
BIG CREEK HATCHERY

**A COMPILATION AND SUMMARY OF
HOT AUDITS FOR FALL CHINOOK,
COHO, WINTER STEELHEAD, AND
CUTTHROAT TROUT**

JULY 1998

**HATCHERY EVALUATION REPORT
SUMMARY FOR**

- Big Creek Hatchery**
- Fall Chinook (Big Creek/Rogue River Stock)**
 - Fall Chinok (Big Creek)**
 - Coho**
 - Winter Steelhead**
 - Sea-Run Cutthroat Trout**

**A Summarized Compilation of Independent Audits Based on
Integrated Hatchery Operations Team (IHOT) Performance
Measures**

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Executive Summary

This report compiles a summary of the findings of five separate Hatchery Evaluation Reports for Fall Chinook (Big Creek/Rogue River and Big Creek Stocks), Coho, Winter Steelhead, and Sea-Run Cutthroat Trout at Big Creek Hatchery. The original Hatchery Evaluation Reports, prepared by Montgomery Watson, presented each species and program separately and include the complete findings. Details on the audit compliance status for each species and program are included in the original reports. The Hatchery Evaluation Reports were based upon audits conducted in 1996-1997 as part of a 2-year effort that will include 67 hatcheries and satellite facilities located on the Columbia and Snake River system in Idaho, Oregon, and Washington. The hatchery operating agencies include the U.S Fish and Wildlife Service, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife.

The hatchery is located 16 miles east of Astoria and is approximately 3 miles upstream from Big Creek's confluence with the Columbia River. The hatchery is used for adult collection, egg incubation, and rearing of winter steelhead, fall chinook, coho, and sea-run cutthroat.

Background

The audit is being conducted as a requirement of the Northwest Power Planning Council (NPPC) "Strategy for Salmon" and the Columbia River Basin Fish and Wildlife Program. Under the audit, the hatcheries are evaluated against policies and related performance measures developed by the Integrated Hatchery Operations Team (IHOT) in January 1995. IHOT is a multi-agency group established by the NPPC to direct the development of new basinwide standards for managing and operating fish hatcheries. The Bonneville Power Administration (BPA) contracted with Montgomery Watson to act as an independent contractor for the audit.

IHOT has established five basic policies that cover: (1) hatchery coordination, (2) hatchery performance standards, (3) fish health, (4) ecological interaction, and (5) genetics. The audit focuses on all these policies, with the exception of hatchery coordination. These policies are set forth in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (IHOT 1995)*, which is the source for the performance measures that are the basis of this audit.

The Audit Process

The audit was based on the facility management's response to a 109-page questionnaire. This audit form was completed through a five-step process in which:

- Information was obtained from headquarters.
- The hatchery manager was asked to fill out and return the audit form.
- A 1-2 day site audit visit was conducted to inspect facilities, review hatchery records, discuss audit form responses, and develop remedial action plans.

- A compliance report was developed to document the compliance status of each performance measure. This report was then shared with the hatchery manager and IHOT representative.
- This hatchery evaluation report was written to document compliance with IHOT performance measures and develop cost estimates for remedial actions when needed.

Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River and Rogue River Stocks), Coho, Winter Steelhead, and Sea-Run Cutthroat Trout Results

The Big Creek facility includes 2 ponds for adult holding, 30 concrete raceways, 1 rearing pond, 2 Canadian troughs, and incubation facilities. Big Creek Hatchery began operation in 1941 as a state-funded facility. It was refurbished in 1957 under the Mitchell Act as part of the Columbia River Fisheries Development Program - a program to enhance declining fish runs in the Columbia River Basin. The purpose of the hatchery is to produce adult salmon and cutthroat trout that will contribute to NE Pacific and Columbia River Basin commercial and sports fisheries.

FALL CHINOOK (BIG CREEK/ROGUE RIVER STOCK)

The Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River Stock) program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery did not have a survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult life-stage and was not meeting its adult return goal. The audit found that the hatchery was not in compliance with adult holding facilities, water quality monitoring requirements, alarm criteria, and pathology-free water criteria, which are all facilities requirements. The hatchery was not meeting the flow criteria for incubation. The hatchery needed to develop written incubation and rearing standards for the IHOT Operations Plan and develop a smoltification goal and monitoring plan. In the compliance area for fish health policy, the hatchery was not using foot baths in incubation and was not meeting all the sanitation protocols. The hatchery did not have a written broodstock collection plan, spawning protocols, or a Genetics Monitoring and Evaluation Program.

