This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

For copies of this report, write to:

Bonneville Power Administration
Division of Fish and Wildlife **- PJ**
P.O. Box 3621
Portland, OR 97208

UMATILLA SATELLITE AND RELEASE SITES PROJECT

Final Conceptual Design Report

Prepared by:

James M. Montgomery, Consulting Engineers, Inc.
Bellevue, WA

Prepared for:

Jay Marcotte, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97208-3621

Contract No. DE-AC79-91BP12031
Project No. 91-14

March 1992

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ACKNOWLEDGEMENTS

James M. Montgomery, Consulting Engineers, Inc. would like to thank all the members of the Umatilla River Technical Work Group, including representatives from Bonneville Power Administration, Oregon Department of Fish and Wildlife, and the Confederated Tribes of the Umatilla Indian Reservation, for their efforts in this project. The assistance and guidance provided by Jay Marcotte, Project Manager for Bonneville Power Administration, is especially appreciated.

Funding for this project was provided by the Bonneville Power Administration under Contract No. DE-AC79-91BP12031.

EXECUTIVE SUMMARY

This report presents the results of conceptual design for the Umatilla Satellite and Release Sites Project. The purpose of this project is to provide engineering services for the siting and conceptual design of satellite and release facilities for the Umatilla Basin hatchery program. The Umatilla Basin hatchery program consists of artificial production facilities for salmon and steelhead to enhance production in the Umatilla River as defined in the Umatilla master plan approved in 1989 by the Northwest Power Planning Council. Facilities identified in the master plan include adult salmon broodstock holding and spawning facilities, facilities for recovery, acclimation, and/or extended rearing of salmon juveniles, and development of river sites for release of hatchery salmon and steelhead.

Preliminary planning for the Umatilla component of spring chinook production facilities, as identified in the draft Master Plan for the Northeast Oregon Hatchery Project (NEOH), was subsequently identified as an additional objective of this project. Site analysis and draft conceptual design of these facilities was taken to a point necessary to identify preferred sites for environmental analysis purposes. However, final conceptual design of these facilities will be conducted as part of the NEOH project and is not considered in this report.

The biological process criteria used for facility planning and water supply options are discussed as they relate to the alternative sites. Temperature adjustment considerations are considered as they relate to production scheduling since summer period warm water temperatures are relatively high in the basin and can have a substantial impact on the proposed program. Options for disinfection of facility influent and effluent are described and recommended options identified.

Final conceptual design of fall chinook adult holding facilities at Three Mile Dam and spring chinook adult holding facilities at the Russell Walker site on the South Fork Walla Walla River were developed. The spring chinook facility was developed in such a way that future potential production for the Umatilla and Walla Walla basins identified in the NEOH project could be accommodated at this site.

Direct release and/or acclimation sites were developed for a number of sites along the Umatilla River to accommodate both the near-term and future requirements for fall chinook and spring chinook juvenile release sites.

Planning level cost estimates were developed for all facilities.

INTRODUCTION

PROJECT BACKGROUND

This report presents the conceptual design for the Umatilla Satellite and Release Sites Project. The purpose of this project is to provide engineering services for the siting and conceptual design of satellite and release facilities for the Umatilla Basin hatchery program. This work was carried out under Task 3 of the contract between Bonneville Power Administration (BPA) and James M. Montgomery, Consulting Engineers, Inc. (JMM).

The Umatilla Basin hatchery program consists of artificial production facilities for salmon and steelhead to enhance production in the Umatilla River as defined in the Umatilla master plan approved in 1989 by the Northwest Power Planning Council. Facilities identified in the master plan include adult salmon broodstock holding and spawning facilities, facilities for recovery, acclimation, and/or extended rearing of juvenile salmon, and development of river sites for release of hatchery salmon and steelhead.

Preliminary planning for the Umatilla component of spring chinook production facilities, as identified in the draft Master Plan for the Northeast Oregon Hatchery Project (NEOH), was subsequently identified as an additional objective of this project. Site analysis and draft conceptual design of these facilities was taken to a point necessary to identify preferred sites for environmental analysis purposes. However, final conceptual design of these facilities will be conducted as part of the NEOH project and is not considered in this report.

This report is divided into 7 sections which contain the following information:

Introduction

Existing Conditions Specific to Conceptual Design

Process Criteria

Water Supply

Facility Layouts

Cost Estimates

Project Schedule

The basis for conceptual design includes information developed in the Final Siting Report (JMM 1992), site specific information developed for conceptual design, and process criteria developed by BPA and the Umatilla River Technical Work Group (TWG), which is comprised of BPA, Oregon Department of Fish and Wildlife (ODF&W), and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).

TERMINOLOGY

Terms used in this report to define fish culture production phases are presented below (Table 1).

TABLE 1

DEFINITION OF FISH CULTURE TERMS

'erm	Process Endpoints	Other Terms
dult Holding	Capture to maturation	
pawning & Fertilization	Gametes to fertilized gametes	
ncubation	Fertilized gametes to swim-up	
tearing		
Early Rearing	Swim-up to 200/lb	
Full-Term Rearing	200/lb to final transport size (or release if direct release from a full-term rearing site). Full-term rearing may occur at a hatchery or a satellite rearing facility.	Satellite Rearing
Release Methods		
Final Rearing & Release	Transport of fingerlings from a full-term rearing facility to a final rearing and release site for 3-30 days The fish may be fed, but no significant growth will occur during this phase.	Acclimation/Extended Rearing
Direct Release	Transport of fingerlings from a full-term rearing facility to a direct release site. The fish will be discharged directly from the transport truck into the river.	
Hatchery	Has the following fish culture elements: Adult holding Spawning Incubation Early rearing Full-term rearing	
Satellite Facility	Has the following fish culture elements: Adult holding Spawning	

PROPOSED UMATILLA PROGRAM

The proposed program used as the basis of conceptual design is summarized below (Table 2). Selection of this program was described in the Final Siting Report (JMM 1992) and was developed through discussions among BPA, the Umatilla TWG, and JMM. Site feasibility analysis conducted by JMM was used to screen available sites on the river and arrive at the final list of sites to be used for facility design.

One objective in identifying programs was to provide options that contained flexibility. Flexibility could be provided by choosing sites that can accommodate more than one type of facility. For example:

- Adult Capture - Capture of ChF and ChS would occur at the existing Three Mile Dam facility under all options. Site conditions were such that capture of ChS could also occur at an upriver site nearer to ChS spawning areas at some time in the future.

- Adult Holding, Early Rearing, and Full Term (Satellite) Rearing - It is most efficient to select sites for these facilities that can accommodate all or most of the functions. This results in reducing environmental disturbance by limiting development to the fewest possible areas.

- Direct Release, Final (Extended) Rearing/Acclimation - Many direct release sites are available in the basin, and a number of these are already in use. For conceptual design of these facilities, we have used direct release sites that also could accommodate Final Rearing/Acclimation functions. These sites would initially be developed for direct release only and that additional facilities associated with final rearing/acclimation may be developed under a second phase. We have illustrated the full range of facilities at these sites in this report, but it is important to remember the phased approach to their development.

- Production Facility - The four sites identified as spring chinook production facility alternatives include 3 sites within the Umatilla Basin (Corporation, Emmett Williams, and Fred Gray) and one out of basin site (Russell Walker on the S. Fork Walla Walla). The full-term rearing required has been incorporated into the layouts for each site and not shown separately. Final conceptual design of new ChS production for the Umatilla basin will be conducted as part of the NEOH project.

TABLE 2

PROPOSED UMATILLA BASIN PROGRAM

dult capture:		ChF and ChS - Three Mile Dam
dult Holding Alternatives:(listed from upstream to downstream for ChS)		
	ChF	Three Mile Dam
	ChS/ChF	Corporation
		Emmett Williams
		Fred Gray
		Russell Walker (S. Fork Walla Walla)
cubation Alternatives:		
	ChF	Umatilla Hatchery
	ChS	Corporation
		Emmett Williams
		Fred Gray
		Russell Walker (S. Fork Walla Walla)
arly Rearing Alternatives:		
	ChF	Umatilla Hatchery
	ChS	Corporation
		Emmett Williams
		Fred Gray
		Russell Walker (S. Fork Walla Walla)
ull term (Satellite) Rearing Alternatives:		
	ChF	not applicable
	ChS	Corporation
		Emmett Williams
		Fred Gray
		Russell Walker (S. Fork Walla Walla)
inal (Extended)Rearing/Acclimation and/or Diit Release Site Alternatives (b):		
	ChF	1. Echo Meadows (c,d)
		2. Nolin (c,d)
		3. Barnhart (c,d)
		4. ODF&W (d,e)
		5. Mission (d,e)
		6. Cayuse Bridge (d,e)
	ChF/ChS	7. Thorn Hollow (d,e,f,g)
	ChS	8. Fred Gray (f,g)
		9. Corporation (f,g)
		10. Meacham Creek at Camp Creek (f)

Notes:

(a) In-basin rearing for Phase 2 planning purposes. Dependent on NEOH siting.
(b) These sites selected on the basis of accommodating both functions, giving more flexibility to the program.
(c) Short term: Direct release of 1.44 million ChF, non-evaluation fish
(d) Long term: Direct release with extended rearing/acclimation
(e) Short term: Direct release 3.24 million ChF, O_2 versus standard
(f) Short term: Non-evaluation ChS
(g) Short term: Direct release 1.44 million ChS, O_2 versus standard

EXISTING CONDITIONS SPECIFIC TO CONCEPTUAL DESIGN

INTRODUCTION

This section describes each site as it relates to the design of proposed facilities (see Table 2). Site maps for each location were developed by BPA's Mapping Department from aerial photography and subsequently digitized at JMM.

Site descriptions are given in order from upstream to downstream for sites identified as potential hatchery locations followed by sites for final rearing/acclimation/direct release functions.

HATCHERY SITES

Corporation Site

The Corporation site is located at river mile 89 on the Umatilla River, approximately 0.6 miles below the confluence of the north and south forks (Figure 1). Access is provided from County Road 900 which is paved to a point within approximately 5 miles of the site (near the location of the Bar M Ranch).

The site is owned by the US Forest Service (USFS) and consists of relatively flat land with ground elevations ranging from 2282 to 2300 feet, trending upward from the northwest to the southeast. The property is bordered by a hill to the north where several existing USFS houses are located. The developable portion of the site consists of alluvial soil, has few trees, and no wetlands. Currently, the property is used as parking for hunters, hikers, or campers. Public restrooms, two small buildings, and a USFS gage station are located on the site.

To accommodate a gravity supply, a diversion structure could be located approximately 1500 feet upstream of the site on the mainstem Umatilla. However, should this site be developed, a diversion on the north fork of the river is the recommended option. This would require approximately 4500 feet of pipeline and a significant amount of rock excavation. A diversion would likely substantially dewater the bypassed reach at critical periods. The benefit of drawing water from the north fork would be cooler water. Otherwise, mechanical cooling of the process water will be required to meet the temperature criteria.

Existing wells should provide adequate potable water.

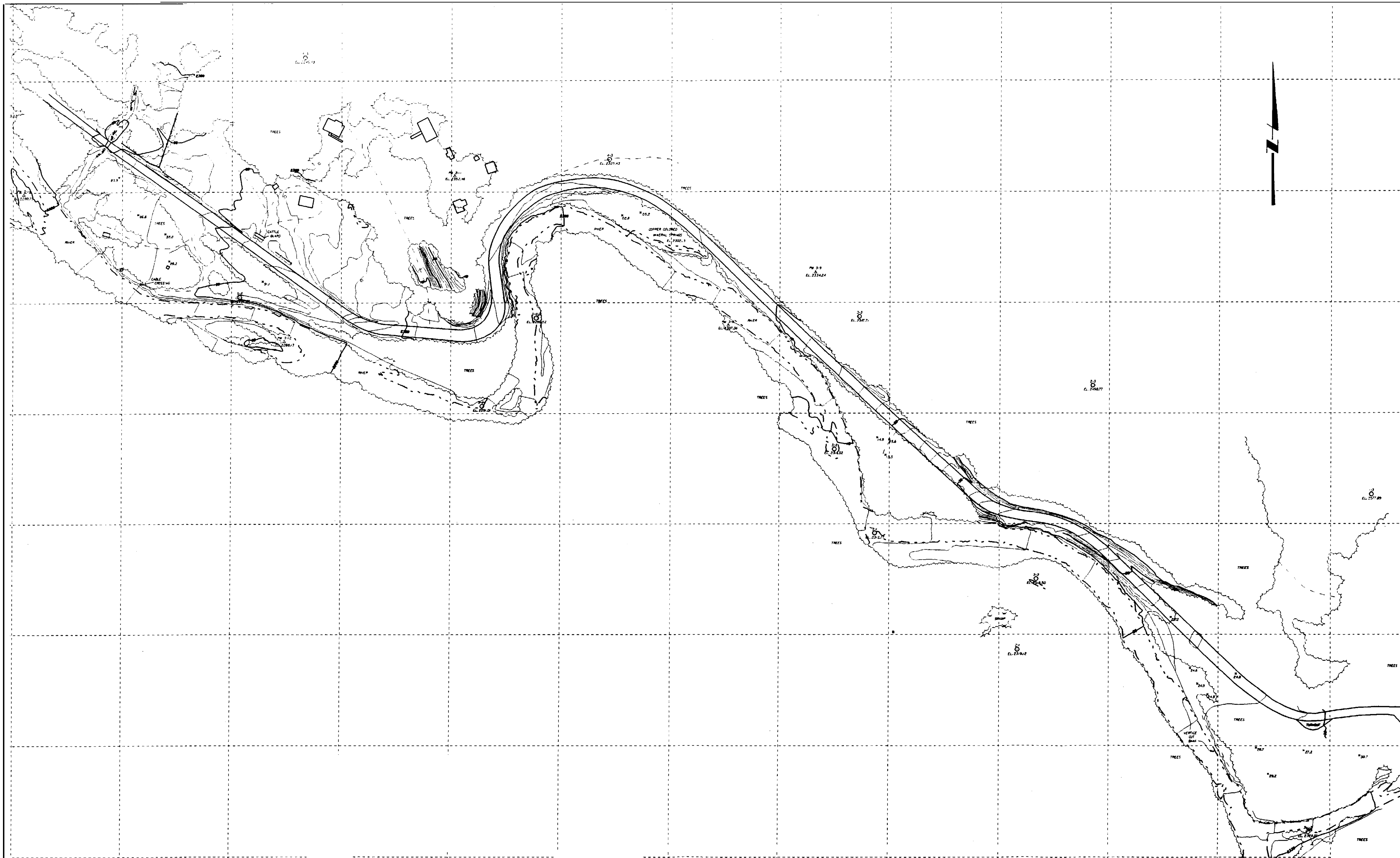
There is no 3 phase power on the site.

Emmett Williams Site

The Emmett Williams site is located at river mile 81 on the Umatilla River, on the Umatilla Indian Reservation (Figure 2). Access is provided from County Road 900.

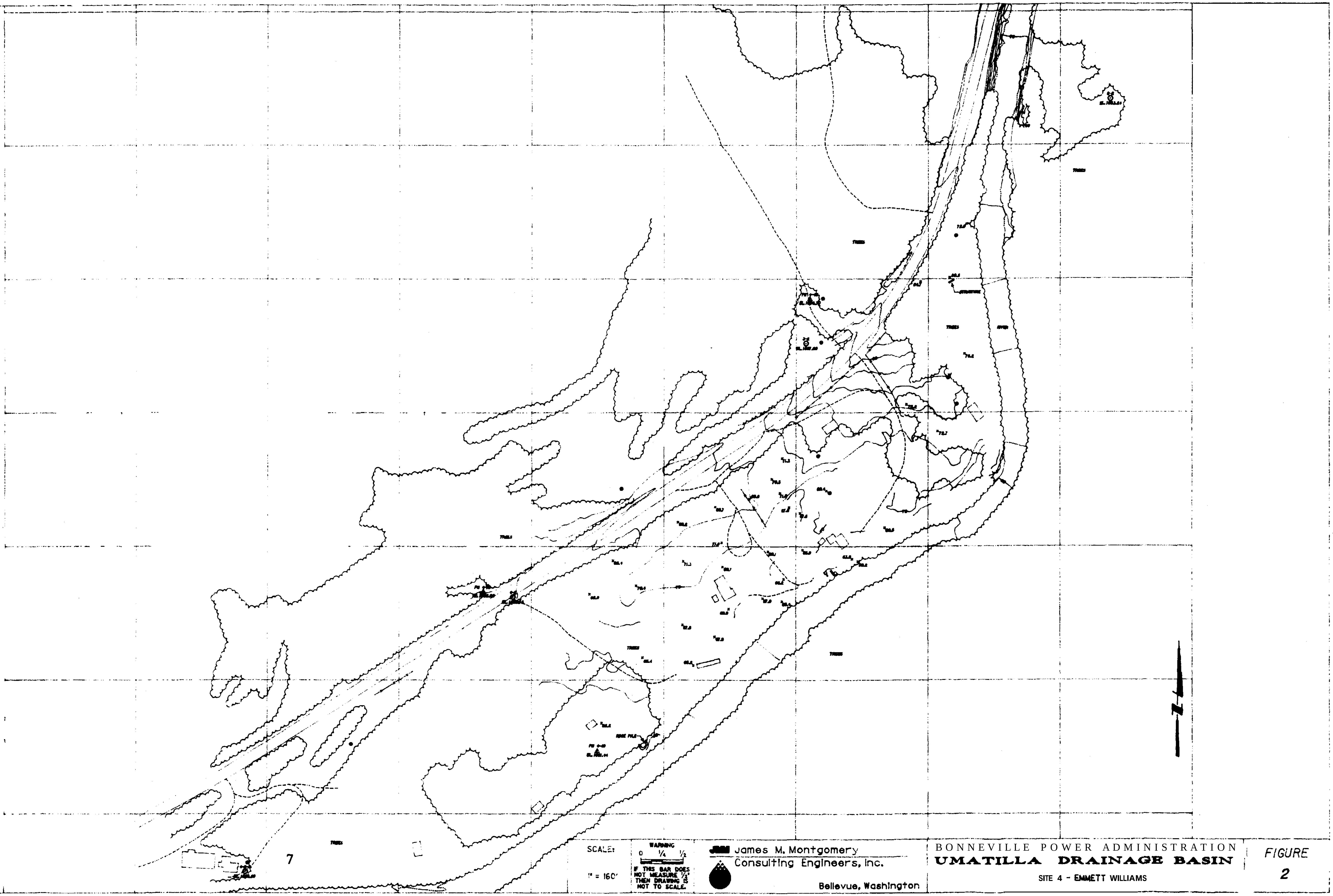
The site is owned by Emmett Williams and consists of relatively flat treed land with ground elevations ranging from 1857 to 1875 feet, trending upward from the southwest to the northeast. The developable portion of the site consists of alluvial soil and thin mixed conifer-deciduous forest with some cleared land. There are several existing houses on the property, along with remnants of old structures.

With a potential 18 - 19 feet of fall on the Umatilla, there is adequate gravity supply potential. An ideal gravity supply diversion would be at the north end of the site, where the river runs adjacent to



SCALE:	WARNING		
1"=200'	0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue. Washlnoton	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN SITE 3 - CORPORATION

FIGURE 1



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Bellevue, Washington

BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 4 - EMMETT WILLIAMS

FIGURE
2

the road. A small diversion dam will be required. River water temperature is high enough in.the summer that some type of process water cooling, either mechanical or other, will be required The property is barely large enough to accommodate all of the proposed facilities if a large reservoir is required.

There is 3 phase power on **the** site and existing wells should provide adequate potable water.

Fred Gray Site

The Fred Gray site is located at river mile 80 on the Umatilla River, on the Umatilla Indian Reservation (Figure 3). Access is provided from County Road 900.

The site is owned by Fred Gray and consists of an **80-acre** parcel containing relatively flat pasture land with ground elevations ranging from 1785 to 1802 feet, trending upward from the southwest to the northeast. The developable portion of the site consists of alluvial soil and is devoid of trees or apparent non-riparian wetlands.

With over 12 feet of fall on the Umatilla, there is adequate gravity supply potential. An ideal gravity supply diversion would be at the north end of the site (on a separate 27 acre parcel), just beneath the large area of exposed riffles. The property is large enough to accommodate any of the proposed facilities, including a large reservoir. High summer water temperature requires some type of process water cooling to meet temperature criteria.

There is 3 phase power on the site and existing wells should provide adequate potable water.

South Fork **Walla Walla** Site

The South Fork **Walla Walla** site is located at river mile 8 on the South Fork **Walla Walla** River (Figure 4). Access is provided from South Fork Road, southeast of the town of Milton-Freewater.

The site consists of relatively flat pasture land with ground elevations ranging from 1752 to 1769 feet, trending upward from the northwest to the southeast. The developable portion of the site consists of alluvial soil, few trees, and no apparent non-riparian wetlands.

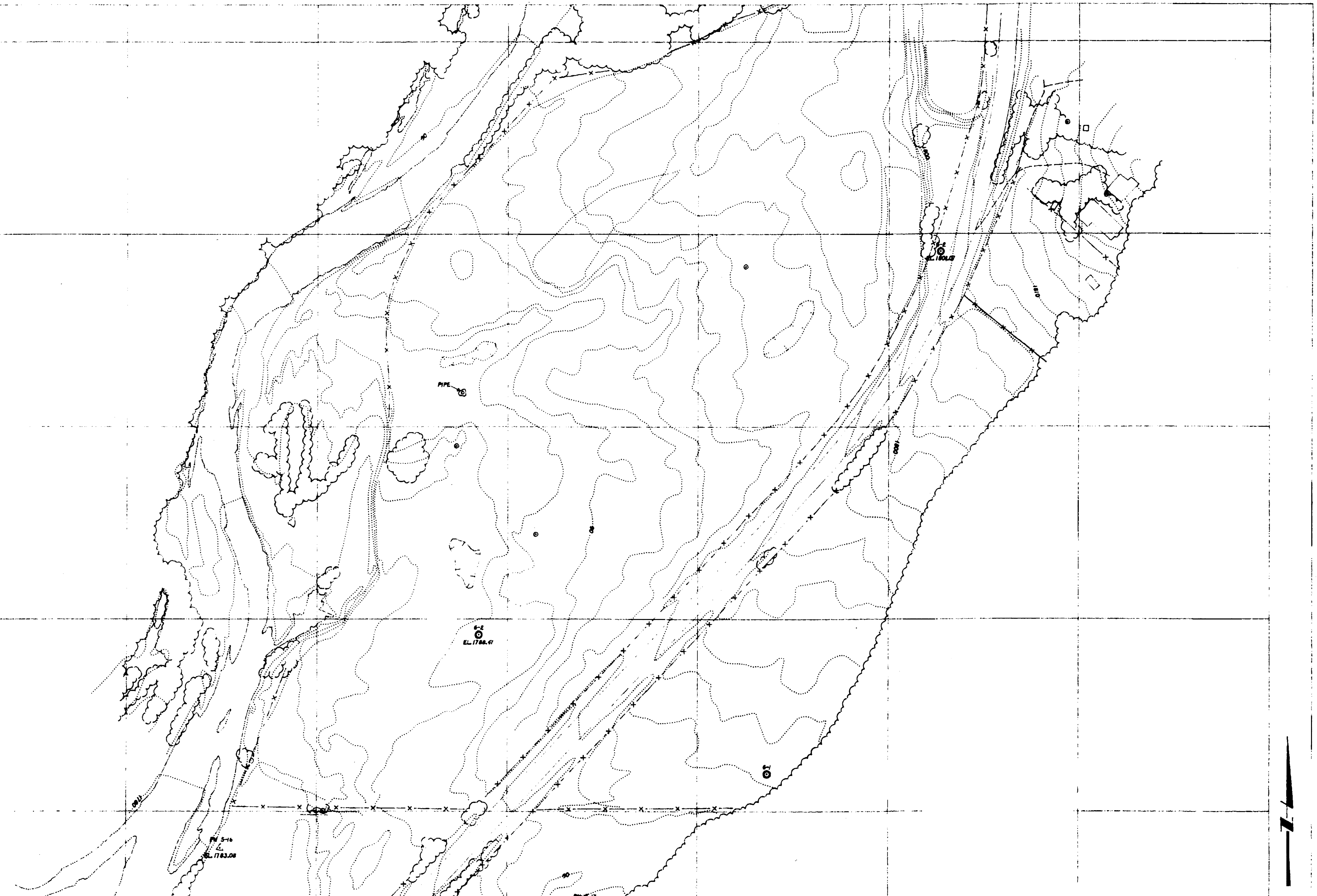
There is approximately 19 feet of drop along this portion of the river and gravity supply potential is good. There is adequate space to accommodate any of the proposed facilities, including rearing ponds and/or raceways. River water temperature is cold enough that no process water cooling would be required.

There is 3 phase power on the site and existing wells should provide adequate potable water.

FINAL REARING/ACCLIMATION AND/OR DIRECT RELEASE SITES

Meacham Creek at Camp Creek

This acclimation site is the most upstream site in the Umatilla River Basin, and is located at mile 11 on Meacham Creek (Figure 5). Meacham Creek discharges to the Umatilla River at approximately river mile 79. The property is owned by the Union Pacific Railroad. Access to the site is by County Road 900, then by gravel railroad right-of-way to the site. Two bridges along the access road will likely require replacement to accommodate the large, fish tanker trucks. Construction of the release facility will require site improvements including clearing and grading, streambank



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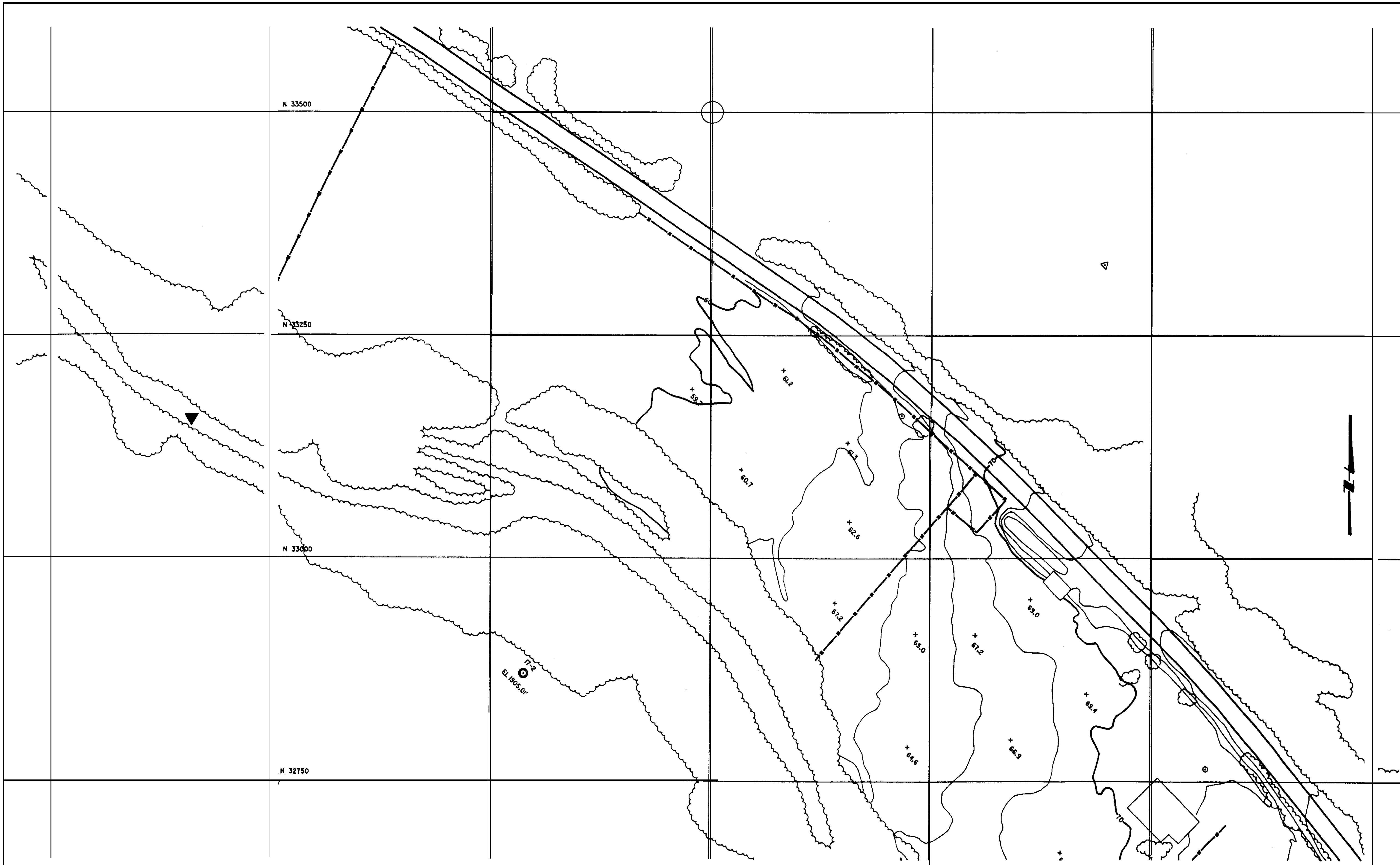
Bellevue, Washington

BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 5 - FRED GRAY

FIGURE 3



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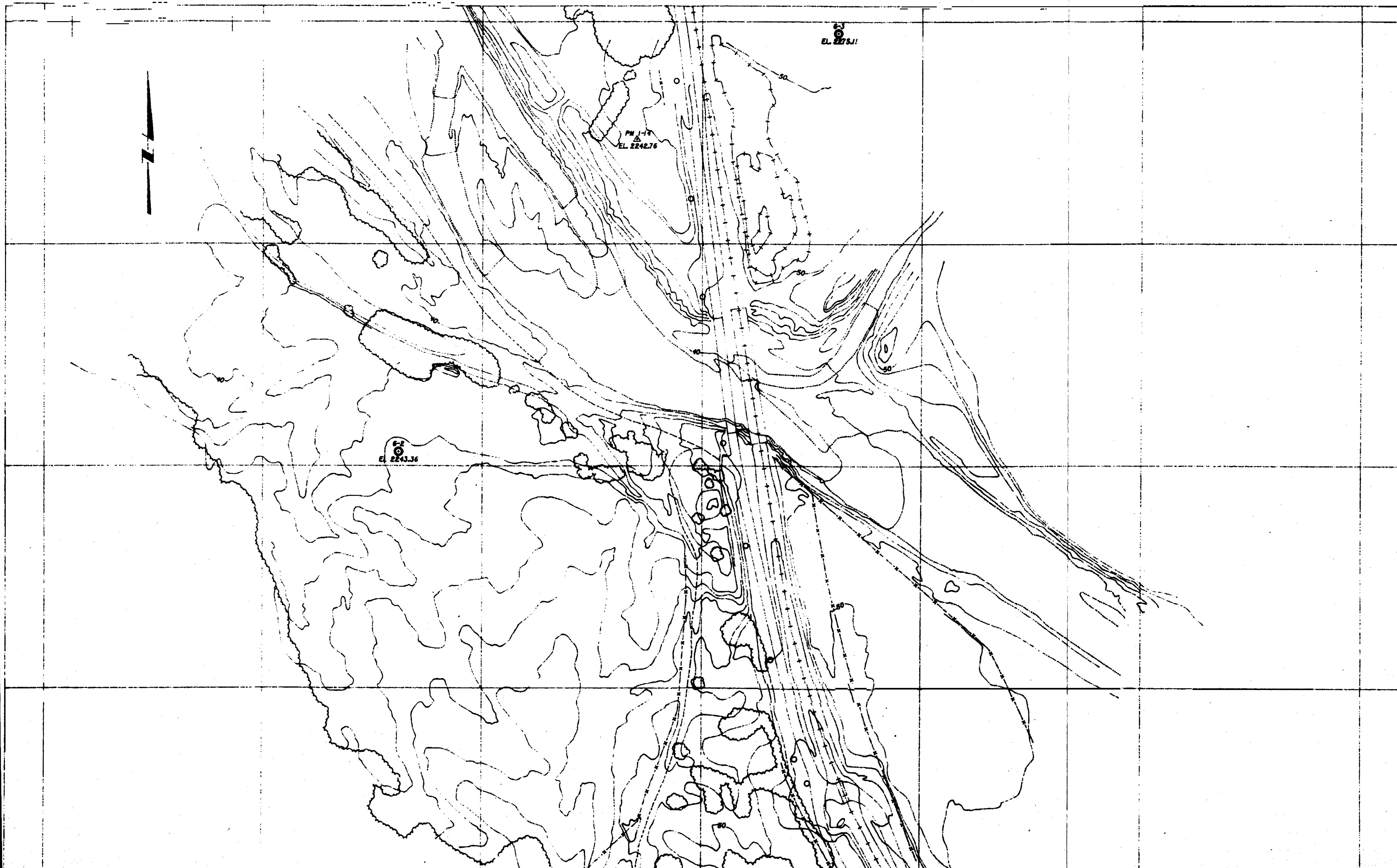
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SOUTH FORK WALLA WALLA

FIGURE 4



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BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 1 - MEACHAM

FIGURE 5

protection near the release site, and improvements to the access road. Gravity supply potential at this site is good with a suitable intake site located near the railroad bridge abutments.

The remoteness of this site makes security and access two major design concerns.

Corporation Site

The Corporation site is located at river mile 89 on the Umatilla River, approximately 0.6 miles below the confluence of the north and south forks (Figure 1). Access is provided from County Road 900 which is paved to a point within approximately 5 miles of the site (near the location of the Bar M Ranch).

Site characteristics are discussed above under the Hatchery Sites heading. Use as a direct release site or a site for final rearing/acclimation could be accommodated within the existing layout of hatchery facilities.

Thorn Hollow Site

The Thorn Hollow site is located within a bend of the Umatilla River at river mile 80, on the Umatilla Indian Reservation (Figure 6). Access is provided from Thorn Hollow Road, about 1/4 mile off County Road 900.

The site consists of flat pasture land with trees on the southwest side. Ground elevations trend upward from the southwest to the northeast. The developable portion of the site consists of alluvial soil. As with most of the Umatilla sites, the river bed is composed of loose gravel and is subject to significant movement.

Due to the shallow grade in this portion of the river, gravity supply would have to come from a location at least 1000 feet upstream and a pumped supply may be the best option for final rearing/ acclimation ponds.

There is 3 phase power within 1/8 mile of the site. Existing wells should provide adequate potable water.

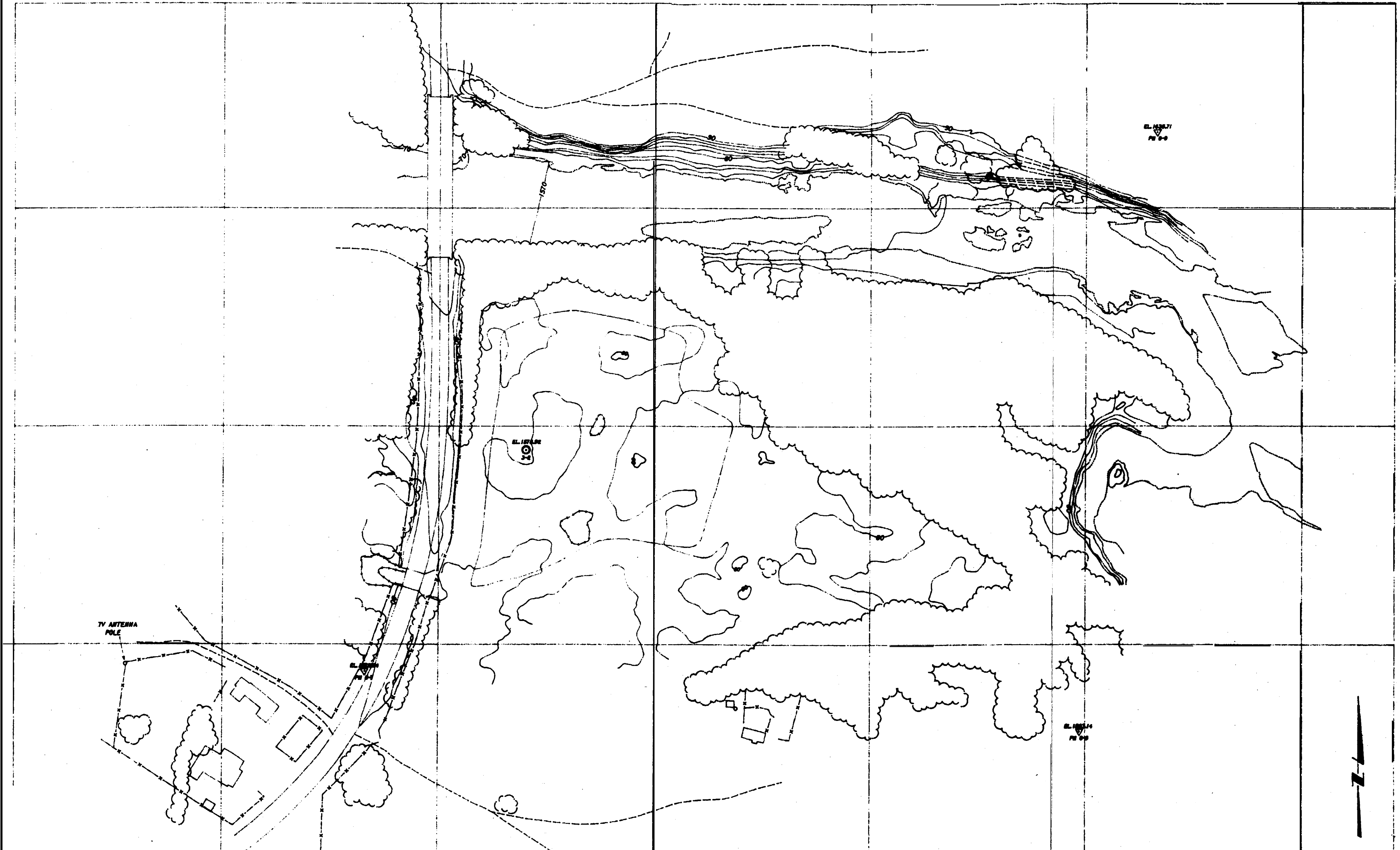
Cayuse

The Cayuse site is located on the Umatilla Indian Reservation at approximately river mile 67.5 on the north side of the Umatilla River (Figure 7). Access is provided by a dirt road off the paved Cayuse Road off County Road 900.

This site is on property owned by the Hoptowit family and is located just east of several of their existing residences, which would remain following development. Adjacent to the site to the east is a large wetland area which periodically floods. An unstable bank and periodic flooding make provision of a permanent intake structure difficult.

Mission

The Mission site is located on the Umatilla Indian Reservation at river mile 61 of the Umatilla River (Figure 8). Access to this site is by paved road off County Road 900 at Mission. The site is flat and lies 8 to 10 feet above the river and requires a pumped supply. There is adequate space for all potential facilities. Blood potential is minimal.



