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**Subject:** 30 Day Review and Comment Period - Chelan River Biological Objectives 2017 Status Report  
**Date:** Tuesday, February 28, 2017 5:12:39 PM  
**Attachments:** [2017 Biological Objectives Status Report - DRAFT.pdf](#)

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**To:** Chelan River Fishery Forum

Washington Department of Ecology

Washington Department of Fish and Wildlife

United States Forest Service

National Park Service

United States Fish and Wildlife Service

National Marine Fisheries Service

CCT (Colville)

YN (Yakama)

CTUIR (Umatilla tribe)

City of Chelan

Lake Chelan Sportsman Association

United States Geological Survey

Washington State Parks and Recreation Commission

Washington State Recreation and Conservation Office

Lake Chelan Recreation Association

American Whitewater

From: Steven Hays, Fish & Wildlife Senior Advisor  
Public Utility District No. 1 of Chelan County (Chelan PUD)  
steve.hays@chelanpud.org  
(509)661-4181

Re: Lake Chelan Hydroelectric Project No. 637 (Project)  
30 Day Review and Comment Period - Chelan River Biological Objectives  
2017 Status Report

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Dear Chelan River Fishery Forum and Other Parties:

The Draft Chelan River Biological Objectives 2017 Status Report is attached for your review and comment. The review period is 30 days.

Please submit your comment letters on or before 5:00 p.m., April 3, 2017, to Steve Hays via email at [steve.hays@chelanpud.org](mailto:steve.hays@chelanpud.org). In order to facilitate documentation of your comments and Chelan PUD's responses to comments regarding significant substantive issues, please provide those comments and any supportive rationales or data in a separate document so that it can be incorporated into the record of consultation. I have provided the report in PDF format. However, upon request I will provide a copy in MSWORD if you wish to propose editorial changes using the review features in MSWORD to make your suggested edits.

All comments received will be incorporated into a summary table and appended to the Final Report, Chelan River Biological Objectives 2017 Status Report, with a notation regarding how each comment or recommendation was incorporated in the report, or, if not incorporated, the reasons why the comment was not incorporated.

If you have any questions, please do not hesitate to contact me at (509-661-4181) or by email.

Steven Hays

Fish and Wildlife Senior Advisor

[steve.hays@chelanpud.org](mailto:steve.hays@chelanpud.org)

(509) 661-4181

# **CHELAN RIVER BIOLOGICAL OBJECTIVES 2017 STATUS REPORT**

**LICENSE ARTICLE 408**

**Draft**

**LAKE CHELAN HYDROELECTRIC PROJECT  
FERC Project No. 637**

**February 28, 2017**



**Public Utility District No. 1 of Chelan County  
Wenatchee, Washington**

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## ***SECTION 1: INTRODUCTION***

The Lake Chelan Hydroelectric Project (Project) is owned and operated by the Public Utility District No. 1 of Chelan County (Chelan PUD). The Federal Energy Regulatory Commission (FERC) license for operation of this project (License), issued on November 6, 2006, authorizes Chelan PUD to operate the Lake Chelan dam and powerhouse for a period of 50 years. As part of the normal operation of the Project, Chelan PUD withdraws water from Lake Chelan for power generation and discharges that water through the powerhouse into an excavated tailrace, which leads to the confluence of the Chelan River and the Columbia River. Flows released from the Chelan Dam follow the natural channel of the Chelan River, joining with the powerhouse tailrace flows and discharging to the Columbia River. As a requirement of the new License, minimum flows were established for the Chelan River and that flow was initiated on October 15, 2009.

The License incorporated conditions regarding biological objectives that were anticipated to be achieved in the Chelan River and Project tailrace. These biological objectives are set forth in the Chelan River Biological Evaluation and Implementation Plan (CRBEIP), which is part of the Lake Chelan Settlement Agreement (October 8, 2003) and is incorporated into the License as Appendix A. The Washington State Department of Ecology (Ecology) incorporated these biological objectives into their 401 Water Quality Certification for the Lake Chelan Hydroelectric Project (Certification) and the FERC, in turn, incorporated the terms and conditions of the Certification into the License. One of the conditions incorporated into the License requires Chelan PUD to file Biological Objectives Status Reports every two years, beginning four years after the effective date of the License. On March 11, 2010, Chelan PUD filed for an extension of time to complete the structural changes to the Project necessary to implement minimum flows and other measures necessary for achievement of the biological objectives, and also to change the dates for the Biological Objectives Status Reports such that they would begin four years after implementation of the minimum flows. On May 19, 2010, FERC granted this time extension, which set the date for the first report to be due April 30, 2013. This third Biological Objectives Status is due April 30, 2017.

The purpose of this Biological Objectives Status Report is to: (1) summarize the results of monitoring and evaluation program detailed in the CRBEIP and evaluate the need for modifications to that program; (2) describe the degree to which the biological objectives have been achieved, and the prospects for achieving those objectives in the next reporting period; (3) review management options taken to meet those biological objectives; and (4) recommend any new or modified restoration and/or monitoring and evaluation measures that are needed to meet, to the extent practicable, the biological objectives. Such recommendations shall contain a schedule for timely implementation. The Chelan River study reaches and biological objectives are shown in Table 1-1.

This report describes the results of monitoring and evaluation programs (M&E) that have been implemented since placement of spawning gravels in the Project tailrace (2008) and completion of the spawning and rearing habitat in Reach 4 of the Chelan River (Habitat Channel) and implementation of minimum flows (October 2009). This report is organized into three sections that pertain to specific biological objectives described in the CRBEIP: (1) biological objectives for Chinook Salmon; (2) biological objectives for Steelhead Trout; and (3) biological objectives for Cutthroat Trout. There are specific measurement objectives for Chinook Salmon and Steelhead Trout in this report, including spawning survey counts, distribution of redds, intragravel dissolved oxygen levels, egg to fry emergence survival rates and presence of rearing juveniles. The measurement objective for Cutthroat Trout is the presence of 200 fish at various age classes.

**Table 1-1. Criteria for achievement of biological objectives in the Chelan River.**

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
<p>Chinook Salmon Spawning Habitat Reach 4 and Tailrace</p>	<p>Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality)</p>	<p>Field measurement to confirm achievement of physical parameters. The presence and success of spawning fish will also be considered in the determination of achievement.</p>	<p>Years 1 – 10, as needed to set flows or further modify channel</p>	<p>Must be met</p>	<p>Must be met</p>
<p>Chinook Salmon Spawning Habitat Use Reach 4 and Tailrace</p>	<p>Distribution of spawning use should reflect distribution of constructed spawning habitat</p>	<p>Spawning use, numbers, distribution and habitat characteristics of selected redds. Qualitative judgment</p>	<p>Years 1 – 10, as needed to set flows</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>
<p>Chinook Salmon Spawning Habitat Quality, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence</p>	<p>Intragravel Dissolved Oxygen <math>\geq 6.0</math> mg/l</p>	<p>During all scheduled (non-emergency) powerhouse shutdowns, tailrace intragravel DO monitored hourly. During egg incubation, tailrace and Reach 4 intragravel DO monitored each week hourly for at least one 24-hour period</p>	<p>Years 1-5. Extend if additional measures needed or as recommended by CRFF</p>	<p>Must be met unless determined not a Project effect</p>	<p>Must be met unless determined not a Project effect</p>

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
<p>Chinook Salmon</p> <p>Spawning Success, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence</p>	<p>Egg to emergence success equal to &gt; 80% of Methow River average or 70% survival, whichever is less</p>	<p>At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF</p>	<p>Years 1-5</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>
<p>Chinook Salmon</p> <p>Juvenile Rearing Habitat Use, Reach 4/Tailrace</p>	<p>Presence and use of available habitat</p>	<p>Snorkel surveys from emergence until fish move into Columbia River (emergence – June). Qualitative judgment</p>	<p>Years 1-5. Extend for next 5 years if fry use is low</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
<p>Chinook Salmon Adult Use of Habitat, Reach 4/Tailrace</p>	<p>Adult production of fish produced in Chelan River</p>	<p>Ratio of Chelan River origin/other origin adult carcasses in spawning population</p>	<p>Years 1-10</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>
<p>Steelhead Trout Spawning Habitat Reach 4 and Tailrace</p>	<p>Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality)</p>	<p>Field measurement to confirm achievement of physical parameters. The presence and success of spawning fish will also be considered in the determination of achievement.</p>	<p>Years 1 – 10</p>	<p>Must be met</p>	<p>Must be met</p>
<p>Steelhead Trout Spawning Habitat Use Reach 4 and Tailrace</p>	<p>Distribution of spawning use should reflect distribution of constructed spawning habitat</p>	<p>Spawning use, numbers, distribution and habitat characteristics of selected redds. Qualitative judgment. Spawning surveys years 1-2 biweekly, weekly years 3-10, March – May or as needed to set flows</p>	<p>Years 1 – 10, extend if additional measures needed</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain habitat achieved</p>

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Steelhead Trout  Spawning Habitat Quality, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Intragravel Dissolved Oxygen $\geq 6.0$ mg/l	During all scheduled (non-emergency) powerhouse shutdowns, tailrace intragravel DO monitored hourly. During egg incubation, tailrace and Reach 4 intragravel DO monitored each week hourly for at least one 24-hour period	Years 1-5. Extend if additional measures needed or as recommended by CRFF	Must be met unless determined not a Project effect	Must be met unless determined not a Project effect
Steelhead Trout  Spawning Success, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Egg to emergence success equal to > 80% of Methow River average or 70% survival, whichever is larger	At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF	Years 1-5	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain best habitat achieved
Steelhead Trout  Juvenile Rearing Habitat Use, Reach 4/Tailrace	Fry presence and use of available habitat	Snorkel surveys from emergence until fish move into Columbia River. 8 times per year, only when redds observed in area. Qualitative judgment	Years 3-10	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
<p>Steelhead Trout Outmigrant success</p>	<p>Adult production of fish produced in Chelan River – net benefit to ESU</p>	<p>Best professional judgment of CRFF and/or new technology showing adult origin</p>	<p>Years 5-10</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>
<p>Cutthroat Trout Habitat, Reaches 1-3</p>	<p>Presence of 200 fish including various age classes. Habitat improvements for Cutthroat Trout, as related to water temperature may include: new, naturally evolved stream channel; riparian shade; thermal refugia/pumping studies; increased flows</p>	<p>Snorkeling surveys, number, distribution, age of resident fish. Cross-sectional and average stream temperature measurements. Flow measurements.</p>	<p>Years 1-5 will serve as establishment. If 200 fish not achieved in year 5, then either continue studies for: A- 10 years beyond year 5 of New License to allow natural Cutthroat Trout colonization from Lake Chelan; or B- 5 years beyond year 5 of New License if no natural colonization is evident and test sample of Cutthroat Trout is deemed necessary by CRFF</p>	<p>Maintain actions</p>	<p>Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.</p>

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
<p>Cutthroat Trout</p> <p>Create habitat to support a viable population of Cutthroat Trout in Reaches 1-3</p>	<p>200 resident fish</p>	<p>Number of fish via snorkeling surveys as specified in Table 7-10</p>	<p>Years 5-10</p>	<p>Maintain Actions. No additional actions needed</p>	<p>Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented</p>