The specific areas in which the Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River Stock) program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Conduct IHOT QA/QC test for feed preparation
- Develop alarm log
- Develop an additional 300 gpm of disease-free water for incubation
- Develop approved genetics M&E plan
- Develop smoltification goal and monitor
- Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult life-stage
- Develop written broodstock collection plan
- Develop written spawning protocols
- Develop written standards for incubation and rearing for the IHOT Operations Plan
- Follow IHOT procedures for checking other alarms weekly
- Follow IHOT protocols for not exposing feed or feed containers to light or heat

- Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery
- Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock
- Install intake alarm on Big Creek
- Install alarms on large rearing pond and adult holding ponds
- Install alarms on rearing ponds
- Install foot baths
- Monitor DO and TGP and record
- Rebuild adult holding and spawning facility
- Review IHOT flow criteria for the deep trough and vertical stack incubators
- Review need for new fingerling release channel
- Review release size goal
- Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery were not listed above.

FALL CHINOOK (BIG CREEK STOCK)

The Big Creek Hatchery - Fall Chinook (Big Creek Stock) program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery did not have a survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult and was not meeting its adult return goal. The audit found that the hatchery was not in compliance with adult holding facilities, water quality monitoring requirements, alarm criteria, and pathology-free water criteria, which are all facilities requirements. The hatchery was not meeting the flow criteria for incubation. The hatchery needed to develop written incubation and rearing standards for the IHOT Operations Plan and develop a smoltification goal and monitoring plan. In the compliance area for fish health policy, the hatchery was not using foot baths in incubation and was not meeting all the sanitation protocols. The hatchery did not have a written broodstock collection plan, spawning protocols, or a Genetics Monitoring and Evaluation Program.

The specific areas in which the Big Creek Hatchery - Fall Chinook (Big Creek Stock) program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Conduct IHOT QA/QC test for feed preparation
- Develop alarm log
- Develop an additional 300 gpm of disease-free water for incubation
- Develop approved genetics M&E plan
- Develop smoltification goal and monitor
- Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult
- Develop written broodstock collection plan
- Develop written spawning protocols
- Develop written standards for incubation and rearing for the IHOT Operations Plan
- Follow IHOT procedures for checking other alarms weekly
- Follow IHOT protocols for not exposing feed or feed containers to light or heat

- Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery
- Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock
- Install intake alarm on Big Creek
- Install alarms on large rearing pond and adult holding ponds
- Install alarms on rearing ponds
- Install foot baths
- Monitor DO and TGP and record
- Rebuild adult holding and spawning facility
- Review IHOT flow criteria for the deep trough and vertical stack incubators
- Review need for new fingerling release channel
- Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery were not listed above.

COHO

The Big Creek Hatchery - Coho program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery did not have a survival goal for green-egg to eyed-egg, eyed-egg to fry, fry to smolt, and smolt to adult. The audit found that the hatchery was not in compliance with adult holding facilities, water quality monitoring requirements, alarm criteria, and pathology-free water criteria, which are all facilities requirements. The hatchery was not meeting the flow criteria for incubation and the loading and density criteria for rearing. The hatchery needed to develop written incubation and rearing standards for the IHOT Operations Plan and develop a smoltification goal and monitoring plan. In the compliance area for fish health policy, the hatchery was not using foot baths in incubation and was not meeting all the sanitation protocols. The hatchery did not have a written broodstock collection plan, spawning protocols, or a Genetics Monitoring and Evaluation Program.

The specific areas in which the Big Creek Hatchery - Coho program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Conduct IHOT QA/QC test for feed preparation
- Develop alarm log
- Develop an additional 300 gpm of disease-free water for incubation
- Develop approved genetics M&E plan
- Develop smoltification goal and monitor
- Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult
- Develop written broodstock collection plan
- Develop written spawning protocols
- Develop written standards for incubation and rearing for the IHOT Operations Plan
- Follow IHOT procedures for checking other alarms weekly
- Follow IHOT protocols for not exposing feed or feed containers to light or heat
- Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery

- Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock
- Follow IHOT protocols for transportation facilities.
- Install intake alarm on Big Creek
- Install alarms on large rearing pond and adult holding ponds
- Install alarms on rearing ponds
- Install foot baths
- Monitor DO and TGP and record
- Rebuild adult holding and spawning facility
- Reduce density prior to release
- Review IHOT flow criteria for the deep trough and vertical stack incubators
- Review need for new fingerling release channel
- Review pond operation and/or reduce production to meet IHOT density and loading criteria
- Review size goal
- Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery were not listed above.