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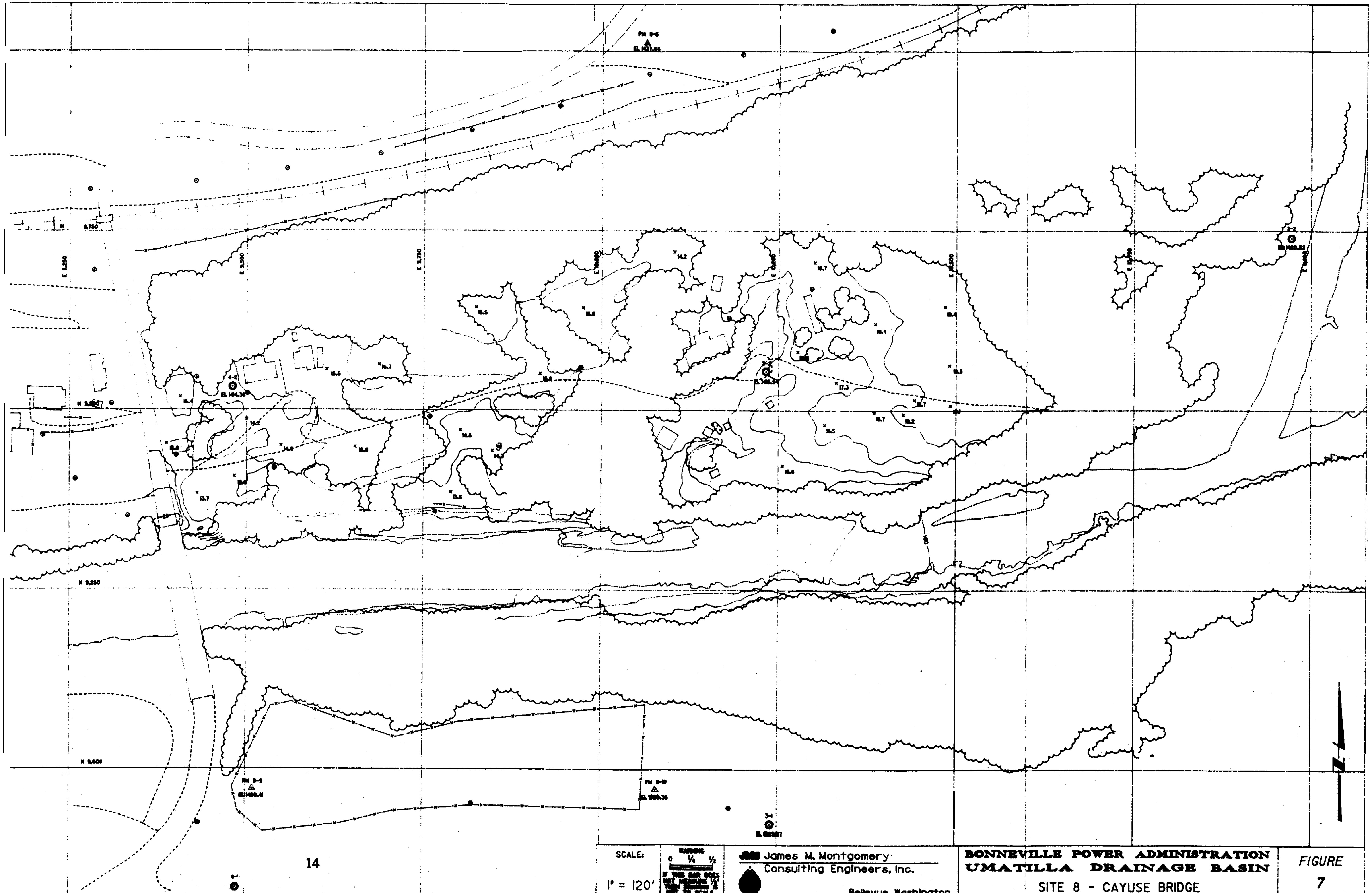
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 6 - THORN HOLLOW

FIGURE 6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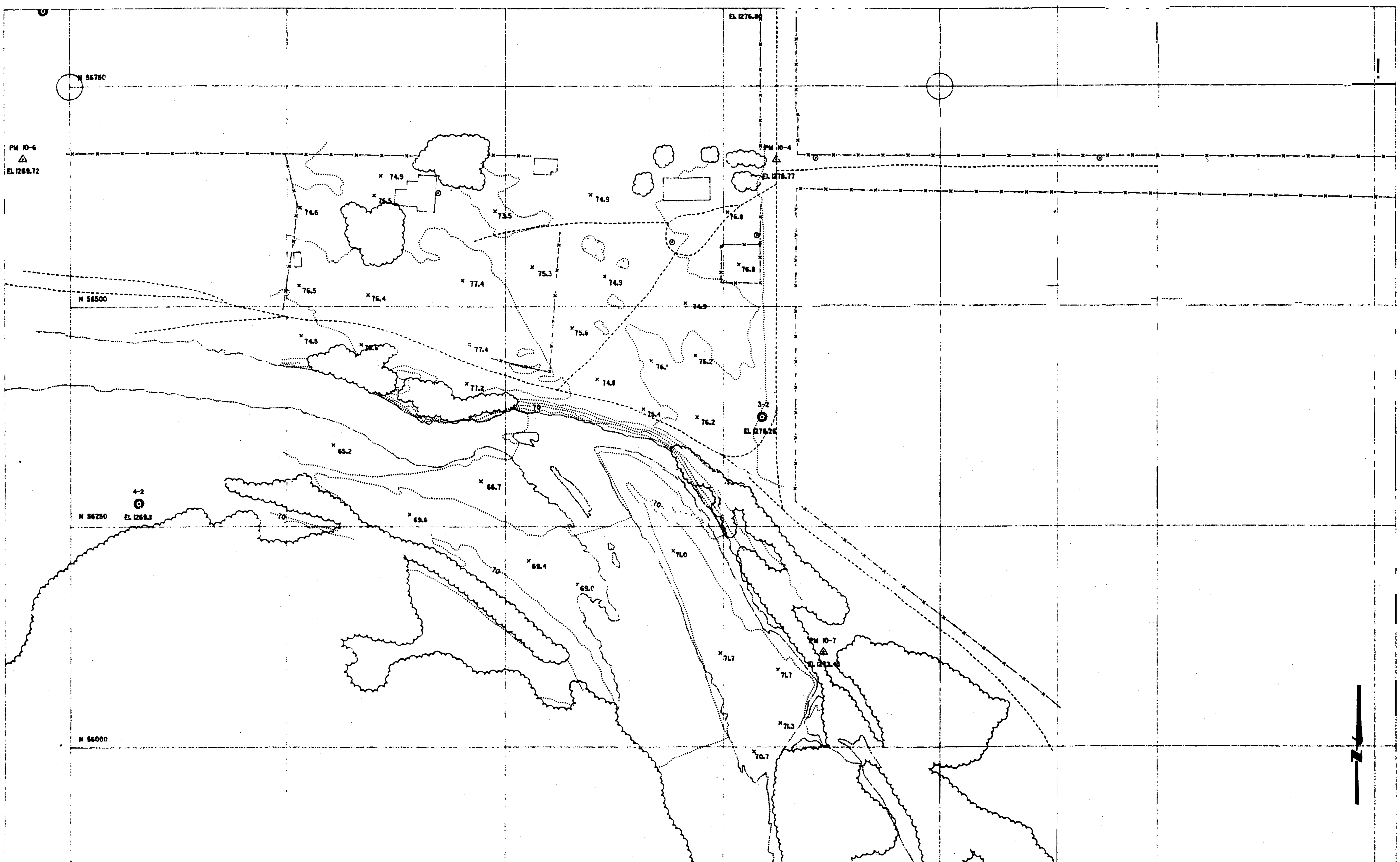
Bellevue, Washington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 8 - CAYUSE BRIDGE
FIGURE
7



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BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 10 - MISSION

FIGURE 8

ODF&W

The ODF&W site is located adjacent to ODF&W headquarters at approximately river mile 56.2, just east of Pendleton (Figure 9). The land is owned by ODF&W. There is sufficient drop in river elevation over a relatively short distance to allow a gravity intake. Flood potential at this site is relatively high; an existing berm at the site would need to be extended somewhat to protect the planned facilities. Wetlands to the east and north of the cleared area and treed, undeveloped portions make the west end of the site most suitable for development of ponds. Security at this site is good.

Barnhart

The Barnhart site is located at river mile 43 and access is off the Echo-Pendleton Highway (Figure 10). Ownership includes the Union Pacific Railroad and some private owners. There are limited sight distances upon exit from the site, and access and signage should be improved. This site is currently being used as a release site, and there is a dirt road from the highway to the river. The release site is just south of the railroad tracks and is at a bend in the river. There is a large flowing pool with a low bank on the north side of the river and a high rock bank on the south side.

Flooding has reportedly occurred recently at this site. There is a low section of bank near the north end of the site where floodwaters leave the channel, and extend south to the railroad. Due to its distance from the highway, security is a concern at this site, especially in the area south of the railroad.

Nolin

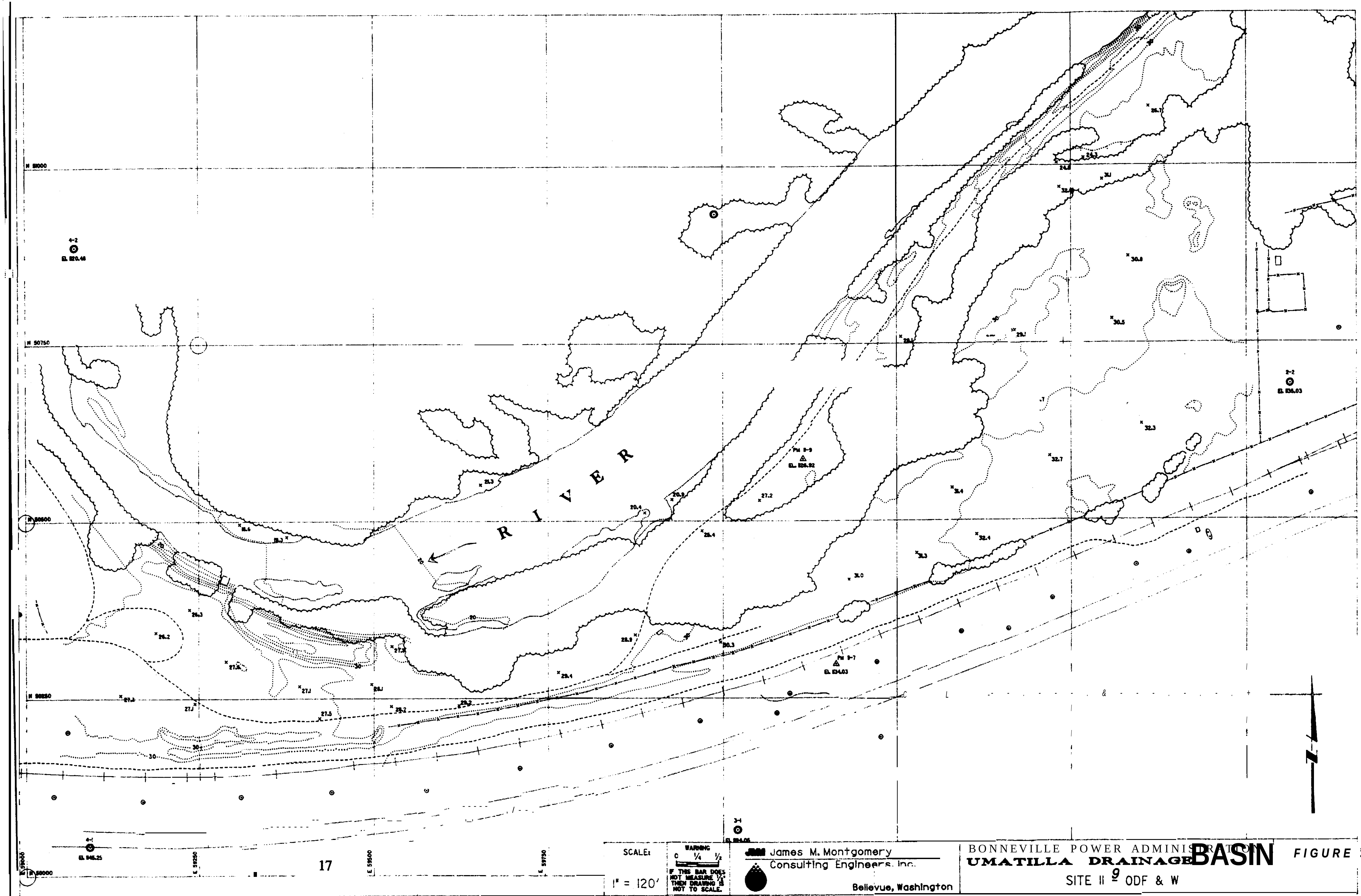
The Nolin site is located at river mile 35 (Figure 11) on land owned by the Cunningham Sheep Company. The channel section at this location is subject to change, as indicated by recent gravel deposition in the river. The south bank of the river at the site is unstable and subject to erosion. The right bank is a high rock bank. A potential pumped intake location exists on the right bank.

Due to the changes in river bed gravel deposition at this site during May 1991 flooding, it may not be suitable for development. A potential alternative site on the same property is located approximately 1/2 mile upstream.

Echo Meadows

The site is just south of Interstate 84 just west of the town of Echo at approximately river mile 23-24 (Figure 12). This site is owned by ODF&W. The river channel at this site is not stable, and deposition of gravel bars, flooding and streambank erosion is evident at the site. Flood potential is very high on the low-lying areas adjacent to the river.

Much of the low-lying portions of the site are treed. However, flat, bare land is available on the west perimeter of the property adjacent to an irrigation canal that appears to have the best potential for location of ponds. This location is best from the standpoint of flood protection and the potential to acquire a water supply from the irrigation ditch. A river intake at this site would require significant pipeline distance (for gravity) as well as significant structural measures to protect the the intake from flooding and streambed movement (both gravity and pumped).


RIVER
N 51000
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4-2
3-2
3-1
4-1
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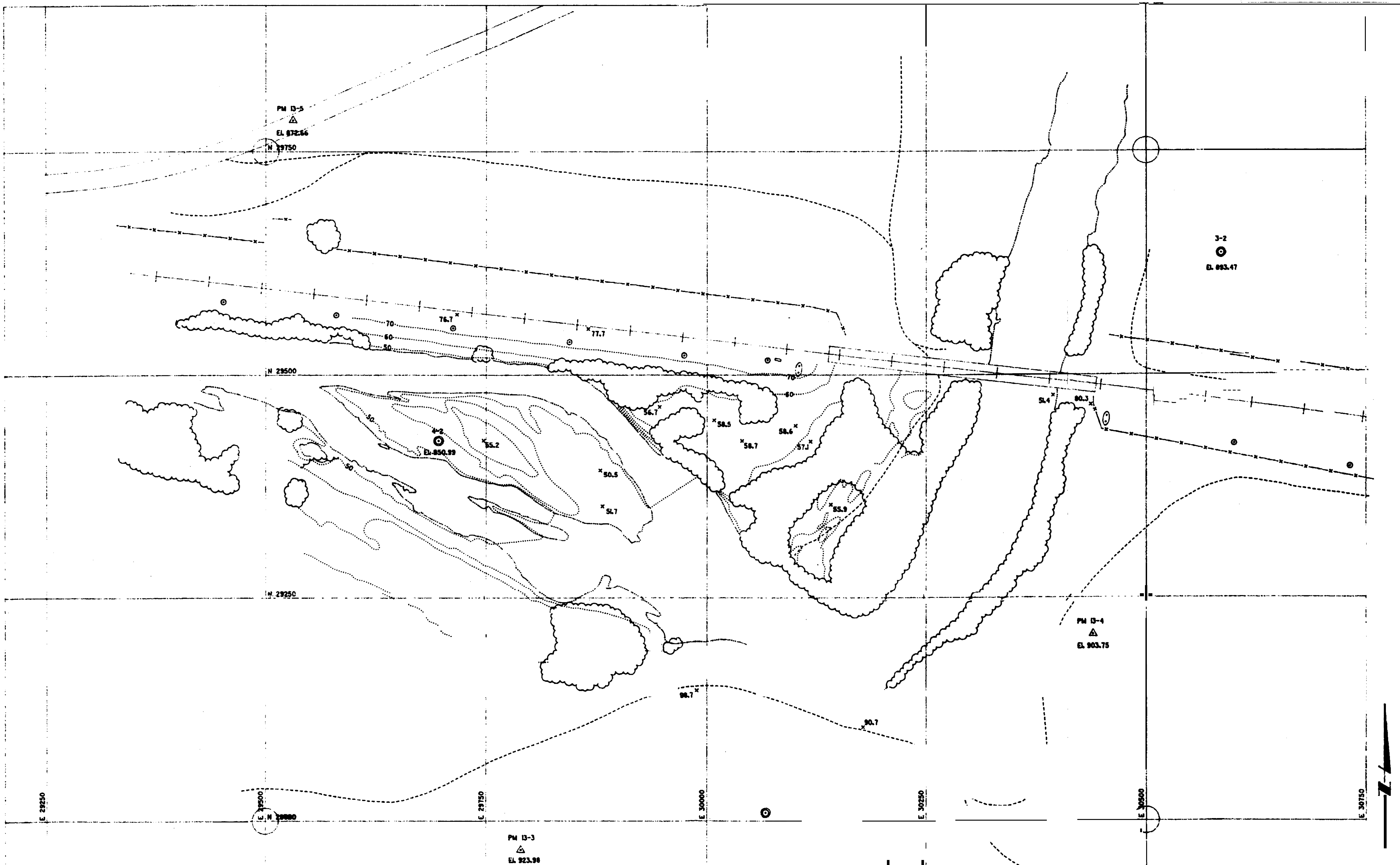
Consulting Engineers, Inc.
Bellevue, Washington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE II 9 ODF & W
FIGURE



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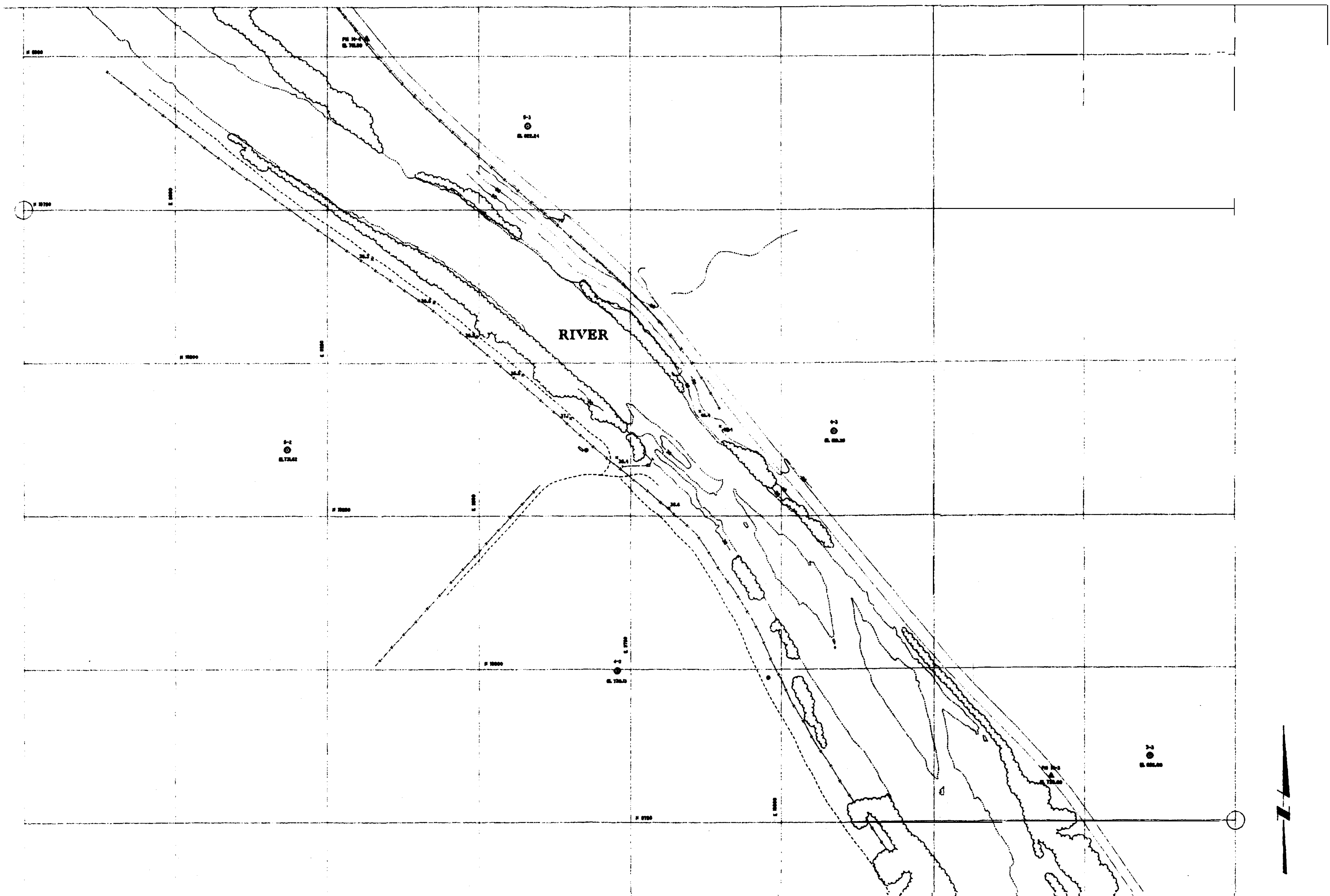
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 13 - BARNHART

FIGURE 10



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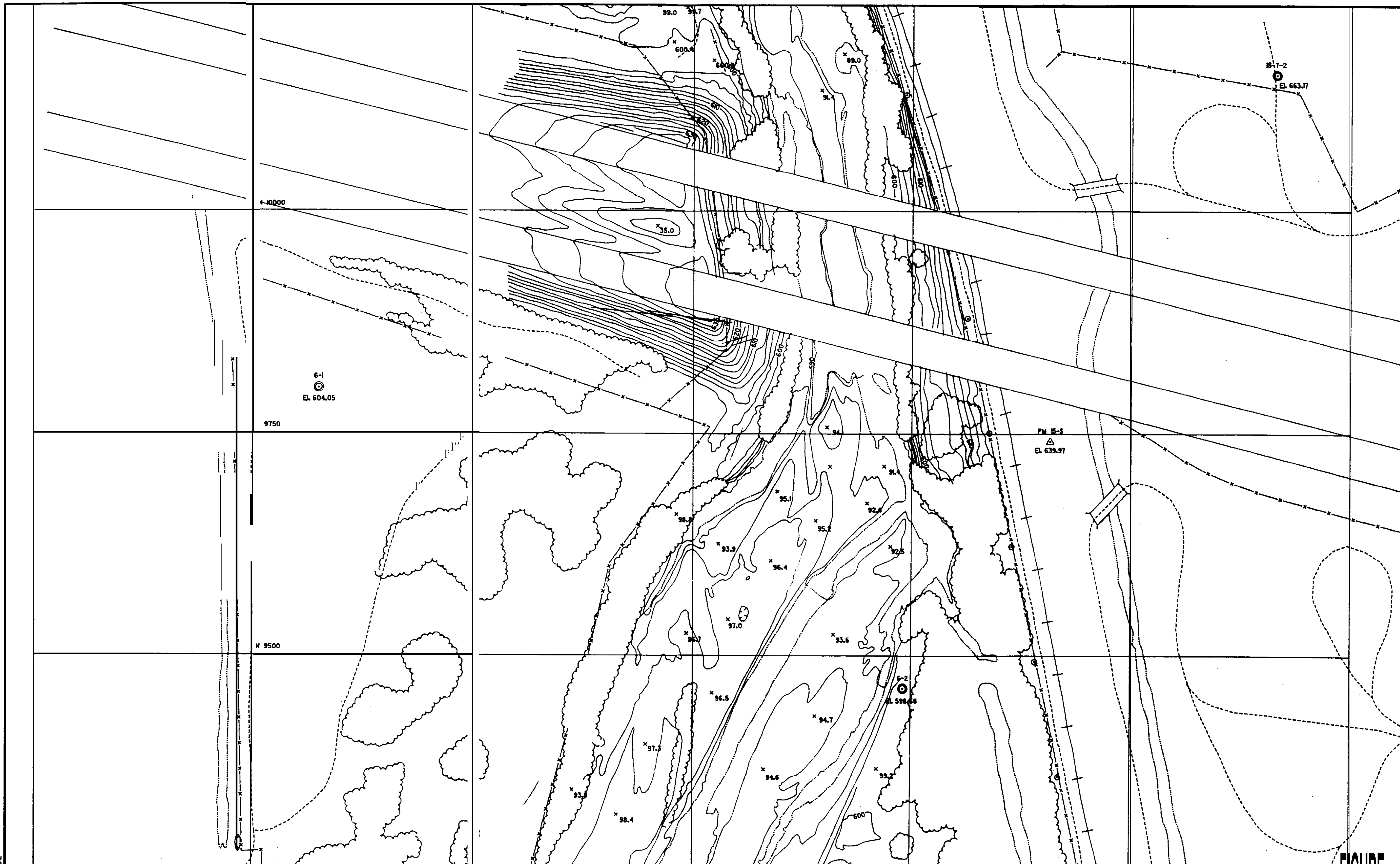
Bellevue, Washington

BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 14 - NOLIN

FIGURE
11



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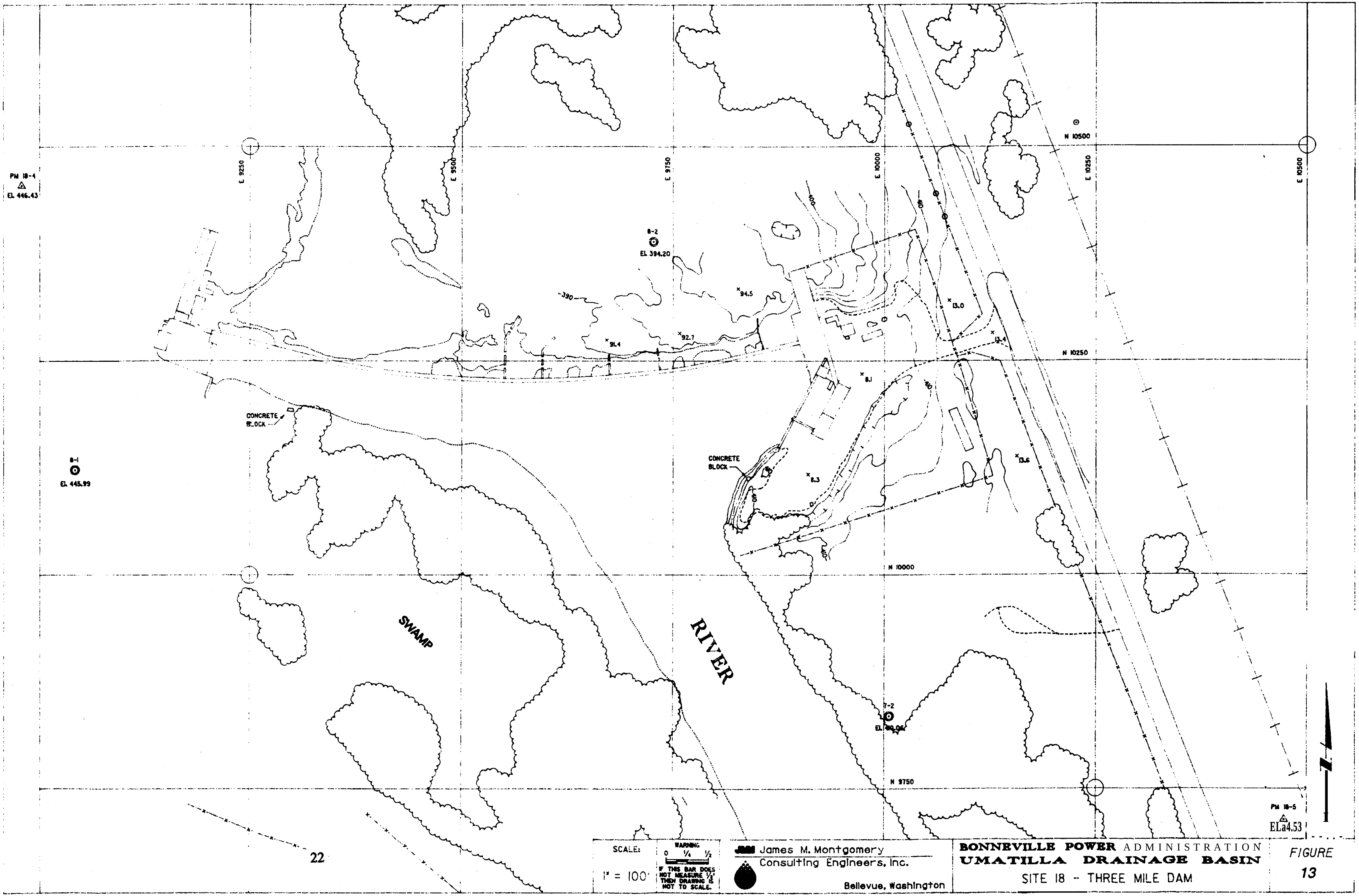
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
ECHO MEADOWS

FIGURE 12

JAN-24-92

Three Mile Dam

There is an existing adult-capture facility at the Three Mile Dam site on the east bank of the Umatilla River jointly operated by CTUIR and ODF&W (Figure 13). The land is owned by BPA. Space at the existing site is constrained, and addition of an adult holding facility would require acquisition and development of additional land to the south of the existing site between the road and the river. The existing entrance and gravelled area for loading fish into trucks would remain. Two existing trailers at the site can be removed and replaced with a permanent bunkhouse.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E 9500
E 9750
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E 10250
E 10500
N 10500
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N 10000
N 9750
8-2
EL 394.20
8-1
EL 445.99
7-2
CONCRETE BLOCK
CONCRETE BLOCK
SWAMP
RIVER
-390
94.5
91.4
92.7
13.0
13.4
8.1
8.3
13.6
PM 18-5
EL 4.53
SCALE:
1" = 100'
WARNING
0 1/4 1/2
IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.
James M. Montgomery
Consulting Engineers, Inc.
Bellevue, Washington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
SITE 18 - THREE MILE DAM
FIGURE
13

PROCESS CRITERIA

INTRODUCTION

This section presents the process criteria used for design of the Umatilla project facilities. Biological criteria for the various life history stages are discussed first followed by a discussion of disinfection alternatives for facility influent and effluent water.

BIOLOGICAL CRITERIA

The process criteria for temperature, density, flow, growth, and survival are presented in Table 3. Of critical importance to this project are the temperature criteria. Temperature criteria are based on percentiles rather than an absolute temperatures. For example, the temperature criteria for spring chinook adults during April to July is 63 °F based on the 75 percentile of the daily maximum temperatures. For incubation, both a maximum and minimum criteria are presented.

Attainment of these criteria during all production phases is needed to meet the programming schedule. However, temperature criteria will be difficult to meet for certain production phases at certain seasons (e.g., spring chinook adult holding and full term rearing in late summer). Further, water temperatures slightly warmer than the criteria during incubation and early rearing phases will significantly advance the development rate and result in “early” fish that exceed the desired timing and size at release criteria. This section describes the ramifications of site specific conditions of not meeting these criteria, presents several optional approaches to meeting these criteria, and recommends an overall approach.

TABLE 3

PROCESS CRITERIA FOR THE UMATILLA BASIN

Process Element	Spring Chinook Group 1	Fall Chinook Group 7	Summer Steelhead Group 10
Adult. Hauling			
Date	Apr. 15-Jul 15	Sep-Dec	Oct-May
Weight (lb)	13	15	6
Adult Holding			
Date	Apr 15-Sep 15	Sep-Dec	act-May
Weight (lb)	13	15	6
Temperature (F)			
Optimum	50	50	50
Average Monthly	45-55	45-55	40-55
Maximum Daily 75 Percentile[a]	63 (Apr-Jul) 60 (Aug-Sep)	63	60
Density (cf/fish)	8	7	2.5
Flow (gpm/fish)	-1.5 + 0.05xT	-1.5 + 0.05xT	-0.5 + 0.05xT
Survival (%) (Capture-Spawning)	75	80	75
Spawning			
Date	Aug 5-Sep 15	Oct 15-Dec	Mar15-May
Female/Male Ratio	1:1	1:1	1:1
Eggs/female	4.200	4.500	5.200
Incubation			
Date	Aug-Dec	Oct 15-Feb	Mar 15-Jun
Eggs/Tray (1 female/tray)	4,200	4,500	5,200
Flow/8 trays (gpm)	6	6	6
Time to Hatch 50F(d)	93	93	54
Temperature (F)			
optimum	42->39->42[b]	52	52
Average Monthly Range	42-55	42-55	42-55
Maximum Daily 75 Percentile[a]	60	60	60
Minimum Daily[c]	38	38	38
Survival (green egg to feeding)	90	90	90
DD to Feeding	1665	1665	975
Length at Feeding (inches))	1.34	1.45	1.02
Weight at Feeding (#/lb)	1100	1100	2800

a Maximum daily temperature criteria are based on the 75th percentile. Therefore, 1 out of four days, the daily maximum will exceed the criteria.

b This temperature profile may be used to delay the development of the eggs

c Minimum daily temperature criteria are based on the 90th percentile. Therefore, 1 out of ten days, the daily minimum will be less that the criteria.

TABLE 3 (continued)

Parameter	Spring Chinook Group 1	Fall Chinook Group 7	Summer Steelhead Group 10
Length-Weight (W =CW^n, inches, lb)			
C	2,959x10-’	2,959x10-’	$3,405x10^{-7}$
n	,00	3.00	3.00
Early Rearing (Feeding to 200/lb)			
Date	**Nov-Feb**	**Jan-Mar**	**May-Jul**
Length at Start (inches)	**1.34**	**1.45**	**1.02**
Weight at Start (#/lb)	**1100**	**1100**	**2800**
Duration (d) @ 50F	**32**	**32**	**64**
Temperature(F)			
Optimum	**50**	**50**	50
Average Monthly Range	**40-60**	**40-60**	**40-60**
Maximum Daily 75 **Percentile**[a]	63	63	63
DI	1.00	1.00	1.00
FI (note: based on Table 13 in Final **Siting Report)**	see note	see note	see note
Survival (%)	**90**	**90**	90
DD /inch	**840**	**840**	810
Length at End (inches)	**2.57**	**2.57**	2.45
Weight at End (#/lb)	**200**	**200**	200
Rearing (**200/lb** to Transport)			
Date	Dee-May 15	Jan-May 15	May-Apr
Length at Start (inches)	2.57	2.57	2.45
Weight at Start (#/lb)	200	200	**200**
Duration (d) @ 50F	205	36	**266**
Temperature **(F)**			
optimum	**55**	55	55
Average Monthly Range	**45-60**	**45-60**	**45-60**
Maximum Daily 75 Percentilea	63	63	63
DI	**0. 8**	0.18	**0. 8**
FI (note: based on Table 13 in Final Siting Report. Table 13 values/1.25)	**see note**	**see note**	see note
Survival (%)	**92**	**92**	92
DD/inch	**840**	**840**	810
Length at End (inches)	**6.97**	**3.83**	8.37
Weight at End (#/lb)	**10**	**60**	**5**
Egg-Smolt			
Survival (%)	72	75	75

[a] Maximum daily temperature criteria are **based** on the **75th** percentile. Therefore, 1 out of four days, the daily maximum will exceed the criteria.

TABLE 3 (continued)

Parameter	Spring Chinook Group 1	Fall Chinook Group 7	Summer Steelhead Group 10
Smolt Hauling			
Date	Mar-May 15	Apr-May 15	Mar-Apr
Length (inches)	6.97	3.83	8.37
Weight (#/lb)	10	60	5
Duration (hr)			
DI			
Survival (%)	99.5	99.5	99.5
Direct Release			
Distance between sites	3-8	3-8	3
Length of river reach	17	8	undefined
Number of Fish/Release Site/Mile/Week	varies	varies	varies
Final Rearing & Release			
Date	Mar-May 15	Apr-May 15	Mar-Apr
Distance between Sites	>5	>5	>5
Length at Start (inches)	6.97	3.83	7.80
Weight at Start (#/lb)	12	65	5.5
Duration (d)	3 to 30	3 to 30	3 to 30
DI	0.11	0.11	0.11
FI (note: based on Table 13 in Final Siting Report. Table 13 values/1.25)	see note	see note	see note
Survival (%)	99.5	99.5	99.5
DD/inch (Rearing value increased by 50%)	1260	1260	1215
Length at End (inches)	6.97	3.83	8.37
Weight at End (#/lb)	10	60	5

TEMPERATURE ADJUSTMENT CONSIDERATIONS (FALL CHINOOK)

Monthly temperatures for Three Mile Dam (Table 4) site were compared to the temperature criteria presented in Table 3 for Fall Chinook. High temperatures occur only in September and possibly October. Temperature information at Three Mile Dam is not as complete as for other stations in the Umatilla Basin. Without extensive temperature modelling of potential water releases under Phase 2 of the USBR Umatilla Pumping Project, it is impossible to predict what the temperatures will be in the future at the Three Mile Dam site. For the purpose of this report, it has been assumed that the Phase 2 of the USBR Umatilla Pumping Project will reduce the maximum temperature at the Three Mile Dam by 2°F during the months of September, October, and December. It is important to note that under the current pumping plan, no water will be pumped until September 15th. Fall Chinook may not return to the Umatilla River until the temperature of the Umatilla River drops to acceptable values. The worst case condition would be a cool water period that allows a significant number of Fall Chinook to return to Three Mile Dam, followed by a warm period with the water temperatures increasing to 70°F and above for extended periods.

TABLE 4

REQUIRED TEMPERATURE ADJUSTMENT AT THREE MILE DAM

	Actual Temperature (°F)			Temperature Criteria (°F)	Required AT (°F)		
Month	Current Conditions Mean	Current Conditions Maximum	Near-Team Future	Adult Holding	Current Conditions Mean	current Conditions Maximum	Near-Term Future
Oct	57.2	68.0	66.0	63.0		-5.0	-3.0
Nov	48.4	59.0	57.0	63.0			
Dec	43.5	54.0	5:2.0	63.0			
Jan	40.8	51.8					
Feb	45.0	56.3					
Mar	50.7	62.1					
Apr	54.0	69.8					
May	58.8	80.1					
Jun	66.6	81.0					
Jul	70.9	83.3					
Aug	70.2	84.9					
Sep	64.4	73.9	71.9	63.0	-1.4	-10.9	-7.9
Oct	57.2	68.0	66.0	63.0		-5.0	-3.0
Nov	48.4	59.0	57.0	63.0			
Dec	43.5	54.0	521.0	63.0			
Jan	40.8	51.8					
Feb	45.0	56.3					
Mar	50.7	62.1					
Apr	54.0	69.8					
May	58.8	80.1					
Jun	66.6	81.0					
Jul	70.9	83.3					
Aug	70.2	84.9					
Sep	64.4	73.9	71.9	63.0	-1.4	-10.9	-7.9
Oct	57.2	68.0	66.0	63.0		-5.0	-3.0
Nov	48.4	59.0	57.0	63.0			
Dec	43.5	54.0	52.0	63.0			
Jan	40.8	51.8					
Feb	45.0	56.3					
Mar	50.7	62.1					
Apr	54.0	69.8					
May	58.8	80.1					
Jun	66.6	81.0					
Jul	70.9	83.3					
Aug	70.2	84.9					
Sep	64.4	73.9	71.9	63.0	-1.4	-10.9	-7.9

During warm years, three options are available for the holding of Fall Chinook at Three Mile Dam. The first option would involve moving the early part of the Fall Chinook to the Spring Chinook holding site. The second option would involve the use of mechanical chillers to reduce the water temperature during the month of September. The third option would increase the number of fish captured during the early run to compensate for the increased mortality during holding.

Because of the small potential overlap between the Falls and Springs, the first option will not require additional holding space at the Spring Chinook facility. It would require the transport of the fish to the Spring Chinook Facility. The holding of Fall Chinook at a Spring Chinook Adult Holding facility outside of the Umatilla Basin may require increased levels of isolation between the species.

The chilling requirements for Option 2 are based on the following assumptions:

Number of fish:	1000
Temperature	60 °F
Water requirement	1.5 gpm/fish
Water Flow	1,500 gpm
ΔT (°F)	-10.9 °F
Power consumption	0.70kW/ton of chiller
Power costs	$0.07/kwh

To cool 1,500 gpm of water by a AT = -10.9 °F requires 682 tons of chiller capacity. Because the temperature criteria is written on a probabilistic basis, it is actually only necessary to supply about 40% of the maximum AT, or 300 tons of chiller capacity. The estimated cost for 300 tons of chiller is approximately $352/day using local electric rates. While it will not be necessary to operate the chillers for more than 20-30 days per year, 300 tons of chillers is a significant capital investment. After Phase 2 of the USBR Pumping Project starts, the chiller requirement will be reduced to 200 tons of capacity. The chiller option will allow holding of the early Fall Chinook at Three Mile Dam, but will significantly increase the complexity and capital costs of the facility.

The third option does not involve increased capital or operational costs, but will require more adult Fall Chinook broodstock to meet the production goals.

TEMPERATURE ADJUSTMENT CONSIDERATIONS (SPRING CHINOOK)

Monthly percentile temperatures from each potential site were compared to the temperature criteria presented in Table 3 for Spring Chinook Temperatures both higher and lower than the criteria occur at all sites. Based on the monthly percentile criteria, the required ΔTs for adult holding, incubation, and rearing are presented for (1) a Corporation site with North Fork supply (Table 5), (2) Williams/Gray site on the Umatilla River (Table 6), and (3) the Russell Walker site on the South Fork Walla Walla River (Table 7). With the exception of some minor heating for incubation, the Corporation and South Fork Walla River sites do not require any temperature adjustment. Because both the AT and flows are small for incubation, temperature adjustment for incubation is

TABLE 5

REQUIRED TEMPERATURE ADJUSTMENT FOR SPRING CHINOOK

CORPORATION WITH NORTH FORK SUPPLY

	Actual Temperature (F)			Temperature Criteria (F)				Required ΔT (F)					
Month	10 % of Daily Minimum	50% of Daily Average	75 % of Daily Maximum	Max Adult Holding	Min Incub	Max Incub	Max Rearing	Adult Holding	Adult Holding Option 1	Incub	Incub Option 1	Rearing	Rearing Option 1
Oct	43	46.1	48										
Nov	40	44.0	46										
Dec	37	40.4	43										
Jan	36	39.0	41										
Feb	37	39.6	42										
Mar	38	40.6	43										
Apr	39	41.8	46	63									
May	40	42.9	48	63									
Jun	42	47.8	56	63									
Jul	47	53.4	60	63									
Aug	48	52.9	58	60	38	60							
Sep	47	50.2	55	60	38	60							
Oct	43	46.1	48		38	60							
Nov	40	44.0	46		38	60	63						
Dec	37	40.4	43		38	60	63			+1			
Jan	36	39.0	41				63						
Feb	37	39.6	42				63						
Mar	38	40.6	43				63						
Apr	39	41.8	46				63						
May	40	42.9	48				63						
Jun	42	47.8	56				63						
Jul	47	53.4	60				63						
Aug	48	52.9	58				63						
Sep	47	50.2	55				63						
							63						
Oct	43	46.1	48				63						
Nov	40	44.0	46				63						
Dec	37	40.4	43				63			+1			
Jan	36	39.0	41				63						
Feb	37	39.6	42				63						
Mar	38	40.6	43				63						
Apr	39	41.8	46				63						
May	40	42.9	48				63						
Jun	42	47.8	56										
Jul	47	53.4	60										
Aug	48	52.9											
Sep	47	50.2	55										

Option 1 involves the use of a reservoir to adjust temperature. It is assumed that the water temperature in the reservoir is equal to the average daily temperatures. This could be achieved by continuously pumping into the reservoir. Temperature less than the average daily temperatures could be achieved by filling the reservoir during the night-time and early morning.

