACILITIES
PRELIMINARY DESIGN REPORT

FIGURE 3-2
CLE ELUM CENTRAL HATCHERY
SITE PLAN

SHEET
DWG NO.
DATE FEB 1990
PROJ NO. SEA27133.A0

PRELIMINARY

There exists the potential for wetlands enhancement and joint development of the property east of the site. This would be done in conjunction with the towns of Cle Elum and South Cle Elum.

PRODUCTION GOALS REVIEW

As presented in Chapter 2, the production goals for this facility include adult holding of Upper Yakima Spring Chinook and incubation and rearing of Upper Yakima and Naches Spring Chinook. No fish are planned to be released from this facility. The 1.15 million Upper Yakima Spring Chinook will be outplanted to 15 acclimation ponds and the 450,000 Naches Spring Chinook would be returned to Oak Flats for final rearing prior to outplanting to 6 Naches basin acclimation sites.

As explained in Chapter 2, the Cle Elum central hatchery will have eighteen 5,000-cubic-foot raceways for rearing Upper Yakima and Naches Spring Chinook. Two of these raceways will be specially modified to hold adult Upper Yakima Spring Chinook. The raceways will be supplied with water from the lake pump station. The adult holding raceways will also be supplied by first pass well water.

CURRENT LAND USE AND OWNERSHIP

Currently, the site is undeveloped. There is a Puget Power transmission line running just east of the hatchery facility, and as mentioned earlier the railroad runs the length of the site along the Yakima river. Parts of the site are used as undeveloped camp grounds and some trash dumping has occurred.

All of the proposed facilities are located in unincorporated Kittitas County, although, part of incorporated South Cle Elum lies just east of the site. The lands are currently owned by either the Plum Creek Timber Company or Burlington Northern.

SITE DEVELOPMENT

The following is a discussion of the items of work required to improve the Cle Elum site for use as the central hatchery for the Upper Yakima Basin.

ACCESS ROADS

There are existing access roads throughout the site but they are in need of clearing and resurfacing with gravel before they can serve as adequate access for the central hatchery. Roads to be improved are shown on Figure 3-1. Onsite roads will be gravel surfaced.

DRAINAGE AND SNOW REMOVALS

Site grading will be designed to ensure adequate drainage. Drainage provisions at this site will be minimal due to the proximity of the ox bow lakes. Snow removal from the access road will be contracted to Kittitas County or the City of Cle Elum. Onsite snow removal will be accomplished by the hatchery staff with use of a plow mounted on a $-wheel-drive pickup.

CONSTRUCTION CLEARING AND GRUBBING

Clearing and grubbing will be required for the entire hatchery site. The site was selected to retain the buffer of trees between the hatchery and the ox bow lake. Some trees will need to be cleared as part of the upgrading of the existing access roads. Most of the river pump station will be constructed on the existing rip rap dike. If one or more of the acclimation ponds called for in the Cle Elum area are put next to the river pump station, further clearing may be needed. At this point, the 12.5KV transmission line to the river pump station is assumed to follow the access road or the Burlington Northern Railroad right-of-way. Clearing for the transmission line should be minimal.

SITE WORK AND SLOPE PROTECTION

At this point, it is assumed that an earthwork balance is obtainable on the site. Only select backfill material and gravel surfacing material will be imported. Final design flood levels will confirm this assumption. If calculated flood levels require that the structure be elevated higher than those assumed imported material will be acquired at gravel pits on site. Fill slopes will be 3:l and protected with hydroseeding, and top soil will be imported for the yard area around the residences.

WETLANDS

The hatchery site was selected to avoid existing wetlands on site. Only water related structures such as the access road across the ox bow lake and the pump stations will encroach on the wetlands. An increased flow will pass through the wetlands due to the operation of the hatchery. Currently 5 to 10 cfs flows through the ox bow lakes. This flow may be increased to 20 cfs during peak hatchery operations.

FLOOD ANALYSIS

The Burlington Northern Railroad tracks and the associated riprapped embankment protect the site from direct flooding from the Yakima River. A Federal Emergency Management Agency (FEMA) study (May 1981) shows the hatchery area as within the 100 year flood plain but not at all in the floodway. The only direct hydraulic connection between the site and the river is by way of the culvert under the railroad track about 2,000 feet east of the site. The 100 year flood level at that point is at elevation 1920.0. Unless there is substantial leakage through the railroad embankment, the 100 year flood level at the hatchery site should then be 1920.0. A detailed review of this study and its findings is recommended for final design.

POWER SUPPLY

Electrical power for the Cle Elum central hatchery will be provided by Puget Power Company. The estimated electrical loads for the Cle Elum site are shown in Table 3-l. Their 12.5KV 3 phase power lines run within 200 feet of the hatchery site. A diesel generator backup will be provided to serve power to one-half of the pumping load and other essential services in case of a power outage. It is anticipated that the river pump station will be treated as a separate load by the power company. However, we recommend that serving that load from the main hatchery be investigated in final design.

Table 3-1
ESTIMATED ELECTRICAL LOADS

Description	Quantity	Horsepower (ea)	KVA t a l)
River Pumps	3	20	60
Lake Pumps	4	30	120
Well Pumps	4	10	40
Hatchery Building	1	--	50
Incubation Building	1	--	110
Freezer Building	1	--	20
Electrical Control Building	1	--	20
Residences	3	--	60
Pole Barn	1	--	20
Cleaning Waste Aerators	2	10	20
Educator Pumps	4	7.5	30
Spray Pumps	2	10	20
Site Lighting	--	--	2
			572

WATER SUPPLY

As presented in Chapter 2, the Cle Elum central hatchery will have need for well water (3 cfs), river water (17 cfs), and infiltration gallery water (4 cfs) at various times during the year. This section presents the design concepts for each water source.

WELL WATER

The USBR water supply report has complete details on the hydrogeologic study done to date on the site. A production well and an observation well have been drilled into an artisan aquifer. It is assumed that four production wells may be required to provide the needed 4 cfs.

RIVER WATER

As shown on Figure 3-1, the river pump station is located about 0.8 mile south-west of the hatchery site. River water pumped at that site will be discharged into the ox bow lake system which is basically the old Yakima River channel. From there, the water will flow to the pump station which is adjacent to the hatchery site. During final design, alternatives to this pump station will be considered. For example, it may be possible to use a gravity diversion through the railroad embankment at that same point and avoid the expense of pumps. It also may be possible to use an infiltration gallery approach at a site on the north side of the railroad embankment opposite the proposed pump station to obtain the required flow rate through the old river channel gravels.

INFILTRATION GALLERY

The existing ox bow lake flow is made up primarily of shallow groundwater which continues to infiltrate onto the site through the railroad embankment along the old river channel. As much as 4 cfs of that flow currently may be available for use in the hatchery. A slurry trench cutoff wall will be investigated during final design to see how much water is available from this source. The pump station sited on the shore of the ox bow lake would pump this flow and any supplemental river water to the hatchery site.

MISCELLANEOUS WATER SUPPLY

Domestic water supply will be taken from one of the hatchery wells. Fire protection will be provided by a fire alarm system and chemical fire extinguishers. No water-based fire fighting system is planned. A tanker fill system will be provided on station.

WATER TREATMENT

Water used at the Cle Elum central hatchery will become contaminated with byproducts of fish culture. These include fish waste, unused food, disease-control chemicals, and river sediment settled out in rearing vessels. The following is a discussion of proposed facilities to deal with water treatment.

HATCHERY EFFLUENT

Water which has passed through adult holding and rearing vessels will be discharged directly to the Yakima River by way of the existing ox bow lake system. The existing culvert under the railroad embankment will have to be improved to allow for a controlled release of the hatchery flow. Provisions will be made to preclude the returning adults from entering the ox bow lakes.

CLEANING WASTE

A vacuum cleaning waste system in keeping with current WDF design practice will be installed for the 18 raceways. The proposed system includes concrete holding pond is capable of holding 5,000 cubic feet in the top 3 feet of depth. This system is similar to that provided at the Eastbank Hatchery. It would be 30 feet by 56 feet in plan, and depending on final site grades, may require an influent booster pump to lift the cleaning waste into the cleaning wastepond. One standard WDF educator pump will be provided for each of the raceway groups. Two

10 horsepower aerators are anticipated for the cleaning waste pond. Adult fish held on site will be treated with formalin however at this time there is no plan for specific treatment of water during these operations.

SEWAGE TREATMENT

Domestic sewage from the hatchery building and residences will be treated onsite in a septic tank and drainfield. A sewage lift station may be required to deliver flow to the drainfield if it is located at a higher elevation than the buildings. Local health department requirements will guide the design.

FACILITY BUILDINGS

The following is a description of the buildings to be provided at the Cle Elum central hatchery.

HATCHERY BUILDING

This 40-foot by 60-foot frame building will include the following rooms.

Description	Size (feet)
Visitor Center	20 x 30
Visitor Restrooms	2@ IO x 10
Office	14 x 15
Lunch Room	15 x 20
Locker Room	12 x 17
Restroom	8 x 7
Mechanical Room	12 x 14
Storage	11 x 14

INCUBATION BUILDING

This 45-foot by 60-foot prefabricated metal building will contain 20 deep trough incubators in a 40-foot by 45-foot room. In addition, there will be a lo-foot by 20-foot egg picking room, a IO-foot by 20-foot lab, and a 9-foot by 20-foot mechanical room.

FREEZER BUILDING

This 25-foot by 60-foot prefabricated metal building will be designed to be similar to the WDF Klickitat freezer building. It will have a frozen fish food capacity of 70,000 lbs and will serve as the central freezer for the Upper Yakima Basin.

ELECTRICAL CONTROL BUILDING

This 25-foot by 30-foot building will contain the electrical equipment for the hatchery as well as a 150 KW diesel generator. Power will be distributed to the various buildings on the hatchery site from this building.

POLE BARN

A 40-foot by 48-foot pole barn will be provided for storage and a shop. The tanker truck assigned to this station will be stored in this structure.

RESIDENCES

These 1,600 square foot single family residences will be provided on this station. They will have two car garages and will be of a style selected during final design.

Chapter 4

OAK FLATS FACILITY DESIGN

GENERAL SITE DESCRIPTION

The Oak Flats site was chosen as the central hatchery facility for the Naches spring and summer chinook and coho. Some steelhead rearing also will occur on this site. The site is on the left bank of the Naches River just downstream of the abandoned City of Yakima water supply intake. The site lies between State Route 410 (Chinook Pass highway) and the Naches River, 5.7 miles west of the town of Naches, at River Mile 19.3.

FACILITY SIZE

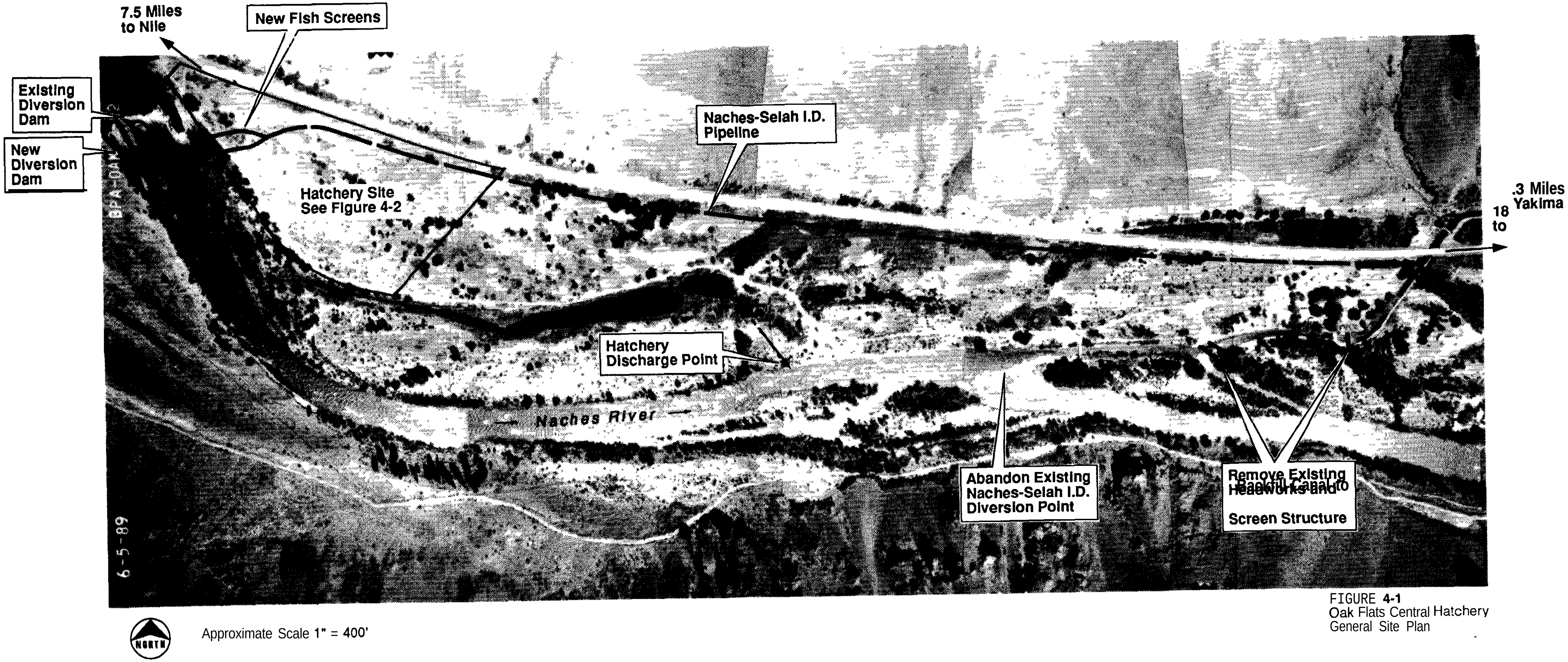
As shown on Figure 4-1, the 6.7 acre facility fits nicely on the site between the highway and the existing ponds. Although a detailed flood plain study will not be completed until final design, the site will probably be out of the 100 year flood plain and will definitely be outside the floodway. The hatchery facility will share the site with the proposed relocated diversion and intake for the Naches--Selah Irrigation District. River water supply for the hatchery will be pumped from the canal downstream of the new fish screens. The hatchery site and both the existing and proposed diversion facilities for the Naches Selah I.D. can be seen on Figure 4- 1.

As with the Cle Elum site, there exists at Oak Flats the potential for wetlands enhancement and preservation of wildlife habitat. There is also potential for nature trails and an interpretive center.

PRODUCTION GOALS REVIEW

The production goals for the Oak Flats facility are spelled out in Chapter 2. In summary, they include adult holding of Naches spring and summer chinook, incubation of Naches spring and summer chinook and coho, and rearing of the above species plus some steelhead rearing. As a central hatchery, there are no plans for release of fish directly from Oak Flats to the Naches River. TWO million coho, 200,000 Naches summer chinook, 450,000 Naches spring chinook, and 200,000 steelhead are programmed for this site.

As explained in Chapter 2, the Oak Flats central hatchery will have twenty-two 5,000-cubic-foot raceways for rearing. One of these raceways will be specially modified to hold adult Naches summer chinook. The raceways will be supplied with river water from the canal pump station. The adult holding raceway will also



Approximate Scale 1" = 400'

FIGURE 4-1
Oak Flats Central Hatchery
General Site Plan

be supplied by first pass well water. The Oak Flats site also will have five 20,000 cubic foot ponds for rearing coho and summer chinook. One of these ponds will be specifically modified to accommodate adult Naches spring chinook.

CURRENT LAND USE AND OWNERSHIP

The site is currently vacant land owned by the City of Yakima. Preliminary discussions with the City indicate a willingness to lease the site on a long-term basis. The site is in unincorporated Yakima County.

SITE DEVELOPMENT

The following is a discussion of the items of work required to improve the Oak Flats site for use as a central hatchery.

ACCESS ROADS

Two short access roads will connect the site with Highway 410. One of these is an existing rough access road for the Old City of Yakima intake. This will have to be reconstructed to meet state and county road standards. The second access point will be a new one connecting the residences with Highway 410 for the exclusive use of the hatchery staff and their families. These access points can be seen on Figure 4-2.

DRAINAGE AND SNOW REMOVAL

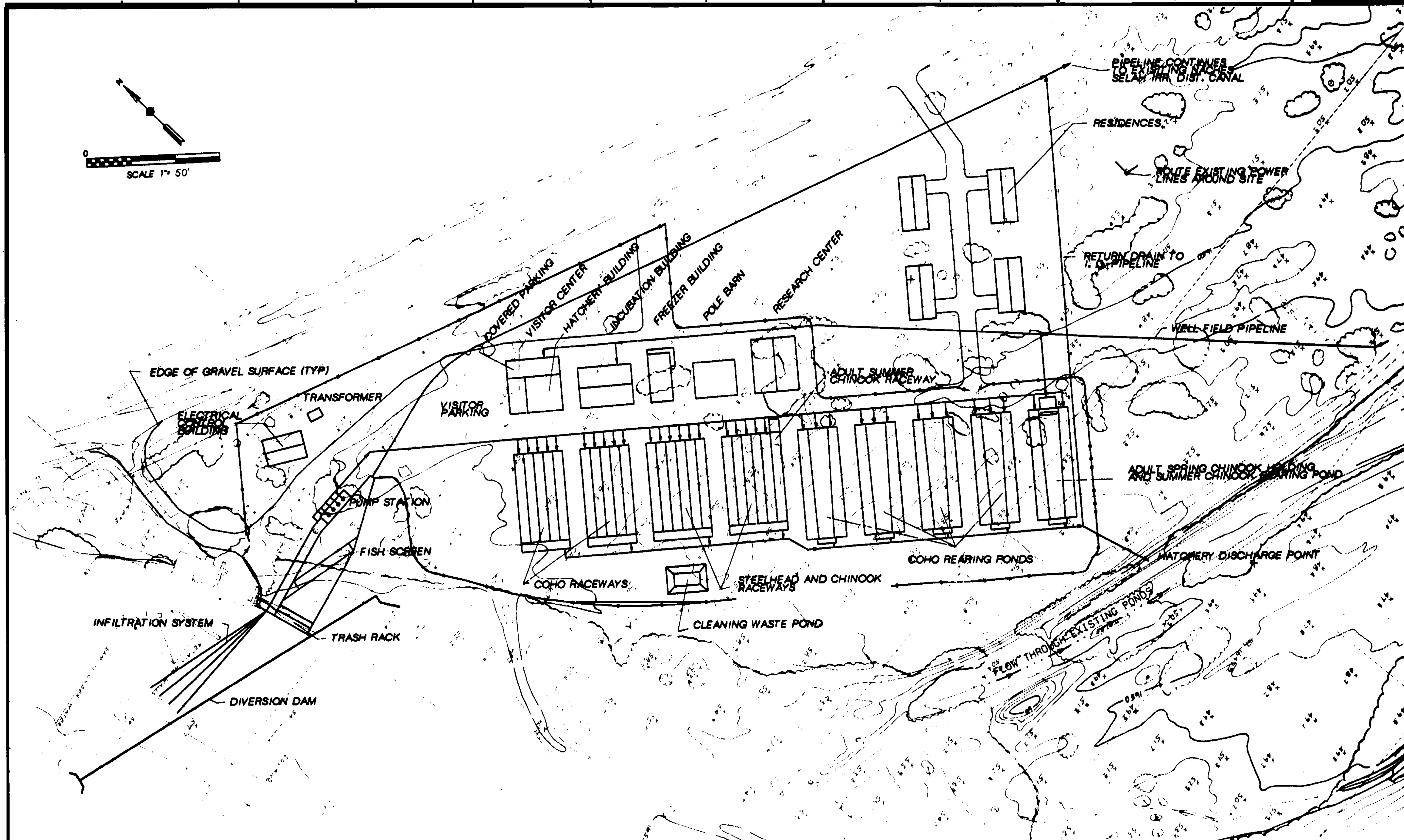
Site grading will be designed to ensure adequate drainage. Drainage provisions at this site will be minimal because of the proximity of the existing ponds. Snow removal from the access roads and onsite roads will be accomplished by the hatchery staff with the use of a plow mounted on a 4-wheel-drive pickup.

CONSTRUCTION CLEARING AND GRUBBING

Clearing and grubbing will be required for the entire hatchery site. However, this effort will be substantially less than at the Cle Elum site because the Oak Flats site is generally open with very few trees.

SITE WORK AND SLOPE PROTECTION

At this point, it is assumed that an earthwork balance is obtainable on the site. Only select backfill material and gravel surfacing material will be imported. Final design flood levels will be needed to confirm this assumption. Fill slopes will be



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YAKIMA RIVER BASIN
SALMON AND STEELHEAD FACILITIES
PRELIMINARY DESIGN REPORT

FIGURE 4-2
OAK FLATS CENTRAL HATCHERY
SITE PLAN

SHEET
DWG NO.
DATE FEB 1990
PROJ. NO. SEA 27133.A0

PRELIMINARY

3:1 and protected with hydroseeding, and top soil will be imported for the yard area around the residences.

WETLANDS

The hatchery site was selected to avoid existing wetlands on site. An increased flow will pass through the existing ponds in the nonirrigation season because of the operation of the hatchery. An improved outlet channel from the ponds to the Naches River will be required.

FLOOD ANALYSIS

A FEMA study (June 1985) shows the hatchery area is within the 100 year flood plain. This area was only studied by approximate methods and as a result, no detailed floor profiles or floodway determination exists for the site. A detailed floor study will be conducted as part of the final design to aid in the final hatchery siting as well as the design of the new Naches--Selah ID diversion dam.

POWER SUPPLY

Electrical power for the Oak Flats central hatchery will be provided by Pacific Power and Light Company. Currently, their 12.5KV 3-phase power lines run near the hatchery site. This line may have to be relocated to the north along the highway. A diesel generator backup will he provided to serve power to one-halt of the pumping load and other essential services in case of a power outage. It is anticipated that the residences will be treated as a separate load by the power company. The estimated electrical loads for the Oak Flats site are presented in Table 4-1.

Table 4-1
ESTIMATED ELECTRICAL LOADS

Description	Quantity	Horsepower (ea)	KVA (total)
Canal Pump	4	45	180
Well Pump	4	10	40
Hatchery Building	1	--	50
Research Center			75
Incubation Building	1	--	110
Freezer Building	1		20
Electrical Control Building	1	--	20
Residences	4	--	75
Pole Barn	1	--	20
Cleaning Waste Aerators	2	10	20
Educator Pump	4	7.5	30
Spray Pump	3	10	20
Site Lighting	--		2
			662

WATER SUPPLY

As presented in Chapter 2, the Oak Flats central hatchery will have need for well water (5 cfs) and river water (44 cfs) at various times during the year. This section presents the design concepts for each water source.

WELL WATER

The USBR water supply report has complete details on the hydrogeologic study done to date on the site. Two production wells and an observation wells have been drilled on the site. It is hoped that four production wells could provide the needed 5 cfs. However, preliminary results from the pump test indicated that it will be difficult to produce that much flow. If sufficient ground water is not found on site mechanical chillers may be needed to provide water cool enough for adult holding in the summer. It may be more economical to move the adult holding to another site.

RIVER WATER

The Naches--Selah I.D. intake is just downstream of the proposed hatchery site. Preliminary discussions between the district and BPA have identified the potential for moving the point of diversion for the district's intake and fish screens to the site of the Old City of Yakima intake.

The design details of this new diversion dam, intake, fish screens, and large diameter irrigation pipe are the subject of a preliminary design study being conducted by the Yakima Basin Passage Group. A schematic representation of these facilities is shown on Figures 4-1 and 4-2.

The water supply arrangement of the hatchery site would include nonconsumptive use of irrigation water during the irrigation season. Effluent from the hatchery would be returned to the district for use in irrigation. In the nonirrigation season, hatchery effluent would be discharged first to the existing onsite ponds and then to the Naches River. Figure 2-6 shows the relative quantities of flow for the different uses on site. A pump station is required to provide river water to the raceways and ponds.

INFILTRATION GALLERY

Provisions for a river bed infiltration gallery is shown in Figure 4-2. This system may be required to provide for winter time hatchery operations when the fish screens and canal are down because of the icing or maintenance.

MISCELLANEOUS WATER SUPPLY

Domestic water supply will be taken from one of the hatchery wells. Fire protection will be provided by a fire alarm system and chemical fire extinguishes. NO water-based fire fighting system is planned. A tanker fill system will be provided at a point next to the pump station.

WATER TREATMENT

Water used at the Oak Flats central hatchery will become contaminated with by-products of fish culture. These include fish waste, unused food, disease-control chemicals, and river sediment settled out in rearing vessels. The following is a discussion of proposed facilities to deal with water treatment.

HATCHERY EFFLUENT

Water which has passed through adult holding and rearing vessels will be discharged either to the Naches--Selah I.D. or to the Naches River by way of the existing onsite ponds. Depending on final site grades hatchery effluent will flow by gravity to both discharge points.

CLEANING WASTE

A vacuum cleaning waste system in keeping with current WDF design practice will be installed for the 22 raceways. The proposed system includes concrete holding pond is capable of holding 5,000 cubic feet in the top 3 feet of depth. This system is similar to that provided at the Eastbank Hatchery. It would be 30 feet by 56 feet in plan, and depending on final site grades, may require an cleaning waste booster pump to deliver the cleaning waste to the cleaning waste pond. One standard WDF educator pump will be provided for each of the raceway groups. Two 10 horsepower aerators are anticipated for the cleaning waste pond. Adult fish held on site will be treated with formalin: however, at this time there is no plan for specific treatment of water during these operations.

SEWAGE TREATMENT

Domestic sewage from the hatchery building, research center and the residences will be treated onsite in a septic tank and drain field. A sewage lift station may be required to deliver flow to the drain field if it is located at a higher elevation than the buildings. Local health department requirements will guide the design.

FACILITY BUILDINGS

The following is a description of the buildings to be provided at the Oak Flats central hatchery.

HATCHERY BUILDING

This 40-foot by 60-foot frame building will include the following rooms.

Description		Size (feet)
Visitor Center		20 x 30
Visitor Restrooms	2@	10 x 10
Office		14 x 15
Lunch Room		15 x 20
Locker Room		12 x 17
Restroom		8 x 7
Mechanical Room		12 x 14
Storage		11 x 14

INCUBATION BUILDING

This 45-foot by 60-foot prefabricated metal building will contain 20 deep trough incubators in a 40-foot by 45-foot room. In addition. there will be a 19-foot by 20-foot egg picking room, a 10-foot by 20-foot lab, and a 9-foot by 20-foot mechanical room.

FREEZER BUILDING

This 25-foot by 60-foot prefabricated metal building will be designed to be similar to the WDF Kittitas freezer building. It will have a frozen fish food capacity of 70,000 lbs.

ELECTRICAL CONTROL BUILDING

This 25-foot by 30-foot building will contain the electrical equipment for the hatchery as well as a 150 KW diesel generator. Power will be distributed to the various buildings on the hatchery site from this building.

POLE BARN

A 40-foot by 48-foot pole barn will be provided for storage and a shop. The tanker truck assigned to this station will be stored in this structure.

RESIDENCES

Three 1,600 square foot single family residences will be provided on this station. They will have two car garages and will be of a style selected during final design.

Chapter 5

NELSON SPRINGS FACILITY DESIGN

GENERAL SITE DESCRIPTION

The Nelson Springs central hatchery is located at the confluence of Buckskin Creek and a creek fed by many springs in the Gleed Valley called Nelson Springs. This site was selected as the central hatchery for fall chinook and summer steelhead. The Nelson Springs site is adjacent to River Mile 3.4 on the Naches River just northwest of the City of Yakima. The site was selected because of a good spring water supply which in recent years has been used by the Northwest Steelheaders in conjunction with Washington Department of Wildlife to rear steelhead.

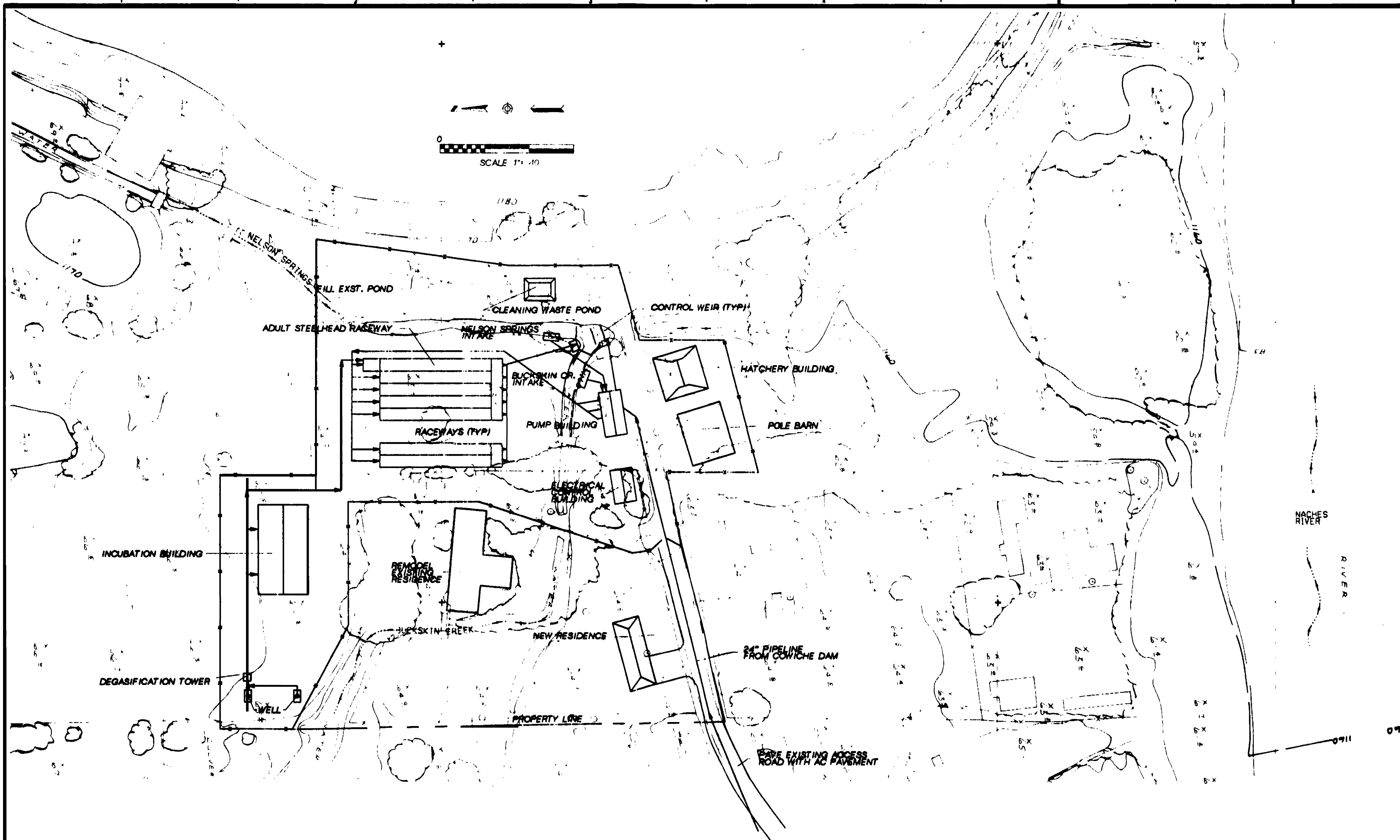
FACILITY SIZE

Nelson Springs is a small site relative to the various project components that are required. As shown on Figure 5-1, the seven raceways will fit on the vacant farm land between the two creeks. The existing house and some of the old buildings on the site will be adapted for hatchery use. A new house will be built southwest of the existing home. Existing flood plain maps of the site are suspect and until a detailed flood study is completed during final design! it is not clear where the floodway for the Naches River is. The results of that study may provide more land which can safely be developed on the site.

PRODUCTION GOALS REVIEW

As presented in Chapter 2, the Nelson Springs site will provide for adult holding, incubation, and rearing of Naches summer steelhead. In addition, fall chinook will be incubated and reared at this station. Four hundred thousand steelhead and 3.6 million fall chinook will be hatched and reared at Nelson Springs. One-half of the steelhead will be transferred to the Oak Flats site in late October with the remainder staying at Nelson Springs until late January. before they are transferred to acclimation sites. The fall chinook are reared at Nelson Springs until mid-March when one-third are transferred to Prosser and one-third are transferred to Wapato for final acclimation. The remaining one-third are transferred at a later time to Wapato for final acclimation.

Seven 5.000 cubic feet concrete raceways will he provided with one of those modified to hold and spawn steelhead. The raceways. as shown in Figure 5-1. are located on vacant farm land between Nelson Springs and Buckskin Creek. Two



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YAKIMA RIVER BASIN
SALMON AND STEELHEAD FACILITIES
PRELIMINARY DESIGN REPORT

FIGURE 5-1
NELSON SPRINGS CENTRAL HATCHERY
SITE PLAN

SHEET
DWG NO.
DATE FEB 1990
PROJ NO. SEA27133.A0

PRELIMINARY

raceways are kept separate from the others to allow the local sportsmen's group to continue to participate in the feeding of steelhead.

SITE DEVELOPMENT

The following is a discussion of the items of work required to improve the Nelson Springs site for use as the central hatchery for fall chinook and summer steelhead.

ACCESS ROADS

Since the site has been used in the past as a steelhead, rearing station adequate access roads already exist at the site. To improve access to the site and reduce dust, the access road will be paved with asphaltic concrete for an approximate distance of 800 feet to connect with the existing paved road. Onsite roads will be gravel surfaced. The adequacy of existing bridges and culverts will need to be verified during final design. Figure 5-1 shows the onsite roads and part of the access road.

DRAINAGE AND SNOW REMOVAL

Site grading will be designed to ensure adequate drainage. Drainage provisions at this site will be minimal since Buckskin Creek and Nelson Springs run directly through the site. Snow removal from the access road will be contracted to Yakima County. Onsite snow removal will be accomplished by the hatchery staff with use of a plow mounted on a 4-wheel-drive pickup.

CONSTRUCTION CLEARING AND GRUBBING

Clearing of existing large trees on the site will be minimized. There will be some trees removed to improve access to site facilities, such as raceways and the incubation building. Much of the area to be occupied by the raceways and new building is vacant farmland which has already been cleared. Grubbing will be required in areas where structures are to be placed.

SITE WORK AND SLOPE PROTECTION

Finished grade at the site will be approximately elevation 1,164.5, which is the average elevation around the existing raceway and the existing home. This elevation may have to be adjusted during final design pending the outcome of a detailed flood plain study. This grade will result in up to 2,000 cubic yards of excess material being generated during the construction of the raceways. Some of this excess material will be used to fill in the old raceway and some will be used to raise the grade of the access road and the general site. Disturbed areas such as fill slopes will be hydroseeded after construction.

At this time, no special flood proofing is planned. The 100 year flood level reported in the June 1985 FEMA flood insurance study is very suspect. As a result, a detailed flood plain and flood way determination of the Naches River will be required for final design. There have been no reports of flooding from Buckskin Creek of Nelson Springs.

WETLANDS

With the exception of Buckskin Creek and Nelson Springs, there are no other wetlands on the site. As a result, no net loss of wetlands is anticipated.

FLOOD ANALYSIS

As mentioned earlier, the Nelson Springs site was covered in a detailed FEMA study. That report shows a 100 year flood elevation of 1,174 on the site. The general ground elevation on the site is 1,164. A 10-foot depth of flooding at the site is very suspect and as a result, it is recommended that a detailed flood study be conducted at the site. It is possible that some part of the site is in the 100 year flood plain; however, no structures will be placed in the floodway.

POWER SUPPLY

Electrical power for the Nelson Springs site will be provided by Pacific Power and Light Company. Their 12.5 kV, 3 phase power line is near the site. A diesel generator backup will be provided to serve one-half of the pumping load. The estimated load at the site is shown in Table 5-1.

Table 5-1
ESTIMATED ELECTRICAL LOADS

Description	Quantity	Horsepower (ea)	KVA (total)
Pumps	3	15	45
Hatchery Building	1	--	50
Incubation Building	1	--	80
Cleaning Waste Aerator	1	10	10
Educator Pumps	2	7.5	15
Spray Pumps	2	5	10
Electrical Building	1	--	2
Pump Building	1	--	2
Pole Barn	1	--	10
Site Lighting	1	--	1
			224

WATER SUPPLY

As presented in Chapter 2, the Nelson Springs site will have the need for Naches River water (5 cfs), Buckskin Creek water (8 cfs), Nelson Springs water (8 cfs), and well water (1 cfs). This section presents the design concepts for each water source.

NACHES RIVER WATER

Up to 5 cfs of water from the Naches River to provide a redundant water supply and needed temperature control for steelhead adult holding and juvenile presmolt acclimation. A screened intake for this water will be designed as an integral part of the new attraction water supply system for the Cowiche Dam fishway and adult trapping facility. It is assumed that this water supply from the Naches River will flow by gravity to a central pumping station on site as shown in Figure 5-1.

Preliminary design considerations included using the existing spring creek and highway and railway culverts to route the flow to the Buckskin Creek pump station. However, for this preliminary design a 1,900-foot-long, 24-inch-diameter pipeline from Cowiche Dam to Nelson Springs will be used. Although more costly. the pipe alternative will ensure that a truly redundant supply is provided for the hatchery.

BUCKSKIN AND NELSON SPRINGS CREEK WATER

Up to eight cfs from both Buckskin Creek and Nelson Springs will be pumped to the raceways. This will require four 10 horsepower pumps. Flow control will be incorporated into the pump station to provide a constant level in the respective creeks so that there will always be 1 cfs of flow over the control weir. Depending on the results of the USBR water supply report water from the two creeks may be blended first before pumping. This will affect the design of the control weirs.

WELL WATER

The well drilled in the center of the site did not produce sufficient flow for incubation (see USBR water supply report). In final design, two additional wells will be drilled in the northwest comer of the site which will hopefully yield 1 cfs. If well water cannot be obtained on the site, spring water will be used for incubation.

Diversion Weirs. Two diversion weirs will be constructed at the confluence of Nelson Springs and Buckskin Creek. These weirs are required to provide enough depth for the fish screens and the pump intakes. The weirs will be as low as possible to minimize the barrier to coho which reportedly use the creeks. A series of low weirs downstream from these diversion weirs and the confluence may be required to facilitate upstream passage. All weirs may be part of a single concrete structure which also will serve as the outflow point for hatchery effluent. This outflow will be screened for adults. As mentioned above, if the results of the USBR water supply report indicate that the two creeks provide basically the same quality water, there may be a single diversion weir which would mix the flow before pumping.

MISCELLANEOUS WATER SUPPLY

Domestic water for the existing residence will be supplied by wells, one of which already exists. A tanker fill station will be provided with a booster pump if needed. Fire Protection will be provided by the fire alarm system and chemical fire extinguishers. No water-based fire fighting system is planned.

WATER TREATMENT

HATCHERY EFFLUENT

Water passing through the raceways will be discharged directly to the creek below the control weirs. As mentioned earlier, this outfall will be screened to prevent returning adults from entering. At certain times the hatchery effluent will makeup 90 percent of the flow of the creek. No special treatment is planned for general hatchery effluent.

Cleaning Waste. A vacuum cleaning waste system in keeping with current WDF design practice will be installed for the seven raceways. The proposed system includes concrete holding pond capable of holding 1,700 cubic feet in the top 3-feet of depth. This system is similar to that provided at the Eastbank Hatchery. It would be 20 feet by 28 feet in plan, and depending on final site grades, may require an effluent booster pump to return the effluent to the main site drain. One standard WDF educator pump will be provided for each group of raceways. A 10 horsepower aerator is anticipated for the cleaning waste pond.

Adult steelhead to be held onsite may be treated with formalin; however, at this time there is no plan for specific treatment of water during these operations is planned.

DOMESTIC SEWAGE

Domestic sewage from the hatchery building will be treated onsite in a septic tank and drainfield. A sewage lift station may be required to deliver flow to the drainfield if it is located at a higher elevation than the hatchery building. Local health department requirements will guide the design.

FACILITY BUILDINGS

The following is a description of buildings to be provided at the Nelson Springs central hatchery.

HATCHERY BUILDING

This 40-foot by 40-foot frame building will include the following rooms.

Description	Size (feet)
Office	15 by 15
Restroom	8 by 10
Lunchroom	15 by 20
Locker Room	16 by 20
Mechanical Room	15 by 14
Laboratory	15 by 12

This will be an energy-efficient building with air conditioning and electric heat. The building will have concrete floors.

INCUBATION BUILDING

This 45-foot by 80-foot building will include the following rooms.

Description	Size (feet)
Steelhead Incubation Room	16 by 45
Egg Picking Room	18 by 19
Laboratory	18 by 19
Salmon Incubation Room	46 by 45

The steelhead incubation room will be designed to accommodate 80 isoflow buckets in eight deep troughs, early rearing of some of the steelhead will also be accomplished in these troughs. Additional troughs in the salmon incubation room will be used by the steelhead for early rearing, but the fall chinook are programmed to be out of the incubation building by that time. If fall chinook remain in the building during the steelhead early rearing period a curtain will be used to separate the two.

RESIDENCES

One existing residence on site will be remodeled and a new 1600-foot^2 residence will be built. The new residence will have a two car garage and will be of a style determined during final design.

PUMP BUILDING

The 20-foot by 40-foot pump building will house the pumps and motor controls for the hatchery. Three 15 horsepower pumps will be available to pump from either creek or the Naches River.

POLE BARN

The 30-foot by 48-foot pole barn will provide room for a walk-in freezer. a shop. and covered storage for hatchery vehicles.

ELECTRICAL CONTROL BUILDING

This 20-foot by 30-foot building will house the diesel generator, auto transfer-switches, and associated electrical equipment.

Chapter 6

WAPATO FACILITY DESIGN

GENERAL SITE DESCRIPTION

The Wapato satellite facility is located between the Wapato Canal, and the Union Pacific Railroad, and U.S. Route 97 approximately 1.2 miles northwest of the town of Parker and 0.4 miles downstream of Wapato Dam. The site is at River Mile 106.2 on the right bank of the Yakima River on government property adjacent to the recently constructed Wapato Canal fish screens.

ALTERNATIVE SITES

A site near Sunnyside Dam was considered during earlier planning but was eliminated because of flood plain constraints. The Wapato site was originally proposed to be fed by gravity on a site east of the canal. The selected site west of the canal will require pumping, but is more protected from floods by the Burlington Northern Railroad and the canal embankment.

In final design, a gravity-supply site east of the Burlington Northern tracks will be investigated. Land is limited at that site and is privately held: however. the potential for gravity supply makes the site potentially desireable. This will require a detailed flood plain and floodway analysis during final design.

FACILITY SIZE

As shown on Figure 6-1, the proposed facility will take up most of the remaining unused land in government ownership. This is approximately 4.0 acres. With the exception of a small meteorological station on the site, the land is currently vacant. In final design near by orchard land may be acquired to provide additional room for construction staging and room for disposal of canal sediments.

PRODUCTION GOALS REVIEW

The Wapato satellite facility will be used for final rearing and acclimation of coho and fall chinook. The facility will be operated from March 1 through the end of May. Coho smolt releases are planned for 1.55 million fish at 15 fish per pound, and fall chinook releases are planned for 2.4 million fish at 65 fish per pound.

The Wapato satellite site will have three 45,000 cubic feet ponds for coho and 12 raceways for fall chinook.

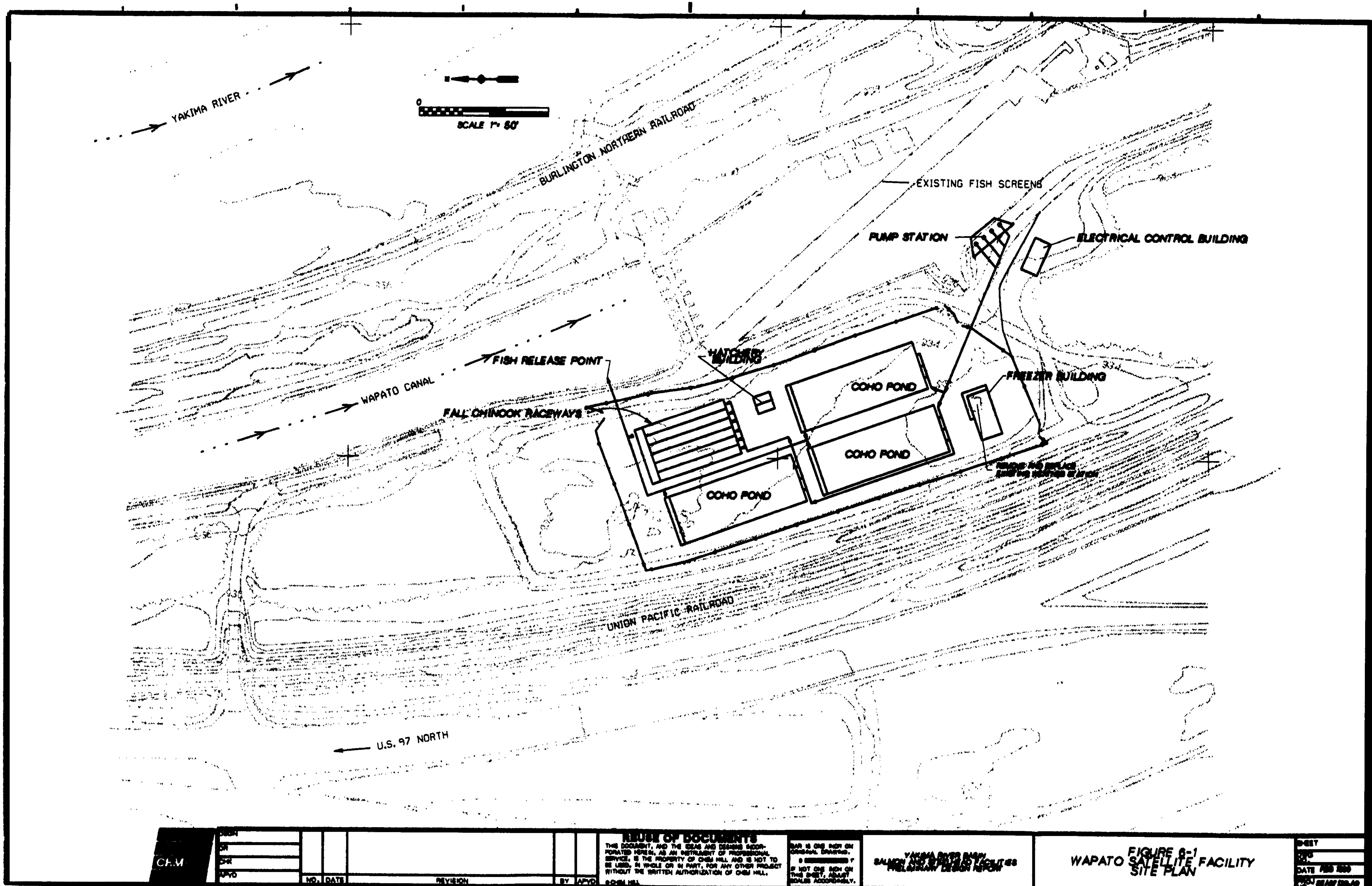


FIGURE 6-1
WAPATO SATELLITE FACILITY
SITE PLAN

CURRENT LAND USE AND OWNERSHIP

As mentioned earlier, the site of the proposed facility is currently vacant land adjacent to the new fish screens on the Wapato Canal. The site is on the Yakima Indian Nation reservation in unincorporated Yakima County. All proposed facility lands are currently owned by the government.

SITE DEVELOPMENT

The following is a discussion of items of work required to improve the selected site for use as a fish culture station.

ACCESS ROADS

Since the Wapato site is currently developed and actively maintained for the fish screen structure, no new access roads are required. Because of the expected increase in traffic from large fish transfer and fish food trucks, access arrangements need to be carefully reviewed with WSDOT and the affected railroads. To ensure that the ponds and raceways will drain completely dry to the canal they will be elevated on fill, resulting in the site roads, and parking areas being 2 to

3 feet higher than the existing roads. As shown in Figure **6-1,** these grade differences will be accommodated with ramps up to the rearing areas. All roads and parking areas will be gravel surfaced. Site plans will be coordinated with the **USBR** and **WIP** to ensure that there are no access problems with the joint use of the site.

DRAINAGE AND SNOW REMOVAL

Site grading will be designed to ensure adequate drainage. Drainage provisions at this site will be minimal. Snow removal will be required in some years to provide access to the site prior to the March 1 startup date. This snow removal will be by local contract forces. Adequate room for snow storage will be provided within the fenced area on the fill slopes.

CONSTRUCTION CLEARING AND GRUBBING

The **Wapato** site was previously used for constructing staging for the new fish screens on the **Wapato** Canal. As a result, minimal clearing and grubbing is anticipated.

SITE WORK AND SLOPE PROTECTION

As much as 10,000 cubic yards of fill will be brought to the site in order to construct the ponds and raceways high enough to allow for gravity drainage to the Wapato Canal. This material will be imported from an offsite location, which will be at the contractor's option. The fill slopes at the site will be at a slope of 3:1 where possible, some low retaining wall may be required to maintain existing access. All disturbed areas and fill slopes will be hydroseeded after construction.

No flood protection is required for this site as currently proposed. If an alternate site on the river side of the Burlington Northern tracks is selected in final design, there will need to be substantial flood proofing. Cost of flood proofing for a gravity supply site will have to be compared with the cost of pumping at the primary site.

WETLANDS

No wetlands have been identified at the site, and there is little opportunity for wetland enhancement.

FLOOD ANALYSIS

The **Wapato** site was included in a June **1985** flood insurance study by **FEMA.** The site is shown as being in the **100-year** flood plain. A detailed flood study was not done by **FEMA** and as a result, no floodway was delineated. As part of the final design, a detailed flood plain and floodway analysis will be done to refine local flood elevations and evaluate the potential for reducing construction and operations cost by a gravity-supply system.

POWER SUPPLY

Electrical power for the **Wapato** site will be provided by the Pacific Power and Light Company. They already serve the **Wapato** fish screen site with **12.5 kV,** 3 phase power. A diesel generator backup will be provided to serve two of the canal pumps if there is a power outage. The estimated electrical load at the **Wapato** site is shown in Table **6-1.**

Table 6-1
ESTIMATED **ELECTRICAL** LOADS

Description	Quantity	Horsepower (ea)	KVA (total)
Canal Pumps	4	75	300
Domestic Well	1	5	5
Hatchery Building	1	--	20
Site Lighting	1	--	1
			326

WATER SUPPLY

As presented in Chapter 2, the Wapato site will need 60 cfs pumped from the Wapato Canal. In addition, a domestic well will be required. This section presents the design concepts for the water supply system.

CANAL WATER

A pump station will be constructed just downstream of the access ramp to the new fish screens on Wapato Canal. The site is on the right bank of the canal directly opposite the downstream end of the fish screen structure. The WIP has agreed to provide at least 500 cfs of flow on March 1 of each year. This should provide sufficient depth of flow in the canal for the pump station to operate. In final design, an evaluation of the tailwater conditions and the effectiveness of the new screens at that low flow will be evaluated. A check structure may be required in the canal to provide sufficient tailwater.

Return flow from the ponds and raceways will be discharged upstream of the existing fish screens which will result in some reuse of water. The reuse of less than 10 percent is not considered detrimental to the fish.

DOMESTIC SUPPLY

A domestic water supply well will be constructed on the site. No preliminary investigations into that system have been done, but all homes nearby have wells, so it should not be a problem.

WATER TREATMENT

Since the return flow enters the Wapato Canal, no special treatment of hatchery effluent is planned at the Wapato site. After the fish have left the station, the ponds and raceways will be drained to allow the accumulated material to dry out for mechanical removal.

SEWAGE TREATMENT

Domestic sewage from the hatchery building will be treated **onsite** in a septic tank and drain field. Local health department requirements will guide the design of this system.

FACILITY BUILDINGS

The following is a description of the buildings to be provided at the **Wapato** site.

HATCHERY BUILDING

The **20-foot** by **20-foot** hatchery building will include the following rooms.

Description	size (feet)
office	**10** by **12**
Restroom	8 by **10**
Storage	**10** by **20**

This will be an energy-efficient frame constructed building with electric heat and no air conditioning. The hatchery building will have concrete floors.

FREEZER BUILDING

The freezer building will be a prefabricated metal building similar to the WDF standard Kittitas freezer. The capacity of this 25-foot by 60-foot building will be 70,000 pounds.

Chapter 7

PROSSER FACILITY DESIGN

GENERAL SITE DESCRIPTION

The Prosser site is located between the Chandler Canal and the Yakima River just northeast of the town of Prosser. The site is at River Mile 46.3 on the Yakima River on government property adjacent to the recently constructed fish screens and juvenile trapping facility on the Chandler Canal.

ALTERNATIVE SITES

TWO alternative sites were considered prior to selecting the new juvenile trap site. The first was proposed for a flood plain area just downstream of the adult trapping facilities on the right bank of the river below the Prosser Dam. This site was rejected because it was subsequently developed as a city park, it had potential flood plain problems and it was reported to have archaeological significance to the Yakima Indian Nation. The second site was at the old juvenile trap just downstream of the selected site. It was determined that the selected site was preferable because it consolidates fisheries-related activities in one secure location on existing government land.

FACILITY SIZE

The proposed facilities will occupy approximately 4.5 acres of land. The site plan for the facility is presented in Figure 7-1. Part of the facility will be in the vacant land between the fish screens and the juvenile trapping building. The six concrete raceways will be located in the 100 year flood plain but outside the floodway on the low land adjacent to the access road for the juvenile trapping facility. This site for the raceways may need to be moved in final design to accommodate USBR plans for a new trash and ice wasteway or to avoid conflict with springs in the vicinity.