WINTER STEELHEAD

The Big Creek Hatchery - Winter Steelhead program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery did not have a survival goal for green-egg to eyed-egg, eyed-egg to fry, fry to smolt, and smolt to adult life-stages. The audit found that the hatchery was not in compliance with adult holding facilities, water quality monitoring requirements, alarm criteria, and pathology-free water criteria, which are all facilities requirements. The hatchery was not meeting the flow criteria for incubation and the density criteria for early rearing. The hatchery needed to develop written incubation and rearing standards for the IHOT Operations Plan and develop a smoltification goal and monitoring plan. In the compliance area for fish health policy, the hatchery was not using foot baths in incubation and was not meeting all the sanitation protocols. The hatchery did not have a written broodstock collection plan, spawning protocols, or a Genetics Monitoring and Evaluation Program.

The specific areas in which the Big Creek Hatchery - Winter Steelhead program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Conduct fisheries contribution studies
- Conduct IHOT QA/QC test for feed preparation
- Develop a written hatchery M&E plan
- Develop alarm log
- Develop an additional 300 gpm of disease-free water for incubation
- Develop approved genetics M&E plan
- Develop smoltification goal and monitor
- Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult
- Develop written broodstock collection plan
- Develop written spawning protocols

- Develop written standards for incubation and rearing for the IHOT Operations Plan
- Document adult contribution
- Follow IHOT procedures for checking other alarms weekly
- Follow IHOT protocols for not exposing feed or feed containers to light or heat
- Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery
- Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock
- Follow IHOT protocols for transportation facilities
- Install intake alarm on Big Creek
- Install alarms on large rearing pond and adult holding ponds
- Install alarms on rearing ponds
- Install foot baths
- Monitor DO and TGP and record
- Rebuild adult holding and spawning facility
- Review density criteria for early rearing
- Review IHOT flow criteria for the deep trough incubators
- Review need for new fingerling release channel
- Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants

SEA-RUN CUTTHROAT TROUT

The Big Creek Hatchery - Sea-run Cutthroat program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery did not have a survival goal for the majority of the fish culture life-stages. The audit found that the hatchery was not in compliance with adult holding facilities, water quality monitoring requirements, alarm criteria, and pathology-free water criteria, which are all facilities requirements. The hatchery needed to develop written incubation standards, rearing standards, and adult holding criteria, and develop a smoltification goal and monitoring plan. In the compliance area for fish health policy, the hatchery was not using foot baths in incubation and was not meeting all the sanitation protocols. The hatchery did not have a written broodstock collection plan, spawning protocols, or a Genetics Monitoring and Evaluation Program.

The specific areas in which the Big Creek Hatchery - Sea-run Cutthroat program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Conduct fishery contribution study
- Conduct IHOT QA/QC test for feed preparation
- Develop a written hatchery M&E plan
- Develop adult holding criteria
- Develop alarm log
- Develop approved genetics M&E plan
- Develop goal for pre-spawning survival, green-egg to eyed-egg survival, eyed-egg to fry survival, fry to smolt survival, production, and smolt to adult survival
- Develop rearing density criteria
- Develop release goal
- Develop smoltification goal and monitor

- Develop written broodstock collection plan
- Develop written spawning protocols
- Develop written standards for incubation and rearing for the IHOT Operations Plan and determine compliance
- Document adult contribution
- Follow IHOT procedures for checking other alarms weekly
- Follow IHOT protocols for not exposing feed or feed containers to light or heat
- Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery
- Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock
- Install intake alarm on Big Creek
- Install alarms on large rearing pond and adult holding ponds
- Install alarms on rearing ponds
- Install foot baths
- Monitor DO and TGP and record
- Rebuild adult holding and spawning facility
- Review need for new fingerling release channel
- Review release strategy
- Review size criteria and/or production plan
- Review size goal and/or production plan
- Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery were not listed above.