TABLE 6

REQUIRED TEMPERATURE ADJUSTMENT FOR SPRING CHINOOK

WILLIAMS/GRAY SITES

	Actual Temperature (F)			Temperature Criteria (F)						Required ΔT (F)			
Month	10 % of Daily Minimum	50% of Daily Average	75 % of Daily Maximum	Max Adult Holding	Min Incub	Max Incub	Max Rearing	Adult Holding	Adult Holding Option 1	Incub	Incub Option 1	Rearing	Rearing Option 1
Oct	44.1	49.2	53.1										
Nov	38.3	43.3	46										
Dec	35.1	39.2	41.9										
Jan	33.1	38.0	40.1										
Feb	36.0	39.5	41										
Mar	37.0	41.0	44.1										
Apr	39.0	43.8	48	63									
May	41.0	47.9	54	63									
Jun	46.0	55.4	64.9	63				-1.9					
Jul	53.1	63.1	72	63				-9	-0.1				
Aug	54.0	62.3	70	60	38	60		-10	-2.3	-10	-2.3		
Sep	48.3	52.8	62.1	60	38	60		-2.1		-2.1			
Oct	44.1	49.2	53.1		38	60							
Nov	38.3	43.3	46		38	60	63						
Dec	35.1	39.2	41.9		38	60	63			+2.9			
Jan	33.1	38.0	40.1				63						
Feb	36.0	39.5	41				63						
Mar	37.0	41.0	44.1				63						
Apr	39.0	43.8	48				63						
May	41	47.9	54				63						
Jun	46.0	55.4	64.9				63					-1.9	
Jul	53.1	63.1	72				63					-9	-0.1
Aug	54.0	62.3	70				63					-7	
Sep	48.3	52.8	62.1				63						
Oct	44.1	49.2	53.1				63						
Nov	38.3	43.3	46				63						
Dec	35.1	39.2	41.9				63						
Jan	33.1	38.0	40.1				63						
Feb	36.0	39.5	41				63						
Mar	37.0	41.0	44.1				63						
Apr	39.0	43.8	48				63						
May	41	47.9	54				63						
Jun	46.0	55.4	64.9										
Jul	53.1	63.1	72										
Aug	54.0	62.3	70										
Sep	48.3	52.8	62.1										

Option 1 involves the use of a reservoir to adjust temperature. It is assumed that the water temperature in the reservoir is equal to the average daily temperatures. This could be achieved by continuously pumping into the reservoir. Temperature less than the average daily temperatures could be achieved by filling the reservoir during the night-time and early morning.

TABLE 7

REQUIRED TEMPERATURE ADJUSTMENT FOR SPRING CHINOOK

RUSSELL WALKER SITE ON SOUTH FORK WALLA WALLA

	Actual Temperature (F)			Temperature Criteria (F)				Required ΔT (F)					
Month	10 % of Daily Minimum	50% of Daily Average	75 % of Daily Maximum	Max Adult Holding	Min Incub	Max Incub	Max Rearing	Adult Holding	Adult Holding Option 1	Incub	Incub Option 1	Rearing	Rearing Option 1
Oct	42.1	44.6	46.0										
Nov	37.9	40.7	42.1										
Dec	37.0	39.5	41										
Jan	36.0	38.5	39.9										
Feb	37.0	39.6	41										
Mar	37.9	40.3	43.0										
Apr	39.0	42.1	44.5	63									
May	41	44.8	48.9	63									
Jun	46.0	51.8	57.9	63									
Jul	48.0	54.3	61.0	63									
Aug	46.9	52.5	59	60	38	60							
Sep	45.0	48.8	52.0	60	38	60							
Oct	42.1	44.6	46.0		38	60							
Nov	37.9	40.7	42.1		38	60	63			+0.1			
Dec	37.0	39.5	41		38	60	63			+1.0			
Jan	36.0	38.5	39.9				63						
Feb	37.0	39.6	41				63						
Mar	37.9	40.3	43.0				63						
Apr	39.0	42.1	44.5				63						
May	41	44.8	48.9				63						
Jun	46.0	51.8	57.9				63						
Jul	48.0	54.3	61.0				63						
Aug	46.9	52.5	59				63						
Sep	45.0	48.8	52.0				63						
Oct	42.1	44.6	46.0				63						
Nov	37.9	40.7	42.1				63						
Dec	37.0	39.5	41				63						
Jan	36.0	38.5	39.9				63						
Feb	37.0	39.6	41				63						
Mar	37.9	40.3	43.0				63						
Apr	39.0	42.1	44.5				63						
May	41	44.8	48.9				63						
Jun	46.0	51.8	57.9										
Jul	48.0	54.3	61.0										
Aug	46.9	52.5	59										
Sep	45.0	48.8	52.0										

Option 1 involves the use of a reservoir to adjust temperature. It is assumed that the water temperature in the reservoir is equal to the average daily temperatures. This could be achieved by continuously pumping into the reservoir. Temperature less than the average daily temperatures could be achieved by filling the reservoir during the night-time and early morning.

not a serious problem. The Williams/Gray sites will require significant temperature adjustment during adult holding, incubation, and rearing. For example, during August the 75 percentile daily maximum temperature is 70 °F and the 75 percentile temperature criteria is 60 °F. Therefore, the temperature must be reduced by -10 °F. During the last week of July through early August, adult holding flow requirements range from approximately 3000 to 4100 gpm. Two options are available to provide the required cooling: use of mechanical chillers or use of a reservoir to store cool water and eliminate the daily "spikes" of high temperature during the summer.

Chilling to Reach Temperature Criteria

To cool 4,000 gpm of water by a AT =10 °F requires 1,700 tons of chiller capacity. Because the temperature criteria is written on a probabilistic basis, it is actually only necessary to supply about 40% of the maximum AT, or 670 tons of chiller capacity. The estimated cost for 670 tons of chiller is approximately **$790/day** using local electric rates.

Use of a Reservoir to Control Temperature

Another temperature control option is the use of a large reservoir. During the summer, the daily water temperature in the Umatilla River varies as much as 10-15 °F. The daily temperature variation at the Fred Gray site for July 31, 1991 is presented in Figure 14. The maximum water temperature occurs at approximately 4-5 pm and the minimum temperature at approximately 7-8 am. This reservoir would be filled during the night and early morning with cooler water. The water would be pumped out of the reservoir during the late morning and afternoon into the adult holding and rearing units. The variation of reservoir and adult temperature with the duration of fill time is presented in Figure 15 based on 5 million gallon reservoir and 14 hour drain period.

The shorter the fill time, the lower the reservoir temperature :

Reservoir Fill Time (hours)	Maximum Temperature (°F)	Minimum Temperature (°F)	Average Temperature (°F)
6	63.3	58.1	59.6
12	63.3	58.1	60.7
18	63.3	58.1	61.8
24	64.8	58.1	62.9
no reservoir	71.1	58.1	64.8

The maximum temp.erature could be reduced by making the transition from the reservoir to the stream gradually over l-2 hours.

For the Williams/Gray site, the reservoirs would have to produce a water temperature lower than the average temperature (see Table 6). At very short fill times, the amount of water withdrawn could approach a significant percentage of flow in the river. Rather than intermittently dewatering a reach on a daily basis, it would be necessary to pump back the facility discharge to the intake site.

The reservoir option will require pumping. If the pumps for the reservoir are not operating, gravity water (with somewhat warmer temperature) would be supplied to the facility directly from the river.

FIGURE 14

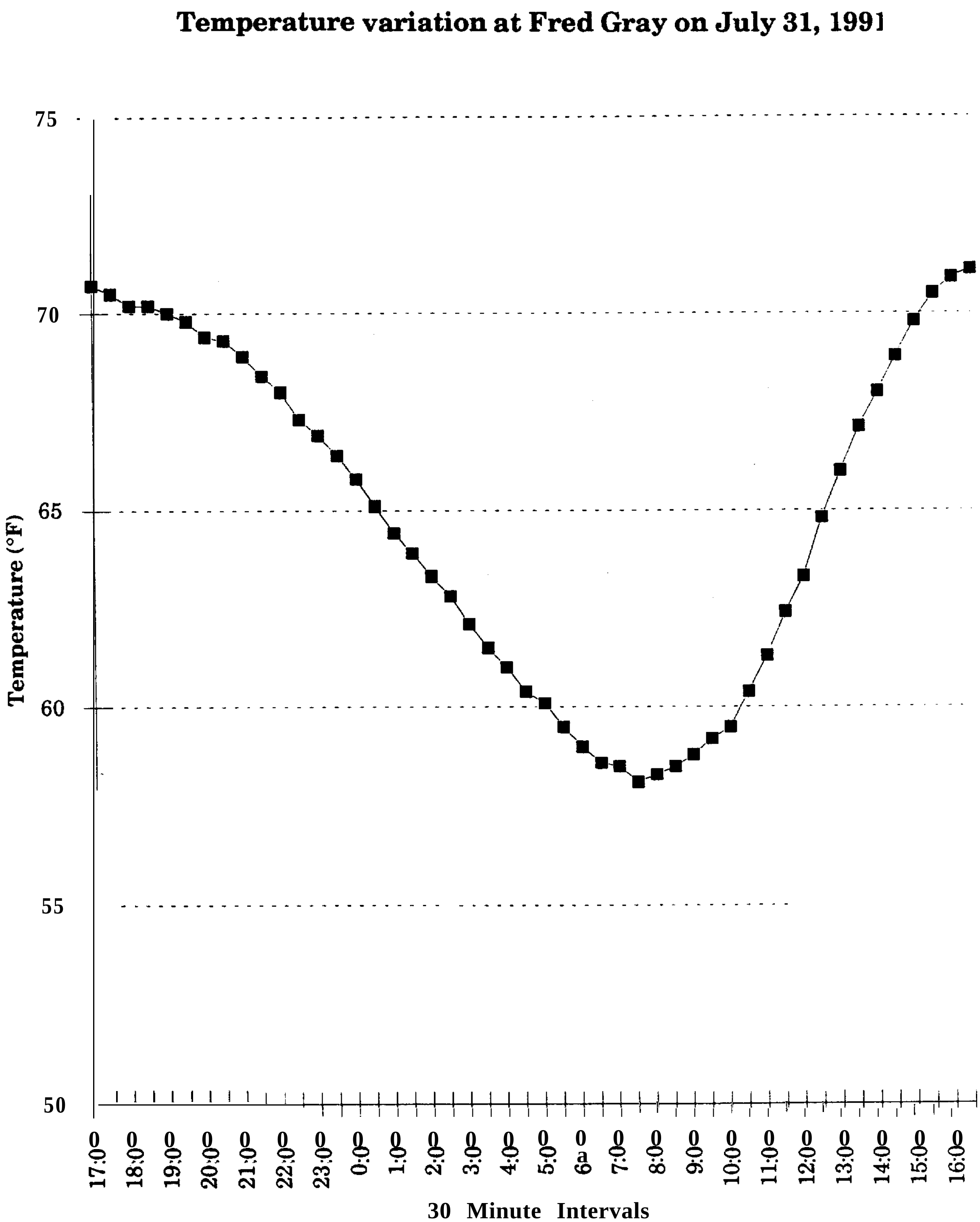
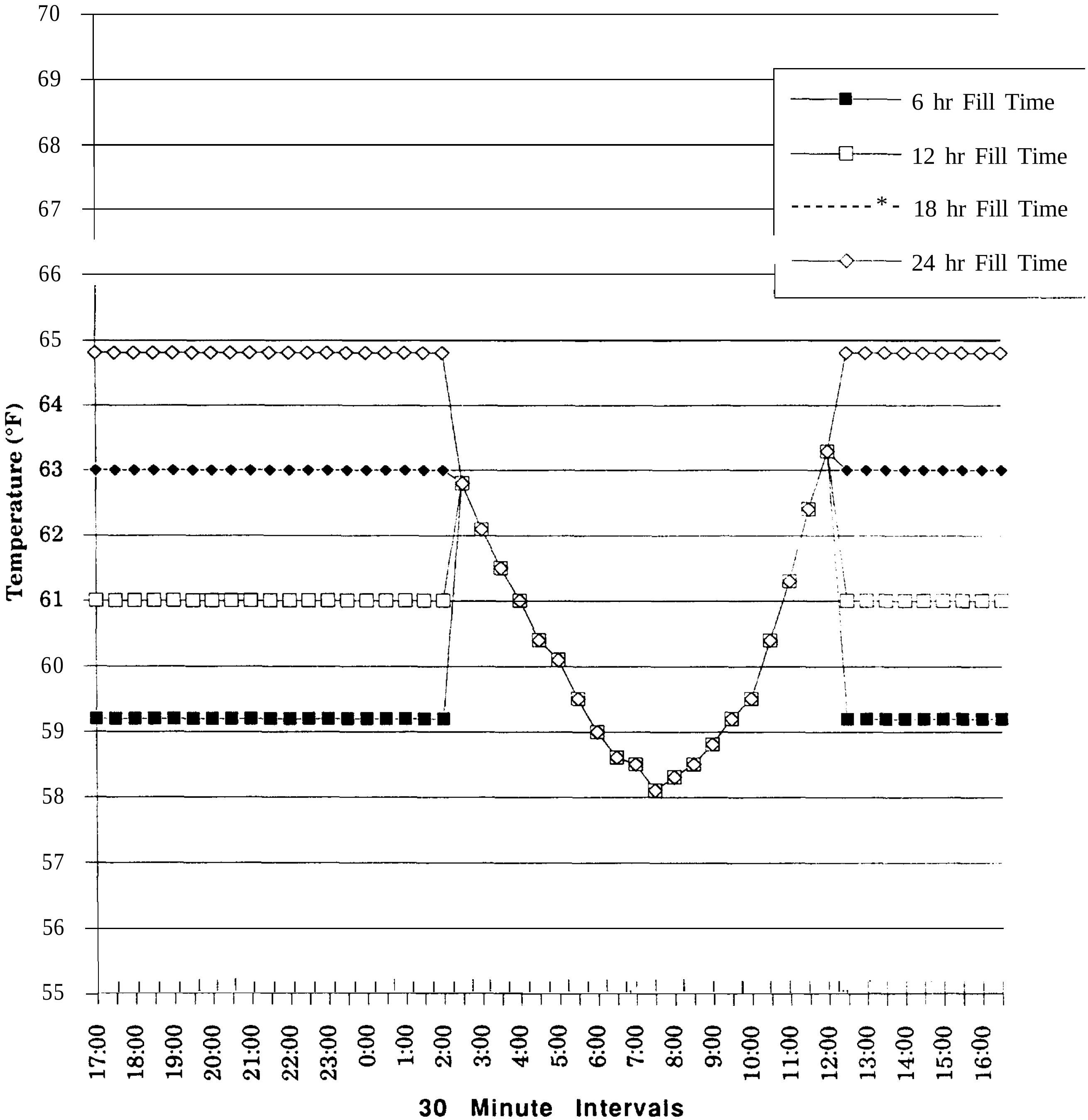

Temperature variation at Fred Gray on July 31, 1991
75
70
65
60
55
50
Temperature (°F)
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
30 Minute Intervals

FIGURE 15

Temperature Variation at Fred Gray Using 5 Million Gallon Reservoir and 14 Hour Drain Period



Detailed design of the reservoir for temperature control cannot be based on monthly, weekly, or daily temperature data. Hourly data is needed. Sizing of the reservoir and development of appropriate operational strategies will require detailed simulation over the full production cycle.

This reservoir can also be used to adjust the production programming to produce fish of the correct size at the right time. For example, if it was desired to increase the growth of fish, the reservoir could be operated in a reverse manner. This would require filling of the reservoir during the day and release of the water during the night and early morning. The daily variation in water temperature at the Fred Gray site is presented in Figure 16 for April 13, 1991. Depending on the filling period, the average temperature could be increased by approximately 3 to 7 °F (Figure 17).

PRODUCTION PROGRAMING

Spring chinook production scheduling within the time periods identified in Table 3 will be difficult given water temperatures in the Umatilla Basin. Based on a 15 month rearing cycle (early + outside rearing), the final release size is presented in Table 8. This analysis is based on mean monthly temperatures from the potential sites. A release size of 10/lb during March to May 15 is desired. The final release weight for the potential Umatilla sites range from 4.4/lb to 7.1/lb. Of all of the sites, the South Fork of the Walla Walla has the best production scheduling characteristics. Based on the same analysis, Lookingglass Hatchery would produce fish of 9.9/lb.

The surface waters in the Umatilla and Walla Walla Basins are too warm to meet the production schedule without modification of the temperature, feeding rate, or some combination of these factors. To match the release weight at Lookingglass, the following average temperature reductions would be required during the whole rearing phase:

Location	ΔT (°F)
Corporation (North Fork supply)	-1.7
Williams/Gray	-4.1
South Fork Walla Walla	-1.5

Several options are available to make adjustments in the production schedule. This analysis has not considered the chilling required to met the temperature criteria.

Reduced Temperature During Incubation

Development rate can be readily adjusted during incubation because water flows are lowest at this stage. The concept of adjusting production scheduling by chilling during incubation is being tested at the Umatilla Hatchery and therefore is not considered in this report. It is unlikely that this option could be used solely to adjust the production schedule for spring chinook for the Umatilla Basin.

FIGURE 16

Temperature Variation at Fred Gray on April 13, 1991

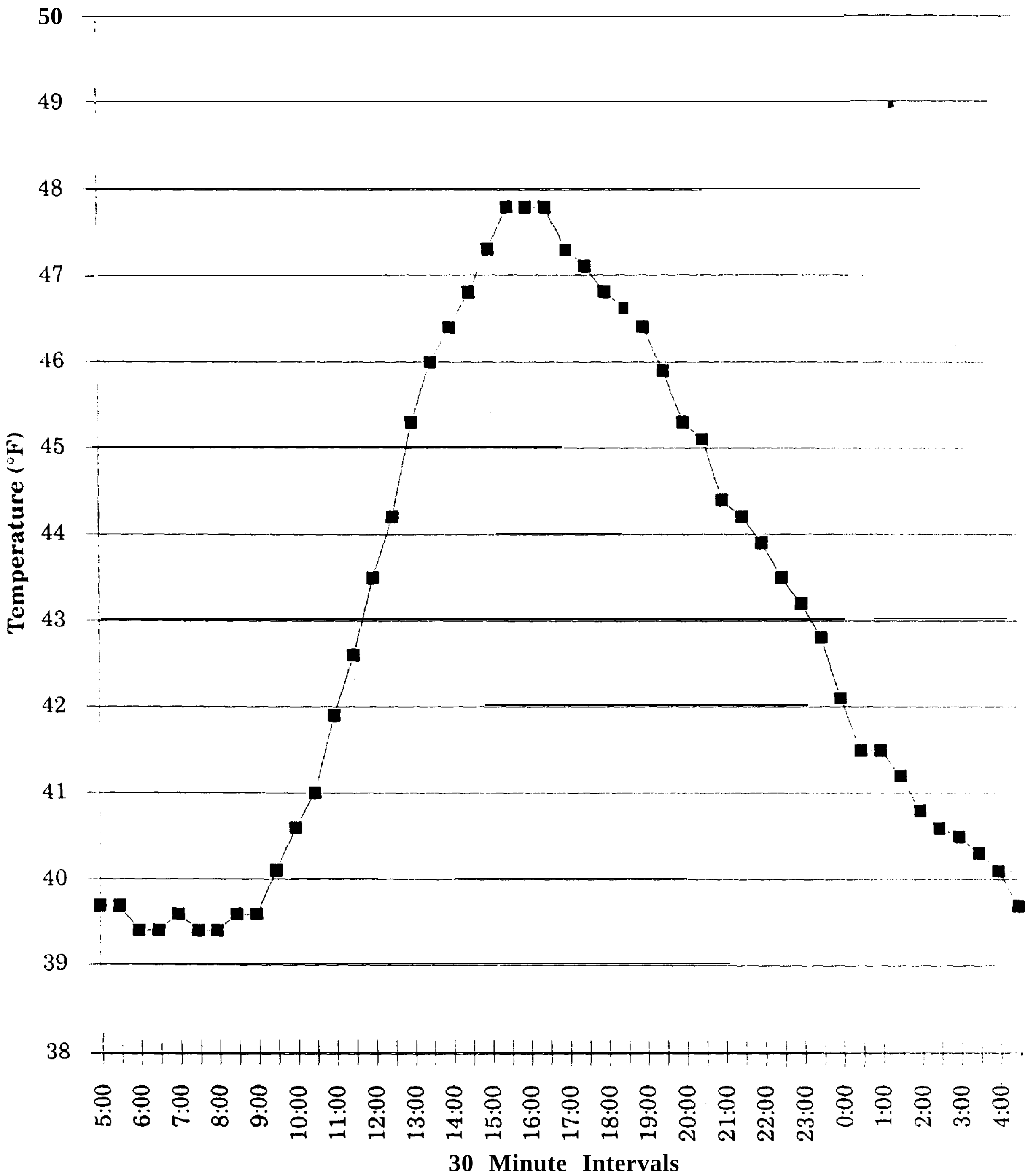


FIGURE 17

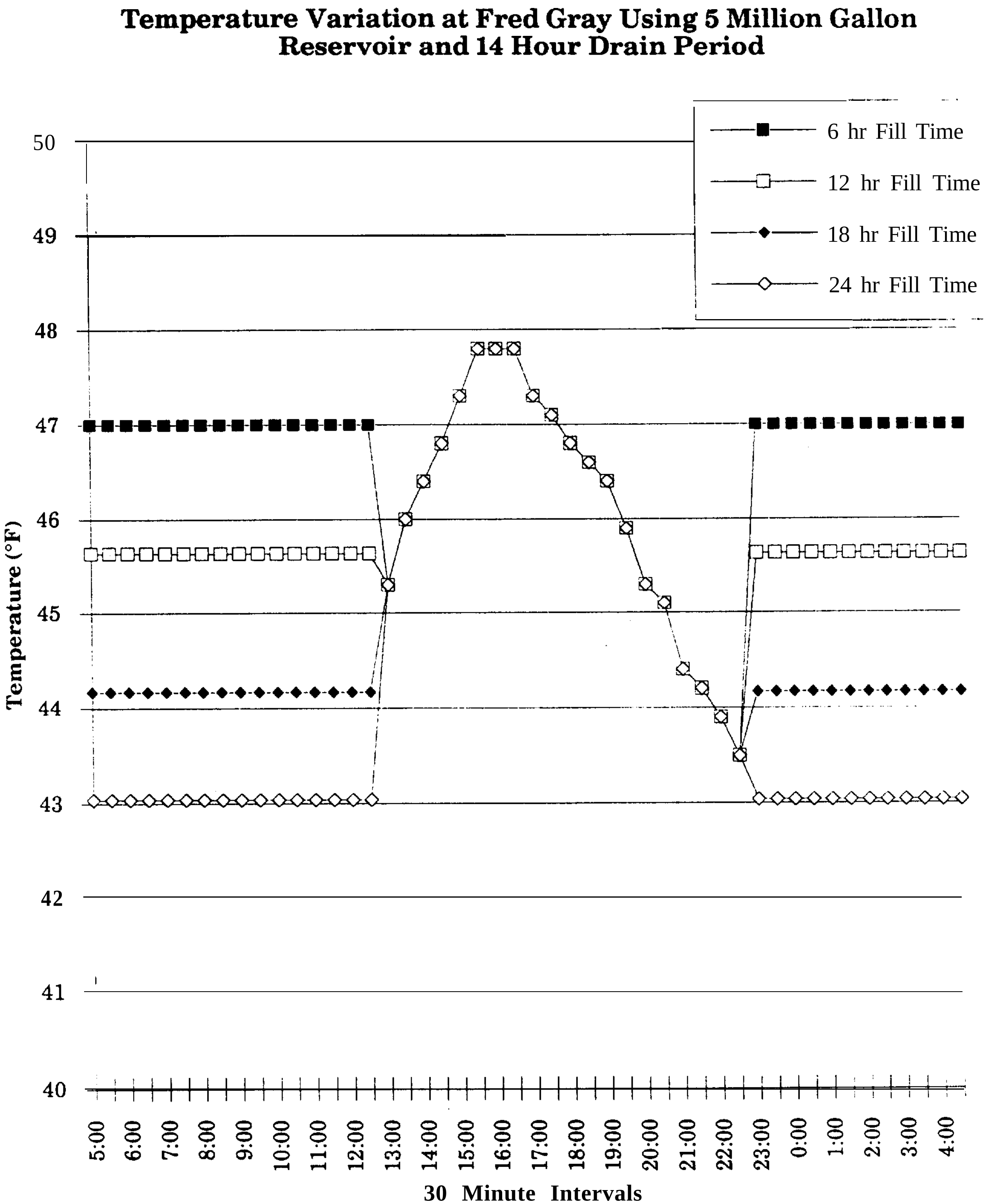

Temperature Variation at Fred Gray Using 5 Million Gallon Reservoir and 14 Hour Drain Period
6 hr Fill Time
12 hr Fill Time
18 hr Fill Time
24 hr Fill Time
Temperature (°F)
50
49
48
47
46
45
44
43
42
41
40
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
30 Minute Intervals

TABLE 8

SUMMARY OF MONTHLY WATER TEMPERATURES

	Temperatures are based on the average daily temperatures																
Site	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Aver**	**Max**
North Fork	39.0	39.9	40.6	41.6	43.3	47.9	53.0	52.8	50.4	46.1	43.5	40.6	39.0	39.9	40.6	43.9	53.0
South Fork	38.1	38.5	39.2	41.0	45.4	52.9	59.9	60.7	57.1	49.1	43.0	39.6	38.1	38.5	39.2	45.4	57.1
Corporation	40.0	41.0	41.2	41.8	44.6	40.3	56.5	55.9	52.5	48.1	44.4	41.4	40.0	41.0	41.2	44.7	52.5
Williams (Computed	38.0	39.5	41.0	43.8	47.9	55.4	63.1	62.3	52.8	49.2	43.3	39.2	38.0	39.5	41.0	46.3	52.8
Walla Walla	38.5	39.6	40.3	42.1	44.8	51.8	54.3	52.5	48.8	44.6	40.7	39.5	38.5	39.6	40.3	43.7	48.8
Lookingglass	36.4	37.3	39.5	41.2	44.4	50.6	54.3	51.8	46.9	42.7	39.0	36.3	36.4	37.3	39.5	42.2	46.9
Carson	b	b	b	43.2	43.7	44.7	46.7	48.2	47.2	45.6	44.5	b	b	b	b	45.5	47.2
Cowlitz	42.1	41.3	42.4	45.1	47.2	48.2	50.7	51.9	51.2	49.8	48.8	46.2	42.1	41.3	42.4	46.0	51.2
Willamette	39.9	40.6	42.8	45.8	48.6	54.0	58.0	57.6	53.0	47.8	42.9	39.6	39.9	40.6	42.8	46.3	53.0

Growthrate (DD/inch	840.0		b =	Indicates no temperature data
Starting Weight(#/l	1100.0			
Starting Lenth (inch	1.45			
C	0.000296			
n	3.0			

Growth Projections Based on 15 months Rearing

	Average	DD/	ΔL	Final Leng	Final Wt	Final Wt
	Temp (F)	15 month	(inches)	(inches)	(#/lb)	(g)
North Fork	43.9	5405	6.44	7.89	6.9	66.0
South Fork	45.4	6076	7.23	8.69	5.2	88.1
Corporation	44.7	5760	6.86	8.31	5.9	77.1
Williams (Computed	46.3	6491	7.73	9.18	4.4	104.0
Walla Walla	43.7	5336	6.35	7.81	7.1	63.9
Lookingglass	42.2	4659	5.55	7.00	9.9	46.1
Cowlitz	46.0	6391	7.61	9.06	4.5	100.0
Willamette	46.3	6488	7.72	9.18	4.4	103.9

Reduced Feeding During Rearing

This option is based on the assumption that some form of temperature reduction is used to meet the temperature criteria of Table 3. Without temperature adjustment during adult holding and rearing the fish may not survive warm-weather periods. How the temperature adjustment is physically accomplished is not important to this discussion. It is very important to other aspects of the design, operation, and energy costs.

Two cases will be considered for the reduced feeding option. The first case uses groundwater for incubation and early rearing and surface water for full term rearing. The groundwater for incubation and early rearing is chilled to the local surface water temperature. The percent reduction in growth needed to achieve a mid-May release date for the three potential hatchery sites are:

Location	Early Rearing	Rearing
Corporation (North Fork supply)	12%	16 %
Williams/Gray	30 %	30 %
South Fork Walla Walla	7 %	9 %

Less growth reduction is needed for the Walla Walla site compared to the other sites. The growth reduction could be accomplished by reduction of the overall feeding rate or withholding of feed for l-2 week periods during the rearing cycle. The withholding of feed has proven superior to reduced feeding rates for steelhead.

The number of days in each process element is present below:

Location	Incubation	Early Rearing	Rearing
Corporation (North Fork Supply)	140	105	364
Williams/Gray	119	140	350
South Fork Walla Walla	168	91	350

Using this strategy, there is no overlap between year classes in any of the rearing processes. The greater amount of growth reduction is needed for Williams/Grey during rearing because of the reduced time spent in incubation and early rearing resulting from higher water temperatures.

The second case uses groundwater for incubation and early rearing and surface water for outdoor rearing. The groundwater for incubation and early rearing is assumed to be from shallow groundwater wells with a temperature of 52 °F. The percent reduction in growth needed to achieve a mid-May release date for the three potential hatchery sites are:

Location	Early Rearing	Rearing
Corporation (North Fork supply)	0 %	31%
Williams/Gray	0 %	41%
South Fork **Walla Walla**	0 %	30 %

Less growth reduction is needed for the **Walla Walla** site. The differences between the different sites is less for this option. This due to greater time spent in outdoor rearing compared to the other option. Significantly more growth reduction is needed during rearing when unchilled, relatively warm (compared to surface water) groundwater is used for incubation and early rearing.

The number of days in each process element is present below:

Location	**Incubation**	**Early Rearing**	**Rearing**
Corporation (North Fork supply)	**84**	**35**	**490**
Williams/Gray	**84**	**35**	**483**
South Fork Walla Walla	**84**	**35**	**490**

Because a constant groundwater temperature was used for all sites, the duration of incubation and early rearing is identical for all sites. The water temperature from the potential shallow gravel aquifers is unknown at this time. Sampling will be required to define the seasonal variation of temperature for these aquifers. The deep aquifers initially considered for these sites can not be used due to high concentrations of hydrogen sulfide gas.

The use of groundwater has significantly reduced the number of days in incubation and early rearing and correspondingly increased the number of days in outdoor rearing. This has two major effects on production scheduling. First, a greater degree of growth reduction is needed to achieve the same release day as compared to using groundwater cooled to ambient stream water temperature. Secondly, and more important, there is overlap between year classes in the outdoor rearing. Therefore, the number of the outdoor rearing units will have to be increased to accommodate the additional number of fish. In addition, having two year classes in outdoor rearing at the same time, is highly undesirable from a disease transmission perspective.

Reduced Temperature during Outdoor Rearing

The reduced feeding option discussed above is based on temperature adjustment only to meet the temperature criteria. Additional temperature adjustment during rearing could be used to adjust production scheduling. Mechanical chilling of rearing water is too expensive to consider (see discussion under Temperature Adjustment problems).

The reservoir option discussed above also has the capability to help adjust production scheduling. This would involve filling a large reservoir during the night and early morning with cooler river water. This water would be pumped out of the reservoir during the late morning and afternoon into the adult holding and rearing units.

This option also has the capability to increase the water temperature during the winter months. The capability could be used to accelerate the growth of fish (if desired). Under this operating mode, the reservoir would be filled during the day with warmer water. This water would be used for outdoor rearing during evening and early morning.

Recommended Option

The recommended option for adjustment of production scheduling includes the following elements:

(1) Chilling of groundwater for incubation and early rearing to a level close to ambient stream water. The chilling would be accomplished by some type of water-water or air-water heat exchanger rather than mechanical chilling. Disinfection of surface water for incubation and early rearing will accomplish the same function.

(2) The reservoir option would be used to reduce water temperature during the summer and adjust temperature to meet production scheduling. This option only applies to the Emmett Williams and Fred Gray sites.

(3) Some level of reduced feeding may need to be considered to fine-tune the production schedule.

FLOWS AND VOLUMES

Adult Holding

The flow and volumes for adult holding are based on the following requirement:

Fall Chinook	5542 fish
Spring Chinook (current)	1652 fish
Spring Chinook (total)	2759 fish

The currently authorized Umatilla Basin spring chinook program is referred to as “current”. The “total” refers to the currently authorized Umatilla Basin spring chinook program plus the NEOH component of the Umatilla and **Walla Walla** Basins. The temperature for the Williams/Gray site has been adjusted to meet the required temperature criteria Temperature adjustment was not required at the Corporation (with North Fork supply) or South Fork **Walla Walla** sites.

The assumed percent returns by week are presented in Table 9. Two options are presented for fall chinook. The first case assumes that all of the fall chinook are held at Three mile dam The second case assumes that during warm years, all of the fall chinook adults returning during September (1000 fish) are trucked to the adult spring chinook holding facility.

TABLE 9

ASSUMED PERCENT RETURNS OF FALL CHINOOK AND SPRING CHINOOK TO THREE MILE DAM

	Max SCH	1652	Current Program		FCH	FCH	FCH	SCH	SCH	FCH	FCH+SCH	FCH+SCH
	Max SCH	2759	Total Program		3 Mile Dam	3 Mile Dam	Held at	Walla Walla	Walla Walla	Walla Walla	Walla Walla	Walla Walla
	Max FCH	5542			Site	Site	Walla Walla	Current	Full		Current	Full
					Warm Years	Cold Years	Warm Years	Cold Years	Cold Years	Warm Years	Warm Years	Warm Years
			SCH	FCH								
Week	Date	Days	% in Holding	% in Holding								
0	1-Jan-91	0	0%	0%								
1	8-Jan-91	7	0%	0%								
2	15-Jan-91	14	0%	0%								
3	22-Jan-91	21	0%	0%								
4	29-Jan-91	28	0%	0%								
5	5-Feb-91	35	0%	0%								
6	12-Feb-91	42	0%	0%								
7	19-Feb-91	49	0%	0%								
8	26-Feb-91	56	0%	0%								
9	5-Mar-91	63	0%	0%								
10	12-Mar-91	70	0%	0%								
11	19-Mar-91	77	0%	0%								
12	26-Mar-91	84	0%	0%								
13	2-Apr-91	91	0%	0%				0	0		0	0
14	9-Apr-91	98	17%	0%				275	460		275	460
15	16-Apr-91	105	33%	0%				551	920		551	920
16	23-Apr-91	112	50%	0%				826	1380		826	1380
17	30-Apr-91	119	67%	0%				1101	1839		1101	1839
18	7-May-91	126	83%	0%				1377	2299		1377	2299
19	14-May-91	133	100%	0%				1652	2759		1652	2759
20	21-May-91	140	100%	0%				1652	2759		1652	2759
21	28-May-91	147	100%	0%				1652	2759		1652	2759
22	4-Jun-91	154	100%	0%				1652	2759		1652	2759
23	11-Jun-91	161	100%	0%				1652	2759		1652	2759
24	18-Jun-91	168	100%	0%				1652	2759		1652	2759
25	25-Jun-91	175	100%	0%				1652	2759		1652	2759
26	2-Jul-91	182	100%	0%				1652	2759		1652	2759
27	9-Jul-91	189	100%	0%				1652	2759		1652	2759
28	16-Jul-91	196	100%	0%				1652	2759		1652	2759
29	23-Jul-91	203	100%	0%				1652	2759		1652	2759
30	30-Jul-91	210	100%	0%				1652	2759		1652	2759
31	6-Aug-91	217	90%	0%				1487	2483		1487	2483
32	13-Aug-91	224	85%	0%				1404	2345		1404	2345
33	20-Aug-91	231	80%	0%				1322	2207		1322	2207
34	27-Aug-91	238	70%	0%				1156	1931		1156	1931
35	3-Sep-91	245	60%	0%		0	0	991	1655	0	991	1655
36	10-Sep-91	252	50%	2%		111	111	826	1380	111	937	1490
37	17-Sep-91	259	40%	5%		277	277	661	1104	277	938	1381
38	24-Sep-91	266	20%	15%		831	831	330	552	831	1162	1383
39	1-Oct-91	273	0%	35%		1940	1940	0	0	1940	1940	1940
40	8-Oct-91	280	0%	55%	1108	3048	1940			1940	1940	1940
41	15-Oct-91	287	0%	75%	2217	4157	1940			1940	1940	1940
42	22-Oct-91	294	0%	85%	2771	4711	1940			1940	1940	1940
43	29-Oct-91	301	0%	95%	3325	5265	1940			1940	1940	1940
44	5-Nov-91	308	0%	98%	3464	5403	1940			1940	1940	1940
45	12-Nov-91	315	0%	100%	3602	5542	1940			1940	1940	1940
46	19-Nov-91	322	0%	80%	2882	4434	1552			1552	1552	1552
47	26-Nov-91	329	0%	70%	2017	3879	1358			1358	1358	1358
48	3-Dec-91	336	0%	60%	1210	3325	1164			1164	1164	1164
49	10-Dec-91	343	0%	50%	605	2771	970			970	970	970
50	17-Dec-91	350	0%	40%	242	2217	776			776	776	776
51	24-Dec-91	357	0%	20%	48	1108	388			388	388	388
52	31-Dec-91	364	0%	0%	0	0	0			0	0	0

Detailed information on holding numbers are presented in Table 9 for the following cases:

Species	Warm/cold	Program	Site
ChF	warm	---	ChF Facility
ChF	cold	---	ChF Facility
ChF	warm	---	ChS Facility
ChS	cold	current	ChS Facility
ChS	cold	total	ChS Facility
ChS+ChF	warm	current	ChS Facility
ChS+ChF	warm	total	ChS Facility

A summary of the holding volumes and maximum flows for the four potential adult holding sites are presented below:

Program/Site	Current Program		Total Program	
	Holding Volume (cf)	Maximum Flow (gpm)	Holding Volume (cf)	Maximum Flow (gpm)
Cold Year				
Three Mile Dam	39,000	5,800	N/A	N/A
Williams/Gray	13,200	3,100	22,100	5,200
Corporation	13,200	2,400	22,100	4,000
South Fork Walla Walla	13,200	2,500	22,100	4,300
Warm Year				
Three Mile Dam	31,800	5,300	N/A	N/A
Williams/Gray	13,200	3,100	22,100	5,200
Corporation	13,200	2,400	22,100	4,000
South Fork Walla Walla	13,200	2,500	22,100	4,300

Problems with potential space limitations during September were checked by computing the space requirements for each species based on Table 9, the number of raceways needed for each species (based on 3680 **cf/pond),** and the total number of ponds needed for the total program.

Program/Date	ChF (# fish)	ChS (# fish)	ChF (cf)	ChS (cf)	ChF (# ponds)	ChS (# ponds)	Total (# ponds)
Current Program							
3 Sept	55	991	385	7928	1	3	4
10 Sept	166	826	1162	6608	1	2	3
17 Sept	388	661	2716	5288	1	2	3
24 Sept	1000	330	7000	2640	2	1	3
Total Program							
3 Sept	55	1655	385	13240	1	4	5
10 Sept	166	1380	1162	11040	1	3	4
17 Sept	388	1104	2716	8832	1	3	4
24 Sept	1000	552	7000	4416	2	2	4

The maximum number of ponds needed during September are 4 for the current program and 5 for the total program. The facility will consist of 4 ponds for the current program and 6 ponds for the total program. Therefore, the holding of Fall Chinook at the Spring Chinook adult holding facility does not increase either the maximum holding volume or maximum water flow. During the period of potential overlap during the month of September, adequate space and number of holding ponds are available so that the two species can be held in separate ponds.

Adequate space is also available for holding a small number of steelhead between November and 7 May. By 14 May, all of the adult holding space is needed for Spring Chinook. Based on spawning information collected in the Umatilla Basin, spawning of summer steelhead should be completed by May. No additional separate adult holding space is included for summer steelhead.

More detailed water requirements for adult holding, incubation, early rearing, rearing, and total system requirements are presented in the following Tables:

Site	Program	Warm or cold year	Table no.
Three Mile Dam	N/A	Cold	10
Williams/Gray	Current	Warm	11
	Total	Warm	12
Corporation	Current	Warm	13
	Total	Warm	14
South Fork Walla Walla	Current	Warm	15
	Total	Warm	16

The design conditions will be a cold year at the Fall Chinook adult holding facility when all of the Fall Chinook will be present and a warm year at the Spring Chinook adult holding when an additional 1000 Fall Chinook will be held. The maximum water flow during the low-flow summer period is more critical that the total maximum yearly water requirement. The “current” program for the Spring Chinook is based on adult holding for the currently authorized Spring Chinook program in the Umatilla Basin. The “total” program includes both the currently authorized Spring Chinook program and the NEOH components for the Umatilla and **Walla Walla** basins.