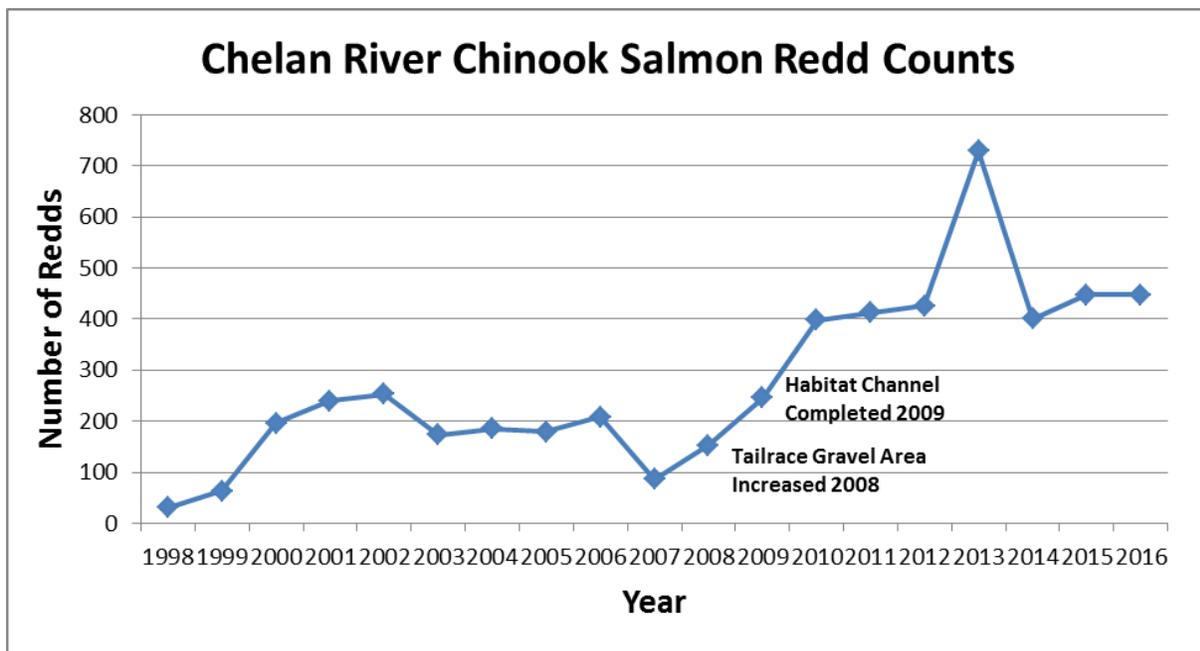
## SECTION 2: BIOLOGICAL OBJECTIVES FOR CHINOOK SALMON

### 2.1 Spawning Habitat for Chinook Salmon Meets Design Characteristics

The CRBEIP states that “salmon and steelhead spawning habitat will be created in Reach 4 and the tailrace, with the objective to create suitable depth, cover, velocity and substrate conditions for these fish. These parameters can be measured independently of fish use, although fish use is the best evidence of achievement. The criteria for achievement are to document that habitat was created and maintained, in accordance with the preference curves established in the IFIM study. Alternatively, if adult fish runs are strong and colonization occurs during the evaluation period, then the presence and success of spawning fish will also be considered in the determination of achievement. Achievement will be evident if spawning fish are distributed in suitable areas in the tailrace, Reach 4 and below the confluence of Reach 4 and the tailrace. Lack of fish will not be termed a failure without evidence that a Project effect prevented fish from using the habitat.”

Chinook Salmon spawning has been observed in the Project tailrace at its confluence with the Columbia River since the 1980s, with redd counts prior to 1993 ranging from 16 – 69 redds per year (Chelan PUD, 1991). Documented redd counts (Hillman, et al. 2016) since 1998 (Table 2-1) show that the spawning population increased to around 200 redds prior to construction of the additional habitat beginning in 2008 (Figure 2-1). The fish per redd (FPR) and escapement estimates in Table 2-1 are based on the male:female sex ratio of summer Chinook Salmon sampled at Wells Dam (Hillman, et al. 2016).

**Figure 2-1. Chelan River Historical Redd Counts.**



The tailrace spawning habitat was created in 2008, with fish use observed in that year. Additional Chinook Salmon and Steelhead Trout spawning habitat was created in 2009, with the habitat available for use by Chinook Salmon in that year. The design parameters (depth, cover, velocity, substrate) defined in the CRBEIP were successfully constructed according to 30%, 60%, 90% and final design plans that were reviewed and approved by the CRFF (Appendix A). Confirmation that suitable spawning habitat for Chinook Salmon was created in the tailrace and in Reach 4 did not require post-construction physical measurements because both areas of new habitat were immediately colonized by Chinook Salmon in the first year following construction and that use has continued.

The full achievement of this biological objective has been documented through spawning survey redd counts, which show use by Chinook Salmon has increased since the construction of this habitat. Since gravel placement in the tailrace and the construction in Reach 4 of the Habitat Channel, the combined Chinook Salmon redd counts in the tailrace, in the Habitat Channel and in the Columbia River below the confluence have increased (Table 2-1). Prior to 2008, the highest redd count was 253. The annual redd counts have increased from an average of 160 redds per year (1998 – 2007) to an average of over 400 redds per year since 2008 when the additional tailrace habitat was constructed.

**Table 2-1. Chelan River Chinook Salmon Redd Counts and Escapement Estimates.**

<b>Year</b>	<b>FPR</b>	<b>Redds</b>	<b>Escapement</b>
1998	3.00	30	90
1999	2.20	63	139
2000	2.40	196	470
2001	4.10	240	984
2002	2.30	253	582
2003	2.42	173	419
2004	2.25	185	416
2005	2.93	179	524
2006	2.02	208	420
2007	2.20	86	189
2008	3.25	153	497
2009	2.54	246	625
2010	2.81	398	1118
2011	3.10	413	1280
2012	3.07	426	1308
2013	2.31	729	1684
2014	2.75	400	1100
2015	3.21	448	1438
2016	2.01	448	900

## **2.2 Chinook Salmon Use of Spawning Habitat Throughout Constructed Habitat**

Spawning has also been distributed throughout the suitable habitat created in the tailrace and in the Reach 4 Habitat Channel and pool area (Table 2-2). In addition to the increased spawning habitat in the tailrace (completed 2008), the new spawning habitat in Reach 4 has had an average of over 140 redds per year since its construction in 2009.

**Table 2-2. Chelan River Chinook Salmon and Coho Salmon Redd Count Distributions.**

<b>Year</b>	<b>Tailrace</b>	<b>Reach 4</b>	<b>Columbia R</b>	<b>Total</b>
2008	153	NA	In tailrace count	153
2009	129	79	58	266
2010	234	115	49	398
2011	192	178	48	418
2012	231	139	56	426
2013	320	269	140	729
2014	246	78	76	400
2015	217	125	106	448
2016	207	167	74	448

### ***2.2.1 Temporary Habitat Channel Flow Reduction and Chinook Salmon Spawning Habitat Availability***

Flow provided in the Chelan River Habitat Channel for Steelhead Trout and Chinook Salmon is a minimum of 320 cfs by a combination of spill and pumping, per the Chelan River Biological Evaluation and Implementation Plan (CRBEIP). Five pumps are available to meet the minimum spawning flow requirement in the Habitat Channel. The pump station was designed to provide 240 cfs at minimum tailwater elevations (maximum "lift" from intake screen to canal, which means minimum discharge per pump). This assured that the 320 cfs minimum flow would always be provided with the addition of the 80 cfs minimum flow coming from Reaches 1-3. However, at normal tailwater elevations, the 5 pumps often discharge from 250-260 cfs and the total Habitat Channel flows during both the Chinook Salmon and Steelhead Trout spawning periods have frequently been 340-350 cfs, which is 20-30 cfs higher than the minimum design flow.

Ecology, Washington Department of Fish and Wildlife (WDFW), and Chelan PUD staff have observed that water velocities being provided in the Habitat Channel, particularly for Steelhead Trout, were higher than desirable when all pumps are operating. Observations included Ecology's Habitat Suitability Index (HSI) measurements, which showed more suitable habitat at lower flows, flow observations in stream margin habitat and log structures during early rearing of Chinook Salmon fry, and best professional judgment that the Habitat Channel would provide more habitat for Steelhead Trout spawning and juvenile Chinook Salmon rearing at lower flows. A remedy for reducing flows in the Habitat Channel for Chinook Salmon and Steelhead Trout

spawning and Chinook Salmon fry early rearing is to reduce the number of pumps operated during the March 15 through May 15 Steelhead Trout spawning period.

These observations led to a decision by the Chelan River Fishery Forum (CRFF) to use adaptive management, as envisioned during the discussions that led to the design of the Habitat Channel, to evaluate conditions for Chinook Salmon and Steelhead Trout spawning under the reduced flow conditions that would be provided if only four pumps were used. The proposed temporary change in pumped flow operation, developed by the CRFF, was as follows:

### **Proposal**

1. Conduct a pump station reduced flow operation during the Chinook Salmon spawning period in 2013
2. Operate 4 pumps instead of 5 pumps from October 15 through November 30, 2013
3. Conduct Chinook Salmon spawning ground surveys, as required by the Lake Chelan comprehensive Settlement Agreement
4. Compare Chinook Salmon redd distribution in the Habitat Channel in 2013 to redd distribution from spawning ground survey redd mapping from 2009 through 2012
5. If Chinook Salmon redd distribution in the Habitat Channel appears to be similar in 2013 to previous years, then conduct the same pump station operation (4 pumps versus 5) during the Steelhead Trout spawning period, March 15 through May 15, in 2014
6. If Chinook Salmon redd distribution in the Habitat Channel appears to be significantly different in 2013 to previous years, then return to 5 pump operation for the Steelhead Trout spawning period in 2014.

Flow conditions for spawning and redd distributions of Chinook Salmon did not demonstrate any reduction in spawning habitat suitability or use with the reduction in flow in 2013. Operation of 4 pumps, instead of 5 pumps, has been used for the past four Chinook Salmon spawning seasons (2013 – 2016). Similarly, flow provided from the pumps has been reduced during the Steelhead Trout spawning seasons from 2014 – 2016.

Information displayed in Table 2-2 demonstrates that Chinook Salmon spawning use of the Habitat Channel and upstream pool area did not decrease following the change in pumped flow. The redd counts for Reach 4 (Habitat Channel and pool) from 2009 – 2012 ranged from 79 - 178 redds, while Reach 4 redd counts from 2013 – 2016 have ranged from 78 – 269 redds. The total number of redds in all areas was somewhat higher during the four years of reduced flows to the Habitat Channel, but the percentage of total redds in the Reach 4 area did not change, with the 2009 – 2012 average being 33 percent in Reach 4, while the 2013 – 2016 average was 30 percent in Reach 4.

Chelan PUD is in the process of seeking a permanent amendment to the Project's license to change the required spawning flows to allow continued operation with four pumps. The proposal

is to change the Reach 4 minimum spawning flow requirement from 320 cfs to 260 cfs. This proposal is currently out for review and approval by the CRFF and will be submitted to FERC as a request to amend license Articles 405 and 408, as well as associated documents. An amendment to Ecology's 401 Water Quality Certification is also necessary to amend the minimum spawning flow requirement.

#### Degree of Achievement of Objectives

Objectives 2.1 and 2.2 have been achieved fully:

**M&E Results:** The results described above document that the habitat areas constructed to support spawning of Chinook Salmon meet the design criteria, as evidenced by Chinook Salmon successfully spawning in this habitat. The Chinook Salmon redds have been distributed throughout the constructed habitat in Reach 4 and the tailrace.

**Objective Achievement:** This objective has been achieved fully. Since construction of the habitat, Chinook Salmon redd counts have increased from an average of 160 redds per year (1998 – 2007) to an average of over 400 redds per year since the additional habitat was constructed.