Facility Description

Name:	Big Creek Hatchery
Stock/Species:	Fall Chinook (Big Creek Stock) Fall Chinook (Big Creek/Rogue Stock) Coho Winter Steelhead Sea-run Cutthroat
Operating Agency:	Oregon Department of Fish and Wildlife
Funding Agency:	Mitchell Act
Location:	The hatchery is located 16 miles east of Astoria and is approximately 3 miles upstream from Big Creek's confluence with the Columbia River.
Address:	Route 4, Box 594 Astoria, OR 97103
Hatchery Manager:	Mr. David Rieben
Phone:	(503) 458-6512
Fax:	(503) 458-6529
Purpose:	Big Creek Hatchery began operation in 1941 as a state-funded facility. It was refurbished in 1957 under the Mitchell Act as part of the Columbia River Fisheries Development Program - a program to enhance declining fish runs in the Columbia River Basin. The purpose of the hatchery is to produce adult salmon and cutthroat trout that will contribute to NE Pacific and Columbia River Basin commercial and sports fisheries.

Production Goal:

Fall Chinook (Big Creek Stock)

Produce 5,700,000 smolts (71,250 lb) and 5,200,000 fingerlings (38,670 lb) for on-station release.

Provide 6,810,000 eggs for ODFW programs.

Fall Chinook (Big Creek/Rogue Stock)

Produce 1,000,000 smolts (67,778 lb) for on-station release.

Coho

Produce 535,000 smolts (48,636 lb) for on-station release.

Produce 60,000 smolts (4,000 lb) for release into the Tualatin River.

Winter Steelhead

Produce 60,000 smolts (12,000 lb) for on-station release.

Produce 63,000 smolts (6,300 lb) for transfer to Klaskanine Hatchery.

Provide 557,300 eggs for ODFW programs.

Sea-run Cutthroat

Produce smolts when adults are available.

Water Supply:

There are four water sources for the hatchery: Big Creek, Mill Creek, and two springs. Current water rights total 36,158 gpm plus an additional 4.2 cfs reservoir water right.

Facilities:

Adult Holding: 2 concrete adult holding ponds, 6,513 and 15,880 cf

Incubation: 4 16-tray vertical incubators

48 shallow troughs - 13 cf each

16 shallow troughs - 26 cf each

Early Rearing: 2 Canadian troughs - 108 cf

Raceways: 9 concrete raceways - 4400 cf each

21 concrete raceways - 4400 cf each

Rearing Ponds: 1 concrete rearing pond - 12,112 cf

Satellite Facilities: None

Section 3
Remedial Actions

Based on the compliance status for each performance measure, remedial actions were developed. The required remedial actions are organized into five categories. The types of categories range across a spectrum from those actions that are beyond human control, to those that require a change in agency policy or procedures, to those that involve a significant capital cost to put in place. The following are the five types of remedial actions identified under phase 1 of the audit:

The Five Types of Remedial Actions

Type	Description
1	Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery
2	Remedial actions requiring changes in agency policies or procedures
3	Remedial actions requiring changes in monitoring coverage or interval
4	Remedial actions requiring significant capital expenditures
5	Remedial actions that may require significant capital expenditures but are not clearly definable at this time

Remedial Actions at Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River and Big Creek Stocks), Coho, Winter Steelhead, and Sea-Run Cutthroat Trout

This section presents the corrective actions required to bring the Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River and Big Creek Stocks) , Coho, Winter Steelhead, and Sea-Run Cutthroat Trout programs into compliance with IHOT performance measures. The remedial actions described here are suggestions developed by the Montgomery Watson Audit Team. The remedial actions and associated cost estimates have not been analyzed or prioritized by the respective operating agencies, fishery managers, or IHOT. There may be additional remedial actions, not included in this report, proposed by the respective operating agencies.

For some non-compliance areas, other remedial actions could be proposed. The required remedial actions are cross-referenced to each IHOT performance measure that was not in compliance. Where appropriate, the costs associated with the remedial actions are also presented (Tables 3a, 3b, 3c, 3d, and 3e).

The cost estimates presented in this section are based on professional experience from similar projects. In most cases, only a lump-sum figure is presented, and detailed take-off lists have not been prepared. The cost estimates are essentially order of magnitude estimates (± 40%).

The suggested remedial activities may also present several levels of action. Optional actions have been listed for several problems. These optional actions are desirable for either operational or safety considerations.