PRODUCTION GOALS REVIEW

The Prosser satellite facility will be used for holding adult coho and fall chinook in the late summer and fall. These adults are to be trapped 0.9 mile away at Prosser Dam. In addition, the facility will be used for final rearing and acclimation of 1.2 million fall chinook in March, April, and May. The facility will have one 20,000-cubic-foot pond for holding adult fall chinook and six 5,000-cubic-foot

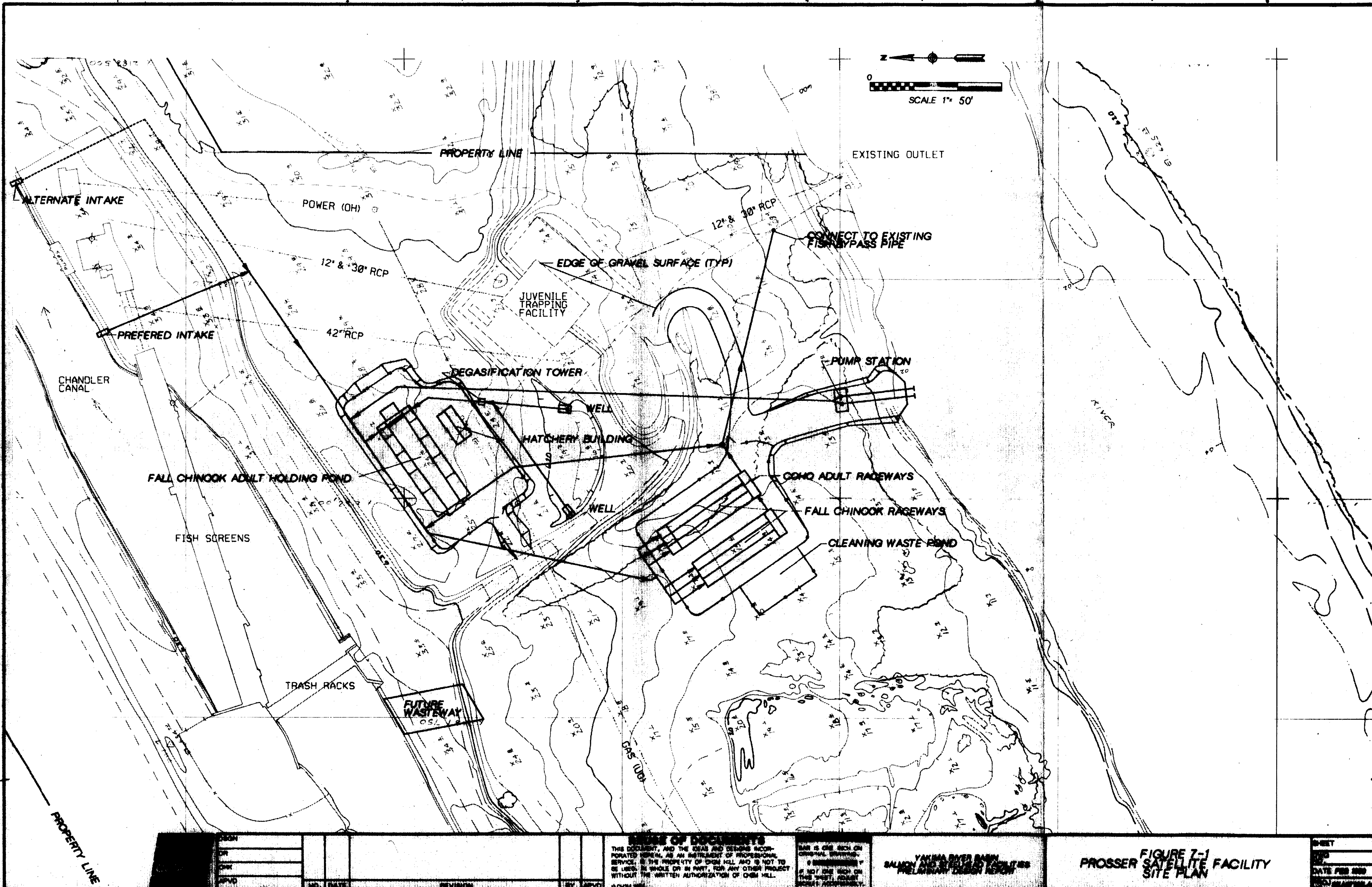


FIGURE 7-1
PROSSER SATELLITE FACILITY
SITE PLAN

raceways for holding adult coho and for final rearing and acclimation of fall chinook.

CURRENT LAND USE AND OWNERSHIP

As mentioned earlier, the site of the proposed facility is currently vacant land adjacent to existing fish screens and is in unincorporated Benton County. All lands required for the facility are currently owned by the government.

SITE DEVELOPMENT

The following is a discussion of items of work required to improve the selected site for use as a fish culture station.

ACCESS ROADS

Since this site is currently developed and actively maintained for the fish screen structure and juvenile trapping facility. no new access road are required. The existing gravel surfaced access roads will be extended to the upper pond. the lower raceways. and the river pump station. as shown on Figure 7-1.

DRAINAGE AND SNOW REMOVAL

Site grading will be designed to ensure adequate drainage. Drainage provisions at this site will be minimal. Some snow may accumulate in the latter part of the adult holding period (November and December). Snow may also still be on the site in mid-March during some years. Snow removal will be accomplished by local contract forces. Adequate room for snow storage will be provided within the fence at the pond and raceway sites.

CONSTRUCTION CLEARING AND GRUBBING

The Prosser site will require very little clearing and grubbing. Some low brush at the site of the proposed raceways will be removed, but the few larger trees near the river will not be disturbed. The area around the pond and hatchery building was previously disturbed during the construction of the fish screens and juvenile trap.

SITE WORK AND SLOPE PROTECTION

The adult holding pond will be located at a point which requires approximately 1,500 cubic yards of cut. The excess material from this cut will be used to fill the existing depression north of the access road to the juvenile trapping facility. Some of this material may also be used around the raceways. Excess material which is not used in final structures will be disposed of onsite as is currently being done with excess material from the Prosser left bank ladder construction.

At this time. no special flood proofing is planned. The 50 year flood in the area may be as high as elevation 615.3 feet. which would encroach on the raceway fill slopes. This elevation and the final elevation of the raceway embankments will be verified during final design. Cut and fill slope area will be 3:1 and will be hydro-seeded after construction.

WETLANDS

Although the pump station and raceways are in the 100 year flood plain and within 200 feet of the bank of the river, no wetlands have been identified and as such, no loss of wetlands is anticipated.

FLOOD ANALYSIS

The Prosser site was studied by the FEMA as part of its Benton County flood insurance study. A detailed flood study. including a floodway determination. was completed in July 1982. This study will form the basis of the final design of the site. The current plan is to have the raceways and their associated fill outside the flood way, but partially in the 100 year flood plain. This configuration should not encroach on the flood plain any more than the existing juvenile trapping facility and its access roads. The adult holding pond, hatchery building. and pump control building will be well above the 100 year flood level.

POWER SUPPLY

Electrical power for the Prosser site will be provided by Benton County PUD. Their 12.5 kV, 3 phase power line already serves the needs of the fish screen and the juvenile trapping facility onsite. A diesel generator backup will be provided to serve power to one of the river pumps and the well pump, if there is a power outage. The estimated electrical load at the Prosser site is shown in Table 7-1.

Table 7-1
ESTIMATED ELECTRICAL LOADS

Description	Quantity	Horsepower (ea)	KVA (total)
River pumps	2	20	40
Well pump	2	10	20
Hatchery Building	1	--	20
Educator Pump	2	7.5	15
Spray pumps	4	10	40
Site Lighting	1	--	1
			135

WATER SUPPLY

As presented in Chapter 2, the Prosser site will have the need for well water (1 cfs), river water (6 cfs), and canal water (14 cfs) at various times during the year. This section presents the design concepts for each water source.

WELL WATER

The USBR water supply report has complete details on the well field. The plan is to pump 1 cfs from the well(s) during the late summer and early fall, when adults are being held. The anticipated 58°F water will be used to temper the warmer canal water.

The well water will be pumped to a degassification tower and will then be delivered to the adult holding pond where it will be mixed with either canal water or river water, depending on the time of year.

RIVER WATER

Six cfs will be pumped directly from the Yakima River during the late fall period when the Chandler Canal is shut down for maintenance. Two 20-horsepower line-shaft pumps will be used to produce a total flow of 6 cfs. Since it is unlikely that a large flood would occur at the site in late fall. the pump station will only be protected up to the 10 year flood level. Pumps and intake screens would be removed during the nonpumping season. Since the river is very shallow at the site of the pump station. minor dredging of sediment may be required each fall to put the pump station in service.

CANAL WATER

A gravity diversion from the Chandler Canal will be the primary water source for the Prosser site. Up to 14 cfs will be diverted from the canal. Two alternative intake points are shown on Figure 7-1. The exact point of diversion will be re-solved in final design after discussion with the USBR on the impact of the pro-posed intake site. The coordination with the USBR also will include discussions on their proposed new ice/trash wasteway for the trash rack structure on the Chandler Canal. For rearing of fall chinook. canal water will be settled first in the large adult holding pond.

MISCELLANEOUS WATER SUPPLY

Although it was originally planned to provide incubation at Prosser through the eyed egg stage for coho and fall chinook. it is recommended that the eggs be shipped green to Nelson Springs and Oak Flats for incubation. As a result, there will be no incubation at Prosser. Since only green eggs are programmed to leave the station, so no tanker fill system will be provided. The 6-inch observation well used during the groundwater investigation will be used for domestic water supply. Fire protection will be provided by a fire alarm system and chemical fire extinguishers. No water-based fire fighting system is planned.

WATER TREATMENT

Water used at the Prosser facility will become contaminated with byproducts of fish culture. These include fish waste, unused food, disease-control chemicals, and river sediment settled out in rearing vessels. The following is a discussion of proposed facilities to deal with water treatment.

HATCHERY EFFLUENT

Water which has passed through adult holding and rearing vessels will be discharged directly to the Yakima River by way of the existing fish bypass piping. If in final design it is determined that this pipe cannot be used, a similar structure will be constructed. Adult holding of fall chinook at the same station as that is used for final acclimation, always presents the risk of false attraction of returning adults. This factor will have to be examined in the final design.

CLEANING WASTE

A vacuum cleaning waste system in keeping with current WDF design practice will be installed for the six raceways. The proposed system includes a large earthen drying bed to receive the cleaning waste. Adult fish held on station may be treated with formalin; however, at this time there is no plan for specific treatment of water during these operations.

SEWAGE TREATMENT

Domestic sewage from the hatchery building will be treated onsite in a septic tank and drainfield. A sewage lift station may be required to deliver flow to the drainfield if it is located at a higher elevation than the hatchery building. Local health department requirements will guide the design. Direct discharge of domestic sewage to the near by sewage treatment plan will also be investigated during final design.

HATCHERY BUILDING

The hatchery building will be a 20-foot by 40-foot frame building and will include the following rooms:

Description	Size (feet)
Office	10 by 12
Restroom	8 by 10
Storage	10 by 20
Pump Controls and Mechanical	10 by 10
Lunch/Bunk Room	10 by 20
Freezer	10 by 10

This will be an energy-efficient building with electric heat and air conditioning. The building will have concrete floors.

Chapter 8

ACCLIMATION SITES

The acclimation sites for spring chinook and for summer steelhead are very important to the concept of supplementation. Acclimation sites will be provided to allow different experimental groups of fish to imprint and thus return to different areas on the main stem of the upper Yakima River and other tributaries throughout the basin.

UPPER YAKIMA SPRING CHINOOK

The plan developed by EDWG for siting the 15 acclimation ponds required for Upper Yakima spring chinook involves putting three ponds in clusters at five areas in the upper basin. Each pond in a cluster would be within a mile or so of each other. The location of these sites can be seen in Figure 2-1. The clusters on the Teanaway River and Yakima River above Lake Easton are referred to as tributary clusters. The three clusters at Easton, Cle Elum, and Thorp are considered main stem clusters. Management and operations of these sites will be coordinated by the hatchery manager at the Cle Elum central hatchery. Food will be distributed on a daily basis by hatchery staff in hatchery pickup trucks. Peak food consumption at each pond is approximately one 50-pound bag per day. Two feedings per day are planned.

NACHES SPRING CHINOOK

The plan for acclimation of the Naches spring chinook was also developed by EDWG and includes three clusters of two ponds each to accommodate the six experimental groups. As shown in Figure 2-1, there is one cluster on the Little Naches River, one cluster on the Bumping River, and one cluster on Rattlesnake Creek. The Rattlesnake Creek sites have single acclimation ponds. The Little Naches and Bumping sites are proposed to have two ponds per site. One pond for the spring chinook and one pond for steelhead.

As with the Upper Yakima acclimation sites the Naches spring chinook acclimation sites will be managed by the manager of the nearby central hatchery at Oak Flats. Staff from Oak Plats will feed the fish and maintain the acclimation sites.

SUMMER STEELHEAD

The plan developed by EDWG for summer steelhead includes six clusters of two ponds each on tributaries of the Naches and Lower Yakima Rivers (see Figure 2-1). As mentioned earlier, the Little Naches and Bumping River steelhead sites will be dual pond sites with chinook in one pond and steelhead in the other. The steelhead acclimation will be managed and serviced by the Oak Flats central hatchery, however, it may be more practical to manage the Toppenish Creek sites from the Wapato satellite site.

ACCLIMATION SITE DESIGN

The acclimation sites described above and their associated design criteria were developed by a joint reconnaissance effort by members of EDWG and Mr. Senn of FMC. Design concepts come from recent work completed by Mr. Senn and Mr. Mack of FMC for very similar acclimation sites for the Nez Perce tribe.

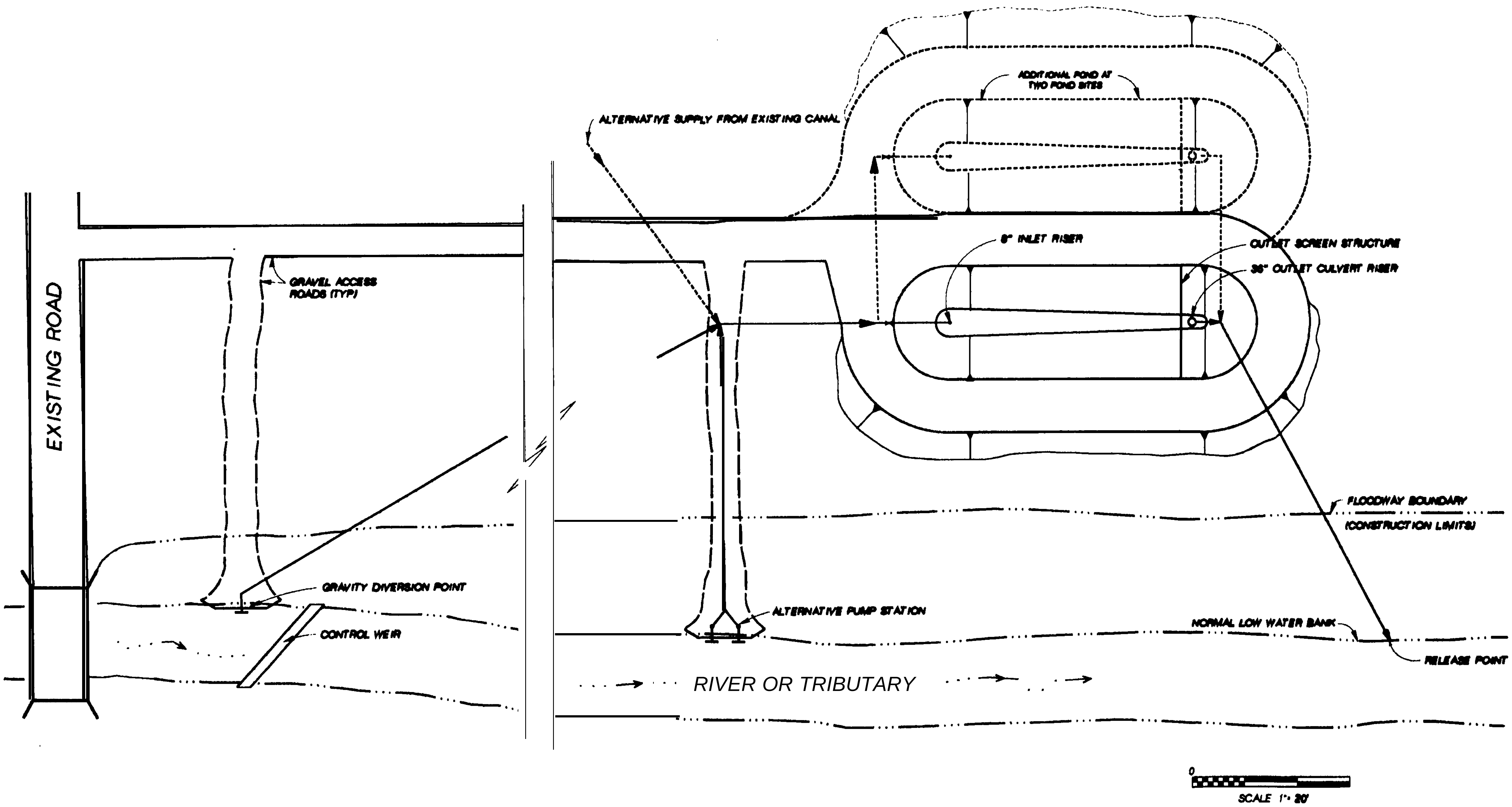
A standardized acclimation pond was designed to accommodate the various experimental groups in the program. The groups are made up of either 33,000 summer steelhead at 7 per pound or 75,000 spring chinook at 15 per pound. A density factor of 1.1, which is one-half of that used in the raceways, resulted in the required pond volume of 9,000 cubic feet. Using an average depth of 5 feet and the current WDF recommended top width to length ratio, the 9,000 cubic feet pond has a top width of 33 feet and a length of 87.8 feet from the 8-inch inlet riser to the outlet screens. The earthen ponds will be lined with river rock to help simulate natural rearing conditions. Simple culvert riser drain structures will be used to minimize cost. The flow rate pond will be 1.2 cfs or

9.28 pounds per gpm for the 5,000 pounds of fish. The outlet will be designed for volitional release with provisions for a counter.

Figure 8-1 shows a typical site plan for an acclimation site. This figure shows general design considerations modeled after the FMC experience with the Nez Perce project. The preferred alternative at any site is a gravity supply of surface water. This is shown on the left side of the figure as being positioned adjacent to a hypothetical existing bridge. This approach would work well on streams with gradients steeper than 50 feet per mile.

On flatter gradient streams such as the Yakima River pump stations will be required. Pump stations allow for shorter transmission piping but of course require electrical power and diesel generator backups.

The pond(s) must be positioned such that they are outside of the floodway and high enough to drain by gravity. Depending on the site, one or two ponds will be constructed. Security fencing, alarm systems, and predator protection devices are not shown on the figure but are required at all sites. There are no current plans for a buildings at the acclimation sites.



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CHK					
APVD					

YAKIMA RIVER BASIN
SALMON AND STEELHEAD FACILITIES
PELIMINARY DESIGN REPORT

FIGURE 8-1
TYPICAL ACCLIMATION POND
SITE PLAN

SHEET

DWG NO.

DATE FEB 1990

PROJ NO. SEA29133.A0

PRELIMINARY

Chapter 9

ADULT AND JUVENILE TRAPPING FACILITIES

Adult and juvenile trapping facilities are required for the Yakima Basin program. EDWG in coordination with the passage Workgroup has identified the sites which will be initially required to collect adult brood stock and to evaluate smolt out migration. The passage work group has started to draft a plan for preliminary design of the required facilities. In developing this plan design concepts have been identified for both new sites and modifications to existing facilities.

At Prosser minor modifications to the existing adult trap and the addition of a short term holding tank is planned. No modifications are currently planned for the juvenile trap at Prosser. At the Cowiche Dam an adult trap has to be added to the existing left bank fishway. In addition, a 10 cfs gravity intake to supply the Nelson Springs central hatchery will be included. A new juvenile trap will be required at the new diversion dam at Oak Flats. At Raza Dam a new adult trap will be added to the existing left bank ladder and the existing juvenile will be modified.

A more complete description of the proposed adult and juvenile trapping facilities including EDWG's fish collection design criteria will be the first product of the upcoming predesign by the passage Workgroup.

Chapter 10

SCHEDULE AND COST

SCHEDULE

Construction of the Yakima River Basin facilities is planned to occur over a five year period from 1992 through 1996. The schedule for individual facilities is shown in Figure 10-1. This schedule is designed to meet the program goals for fish culture as well as to phase in construction to meet funding limitations. The schedule for construction is driven by the goal of taking adult brood stock. Upper Yakima spring chinook will be taken in 1993. Naches spring and summer chinook and coho will be taken in 1944 although the coho brood stock may initially need to come from outside the basin. Fall chinook and Naches summer steelhead will be taken in 1995.

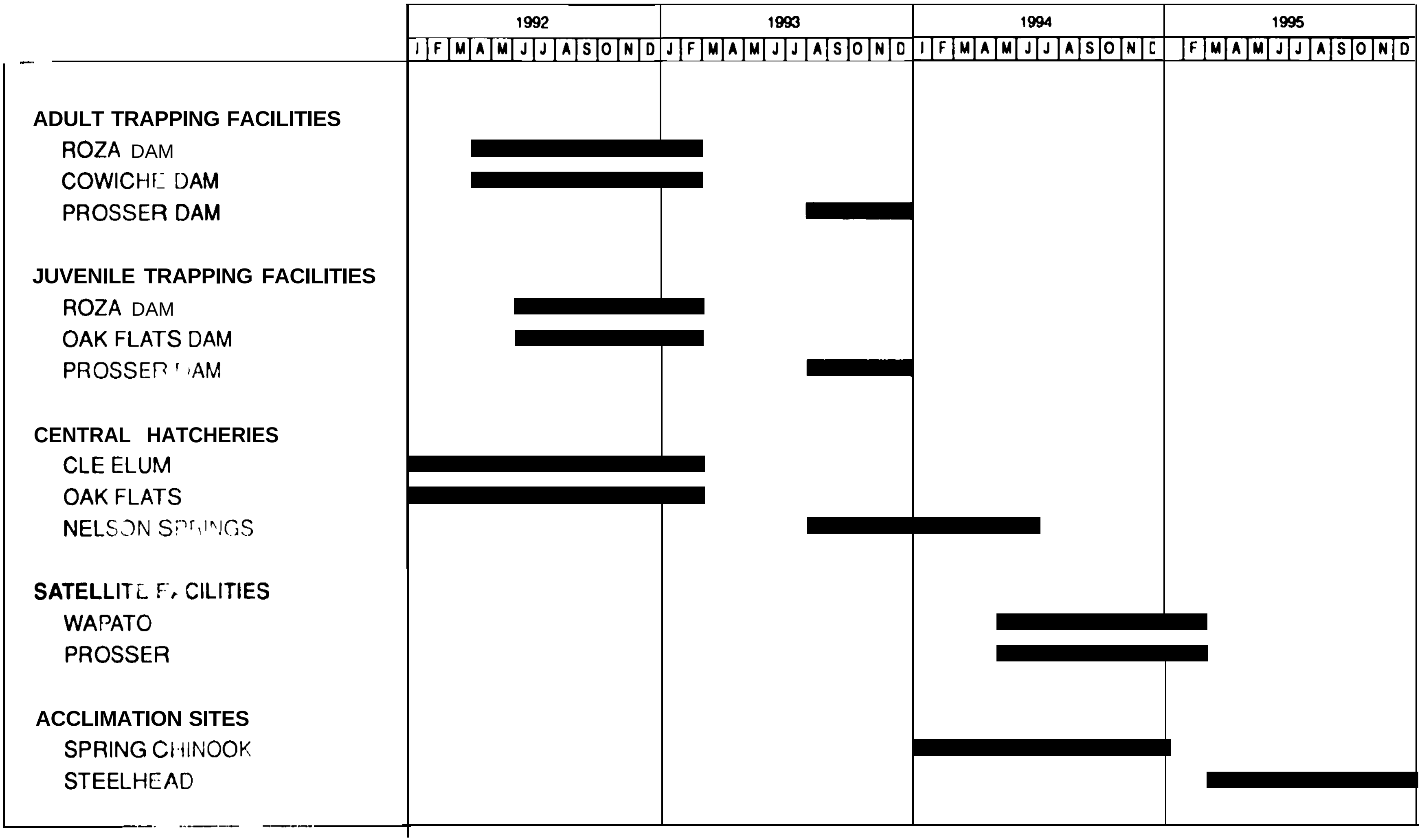


FIGURE 10-1
Yakima River Basin
Enhancement Facilities
Construction Schedule

COSTS

CAPITAL COST

An estimate of the capital cost of each of the Yakima Basin facilities has been made. Due to the varying level of site specific data and engineering design three sources of estimates were used. For the three central hatcheries and the two satellite facilities most of the costs were based on the recently constructed Chelan County PUD Rock Island central hatchery and satellite sites. For the acclimation sites the estimate was based on recent experience with similar facilities on the Nez Perce acclimation site at Meadow Creek. this estimate was prepared by Mr. John Mack of FMC. The estimate for the adult and juvenile trapping facilities was prepared by the USBR passage group based on previous projects and knowledge of the proposed sites. All of the capital cost estimates presented in this report are based on similar facilities, either constructed or planned for other basins.

The estimates represent the best judgement of the respective estimators as to the bids which would be received in January 1990 for the facilities as currently designed for construction in 1990. No escalation to or during construction or construction financing cost is included. Local sales taxes are also excluded since they will not likely be required. These estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final product costs will vary from the estimates presented herein. Because of these factors, funding needs must be carefully reviewed prior to establishing final project budgets.

Table 10-1 shows a summary of the estimated construction costs for the various Yakima River Basin facilities. An estimated 25% for engineering, legal, and administrative cost is also included in Table 10-1. Also shown in Table 10-1, is the BPA Realty-Acquisition Section estimate that the cost to acquire the sites for the three central hatcheries and the two satellite sites are $500,000. No land acquisition cost is available for the acclimation sites or the adult and juvenile trapping facilities.

Tables 10-2 through 10-6 show a more detailed breakdown of estimated costs for the three central hatcheries and the two satellite sites.

Table 10-1
YAKIMA RIVER BASIN
SALMON AND STEELHEAD FACILITIES
CAPITAL COST SUMMARY
(JANUARY 1990 $)

Central Hatcheries		
Cle Elum		$5,160,000
Oak Flats		6,216,000
Nelson Springs		2,647,000
Satellite Facilities		
Wapato		2,154,000
Prosser		1,390,000
Acclimation Sites		
Spring Chinook (17 sites)		3,060,000
Steelhead (8 sites)		1,440,000
Chinook/Steelhead (4 sites)		1,000,000
Adult Trapping Facilities		
Raza		875,000
Cowiche		625,000
Prosser		80,000
Juvenile Trapping Facilities		
Oak Flats		390,000
Raza		110,000
Prosser		-0-
	Subtotal	25,147,000
Engineering Legal and Administrative Costs (25%)		6,287,000
Land Acquisition Costs		500,000
	Total	$31,934,000

Table 10-2 through 10-6 show a more detailed breakdown of estimated costs for the three central hatcheries and the two satellite sites.

Table 10-2 Cle Elum Central Hatchery Cost Estimate 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Site Development					
General Requirements	1	LS	$339,800.00	$339,800	
Clearing & Grubbing	5	AC	$2,288.00	$10,982	
Access Roadway	11,400	LF	$10.01	$114,114	
Misc Surfaced* Areas	9,680	SY	$2.97	$28,792	
Drainage & Culverts	1	LS	$3,000.00	$3,000	
Site Grading	5	AC	$1,258.40	$6,040	
Fencing	1,450	LF	$13.73	$19,906	
Subtotal					$522,635
Water Supply System					
Water Supply Well	4	EA	$50,000.00	$200,000	
River Pump Station:					
Care And Diversion Of Water	1	LS	$80,000.00	$80,000	
Civil Works	1	LS	$145,000.00	$145,000	
Electrical/Mechanical	1	LS	$225,000.00	$225,000	
Pumps	3	EA	$18,000.00	$54,000	
Diesel Generator	1	LS	$32,000.00	$32,000	
Lake Pump Station:					
Cut-Off Trench	1	LS	$150,000.00	$150,000	
Care And Diversion Of Water	1	LS	$20,000.00	$20,000	
Civil Works	1	LS	$80,000.00	$80,000	
Electrical/Mechanical	1	LS	$225,000.00	$225,000	
Pumps	4	EA	$13,000.00	$52,000	
Site Piping:					
Discharge 30"	480	LF	$123.55	$59,305	
Drain 36"	640	LF	$83.51	$53,448	
well 12"	1200	LF	$68.64	$82,368	
Minor Piping (>12")	0.9	AC	$19,136.83	$17,223	
Degasification Tower	1	LS	$85,800.00	$85,800	
Modify Outfall Structure	1	LS	$40,000.00	$40,000	
Subtotal					$1,601,144
Fish Production Facilities					
Raceway	16	EA	$51,000.00	$816,000	
Adult Raceway	2	EA	$90,000.00	$180,000	
Subtotal					$996,000

Table 10-2 (cont'd) Cle Elum Central Hatchery Cost Est. 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Buildings					
Hatchery Building	2,400	SF	$110.00	$264,000	
Incubation Building:	2,700	SF	$85.00	$229,500	
Troughs	20	EA	$2,667.00	$53,340	
Pole Barn	1,920	SF	$15.00	$28,800	
Electrical Control Building	1,500	SF	$50.00	$75,000	
Residences	3	EA	$120,000.00	$360,000	
Freezer Building	1	LS	$180,000.00	$180,000	
Covered Parking	1500	SF	$5.00	$7,500	
Subtotal					$1,198,140
Waste Treatment					
Septic Tank/Drain Field	1	LS	$40,000.00	$40,000	
Cleaning Waste Pond	1	LS	$125,000.00	$125,000	
Subtotal					$165,000
Electrical System					
Standby Generator	1	EA	$60,000.00	$60,000	
Site Electrical	1	LS	$120,000.00	$120,000	
Electrical Service					
Main	1	LS	$20,000.00	$20,000	
River Pump Station	1	LS	$55,000.00	$55,000	
Instrumentation and Controls	1	LS	$120,000.00	$120,000	
Subtotal					$375,000
Hatchery Equipment					
General Equipment	1	LS	$100,000.00	$100,000	
3/4 Ton 4x4 Pickup	1	EA	$18,000.00	$18,000	
Snow Plow Attachment	1	EA	$1,500.00	$1,500	
1/2 Ton 4x4 Pickup	2	EA	$12,000.00	$24,000	
Fork Lift	1	EA	$25,000.00	$25,000	
2000 Gal Tanker	1	EA	$120,000.00	$120,000	
300 Gal Trailer	1	EA	$15,000.00	$15,000	
Subtotal					$303,500

Estimated Construction Cost (Cle Elum) = $5,161,418

Table 10-3 Oak Flats Central Hatchery Cost Estimate 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Site Developrent					
General Requirements	1	LS	$297,600.00	$297,600	
Clearing & Grubbing	5	AC	$1,000.00	$4,800	
Access Roadway	630	LF	$10.01	$6,306	
Misc Surfaced Areas	17,000	SY	$2.97	$50,565	
Drainage & Culverts	1	LS	$2,500.00	$2,500	
Site Grading	5	AC	$1,258.40	$6,292	
Fencing	2,430	LF	$13.73	$33,359	
Subtotal					$401,422
Water Supply System					
Water Supply Wells	4	EA	$45,000.00	$180,000	
Diversion Dam	1	LS	$500,000.00	$500,000	
River Pump Station:					
Civil Works	1	LS	$140,000.00	$140,000	
Electrical/Mechanical	1	LS	$120,000.00	$120,000	
Pumps	4	EA	$19,000.00	$76,000	
Share Of Fish Screens	1	LS	$68,000.00	$68,000	
Infiltration System					
Infiltration Drain (18")	600	LF	$35.00	$21,000	
Transmission Pipe (30")	150	LF	$125.00	$18,750	
Mechanical	1	LS	$28,000.00	$28,000	
Site Piping:					
Process Water 42"	530	LF	$167.02	$88,523	
Process Water 30"	310	LF	$123.55	$38,301	
Drain Water 48"	900	LF	$98.38	$88,546	
Drain 36"	260	LF	$83.51	$21,713	
Well 6"	4000	LF	$45.76	$183,040	
Minor Piping (<12")	1.6	AC	$19,136.83	$30,619	
Degasification Tower	1	Is	$24,000.00	$24,000	
Subtotal					$1,626,491
Fish Production Facilities					
Raceways	21	EA	$51,000.00	$1,071,000	
Adult Raceways	1	EA	$90,000.00	$90,000	
Rearing Ponds	4	EA	$50,000.00	$200,000	
Adult Ponds	1	EA	$90,000.00	$90,000	
Subtotal					$1,451,000

Table 10-3 (cont'd) Oak Flats Central Hatchery Cost Est. 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Buildings					
Hatchery Building	2,400	SF	$110.00	$264,000	
Incubation Building:	2,700	SF	$85.00	$229,500	
Troughs	20	EA	$2,667.00	$53,340	
Pole Barn	1,920	SF	$15.00	$28,800	
Electrical Control Building	1,500	SF	$50.00	$75,000	
Residences	4	EA	$120,000.00	$480,000	
Freezer Building	1	LS	$180,000.00	$180,000	
Covered Parking	1500	SF	$5.00	$7,500	
Research Center	6000	SF	$80.00	$480,000	
Subtotal					$1,798,140
Waste Treatment					
Septic Tank/Drain Field	1	LS	$40,000.00	$40,000	
Cleaning Waste Pond	1	LS	$125,000.00	$125,000	
Subtotal					$165,000
Electrical System					
Standby Generator	1	EA	$60,000.00	$60,000	
Site Electrical	1	LS	$210,000.00	$210,000	
Electrical Service	1	LS	$40,000.00	$40,000	
Instrumentation and Control	1	LS	$120,000.00	$120,000	
Subtotal					$430,000
Hatchery Equipment					
General Equipment	1	LS	$120,000.00	$120,000	
3/4 Ton 4x4 Pickup	1	EA	$18,000.00	$18,000	
Snow Plow Attachment	1	EA	$1,500.00	$1,500	
1/2 Ton 4x4 Pickup	3	EA	$12,000.00	$36,000	
Pathologist Car	1	EA	$10,000.00	$10,000	
Fork Lift	1	EA	$25,000.00	$25,000	
2000 Gal Tanker	1	EA	$120,000.00	$120,000	
300 Gal Trailer	1	EA	$15,000.00	$15,000	
Subtotal					$345,500

Estimated Construction Cost (Oak Flats) = $6,217,554

Fable 10-4 Nelson Springs Central Hatchery Cost Estimate 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Site Development					
General Requirements	1	LS	$175,000.00	$175,000	
Clearing & Grubbing	2	AC	$1,000.00	$1,600	
Access Roadway (Paved)	800	LF	$16.00	$12,800	
Misc Surfaced Areas	5,808	SY	$3.00	$17,424	
Drainage & Culverts	1	LS	$3,800.00	$3,800	
Site Grading	2	AC	$1,300.00	$2,080	
New Creek Culverts	1	LS	$22,000.00	$22,000	
Fencing	1,800	LF	$13.73	$24,710	
Fill/Demo Exist Pond	1	LS	$6,000.00	$6,000	
Subtotal					$265,414
Water Supply System					
Water Supply Well	2	EA	$45,000.00	$90,000	
Domestic Well	1	EA	$5,000.00	$5,000	
Nelson Springs Intake	1	LS	$15,000.00	$15,000	
Buckskin Creek Intake	1	LS	$15,000.00	$15,000	
Drain Outfall and Weirs	1	LS	$56,000.00	$56,000	
Pump Building					
Care And Diversion Of Water	1	LS	$10,000.00	$10,000	
Civil Works	1	LS	$40,000.00	$40,000	
Pumps	3	Ea	$11,000.00	$33,000	
Electrical/Mechanical	1	LS	$180,000.00	$180,000	
Site Piping:					
Suction RCP 18"	90	LF	$54.91	$4,942	
Cowiche RCP 24"	1550	LF	$65.21	$101,072	
Added Cost To Cross Highway	1	LS	$50,000.00	$50,000	
Cowiche Intake	1	LS	$30,000.00	$30,000	
Discharge 20" CCP	230	LF	$101.82	$23,418	
Discharge 6" CCP	390	LF	$45.76	$17,846	
Drain 30"	160	LF	$74.36	$11,898	
Minor Piping (<12")	0.4	AC	$19,136.83	$7,655	
Degasification Tower	1	LS	$22,000.00	$22,000	
Subtotal					$712,831

Table 10-4 (cont'd) Nelson Springs Central Hatchery Cost Est. 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Fish Production Facilities					
Raceway	6	EA	$51,000.00	$306,000	
Adult Raceway	1	EA	$90,000.00	$90,000	
Subtotal					$396,000
Buildings					
Hatchery Building & Visitor Bu	1,600	SF	$110.00	$176,000	
Incubation Building:	3,600	SF	$85.00	$306,000	
Troughs	34	EA	$2,667.00	$90,678	
Pole Barn	1,920	SF	$15.00	$28,800	
Electrical Control Building	1,500	SF	$50.00	$75,000	
New Residence	1	EA	$120,000.00	$120,000	
Pump Building	800	SF	$50.00	$40,000	
Subtotal					$836,478
Waste Treatment					
Septic Tank/Drain Field		LS	$12,000.00	$12,000	
Cleaning Waste Pond	1	LS	$62,000.00	$62,000	
Subtotal					$74,000
Electrical System					
Standby Generator		EA	$40,000.00	$40,000	
[illegible] Electrical		LS	$120,000.00	$120,000	
Electrical Service		LS	$40,000.00	$40,000	
Instrumentation and Control		LS	$60,000.00	$60,000	
Subtotal					$260,000
[illegible]ry Equipment					
General Equipment		LS	$70,000.00	$70,000	
3/4 Ton 4x4 Pickup		EA	$18,000.00	$18,000	
Snow Plow Attachment		EA	$1,500.00	$1,500	
Small Loader		EA	$15,000.00	$15,000	
Subtotal					$104,500

Estimated Construction Cost (Nelson Springs) = $2,649,223

Table 10-5 Wapato Satellite Facility Cost Estimate 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Site Development					
General Requirements	1	LS	$143,249.13	$143,249	
Clearing & Grubbing	2	AC	$1,000.00	$2,100	
Railroad Crossing	1	LS	$100,000.00	$100,000	
Misc Surfaced Areas	6,800	SY	$2.97	$20,226	
Drainage & Culverts	1	LS	$800.00	$800	
Site Grading	2	AC	$1,258.40	$2,643	
Fencing	1,320	LF	$13.73	$18,121	
Subtotal					$287,139
Water Supply System					
Domestic Well	1	EA	$5,000.00	$5,000	
Pump Station:					
Care And Diversion Of Water	1	LS	$10,000.00	$10,000	
Civil Works	1	LS	$190,000.00	$190,000	
Pumps	4	EA	$30,500.00	$122,000	
Electrical/Mechanical	1	LS	$198,000.00	$198,000	
Site Piping:					
Process Water 42"	170	LF	$167.02	$28,394	
Process Water 30"	180	LF	$123.55	$22,239	
Drain 48"	165	LF	$98.38	$16,233	
Drain 42"	195	LF	$91.52	$17,846	
Minor Piping (<12")	0.7	AC	$19,136.83	$13,396	
Subtotal					$623,109
Fish Production Facilities					
Raceway	6	EA	$51,000.00	$306,000	
Coho Ponds	3	EA	$162,000.00	$486,000	
Subtotal					$792,000

Table 10-5 (cont'd) Wapato Satellite Facility Cost Est. 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Buildings					
Hatchery Building	400	SF	$50.00	$20,000	
Freezer Building	1	LS	$180,000.00	$180,000	
R&R Weather Sta.	1	LS	$2,000.00	$2,000	
Subtotal					$202,000
Waste Treatment					
Septic Tank: Drain Field	1	LS	$6,000.00	$6,000	
Subtotal					$6,000
Electrical System					
Standby Generator (200 KW)	1	EA	$75,000.00	$75,000	
Site Electrical	1	LS	$40,000.00	$40,000	
Electrical Service	1	EA	$12,000.00	$12,000	
Instrumentation & Control	1	LS	$45,000.00	$45,000	
Subtotal					$172,000
Hatchery Equipment					
General Equipment	1	LS	$30,000.00	$30,000	
3/4 Ton 4x4 Pickup	1	LS	$18,000.00	$18,000	
Snow Plow Attachment	1	LS	$1,500.00	$1,500	
Fork Lift	1	LS	$25,000.00	$25,000	
Subtotal					$74,500
Estimated Construction Cost (Wapato)=					$2,156,748

Table 10-6 Prosser Satellite Facility Cost Estimate 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Site Development					
General Requirements	1	LS	$93,300.00	$93,300	
Clearing & Grubbing	1	AC	$1,000.00	$1,250	
Access Roadway	270	LF	$10.01	$2,703	
Misc Surfaced Areas	4,452	SY	$2.97	$13,242	
Drainage & Culverts	1	LS	$800.00	$800	
Site Grading	1	AC	$1,258.40	$1,573	
Fencing	930	LF	$13.73	$12,767	
Subtotal					$125,635
Water Supply System					
Water Supply Well	2	EA	$45,000.00	$90,000	
Domestic Well	1	LS	$5,000.00	$5,000	
Canel Intake	1	EA	$12,000.00	$12,000	
Pump Station:			?		
Care And Diversion Of Water	1		$20,000.00	$20,000	
Civil/Mechanical	1		$106,000.00	$106,000	
Pumps	2		$12,000.00	$24,000	
Compressor	1		$6,000.00	$6,000	
Diesel Generator ?	0		$0.00	$0	
Site Piping:					
Process Water 16"	570	LF	$82.37	$46,950	
Process Water 24"	1090	LF	$114.40	$124,696	
Process Water 6"	340	LF	$45.76	$15,558	
Drain 30"	290	LF	$74.36	$21,564	
Drain 16"	310	LF	$51.48	$15,959	
Minor Piping (<12")	0.33	AC	$19,136.83	$6,315	
Manholes 4' Dia 8'H	2	EA	$2,478.00	$4,956	
Connect to Exist Pipe	1	EA	$2,000.00	$2,000	
Degasification Tower	1	LS	$18,000.00	$18,000	
Subtotal					$518,999
Fish Production Facilities					
Raceways	3	EA	$51,000.00	$153,000	
Adult Raceways	3	EA	$90,000.00	$270,000	
20,000 CF Pond	1	EA	$90,000.00	$90,000	
Subtotal					$513,000

Fable 10-6(cont'd) Prosser Satellite Facility Cost Est. 13-Feb-90

Description	Quantity	Unit	Unit Cost	Total	
Buildings					
Hatchery Building	800	SF	$65.00	$52,000	
Subtotal					$52,000
Waste Treatment					
Septic Tank/Drain Field	1	LS	$6,000.00	$6,000	
Cleaning Waste Pond	1	LS	$12,000.00	$12,000	
Subtotal					$18,000
Electrical System					
Standby Generator	1	LS	$40,000.00	$40,000	
Site Electrical	1	LS	$40,000.00	$40,000	
Electrical Service	1	LS	$10,000.00	$10,000	
Instrumentation & Controls	1	LS	$45,000.00	$45,000	
Subtotal					$135,000
Hatchery Equipment					
General Equipment	1	LS	$30,000.00	$30,000	
Subtotal					$30,000
Estimated Construction Cost (Prosser)=					$1,392,633

OPERATIONS AND MAINTENANCE COSTS

An O&M estimate for the Yakima River Basin facilities was prepared by Mr. Senn of FMC. The estimate, in January 1990 dollars, was based on the food. staffing and transportation estimates provided in Chapter 2.

The annual food cost was estimated to be $226.000 based on 46¢/lb for OMP#2 and an annual consumption of 578,000 lbs. Transportation costs were estimated at $35,000 per year based on 24¢ per mile for cars, 40¢ per mile for pickups, and $1.00 per mile for tanker trucks. This includes $1500 per year per diem. Labor costs are based on the average of current WDF pay scales for the various positions itemized in Table 2-10. The total estimated labor budget is $410,000 per year. This estimate does not include staff for operations of the traps staff for fish marking. No cost for general management or payroll administration are included. A power cost was prepared based on comparisons with similar facilities. The estimated annual power cost is $165,000. With a 5 percent allowance for the annual cost for miscellaneous supplies, this brings the total annual O&M estimate to $920,000.

APPENDIX A

FLOW, SPACE, FOOD
SUMMARY

FOR YAKIMA BASIN HATCHERIES

Wapato
Prosser
Cle Elum
Oak Flat
Nelson Springs

By Fish Management Consultants
Olympia, WA

December 1989

F L O W, S P A C E l F O O D

S U M M A R Y

For

WAPATO

By Fish Management Consultants
Olympia, WA

February 2, 1990

WAPATO – FALL CHINOOK **Growth – Food**

RUN NAME: HYWP1A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
43	03/19/91	1,225,353				57.7	288.1	4,253			
57	04/02/91	1,215,860	0.74	45.0	29.0	63.0	221.9	5,478	1.13	1,390	2.2
71	04/16/91	1,209,404	0.50	47.0	29.0	69.0	168.5	7,176	1.16	1,962	2.4
85	04/30/91	1,205,014	0.34	50.0	29.0	76.3	124.8	9,653	1.18	2,915	2.7
99	05/14/91	1,202,029	0.23	52.0	29.0	84.3	92.3	13,019	1.20	4,035	2.8
113	05/28/91	1,200,000	0.16	57.0	29.0	94.4	65.8	18,239	1.22	6,368	3.2

BIOMASS PRODUCED (LBS.) = 13,985
TOTAL FOOD FED (LBS.) = 16,670 AVERAGE CONVERSION = 1.19

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

WATER FLOW = 5,850 GPM (13 cfs)

RACEWAY SPACE = 30,000 CU.FT.

HYWP1AR

			------WATER FLOW REQMT'S--------				--------RACEWAY REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW- ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW- ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	03/19/91	4,253	3,150	1.35	7.68	553	30,000	0.14	0.43	9,806
15	04/02/91	[illegible]	3,150	[illegible]	7.68	713	30,000	0.18	0.43	12,630
29	04/16/91	7,176	3,150	2.28	6.37	1,127	30,000	0.24	0.48	15,094
43	04/30/91	9,653	3,150	3.06	5.06	1,907	30,000	0.32	0.53	18,370
57	05/14/91	13,019	3,150	4.13	4.49	2,901	30,000	0.43	0.58	22,406
71	05/28/91	18,239	5,850	3.12	3.12	5,837	30,000	0.61	0.65	28,037

WAPATO - COHO Growth - Food

RUN NAME: HYWP3A

PERIOD ENDING DAY	PERIOD ENDING DATE	SC. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
365	02/28/92	1,558,006				119.8	25.5	61,089			
379	03/13/92	1,556,432	0.08	43.0	44.0	122.7	23.7	65,606	2.01	9,064	1.0
393	03/27/92	1,554,858	0.08	45.0	44.0	126.2	21.8	71,234	2.05	11,510	1.2
407	04/10/92	1,553,284	0.08	47.0	44.0	130.2	19.9	78,124	2.08	14,358	1.4
421	04/24/92	1,551,710	0.08	50.0	44.0	135.0	17.8	86,973	2.12	18,782	1.7
435	05/08/92	1,550,137	0.08	52.0	44.0	140.3	15.9	97,564	2.16	22,891	1.8
449	05/22/92	1,548,563	0.08	53.0	44.0	145.9	14.1	109,572	2.20	26,417	1.9

BIOMASS PRODUCED (LBS.) = 48,483

TOTAL FOOD FED (LBS.) = 103,022 AVERAGE CONVERSION = 2.12

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:
WATER FLOW = 17,550 GPM (39 cfs)
POND SPACE = 135,000 CU.FT.

HYWP3AR

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	----WATER FLOW REQMT'S---- ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	----POND REQMT'S---- ACTUAL POND SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
15	02/23/92	65,606	17,550	3.74	17.68	3,456	135,000	0.49	0.68	90,310
29	03/27/92	71,234	17,550	4.06	13.69	5,204	135,000	0.53	0.70	102,424
43	04/10/92	78,124	17,550	4.45	10.81	7,229	135,000	0.58	0.72	108,890
57	04/24/92	86,973	17,550	4.96	8.14	10,687	135,000	0.64	0.74	116,925
71	05/08/92	97,564	17,550	5.56	6.79	14,367	135,000	0.72	0.77	126,191
85	05/22/92	109,572	17,550	6.24	6.39	17,147	135,000	0.81	0.80	136,298

FOOD REQUIREMENTS AT WAPATO

HYWP1AF

PERIOD ENDING DATE	******LBS. FOOD REQUIRED, BY SPECIES ****** FALL CHINOOK	COHO	TOTAL LBS. FOOD REQUIRED
01/29/91			
02/28/91			
03/30/91	1,390	20,574	21,964
04/30/91	4,877	33,140	38,018
05/30/91	10,403	49,308	59,710
06/30/91			
07/30/91			
08/29/91			
09/29/91			
10/29/91			
11/29/91			
12/29/91			
01/29/92			

WATER FLOW REQUIREMENTS
AT WAPATO

HYWP1AZ

PERIOD ENDING DAY	PERIOD ENDING DATE	------ ACTUAL ------ GPM WATER	CFS WATER	-- MIN. REQ'D -- GPM WATER	CFS WATER
1	01/01/91				
15	01/15/91				
29	01/29/91				
43	02/12/91				
57	02/26/91	17,550	39.0	3,456	7.7
71	03/12/91	17,550	39.0	3,711	8.2
85	03/26/91	20,700	46.0	5,757	12.8
99	04/09/91	20,700	46.0	7,942	17.6
113	04/23/91	20,700	46.0	11,814	26.3
127	05/07/91	20,700	46.0	16,274	36.2
141	05/21/91	20,700	46.0	20,048	44.6
155	06/04/91	5,850	13.0	5,837	13.0
169	06/18/91				
183	07/02/91				
197	07/16/91				
211	07/30/91				
225	08/13/91				
239	08/27/91				
253	09/10/91				
267	09/24/91				
281	10/08/91				
295	10/22/91				
309	11/05/91				
323	11/19/91				
337	12/03/91				
351	12/17/31				
365	12/31/91				
379	01/14/92				
393	01/28/92				

WAPATO **Pollutants**

Estimated PPM of Pollutants Generated Daily for all Species Programed at Wapato

HYWP1AP

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	POLLUTANTS GENERATED IN PPM ** TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLE'; SOLIDS	B.O.D.	RECEIVING WATER (C'S)
1	02/26/91		17,550							
15	03/12/91	647	17,550	0.10	0.0001	0.27	0.02	0.92	1.04	
29	03/26/91	822	20,700	0.11	0.0002	0.29	0.02	0.99	1.12	
43	04/09/91	1,125	20,700	0.15	0.0002	0.39	0.02	1.36	1.54	
57	04/23/91	1,482	20,700	0.19	0.0003	0.52	0.03	1.79	2.03	
71	05/07/91	1,843	20,700	0.24	0.0003	0.65	0.04	2.23	2.52	
85	05/21/91	2,175	20,700	0.28	0.0004	0.76	0.04	2.63	2.97	
99	06/04/91	455	5,850	0.21	0.0003	0.56	0.03	1.94	2.20	

** The ppm of pollutants in the **discharge** water is illustrated in the table. Vacuum cleaning will significantly reduce the level of settleable solids and B.O.D.

FLOW, SPACE, FOOD

S U M M A R Y

For

PROSSER

By Fish Management Consultants
Olympia, WA

December 1989

RUN NAME: HYPR1A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
43	03/19/91	1,225,353				57.7	288.1	4,253			
57	04/02/91	1,215,860	0.74	50.0	34.0	63.9	212.2	5,730	1.13	1,675	2.6
71	04/16/91	1,209,404	0.50	52.0	34.0	70.8	156.1	7,746	1.16	2,330	2.7
85	04/30/91	1,205,014	0.34	55.0	34.0	78.7	113.6	10,606	1.18	3,367	2.9
99	05/14/91	1,202,029	0.23	57.0	34.0	87.3	83.2	14,441	1.20	4,597	2.9
113	05/28/91	1,200,000	0.16	59.0	34.0	96.6	61.5	19,526	1.22	6,203	2.8

BIOMASS PRODUCED (LBS.) = 15,273

TOTAL FOOD FED (LBS.) = 18,172 AVERAGE CONVERSION = 1.19

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

WATER FLOW = 6,300 GPM (14 cfs)

RACEWAY SPACE = 30,000 CU.FT.

HYPRIAR

			WATER FLOW REQMT'S				RACEWAY REQMT'S			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./GPM	ALLOW-ABLE LBS./GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./CU.FT.	ALLOW-ABLE LBS./CU.FT.	TOTAL CU.FT. REQ'D
1	03/19/91	4,253	6,300	0.68	5.22	814	30,000	0.14	0.44	9,660
15	04/02/91	5,730	6,300	0.91	5.22	1,097	30,000	0.19	0.44	13,014
29	04/16/91	7,746	6,300	1.23	4.62	1,678	30,000	0.26	0.49	15,882
43	04/30/91	10,606	6,300	1.68	3.91	2,710	30,000	0.35	0.54	19,560
57	05/14/91	14,441	6,300	2.29	3.50	4,127	30,000	0.48	0.60	24,010
71	05/28/91	19,526	6,300	3.10	3.10	6,296	30,000	0.65	0.67	29,341

FOOD REQUIREMENTS AT PROSSER

HYPR1AF

PERIOD ENDING DATE	****** LBS. FOOD REQUIRED BY SPECIES ****** FALL CHINOOK	TOTAL LBS. FOOD REQUIRED
01/29/91		
02/28/91		
03/30/91	1,675	1,675
04/30/91	10,294	10,294
05/30/91	6,203	6,203
06/30/91		
07/30/91		
08/29/91		
09/29/91		
10/29/91		
11/29/91		
12/29/91		
01/29/92		

WATER FLOW REQUIREMENTS
AT PROSSER

HYPR1AZ

PERIOD ENDING DAY	PERIOD ENDING DATE	----- ACTUAL ------ GPM WATER	CFS WATER	-- MIN. REQ'D -- GPM WATER	CFS WATER
1	01/01/91				
15	01/15/91				
29	01/29/91				
43	02/12/91				
57	02/26/91				
71	03/12/91				
85	03/26/91	6,300	14.0	814	1.8
99	04/09/91	6,300	14.0	1,097	2.4
113	04/23/91	6,300	14.0	1,678	3.7
127	05/07/91	6,300	14.0	2,710	6.0
141	05/21/91	6,300	14.0	4,127	9.2
155	06/04/91	6,300	14.0	6,296	14.0
169	06/18/91				
183	07/02/91				
197	07/16/91				
211	07/30/91				
225	08/13/91				
239	08/27/91				
253	09/10/91	2,250	5.0	2,250	5.0
267	09/24/91	2,250	5.0	2,250	5.0
281	10/08/91	2,250	5.0	2,250	5.0
295	10/22/91	2,250	5.0	2,250	5.0
309	11/05/91	3,150	7.0	3,150	7.0
323	11/19/91	2,700	6.0	2,700	6.0
337	12/03/91	2,700	6.0	2,700	6.0
351	12/17/91	2,700	6.0	2,700	6.0
365	12/31/91				
379	01/14/92				
393	01/28/92				

PROSSER **Pollutants**

Estimated PPM of Pollutants Generated Daily for all Species Programed at Prosser

HYPR1AP

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	POLLUTANTS GENERATED IN PPM ** TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLED SOLIDS	B.O.D.	RECEIVING WATER (CFS)
1	03/19/91		6,300							
15	04/02/91	120	6,300	0.05	0.0001	0.14	0.01	0.47	0.54	
29	04/16/91	166	6,300	0.07	0.0001	0.19	0.01	0.66	0.75	
43	04/30/91	240	6,300	0.10	0.0001	0.28	0.02	0.95	1.08	
57	05/14/91	328	6,300	0.14	0.0002	0.38	0.02	1.30	1.47	
71	05/28/91	443	6,300	0.19	0.0003	0.51	0.03	1.76	1.99	

** The ppm of pollutants in the discahrge water is illustrated in the table. Vacuum cleaning will significantly reduce the level of settleable solids and B.O.D.