**Management Actions Taken:** The Project is being operated to maintaining the achievement of this objective by maintain powerhouse generation in the tailrace and providing pumped flow to the Habitat Channel. In addition, Lake Chelan spill levels are being managed to the extent practicable to protect the Reach 4 Habitat Channel from damage due to high flows and to limit bed load accumulations in the tailrace spawning habitat at the Reach 4 confluence. In the summer of 2014, bed load accumulations of river cobble at the confluence of the Reach 4 high flow channel were excavated to reduce the potential of Chinook Salmon redd dewatering during low water conditions in the Columbia River. The river cobbles removed were suitable spawning gravel material and were stockpiled on the shoreline at the site for potential future use. Redd surveys in the fall of 2014 documented Chinook Salmon spawning use in the excavated area, demonstrating that the maintenance operation maintained the depth, velocity and substrate characteristics suitable for Chinook Salmon spawning. Very high spring flows in 2016 deposited even more river bed load in that area, which was removed prior to initiation of Chinook Salmon spawning in 2016. In addition, the pool area upstream of the Habitat Channel was excavated to remove accumulations of river bed material.

**Future Actions:** The amount of pumped flow needed to provide good spawning conditions in the Habitat Channel was experimentally reduced to provide a minimum flow of 260 cfs instead of the 320 cfs minimum flow required in the Project's license. Monitoring determined that Chinook Salmon redd counts in the Habitat Channel did not decrease as a result of the lower minimum flow. Chelan PUD is in the process of seeking a permanent amendment to the Project's license to change the required spawning flows to a minimum of 260 cfs. Maintenance for management of river bed material will continue as needed.

### **2.3 Chinook Salmon Tailrace Intragravel Dissolved Oxygen $\geq$ 6.0 mg/l**

The License required that the Project be operated to achieve the CRBEIP biological objective to provide conditions suitable for Chinook Salmon survival from egg to emergence. Specifically the requirement is to operate the Project powerhouse to maintain intragravel dissolved oxygen (IGDO) levels of 6.0 mg/l or higher to support survival of Chinook Salmon from egg deposition to emergence. If it is not reasonable and feasible to operate the powerhouse to meet this requirement, or if the spawning gravel placed in the tailrace does not have sufficient permeability to meet this requirement, then the CRBEIP allows for alternative actions, such as use of the pump station to increase water circulation in the tailrace or physical modification of the habitat through addition of more permeable substrate and/or use of pumps and pipes under the substrate to create upwelling flows within the spawning gravel.

Studies to determine the level of powerhouse operation needed to meet IGDO requirements were conducted for four incubation seasons from 2011 - 2015. These studies monitored dissolved oxygen meters taking hourly IGDO readings in the egg pockets of 10 redds during each incubation season. Different periods of powerhouse outages and powerhouse flow levels were tested to determine the powerhouse operations necessary to meet the dissolved oxygen requirement. These tests indicated that operation of the powerhouse with one turbine at minimum generation (approximately 800 cfs) maintains intragravel dissolved oxygen levels above 6.0 mg/l. For limited times, powerhouse flow can be shut off with minimal reductions of oxygen levels in the salmon redds, particularly early (December – January) in the incubation season. During the final year of the study, twice daily periods of three hours with no flow from the powerhouse, with one hour of 800 - 1100 cfs flow in between the two periods, maintained oxygen levels above 6.0 mg/l in all ten redds that were monitored during December and January. However, similar operations in February and March demonstrated that oxygen levels dropped below 6.0 mg/l in a number of the monitored redds. The results of the dissolved oxygen studies were presented in detail in the 2013 and 2015 Biological Objectives Status Reports.

#### Degree of Achievement of Objective

Objective 2.3 has been achieved fully:

M&E Results: Four years of studies determined that IGDO levels in tailrace redds may fall below 6.0 mg/l if the powerhouse discharge is discontinued for more than three hours. Late in the incubation period (February – March), IGDO levels may fall below 6.0 mg/l in less than three hours. Powerhouse flows of about 800 cfs are sufficient to maintain IGDO levels above 6.0 mg/l.

Objective Achievement: The objective of providing minimum IDGO levels of 6.0 mg/l in tailrace Chinook Salmon redds is achieved by maintaining powerhouse flows with one

turbine operating at minimum generation flows (approximately 800 cfs) throughout the spawning and incubation period (October 15 – March 31).

Management Actions Taken: Extensive modeling work has been undertaken by Chelan PUD to develop operating procedures that will manage power generation operations to best meet both the tailrace IDGO requirements and refill timing requirements for recreational use in Lake Chelan. These operating procedures incorporate, at a minimum, operation of one turbine at minimum generation throughout the incubation period to maintain IDGO levels. In the event of an unplanned electrical grid or other system reliability event the operating guidelines require a minimum flow of 800 cfs for one hour out of every 4 hours (1 hour on, 3 hours off). This requirement is effective from December 1 – March 31. During the October 15 – November 30 spawning period, a similar procedure applies but with a higher minimum flow (one turbine at full load, approximately 1,100 cfs) to promote spawning activity. During the 2015 – 2016 spawning and incubation period, there was a three hour system reliability event on November 19, 2015, with flows restored to 2,530 cfs on the fourth hour. There were no system reliability events during the 2016 – 2017 spawning and incubation season.

Future Actions: Maintenance activities, both at the Project and in areas of the electrical grid that are necessary for operation of the powerhouse, will be planned to avoid the October 15-March 31 spawning and incubation period. Management of Lake Chelan storage will continue to assure operation of the powerhouse as necessary to achieve this objective.

#### **2.4 Egg to emergence success equal to > 80% of Methow River average or 70% survival**

Studies of Chinook Salmon egg to emergence survival were also initiated in 2011, in conjunction with the IGDO studies. A set of studies conducted in the Columbia River, Hanford Reach, measured egg to emergence survival for Chinook Salmon, using a technique they developed suitable for placing a known number of eggs in a container with local substrate in a manner that can be done by divers in relatively deep, flowing water (Oldenburg et al. 2012). The Hanford Reach studies used cylindrical egg tubes (CET) to place 100 eyed eggs in the tube, then manually excavated an area to simulate a redd, and burying the CET at the same depth as found in the egg pockets of nearby, natural redds. At the end of the study, the CETs are retrieved and the number of live Chinook Salmon fry counted in the CET provides an estimate of egg to emergence survival. Chelan PUD adapted this study methodology to address the biological objective that egg to emergence survival be either greater than 80 percent of the average egg to emergence survival in good quality spawning areas in the Methow River or meet 70 percent survival outright, whichever is less.

The 2011-2012 study was designed to evaluate egg to emergence survival in four different areas, including: (1) the tailrace in the area filled with gravel to create more spawning habitat; (2) the area at the confluence of the tailrace and Reach 4 of the Chelan River, where the spawning gravel has accumulated as a result of natural processes; (3) in the Columbia River on the alluvial

fan formed below the confluence of the Chelan and Columbia rivers; and (4) in the Chelan River Habitat Channel. The new spawning gravels placed in the tailrace and the spawning areas in the Habitat Channel were the areas being tested to determine if the biological objective for egg to emergence survival is being met in these constructed areas. The naturally occurring spawning areas at the confluence of the tailrace and Reach 4 and on the alluvial fan in the Columbia River were meant to serve as a natural control for comparison.

The CET studies were repeated for three years, but the use of CETs was only successful in the Habitat Channel. In the tailrace and in the Columbia River, most of the eggs in CETs died prior to hatching or shortly after hatching, as also happened with CET control sites placed in the tailrace with just a light covering of cobble. This was contrasted with apparently successful incubation and fry survival observed in natural Chinook Salmon redds by divers when replacing or removing dissolved oxygen sensors. However, the CETs did function well in the shallower water and higher velocities of the Habitat Channel. The CET methodology in the tailrace was replaced with monthly direct sampling of Chinook Salmon redds by divers to determine egg to emergence survival. These redd sampling studies were conducted during the 2013-2014 and 2014-2015 incubation periods.

The CET studies in the Habitat Channel have demonstrated that egg to emergence survival exceeds 70 percent. The average survival of eggs to emergent fry in the CETs placed in the Habitat Channel was 81percent, while control CETs in the Habitat Channel had 90 percent survival. The CET survival data in the Habitat Channel, from upper (A) to lower (E) spawning sections, is in Table 2-3.

**Table 2-3. Habitat Channel CETs Egg – Emergent Fry Survival.**

Location/year	Section	Live Fry	Dead Fry	Dead Eggs	Notes
Habitat Channel 2011-2012	A	94	0	6	
	B	53	0	-	Eggs not countable
	C	59	0	-	Eggs not countable
	D	43	0	-	Eggs not countable
	E	96	0	4	
Habitat Channel 2012-2013	A	91	0	9	
	B	98	0	4	
	C	95	0	5	
	D	90	1	10	
	E	98	0	2	
Habitat Channel 2013-2014	A	40	34	4	Tube Washed Out
	B	89	0	-	Eggs not countable
	C	94	0	2	
	D	77	0	6	
	E	97	0	2	
<b>Average Survival</b>	<b>All</b>	<b>81%</b>			
	<b>Sections</b>				
Habitat Channel 2011-2012	Control	85	2	11	
	Control	93	1	2	
	Control	75	0	16	
Habitat Channel 2012-2013	Control	91	0	8	
	Control	93	0	6	
	Control	88	0	11	
Habitat Channel 2013-2014	Control	95	0	6	
	Control	99	0	0	
	Control	92	1	3	
	Control	94	0	0	
<b>Average Survival</b>	<b>All</b>	<b>90%</b>			
	<b>Controls</b>				

Survival of Chinook Salmon eggs and pre-emergent fry in redds in the tailrace was measured for two incubation periods, 2013-2014 and 2014-2015, by hand excavating into egg pockets of redds. Active egg pockets have been excavated by divers until either eggs or hatched fry are located, at which time an underwater airlift tube is used to collect approximately 80-100 embryos. The contents of each sample were enumerated as either live or dead, eggs or fry, to estimate the survival rate for that redd. At the conclusion of each sample, the excavated egg pocket and surrounding area was refilled with the excavated material to prevent further disturbance to the redd. The sampling design was to sample one redd in each zone of the tailrace, from upstream to downstream, in the vicinity of each of the 10 dissolved oxygen probes. The sampling events were scheduled to occur five times over the course of the incubation period.

These events have been in December at time of oxygen probe placement, once in January, once in early February, once late February or early March and at time of oxygen probe removal in late March.

The redd samples in 2013-2014 had an overall survival rate of 87 percent (Table 2-4). The redd samples in 2014-2015 had an overall survival rate of 86 percent (Table 2-5). It is noteworthy that these survival rates were reached despite having a number of periods with no powerhouse flow for oxygen probe installation in December and later redd sampling events and, in 2013-2014, extensive periods of time with only minimum generation flows from the powerhouse.

The other finding of the tailrace redd sampling is that most Chinook Salmon fry had completely absorbed the yolk sac by the time of the March 25, 2014 sampling. The findings were similar during sampling on March 24, 2015. This level of development is consistent with the accumulated temperature units from surface water temperatures, which predicts that over 1000 temperature units would have been accumulated by that date for 95 percent of the redds that year. Accumulation of 1000 temperature units is commonly considered to be the average incubation period for emergence timing of Chinook Salmon. In the late March sampling events, many of the fry were actively swimming away when the redd was excavated and had to be counted or netted because they were too quick for capture with the airlift tube.

#### Degree of Achievement of Objective

Objective 2.4 has been achieved fully:

M&E Results: Three years of CET egg to emergence studies in the habitat channel achieved an average survival of 81 percent. Two years of hand excavation studies of egg to emergence survival in tailrace Chinook Salmon redds demonstrated an average survival rate of over 86 percent.

Objective Achievement: The objective that Chinook Salmon egg to emergence survival be at least 70 percent in the constructed spawning habitat in the tailrace and Habitat Channel has been achieved fully.