TABLE 10

WATER REQUIREMENTS FOR FALL CHINOOK ADULT HOLDING
AT THREE MILE DAM

Week	Date	Adult Hold. Warm Year Flow (GPM)	Adult Hold. Cold Year Flow (GPM)
0	1-Jan-91		
1	8-Jan-91	0	0
2	15-Jan-91	0	0
3	22-Jan-91	0	0
4	29-Jan-91	0	0
5	5-Feb-91	0	0
6	12-Feb-91	0	0
7	19-Feb-91	0	0
8	26-Feb-91	0	0
9	5-Mar-91	0	0
10	12-Mar-91	0	0
11	19-Mar-91	0	0
12	26-Mar-91	0	0
13	2-Apr-91	0	0
14	9-Apr-91	0	0
15	16-Apr-91	0	0
16	23-Apr-91	0	0
17	30-Apr-91	0	0
18	7-May-91	0	0
19	14-May-91	0	0
20	21-May-91	0	0
21	28-May-91	0	0
22	4-Jun-91	0	0
23	11-Jun-91	0	0
24	18-Jun-91	0	0
25	25-Jun-91	0	0
26	2-Jul-91	0	0
27	9-Jul-91	0	0
28	16-Jul-91	0	0
29	23-Jul-91	0	0
30	30-Jul-91	0	0
31	6-Aug-91	0	0
32	13-Aug-91	0	0
33	20-Aug-91	0	0
34	27-Aug-91	0	0
35	3-Sep-91	0	0
36	10-Sep-91	[illegible]	98
37	17-Sep-91	0	290
38	24-Sep-91	0	365
39	1-Oct-91	1593	1695
40	8-Oct-91	3083	2919
41	15-Oct-91	4309	4161
42	22-Oct-91	4305	4822
43	29-Oct-91	5267	5818
44	5-Nov-91	4734	5660
45	12-Nov-91	4474	5322
46	19-Nov-91	3348	5403
47	26-Nov-91	2577	3968
48	3-Dec-91	1802	3007
49	10-Dec-91	1311	2461
50	17-Dec-91	828	1884
51	24-Dec-91	62	1275
52	31-Dec-91	0	687
	Maximum	5267	5818

TABLE 11

WATER REQUIREMENTS BY LIFE STAGE FOR THE CURRENT PROGRAM AT WILLIAMS/GRAY SITES

		Adult Holding Surface Water Flow (gpm)	Incubation Groundwater Flow (gpm)	Early Rearing Groundwater Flow (gpm)	Rearing Surface Water Flow (gpm)	Reservoir Surface Flow (gpm)	Total Surface Flow (gpm)	Total Surface Flow (cfs)	Total GW Flow (gpm)	Total Water Flow (gpm)
Week	Date									
0	1-Jan									
1	8-Jan	0	0	175	2888	4630	7517	17	175	7693
2	15-Jan	0	0	182	2934	4630	7564	17	182	7746
3	22-Jan	0	0	192	2998	4630	7627	17	192	7819
4	29-Jan	0	0	197	2965	4630	7595	17	197	7792
5	5-Feb	0	0	211	3093	4630	7723	17	211	7933
6	12-Feb	0	0	226	3193	4630	7823	17	226	8049
7	19-Feb	0	0	239	3262	4630	7891	18	239	8130
8	26-Feb	0	0	254	3331	4630	7960	18	254	8214
9	5-Mar	0	0	265	3357	4630	7987	18	265	8251
10	12-Mar	0	0	282	3432	4630	8061	18	282	8343
11	19-Mar	0	0	303	3549	4630	8179	18	303	8482
12	26-Mar	0	0	328	3658	4630	8288	18	328	8616
13	2-Apr	0	0	353	3787	4630	8417	19	353	8770
14	9-Apr	345	0	386	3925	4630	8900	20	386	9286
15	16-Apr	712	0	419	4107	4630	9448	21	419	9867
16	23-Apr	1070	0	441	4156	4630	9856	22	441	10297
17	30-Apr	1639	0	505	4479	4630	10747	24	505	11252
18	7-May	2138	0	550	4634	4630	11402	25	550	11952
19	14-May	2765	0	612	4864	4630	12259	27	612	12870
20	21-May	2971	0	0	800	4630	8401	19	0	8401
21	28-May	3190	0	0	886	4630	8706	19	0	8706
22	4-Jun	3421	0	0	997	4630	9047	20	0	9047
23	11-Jun	3754	0	0	1156	4630	9539	21	0	9539
24	18-Jun	3940	0	0	1322	4630	9892	22	0	9892
25	25-Jun	4410	0	0	1567	4630	10606	24	0	10606
26	2-Jul	4467	0	0	1741	4630	10838	24	0	10838
27	9-Jul	4665	0	0	2043	4630	11338	25	0	11338
28	16-Jul	4919	0	0	2334	4630	11883	27	0	11883
29	23-Jul	5092	0	0	2608	4630	12330	28	0	12330
30	30-Jul	5157	0	0	2862	4630	12649	28	0	12649
31	6-Aug	4531	0	0	3153	4630	12314	27	0	12314
32	13-Aug	4217	0	0	3376	4630	12222	27	0	12222
33	20-Aug	3675	0	0	3503	4630	11808	26	0	11808
34	27-Aug	3042	0	0	3624	4630	11295	25	0	11295
35	3-Sep	2816	140	0	3717	4630	11162	25	140	11302
36	10-Sep	2452	140	0	3796	4630	10878	24	140	11018
37	17-Sep	2211	140	0	3791	4630	10632	24	140	10772
38	24-Sep	2150	140	0	3834	4630	10615	24	140	10755
39	1-Oct	1311	140	0	3772	4630	9712	22	140	9852
40	8-Oct	1192	140	0	3653	4630	9475	21	140	9615
41	15-Oct	1110	140	0	3713	4630	9453	21	140	9593
42	22-Oct	1023	140	0	3578	4630	9230	21	140	9370
43	29-Oct	946	140	0	3548	4630	9124	20	140	9264
44	5-Nov	863	140	0	3456	4630	8948	20	140	9088
45	12-Nov	772	140	0	3343	4630	8745	20	140	8885
46	19-Nov	568	140	0	3275	4630	8472	19	140	8612
47	26-Nov	448	140	0	3159	4630	8236	18	140	8376
48	3-Dec	342	140	0	3066	4630	8038	18	140	8178
49	10-Dec	261	140	0	2990	4630	7880	18	140	8020
50	17-Dec	190	140	0	2917	4630	7737	17	140	7877
51	24-Dec	95	140	0	2952	4630	7676	17	140	7816
52	31-Dec	0	0	174	2984	4630	7613	17	174	7788
	Maximum	5157	140	612	4864	4630	12649	28	612	12870

TABLE 12

WATER REQUIREMENTS BY LIFE STAGE FOR THE TOTAL PROGRAM AT WILLIAMS/GRAY SITES

Week	Date	Adult Holding Surface Water Flow (gpm)	Incubation Groundwater Flow (gpm)	Early Rearing Groundwater Flow (gpm)	Rearing Surface Water Flow (gpm)	Reservoir Surface Flow (gpm)	Total Surface Flow (gpm)	Total Surface Flow (cfs)	Total GW Flow (gpm)	Total Water Flow (gpm)
0	1-Jan									
1	8-Jan	0	0	354	5830	9259	15090	34	354	15444
2	15-Jan	0	0	368	5924	9259	15183	34	368	15552
3	22-Jan	0	0	388	6052	9259	15311	34	388	15699
4	29-Jan	0	0	398	5987	9259	15246	34	398	15645
5	5-Feb	0	0	426	6245	9259	15504	35	426	15930
6	12-Feb	0	0	456	6447	9259	15707	35	456	16162
7	19-Feb	0	0	482	6585	9259	15844	35	482	16326
8	26-Feb	0	0	512	6725	9259	15984	36	512	16496
9	5-Mar	0	0	534	6778	9259	16037	36	534	16572
10	12-Mar	0	0	569	6929	9259	16188	36	569	16757
11	19-Mar	0	0	612	7166	9259	16425	37	612	17037
12	26-Mar	0	0	663	7386	9259	16645	37	663	17308
13	2-Apr	0	0	713	7646	9259	16905	38	713	17618
14	9-Apr	345	0	779	7925	9259	17529	39	779	18308
15	16-Apr	712	0	845	8292	9259	18263	41	845	19108
16	23-Apr	1070	0	891	8391	9259	18721	42	891	19612
17	30-Apr	1639	0	1020	9043	9259	19941	45	1020	20961
18	7-May	2138	0	1110	9357	9259	20754	46	1110	21864
19	14-May	2765	0	1235	9820	9259	21844	49	1235	23079
20	21-May	2971	0	0	1616	9259	13846	31	0	13846
21	28-May	3190	0	0	1790	9259	14239	32	0	14239
22	4-Jun	3421	0	0	2013	9259	14693	33	0	14693
23	11-Jun	3754	0	0	2333	9259	15347	34	0	15347
24	18-Jun	3940	0	0	2670	9259	15869	35	0	15869
25	25-Jun	4410	0	0	3183	9259	16832	38	0	16832
26	2-Jul	4467	0	0	3516	9259	17242	38	0	17242
27	9-Jul	4665	0	0	4126	9259	18050	40	0	18050
28	16-Jul	4919	0	0	4713	9259	18891	42	0	18891
29	23-Jul	5092	0	0	5266	9259	19617	44	0	19617
30	30-Jul	5157	0	0	5778	9259	20194	45	0	20194
31	[illegible]	4531	0	0	6367	9259	20157	45	0	20157
32	13-Aug	4217	0	0	6815	9259	20292	45	0	20292
33	20-Aug	3675	0	0	7073	9259	20007	45	0	20007
34	27-Aug	3042	0	0	7316	9259	19617	44	0	19617
35	3-Sep	2816	283	0	7505	9259	19580	44	283	19863
36	10-Sep	2452	283	0	7664	9259	19375	43	283	19658
37	17-Sep	2211	283	0	7655	9259	19125	43	283	19408
38	24-Sep	2150	283	0	7742	9259	19151	43	283	19434
39	1-Oct	1311	283	0	7615	9259	18185	41	283	18468
40	8-Oct	1192	283	0	7376	9259	17827	40	283	18110
41	15-Oct	1110	283	0	7497	9259	17866	40	283	18149
42	22-Oct	1023	283	0	7225	9259	17506	39	283	17789
43	29-Oct	946	283	0	7164	9259	17370	39	283	17652
44	5-Nov	863	283	0	6977	9259	17099	38	283	17382
45	12-Nov	772	283	0	6750	9259	16782	37	283	17065
46	19-Nov	568	283	0	6613	9259	16439	37	283	16722
47	26-Nov	448	283	0	6378	9259	16085	36	283	16368
48	3-Dec	342	283	0	6191	9259	15793	35	283	16075
49	10-Dec	261	283	0	6036	9259	15556	35	283	15839
50	17-Dec	190	283	0	5890	9259	15339	34	283	15622
51	24-Dec	95	283	0	5960	9259	15314	34	283	15597
52	31-Dec	0	0	352	6024	9259	15283	34	352	15635
	Maximum	5157	283	1235	9820	9259	21844	49	1235	23079

TABLE 13

WATER REQUIREMENTS BY LIFE STAGE FOR THE CURRENT PROGRAM AT CORPORATION

Week	Date	Adult Holding Surface Water Flow (gpm)	Incubation Groundwater Flow (gpm)	Early Rearing Groundwater Flow (gpm)	Rearing Surface Water Flow (gpm)	Reservoir Surface Flow (gpm)	Total Surface Flow (gpm)	Total Surface Flow (cfs)	Total GW Flow (gpm)	Total Water Flow (gpm)
0	1-Jan									
1	8-Jan	0	140	0	2842	0	2842	6	140	2982
2	15-Jan	0	140	0	3056	0	3056	7	140	3196
3	22-Jan	0	140	0	3030	0	3030	7	140	3170
4	29-Jan	0	0	180	3057	0	3057	7	180	3237
5	5-Feb	0	0	190	3080	0	3080	7	190	3270
6	12-Feb	0	0	203	3264	0	3264	7	203	3467
7	19-Feb	0	0	226	3345	0	3345	7	226	3571
8	26-Feb	0	0	241	3446	0	3446	8	241	3687
9	5-Mar	0	0	261	3418	0	3418	8	261	3679
10	12-Mar	0	0	274	3519	0	3519	8	274	3793
11	19-Mar	0	0	294	3616	0	3616	8	294	3911
12	26-Mar	0	0	315	3613	0	3613	8	315	3928
13	2-Apr	0	0	331	3721	0	3721	8	331	4052
14	9-Apr	306	0	358	3829	0	4135	9	358	4493
15	16-Apr	620	0	384	3922	0	4542	10	384	4927
16	23-Apr	918	0	408	4033	0	4951	11	408	5359
17	30-Apr	1340	0	442	4165	0	5506	12	442	5947
18	7-May	1659	0	470	4259	0	5918	13	470	6388
19	14-May	2132	0	508	4395	0	6528	15	508	7036
20	21-May	2160	0	0	685	0	2845	6	0	2845
21	28-May	2294	0	0	751	0	3045	7	0	3045
22	4-Jun	2448	0	0	821	0	3269	7	0	3269
23	11-Jun	2704	0	0	929	0	3633	8	0	3633
24	18-Jun	2802	0	0	1028	0	3830	9	0	3830
25	25-Jun	3090	0	0	1159	0	4249	9	0	4249
26	2-Jul	3299	0	0	1282	0	4581	10	0	4581
27	9-Jul	3599	0	0	1486	0	5084	11	0	5084
28	16-Jul	3800	0	0	1668	0	5467	12	0	5467
29	23-Jul	3823	0	0	1819	0	5642	13	0	5642
30	30-Jul	3973	0	0	1997	0	5970	13	0	5970
31	6-Aug	3498	0	0	2155	0	5653	13	0	5653
32	13-Aug	3250	0	0	2271	0	5521	12	0	5521
33	20-Aug	2948	0	0	2392	0	5340	12	0	5340
34	27-Aug	2450	0	0	2495	0	4945	11	0	4945
35	3-Sep	2119	140	0	2596	0	4715	11	140	4855
36	10-Sep	1926	140	0	2707	0	4632	10	140	4772
37	17-Sep	1764	140	0	2763	0	4528	10	140	4668
38	24-Sep	1724	140	0	2842	0	4567	10	140	4707
39	1-Oct	1071	140	0	2931	0	4003	9	140	4143
40	8-Oct	957	140	0	2794	0	3751	8	140	3891
41	15-Oct	908	140	0	2885	0	3793	8	140	3933
42	22-Oct	867	140	0	2883	0	3750	8	140	3890
43	29-Oct	796	140	0	2903	0	3699	8	140	3839
44	5-Nov	773	140	0	2955	0	3728	8	140	3868
45	12-Nov	766	140	0	3055	0	3821	9	140	3961
46	19-Nov	585	140	0	3073	0	3658	8	140	3798
47	26-Nov	456	140	0	2914	0	3370	8	140	3510
48	3-Dec	352	140	0	2864	0	3216	7	140	3356
49	10-Dec	284	140	0	2869	0	3152	7	140	3292
50	17-Dec	231	140	0	2933	0	3164	7	140	3304
51	24-Dec	109	140	0	2958	0	3067	7	140	3207
52	31-Dec	0	140	0	2963	0	2963	7	140	3103
	Maximum	3973	140	508	4395	0	6528	15	508	7036

TABLE 14

WATER REQUIREMENTS BY LIFE STAGE FOR THE TOTAL PROGRAM AT CORPORATION

		Adult Holding Surface Water	Incubation Groundwater	Early Rearing Groundwater	Rearing Surface Water	Reservoir Surface	Total Surface	Total Surface	Total GW	Total Water
		Flow (gpm)	Flow (gpm)	Flow (gpm)	Flow (gpm)	Flow (gpm)	Flow (gpm)	Flow (cfs)	Flow (gpm)	Flow (gpm)
Week	Date									
0	1-Jan									
1	8-Jan	0	283	0	5737	0	5737	13	283	6020
2	15-Jan	0	283	0	6170	0	6170	14	283	6452
3	22-Jan	0	283	0	6117	0	6117	14	283	6400
4	29-Jan	0		364	6172	0	6172	14	364	6535
5	5-Feb	0		384	6218	0	6218	14	384	6602
6	12-Feb	0		409	6590	0	6590	15	409	6999
7	19-Feb	0		455	6754	0	6754	15	455	7209
8	26-Feb	0		487	6958	0	6958	16	487	7445
9	5-Mar	0		527	6901	0	6901	15	527	7428
10	12-Mar	0		553	7106	0	7106	16	553	7659
11	19-Mar	0		595	7301	0	7301	16	595	7896
12	26-Mar	0		636	7294	0	7294	16	636	7930
13	2-Apr	0		667	7513	0	7513	17	667	8180
14	9-Apr	306		723	7730	0	8036	18	723	8759
15	16-Apr	620		776	7919	0	8539	19	776	9315
16	23-Apr	918		824	8142	0	9060	20	824	9885
17	30-Apr	1340		892	8410	0	9750	22	892	10642
18	7-May	1659		948	8600	0	10258	23	948	11207
19	14-May	2132		1026	8874	0	11007	25	1026	12033
20	21-May	2160		0	1383	0	3543	8	0	3543
21	28-May	2294		0	1517	0	3811	9	0	3811
22	4-Jun	2448		0	1657	0	4105	9	0	4105
23	11-Jun	2704		0	1875	0	4579	10	0	4579
24	18-Jun	2802		0	2075	0	4877	11	0	4877
25	25-Jun	3090		0	2339	0	5429	12	0	5429
26	2-Jul	3299		0	2588	0	5887	13	0	5887
27	9-Jul	3599		0	2999	0	6598	15	0	6598
28	16-Jul	3800		0	3367	0	7166	16	0	7166
29	23-Jul	3823		0	3673	0	7496	17	0	7496
30	30-Jul	3973		0	4031	0	8004	18	0	8004
31	6-Aug	3498		0	4351	0	7849	18	0	7849
32	13-Aug	3250		0	4585	0	7835	17	0	7835
33	20-Aug	2948		0	4829	0	7777	17	0	7777
34	27-Aug	2450		0	5038	0	7488	17	0	7488
35	3-Sep	2119	283	0	5240	0	7359	16	283	7642
36	10-Sep	1926	283	0	5465	0	7390	16	283	7673
37	17-Sep	1764	283	0	5579	0	7343	16	283	7626
38	24-Sep	1724	283	0	5739	0	7463	17	283	7746
39	1-Oct	1071	283	0	5918	0	6990	16	283	7272
40	8-Oct	957	283	0	5641	0	6597	15	283	6880
41	15-Oct	908	283	0	5824	0	6732	15	283	7015
42	22-Oct	867	283	0	5821	0	6688	15	283	6971
43	29-Oct	796	283	0	5862	0	6658	15	283	6940
44	5-Nov	773	283	0	5965	0	6738	15	283	7021
45	12-Nov	766	283	0	6169	0	6935	15	283	7217
46	19-Nov	585	283	0	6204	0	6789	15	283	7072
47	26-Nov	456	283	0	5884	0	6340	14	283	6622
48	3-Dec	352	283	0	5782	0	6134	14	283	6416
49	10-Dec	284	283	0	5792	0	6075	14	283	6358
50	17-Dec	231	283	0	5922	0	6152	14	283	6435
51	24-Dec	109	283	0	5972	0	6081	14	283	6364
52	31-Dec	0	283	0	5983	0	5983	13	283	6265
	Maximum	3973	283	1026	8874	0	11007	25	1026	12033

TABLE 15

WATER REQUIREMENTS BY LIFE STAGE FOR THE CURRENT PROGRAM AT RUSSELL WALKER - S. FORK WALLA WALLA

Date	Adult Holding Surface Water Flow (gpm)	Incubation Groundwater Flow (gpm)	Early Rearing Groundwater Flow (gpm)	Rearing Surface Water Flow (gpm)	Reservoir Surface Flow (gpm)	Total Surface Flow (gpm)	Total Surface Flow (cfs)	Total GW Flow (gpm)	Total Water Flow (gpm)
1-Jan									
8-Jan	0	283	0	5392	0	5392	12	283	5675
15-Jan	0	283	0	5759	0	5759	13	283	6042
22-Jan	0	283	0	5655	0	5655	13	283	5938
29-Jan	0	283	0	5778	0	5778	13	283	6061
5-Feb	0	283	0	6362	0	6362	14	283	6645
12-Feb	0	283	0	6554	0	6554	15	283	6837
19-Feb	0	283	0	6414	0	6414	14	283	6697
26-Feb	0	0	367	6410	0	6410	14	367	6777
5-Mar	0	0	365	5884	0	5884	13	365	6250
12-Mar	0	0	419	6674	0	6674	15	419	7093
19-Mar	0	0	475	7053	0	7053	16	475	7527
26-Mar	0	0	531	7409	0	7409	17	531	7939
2-Apr	0	0	540	7136	0	7136	16	540	7677
9-Apr	303	0	612	7635	0	7938	18	612	8550
16-Apr	553	0	640	7757	0	8310	19	640	8950
23-Apr	855	0	685	7873	0	8727	19	685	9412
30-Apr	1413	0	809	8568	0	9980	22	809	10789
7-May	1641	0	844	8624	0	10265	23	844	11109
14-May	2236	0	966	9217	0	11452	26	966	12418
21-May	2372	0	1065	9493	0	11865	26	1065	12930
28-May	2367	0	1174	0	0	2367	5	1174	3541
4-Jun	2958	0	0	1697	0	4654	10	0	4654
11-Jun	3196	0	0	1944	0	5140	11	0	5140
18-Jun	3440	0	0	2284	0	5724	13	0	5724
25-Jun	3818	0	0	2562	0	6380	14	0	6380
2-Jul	3776	0	0	2750	0	6526	15	0	6526
9-Jul	3803	0	0	3008	0	6811	15	0	6811
16-Jul	4212	0	0	3368	0	7581	17	0	7581
23-Jul	4257	0	0	3710	0	7967	18	0	7967
30-Jul	4060	0	0	3877	0	7937	18	0	7937
6-Aug	3512	0	0	4103	0	7615	17	0	7615
13-Aug	3361	0	0	4374	0	7736	17	0	7736
20-Aug	2942	0	0	4617	0	7559	17	0	7559
27-Aug	2319	0	0	4846	0	7166	16	0	7166
3-Sep	2047	283	0	5035	0	7083	16	283	7366
10-Sep	1695	283	0	5068	0	6763	15	283	7046
17-Sep	1642	283	0	5391	0	7032	16	283	7315
24-Sep	1462	283	0	5215	0	6677	15	283	6960
1-Oct	928	283	0	5599	0	6527	15	283	6810
8-Oct	823	283	0	5403	0	6226	14	283	6509
15-Oct	744	283	0	5372	0	6116	14	283	6399
22-Oct	748	283	0	5545	0	6293	14	283	6576
29-Oct	771	283	0	5931	0	6702	15	283	6985
5-Nov	669	283	0	5573	0	6243	14	283	6526
12-Nov	577	283	0	5330	0	5907	13	283	6190
19-Nov	393	283	0	5044	0	5437	12	283	5720
26-Nov	392	283	0	5522	0	5914	13	283	6197
3-Dec	306	283	0	5402	0	5708	13	283	5991
10-Dec	231	283	0	5311	0	5541	12	283	5825
17-Dec	211	283	0	5656	0	5868	13	283	6151
24-Dec	106	283	0	5849	0	5954	13	283	6237
31-Dec	0	283	0	5534	0	5534	12	283	5817
Maximum	4257	283	1174	9493	0	11865	26	1174	12930

TABLE 16

WATER REQUIREMENTS BY LIFE STAGE FOR THE TOTAL PROGRAM AT RUSSELL WALKER - S. FORK WALLA WALLA

	Adult Holding Surface Water Flow (gpm)	Incubation Groundwater Flow (gpm)	Early Rearing Groundwater Flow (gpm)	Rearing Surface Water Flow (gpm)	Reservoir Surface Flow (gpm)	Total Surface Flow (gpm)	Total Surface Flow (cfs)	Total GW Flow (gpm)	Total Water Flow (gpm)
Date									
1-Jan									
8-Jan	0	140	0	2670	0	2670	6	140	2811
15-Jan	0	140	0	2852	0	2852	6	140	2992
22-Jan	0	140	0	2801	0	2801	6	140	2941
29-Jan	0	140	0	2862	0	2862	6	140	3002
5-Feb	0	140	0	3151	0	3151	7	140	3291
12-Feb	0	140	0	3246	0	3246	7	140	3386
19-Feb	0	140	0	3177	0	3177	7	140	3317
26-Feb	0	0	182	3175	0	3175	7	182	3357
5-Mar	0	0	181	2914	0	2914	7	181	3095
12-Mar	0	0	208	3306	0	3306	7	208	3513
19-Mar	0	0	235	3493	0	3493	8	235	3728
26-Mar	0	0	263	3670	0	3670	8	263	3932
2-Apr	0	0	268	3535	0	3535	8	268	3802
9-Apr	303	0	303	3782	0	4084	9	303	4388
16-Apr	553	0	317	3842	0	4395	10	317	4712
23-Apr	855	0	339	3899	0	4754	11	339	5093
30-Apr	1413	0	401	4244	0	5656	13	401	6057
7-May	1641	0	418	4271	0	5913	13	418	6330
14-May	2236	0	478	4565	0	6801	15	478	7279
21-May	2372	0	528	4702	0	7074	16	528	7602
28-May	2367	0	581		0	2367	5	581	2948
4-Jun	2958	0	0	840	0	3798	8	0	3798
11-Jun	3196	0	0	963	0	4159	9	0	4159
18-Jun	3440	0	0	1131	0	4571	10	0	4571
25-Jun	3818	0	0	1269	0	5087	11	0	5087
2-Jul	3776	0	0	1362	0	5138	11	0	5138
9-Jul	3803	0	0	1490	0	5293	12	0	5293
16-Jul	4212	0	0	1668	0	5881	13	0	5881
23-Jul	4257	0	0	1838	0	6095	14	0	6095
30-Jul	4060	0	0	1920	0	5980	13	0	5980
6-Aug	3512	0	0	2032	0	5544	12	0	5544
13-Aug	3361	0	0	2167	0	5528	12	0	5528
20-Aug	2942	0	0	2287	0	5229	12	0	5229
27-Aug	2319	0	0	2400	0	4720	11	0	4720
3-Sep	2047	140	0	2494	0	4541	10	140	4682
10-Sep	1695	140	0	2510	0	4205	9	140	4346
17-Sep	1642	140	0	2670	0	4312	10	140	4452
24-Sep	1462	140	0	2583	0	4045	9	140	4185
1-Oct	928	140	0	2773	0	3701	8	140	3841
8-Oct	823	140	0	2676	0	3499	8	140	3639
15-Oct	744	140	0	2661	0	3405	8	140	3545
22-Oct	748	140	0	2747	0	3494	8	140	3635
29-Oct	771	140	0	2937	0	3708	8	140	3849
5-Nov	669	140	0	2760	0	3430	8	140	3570
12-Nov	577	140	0	2640	0	3217	7	140	3357
19-Nov	393	140	0	2498	0	2891	6	140	3032
26-Nov	392	140	0	2735	0	3127	7	140	3267
3-Dec	306	140	0	2676	0	2981	7	140	3121
10-Dec	231	140	0	2630	0	2861	6	140	3001
17-Dec	211	140	0	2802	0	301a	7	140	3153
24-Dec	106	140	0	2897	0	3002	7	140	3143
31-Dec	0	140	0	2741	0	2741	6	140	2881
Maximum	4257	140	581	4702	0	7074	16	581	7602

Rearing

Incubation, early rearing, and rearing is necessary only for the spring chinook. The flow and volume are based on the weekly water temperatures at each potential site. Water temperatures have been adjusted to meet the water temperature criteria at the Williams/Gray site. Temperature adjustment was not required at the Corporation (with North Fork Supply) or South Fork Walla Walla sites. The following maximum flows and rearing volumes are based on the use of groundwater chilled to ambient surface water temperatures during incubation and early rearing (see discussion on Temperature Adjustment Requirements). Separate information is presented for the Umatilla and total NEOH programs.

Umatilla Spring Chinook Program

Process	Corporation with North Fork supply	Williams/Gray	South Fork Walla Walla
Incubation			
Maximum Flow (gpm)	140	140	140
# incubators	23	23	23
Early Rearing			
Maximum Flow (gpm)	508	612	581
Volume (cf)	1,157	1,179	1,189
Rearing			
Maximum Flow (gpm)	4,395	4,864	4,702
Volume (cf)	47,819	47,382	48,310
Maximum Annual System Flow (gpm)	7,036	12,870	7,602

Umatilla and Walla Walla Spring Chinook Program (NEOH Components)

Process	Corporation with North Fork supply	Williams/Gray	South Fork Walla Walla
Incubation			
Maximum Flow (gpm)	283	283	283
# incubators	46	46	46
Early Rearing			
Maximum Flow (gpm)	1,026	1,235	1,174
Volume (cf)	2,336	2,380	2,400
Rearing			
Maximum Flow (gpm)	8,874	8,920	9,493
Volume (cf)	96,531	95,649	97,522
Maximum Annual System Flow (gpm)	12,033	23,079	12,930

Detailed weekly water requirements for incubation, early rearing, and rearing are presented in Tables 10 to 16. If groundwater is used directly without temperature modification, there will be overlap between year classes and additional outdoor rearing volume and flow will be needed for incubation and early rearing.

Release Sites

The flow and volumes needed for the release sites were based on providing space for **100,000** spring chinook at **10/lb** and **300,000, 600,000,** and 900,000 fall chinook at **60/lb** and are equal to:

Species	Flow (gpm)	Volume **(cf)**
Spring Chinook	1,000	13,000
Fall Chinook (300,000)	1,100	14,000
Fall Chinook (600,000)	2,200	28,000
Fall Chinook (900,000)	3,300	42,000

These flows and volumes are based on a design DI and FI equal to 1.34 (50F) and 0.11, respectively. The Fall Chinook flows and volumes will be used for conceptual design purposes.

DISINFECTION ALTERNATIVES FOR ADULT HOLDING

The prevention and control of disease will be critical to the successful operation of the spring and fall chinook programs for the Umatilla basin. The effective management of pathogenic diseases must be provided to reduce adult mortality during holding to an absolute minimum. In addition, if adult **fish** from one basin are held within another (eg., holding Umatilla **ChF** at the Russell Walker site on the S. Fork **Walla Walla),** effluent disinfection will be needed to prevent the potential transmission of exotic disease to resident and anadromous fish.

Effective disinfection will also be needed for any future hatchery production to prevent vertical and horizontal transmission of diseases such as IHN, VI-IS, **BKD,** and **C. shasta**. A number of hatcheries, such as Dworshak Kooskia NFH and **Cowlitz** Trout Hatcheries, have suffered major disease losses, but have been able to function effectively with **influent** disinfection. The technology to disinfect the **influent** and effluent from fisheries facilities is available at the present time. The specification of the degree of disinfection required at the spring chinook adult holding facility is not yet well-defined as neither the disease or degree of disinfection has been clearly identified. With increased regulation of therapeutic chemicals, **control of Saprolegnia zoospores could be of critical** concern in the holding of Spring Chinook adults.

There are a number of disinfection methods available. The most commonly used methods in fish culture are ozonation, ultra-violet radiation **(UV),** and chlorination. Within these three basic types **of disinfection numerous options exist (Table 17).**

UV radiation achieves disinfection through photochemical damage to RNA and DNA within the **cells of an organism. Because** DNA **and** RNA **carry genetic information for reproduction, damage** can effectively sterilize the cell. The required **UV** dose for disinfection of bacteria and virus **typically varies by a factor of four. Moreover, the virus causing IPN is 6 times more resistant to UV than a "typical" virus. UV is not as effective against larger organisms such as protozoans and** parasites. For example, a UV dose of **13,000-28,000 $\mu W/cm^2/s$** will control the bacterial pathogen that causes **furunculosis** while a dosage of lOO,OOO-300,000 **$\mu W/cm^2/s$** is needed to control the **tomite** stage of the protozoan Icthyophthirius ("Ich").

TABLE 17

DESCRIPTION OF DISINFECTION ALTERNATIVES

ALTERNATIVE	Application	Effectiveness	Criteria Assumed	Status of Technology	Head Requirements	Approximate Construction Costs per 5000 gpm unit 1	Approximate Annual Operating Costs 2
1. Ozonation/ Bubble contactor, filtration with UV removal	complete influen disinfection	Effective sterilization Effective control of virus, bacteria, protozoa, parasites	Sand filters Ozone - 15 minute contact, influent up to 5 mg/L (ave 2.0 mg/l), effluent 0.1-0.2 mg/l Ozone removal with UV, 112,500 $\mu W/cm^2/s$	Excellent: recently designed for hatchery at Cold Lake, Alberta	5 ft in Cold Lake application	$3,300,000	$164,000
2. Ozonation/ Bubble contactor with air stripper removal	complete influen disinfection	Effective disinfection baaed on 3 log reduction of <u>Giardia</u> cysts Effective for control of virus, bacteria, protozoa, parasites	Ozone - 16 minute contact, influent up to 2.5 mg/l (ave 1.0 mg/l), effluent 0.2 mg/l Ozone removal with packed column, 40 gpm/sf, and 15:1 air:water ratio	Excellent: designed for Cowlitz and Merwin Hatcheries	7 ft in Merwin application	$1,700,000	$71,000
3. Ozonation / Injection with air stripper removal	Potentially complete influent dieinfection	Should be as effective as above, but no operating experience	Ozone injection with static mixer with minimum detention time, ave dose 1.0 mg/l Ozone removal at 40 gpm/sf and 15:1 air:water ratio --	Good technical basis for design, no operating experience	Approximately 30 ft	$1,100,000	$58,000
4. Ozonation / Injection with packed column removal	Partialto complete influent dieinfection	Should be as effective as above, but no operating experience	As above except ozone removal in packed columns at 75 gpm/sf and 2:1 air:water ratio. Reduced O_3 dose to meet effluent requirements.	Fair technical barb for design, no operating experience	Approximately 17 ft	$1,000,000	$47,000

1) Estimated costs are based on specific assumptions that may vary widely with site conditions. Assumes LOX feed
2) Estimate includes power, chemicals, and lamps.

TABLE 17 (cont.)

ALTERNATIVE	Application	Effectiveness	Criteria Assumed	Status of Technology	Head Requirements	Approximate Construction Costs per 5000 gpm unit 1	Approximate Annual Operating Costs 2
5. Ozonation / Injection with storage (glass-lined tanks) for detention contact and removal	Complete influent dirinfection	Should be as effective as above, but no operating experience	As above except ozone removal through 2 hr detention	Good technical basis; design for California Wild Trout Hatchery influent treatment	Approximately 11 ft	$1,400,000	$43,000
6. Ozonation / Injection with storage (earthen pond) for removal	Complete effluent dirinfection	Should be as effective as above, but no operating experience	As above except ozone removal through 2 hr detention	Same as above	Approximately 11 ft	$1,000,000	$43,000
7. WI with filtration	Complete influent or effluent dirinfection	99.9% kill for some virus and bacteria which approximates "effective disinfection". Protozoa and parasites require ≅ 3X the dose. Therefore, the kill for these organisms may not be adequate for effective control.	sand pressure filtration at 10 gpm/sf, removal to 25 microns. Maximum head losses 15 psi. UV system in an open channel at 37,000 $\mu W/cm^2/s$	Much used in past with varied results. Gaod technical barb for projecting results	30 ft average in filters; 36 ft at backwash; total average head loss = 32 ft	$1,000,000	$49,000
8. UV / without filtration	Partial to complete influent or effluent disinfection	As above when water is verv clear but turbidity can - - significantly reduce effectiveness	UV system in an open channel at 37,000 $\mu W/cm^2/s$	Use in past projects confirms not effective disinfection during periods of turbidity. May have applications for reduction of organism density	Approximately 2 ft	$400,000	$30,000
9. Chlorination/ dechlorination (earthen pond)	Complete influent or effluent disinfection	Effective disinfection for control of virur, bacteria, protozoa, and parasites.	Dosage to 2 mg/l with 90 min. detention time Chemical removal of residual chlorine.	Operating experience at production facilities	Approximately 2ft	$400,000	$24,000

1) Estimated costs are based on specific assumptions that may vary widely with rite conditions. Assumes LOX feed.
2) Estimate includes power, chemicals, and lampr.

Ozone and chlorine are both effective at inactivating bacterial, viral, and protozoan pathogens. Ozone (03) is 3-5 times more powerful than chlorine (C12). Residual ozone is unstable, has a **half-**life of 20-30 minutes and can be removed by detention or air stripping. Residual chlorine decays relative slowly and chemical removal (with compounds such as sulfur dioxide or thiosulfate) is generally required to avoid prohibitively long detention times.

Any of the three options can be designed to achieve a given level of disinfection. Increasing the level of disinfection increases both the capital and operating costs. At a given level of disinfection, the capital costs, operating costs, head requirements, and space requirements can vary significantly (Table 17). The only two options that would not require pumping at the South Fork **Walla Walla** site are (1) UV without filtration and (2) chlorination/dechlorination. Further, chlorination/dechlorination has both the lowest capital and operating costs of any of the disinfection options.

However, due to the need for broad spectrum disinfection, only ozone and chlorine were considered as disinfection methods applicable to the Umatilla project. For the purposes of the concept design, the following disinfection options appear to be the most appropriate given the current level of information:

- Influent: **Ozonation/Injection** with packed column removal (Table 17, Option 4)

- Effluent: Chlorination/dechlorination with sulfur dioxide (Table 17, Option 9)

Based on operating assumptions stated in Table 17, the ozone and chlorine doses selected will provide effective control for pathogens such as IHN and **C. shasta.** They should also provide effective control for other important pathogens common to the Pacific Northwest.

An **influent** pump station will be needed at the South Fork **Walla Walla** site because there is not enough head for the ozone system. Chlorination/dechlorination was not selected for the **influent** because of potential toxicity problems that could occur if the dechlorination system malfunctions. Toxicity considerations are not as serious a problem with the effluent because of dilution upon discharge into the river. If the full hatchery for both the Umatilla and **Walla Walla** components of the NEOH project is developed at the spring chinook adult holding site, it may be possible to use the required pollution abatement ponds for the chlorination detention ponds.

Because **influent** and effluent disinfection was not initially required, it was not possible to discuss these options with the appropriate federal and state fish health personnel. Because of the significant impact of disinfection on capital and operating budgets, additional discussion on objectives, degree of disinfection, and operational considerations is needed. While it is possible to design a disinfection facility to provide effective control of a number of major **fish** pathogens, the actual degree of disinfection required for the Umatilla Project is not well defined. This is especially true for adult holding where limited results from operating experience are available at this time.

WATER SUPPLY

INTRODUCTION

This section describes various water supply issues for the proposed facilities. These include:

- supply of disease free water for incubation and early rearing of spring chinook
- pump versus gravity supply for the final rearing/acclimation ponds.

INCUBATION AND EARLY REARING WATER SUPPLY

Test wells were drilled at three of the potential sites for incubation and early rearing of spring chinook. The fourth site, Corporation, was not drilled because of information obtained at test well sites downstream at Emmett Williams and Fred Gray. The test well drilling program and results are described in the Final Siting Report (JMM 1992), results are summarized below.

Three distinct aquifers zones were evaluated for a disease-free, incubation and early-rearing water supply: a shallow gravel aquifer extending to a maximum depth of approximately 50 feet, a shallow basalt aquifer extending from approximately 50 feet to 200 feet, and a deep basalt aquifer extending from approximately 200 to 400 feet. Test wells were constructed and tested in the deep basalt aquifer zone at the three sites. The gravel aquifer and shallow basalt zones have been evaluated based upon well log data, published information, and conversations with local residents. These zones have not been tested, and additional investigation is necessary to confirm estimated yield and water quality.

Shallow Gravel Aquifer

The shallow gravel aquifers at Fred Gray and Emmett Williams are similar in nature, both have potential to develop approximately 500 to 1,000 gpm supply from an infiltration gallery or shallow well field (Table 18). Water temperature can be expected to vary in relation to river temperatures. No hydrogen sulfide is present in this shallow aquifer. At the Russell Walker site on the S. Fork Walla Walla, the only difference in the quality of the water in this aquifer compared to the Emmett Williams and Fred Gray sites was lower temperature, which is due to the lower temperature of the S. Fork Walla Walla compared to the Umatilla. Anticipated quantity of development at the Russell Walker site is the same as for the two Umatilla Basin sites.

Shallow Basalt Aquifer

The shallow basalt aquifer, located between approximately 50 and 200 feet, includes the zone from which most residents of the areas receive their domestic supply. The quantity available from this aquifer is probably too low at the Emmett Williams and Russell Walker sites to warrant serious consideration as a hatchery supply. There does appear to be substantially more water in this zone at the Fred Gray site with good potential for developing a wellfield yielding from 200 to 600 gpm. While possibly not enough to supply peak early rearing water requirements, this is still a potential water supply source that should be considered for development of facilities at the Fred Gray site.

Temperature of this water at the Fred Gray site ranges from 54 to 56 °F and no hydrogen sulfide is anticipated.

TABLE 18

TEST WELL DRILLING RESULTS

	Emmett Williams Quantity	Emmett Williams Quality	Fred Gray Quantity	Fred Gray Quality	Russell Walker Quantity	Russell Walker Quality
Shallow gravel aquifer (≤ 50 ft. depth)	1000 gpm± total from infiltration gallery or shallow well field	45-65°F similar to river no H2S	1000 gpm± total from infiltration gallery or shallow well field	45-65°F similar to river no H2S	1000 gpm± total from infiltration gallery or shallow well field	45-60°F similar to river no H2S
Shallow basalt aquifer (50-200 ft. depth)	approx. 2-20 gpm per well in wellfield <100 gpm total	not tested due to low yield	approx. 25-200 gpm per well in wellfield 200-600 gpm total	54-56°F no apparent H2S	approx. 5-50 gpm per well in wellfield 25-200 gpm total	55-60°F no apparent H2S
Deep basalt aquifer (200-400 ft. depth)	1200 gpm per well 1800 total	56-57°F during test 3-5 ppm H2S	1000 gpm per well 1500 total	57-58°F during test 0.3-0.5 ppm H2S	250± gpm per well 400 total	66-70°F during test 1 ppm H2S

Deep Basalt Aquifer

The deep basalt aquifer, lying between approximately 200 and 400 feet, contained the highest potential yield of water, with a good probability of developing a well with approximately 1,200 g-pm yield at Emmett Williams, 1,000 gpm at Fred Gray, and 250 gpm at Russell Walker (Table 18).

Temperature at Emmett Williams varied from 56 to 57 °F during test pumping. At Fred Gray the temperature was similar, approximately 57 to 58 °F and at Russell Walker the temperature was considerably higher, ranging from 66 to 70 °F during the pump test. All three sites would require cooling of this water prior to its use in incubation and rearing.

The deep basalt aquifers at each site also contained hydrogen sulfide at concentrations ranging from 0.3 to 0.5 ppm at Fred Gray to 3 to, 5 ppm at Emmett Williams. Hydrogen sulfide at Russell Walker was measured at approximately 1 ppm. Water quality criteria for hydrogen sulfide concentrations in water used for salmon culture range from <.002 to <.003 ppm. Hydrogen sulfide levels at all three sites exceed these recommendations by a factor of 100 to 1,000 depending on the site. Treatment of this water to remove hydrogen sulfide would be required prior to its use for incubation and early rearing.

Recommended Supply Option

Based on the results on the test well drilling program, it is recommended that the shallow gravel aquifer is the first choice in incubation and early rearing water supply at any of the alternative sites. The advantages of this aquifer over the others includes:

- adequate quantity to meet peak demands for incubation and early rearing
- no hydrogen sulfide
- temperature regime relatively close to that of the river, requiring the least heating or cooling of any of the aquifers to achieve the desired timing for fish production
- minimal drawdown impact on neighboring domestic wells.

It is further recommended that any future planning for the Fred Gray site include consideration of developing the shallow basalt aquifer as an additional source of supply.

FINAL. REARING/ACCLIMATION WATER SUPPLY

Based on site visits conducted at the sites proposed for potential final rearing/acclimation ponds, recommended water supply options for each site were developed. All sites, with the exception of the Mission site, could make use of a gravity supply pipeline. However, only a few of these sites have characteristics that make gravity supply more practical than a pumped supply in terms of costs and site development.