FLOW, SPACE, FOOD

SUMMARY

For

CLE ELUM

By Fish Management Consultants
Olympia, WA

December 1989

CLE ELUM **UPPER YAKIMA SPRING CHINOOK** **Growth - Food**

RUN NAME: HYCE3A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
1	02/28/91	1,586,164				34.1	1,400.0	1,133			
15	03/14/91	1,463,493	7.73	47.0	37.0	38.8	947.0	1,545	1.00	412	2.4
29	03/28/91	1,379,542	5.29	43.0	37.0	42.3	732.1	1,884	1.03	350	1.5
43	04/11/91	1,322,990	3.57	44.0	37.0	46.1	565.8	2,338	1.07	484	1.7
57	04/25/91	1,284,534	2.42	46.0	37.0	50.5	429.7	2,989	1.10	716	2.1
71	05/09/91	1,258,385	1.65	50.0	37.0	56.2	311.9	4,034	1.13	1,184	2.6
85	05/23/91	1,240,603	1.12	53.0	37.0	62.8	223.2	5,559	1.17	1,780	2.9
99	06/06/91	1,228,511	0.76	53.0	37.0	69.5	165.1	7,441	1.20	2,258	2.7
113	06/20/91	1,220,289	0.52	53.0	37.0	76.1	125.6	9,719	1.23	2,809	2.5
127	07/04/91	1,214,632	0.36	53.0	37.0	82.8	97.7	12,432	1.27	3,437	2.4
141	07/18/91	1,210,127	0.28	53.0	37.0	89.4	77.5	15,612	1.30	4,134	2.2
155	08/01/91	1,205,820	0.27	53.0	37.0	96.0	62.5	19,286	1.33	4,899	2.1
169	08/15/91	1,201,630	0.26	53.0	37.0	102.7	51.2	23,487	1.37	5,741	2.0
183	08/29/91	1,197,563	0.26	53.0	37.0	109.3	42.4	28,248	1.40	6,665	1.9
197	09/12/91	1,193,617	0.25	53.0	37.0	116.0	35.5	33,603	1.43	7,675	1.9
211	09/26/91	1,189,802	0.24	52.0	37.0	122.3	30.3	39,279	1.47	8,325	1.7
225	10/10/91	1,186,123	0.23	47.0	37.0	127.0	27.0	43,892	1.50	6,920	1.2
239	10/24/91	1,182,580	0.22	44.0	37.0	130.8	24.7	47,800	1.53	5,993	1.0
253	11/07/91	1,179,173	0.21	42.0	37.0	134.0	23.0	51,202	1.57	5,330	0.8
267	11/21/91	1,175,902	0.21	40.0	37.0	136.5	21.8	54,007	1.60	4,487	0.6
281	12/05/91	1,172,767	0.20	37.0	37.0	138.1	21.0	55,756	1.63	2,857	0.4
295	12/19/91	1,169,768	0.19	36.0	37.0	139.3	20.5	57,155	1.67	2,332	0.3
309	01/02/92	1,166,905	0.18	33.0	37.0	139.7	20.3	57,404	1.70	1,607	0.2
323	01/16/92	1,164,179	0.17	34.0	37.0	140.3	20.1	58,052	1.73	1,625	0.2
337	01/30/92	1,161,588	0.16	35.0	37.0	141.2	19.7	59,105	1.77	1,861	0.2
351	02/13/92	1,159,134	0.15	36.0	37.0	142.5	19.1	60,579	1.80	2,652	0.3
365	02/27/92	1,156,815	0.15	38.0	37.0	144.4	18.4	62,904	1.83	4,263	0.5
379	03/12/92	1,154,565	0.14	40.0	37.0	146.9	17.5	66,138	1.87	6,038	0.7
393	03/26/92	1,152,314	0.14	43.0	37.0	150.4	16.3	70,808	1.90	8,872	0.9
407	04/09/92	1,150,064	0.14	44.0	37.0	154.2	15.1	76,153	1.93	10,334	1.0

BIOMASS PRODUCED (LBS.) = 76,153
TOTAL FOOD FED (LBS.) = 116,042 AVERAGE CONVERSION = 1.55

NOTE: average temperature is programed for 53 F
during first week after ponding

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS (INCL. PREVIOUS AND NEXT BROODS):

WELL WATER = 5,400 GPM (12 cfs; used from June 1st through September 1st)

RIVER WATER = 7,200 GPM (lb cfs; used from September 1st through June 1st)

RACEWAY SPACE = 75,000 CU.FT.

HYCE3AR

			------WATER FLOW REQMT'S--------				--------RACEWAY REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	02/28/91	1,133	450	2.52	6.34	179	10,000	0.11	0.27	4,237
15	03/14/91	1,545	450	3.43	6.34	244	10,000	0.15	0.27	5,779
29	03/28/91	1,884	450	4.19	11.96	158	10,000	0.19	0.29	6,467
43	04/11/91	2,338	450	5.20	10.13	231	10,000	0.23	0.32	7,364
57	04/25/91	2,989	450	6.64	7.79	384	45,000	0.07	0.35	8,590
71	05/09/91	4,034	1,350	2.99	5.20	776	45,000	0.09	0.39	10,418
85	05/23/91	5,559	1,350	4.12	4.14	1,343	45,000	0.12	0.43	12,840
99	06/06/91	7,441	2,700	2.76	4.46	1,668	45,000	0.17	0.48	15,544
113	06/20/91	9,719	2,700	3.60	4.77	2,039	45,000	0.22	0.52	18,531
127	07/04/91	12,432	4,950	2.51	5.06	2,456	45,000	0.28	0.57	21,803
141	07/18/91	15,612	4,950	3.15	5.36	2,915	45,000	0.35	0.62	25,347
155	08/01/91	19,286	4,950	3.90	5.65	3,412	45,000	0.43	0.66	29,148
169	08/15/91	23,487	4,950	4.74	5.94	3,957	45,000	0.52	0.71	33,201
183	08/29/91	28,248	5,400	5.23	6.21	4,552	45,000	0.63	0.75	37,506
197	09/12/91	33,603	5,400	6.22	6.46	5,199	45,000	0.75	0.80	42,061
211	09/2[illegible]/91	39,279	5,400	7.27	7.29	5,387	75,000	0.52	0.84	46,624
225	10/10/91	43,892	7,200	6.10	12.42	3,533	75,000	0.59	0.88	50,155
239	10/24/91	47,800	7,200	6.64	18.44	2,592	75,000	0.64	0.90	53,036
253	11/07/91	51,202	7,200	7.11	24.02	2,132	75,000	0.68	0.92	55,471
[illegible]7	11/[illegible]/91	54,007	7,200	7.50	31.73	1,702	75,000	0.72	0.94	57,425
[illegible]1	12/[illegible]/91	55,756	7,200	7.74	53.36	1,045	75,000	0.74	0.95	58,606
[illegible]95	12/[illegible]/91	57,155	7,200	7.94	67.35	849	75,000	0.76	0.96	59,532
309	01/02/92	57,404	7,200	7.97	99.67	576	75,000	0.77	0.96	59,656
323	01/16/92	58,052	7,200	8.06	99.[illegible]6	585	75,000	0.77	0.97	60,057
[illegible]	01/30/92	59,105	7,200	8.21	87.[illegible]3	674	75,000	0.79	0.97	60,736
[illegible]1	02/13/92	60,579	7,200	8.41	62.[illegible]3	965	75,000	0.81	0.98	61,698
365	02/2[illegible]/92	62,904	7,200	8.74	40.[illegible]7	1,566	75,000	0.84	0.99	63,224
[illegible]9	03/[illegible]/92	66,138	7,200	9.19	28.95	2,284	75,000	0.88	1.01	65,331
[illegible]	[illegible]/92	70,808	7,200	9.83	19.[illegible]4	3,625	75,000	0.94	1.04	68,326

RUN NAME: HYCE4A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB	BIOMASS (LBS.)	CONV RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
1	02/28/91	623,077				34.1	1,400.0	445			
15	03/14/91	574,139	7.85	45.5	37.0	38.3	982.6	584	1.00	139	2.1
29	03/28/91	540,649	5.37	43.0	37.0	41.8	757.3	714	1.04	134	1.6
43	04/11/91	518,088	3.62	44.0	37.0	45.6	583.6	888	1.07	187	1.8
57	04/25/91	502,747	2.46	46.0	37.0	50.0	442.0	[illegible]	1.11	[illegible]	2.1
71	05/09/91	492,315	1.67	50.0	37.0	55.7	320.0	1,539	1.13	461	2.7
85	05/23/91	485,221	1.14	53.0	37.0	62.4	228.3	2,125	1.19	696	3.0
99	06/06/91	480,398	0.77	53.0	37.0	69.0	168.5	2,851	1.22	886	2.8
113	06/20/91	477,117	0.53	53.0	37.0	75.6	127.9	[illegible]	1.26	[illegible]	2.6
127	07/04/91	474,861	0.36	53.0	37.0	82.3	99.4	[illegible]	1.30	[illegible]	2.4
141	07/18/91	473,063	0.29	52.0	37.0	88.9	78.8	6,007	1.33	1,639	2.3
155	08/01/91	[illegible]345	0.28	53.0	37.0	95.6	63.5	7,428	1.37	1,948	2.2
169	08/15/91	469,674	0.17	53.0	37.0	102.2	51.9	9,054	1.41	1,298	2.1
183	08/29/91	468,051	0.26	53.0	37.0	108.8	43.0	[illegible]	1.44	2,563	2.0
197	09/12/91	466,477	0.25	53.0	37.0	115.5	36.0	[illegible]	1.46	[illegible]	1.9
211	09/26/91	464,955	0.24	52.0	37.0	121.8	30.6	[illegible]	1.50	[illegible]	1.8

BIOMASS PRODUCED (LBS.) = 15,[illegible]72
TOTAL FOOD FED (LBS.) = 20,197 AVERAGE CONVERSION = 1.37

NOTE: average temperature is programmed for 53 F
during first week after ponding

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

YELL WATER = 1,800 GPM (4 cfs; used from June 1st through September 1st)
RIVER WATER = 2,250 GPM (5 cfs; used from September 1st through June 1st)
RACEWAY SPACE = 20,000 CU.FT.

HYCE4AR

			------WATER FLOW REQMT'S--------				-------- RACEWAY REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	02/28/91	445	225	1.98	8.06	55	5,000	0.09	0.26	1,685
15	03/14/91	584	225	2.60	8.06	72	5,000	0.12	0.26	2,212
29	03/28/91	714	225	3.17	11.79	61	5,000	0.14	0.29	2,478
43	04/11/91	888	225	3.95	9.96	89	5,000	0.18	0.31	2,825
57	04/25/91	1,137	225	5.05	7.64	149	5,000	0.23	0.34	3,299
71	05/09/91	1,539	225	6.84	5.08	303	5,000	0.31	0.38	4,007
85	05/23/91	2,126	450	4.72	4.04	526	20,000	0.11	0.43	4,947
99	06/06/91	2,851	900	3.17	4.35	656	20,000	0.14	0.48	5,996
113	06/20/91	3,729	900	4.14	4.64	804	20,000	0.19	0.52	7,155
127	07/04/91	4,777	900	5.31	4.92	972	20,000	0.24	0.57	8,427
141	07/18/91	6,007	1,800	3.34	5.19	1,157	20,000	0.30	0.61	9,804
155	08/01/91	7,428	1,800	4.13	5.47	1,358	20,000	0.37	0.66	11,281
169	08/15/91	9,054	1,800	5.03	5.74	1,578	20,000	0.45	0.70	12,857
183	08/29/91	10,897	1,800	6.05	5.99	1,820	20,000	0.54	0.75	14,532
197	09/12/91	12,972	2,250	5.77	6.23	2,083	20,000	0.65	0.80	16,304
211	09/26/91	15,172	2,250	6.74	7.02	2,163	20,000	0.76	0.84	18,079

FOOD REQUIREMENTS AT CLE ELUM

HYCE1AF

PERIOD ENDING DATE	****** LBS. FOOD REWIRED BY SPECIES ****** YAKIMA SP. CHINOOK	NACHES SP. CHINOOK	TOTAL LBS. FOOD REWIRED
01/29/91	6,139		6,139
02/28/91	10,713	139	10,852
03/30/91	20,041	321	20,362
04/30/91	1,900	738	2,638
05/30/91	4,037	1,582	5,619
06/30/91	6,246	2,465	8,711
07/30/91	9,033	3,587	12,620
08/29/91	20,081	8,025	28,106
09/29/91	15,245	3,341	18,586
10/29/91	11,323		11,323
11/29/91	7,344		7,344
12/29/91	3,940		3,940
01/29/92	6,139		6,139

WATER FLOW REQUIREMENTS
AT CLE ELUM

HYCE1AZ

PERIOD ENDING DAY	PERIOD ENDING DATE	----- ACTUAL ------		-- MIN. REQ'D --	
		GPM WATER	CFS WATER	GPM WATER	CFS WATER
1	02/28/91	7,875	17.5	1,800	4.0
15	03/14/91	7,875	17.5	2,600	5.8
29	03/28/91	7,875	17.5	3,844	8.5
43	04/11/91	675	1.5	320	0.7
57	04/25/91	675	1.5	533	1.2
71	05/09/91	1,575	3.5	1,079	2.4
85	05/23/91	1,800	4.0	1,869	4.2
99	06/06/91	3,600	8.0	2,324	5.2
113	06/20/91	3,600	8.0	2,843	6.3
127	07/04/91	5,850	13.0	3,428	7.6
141	07/18/91	6,750	15.0	4,072	9.0
155	08/01/91	6,750	15.0	4,770	10.6
169	08/15/91	6,750	15.0	5,535	12.3
183	08/29/91	7,200	16.0	6,372	14.2
197	09/12/91	7,650	17.0	7,282	16.2
211	09/26/91	7,650	17.0	7,550	16.8
225	10/10/91	7,200	16.0	3,533	7.9
239	10/24/91	7,200	16.0	2,592	5.8
253	11/07/91	7,200	16.0	2,132	4.7
267	11/21/91	7,200	16.0	1,702	3.8
281	12/05/91	7,200	16.0	1,045	2.3
295	12/19/91	7,200	16.0	849	1.9
309	01/02/92	7,200	16.0	576	1.3
323	01/16/92	7,200	16.0	585	1.3
337	01/30/92	7,200	16.0	674	1.5
351	02/13/92	7,200	16.0	965	2.1
365	02/27/92	7,875	17.5	1,800	4.0
379	03/12/92	7,875	17.5	2,600	5.8

50/50 RIVER & WELL

CLE ELUM **Pollutants**

Estimated PPM of Pollutants Generated Daily for all Species Programmed at Cle Elum Facility

HYCE1AP

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	POLLUTANTS GENERATED IN PPM ** TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLED SOLIDS	B.O.D.	RECEIVING WATER (CFS)
1	02/28/91	304	7,875	0.10	0.0002	0.28	0.02	0.97	1.09	
15	03/14/91	471	7,875	0.16	0.0002	0.43	0.02	1.49	1.69	
29	03/28/91	668	7,875	0.23	0.0003	0.62	0.04	2.12	2.40	
43	04/11/91	786	675	3.11	0.0046	8.44	0.49	29.11	32.96	
57	04/25/91	71	675	0.28	0.0004	0.76	0.04	2.63	2.98	
71	05/09/91	117	1,575	0.20	0.0003	0.54	0.03	1.86	2.11	
85	05/23/91	177	1,800	0.26	0.0004	0.71	0.04	2.46	2.78	
99	06/06/91	225	3,600	0.17	0.0002	0.45	0.03	1.56	1.77	
113	06/20/91	280	3,600	0.21	0.0003	0.56	0.03	1.94	2.20	
127	07/04/91	343	5,850	0.16	0.0002	0.42	0.02	1.46	1.66	
141	07/18/91	412	6,750	0.16	0.0002	0.44	0.03	1.53	1.73	
155	08/01/91	489	6,750	0.19	0.0003	0.53	0.03	1.81	2.05	
169	08/15/91	574	6,750	0.23	0.0003	0.62	0.04	2.12	2.40	
183	08/29/91	666	7,200	0.25	0.0004	0.67	0.04	2.31	2.62	
197	09/12/91	768	7,650	0.27	0.0004	0.73	0.04	2.51	2.84	
211	09/26/91	833	7,650	0.29	0.0004	0.79	0.05	2.72	3.08	
225	10/10/91	494	7,200	0.18	0.0003	0.50	0.03	1.72	1.94	
239	10/24/91	428	7,200	0.16	0.0002	0.43	0.02	1.49	1.68	
253	11/07/91	381	7,200	0.14	0.0002	0.38	0.02	1.32	1.50	
267	11/21/91	321	7,200	0.12	0.0002	0.32	0.02	1.11	1.26	
281	12/05/91	204	7,200	0.08	0.0001	0.21	0.01	0.71	0.80	
295	12/19/91	167	7,200	0.06	0.0001	0.17	0.01	0.58	0.65	
309	01/02/92	115	7,200	0.04	0.0001	0.12	0.01	0.40	0.45	
323	01/16/92	116	7,200	0.04	0.0001	0.12	0.01	0.40	0.46	
337	01/30/92	133	7,200	0.05	0.0001	0.13	0.01	0.46	0.52	
351	02/13/92	189	7,200	0.07	0.0001	0.19	0.01	0.66	0.74	
365	02/27/92	304	7,875	0.10	0.0002	0.28	0.02	0.97	1.09	
379	03/12/92	471	7,875	0.16	0.0002	0.43	0.02	1.49	1.69	

** The ppm of pollutants in the discahrge water is illustrated in the table. Vacuum cleaning will significantly reduce the level of settleable solids and B.O.D.

F L O W l S P A C E . F O O D

SUMMARY

For

OAK FLAT

By Fish Management Consultants
Olympia, WA

December 1989

RUN MANE: HYOF4A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS)	% FOOD FED /DAY
211	09/26/91	465,771				121.8	30.6	15,197			
225	10/10/91	464,311	0.23	52.0	33.0	128.9	25.9	17,952	1.54	4,230	1.9
239	10/24/91	462,905	0.23	47.0	33.0	134.2	22.3	20,205	1.57	3,541	1.4
253	11/07/91	461,553	0.22	40.0	33.0	137.0	21.5	21,450	1.61	2,001	0.7
267	11/21/91	460,254	0.21	35.0	33.0	138.1	21.0	21,891	1.64	725	0.2
281	12/05/91	459,010	0.20	35.0	33.0	139.2	20.5	22,340	1.68	754	0.2
295	12/19/91	457,820	0.19	32.5	33.0	139.3	20.5	22,368	1.71	626	0.2
309	01/02/92	456,684	0.18	34.0	33.0	140.1	20.2	22,655	1.75	634	0.2
323	01/16/92	455,602	0.17	34.0	33.0	140.8	19.9	22,946	1.79	642	0.2
337	01/30/92	454,574	0.16	34.0	33.0	141.5	19.6	23,242	1.82	651	0.2
351	02/13/92	453,600	0.16	34.0	33.0	142.2	19.3	23,542	1.86	659	0.2
365	02/27/92	452,679	0.15	36.0	33.0	143.6	18.7	24,204	1.89	1,253	0.4
379	03/12/92	451,786	0.14	40.0	33.0	146.4	17.6	25,616	1.93	2,723	0.8
393	03/26/92	450,893	0.14	42.0	33.0	150.0	16.4	27,467	1.96	3,636	1.0
407	04/09/92	450,000	0.14	44.0	33.0	154.2	15.1	29,812	2.00	4,690	1.2

BIOMASS PRODUCED (LBS.) = 14,615

TOTAL FOOD FED (LBS.) = 26,766 AVERAGE CONVERSION = 1.83

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

WATER FLOW = 4,050 GPM (9 cfs)

RACEWAY SPACE = 30,000 CU.FT.

HYOF4AR

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	WATER FLOW REQMT'S: ACTUAL WATER FLOW USED	WATER FLOW REQMT'S: ACTUAL LBS./GPM	WATER FLOW REQMT'S: ALLOWABLE LBS./GPM	WATER FLOW REQMT'S: FLOW REQ'D (GPM)	RACEWAY REQMT'S: ACTUAL RACEWAY SPACE USED	RACEWAY REQMT'S: ACTUAL LBS./CU.FT.	RACEWAY REQMT'S: ALLOWABLE LBS./CU.FT.	RACEWAY REQMT'S: TOTAL CU.FT. REQ'D
1	09/26/91	15,197	3,150	4.82	6.51	2,335	30,000	0.51	0.89	17,113
15	10/10/91	17,952	3,150	5.70	6.51	2,759	30,000	0.60	0.89	20,215
29	10/24/91	20,205	3,150	6.41	11.12	1,817	30,000	0.67	0.92	21,851
43	11/07/91	21,450	3,600	5.96	28.13	763	30,000	0.71	0.94	22,718
57	11/21/91	21,891	3,600	6.08	83.23	263	30,000	0.73	0.95	23,007
71	12/05/91	22,340	3,600	6.21	81.74	273	30,000	0.74	0.96	23,299
85	12/19/91	22,368	3,600	6.21	99.91	224	30,000	0.75	0.96	23,298
99	01/02/92	22,655	3,600	6.29	99.05	229	30,000	0.76	0.96	23,478
113	01/16/92	22,946	3,600	6.37	99.05	232	30,000	0.76	0.97	23,660
127	01/30/92	23,242	3,600	6.46	99.04	235	30,000	0.77	0.97	23,845
141	02/13/92	23,542	3,600	6.54	99.04	238	30,000	0.78	0.98	24,033
155	02/27/92	24,204	3,600	6.72	52.96	457	30,000	0.81	0.99	24,465
169	03/12/92	25,616	4,050	6.32	24.74	1,035	30,000	0.85	1.01	25,390
183	03/26/92	27,467	4,050	6.78	18.87	1,456	30,000	0.92	1.03	26,582
197	04/09/92	29,812	4,050	7.36	14.73	2,023	30,000	0.99	1.06	28,055

RUN NAME: HYOF5A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% "CR".	AVE. TEMP (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
	03/01/91	276,923				34.1	1,400.0	198			
15	03/15/91	255,396	7.77	45.5	36.0	38.5	973.5	262	1.00	65	2.[illegible]
29	03/29/91	240,664	5.32	42.0	36.0	41.7	763.3	315	1.03	55	1.4
43	04/12/91	230,740	3.58	44.0	36.0	45.6	583.8	395	1.07	85	1.8
57	04/26/91	223,992	2.44	[illegible]	36.0	49.8	447.5	500	1.10	116	2.0
71	05/10/91	219403	1.66	47.0	36.0	54.7	338.3	649	1.14	169	2.[illegible]
85	05/24/91	216,263	1.13	[illegible]	36.0	60.6	249.4	867	[illegible]	255	[illegible]
99	06/07/91	214,[illegible]	0.77	[illegible]	36.0	67.4	181.[illegible]	1,193	1.2[illegible]	381	[illegible]
113	06/21/91	212,[illegible]	0.[illegible]	[illegible]	[illegible]	[illegible]	135.6	1,569	1.24	480	2.[illegible]
127	07/05/91	211,[illegible]	1.36	[illegible]	36.0	[illegible]	104.[illegible]	2,034	[illegible]	593	[illegible]
141	07/19/91	210,935	0.29	53.0	36.0	[illegible]	81.7	2,582	1.31	719	2.4
155	08/02/91	210,[illegible]	0.27	53.0	36.0	[illegible]	65.3	3,220	1.34	858	2
169	08/16/91	209,444	0.27	[illegible]	36.0	[illegible]5	53.0	3,954	1.38	1,012	2.[illegible]
183	08/30/91	208,730	0.[illegible]	[illegible]	36.0	108.3	43.6	4,790	1.41	1,182	2.0
197	09/13/91	208[illegible]	[illegible]	[illegible]	[illegible]	114.8	36.6	5,686	1.45	1,298	[illegible]
211	09/27/91	207,36[illegible]	0.24	52.[illegible]	36.0	[illegible]	[illegible]	6,686	1.48	1,432	[illegible]
225	10/11/91	206,[illegible]	0.23	[illegible]	36.0	[illegible]	26.5	7,794	[illegible]	1,682	[illegible]
239	10/25/91	206,[illegible]	0.2[illegible]	47.0	36.0	132.[illegible]	23.7	8,694	1.55	1,396	[illegible]
253	11/08/91	205,503	0.22	40.0	36.0	13[illegible]	22.4	9,188	1.59	784	0.[illegible]
267	11/22/91	204,929	0.2[illegible]	35.0	36.0	136.3	21.9	9,362	1.62	292	0.2
281	12/06/91	204 379	0.20	35.0	36.0	137.2	21.4	9,539	1.66	292	0.2
295	12/20/91	203,853	0.19	32.5	36.0	137.4	21.4	9,548	1.69	267	0.2
309	01/03/92	203,350	0.18	34.0	36.0	138.0	21.1	9,660	1.72	270	0.2
323	01/17/92	202,872	0.17	34.0	36.0	138.7	20.8	9,774	1.76	274	0.2
337	01/31/92	202,417	0.16	34.0	36.0	139.3	20.5	9,890	1.79	277	0.2
351	02/14/92	201,986	0.16	34.0	36.0	140.0	20.2	10,008	1.83	280	0.[illegible]
365	02/28/92	201,580	0.15	36.0	36.0	141.3	19.6	10,268	1.86	485	[illegible]
379	03/13/92	2[illegible]185	0.14	40.0	36.0	143.9	18.6	10,824	1.90	1,054	0.7
393	03/27/92	200,790	0.14	42.0	36.0	147.1	17.4	11,552	1.93	1,404	3.9
407	04/10/92	200,395	0.14	44.0	36.0	151.0	16.1	12,470	1.97	1,805	1.[illegible]
421	04/24/92	200,000	0.14	45.0	36.0	155.3	14.8	13,519	2.00	2,098	1.2

BIOMASS PRODUCED (LBS.) = 13,519
TOTAL FOOD FED (LBS.) 21,402 AVERAGE CONVERSION = 1.61

NOTE: average temperature is programmed for 53 F
during first week after ponding

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS (INCL. PREVIOUS AND NEXT BROODS):

WELL WATER = 900 GPM (2 cfs; used from June 1st through September 2nd)

RIVER WATER = 1,800 GPM (4 cfs; used from September 2nd through June 1st)

RACEWAY SPACE = 15,000 CU.FT. (MAX.)

HYOF5AR

			WATER FLOW REQMT'S				RACEWAY REQMT'S			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	03/01/91	198	900	0.22	7.75	26	15,000	0.01	0.26	746
15	03/15/91	262	900	0.29	7.75	34	15,000	0.02	0.26	990
29	03/29/91	315	900	0.35	13.21	24	15,000	0.02	0.29	1,097
43	04/12/91	395	900	0.44	9.63	41	15,000	0.03	0.31	1,258
57	04/26/91	500	900	0.56	8.51	59	15,000	0.03	0.34	1,458
71	05/10/91	649	900	0.72	6.76	96	15,000	0.04	0.38	1,721
85	05/24/91	867	900	0.96	5.20	167	15,000	0.06	0.42	2,079
99	06/07/91	1,183	900	1.31	4.14	285	15,000	0.08	0.46	2,548
113	06/21/91	1,569	900	1.74	4.46	352	15,000	0.10	0.51	3,070
127	07/05/91	2,034	900	2.26	4.76	428	15,000	0.14	0.56	3,643
141	07/19/91	2,582	900	2.87	5.05	511	15,000	0.17	0.61	4,266
155	08/02/91	3,220	900	3.58	5.35	602	15,000	0.21	0.65	4,937
169	08/16/91	3,954	900	4.39	5.63	702	15,000	0.26	0.70	5,655
183	08/30/91	4,790	900	5.32	5.90	811	15,000	0.32	0.75	6,418
197	09/13/91	5,686	1,350	4.21	6.70	849	15,000	0.38	0.79	7,188
211	09/27/91	6,686	1,350	4.95	6.94	963	15,000	0.45	0.84	7,999
225	10/11/91	7,794	1,350	5.77	7.18	1,086	15,000	0.52	0.88	8,851
239	10/25/91	8,694	1,350	6.44	12.21	712	15,000	0.58	0.91	9,510
253	11/08/91	9,188	1,800	5.10	30.85	298	15,000	0.61	0.93	9,858
267	11/22/91	9,362	1,800	5.20	91.75	102	15,000	0.62	0.94	9,972
281	12/06/91	9,539	1,800	5.30	90.06	106	15,000	0.64	0.95	10,088
295	12/20/91	9,548	1,800	5.30	99.93	96	15,000	0.64	0.95	10,086
309	01/03/92	9,660	1,800	5.37	99.13	97	15,000	0.64	0.95	10,157
323	01/17/92	9,774	1,800	5.43	99.12	99	15,000	0.65	0.96	10,228
337	01/31/92	9,890	1,800	5.49	99.12	100	15,000	0.66	0.96	10,301
351	02/14/92	10,008	1,800	5.56	99.12	101	15,000	0.67	0.96	10,376
365	02/28/92	10,268	1,800	5.70	58.12	177	15,000	0.68	0.97	10,548
379	03/13/92	10,824	1,800	6.01	27.08	400	15,000	0.72	0.99	10,918
393	03/27/92	11,552	1,800	6.42	20.62	560	15,000	0.77	1.01	11,394
407	04/10/92	12,470	1,800	6.93	16.08	776	15,000	0.83	1.04	11,983
421	04/24/92	13,519	1,800	7.51	14.27	948	15,000	0.90	1.07	12,637

OAK FLAT – COHO **Growth – Food**

RUN NAME: HYOF1A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	2 MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14DAY FEED REQ. (LBS.)	2 FOOD FED /DAY
1	03/15/91	2,400,000				29.0	1,800.0	1,333			
15	03/29/91	2,288,061	4.66	42.0	44.0	31.6	1,383.4	1,654	1.00	321	1.6
29	04/12/91	2,211,455	3.19	44.0	44.0	34.8	1,037.1	2,132	1.04	498	2.0
43	04/26/91	2,159,850	2.15	45.0	44.0	38.3	780.9	2,766	1.08	686	2.1
57	05/10/91	2,124,760	1.46	47.0	44.0	42.3	580.1	3,663	1.12	1,008	2.4
71	05/24/91	2,100,898	0.99	50.0	44.0	47.1	420.6	4,995	1.17	1,553	1.8
85	06/07/91	2,084,672	0.68	53.0	44.0	52.6	300.5	6,938	[illegible]	2,345	3.1
99	06/21/91	2,073,638	0.46	57.0	44.0	59.3	210.3	9,859	1.25	3,646	3.4
113	07/05/91	2,066,135	0.31	57.0	44.0	65.9	152.9	13,510	1.29	4,709	3.1
127	07/19/91	2,060,973	0.22	58.0	44.0	72.9	113.4	18,174	1.33	6,208	3.0
141	08/02/91	2,056,861	0.17	58.0	44.0	79.8	86.4	23,806	1.37	7,729	2.8
155	08/16/91	2,052,931	0.16	59.0	44.0	86.9	66.7	30,769	1.41	9,845	2.8
169	08/30/91	2,049,108	0.16	54.0	44.0	92.8	54.9	37,336	1.46	9,556	2.1
183	09/13/91	2,045,397	0.15	52.0	44.0	98.1	46.4	44,049	1.50	10,046	1.8
197	09/27/91	2,041,796	0.15	52.0	44.0	103.4	39.6	51,515	1.54	11,482	1.8
211	10/11/91	2,038,315	0.15	52.0	44.0	108.7	34.1	59,773	1.58	13,042	1.7
225	10/25/91	2,034,958	0.14	47.0	44.0	112.7	30.6	66,484	1.62	10,875	1.3
239	11/08/91	2,031,725	0.13	40.0	44.0	114.9	28.9	70,206	1.66	6,187	0.7
253	11/22/91	2,028,616	0.13	35.0	44.0	115.7	28.3	71,569	1.70	2,322	0.2
267	12/06/91	2,025,631	0.12	35.0	44.0	116.5	27.8	72,953	1.74	2,414	0.2
281	12/20/91	2,022,770	0.12	32.5	44.0	116.6	27.7	73,099	1.79	2,047	0.2
295	01/03/92	2,020,034	0.11	34.0	44.0	117.1	27.3	74,004	1.83	2,072	0.2
309	01/17/92	2,017,422	0.11	34.0	44.0	117.6	26.9	74,919	1.87	2,098	0.2
323	01/31/92	2,014,934	0.10	34.0	44.0	118.2	26.6	75,846	1.91	2,124	0.2
337	02/14/92	2,012,570	0.10	34.0	44.0	118.7	26.2	76,784	1.95	2,150	0.2
351	02/28/92	452,324	0.09	36.0	44.0	119.8	25.5	78,778	1.99	3,975	0.4
365	03/13/92	451,848	0.09	40.0	30.0	122.9	23.6	19,126	2.03	2,850	1.1
379	03/27/92	451,386	0.09	42.0	30.0	126.8	21.5	20,983	2.08	3,856	1.4
393	04/10/92	450,924	0.09	44.0	30.0	131.5	19.3	23,369	2.12	5,051	1.7
407	04/24/92	450,462	0.09	45.0	30.0	136.5	17.2	26,151	2.16	6,005	1.8
421	05/08/92	450,000	0.09	47.0	30.0	142.4	15.2	29,627	2.20	7,647	2.0

BIOMASS PRODUCED (LBS.) = 90,680
TOTAL FOOD FED (LBS.) = 144,346 AVERAGE CONVERSION = 1.62

NOTE: 77.5 percent of fish are moved to ponds on August 2nd; these fish are relocated to Wapato on February 28th.

GIVEN THE FOLLOWING MAXIMUMWATER FLOW AND SPACE REQUIREMENTS (INCL. PREVIOUS AND NEXT BROODS):

RIVER WATER = 9,900 GPM (22 cfs)
RACEWAY SPACE = 50,000 CU.FT. (MAX.) POND SPACE = 100,000 CU.FT. (MAX.)

HYOF1AR

			------WATER FLOW REQMT'S--------				--------RACEWAY REQMT'S----------				-----------POND REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D	ACTUAL POND SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	03/15/91	1,333	900	1.48	11.57	115	20,000	0.07	0.22	6,115				
15	03/29/91	1,654	900	1.84	11.57	143	20,000	0.08	0.22	7,585				
29	04/12/91	2,132	900	2.37	8.73	244	20,000	0.11	0.24	8,884				
43	04/26/91	2,766	900	3.07	7.82	354	20,000	0.14	0.26	10,483				
57	05/10/91	3,663	1,350	2.71	6.28	583	20,000	0.18	0.29	12,573				
71	05/24/91	4,995	1,350	3.70	4.87	1,027	50,000	0.10	0.32	15,405				
85	06/07/91	6,938	8,100	0.86	3.90	1,780	50,000	0.14	0.36	19,127				
99	06/21/91	9,859	8,100	1.22	2.92	3,377	50,000	0.20	0.41	24,132				
113	07/05/91	13,510	8,100	1.67	3.18	4,247	50,000	0.27	0.45	29,737				
127	07/19/91	18,174	8,100	2.24	3.16	5,754	50,000	0.36	0.50	36,208				
141	08/02/91	23,806	8,100	2.94	3.39	7,025	50,000	0.48	0.55	43,317				
155	08/16/91	30,769	9,900	3.11	3.18	9,667	50,000	0.14	0.60	11,557	100,000	0.24	0.48	49,761
169	08/30/91	37,336	9,900	3.77	5.49	6,795	50,000	0.17	0.64	13,140	100,000	0.29	0.51	56,575
183	09/13/91	44,049	9,900	4.45	6.73	6,545	50,000	0.20	0.68	14,662	100,000	0.34	0.54	63,130
197	09/27/91	51,515	9,900	5.20	6.93	7,433	30,000	0.39	0.71	lb ,266	100,000	0.40	0.57	70,034
211	10/11/91	59,773	9,900	6.04	7.12	8,393	30,000	0.45	0.75	17,951	100,000	0.46	0.60	77,288
225	10/25/91	66,484	8,100	8.21	12.02	5,533	30,000	0.50	0.78	19,260	100,000	0.52	0.62	82,923
239	11/08/91	70,206	8,100	8.67	29.89	2,349	30,000	0.53	0.79	19,961	100,000	0.54	0.63	85,945
253	11/22/91	71,569	8,100	8.84	85.08	841	30,000	0.54	0.80	20,209	100,000	0.55	0.64	87,009
267	12/06/91	72,953	8,100	9.01	83.42	874	30,000	0.55	0.80	20,458	100,000	0.57	0.64	88,084
281	12/20/91	73,099	8,100	9.02	99.85	732	30,000	0.55	0.80	20,476	100,000	0.57	0.64	88,160
295	01/03/92	74,004	8,100	9.14	99.08	747	30,000	0.56	0.81	20,635	100,000	0.57	0.65	88,846
309	01/17/92	74,919	8,100	9.25	99.08	756	30,000	0.56	0.81	20,796	100,000	0.58	0.65	89,538
323	01/31/92	75,846	8,100	9.36	99.08	765	30,000	0.57	0.81	20,959	100,000	0.59	0.65	90,238
337	02/14/92	76,784	8,100	9.48	99.08	775	30,000	0.58	0.82	21,123	100,000	0.60	0.65	90,945
351	02/28/92	78,778	8,100	9.73	54.44	1,447	30,000	0.59	0.83	21,479	100,000	0.61	0.66	92,479
365	03/13/92	19,126	4,500	4.25	17.39	1,100	20,000	0.96	0.85	22,588				
379	03/27/92	20,983	4,500	4.66	13.37	1,570	30,000	0.70	0.87	24,020				
393	04/10/92	23,369	4,500	5.19	10.52	2,222	30,000	0.78	0.91	25,799				
407	04/24/92	26,151	4,500	5.81	9.42	2,777	30,000	0.87	0.94	27,798				
421	05/08/92	29,627	4,500	6.58	7.51	3,944	30,000	0.99	0.98	30,199				

OAK FLAT **STEELHEAD** **Growth – Food**

RUN WANE: HYOF2A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
211	10/11/91	204,670				158.9	12.0	17,056			
225	10/25/91	204,210	0.18	47.0	28.0	165.1	10.7	19,112	1.51	3,106	1.3
239	11/08/91	203,767	0.17	40.0	28.0	168.5	10.1	20,251	1.55	1,769	0.7
253	11/22/91	203,341	0.17	35.0	28.0	169.7	9.8	20,663	1.59	656	0.2
267	12/06/91	202,932	0.16	35.0	28.0	[illegible]	9.6	21,082	1.63	684	0.2
281	12/20/91	202,541	0.15	32.5	28.0	[illegible]	9.6	21,119	1.64	591	0.2
295	01/03/92	202,166	0.15	34.0	28.0	[illegible]	3.5	21,390	[illegible]	599	0.2
309	01/17/92	201,808	0.14	34.0	28.0	172.9	9.3	21,664	1.76	607	0.2
323	01/31/92	201,467	0.13	34.0	28.0	173.7	9.2	21,943	1.80	614	0.2
337	02/14/92	201,143	0.13	34.0	28.0	174.5	9.1	22,225	1.84	622	0.2
351	02/28/92	200,836	0.12	36.0	28.0	176.2	8.8	22,835	1.88	1,145	0.4
365	03/13/92	200,547	0.11	40.0	28.0	179.6	8.3	24,124	1.92	2,473	0.8
379	03/27/92	200,265	0.11	42.0	28.0	183.7	7.8	25,811	1.96	3,305	1.0
393	04/10/92	199,984	0.11	44.0	28.0	188.7	7.2	27,943	2.00	4,263	1.2

BIOMASS PRODUCED (LBS.) = 10,887

TOTAL FOOD FED (LBS.)= 20,435 AVERAGE CONVERSION = 1.88

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIRENEWTS:
WATER FLOW = 4,050 GPM (9 cfs)
RACEWAYSPACE = 30,000 CU.FT.

HYOF2AR

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	------WATER FLOW REQMT'S-------- ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	--------RACEWAY REQMT'S---------- ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	10/11/91	17,056	3,600	4.74	12.03	1,418	30,000	0.57	1.14	14,990
15	10/25/91	19,112	3,600	5.31	12.03	1,589	30,000	0.64	1.14	16,797
29	11/08/91	20,251	3,600	5.63	30.08	673	30,000	0.68	1.16	17,446
43	11/22/91	20,663	3,600	5.74	86.85	238	30,000	0.69	1.17	17,669
57	12/06/91	21,082	3,600	5.86	85.05	248	30,000	0.70	1.18	17,895
71	12/20/91	21,119	3,600	5.87	99.87	211	30,000	0.70	1.18	17,904
85	01/03/92	21,390	3,600	5.94	99.05	216	30,000	0.71	1.19	18,046
99	01/17/92	21,664	3,600	6.02	99.05	219	30,000	0.72	1.19	18,189
113	01/31/92	21,943	3,600	6.10	99.05	222	30,000	0.73	1.20	18,334
127	02/14/92	22,225	3,600	6.17	99.05	224	30,000	0.74	1.20	18,481
141	02/28/92	22,835	3,600	6.34	54.74	417	30,000	0.76	1.21	18,808
155	03/13/92	24,124	4,050	5.96	25.69	939	30,000	0.80	1.24	19,500
169	03/27/92	25,811	4,050	6.37	19.54	1,321	30,000	0.86	1.27	20,390
183	04/10/92	27,943	4,050	6.90	15.22	1,836	30,000	0.93	1.30	21,487

FOOD REQUIREMENTS AT OAK FLAT

HYOF1AF

PERIOD ENDING DATE	****** LBS. FOOD REQUIRED BY SPECIES ****** SPRING CHINOOK	SUMMER CHINOOK	STEELHEAD	COHO	TOTAL LBS. FOOD REQUIRED
01/29/91	1,952	551	1,221	4,221	7,945
02/28/91	3,976	1,884	4,240	8,975	19,076
03/30/91	8,326	3,349	7,569	9,726	28,969
04/30/91		2,383		15,346	17,729
05/30/91		637		3,898	4,535
06/30/91		1,072		8,355	9,427
07/30/91		1,577		13,937	15,514
08/29/91		3,492		29,447	32,939
09/29/91	4,230	3,164		24,524	31,919
10/29/91	5,542	2,180	4,875	17,062	29,660
11/29/91	1,479	574	1,340	4,735	8,129
12/29/91	1,261	538	1,190	4,119	7,108
01/29/92	1,952	551	1,221	4,221	7,945

WATER FLOW REQUIREMENTS
AT OAK FLAT

HYOF1AZ

PERIOD ENDING DAY	PERIOD ENDING DATE	----- ACTUAL ------ GPM WATER	CFS WATER	-- MIN. REQ'D -- GPM WATER	CFS WATER
1	01/01/91	17,100	38.0	1,289	2.9
15	01/15/91	17,100	38.0	1,306	2.9
29	01/29/91	17,100	38.0	1,322	2.9
43	02/12/91	17,100	38.0	1,338	3.0
57	02/26/91	18,000	40.0	2,524	5.6
71	03/12/91	16,200	36.0	3,623	8.1
85	03/26/91	16,200	36.0	5,074	11.3
99	04/09/91	16,200	36.0	7,142	15.9
113	04/23/91	8,100	18.0	4,138	9.2
127	05/07/91	6,750	15.0	4,623	10.3
141	05/21/91	2,250	5.0	1,194	2.7
155	06/04/91	9,000	20.0	2,065	4.6
169	06/18/91	9,000	20.0	3,729	8.3
183	07/02/91	9,000	20.0	4,675	10.4
197	07/16/91	9,000	20.0	6,265	13.9
211	07/30/91	9,000	20.0	7,627	16.9
225	08/13/91	10,800	24.0	10,369	23.0
239	08/27/91	10,800	24.0	7,606	16.9
253	09/10/91	11,250	25.0	7,394	16.4
267	09/24/91	14,400	32.0	10,731	23.8
281	10/08/91	18,000	40.0	13,656	30.3
295	10/22/91	16,200	36.0	9,651	21.4
309	11/05/91	17,100	38.0	4,083	9.1
323	11/19/91	17,100	38.0	1,444	3.2
337	12/03/91	17,100	38.0	1,501	3.3
351	12/17/91	17,100	38.0	1,263	2.8
365	12/31/91	17,100	38.0	1,289	2.9
379	01/14/92	17,100	38.0	1,306	2.9
393	01/28/92	17,100	38.0	1,322	2.9

OAK FLAT **Pollutants**

Estimated PPM of Pollutants Generated Daily for
all Species Programmed at Oak flats

HYOF1AP

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLED SOLIDS	B.O.D.	RECEIVING WATER (CFS)
				POLLUTANTS GENERATED IN PPM **						
1	01/01/91	255	17,100	0.04	0.0001	0.11	0.01	0.37	0.42	
15	01/15/91	259	17,100	0.04	0.0001	0.11	0.01	0.38	0.43	
29	01/29/91	262	17,100	0.04	0.0001	0.11	0.01	0.38	0.43	
43	02/12/91	265	17,100	0.04	0.0001	0.11	0.01	0.39	0.44	
57	02/26/91	490	18,000	0.07	0.0001	0.20	0.01	0.68	0.77	
71	03/12/91	655	16,200	0.11	0.0002	0.29	0.02	1.01	1.14	
85	03/26/91	898	16,200	0.15	0.0002	0.40	0.02	1.39	1.57	
99	04/09/91	1,171	16,200	0.19	0.0003	0.52	0.03	1.81	2.05	
113	04/23/91	636	8,100	0.21	0.0003	0.57	0.03	1.96	2.22	
127	05/07/91	630	6,750	0.25	0.0004	0.68	0.04	2.33	2.64	
141	05/21/91	129	2,250	0.15	0.0002	0.42	0.02	1.44	1.63	
155	06/04/91	195	9,000	0.06	0.0001	0.16	0.01	0.54	0.61	
169	06/18/91	295	9,000	0.09	0.0001	0.24	0.01	0.82	0.93	
183	07/02/91	379	9,000	0.11	0.0002	0.31	0.02	1.05	1.19	
197	07/16/91	495	9,000	0.15	0.0002	0.40	0.02	1.37	1.56	
211	07/30/91	613	9,000	0.18	0.0003	0.49	0.03	1.70	1.93	
225	08/13/91	776	10,800	0.19	0.0003	0.52	0.03	1.80	2.03	
239	08/27/91	767	10,800	0.19	0.0003	0.51	0.03	1.78	2.01	
253	09/10/91	810	11,250	0.19	0.0003	0.52	0.03	1.80	2.04	
267	09/24/91	926	14,400	0.17	0.0003	0.47	0.03	1.61	1.82	
281	10/08/91	1,354	18,000	0.20	0.0003	0.55	0.03	1.88	2.13	
295	10/22/91	1,351	16,200	0.22	0.0003	0.60	0.03	2.09	2.36	
309	11/05/91	767	17,100	0.12	0.0002	0.33	0.02	1.12	1.27	
323	11/19/91	285	17,100	0.04	0.0001	0.12	0.01	0.42	0.47	
337	12/03/91	296	17,100	0.05	0.0001	0.13	0.01	0.43	0.49	
351	12/17/91	252	17,100	0.04	0.0001	0.11	0.01	0.37	0.42	
365	12/31/91	255	17,100	0.04	0.0001	0.11	0.01	0.37	0.42	
379	01/14/92	259	17,100	0.04	0.0001	0.11	0.01	0.38	0.43	
393	01/28/92	262	17,100	0.04	0.0001	0.11	0.01	0.38	0.43	

** The ppm of pollutants in the discahrge water is illustrated in the table. **Vacuum cleaning** will significantly reduce the level of settleable solids and B.O.D.

F L O W l S P A C E, F O O D

S U M M A R Y

For

NELSON SPRINGS

By Fish Management Consultants
Olympia, WA

February 2, 1990

NELSON SPRINGS - FALL CHINOOK

RUN NAME: HYBK1A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
1	02/05/91	3,870,967				36.3	1,160.6	3,335			
15	02/19/91	3,780,117	2.35	52.0	30.0	44.1	647.1	5,842	1.00	2,507	4.6
29	03/05/91	3,717,942	1.61	50.0	30.0	51.1	415.4	8,951	1.03	3,207	3.5
43	03/19/91	1,225,353	1.08	50.0	30.0	58.1	282.3	13,022	1.06	4,327	3.[illegible]
57	04/02/91	1,215,860	0.74	51.0	33.0	64.8	203.1	5,985	1.09	1,799	2.7
71	04/16/91	1,209,404	0.50	52.0	33.0	71.9	148.8	8,127	1.13	2,412	2.7
85	04/30/91	1,205,015	0.34	53.0	33.0	79.4	110.7	10,881	1.16	3,186	2.6
99	05/14/91	1,202,030	0.23	54.0	33.0	87.2	83.6	16,378	1.19	4,156	2.5
113	05/28/91	1,200,000	0.16	55.0	33.0	95.3	63.9	18,769	1.22	5,357	2.5

BIOMASS PRODUCED (LBS.) = 27,450
TOTAL FOOD FED (LBS.) = 26,951 AVERAGE CONVERSION = 1.12

NOTE: average temperature is programed for 54 F
from February 5th through February 12th;
67% of fish are relocated to Wapato and Prosser
March 19.

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:
WATER FLOW = 4,500 GPM (10 cfs)
RACEWAY SPACE = 30,000 CU.FT.

HYBK1AR

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	WATER FLOW REQMT'S: ACTUAL WATER FLOW USED	ACTUAL LBS./GPM	ALLOWABLE LBS./GPM	FLOW REQ'D (GPM)	RACEWAY REQMT'S: ACTUAL RACEWAY SPACE USED	ACTUAL LBS./CU.FT.	ALLOWABLE LBS./CU.FT.	TOTAL CU.FT. REQ'D
	02/05/91	3,335	3,150	1.06	2.68	1,243	30,000	0.11	0.30	10,985
15	02/19/91	5,842	3,150	1.85	2.68	2,178	30,000	0.19	0.30	19,240
29	03/05/91	8,951	3,150	2.84	3.88	2,307	30,000	0.30	0.35	25,431
43	03/19/91	13,022	3,150	4.13	4.34	2,997	30,000	0.43	0.40	32,528
57	04/02/91	5,985	3,150	1.90	4.85	1,235	30,000	0.20	0.45	13,397
71	04/16/91	8,127	3,150	2.58	4.66	1,742	30,000	0.27	0.50	16,400
85	04/30/91	10,881	3,150	3.45	4.62	2,355	30,000	0.36	0.55	19,897
99	05/14/91	14,378	4,500	3.20	4.57	3,147	30,000	0.48	0.60	23,939
113	05/28/91	18,769	4,500	4.17	4.51	4,164	30,000	0.63	0.66	28,578

NELSON SPRINGS – STEELHEAD **Growth – Food**

RUN NAME: HYBK2A

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED RED. (LBS.)	2 FOOD FED /DAY
1	03/15/91	553,845				25.8	2,806.1	197			
15	03/29/91	509,122	8.08	51.0	39.0	31.5	1,541.6	330	0.90	120	3.8
29	04/12/91	478,515	5.53	52.0	39.0	37.5	913.6	524	0.95	184	3.5
43	04/26/91	457,898	3.72	53.0	39.0	43.8	573.4	799	1.00	275	3.4
57	05/10/91	443,878	2.53	54.0	39.0	50.4	376.3	1,180	1.05	400	3.2
71	05/24/91	434,344	1.72	55.0	39.0	57.3	256.1	1,696	1.10	568	3.1
85	06/07/91	427,862	1.17	59.0	39.0	65.4	172.2	2,485	1.15	907	3.5
99	06/21/91	423,453	0.80	60.0	39.0	73.8	119.8	3,533	1.20	1,259	3.3
113	07/05/91	420,456	0.54	61.0	39.0	82.5	85.8	4,901	1.25	1,710	3.2
127	07/19/91	418,393	0.37	61.0	39.0	91.2	63.5	6,589	1.30	2,194	3.0
141	08/02/91	416,751	0.30	61.0	39.0	99.9	48.3	8,626	1.35	2,750	2.8
155	08/16/91	415,180	0.28	61.0	39.0	108.6	37.6	11,040	1.40	3,380	2.6
169	08/30/91	413,653	0.28	60.0	39.0	117.0	30.1	13,755	1.45	3,936	2.4
183	09/13/91	412,170	0.27	59.0	39.0	125.1	24.6	16,754	1.50	4,498	2.2
197	09/27/91	410,732	0.26	58.0	39.0	132.9	20.5	20,017	1.55	5,056	2.1
211	10/11/91	204,670	0.25	55.0	39.0	139.8	17.6	23,221	1.60	5,126	1.8
225	10/25/91	204,112	0.20	53.0	28.0	122.2	26.4	7,735	1.59	2,433	2.6
239	11/08/91	203,576	0.19	49.0	28.0	129.3	22.3	9,139	1.63	2,294	2.0
253	11/22/91	203,059	0.19	49.0	28.0	136.4	19.0	10,703	1.68	2,625	2.0
267	12/06/91	202,564	0.18	49.0	28.0	143.5	16.3	12,433	1.73	2,985	1.9
281	12/20/91	202,088	0.17	49.0	28.0	150.6	14.1	14,338	1.77	3,374	1.9
295	01/03/92	201,634	0.16	49.0	28.0	157.7	12.3	16,427	1.82	3,795	1.8
309	01/17/92	201,200	0.16	50.0	28.0	165.2	10.7	18,850	1.86	4,513	1.9
323	01/31/92	200,787	0.15	50.0	28.0	172.7	9.3	21,499	1.91	5,055	1.9
337	02/14/92	200,394	0.14	50.0	28.0	180.2	8.2	24,383	1.95	5,636	1.8
351	02/28/92	200,022	0.13	50.0	28.0	187.8	7.3	27,513	2.00	6,259	1.8

BIOMASS PRODUCED (LBS.) = 39,123
TOTAL FOOD FED (LBS.) = 71,333 AVERAGE CONVERSION = 1.83

50% of brood stock averaging 12/lb are transfered to Oak Fiat on 10/11. The 50% remaining at Nelson Springs average 33/lb on 10/11.

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

WATER FLOW = 4,500 GPM (10 cfs)

RACEWAY SPACE = 25,000 CU.FT.