Management Actions Taken: Project operations provided for continuation of minimum generation flows during the October – March spawning and incubation period to ensure that favorable survival conditions were maintained in the tailrace. Minimum flows of 80 cfs were maintained in the Habitat Channel. Accumulations of gravel and cobble in the tailrace below the confluence with the high flow channel in Reach 4 were removed in 2014 and 2016 to prevent Chinook Salmon redds on high points in the deposition zone that could be subject to dewatering during low Columbia River flows.

Future Actions: Continue to operate the Project to maintain minimum generation flows from October 15 – March 31 and maintain minimum flows in the Habitat Channel. Maintenance for management of river bed material at the confluence with the Reach 4 high flow channel will continue as needed.

**Table 2-4. Tailrace Redd Excavation Egg – Emergent Fry Survival, 2013-2014.**

Date	Location	Live Egg	Dead Egg	Live Fry	Dead Fry	% Survival	Mean of Samples
12/15/2013	T1	130	1	0	0	99%	
12/15/2013	T2	88	2	0	0	98%	
12/15/2013	T3	83	13	7	0	87%	
12/15/2013	T4	0	0	118	4	97%	
12/15/2013	T5	118	21	0	0	85%	
12/15/2013	C1	186	3	0	0	98%	
12/15/2013	C2	11	2	96	2	96%	
12/15/2013	C3	62	0	0	0	100%	
12/15/2013	C4	104	2	1	0	98%	
12/16/2013	C5	1	0	36	26	59%	
	Total	783	44	258	32	93.2%	91.8%
1/16/2014	T1	113	3	3	2	96%	
1/16/2014	T2	0	6	97	1	93%	
1/16/2014	T3	150	3	1	1	97%	
1/16/2014	T4	7	2	1	0	80%	
1/16/2014	T5	153	1	8	1	99%	
1/15/2014	C1	0	4	64	2	91%	
1/15/2014	C2	123	3	0	0	98%	
1/15/2014	C3	16	2	44	4	91%	
1/15/2014	C4	0	4	61	10	81%	
1/15/2014	C5	5	0	45	1	98%	
	Total	454	25	321	20	94.5%	92.5%
2/4/2014	T1	0	2	81	2	95%	
2/4/2014	T2	54	4	14	3	91%	
2/4/2014	T3	0	0	78	6	93%	
2/4/2014	T4	0	0	98	3	97%	
2/4/2014	T5	0	0	64	2	97%	
2/4/2014	C1	0	0	97	0	100%	
2/5/2014	C2	0	2	73	1	96%	
2/5/2014	C3	2	2	65	1	96%	
2/5/2014	C4	0	1	70	2	96%	
2/5/2014	C5	0	1	119	2	98%	
	Total	56	10	678	20	96.1%	95.8%
2/25/2014	T1	0	2	108	0	98%	
2/25/2014	T2	0	2	139	0	99%	
2/25/2014	T3	0	4	99	0	96%	
2/25/2014	T4	0	59	3	0	5%	
2/25/2014	T5	0	2	95	0	98%	
2/25/2014	C1	0	86	4	0	4%	
2/25/2014	C2	0	79	32	0	29%	
2/26/2014	C3	0	0	1	133	1%	
2/26/2014	C4	0	0	144	2	99%	
2/26/2014	C5	0	0	84	5	94%	
	Total	0	232	601	140	61.8%	62.3%
3/25/2014	T1	0	3	87	0	97%	
3/25/2014	T2	0	4	100	0	96%	
3/25/2014	T3	0	1	127	0	99%	
3/25/2014	T4	0	3	69	0	96%	
3/25/2014	T5	0	14	73	0	84%	
3/25/2014	C1	0	13	115	1	89%	
3/25/2014	C2	0	0	114	0	100%	
3/25/2014	C3	0	3	104	0	97%	
3/26/2014	C4	0	0	92	6	94%	
3/26/2014	C5	0	0	97	3	97%	
	Total	0	38	891	10	94.9%	94.9%
<b>Grand Total</b>		<b>1293</b>	<b>349</b>	<b>2749</b>	<b>222</b>	<b>87.6%</b>	<b>87.4%</b>

**Table 2-5. Tailrace Redd Excavation Egg – Emergent Fry Survival, 2014-2015.**

Date	Location	Live Egg	Dead Egg	Live Fry	Dead Fry	% Survival	Mean of Samples
12/10/2014	T1	201	15	0	0	93%	
12/10/2014	T2	191	2	0	0	99%	
12/10/2014	T3	75	0	0	0	100%	
12/10/2014	T4	95	1	0	0	99%	
12/10/2014	T5	261	3	0	0	99%	
12/11/2014	C1	151	3	0	0	98%	
12/11/2014	C2	87	29	0	0	75%	
12/11/2014	C3	53	18	0	0	75%	
12/11/2014	C4	119	2	24	0	99%	
12/11/2014	C5	108	1	0	0	99%	
	Total	1341	74	24	0	95%	94%
1/6/2015	T1	67	2	0	0	97%	
1/6/2015	T2	72	2	0	0	97%	
1/6/2015	T3	92	5	0	0	95%	
1/6/2015	T4	0	1	67	1	97%	
1/5/2015	T5	104	0	0	0	100%	
1/5/2015	C1	131	3	0	1	97%	
1/5/2015	C2	79	4	0	0	95%	
1/5/2015	C3	0	2	64	0	97%	
1/5/2015	C4	4	80	5	0	10%	
1/5/2015	C5	78	3	0	0	96%	
	Total	627	102	136	2	88%	88%
2/10/2015	T1	0	0	102	0	100%	
2/10/2015	T2	0	0	33	0	100%	
2/10/2015	T3	0	99	1	0	1%	
2/10/2015	T4	0	93	20	0	18%	
2/10/2015	T5	0	4	36	1	88%	
2/10/2015	C1	2	4	64	0	94%	
2/10/2015	C2	0	0	113	1	99%	
2/11/2015	C3	11	2	108	11	90%	
2/11/2015	C4	0	0	88	3	97%	
2/11/2015	C5	0	3	56	0	95%	
	Total	13	205	621	16	74%	78%
3/11/2015	T1	0	0	89	4	96%	
3/11/2015	T2	0	1	65	1	97%	
3/11/2015	T3	0	2	84	1	97%	
3/11/2015	T4	0	0	88	1	99%	
3/11/2015	T5	0	0	89	1	99%	
3/12/2015	C1	0	2	112	2	97%	
3/12/2015	C2	0	0	78	2	98%	
3/12/2015	C3	0	0	124	4	97%	
3/12/2015	C4	0	30	72	3	69%	
3/11/2015	C5	0	0	98	2	98%	
	Total	0	35	899	21	94%	94%
3/24/2015	T1	0	2	98	12	88%	
3/24/2015	T2	0	1	98	2	97%	
3/24/2015	T3	0	2	74	44	62%	
3/24/2015	T4	0	0	83	0	100%	
3/24/2015	T5	0	13	68	0	84%	
3/24/2015	C1	0	6	74	0	93%	
3/24/2015	C2	0	1	75	21	77%	
3/24/2015	C3	0	0	96	34	74%	
3/24/2015	C4	0	2	57	9	84%	
3/24/2015	C5	0	3	0	108	0%	
	Total	0	30	723	230	74%	76%
<b>Grand Total</b>		<b>1981</b>	<b>446</b>	<b>2403</b>	<b>269</b>	<b>86.0%</b>	<b>86.0%</b>

### **2.5 Juvenile Rearing Habitat – Chinook Salmon Use Available Habitat From Emergence - June**

The Biological Objective to provide early rearing habitat for Chinook Salmon fry is that the available habitat, particularly habitat constructed in Reach 4, is used by Chinook Salmon fry from time of emergence until they move out into the Columbia River. Snorkel surveys have been conducted in the tailrace and Reach 4 in 2010 (May only), and with surveys in April, May, June, August, September and November from 2012 - 2016. Due to high spill levels, the July 2012 survey was cancelled. In addition to snorkel surveys, Chinook Salmon fry have been observed in Reach 4 during Steelhead Trout spawning surveys and other activities. Some of the surveyors have attempted to distinguish Chinook Salmon fry from Coho Salmon fry and have given separate counts for each species, however it is very difficult to make that determination without actually having the fish in hand. Chinook Salmon and Coho Salmon counts have been combined in Table 3-1, but separate counts are provided in the survey data spreadsheet in Appendix A.

**Table 2-6. Chelan River Chinook Salmon and Coho Salmon Fry Counts.**

Year	Location	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Nov.
2010	Tailrace	-	-	0	-	-	-	-	-
2010	Channel	-	-	3945	-	-	-	-	-
2010	Pool	-	-	845	-	-	-	-	-
2012	Tailrace	0	0	2670	285	-	0	0	0
2012	Channel	0	0	2312	0	-	0	0	0
2012	Pool	0	8	0	-	-	0	0	0
2013	Tailrace	0	25	9000	5	0	0	0	0
2013	Channel	0	0	3845	1	1	0	0	0
2013	Pool	0	5	30	1	1	0	0	0
2014	Tailrace	0	4090	3000	0	0	0	0	0
2014	Channel	0	11035	4710	0	0	0	0	0
2014	Pool	0	2600	22	0	0	0	0	0
2015	Tailrace	0	50	100	0	0	0	0	0
2015	Channel	0	2073	95	0	0	0	0	0
2015	Pool	2	0	393	0	0	0	0	0
2016	Tailrace	1250	NS	2679	0	0	0	0	0
2016	Channel	3304	NS	6637	6	1	0	0	0
2016	Pool	1236	NS	0	0	0	0	0	0

Chinook Salmon fry have been observed using the available habitat in each year surveyed. Prior to 2016, the observation of few Chinook Salmon fry in March and April was due to surveys being conducted in the daytime when water temperatures were low (<12 °C). The survey in April 2014 was later in the month (4/24) and water temperatures had been warmer for over a week prior to the survey (>12 °C). Monthly surveys were conducted in 2016, with nighttime surveys in January, February, March and December. There was no April survey in 2016 due to high flows and the snorkel survey was scheduled for the first week in May when spill flows could be reduced for two days in order to complete the snorkel surveys and a separate macroinvertebrate

study. The nighttime surveys observed two Chinook Salmon fry in mid-January and 307 in late February, with large numbers of Chinook Salmon fry rearing in the shallow shoreline margins by the end of March (water temperature 8.8 °C). The results of the monthly snorkel surveys are presented in detail in a separate report (Appendix B).

Chinook Salmon fry have moved out of the pool, Habitat Channel and tailrace by the June surveys, which have been conducted after mid-June. Water temperatures during the June surveys have ranged from 17 °C – 19 °C. Water temperatures from late April – May range from 12 °C – 17 °C, which results in rapid growth for Chinook Salmon fry in the Chelan River and tailrace. The larger members of the population have been observed in deeper and swifter water on the outside edge of the log structures during May surveys.

#### Degree of Achievement of Objective

Objective 2.5 has been achieved fully:

M&E Results:. Snorkel surveys have confirmed that large numbers of Chinook Salmon fry are rearing in shallow water, low velocity habitat in the tailrace, Habitat Channel and pool. The highest use coincides with beginning of emergence in March and continues through May and into June. Most Chinook Salmon fry have moved out of the Chelan River habitats by late June.

Objective Achievement: The objective to provide early rearing habitat for Chinook Salmon fry has been met, with extensive use of shallow water, low velocity rearing habitat

Management Actions Taken: Log structures, boulder clusters and extensive plantings of willows and other riparian shrubs were included during construction of the Habitat Channel. These habitat features, particularly inundated willow zones and log structures, were observed to harbor large numbers of Chinook Salmon fry during snorkel surveys.