Table 3a Remedial Actions Required at Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River Stock)

Remedial Action Required	Cost	PMs¹
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		
Improve adult returns		4c, 4g, 22a4
Install security alarms	----	6
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult	----	4d, 4e, 4h
Follow IHOT procedures for checking other alarms weekly	----	6
Develop alarm log	----	6
Conduct IHOT QA/QC test for feed preparation	----	12
Follow IHOT protocols for not exposing feed or feed containers to light or heat	----	12
Develop written standards for incubation and rearing for the IHOT Operations Plan	----	18-19
Review IHOT flow criteria for the deep trough and vertical stack incubators	----	18
Develop smoltification goal and monitor	----	22a1
Review release size goal		22a5
Install foot baths	----	28
Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery	----	28
Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock	----	28

¹ PMs are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS¹
Type 2 - cont.		
Develop written broodstock collection plan	----	41
Develop written spawning protocols	----	42
Develop approved genetics M&E plan	----	43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor DO and TGP and record	----	5b
Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants	----	5c-5g
Type 4 - Remedial actions requiring significant capital expenditures		
Rebuild adult holding and spawning facility	\$2.0 million	4b,7,
Install intake alarm on Big Creek	\$10,000	6
Install alarms on large rearing pond and adult holding ponds	\$20,000	6
Install alarms on rearing ponds	\$10,000	6
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Develop an additional 300 gpm of disease-free water for incubation	----	5h, 28
Review need for new fingerling release channel	----	13

Table 3b. Remedial Actions Required at Big Creek Hatchery - Fall Chinook (Big Creek Stock)

Remedial Action Required	Cost	PMS²
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

² PMS are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS²
Improve adult returns		4c, 4g, 22a4, 42e, 42f
Install security alarms	----	6
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult	----	4d, 4e, 4h
Follow IHOT procedures for checking other alarms weekly	----	6
Develop alarm log	----	6
Conduct IHOT QA/QC test for feed preparation	----	12
Follow IHOT protocols for not exposing feed or feed containers to light or heat	----	12
Develop written standards for incubation and rearing for the IHOT Operations Plan	----	18-19
Review IHOT flow criteria for the deep trough and vertical stack incubators	----	18
Develop smoltification goal and monitor	----	22a1
Install foot baths	----	28
Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery	----	28
Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock	----	28
Develop written broodstock collection plan	----	41

Remedial Action Required	Cost	PMS¹
Type 2 (cont)		
Develop written spawning protocols	----	42
Develop approved genetics M&E plan	----	43

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS¹
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor DO and TGP and record	----	5b
Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants	----	5c-5g
Type 4 - Remedial actions requiring significant capital expenditures		
Rebuild adult holding and spawning facility	\$2.0 million	4b,7
Install intake alarm on Big Creek	\$10,000	6
Install alarms on large rearing pond and adult holding ponds	\$20,000	6
Install alarms on rearing ponds	\$10,000	6
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Develop an additional 300 gpm of disease-free water for incubation	----	5h, 28
Review need for new fingerling release channel	----	13

Table 3b. Remedial Actions Required at Big Creek Hatchery - Coho

Remedial Action Required	Cost	PMS¹
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		
Install security alarms	----	6
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult	----	4d, 4e, 4h
Follow IHOT procedures for checking other alarms weekly	----	6
Develop alarm log	----	6
Conduct IHOT QA/QC test for feed preparation	----	12

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS¹
Follow IHOT protocols for not exposing feed or feed containers to light or heat	----	12
Develop written standards for incubation and rearing for the IHOT Operations Plan	----	18-19
Review IHOT flow criteria for the deep trough and vertical stack incubators	----	18
Review pond operation and/or reduce production to meet IHOT density and loading criteria	----	19
Develop smoltification goal and monitor	----	22a1
Reduce density prior to release	----	22a2
Review size goal	----	22a5
Follow IHOT protocols for transportation facilities	----	23
Install foot baths	----	28
Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery	----	28

Remedial Action Required	Cost	PMS¹
Type 2 (cont)	----	28
Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock		
Develop written broodstock collection plan	----	41
Develop written spawning protocols	----	42
Develop approved genetics M&E plan	----	43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor DO and TGP and record	----	5b
Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants	----	5c-5g

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMs ¹
Type 4 - Remedial actions requiring significant capital expenditures		
Rebuild adult holding and spawning facility	\$2.0 million	4b,7
Install intake alarm on Big Creek	\$10,000	6
Install alarms on large rearing pond and adult holding ponds	\$20,000	6
Install alarms on rearing ponds	\$10,000	6
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Develop an additional 300 gpm of disease-free water for incubation	----	5h, 28
Review need for new fingerling release channel	----	13