HYBK2AR

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	------ WATER FLOW REQMT'S -------- ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW-ABLE LBS./ GPM	FLOW REQ'D (GPM)	-------- RACEWAY REQMT'S ---------- ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT.	ALLOW-ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	03/15/91	197	450	0.44	3.50	56	25,000	0.01	0.22	910
15	03/29/91	330	450	0.73	3.50	94	25,000	0.01	0.22	1,522
29	04/12/91	524	450	1.16	3.52	149	25,000	0.02	0.26	2,028
43	04/26/91	799	450	1.77	3.58	223	25,000	0.03	0.30	2,647
57	05/10/91	1,180	450	2.62	3.59	329	25,000	0.05	0.35	3,398
[illegible]	[illegible]	1,696	900	1.88	3.58	474	25,000	0.07	0.39	4,298
85	06/07/91	2,485	1,350	1.84	2.55	975	25,000	0.10	0.45	5,516
99	06/21/91	3,533	3,150	1.12	2.54	1,389	25,000	0.14	0.51	6,951
113	07/05/91	4.901	3,150	1.56	2.65	1,852	25,000	0.20	0.57	8,626
127	07/19/91	6,589	3,150	2.09	2.84	2,323	25,000	0.26	0.63	10,489
141	08/02/91	8,626	3,150	2.74	3.02	2,856	25 ,000	0.35	0.69	12,536
155	08/16/91	11,040	4,050	2.73	3.20	3,452	25,000	0.44	0.75	14,759
169	08/30/91	13,755	4,050	3.40	3.49	3,941	25,000	0.55	0.81	17,068
183	09/13/91	16,754	4,500	3.72	3.96	4,228	25,000	0.67	0.86	19,443
197	09/27/91	20,017	4,500	4.45	4.66	4,297	25,000	0.80	0.92	21,867
211	10/11/91	23,221	4,050	5.73	6.36	3,652	25,000	0.93	0.96	24,115
225	10/25/91	7,735	4,050	1.91	4.53	1,706	25,000	0.31	0.84	9,189
239	11/08/91	9,139	4,050	2.26	7.09	1,289	25 ,000	0.37	0.89	10,261
253	11/22/91	10,703	4,050	2.64	7.31	1,465	25,000	0.43	0.94	11,390
267	12/06/91	12,433	4,050	3.07	7.51	1,655	25,000	0.50	0.99	12,577
281	12/20/91	14,338	4,050	3.54	7.70	1,861	25,000	0.57	1.04	13,820
295	01/03/92	16,427	4,050	4.06	7.89	2,083	25,000	0.66	1.09	15,120
309	01/17/92	18,850	4,050	4.65	7.18	2,627	25,000	0.75	1.14	16,561
323	01/31/92	21,499	4,050	5.31	7.34	2,928	25,000	0.86	1.19	18,066

FOOD REQUIREMENTS AT NELSON SPRINGS

HYBK1AF

PERIOD ENDING DATE	****** LBS. FOOD REQUIRED BY SPECIES ****** FALL CHINOOK	STEELHEAD	TOTAL LBS. FOOD REQUIRED
01/29/91		9,568	9,568
02/28/91	5,714	11,896	17,609
03/30/91	6,126	120	6,246
04/30/91	5,598	459	6,057
05/30/91	9,514	968	10,482
06/30/91		3,875	3,875
07/30/91		4,944	4,944
08/29/91		7,316	7,316
09/29/91		9,557	9,557
10/29/91		7,559	7,559
11/29/91		7,904	7,904
12/29/91		7,169	7,169
01/29/92		9,568	9,568

WATER FLOW REQUIREMENTS
AT NELSON SPRINGS

HYBK1AZ

PERIOD ENDING GAY	PERIOD ENDING DATE	----- ACTUAL ----- GPM WATER	CFS WATER	-- MIN. REQ'D -- GPM WATER	CFS WATER
1	01/01/91	4,050	9.0	2,083	4.6
15	01/15/91	4,050	9.0	2,627	5.8
29	01/29/91	4,050	9.0	2,928	6.5
43	02/12/91	3,150	7.0	1,243	2.8
57	02/26/91	3,150	7.0	2,178	4.8
71	03/12/91	3,600	8.0	2,363	5.3
85	03/26/91	3,600	8.0	3,091	6.9
99	04/09/91	3,600	8.0	1,384	3.1
113	04/23/91	3,600	8.0	1,965	4.4
127	05/07/91	3,600	8.0	2,684	6.0
141	05/21/91	5,400	12.0	3,621	8.0
155	06/04/91	5,850	13.0	5,139	11.4
169	06/18/91	3,150	7.0	1,389	3.1
183	07/02/91	3,150	7.0	1,852	4.1
197	07/16/91	3,150	7.0	2,323	5.2
211	07/30/91	3,150	7.0	2,856	6.3
225	08/13/91	4,050	9.0	3,452	7.7
239	08/27/91	4,050	9.0	3,941	8.8
253	09/10/91	4,500	10.0	4,228	9.4
267	09/24/91	4,500	10.0	4,297	9.5
281	10/08/91	4,050	9.0	3,652	8.1
295	10/22/91	4,050	9.0	1,706	3.8
309	11/05/91	4,050	9.0	1,289	2.9
323	11/19/91	4,050	9.0	1,465	3.3
337	12/03/91	4,050	9.0	1,655	3.7
351	12/17/91	4,050	9.0	1,861	4.1
365	12/31/91	4,050	9.0	2,083	4.6
379	01/14/92	4,050	9.0	2,627	5.8
393	01/28/92	4,050	9.0	2,928	6.5

NELSON SPRINGS **Pollutants**

Estimated PPM of Pollutants Generated Daily for all Species Programed at Nelson Springs

HYBK1AP

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	POLLUTANTS GENERATED IN PPM ** TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLED SOLIDS	B.O.D.	RECEIVING WATER (CFS)
1	01/01/91	271	4,050	0.18	0.0003	0.49	0.03	1.67	1.89	
15	01/15/91	322	4,050	0.21	0.0003	0.58	0.03	1.99	2.25	
29	01/29/91	361	4,050	0.24	0.0003	0.65	0.04	2.23	2.52	
43	02/12/91	403	3,150	0.34	0.0005	0.93	0.05	3.20	3.62	
57	02/26/91	626	3,150	0.53	0.0008	1.44	0.08	4.97	5.63	
71	03/12/91	229	3,600	0.17	0.0002	0.46	0.03	1.59	1.80	
85	03/26/91	318	3,600	0.24	0.0003	0.64	0.04	2.21	2.50	
99	04/09/91	142	3,600	0.11	0.0002	0.29	0.02	0.98	1.11	
113	04/23/91	192	3,600	0.14	0.0002	0.39	0.02	1.33	1.51	
127	05/07/91	256	3,600	0.19	0.0003	0.52	0.03	1.78	2.01	
141	05/21/91	337	5,400	0.17	0.0002	0.45	0.03	1.56	1.77	
155	06/04/91	447	5,850	0.20	0.0003	0.55	0.03	1.91	2.16	
169	06/18/91	90	3,150	0.08	0.0001	0.21	0.01	0.71	0.81	
183	07/02/91	122	3,150	0.10	0.0002	0.28	0.02	0.97	1.10	
197	07/16/91	157	3,150	0.13	0.0002	0.36	0.02	1.24	1.41	
211	07/30/91	196	3,150	0.17	0.0002	0.45	0.03	1.56	1.77	
225	08/13/91	241	4,050	0.16	0.0002	0.43	0.02	1.49	1.69	
239	08/27/91	281	4,050	0.19	0.0003	0.50	0.03	1.74	1.96	
253	09/10/91	321	4,500	0.19	0.0003	0.52	0.03	1.79	2.02	
267	09/24/91	361	4,500	0.21	0.0003	0.58	0.03	2.01	2.27	
281	10/08/91	366	4,050	0.24	0.0004	0.66	0.04	2.26	2.56	
295	10/22/91	174	4,050	0.11	0.0002	0.31	0.02	1.07	1.21	
309	11/05/91	164	4,050	0.11	0.0002	0.29	0.02	1.01	1.15	
323	11/19/91	187	4,050	0.12	0.0002	0.34	0.02	1.16	1.31	
337	12/03/91	213	4,050	0.14	0.0002	0.38	0.02	1.32	1.49	
351	12/17/91	241	4,050	0.16	0.0002	0.43	0.02	1.49	1.68	
365	12/31/91	271	4,050	0.18	0.0003	0.49	0.03	1.67	1.89	
379	01/14/92	322	4,050	0.21	0.0003	0.58	0.03	1.99	2.25	
393	01/28/92	361	4,050	0.24	0.0003	0.65	0.04	2.23	2.52	

** The ppm of pollutants in the discharge water is illustrated in the table. Vacuum cleaning will significantly reduce the level of settleable solids and B.O.D.

KLICKITAT SALMON AND STEELHEAD HATCHERY

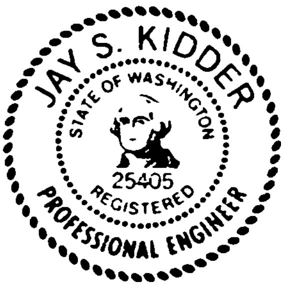
PRELIMINARY DESIGN REPORT

CERTIFICATE OF ENGINEER

KLICKITAT SALMON AND STEELHEAD HATCHERY
PRELIMINARY DESIGN REPORT

January 1990

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a professional engineer licensed to practice as such in the State of Washington, is affixed below.



Jay S. Kidder
Civil Engineer

KLICKITAT SALMON AND STEELHEAD HATCHERY

PRELIMINARY DESIGN REPORT

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SECTION I

INTRODUCTION

1. AUTHORIZATION

The Klickitat Salmon and Steelhead Hatchery Preliminary Design Report was jointly prepared by R. W. Beck and Associates; Bonneville Power Administration, Fish and Wildlife Division (BPA); Yakima Indian Nation; and Fish Management Consultants. The funding and authorization for the Preliminary Design Report were provided by BPA under the terms in the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, 1987 (NPPC, 1987), Sections 703(f)(3), 503(c)(2), and 803(d). R. W. Beck and Associates' authorization and payment has been provided under a Professional Services Agreement dated December 23, 1988.

2. PURPOSE

The reason for planning and constructing a salmon and steelhead hatchery in the Klickitat River Basin, as outlined in the NPPC Program (NPPC, 1987), is to test the hypothesis that new artificial propagation in the basin can be used to increase harvest and enhance natural production while maintaining genetic resources of wild stock fishes.

Salmon and steelhead populations in the Klickitat River Basin are a fraction of their pre-1900 levels. The Klickitat River anadromous fish runs have been impacted from the construction and operation of Bonneville Dam and ocean and river overfishing. (BPA, Environmental Assessment, 1989.) For these reasons, BPA funded the predesign, design, and construction of the Klickitat Salmon and Steelhead Hatchery, which is planned to produce anadromous spring chinook and steelhead species.

This Preliminary Design Report is a result of 14 months of joint efforts by the Technical Work Group including BPA, R. W. Beck and Associates, Yakima Indian Nation, and members of the various fish and wildlife agencies. It serves as a guide that can be used by the Technical Work Group and the design engineers when the process of final design begins.

3. DESIGN REVIEW

Klickitat Salmon and Steelhead Hatchery

Active Participants
Technical Work Group

Bonneville Power Administration

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Yakima Indian Nation

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Active Participants
Technical Work Group (continued)

Consultants

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Consulting Engineer

Project Manager:	Jay Kidder Senior Engineer R. W. Beck and Associates 2101 Fourth Avenue Seattle, Washington 98121-2375	(206) 441-7500 (206) 347-8873

4. ACKNOWLEDGMENTS

We acknowledge the assistance of the Yakima and Klickitat Hatchery Technical Work Group through their lengthy and continual discussion and review of the preliminary design work. We also acknowledge the assistance of the staffs of the Bonneville Power Administration hatchery team and the Yakima Indian Nation for their excellent guidance and review throughout the project.

SECTION II

FISH CULTURE REQUIREMENTS

1. INTRODUCTION

This report is founded on the initial fish production goals that were adopted into the appropriate sections of the NPPC Columbia River Basin Fish and Wildlife Program and as later modified by the current Technical Work Group involved in the predesign. This report specifies a facility that will meet the hatchery goal of being a low-cost facility for the enhancement of the target species.

Section II[(1)] describes the biological and physical fish culture requirements of the Klickitat Hatchery System from which the concepts for the design are formulated in Section III. Biological criteria are presented that provide a basis to size for the water system, adult holding space, incubation units, rearing space, and finally transportation and release methods. The biological criteria address the number and type of water vessels, and the related support requirements. To be assured the components of the system meet all program demands, each life phase from adult capture to the juvenile transfer into acclimation sites is analyzed.

2. PROGRAM GOALS OF FISH CULTURE/SITING

a. Goals

The Northwest Power Planning Council's Facility Master Plan (FMC, 1987) provides the basis for the fish production goals that are set for the Klickitat River Basin. This predesign report references these goals as those that drive the size and extent of the proposed Klickitat Hatchery. Fish production goals are outlined in Table II-1, and include a production level at the 10th year of operation of 2,100,000 spring chinook and 270,000 summer steelhead juvenile releases.

b. Siting

The proposed sites to culture fish are listed in Table II-2. A description of sites within the Klickitat River Basin is included in Section III of this report. The site listed as a central facility include operations for adult holding, spawning, egg incubation, and early and extended rearing, as well as acclimation and release. (See BPA, Environmental Assessment, 1989, p. 8.) Acclimation sites receive fish from the central facility for short-term holding and rearing prior to release. This reduces transportation stress and acclimate fish to the receiving waters. (BPA, Environmental Assessment, 1989, p. 13.)

(1) Section II, Fish Culture Requirements, was provided in cooperation with Fish Management Consultants, Olympia, Washington.

TABLE II-1

TOTAL SMOLT RELEASES FROM THE KLICKITAT HATCHERY
(YEAR 10 PRODUCTION GOAL)

(With the number of Experimental
Study Groups in Parentheses)[1][2]

Stock	Release Size	Klickitat
Spring chinook	15/lb	2,100,000 (130)
Steelhead	9/lb	260,000 (8)
Coho	15/lb	

(1) The listings in this table supersede all previous production and study design numbers.
(2) Provided by Experimental Design Work Group (EDWG).

TABLE II-2

PROPOSED ENHANCEMENT FACILITY SITES
IN THE KLICKITAT RIVER BASIN

Central Facilities	Satellite Facilities
Cascade Springs (upper site)	None
Acclimation Facilities	**Trapping and Hauling**
Various Upper Klickitat Basin Sites	Falls 5 Fishway Klickitat Hatchery (WDF) Castile Falls Fishway

Figures III-1 and III-2 illustrate the general location of the selected site.

3. FISH CULTURAL PROGRAM CRITERIA

a. Water Quality and Quantity

The controlling criteria for the fish culture program are the water quality and quantity. Criteria for these follow:

(1) Quality

(a) Water Chemistry

The general water chemistry guidelines for the enhancement facility are shown in Table III-1 (Alaska Department of Fish and Game Water Quality Standards), along with the findings for water chemistry for each water source on the Klickitat River.

(b) Disease Criteria as a Part of Water Quality

Several criteria have been agreed upon in the hatchery design that relate to disease. These include:

- The initial incubation of all eggs will use disease-free water, e.g., spring or well water. Isolation in bucket incubators is suggested initially for steelhead and will be designed for future use options on chinook.
- Rearing will be conducted only with first pass water.
- Second or third pass water can be used for holding adults.
- To reduce stress and potential disease outbreaks, dissolved oxygen gas in the water shall remain 7.0 ml/l or above. Thus, inflowing water or second pass water should be returned to near saturation.
- The rearing of steelhead in raceways or troughs shall be physically isolated from chinook to reduce the chance of disease-bearing water from being easily transferred, e.g., raceways should not have common walls between steelhead and chinook.

(c) Temperature

The criteria for water temperature can be flexible; however, Table II-3, Suggestive Temperature Profile for Hatchery Design, documents a target for the design engineer.

TABLE II-3

SUGGESTIVE TEMPERATURE PROFILE
FOR THE KLICKITAT HATCHERY DESIGN

		Incubation		Rearing		
Species	Adults	First 21 Days	All Other Time	7 Days	After 7 Days to Smoltification	7 Months Smoltification
Spring Chinook	50 F	42	38	44	54	Seasonal stream temp.
Steel head 1 yr. Smolts	52	53	53	54	56	Seasonal stream temp.
Steel head 2 yr. Smolts	Seasonal stream or 45	42	42	44	44	Seasonal stream temp.

(2) Water Quantity

The minimum quantity of water required for the Klickitat Hatchery is summarized in Table II-4, Minimum Water Flow Requirements. A detailed analysis is included in Section III-3.a.(2), and in the discussions that follow on adult holding, incubation, and rearing.

TABLE II-4

MINIMUM WATER FLOW REQUIREMENTS
FOR DESIGN OF
THE KLICKITAT HATCHERY

	Surface		Spring		Total
Location	(gpm)	(cfs)	(gpm)		(gpm/cfs)
Klickitat	13,658	30	9,298	21	22,456/51

b. Life-Cycle Criteria

(1) Adult Holding and Spawning

Adult brood stock will be trapped at the Falls 5 Fishway, and at the WDF Klickitat Hatchery as shown in Table II-2. Table II-5 identifies returning adult criteria.

Presented in Table II-6, Recommended Adult Holding Units at the Klickitat Hatchery, are the required numbers of 20,000 ft^3 ponds and 5,000 ft^3 raceways that will be used to hold adults. The spring chinook adults require two ponds and the steelhead adults require one raceway.

TABLE II-6

RECOMMENDED ADULT HOLDING UNITS AT KLICKITAT HATCHERY(1)

Facility	20,000 ft^3 Asphalt Pond	5,000 ft^3 Raceways
Spring Chinook	2	0
Steelhead	0	1

(1) All adult holding facilities will be used for juvenile rearing.

(2) Incubation of Eggs and Alevins

The proposed strategy for incubation of eggs is to employ deep trough incubators (Senn, et al, 1984, pp. 89-93) for all salmon and IsoFlow buckets for steelhead. The incubation strategy will be to chill incubation water to slow the development rate of all salmon that are to be reared for more than 12 months. This strategy will match closely the emergence of fry from the naturally spawning population. Two-year smolt Klickitat River steelhead will be incubated as 12-month reared salmon using chilled incubation water.

All salmon incubation will include substrate. Table II-7, Incubation Criteria for the Klickitat Hatchery, provides a summary of incubation criteria. Incubation criteria include spawning, incubation as a percentage of survival, and development rates. Table II-8 is a summary of the number of incubation units required to meet the goals of the hatchery.

TABLE II-5

RETURNING ADULT CRITERIA

	Klickitat River Basin	
	Spring Chinook	Steelhead
Adult		
Collection Sites	Falls Five/ WDF	Falls Five/ WDF
Holding Facility	Cascade Sp.	Cascade Sp.
Arrival Time (month/day)		
From	5/1	6/15
To	9/10	11/1
Male/Female Ratio	1.5:1	1:1
Male/Female Holding Ratio	1.5:1	1:1
Average Weight	15	8
% Pre-Spawn Survival	80	90
% Female Suitable for Spawning	100	90
% Female Collected for Spawning	80	80
% of Run Held at One Time	100	100
Flow as per FMC, 1984, pg. 69(1) (gpm/adult)	1.0	0.5
Holding Space (ft³/adult	10	2.5
Spawning		
Max. No. Females Spawned per Male	2	1
Spawning Period (month/day)		
From	8/15	1/15
To	9/20	4/1
Average No. Eggs/Female	3,600	3,750
Average No. Eggs/lb (eyed)	1,600	3,500
Number of Females Spawned to Meet Goals	980	118

(1) Compendium of Low-Cost Pacific Salmon and Steelhead Trout Production Facilities and Practices in the Pacific Northwest, U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Senn, Harry; Mack, John; and Rothfus, Lloyd, Fish Management Consultants (FMC), 1984.

(2) 100 females to be used.

TABLE II-7

INCUBATION CRITERIA
FOR THE YAKIMA AND KLICKITAT
BASIN ENHANCEMENT FACILITIES

	Klickitat River Basin	
	Spring Chinook	Steelhead
Spawning		
Average No. Eggs/Female	4,300	4,500
Average No. Eggs/lb (eyed)	1,600	3,500
Incubation (Survival rates in %)		
From Fertilization to Eyed Stage	92	92
From Fertilization to First Feeding ...	90	90
Fertilization to Release (see Table 4)	65	60
Development Rate		
Days to First Feeding @ 52°F	83	32
Days to First Feeding @ 48°F	104	36
Days to First Feeding @ 39°F	186	N/A
Total Eggs Required for Program	4,200,000	433,000
Location of Incubation Station	Upper Cascade Spring	Upper Cascade Spring

Water flow/deep trough = 7 gpm to eye = 10 gpm after hatching
Water flow/ISO bucket = 0.32 gpm
Water temperature - See Table II-3
Egg density in ISO bucket = 7,500 to eye and hatch
Egg density/deep trough = up to 1,000,000 to eye; 180,000 coho and spring chinook and 152,000 fall chinook

(1) Compendium of Low-Cost Pacific Salmon and Steelhead Trout Production Facilities and Practices in the Pacific Northwest, U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Senn, Harry; Mack, John; and Rothfus, Lloyd, Fish Management Consultants (FMC), 1984.

TABLE II-8

RECOMMENDED MINIMUM INCUBATION UNITS
FOR THE KLICKITAT HATCHERY[1]

Facility	Deep Trough	IsoFlow Buckets
Klickitat (Cascade Springs)	22	52

(1) The incubation of steelhead eggs should be isolated until certification is complete or until eggs are eyed.

(3) Rearing of Juveniles

The flow and density indexes are the most important design criteria for design of rearing vessels and are described in Table II-9, Rearing Criteria for the Klickitat Hatchery. Also summarized in this table are some of the early rearing criteria for feeding and projected growth rates.

TABLE II-9

REARING CRITERIA FOR THE KLICKITAT HATCHERY

	Klickitat River Basin	
	Spring Chinook	Steelhead
Rearing		
First 30 Days of Feeding	97	97
First 100 Days of Feeding	93	93
First Feeding until Smolt	72	72
% Survival from Fertilization to Release	65	65
Growth		
MTU/inch of length (MTU = Monthly Temperature Units)	30	32
Release		
Time of Smolt Release		
From	4/1	4/20
To	5/1	5/10
Size at Release as Smolts (fish/lb)	15	7
Location of Rearing Station	Upper Cascade Springs	Upper Cascade Springs

Note: Release sites to be determined.

Figures II-1 and II-2 present the description of rearing vessel utilization with time and species. These figures show that year-round use of the raceways will be the normal practice for both steelhead and spring chinook and that adult space sharing must be integrated into the timing of raceway use.

(a) Water Flow Index

Flow rates for individual rearing vessels will be designed according to the following formula for raceway and pond loadings:

$$\text{lbs of fish/gpm} = \frac{(4)(\text{available oxygen, ppm})}{\%\ \text{food fed}}$$

The peak flow requirement for the 5,000 ft^3 raceways is 1.5 cfs and for the 20,000 ft^3 ponds is 3.0 cfs.

or

$$Q\ \text{gpm/lb} = \frac{(\%\ \text{food fed})}{(4)(\text{available oxygen, ppm})}$$

Note: available oxygen = influent concentration - effluent concentration

(b) Rearing Density Index

Rearing densities use the following formula which is applied to the appropriate rearing vessel. The results of these calculations are shown in Table II-10, Required Rearing Units for the Klickitat Hatchery, which shows 42 raceways and three ponds required for the program goals.

Density lb/ft^3 = (0.175 raceways)(fish length, inches)

Densities in the ponds will be according to the following formula:

Density lb/ft^3 = (0.150 hatchery ponds)(fish length inches)
Density lb/ft^3 = (0.11 acclimation ponds)

TABLE II-10

REQUIRED REARING UNITS FOR THE KLICKITAT HATCHERY

	5,000 ft^3 Raceways (ea)	20,000 ft^3 Ponds (ea)
Klickitat (Cascade Springs)	42[1]	3

(1) This allows for two spare raceways at peak usage. The peak raceway usage is in mid-April.

(c) Food Conversion and Amount of Food

The estimated food conversions and total food requirements are presented in the calculations supplied by Fish Management Consultants. These estimates are contained in Appendix A and summarized in Table II-11, Monthly Food Requirements at the Klickitat Hatchery. The total annual food requirement for the Klickitat Hatchery is 337,000 pounds.

TABLE II-11

MONTHLY FOOD REQUIREMENTS
AT THE KLICKITAT HATCHERY

Period Ending Date	Lbs. Food Required by Species: Spring Chinook	Lbs. Food Required by Species: Steelhead	Total Lbs. Food Required
01/29/90	14,112	2,436	16,547
02/28/90	21,718	3,670	25,388
03/30/90	42,924	10,325	53,249
04/30/90	34,144	12,375	46,520
05/30/90	7,421	2,783	10,204
06/30/90	10,626	3,329	13,955
07/30/90	14,486	3,782	18,268
08/29/90	17,357	4,239	21,596
09/29/90	21,883	4,903	26,786
10/29/90	42,830	8,737	51,566
11/29/90	28,036	5,306	33,342
12/29/90	16,281	2,924	19,205
			336,626

(d) Growth Rates

Growth in inches per fish is calculated using the Monthly Temperature Units (MTU) available. MTUs are determined from the mean temperature (F) for the month minus 32F, e.g., if July averages 52°F then July has 20 MTU or 52°F - 32°F. If 40 MTUs is the requirement to obtain an inch of growth then it will take 2 months at 52. Each species' MTUs and growth are documented in Table II-9, Rearing Criteria for the Klickitat Hatchery.

c. Transportation and Release

Smolts will be programmed to volitionally exit from their last culture facility to a nearby stream.

Because of outplanting goals, extensive transportation will be required in the Klickitat Basin. Table II-12 shows the transportation requirements for truck hauled fish in the Klickitat River Basin.

TABLE II-12

TRUCK HAULING FISH TRANSPORTATION SCHEDULE
IN TRUCK DAYS IN THE KLICKITAT RIVER BASIN
(Truck Day = 8 Hours of Time)

Month	Spring Chinook Adult	Spring Chinook Smolt[1]	Steelhead Adult	Steelhead Smolt[1]	Total
Jan.					
Feb.		0			
Mar.		13			16
April		14			17
May	10				10
June	15		(2)		15
July	15		(2)		15
Aug.	15		(2)		15
Sept.	5		2		7
Oct.			4		4
Nov.			4		4
Dec.					
					103

(1) This assumes 27 study groups of spring chinook and six study groups of steelhead are transferred to acclimation sites - and two trips/truck day.
(2) Haul with spring chinook in the second compartment.

The Klickitat River Basin will require 103 truck days.

d. Personnel/Housing

The Klickitat Hatchery will require approximately 106 staff months for operation as presented in detail in Table II-13. The requirements include specialized training and, at other times, some overlapping of tasks such as truck driving that will be accomplished by the fish culturists.

TABLE II-13

SUGGESTED STAFF LEVEL IN STAFF MONTHS
AT THE KLICKITAT HATCHERY[1]
(In Staff Months)

	Manager	Asst. Manager	Culturist	Temp.	Truck Driver	Pathologist	Total
Klickitat	12	12	60	10		12	106

(1) Assumes contracting all mechanical repair; major hatchery repairs; does not include main office assistance, experimental design assistance in fish identification and is based on levels similar to WDW and WDF.

Security at the Klickitat Hatchery was the basis of reasoning for the number of houses that are planned to be built. Four, 1,500-square-foot houses are required at the Klickitat Hatchery. This will include the construction of one duplex for capital cost savings. Each house will have finished basements for seasonal employee housing space.

FIGURE II-1
KLICKITAT FISH HATCHERY
SHOWING REARING VESSELS USED FOR
ADULT AND JUVENILE STEELHEAD

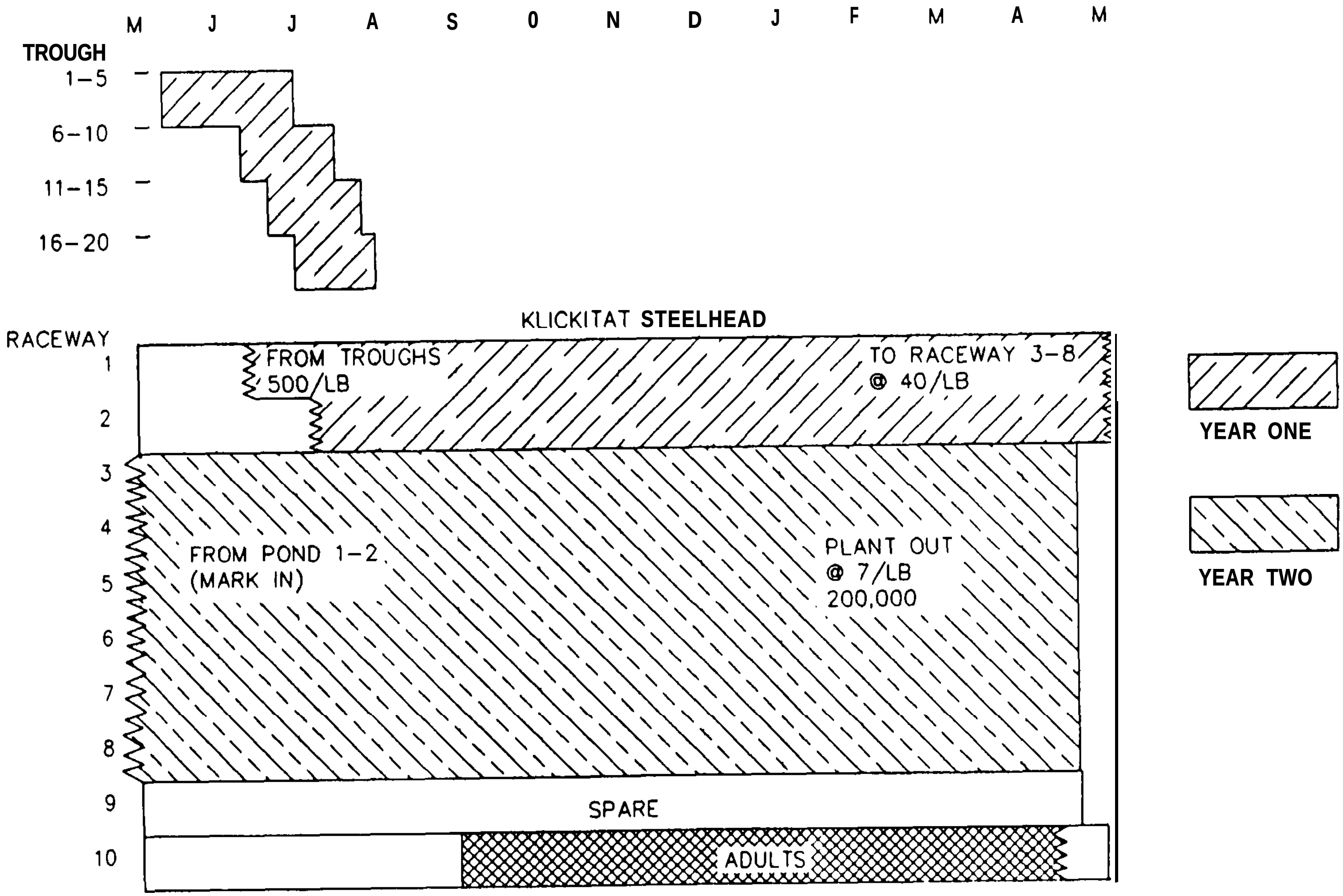
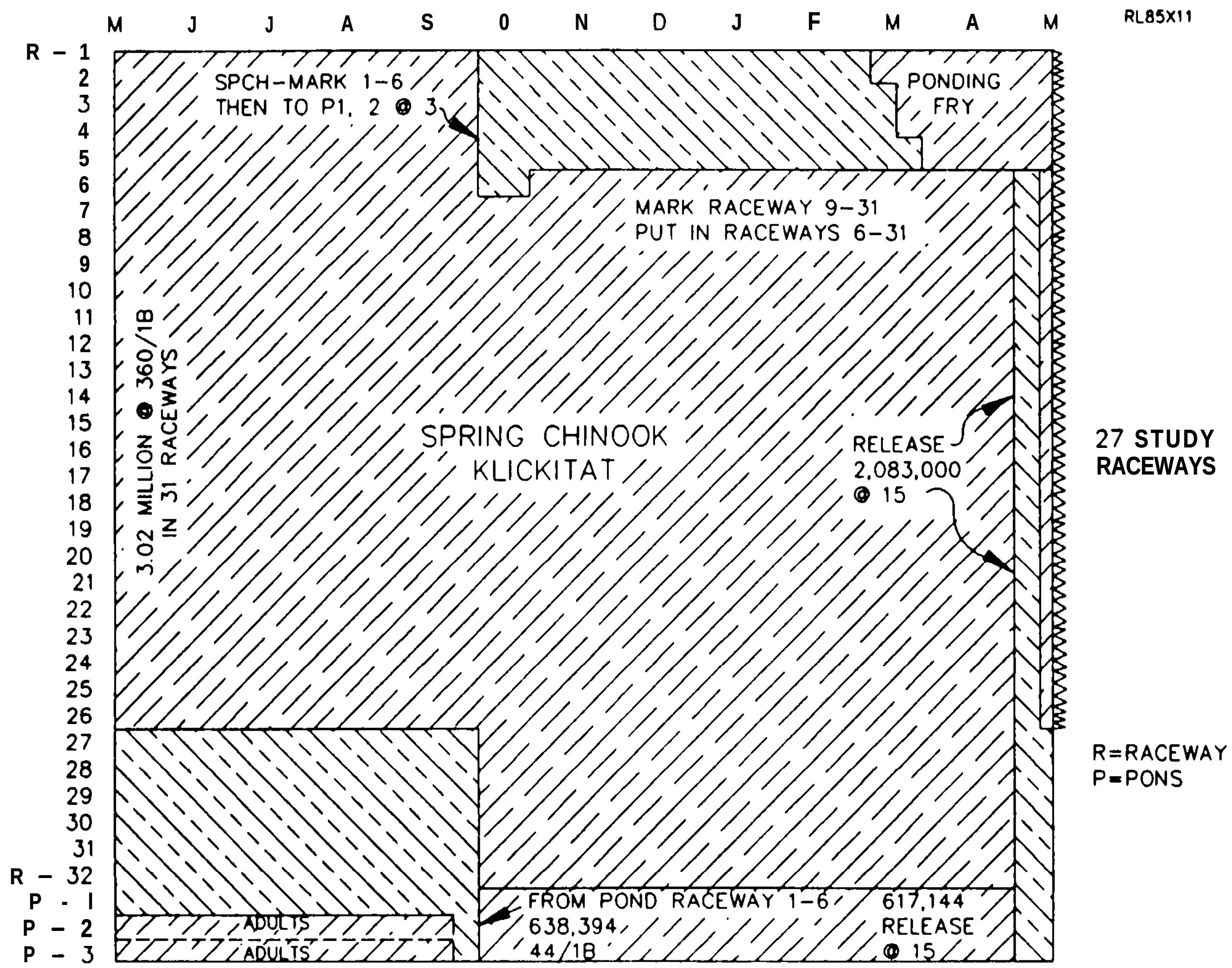


FIGURE II-2
KLICKITAT FISH HATCHERY
SHOWING REARING VESSELS USED FOR
SPRING CHINOOK



SECTION III

KLICKITAT FACILITY DESIGN

1. GENERAL DESCRIPTION OF SITE

a. Vicinity Location

The site for the Klickitat Hatchery is known as Upper Cascade Springs. It is located approximately three-quarters of a mile upstream from Cascade Springs along the Klickitat River (River Mile 40.8, refer to Figure III-1, Vicinity Plan). The site is located on a stable river bar composed of sand, gravel, and large boulders formed by a meander of the Klickitat River. The bench is approximately 20 feet higher than the normal river water elevation. The bench is estimated to be several hundred years old based on the presence of old growth Douglas fir and ponderosa pine.

b. Alternative Sites

The following alternative sites were considered for some form of facility development, ranging from a centralized station with acclimation sites through the Klickitat Basin to a divided station with a portion of the rearing capacity located at several different rearing ponds and acclimation sites. (See Master Plan for the Klickitat Station--KCM, 1988; FMC, 1989.) The alternative sites are:

White Creek Site
Summit Creek Site
Klickitat WDF Station, Cooperative
Wonder Springs Site
Indian Ford Springs Site

The multiple site approach to the Klickitat Hatchery was discounted primarily for difficulty of winter operation and the capital costs associated with the development of the facility. The Upper Cascade Springs site was selected considering pipeline costs, spring diversions, access roads, bridges, and site grading and operations. (A Site Investigation Letter Report is included in Appendix B.)

c. Facility Size

The Klickitat Hatchery will cover much of the proposed site. The bench where the hatchery will be located is the largest piece of land for approximately 10 river miles up and downstream that could adequately accommodate the hatchery. The bench containing the facility is about 150 feet wide and 1,500 feet long. The overall development area is approximately 5 acres. The Cascade Springs intake is 3,000 feet from the hatchery, the river intake is 300 feet from the hatchery, and Kidder Springs is 500 feet from the hatchery.

d. Production Goals Review

As shown in Table II-1, the Klickitat Hatchery will produce 2,700,000 spring chinook smolts and 270,000 steelhead smolts for release into the Klickitat River Basin. The spring chinook will be divided into 130 experimental study groups. The steelhead will be divided into eight experimental study groups. The spring chinook will be grown from hatching time in January to release in April of the same year. With a 2-year growth cycle, the steelhead will hatch in January-February with release in May of the following year.

e. Current Land Use and Ownership

Current ownership of the hatchery site varies among three entities. The bench of land that the hatchery buildings, rearing ponds, and the Kidder Springs diversion will be located on is owned by the Plumb Creek Timber Company. The road and right-of-way along and accessing the site is owned by Champion Timber International. The site where Cascade Springs is to be diverted is owned by the Yakima Indian Nation. All three areas are considered to be timber lands. Coordination with the U.S. Forest Service must be provided through the design phase, as this section of the Klickitat River is planned to be incorporated into a wild and scenic river designation. Easements and purchase of appropriate lands will occur through a coordinated effort among the Bonneville Land Acquisition Office, design team, landowners, and the Yakima Tribe.

2. SITE DEVELOPMENT

a. Access Roads

Access road requirements will include access to the spring intakes and access to the hatchery site. The planned facility is approximately four miles up the valley. This road is maintained by the Champion Timber International Company and will require special use agreements between the Tribe and Champion. The access road will be used consistently by logging trucks and equipment at all hours of the day during the year, depending on the severity of the winter. The facility designer must consider safety and traffic ramifications and how the Klickitat Hatchery can share this road with other users. Please refer to Figure III-2, Site Plan.

The road bisects the planned facility, with the residences on the east side and the hatchery facility on the west side. A design feature is a vehicle and pedestrian underpass. Using a large arch culvert, the hatchery complex can be accessed from the residences without crossing over Champion Road. The arch culvert will allow free passage by hatchery personnel and families to and from the residences and the hatchery, and unrestricted movement of road traffic by the timber company. Champion Road, adjacent to to the hatchery site, will be paved with an asphalt pavement for dust and drainage control. The design wheel loads for this section of asphalt pavement will be adequate to withstand loads in excess of HS20. All roadway designs will conform to Champion Timber International Co. specifications.

Cable cars, identical to the cable trams employed by the U.S. Geological Survey, will provide access to the two spring intakes. The terminals for these cable trams will be set above the road far enough to prevent interference with oversize logging equipment traffic. This will also provide year-round foot access to the spring intakes.

b. Drainage and Snow Removal

Site grading will be designed for maximum drainage efficiency during the spring snow melt. Hatchery grounds will be covered with a top coarse of 3/4-inch minus crushed rock, and the access road will be asphalt concrete paved with proper crown and ditching to control water runoff. The stormwater ditches will be directed toward a detention pond dedicated for stormwater only, with discharge into the Klickitat River. The detention pond must be sized by the designer to conform with Klickitat County stormwater code. The pedestrian and vehicle underpass will be designed to prevent significant snow and water accumulation.

Snow removal will be performed using a pickup-mounted blade to push the snow into proper areas for storage and melting. Designated areas will be provided for winter storage of built-up snow away from the roads and parking areas. Curbs and catch basins must be given special consideration for snow removal strategies.

c. Construction Clearing and Grubbing

The proposed site for the Klickitat Station is presently timbered with old growth Douglas fir, ponderosa pine, and oak. To build the hatchery, timber must be removed. Heavy logging equipment will need to be used to harvest selected trees. Grubbing of other areas to remove topsoil and overburden shall follow with conventional heavy equipment.

Some additional site work must be initiated at the time of clearing. This includes fill work and slope protection of the riverward slopes of the site. This phase of construction will overlap the clearing, site preparation, and finish site work phases of construction.

d. Site Work and Slope Protection

Site work includes several tasks including site grading for drainage and stormwater control, provision for parking areas, provision for the access road and pedestrian underpass, fill of the south edge of the site for the pollution abatement ponds and the hatchery discharge, excavation for the pipelines, river crossings, building foundations, and raceways and rearing ponds. In addition to the site grading and excavation for pipelines, site work will include the filling and slope revetment of the riverbank along the southern downstream end and along the upstream end of the site. The approximate quantity of this fill and revetment will be 12,000 total cubic yards of material. The fill and revetment, composed of heavy, loose riprap and light, loose riprap found locally, will need to be placed along the outward and downstream portion of the site. Revetment of large riprap will need to be placed along the upstream face of the site for protection from high flow events. The areas of fill and riprap are shown on the attached site plan. Please refer to Figure III-3, Hatchery Site Plan.

e. Wetlands

The facility designers will be required to mitigate for lost wetland habitat so that there is no net loss of wetland habitat due to the hatchery construction. This will be accomplished by reseeding native grasses, willows, and thules along the revetted slopes and by actively designing bays and groins into the slopes to increase the surface area and wetland areas to equal preconstruction levels. Upstream of the adult fish weir and in the hatchery discharge channel, creating slow moving meanders and weirs will provide for pools and marshy areas. During the final design phase, the engineer must meet with the Washington State Department of Ecology, the Klickitat County Shoreline Protection Group, Yakima Indian Nation, and a landscape architect/wetland specialist familiar with the construction of wetlands commonly found in the Klickitat basin to design a net increase of wetland habitat at the site.

f. Flood Analysis

A flood analysis was carried out for the Klickitat River around the proposed hatchery location at River Mile 40.8. Approximately 69 years of water flow records are available from the USGS gaging station "Number 14110000 Klickitat River, Near Glenwood" (located at River Mile 51) that was used as the gage of record.

Attached in Appendix C is an analysis of the flood flows and associated calculations of flood elevations. The approximate proposed elevation of the finished site is above elevation 1175.0 feet MSL at the upstream end of the site and above 1168.0 feet MSL at the downstream end of the site. The flood elevations that result from the 100-year flood event, plus a factor of safety of approximately four times this flow, display elevations 10 feet higher than the original water surface at normal flows. These flood flow elevations are approximately 1172.0 feet MSL at the upstream end of the site and 1163.0 feet MSL at the downstream end of the site, carrying the existing river gradient along the riverbed at about 0.7% or 0.007 foot/foot.

The flood flow elevations are based on a standard hydrologic method of statistical analysis and provide a rough envelope of elevations to prevent important structures or facilities from being sited below mean elevation. From this elevation and above, flood events of 100-year duration should not occur. Calculations for the Flood Flow Elevations can be found in Appendix C.

g. Power Supply

Electrical power for the Klickitat Hatchery will be installed from a distance of approximately 1.0 to 1.5 miles, with new overhead power cables and treated wood support poles. See Figure III-4, New Electric Supply Route. The preferred location for the starting point for the new power supply line is at the existing WDF Klickitat Station. A new, single line upgrade installed along the existing route from the Glenwood-Goldendale Road to the existing WDF hatchery is anticipated. From this point to the Upper Cascade site is a distance of about 1.5 miles and new power line right-of-way will have to be cleared and wood support poles installed. The new route would lead from the WDF rearing ponds, across the Klickitat River to the existing Wonder Springs access road, and then along this road and the Champion Timber International Co. logging road to the hatchery site. The facility will require the new construction of a 7,200-volt, 3-phase, 4-wire primary power line from the existing WDF station. The Klickitat County Public Utility District office that will be in charge of service for this line will be the White Salmon office, telephone No. 1-800-548-8358, contact engineer, Bill Hamm.

The sequence of work for the construction of the new power supply will begin with the clearing of a power line right-of-way approximately 30 feet wide. The PUD prefers that the power lines travel along existing roads for ease of maintenance. From the west side of the Klickitat River and adjacent to the existing WDF hatchery, the power lines will cross the river with two poles and a system of deadends for support. The new right-of-way will need clearing on the east side of the river near the existing Wonder Spring intake system. This portion of the route is along an existing primitive road and will require limited widening. The proposed power line route then turns south along the existing Champion Timber International Co. logging road. Along this section of the route, pole setbacks must be considered for off-road logging truck and logging equipment traffic. The route terminates at the hatchery in a new transformer that will step the power down to usable voltages. The proposed transformer is preliminarily sized to be a 7,200-volt/480-volt, 300 kVA, 3-phase unit.

3. WATER SUPPLY

A U.S. Bureau of Reclamation report (USBR, 1990) contains information on the condition of water sources that are planned to be developed for water supply. This information is identical to the data presented in the following section. However, because of separate contract requirements, this Preliminary Design Report will outline the required water characteristics necessary for a successful fish culture program at the hatchery.

a. Water Requirements

Water for the Klickitat Hatchery will come from three sources. Used separately, no one source is of adequate quantity or quality to provide the entire supply demand for the hatchery year-round. The three sources are: Cascade Spring, Kidder Spring, and the Klickitat River.

(1) Quality

Water quality is the single most important water characteristic that determines the success of hatchery-produced fish. The water quality along the Klickitat River and its tributaries is exceptionally high quality. The basin itself is classified as a Double A River in the Washington State Water Quality Standards For Surface Waters and will be an excellent source for the Klickitat Hatchery.

The required minimum standards for the successful culturing of salmonids is presented in Table III-1. This table compares the three sources of water supply proposed for the hatchery with established ADF&G water quality standards. Alaska Department of Fish & Game (ADF&G) Standards for Salmonid Aquaculture are commonly used in siting hatcheries. All sources of water supply meet or surpass the minimum requirements for water quality in terms of chemical constituency except those noted. Several constituents must be tested in additional sampling efforts before appropriate measures can be taken during design. The constituents above maximum standards include carbon dioxide, chlorine, hydrogen sulfide, iron, oils, and zinc.

The Klickitat River experiences a very high concentration of glacial silt and fine mud during the summer months when glaciers melt in the river's headwaters. During this phenomenon, the hatchery will use significantly less river water and shift water supply toward the springs. USBR raw water data are contained in Appendix D. See Figure III-5, Klickitat River Basin Enhancement Facility Flow Rates vs. Month.

(2) Quantity

Water quantity from the three proposed sources has been measured by various people throughout the course of the hatchery feasibility study. The summaries of the measured flows are presented below in Table III-2 for the two spring water sources only. The river water source flow rates are assumed to be as presented in the USBR report to be published in 1990. The summer 7-day, 10-year low flow rate and the winter 7-day, 10-year low flow rate were not available from the USBR at the time of printing. The lowest recorded flow rate is 236 cfs during the month of November.

The flows of Cascade and Kidder springs were measured twice during the preliminary design investigations. Dye injection flow analysis was used to measure the water flow rate at both springs. The method included an assessment of the flow rate in August 1988 and a dye injection flow analysis in spring. The accuracy of the methodology is a function of adequate dye mixing in the subject water flow. The mixing of dye in Kidder Spring was rated at fair to good and the mixing in Cascade Spring was excellent. Together with the educated guess, the flow results from the dye injection were consistent. The first measurement was on April 3, 1989 and the second measurement was on August 22, 1989.

TABLE III-1

QUALITY OF WATER SOURCES
FOR THE KLICKITAT ENHANCEMENT FACILITY
COMPARED WITH ALASKA DEPARTMENT Of FISH AND GAME (ADF&G 1983)
WATER QUALITY STANDARDS FOR SALMONID AQUACULTURE

Water Qualities	Salmonid Aquaculture Standards (ADF&G 1983)	Klickitat River at WDF Hatchery 6/21/89	Cascade Spring Klickitat River River Mile 40 6/20/89	Kidder Spring Klickitat River River Mile 41 6/20/89	Water Supply Exceeds Standard
Alkalinity	Undetermined		.38 mg/l	36 mg/l	
Aluminum	0.01 my/l		0.010 mg/l	0.15 mg/l	
Ammonia (un-ionized)	0.0125 mg/l	0.00009 mg/l	0.00011 mg/l	0.0003 mg/l	
Arsenic	0.05 mg/l	0.005 mg/l	0.005 mg/l	0.005 ma/l	
Barium	5.0 mg/l	0.005 mg/l	0.005 mg/l	0.005 mg/l	
Cadmium	0.0005 mg/l (100 mg/l alk.) 0.005 (100 mg/l alk.)	0.0005 mg/l	0.0005 mg/l	0.005 mg/l	
Calcium Hardness	mg/l	21 mg/l	28 mg/l	27 mg/l	
Carbon Dioxide	1.0 mg/l		1.8 mg/l	6.7 mg/l	x
Chloride	4.0 mg/l	0.4 mg/l	0.4 mg/l	0.4 mg/l	
Chlorine	0.003 mg/l		0.01 mg/l	0.01 mg/l	x
Chromium	0.03 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	
Copper	0.006 mg/l (100 mg/l alk.) 0.03 mg/l (100 mg/l alk.)	0.005 mg/l	0.005 mg/l	0.005 mg/l	
Dissolved Oxygen	7.0 mg/l	10.6 mg/l	11.9 mg/l	11.8 mg/l	
Fluorine	0.5 mg/l	0.10 mg/l	0.10 mg/l	0.10 mg/l	
Hydrogen Sulfide	0.003 mg/l		0.01 mg/l	0.01 mg/l	x
Iron	0.1 mg/l	0.13 mg/l	0.010 mg/l	0.04 mg/l	x
Lead	0.02 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	
Magnesium	15 mg/l	2.1 mg/l	3.3 ma/l	3.2 mg/l	
Manganese	0.01 mg/l	0.010 mg/l	0.005 mg/l	0.005 mg/l	
Mercury	0.0002 m /l	0.0002 mg/l	0.0002 mg/l	0.0002 mg/l	
Nickel	0.01 mg/3	0.010 mg/l	0.010 mg/l	0.010 mg/l	
Nitrate (NO_3)	1.0 mg/l	combined 0.1 mg/l	combined 0.2 mg/l	combined 0.1 mg/l	
Nitrite (NO_2)	0.1 mg/l	combined 0.1 mg/l	combined 0.2 mg/l	combined 0.1 mg/l	
Nitrogen (N_2)	110% Total Gas Pressure (103% nitrogen gas)		100%	100%	
Oxygen	90% Saturation	100%	101.9%	100.9%	
Petroleum (oil)	0.001 mg/l		1.0 mg/l	1.0 mg/l	x
pH	6.5 - 8.0	7.32	7.62	7.03	
Potassium	5.0 mg/l	1.17 mg/l	1.96 mg/l	1.96 mg/l	
Salinity	5.0 Parts per 1,000				
Selenium	0.01 mg/l	0.010 mg/l	0.010 mg/l	0.101 mg/l	
Silver	0.003 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	
Zinc	0.005 mg/l	0.010 mg/l	0.01 mg/l	0.010 mg/l	x
Sodium	75.0 mg/l	2.99 mg/l	3.68 mg/l	3.68 mg/l	
Sulfate (SO_4^{-2})	50.0 mg/l	2.4 mg/l	0.4 mg/l	0.5 mg/l	
Temperature	0° - 15°C	13.4°C, 56.1°F	7.3°C, 45.1°F	7.3°C, 45.1°F	
Total Dissolved Solids	400.0 mg/l	56 mg/l	75 mg/l	73 mg/l	
Total Settleable Solids	80.0 mg/l (25 JTU)				

The results are as follows:

TABLE III-2

KLICKITAT HATCHERY
SPRING WATER FLOWS

	April 3, 1989	August 22, 1989	Average
Cascade Spring	24 cfs	21 cfs	22.5 cfs
Kidder Spring	17 cfs	13 cfs	15 cfs

Sufficient information concerning flow quantity from both springs has been gathered to date. The above information is a conservative figure to base the preliminary design upon. The true quantity of water that is actually delivered to the facility will not be known until the spring intakes are constructed, and in-place and functioning. Both springs are constant in flow rates as measured 5 months apart. The combined peak flow required from the springs is 21 cfs. Please refer to Figure III-5 to review the hatchery water demand requirements for a one-year cycle.

(3) Temperature

Generally, the temperatures are stable for the two spring sources. However, there is a slight variation in temperature, which is critical for the fish programming at this hatchery. The cool temperatures can be used in a positive fashion for temperature modulation during the incubation phases. If there is a difference in the temperatures between what was measured and what is actually delivered to the hatchery in the future, fine-tuning adjustments must be made for fish protection. Figure III-6 shows the dates and temperatures for the three water sources for the Klickitat Hatchery.

The Klickitat River varies in temperature over a range of about 20°F through the year. The hatchery fish programming considers this variation and will use all three water sources in concert to provide the desired water quality and temperature for various species and lifestages. (See Figure III-5, Water Flow Rates vs. Month.)

b. River Water Development

The river water supply will be the only water supply system at the Klickitat Hatchery that will require pumping. The reason for pumping is founded on economics and environmental impacts. Construction of a pipeline that will provide gravity-supplied water to the hatchery is not cost-effective based on our evaluations.

The gradient along the stretch of the Klickitat River in front and above the proposed site is approximately 0.7 foot of rise per 100 feet of run. The total river water system head requirements will be approximately 20 feet. Therefore, the pipeline will be approximately 3,000 to 3,500 feet in length. The route the pipeline would take is along the river's edge. Construction would be difficult because of the water and the very large boulders present in this canyon. The environmental impacts associated with a pipeline route along the river's edge would be high. The route would require a 30-foot right-of-way and room to cast the large boulders aside. Blasting of some of the boulders would be required. The estimated cost to construct a pipeline of approximately 30 inches in diameter along a route on the river edge would be roughly $200/foot of length in-place, and would total approximately $700,000. This concept was compared with a riverside pumping station and shortened delivery pipe. Construction of a pump station and delivery pipe will be more economical.

The suggested water supply alternative is to construct a pumped river intake approximately 300 feet upstream from the hatchery site and along the riverbank adjacent to a deep pool. A natural pool is created by a hydraulic control just above the hatchery site. The intake will require a cast-in-place concrete intake with trash rack, screen, and pump footing structure to be built next to the river and into the bank next to the existing logging road. Four vertical turbine pumps, each capable of delivering 10 cfs running simultaneously will be set under cover of a small building on top of a concrete slab. The design flow capacity from this pump station will be 40 cfs; however, only 30 cfs is required for the hatchery at any one time. Providing four pumps allows for one pump to sit idle as a redundant pump. This assures that the hatchery river water supply will be maintained in the event that one pump fails. Screens and trash rack assembly structures will help keep floating debris and animals out of the intake. The river water will flow by gravity through the trash rack and screen and into the pump sump where water will be pulled from the river and delivered to the sedimentation structure at the hatchery. The river intake system will require a pipeline of approximately 400 feet in length and 30 inches in diameter.

The screens at the river intake will be designed for the safe bypass of fish fry and smolts. The screen mesh size will be a maximum of 3/16 inch across the largest opening. In addition to the maximum mesh requirements, the screen area will have to be sufficiently large to create a maximum through screen velocity of 0.2 fps.

The trash rack and screen at the river intake will be accessible by the existing logging road and will be covered with a small metal building to keep snow and falling debris out. However, the screens will be susceptible to frazzle ice that floats in the river or forms at the screen. To keep the screen from plugging with ice, 45°F spring water will be delivered to the river intake screen during the winter. The spring water is warm enough to keep ice from forming on the screen and trash rack and support structure. Spring water flow will be controlled by valves and a nozzle system at the discretion of the hatchery manager. The river intake building will be a secured and locked facility. The estimated cost of the pump station and the pipeline is approximately $300,000 and provides substantial capital savings compared to the gravity pipeline alternative.

c. River Sedimentation Reservoir

The Klickitat River experiences a heavy load of rock flour and mud from the snow and ice melt of the glaciers. This silt will be carried into the pump station and must not be transported into the hatchery water system. The velocities in the pump station will be held to a minimum, yet some material will be carried into the pumps. The silt which is pumped into the delivery pipe will be removed in the sedimentation reservoir between the pipeline and the station reservoir.

The sedimentation reservoir will be a concrete structure designed for silt and sand settling. The design of this reservoir will allow for the characteristic settling velocities of the material and will be sized to a capacity of 40 cfs. The settled material will be either flushed back to the river or removed by vacuum pumps to a solid waste disposal site. The water surface elevation of the sedimentation reservoir will allow for gravity flow of the river water out and into the station reservoir. Gas stabilization of the river water will not be necessary.

d. Spring Water Development

Developing spring water supplies will be the most difficult construction aspect of the entire project. Both Cascade and Kidder springs are located on the west side of the river opposite the site. Both springs will be developed using a similar method. Cascade Spring will be the most sensitive to environmental impact from the standpoint of its visibility to the public that travel along the private logging road. Both springs will require special attention by the designer, contractor, and construction inspectors to maintain aesthetics.

Cascade Spring will be diverted from a point above a rock bench that is not visible from the logging road. The elevation of this point of diversion is approximately 1210.0 feet MSL datum. The intake system that will be employed at this location will be a concrete structure with an inclined plane screen with a bypass. Please see Figures III-2, 3, and 7. The structure will straddle the creek, in which water from the spring will flow over the top of the inclined plane screen and fall through the mesh to the basin below. The debris carried onto the screen will be spilled over the spillway and transported down the creek toward the Klickitat River. The basin water surface elevation will be set at the head required to drive the gravity supply of the Cascade Spring water down the hill, across the Klickitat River, and up along the logging road to the station. The screen diversion will be covered to keep animals and falling debris out. The diverted water will flow through a butterfly valve located on the downstream side of the diversion and at the top end of the delivery pipeline. Adjacent to this valve will be a spillway at the end of the screen that will allow extra water to be diverted past the intake and over the falls. See Figure III-8, Cascade Spring Intake Profile View.

The ability to divert excess water will be critical for the Cascade Spring intake because of the high aesthetic value of the Cascade Spring Falls. The intake design flow will be set at 25 cfs. There will be some leakage. For aesthetic reasons, the falls must remain intact. The water right permit process, which is conducted during design, will address this requirement and the exact quantities of water that can be diverted and when.