Future Actions: Continue Lake Chelan storage management to avoid, to the extent practicable, very high flows in the Chelan River that could damage riparian zones in the Habitat Channel. Manage river bed material accumulations to prevent extensive deposition in the Habitat Channel.

#### **2.6 Evidence of Adult Production from Chinook Salmon Produced in Chelan River**

Chinook Salmon from the Upper Columbia summer Chinook Salmon stock that spawns in the tailrace and Reach 4 Habitat Channel are adapted to simultaneously rear and migrate downstream toward the ocean as they grow. However, to be certain that the spawning and rearing habitat created in the tailrace and Reach 4 of the Chelan River is providing suitable conditions to support this life history, the CRBEIP contains the Biological Objective that there be evidence of naturally produced adult Chinook Salmon returning to this habitat as an indication of achievement. In addition to spawning surveys, the carcasses of Chinook Salmon that died after spawning are collected and examined for marks, primarily a clipped adipose fin indicating the

presence of a coded wire tag (CWT) in the snout. The snouts of carcasses are collected and processed for extraction and identification of the CWT, which identifies fish from hatchery releases and other programs. In addition, a sample of scales is also taken, if possible, and the scales are analyzed to determine the age of the fish and whether of natural or hatchery origin. The information from both sources is combined to produce an estimate of the composition of the spawning population by origin and brood year.

Prior to construction of the tailrace spawning habitat and Habitat Channel spawning and rearing channel, carcasses had been collected from the summer Chinook Salmon that were spawning in the gravel deposits below the confluence of the Chelan and Columbia rivers. These fish historically were a mix of natural and hatchery origin fish. The marked hatchery fish were predominately produced by the Turtle Rock and Wells hatchery programs, while the unmarked fish could be a combination of natural production from the existing habitat and unmarked fish from both these hatcheries and other sources. Over time, an increase in either the ratio of natural origin Chinook Salmon carcasses or in the total number of unmarked Chinook Salmon using the tailrace and Habitat Channel would indicate that adult production has increased following creation of this habitat. Since the number of spawners is variable due to different survival between years, the ratio of natural to hatchery origin spawners might be expected to be the least variable, provided that hatchery release numbers, locations and stray rates remained constant from year to year. However, that has not been the case. Since 2007 part of the Turtle Rock fish production was released directly into the Chelan tailrace. The Turtle Rock program was relocated in fall of 2011 to a new rearing facility at the Chelan tailrace and all fish are now released at that location. The release of yearling summer Chinook Salmon smolts into the Chelan tailrace went from about 100,000 – 200,000 smolts from 2007 and 2011, to 500,000 – 600,000 from 2012 - 2015 (Hillman et al, 2016). The increase in these direct releases has affected the size of the spawning population due to the influx of returning adult Chinook Salmon that are homing back to the release site. The ratio of hatchery produced spawners, compared to naturally produced spawners, would be expected to increase, particularly since smolt to adult survival rates are high for the hatchery releases. If the ratio of hatchery produced spawners did not increase, then a logical inference would be that natural production of adult returns to the Chelan River has increased over time.

The production of natural origin adult Chinook Salmon from the Chelan tailrace and Habitat Channel can be estimated by comparing historical to current and future numbers of natural origin fish using that spawning area. The increase in the quantity and quality of habitat for both spawning and initial fry rearing would be expected to result in an increase in the number of naturally produced Chinook Salmon spawning in the Chelan River. The total number of spawners is estimated from redd counts using a fish per redd factor (Table 2-1). The proportion of natural origin fish in the spawning population for that year can be estimated from carcass surveys, as discussed above. The product of that proportion and the total number of spawners

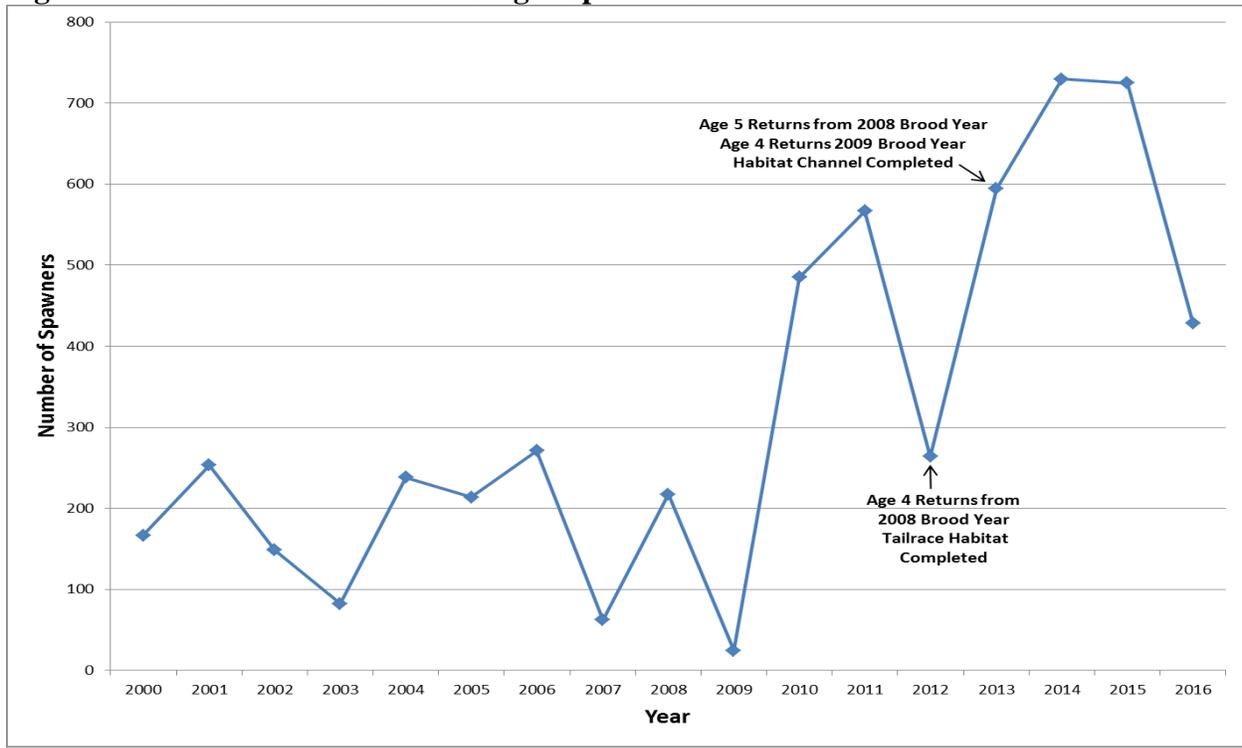
yields an estimate of natural origin Chinook Salmon in the spawning population. If the rate of natural origin Chinook Salmon straying into the Chelan River from other spawning populations is relatively constant, then an increase in the natural origin spawning population in the Chelan tailrace and Habitat Channel would be evidence of adult production originating from this habitat. The number of natural origin Chinook Salmon using the Chelan tailrace and Habitat Channel has been higher since 2010 than prior to construction of these habitat areas (Table 2-6; Figure 2-2). However, the first two years of higher returns were prior to the year that the first adults (four year old) could return from fish that spawned in the expanded tailrace habitat in 2008. High survivals and increased spawning escapements of summer Chinook Salmon have been observed in both natural and hatchery origin populations over the past decade. Thus, there has been some increase in the number of natural origin Chinook Salmon using the Chelan River spawning habitat that is independent of returning adults produced from that habitat. In spite of the large increase in the number of hatchery smolts released into the Chelan tailrace, the proportion of naturally produced fish in the spawning population has been high for the past three years (Table 2-8). The combination of sustained higher numbers and a higher proportion of naturally produced Chinook Salmon in the spawning population, despite a major increase in the release of hatchery smolts into the tailrace, indicates that adult Chinook Salmon production has increased since construction of the new spawning and rearing habitat.

**Table 2-7. Natural and Hatchery Origin Chinook Salmon Spawning in the Chelan Tailrace and Habitat Channel.**

Return Year	Hatchery	Wild	Hatchery	Wild
Return Year	Proportion		Number of Fish	
	Hatchery	Wild	Hatchery	Wild
2000	0.65	0.35	304	166
2001	0.74	0.26	731	253
2002	0.74	0.26	433	149
2003	0.80	0.20	337	82
2004	0.43	0.57	178	238
2005	0.59	0.41	310	214
2006	0.36	0.64	149	271
2007	0.67	0.33	127	62
2008	0.56	0.44	280	217
2009	0.96	0.04	600	25

Return Year	Hatchery	Wild	Hatchery	Wild
Return Year	Proportion		Number of Fish	
	Hatchery	Wild	Hatchery	Wild
2010	0.57	0.43	633	485
2011	0.56	0.44	713	567
2012	0.80	0.20	1044	264
2013	0.65	0.35	1090	594
2014	0.34	0.66	370	730
2015	0.50	0.50	713	725
2016	0.52	0.48	471	429

**Figure 2-2. Chelan River Natural Origin Spawners.**



Degree of Achievement of Objective

Objective 2.6 has been achieved based on the available evidence:

M&E Results: Spawning surveys and carcass surveys have demonstrated an increase in the number of natural origin spawners in the Chelan River. The combination of sustained higher numbers and a higher proportion of naturally produced Chinook Salmon in the spawning population, despite a major increase in the release of hatchery smolts into the tailrace, indicates that adult Chinook Salmon production has increased since construction of the new spawning and rearing habitat.

Objective Achievement: The objective that there be evidence of adult production of Chinook Salmon produced in the Chelan River has been achieved based on the increase in natural origin spawners since construction of the additional spawning and rearing habitat. This is further confirmed by a high proportion of naturally produced adult Chinook Salmon in the carcass surveys.

Management Actions Taken: Construction of additional spawning and rearing habitat in the tailrace and Reach 4 of the Chelan River was completed in 2008 and 2009. Powerhouse operations have been managed to assure high egg to emergence survival in the tailrace. Minimum flows have been maintained Reach 4 to maintain high egg to emergence survival and shallow water rearing habitat.

Future Actions: Continue Lake Chelan storage management, powerhouse operations and minimum flows to the Chelan River to protect the habitat from high flows and to maintain the conditions that lead to high egg to emergence survival and good rearing habitat.

### ***SECTION 3: BIOLOGICAL OBJECTIVES FOR STEELHEAD TROUT***

#### ***3.1 Spawning Habitat for Steelhead Trout Meets Design Characteristics***

The CRBEIP states that “salmon and Steelhead Trout spawning habitat will be created in Reach 4 and the tailrace, with the objective to create suitable depth, cover, velocity and substrate conditions for these fish. These parameters can be measured independently of fish use, although fish use is the best evidence of achievement. The criteria for achievement are to document that habitat was created and maintained, in accordance with the preference curves established in the IFIM study. Alternatively, if adult fish runs are strong and colonization occurs during the evaluation period, then the presence and success of spawning fish will also be considered in the determination of achievement. Achievement will be evident if spawning fish are distributed in suitable areas in the tailrace, Reach 4 and below the confluence of Reach 4 and the tailrace. Lack of fish will not be termed a failure without evidence that a Project effect prevented fish from using the habitat.”

Steelhead Trout spawning has been observed in the Habitat Channel in six of the seven years since Steelhead Trout spawning flows were first provided in 2010. The number of redds has varied, with 11 redds in 2010, 21 redds in 2011, 7 redds in 2012, 21 redds in 2013, 0 redds in 2014, 3 redds in 2015 and 2 redds in 2016. The Steelhead Trout redd surveys since 2011 were made weekly, beginning in late March and continuing into June or until high flows precluded further observations. Surveys are conducted by observing from high points overlooking the tailrace and pool area and walking both shores of the Habitat Channel. Steelhead Trout redds have not been observed in the tailrace, except for the shoreline margin in flow exiting the Habitat Channel (one redd each in 2011 and 2013).