Our recommendations were developed by evaluating the distance of pipeline required to 1) obtain adequate hydraulic head to supply the ponds and 2) still provide an intake location that was relatively permanent and did not require placing a diversion structure across the river. This second point was important since it is probably not realistic to plan for 10 new diversion weirs on the Umatilla River to supply water to fish ponds.

Another consideration was the length of time during the year these ponds would be in use. If not associated with any other facilities (ie., adult holding, full-term rearing), the ponds would be in use for, at most, approximately 4 months from mid February through early May. Given this short duration, it was felt that a more portable system of water supply was appropriate for those sites that did not allow a straightforward gravity supply line. A portable system such as a trailer mounted pump with flexible intake lines could be moved to the site each year as needed and the intake location determined based on current river conditions. This would have the advantage of accommodating movement of gravel bars or other changes to the river bed that a permanent intake location would not. This sort of supply would, however, require more labor to set up and take down on an annual basis.

Gravity Supply Sites

Five sites are suitable for development of gravity water supplies based on the above considerations: Meacham Creek at Camp Creek, Corporation, Fred Gray, ODF&W, Barnhart, and Echo Meadows (through the adjacent irrigation ditch if water rights issues could be resolved).

At the Corporation site, if no additional facilities are developed, it is economically prohibitive to develop a gravity supply line from the North Fork Umatilla just to supply final rearing/acclimation ponds and a pumped supply would be recommended.

Pumped Supply Sites

Five sites would require pumped supply: Thorn Hollow, Cayuse Bridge, Mission, Nolin and Three Mile Dam. We are recommending that a portable pumped supply be evaluated as the primary option at these sites, with a permanent pumped intake being the second option.

FACILITY LAYOUTS

INTRODUCTION

This section describes in greater detail the proposed facility layouts for the Umatilla Satellite and Release Sites Project. Conceptual design drawings have been prepared which illustrate the physical characteristics of each site including proposed construction. Drawings have been developed that show the maximum use of a site. For example, the alternative hatchery sites include facilities for adult holding, incubation early rearing, full term rearing, and final rearing/release. Direct release sites have been illustrated as containing both the initial phase of development to accommodate direct release but also the pond/raceway and other structures required if eventually developed as final rearing/acclimation sites.

In order to design the facilities, the maximum requirements for water flow and space, for each production phase, must be determined. These maximum criteria define the upper limit of flow and space requirements. A summary of these criteria is shown on Table 19.

TABLE 19

SUMMARY OF MAXIMUM FACILITY CRITERIA

Facility	Water Supply	Volume	Proposed Layout
Incubation	140 gpm	785,000 eggs	24 stacks of 8 trays/stack
Early Rearing	612 gpm	1,179 cf	20 fry troughs 20' x 2.5' x 1.5'
Adult Holding/ Spawning	4264 gpm	39,000 cf	6 raceways 10' x 92' x 4'
Full Term Rearing	5147 gpm	48,277 cf	20 raceways 10' x 100' x 2.5', or 4 ponds 50' x 100' x 4
Final Rearing	1100 gpm for 3000,000 ChF	14,000 cf for 300,000 ChF	1 pond 50' x 100' x 3', or 4 raceways 10' x 100' x 2.25'

HATCHERY SITES

Basic assumptions for the conceptual design of the hatchery sites include:

- Additional ChS production for the Umatilla Basin will be considered in the NEOH project. Site layouts were developed to point necessary to determine if the required facilities fit on a particular site and to allow identification of a preferred site.

- Each hatchery site is sized to accommodate all life stages of the full ChS production requirements.

- Each hatchery site is also sized to accommodate adult holding for early ChF returns during warm years when temperatures at Three Mile Dam are too high.

- Extended (satellite) rearing space at each hatchery site is sized to accommodate all satellite rearing requirements at one site.

A comparison of selected attributes of the four potential hatchery sites is shown on Table 20. The Russell Walker site on the S. Fork **Walla Walla** was selected as the preferred site for both adult holding and future additional production facilities. Water temperature considerations were the primary reason for this selection: summer temperatures in the S. Fork **Walla Walla** were closest to adult holding criteria for spring chinook and met production scheduling with minor manipulation.

Corporation

A conceptual layout of this facility is shown on Figure 18. This facility incorporates incubation, early rearing, satellite rearing, adult holding, and direct release. There is also a potential to develop adult capture facilities at this site. Also shown is an operations and shop building, 2 residences, effluent ponds, and a gravity intake originating at the north fork of the Umatilla River. Again, raceways should be used rather than rearing ponds due to space limitations. It may be necessary to cut into the hill on the north side of the property to make room for the raceways

All building sizes and tank volumes are identical to those described below for the Fred Gray site.

The North Fork water supply would require approximately 4500 feet of pipeline and a significant amount of rock excavation. The benefit of drawing water from the north fork would be cooler water, it is our recommendation that any facility developed at this site use the north fork as the supply. Otherwise, mechanical cooling of the process water will be required to meet the temperature criteria.

Emmett Williams

A conceptual layout of this facility is shown on Figure 19. This facility incorporates incubation, early rearing, satellite rearing, adult holding, and direct release. There is also a potential to develop adult capture facilities at this site. Also shown is an operations and shop building, 2 residences, effluent ponds, a **5,000,000** gallon reservoir, and a gravity intake at the north end of the property. Raceways should be used rather than rearing ponds due to space limitations.

All building sizes and tank volumes **are** identical to those described below for the Fred Gray site. The site is barely large enough to accommodate the required facilities and allow the property owner to retain use of their existing residence. Development of a reservoir would definitely require use of the entire site.

A more detailed land survey will be needed to determine actual cut and fill volumes, but an appreciable amount of cut may be required on the southern end of the property to facilitate gravity flow through the facility.

Fred Gray

A conceptual layout of this facility is shown on Figure 20. This facility incorporates incubation, early rearing, satellite rearing, adult holding, and direct release. Also shown is an operations and shop building, 2 residences, effluent ponds, a **5,000,000** gallon **reservoir, and a gravity intake at** the north end of the property. The site is shown with raceways, however, rearing ponds could also be accommodated at this site.

Incubation will be performed using Heath Tray incubators. 8 tray stacks will be used (rather than 16-tray) to reduce the static lift required from the gravity intake. 1,200 sq. ft. is allocated for this purpose as shown in the drawings.

TABLE 20

COMPARISON OF INCUBATION AND FRY REARING SITES

CRITERION	CORPORATION	EMMETT WILLIAMS	FRED GRAY	RUSSELL WALKER
TECHNOLOGICAL COMPLEXITY 1. **Mechanical Components**	Standard components	Reservoir or mechanical chilling forcoolwater	Reservoiror mechanical chilling for cool water	**Standard** components
CONSTRUCTABILITY 1. Hydraulic profile	1. **Adequate head** available for gravity supply from North Fork	1. Pumping required **for** reservoir **operation** in addition to **gravity supply**	1. Pumping **required** fa **reservoir operation in addition to** gravity supply. **Sump pump required fa** draining effluent **ponds**	1. Adequatehead available for gravity supply
2. Flood protection requirements	**2. Appear to be** minimal	**2. Appear to be** minimal	**2.** Portions of site maybefloodprone **and require** protection.	2. Portions of site maybefloodptone **and require protection.**
RELIABILITY **1.** Water Temperature	1. No cooling **required.** Some **heating needed in Dec (+1 °F)** for incubation	1. Cooling **required, max - 9°F for adult** holding in July. **Heating needed,** max **+2.9°F** in **December for** incubation.	1. Cooling **required, max - 9°F fa adult** holding in July. **Heating needed, max +2.9°F** in December for incubation.	1. No cooling **required.** Some **heating needed in** Nov **(+0.1°F)** and **Dec (+1 °F) for** incubation.
WATER SUPPLY 1. Incubation and Early Rearing	1. No test well at site. Shallow gravel aquifer may provide incubation water. Deep wells likely contain **H2S** and **warm water**	1. Potential 500 to 1,000 gpm from shallow gravel **aquifer.**	1. Potential 500 to 1,000 gpm from **shallow** gravel aquifer. Shallow basalt aquifer may **yield 200 to 600** gpm total	1. Potential 500 to 1,000 gpm from **shallow** gravel aquifer.
2. Surface Water	2. Diversion from N. Fork Umatilla	2. Diversion from **mainstem** Umatilla	2. Diversion from **mainstem** Umatilla	2. Diversion from S. Fork **Walla Walla**

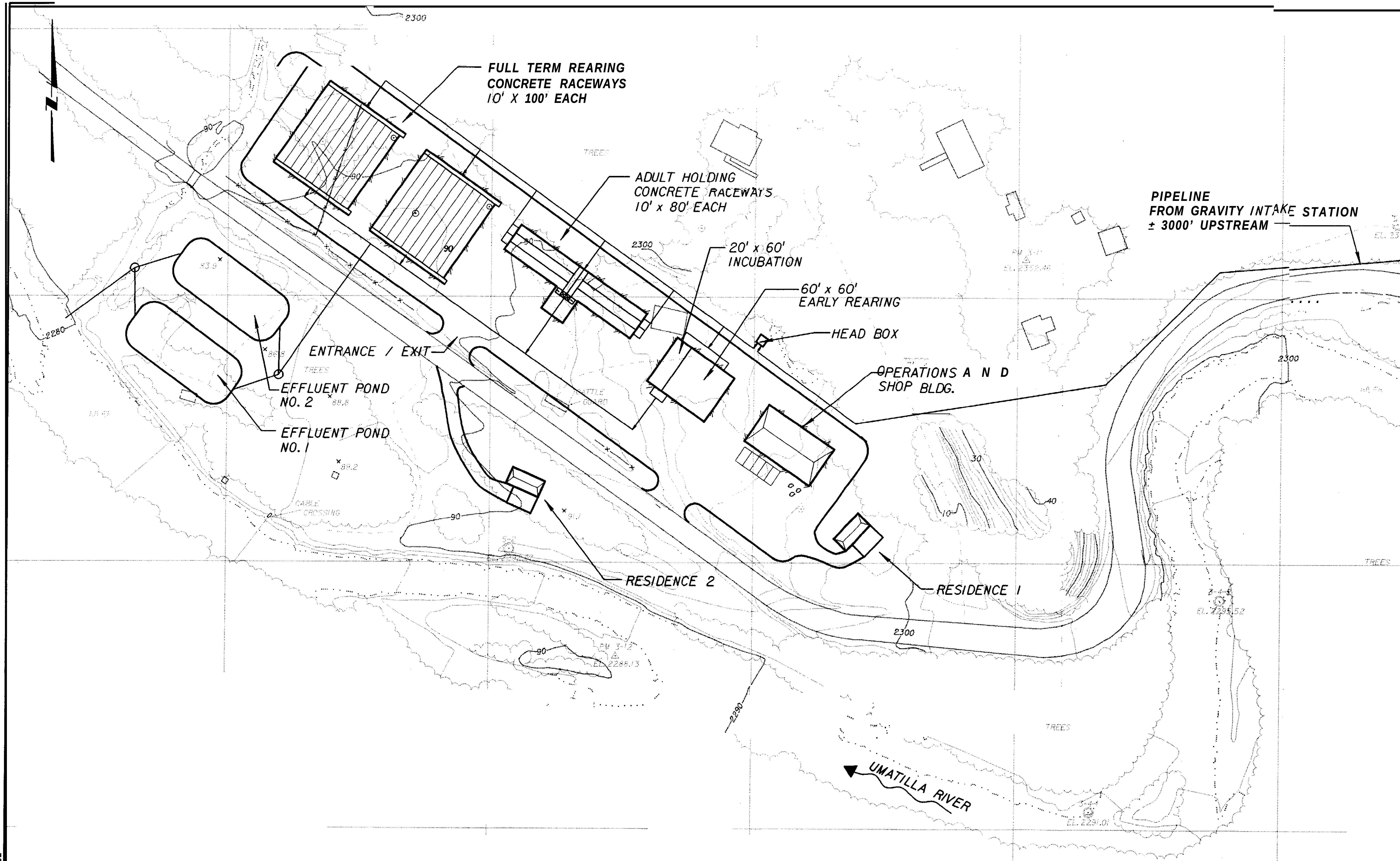
TABLE 20 (continued)

CRITERION	CORPORATION	EMMETT WILLIAMS	FRED GRAY	RUSSELL WALKER
WATER RIGHTS /USAGE 1. Minimum Flow Requirements (Requirements for Umatilla River above **Meacham Creek)**	Oct.- Nov. 25 cfs **Dec-** Jan. **60** cfs Feb-May 97 cfs June 6ocfs Jul-Sep 40 cfs	same requirements	**same requirements**	Same as Umatilla **requirements** except Feb-May 80 cfs
2. Actual average minimum monthly flow in river	2. Below minimum flow requirement in all months except November	**2.Below** minimum flow requirement in Jan-Feb, May. **Jul-**Sep.	**2.Below** minimum flow requirement in Jan-Feb, May, **Jul-**Sep.	**2.Above** minimum flow requirement in **all** months.
3. Institutional Issues	3. Pump-back **probably required** for a water right to preserve minimum flows	3. Bump-back probably **required** for a water right to preserve minimum flows	3. **Pump-back probably required** fa a water right to preserve minimum flows	3. Bump-back not **necessarily required** for a water right to preserve minimum **flows**
ENVIRONMENTAL CONCERNS				
1. Wetlands (other than riparian zone)	1. At intake location	1. None identified	1. None **identified**	1. None identified
2. Work required in river	2. Barrier, intake **ladder required**	2. Barrier, intake, **ladder required**	2. Dam, intake, **ladder required**	2. Dam, intake, **ladder required**
3. Bypassed reach of river	3. **4000 feet (approx)**	3. 18oofeet **(approx)**	3. 1600feet **(approx)**	3. 1300 feet **(approx)**
4. Land use considerations	4. USFS developed **campground**	4. CTUIR Reservation	4. CTUIR Reservation	4. Private property

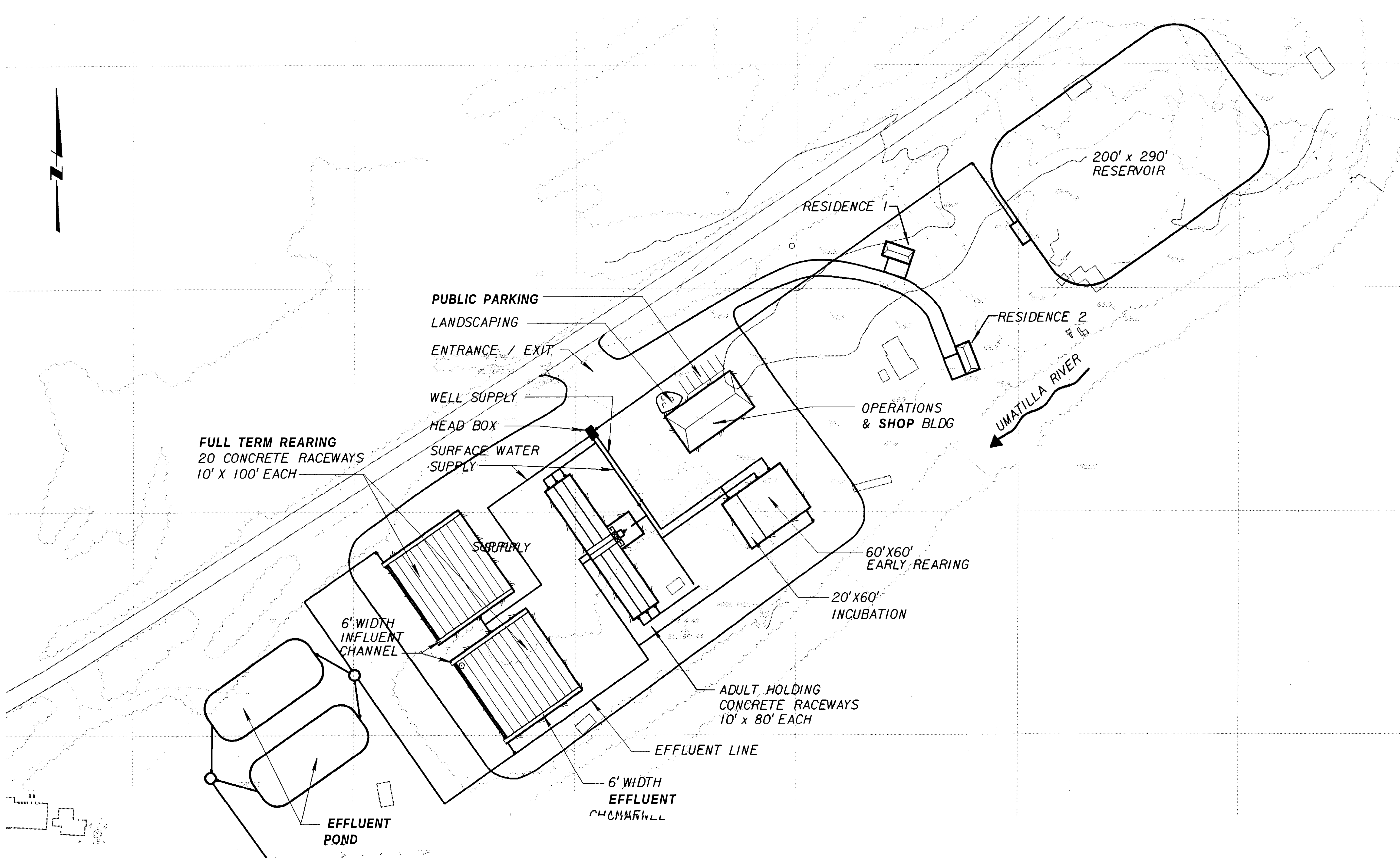
TABLE 20 (continued)

CRITERION	CORPORATION	EMMETT WILLIAMS	FRED GRAY	RUSSELL WALKER
COSTS 1. Construction costs from Draft Report	$4,009,953	$4,088,0013	$4,250,554	$3,404,971
revised for Final	not applicable	not applicable	not applicable	$7,253,984 (a)
2. Operating and maintenance differences	2.Winter road access	2. Reservoir pumping or mechancial chilling costs	2. Reservoir pumping or mechancialchilling costs	2.Smolt transportation costs to Umatilla basin,
FUTURE DEVELOPMENT 1. Phased development potential	Additional space limited	Additional space limited	Additional space available	Space available to accomodate NEOH Walla Walla production goals
SMOLT HAULING TO ACCLIMATION OR RELEASE SITES	Facility within Umatilla Basin. Smolt hauling over maximum 21 mile distance to furthest release /acclimation site (Corporation to Meacham Creek at Camp Creek).	Facility within Umatilla Basin. Smolt hauling over maximum 13 mile distance to furthest release / acclimation site (Emmett Williams to Meacham Creek at Camp Creek).	Facility within Umatilla Basin. Smolt hauling over maximum 12 mile distance to furthest release / acclimation site (Emmett Williams to Meacham Creek at Camp Creek).	Facility outside Umatilla Basin. Would require smolt hauling from hatchery for approxmately 50 to 70 miles to reach all planned ChS release/acclimation sites .

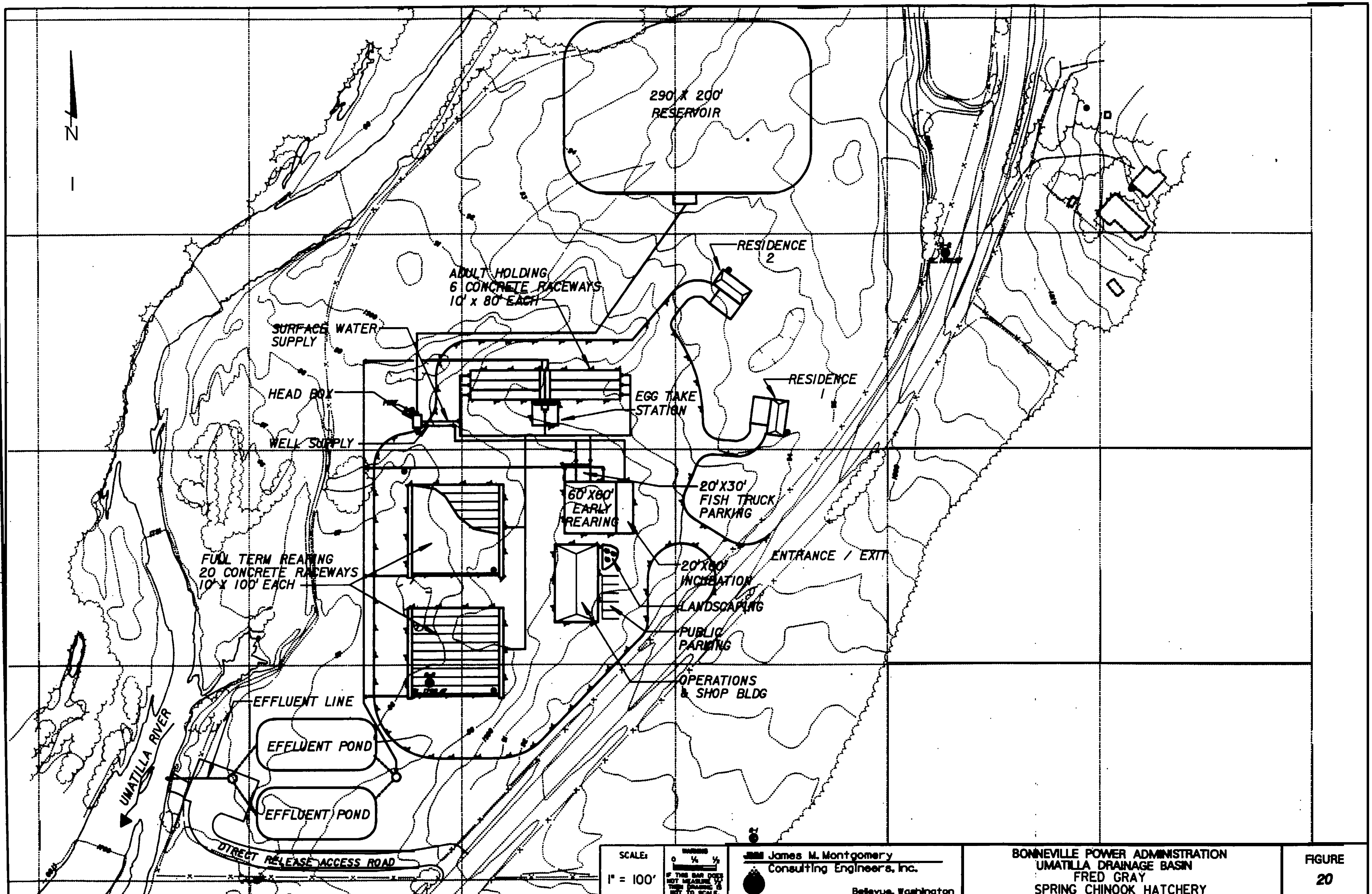
(a) This cost reflects revisions made to the planned facilities at the Russell Walker site during final conceptual design. Similar revisions were not made to the cost estimates at the other sites. Revisions included influent and effluent disinfection and doubling the number of full term rearing raceways for ChS.



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN CORPORATION SPRING CHINOOK HATCHERY	FIGURE 18



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN EMMETT WILLIAMS SPRING CHINOOK HATCHERY	FIGURE 19


N
290' X 200'
RESERVOIR
RESIDENCE
2
ADULT HOLDING
6 CONCRETE RACEWAYS
10' x 80' EACH
SURFACE WATER
SUPPLY
HEAD BOX
EGG TAKE
STATION
RESIDENCE
1
WELL SUPPLY
20'X30'
FISH TRUCK
PARKING
60'X60'
EARLY
REARING
ENTRANCE / EXIT
FULL TERM REARING
20 CONCRETE RACEWAYS
10' X 100' EACH
20'X60'
INCUBATION
LANDSCAPING
PUBLIC
PARKING
OPERATIONS
& SHOP BLDG
EFFLUENT LINE
EFFLUENT POND
EFFLUENT POND
UMATILLA RIVER
DIRECT RELEASE ACCESS ROAD
SCALE:
1" = 100'
James M. Montgomery
Consulting Engineers, Inc.
Bellevue, Washington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
FRED GRAY
SPRING CHINOOK HATCHERY
FIGURE
20

Early rearing will occur in square or circular rearing tanks. 3,600 sq. ft. has been allocated for early rearing.

Adult holding requirements can be fulfilled with 6 raceways shown as 80' long, 12' wide, and 8' deep Recommended raceway depth was decreased to 4 feet following discussions with the Umatilla TWG.. A 30'x 30' egg picking area will be provided adjacent to the adult holding ponds. This is about 100 feet from the incubation/early rearing building.

If the raceway option is chosen for final rearing, 20 raceways - each 100' long, 10' wide, and 2.25' deep will accommodate the expected fish load. Alternately, the raceways could be designed with a greater water depth, which will reduce the required length and width of the tanks. Raceways with 2.25' water depth are depicted in the drawing to show the maximum size required. If rearing ponds are used, 2 ponds each 135' long, 65' wide, with a bottom depth of 4' will suffice. They should have a 2.5: 1 side slope and a narrow channel in the center of the pond for fish crowding.

As water enters the diversion/intake, it flows by gravity to the headbox and, when needed, to the reservoir. From the headbox, water is distributed between incubators, early rearing troughs, adult holding ponds, and raceways or rearing ponds. Knife type valves will be provided at every tank to completely shut off flow. Flow modulation, however, will be controlled by means of orifices which are calibrated to provide a constant flow from the headbox. In order to keep the headbox level constant, it will be necessary to constantly overflow a small amount of water from the headbox. The flow from the intake to the headbox is also orifice controlled.

After flowing through the various tanks and incubators, the water will flow by gravity to one of two effluent ponds where it will receive the required retention time for solids removal, From here, the water will either exit to the river at the base of the site or be pumped back to the intake structure if required to mitigate for reservoir withdrawals.

Cut and fill on this site should be minimal. A more detailed flood analysis will be required to determine flood potential - particularly for the low lying effluent ponds.

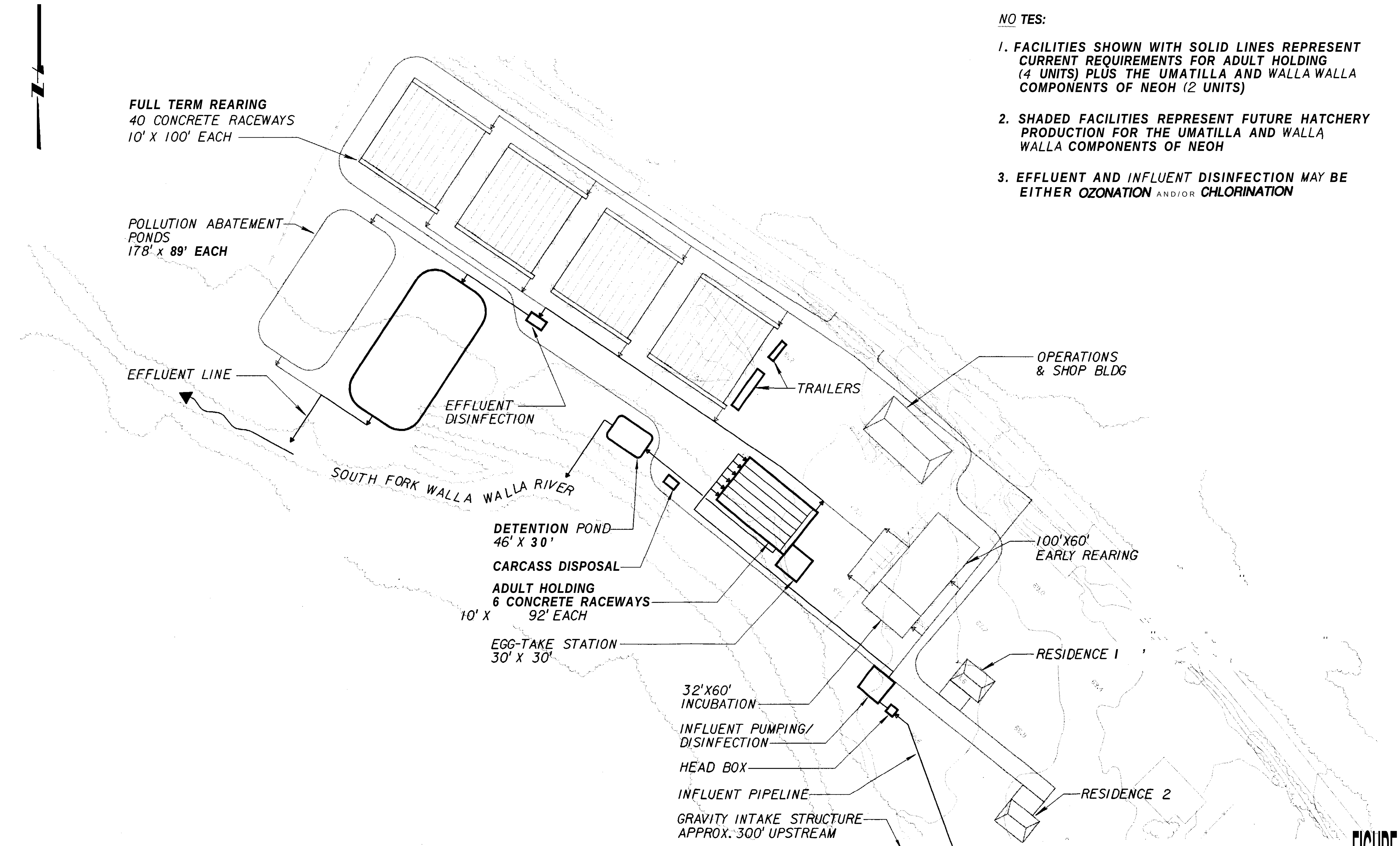
South Fork Walla Walla

A conceptual layout of this facility is shown on Figure 21. This facility incorporates incubation, early rearing, satellite rearing, adult holding, egg-take facilities, and direct release. Also shown is an operations and shop building, 2 residences, effluent ponds, chemical treatment detention . . pond,influent and effluent ozonation (disinfection), and a gravity intake at the south end of the property. Table 21 lists the functions and design basis associated with each component.

Incubation will be performed using Heath Tray incubators. 1,200 sq ft is allocated for this purpose as shown in the drawing. Early rearing will occur in square or circular rearing tanks . 3,600 sq ft has been allocated for early rearing.

Adult holding requirements can be fulfilled with 6 tanks, each 92' long, 10' wide, and 4' deep. A 30'x 30' egg-take station will be provided adjacent to the adult holding ponds. This is about 100 feet from the incubation/early rearing building.

Satellite rearing can be performed in 40 raceways - each 100' long, 10' wide, and 2.25' deep. Alternately, the raceways could be designed with a greater water depth (as has been suggested), which will reduce the required length and width of the tanks. Raceways with 2.25' water depth arc depicted in the drawings to show the maximum space required.



NOTES:

1. FACILITIES SHOWN WITH SOLID LINES REPRESENT CURRENT REQUIREMENTS FOR ADULT HOLDING (4 UNITS) PLUS THE UMATILLA AND WALLA WALLA COMPONENTS OF NEOH (2 UNITS)
2. SHADED FACILITIES REPRESENT FUTURE HATCHERY PRODUCTION FOR THE UMATILLA AND WALLA WALLA COMPONENTS OF NEOH
3. EFFLUENT AND INFLUENT DISINFECTION MAY BE EITHER OZONATION AND/OR CHLORINATION

SCALE: 1" = 100'	WARNING: 0 1/4 1/2 — IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN SOUTH FORK WALLA WALLA SPRING CHINOOK SATELLITE FACILITY	FIGURE 27

TABLE 21

SOUTH FORK **WALLA WALLA**
ADULT HOLDING AND SPAWNING FACILITY

FACILITY ELEMENT	SIZE	DESIGN BASIS	FUNCTIONAL CAPABILITY OR REQUIREMENTS
Intake	11,900 gpm	Full potential site development	Year-round operation
Pipeline	11,900 gpm	Full potential site development	Year-round operation
Head Box	11,900 gpm	Full potential site development	Maintain constant head in system
Influent Disinfection	2,553 gpm current 4,264 gpm current plus NEOH	Current use or full potential program for adult holding.	Effective disinfection based on 3 log reduction of Giardia cysts Effective for control of virus, bacteria, protozoa, and parasites
Adult Holding Ponds	4 - 10x92x4 current 6 - 10x92x4 current plus NEOH	Density = 8 ft^3/fish Flow = -1.5+0.05(T) gpm/fish see Table 3	4 ft. water depth, diffuser, spray, fencing to prevent loss of fish
Spawning Building	30x30 ft.	1,652 current 2,759 current plus NEOH	spawning, pathology,scale and snout sampling, weighing and measuring, egg bucket storage, ventilation, non-potable water supply, dry-room area, drain/sump for blood or chemicals, freezer
Effluent Disinfection	2,553 gpm current 4,264 gpm current plus NEOH	Current use or full potential program for adult holding.	Effective disinfection based on 3 log reduction of Giardia cysts Effective for control of virus, bacteria, protozoa, and parasites
Detention Pond	11,000 ft^3	3x size of single adult holding unit for chemical treatment	Discharge to river. Adequate detention time to reduce peak concentration in discharge and provide some decay of formalin.
Pollution abatement pond	2 @ 76,130 ft^3 for NEOH production	Units needed only for future production facilities	1-hour detention time
Discharge Pipeline	2,553 gpm 4,264 gpm	Current use or full potential adult holding.	Discharge disinfected effluent to river.
Trailers	8x30ft. 14x56 ft.	full time staff part time staff	Provide staff housing during adult holding and spawning operation
Carcass Disposal	10x15 ft.	7 days holding at 130 fish/day	Holding for offsite disposal or incineration
Fencing	700 ft. current 2,200 ft. current plus NEOH	7 ft. chain link with 3 strands of barbed wire	Site security

For concept design purposes, influent disinfection by ozone injection with packed column removal, and effluent disinfection by chlorination with earthen pond storage removal (which seems to be the most practical alternative at this stage of design) is recommended. Therefore, as water from the river enters the diversion/intake, it flows by gravity to the influent pump station where it is pumped through an ozone injector and feeds into a constant head tank, from where the disinfected water is distributed to facility components. Knife type valves will be provided at every tank to completely shut off flow. Flow modulation, however, will be controlled by means of orifices which are calibrated to provide a constant flow from the head tank. In this manner, flow to an individual unit will be changed by inserting a different sized orifice, rather than turning a valve. In order to keep the head tank at constant level, it will be necessary to constantly overflow a small amount of water from the head tank.

After flowing through the facility, the water will flow by gravity to a chlorine injector, then into a detention pond. The detention time provided by the detention ponds will serve to remove residual ozone from the water. Finally, the water will be treated with SO_2 as it leaves the detention pond to remove any remaining chlorine residual.

This portion of the Walla Walla River is cold enough that no process water cooling (mechanical or reservoir) will be needed to meet the temperature criteria.

A more detailed land survey will be needed for this site, but cut and fill requirements should be minimal.

FINAL REARING/ACCLIMATION AND/OR DIRECT RELEASE SITES

Basic assumptions for the conceptual design of the final rearing/acclimation or direct release sites include:

- Direct release to be the initial phase of development
- Final rearing/acclimation may be developed in future if required
- Direct release sites taken together would accommodate all defined needs for release of ChF and ChS in the Umatilla Basin
- Final rearing/acclimation ponds are sized to receive groups of fish on a weekly basis, with an average residence in the pond of about 3-5 days

Each of the following sites were identified for initial use in the near term as direct release sites with long-term potential for development of ponds for final rearing and/or acclimation of either spring or fall chinook. Many of the sites are currently being used as release sites, however, improvements are needed to allow dependable access. Table 22 presents a summary of acclimation facility and release ramp needs for the Umatilla Basin as identified by CTUIR Office of Fisheries. Differences between this list of sites and the sites shown in Table 2 include the deletion of 4 sites for near-term needs: Corporation, Emmett Williams, Cayuse, and Echo Meadows. Conceptual layouts for all sites are included, however.

Release facilities will include proper access from the highway and a gravel road to the river or release point. The road will be 20 feet wide and a turnaround will be provided to accommodate the fish trucks. Space for parking near the release ramp and portable restrooms can be provided for public recreational use.

TABLE 22

ACCLIMATION FACILITY AND RELEASE RAMP NEEDS FOR CURRENT AND FUTURE RELEASES IN THE UMATILLA BASIN (a)

Site	River Mile	Juvenile Release Sites By Species: STS	COH	0+ CHS	1+1+ CHS	0+ CHF	CHF	Release Ramp Use: JUV	ADULT	Construction Priority
Fred Gray	80			Current anc Future (b) mid April - early May	Current and Future mid March-mid April		Future mid Feb-mid March	X	X	X Acclimation facility
Thornhollow	73.5				Future mid March-mid April	Current and Future mid April - early May	Future mid Feb-mid March	X	X	X Acclimation facility
Mission	60		Current and Future mid March-mid April			Future mid April - early May	Future mid Feb-mid March	X		X Release ramp only for initial construction
ODF&W	56		Current and Future mid March-mid April			Future mid April - early May	Current and Future mid Feb-mid March	X		X Acclimation facility
Barnhart	42.5		Future mid March-mid April			Future mid April - early May	Future mid Feb-mid March			
Nolin	33	Future mid March-mid April				Future mid April - early May	Future mid Feb-mid March	X	X	X Release ramp only far initial construction
Meacham Ck. at Camp Creek	11 (c)	Future mid March-mid April				Future mid April - early May				
Bonifer on Meacham Ck	2 (c)	Current and Future mid March-mid April		Future mid April - early May	Current release in spring and fall					
Minthorn	63	Current and Future mid March-mid April				Current and Future mid April - early May	Future mid Feb-mid March			X Renovation of existing facility

a) Source: CTUIR Office of Fisheries
b) Current releases will occur during an approximate 5-year monitoring and evaluation period (M&E). Future releases are post M&E.
c) Refers to mileage on Meacham Creek

Development of an acclimation facility will include construction of either a large pond or raceways for 3-30 day holding of fish. The maximum size pond required would be 70 feet by 120 feet, asphalt-lined and have side-slopes of a minimum of 2.51 for cleaning purposes. If space is constrained, raceways may be used. A maximum of four raceways would be required, of dimensions 10 feet by 100 feet. Fencing around the pond or raceways will be provided for security. A constant water supply of approximately 800 gpm will be required to accommodate the maximum number of fish at each acclimation site. This will require the construction of either a gravity or pumped intake, and influent and effluent pipelines. The effluent pipeline will also be used for volitional release of fish. If there is not a suitable location for a permanent intake structure, a portable pump setup can be used for the required acclimation period.

No permanent living facilities have been shown at the rearing/acclimation sites; it is our opinion that they are not necessary given the relatively short duration of yearly use (approximately 75 days) and the proximity of the sites to the Pendleton area. Sites could be tended on a daily basis for feeding, maintenance, and routine checking. At locations where a pumped supply is required, an alarm system with an automatic dialer could be installed for notification in the event of pump failure.

Meacham Creek at Camp Creek

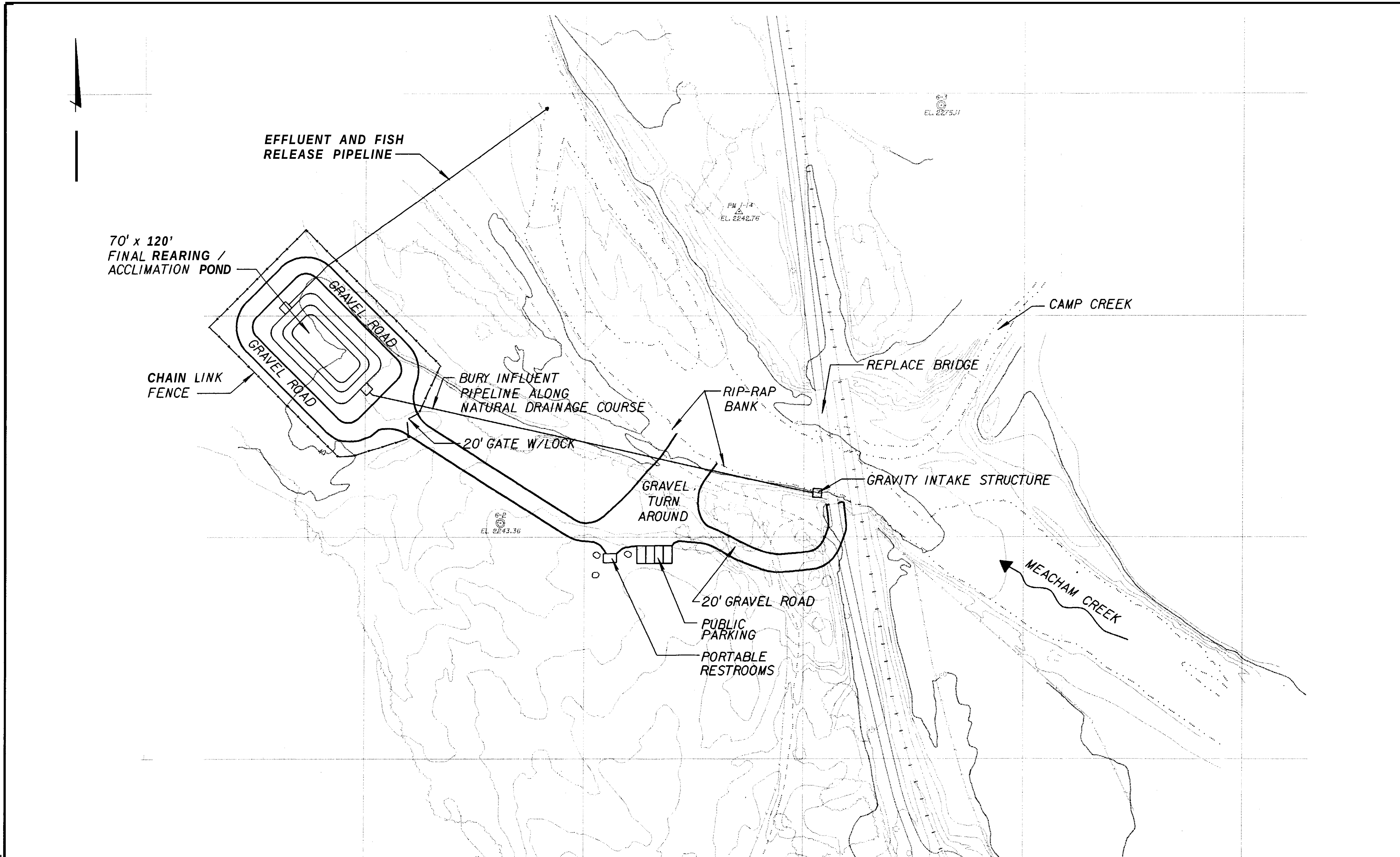
The Meacham Creek facility will be used in the short term for direct release of some portion of the 589,000 non-evaluation spring chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for spring chinook could be developed if needed Figure 22 shows the site with full development of both near term and long term facilities.