The delivery pipeline will be an above-ground pipeline originating at the intake structure. It will proceed down the hill to the river's edge on the right bank. This will minimize impact to the hillside, as this is mostly solid bedrock. Extensive blasting would be needed to bury the pipeline. The pipeline will be supported by concrete plinths at certain intervals down the hill depending on the pipeline material and the size. It is anticipated that the pipeline will be approximately 24 inches in diameter; however, the final size will be determined when the diversion is constructed and operating. At the base of the hill and adjacent to the river's edge, the pipeline will plunge into the riverbed below. An architectural thrust block will restrain the pipe from forces exerted on it by the moving water. At this point, the pipeline will be buried underneath the Klickitat River, below the level of the riverbed, and will remain buried until termination at the hatchery reservoir. The trench will cross the river perpendicular to the stream lines and then turn upstream at the embankment of the existing logging road. The construction of this trench will entail special scheduling for protection of aquatic species during sensitive times and river diversion of water around construction. The required permit to perform the work will be granted through a Hydraulic Project Permit with the Departments of Fisheries and Wildlife. See Section VI-3.

The architectural thrust block will be designed to act as a concrete dead weight on the pipe. Attention will be given to blending the concrete and pipe into the surrounding terrain. Colored concrete and texture of tree branches will help to accomplish this. If possible, the thrust block will be buried out of sight. Individual trees will be marked for removal in the final design phase, and strict penalties will be levied for damage or removal of other trees by the construction company. The pipeline will be painted to match the surroundings or will be black in color. Repair to the construction scar will include planting of native trees and bushes. There will be no net loss of wildlife or wetland habitat allowed. These aspects of construction will require extensive construction inspection to assure their compliance.

The access to the springs will be by use of an aerial tram identical to the type employed by the U.S. Geological Survey stream gaging hydrologists. The cable car tram is supported by wire rope and two support towers on opposite sides of the river. The car is accessed by a ladder and the car is pulled across the cable by hand to the opposite tower. At Cascade Springs there will be timber stairs built up to the intake structure. The cleaning of the spring screens will need daily attention during certain months of the year and no attention during others.

The spring diversion for the Kidder Spring intake will be identical to the Cascade Spring intake. Special care will be taken as well to protect this spring. The pipeline will be above ground down to the river at which point it will be below grade until it reaches the hatchery.

e. Station Reservoir and Gas Stabilization

Spring water quality is exceptionally good in all regards except the total gas pressures and dissolved gas concentration of nitrogen. This can cause stress and gas bubble disease in juvenile salmon and steelhead. The level of nitrogen and argon gas saturation for Cascade Springs was measured once by the U.S. Bureau of Reclamation on June 20, 1989, and was measured to be at 100.0%. The level of nitrogen and argon gas saturation for Kidder Springs was measured once by the U.S. Bureau of Reclamation on June 20, 1989, and was 100.0%, also. These levels of saturation are below the critical level for fish culture of 102.0% maximum; however, the measurements were a one-time sample and the design of the spring source water supply system will include gas stabilization. Spring water supply pipelines will empty into the station reservoir by falling through 6-foot-high packed columns. The packed columns will be open atmosphere type. This precaution will provide protection from some supersaturation that may occur.

The packed columns will empty into the station reservoir. A constant elevation will be maintained that is sufficient to drive the entire system's hydraulics. The hatchery reservoir will be constructed of reinforced concrete and will be covered by a shed roof to keep snow and debris from disrupting the flow and entering the system. Butterfly valves will control flow into the reservoir from Cascade and Kidder springs. The Klickitat River water will flow into the reservoir over a weir. Water supply to the hatchery will be controlled by butterfly valves and then into the distribution system of pipes that will deliver water to the raceways, hatchery building, and the ponds.

f. Water Chillers

Spring water will be circulated for incubation supply. Water chillers will be used to modify the temperature of the recirculating incubation water system from a constant 45^{o} to the goal of 38^{o}.

The water chillers will be modular, 120-volt, 1-hp electric type units as manufactured by Frigid Units of Toledo, Ohio or equals. These modular units will be plugged into a receptacle and will have switches to turn them on and off. The system will consist of four units with a recirculation ratio of 90 parts recirculated water and 10 parts new water. The required temperature requirements are outlined for all lifestages in Table II-3 and will be further reviewed during the final design.

g. Planting Truck Fill Station

A very important aspect of the Klickitat Hatchery is the outplanting of the majority of the smolt production away from the station. This outplanting task will be done using planting trucks specifically equipped to transport fish. The trucks carry water and fish in large, baffled, compartmented trucks. The trucks will be filled at the planting truck fill station, which will be supplied by gravity-fed water from the station reservoir. This fill station will include a concrete pad and an 8-inch-diameter pipe riser and flexible hose used to direct the water into the tankers. Control of this riser will be done using a butterfly valve set below the frost depth.

4. FISH PRODUCTION FACILITIES

Table III-3 lists the fish production components and their size as related to the Klickitat Hatchery.

a. Adult Collection

Adult collection will occur at several locations throughout the basin. Falls Five Fishway, the Klickitat Hatchery, the WDF Klicki tat Station, and the Castile Falls Fishway sites are discussed in this report. It is assumed that the adult collection facilities are a separate construction project to be coordinated by BPA, and therefore no design or cost discussions are included.

The Falls Five Fishway is an existing fishway that has an adult trap that has fallen into disrepair. This trap will be repaired and modified as required to trap adult spring chinook and steelhead and for subsequent transport back to the Klickitat Hatchery for extended holding. The cost to repair and modify this trap is not included in the cost estimate, Section V-1., and will be addressed in an adult passage report that will be prepared by the USBR.

Another potential site for adult collection is the Klickitat Hatchery. The preliminary design calls for a fish rack to stop adults from entering the hatchery discharge; however, the design will allow for the future incorporation of an adult trap into the hatchery discharge if the plan for collection allocations of adults should change. There are no plans for the construction of adult trapping facilities at the Klickitat Hatchery.

The other potential sites for adult collection are the WDF Klickitat Station and the Castile Falls Fishway, both upriver from the proposed hatchery. The WDF Klickitat site does not require any modification for trapping as a trap already exists; however, there is a problem with collection of hatchery stock adults rather than target F2 generation adults and mixing of WDF stocks. Plans for modifying the Castile Falls Fishway are in progress.

TABLE III-3

SUMMARY OF FISH PRODUCTION FACILITIES
AT THE
KLICKITAT RIVER BASIN ENHANCEMENT FACILITY

Location:	Klickitat River
Species:	Spring Chinook and Steelhead
ADULT HOLDING	
Size:	15 lb Spring Chinook 8 lb Steelhead
No. of Adult Fish On Hand:	2,000 Spring Chinook 500 Steelhead
No. of Ponds:	2 Spring Chinook
No. of Raceways:	1 Steelhead
Size of Pond:	150 x 45 x 6 feet
Volume:	20,000 cubic feet
Construction:	Gravel with concrete inlets and outlets
Design Flow:	3.0-cfs Ponds 1.0-cfs Raceways
Flow Index:	1.0 GPM/Adult Spring Chinook 0.5 GPM/Adult Steelhead
Density Index:	10 cubic feet/Adult Spring Chinook 2.5 cubic feet/Adult Steelhead

INCUBATION

Egg Capacity:	4,200,000 Spring Chinook 433,000 Steelhead
Incubator Type:	Deep Trough IsoFlow Buckets Stacked Tray Cabinets
No. Eggs/Bucket:	7,500 to eye
No. Eggs/Tray:	5,000 to hatch
No. Eggs/Deep Trough:	180,000 to hatch 1,000,000 to eye
No. Cabinet Stacks (16 tray):	4
No. Deep Troughs:	22
No. IsoFlow Buckets:	52
Chilled Water Temperature:	38F^{o}
Deep Trough Flow:	10 gpm max.
IsoFlow Bucket Flow:	0.38 gpm
Total Chilled Water Flow:	150 gpm

REARING

Early Rearing Inside

No. Deep Troughs:	22
Size:	1'4" x 1'4" x 16'0"
Volume:	19 cu ft
Flow:	10 gpm max.
Total Flow:	220 gpm

<u>Outdoor Rearing</u>

No. Raceways:	32 Spring Chinook 10 Steelhead
Volume each:	5,000 cu ft
Volume total:	210,000 cu ft
Flow index:	____________
Density Index:	____________
Flow in each Raceway:	1.0 cfs
Total Flow:	42 cfs
Total Flow at Station:	51 cfs
No. Ponds:	3
Size of Pond:	150 ft x 45 ft x 6 ft
Volume:	20,000 cu ft
Construction:	Gravel with concrete inlets and outlets
Pond Design Flow:	3.0 cfs

b. Adult Holding

Adult holding of both spring chinook and steelhead will occur on-site. The spring chinook and steelhead will be held in both ponds and raceways, respectively. The spring chinook will be held from the time of capture, approximately May 1, until spawning in August in the gravel-lined pond with the spawning shed. See Table II-5 and Figure III-9. The pond will have fencing and partitioning to allow for sorting of adults during the ripening phase of the holding cycle and just prior to their spawning. The bottom of the ponds will be lined with an asphalt paver along the centerline and to the edge of the sloped bank for ease of access and crowding.

Adult steelhead will be held in the concrete raceways that are also used for rearing. These raceways will have no special adult design characteristics except that three raceways will have an up-welling type water supply in addition to the header type supply with jets. The up-welling supply will have its own control valve and will have a covered metal grate in the head end of the raceway. The raceways will have adult sorting tubes made of 10-inch-diameter pipe that can be directed between them. No spawning shed or other arrangements are planned for the raceways at this time. See Figure III-9, Raceway and Rearing Pond Plans and Elevations. Hypalon liners that can be removed and disinfected will be used to prevent adult abrasion on the concrete raceway walls.

c. Incubation and Early Rearing Building

The hatchery building will be constructed for the purpose of housing the incubation, early rearing, feed storage, general storage, office, laboratory, and mechanical/electrical control room. The building will be set on the site so that access to the built-in freezer and loading dock will be easily maneuvered by a 45-foot truck and trailer. The building will have 60 feet of buffer between it and other structures. There will be a drive-through feature so that access from the hatchery indoor rearing troughs to the ponds can be conducted by truck for fry ponding. See Figure III-10, Hatchery Building Plan and Elevations.

A description of the structural system and material selection will follow in Section IV. A listing of the rooms and their associated square footage is shown in Table III-4 following.

TABLE III-4

HATCHERY BUILDING ROOM SQUARE FOOTAGE

Room	Dimension	Square Feet
Hatchery Building - Total	54 x 100	5,400
Office	25 x 25	625
Laboratory	12 x 25	300
Restroom	10 x 8	80
Mechanical/Electrical	12 x 25	300
Hatchery	50 x 50	2,500
Walk-in-Freezer	25 x 25	625
Storage	9 x 15	135
Generator Room	9 x 10	90
Shop and Garage	16 x 25	400
Loading Dock Covered Area	16 x 50	800
Halls and Wall Space		335

The hatchery building is set between the steelhead rearing raceways and the spring chinook raceways to retard the transmission of disease between the two groups of fish, as there will be year-round rearing of steelhead to age two. The steelhead raceways will be on the upstream side of the building while the spring chinook raceways will be on the downstream side of the building. Incubation will occur simultaneously; however, steelhead and spring chinook will be separated in timing and physically with IsoFlow buckets, movable drop curtains, equipment, and tools for handling fish. The troughs that will be used after incubation of spring chinook and for early rearing of steelhead will be disinfected and dried before transfer of species.

The office will be located in the southeast corner of the building to provide the best view to raceways, ponds and most of the facility except the steelhead raceways. During discussions with the design team it was decided that the gains in less disease transmission provided by the split facility arrangement would outweigh the loss of security visibility toward the steelhead raceways. The office will include for the manager, the assistant manager and the lunch room for the crew. The "hatchery personnel only" restroom will adjoin the office and will be the minimum size required by the building code. No public restrooms are planned for this hatchery.

The laboratory will be equipped with cabinetry and storage space for a microscope, sampling equipment, tissue and disease culture and analysis equipment and supplies. The lab will have the space for traveling pathologists to set up equipment and to conduct small-scale experiments and field pathology work.

The hatchery room will be the largest room of the building. It will house the deep trough incubators and the cabinet tray type incubators that will be used for both species. This room will also be used for incubation and early rearing. Contained in this room will be storage space for nets and dip nets for use in the hatchery and yard. Boot washes will be located at all points of entry into this room for disinfection and disease control.

Two sets of personnel doors and overhead rolling doors will be located on the north and south sides of the building for trucks and personnel access. Lighting and window shading in this room will be controlled with switches and hand-operated blinds. Control of light during incubation and early lifestages is essential for fish health. Cool white fluorescent lights operated by delay start dimmers and incandescent lights that can be operated in the off season are included. The use of pull cord-type lights connected to reels in the form of drop lights will allow for lighting of a small area by an individual during egg picking or inspection without having to turn on the entire bank of lights.

The water supply to the hatchery room will be delivered through an overhead large-diameter pipe, which will act as a manifold to supply water to the cabinet incubators and to all the deep troughs. This manifold will be large enough in capacity to provide very low interference between each valve control and to points of demand so that one valve can be changed without the entire bank of valves having to be readjusted. Each deep trough will have a water supply for supplying the upper end of the trough for early rearing or non-isolation rearing and also for the supply of water to the IsoFlow buckets that will be placed directly into the trough for isolation incubation and hatching. The water supply will have a dual system that will provide chilled water as required for incubation water temperature modulation. This will be supplied in a separate pipe system and delivered to the incubators with proper mixing before application.

The chilled water will be circulated through a recirculation system that will return water to the incubators at the desired temperature. The recirculation system and chillers will be a self-contained system. Four chillers, as discussed in Section III-3.f., will provide enough chilled water to incubate the desired number of eggs. The return water will flow by gravity back to a sump where the chillers will cool this and the 10% makeup water. A continual-operation circulation pump will recirculate water back to the incubators via the chilled water delivery pipes.

d. Rearing

Early rearing will occur indoors for all species. The early rearing will be accomplished in deep troughs. Hatching of eggs will occur in both cabinet type incubators and IsoFlow buckets at which shortly thereafter the alevins will be transferred to the deep troughs and early rearing can begin. Each deep trough will have its own set of buckets, baskets, baffles, and screens for water control. Table II-7 describes the time and size fry that will be ponded to the outdoor raceways or ponds.

Extended rearing of fingerlings to smolts will be conducted outdoors in earthen ponds and concrete raceways. The concrete raceways will be constructed with overall dimensions of 10' x 110' x 6' high with a usable rearing volume of 5,000 cubic feet. The raceways will be constructed with 8-inch walls and will have an 8-inch-thick slab as the floor. Water stops will be used at all expansion and construction joints. Screen slots will be provided at the end location only, and two sets of screens of different mesh size will be manufactured for each raceway.

Water supply will be delivered via an 8-inch-diameter manifold that will straddle the head end of the raceway, and will be controlled by underground butterfly valves. Two sets of standpipe drains will allow for drainage and water level control of the raceway while fish production is in progress. One standpipe will flow directly to the sedimentation pond as wastewater, which will be used for raceway cleaning and the other standpipe will provide water level control and will direct continual raceway water to the hatchery discharge without treatment. Vacuum pumping systems will be able to discharge directly into this standpipe for daily pond cleaning. Occasionally, these standpipes can be pulled for final mop-up and cleaning of the raceway after fish are outplanted. All water supplies to the raceways will be first use water except those raceways that will be plumbed to receive second use and gravity water from the hatchery. Wood drainboards will provide access to clean river silt out of the raceways.

The earthen ponds will have a gravel-sloped side, with a slope of 3:1. An asphalt strip will run the full length of the pond, along its centerline, and will extend to the toe of the slope. Water will be supplied by a 12-inch-diameter manifold that will direct the flow parallel to the centerline of the pond. At the inlet and outlet ends of the pond, concrete slabs will provide erosion control. These slabs will provide locations to pump fish for outplanting work and during crowding operations. At the inlet end of the adult holding pond, a spawning shed will be constructed of treated wood and concrete to provide a spawning area for adult salmon. At the outlet of each pond, an array of screens and wood damboards for fish and water level control will be constructed. There will be six drains in each pond, three for flow-through rearing water directed back to the river, and three directed to the sedimentation ponds for use during cleaning operations.

e. <u>Marking</u>

There will be an extensive fish marking program at the Klickitat Hatchery. Special consideration must be given to this aspect of the hatchery and appropriate facilities will be provided for marking, temporary water supply, electric power, and return water and fish piping. The hatchery site will have a concrete pad located adjacent to the raceways to park a mobile tagging trailer. The concrete pad will provide a footing where the tagging trailer can accept water through a 4-inch-diameter supply hose with quick disconnects. 240-volt outdoor electrical power will be provided. The concrete pad will be elevated sufficiently to provide enough head to return the fish back into the raceways by gravity using a pipeline or flexible hose.

5. FACILITY BUILDINGS

a. Hatchery Building

The hatchery building will have several features in addition to fish production facilities. The exterior will be a prefabricated metal-shelled pole building with a wood-frame support structure. Treated timber columns will support wood trusses, roof purlins, and wall girts. The roof will be a standing seam roof with 4-foot eaves and gable overhangs for snow protection. No gutters will be attached because of ice buildup. The roof pitch will be 6 in 12 to provide for snow accumulation and removal. The color of the facility will be prescribed by the client.

The building will have windows that are metal clad Thermopane, with 3/8-inch dead space thickness between the glass. The personnel doors will be metal insulated solid-type doors. The rollup doors will be metal and insulated. Insulated wall and roof panels will be Robertson, Formawall foam sandwich type or equal.

b. Fish Food Freezer

The fish food freezer will be a built-in, walk-in type freezer with a self-contained compressor unit. The freezer's capacity will allow for 100,000 pounds of Oregon Moist pellets stacked on pallets. The freezer will have a floor strong enough to support a forklift. Outside of the freezer will be a thawing and scale area for weighing and proportioning rations. A rollup door will provide access to this room from the loading dock.

c. Mechanical and Electrical Room

The mechanical and electrical room will be shared. The generator system will be placed in the northeast corner of the building. This room will contain the domestic water system hydropneumatic pressure tank, the building heating system for the office and lab, the pump motor control centers, the electric power supply panel, and the automatic switching panel for emergency power start-up of the generator. There will be some limited storage in this room. The generator will also be located in this room. An additional mechanical room will be adjacent to the storage room and will have additional HVAC and electrical panels as required.

d. General Storage

The general storage room for the hatchery will be located centrally for easy access. This storage space will be dedicated for the indoor items that need seasonal or intermittent use. Outside door access will not be provided.

e. Shop and Garage

The shop and garage, approximately 400 square feet, are located on the north side of the hatchery building. Two overhead rollup doors will provide access and a personnel door will open into the general storage room. The shop will be equipped with light tools and hand tools required for routine maintenance of hatchery equipment and grounds. There will be a table saw and drill press located in the shop. Space is provided for two full size pickup trucks. Lighting in this room will be provided by cool white fluorescent tubes. Diesel and gasoline fuel storage tanks will be located adjacent to the garage. A 1,000 gallon diesel and 500 gallon gasoline tank will be provided. Special anti-leak tank lining and containment construction will be specified.

f. Hatchery Housing

Residences at the Klickitat Hatchery include three single-family homes and a duplex. The houses will be located adjacent to the Champion Timber International Co. logging road. The houses are approximately 1,500 to 1,800 square feet in size with finished daylight basements for temporary housing apartments. The duplex will be a modification and extension of one of the single-family plans. The homes are situated so that the hatchery manager's home would be the closest to the hatchery building in case of an emergency. Insulation would be as specified by the BPA "Good Cents" program and wood stoves will be provided as backup heat. The primary source of heat will be fuel oil, centralized forced air heat. Each house will have its own fuel oil storage tank and a separate electric meter. Views from the houses will be directed at the hatchery site. Access roads and driveways will be set back from the logging road approximately 50 feet. A frontage road will allow for travel into the underpass without traveling on the logging road. Furniture is not included in the cost estimate; however, the houses will be equipped with carpeting, cabinetry, and drapes.

6. WATER EFFLUENT TREATMENT

a. Hatchery Effluent and NPDES Pollution Abatement Ponds

The Klickitat Hatchery will require a National Pollution Discharge Elimination System permit to operate. The lead agency for this permit is the Washington Department of Ecology. This permit will include Best Management Practices that govern hatchery operations with regards to the fish culture process and minimizing the facility's pollution impacts.

Hatchery effluent, because of its quality, will not require sedimentation treatment. However, on a daily basis the raceways will be vacuum cleaned of ash waste products, waste food, and river silt. Vacuumed and other waste from the raceways and ponds will be removed and directed down the separate waste drain toward the sedimentation ponds for treatment.

The sedimentation ponds will be lined with native gravels and sands of the site and will be a square- or rectangular-shaped pond of about 25' x 25' x 2' deep and will have an inlet that will direct flow across the entire cross-section of the pond. Likewise, the outlet will have a skimmer weir that will pull an even flow from all points of the pond. The design detention time required for fish waste constituents is approximately 5 hours. In the proposed pond, the calculated detention time will be approximately 24 hours, providing a factor of safety of 5. There will be two identical ponds with this capacity so that one can be rested, dried, and cleaned while the other pond is being used for the waste stream.

b. Waste Cleaning System

The waste cleaning system will be a system of pipes that will carry waste toward the sedimentation ponds from all connected rearing and hatchery drains. The pipes will be designed to carry the waste at a minimum velocity of 2.5 fps. The system will terminate at the raceways as a "waste standpipe." The waste drain will also be placed to carry waste from the hatchery at various points in the building. The large earthen rearing ponds will also have waste drains for the annual cleaning of these ponds after the rearing season.

In addition to the drain pipes that will carry waste to the ponds, there will be two electric vacuum pumps that will be supplied with a pool-type attachment for vacuuming waste from off the bottom of the raceways. The electric pumps, which will handle solids, will be rated at 30 gpm with 20 feet of water pressure head.

c. Disease and Chemical Control

The Best Management Practices outlined in the NPDES permit will describe how treatment of some of the disease will be carried out. Formalin is a technique that will commonly be used for the treatment of fungus. Effluent containing formalin will be sent down the waste drain and directed toward the sedimentation ponds. Iodine solutions, erythromycin, and formalin will be the three chemicals most commonly used at this hatchery.

7. FACILITY EQUIPMENT

a. Equipment List

A list of equipment is included in the operation and maintenance cost estimate. This equipment is necessary for the normal operation and maintenance of the Klickitat Hatchery. See Appendix E.

8. OPERATION AND MAINTENANCE

a. Hatchery Monitoring and Control System

A control and monitoring system is designed for the hatchery. The system is operated by an IBM-compatible central computer which monitors various phases of the hatchery operation that are deemed important. It also controls emergency alarms and records their frequency.

The control panels for the pumps and heating system will be located in the hatchery office. The automatic switch and generator controls will be located in the mechanical and electrical room. The central computer, which will monitor all these controls, will be located in the hatchery office.

b. Alarm System

The alarm system will include alarms and an automatic telephone dialer that will automatically dial personnel in the event an alarm is triggered. The alarm system will be designed to work in concert with the monitoring and control system central computer by placement of various alarm sensors strategically in the hatchery system.

The following locations will have water level sensors for the detection of low water levels:

Hatchery water reservoir
Each outside raceway
Each outside rearing pond

The following locations will have flow sensors for the detection of low water flow in the pipe or open channel;

River water supply pipe
Kidder Spring water supply pipe
Cascade Spring water supply pipe

All sensors will communicate with the central computer for alarm firing and recording. Alarms will consist of an audible siren. The alarm will be located away from the computer screen. The automatic telephone dialer will call the residences and up to a total of eight phone numbers in a preset sequence. Acknowledgment of the call must occur before the dialer quits calling.

In addition to the water alarms there will be fire, smoke, and electrical failure alarms all tied into the monitoring and control central computer. This system will have a dedicated emergency backup battery power supply.

c. Data Management

(1) Monitoring Sensors

The monitoring system will be set to monitor dissolved oxygen and waste product levels at any point in the water supply system. This monitoring system will also log and monitor the pump station's electric motors and will provide a record of their run time for maintenance purposes.

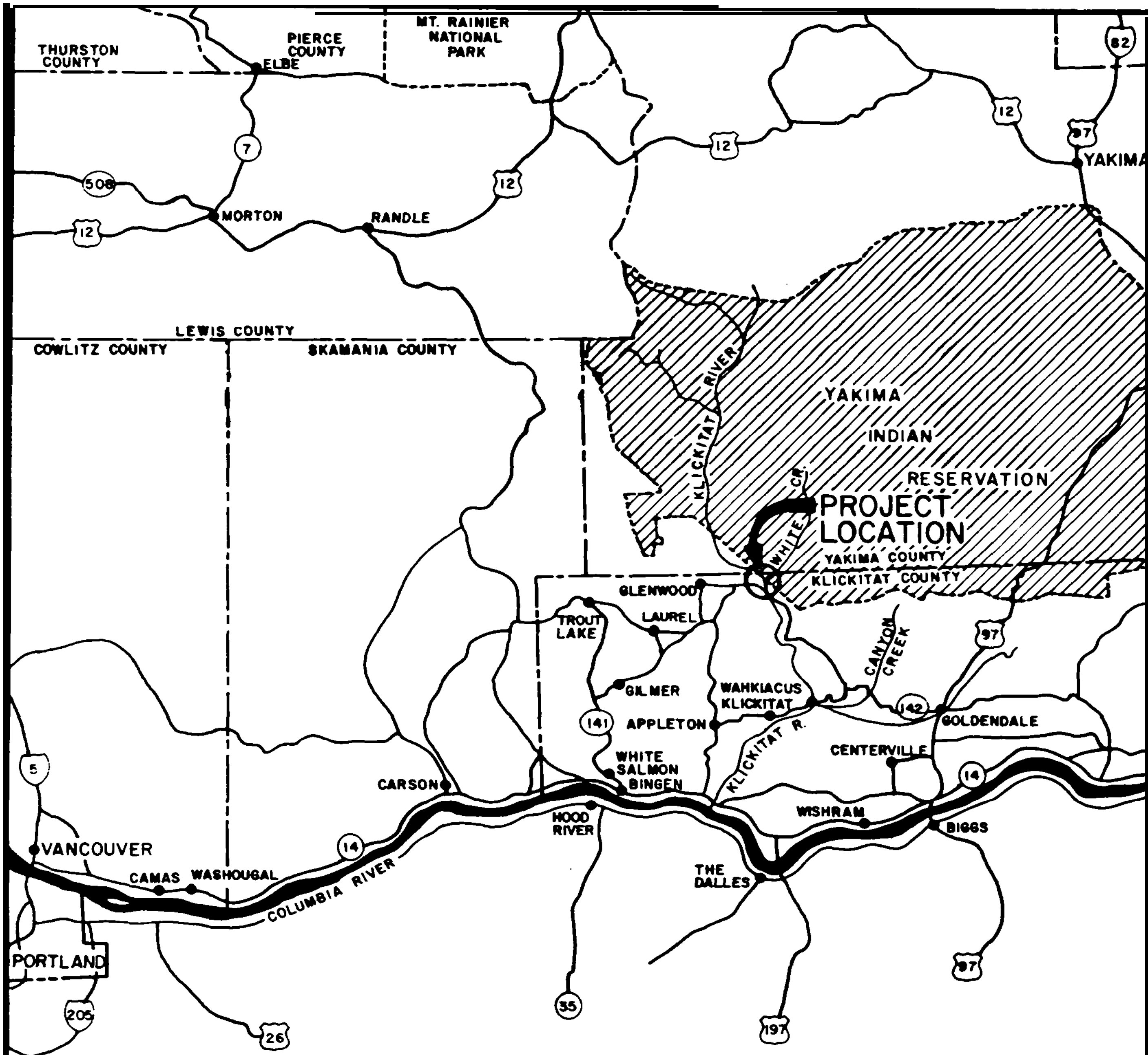
(2) Central Computer

The central computer will be used only for the monitoring, alarm, and recording tasks of the hatchery. It cannot be used for special projects. Separate computers will need to be installed for special projects. The central computer will be located in the manager's office. It will provide the manager with immediate information on where alarm sensors might have been activated in alarm actions, and it will give the manager the record of any sensor that has been recording the water temperature or dissolved oxygen content over the past few months or years.

d. Fuel Consumption

Fuel consumption will consist of fuel oil for heating the hatchery building and the residences, diesel fuel for the trucks and generator, and gasoline for the other hatchery vehicles. The estimated annual fuel consumptions for the Klickitat Station are estimated to be:

Fuel Oil	2,000 gallons
Gasoline	5,000 gallons



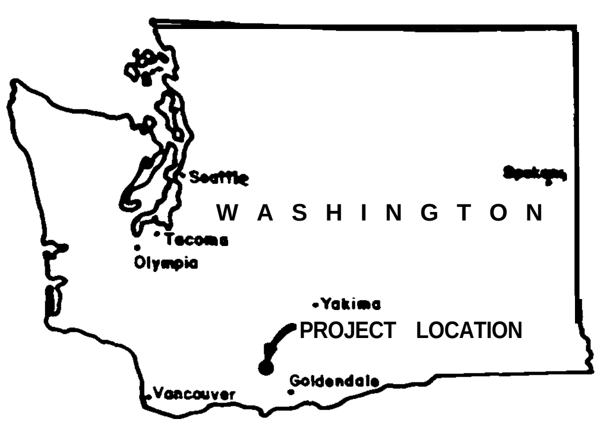


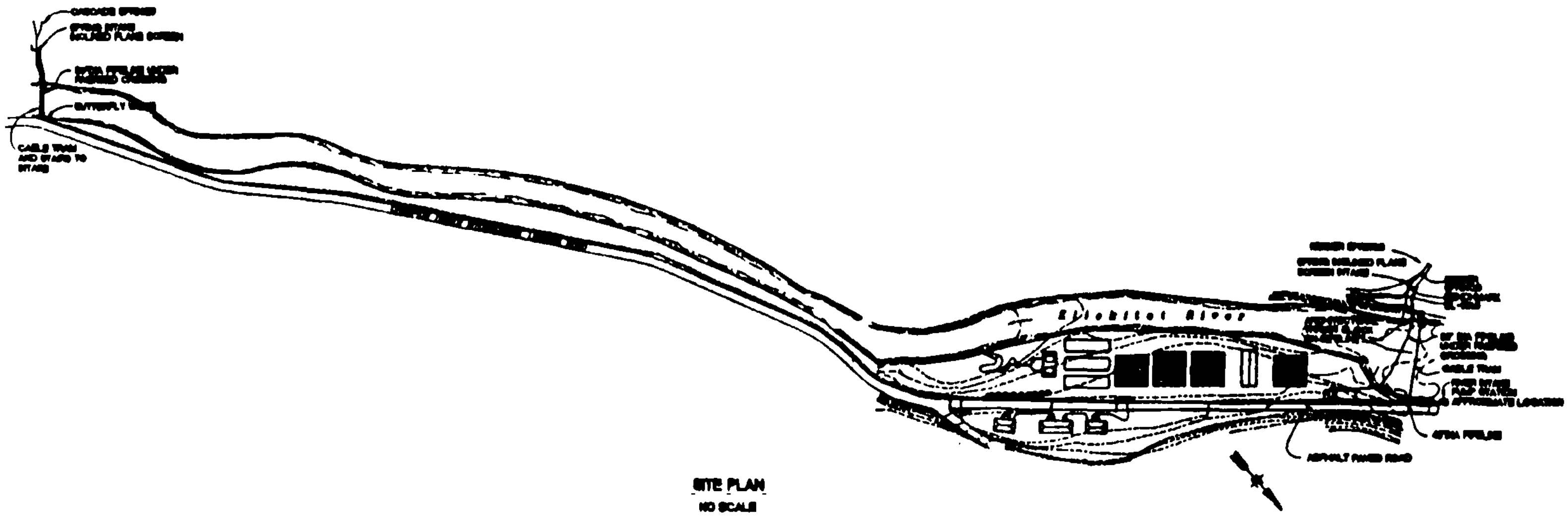
FIGURE III-1

BONNEVILLE POWER ADMINISTRATION

KLICKITAT SALMON AND STEELHEAD HATCHERY

VICINITY MAP

R.W. BECK AND ASSOCIATES



SITE PLAN

NO SCALE

USGS DATUM MSL = EL. 0.0

GRAPHIC SCALE:

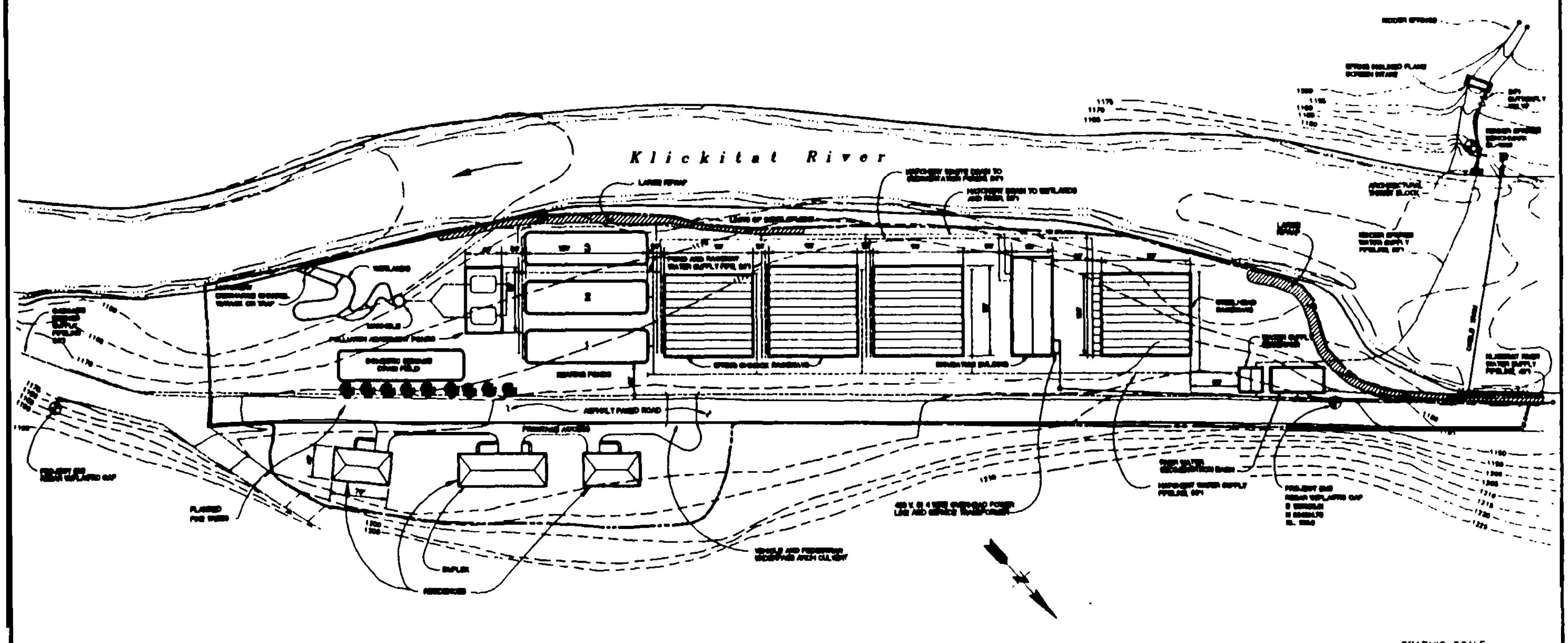
200 0 200 400

R.W. BECK AND ASSOCIATES

KLICKITAT SALMON AND STEELHEAD HATCHERY

SITE PLAN

Fig. III-2



HATCHERY SITE PLAN

USGS DATUM MSL = EL 0.0

R.W. BECK AND ASSOCIATES

BONNEVILLE POWER ADMINISTRATION

KLICKITAT SALMON AND STEELHEAD HATCHERY

HATCHERY SITE PLAN

Fig III-3

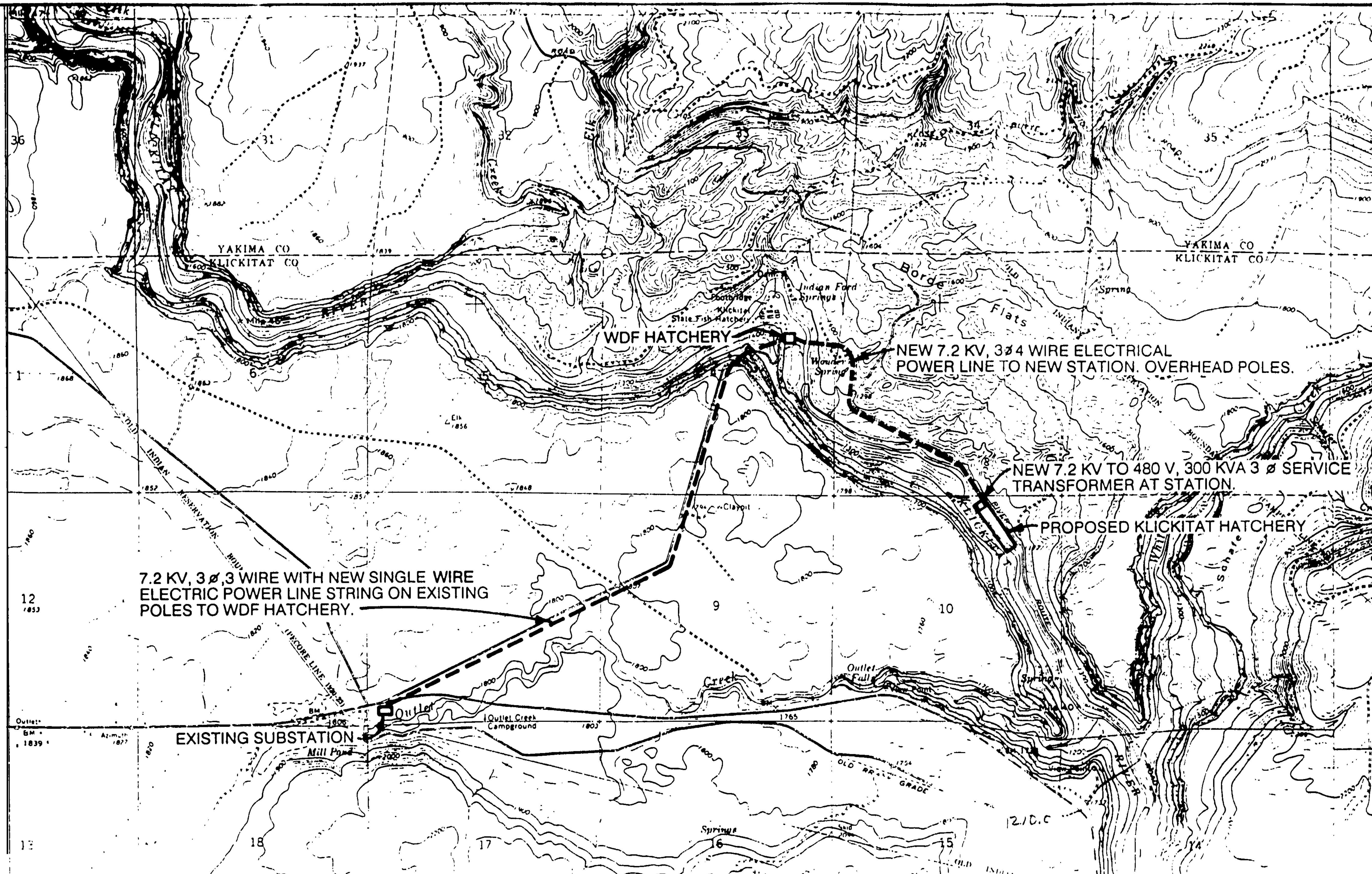


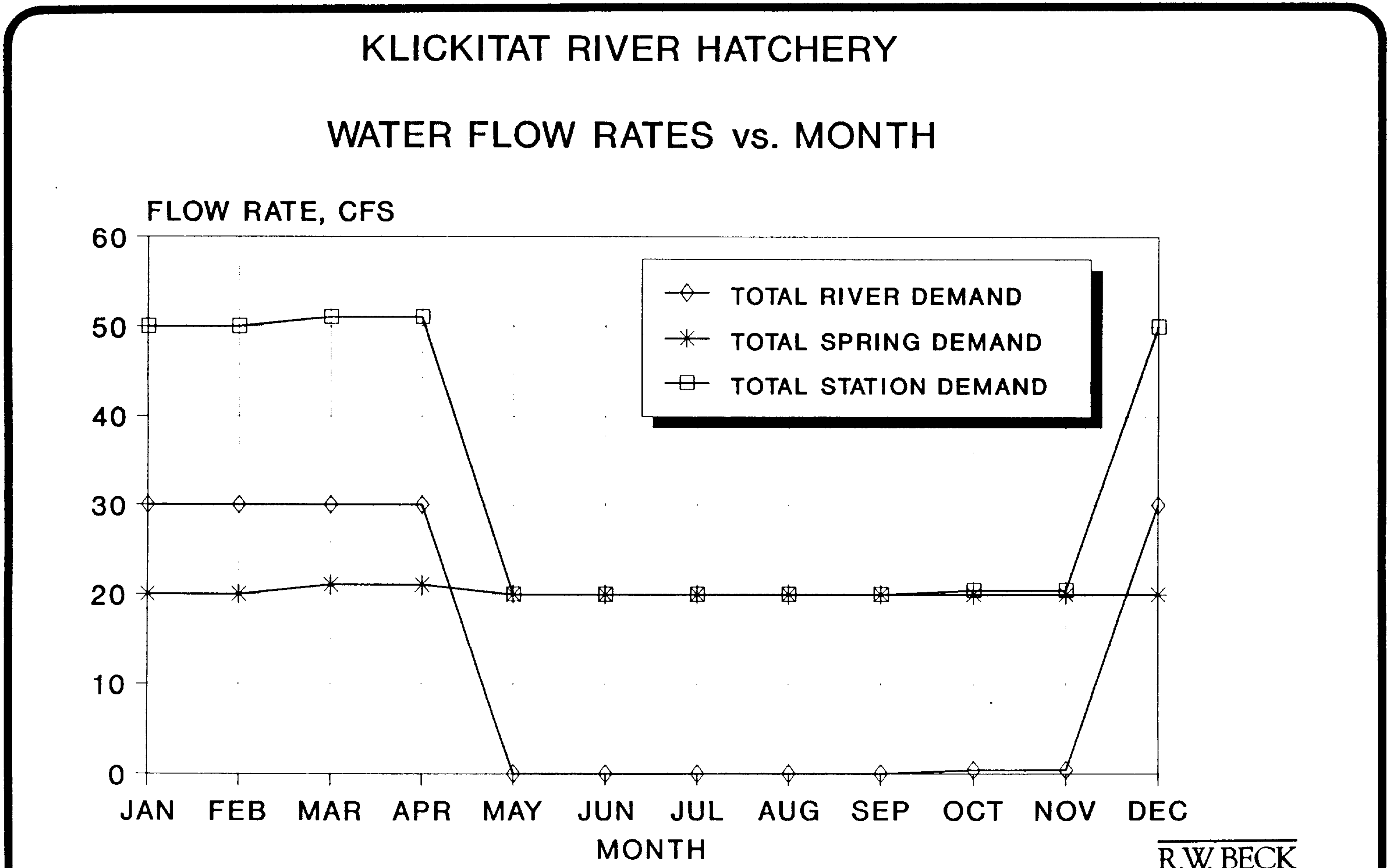
FIGURE III-4

BONNEVILLE POWER ADMINISTRATION

KLICKITAT SALMON AND STEELHEAD HATCHERY

R.W. BECK AND ASSOCIATES

NEW ELECTRIC POWER SUPPLY ROUTE



R.W. BECK AND ASSOCIATES

FIGURE III-5

WATER TEMPERATURES vs. MONTH KLICKITAT RIVER, CASCADE AND KIDDER SPRINGS

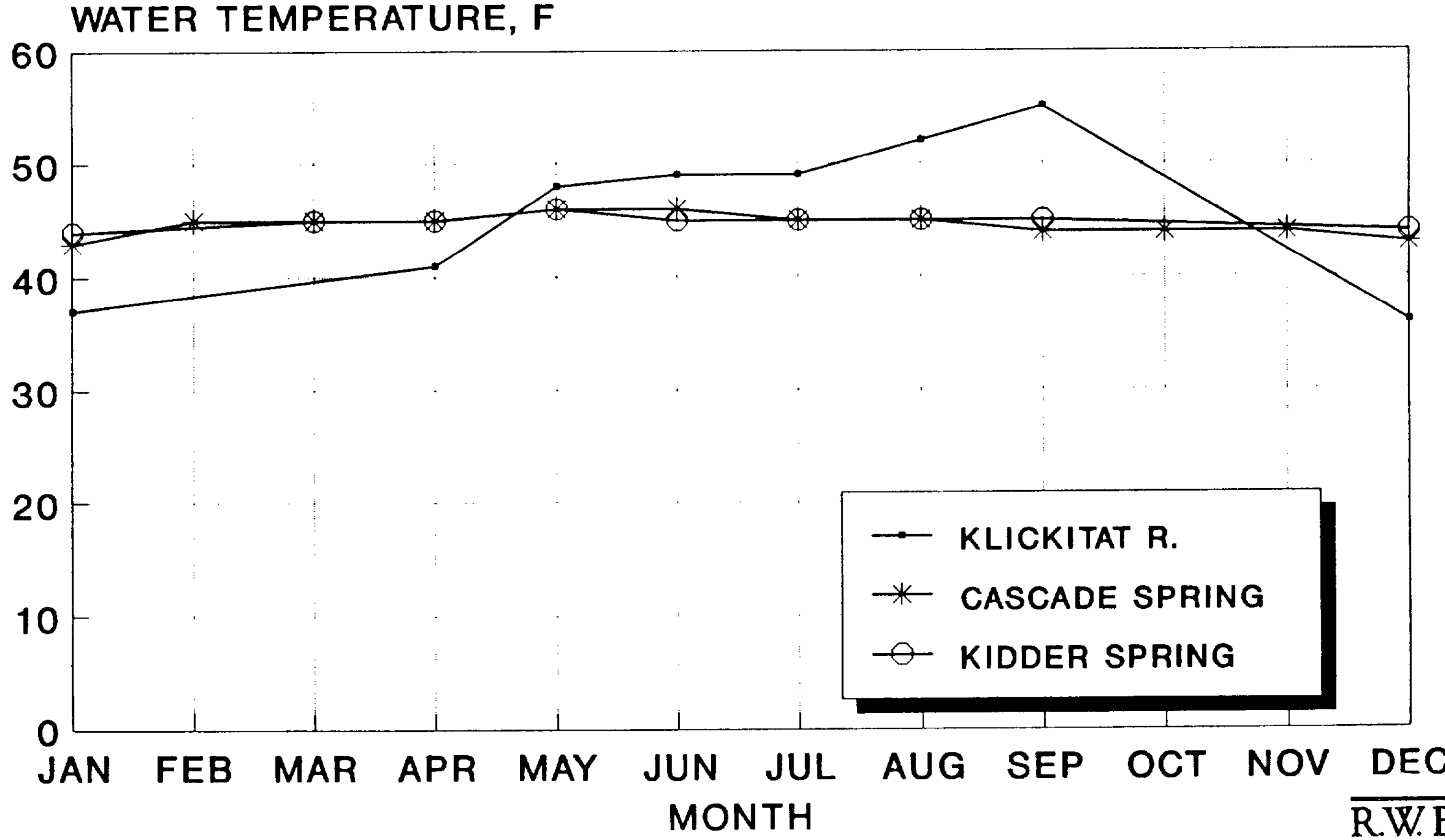


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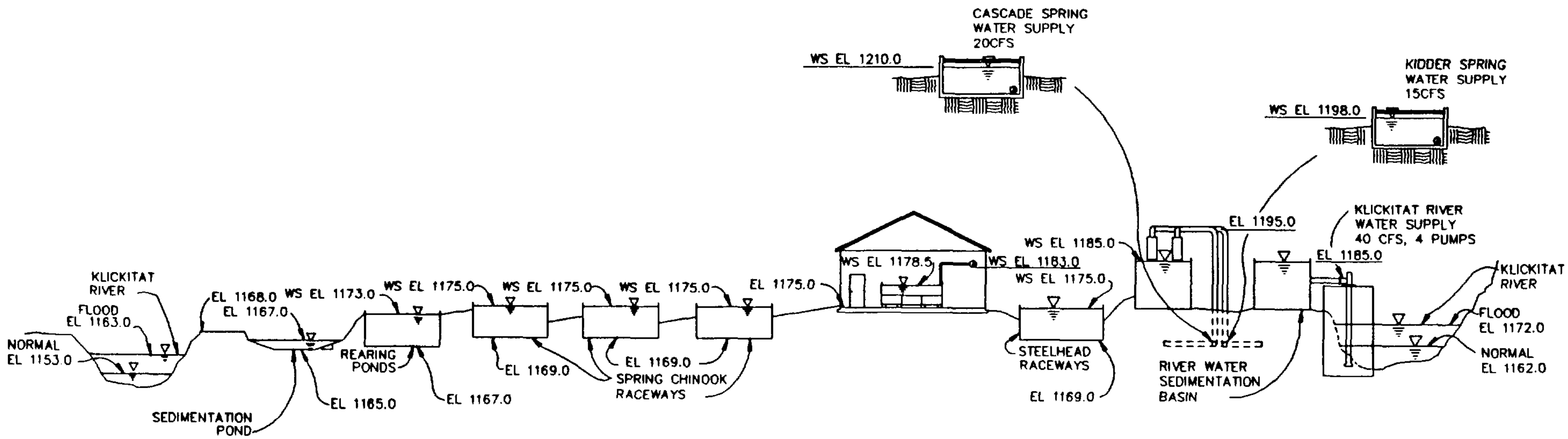
FIGURE III-6



SCHEMATIC HYDRAULIC PROFILE

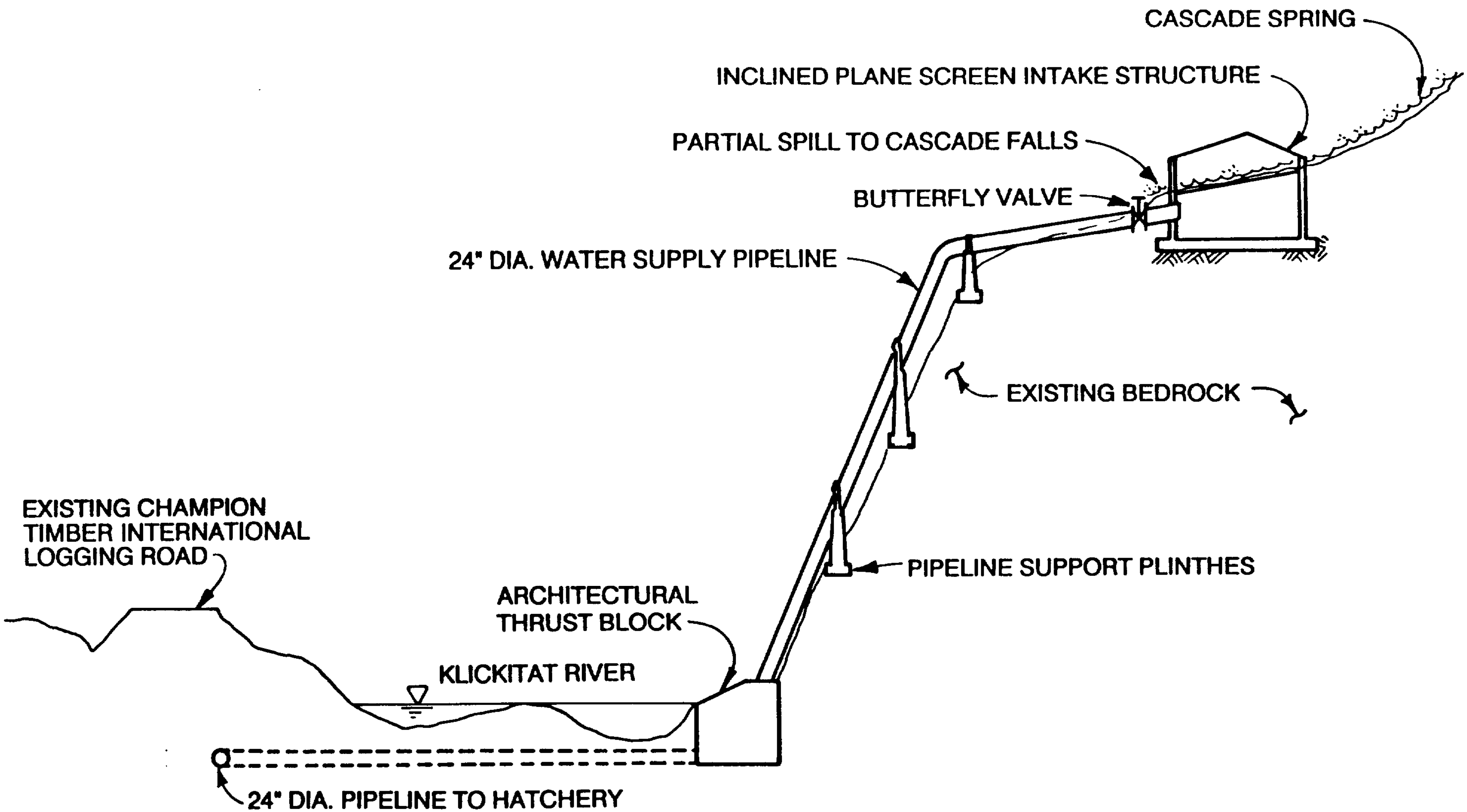
SCALE: NONE

REV. | DATE | BY | CK'D | APPROVALS | DESCRIPTION

R.W. BECK AND ASSOCIATES

BONNEVILLE POWER ADMINISTRATION
KLICKITAT SALMON AND STEELHEAD HATCHERY
SCHEMATIC HYDRAULIC PROFILE

Fig. III-7



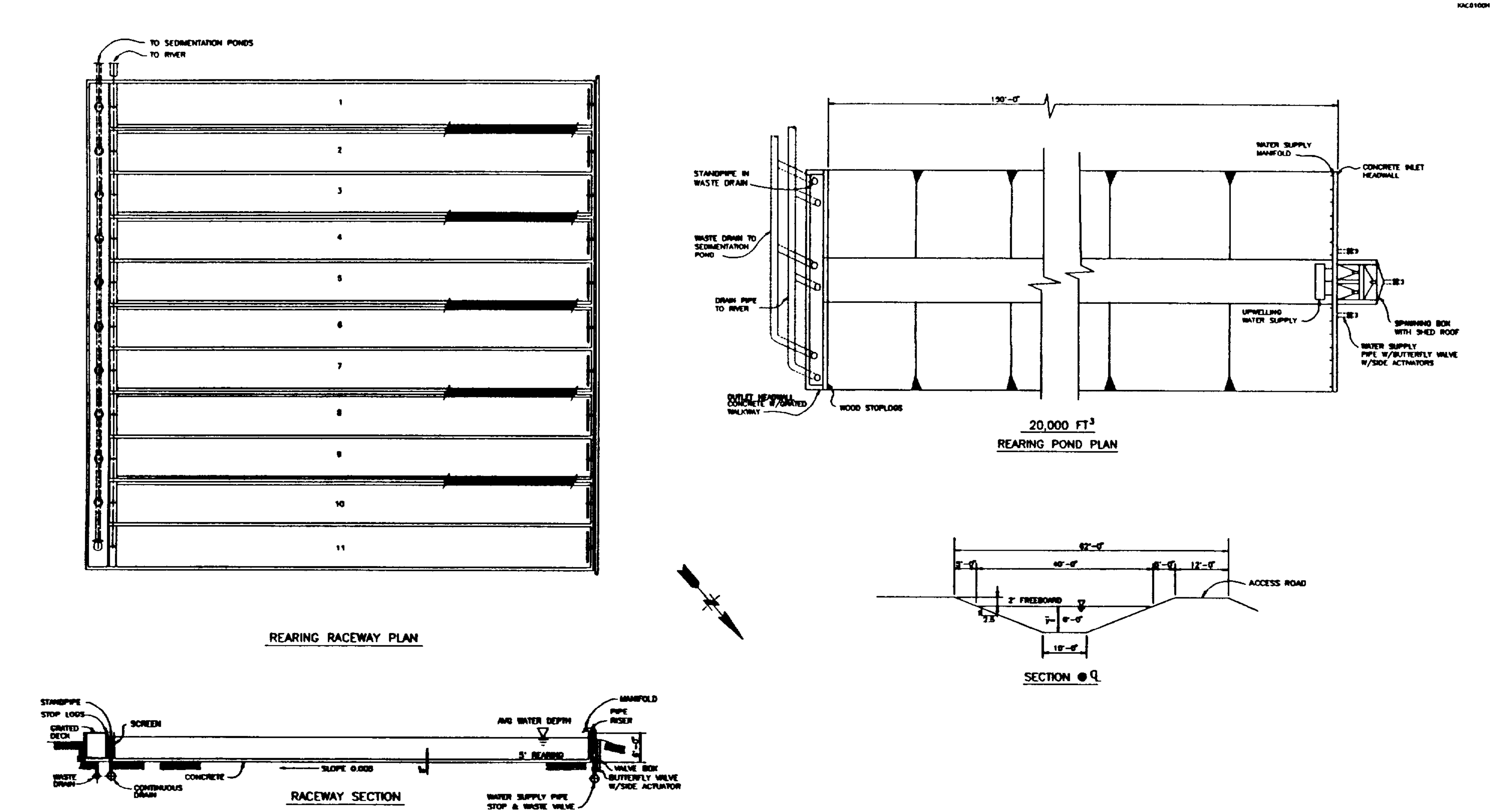
CASCADE SPRING INTAKE

PROFILE VIEW

NO SCALE

FIGURE III-8

R.W. BECK AND ASSOCIATES



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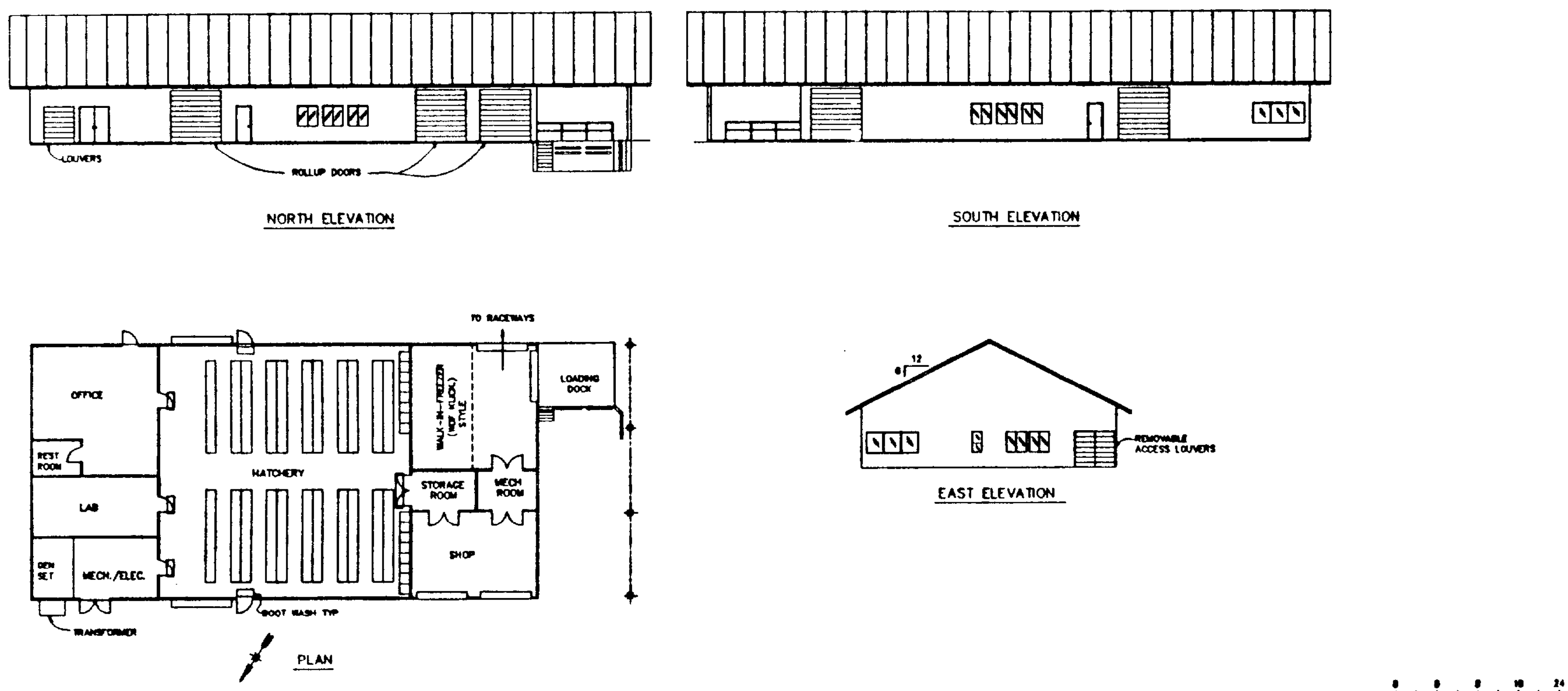
KLICKITAT SALMON AND STEELHEAD HATCHERY
RACEWAY AND REARING POND
PLANS AND SECTIONS

Fig. III-9



R.W. BECK AND ASSOCIATES

BONNEVILLE POWER ADMINISTRATION
KLICKITAT SALMON AND STEELHEAD HATCHERY
HATCHERY BUILDING
PLAN AND ELEVATIONS

Fig. III-10

SECTION IV

FACILITY ENGINEERING

1. STRUCTURAL DESIGN

The Building Codes that will be referenced during the design of the Klickitat hatchery are;

Uniform Building Code. 1988
Uniform Plumbing Code, 1988
Uniform Fire Code, 1988
American National Standards Institute, ANSI 1982
American Standards for Testing Materials, ASTM
American Concrete Institute, ACI 318-83
American Timber Institute
Structural Welding Code, AWS D1.1-84
Klickitat County, Local Codes
Occupational Safety and Health Administration, OSHA

a. Load Criteria

The following load criteria will be used to govern the design of the station:

(1) Snow

ANSI A58.1-82

Ground snow load:	135 psf
Occupancy Importance Factor:	1.0 (low occupancy)
Roof snow load:	110 psf or as governed by Klickitat County

(2) Wind

Base wind velocity:	70 mph or as required by the local building authorities.
Exposure:	C (open territory)
Occupancy Importance Factor:	1.0 (low occupancy)

(3) Seismic

Seismic Zone 2B
Occupancy Importance Factor: 1.0
Per UBC 1988

(4) Soil

Active Pressure: To be determined
Passive Pressure: To be determined
Coefficient of Friction: 0.25
Surcharge due to HS20 wheel loads: loo psf
Allowable soil bearing pressure: 2,000 psf

(5) Floor Loads

All floor areas: 100 psf

b. Structural Systems and Materials

The hatchery building will be constructed with a concrete slab on grade. The incubation and rearing room floor will be covered by an agricultural-style pole building with treated timber columns. Adjacent office and lab areas will use a slab on grade floor and sheet rock partition walls and celling system. The exterior walls and roof will be a painted galvanized steel skin. The roof system will be a standing seam-type roof to prevent leakage. No gutters will be Installed along the roof edges to avoid breakage by Ice. The wall panels will be an insulated sandwich-type panel with a metal covering on the Interior and exterior surfaces. The approximate size of the building will be 54 x 100 feet. There will be a 25 x 25-foot bay for the access and receiving dock for fish food transfer Into the freezer area. The roof system of the bay area will consist of treated wood pole columns and wood trusses.