While the number of redds observed per year has decreased since 2013, this decrease coincides with a decrease in the number of Steelhead Trout adults available to populate the Chelan River. The number of Steelhead Trout counted passing over Rocky Reach Dam averaged nearly 19,000 per year from 2009 – 2012 (13,100-29,547), whereas the Steelhead Trout return from 2013 – 2015 averaged about 10,000 per year (9,204-10,894). Most of the Steelhead Trout return is during the summer and fall of the year preceding spawning, thus these dates match the spawning years of 2010 – 2013 and 2014-2016. There are no releases of hatchery Steelhead Trout into the Chelan River.

The first redds have been observed in late March, with the majority of spawning initiated in early to mid April. In 2011, one redd was initiated at the end of May. In the Habitat Channel, more Steelhead Trout redds (2011-2016) have been observed in the downstream sections than in the upper sections. However, this may in part be due to greater ability to observe redds in the lower section. The snorkel surveys in 2016 observed Steelhead Trout adults, likely on a redd, in the upper part of the Habitat Channel in water too deep to observe the redd from shore. A few redds have also been observed in the pool formed by the hydraulic control structure. Most of the redds have been in the vicinity of cover from either boulders or log structures or in deep water runs near structure. Steelhead Trout redds were located in areas with smaller substrate, primarily in small gravels less than two inches in diameter. There are limited amounts of this smaller substrate except in the lower part of the Habitat Channel and in the pool area.

Another factor that may be affecting the habitat available for Steelhead Trout spawning is that velocities in some areas of the Habitat Channel are greater than desired to provide the preferred velocities for this species. The pumping station is designed to provide 240 cfs under low tailwater conditions, which when combined with the 80 cfs minimum flow in Reach 1 of the Chelan River yields the design minimum spawning flow of 320 cfs. In spring, when Steelhead Trout spawning occurs, the tailwater level is usually not low and the discharge from the pumps under that condition typically result in Habitat Channel flows of 340 cfs or greater. Depth and velocity measurements taken in 2011 and 2013 at Steelhead Trout redds found most were within the expected preferences for this species, but some redds were deeper than 30 inches (8 of 34) or with mid-depth velocities exceeding three feet per second (4 of 34). Also, the higher flows reduce the available low velocity habitat preferred by Chinook Salmon fry, which are rearing in the Habitat Channel from April – June. The Chelan River Fishery Forum has approved testing a lower flow during the Steelhead Trout spawning period, which is discussed in Section 3.2.1. Future operations at that lower flow are being requested as a permanent modification to the Project's license.

The Habitat Channel was constructed to provide spawning and rearing habitat for Chinook Salmon and Steelhead Trout, with an expectation that the wood and boulder cover and riffle habitat would provide suitable conditions for Steelhead Trout spawning and early rearing. It appeared that the availability of suitable small gravel substrate has diminished over time, including some of the areas of the Habitat Channel where Steelhead Trout redds had been observed. To provide more small gravel substrate, the CRFF approved the addition of 70 cubic yards of small gravel to various locations in the Habitat Channel. This gravel was placed in late summer of 2014. Two of the five redds observed in 2015 – 2016 were in locations where small gravel was added, while the other three were in locations that already had adequate small gravel available.

Ecology and WDFW have been measuring Habitat Channel cross-sections for depth, velocity, substrate and cover. These data have been modeled to estimate weighted useable area for

Steelhead Trout spawning, with 15 transects extrapolated to predict the percent of the channel suitable for Steelhead Trout spawning conditions based on current Washington State preference curves for Steelhead Trout spawning. The modeling study evaluated the percent of the channel with suitable substrate, combined depth/velocity, and overall useable area for Steelhead Trout spawning (Jim Pacheco, CRFF presentation 2015). The addition of gravel in 2014 improved the proportion of suitable channel bed from 37.6% useable to 41.4% useable substrate. Evaluation of depth/velocity suitability at different flows showed that lower flows would increase suitable spawning area in the Habitat Channel. The overall useable area estimates, with the 2014 gravel addition, were 13.5% useable area at 300 cfs flow and 16.0% useable area at 250 cfs flow.

### Degree of Achievement of Objective

Objective 3.1 has been achieved based on the available evidence:

M&E Results: Steelhead Trout spawning has been observed in the Habitat Channel in six of the seven years since Steelhead Trout spawning flows were first provided in 2010. The number of redds has varied, with 11 redds in 2010, 21 redds in 2011, 7 redds in 2012, 21 redds in 2013, 0 redds in 2014, 3 redds in 2015 and 2 redds in 2016. The lower number of Steelhead Trout redds from 2014 – 2016 coincides with low Steelhead Trout run size returning to habitats upstream from Rocky Reach Dam. Depth and velocity measurements taken in 2011 and 2013 at Steelhead Trout redds found most were within the expected preferences for this species, but some redds were deeper than 30 inches (8 of 34) or with mid-depth velocities exceeding three feet per second (4 of 34). The addition of small gravel in 2014 improved the proportion of suitable channel bed from 37.6% useable to 41.4% useable substrate. Evaluation of depth/velocity suitability at different flows showed that lower flows would increase suitable spawning area in the Habitat Channel. The overall useable area estimates, with the 2014 gravel addition, were 13.5% useable area at 300 cfs flow and 16.0% useable area at 250 cfs flow.

Objective Achievement: The objective that spawning habitat for Steelhead Trout meets design criteria is met based on the fact that Steelhead Trout redds have been observed in six of seven years, most Steelhead Trout redds observed were at depths and velocities within the preferences for this species, and habitat modeling by Ecology found useable spawning habitat existed in the Habitat Channel.

Management Actions Taken: Lower flows during the spawning period have been evaluated and implemented on a trial basis from 2014-2016. Small gravel of the size preferred by Steelhead Trout was added to the Habitat Channel in 2014, resulting in an increase in the useable substrate area. The gravel additions were located in areas with suitable depths and velocities for Steelhead Trout spawning.

Future Actions: Provide reduced flows during the Steelhead Trout spawning period, pending approval by the CRFF and FERC. Monitor the availability of small gravel in areas with preferred depths and velocities for Steelhead Trout spawning and replenish as needed.

### **3.2 Steelhead Trout Use of Spawning Habitat Throughout Constructed Habitat**

The distribution of Steelhead Trout redds within the Habitat Channel was fairly even between the upper and lower parts of the channel in 2010 and 2011. However, by 2013 the preponderance of redds was in the lower channel areas, while the upper part of the channel had only three of the 20 redds observed in the Habitat Channel. This observation is concurrent with the observation that some of the small gravel patches in the upper Habitat Channel that were previously used by spawning Steelhead Trout appeared to have diminished. The Habitat Channel has changed over time, with a more pronounced thalweg and some shallow shoreline areas now growing willows and trapping sand. This is a natural evolution of the stream channel in response to annual flow cycles. As previously mentioned, 70 cubic yards of small gravel was placed in the upper and middle sections of the Habitat Channel. The gravel additions were focused on areas where Steelhead Trout redds had been observed in 2011, but not present in 2013, as well as in other areas with suitable cover that appeared to have the preferred depths and velocities but lacked suitable substrate for Steelhead Trout spawning. As mentioned, two of the five redds observed in 2015-2016 were in a location where small gravel had been depleted and was replenished in 2014. The probable deep water redd location that was observed during the 2016 snorkel surveys was also in a location where gravel was added in 2014, but the existence of this redd could not be confirmed during daytime redd surveys. This probable redd was in the uppermost section of the Habitat Channel, where few redds have been observed since 2013.

Very high spill flows occurred during 2016 in May and most likely small gravel was moved downstream, depleting some of the areas where gravel was placed in 2014. The Steelhead Trout population migrating past Rocky Reach dam in 2016 was the lowest (5,728) since 1999, thus there could be few Steelhead Trout available to spawn in the Habitat Channel in 2017. However, a Steelhead Trout egg to emergence study is scheduled to take place in the Habitat Channel in 2017 and the presence of small gravel areas suitable for Steelhead Trout spawning will be evaluated during that study.

#### **Degree of Achievement of Objective**

Objective 3.2 was achieved in 2010-2011, but distribution has not been even since then

M&E Results: The distribution of Steelhead Trout redds within the Habitat Channel was fairly even between the upper and lower parts of the channel in 2010 and 2011. However, by 2013 the preponderance of redds was in the lower channel areas, while the upper part of the channel had only three of the 20 redds. Small gravel additions in 2014 were intended

to replenish gravel suitability in the upper Habitat Channel for the 2015 and 2016 spawning seasons, but few Steelhead Trout redds were observed in these years.

**Objective Achievement:** The objective that Steelhead Trout use of spawning habitat be dispersed throughout the constructed habitat appeared to be met in the first three years of monitoring, but has not been met since 2013. Replenishment of small gravel in the Habitat Channel has been initiated with the intent to improve distribution of Steelhead Trout spawning.

**Management Actions Taken:** Lower flows during the spawning period have been evaluated and implemented on a trial basis from 2014-2016. Small gravel of the size preferred by Steelhead Trout was added to the Habitat Channel in 2014, resulting in an increase in the useable substrate area. The gravel additions were located in areas with suitable depths and velocities for Steelhead Trout spawning and directed towards increasing useable habitat in the upper part of the Habitat Channel.

**Future Actions:** Provide reduced flows during the Steelhead Trout spawning period, pending approval by the CRFF and FERC. Monitor the availability of small gravel in areas with preferred depths and velocities for Steelhead Trout spawning and replenish as needed.

### **3.3 Steelhead Trout Tailrace/Reach 4 Intragravel Dissolved Oxygen $\geq 6.0$ mg/l**

Since there have not been any Steelhead Trout redds in the tailrace that are dependent on powerhouse flows, there has been no need to provide powerhouse flows during the Steelhead Trout incubation period. The only redds observed were adjacent to the shoreline above the Chelan Falls highway bridge in flowing water coming from the Habitat Channel. Although suitable substrate and velocities exist in some parts of the tailrace, no Steelhead Trout have used it for spawning, possibly due to lack of any boulder, wood or vegetative cover. Also, the substrate in the Habitat Channel spawning area is porous and free of sediments, thus Steelhead Trout redds would not lack intragravel flow. Water quality monitoring in the Habitat Channel has demonstrated that the surface water meets the water quality standards for dissolved oxygen during the Steelhead Trout spawning and incubation season. Since the Habitat Channel is never without sufficient flow to maintain intragravel dissolved oxygen, there is no need to monitor intragravel dissolved oxygen.

#### **Degree of Achievement of Objective**

Objective 3.3 is achieved because Steelhead Trout redds only occur in areas with continuous flow

**M&E Results:** No Steelhead Trout redds have been observed in areas without continuous flow.

**Objective Achievement:** This objective is achieved because no Steelhead Trout redds have been observed in areas that are dependent on powerhouse flows to maintain IGDO  $\geq 6.0$  mg/l.

Management Actions Taken: Continuous flow has been maintained at required levels in all areas where Steelhead Trout redds have been observed.

Future Actions: This objective has been met by nature of maintaining continuous flow and by design of the clean substrate in the Habitat Channel. If in the future a landslide or other natural disaster were to cause heavy deposition of fine sediments into the Habitat Channel, then the substrate would need to be restored to a clean gravel condition through excavation and replacement or other suitable method. Steelhead Trout egg to emergence survival studies discussed in the next section will also confirm that IGDO  $\geq$  6.0 mg/l since lower IGDO would not meet the 70 percent survival objective.