The acclimation facility shown in Figure 22 consists of a pond, but the site is also well-suited to a side channel facility. A large gravel bar in the creek here has defined a side channel which could be improved to define a natural acclimation facility. However, gravel bars, gravel banks and historical flooding indicate that the river moves around at this site. For this reason, annual improvement or replacement of a side channel facility may be necessary.

An intake structure, whether gravity or pumped, would be located at or just downstream of the existing bridge. Although more head could be achieved by being upstream of the bridge, an intake structure located here would require tunneling under the railroad, which is prohibitively expensive. The pond or raceways would need to be constructed below the existing grade to receive gravity flow. Although the bank at the intake structure location is gravel, the bridge abutments will provide channel stability. Gravity supply is recommended at this site.

Corporation

As a direct release site, Corporation will be used in the short term for direct release of some portion of the 1.44 million, 02 versus standard, experimental spring chinook slated for release in the Umatilla River. It is also slated for use in the short term for direct release of some portion of the 589,000 non-evaluation spring chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for spring chinook could be developed if needed Figure 18 shows the site with full development as a hatchery facility. Direct release activities are accommodated with this layout, as could short term final rearing/acclimation.



SCALE: 1" = 100'	WARNING 0 ¼ ½ IF THIS BAR DOES NOT MEASURE ½" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN MEACHAM CREEK DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 22

Fred Gray

Conceptual drawings of this facility are shown on Figures 23 and 24. The facility consists of a diversion/intake, **influent** pipeline, acclimation pond(s), effluent and fish release line, storage building, access road/truck turn-around, and security fence. The functions and design basis for each component are listed on Table 23.

The facility is shown alternately with one large pond, or 3 smaller ponds with a combined volume equal to that of the large pond. Each arrangement has advantages over the other. Primarily, the construction of a single large pond would be less expensive than constructing 3 smaller ones, but it would also be less flexible during operations.

As water enters the diversion/intake, it flows by gravity through a 1250 ft pipeline to the acclimation pond(s) via a diffuser box at the head end of the pond. The water then flows over the discharge weir/fish release structure at the other end of the pond and back to the river as shown on the figures. When the time comes to release the fish into the river, they can be crowded into a narrow center channel **and** swim through the effluent pipe directly into the river.

The diversion/intake consists of a small dam, intake box, fish screen, screen cleaner, gate, and fish ladder. This river intake can be designed with the ability to allow the later addition of adult trapping facilities.

Thorn Hollow Site

The Thorn Hollow site has multiple planned uses. For fall chinook, it will be used in the short term for direct release of some portion of the 3.24 million, 02 versus standard, experimental fall chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. For spring chinook, it will be used in the short term for direct release of some portion of the 1.44 million, 02 versus standard, experimental spring chinook slated for release in the Umatilla River. It is also slated for use in the short term for direct release of some portion of the 589,000 non-evaluation spring chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for spring chinook could be developed if needed Figure 21 shows the site with full development of both near term and long term facilities.

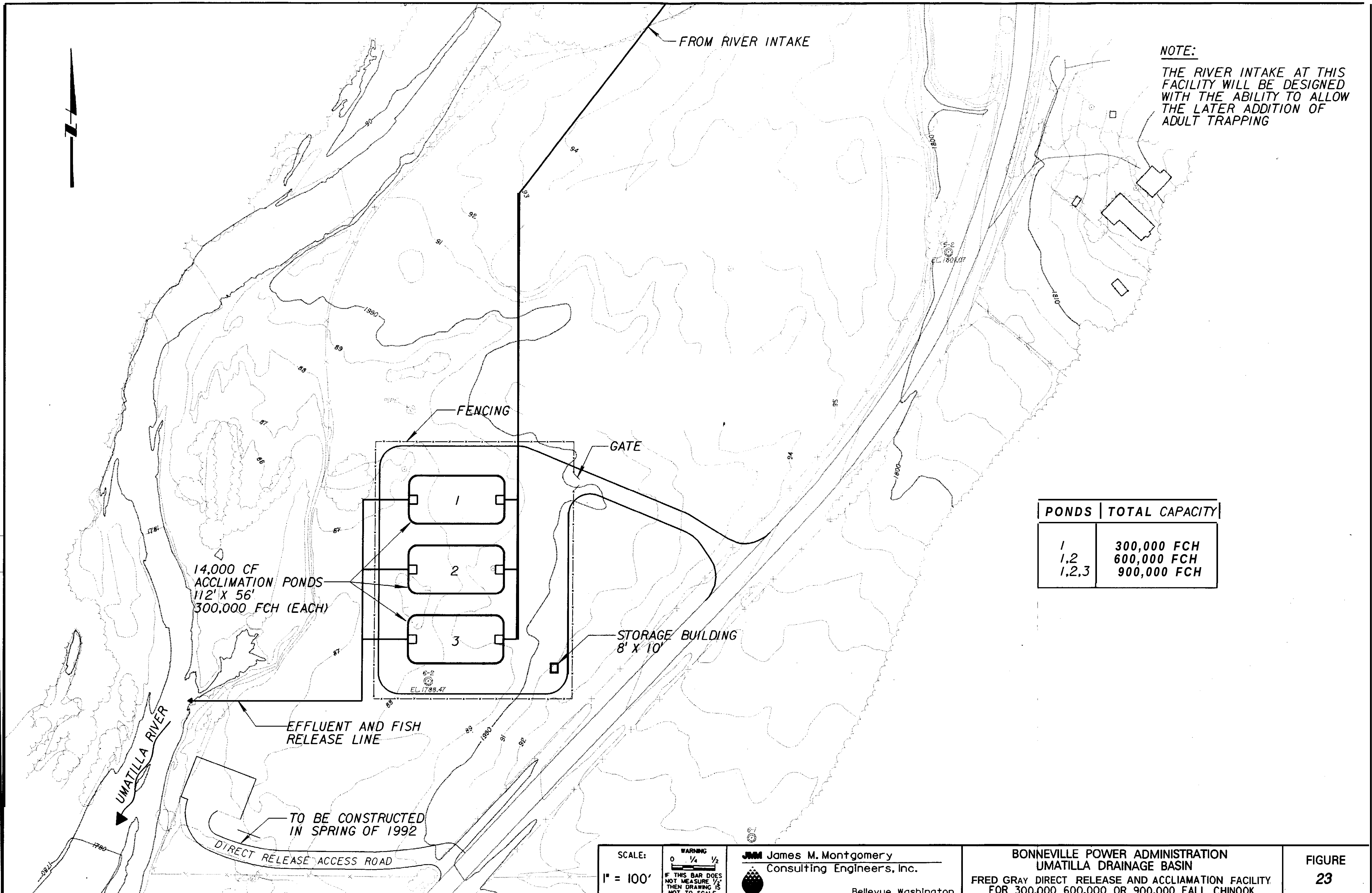
The acclamation pond is 70' x 120' asphalt lined with **2.5:1** sloped sides and a maximum depth of 3 feet . The effluent structure will be designed so that fish can swim through it and directly out to the river at release time. Note the long entrance road - necessitated by the existence of the small bridge on Thorn Hollow Road which cannot support a large fish transport truck.

Cut and fill on this site should be minimal. Three phase power may be up to **1/8** mile away, which should be investigated further if that type of power is desirable for pump operation. A pumped supply is recommended for this site.

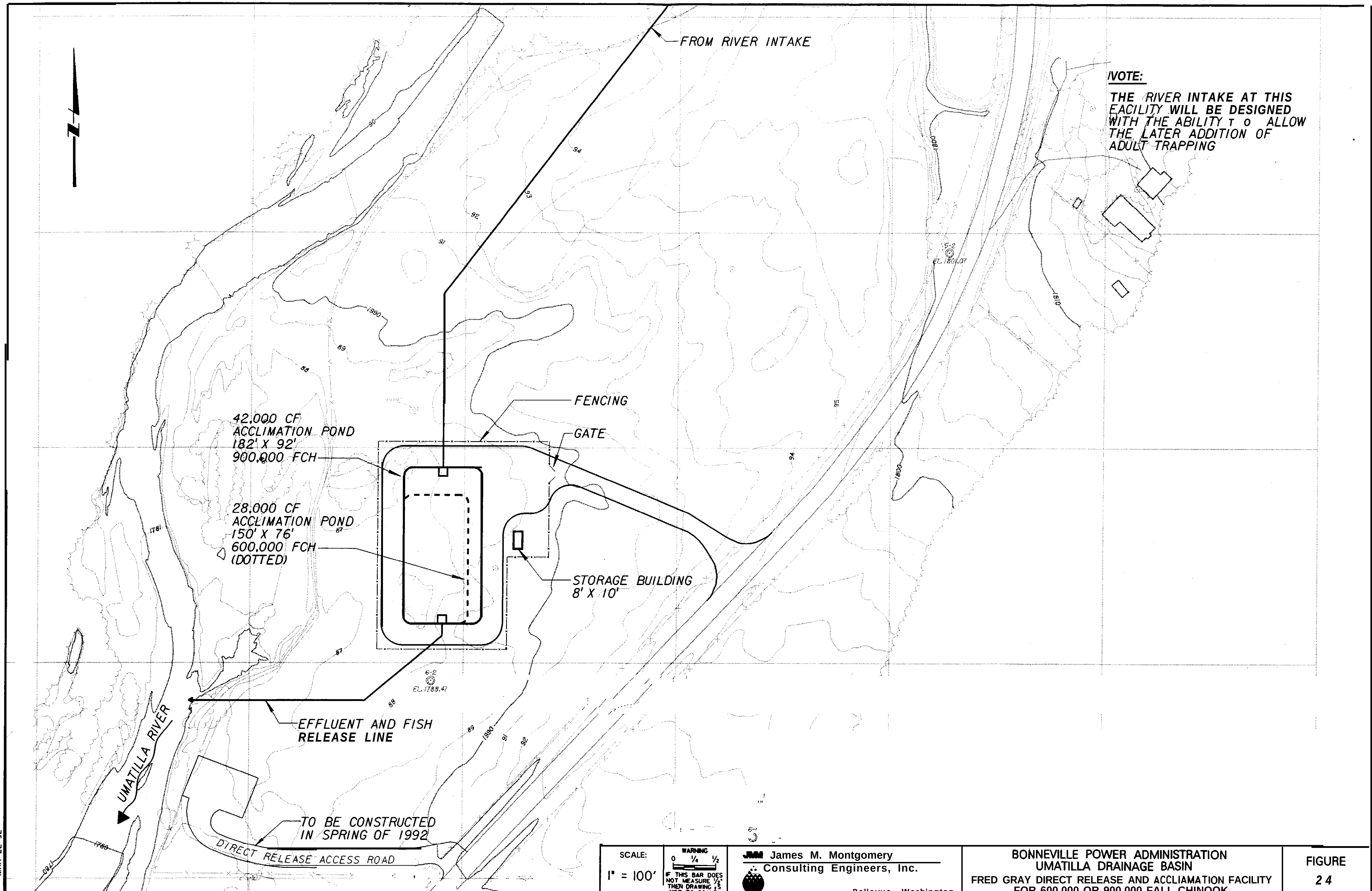
Cayuse

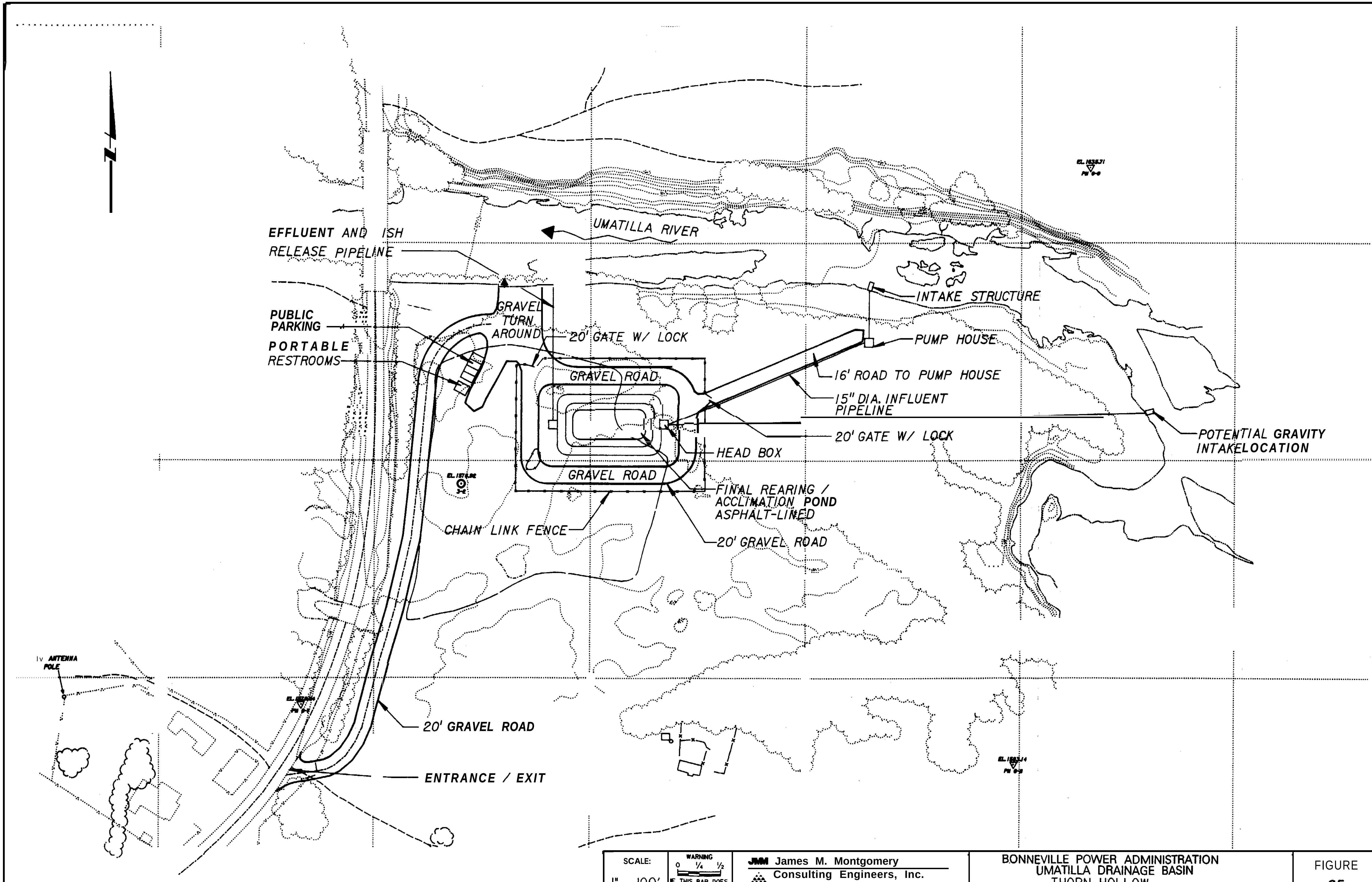
The **Cayuse** site will be used in the short term for direct release of some portion of the 3.24 million, 02 versus standard, experimental fall chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 22 shows the site with full development of both near term and long term facilities.

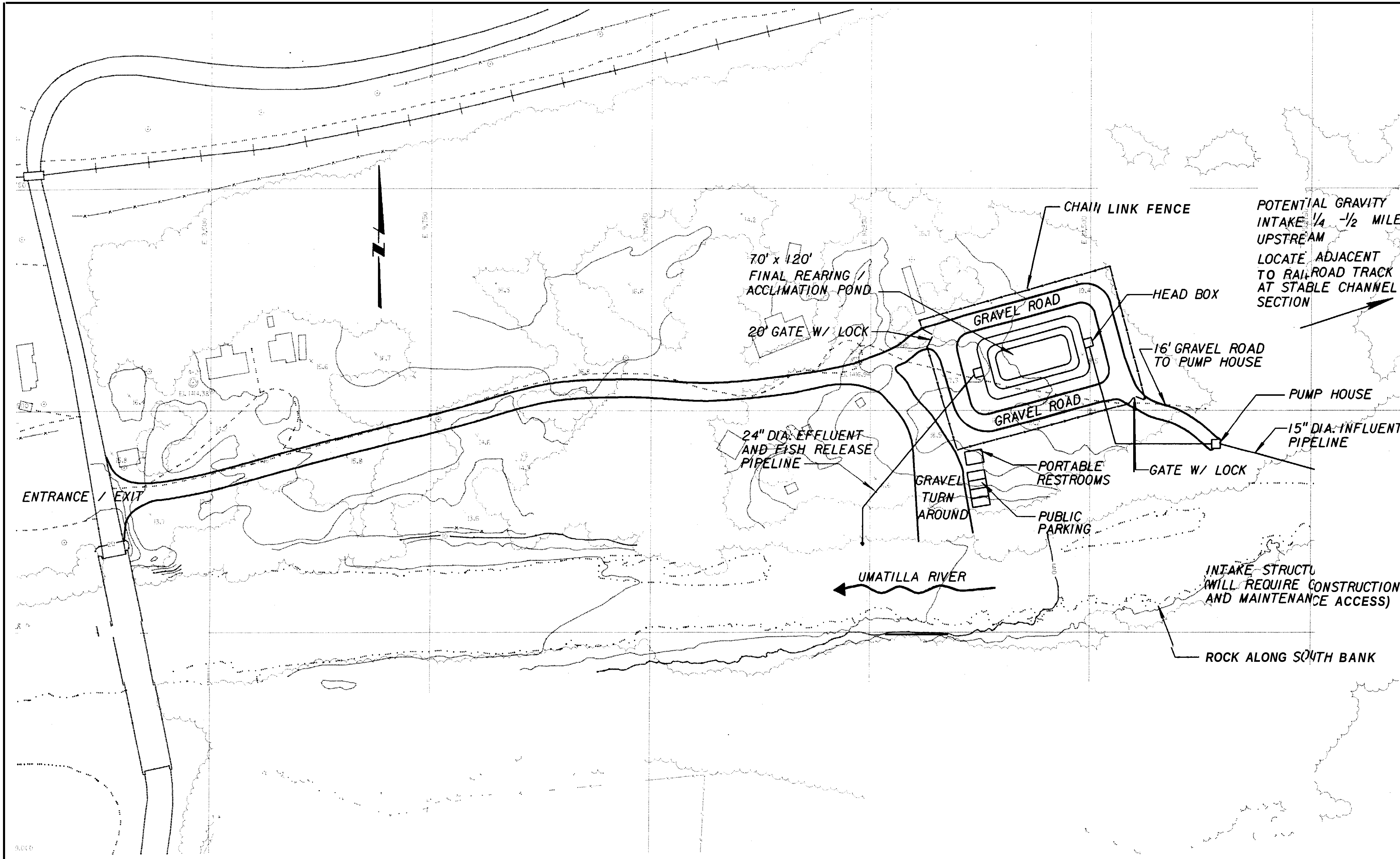
Space is somewhat constrained due to the proximity of the existing residences on this property, so raceways may be considered as an alternative to the large pond. The north bank is not appropriate



PONDS	TOTAL CAPACITY
1	300,000 FCH
1,2	600,000 FCH
1,2,3	900,000 FCH


FROM RIVER INTAKE
NOTE:
THE RIVER INTAKE AT THIS FACILITY WILL BE DESIGNED WITH THE ABILITY TO ALLOW THE LATER ADDITION OF ADULT TRAPPING
FENCING
GATE
42,000 CF ACCLIMATION POND 182' X 92' 900,000 FCH
28,000 CF ACCLIMATION POND 150' X 76' 600,000 FCH (DOTTED)
STORAGE BUILDING 8' X 10'
EFFLUENT AND FISH RELEASE LINE
UMATILLA RIVER
TO BE CONSTRUCTED IN SPRING OF 1992
DIRECT RELEASE ACCESS ROAD
SCALE: 1" = 100'
WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.
JMM James M. Montgomery Consulting Engineers, Inc.
Bellevue. Washington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
FRED GRAY DIRECT RELEASE AND ACCLIAMATION FACILITY FOR 600,000 OR 900,000 FALL CHINOOK
FIGURE 24


UMATILLA RIVER
EFFLUENT AND ISH RELEASE PIPELINE
PUBLIC PARKING
PORTABLE RESTROOMS
GRAVEL TURN AROUND
20' GATE W/ LOCK
INTAKE STRUCTURE
PUMP HOUSE
16' ROAD TO PUMP HOUSE
15" DIA. INFLUENT PIPELINE
GRAVEL ROAD
20' GATE W/ LOCK
POTENTIAL GRAVITY INTAKELOCATION
HEAD BOX
GRAVEL ROAD
FINAL REARING / ACCLIMATION POND ASPHALT-LINED
CHAIN LINK FENCE
20' GRAVEL ROAD
ANTENNA POLE
20' GRAVEL ROAD
ENTRANCE / EXIT
SCALE: 1" = 100'
WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.
JMM James M. Montgomery Consulting Engineers, Inc.
Bellevue. Woshington
BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
THORN HOLLOW
DIRECT RELEASE / ACCLIMATION FACILITY
FIGURE 25



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN CAYUSE DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 26

TABLE 23

FRED GRAY
ACCLIMATION AND DIRECT RELEASE FACILITY

FACILITY ELEMENT	SIZE	DESIGN BASIS	FUNCTIONAL CAPABILITY OR REQUIREMENTS
Acclimation			
Intake	3,300 gpm @ 900,000 ChF 2,200 gpm @ 600,000 ChF 1,100 gpm @ 300,000 ChF	See Table 3 for criteria	Provide water to facility, cold weather capability, trash rack/screened
Fish trap (future)	to be determined	build into intake structure	Capture all fish moving upstream or allow free passage
Intake pipeline	5,300 gpm maximum		
Distribution box			
Acclimation pond	42,000 ft^3 @ 900,000 ChF 28,000 ft^3 @ 600.000 ChF 14,000 ft^3 @ 300,000 ChF	See Table 3 for criteria	Drainage by gravity without stranding steelhead, asphalt with center drain channel bird screens, disinfectable Provides 1.5 hours detention time
Effluent structure			Constant head during normal operation, both volitional and non-volitional release
Effluent pipeline	20-in. diameter	drain in 4 hours	
Storage building	8x10 ft.		Concrete block construction, metal roof, storage, electricity
Fencing	1,060 ft.	7 ft. chain link with 3 strands of barbed wire	Site security
Access road	20 ft. wide	6 in. gravel fill	All weather road, support fish hauling trucks
Direct Release			
Access road	20 ft. wide	6 in. gravel fill	All weather road, support fish hauling trucks
Turn around	70x70 ft. minimum		Accommodate turning radius of large fish hauling trucks

for locating a permanent intake structure, due to the **low** bank and **soil conditions. There is a rock bank on the far side, and** a permanent intake could potentially be constructed across the river from the release site. It is our recommendation that a portable, pumped intake system be **planned** for this site if ponds are developed in the future.

Mission

The Mission site will he used in the short term for direct release of some portion of the 3.24 million, 02 versus standard, experimental fall chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 27 shows the site with full development of **both near** term and long term facilities.

This site will require very little grading or clearing, although construction of a ramp may be required for direct release of fish from the fish truck. There is adequate space for a large acclimation pond. The flat gradient of the river here will require a pumped intake, which will he located just upstream of the release site. There is a good location here for a permanent, pumped intake.

ODF&W

The **ODF&W** site will he used in the short term for direct release of some portion of the 3.24 million, 02 versus standard, experimental fall chinook slated for release in the Umatilla River. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 28 shows the site with full development of both near term and long term facilities.

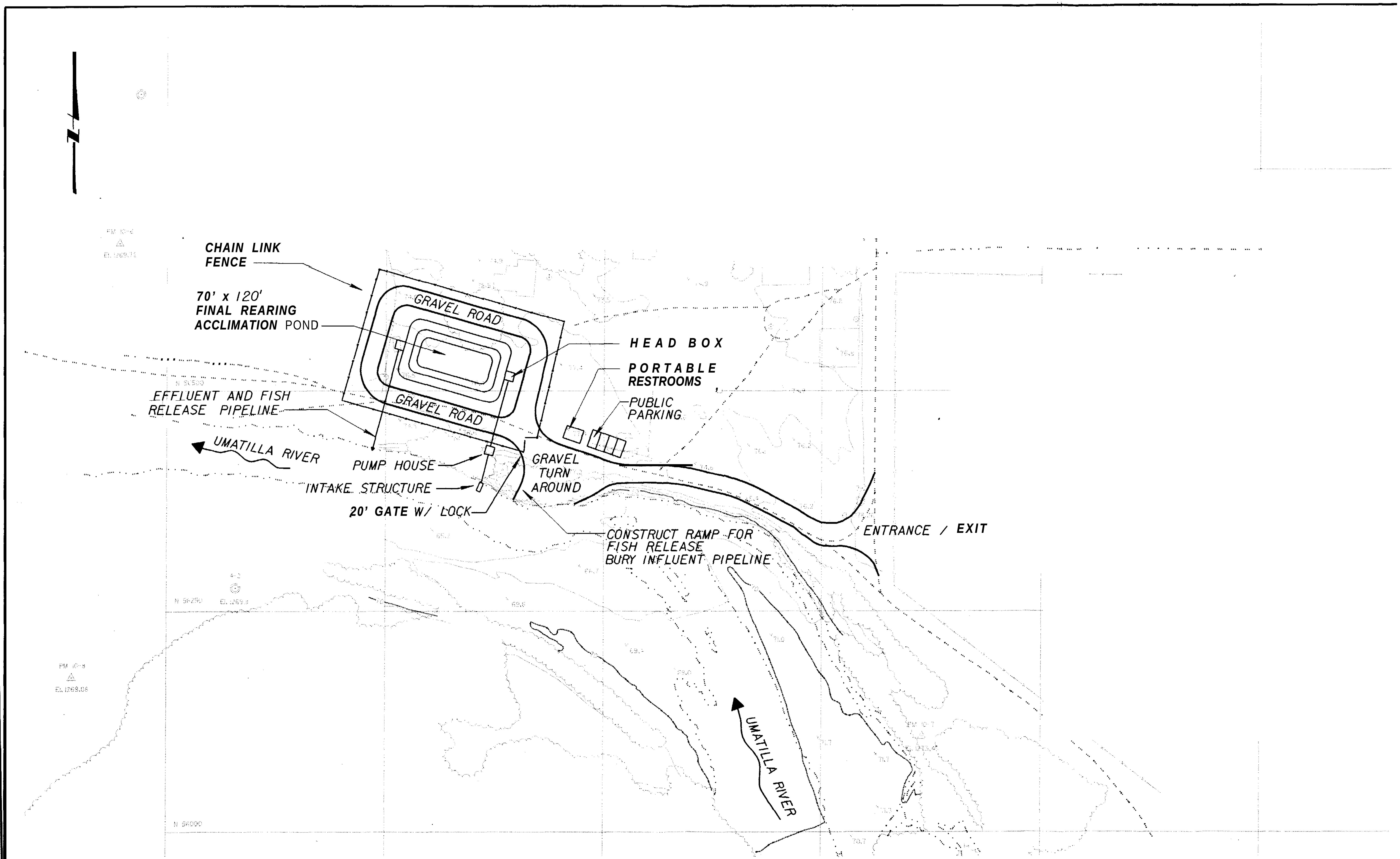
The existing road to the release site will need to be widened to accommodate the fish trucks. There is a natural location for release, which will be widened to allow trucks to turn around. The pond or raceways will be sited in the area currently used by **ODF&W** for storage. The berm may need to be extended and otherwise improved here to protect the facility from flooding. There is adequate head for a gravity supply, with the intake location approximately 1500 feet upstream. The intake pipeline would be buried in the existing roadway running adjacent to the river.

Bamhact

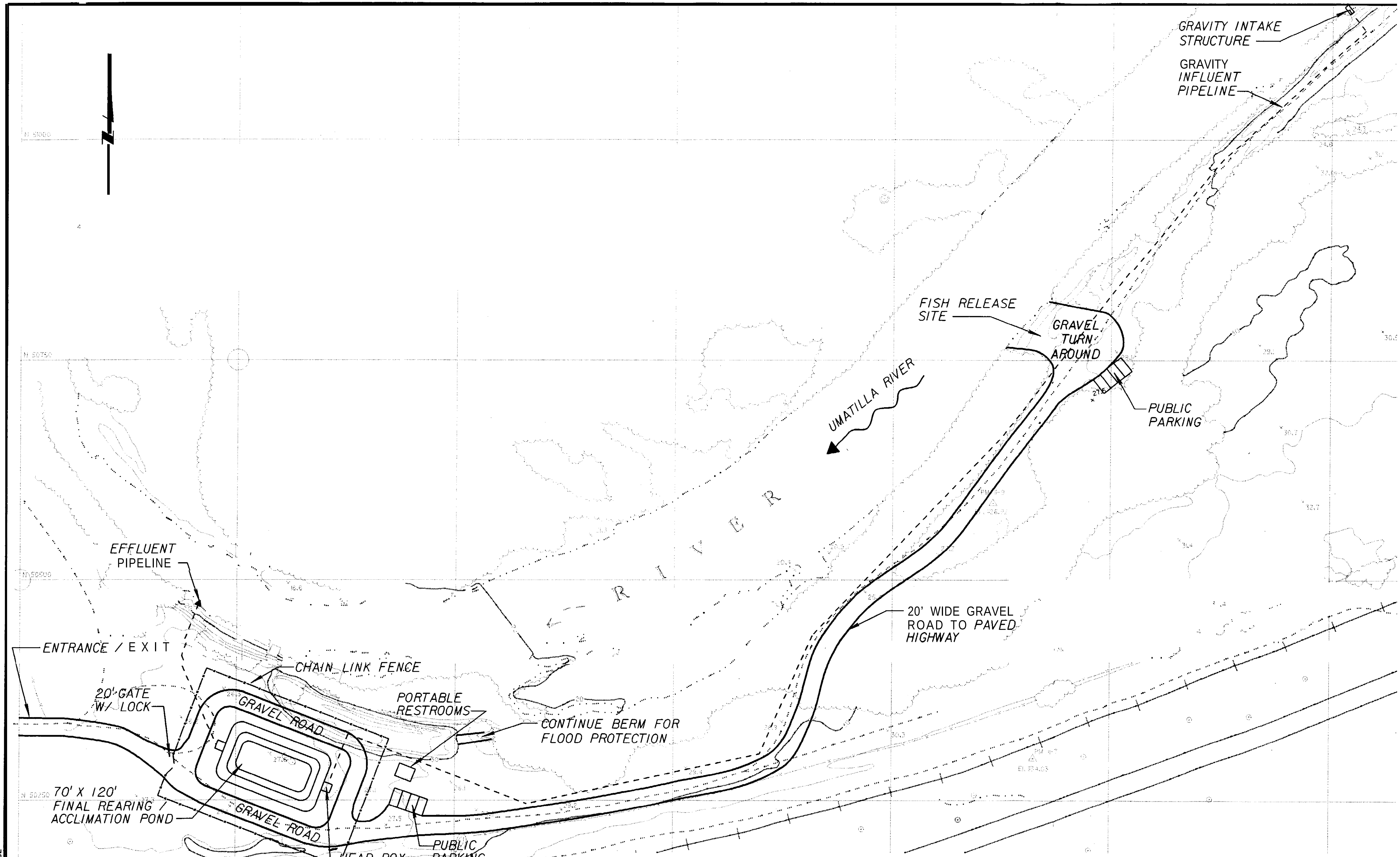
The Bamhart site will be used in the short term for direct release of some portion of the 1.44 million, non-evaluation fall chinook slated for release. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 29 shows the site with full development of both near term and long term facilities.

The acclimation pond (or raceways) would be located north of the **railroad** and west of the existing dirt road. Their location here provides improved flood protection and better security. The road should be improved and **bermed** on the east for flood protection.

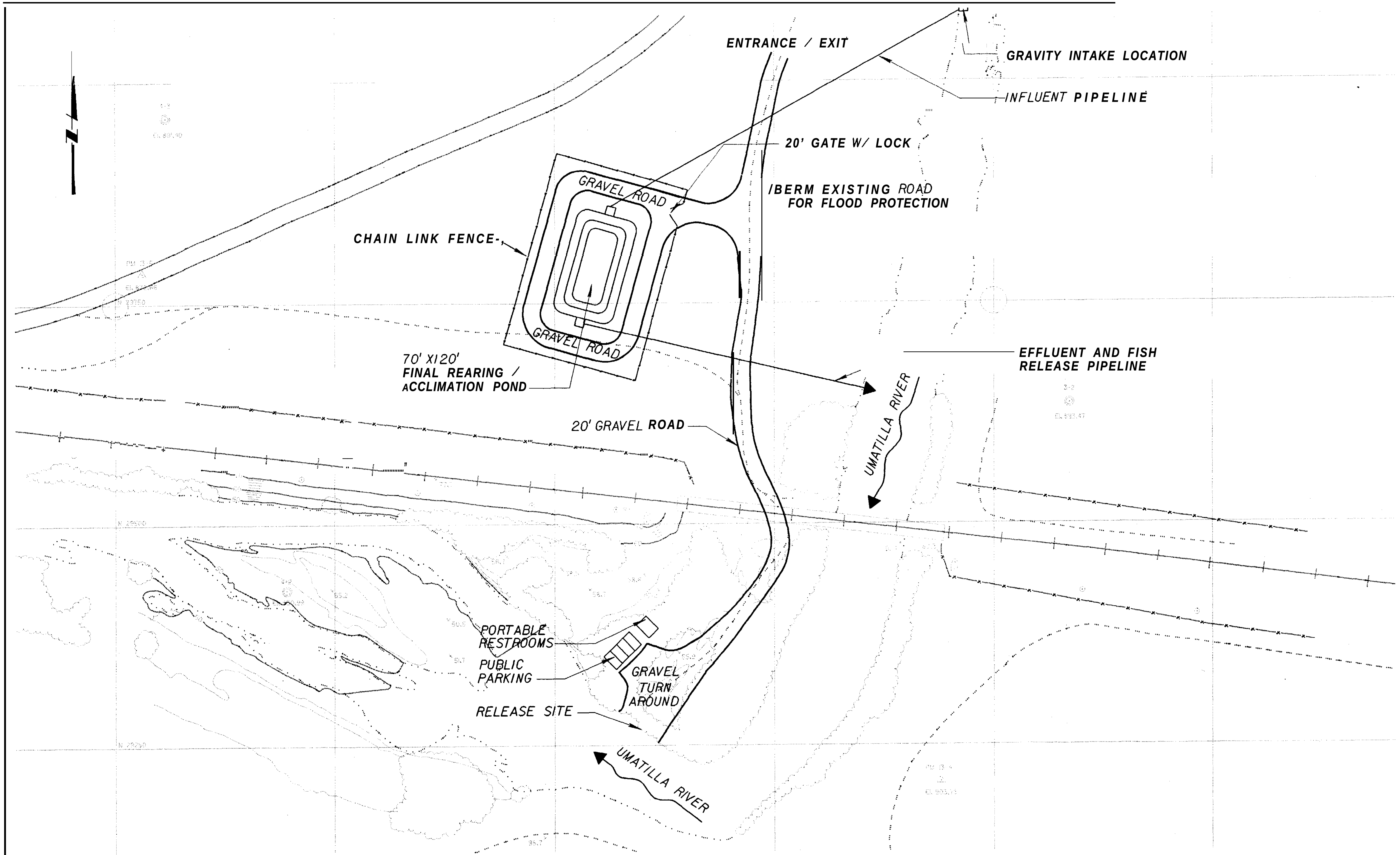
Release would **occur** at the existing release site. Some clearing, filling and grading will be required to construct a turnaround near the river. The best location for an intake structure is at the north end of the reach, where gravity supply is possible. The improvements to the access road and release site should result in providing all-year access to the Bamhart site and would allow use of this site for the ongoing adult trap and haul program.



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN MISSION DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 27



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue. Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN ODFW DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 28



SCALE: 1" = 100'	WARNING 0 ¼ ½ IF THIS BAR DOES NOT MEASURE ½" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN BARNHART DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 29

Nolin

The Nolin site will be used in the short term for direct release of some portion of the 1.44 million, non-evaluation fall chinook slated for release. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 30 shows the site with full development of both near term and long term facilities.

There is adequate space for an acclimation pond and clearing and grading of the site will be minimal. There is not an appropriate location for a permanent intake structure, either pumped or gravity on the south bank. The nearest potential site on the south bank would be approximately one-half mile upstream at a more stable channel section. It is recommended that the entire facility be relocated nearer to this intake site. Land ownership and topography are the same as previously investigated.. It is our recommendation that a portable, pumped intake system be planned for this site if ponds are developed in the future.

Echo Meadows

The Echo Meadows site will be used in the short term for direct release of some portion of the 1.44 million, non-evaluation fall chinook slated for release. In the long-term, final rearing/acclimation facilities for fall chinook could be developed if needed. Figure 31 shows the site with full development of both near term and long term facilities.

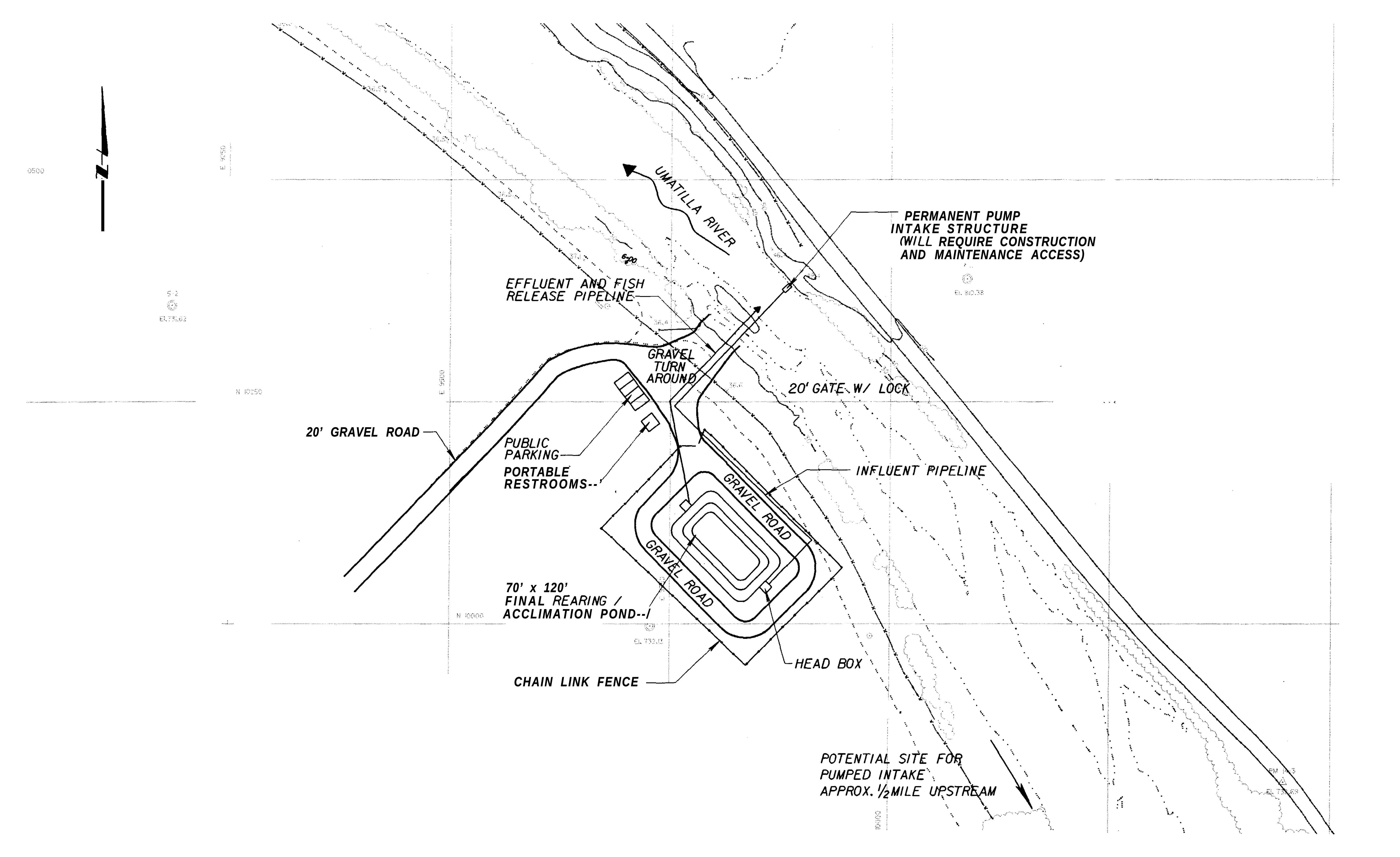
Construction of the road for fish release would be north along an existing fenceline and then parallel to the highway and down to the river. A gravel pad would be constructed for a turnaround near the northeast corner of the site, where trucks could then back down a ramp to release fish. The fish could be released by pipe from the truck if changes in the river channel make this necessary.

The acclimation facility would be located in the northwest location of the site to minimize potential flood damage to the facility. A potential water supply would be by gravity diversion of irrigation water from an existing irrigation ditch which runs north-south adjacent to the site. Alternatively, location of an intake structure would be approximately one-half mile upstream at a stable section of the river. It is our recommendation that a portable, pumped intake system be planned for this site if ponds are developed in the future and procurement of water from the irrigation ditch is not possible.