2. CIVIL/MECHANICAL DESIGN

a. Codes and Standards

The applicable codes that will considered during design are:

Uniform Plumbing Code, 1988
Uniform Fire Code, 1988
Uniform Mechanical Code, 1988

b. Piping Materials

The piping materials used for the design of the Klickitat Hatchery will be specifically selected for suitability In the culture of fish. No material will be specified that will be in contact with process water that contains yellow metals such as brass or bronze. PVC and HOPE pipe will be specified where possible.

c. Valves and Material

Valves and joining materials will be chosen specifically for fish culture compatibility. No yellow metals or copper will be specified for use in the process water system. Internal parts will be specified as cast iron, stainless steel, or rubberized cast iron.

d. Manholes and Catch Basins

Manholes and catch basins will be specified as precast concrete type, standard 4-foot-diameter sewer appurtenances.

e. Heating, Ventilation and Air Conditioning

The rearing and incubation room of the hatchery building will be heated with eight 10,000 BTU/hr space heaters with individual thermostats. The design indoor incubation room temperature shall be set at 45°F year-round. The office and laboratory will be heated with a forced air oil, or forced air electric furnace system. The office and lab space will be heated to an indoor design temperature of 72°F. The outside design temperature shall be assumed at -10°F.

f. Insulation

Insulation of the hatchery building will be contained in the insulated wall and roof panels. Other select areas that will require more insulation will utilize rigid batts. The walls in the office and lab that are adjacent to the incubation room will require a glass blanket-type wall insulation that will be installed into a rigid sheetrock partition. Walls and roof Insulation shall be minimum R:30 rated for the office and lab spaces.

Special consideration shall be given to vapor and draft control throughout the hatchery building. The interior partition walls will be vapor sealed and will have waterproof sheet rock for water damage protection. The exterior walls will be sheathed with the metal surface on the Interior of the panel and will act as a self-contained water vapor barrier. The interior walls between the hatchery room and the office and laboratory will have a special polyethylene vapor barrier to prevent the transfer of moisture into the office.

g. Domestic Water Supply

The domestic water supply system will be supplied with untreated spring water. The water will be circulated by a booster pump to a hydro-pneumatic tank which will provide a constant pressure and deliver a constant flow to the residences and the hatchery building. The water demand design flow to the residences will be 40 gpm each and to the hatchery building will be 40 gpm. The residual pressure at a 40-gpm flow rate at the tap will be set at 40 psi.

h. Fire Protection Supply

A fire protection system will be designed to be supplied with 800 gpm of water from the station reservoir at all times. The system will Include an electric booster pump with a separate fire protection system of pipe to distribute water to the residences and the hatchery building. Fire fighting hose reels will be located at strategic points throughout the hatchery site. The electric booster pump will be automatically switched on in the event of a fire alarm being activated. The fire fighting electrical system will be backed up by the diesel generator on the essential circuit of the hatchery electrical system. The residual pressure at the hose reels will be set at 40 psi with a combined fire flow rate of 800 gpm at any two hose reels.

i. Domestic Sewage Treatment

The domestic sewage at the Klickitat station will be generated at the hatchery building as well as the residences. The system will be based on a pressurized sewage system commonly known as a septic tank effluent pumping (STEP) system. The system is composed of individual septic tanks located at each residence, two at the duplex and one at the hatchery building, a pressurized comminuting effluent pump, and system of small-diameter pipes that lead to a common soil absorption field (drainfield). The soil absorption field will be located at the east end of the site adjacent. to the sedimentation ponds.

3. ELECTRICAL DESIGN

a. Commercial Power Supply

Commercial 3- phase power will be required for the hatchery site. The large hatchery water supply pumps will require 3-phase power. The hatchery power supply will be 480-volt. Large motors will be required for equipment operation at this site. The following table lists the power loads that are anticipated at the Klickitat Hatchery; Table IV-l shows the estimated consumption of power for the Klickitat Hatchery and the associated large power motors and lights that are consuming the power. This list Is an estimate of power demand during the design phase. The facility designer must be aware that this list is a partial list of what will probably be Installed In the hatchery. The column labeled Essential/Non indicates If the electrical load listed is supplied with emergency power backup.

TABLE IV-1

ELECTRICAL POWER DEMANDS

Item	Quantity	Essential/Non	Power Demand Each/Total
Pumps, 50 hp	4 ea	3 Ess	37.5 kW/150 kW
Pumps, 10 hp	2 ea	Ess	7.5 kW/15 kW
Hatchery Lights	60 ea	1/4 Ess	0.2 kW/12 kW
Hatchery Space Heaters	8 ea	1/4 Ess	10 kW/80 kW
Hatchery Forced Air Electric Heat	1 ea	1/4 Ess	20 kW/20 kW
Walk-in Freezer	1 ea	Ess	40 kW/40 kW
Shop Equip.	Misc.	Non	30 kW/30 kW
Outlets	60	1/4 Ess	0.05 kW/3 kW
Alarm System	1 ea	Ess	1 kW/1 kW
Residences	4 ea	Non	10 kW/40 kW
Yard Lighting	10 ea	1/4 Ess	2 kW/20 kW
Predator Control Fence	1 ea	Non	2 kW/2 kW
Total Power Demand			413 kW
Total Essential Power Demand			202 kW

b. Emergency Power Supply

Emergency power will be supplied by an automatically switched generator, dedicated to the hatchery and other essential power demands. The generator will be equipped with an automatic switch for immediate start sequencing during a power outage. Essential equipment such as water supply pumps, water heaters, alarms and certain lights will be on the essential side of the circuit. The diesel generator Is preliminarily sized to be a 220-kW unit and will have an extended tank of 'I-day fuel capacity.

c. Power Distribution

Power distribution throughout the hatchery will be in underground rigid plastic conduit encased in sand filled trenches and marked with a metal detectable plastic tape. Power will be supplied overhead to the mechanical/ electrical room, at which point the power Is stepped down at a 720/480-volt, 300-kVA transformer and distributed through the hatchery. The hatchery building will be supplied with 400 amperage service.

d. Lighting System

Incandescent and fluorescent lights will be specified in certain areas of the hatchery building. All fluorescent lights will be of a spectrum that is acceptable for fish culture (cool white). All hatchery lighting will be controlled with delay switches to reduce the light shock to the fish present indoors. Several separate banks of lights will be provided with individual switches for versatility. Drop light fixtures will be strategically located in the incubation room for use with tasks during the incubation cycle that require limited light for working.

e. Pump and Large Load Power Supply

Pump and large load power supply will be provided with 3-phase 480-volt service. The power will be supplied through burled plastic conduit that will originate In the motor control centers In the hatchery building electrical room and lead to the point of demand at the pump or motor. Four 50-hp pump motors will be located at the river water supply Intake. The walk-in freezer will also require a large power supply of 460 volts for operation of Its compressor.

f. Controls

Control indicator panels for the water supply pumps and other equipment will be provided and housed In the hatchery office. The motor control centers for these water supply pumps will be located in the electrical room. Some control of lights, heaters and certain other electrical equipment may be controlled through the control computer. (See Section III-8.a.)

g. Future Electrical Loads

Future electrical capacity and emergency backup capacity of electrical loads will be included in the final design. The additional capacity that will be allowed for is 20 kW and is reflected In the size of the power supply system and the emergency power generator.

h. Residence Power

The residential power will be single-phase 240-volt. Residence power will be supplied from the overhead power supply. through the transformer at the hatchery building, through a meter in that room and then directly to individual 200-amperage service panels at the residences. The residences will not be supplied backup power In the event of an electrical power outage. Oil, wood, or propane sources of heat must be utilized If the homes are on the nonessential power circuit and, therefore, a wood burning stove Is specified for each residence. Standard lighting and electrical equipment and appliances will be installed in the houses.

i. Phone System

The hatchery office and each of the residences will be equipped with telephones. Six pairs of wires must be brought from existing telephone service lines to the hatchery site. The telephone system will be Installed on shared poles with the power supply system. The telephones will be wired underground in plastic conduit through the hatchery site to the houses from the hatchery building. The automatic dialing system of the control computer will be equipped to dial the residences or some other off station telephone number in the case of an emergency and alarm sequencing.

SECTION V

COST ESTIMATION AND IMPLEMENTATION SCHEDULE

1. COSTS

The cost estimate that follows contains a description of each item as well as the unit costs for material and labor. The quantity and unit costs are multiplied to arrive at the total cost of the item. Contractor overhead and profit are included in the column titled "Amount." This column is added and subtotaled to arrive at the construction cost.

A design engineering and construction management fee of 18% of the construction cost Is added to the construction cost subtotal. A cost associated with the administrative and legal costs of 7% of the construction costs is also added and another subtotal is summed. The total cost for construction of the Klickitat Hatchery, including five acclimation sites and fees for design and construction engineering, legal and administrative fees, Is $9,040,000.

The total cost of the project includes additional items beyond capital expenses required for final design, such as: floodplain computer modeling, geotechnical and foundation investigations, water quality continuing review, route surveying. and environmental permitting. The total cost does not include sales tax for the construction materials. It does not include the cost of acclimation sites that will likely be developed in the basin in the future and it does not include the costs to design and construct adult collection facilities.

The annual capital cost to produce one pound of combined salmon and steelhead can be calculated by dividing $9,040,000 by 180,000 pounds of annual production. The estimated annual cost to produce one pound of fish Is $50.00.

The operation and maintenance costs are estimated to be approximately $220,000 annually for the Klickitat Hatchery.

2. REQUIRED PERMITS

The permits that are identified as required for the Klickitat station are:

Klickitat County:

- Building Permit
- Compliance with County Shoreline Management Regulations; included by definition In the Environmental Assessment document
- On-site Wastewater Discharge Permit

Washington State:

- Department of Ecology:
  - State Environmental Policy Act; in-place within Environmental Assessment
  - Hater Right Permit
  - Flood Control Zone Permit
  - Hater Quality Exception or Certification
  - National Pollution Discharge Elimination System, NPDES
- Department of Wildlife and Fisheries:
  - Hydraulic Project Approval
- Department of Natural Resources:
  - Notification of work

United States Corps of Engineers:

- Section 10 Permit
- Section 404 Permit

United States Forest Service:

- Notification and Coordination

United States Fish and Wildlife Service:

- Notification and Coordination

Yakima Indian Nation:

- Water Use Permit
- Stream Zone Alteration Permit
- Zoning Permit
- Conditional Use Permit
- Lease Agreement, BIA
- Building Permit

Champion International Timber:

- Land Purchase Agreement
- Road Use and Easement Agreement

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIAL COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	MOBILIZATION	1	LS		$75,000.00		$75,000.00	$75,000.00
2	SCHEDULING	1	LS		$1,000.00		$1,000.00	$1,000.00
3	CONSTRUCTION SURVEYING	1	LS		$20,000.00		$20,000.00	$20,000.00
4	INSURANCE/BONDING	1	LS		$50,000.00		$50,000.00	$50,000.00
5	CLEAN-UP AND DEMOBILIZE	1	LS		$75,000.00		$75,000.00	$75,000.00
	SITE WORK							
6	CLEARING AND GRUBBING	10	AC	$1,000.00	$3,000.00	$10,000.00	$30,000.00	$40,000.00
7	ACCESS ROADWAY IMPROVEMENTS-ASPHALT	5000	SY	$3.50	$3.00	$17,500.00	$15,000.00	$32,500.00
8	ACCESS ROADWAY IMPROVEMENTS-ARCH CULVERT	50	LF	$300.00	$350.00	$15,000.00	$17,500.00	$32,500.00
9	ACCESS ROADWAY IMPROVEMENTS-SHOULDER WOR	600	LF	$8.00	$10.00	$4,800.00	$6,000.00	$10,800.00
10	SITE ROADWAYS 25' WIDTH	2000	LF	$8.00	$10.00	$16,000.00	$20,000.00	$36,000.00
11	SITE SURFACING	5000	SY	$1.25	$2.00	$6,250.00	$10,000.00	$16,250.00
12	SITE GRADING	5	AC		$5,000.00		$25,000.00	$25,000.00
13	SITE DRAINAGE, CULVERTS AND CATCH BASINS	250	LF	$60.00	$60.00	$15,000.00	$15,000.00	$30,000.00
14	RIPRAP LIGHT LOOSE	18000	TON	$6.00	$2.00	$108,000.00	$36,000.00	$144,000.00
15	RIPRAP HEAVY LOOSE	9000	TON	$5.00	$2.00	$45,000.00	$18,000.00	$63,000.00
16	GEOTEXTILE	5000	SY	$1.10	$0.50	$5,500.00	$2,500.00	$8,000.00
17	LANDSCAPING	5	AC	$2,000.00	$5,000.00	$10,000.00	$25,000.00	$35,000.00
18	ELECTRIC POWER SUPPLY LINES	4	MI	$20,000.00		$80,000.00		$80,000.00
19	SERVICE TRANSFORMER,7.2 KV YO 480 V	1	EA	$10,000.00		$10,000.00		$10,000.00
20	TELEPHONE SERVICE	4	MI	$5,000.00		$20,000.00		$20,000.00
						$363,050.00	$441,000.00	$804,050.00

SUBTOTAL	$804,050
SUBTOTAL	$804,050
SUBTOTAL	$804,050
TOTAL	$804,050

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	WATER SUPPLY AND DRAINS ITEM	QUANTITY	UNIT	UNIT MATERIAL COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	CASCADE SPRINGS INTAKE, 20x10x5 CONCRETE	25	CY	$100.00	$250.00	$2,500.00	$6,250.00	$8,750.00
2	SCREENS, MISC STEEL, LADDERS	1	LS	$6,000.00	$1,000.00	$6,000.00	$1,000.00	$7,000.00
3	24" DIAMETER BUTTERFLY VALVE	1	LS	$1,800.00	$1,000.00	$1,800.00	$1,000.00	$2,800.00
4	MISC FITTINGS	1	LS	$8,000.00	$2,000.00	$8,000.00	$2,000.00	$10,000.00
5	24" HDPE PIPE TO RIVER W/PLINTHES	120	LF	$85.00	$75.00	$10,200.00	$9,000.00	$19,200.00
6	ARCHITECTURAL THRUST BLOCK	10	CY	$100.00	$250.00	$1,000.00	$2,500.00	$3,500.00
7	USGS AREIAL TRAM	1	LS	$8,000.00	$4,000.00	$8,000.00	$4,000.00	$12,000.00
8	24" DUCTILE IRON PIPE RIVER CROSSING	100	LF	$80.00	$150.00	$8,000.00	$15,000.00	$23,000.00
9	24" DIAMETER ISOLATION BF VALVE	2	LS	$1,800.00	$1,000.00	$3,600.00	$2,000.00	$5,600.00
10	24" WATER SUPPLY PIPELINE TO STATION	4400	LF	$75.00	$80.00	$330,000.00	$352,000.00	$682,000.00
11	KIDDER SPRINGS INTAKE, 20x10x5 CONCRETE	25	CY	$100.00	$250.00	$2,500.00	$6,250.00	$8,750.00
12	SCREENS, MISC STEEL, LADDERS	1	LS	$6,000.00	$1,000.00	$6,000.00	$1,000.00	$7,000.00
13	24" DIAMETER BUTTERFLY VALVE	2	LS	$1,800.00	$1,000.00	$3,600.00	$2,000.00	$5,600.00
14	MISC FITTINGS	1	LS	$8,000.00	$2,000.00	$8,000.00	$2,000.00	$10,000.00
15	24" HDPE PIPE TO RIVER W/PLINTHES	100	LF	$85.00	$75.00	$8,500.00	$7,500.00	$16,000.00
16	ARCHITECTURAL THRUST BLOCK	10	CY	$100.00	$250.00	$1,000.00	$2,500.00	$3,500.00
17	USGS AREIAL TRAM	1	LS	$8,000.00	$4,000.00	$8,000.00	$4,000.00	$12,000.00
18	24" DUCTILE IRON PIPE RIVER CROSSING	240	LF	$80.00	$150.00	$19,200.00	$36,000.00	$55,200.00
19	24" DIAMETER ISOLATION BF VALVE	1	LS	$1,800.00	$1,000.00	$1,800.00	$1,000.00	$2,800.00
20	24" WATER SUPPLY PIPELINE TO STATION	200	LF	$75.00	$80.00	$15,000.00	$16,000.00	$31,000.00
						$452,700.00	$473,000.00	$925,700.00

SUBTOTAL	$925,700
SUBTOTAL	$925,700
SUBTOTAL	$925,700
TOTAL	$925,700

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIA COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	KLICKITAT RIVER INTAKE, 30x15x20 CONCRET	90	CY	$80.00	$250.00	$7,200.00	$22,500.00	$29,700.00
2	SCREENS, MISC STEEL	300	SF	$150.00	$50.00	$45,000.00	$15,000.00	$60,000.00
3	10 CFS, 50 HP VERTICAL TURBINE PUMPS	4	EA	$35,000.00	$2,000.00	$140,000.00	$8,000.00	$148,000.00
4	EXCAVATION	200	CY	$7.00	$10.00	$1,400.00	$2,000.00	$3,400.00
5	24" MANIFOLD, W/FITTINGS	1	LS	$40,000.00	$10,000.00	$40,000.00	$10,000.00	$50,000.00
6	24" BF VALVES	4	EA	$1,800.00	$1,000.00	$7,200.00	$4,000.00	$11,200.00
7	MISC FITTINGS, REDUCERS	10	EA	$1,500.00	$1,000.00	$15,000.00	$10,000.00	$25,000.00
8	METAL BUILDING COVER	450	SF	$10.00	$10.00	$4,500.00	$4,500.00	$9,000.00
9	DE-ICING EQUIPMENT	1	LS	$3,000.00	$1,000.00	$3,000.00	$1,000.00	$4,000.00
10	30" WATER SUPPLY PIPELINE TO STATION	400	LF	$90.00	$95.00	$36,000.00	$38,000.00	$74,000.00
11	10" DE-ICING PIPELINE	400	LF	$15.00	$10.00	$6,000.00	$4,000.00	$10,000.00
12	RIVER WATER SEDIMENTATION BASIN,20x20x15	60	CY	$100.00	$200.00	$6,000.00	$12,000.00	$18,000.00
13	MISC FITTINGS, 30"	4	EA	$2,500.00	$1,000.00	$10,000.00	$4,000.00	$14,000.00
14	WATER SUPPLY RESERVOIR, 20x20x15	60	CY	$100.00	$200.00	$6,000.00	$12,000.00	$18,000.00
15	RESERVOIR COVERS	4	EA	$2,000.00	$500.00	$8,000.00	$2,000.00	$10,000.00
16	36" BF VALVES	1	EA	$2,300.00	$1,500.00	$2,300.00	$1,500.00	$3,800.00
17	24" BF VALVES	2	EA	$1,800.00	$1,000.00	$3,600.00	$2,000.00	$5,600.00
18	36" WATER SUPPLY PIPING	720	LF	$100.00	$120.00	$72,000.00	$86,400.00	$158,400.00
19	24" WATER SUPPLY PIPING	650	LF	$75.00	$80.00	$48,750.00	$52,000.00	$100,750.00
20	MISC FITTINGS	10	EA	$1,500.00	$100.00	$15,000.00	$1,000.00	$16,000.00
						$476,950.00	$291,900.00	$768,850.00

SUBTOTAL	$768,850
SUBTOTAL	$768,850
SUBTOTAL	$768,850
TOTAL	$768,850

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIAL COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	12" BF VALVE W/SIDE ACTUATOR	42	EA	$650.00	$100.00	$27,300.00	$4,200.00	$31,500.00
2	RACEWAY WATER SUPPLY RISER AND MANIFOLD	42	EA	$500.00	$500.00	$21,000.00	$21,000.00	$42,000.00
3	HATCHERY BUILDING WATER SUPPLY 24", 12"	200	LF	$75.00	$80.00	$15,000.00	$16,000.00	$31,000.00
4	HATCHERY INDOOR PIPING AND MANIFOLDS	1	LS	$20,000.00	$25,000.00	$20,000.00	$25,000.00	$45,000.00
5	SEALED PACKED COLUMNS	4	EA	$3,500.00	$1,000.00	$14,000.00	$4,000.00	$18,000.00
6	STATION RESERVOIR PIPING	4	EA	$1,500.00	$1,500.00	$6,000.00	$6,000.00	$12,000.00
7	24" WASTE DRAIN	1350	LF	$60.00	$60.00	$81,000.00	$81,000.00	$162,000.00
8	36" HATCHERY DRAIN	1450	LF	$100.00	$120.00	$145,000.00	$174,000.00	$319,000.00
9	STANDPIPES, 12"	42	EA	$50.00	$25.00	$2,100.00	$1,050.00	$3,150.00
10	STANDPIPES, 10"	42	EA	$45.00	$25.00	$1,890.00	$1,050.00	$2,940.00
11	POND MANIFOLDS	3	EA	$4,500.00	$1,500.00	$13,500.00	$4,500.00	$18,000.00
12	POND DRAINS, CORRUGATED METAL RISERS	3	EA	$3,500.00	$2,000.00	$10,500.00	$6,000.00	$16,500.00
13	4' PRECAST MANHOLE	2	EA	$2,000.00	$1,000.00	$4,000.00	$2,000.00	$6,000.00
14	SEDIMENTATION PONDS	600	CY	$20.00	$8.00	$12,000.00	$4,800.00	$16,800.00
15	RACEWAYS,CONCRETE 110x10x6, 76 CY EA	42	EA	$26,000.00	$25,000.00	$1,092,000.00	$1,050,000.00	$2,142,000.00
16	PONDS	3	EA	$45,000.00	$10,000.00	$135,000.00	$30,000.00	$165,000.00
17	SCREENS	84	EA	$3,000.00	$250.00	$252,000.00	$21,000.00	$273,000.00
18	WETLAND CONSTRUCTION	1	LS	$5,000.00	$2,000.00	$5,000.00	$2,000.00	$7,000.00
19	DOMESTIC SEWAGE DISPOSAL SYSTEM	1	LS	$41,000.00	$2,000.00	$41,000.00	$2,000.00	$43,000.00
20	DOMESTIC WATER SUPPLY SYSTEM	1	LS	$35,000.00	$5,000.00	$35,000.00	$5,000.00	$40,000.00
						$1,933,290.00	$1,460,600.00	$3,393,890.00

SUBTOTAL	$3,393,890
SUBTOTAL	$3,393,890
SUBTOTAL	$3,393,890
TOTAL	$3,393,890

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIAL COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	HATCHERY BUILDING	5000	SF	$18.00	$15.00	$90,000.00	$75,000.00	$165,000.00
2	WALK-IN FREEZER, WITHIN BUILDING	325	SF	$20.00		$6,500.00		$6,500.00
3	LOADING DOCK	900	SF	$5.00		$4,500.00		$4,500.00
4	LABORATORY SPECIAL CONSTRUCTION	325	SF	$10.00		$3,250.00		$3,250.00
5	RECIRCULATION SYSTEM	1	LS	$5,000.00	$1,000.00	$5,000.00	$1,000.00	$6,000.00
6	DEEP TROUGHS AND PLUMBING TO EACH	22	EA	$1,600.00	$800.00	$35,200.00	$17,600.00	$52,800.00
7	CABINET INCUBATORS, 16 TRAY STACK	8	EA	$1,300.00	$200.00	$10,400.00	$1,600.00	$12,000.00
8	BUILDING HEATING, SPACE HEATERS	8	EA	$600.00	$200.00	$4,800.00	$1,600.00	$6,400.00
9	BUILDING HEATING, FORCED AIR FURNACE	1	LS	$6,000.00	$1,000.00	$6,000.00	$1,000.00	$7,000.00
10	BUILDING ELECTRICITY	1	LS	$20,000.00	$10,000.00	$20,000.00	$10,000.00	$30,000.00
11	BUILDING LIGHTING	1	LS	$8,000.00	$5,000.00	$8,000.00	$5,000.00	$13,000.00
	SITE ELECTRICAL							
12	SITE LIGHTING	8	EA	$500.00	$200.00	$4,000.00	$1,600.00	$5,600.00
13	CONDUIT AND CONDUCTORS	1	LS	$12,000.00	$5,000.00	$12,000.00	$5,000.00	$17,000.00
14	MOTOR CONTROL CENTERS	4	EA	$5,000.00	$1,200.00	$20,000.00	$4,800.00	$24,800.00
15	CENTRAL ALARM SYSTEM AND COMPUTER	1	LS	$40,000.00	$20,000.00	$40,000.00	$20,000.00	$60,000.00
16	BACKUP GENERATOR, 220 KW	220	KW	$1,000.00	$25.00	$220,000.00	$5,500.00	$225,500.00
17	RESIDENCE POWER SUPPLY AND METERS	4	EA	$1,500.00	$1,000.00	$6,000.00	$4,000.00	$10,000.00
18	RESIDENCES, 1500 SF, PREFAB OR STICK	4	EA	$120,000.00	$2,000.00	$480,000.00	$8,000.00	$488,000.00
19	HATCHERY EQUIPMENT, TOOLS, FISH CULTURE	1	LS	$200,000.00		$200,000.00		$200,000.00
20	1 TON FLATBED & 3/4 TON PICKUP, 4x4'S	2	EA	$24,000.00		$48,000.00	- -	$48,000.00
						$1,223,650.00	$161,700.00	$1,385,350.00

SUBTOTAL	$1,385,350
SUBTOTAL	$1,385,350
SUBTOTAL	$1,385,350
TOTAL	$1,385,350

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIA COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	FIRE PROTECTION SYSTEM	1	LS	$45,000.00	$20,000.00	$45,000.00	$20,000.00	$65,000.00
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
						$45,000.00	$20,000.00	$65,000.00

SUBTOTAL	$65,000
SUBTOTAL	$65,000
SUBTOTAL	$65,000
TOTAL	$65,000

23-Jan-90

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST
PRELIMINARY DESIGN COST

OWNER: BONNEVILLE POWER ADMINISTRATION
PROJECT: KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT MATERIAL COST	UNIT LABOR COST	MATERIAL COST	LABOR COST	AMOUNT
1	SUMMARY							
2	PAGE 1	1	EA	$804,050.00		$804,050.00		$804,050.00
3	PAW 2	1	EA	$925,700.00		$925,700.00		$925,700.00
4	PAGE 3	1	EA	$768,850.00		$768,850.00		$768,850.00
5	PAGE 4	1	EA	$3,393,890.00		$3,393,890.00		$3,393,890.00
6	PAGE 5	1	EA	$1,385,350.00		$1,385,350.00		$1,385,350.00
7	PAGE 6	1	EA	$65,000.00		$65,000.00		$65,000.00
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
						$7,342,840.00		$7,342,840.00

CONTRACTOR OVERHEAD AND PROFIT INCLUDED	SUBTOTAL	$7,342,840
DESIGN AND CONSTRUCTION ENGINEERING, ADMINISTRATIVE, AND LEGAL FEES, 25% 0.25		$1,835,710
	SUBTOTAL	$9,178,550
ADDITIONAL ENGINEERING REQUIREMENTS FOR FINAL DESIGN:		
HEC 2 FLOOD PLAIN MODELLING		$135,000
GEOTECHNICAL AND FOUNDATION ENGINEERING		$180,000
WATER QUALITY REVIEW AND ADDITIONAL INVESTIGATION		$20,000
PIPELINE ROUTE SURVEYS		$35,000
ENVIRONMENTAL PERMITTING		$85,000
TOTAL		$9,634,000

3. CONSTRUCTION STAGING

The cost to build and design the Klickitat Station will depend on the schedule of construction and whether the construction can be staged to any degree. The Klickitat Hatchery construction can be staged into two or three phases. The first stage would be to complete the site work and construct the building, raceways that would be required for year one operation, sedimentation ponds, and the water intakes and supply. This level of construction would allow for operation of the facility the first year and the additional raceways and rearing ponds could be built during Phase 2 of the construction. The steelhead program at this station is planned to be a two-year smolt program, which will allow for construction staging. The logical components to build in stages are the concrete raceways. One 12-raceway bank of chinook raceways may be built the first year along with the 10 steelhead raceways. This would leave 21 raceways to be constructed during Phase 2 construction and would save approximately $500,000 In construction costs during the first year.

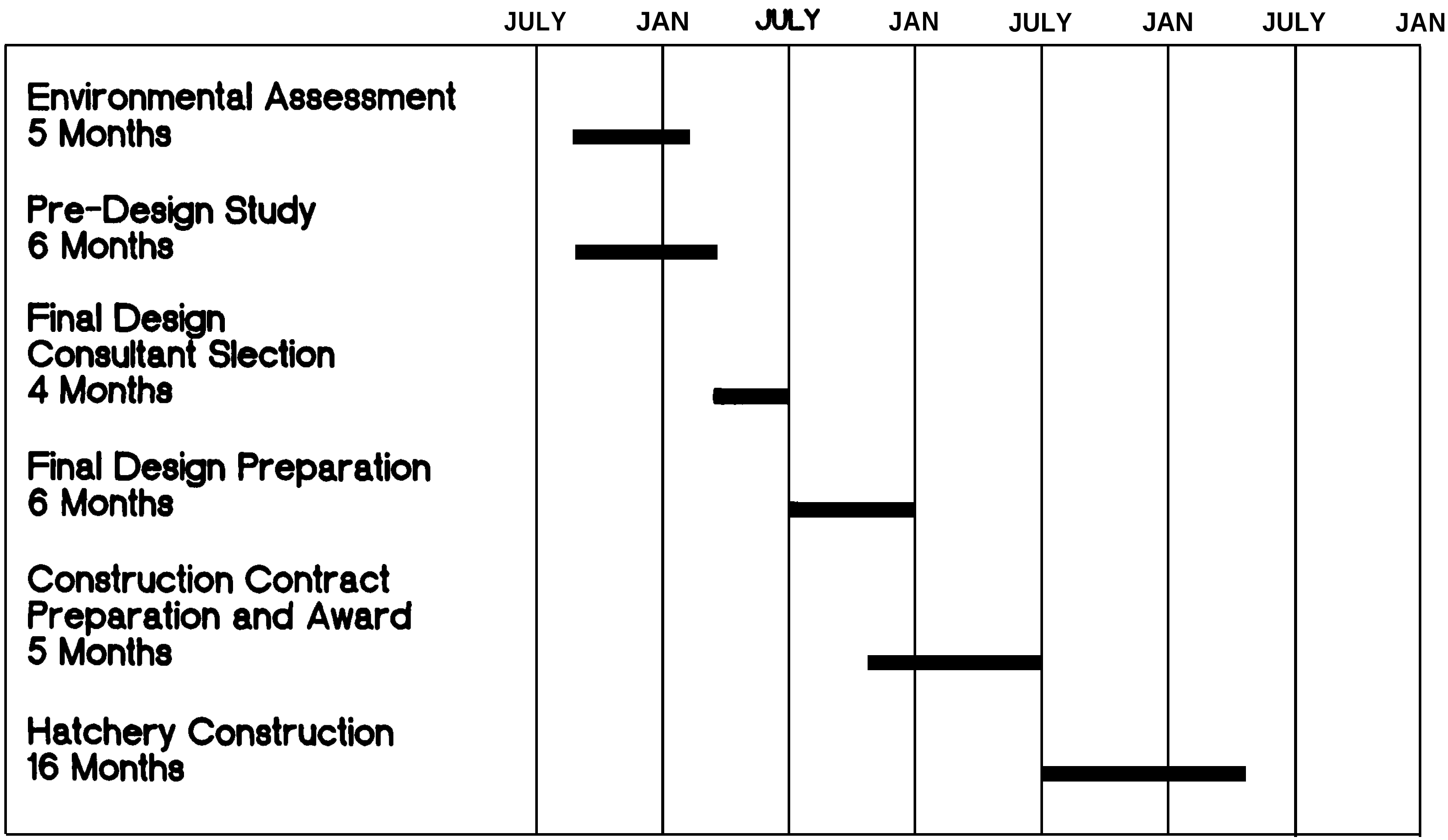
4. DESIGN AND CONSTRUCTION SCHEDULE

A design and construction schedule follows.

FIGURE V-1

KLICKITAT SALMON AND STEELHEAD HATCHERY

Design and Construction Schedule



WA00717

SECTION VI

REFERENCES

1. Fish Management Consultants, Yakima and Klickitat Rivers Central Outplanting Facility Proposed Master Plan. 1987.

2. Bonneville Power Administration, Draft Environmental Assessment Yakima/Klickitat Production Project. June 1989.

3. Northwest Power Planning Council, Columbia River Basin Fish and Wildlife Program.

4. Fish Management Consultants, Compendium of Lou Cost Pacific Salmon and Steelhead Trout Production Facilities and Practices in the Pacific Northwest, 1984.

SECTION VII

APPENDICES

APPENDIX A

FISH CULTURE PROGRAM, COMPUTER ESTIMATES, FISH MANAGEMENT CONSULTANTS

FINAL WATER AND SPACE CALCULATIONS

FOR KLICKITAT

WITH ADDED COMMENTS

By Fish Management Consultants

Olympia, WA 98503
(206)456-3826

May 1989

Fish Management Consultants

TO: Jay Kidder, R. W. Beck

FROM: Harry Senn HS

DATE: May 2, 1989

SUBJECT: Final Water and Space Calculations for Klickitat With Added Comments

A. Reference Water Needs

Tables 1A and 1B summarize rater flow recommendations. Several comments are:

- If a hatchery is to be over-design* here's the place to do it. We are suggesting this (see computer runs at end). Based on recent studies, we could likely get by on half of the rater without changing survival, however, I would surely cut elsewhere Wore I'd cut here.

- Table 1B would be my recommended design flow, however, in the feasibility report, it may be best to show the flow in Table 1A then comments on Table 1B. There is no difference in pounds/gpm between the program of Table 1A and Table 1B.

- Computer runs are enclosed for review showing flow/space.

B. **Space**

- Table 2 shows suggested space design

- Reference adult raceways

  1. We suggest two pairs of two each with access by truck to the outside wall. Consider a center wall with Pus through slots for easy adult sorting.

  2. Raceways are not highly recommended for holding spring chinook. WDF has suggested (P.C. Peck, 1989) epoxy paint may solve abrasions and high losses. Tea feet may be pretty narrow. Epoxy is another variable. Could we cost in removable liners in the four raceways. It may help.

- Space is not conservative, but realistic until we know better or go to lower cost units.

Table 1 - Klickitat Water Design

Table 1A - Klickitat Water Design: without mixing spring rater with river rater during last 5 months

	Spring Chinook	Steelhead	Total
Spring Source	30 cfs	10 cfs	40 cfs
River	60 cfs	15 cfs	75 cfs

- or-

Table 1B - Klickitat Water Design: by mixing spring rater with river rater during December through April

	Spring Chinook	Steelhead	Total
Spring Source	33.0 cfs	7.0 cfs	40 cfs
River (approx.)	30.0 cfs	8.0 cfs	38 cfs
	Total used at one time:		78 cfs

Table 2 - Klickitat - Raceways/adult/deep trough

Steelhead Minimum

Raceways = 6 for 2+ smolts
2 for 1+ smolts
1 for adults (100 females, 433,333 eggs)
1 spare

Deep trough= (20) trough for rearing need about 20, use 22
Raceways = 10 total (set in bank of 10)

Spring Chinook

Raceways = 5 for overlap period- March 1 to May
35 for smolts.[1]
0 for adults (need 4 raceways set up for adults out of the 35 through September 15).
2 spare

Deep trough= (21) 4.1 million green eggs
Raceways = 42 total (need 20.5 - we 22 deep)

[1]Note: The number 35 may not be compatible for Lars. The option would be to use one spare with 36 groups or reduce the study raceways from 35 to 33; retain one spare.

C. Pollution Runs

Please find these at the end of this report. They are only added to update the records.

HS:bp050289
Enclosure

cc: Clune
Scribner
Ward
Boyce
Gatton

Spring Chinook **program growth/food**

Culture Program for Spring Chinook at Cascade Springs
With 30 T.U./Inch of Growth

RUN NAME: [illegible]

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
1	03/06/89	3,738,461				33.3	1,496.1	2,499			
15	03/20/89	3,446,351	7.91	45.0	30.0	38.4	978.4	3,523	1.00	1,024	2.9
29	04/03/89	3,246,443	5.35	45.0	30.0	43.5	674.4	4,814	1.04	1,337	2.7
43	04/17/89	3,111,779	3.60	45.0	30.0	48.5	484.4	6,424	1.07	1,725	2.6
57	05/01/89	3,020,207	2.45	45.0	30.0	53.6	359.6	8,399	1.11	2,167	2.4
71	05/15/89	2,957,938	1.67	45.0	30.0	58.7	274.2	10,787	1.14	2.729	2.3
85	05/29/89	2,915,596	1.13	45.0	30.0	63.7	213.9	13,634	[illegible]	3,355	2.2
99	06/12/89	2,886,803	0.77	45.0	30.0	68.8	170.0	16,982	1.21	4,066	2.1
113	06/26/89	2,867,223	0.52	45.0	30.0	73.9	137.3	20,876	1.25	4,867	2.0
127	07/10/89	2,853, 753	0.36	45.0	30.0	78.9	112.6	25,355	1.29	5,759	2.0
141	07/24/89	2,843,024	0.29	45.0	30.0	84.0	93.4	30,444	1.32	6,725	1.9
155	08/07/89	2,832,768	0.27	45.0	30.0	89.1	78.3	36,163	1.36	7,761	1.8
169	08/21/89	2,822,791	0.27	44.0	30.0	93.5	67.2	42,017	1.39	8,154	1.6
183	09/04/89	2,813.106	0.26	44.0	30.0	98.4	58.1	48,459	1.43	9,203	1.6
197	09/18/89	2,803,711	0.25	44.0	30.0	103.1	50.5	55,517	1.46	10,334	1.5
211	10/02/89	2,794,626	0.24	44.0	30.0	107.8	44.2	63,216	1.50	11,549	1.5
225	10/16/89	2,785 ,265	0.23	44.0	30.0	112.5	38.9	71,585	1.54	12,852	1.5
239	10/30/89	2 ,777,428	0.23	44.0	30.0	117.2	34.4	80,650	1 .57	14,245	1.4
253	11/13/89	2,769,315	0.22	44.0	30.0	121.8	30.6	90,439	1.61	15,732	1.4
267	11/27/89	2,761,526	0.21	44.0	30.0	126.5	27.3	100,979	1.64	17,316	1.4
281	12/11/89	2,754 ,062	0.20	39.0	30.0	129.2	25.7	107,365	1.68	10,720	0.8
295	12/25/89	2,746,921	0.19	36.0	30.0	131.6	24.3	113,008	1.71	9,673	0.6
309	01/08/90	2,740,104	0.18	36.0	30.0	133.1	23.5	116,784	1.75	6,607	0.4
323	01/22/90	2,733,611	0.17	36.0	30.0	134.7	22.7	120,650	1.79	6,903	0.4
337	02/05/90	2,727,442	0.17	36.0	30.0	136.3	21.9	124,607	1.82	7,209	0.4
351	02/19/90	2,721,597	0.16	37.0	30.0	138.2	21.0	129,754	1.86	9,558	0.5
365	03/05/90	2,716,076	0.15	38.0	30.0	140.6	19.9	136,178	1.89	12,160	0.7
379	03/19/90	2,710,717	0.14	40.0	30.0	143.7	18.7	145,160	1.93	17,323	0.9
393	04/02/90	2,705,358	0.14	42.0	30.0	147.6	17.2	156,991	1.96	23,240	1.1
407	04/16/90	2,700,000	0.14	43.0	30.0	151.9	15.8	170,743	2.00	27,503	1.3

BIOMASS PRODUCED (LBS.) = 170,743
TOTAL FOOD FED (LOS.) = 271,816 AVERAGE CONVERSION = 1.62

Spring Chinook **flow/space**

Water Flow and Space Requirements for a Single Run of Swing Chinook at Cascade Springs (using 30 T.U./Inch of Growth)

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

SPRING WATER = 13,500 GPM (30 cfs; used first 9 months of rearing)
RIVER WATER = 27,000 GPM (60 cfs; used from December 1st to release)
RACEWAY SPACE = 200,000 CU.FT.

HYKLIAR

			------WATER FLOW REQMT'S--------				--------RACEWAY REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./ GPM	ALLOW- ABLE LBS./ GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./ CU.FT	ALLOW- ABLE LBS./ CU.FT.	TOTAL CU.FT. REQ'D
1	03/06/89	2,499	1350	1.85	5.74	435	25000	0.10	0.26	9,446
15	03/20/89	3.523	1350	2.61	5.74	614	25000	0.14	0.26	13,316
29	04/03/89	4,814	1350	3.57	6.20	777	25000	0.19	0.30	16,074
43	04/17/89	6,424	1350	4.76	6.56	979	25000	0.26	0.33	19,210
57	05/01/89	8,399	13500	0.62	6.91	1,216	155000	0.05	0.37	22,743
71	05/15/89	10,787	13500	0.80	7.24	1,490	155000	0.07	0.40	26,686
85	05/29/89	13,634	13500	1.01	7.56	1,803	155000	0.09	0.44	31,045
99	06/12/89	16,982	13500	1.26	7.89	2,154	155000	0.11	0.47	35,822
113	06/26/89	20,876	13500	1.55	8.21	2,544	155000	0.13	0.51	41,014
127	07/10/89	25,355	13500	1.88	8.53	2,974	155000	0.16	0.54	46,615
141	07/24.89	30,444	13500	2.26	8.87	3,433	155000	0.20	0.58	52,595
155	08/07/89	36,163	13500	2.68	9.23	3,919	155000	0.23	0.61	58,919
169	08/21/89	42,017	13500	3.11	10.93	3,845	155000	0.27	0.65	65,041
183	09/04/89	48,459	13500	3.59	11.25	4,308	155000	0.31	0.68	71,448
197	09/18/89	55,517	13500	4.11	11.55	4,805	155000	0.36	0.71	78,140
211	10/02/89	63,216	13500	4.68	11.84	5,337	175000	0.36	0.74	85,115
225	10/16/89	71,585	13500	5.30	12.12	5,906	175000	0.41	0.77	92,373
239	10/30/89	80,650	13500	5.97	12.38	6,514	175000	0.46	0.81	99,915
253	11/13/89	90,439	13500	6.70	12.63	7,160	175000	0.52	0.84	107,739
267	11/27/89	100,979	13500	7.48	12.87	7,846	175000	0.58	0.87	115,846
281	12/11/89	107,365	27000	3.98	26.38	4,071	175000	0.61	0.89	120,571
295	12/25/89	113,008	27000	4.19	31.08	3,636	175000	0.65	0.91	124,652
309	01/08/90	116,784	27000	4.33	47.89	2,439	175000	0.67	0.92	127,308
323	01/22/90	120,650	27000	4.47	47.37	2,547	175000	0.69	0.93	129,999
337	02/05/90	124,607	27000	4.62	46.86	2,659	175000	0.71	0.94	132,726
351	02/19/90	129,754	27000	4.81	36.50	3,555	175000	0.74	0.95	136,259
365	03/05/90	136,178	27000	5.04	29.88	4,558	175000	0.78	0.97	140,625
379	03/19/90	145,160	27000	5.38	21.57	6,729	175000	0.83	0.99	146,646
393	04/02/90	156,991	27000	5.81	16.44	9,549	175000	0.90	1.02	154,408
407	04/16/90	170,743	27000	6.32	14.70	11,612	175000	0.98	1.05	163,190

2 Year Culture Program for Steelhead at Cascade Springs
with 38 TU/Inch of Growth

RUN NAME: [illegible]

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
1	05/01/89	390,000				25.8	2,806.1	139			
15	05/15/89	357,462	8.34	45.0	38.0	29.8	1,820.4	196	0.80	46	2.4
29	05/29/89	335,194	5.71	45.0	38.0	33.8	1,247.2	269	0.83	60	2.2
43	06/12/89	320,194	3.85	45.0	38.0	37.8	891.[illegible]	359	0.85	77	2.0
57	06/26/89	309,994	2.62	45.0	38.0	41.8	659.2	470	0.88	97	1.9
71	07/10/89	303,058	1.79	45.0	38.0	45.[illegible]	501.0	[illegible]	0.90	121	1.8
[illegible]	07/24/89	298,341	1.21	45.0	38.0	49.8	389.7	766	0.93	149	1.8
99	08/07/89	295,134	0.82	44.0	38.0	53.5	314.4	939	0.95	164	1.5
113	08/21/89	292,953	0.56	44.0	38.0	57.2	257.3	1,136	0.98	195	1.5
127	09/04/89	291,453	0.28	44.0	38.0	60.9	213.3	1,367	1.00	228	1.4
141	09/18/89	290,258	0.31	44.0	38.0	64.6	178.7	1,624	1.03	264	1.4
155	10/02/89	289,115	0.29	44.0	38.0	68.3	151.3	1,911	1.05	302	1.3
169	10/16/89	288,004	0.28	44.0	38.0	72.0	129.1	2,230	1.08	343	1.3
183	10/30/89	286,925	0.28	44.0	38.0	75.7	[illegible]	2,582	1.10	387	1.2
197	11/13/89	285,879	0.27	44.0	38.0	79.4	96.3	2,968	1.13	434	1.2
211	11/27/89	284,867	0.26	44.0	38.0	83.0	84.0	3,390	1.15	485	1.2
225	12/11/89	283,891	0.25	39.0	38.0	85.2	77.9	3,648	1.18	303	0.6
239	12/25/89	282,951	0.24	38.0	38.0	87.0	73.0	3,878	1.20	275	0.5
253	01/08/90	282,047	0.23	36.0	38.0	88.3	70.0	4,032	1.23	189	0.3
267	01/22/90	281,180	0.22	36.0	38.0	89.5	67.1	4,190	1.25	198	0.4
281	02/05/90	280,348	0.21	36.0	38.0	90.7	64.4	4,352	1.28	207	0.4
295	02/19/90	279,553	0.20	37.0	38.0	92.3	61.2	4,564	1.30	276	0.5
309	03/05/90	278,793	0.19	38.0	38.0	94.1	57.7	4,831	1.33	353	0.6
323	03/19/90	278,070	0.19	40.0	38.0	96.6	53.4	5,206	1.35	507	0.7
337	04/02/90	277,383	0.18	42.0	38.0	99.7	48.6	5,706	1.38	687	0.9
351	04/16/90	276,732	0.17	43.0	38.0	103.1	44.0	6,293	1.40	821	1.0
365	04/30/90	276,117	0.16	45.0	38.0	107.1	39.2	7,039	1.43	1,063	1.2
379	05/14/90	275,520	0.15	45.0	38.0	111.1	35.1	7,841	1.45	1,163	1.2
393	05/28/90	274,923	0.15	45.0	38.0	115.1	31.6	8,701	1.48	1,268	1.2
407	06/11/90	274,326	0.15	45.0	38.0	119.1	28.5	9,620	1.50	1,378	1.1
421	06/25/90	273,729	0.15	45.0	38.0	123.1	25.8	10,600	1.53	1,494	1.1
435	07/09/90	273,132	0.15	45.0	38.0	127.1	23.5	11,643	1.55	1,616	1.1
449	07/23/90	272,535	0.15	45.0	38.0	131.1	21.4	12,750	1.58	1,744	1.1
463	08/06/90	271,938	0.15	44.0	38.0	134.8	19.7	13,828	1.60	1,725	1.0
477	08/20/90	271,342	0.15	44.0	38.0	138.5	18.1	[illegible],964	1.63	1,845	1.0
491	09/03/90	270,745	0.15	44.0	38.0	142.1	16.8	16,158	1.65	1,971	0.9
505	09/17/90	270,148	0.15	44.0	38.0	145.8	15.5	17,412	1.68	2,101	0.9
519	10/01/90	269,551	0.15	44.0	38.0	149.5	14.4	18,728	1.70	2,236	0.9
533	10/15/90	268,954	0.15	44.0	38.0	153.2	13.4	20,105	1.73	2,377	0.9
547	10/29/90	268,357	0.15	44.0	38.0	156.9	12.5	21,547	1.75	2,523	0.9
561	11/12/90	267,760	0.15	44.0	38.0	160.6	11.6	23,053	1.78	2,674	0.9
575	11/26/90	267,163	0.15	44.0	38.0	164.3	10.8	24,625	1.80	2,830	0.9
589	12/10/90	266,566	0.15	39.0	38.0	166.5	10.4	25,550	1.83	1,687	0.5
603	12/24/90	265,969	0.15	36.0	38.0	[illegible]	10.[illegible]	26,351	1.85	1,481	0.4
617	01/07/91	265,372	0.15	36.0	38.0	169.5	9.9	26,873	1.88	979	0.3
631	01/21/91	264,775	0.15	36.0	38.0	170.8	9.7	27,401	1.90	1,003	0.3

2 Year Culture Program for Steelhead at Cascade Springs
with 38 T.U./Inch of Growth

PERIOD ENDING DAY	PERIOD ENDING DATE	NO. FISH	% MORT.	AVE. TEMP. (F)	#TU'S /IN.	LENGTH (MM)	NO. FISH /LB.	BIOMASS (LBS.)	CONV. RATE	14 DAY FEED REQ. (LBS.)	% FOOD FED /DAY
645	02/04/91	264,178	0.15	36.0	38.0	172.0	9.5	27,935	1.93	1,028	0.3
659	02/18/91	263,582	0.15	37.0	38.0	173.5	9.2	28,626	1.95	1,349	0.3
673	03/04/91	262,985	0.15	38.0	38.0	175.4	8.9	29,483	1.98	1,692	0.4
687	03/18/91	262,388	0.15	40.0	38.0	177.9	8.6	30,673	2.00	2,379	0.6
701	04/01/91	261,791	0.15	42.0	38.0	180.9	8.1	32,220	2.03	3,132	0.7
715	04/15/91	261,194	0.15	43.0	38.0	184.3	7.7	33,985	2.05	3,619	0.8
729	04/29/91	260,597	0.15	45.0	38.0	188.3	7.2	36,164	2.08	4,522	1.0
743	05/13/91	260,000	0.15	45.0	38.0	192.3	6.8	38,431	2.10	4,760	0.9

BIOMASS PRODUCED (LBS.) = 38,431
TOTAL FOOD FED (LBS.) = 64,808 AVERAGE CONVERSION = 1.69

Steelhead flow/space

Water Flow and Space Requirements for a Single Run of Steelhead
at Cascade Springs (using 33 T.U./Inch of Growth)

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

SPRING WATER = 4,500 GPM (10 cfs; used from May 1st to December 1st)

RIVER WATER = 6,750 GPM (15 cfs; used from December 1st to May 1st)

RACEWAY SPACE = 40,000 CU.FT.