### **3.4 Egg to emergence success equal to > 80% of Methow River average or 70% survival**

The survival from egg to emergence of Steelhead Trout has not been evaluated due to technical issues that make such evaluation difficult. Since Steelhead Trout are listed as threatened under the Endangered Species Act (ESA), actions to disturb redds such as redd capping or excavation are considered a “take” and prohibited except under permits. An experiment using egg baskets will be conducted in 2017 and will use surplus hatchery Steelhead Trout eggs from a stock not listed under the ESA. However, it is difficult to find hatchery Steelhead Trout eggs that match the timing of Steelhead Trout spawning in the Habitat Channel. The study design includes collection of adult Steelhead Trout in March or April from a source where late arriving fish can be captured.

#### Degree of Achievement of Objective

Objective 3.4 has not yet been evaluated. The expectation is that the egg to emergence survival will meet the objective based on the studies done for Chinook Salmon egg to emergence survival. A study will be conducted in 2017.

### **3.5 Juvenile Rearing Habitat – Steelhead Trout Use Available Habitat Until Enter Columbia River**

Steelhead Trout emergence timing in the Chelan River is predicted to occur in June, based on spawning timing and accumulated temperature units. There were no Steelhead Trout fry or parr observed during snorkel surveys in 2012 because high spill flows began prior to emergence of Steelhead Trout, which made the snorkel survey ineffective and may also have flushed emerging Steelhead Trout fry out of the Habitat Channel. However, in 2013 the snorkel surveys in June and July found Steelhead Trout fry in the Habitat Channel and upstream in the pool (Appendix A). Steelhead Trout fry (mostly 40 mm size range) were observed on June 15 in very shallow boulder/cobble areas of the stream margin. In July, the Steelhead Trout were larger and flow was lower (82 cfs), with the parr inhabiting midstream areas behind large boulder/cobbles. Only a few parr were observed in August. Since there were no Steelhead Trout redds in 2014, there were no Steelhead Trout fry observed. There were no Steelhead Trout fry or parr observed during snorkel surveys in 2015, either.

The monthly surveys conducted in 2016 documented use of the Habitat Channel and tailrace by parr and pre-smolt sized *O. mykiss* during the months of December – March. Since only one Steelhead Trout fry or parr was observed in May – June, it is unknown whether these fish present in winter were Steelhead Trout or Rainbow Trout that either migrated in from the Columbia River or migrated downstream from the upper Chelan River. Parr (*O. mykiss* < 6 inches long) counts ranged from 41 in March to 6 in December and 14 in both January and February. Pre-smolt sized *O. mykiss* (6-9 inches long) counts ranged from 5-13 fish during those months, however there were 37 fish of that size counted in July.

The pool, Habitat Channel and tailrace were also used by larger *O. mykiss* (9-12 inches; > 12 inches) throughout the year. The highest count of 9-12 inch fish was 33 in November. These fish could also include pre-smolt or residual Steelhead Trout that migrated out the next spring since there were not any *O. mykiss* in that size class observed in May or June.

#### Degree of Achievement of Objective

Objective 3.3 was likely achieved in 2013, but it is not known if in other years due to high flows.

M&E Results: High flows in June and July have prevented observations of Steelhead Trout fry and parr rearing in all years, except 2013, when sufficient numbers of Steelhead Trout redds were present to provide Steelhead Trout fry to seed the available rearing habitat.

Objective Achievement: This objective was likely achieved in 2013, but it is unknown if Steelhead Trout fry have used Reach 4 for rearing. Since high flows in June and July would occur in the absence of the Project, there may not be a Project Effect even if Steelhead Trout fry are unable to rear in the Habitat Channel due to high flows.

Management Actions Taken: Management of the Lake Chelan storage to meet recreation target elevations and minimize high flows in the Chelan River has been in effect since 2009. However, spill occurs in June during Steelhead Trout emergence in most years due to the amount of inflow from snow melt entering Lake Chelan. This natural occurrence may limit the suitability of the Reach 4 Habitat Channel for Steelhead Trout fry rearing even though spill flows in May have not prevented use of rearing habitat for Chinook Salmon fry.

Future Actions: Continue to manage refill of Lake Chelan to minimize high flows in the Chelan River in June and July to the extent practicable.

### **3.6 Evidence of Adult Production from Steelhead Trout Produced in Chelan River**

This objective has not been evaluated due to lack of a suitable method. Since Steelhead Trout do not die after spawning, there are no carcasses to evaluate. The CRBEIP recognized that measurement of this objective would require either new technology or best professional

judgment of the CRFF regarding whether Steelhead Trout spawning in the Chelan River would be successful in producing smolts and adults.

## ***SECTION 4: BIOLOGICAL OBJECTIVES FOR CUTTHROAT TROUT***

### ***4.1 Cutthroat Trout Presence of 200 Fish of Various Age Classes***

The CRBEIP provided for restoring flows to Reaches 1-3 of the Chelan River with the objective that a population of 200 Cutthroat Trout, of various age classes, would become established in the river. The initial five years following reestablishment of flows was set to wait and see if 200 Cutthroat Trout would recruit to the Chelan River from Lake Chelan during the annual spill period. If, after year 5, a population of 200 fish has not been achieved, then the CRBEIP provided for either extending the evaluation for another ten years to allow natural colonization from Lake Chelan or to stock Cutthroat Trout into the Chelan River to determine if they could survive and persist. If Cutthroat Trout failed to survive and persist, then habitat improvements directed toward reducing water temperatures were to be pursued.

Snorkel surveys were initiated in 2012 and originally included Reach 2 and the very upper portion of Reach 3. However, due to safety concerns from large rocks falling into Reach 2 from unstable hillsides, snorkel surveys in Reaches 2 and 3 were discontinued in 2015. This safety concern makes it difficult to determine if the objective of 200 fish in Reaches 1-3 has been met since only Reach 1 is being surveyed. However, surveys in Reach 1 are adequate to determine if Cutthroat Trout can survive and persist, even if the Reach 1 population is less than 200 fish throughout the year.

Snorkel surveys have determined that Cutthroat Trout have been slowly colonizing from Lake Chelan, but in the first years there were more Rainbow Trout coming out of the lake than Cutthroat Trout (Table 4-1). This is probably a result of there being more Rainbow Trout than Cutthroat Trout present in Lake Chelan. Successful rearing of Cutthroat Trout to catchable size has led to a shift in fish stocking in Lake Chelan and the number of Cutthroat Trout entering the Chelan River from the lake has likely increased. However, since five years had passed without sufficient recruitment of Cutthroat Trout from Lake Chelan via spillway flows, stocking of Cutthroat Trout directly into the Chelan River was initiated in 2014.

The snorkel surveys did find Cutthroat Trout of more than one age class in 2014. The November survey found Cutthroat Trout as small as 7 inches and as large as 15 inches, which probably represents at least two age classes. However, through 2014 there had not been any young of year or yearling sized Cutthroat Trout or Rainbow Trout observed in Reaches 1-3. In order to determine if younger age classes of Cutthroat Trout can survive and persist in Reaches 1-3, the CRFF agreed that Cutthroat Trout fry and fingerlings should be planted in Reach 1 prior to surveys in 2015. Approximately 2,000 Cutthroat Trout about one inch in length (272 fish per

pound) were planted below the Low Level Outlet in October, 2014. None of these fish were observed during the November survey, but water temperature was cold enough (9.4 °C) that such small fish were likely hiding in the substrate. However, no Cutthroat Trout smaller than 6 inches in length were observed during the April 2015 survey, thus it is unlikely that any of the fall stocked Cutthroat Trout parr survived the winter.

Stocking of 200 Cutthroat Trout fingerlings, ranging in size from 4 – 7 inches (7.1 fish per pound), was initiated on March 24, 2015 and repeated on May 3, 2016. These fish, stocked in about equal numbers at two locations, just below the Low Level Outlet and about the midpoint of Reach 1, did survive and were readily observed during subsequent snorkel surveys and sampling by angling. Also, these fish grew through the summer as evidenced by changes in the size categories recorded during snorkel surveys and were in good condition (Figure 4-1). During monthly snorkel surveys in 2016, the Cutthroat Trout were classified into four size categories (<6, inches, 6-9 inches, 9-12 inches and >12 inches). While it is difficult to estimate fish size during snorkeling, the proportion of fish in the 6-9 inch category decreased over the summer, while the proportion of fish in the 9-12 inch and greater than 12 inch categories increased (Stevenson et al. 2017; Appendix B). During the September survey, no Cutthroat Trout smaller than the 9-12 inch category were observed and by the December survey the proportion of Cutthroat Trout in the greater than 12 inch category was double the number in the 9-12 inch category. There were no Cutthroat Trout less than 3 inches in length observed during the snorkel surveys in 2016, thus it is unlikely that any successful reproduction of Cutthroat Trout occurred in Reach 1 during 2016 (Stevenson et al. 2017; Appendix B).

The number of Cutthroat Trout in Reach 1 of the Chelan River counted during snorkel surveys increased from January (6 fish) to July (214 fish), then decreased from August to December (Table 4-1). The number of Cutthroat Trout observed in December (62 fish) was ten times greater than observed in January and nearly three times greater than the number observed in November, 2015 (22 fish). The peak count of 214 fish in July most likely included fish from the May stocking event and Cutthroat Trout that entered Reach 1 from Lake Chelan. In addition to the Cutthroat Trout counted in Reach 1, there were also 68 Cutthroat Trout (60 in 9-12 inch size) counted in the pool and Habitat Channel during the June survey. Spillway flows in May and June exceeded 9,000 cfs and 6,000 cfs, respectively, thus Cutthroat Trout observed in the Reach 4 pool and Habitat Channel likely represented downstream movement of these fish from Reaches 1 – 3 of the Chelan River.

The snorkel surveys have determined that some colonization of adult Cutthroat Trout has occurred, but no young age classes (less than 3 inches in length) have been observed thus far in either Cutthroat Trout or Rainbow Trout. Planting of test fish for these younger age classes was initiated in the fall of 2014 to provide a means to evaluate the suitability of the Reach 1 habitat for these smaller fish, but none were documented as having survived the winter. Natural reproduction of Cutthroat Trout would occur in spring and young of year parr would be expected

to approach 1 inch by early fall, but there have been no observations thus far of fish in this size class. Surveys of Reaches 2 and 3 have proven to not be feasible due to safety concerns. A number of large rocks recently fallen into Reach 2 were noted during the November 2014 survey.

The frequency of rock fall is sufficient to warrant suspension of snorkel surveys in Reach 2 for safety reasons. Future surveys will be limited to Reach 1. However, sufficient habitat area may exist in Reach 1 to support a Cutthroat Trout population of 200 fish, thus future measurement of progress toward meeting this objective may be possible with the reduced survey area. Since the December survey ended the year with at least 62 Cutthroat Trout in Reach 1, with an unknown number of these fish in Reaches 2 and 3, it is likely that the 200 fish of various age classes in Reaches 1-3 is an objective that can be achieved and documented in the future.

The absence of small, young of year, Cutthroat Trout in surveys thus far is more likely due to lack of a spawning population rather than lack of suitability of the habitat to support rearing fry and parr. The prevalence of annual high spill flows and lack of low velocity habitat in Reach 1 may be unfavorable for Cutthroat Trout reproduction. However, natural reproduction of Cutthroat Trout is not a required biological objective for Reaches 1-3. The requirement that the 200 Cutthroat Trout be of various age classes was intended to assure that Cutthroat Trout be able to survive throughout the year. Cutthroat Trout that carry over from one year to the next would contribute to a population of various age classes.