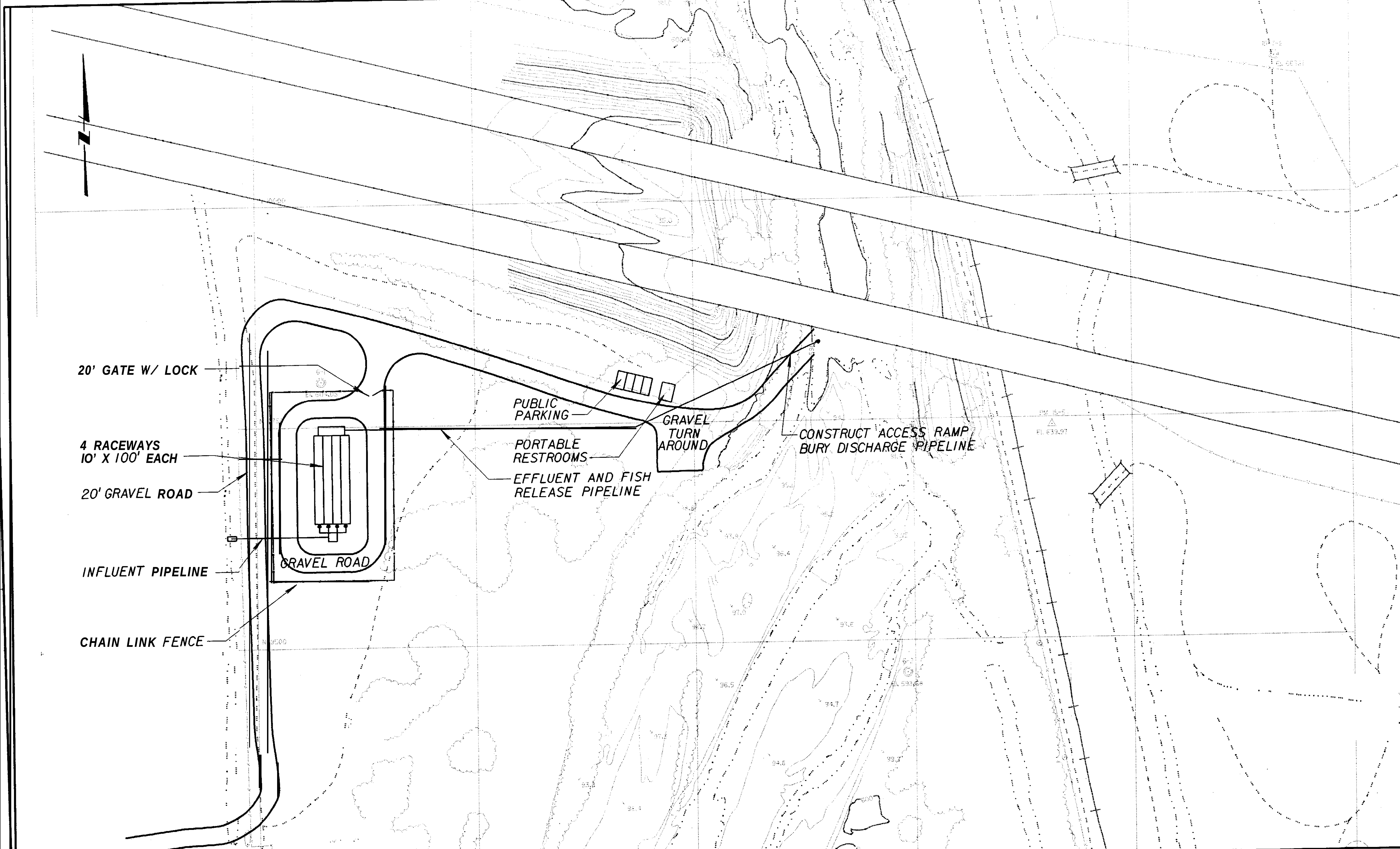
Three Mile Dam

Facilities at Three Mile Dam will be expanded to hold Fall Chinook (Figures 32 and 33). The functions and design basis for facility components are listed on Table 24. 12 Raceways, each 80’ x 10’ x 4’ deep should be constructed adjacent to the existing trapping facility. In this arrangement, fish can be transferred not only to live transport trucks, but also directly to the adult holding ponds. By using a moveable pipe, the fish can be transferred either to the common center channel of the raceways, or directly to individual raceways, as conditions may require. An egg-take station will be constructed adjacent to the raceways which will incorporate the operation functions for the facility. It will still be necessary to have a separate garage/shop building since some activities occurring there might be harmful to the egg-take environment.

Water is pumped from the intake structure to the outer ends of the raceways. It then flows through the raceways and into the common center channel from where it will flow to the existing fish ladder and increase flows there. The intake structure should be constructed at the rivers edge on the upstream side of the dam.



SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN NOLIN DIRECT RELEASE / ACCLIMATION FACILITY	FIGURE 30

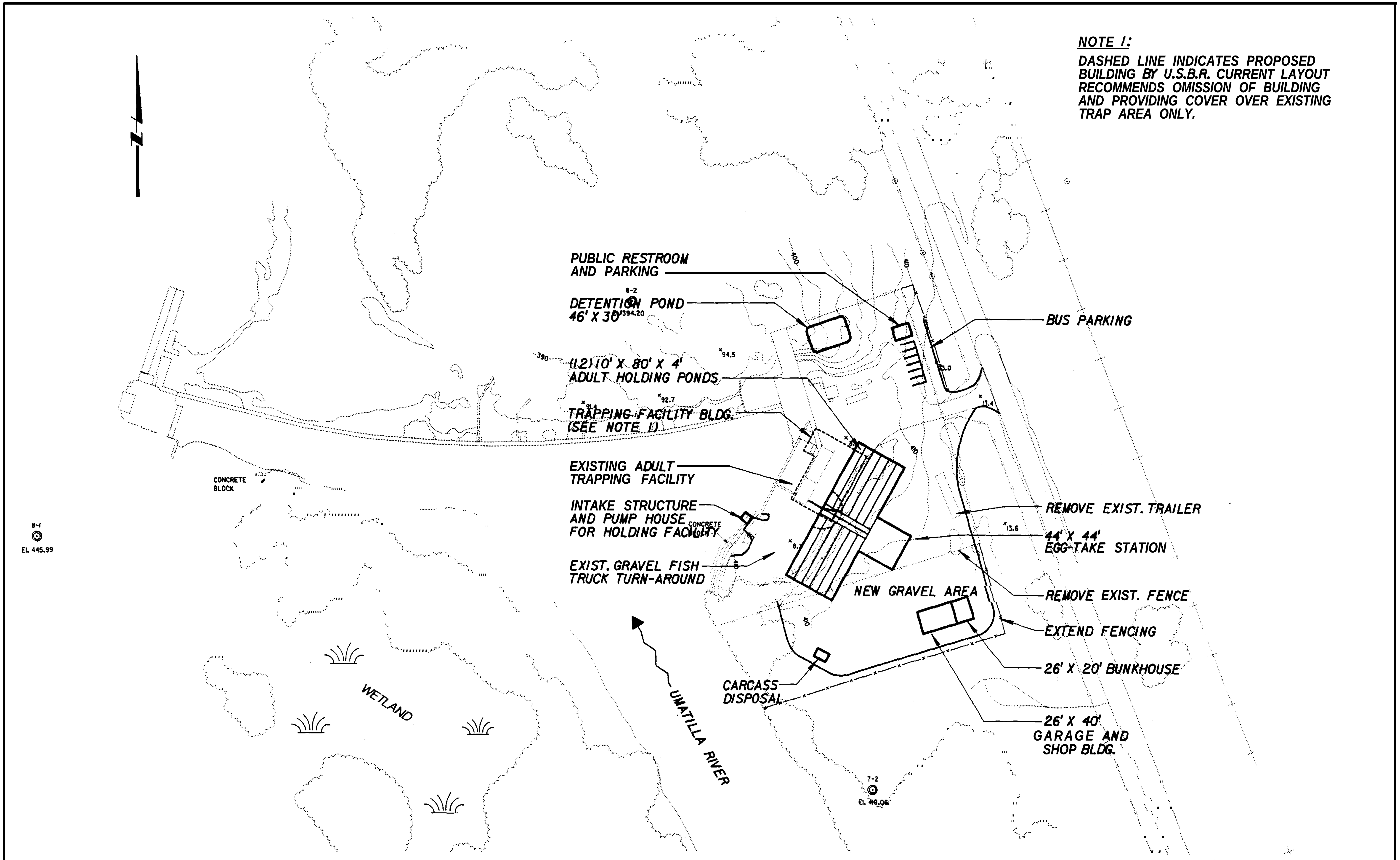


SCALE: 1" = 100'

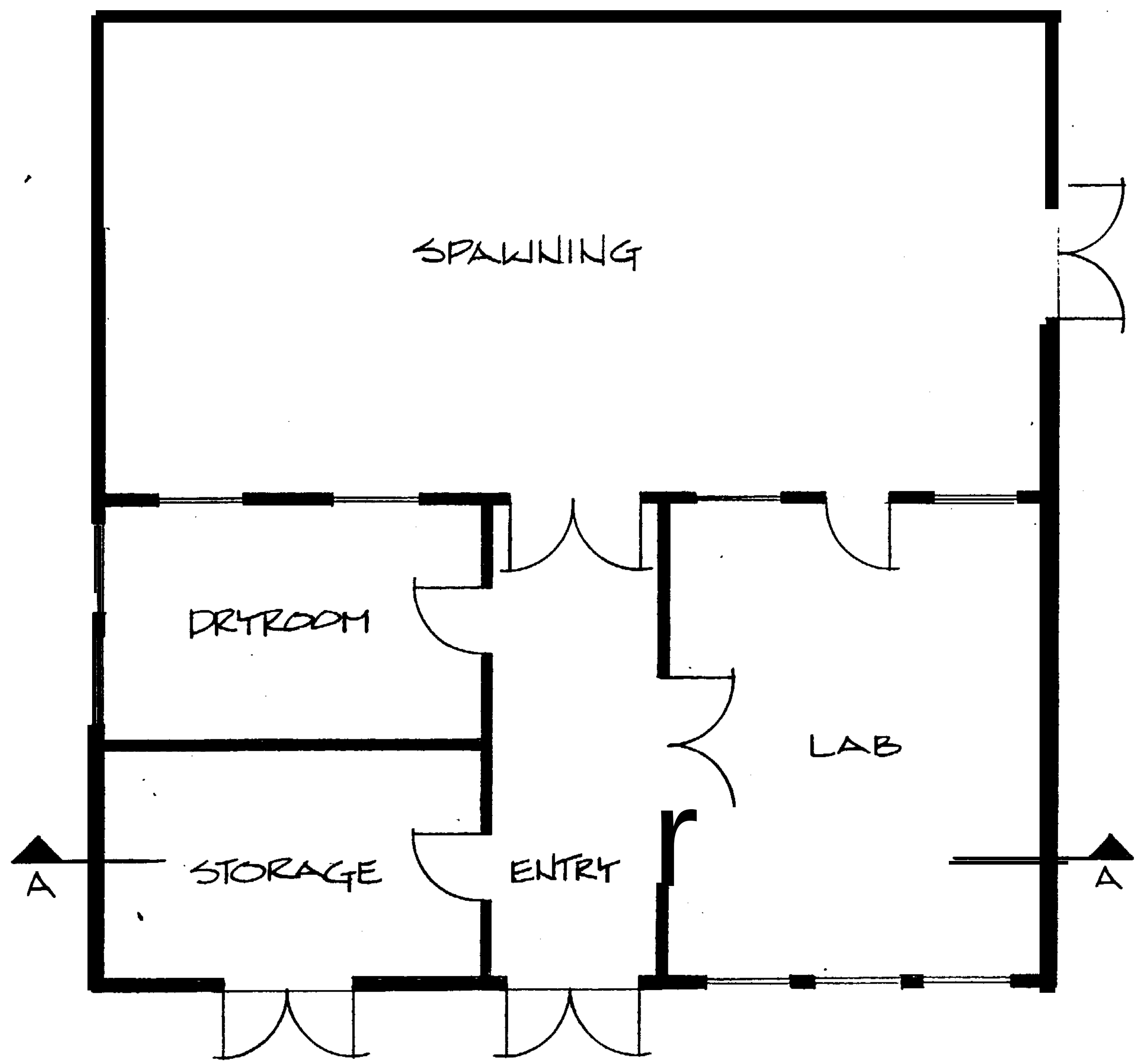
James M. Montgomery Consulting Engineers, Inc.
Bellevue, Washington

BONNEVILLE POWER ADMINISTRATION
UMATILLA DRAINAGE BASIN
ECHO MEADOWS
DIRECT RELEASE / ACCLIMATION FACILITY

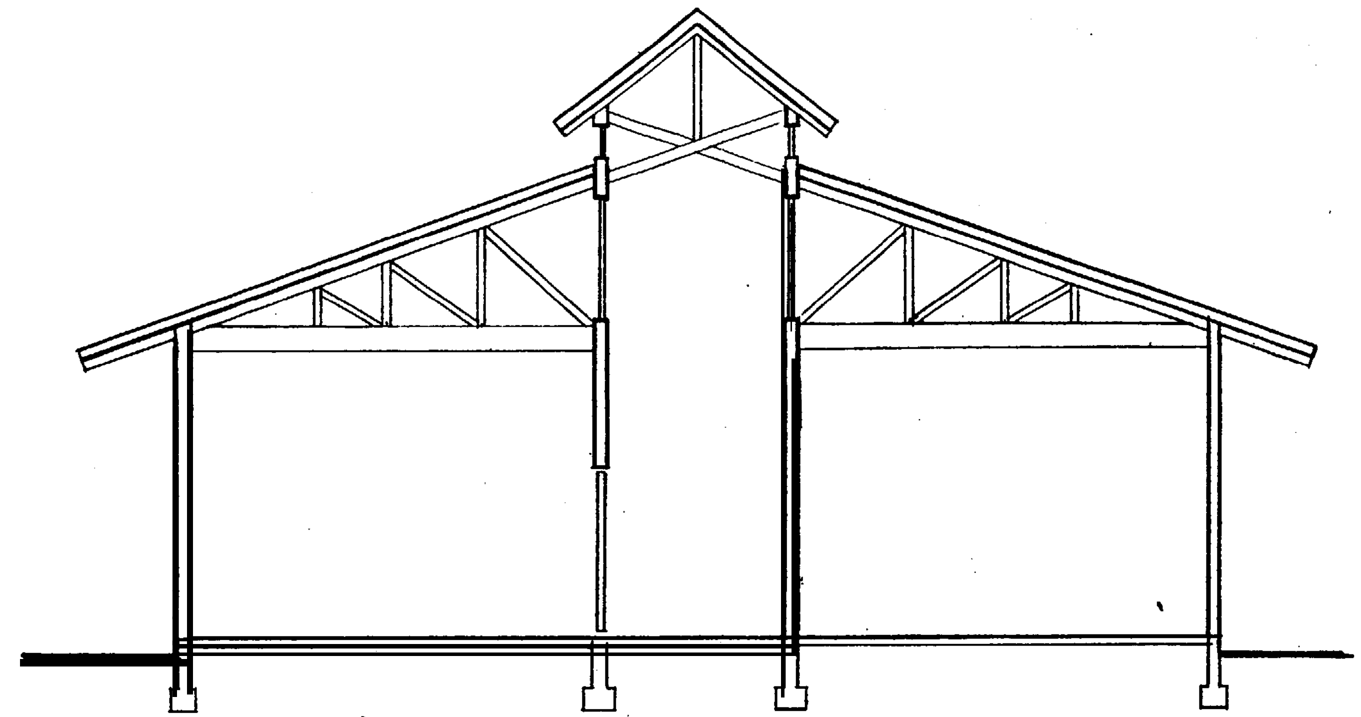
FIGURE 37



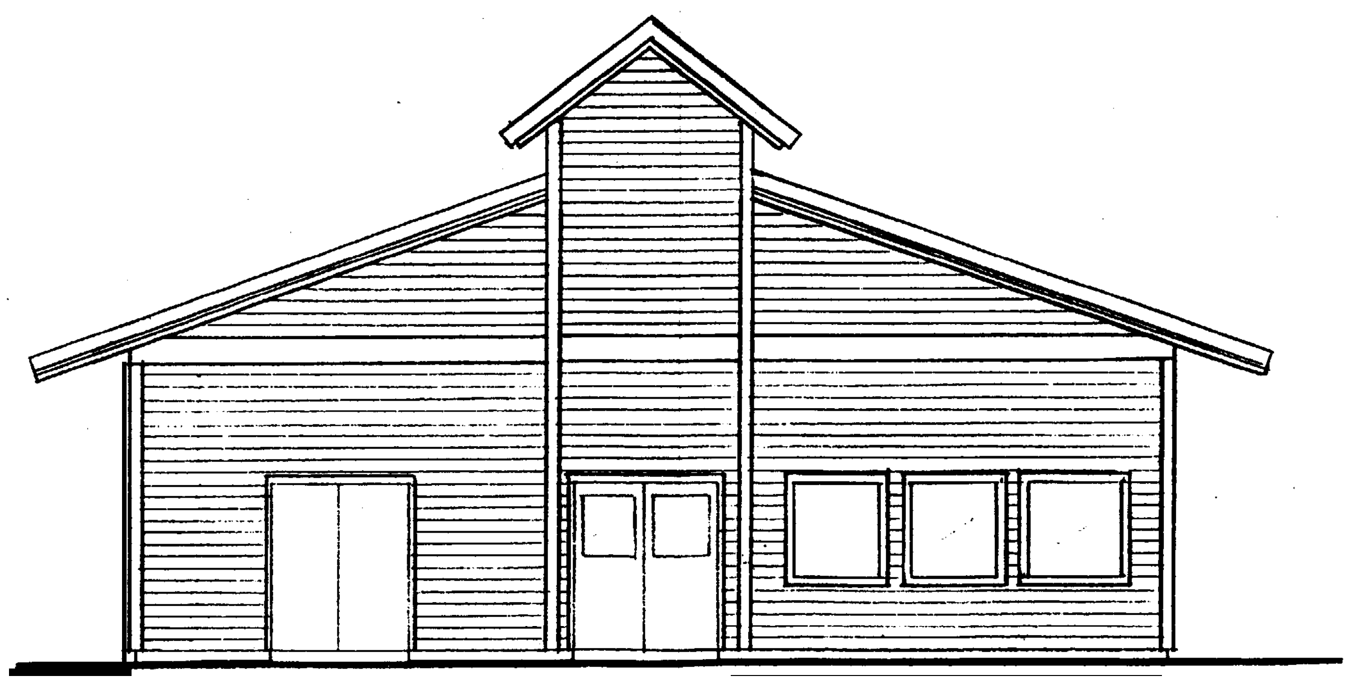
SCALE: 1" = 100'	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers, Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN THREE MILE DAM FALL CHINOOK ADULT HOLDING FACILITY	FIGURE 32



PLAN
SCALE: 1/8" = 1'-0"



SECTION AA
SCALE: 1/8" = 1'-0"



SOUTHEAST ELEV.
SCALE: 1/8" = 1'-0"

SCALE:	WARNING 0 1/4 1/2 IF THIS BAR DOES NOT MEASURE 1/2" THEN DRAWING IS NOT TO SCALE.	JMM James M. Montgomery Consulting Engineers. Inc. Bellevue, Washington	BONNEVILLE POWER ADMINISTRATION UMATILLA DRAINAGE BASIN *THREE MILE DAM SPAWNING BUILDING SCHEMATIC*	*FIGURE* 33

TABLE 24

THREE MILE DAM
ADULT HOLDING AND SPAWNING FACILITY

FACILITY ELEMENT	SIZE	DESIGN BASIS	FUNCTIONAL CAPABILITY OR REQUIREMENTS
Intake and pumphouse	6,500 gpm	Full potential site development	
Intake piping	6,500 gpm	Full potential site development	
Adult holding	12 units - 10x80x4 ft.	see Table 3 for criteria	4 ft. water depth, diffuser, spray, fencing to prevent loss of fish Capability to chill water for early 10% (approx.) of run
Discharge piping	6,500 gpm		Discharge to ladder (normal operations) or detention pond (treated)
Detention pond	9,600 ft^3	3x size of single adult holding unit	Discharge to river below ladder. Adequate detention time to reduce peak concentration in discharge and provide some decay of formalin.
Spawning building	44x44 ft.	5,542 ChF	spawning, pathology,scale and snout sampling, weighing and measuring, egg bucket storage, ventilation, non-potable water supply, dry-room area, drain/sump for blood or chemicals, freezer
Transfer from sorting to holding	20 ft.		Discharge into center channel or several adult holding ponds
Garage and shop	26x40 ft.		Office, space for one vehicle, shop, standby generator, fuel storage
Bunkhouse	20x30 ft.	full time staff	Provide staff housing during adult holding and spawning operation two bedrooms, kitchen, bathroom, storage for personal items
Public restroom	280 ft^2	per state/federal requirements	Separate sex facilities, handicap accessible
Public parking	2,100 ft^2	2 buses 4-6 cars	On-site parking for limited public access located away from operations area
Carcass Disposal	10x15	7 days holding at 320 fish/day	Holding for offsite disposal or incineration
Fencing	550 ft	7 ft. chain link with 3 strands of barbed wire	Site security

A small bunkhouse can be built adjacent to the garage/shop building and should be located as far from the carcass disposal area as possible. Carcass disposal may be either incineration or a freezer to store fish for later transport.

The detention pond shown on the drawing is intended to treat the formalin which is anticipated to be used in the raceways. While there is not enough space on the site to completely break down the chemical when used in large quantities, this pond, used in conjunction with a simple recirculating system, can greatly decrease the amount of this chemical that is discharged to the river.

Also planned for this site are public restrooms and space for car and bus parking.

COST ESTIMATES

This section presents estimated bid costs for construction of the various facilities. Details were obtained from the cost estimate for the Merwin Hatchery, which is included as Appendix A. A summary of the estimates is shown on Table 25. The remainder of the section provides details for each facility at a particular site.

The Russell Walker Site on the S. Fork Walla Walla was identified as the preferred site for ChS adult holding and as the potential site for accommodating new ChS production facilities as identified in the NEOH project. As a result, the cost estimates for this site on Table 25 have undergone revision to include additional full term rearing raceways and disinfection of the influent and effluent. The Phase 1 cost estimate for the S. Fork site accounts for all ChS adult holding needs, potential overlap with ChF adult holding during warm years, and adult holding of

TABLE 25

SUMMARY OF COST ESTIMATES (a)

Hatchery Sites:

1.	Corporation		$4,009,953
2.	Emmett Williams		$4,088,013
3.	Fred Gray		$4,250,554
4.	South Fork Walla Walla		
	Phase 1	$3,345,597	
	Phase 2	$3,908,387	
	Total		$7,253,984

Adult Holding:

1.	Three Mile Dam	$1,699,088

Direct Release/Acclimation Sites:

		Direct Release	Final Rearing/ Acclimation
1.	Echo Meadows	$47,414	$392,685
2.	Nolin	$20,267	$412,744
3.	Barnhart	$34,832	$356,584
4.	ODF&W	$51,280	$391,297
5.	Mission	$23,501	$288,513
6.	Cayuse	$35,537	$393,137
7.	Thorn Hollow	$26,738	$308,786
8.	Meacham Creek	$23.837	$351,956
9.	Fred Gray		
	1 Pond		$683,113
	3 Ponds		$835,980

(a) Based on estimate for Merwin Hatchery (Appendix A) steelhead. It also includes influent and effluent disinfection and sizing of the water delivery system to accommodate future production needs at the site. The Phase 2 cost estimate includes development of production facilities to accommodate Umatilla and Walla Walla basin ChF production identified in the NEOH project Draft Master Plan. Functional assumptions for this facility are stated in Table 2 1.

Cost estimates for the other three sites (Corporation, Emmett Williams, and Fred Gray) were not revised to reflect these changes. Thus, they are much lower. Similar facilities at these sites would probably result in a similar level of cost increase, or higher, in some cases. This is due to the need to substantially cool the water supply at the Williams and Gray sites during the summer.

The Three Mile Dam adult holding facility cost estimate is based on the functional assumptions stated in Table 24.

Cost estimates for the acclimation ponds at the Fred Gray site are based on the functional assumptions stated in Table 23. Cost estimates for the acclimation ponds at the other sites were based on a smaller pond capacity and thus are not directly comparable to the Fred Gray site.

Corporation detailed cost estimate based on adjusted Mora and Merwin Values									
(Dissimilar elements estimated using Means Cost Estimating)									
		Units	**Quantity**	**Unit Labor**	**Unit Material**	**Unit Equip.**	**Unit Subc.**	**Unit Base Cost**	**Ext. Base Cost**
Electrical	(4.5% of total)	Ea	1					$156,127	$170,233
Instrumentation	(1.5% of total)	Ea	1					$52,042	$56,744
Site									
100020	Clearing and Grubbing	Acres*	5.9	$569.00		$845.00	$6,006.00	$7,420.00	$43,778
100023	Landscaping	Acres**	2.3				$23,100.00	$23,100.00	$53,130
100025	Paving and Walkways	SF	97860				$1.39	$1.39	$136,025
1003XX	Manholes, catch basins, curbs, gutters,	SF	97860	$0.05	$0.08	$0.01	$1.00	$1.14	$111,560
	fences (tie to paving area for estimating)								
	* Limits of construction								
	**Disturbed area w/o paving or structures								
Hatchery Bldg.									
1100XX	Building is one floor with everything	SF	4800	$10.73	$12.00	$1.39	$53.98	$78.10	$374,880
	w/in walls except:								
1100XX	Incubators, 8 stack	Ea	24	$90.00	$762.00			$852.00	$20,448
1100XX	Rearing troughs, 500 gal	Ea	20	$240.00	$3,175.00			$3,415.00	$68,300
Operations Bldg.									
1200XX	Building is one floor with feed room,	SF	4500	$12.73	$14.23	$1.65	$63.99	$92.60	$416,700
	garage, offices, lab. Estimate includes								
	everything w/in walls								
Residences									
	2 Houses, each 3 bdr, 1400 sqft living area	SF	2800				$85.00	$85.00	$238,000
	600 sqft garage	SF	1200				$60.00	$60.00	$72,000
Raceways	(measured concrete volume)	CY	1176	$192.00	$230.00	$22.00	$27.00	$471.00	$553,896
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
140055	netting	SF	25000				$4.85	$4.85	$121,250

Adult **Holding**	(measured concrete volume)								
Raceways	Includes excavation, concrete, and misc.								
130022	metals	CY	480	$192.00	$230.00	$22.00	$27.00	$471.00	$226,080
130030									
130065									
Headbox	(measured concrete volume)	CY	25	$192.00	$230.00	$22.00	$27.00	$471.00	$11,775
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
Effluent Ponds	**(area** measured in rectangular dimension)								
166920	Earthwork and 3" AC	SF	16800	$0.69	$0.28	$0.74	$1.39	$3.10	$52,080
1601xX	Concrete, piping, and **mech.** equip. for	Ea	2	$1,241.00	$4,917.00	$152.00	$11,261.00	$17,571.00	$35,142
	each pond								
Yard Piping	(based on measured length and diameter of all pipes over 6")								
200xXx	**All** supply, drain, utility pipes, valves	Inch*Ft	61400	$2.07	$1.98	$1.82	$0.53	$6.40	$392,960
	excavation, backfill								
Main Supply pipe									
300020	All supply pipes, valves	Inch*Ft	100800	$2.15	$1.98	$1.90	$0.62	$6.65	$670,320
300022	(excavation, backfill								
300150									
Intake	**Dam**	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
	Riprap	CY	67	$45.00	$15.00	$15.00		$75.00	$5,025
	Intake box	CY	12	$244.20	$292.80	$28.20	$34.20	$599.40	$7,193
	Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
	Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
	Gate	Ea	1				$5,000.00	$5,000.00	$5,000
	Dewatering	Ea	1				$50,000.00	$50,000.00	$50,000
	Fish ladder	Vertical Ft	3				$5,000.00	$5,000.00	$15,000
				TOTAL BID ESTIMATE					**$4,009,953**

Emmett Williams detailed cost estimate based on adjusted Mora and Merwin Values

(Dissimilar elements estimated using Means Cost Estimating)

		Units	Quantity	Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext. Base Cost
Electrical	(4.5% of total)	Ea	1					$173,547	$173,547
Instrumentation	(1.5% of total)	Ea	1					$57,849	$57,849
Site									
100020	Clearing and Grubbing	Acres*	11.6	$569.00		$845.00	$6,006.00	$7,420.00	$86,072
100023	Landscaping	Acres**	5.9				$23,100.00	$23,100.00	$136,290
100025	Paving and Walkways	SF	133570				$1.39	$1.39	$185,662
1003XX	Manholes, catch basins, curbs, gutters,	SF	133570	$0.05	$0.08	$0.01	$1.00	$1.14	$152,270
	fences (tie to paving area for estimating)								
	* Limits of construction								
	**Disturbed area w/o paving or structures								
Hatchery Bldg.									
1100XX	Building is one floor with everything	SF	4800	$10.73	$12.00	$1.39	$53.98	$78.10	$374,880
	w/in walls except:								
1100XX	Incubators, 8 stack	Ea	24	$90.00	$762.00			$852.00	$20,448
1100XX	Rearing troughs, 500 gal	Ea	20	$240.00	$3,175.00			$3,415.00	$68,300
Operations Bldg.									
1200XX	Building is one floor with feed room,	SF	4500	$12.73	$14.23	$1.65	$63.99	$92.60	$416,700
	garage, offices, lab. Estimate includes								
	everything w/in walls								
Residences									
	2 Houses, each 3 bdr, 1400 sqft living area	SF	2800				$85.00	$85.00	$238,000
	600 sqft garage	SF	1200				$60.00	$60.00	$72,000
Raceways	(measured concrete volume)	CY	1176	$192.00	$230.00	$22.00	$27.00	$471.00	$553,896
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
140055	netting	SF	25000				$4.85	$4.85	$121,250

Adult Holding	(measured concrete volume)								
Raceways	Includes excavation, concrete, and misc.								
136022	metals	CY	480	$192.00	$230.00	$22.00	$27.00	$471.00	$226,080
130030									
130055									
Headbox	(measured concrete volume)	CY	25	$192.00	$230.00	$22.00	$27.00	$471.00	$11,775
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
Effluent Ponds	(area measured in rectangular dimension)								
160020	Earthwork and 3" AC	SF	16800	$0.69	$0.28	$0.74	$1.39	$3.10	$52,080
1601XX	Concrete, piping, and mech. equip. for	Ea	2	$1,241.00	$4,917.00	$152.00	$11,261.00	$17,571.00	$35,142
	each pond								
Yard Piping	(based on measured length and diameter c all pipes over 6)								
200xXx	All supply, drain, utility pipes, valves	Inch*Ft	56260	$2.07	$1.98	$1.82	$0.53	$6.40	$360,064
	excavation, backfill								
Main Supply pipe									
300020	All supply pipes, valves	Inch*Ft	18000	$2.15	$1.98	$1.90	$0.62	$6.65	$119,700
300022	excavation, backfill								
300150									
Pump Station	(3-20 HP pumps = 60 HP)								
	Includes excavation, building, and	HP	60	$515.00	$1,838.55	$131.84	$78.28	$2,563.67	$153,820
	electrical								
Intake	Dam	CY	36	$244.20	$292.80	$28.20	$34.20	$599.40	$21,578
	Riprap	CY	89	$45.00	$15.00	$15.00		$75.00	$6,675
	Intake box	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
	Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
	Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
	Gate	Ea	1				$5,000.00	$5,000.00	$5,000
	Dewatering	Ea	1				$50,000.00	$50,000.00	$50,000
	Fish ladder	per vert. ft	3				$5,000.00	$5,000.00	$15,000

Storage Reservoir	**Excavation**	CY	24000	$2.50		$3.50		$6.00	$144,000
	Hypalon liner w/ geotextile liner	SF	61000				$1.50	$1.50	$91,500
	Drain Rock	CY	2500	$2.00	$8.00			$10.00	$25,000
	Under Drains	Ea	1	$7,000.00	$4,000.00			$11,000.00	$11,000
				TOTAL BID ESTIMATE					$4,088,013

Fred Gray detailed cost estimate based on adjusted Mora and Merwin Values
(Dissimilar elements estimated using Means Cost Estimating)

		units	Quantity	Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext. Base Cost
Electrical	(4.5% of total)	Ea	1					$180,448	$180,448
Instrumentation	(1.5% of total)	Ea	1					$60,149	$60,149
Site									
100020	Clearing and Grubbing	Acres*	12.8	$569.00		$845.00	$6,006.00	$7,420.00	$94,976
100023	Landscaping	Acres**	7.4				$23,100.00	$23,100.00	$170,940
100025	Paving and Walkways	SF	115560				$1.39	$1.39	$160,628
1003XX	Manholes, catch basins, curbs, gutters,	SF	115560	$0.05	$0.08	$0.01	$1.00	$1.14	$131,738
	fences (tie to paving area for estimating)								
	* Limits of construction								
	**Disturbed area w/o paving or structures								
Hatchery Bldg.									
1100XX	Building is one floor with everything	SF	4800	$10.73	$12.00	$1.39	$53.98	$78.10	$374,880
	w/in walls except:								
1100XX	Incubators, 8 stack	Ea	24	$90.00	$762.00			$852.00	$20,448
1100XX	Rearing troughs, 500 gal	Ea	20	$220.00	$3,175.00			$3,395.00	$67,900
Operations Bldg.									
1200XX	Building is one floor with feed room,	SF	4500	$12.73	$14.23	$1.65	$63.99	$92.60	$416,700
	garage, offices, lab. Estimate includes								
	everything w/in walls								
Residences									
	2 Houses, each 3 bdr, 1400 sqft living area	SF	2800				$85.00	$85.00	$238,000
	600 sqft garage	SF	1200				$60.00	$60.00	$72,000
Raceways	(measured concrete volume)	CY	1176	$192.00	$230.00	$22.00	$27.00	$471.00	$553,896
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
140055	netting	SF	25000				$4.85	$4.85	$121,250

Adult Holding	(measured concrete volume)								
Raceways	Includes excavation, concrete, and misc.								
130022	metals	CY	480	$192.00	$230.00	$22.00	$27.00	$471.00	$226,08(
130030									
130055									
Headbox	(measured concrete volume)	CY	25	8 192.00	$230.00	$22.00	827.00	$471.00	$11,77[illegible]
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
Effluent Ponds	(area meosured in rectangular dimension)								
160020	Earthwork and 3" AC	SF	16800	$0.69	$0.28	$0.74	$1.39	$3.10	$52,08(
1601XX	Concrete, piping, and mech. equip. for	Ea	2	$1,241.00	$4,917.00	$152.00	$11,261.00	$17,571.00	$35,14[illegible]
	each pond								
Yard Piping	(based on measured length and diameter of all pipes over 6")								
200XXX	All supply, drain, utility pipes, valves	Inch*Ft	55400	$2.07	$1.98	$1.82	$0.53	$6.40	$354,560
	excavation, backfill								
Main Supply pipe									
300020	All supply pipes, valves	Inch*Ft	45000	$2.07	$1.98	$1.82	$0.53	$6.40	$288,000
300022	excavation, backfill								
300150									
Pump Station	(3-20 HP pumps = 60 HP)								
	Includes excavation, building, and	HP	60	$515.00	$1,838.55	$131.84	$78.28	$2,563.67	$153,820
	electrical								
Intake	Dam	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
	Riprap	CY	67	$45.00	$15.00	$15.00		$75.00	$5,025
	Intake box	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
	Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
	Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
	Gate	Ea	1				$5,000.00	$5,000.00	$5,000
	Dewatering	Ea	1				$50,000.00	$50,000.00	$50,000
	Fish ladder	per vert. ft	3				$5,000.00	$5,000.00	$15,000

Storage Reservoir	Excavation	CY	24000	$2.50		$3.50		$6.00	$144,000
	Hypalon liner w/ geotextile liner	SF	61000				$1.50	$1.50	$91,500
	Drain Rock	CY	2500	$2.00	$8.00			$10.00	$25,000
	Under Drains	Ea	1	$7,000.00	$4,000.00			$11,000.00	$11,000
				TOTAL BID ESTIMATE					**$4,250,554**

South Fork Walla Walla detailed cost estimate based on adjusted Mora and Merwin Values									
(Dissimilar elements estimated using Means Cost Estimating)									
		Units	**Quantity**	**Unit Labor**	**Unit Material**	**Unit Equip.**	**Unit Subc.**	**Unit Base Cost**	**Ext. Base Cost**
	********** PHASE 1 **********								
Mobilization	(3% of Phase 1 construction cost)	LS	1					$97,444.00	$97,444
Site									
100020	Clearing and Grubbing	Acres	1.4	$920.00		$1,100.00		$2,020.00	$2,828
100023	Landscaping	Acres	0.5				$23,100.00	$23,100.00	$11,550
	Access Road (20' wide, 6" gravel)	SF	26000	$0.45	$0.20	$0.35		$1.00	$26,000
	(incl. subgrade prep. & truck turn around)								
	Fencing	LF	700	$2.00	$9.00			$11.00	$7,700
Adult Holding	(measured concrete volume)								
Raceways	Includes excavation, concrete, and misc.								
130022	metals	CY	340	$192.00	$230.00	$22.00	$27.00	$471.00	$160,140
130030									
Egg-Take Station	30' x 30' (Incl. everything w/in walls)	SF	900				$120.00	$120.00	$108,000
Detention Pond	46' x 30' x 8' deep								
	Excavation	CY	500	$2.44		$3.57		$6.01	$3,005
	Hauling	CY	500	$1.44		$3.56		$5.00	$2,500
	AC Pavement	SY	300				$8.50	$8.50	$2,550
Headbox	(measured concrete volume)	CY	45	$192.00	$230.00	$22.00	$27.00	$471.00	$21,195
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
Ozone Contactors	Concrete, earthwork, misc. metals	CY conc.	660	$231.00	$236.00	$35.00	$35.00	$537.00	$354,420
	Mech. Equipment, piping and valves	GPM	10000	$6.70	$22.30	$0.40	$1.11	$30.51	$305,100
Ozone Gen. Bldg.	(Based on Building Size and Ozone Production)								
	Building concrete, earthwork, misc.	SF	1000	$5.12	$5.07	$0.88	$17.12	$28.19	$28,188
	metals								
	Mechanical equipment, piping,	lb/day O3	400	$237.88	$988.38	$24.32	$16.72	$1,267.30	$506,920
	instruments								

Ozone Destruct System (Blower/Strippers)									
	Concrete, earthwork, misc. metals	CY conc.	100	$408.10	$240.62	$24.38	$153.17	$826.27	$82,627
	Mech. Equipment	GPM	10000	$2.25	$46.01	$0.94		$49.20	$491,999
	piping	GPM	10000	$7.95	$11.93	$0.05	$0.05	$19.98	$199,810
LOX Storage Area	(measured as concrete volume)								
	Ready to receive rental tank w/ LOX	CY conc.	35	$92.88	$57.74	$7.49	$120.96	$279.07	$9,768
	piping (35% of cost)								
			Total Disinfection (not including pumping)=				$1,978,832		
Carcass Disposal		LS	1				$20,000.00	$20,000.00	$20,000
Residences	14' x 56' Mobile Home*	SF	784				$32.00	$32.00	$25,088
	8' x 30' Trailer	LS	1				$15,000.00	$15,000.00	$15,000
	*Incl. Foundation and Misc.								
Yard Piping	(based on measured length and diameter of all pipes over 6")								
200XXX	All supply, drain, utility pipes, valves	Inch*Ft	6000	$2.07	$1.98	$1.82	$0.53	$6.40	$38,400
	excavation, backfill								
Main Supply Pipe									
300020	All supply pipes, valves	Inch*Ft	21000	$2.07	$1.98	$1.82	$0.53	$6.40	$134,400
300022	excavation, backfill								
300150									
Intake	Dam	CY	40	$244.20	$292.80	$28.20	$34.20	$599.40	$23,976
	Riprap	CY	100	$45.00	$15.00	$15.00		$75.00	$7,500
	Intake box	CY	12	$244.20	$292.80	$28.20	$34.20	$599.40	$7,193
	Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
	Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
	Gate	Ea	1				$5,000.00	$5,000.00	$5,000
	Dewatering	Ea	1				$50,000.00	$50,000.00	$50,000
	Fish ladder	per vert. ft	3				$8,000.00	$8,000.00	$24,000
Influent and Effluent Pump Station									
	(4-30 HP = 120 HP) Incl. Excavation,	HP	120	$515.00	$1,838.00	$131.84	$78.28	$2,563.12	$307,574
	building, and electrical								
Electrical	(6% of total)	Ea	1					$138,056	$138,055

Instrumentation	(1.5% of total)	Ea	1					$41,417	$41,417
							TOTAL PHASE 1=		**$3,345,597**
	********** PHASE 2 **********								
Mobilization	(3% of Phase 2 construction cost)	LS	1					$113,843	$113,843
Site									
100020	Clearing and Grubbing	Acres*	9	$920.00		$1,100.00		$2,020.00	$18,180
100023	Landscaping	Acres**	5				$23,100.00	$23,100.00	$115,500
100025	Paving and Walkways	SF	114670				$1.39	$1.39	$159,391
1003XX	Manholes, catch basins, curbs, gutters,	SF	114670	$0.05	$0.08	$0.01	$1.00	$1.14	$130,724
	fences (tie to paving area for estimating)								
	* Limits of construction								
	**Disturbed area w/o paving or structures								
Hatchery Bldg.									
1100XX	Building is one floor with everything	SF	4800	$11.70	$13.00	$1.39	$53.98	$80.07	$384,336
	w/in walls except:								
1100XX	Incubators, 8 stack	Ea	24	$90.00	$762.00			$852.00	$20,448
1100XX	Rearing troughs, 500 gal	Ea	20	$120.00	$3,175.00			$3,295.00	$65,900
Operations Bldg.	Building is one floor with feed room,	SF	4500	$12.73	$14.23	$1.65	$63.99	$92.60	$416,700
1200XX	garage, offices, lab. Estimate includes								
	everything w/in walls								
Residences	2 Houses, each 3 bdr, 1400 sqft living area	SF	2800				$65.00	$65.00	$182,000
	400 sqft garage	SF	800				$40.00	$40.00	$32,000
Raceways	(measured concrete volume)	CY	2352	$192.00	$230.00	$22.00	$27.00	$471.00	$1,107,792
130022	Includes excavation, concrete, and misc.								
130030	metals								
130055									
140055	netting	SF	50000				$4.85	$4.85	$242,500
Expansion of Influent and Effluent Pump Station									
	(Total of 4-40 HP and 2-30 HP =220 HP)	HP	100	$515.00	$1,838.00	$131.84	$78.28	$2,563.12	$256,312
	use difference from Phase 1 quantity								