HYKL3AP

PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	WATER FLOW REQMT'S: ACTUAL WATER FLOW USED	ACTUAL LBS./GPM	ALLOWABLE LBS./GPM	FLOW REQ'D (GPM)	RACEWAY REQMT'S: ACTUAL RACEWAY SPACE USED	ACTUAL LBS./CU.FT.	ALLOWABLE LBS./CU.FT.	TOTAL CU.FT. REQ'D
1	05/01/89	139	500	0.28	7.12	20	10000	0.01	0.21	677
15	05/15/89	196	500	0.39	7.12	28	10000	0.02	0.21	957
29	05/29/89	269	500	0.54	7.73	35	10000	0.03	0.23	1,154
43	06/12/89	359	500	0.72	8.23	44	10000	0.04	0.26	1,379
57	06/26/89	470	500	0.94	8.69	54	10000	0.05	0.29	1,633
71	07/10/89	605	500	1.21	9.13	66	10000	0.06	0.32	1,917
85	07/24/89	766	500	1.53	9.57	80	10000	0.08	0.34	2,231
99	08/07/89	939	500	1.88	11.47	82	10000	0.09	0.37	2,547
113	08/21/89	1,138	500	2.28	11.88	96	10000	0.11	0.39	2,869
127	09/04/89	1,367	500	2.73	12.30	111	10000	0.14	0.42	3,258
141	09/18/89	1,624	500	3.25	12.76	127	10000	0.16	0.44	3,650
155	10/02/89	1,911	500	3.82	13.26	144	10000	0.19	0.47	4,064
169	10/16/89	2,230	500	4.46	13.74	162	10000	0.22	0.50	4,498
183	10/30/89	2,582	500	5.16	14.21	182	10000	0.26	0.52	4,953
197	11/13/89	2,968	500	5.94	14.65	203	10000	0.30	0.55	5,429
211	11/27/89	3,390	500	6.78	15.07	225	10000	0.34	0.57	5,925
225	12/11/89	3,648	1350	2.70	31.28	117	10000	0.36	0.59	6,215
239	12/25/89	3,878	1350	2.87	37.08	105	10000	0.39	0.60	6,466
253	01/08/90	4,032	1350	2.99	57.56	70	10000	0.40	0.61	6,629
267	01/22/90	4,190	1350	3.10	57.10	73	10000	0.42	0.62	6,794
281	02/05/90	4,352	1350	3.22	56.66	77	10000	0.44	0.63	6,962
295	02/19/90	4,564	1350	3.38	44.16	103	10000	0.46	0.64	7,179
309	03/05/90	4,831	1350	3.58	36.20	133	10000	0.48	0.65	7,449
323	03/19/90	5,206	1350	3.86	26.14	199	10000	0.52	0.67	7,824
337	04/02/90	5,706	1350	4.23	19.94	286	10000	0.57	0.69	8,310
351	04/16/90	6,293	1350	4.66	17.89	352	10000	0.63	0.71	8,863
365	04/30/90	7,039	1350	5.21	13.92	506	10000	0.70	0.74	9,544
379	05/14/90	7,841	4000	1.96	14.23	551	30000	0.26	0.77	10,248
393	05/28/90	8,701	4000	2.18	14.54	598	30000	0.29	0.79	10,976
407	06/11/90	9,620	4000	2.41	14.85	648	30000	0.32	0.82	11,728
421	06/25/90	10,600	4000	2.65	15.14	700	30000	0.35	0.85	12,502
435	07/09/90	11,643	4000	2.91	15.43	755	30000	0.39	0.88	13,299
449	07/23/90	12,750	4000	3.19	15.70	812	30000	0.42	0.90	14,119
463	08/06/90	13,828	4000	3.46	18.21	759	30000	0.46	0.93	14,893
477	08/20/90	14,964	4000	3.74	18.46	810	30000	0.50	0.95	15,687
491	09/03/90	16,158	4000	4.04	18.71	864	30000	0.54	0.98	16,499
505	09/17/90	17,412	4000	4.35	18.95	919	30000	0.58	1.00	17,329
519	10/01/90	18,728	4000	4.68	19.19	976	30000	0.62	1.03	18,178
533	10/15/90	20,105	4000	5.03	19.42	1,036	30000	0.67	1.06	19,044
547	10/29/90	21,547	4000	5.39	19.64	1,097	30000	0.72	1.08	19,929
561	11/12/90	23,053	4000	5.76	19.86	1,161	30000	0.77	1.11	20,832
575	11/26/90	24,625	4000	6.16	20.07	1,227	30000	0.82	1.13	21,753

Steelhead

Water Flow and Space Requirements for a Single Run of Steelhead
at Cascade Springs (using 38 T.U./Inch of Growth)

GIVEN THE FOLLOWING MAXIMUM WATER FLOW AND SPACE REQUIREMENTS:

SPRING WATER = 4,500 GPM (10 cfs; used from May 1st to December 1st)
RIVER WATER = 6,750 GPM (15 cfs; used from December 1st to May 1st)
RACEWAY SPACE = 40,000 CU.FT.

HYKL34P

			------WATER FLOW REQMT'S--------				--------RACEWAY REQMT'S----------			
PERIOD ENDING DAY	PERIOD ENDING DATE	TOTAL BIOMASS (LBS.)	ACTUAL WATER FLOW USED	ACTUAL LBS./GPM	ALLOW-ABLE LBS./GPM	FLOW REQ'D (GPM)	ACTUAL RACEWAY SPACE USED	ACTUAL LBS./CU.FT.	ALLOW-ABLE LBS./CU.FT.	TOTAL CU.FT. REQ'D
589	12/10/90	25,550	5400	4.73	40.87	625	30000	0.85	1.15	22,277
603	12/24/90	26,351	5400	4.88	48.29	546	30000	0.88	1.16	22,723
617	01/07/91	26.873	5400	4.98	75.37	357	30000	0.90	1.17	23,005
631	01/21/91	27,401	5400	5.07	75.01	365	30000	0.91	1.18	23,288
645	02/04/91	27,935	5400	5.17	74.66	374	30000	0.93	1.19	23,572
659	02/18/91	28,626	5400	5.30	57.98	494	30000	0.95	1.20	23,941
673	03/04/91	29,483	5400	5.46	47.37	622	30000	0.98	1.21	24.398
687	03/18/91	30,673	5400	5.68	34.00	902	30000	1.02	1.23	25,031
701	04/01/91	32,220	5400	5.97	25.77	1,250	30000	1.07	1.25	25,846
715	04/15/91	33,985	5400	6.29	22.93	1,482	30000	1.13	1.27	26,762
729	04/29/91	36,164	5400	6.70	17.68	2,046	30000	1.21	1.30	27,872
743	05/13/91	38,431	5400	7.12	17.87	2,151	30000	1.28	1.33	29,003

Discharge - **Klickitat**

Estimated PPM of Pollutants Generated Daily for
all Species Programmed at Cascade Springs

KLICKITAT

PERIOD ENDING DAY	PERIOD ENDING DATE	FOOD FED ALL SPECIES (LBS.)	GPM WATER ACTUAL	POLLUTANTS GENERATED IN PPM ** TOTAL AMMONIA	NH3	NITRATE	PHOSPHATE	SETTLED SOLIDS	B.O.D.	RECEIVING WATER (CFS)
1	06/01/89	334	18,000	0.05	0.0001	0.13	0.01	0.46	0.53	
15	06/15/89	394	18,000	0.06	0.0001	0.16	0.01	0.55	0.62	
29	06/29/89	461	18,000	0.07	0.0001	0.19	0.01	0.64	0.73	
43	07/13/89	535	18,000	0.08	0.0001	0.22	0.01	0.74	0.84	
57	07/27/89	616	18,000	0.09	0.0001	0.25	0.01	0.85	0.97	
71	08/10/89	689	18,000	0.10	0.0002	0.28	0.02	0.96	1.08	
85	08/24/89	728	18,000	0.11	0.0002	0.29	0.02	1.01	1.14	
99	09/07/89	814	18,000	0.12	0.0002	0.33	0.02	1.13	1.28	
113	09/21/89	907	18,000	0.13	0.0002	0.37	0.02	1.26	1.43	
127	10/05/89	1,006	18,000	0.16	0.0002	0.41	0.02	1.40	1.58	
141	10/19/89	[illegible]	18,000			0.45	0.03	1.54	1.75	
155	11/02/89	1,225	18,000	0.16	0.0003	0.49	0.03	1.70	1.93	
169	11/16/89	1,346	18,000	0.20	0.0003	0.54	0.03	1.87	2.12	
183	11/30/89	1,474	18,000	0.22	0.0003	0.59	0.03	2.05	2.32	
197	12/14/89	908	33,750	0.07	0.0001	0.20	0.01	0.67	0.76	
211	12/28/89	816	33,750	0.06	0.0001	0.18	0.01	0.60	0.68	
225	01/11/90	555	33,750	0.04	0.0001	0.12	0.01	0.41	0.47	
239	01/25/90	579	33,750	0.05	0.0001	0.12	0.01	0.43	0.49	
253	02/08/90	603	33,750	0.05	0.0001	0.13	0.01	0.45	0.51	
267	02/22/90	799	33,750	0.06	0.0001	0.17	0.01	0.59	0.67	
281	03/08/90	1,015	35,100	0.08	0.0001	0.21	0.01	0.72	0.82	
295	03/22/90	1,517	35,100	0.12	0.0002	0.31	0.02	1.08	1.22	
309	04/05/90	2,028	35,100	0.15	0.0002	0.42	0.02	1.44	1.64	
323	04/19/90	2,405	35,100	0.18	0.0003	0.50	0.03	1.71	1.94	
337	05/03/90	555	18,000	0.08	0.0001	0.22	0.01	0.77	0.87	
351	05/17/90	621	18,000	0.09	0.0001	0.25	0.01	0.86	0.98	
365	05/31/90	334	18,000	0.05	0.0001	0.13	0.01	0.46	0.53	
379	06/14/90	394	18,000	0.06	0.0001	0.16	0.01	0.55	0.62	
393	06/28/90	461	18,000	0.07	0.0001	0.19	0.01	0.64	0.73	
407	07/12/90	535	18,000	0.08	0.0001	0.22	0.01	0.74	0.84	

** The ppm of pollutants in the discahrge water is illustrated in the table. Vacuum cleaning will significantly reduce the level of settleable solids and B.O.D.

APPENDIX B

SITE INVESTIGATION REPORT,
R. W. BECK AND ASSOCIATES

WV-1715-EA1-AX
3023

September 14, 1989

Tom Clune
Senior Project Manager
Yakima Project
Fish And Wildlife Division
Bonneville Power Administration
Sunfair Professional Building
103 S. Third Street
P.O. Box 2685
Yakima, Washington 98907

Dear Tom:

Subject: Klickitat Salmon and Steeelhead
Hatchery Preliminary Design
Site Investigation Report

Included in this letter report are results to several months of field investigations and measurements. Through the course of approximately one year, starting in August of 1988 R.W. Beck personnel have visited the proposed area for the Klickitat Hatchery in the canyon of the Klickitat River near Cascade Spring. We began our work where the Waster Plan stopped. We set out to accomplish the preliminary site selection and design for the proposed hatchery and we are approaching the completion of this task at the end of October, 1989.

This letter will recap the history and results of the following investigations:

1. WDF Hatchery Co-operation Feasibility Review.
2. Property Line Boundary Review.
3. Topographic Site Survey.
4. Water Quality and Quantity Analysis and Review.
5. Measurement of Cascade Spring Water Flow.

6. Indian Ford Spring Water Flow Measurement/Later to be replaced with Kidder Spring water flow measurement.
7. River Flood Stage Elevation Analysis.

Upon the second trip to the proposed site we discovered another large Spring upriver from the Cascade Spring. This Spring has been named Kidder Spring and is currently ear-marked for about one third of the overall hatchery water demand. As was referenced in our letter dated April 21, 1989 we discussed the reasoning behind investigating the site we called "Midway Bar". The other proposed sites at White Creek and Indian Ford are more restrictive in space than the "Midway Bar" site and don't afford the convenience of the water supply from Kidder and Cascade Springs. We still do not see any "fatal flaws" with this site and we are proceeding with the preliminary design of the Klickitat Hatchery located at the "Midway Bar" site.

The potential for a co-operation plan with the WDF at their already established station on the Klickitat was considered as a possible means to provide for the required fish production goals. The idea entertained, was to utilize space at the Klickitat Salmon Hatchery at the same time that WDF was occupying the facility. This was thought to be possible because the Klickitat Salmon Hatchery was not at full capacity. However, when R. W. Beck and Associates researched the capacity of the station with the help of Bill Hopley of the WDF,we ascertained that the station was indeed at full capacity. The WDF policy concerning this co-operation idea was positive, however not possible because the station is continuing to operate at full capacity as planned for the long run. For this reason we requested a letter from Bill Hopley officially addressing this idea. This letter is attached for reference.

Initially we planned to do a property line description, survey and monument placement for the proposed hatchery site. Once the preliminary design began, your BPA office of Lands and Acquisition was engaged to do this task in-house. The results of this investigation are that the hatchery site proper, and Kidder Spring lie on Champion Timber Company land and that Cascade Spring exists on Tribal lands.

We also stated that the preliminary site elevations gathered early in our investigations would allow for gravity flow of water to the Midway Bar site from the springs. This can be accomplished through gravity pipelines starting at the Spring sources and flowing toward the hatchery. We now feel comfortable that gravity flow can be provided to the hatchery and its head boxes and supply manifolds by gravity pipelines as can be seen in the site plan and schematic profile attached. The Klickitat River water supply system will be more economical to pump than to construct a gravity pipeline the approximately 3500 feet upstream required for a gravity feed to the hatchery. During the final phases of design, the final elevations and grades between the Spring and River water supplies and the Hatchery must be refined one step further to provide topographic resolution sufficient for construction. The Midway Bar was the only site surveyed for topography because of the discounting of the White Creek and Indian Ford sites. Attached is the topographic survey to the nearest 5 feet for the Midway Bar site and the two spring water sources.

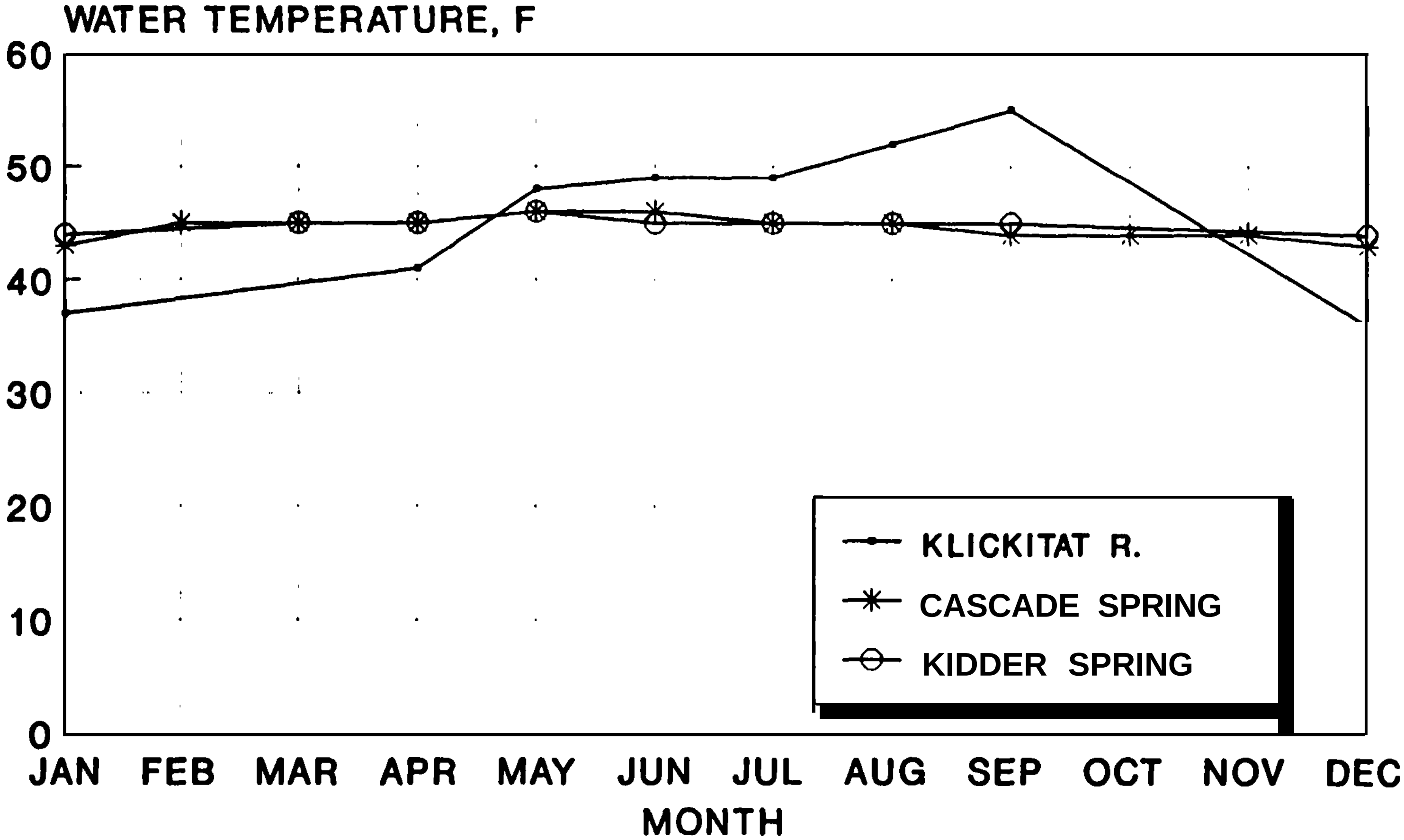
We measured the Spring flows of Cascade and Kidder Springs twice through the course of our investigations. The first measurement was on April 3rd,1989 and the second measurement was on August 22nd, 1989. Both Springs were measured using the dye injection flow measurement technique discussed in the letter of April 3, 1989. The results are as follows:

	April 3	August 22	Average
Cascade Spring	24 CFS	21 CFS	22.5 CFS
Kidder Spring	17 CFS	13 CFS	15 CFS

We feel that sufficient information concerning flow quantity from both Springs has been gathered to date and that this information is a conservative figure to base the preliminary design upon. The true quantity of water that is actually delivered to the facility will not be known until the Spring Diversions are in-place and functioning. Both springs are constant in flow rates as measured five months apart and for the most part the temperatures are close to stable. However there is a slight variation in temperature which is critical for the fish programming at this station. The cool temperatures can work for us as Harry Senn has programmed around these small fluctuations. If there is a difference in the temperatures between what was measured and what is actually delivered to the hatchery in the future then there will have to be an adjustment to the programming that allows for the variation.The attached plot of dates and temperatures for the three water sources for the Klickitat station is a culmination of what we know to date about them. Also attached is the hatchery flow requirements for a one year cycle in graphic and tabular format. This data was provided by Harry Senn.

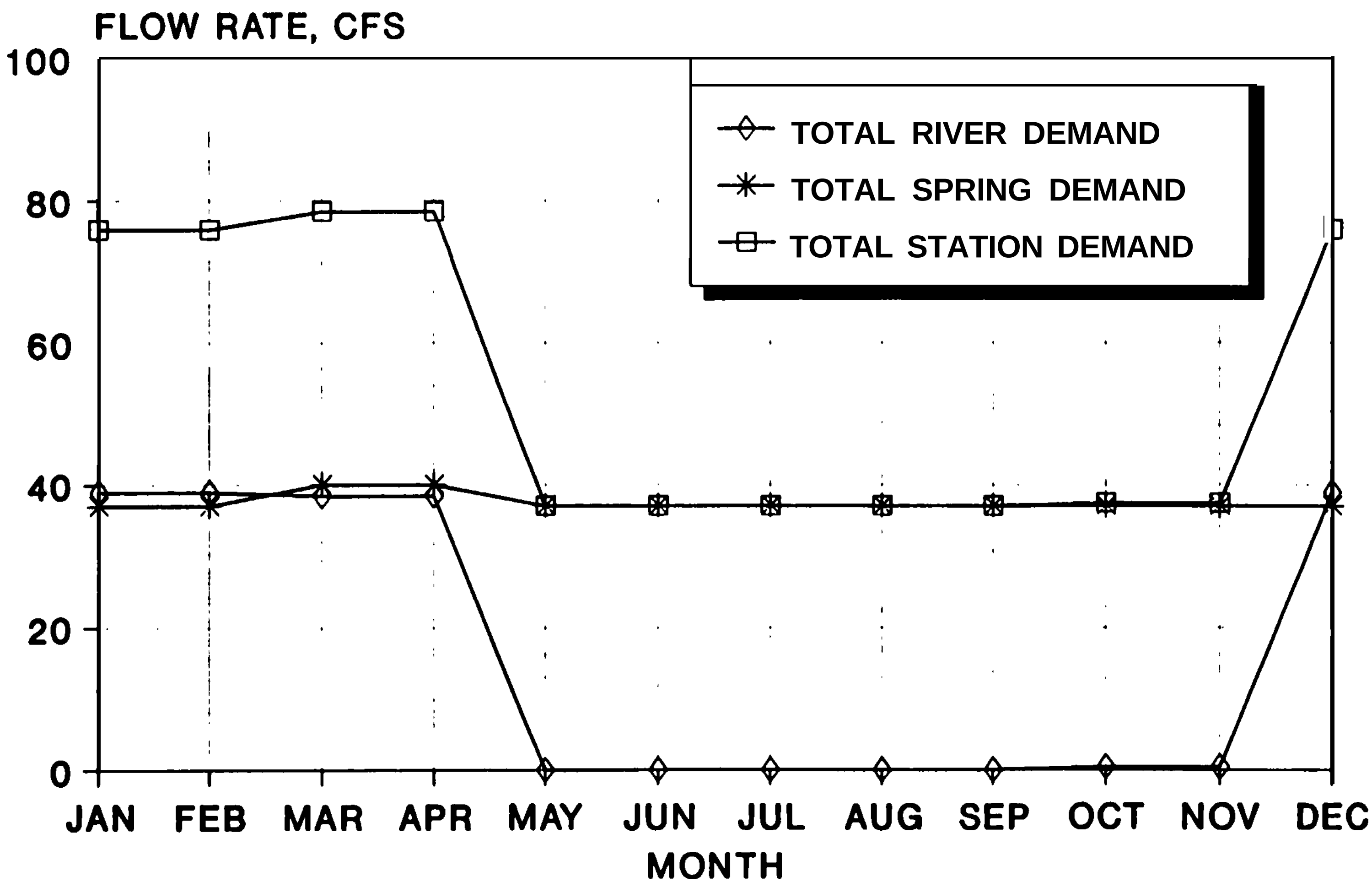
Also attached in a memorandum format to the file is our analysis of the flood flows and associated calculations of flood elevations. The approximate elevation of the finished site is above elevation 1175.0 feet MSL at the upstream end of the site and above 1168.0 feet MSL at the downstream end of the site. Likewise, the flood elevations that result from the 100 year flood event, plus a factor of safety of approximately four times this flow, display elevations ten feet higher than the original water surface at normal flows. The flood elevations are approximately 1172.0 feet MSL at the upstream end of the site and 1163.0 feet MSL at the downstream end of the site. Please see attached memo and calculations.

WATER TEMPERATURES vs. MONTH
KLICKITAT RIVER,
CASCADE AND KIDDER SPRINGS



X Data	KLICKITAT R.	CASCADE SPRING	KIDDER SPRING
JAN	37	43	44
FEB		45	
MAR		45	45
APR	41	45	45
MAY	48	46	46
JUN	49	46	45
JUL	49	45	45
AUG	52	45	45
SEP	55	44	45
OCT		44	
NOV		44	
DEC	36	43	44

KLICKITAT HATCHERY
WATER FLOW RATES vs. MONTH



X Data	KLICKITAT R.	TOTAL RIVER DE	TOTAL SPRING D	TOTAL STA
JAN	637	38.95	37	75.95
FEB	656	38.95	37	75.95
MAR	694	38.45	40	78.45
APR	1178	38.45	40	78.45
MAY	1849	0	37	37
JUN	1552	0	37	37
JUL	859	0	37	37
AUG	542	0	37	37
SEP	441	0	37	37
OCT	453	0.45	37	37.45
NOV	578	0.45	37	37.45
DEC	658	38.95	37	75.95

X Data	SPR CHINOOK 0	STEELHEAD 1 DE	STEELHEAD 2 DE	STEELHEAD
	0.5			8
FEB	0.5	0.45		8
MAR				
APR		0.45		8
MAY				
JUN				
JUL				
AUG				
SEP				
OCT				
NOV				
DEC	0.5			

STATE OF WASHINGTON
DEPARTMENT OF FISHERIES
115 General Administration Building • Olympia, Washington 98504 • (206) 753-6600 • (SCAN) 234-6600

RECEIVED
JUN 13 1989
R W BECK AND ASSOC.

June 12, 1989

Mr. Jay Kidder
Project Manager
R. W. Beck and Associates
2121 Fourth Avenue, Suite 600
Seattle, Washington 98121-2317

Dear Jay:

SUBJ: **KLICKITAT RIVER SALMON AND STEELHEAD HATCHERY**
EXISTING FACILITY REVIEW

Your letter of April 20, 1989 requests confirmation of the fact that no extra water or space is available for incubation or rearing at the Washington Department of Fisheries Klickitat station that could be utilized for a portion of the production program for the Klickitat tribal station.

We concur in general with your assessment. The water and pond use schedule for Klickitat was reviewed and, with one exception, there is no opportunity for additional rearing. The exception is Wonder Springs pond which is vacant between August and January. This time period normally does not offer any particular advantage for added production. There might be some sensible role, such as temperature advantage, that would complement the YKPP on an interim basis but no such role has been identified in the program.

There might also be a moderate level of hatching capacity if newly-hatched fry were ponded elsewhere. I doubt the benefits would be worth the added operational complexity.

In summary, although there might be minor opportunity for interim use of Klickitat Hatchery, there is no opportunity to achieve increased production at Klickitat Hatchery.

Please feel free to call if additional questions should arise.

Sincerely,

Bill

Bill Hopley, Asst. Chief
Assessment & Development

BH:fw

The water flow measurements performed by the U. S. Fish and Wildlife Biologists from the Vancouver Assistance office are not published within this report because the IFIM study is currently ongoing. This information will hopefully be ready when the final draft of the preliminary design report is finished and will be included at that time. The previously mentioned flood flow elevations are based on a standard hydrologic method of statistical analysis and provide a rough envelope of elevations to not set structures or facilities below. From this elevation and above, flood events of 100 year duration should not occur. Some fill will need to be placed along the outward and downstream portion of the site and revetment of riprap will need to be placed along the upstream face of the site for protection from high flow events. The areas of fill and riprap are shown on the attached site plan.

The outcome of all this field work and data collection is that the Midway Bar site for the Klickitat Salmon and Steelhead Hatchery is a good choice for the facility. To date there are no "fatal-flaws" with the site and its potential to provide for the proposed fish production program that is to be grown there. If there is any one problem with the development of the Midway Bar site, it is the affects that will be caused to the Springs and the Site by construction of the buildings and the water supply structures. Otherwise, the site development will require a moderate to high level of difficulty during construction of the water supply system and a moderate level of difficulty for construction of the hatchery facilities proper. The site is 40 miles remote from Goldendale and this may cause some inconvenience with certain phases of construction.

If you perceive any problems or have requests and questions please feel to call.

Sincerely,
R.W. Reck and Associates

Jay S. Kidder
Project Manager

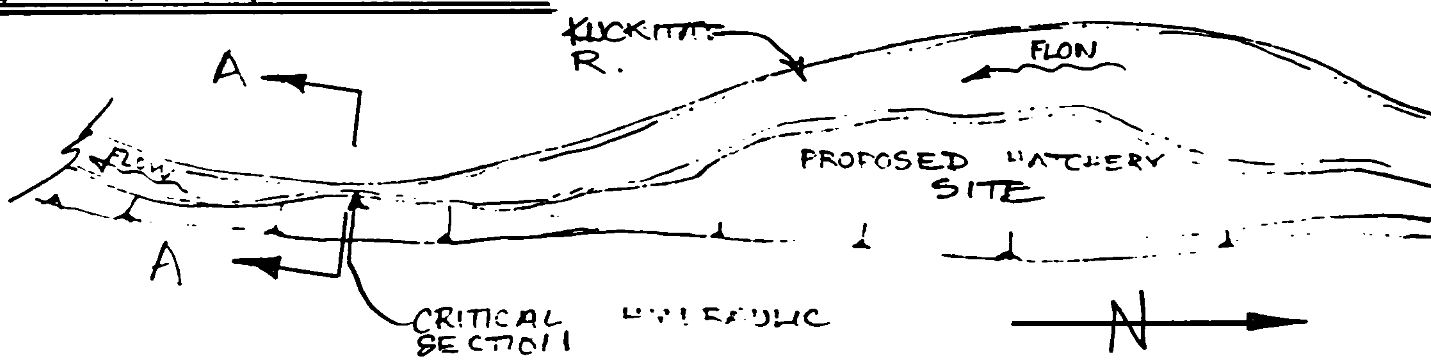
RWB
SD 31

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PREDESIGN RIVER FLOOD STAGE COMP. JK CHK. ______ REV. ______ DATE 6/29/87 DATE ______ DATE ______	PROJECT KLICKITAT FILE NO. ______ PAGE 1 OF 8 PAGES

I PURPOSE:

TO CALCULATE THE RIVER FLOOD STAGE AT THE PROPOSED HATCHERY SITE. THE RIVER STAGE WAS MEASURED WITH SURVEY INSTRUMENTS AND A CROSS SECTION WAS DEVELOPED AT THE SECTION VISUALLY CHOSEN TO BE THE CRITICAL SECTION FOR HYDRAULIC CONTROL IN FRONT OF THE HATCHERY SITE.

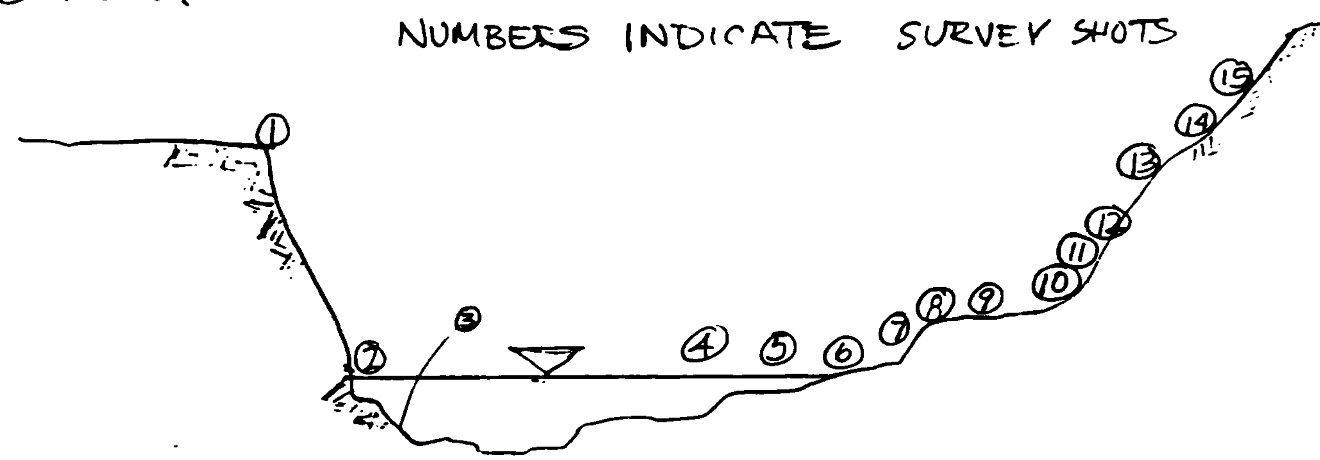
II SITE DESCRIPTION



SITE PLAN
SCALE: NONE

SECTION AA IS CHOSEN AS THE CRITICAL SECTION.

NUMBERS INDICATE SURVEY SHOTS



SCHEMATIC SECTION AA
SCALE: NONE

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PREDESIGN FLOOD STAGE CALCULATION.	PROJECT KLICKITAT
	COMP. — CHK. — REV. —	FILE NO.
	DATE 6/20/89 DATE — DATE —	PAGE 2 OF 8 PAGES

SURVEY NOTES

SECTION AA

NUMBER OF STA	HORIZ ∡	HORIZ DIST	VERT DIST	ELEV	COMMENT
1 LFT BANK @ RD.	183°-48-37	47.63	-0.53	1274.52	
2 WS @ TOE	209°-59-03	59.75	-24.20	1250.85	
3 EDGE OF POOL	218°-18'-14"	71.61	-27.62	1247.43	
4 IN POOL	238°-34-49	100.19	-26.82	1248.23	
5 IN POOL	239° 37' 19"	107.10	-26.13	1248.92	
6 WS RT BANK	241° 24' 19"	120.81	-24.07	1250.98	
7 RT BANK	243° 45' 02"	132.75	-22.73	1252.23	
8 "	247° 23' 24"	148.13	-21.67	1253.38	
9 "	248° 22' 55"	151.28	-19.71	1255.34	
10 TOP OF BENCH	249° 34' 51"	154.6	-17.12	1257.93	
11 ON BENCH	252° 40' 45"	167.45	-17.42	1257.63	
12 TOE OF HILL	250° 01' 21"	260.49	-17.64	1257.41	
13	251° 28' 48"	268.05	-13.13	1261.92	
14	249° 24' 34"	298.42	-4.14	1270.91	
15	248° 32' 42"	320.43	0.64	1274.41	

AREA OF WATER CROSS SECTION = 137.8 FT^2

III ASSUMPTIONS

1. ASSUME THE FLOW IN THE RIVER IS GRADUALLY VARIED OR CONSTANT. DURING THE INSTANCE OF ANALYSIS
2. ASSUME THE CROSS SECTION AA IS PERPENDICULAR TO THE FLOW STREAMLINES
3. USE MANNINGS EQUATION TO DESCRIBE THE FLOW IN THIS CROSS SECTION.

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PREDESIGN FLOOD STAGE CALCULATION. COMP. [illegible] CHK. ______ REV. ______ DATE 6/29/87 DATE ______ DATE ______	PROJECT KLICKITAT FILE NO. ______ PAGE 3 OF 8 PAGES

IV CALCULATE HYDRAULIC PARAMETERS OF SECTION AA

DETERMINE Q

ESTIMATED AVERAGE Q @ SECTION AA AND VERIFIED BY IFIM RECORDS OF USFWS 5/89 MEASUREMENTS.

REF. DON ENGLIN VACOUVER $\bar{Q} \cong 900$ CFS

A RELATIONSHIP OF AVG. Q AND MEAN MAXIMUM Q IS GIVEN BY, BELL, 1989 ; FISHERIES HANDBOOK USCOE.

$$\bar{Q}_{MAX} = 7.72\ \bar{Q} \qquad \text{EASTERN WASHINGTON}$$

$\therefore$ IF $\bar{Q} = 900$ CFS

$$\bar{Q}_{MAX} = (7.72)(900) = 6940 \text{ CFS}$$

USE $\bar{Q}_{MAX} = 7000$ CFS

WITHOUT FURTHER IN DEPTH PROBABILITY ANALYSIS AT THIS POINT USE A FACTOR OF SAFETY OF 4.

$$FS = 4$$

$$Q_{MAX} = (7000)(4) = 28{,}000 \text{ CFS}$$

USE THE FOLLOWING FLOWS FOR ANALYSIS:

$\bar{Q} \cong 900$ CFS
$\bar{Q}_{MAX} \cong 7000$ CFS
$Q_{MAX} = 28{,}000$ CFS

R. W. BECK AND ASSOCIATES	KLUCKNIT HATCHERY PREDESIGN FLOW STAGE CALCULATION	PROJECT KLUCKNIT
	COMP. [illegible] CHK. REV.	FILE NO.
	DATE 6/2?/87 DATE DATE	PAGE 4 OF 8 PAGES

NOTE ALSO THAT IN THE USFWS, 1979 FEASIBILITY STUDY, THE TWO FLOWS [illegible] NEAR GLENWOOD AT RIVER MILE 30.3 WERE IN 1933 AND 1979 AND MEASURED [illegible]870 CFS AND 9300 CFS RESPECTIVELY.

THE PROPOSED HATCHERY SITE IS LOCATED AT RIVER MILE ~41.0

ASSUME MANNINGS n

ASSUME $n = 0.028$

REF CHOW, OPEN CHANNEL HYDRAULIC 1959 PG 110.

ONE FORM OF MANNINGS EQUATION:

$$AR^{2/3} = \frac{Q\,n}{1.49\sqrt{S}}$$

A: AREA OF WETTED CROSS SECTION
R = HYDRAULIC RADIUS = A/P
Q = FLOW RATE
S = REACH SLOPE

REACH SLOPE WAS MEASURED TO BE
$S = 0.007$

FOR SECTION AA APRIL 3, 1987

$A = 137.9\ FT^2$
$P = 61\ FT$
$R = 2.26$
$b = 30'$ = BOTTOM WIDTH

RWB
SD 31

R. W. BECK AND ASSOCIATES		PROJECT KLICKITAT
	COMP. ____ CHK. R E V . ____	FILE NO. ____
	DATE ____ DATE ____ DATE ____	PAGE 5 OF 8 PAGES

CHECK GIVEN DIMENSIONS TO GIVEN Q

$$AR^{2/3} = \frac{Q\,n}{1.49\sqrt{S}}$$

$$(137.8\ FT^2/2.26)^{2/3} = \frac{(900)(0.028)}{1.49\sqrt{0.007}}$$

237.31 = 202.15 DOES NOT EQUATE

∴ Q = 900 CFS IS LOW

TRY Q = 1000 CFS

237.31 = 1000 (0.22)
237.31 = 224.61 CLOSER

TRY Q = CFS

237.31 = 1078 (0.22
237.31 = 237.31 OK

Q = 1078

∴ $\bar{Q}_{MAX}$ & Q_{MAX} ARE OK.

SOLVE FOR $AR^{2/3}$ AT Q_{MAX} = 28,000 CFS

$$AR^{2/3} = \frac{28{,}000\ (0.028)}{1.49\sqrt{0.007}} = 6160$$

FLOOD $AR^{2/3}$ = 6160

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY FLOOD ELEVATIONS. COMP. [illegible] DATE 9/11/[illegible] CHK. ____ DATE ____ REV. ____ DATE ____	PROJECT ____ FILE NO. ____ PAGE 6 OF 8 PAGES

CALCULATE NORMAL DEPTH

FIRST TRY

$Q = 28{,}000$

$S = 0.007$

$AR^{2/3} = 6160$

$b = 30'$

$AR^{2/3}/b^{8/3} = 6160/30^{8/3} = 6160/8689 = 0.71$

$y/b = 0.5$ REF CHOW Pg 130

$y = 0.5(30) = 15'$

$A = 1930\ FT^2$ $P = 236'$ $R = 1930/236 = 7.97$

$AR^{2/3} = 7501$

$7501 \neq 6160$ ∴ y = depth is too deep.

TRY $y = 14'$

$A = 1680\ FT^2$ $P = 230$ $R = 1680/230 = 7.30$

$AR^{2/3} = 6324 \neq 6160$ ∴ $y = 14'$ IS TOO DEEP ALSO

TRY $y = 13'$

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY ELEVATIONS	PROJECT KLICKITAT FILE NO. PAGE ___ OF 5 PAGES
	COMP. [illegible] CHK. ___ REV. ___ DATE 2/11/[illegible] DATE ___ DATE ___	

USE $Y = 13'$ PLUG INTO MANNINGS EQ.

$$AR^{2/3} = \frac{Q\,n}{1.49\sqrt{S}} = 6160 \qquad S = 0.[illegible]7$$

[illegible] CHOW [illegible] 130

$$AR^{2/3}/b^{8/3} = 6160/30^{8/3} = 0.71$$

$$y/b = 0.5$$

@ $y = 12'$ $A = 1360$ ft² $P = 223'$

$$R = 1360/223 = 6.1$$

[illegible] $AR^{2/3}$

$$[illegible] (1360)(6.1)^{2/3} = 4540$$

$$4540 \neq 6160$$

∴ FLOOD STAGE THROUGH THIS [illegible] SECTION WHEN Q_{MAX} = 28,[illegible] CFS WILL BE A [illegible] DEPTH,

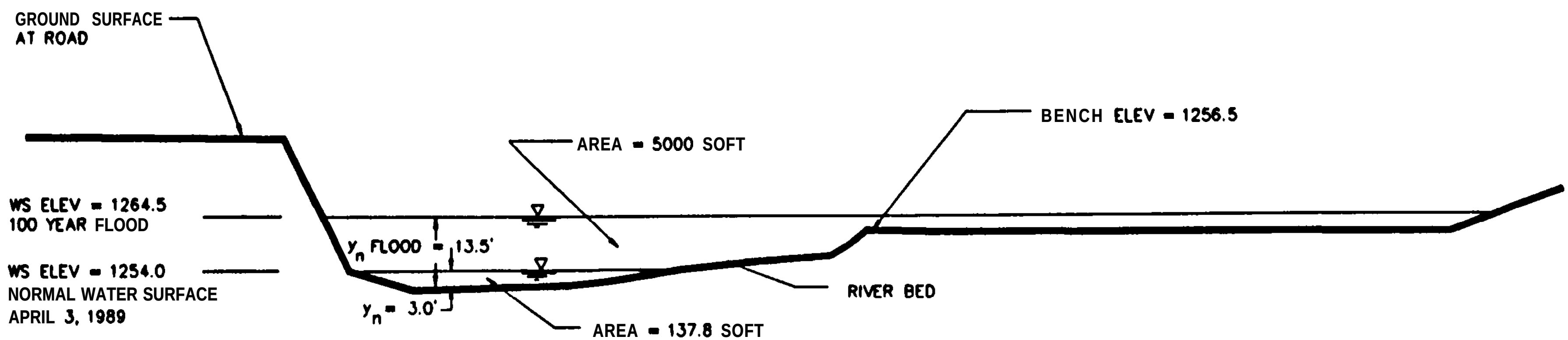
$$y_n \approx 13.5'$$

USE $y_n = 13.5'$ ALL ALONG HATCHERY SITE TO

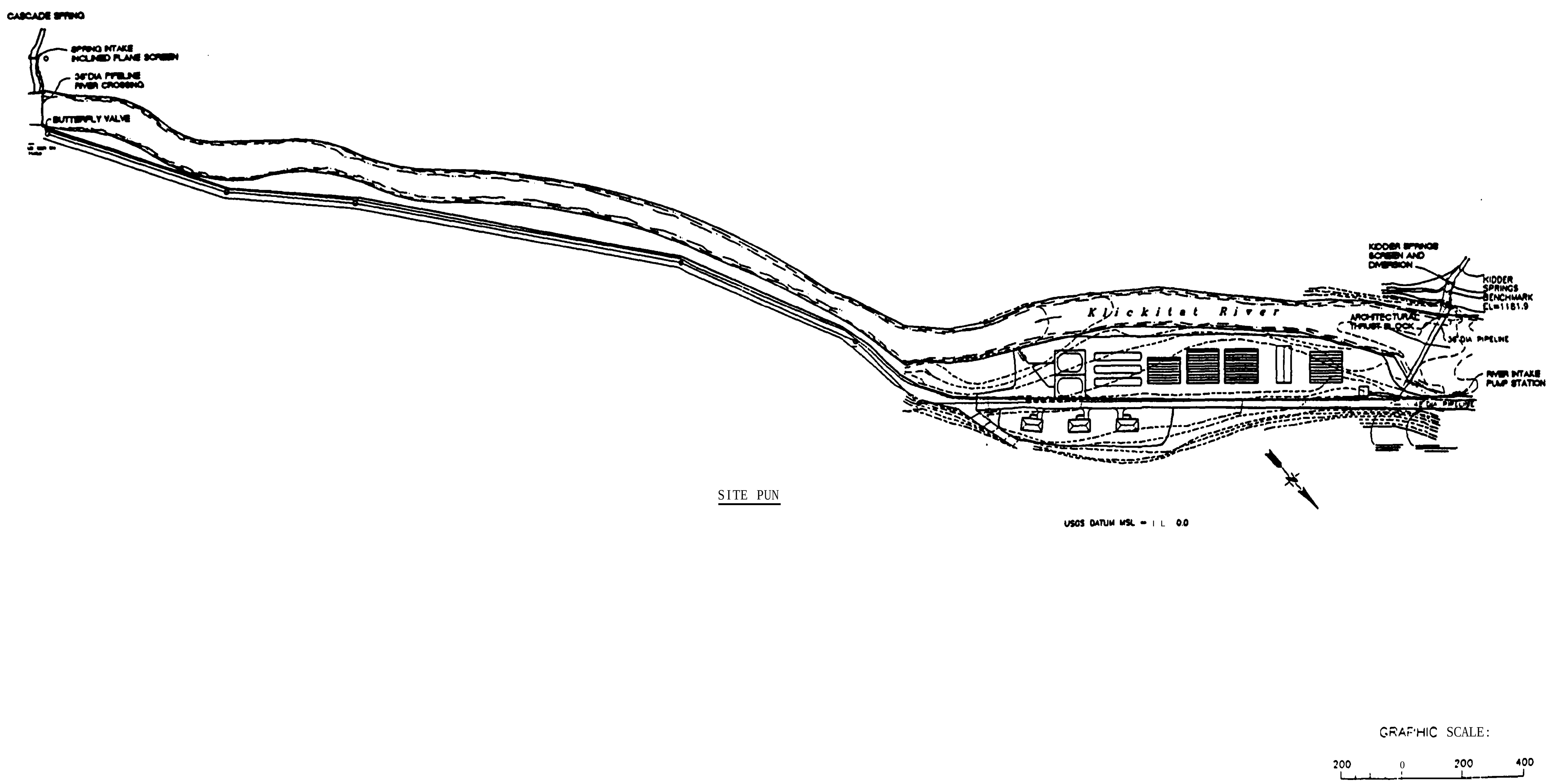
ESTABLISH THE ELEVATION OF MAXIMUM FLOOD.

THIS ANALYSIS MUST BE [illegible] AGAINST THE STATISTICAL ANALYSIS [illegible]. THE STATISTICAL ANALYSIS FOLLOWS.

CROSS SECTION OF KLICKITAT RIVER



SECTION AA



SITE PUN

R.W. BECK AND ASSOCIATES

KLICKITAT SALMON AND STEELHEAD HATCHERY

SITE PLAN

1

WV-1715-EA1-AX
3102

August 1, 1989

MEMORANDUM

TO: Lowell Warro, ~~Project Manager~~ PARTNER IN CHARGE

FROM: Paul Tappel

SUBJECT: Klickitat River Salmon and Steelhead Hatchery Flood Flow Analysis

INTRODUCTION

A Log-Pearson Type III distribution was done to analyze flood flows In the Klickitat River, and estimate the 100-year flood to be used during design of the hatchery. Flood flow data for the Klickitat River were obtained for years 1910-1979 for USGS Gauge No. 14110000, Klickitat River near Glenwood, Washington. This gauge is about 10 miles upstream from the proposed hatchery site, and there are no large tributaries entering the Klickitat River between the gauge and the hatchery site. Therefore, the Log-Pearson Type III analysis presented below should provide reliable estimates for flood flows at the hatchery site.

DATA AND CALCULATIONS

Calculations were done as suggested In the following reference:

Linsley, R. K., M. A. Kohler, and J. L. H. Paulhus. 1975. Hydrology for Engineers. McGraw-Hill Book Company. New York, New York.

The maximum annual flood flow observed In the Klickitat River, from 1910 to 1979, is shown In Table 1 along with calculations related to the Log-Pearson Type III analysis.

The Log-Pearson Type III analysis generated the following predictions of flood flows for the hatchery site:

100-year flood = 7,900 cfs
SO-year flood = 7,200 cfs
IO-year flood = 5,400 cfs
2-year flood = 3,200 cfs

TABLE 1: PEAK ANNUAL DISCHARGE DATA AND FLOOD-PROBABILITY ANALYSIS FOR USGS GAGE NUMBER 14110000, KLICKITAT RIVER NEAR GLENWOOD

WATER YEAR	PEAK DISCHARGE IN CFS	ORDER M	PLOTTING POSITION	LOG(CFS)	LOG(CFS)-LOG(X)	LOG(CFS)-LOG(X)SQ	LOG(CFS)-LOG(X)CU
1910	6250	4	17.50	3.796	0.296	0.088	0.026
1911	2910	43	1.63	3.464	-0.036	0.001	-0.000
1912	2790	48	1.46	3.446	-0.054	0.003	-0.000
1913	3310	30	2.33	3.520	0.020	0.000	0.000
1914	2890	44	1.59	3.461	-0.039	0.001	-0.000
1915	2200	58	1.21	3.342	-0.157	0.025	-0.004
1916	4620	13	5.38	3.665	0.165	0.027	0.004
1917	3300	31	2.26	3.519	0.019	0.000	0.000
1918	6200	5	14.00	3.792	0.293	0.086	0.025
1919	4600	14	5.00	3.663	0.163	0.027	0.004
1920	1840	63	1.11	3.265	-0.235	0.055	-0.013
1921	3770	21	3.33	3.576	0.077	0.006	0.000
1922	3420	27	2.59	3.534	0.034	0.001	0.000
1923	3160	37	1.89	3.500	0.000	0.000	0.000
1924	2230	57	1.23	3.348	-0.151	0.023	-0.003
1925	3030	41	1.71	3.481	-0.018	0.000	-0.000
1926	1750	64	1.09	3.243	-0.257	0.066	-0.017
1927	4490	15	4.67	3.652	0.153	0.023	0.004
1928	3100	38	1.84	3.491	-0.008	0.000	-0.000
1929	2560	51	1.37	3.408	-0.091	0.008	-0.001
1930	1520	67	1.04	3.182	-0.318	0.101	-0.032
1931	2200	59	1.19	3.342	-0.157	0.025	-0.004
1932	2700	49	1.43	3.431	-0.068	0.005	-0.000
1933	3950	19	3.68	3.597	0.097	0.009	0.001
1934	9870	1	70.00	3.994	0.495	0.245	0.121
1935	2680	50	1.40	3.428	-0.071	0.005	-0.000
1936	3070	39	1.79	3.487	-0.012	0.000	-0.000
1937	2390	54	1.30	3.378	-0.121	0.015	-0.002
1938	3960	18	3.89	3.598	0.098	0.010	0.001
1939	2140	60	1.17	3.330	-0.169	0.029	-0.005
1940	2040	62	1.13	3.310	-0.190	0.036	-0.007
1941	1540	66	1.06	3.188	-0.312	0.097	-0.030
1942	2050	61	1.15	3.312	-0.188	0.035	-0.007
1943	3280	33	2.12	3.516	0.016	0.000	0.000
1944	1220	68	1.03	3.086	-0.413	0.171	-0.071
1945	2380	55	1.27	3.377	-0.123	0.015	-0.002
1946	3210	36	1.94	3.507	0.007	0.000	0.000
1947	3970	17	4.12	3.599	0.099	0.010	0.001
1948	4710	11	6.36	3.673	0.173	0.030	0.005
1949	4710	12	5.83	3.673	0.173	0.030	0.005
1950	3410	28	2.50	3.533	0.033	0.001	0.000
1951	3830	20	3.50	3.583	0.084	0.007	0.001
1952	2810	46	1.52	3.449	-0.051	0.003	-0.000
1953	2830	45	1.56	3.452	-0.048	0.002	-0.000
1954	3380	29	2.41	3.529	0.029	0.001	0.000
1955	3500	26	2.69	3.544	0.044	0.002	0.000
1956	4920	7	10.00	3.692	0.192	0.037	0.007
1958	3700	23	3.04	3.568	0.069	0.005	0.000
1959	2230	56	1.25	3.348	-0.151	0.023	-0.003
1960	2800	47	1.49	3.447	-0.052	0.003	-0.000
1961	3060	40	1.75	3.486	-0.014	0.000	-0.000
1962	2410	53	1.32	3.382	-0.118	0.014	-0.002
1963	5110	6	11.67	3.708	0.209	0.044	0.009
1964	2430	52	1.35	3.386	-0.114	0.013	-0.001
1965	3020	42	1.67	3.480	-0.020	0.000	-0.000
1966	3540	25	2.80	3.549	0.049	0.002	0.000
1967	3280	32	2.19	3.516	0.016	0.000	0.000
1968	3590	24	2.92	3.555	0.055	0.003	0.000
1969	3260	35	2.00	3.513	0.014	0.000	0.000
1970	3260	34	2.06	3.513	0.014	0.000	0.000
1971	4010	16	4.38	3.603	0.104	0.011	0.001
1972	4870	8	8.75	3.688	0.188	0.035	0.007
1973	3770	22	3.18	3.576	0.077	0.006	0.000
1974	7600	2	35.00	3.881	0.381	0.145	0.055
1975	4800	9	7.78	3.681	0.182	0.033	0.006
1976	6550	3	23.33	3.816	0.317	0.100	0.032
1977	835	69	1.01	2.922	-0.578	0.334	-0.193
1978	4800	10	7.00	3.681	0.182	0.033	0.006
1979	1650	65	1.08	3.217	-0.282	0.080	-0.022
			SUMS:	241.473		2.247	-0.097

MEAN: 3.500
STD DEV: 0.182
SKEW COEF: -0.245

DISCUSSION AND SUMMARY

Klickitat River data (Table 1) were plotted on log-normal paper to relate river flow data to the Log-Pearson Type III analysis (Figure 1). There was an excellent correlation between the flow data and the Log-Pearson Type III curve (Figure 10).