Table 3d. Remedial Actions Required at Big Creek Hatchery - Winter Steelhead

Remedial Action Required	Cost	PMs¹
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		
Install security alarms	----	6
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Develop a written hatchery M&E plan	----	3
Document adult contribution	----	4a
Develop survival goal for green-egg to eyed-egg, eyed-egg to fry, and smolt to adult	----	4d-4f, 4h
Follow IHOT procedures for checking other alarms weekly	----	6
Develop alarm log	----	6
Conduct IHOT QA/QC test for feed preparation	----	12
Follow IHOT protocols for not exposing feed or feed containers to light or heat	----	12
Develop written standards for incubation and rearing for the IHOT Operations Plan	----	18-19
Review IHOT flow criteria for the deep trough incubators	----	18
Review density criteria for early rearing	----	19
Develop smoltification goal and monitor	----	22a1
Follow IHOT protocols for transportation facilities	----	23
Conduct fisheries contribution studies	----	24
Install foot baths	----	28
Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery	----	28

Remedial Action Required	Cost	PMs¹
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¹ PMs are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS¹
Type 2 (Continued) - Remedial actions requiring changes in agency policies or procedures		
Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock	----	28
Develop written broodstock collection plan		41
Develop written spawning protocols	----	42
Develop approved genetics M&E plan	----	43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor DO and TGP and record	----	5b
Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants	----	5c-5g
Type 4 - Remedial actions requiring significant capital expenditures		
Rebuild adult holding and spawning facility	\$2.0 million	4b,7
Install intake alarm on Big Creek	\$10,000	6
Install alarms on large rearing pond and adult holding ponds	\$20,000	6
Install alarms on rearing ponds	\$10,000	6
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Develop an additional 300 gpm of disease-free water for incubation	----	5h, 28
Review need for new fingerling release channel	----	13

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Table 3e. Remedial Actions Required at Big Creek Hatchery - Sea-run Cutthroat

Remedial Action Required	Cost	PMS¹
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		
Improve adult survival	----	4c
Install security alarms	----	6
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Develop a written hatchery M&E plan	----	3
Document adult contribution	----	4a
Develop goal for pre-spawning survival, green-egg to eyed-egg survival, eyed-egg to fry survival, fry to smolt survival, production, and smolt to adult survival	----	4b-4h
Follow IHOT procedures for checking other alarms weekly	----	6
Develop alarm log	----	6
Develop adult holding criteria	----	7
Conduct IHOT QA/QC test for feed preparation	----	12
Follow IHOT protocols for not exposing feed or feed containers to light or heat	----	12
Develop written standards for incubation and rearing for the IHOT Operations Plan and determine compliance	----	18-19
Develop smoltification goal and monitor	----	22a1
Develop rearing density criteria	----	22a2
Develop release goal	----	22a4
Review size goal and/or production plan	----	22a5
Review size criteria and/or production plan	----	22a6
Review release strategy	----	22c
Conduct fishery contribution study	----	24

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Remedial Action Required	Cost	PMS¹
Type 2 (Continued) - Remedial actions requiring changes in agency policies or procedures		
Install foot baths	----	28
Follow IHOT protocols for sanitation of equipment and rain gear utilized in broodstock handling or spawning prior to its use elsewhere in the hatchery	----	28
Follow IHOT protocols for sanitation of rearing vessels after fish are removed and prior to introducing a new fish lot or stock	----	28
Develop written broodstock collection plan	----	41
Develop written spawning protocols	----	42
Develop approved genetics M&E plan	----	43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor DO and TGP and record	----	5b
Run analysis for water chemistry parameters, turbidity, alkalinity, hardness, and contaminants	----	5c-5g
Type 4 - Remedial actions requiring significant capital expenditures		
Rebuild adult holding and spawning facility	\$2.0 million	4b,7
Install intake alarm on Big Creek	\$10,000	6
Install alarms on large rearing pond and adult holding ponds	\$20,000	6
Install alarms on rearing ponds	\$10,000	6
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Review need for new fingerling release channel	----	13

¹ PMS are performance measures that were extracted from the IHOT 1995 report.

Hatchery Contribution to Fisheries, Spawning Grounds, and Hatcheries

This section presents the audit findings for the Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River and Big Creek Stocks), Coho, Winter Steelhead, and Sea-Run Cutthroat Trout program contribution of adult fish to fisheries, local fisheries, spawning grounds, and hatcheries (Tables 4a, 4b, 4c, 4d, and 4e). Data is reported by broodyear. A broodyear refers to the adult contribution from the eggs produced from a single group of spawning adults. For some species, this may include fish caught as 2-, 3-, 4-, 5-, and 6-year old fish. Because of the return distribution and data processing delays, the complete adult contribution for a given broodyear may not be available until 4 to 5 years after the fish have been released from the hatchery.