Effluent Ponds	**(area measured in rectangular dimension)**									
160020	**Earthwork and 3" AC**	SF	31684	$0.69	$0.28	$0.74	$1.39	$3.10	$98,220
1601XX	**Concrete, piping, and mech. equip. for**	Ea	2	$2,400.00	$9,800.00	$300.00	$22,500.00	$35,000.00	$70,000
	each pond									
Yard Piping	**(based** on **measured** length and diameter of all pipes over 6")									
200xXx	AU supply, drain, utility pipes, valves	Inch*Ft	40000	$2.07	$1.98	$1.82	$0.53	$6.40	$256,000
	excavation, backfill									
Electrical	**(5%** of total)	Ea	1					$183,492	$183,492
Instrumentation	(1.6% of total)	Ea	1					$55,048	$55,048
							TOTAL PHASE 2=		**$3,908,387**
						TOTAL BIDESTIMATE =			**$7,253,984**

Three Mile Dam detailed cost estimate based on adjusted Mora and Merwin Values									
(Dissimilar elements estimated using Means Cost Estimating)									
		Units	**Quantity**	**Unit Labor**	**Unit Material**	**Unit Equip.**	**Unit Subc.**	**Unit Base Cost**	**Ext. Base Cost**
Mobilization	(3% of total construction cost)		1					$49,488.00	**$49,488**
Site									
100020	Clearing and Grubbing	Acres*	3	$920.00		$1,100.00		**$2,020.00**	**$6,060**
100023	Landscaping	Acres**	1.5				$23,100.00	$23,100.00	**$34,650**
100025	Paving and Walkways	SF	43560				**$1.39**	**$1.39**	**$60,548**
1003XX	Manholes, catch basins, curbs, gutters, fences (tie to paving area for estimating)	SF	43560	**$0.05**	**$0.08**	**$0.01**	**$1.00**	**$1.14**	**$49,658**
	Gravel Area (incl. subgrade prep.)	SF	32000	**$0.45**	**$4.86**	**$0.35**		**$5.66**	**$181,120**
	* Limits of construction								
	**Disturbed area w/o paving or structures								
Garage/Shop 1200XX	26' x 40' garage/shop (incl. everything w/in walls)	SF	1040	**$12.73**	**$14.23**	**$1.65**	**$33.00**	**$61.61**	**$64,074**
Bunkhouse	26'x20' Includes bedroom, kitchen, and bathroom	SF	520				**$70.00**	**$70.00**	**$36,400**
Public Restrooms	20' x 14' (incl. everything w/in walls)	SF	280				**$90.00**	**$90.00**	**$25,200**
Carcass Disposal		LS	1				**$20,000.00**	**$20,000.00**	**$20,000**
Egg-Take Station	44' x 44' (incl. everything w/in walls)	SF	1936				**$120.00**	**$120.00**	**$232,320**
Adult Holding Raceways	(measured concrete volume) (12) 10' x 80' x 4' deep								
130022 130030 130055	Includes excavation, concrete, and misc. metals	CY	750	**$192.00**	**$230.00**	**$22.00**	**$27.00**	**$471.00**	**$353,250**
Detention Pond	50' x 28' x 8' deep								
	Excavation	CY	550	$2.15		83.57		$5.72	$3,146
	Hauling	CY	550	$1.15		$3.66		$4.71	$2,591

	AC Pavement	**SY**	300)				$8.60	$8.60	$2,550
	Piping, and **mech.** equipment	**Ea**	1	**$1,650.00**	**$6,500.00**	$500.00	**$5,000.00**	**$13,650.00**	$13,650
Yard Piping	(**based** on measured length and diameter of all **pipes** over 6")								
200XXX	All **supply,** drain, utility **pipes,** valves	Inch*Ft	12960	$2.07	$1.98	$1.82	$0.53	$6.40	$85944
	excavation, backfill								
Intake									
	Riprap	**CY**	**67**	**$45.00**	**$15.00**	**$15.00**		**$75.00**	**$5,025**
	Intake box	**CY**	**50**	**$244.20**	**$292.80**	**$28.20**	**$34.20**	**$599.40**	**$29,970**
	Fish screen	**SF**	**36**	**$50.00**	**$100.00**			**$150.00**	**$5,400**
	Screen cleaner	**Ea**	**1**				**$75,000.00**	**$75,000.00**	**$75,000**
	Gate	**Ea**	**1**				**$5,000.00**	**$5,000.00**	**$5,000**
	Dewatering	**Ea**	**1**				**$50,000.00**	**$50,000.00**	**$50,000**
Pump Station	**(3-30 HP pumps = 90 hp) Incl. excavation,**	**HP**	**90**	**$515.00**	**$1,838.55**	**$131.84**	**$78.28**	**$2,563.67**	**$230,730**
	building, and electrical								
Electrical	**(4.5%** of **totol)**	**Ea**	**1**					**$60,235**	**$60,235**
Instrumentation	**(1.5% of total)**	**Ea**	**1**					**$20,078**	**$20,078**
				TOTAL BID ESTIMATE					**$1,699,088**

Echo Meadows Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	1.	1 0	$569.00		$845.00	$6,006.00	$7,420.00	$11,872	$7,42(
Landscaping	acre		0.5					$23,100.00	$0	$11,55(
Road (incl. exc., subgrade and gravel	LS								$24,600	$(
for access, turnaround, and ramp)										
Gravel (incl. exc. and crushed rock for	CY		535					$22.00	$0	$11,77(
acclimation facility)										
Fencing	LF		750	$2.00	$8.50			$10.50	$0	$7,87!
RACEWAYS (alternative)										
Raceways (incl. excavation, conc.,	CY		25?	$192.0( )	$230.00	$22.00	$27.00	$471.00	$0	$118,69?
misc. metals)										
Discharge/fish release incl. conc.	CY		14	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$6,594
structure, screen, fittings)										
Neuing	SF		4,000					$4.85	$0	$19,40(
INTAKE										
Concrete (incl. exc., conc.,	CY		4	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$1,884
misc. metals)										
Erosion control, screen, flow control	LS		1					$4,000.00	$0	$5,00(
Dewatering	LS		1					$5,000.00	$0	$5,00(
YARD PIPING										
Piping incl. trench costs, finings										
Supply piping	Inch*ft		2,700	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$17,280
Effluent piping	Inch*ft		9,000	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$57,600
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS		1					$15,000.00	$0	$15,000
Subtotal									$36,472	$302,065
Contingency	30%								$10,942	$90,620
Total Cost									$47,414	$392,685

Nolin Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	0.5	1.0	$569.00		5845.00	$6,006.00	$7,420.00	$3,710	$4,00$7,420
Landscaping	acre		0.4					$10,000.00	$0	0
Road (incl. exc., subgrade and gravel for access. turnaround. and ramp)	LS	1							$11,880	$0
Gravel (incl. exc. and crushed rock for acclimation facility)	CY		500					$22.00	$0	$11,000
Fencing	LF		780	$2.00	$8.5(			$10.50	$0	$8,190
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,800
Asphalt coating	SY		970					$8.50	$0	$8,245
Piping and mechanical equip.	Ea.		1					$8,000.00	$0	$8,000
Discharge/fish release incl. conc. structure. misc. metals)	CY		14	$192.00	$230.0(	$22.0( )	527.0(	$471.00	$0	$6,594
Netting	SF		8,400					$4.85	$0	$40,740
INTAKE										
Mobil./Construct access to intake	LS		1					$10,000.00	$0	$10,00( )
Rock excavation	per hour		8					$200.00	$0	$1,600
Sheeting & shoring	LF		90					$200.00	$0	$18,000
Dewatering	LS		1					$10,000.00	$0	$10,000
Trench and pipe install. in river	Inch*diam.		1,350					$20.00	$0	$27,000
Concrete (incl. exc., conc., misc. metals)	CY		6	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$2,826
Erosion control, screen, flow control	LS		1					$5,000.00	$0	$5,000
Pumps (Incl. exc., housing, electrical) One duty, one standby @ 3 hp ea	hp		6					$6,000.00	$0	$36,000
YARD PIPING										
Piping incl. trench costs, fittings										
Supply piping	Inch*ft		7.050	52.07	$1.98	$1.82	$0.53	$6.40	$0	$45,120
Effluent piping	Inch*ft		3,900	52.07	51.98	St.82	$0.53	$6.40	$0	$24,960
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS		1					$15,000.00	$0	$15,000
Subtotal									$15,590	5317.495
Contingency	30%								$4,677	595.249
Total									$20,267	$412,744

Barnhart Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Suhcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	0 7	0.9	$569.00		5845 0(	$6,006 0(	$7,420.00	$5,194	$6,671
Landscaping	acre		0.5					$23,100.00	$0	$11,55(
Road (incl. exLS subgrade and gravel for access, turnaround. and ramp)		1							$21,600	$(
Gravel (incl. exc. and crushed rock fo acclimation facility)	CY		555					$22.00	$0	$12,21(
Fencing	LF		7; 70	$2.00	$8.5(			$10.50	$0	$8,08!
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,80(
Asphalt coating	Y		970					$8.50	$0	$8,24!
Piping and mechanical equip.	Ea.		1					$8,000.00	$0	$8,00(
Discharge/fish release incl. conc. structure, misc. metals)	CY		14	$192.00	$230.0(	$22.0(	$27.0(	$471.00	$0	$6,594
Netting	SF		8,400					$4.85		$40,74(
INTAKE										
Concrete (incl. exc., conc., misc. metals)	CY		6	$192.00	s230.a:	$22.0(	$27.00	$600.00	$0	$3,600
Erosion control. screen, flow control	S		1					$6,000.00	$0	$6,000
Dewatering	IS		1					$6,000.00	$0	$6,000
YARD PIPING										
Piping incl. trench costs. finings										
Supply piping	Inch*ft		9,500	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$60,800
Effluent piping	Inch*ft		6.930	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$44,352
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Flood Protection (berm)	CY		444					$16.00	$0	$7,104
Erosion control, seeding	SY		1,025					$1.50	$0	$1,538
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	IS		1					$15,000.00	$0	$15,000
Subtotal									$26,794	$274 296
Contingency	30%								$8,038	$82 289
Total Cost									$34,832	$356,584

ODFW Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	I.	I	$569.00		$845 a	$6,006.00	$7,420.00	$9,646	$7,42(
Landscaping	acre		0.					$23,100.00	$0	$13,86(
Road (incl. exc, subgrade and gravel	LS								$29,800	$(
for access, turnaround. and ramp)										
Gravel (incl. exc. and crushed rock for	CY		420					$22.00	$0	$9,24(
acclimation facility)										
Fencing	LF		770	$2.00	58.50			$10.50	$0	$8,08[illegible]
ACCLIMATION POND										
Excavation	CY		1,20(					$9.00	$0	$10,80(
Asphalt coating	SY		97(					$8.50	$0	$8,24[illegible]
Piping and mechanical equip.	Ea.							$8,000.00	$0	$8,00(
Discharge/fish release incl. conc.	CY		1	5192.00	5230.00	$22.00	$27.00	$471.00	$0	$6,594
structure, misc. metals)										
Netting	SF		8,40(					$4.85		
INTAKE										
Concrete (incl. exc, conc.,	CY		(	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$2,826
misc. metals)										
Erosion control screen flow control	LS							$4,000.00	$0	$5,000
Dewatering	LS							$5,000.00	$0	$5,000
YARD PIPING										
Piping incl. trench costs, fittings										
Supply piping	Inch*ft		25,50(	52.0-I	SI.98	$1.82	$0.53	$6.40	$0	$163,200
Effluent piping	Inch*ft		2,70(	52.07	$1.98	$1.82	$0.53	$6.40	$0	$17,280
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Flood protection (berm)	CY		17[illegible]					$16.00	$0	52,848
Erosion control. seeding	SY		40(					$1.50	$0	$600
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS							$15,000.00	$0	$15,000
Subtotal									$39,446	$300,998
Contingency	30%								$11,834	$90,299
Total Cost									$51,280	5391,297

Mission Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	0.!	0.9	$569.00		$845.0(	$6.006 (X	$7,420.00	$6.678	$6,67‹
Landscaping	acre		0.6					$23 100.00	$0	$13,86(
Road (incl. exc., subgrade and gravel for access, turnaround, and ramp)	LS								$1 1.400	$(
Gravel (incl. exc. and crushed rock for acclimation facility)	CY		515					$22.00	$0	$11,33(
Fencing	LF		760	$2.00	$8.5(			$10.50	$0	$7,98(
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,80(
Asphalt coating	SY		970					$8.50	$0	$8,245
Piping and mechanical equip.	Ea.		1					$8,000.00	$0	$8,00(
Discharge/fish release incl. conc. structure. misc. metals)	CY		14	$192.W	$230.0(	$22 0(	$27 0(	$471.00	$0	$6,594
Netting	SF		8,400					$4.85	$0	$40,74(
INTAKE										
Concrete (incl. exc., conc., misc. metals)	CY		6	$192.00	$230.0(	$22.0(	$27.0(	$471.00	$0	$2,826
Erosion control, screen, flow control	LS		1					$7,000.00	$0	$5,000
Dewatering	LS		1					$5,000.00	$0	$5,000
Pumps (Incl. exc., housing, electrical) One duty, one standby @ 3 hp ea	hp		6					$6,000.00	$0	$36,000
YARD PIPING										
Piping incl. trench costs, fittings										
Supply piping	Inch*ft		2,100	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$13,440
Effluent piping	Inch*ft		2,100	$1.07	$1.98	$1.82	$0.53	$6.40	$0	$13,440
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS							$15,000.00	$0	$15,000
Subtotal									$18,078	$221,933
Contingency	30%								$5,423	$66,580
									$23,501	$288,513

Cayuse Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	0.8	0.9	$569.00		$845.0(	$6,006.00	$7,420.00	$5,936	$6,678
Landscaping	acre		0.3					$23,100.00	$0	$6,930
Road (incl. exc., subgrade and gravel	LS	1							$21,400	$0
for access, turnaround, and ramp)										
Gravel (incl. cxc. and crushed rock fo	CY		550					$22.00	$0	$12,100
acclimation facility)										
Fencing	LF		760	$2.00	$8.50			$10.50	$0	$7,980
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,800
Asphalt coating	SY		970					SE.50	$0	$8,245
Piping and mechanical equip.	Ea.		1					$8 000.00	$0	$8,000
Discharge/fish release incl. conc.	Y		14	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$6,594
structure, misc. metals)										
Netting	SF		8,400					54.85	$0	$40,740
INTAKE										
Mobil./Construct access to intake	LS		1					$10,000.00	$0	$10,000
Rock excavation	per hour		8					$200.00	$0	$1,600
Sheeting & shoring	LF		60					$200.00	$0	$12,000
Dewatering	LS		1					$10,000.00	$0	$10,000
Trench and pipe install. in river	Inch*diam.		900					$20.00	$0	$18,000
Concrete (incl. exc., conc.,	CY		6	$192.00	5230.06	$22.00	$27.00	$471.00	$0	$2,826
misc. metals)										
Erosion control, screen, flow control	LS		1					$6,000.00	$0	$6,000
Pumps (Incl. exc., housing, electrical)	hp		6					$6,000.00	$0	$36,000
One duty, one standby @ 3 hp ea										
YARD PIPING										
Piping incl. trench costs, finings										
Supply piping	Inch*ft		6,500	$2.07	51.98	$1.82	$0.53	$6.40	$0	$41,600
Effluent piping	Inch*ft		3,800	$2.07	$1.98	SI.82	$0.53	$6.40	$0	S24.320
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,000
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS		1					$15,000.00	$0	$15,000
Subtotal									$27,336	$302,4 13
Contingency	30%								$8,201	$90.724
Total Cost									$35,537	$393,137

Thornhollow Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing grubbing	acre	0.	0.9	$569.00		$845.0(	$6,006.00	$7,420.00	$2,968	$6,67(
Landscaping	acre		0.3					$23,100.00	$0	$6,93(
Road (incl. exc., subgrade and gravel	LS								$17,600	$(
for access, turnaround, and ramp)										
Gravel (incl. exc. and crushed rock for	CY		700					$22.00	$0	$15,40(
acclimation facility)										
Fencing	LF		750	$2.00	$8.50			510.50	$0	$7,87!
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,80(
&hall coaling	SY		970					$8.50	$0	$8,24!
Piping and mechanical equip.	Ea.		1					$8,000.00	so	$8,00(
Discharge/fish release incl. conc.	CY		14	$192.00	$230.00	$22.0(	$27.00	$471.00	so	$6,59(
structure, misc. metals)										
Netting	SF		8,400					$4.85	$0	$40,74(
INTAKE										
Concrete (incl. exc., conc.,	CY		6	$192.00	$230.00	$22.0(	$27.00	$471.00	$0	52.82(
misc. metals)										
Erosion control, screen, flow control	LS		1					$5,000.00	$0	$5,00(
Dewatering	LS		1					$5,000.00	$0	$5,00(
Pumps (Incl. exc., housing, electrical)	hp		6					$6,000.00	$0	$36,00(
One duty, one standby @ 3 hp ea										
YARD PIPING										
Piping incl. trench costs, fittings			4,500							
Supply piping	Inch*ft		2,600		$1.98	$1.82	$0.53	$6.40	$0	$28,80(
Effluent piping	Inch*ft		2,600	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$16,64(
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,00(
Electrical	LS		1					$15,000.00	$0	$15,000
Instrumentation	LS		1					$15,000.00	$0	$15,000
Subtotal									$20,568	$237,528
Contingency	30%								$6,170	$71,258
Total cost									$26,738	$308,786

Meacham Creek Acclimation/Release Facility Cost Summary

Item	Unit	Quantity Release	Quantity Acclimation	Labor	Material	Equip.	Subcon.	Total Unit Cost	Total Cost Release	Total Cost Acclimation
SITEWORK										
Clearing and grubbing	acre	0.8	1.5	$569.00		$845.00	$6,006.00	$7,420.00	$5,936	$11,13(
Landscaping	acre		0.7					$23,100.00	$0	$16,17(
Road (incl. exc., subgrade and gravel for access, turnaround, and ramp)	LS	1							$12,400	$(
Gravel (incl. exc. and crushed rock for acclimation facility)	CY		500					$22.00	$0	$11,0[illegible]
Fencing	LF		780	$2.00	$8.50			$10.50	$0	$8,19(
ACCLIMATION POND										
Excavation	CY		1,200					$9.00	$0	$10,80(
Asphalt coaling	SY		970					$8.50	$0	$8,24
piping and mechanical quip.	Ea.		1					$8,000.00	$0	$8,00(
Discharge/fish release incl. conc. structure, misc. metals)	CY		14	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$6,59
Netting	SF		8,400					$4.85	$0	$40,74(
INTAKE										
Concrete (incl. exc., conc., misc. metals)	CY		6	$192.00	$230.00	$22.00	$27.00	$471.00	$0	$2,82(
Erosion control, screen, flow control	LS		1					$7,000.00	$0	$7,00(
Dewatering	LS		1					$5,000.00	$0	$5,00(
YARD PIPING										
Piping incl. trench costs, fittings										
Supply piping	Inch*ft		9,400	$2.07	$1.98	$1.82	$0.53	$6.40	$0	$60,16(
Effluent piping	Inch*ft		6,700	$2.07	$1.98	$1.82	$0.53	56.40	$0	$42,88(
OTHER										
Public facilities	LS		1					$2,000.00	$0	$2,00(
Electrical	LS		1					$15,000.00	so	$15,000
Instrumentation	LS		1					$15,000.00	so	$15,000
Subtotal									$18,336	$270,735
Contingency	30%								$5,501	$81,221
Total Cost									$23,837	$351,956

* Note: Cost does not include replacement of bridges

***** 1 - 42,000 CF Pond *****								
Item	Units	Quantity	Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext. Base Cost
SITEWORK								
Clearing and grubbing	acre	1.3	$920.00		$1,100.00		$2,020.00	$2,626
Landscaping	acre	0.4						
Access Road (20' wide, 6" gravel)	SF	26800	$0.45	$0.20	$0.35		$1.00	$26,800
(incl. subgrade prep. & truck turn aro								
Fencing	LF	880	$2.00	$9.00			$11.00	$9,680
ACCLIMATION PONDS								
Excavation	CY	45,000	$0.89		$2.75		$3.64	$163,800
Asphalt coating	SY	1,444				$8.50	$8.50	$12,274
Piping and mechanical equip.	Ea.	1					$8,000.00	$8,000
Discharge/fish release incl. conc.	CY	14	$192.00	$230.00	$22.00	$27.00	$471.00	$6,594
structure, misc. metals)								
Netting	SF	11,856				$4.85	$4.85	$57,502
INTAKE								
Dam	CY	60	$244.20	$292.80	$28.20	$34.20	$599.40	$35,964
Riprap	CY	100	$45.00	$15.00	$15.00		$75.00	$7,500
Intake box	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
Gate	Ea	1				$5,000.00	$5,000.00	$5,000
Dewatering	Ea	1				$50,000.00	$50,000.00	
Fish ladder	per vert. ft	3				$8,000.00	$8,000.00	$24,000
YARD PIPING								
Piping incl. trench costs, fittings								
Supply piping	Inch*ft	24,000	$2.07	$1.98	$1.82	$0.53	$6.40	$153,600
Effluent piping	Inch*ft	5,600	$2.07	$1.98	$1.82	$0.53	$6.40	$35,840
OTHER								
8' x 10' Storage Building	LS	1					$1,500.00	$1,500
Electrical	LS	1					$15,000.00	$15,000
Instrumentation	LS	1					$15,000.00	$15,000
Total								$683,113

Fred Gray Cost Est. Revised

***** 3 - 14,000 CF Ponds *****								
Item	**Units**	**Quantity**	**Unit Labor**	**Unit Material**	**Unit Equip.**	**Unit Subc.**	**Unit Base Cost**	**Ext. Base Cost**
SITEWORK								
Clearing and grubbing	acre	1.6	$920.00		$1,100.00		$2,020.00	$3,232
Landscaping	acre	0.5					$10,000.00	$5,000
Access Road (20' wide, 6" gravel)	SF	45000	$0.45	$0.20	$0.35		$1.00	$45,000
(incl. subgrade prep. & truck turn around)								
Fencing	LF	1,060	$2.00	$9.00			$11.00	$11,660
ACCLIMATION PONDS								
Excavation	CY	45,000	$0.89		$2.75		$3.64	$163,800
Asphalt coating	SY	2,224				$8.50	$8.50	$18,904
Piping and mechanical equip.	Ea.	1					$8,000.00	$8,000
Discharge/fish release incl. conc.	CY	42	$192.00	$230.00	$22.00	$27.00	$471.00	$19,782
structure, misc. metals)								
Netting	SF	19,836				$4.85	$4.85	$96,205
INTAKE								
Dam	CY	60	$244.20	$292.80	$28.20	$34.20	$599.40	$35,964
Riprap	CY	100	$45.00	$15.00	$15.00		$75.00	$7,500
Intake box	CY	27	$244.20	$292.80	$28.20	$34.20	$599.40	$16,184
Fish screen	SF	75	$50.00	$100.00			$150.00	$11,250
Screen cleaner	Ea	1				$75,000.00	$75,000.00	$75,000
Gate	Ea	1				$5,000.00	$5,000.00	$5,000
Dewatering	Ea	1				$50,000.00	$50,000.00	$50,000
Fish ladder	per vert. ft	3				$8,000.00	$8,000.00	$24,000
YARD PIPING								
Piping incl. trench costs, fittings								
Supply piping	Inch*ft	25,000	$2.07	$1.98	$1.82	$0.53	$6.40	$160,000
Effluent piping	Inch*ft	7,500	$2.07	$1.98	$1.82	$0.53	$6.40	$48,000
OTHER								
8' x 10' Storage Building	LS	1					$1,500.00	$1,500
Electrical	LS	1					$15,000.00	$15,000
Instrumentation	LS	1					$15,000.00	$15,000
Total								$835,980

PROJECT SCHEDULE

INTRODUCTION

This section presents a review of the scheduling requirements for design and construction of the proposed facilities. This review is preliminary in nature: there are a number of procedural requirements that must be initiated or completed prior to any construction activities. These include:

- the time required to conduct any necessary NEPA procedures
- the time required to obtain land, or easements, for the facilities
- the time required to obtain the necessary permits.

The time period required to complete these actions affects the project schedule. Design work can be carried out during this period, and, may in fact be required to address NEPA questions or provide information for permit applications. However, construction activities would not begin until any required NEPA activities are complete and permits have been obtained.

DESIGN PHASE

Following identification of the preferred alternative site for various facilities it would be possible to begin design work. This decision is critical since it involves the definition of the location of the facilities for **ChS** adult holding, and possibly for future incubation, early rearing, and full term rearing. Design of **ChF** adult holding facilities at Three Mile Dam could also begin immediately.

The 10 sites currently identified for direct release are all proposed for development in the short term. Design work could be initiated immediately on these sites. Construction could not begin until the NEPA requirements are fulfiied and necessary permits were obtained

The main tasks envisioned in the design of the facilities follows. However, not all facility types would require all tasks, or the same degree of design.

- Develop a **workplan** for the design phase including project control procedures, subcontractors, and detailed schedule
- Complete any required subcontractor work, such as geotechnical investigations, site surveying, circulation planning
- Finalize the bioengineering design
- Further develop the schematic design provided here to more complete design documentation
- Prepare and submit permit applications
- Develop final design: plans, specifications, and cost estimates for civil/site work, process/mechanical, **structural/architectural,** electrical, and instrumentation/controls
- Printing and advertisement, bidding and award.

A 6 month design period could be used for planning purposes, however, this would require very rapid client review of the work and a straightforward NEPA and/or permitting process.

Development of a hatchery design could require up to 10 months with complicated NEPA or permit issues. An estimated range could be from approximately 8 to 12 months. Adult holding only may be accomplished in a shorter time frame, though the permitting process may not necessarily be any faster.

CONSTRUCTION PHASE

The major construction activities (for a hatchery or adult holding facility) are listed below. Construction of the direct release sites would be less complex.

- Mobilization at site(s)
- Order mechanical equipment or items with long lead times
- Construct water supply intake and pipeline
- Conduct site work and drainage, including preliminary roadways
- Structural foundation work: buildings, raceways
- Yard piping, process drains, septic systems
- Construct rearing and holding ponds, effluent ponds, final site grading
- Construct operations and hatchery buildings, effluent piping
- Construct domestic housing units
- Construct miscellaneous small facilities, pipeline tie-ins
- Install mechanical, electrical, and instrumentation
- Final construction activities, landscaping, paving
- Equipment testing, punch list completion
- Operational acceptance, demobilization, cleanup
- Prepare O& M manual
- Personnel training and facility testing

A 15 month construction period for hatchery facilities (or a hatchery facility combined with a satellite facility) can be used for planning purposes to. This could vary from approximately 12 to 18 months depending on site conditions. It would be desirable to phase the construction so that the facility was completed at a time to receive returning adult spring chinook for holding to maturation.

The direct release sites could also be developed within this H-month construction period but would obviously require much less time to complete.

APPENDIX A

MERWIN HATCHERY COST ESTIMATE

Two tables are presented in this Appendix. Table A-l presents a cost estimate breakdown for the Merwin Hatchery. Table A-2 presents and estimate of bid prices for the Merwin and Mora hatcheries adjusted to the sites for this project. These tables provide backup to the cost estimates presented in this report.

TABLE A-l

				Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext.Base Cost
These are the estimating units defined in the Merwin Estimate of 3/30/90									
Do not include Profit, OH, Labor OH, Fringes									
Electrical Costs		Ea	1					$225,000	$225,000
			1						
Instramentation Costs		Ea						$75,000	$75,000
Site									
100020	Clearing and Grubbing	Acres*	10.3	$380		$665	$5,200	$6,245	$64,324
100023	Landscaping	Acres**	4.0				$20,000	$20,000	$80,000
100025	Paving and Walkways (3"AC)	SF	123,900				$1.20	$1.20	$148,680
1003XX	Manholes, Catch Basins, Curbs and Gutters (tie to Paving area for estimating)	SF	123,900	$0.03	$0.06	$0.01	$0.87	$0.97	$120,431
									$413,434
		*Limits of Construction							
		** Disturbed area without paving or structures							
Hatchery Building (11,000 SF as measured at building line plus ramp and covered entry)									
1100XX	Building is on one floor with cast in place tanks over much of the area. Estimate includes everything within the walls	SF	11,000	$9.85	$15.13	$1.45	$30.44	$56.86	$625,480
Operations Building (Measured as 4414 SF on Main Floor, 1924 on upper-open-floor, Discount open area by 40% in calc. area)									
1200XX	Building is on two floor with cast in place floor, feed room, garage, offices, lab. Estimate includes everything within the walls	SF	5,570	$8.50	$11.20	$1.30	$55.40	$76.40	$425,548
Fingerling Raceways (Measured Concrete Volume)									
130022, 130030, 130055	Includes Excavation, Concrete and Misc Metals	CY	656	$128	$181	$17	$23	$349	$228,944
Rearing Ponds (Area as measured in rectangular dimension, Concrete by take-off, Netting - Misc. Metals - rectangular dimension.)									
140020	Earthwork and 3" AC	SF	65,472	$0.73	$0.64	$0.41	$1.00	$2.78	$182,012
140030	Concrete in System	CY	225	$545	$330	$21	$0	$896	$201,600
140055	Misc. Metals (Netting)	SF	72,192				$4.85	$4.85	$350,131
1401XX	Piping and Mechanical Equip. for each pond	Ea	4	$1,912	$15,750	$488	$0	$18,150	$72,600
									$806,343
Smolt Pond (Measured Concrete Volume)									
150022, 150030, 150055. 150150	Includes Excavation, Concrete, Misc Metals 8 Piping	CY	201	$155	$224	$28	$62	$469	$94,266

TABLE A-l

				Unit Labor	Unit Material	Unit! Equip.	Unit/ Subc.	Unit Base cost	Ext.Base cost
Effluent Ponds (Area as measured in rectangular dimension)									
160020	Earthwork and 3' AC	SF	16,800	SO.46	$0.22	$0.58	$1.20	$2.46	$41,328
1601 XX	Concrete, Piping and Mechanical Equip. for each pond with a chlorinator building.	Ea	2	$829	$3,870	$120	59.750	$14,569	$29,138
									$70,466
Yard Piping (Based on measured length and diameter of all pipes over 6", Includes Valves)									
200xxx	All Supply, Drain, Utility Pipes, Valves, Excavation, Backfill	Inch-Ft	95,640	$1.38	$1.56	$1.43	$0.46	$4.83	$461,941
Main Supply Pipe (Based on Measured Length and Diameter in inch-ft)									
300020 300022 300150	All Supply Pipes, Valves, Excavation, Backfill. Does not include Pump Station.	Inch-Ft	40,860	$1.59	$4.19	$0.58	$0.04	$6.40	$261,504
Main Pumps Station (3-75 HP pumps = 225 HP)									
	With all elements but the pipeline to the hatchery	HP	225	$188	$775	$56	$36	$1,055	$237,375
Ozone Contactors									
	Concrete, EarthW.. Misc. Metals	CY Conc.	326	$193	$233	535	538	5499	$162,674
	Mechanical Equipment Piping & Valves	GPM	3000	$5.60	$22.00	$0.40	$1.20	$29.20	$87,600
									$250,274
Ozone Generator Building (Based on Building Size and Ozone Production)									
	Building, Concrete, EarthW.. Misc. Metals	SF	912	$9.00	$10.50	$1.82	$39.00	$60.32	$55,009
	Mech. Eq., Piping 8 Instr.	lbs/Day C	2001	$418	$2,047	$50	$38	$2,553	$510,600
									$565,606
Ozone Distruction System (Blower/Strippers)									
	Concrete, EarthW., Misc. Metals	CY Conc.	50	$514	$357	$36	$250	$1,157	$57,850
	Mechanical Equipment	GPM	3000	$2.83	$68.33	$1.40	$0.00	$72.56	$217,680
	Piping	GPM	3000	$15.00	$22.50	$0.10	$0.10	$37.70	$113,100
									$388,630
Aeration System									
	Concrete, EarthW.. Misc. Metals	CY Conc.	35	$595	$330	598	$220	$1.243	$43,501
	All Other	GPM	5000	$1.90	$8.30	$0.10	$0.00	$10.30	$51,500
									$95,005
LOX Storage Area (Measured as Concrete Volume)									
	Ready to Receive Rental Tank Complete with Lox Piping (35% of Cost)	CY	32	$431	$316	$41	$727	$1.515	$48,480

TABLE A-l

				Unit Labor	Unit Material	Unit Equip.	Unit **Subc.**	Unit Base cost	Ext. Base cost
Post Ozone Pumps Station									
	Including	**GPM**	1000	$20.90	$68.20	$3.50	$15.00	$107.60	$107,600
SUBTOTAL CONTRACTOR'S COSTS									**$5,286,634**
Alternate Approaches									
Alt. Main Pumps Station (3-2500 GPM pumps = 5000 GPM -w/one standby)									
	With all elements but the pipeline to the hatchery	**GPM**	5000	$8.45	$34.87	$2.51	$1.62	$47.45	$237,250
Alt. Main Supply Pipe (Based on Measured Length and Diameter in feet)									
300020 300022 300150	**All Supply** Pipes, Valves, **Excavation,** Backfill. Does not include **Pump** Station.	**Feet**	2,270	$29	$75	$11	$1	**$116**	$263,320
Mora Hatchery Building Costs (Based on September, 91 design and Title I estimate)									
					Contractor's Bid				
					$1.000				
	General Conditions				$312				
	Site Development				$1,235				
	Office Building	12.0131	SF@	$110	$1,321				
	Fish Culture Building	**11,460**	SF	$70	$802				
	Water Treament Building	14,864	SF	$110	$1,637				
	Shop **&** Vehicle Building	7,384	SF	$79	$583				
	Hatchery (Tank) Building	23.500	SF	**$63**	$1,481				
	Water Treatment				$3,695				
					$11,067				

TABLE A-2

				Unit Labor	Unit/ Material	Unit Equip.	Unit Subc.	Unit Base cost	Ext. Base cost
Merwin and Mora detailed estimates adjusted to BPA Sites, 1/1/92 Date, to produce contractor's Bid Price.									
They are	Contractor's Costs Plus factors' shown>>>>			150%	127%	127%	116%		
ctrical Costs		Ea	1				$259,875	$259,875	$259,875
strumentation Costs		Ea	1				$86,625	$86,625	$86,625
ite									
00020	Clearing and Grubbing	Acres'	10.3	$569	$0	$845	$6,006	$7.420	$76,425
00023	Landscaping	Acres"	4.0	$0	$0	$0	$23,100	$23,100	$92,400
00025	Paving and Walkways (3"AC)	SF	123,900	$0.00	$0.00	$0.00	$1.39	$1.39	$171,725
003XX	Manholes, Catch Basins, Curbs and Gutters (tie to Paving area for estimating)	SF	123,900	$0.05	$0.08	$0.01	$1.00	$1.14	$141,456
									$482,006
		*Limits of Construction							
		** Disturbed area without paving or structures							
latchery Building (11,000 SF as measured at building line plus ramp and covered entry)									
100XX	Building is on one floor with cast in place tanks over much of the area. Estimate includes everything within the walls	SF	11,000	$14.75	$19.22	$1.84	$35.16	$70.96	$780,579
Operations Building (Measured as 4414 SF on Main Floor, 1924 on upper-open-floor, Discount open area by 40% in calc. area)									
200XX	Building is on two floor with cast in place floor, feed room, garage, offices, lab. Estimate includes everything within the walls	SF	5,570	$12.73	$14.23	$1.65	$63.99	$92.60	$515,756
Fingerling Raceways (Measured Concrete Volume)									
130022, 130030, 130055	Includes Excavation, Concrete and Misc Metals	CY	656	$192	$230	$22	$27	$470	$308,175
Rearing Ponds (Area as measured in rectangular dimension, Concrete by take-off, Netting - Misc. Metals - rectangular dimension.)									
140020	Earthwork and 3' AC	SF	65,472	$1.09	$0.61	$0.52	$1.16	$3.58	$234.524
140030	Concrete in System	CY	225	$816	$419	$27	$0	$1,262	$283,944
140055	Misc. Metals (Netting)	SF	72.192				$4.85	$4.85	$350.131
1401XX	Piping and Mechanical Equip. for each pond	Ea	4	$2,863	$20.010	$620	$0	$23,493	$93,973
									$962,572
Smolt Pond (Measured Concrete Volume)									
150022, 150030, 150055. 150150	Includes Excavation, Concrete, Misc Metals & /Piping	CY	201	$232	$285	$36	$72	$624	$125,395
	* Basis for Factors			Labor	Materials	Equipment	Subcontractors		
	Inflation 3/90-1/92			105%	105%	105%	105%		
	Adjust for location			92%	100%	100%	100%		
	Means Labor Overhead			34%					
	General Contractors OH			11%	11%	11%			
	Profit			10%	10%	10%	10%		
	Contractors 'Plus' Factor			150%)	127%	127%	116%		

TABLE A-2

				Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext.Base Cos'
:ffluent Ponds (Area as measured in rectangular dimension)									
60020	Earthwork and 3' AC	SF	16,800	$0.69	$0.28	$0.74	$1.39	$3.09	$51,931
601XX	Concrete, Piping and Mechanical Equip. for each pond with a chlorinator building.	Ea	2	$1.241	$4.917	$152	$11,261	$17,572	$35.144
									$87,075
'ard Pi ing (Based on measured length and diameter of all pipes over 6", Includes Valves)									
:00XXX	All Supply, Drain, Utility Pipes, Valves, Excavation, Backfill	Inch-Ft	95,640	$2.07	$1.98	$1.82	$0.53	$6.40	$611,749
/lain Supply Pipe (Based on Measured Length and Diameter in inch-ft)									
;00020 100022 ;001 50	All Supply Pipes, Valves, Excavation, Backfill. Does not include Pump Station.	Inch-Ft	40.8601	$2.38	$5.32	$0.74	$0.05	38.49	$346,767
/lain Pumps Station (3-75 HP pumps = 225 HP)									
	With all elements but the pipeline to the hatchery	HP	225	$281	$985	$71	$42	$1,379	$310,243
ɔzone Contactors									
	Concrete, EarthW., Misc. Metals	CY Conc.	326	$289	$296	$44	$44	$673	$219,516
	Mechanical Equipment Piping & Valves	GPM	3000	$8.38	$27.95	$0.51	$1.39	$38.23	$114,690
									$334.207
3zone Generator Building (Based on Building Size and Ozone Production)									
	Building, Concrete, EarthW., Misc. Metals	SF	912	$13.48	$13.34	$2.31	$45.05	$74.17	$67,642
	Mech. Eq., Piping 8 Instr.	lbs/Day O	200	$626	$2,601	$64	$44	$3.334	$666,800
									$734.442
ɔzone Distruction System (Blower/Strippers)									
	Concrete, EarthW., Misc. Metals	CY cow.	50	$770	$454	$46	$289	$1,558	$77,883
	Mechanical Equipment	GPM	3000	$4.24	$86.81	$1.78	$0.00	$92.83	$278,488
	Piping	GPM	3000	$15.00	$22.50	$0.10	$0.10	$37.70	$113,100
									$469,471
Aeration System									
	Concrete, EarthW., Misc. Metals	CY Conc.	35	$891	$419	$125	$254	$1,689	$59,107
	All Other	GPM	5000	$2.84	$10.55	$0.13	$0.00	$13.52	$67,585
									$126.692
LOX Storage Area (Measured as Concrete Volume									
	Ready to Receive Rental Tank Complete with Lox Piping (35% of Cost)	CY	32	$645	$401	$52	$840	$1,939	$62,035

TABLE A-2

				Unit Labor	Unit Material	Unit Equip.	Unit Subc.	Unit Base Cost	Ext.Base cost
Post Ozone Pumps Station									
	Including	GPM	1000	$31.29	$86.65	$4.45	$17.33	$139.71	$139,713
SUBTOTAL CONTRACTOR'S COSTS									$6,618,002
Alternate Approaches									
Alt. Main Pumps Station (3-2500 GPM pumps = 5000 GPM -w/one standby)									
	With aft elements but the pipeline to the hatchery	GPM	5000	$8.45	$34.87	$2.51	$1.62	$47.45	$237,250
Alt. Main Supply Pipe (Based on Measured Length and Diameter in feet)									
300020 300022 3001 50	All Supply Pipes, Valves, Excavation, Backfill. Does not include Pump Station.	Feet	2,270	$43	$95	$14	$1	$154	$349,216

Mora Hatchery Building Costs (Based on September, 91 design and Title I estimate)								
					Contractor's Bid'			
					$1,000	For the BPA Estimate no adjustments are made as it is assumed that lower labor rates in New Mex are offset by higher isolation costs.		
	General Conditions				$312			
	Site Development				$1,235			
	Office Building	12,013	SF@	$110	$1,321			
	Fish Culture Building	11,460	SF	$70	$802			
	Water Treament Building	14.884	SF	$110	$1,637			
	Shop & Vehicle Building	7.384	SF	$79	$583			
	Hatchery (Tank) Building	23,500	SF	$63	$1,481			
	Water Treatment				$3,695			
	* with 1% Bond				$11,067			