The predicted 100-year flow of 7,900 cfs would be reasonable for hatchery design if there were no flood flow data existing which exceeded this amount. However, a peak flow of 9,870 cfs was repotted for Water Year 1934 (Table 1) and this data point was substantially higher than predicted by the Log-Pearson Type III analysis (Figure 1).

It is recommended that a flood flow of 10,000 cfs be used for design of the Klickitat Hatchery. This flow Is larger than the 100-year flood predicted by the Log-Pearson Type III analysis, and is also slightly larger than the maximum recorded flood during a 70-year period of record for the Klickitat River.

Paul Tappel

Paul Tappel
Civil Engineer

cc: Jay Kidder

(L7508C)

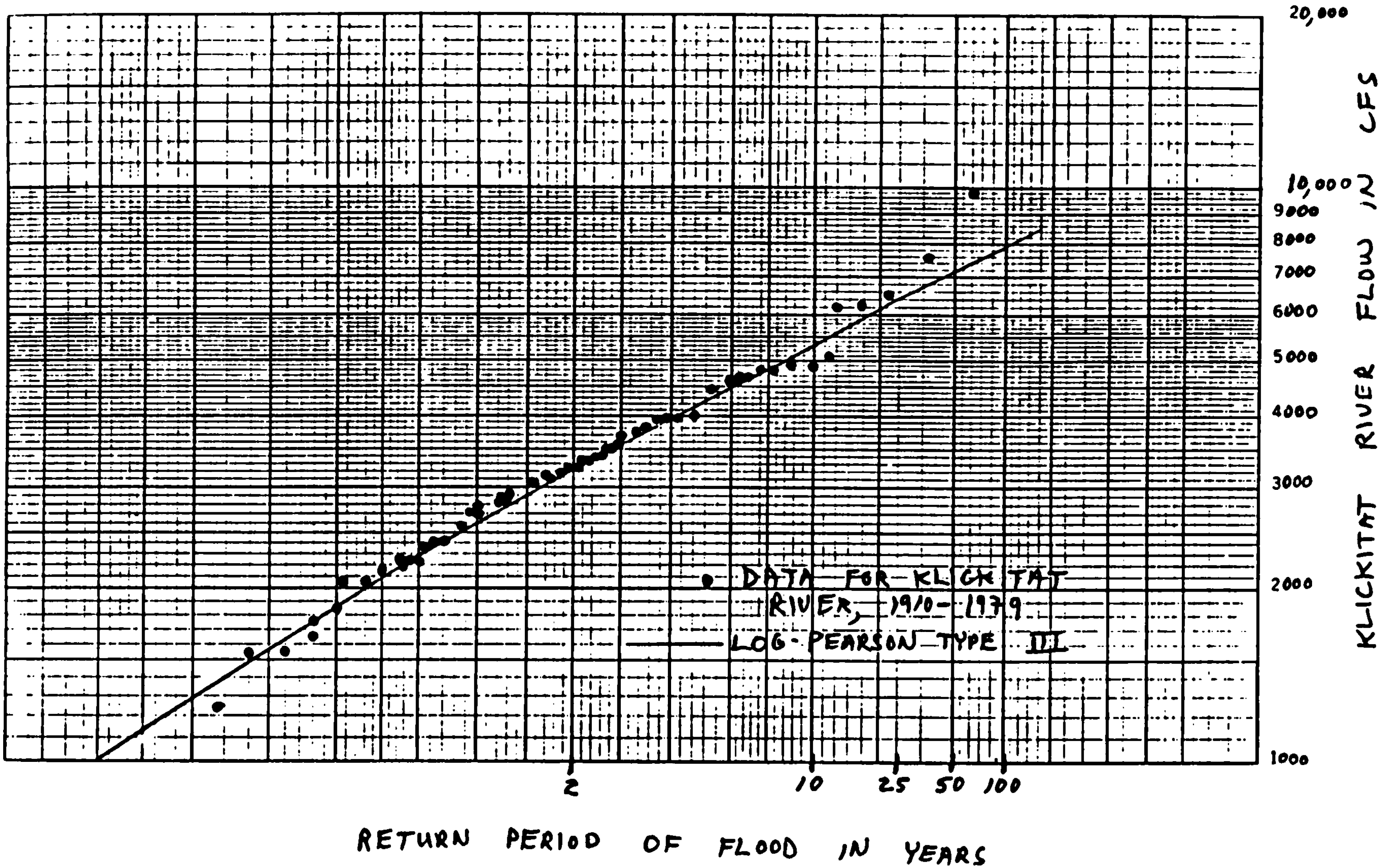


FIGURE 1: FLOOD FREQUENCY CURVE FOR THE KLICKITAT RIVER NEAR GLENWOOD, WASHINGTON.

RWB
SD 31

R. W. BECK AND ASSOCIATES	[illegible] [illegible] COMP. [illegible] CHK. ____ REV. ____ DATE 8/11/87 DATE ____ DATE ____	PROJECT ____ FILE NO. ____ PAGE 8 OF 8 PAGES

THE MEMORANDUM DATED 2/1/87 AND TITLED FLOOD FLOW ANALYSIS CONCLUDES THAT THE 100, 50, 10, AND 2 YEAR FLOODS ARE;

100 YR.	--	7,900 CFS
50 YR	–	7,200 CFS
10 YR	–	5,400 CFS
2 YR	–	3,200 CFS.

THEREFORE, THE PRECEDING ANALYSIS THAT USES Q_{MAX} = 28,000, OR $Q_{MAX} = 4\ \overline{Q}_{MAX}$ WHERE 4 = FS, IS VERY CONSERVATIVE.

THE NORMAL DEPTH OF y_n = 13.5' IS ALSO CONSERVATIVE AND RESULTS IN ABOUT A 10' CHANGE IN STAGE ALL ALONG THE HATCHERY SITE. FINAL PLAT BEYOND MUST CONSIDER THE FOLLOWING;

100 YR FLOOD, Q_{100} = 7100 CFS 100 YR FLOOD STAGE TO ~~BE~~ y_n = 13.5 @ SECTION AA AND A 10.0' INCREASE IN DEPTH OF THE KLICKITAT RIVER

APPENDIX C

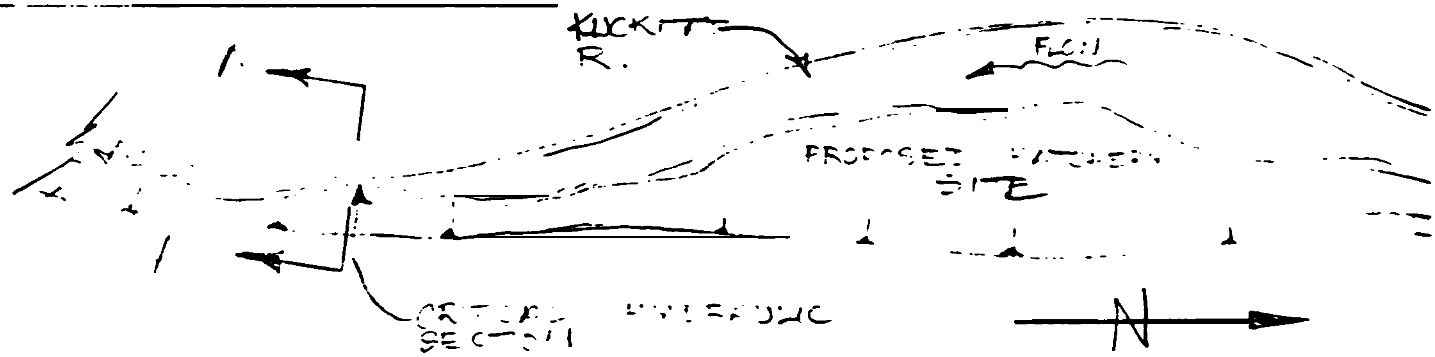
FLOOD STAGE ANALYSIS

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PREDESIGN RIVER FLOOD STAGE	PROJECT
	COMP. ____ CHK. ____ REV. ____	FILE NO.
	DATE 5/27/83 DATE ____ DATE ____	PAGE 1 OF 2

I PURPOSE:

TO CALCULATE THE RIVER FLOOD STAGE AT THE PROPOSED HATCHERY SITE. THE RIVER STAGE WAS MEAS... WITH SURVEY INSTRUMENTS AND A CROSS SECTION WAS DEVELOPED AT THE SECTION VISUALLY CHOSEN TO BE THE CRITICAL SECTION FOR HYDRAULIC CONTROL IN FRONT OF THE HATCHERY SITE.

II SITE DESCRIPTION

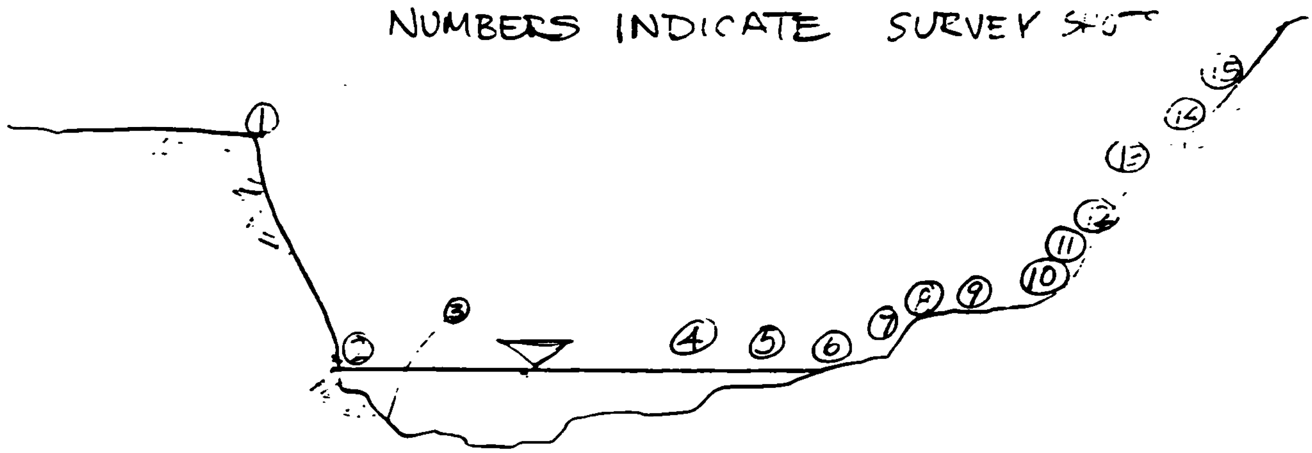


SITE PLAN

SCALE: NONE

SECTION AA IS CHOSEN AS THE CRITICAL SECTION.

NUMBERS INDICATE SURVEY SHOT



SCHEMATIC SECTION AA

SCALE: NONE

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PR[illegible]	PROJECT KLICKITAT
	FLOOD STAGE CALCULATION.	FILE NO.
	COMP. [illegible] CHK. REV.	PAGE 2 OF 5 PAGES
	DATE [illegible] DATE DATE	

SURVEY NOTES

SECTION AA

NUMBER OF STA	HORIZ ∡	HORIZ DIST	VERT DIST	ELEV	COMMENT
1 [illegible] RD.	183-48-37	47.63	-0.53	1274.52	
2	209-59-03	59.75	-24.20	1250.85	
3 [illegible]	215°-18'-14"	71.61	-27.62	1247.43	
4 [illegible]	233-34-49	100.19	-26.[illegible]	[illegible]	
5 [illegible]	239° 37' 19"	107.10	-26.13	124[illegible]	
6. [illegible] BANK	241° 24' [illegible]	120.81	-24.07	125[illegible]	
7 RT BANK	243° 45' 02"	132.75	-22.73	1252.23	
8	247° 23' 24"	148.13	-21.67	1253.38	
9	248° 22' 55"	151.29	-19.71	1255.34	
10 [illegible]	249° 34' 51"	154.6	-17.12	1257.93	
11 [illegible]	252° 40' 45"	167.45	-17.42	1257.63	
12 [illegible] LL	250° 01' 21"	260.49	-17.64	1257.41	
13	251° 28' 48"	268.05	-13.13	1261.92	
14	249° 24' 34"	298.42	-4.14	1270.91	
15	248° 32' 42"	320.43	0.64	1274.41	

AREA OF WATER CROSS SECTION = 137.8 FT^2

III ASSUMPTIONS

1. ASSUME THE FLOW IN THE RIVER IS GRADUALLY VARIED OR CONSTANT DURING THE INSTANCE OF ANALYSIS
2. ASSUME THE CROSS SECTION AA IS PERPENDICULAR TO THE FLOW STREAMLINES
3. USE MANNINGS EQUATION TO DESCRIBE THE FLOW IN THIS CROSS SECTION.

RWB
SD 31

R. W. BECK AND ASSOCIATES	KLICKITT HATCHERY PREDESIGN FLOOD STAGE CALCULATION. COMP. [illegible] CHK. REV. DATE 6/2[illegible] DATE DATE	PROJECT KLICKITT FILE NO. PAGE 3 OF 3 PAGES

IV CALCULATE HYDRAULIC PARAMETERS OF SECTION AA

DETERMINE Q

ESTIMATED AVERAGE Q @ SECTION AA AND VERIFIED BY IFIM RECORDS OF USFWS 5/89 MEASUREMENTS.

REF DON ENGLIN VANCOUVER $\bar{Q} \cong 900$ CFS

A [illegible] OF AVG Q AND MEAN MAXIMUM Q IS GIVEN BY, BELL, 1989; FISHERIES [illegible] USCOE.

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USE $\bar{Q}_{MAX} = 7000$ CFS

WITHOUT FURTHER IN DEPTH PROBABILITY ANALYSIS AT THIS POINT USE A FACTOR OF SAFETY OF 4.

$$FS = 4$$

$$Q_{MAX} = (7000)(4) = 28{,}000 \text{ CFS}$$

USE THE FOLLOWING FLOWS FOR ANALYSIS:

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$\bar{Q}_{MAX} \cong 7000$ CFS
$Q_{MAX} = 28{,}000$ CFS

RWB
SD 31

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY PREDESIGN FLOOD STAGE CALCULATION	PROJECT KLICKITAT
	COMP. [illegible] CHK. REV.	FILE NO.
	DATE [illegible] DATE DATE	PAGE 4 OF 8 PAGES

NOTE ALSO THAT IN THE USFWS, 1979 FEASIBILITY STUDY, THE TWO FLOODS OF REC. NEAR GLENWOOD AT RIVER MILE 50.3 WERE IN 1933 AND 1978 AND MEASURED 4,370 CFS AND 9300 CFS RESPECTIVELY.

THE PROPOSED HATCHERY SITE IS LOCATED AT RIVER MILE ~ 41.0

ASSUME MANNINGS n

ASSUME $n = 0.028$

REF. CHOW, OPEN CHANNEL HYDRAULICS 1959 PG 110.

ONE FORM OF MANNINGS EQUATION:

$$AR^{2/3} = \frac{Qn}{1.49\sqrt{S}}$$

A: AREA OF WETTED CROSS SECTION
R: HYDRAULIC RADIUS = A/P
Q: FLOW RATE
S: REACH SLOPE

REACH SLOPE WAS MEASURED TO BE
$S = 0.007$

FOR SECTION AA APRIL 3, 1989
$A = 137.9 \text{ FT}^2$
$P = 61$ FT
$R = 2.26$
$b = 30'$ = BOTTOM WIDTH

CHECK GIVEN DIMENSIONS TO GIVEN Q

$$AR^{2/3} = \frac{Q\,n}{1.49\sqrt{S}}$$

$$137.8\ FT^2 (2.26)^{2/3} = \frac{(900)(0.028)}{1.49\sqrt{0.007}}$$

237.31 = 202.15 DOES NOT EQUATE

∴ Q = 900 CFS IS LOW

TRY Q = 1000 CFS

237.31 = 1000 (0.22)
237.31 = 224.61 CLOSER

TRY Q = CFS

237.31 = 1078 (0.22

237.31 = 237.31 OK ✓

Q = 1078

∴ $\bar{Q}_{MAX}$ & Q_{MAX} ARE OK.

SOLVE FOR $AR^{2/3}$ AT Q_{MAX} = 28000 CFS

$$AR^{2/3} = \frac{28000\ (0.028)}{1.49\sqrt{0.007}} = 6160$$

FLOOD $AR^{2/3} = 6160$

R. W. BECK AND ASSOCIATES	KLICKITAT HATCHERY FLOOD ELEVATIONS COMP. [illegible] CHK. REV. DATE [illegible] DATE DATE	PROJECT FILE NO. PAGE 6 OF 8 PAGES

CALCULATE NORMAL DEPTH

FIRST TRY

$Q = 28,000$

$S = 0.007$

$AR^{2/3} = 6160$

$D = 30'$

$AR^{2/3}/D^{8/3} = 6160/30^{8/3} = 6160/8689 = 0.71$

$y/D = 0.5$ REF CHOW PG 130

$y = 0.5(30) = 15'$

$A = 1980\ FT^2$ $P = 236'$ $R = 1980/236 = 7.97$

$AR^{2/3} = 7501$

$7501 \neq 6160$ ∴ y = depth is too deep.

TRY $y = 14'$

$A = 1680\ FT^2$ $P = 230$ $R = 1680/230 = 7.30$

$AR^{2/3} = 6324 \neq 6160$ ∴ y = 14' IS TOO

DEEP ALSO

TRY $y = 13'$

R. W. BECK AND ASSOCIATES	ELEVATIONS.	PROJECT
	COMP. CHK. REV.	FILE NO.
	DATE DATE DATE	PAGE OF PAGES

USE $Y = 13'$ PLUG INTO MANNINGS EQ.

$$AR^{2/3} = \frac{Q\,n}{1.49\sqrt{S}} = 6160 \qquad S = 0.0\ 7$$

REF: CHOW

$$AR^{2/3}/b^{8/3} = 6160/30^{8/3} = 0.71$$

$y/b = 0.5$

$A = 1360$ ☐ $P = 223'$

$R = 1360/223 = 6.1$

$1360(6.1)^{2/3} = 4540$

$4540 \neq 6160$

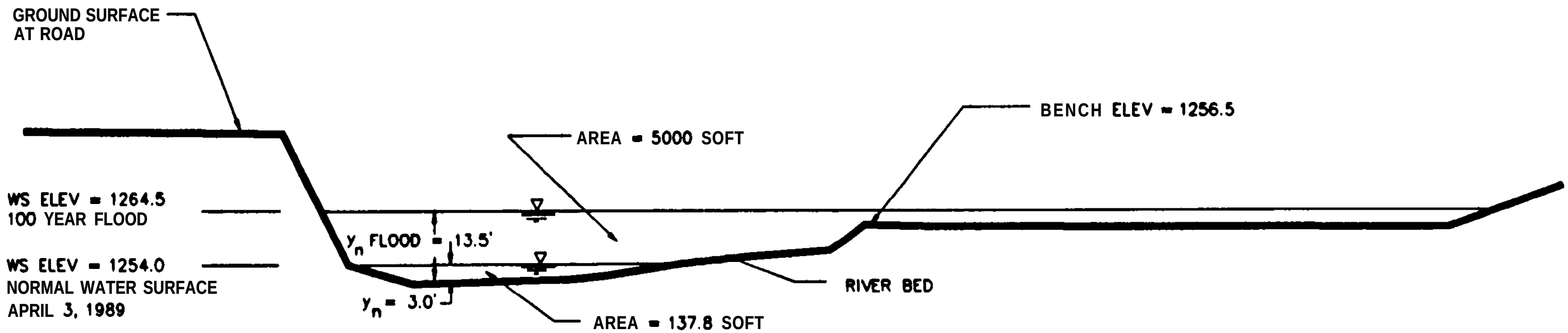
∴ FLOOD STAGE THROUGH THIS ... SECTION AFTER $Q_{max} = 25,000$ CFS WILL BE ...

$y_{cr} \approx 13.5'$

USE $y_{cr} = 13.5'$ ALL ALONG HATCHERY SITE TO ESTABLISH THE ELEVATION OF MAXIMUM FLOOD.

THIS ANALYSIS MUST BE CHECKED ... ANALYSIS OF THE ... THE STATISTICAL ANALYSIS FOLLOWS.

CROSS SECTION OF KLICKITAT RIVER



SECTION AA

WV-1715-EA1-AX
3102

August 1, 1989

MEMORANDUM

TO: Lowell Warren, ~~Project Manager~~ PARTNER IN CHARGE

FROM: Paul Tappel

SUBJECT: Klickitat River Salmon and Steelhead Hatchery Flood Flow Analysis

INTRODUCTION

A Log-Pearson Type III distribution was done to analyze flood flows In the Klickitat River, and estimate the 100-year flood to be used during design of the hatchery. Flood flow data for the Klickitat River were obtained for years 1910-1979 for USGS Gauge No. 14110000, Klickitat River near Glenwood, Washington. This gauge is about 10 miles upstream from the proposed hatchery site, and there are no large tributaries entering the Klickitat River between the gauge and the hatchery site. Therefore, the Log-Pearson Type III analysis presented below should provide reliable estimates for flood flows at the hatchery site.

DATA AND CALCULATIONS

Calculations were done as suggested In the following reference:

Linsley, R. K., M. A. Kohler, and J. L. H. Paulhus. 1975. Hydrology for Engineers. McGraw-Hill Rook Company, New York, New York.

The maximum annual flood flow observed In the Klickitat River, from 1910 to 1979, is shown In Table 1 along with calculations related to the Log-Pearson Type III analysis.

The Log-Pearson Type III analysis generated the following predictions of flood flows for the hatchery site:

100-year flood = 7,900 cfs
SO-year flood = 7,200 cfs
lo-year flood = 5,400 cfs
2-year flood = 3,200 cfs

TABLE 1: PEAK ANNUAL DISCHARGE DATA AND FLOOD-PROBABILITY ANALYSIS FOR USGS GAGE NUMBER 14110000, KLICKITATRIVER NEAR GLENWOOD

WATER YEAR	PEAK DISCHARGE IN CFS	ORDER M	PLOTTING POSITION	LOG(CFS)	LOG(CFS)-LOG(X)	LOG(CFS)-LOG(X)SQ	LOG(CFS)-LOG(X)CU
1910	6250	4	17.50	3.796	0.296	0.088	0.026
1911	2910	43	1.63	3.464	-0.036	0.001	-0.000
1912	2790	48	1.46	3.446	-0.054	0.003	-0.000
1913	3310	30	2.33	3.520	0.020	0.000	0.000
1914	2890	44	1.59	3.461	-0.039	0.001	-0.000
1915	2200	58	1.21	3.342	-0.157	0.025	-0.004
1916	4620	13	5.38	3.665	0.165	0.027	0.004
1917	3300	31	2.26	3.519	0.019	0.000	0.000
1918	6200	5	14.00	3.792	0.293	0.086	0.025
1919	4600	14	5.00	3.663	0.163	0.027	0.004
1920	1840	63	1.11	3.265	-0.235	0.055	-0.013
1921	3770	21	3.33	3.576	0.077	0.006	0.000
1922	3420	27	2.59	3.534	0.034	0.001	0.000
1923	3160	37	1.89	3.500	0.000	0.000	0.000
1924	2230	57	1.23	3.348	-0.151	0.023	-0.003
1925	3030	41	1.71	3.481	-0.018	0.000	-0.000
1926	1750	64	1.09	3.243	-0.257	0.066	-0.017
1927	4490	15	4.67	3.652	0.153	0.023	0.004
1928	3100	38	1.84	3.491	-0.008	0.000	-0.000
1929	2560	51	1.37	3.408	-0.091	0.008	-0.001
1930	1520	67	1.04	3.182	-0.318	0.101	-0.032
1931	2200	59	1.19	3.342	-0.157	0.025	-0.004
1932	2700	49	1.43	3.431	-0.068	0.005	-0.000
1933	3950	19	3.68	3.597	0.097	0.009	0.001
1934	9870	1	70.00	3.994	0.495	0.245	0.121
1935	2680	50	1.40	3.428	-0.071	0.005	-0.000
1936	3070	39	1.79	3.487	-0.012	0.000	-0.000
1937	2390	54	1.30	3.378	-0.121	0.015	-0.002
1938	3960	18	3.89	3.598	0.098	0.010	0.001
1939	2140	60	1.17	3.330	-0.169	0.029	-0.005
1940	2040	62	1.13	3.310	-0.190	0.036	-0.007
1941	1540	66	1.06	3.188	-0.312	0.097	-0.030
1942	2050	61	1.15	3.312	-0.188	0.035	-0.007
1943	3280	33	2.12	3.516	0.016	0.000	0.000
1944	1220	68	1.03	3.086	-0.413	0.171	-0.071
1945	2380	55	1.27	3.377	-0.123	0.015	-0.002
1946	3210	36	1.94	3.507	0.007	0.000	0.000
1947	3970	17	4.12	3.599	0.099	0.010	0.001
1948	4710	11	6.36	3.673	0.173	0.030	0.005
1949	4710	12	5.83	3.673	0.173	0.030	0.005
1950	3410	28	2.50	3.533	0.033	0.001	0.000
1951	3830	20	3.50	3.583	0.084	0.007	0.001
1952	2810	46	1.52	3.449	-0.051	0.003	-0.000
1953	2830	45	1.56	3.452	-0.048	0.002	-0.000
1954	3380	29	2.41	3.529	0.029	0.001	0.000
1955	3500	26	2.69	3.544	0.044	0.002	0.000
1956	4920	7	10.00	3.692	0.192	0.037	0.007
1958	3700	23	3.04	3.568	0.069	0.005	0.000
1959	2230	56	1.25	3.348	-0.151	0.023	-0.003
1960	2800	47	1.49	3.447	-0.052	0.003	-0.000
1961	3060	40	1.75	3.486	-0.014	0.000	-0.000
1962	2410	53	1.32	3.382	-0.118	0.014	-0.002
1963	5110	6	11.67	3.708	0.209	0.044	0.009
1964	2430	52	1.35	3.386	-0.114	0.013	-0.001
1965	3020	42	1.67	3.480	-0.020	0.000	-0.000
1966	3540	25	2.80	3.549	0.049	0.002	0.000
1967	3280	32	2.19	3.516	0.016	0.000	0.000
1968	3590	24	2.92	3.555	0.055	0.003	0.000
1969	3260	35	2.00	3.513	0.014	0.000	0.000
1970	3260	34	2.06	3.513	0.014	0.000	0.000
1971	4010	16	4.38	3.603	0.104	0.011	0.001
1972	4870	8	8.75	3.688	0.188	0.035	0.007
1973	3770	22	3.18	3.576	0.077	0.006	0.000
1974	7600	2	35.00	3.881	0.381	0.145	0.055
1975	4800	9	7.78	3.681	0.182	0.033	0.006
1976	6550	3	23.33	3.816	0.317	0.100	0.032
1977	835	69	1.01	2.922	-0.578	0.334	-0.193
1978	4800	10	7.00	3.681	0.182	0.033	0.006
1979	1650	65	1.08	3.217	-0.282	0.080	-0.022
			SUMS:	241.473		2.247	-0.097

MEAN: 3.500
STD DEV: 0.182
SKEW COEF: -0.245

DISCUSSION AND SUMMARY

Klickitat River data (Table 1) were plotted on log-normal paper to relate river flow data to the Log-Pearson Type III analysis (Figure 1). There was an excellent correlation between the flow data and the Log-Pearson Type III curve (Figure 10).

The predicted 100-year flow of 7,900 cfs would be reasonable for hatchery design If there were no flood flow data existing which exceeded this amount. However, a peak flow of 9,870 cfs was reported for Water Year 1934 (Table 1) and this data point was substantially higher than predicted by the Log-Pearson Type III analysis (Figure 1).

It Is recommended that a flood flow of 10,000 cfs be used for design of the Klickitat Hatchery. This flow Is larger than the 100-year flood predicted by the Log-Pearson Type III analysis, and Is also slightly larger than the maximum recorded flood during a 'IO-year period of record for the Klickitat River.

Paul Tappel

Paul Tappel
Civil Engineer

cc: Jay Kidder

(L7508C)

C-13

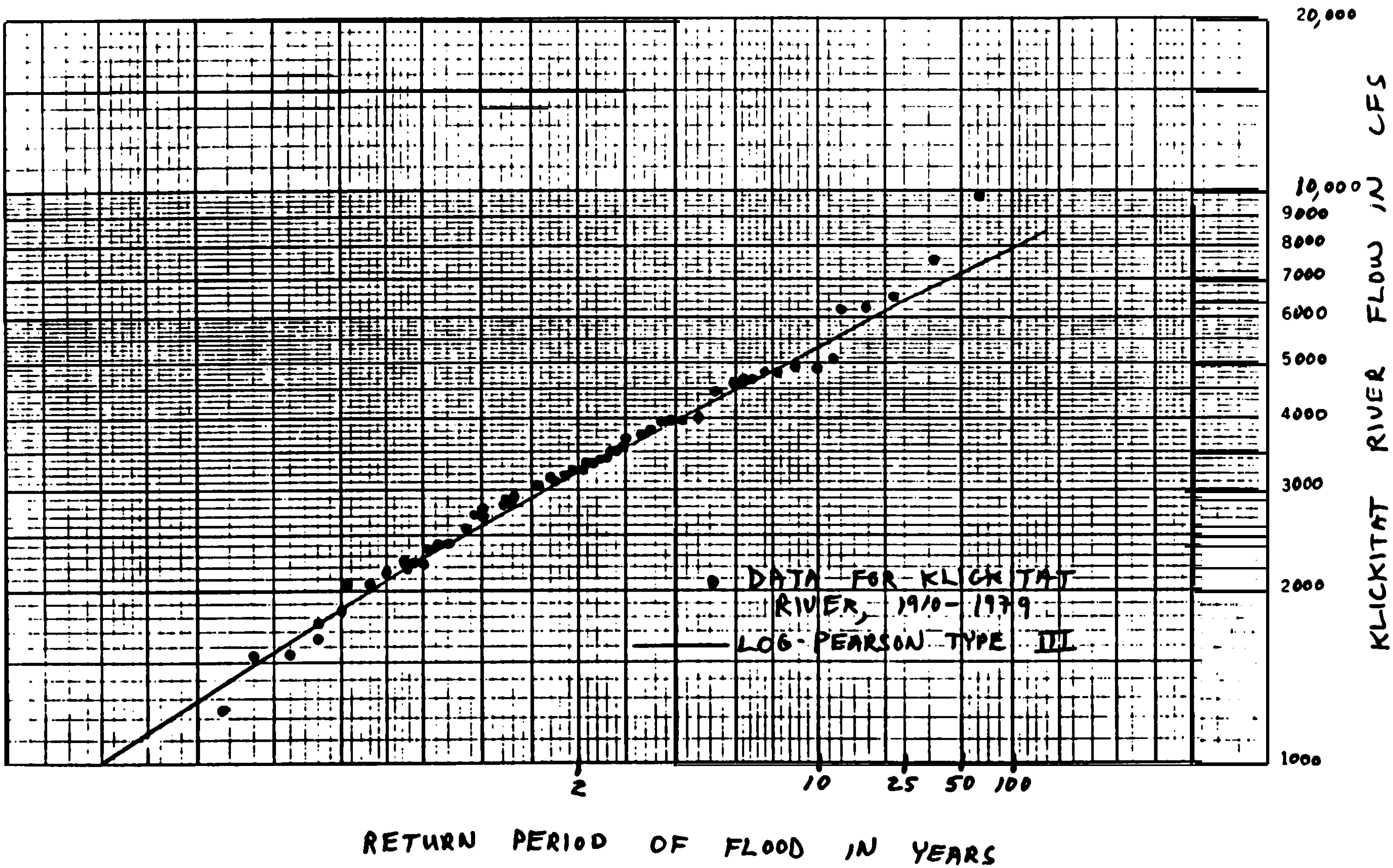


FIGURE 1: FLOOD FREQUENCY CURVE FOR THE KLICKITAT RIVER NEAR GLENWOOD, WASHINGTON.

RWB
SD 31

R. W. BECK AND ASSOCIATES	[illegible]	PROJECT
	[illegible]	FILE NO.
	COMP. [illegible] CHK. REV.	PAGE [illegible] OF [illegible] PAGES
	DATE [illegible] DATE DATE	

[illegible] DATED [illegible] AND TITLED FLOOD FLOW ANALYSIS CONCLUDES THAT THE 100, 50, 10, AND 2 YEAR FLOOD [illegible]:

100 YR	—	7,900 CFS
50 YR	—	7,200 CFS
10 YR	—	5,400 CFS
2 YR	—	3,200 CFS.

THEREFORE, THE PREVIOUS ANALYSIS THAT USED Q_{max} = [illegible], OR $Q_{max} = 4\overline{Q}_{max}$ WHERE A = FS, IS VERY CONSERVATIVE.

THE NORMAL DEPTH OF y_n = 12.5' IS

CONSERVATIVE AND RESULTS IN ABOUT A [illegible] CHANGE IN STAGE ALL ALONG THE [illegible] SITE. [illegible] DESIGN MUST CONSIDER THE FOLLOWING;

100 YR FLOOD, Q_{max} = 7100 CFS
100 YR FLOOD STAGE TO BE y_n = 12.5 @ SECTION AA AND A 10.0' INCREASE IN DEPTH OF THE KLICKITAT RIVER

APPENDIX D

U.S. BUREAU OF RECLAMATION
RAW WATER QUALITY DATA

STORET RETRIEVAL DATE 89/11/02 PGM=ALLPARM

KLI112
46 21 54.0 121 10 20.0 3
KLICKITAT RIVER 1 MI ABV PISCOE CK CONFLUENCE
53077 WASHINGTON YAKIMA
PACIFIC NORTHWEST 130400
YAKIMA RIVER
111)USGR 890506 17070106
0000 FEET DEPTH 988 METERS ELEVATION

/TYPA/AMBNT/STREAM

INITIAL DATE				89/04/26	89/06/21
INITIAL TIME				0000	1045
MEDIUM				WATER	WATER
00010	WATER	TEMP	CENT	5.0	6.9
00011	WATER	TEMP	FAHN	41.0	44.4
00061	STREAM	FLOW,	INST-CFS	2000	1600
00076	TURB	TRBIDMTR	HACH FTU	2.0	1.00
00094	CNDUCTVY	FIELD	MICROMHO	70	
00095	CNDUCTVY	AT 25C	MICROMHO		53
00300	DO		MG/L	10.9	11.7
00301	DO	SATUR	PERCENT	65.2	95.9
00335	COD	LOWLEVEL	MG/L	4.0	4.0
00400	PH		SU		7.21
00403	PH	LAB	SU	7.4	
00440	HCO3 ION	HCO3	MG/L	30	26
00445	CO3 ION	CO3	MG/L	0	0
00530	RESIDUE	TOT NFLT	MG/L	8	2
00608	NH3+NH4-	N DISS	MG/L	.010	.010U
00612	UN-IONZD	NH3-N	MG/L	.000035	.000026
00619	UN-IONZD	NH3-NH3	MG/L	.000036	.000025
00625	TOT KJEL	N	MG/L	.100	.100
00631	NO2&NO3	N-DISS	MG/L	.010U	.1K
00665	PHOS-TOT		MG/L P	.026	.025
00671	PHOS-DIS	ORTHO	MG/L P	.009	.008
00915	CALCIUM	CA,DISS	MG/L	6.4	5.6
00925	MGNSIUM	MG,DISS	MG/L	1.6	1.3
00930	SODIUM	NA,DISS	MG/L	2.30	2.07
00931	SODIUM	ADSBTION	RATIO	.2	.2
00935	PTSSIUM	K,DISS	MG/L	.86	.78
00940	CHLORIDE	TOTAL	MG/L	.4	.4
00946	SULFATE	SO4-DISS	MG/L	1.9	2.4
00950	FLUORIDE	F,DISS	XC/L		.10K
00955	SILICA	DISOLVED	MG/L	21.0	18.4
01002	ARSENIC	AS,TOT	UG/L		5U
01007	BARIUM	BA,TOT	UG/L		5U
01027	CADMIUM	CD,TOT	UG/L		.5U
01034	CHROMIUM	CR,TOT	UG/L		2U
01042	COPPER	CU,TOT	UG/L		5U

INITIAL DATE				89/04/26	89/06/21
INITIAL TIME				0000	1045
MEDIUM				WATER	WATER
01045	IRON	FE,TOT	UG/L		120
01051	LEAD	PB,TOT	UG/L		20
01055	MANGNESE	MN	UC/L		10.0
01067	NICKEL	NI,TOTAL	UG/L		100
01077	SILVER	AG,TOT	UG/L		2.00
01092	ZINC	ZN,TOT	UG/L		100
01105	ALUMINUM	AL,TOT	UG/L		3
01147	SELENIUM	SE,TOT	UG/L		100
46570	CAL HARD	CA MG	MG/L	23[illegible]	20[illegible]
70301	DISS SOL	SUM	MG/L	[illegible]	[illegible]
71900	MERCURY	HG,TOTAL	UG/L		.20

STORET RETRIEVAL DATE 89/ /02 PGM=ALLPARM PAGE:

KLI104
46 02 23.0 121 11 00.0 3
KLICKITAT RIVER AT WDF FISH HATCHERY S4 6N 13E
53039 WASHINGTON KLICKITAT
PACIFIC NORTHWEST 131090
COLUMBIA RIVER BELOW YAKIMA RIVER
11120SAR 880127 17070106027 0002.840 0I
0000 FEET DEPTH 387 METERS ELEVATION

/TYPA/AMBNT/STREAM

INITIAL DATE				89/04/26	89/06/21
INITIAL TIME				0900	1455
MEDIUM				WATER	WATER
00010	WATER	TEMP	CENT	8.9	13.4
00011	WATER	TEMP	FAHN	46.0F	56.1F
00061	STREAM	FLOW,	INST-CFS		3500
00076	TURB	TRBIDMTR	HACH FTU	3.0	2.0
00094	CNDUCTVY	FIELD	MICROMHO	72	58
00300	DO		MG/L	11.3	10.6
00301	DO	SATUR	PERCENT	97.4$	100.0$
00335	COD	LOWLEVEL	MG/L	6.0	3.0
00400	PH		SU		7.32
00403	PH	LAB	SU	7.7	
00440	HCO3 ION	HCO3	MG/L	30	32
00445	CO3 ION	CO3	MG/L	0	0
00530	RESIDUE	TOT NFLT	MG/L	15	12
00608	NH3+NH4-	N DISS	MG/L	.0100	.0100
00612	UN-IONZD	NH3-N	MG/L	.00007$	.00004$
00619	UN-IONZD	NH3-NH3	MG/L	.00008$	.00005$
00625	TOT KJEL	N	MG/L	.110	.100
00631	NO2&NO3	N-DISS	MG/L	.01U	.1K
00665	PHOS-TOT		MG/L P	.036	.049
00671	PHOS-DIS	ORTHO	MG/L P	.016	.021
00915	CALCIUM	CA,DISS	MG/L	5.2	4.8
00925	MGNSIUM	MG,DISS	MG/L	1.9	2.1
00930	SODIUM	NA,DISS	MG/L	2.76	2.99
00931	SODIUM	ADSORTION	RATIO	.3	.2
00935	PTSSIUM	K,DISS	MG/L	1.10	1.17
00940	CHLORIDE	TOTAL	MG/L	.5	.4
00945	SULFATE	SO4-DISS	MG/L	1.9	2.4
00950	FLUORIDE	F,DISS	MG/L		.10K
00955	SILICA	DISOLVED	MG/L	24.6	25.1
01002	ARSENIC	AS,TOT	UG/L		5U
01007	BARIUM	BA,TOT	UG/L		5U
01027	CADMIUM	CD,TOT	UG/L		.5U
01034	CHROMIUM	CR,TOT	UG/L		2U
01042	COPPER	CU,TOT	UG/L		5U
01045	IRON	FE,TOT	UG/L		130

INITIAL DATE				89/04/26	89/06/21
INITIAL TIME				0900	1455
MEDIUM				WATER	WATER
01051	LEAD	PB,TOT	UG/L		[illegible]U
01055	MANGNESE	MN	UG/L		10.0
01067	NICKEL	NI,TOTAL	UG/L		10U
01077	SILVER	AG,TOT	UG/L		2.0U
01092	ZINC	ZN,TOT	UG/L		10U
01105	ALUMINUM	AL,TOT	UG/L		0
01147	SELENIUM	SE,TOT	UG/L		10U
46570	CAL HARD	CA MG	MG/L	21	21
70301	DISS SOL	SUM	MG/L	[illegible]	[illegible]5
71900	MERCURY	HG,TOTAL	UG/L		[illegible]

STORET RETRIEVAL DATE 89/09/19 PGM=ALLPARM PAGE: 1

KLI902
46 01 06.0 121 09 21.0 3
CASCADE SPRINGS NR KLICKITAT R AT RM 40
53039 WASHINGTON KLICKITAT
PACIFIC NORTHWEST 131000
/TYPA/AMBNT/SPRING COLUMBIA RIVER BELOW YAKIMA RIVER
1119USBR 880827 17070106027 0000.340 OFF
0000 FEET DEPTH 357 METERS ELEVATION

	INITIAL DATE			89/06/20
	INITIAL TIME			1245
	MEDIUM			WATER
00010	WATER	TEMP	CENT	7.3
00011	WATER	TEMP	FAHN	45.1$
00025	BAROMTRC	PRESSURE	MM OF HG	738
00076	TURB	TRBIDMTR	HACH FTU	1.0U
00094	CNDUCTVY	FIELD	MICROMHO	70
00300	DO		MG/L	11.9
00301	DO	SATUR	PERCENT	101.9
00335	COD	LOWLEVEL	MG/L	1.0U
00400	PH		SU	7.62
00405	CO2		MG/L	1.8
00410	T ALA	CACO3	MG/L	38
00440	HCO3 ION	HCO3	MG/L	46
00445	CO3 ION	CO3	MG/L	0
00530	RESIDUE	TOT NFLT	MG/L	1U
00556	OIL-GRSE	FREON-CR	MG/L	1.00U
00608	NH3+NH4-	N DISS	MG/L	.010U
00612	UN-IONZD	NH3-N	MG/L	.00005$
00619	UN-IONZD	NH3-NH3	MG/L	.00006$
00625	TOT KJEL	N	MG/L	.030
00631	NO2&NO3	N-DISS	MG/L	.2
00665	PHOS-TOT		MG/L P	.046
00671	PHOS-DIS	ORTHO	MG/L P	.037
00915	CALCIUM	CA,DISS	MG/L	5.8
00925	MGNSIUM	MG,DISS	MG/L	3.3
00930	SODIUM	NA,DISS	MG/L	3.68
00931	SODIUM	ADSBTION	RATIO	.3
00935	PTSSIUM	K,DISS	MG/L	1.96
00940	CHLORIDE	TOTAL	MG/L	.4
00946	SULFATE	SO4-DISS	MG/L	.5
00950	FLUORIDE	F,DISS	MG/L	.10K
00955	SILICA	DISOLVED	MG/L	35.7
01002	ARSENIC	AS,TOT	UG/L	5U
01007	BARIUM	BA,TOT	UG/L	5U
01027	CADMIUM	CD,TOT	UG/L	.5U
01034	CHROMIUM	CR,TOT	UG/L	2U

	INITIAL DATE			89/06/20
	INITIAL TIME			1245
	MEDIUM			WATER
01042	COPPER	CU,TOT	UG/L	5U
01045	IRON	FE,TOT	UG/L	10
01051	LEAD	PB,TOT	UG/L	2K
01055	MANGNESE	MN	UG/L	5.0
01067	NICKEL	NI,TOTAL	UG/L	10U
01077	SILVER	AG,TOT	UG/L	2.0U
01092	ZINC	ZN,TOT	UG/L	10U
01105	ALUMINUM	AL,TOT	UG/L	10
01147	SELENIUM	SE,TOT	UC/L	10U
46570	CAL HARD	CA MG	MG/L	28$
50064	CHLORINE	FREE AVL	MG/L	.01U
70301	DISS SOL	SUM	MG/L	75
71875	H2S		MG/L	.01U
71900	MERCURY	HG,TOTAL	UC/L	.2U
73004	NIT+AR	GAS SATR	% SAT	100.0
74041	WQF	SAMPLE	UPDATED	890914

KLI908
46 01 42.0 121 09 50.0 4
KIDDER SPRINGS NR KLICKITAT R AT RM 41
53039 WASHINGTON KLICKITAT
PACIFIC NORTHWEST 131000
COLUMBIA RIVER BELOW YAKIMA RIVER
1119USBR 890701 17070106
0000 FEET DEPTH

/TYPA/AMBNT/SPRING

	INITIAL DATE			89/06/20
	INITIAL TIME			1135
	MEDIUM			WATER
00010	WATER	TEMP	CENT	7.3
00011	WATER	TEMP	FAHN	45.1$
00025	BAROMIRC	PRESSURE	MM OF HG	739
00076	TURB	TRBIDMTR	HACH FTU	1.0U
00094	CNDUCTVY	FIELD	MICROMHO	72
00300	DO		MG/L	11.8
00301	DO	SATUR	PERCENT	100.9
00335	COD	LOWLEVEL	MG/L	1.0U
00400	PH		SU	7.03
00405	CO2		MG/L	6.7
00410	T ALK	CACO3	MG/L	36
00440	HCO3 ION	HCO3	MG/L	44
00445	CO3 ION	CO3	MG/L	0
00530	RESIDUE	TOT NFLT	MG/L	1U
00556	OIL-GRSE	FREON-CR	MG/L	1.00U
00608	NH3+NH4-	N DISS	MG/L	.010U
00612	UN-IONZD	NH3-N	MG/L	.00001$
00619	UN-IONZD	NH3-NH3	MG/L	.00002$
00625	TOT KJEL	N	MG/L	.020
00631	NO2&NO3	N-DISS	MG/L	.1
00665	PHOS-TOT		MG/L P	.060
00671	PHOS-DIS	ORTHO	MG/L P	.035
00915	CALCIUM	CA,DISS	MG/L	5.6
00925	MGNSIUM	MG,DISS	MG/L	3.2
00930	SODIUM	NA,DISS	MG/L	3.68
00931	SODIUM	ADSBTION	RATIO	.3
00935	PTSSIUM	K,DISS	MG/L	1.96
00940	CHLORIDE	TOTAL	MG/L	.4
00946	SULFATE	SO4-DISS	MG/L	.5
00950	FLUORIDE	F,DISS	MG/L	.10K
00955	SILICA	DISOLVED	MG/L	35.7
01002	ARSENIC	AS,TOT	UG/L	5U
01007	BARIUM	BA,TOT	UG/L	5U
01027	CADMIUM	CD,TOT	UG/L	.5U
01034	CHROMIUM	CR,TOT	UG/L	2U

D-5

	INITIAL DATE			89/06/20
	INITIAL TIME			1135
	MEDIUM			WATER
01042	COPPER	CU,TOT	UG/L	5U
01045	IRON	FE,TOT	UG/L	40
01051	LEAD	PB,TOT	UG/L	2U
01055	MANGNESE	MN	UG/L	5.0U
01067	NICKEL	NI,TOTAL	UG/L	10U
01077	SILVER	AG,TOT	UG/L	2.0U
01092	ZINC	ZN,TOT	UG/L	10U
01105	ALUMINUM	AL,TOT	UG/L	15
01147	SELENIUM	SE,TOT	UG/L	10U
46570	CAL HARD	CA MG	MG/L	27$
50064	CHLORINE	FREE AVL	MG/L	.01U
70301	DISS SOL	SUM	MG/L	73
71875	H2S		MG/L	.01U
71900	MERCURY	HG,TOTAL	UG/L	.2U
73004	NIT + AR	GAS SATR	% SAT	100.0
74041	WQF	SAMPLE	UPDATED	890914

APPENDIX E

HATCHERY EQUIPMENT LIST

HATCHERY EQUIPMENT LIST BY FUNCTION

Function and Equipment	Estimated cost
A. TRANSPORTATION, FISH AND PERSONNEL	
1. Fish Plant Truck, 2-1/2 Ton with Fish Tank	$ 85,000
2. Pickup Truck, 1/2 Ton, 4WD	12,000
3. Pickup Truck, 1 Ton with Fish Tank, 4WD	18,000
4. CB Mobile Units	240
5. Boat Suitable for Need and Trailer	4,500
6. Tractor/Hoe, Broom, Loader and Mower	15,660
7. CB Base Station	150
8. CB Antenna	76
Subtotal	$135,626
B. MAINTENANCE OF GROUNDS - FACILITIES	
1. Sludge Pump and 3-Inch-Diameter Hose	1,944
2. Ladders, Step and Extension	252
3. Push Brooms	15
4. Power Broom for Snow Blowing	774
5. Plumbing Snake	200
Subtotal	$ 3,185
MAINTENANCE OF GROUNDS - EQUIPMENT	
1. Hydraulic Jack, 12 Ton	206
2. Battery Charger, 6 and 12 Volts, 10 Amp	52
3. Booster Cables, 12 Volt x 25 ft long	41
4. Grease Gun	22
5. Auto Creeper	23
6. Oil and Gasoline Containers	102
7. Funnels (Various Sizes)	16
Subtotal	$ 462
MAINTENANCE OF GROUNDS - GENERAL	
1. Woodworking Hand Tools	499
2. Metalworking Hand Tools	200
3. Welding Equipment and Clothing	200
4. Portable Emergency Generator	550
5. Portable Emergency Lighting	66
6. Gas Welder	290
7. Arc Welder	300
8. Wood Vise	90
9. Drill Press and Vise	145

HATCHERY EQUIPMENT LIST BY FUNCTION

Function and Equipment	Estimated cost
MAINTENANCE OF GROUNDS - GENERAL (cont.)	
10. Band Saw	$ 145
11. Face Shield	19
12. Metal Vise with Cinch	80
13. Table Saw	400
14. Flammable Storage Cabinet	427
15. Shotgun and Gun Safe	298
16. Small Hand and Power Tool Cabinets/Lock	350
17. Sawdust Vacuum	187
18. Electric Air Compressor	687
19. Portable Electric Circle Saw	100
20. Radial Arm Saw	480
21. Miter Box/Back Saw	100
22. Hand Truck, 400 lb. Capacity	91
23. Bench Grinder, 3/4 HP	150
24. Electric Drill and Bits	140
25. Solder Gun Kit	30
26. Heavy Duty Staple Gun Set	60
27. Pop Rivet Gun Set	40
28. Hand Saws	60
29. Hack Saw	8
30. Come-A-Long	34
31. Hand Truck	91
32. Pipe Cutter	30
33. Wrecking Prybar (Small and Large)	30
34. Cloth and Metal Measuring Tapes	45
35. Wire and Paint Brushes	25
36. Tap and Die Set	130
37. Power Sanders	150
38. Pipe Threader	170
39. Rubber Mallet	10
40. Hammers. Sledges and Axes	150
41. Pickaroon	20
42. Bolt Cutter	20
43. Extension Cord with Trouble Lite	31
44. Garbage Cans	132
45. Miscellaneous	1,500
Subtotal	$ 8,760

HATCHERY EQUIPMENT LIST BY FUNCTION

Function and Equipment	Estimated cost
MAINTENANCE OF GROUNDS - GROUNDS	
1. Shovels, Snow and Gardening	$ 40
2. Lawn Mower - Gas	331
3. Wheelbarrow - Industrial	140
4. Garden and Leaf Rake and Hoe	30
5. Brush and Limb Trimmers	20
6. Garden Hose, Spray Nozzles and Sprinklers	186
Subtotal	$ 747
C. HATCHERY BUILDING - OFFICE	
1. Personal Computer/Printer	2,500
2. Calculator with Tape	89
3. Desks	510
4. Chairs	312
5. Filing Cabinets	126
6. Waste Baskets	42
7. Table	200
8. Book Case and Credenzas	275
9. Clock	60
10. Stapler, Tape, Pens, etc.	100
Subtotal	$ 4,214
HATCHERY BUILDING - LAB	
1. Laboratory Stools	$ 88
2. Glassware	200
3. Chemicals	200
4. Microscope, 100X	2,200
5. Dissecting Microscope	620
6. Balance Scales	240
7. Water Pollution Kit	269
8. Maximum-Minimum Thermometers	48
9. Calibrating Thermometers	95
10. Dissecting Tools	30
11. Propane Torch with Holder	50
12. Bench Top Autoclave	100
13. Stir Hot plates	60
Subtotal	$ 4,200

HATCHERY EQUIPMENT LIST BY FUNCTION

Function and Equipment	Estimated cost
HATCHERY BUILDING - CREW ROOM	
1. Microwave Oven	$ 250
2. Rooms, Mops and Dust Pans	20
3. Small Dinette Set	260
4. Refrigerator	350
5. cots	130
6. Lockers	400
7. Large Bulletin Board	54
Subtotal	$ 1,464
D. SPAWNING - HOLDING POND	
1. Egg Pails and Stands	$ 208
2. Work Table	120
3. Portable 12 Cubic Foot Temporary Holding Tank	1,186
4. Adult Dip Nets	150
5. Adult Fish Crowder or Seine	300
6. Spawning Knives	80
7. Insulated Chest Coolers	120
8. 25-ft House Trailer for Security During Spawning	10,000
9. Spawning Clothing. Gloves and Boots	234
10. Boom Hoist for Weighing Fish	671
11. Gloves, Boots	160
12. Lake Merwin Trap	500
Subtotal	$ 15,729
E. INCUBATION	
1. Egg Weighing Scoop	$ 5
2. Egg Tongs	15
3. Burlap Bags	15
Subtotal	$ 35

HATCHERY EQUIPMENT LIST BY FUNCTION

Function and Equipment	Estimated cost
F. REARING - POND	
1. Screen and Pond Brushes	$ 128
2. Fish Weighing Scale/Holder	454
3. Hand Cart	257
4. Dip Nets - Small Fish	50
5. Seine - Small Fish	90
6. Rack and Screen Rakes	18
7. Pump/Standpipe for Filling Fish Hauling Tanks	435
8. Pond Crowders	1,200
9. Grader Boxes	390
10. Poles and Rakes	66
Subtotal	$ 3,088
REARING - FEED ROOM	
1. Feed Weighing Scales	$ 355
2. Hand Cart	257
3. Feed Buckets (5 gal.)	12
4. Feed Room Scoops	17
5. Feed Hopper	300
Subtotal	$ 941
REARING - GENERAL	
1. Wash Down Pump/Suction and Discharge Hose	$ 1,944
2. Portable High Pressure Washer Pump with Accessories	2,000
Subtotal	$ 3,944
G. SAFETY-FIRST AID - GENERAL	
1. First Aid Kits (Shop & Trucks)	$ 124
2. Stretcher/Wool Blanket	185
3. Safety Goggles	12
4. Respirator Mask/Filters	17
5. Air Splint Set	93
6. Hard Hats	36
7. Hazard Signs (Keep Out, Danger, etc.)	200
8. Fire Pump/Hose Nozzle	2,000
9. Fire Extinguishers (Buildings & Trucks)	300
10. Life Vests	60
11. Ear Cover - Noise Suppression	60
12. Bulletin Board	54
Subtotal	$ 3,141
TOTAL FOR ALL EQUIPMENT	$185,536
SAY	$186,000
EQUIPMENT COST WITHOUT 2-1/2 TON TRUCK	$101,000