**Table 4a. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Big Creek Hatchery - Fall Chinook (Big Creek/Rogue River Stock)**

Year	Fisheries ¹ (Broodyear)	Spawning Grounds ¹ (Broodyear)	Hatchery ¹ (Broodyear)	Total Combined Contribution ² (Broodyear)	Smolt to Adult Survival (percent)
1982					
1983					
1984					
1985				3,067	2.10
1986				3,594	2.27
1987				3,005	2.26
1988				2,135	1.37
1989				2,991	0.78
1990					
1991					
1992					

¹ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

² Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

**Table 4b. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Big Creek Hatchery - Fall Chinook (Big Creek Stock)**

Year	Fisheries¹ (Broodyear)	Spawning Grounds¹ (Broodyear)	Hatchery¹ (Broodyear)	Total Combined Contribution² (Broodyear)	Smolt to Adult Survival (percent)
1982					
1983					
1984					
1985					
1986				15,646	0.18
1987				4,426	0.05
1988				17,979	0.17
1989				11,696	0.12
1990					
1991					
1992					

**Table 4c. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Big Creek Hatchery - Coho**

Year	Fisheries³ (Broodyear)	Spawning Grounds¹ (Broodyear)	Hatchery¹ (Broodyear)	Total Combined Contribution⁴ (Broodyear)	Smolt to Adult Survival (percent)
1981					
1982					

¹ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

² Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

³ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

⁴ Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

1983					
1984					
1985					
1986					
1987				14,183	2.42
1988				26,773	4.22
1989				18,091	2.85
1990				1,163	0.21
1991				5,234	0.80
1992					

**Table 4d. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Big Creek Hatchery - Winter Steelhead**

Year	Fisheries¹ (Broodyear)	Spawning Grounds¹ (Broodyear)	Hatchery¹ (Broodyear)	Total Combined Contribution² (Broodyear)	Smolt to Adult Survival (percent)
1983					
1984					
1985					
1986					
1987	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1988	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1989	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1990	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available

¹ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

² Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

	available	available	available	available	available
1991					
1992					

**Table 4e. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Big Creek Hatchery - Sea-run Cutthroat**

Year	Fisheries¹ (Broodyear)	Spawning Grounds¹ (Broodyear)	Hatchery¹ (Broodyear)	Total Combined Contribution² (Broodyear)	Smolt to Adult Survival (percent)
1983					
1984					
1985					
1986					
1987	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1988	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1989	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1990	Complete data not available	Complete data not available	Complete data not available	Complete data not available	Complete data not available
1991					
1992					

¹ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

² Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

Annual Operating Expenditures

The level and detail of annual operating expenditures varies widely depending on hatchery, operating agency, and funding source. When provided, expenditures were presented in terms of personnel costs, operating costs (power, feed, and supplies), capital costs, indirect costs charged to the federal government, third-party costs, and other costs. These cost components were summed to determine a total hatchery annual cost. Based on discussion with the hatchery manager, the percent of total hatchery costs allocated to a given program was estimated. The total hatchery costs and the percent of hatchery costs allocated to a given program were used to compute the cost of a given program. The total expenditures for the Big Creek Hatchery are presented in Table 5 by program. The detailed breakdown of program expenditures for fall chinook, coho, winter steelhead, and sea-run cutthroat trout at this hatchery are presented in separate tables (Tables 6a, 6b, 6c, 6d, and 6e).

Table 6. Annual Operating Expenses - Big Creek Hatchery

Program	1994	1995	1996
1. Fall Chinook (Big Creek)	\$362,121	\$284,449	\$229,385
2. Fall Chinook (Big Creek/Rogue River)	\$210,277	\$136,115	\$214,984
3. Coho	\$140,688	\$131,696	\$157,331
4. Winter Steelhead	\$51,478	\$55,520	\$107,314
5. Sea-run Cutthroat	\$8,134	\$0	\$3,435
Total Hatchery Costs	\$772,698	\$607,779	\$712,449

Table 6a. Detailed Expenditures at Big Creek Hatchery by Program
Fall Chinook (Big Creek Stock)

Component	1994	1995	1996
Personnel Costs	\$304,339	\$274,232	\$313,356
Operational Costs	\$215,988	\$174,801	\$162,612
Capital Costs	\$61,043	\$1,632	\$4,527
Indirect Costs	\$99,635	\$78,622	\$92,805
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs	\$91,643	\$78,493	\$139,149
Total Hatchery Costs	\$772,698	\$607,779	\$712,449
Source of Funds			
Mitchell Act	88.1%	87.1%	80.5%
Bureau of Reclamation	2.3%	3.0%	2.9%
ODFW (R &E)	9.5%	10.0%	16.6%
Program Production (lb)	123,322	105,552	71,250
Total Production (lb)	263,146	225,532	221,296
Program as Percent of Total	46.9%	46.8%	32.2%
Program Costs	\$362,121	\$284,449	\$229,385

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6b. Detailed Expenditures at Big Creek Hatchery by Program
Fall Chinook (Big Creek/Rogue River Stock)

Component	1994	1995	1996
Personnel Costs	\$304,339	\$274,232	\$313,356
Operational Costs	\$215,988	\$174,801	\$162,612
Capital Costs	\$61,043	\$1,632	\$4,527
Indirect Costs	\$99,635	\$78,622	\$92,805
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs	\$91,643	\$78,493	\$139,149
Total Hatchery Costs	\$772,698	\$607,779	\$712,449
Source of Funds			
Mitchell Act	88.1%	87.1%	80.5%
Bureau of Reclamation	2.3%	3.0%	2.9%
ODFW (R &E)	9.5%	10.0%	16.6%
Program Production (lb)	71,611	50,509	66,777
Total Production (lb)	263,146	225,532	221,296
Program as Percent of Total	27.2%	22.4%	30.2%
Program Costs	\$210,277	\$136,115	\$214,984

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6c. Detailed Expenditures at Big Creek Hatchery by Program

Coho

Component	1994	1995	1996
Personnel Costs	\$304,339	\$274,232	\$313,356
Operational Costs	\$215,988	\$174,801	\$162,612
Capital Costs	\$61,043	\$1,632	\$4,527
Indirect Costs	\$99,635	\$78,622	\$92,805
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs	\$91,643	\$78,493	\$139,149
Total Hatchery Costs	\$772,698	\$607,779	\$712,449
Source of Funds			
Mitchell Act	88.1%	87.1%	80.5%
Bureau of Reclamation	2.3%	3.0%	2.9%
ODFW (R &E)	9.5%	10.0%	16.6%
Program Production (lb)	47,912	48,869	48,869
Total Production (lb)	263,146	225,532	221,296
Program as Percent of Total	18.2%	21.7%	22.1%
Program Costs	\$140,688	\$131,696	\$157,331

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6d. Detailed Expenditures at Big Creek Hatchery by Program

Winter Steelhead

Component	1994	1995	1996
Personnel Costs	\$304,339	\$274,232	\$313,356
Operational Costs	\$215,988	\$174,801	\$162,612
Capital Costs	\$61,043	\$1,632	\$4,527
Indirect Costs	\$99,635	\$78,622	\$92,805
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs	\$91,643	\$78,493	\$139,149
Total Hatchery Costs	\$772,698	\$607,779	\$712,449
Source of Funds			
Mitchell Act	88.1%	87.1%	80.5%
Bureau of Reclamation	2.3%	3.0%	2.9%
ODFW (R &E)	9.5%	10.0%	16.6%
Program Production (lb)	17,531	20,602	33,333
Total Production (lb)	263,146	225,532	221,296
Program as Percent of Total	6.7%	9.1%	15.1%
Program Costs	\$51,478	\$55,520	\$107,314

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6e. Detailed Expenditures at Big Creek Hatchery by Program

Sea-run Cutthroat

Component	1994	1995	1996
Personnel Costs	\$304,339	\$274,232	\$313,356
Operational Costs	\$215,988	\$174,801	\$162,612
Capital Costs	\$61,043	\$1,632	\$4,527
Indirect Costs	\$99,635	\$78,622	\$92,805
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs	\$91,643	\$78,493	\$139,149
Total Hatchery Costs	\$772,698	\$607,779	\$712,449
Source of Funds			
Mitchell Act	88.1%	87.1%	80.5%
Bureau of Reclamation	2.3%	3.0%	2.9%
ODFW (R &E)	9.5%	10.0%	16.6%
Program Production (lb)	2,770	0	1,067
Total Production (lb)	263,146	225,532	221,29
Program as Percent of Total	1.053%	0%	0.482%
Program Costs	\$8,134	\$0	\$3,435

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¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.