**Table 4-1. Cutthroat Trout and Rainbow Trout counted in snorkel surveys in Chelan River Reaches 1-3.**

NS- No Survey		2012			2013			2014		
		March	August	November	April	August	November	April	August	November
Cutthroat Trout	R1	0	NS	0	5	0	0	19	11	20
	R2	0	NS	NS	0	0	0	2	2	1
	R3	8	NS	NS	3	2	0	NS	NS	NS
Rainbow Trout	R1	7	NS	12	5	0	1	5	58	51
	R2	0	NS	NS	0	11	7	5	39	32
	R3	5	NS	NS	5	0	0	NS	NS	NS
		2015			2016					
		April	September	November	January	February	March	May	June	July
Cutthroat Trout	R1	20	24	22	6	12	18	82	189	214
Rainbow Trout	R1	11	24	46	22	39	41	22	34	41
		August	September	October	November	December				
Cutthroat Trout	R1	129	111	86	72	62				
Rainbow Trout	R1	31	44	32	38	14				

**Figure 4-1. Cutthroat Trout stocked in Reach 1 on 3/24/15 and recaptured 6/24/15 (photo by Graham Simon, WDFW).**



Degree of Achievement of Objective

Objective 4.1 will likely be achieved by 2018 with continued stocking.

M&E Results: Recruitment of Cutthroat Trout from Lake Chelan via spillway flows did not provide enough Cutthroat Trout colonizing Reach 1 for evaluation, thus stocking was initiated. Survival and growth of fingerling Cutthroat Trout stocked in the spring of 2015 was promising and snorkel surveys in 2016 ended the year with 62 Cutthroat Trout observed in December. Stocking of one inch long Cutthroat Trout in the fall did not appear to be successful. Snorkel surveys in Reaches 2 and 3 have not been possible due to safety concerns.

Objective Achievement: This objective will likely be achieved by 2018 with continued stocking of Cutthroat Trout, but it may be necessary to survey Reaches 2 and 3 in order to confirm presence of at least 200 Cutthroat Trout. Cutthroat Trout stocked in 2015 and 2016 continued to grow and survive through the high water temperatures in July, August and September.

Management Actions Taken: Management of the Lake Chelan storage to meet recreation target elevations and minimize high flows in the Chelan River has been in effect since 2009. Cutthroat Trout stocking of fingerling-sized fish began in 2015.

Future Actions: Continue to stock fingerling-sized Cutthroat Trout in the spring and continue to evaluate survival through the summer and subsequent winter in Reach 1.

**4.2 Create Habitat to Support a Viable Population of Cutthroat Trout in Reaches 1-3**

The CRBEIP has the objective of taking reasonable and feasible actions to improve habitat in Reaches 1-3 if necessary to establish a viable population of Cutthroat Trout. The primary measures envisioned as potentially necessary were related to management of high summer water temperatures. The temperature modeling study completed in 2016 (WEST Consultants, 2016) determined that a small decrease in daily maximum water temperature (up to 1 °C) could be achieved by increasing July minimum flows from 80 cfs to 200 cfs. However, Cutthroat Trout have shown to survive summer water temperature, most likely by finding hyporheic flow as a refuge during peak daytime temperatures. An increase in minimum flow to reduce daytime high temperature by 1 °C would also increase nighttime minimum temperature by the same amount (West Consultants, 2016). If the Cutthroat Trout are relying on hyporheic flow to mitigate peak water temperatures in the afternoon, they are likely also finding relief during the nighttime when minimum water temperatures are 3-5 degrees cooler than the afternoon peak (West Consultants, 2016). Increased flows that may reduce, through mixing, the hyporheic refuge area during daytime and increase the nighttime minimum water temperature may not provide any benefit to the Cutthroat Trout population.

Improvement in the amount of riparian vegetation in Reach 1 would potentially improve habitat for Cutthroat Trout through three mechanisms, localized water temperature cooling, increased cover and low velocity habitat during high flows, and increased coarse and fine particulate organic material to provide a food source for aquatic insects (which are a food source for Cutthroat Trout). A riparian feasibility study has been conducted which determined that it is feasible to increase shoreline riparian vegetation through planting of a willow band and some limited riparian zones on point bars and other river bends that would be partially inundated during high flows (Herrera Environmental Consultants, 2015). Although development of a mature riparian zone in Reach 1 would only reduce daytime peak water temperatures by 0.2 °C (West Consultants, 2016), the increase in shade, organic inputs and high flow refugia for small fish would all increase the quality of Reach 1 habitat for Cutthroat Trout. A riparian planting plan for Reach 1 will be developed in 2017, with riparian zone planting of willows and other species at a later time.

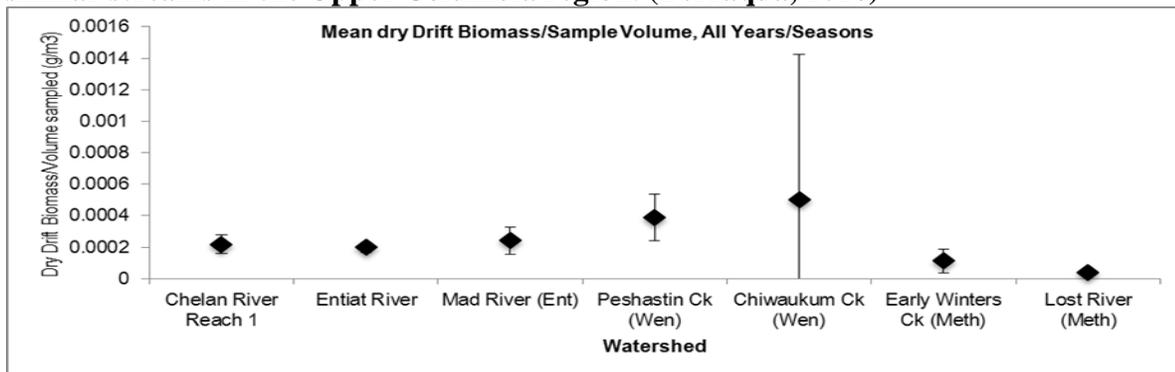
The other component necessary to support a Cutthroat Trout population in Reaches 1-3 is a source of food. As previously described, the physical condition and growth of Cutthroat Trout observed in Reach 1 has been healthy, with no indications of food being a limiting factor. The CRBEIP calls for sampling of the benthic macroinvertebrate community to determine if conditions (flows, water temperature) have allowed the development of a benthic community commensurate with the potential of the location. Since Reach 1 is lake fed and the water source is both warm and oligotrophic, the potential for development of a diverse benthic community is limited to its site potential. The CRBEIP stated that the benthic community in the Chelan River upstream of the Lake Chelan Dam would be a suitable reference site for Reach 1. The upstream pool of potential colonizers will define if the benthic community in Reach 1 has developed a diversity that meets or exceeds that of the upstream source of colonizers. The Reach 4 tailrace, which also has access for colonizing benthic organisms from the Columbia River, is also mentioned as a reference for comparison. In regards to providing nutrition for a Cutthroat Trout population, the abundance and food value of the macroinvertebrate drift community (organisms suspended in the stream, whether from aquatic benthic or terrestrial origin) is of greater importance. Monitoring and analysis of the drift community has been adopted in the Upper Columbia region as a more appropriate method for evaluating salmonid habitat value than evaluation of the diversity of the benthic macroinvertebrate community (Pacific Northwest Aquatic Monitoring Partnership, Columbia River Aquatic Habitat Monitoring Program).

The benthic macroinvertebrate population and the macroinvertebrate drift community were sampled in Reach 1 and the Reach 4 Habitat Channel in 2016. Also, benthic samples from above the Lake Chelan Dam and both benthic and drift samples were collected for use as reference comparisons. The benthic community in Reach 1 was both more abundant and slightly higher in diversity than samples taken from above the Lake Chelan Dam (Terraqua, 2017; Appendix C). Benthic kick net sample abundance was not compared to other streams outside the Chelan River

area, but diversity (taxa richness) was compared to data from a number of other streams. In these comparisons, the diversity of the benthic macroinvertebrate community in both Reach 1 and the Habitat Channel was low compared to other salmonid habitats in the region. Other lake-fed or warm water streams were included in the comparisons, but all had higher diversity than the Chelan River, thus lack of diversity is not necessarily due solely to either temperature or the low productivity of the lake water. One factor, for which there were no reference streams for comparison, is the rate of colonization that should be expected for a recently restored stream (from no flow for most of the year to a minimum flow) and with limited nearby source pools for colonizers.

The drift community had taxonomic composition and abundance that was similar to that of six reference streams from the Wenatchee, Entiat and Methow watersheds (Figure 4.2; Terraqua, 2017; Appendix C). In short, the favorable abundance and composition of the macroinvertebrate drift community is supportive of meeting the biological objective for establishment of a Cutthroat Trout population in Reaches 1-3 of the Chelan River.

**Figure 4-2. Total drift fauna biomass in Reach 1 of the Chelan River compared with 6 similar streams in the Upper Columbia region. (Terraqua, 2016)**



Degree of Achievement of Objective

Objective 4.2 has been achieved.

M&E Results: Cutthroat Trout stocked in Reach 1 during 2015 and 2016 have survived through the months of July – September when water temperatures are high. Water temperature modeling studies determined that Reach 1 has a significant amount of hyporheic exchange, which moderates daytime peak water temperatures and may provide cool water refugia for Cutthroat Trout. The Cutthroat Trout that were stocked in 2015 and 2016 demonstrated good growth rates and condition factor. The macroinvertebrate drift community, the prime source of food for Cutthroat Trout, had taxonomic composition and abundance that was similar to that of six reference streams from the Wenatchee,

Entiat and Methow watersheds. Thus, the food supply is adequate to sustain a Cutthroat Trout population of 200 fish.

**Objective Achievement:** This objective has been achieved. Cutthroat Trout have demonstrated survival throughout the year, with healthy growth and condition of fish evident during sampling and snorkel surveys.

**Management Actions Taken:** Management of the Lake Chelan storage to meet recreation target elevations and minimize high flows in the Chelan River has been in effect since 2009. Minimum flows have been maintained throughout the year.

**Future Actions:** A riparian planting plan is being prepared in 2017, which will be followed by planting of willows and other riparian vegetation. Macroinvertebrate studies of both the benthic and drift communities are continuing in 2017, with the objective to determine the abundance and diversity for a second year. This study may help determine if benthic macroinvertebrate species diversity is limited by characteristics specific to the Chelan River or if colonization is limited by lack of an upstream source of colonizing organisms. Over time, development of riparian vegetation will increase the habitat value of Reach 1 for a more diverse benthic and drift macroinvertebrate community, which should also increase food sources for Cutthroat Trout.

***SECTION 5: LITERATURE CITED***

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**APPENDIX A: SNORKEL SURVEY DATA FOR THE CHELAN RIVER**

Chelan River Habitat Channel Snorkel Fish Survey																							
Chelan River Habitat Channel Snorkel Fish Survey																							
5/20/2010 Flow/Temperature in Channel - 200 cfs/14.0 C Flow/Temperature in Tailrace (powerhouse) - 0 cfs/14.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	75	2	0	0	20	0	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	66	0	0	36	1	0	0	4	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	135	0	0	92	1	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	293	0	0	3	0	5	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	1300	0	0	17	1	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	402	0	0	66	1	1	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	1748	75	0	40	5	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	1	30	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	845	0	0	69	11	0	0	1	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	4790	105	0	399	22	6	5	20	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
3/29/2012 Flow/Temperature in Channel - 338 cfs/7.5 C Flow/Temperature in Tailrace (powerhouse) - 800 cfs/7.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	5	0	1	0	0	0	0	0	0	8	1	0	0	0	0	0	0	0	0	0	0	0
Habitat Channel	0	0	0	1	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Total	0	5	0	2	0	0	2	0	0	0	8	3	0	0	0	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
4/17/2012 Flow/Temperature in Channel - 342 cfs/10.5 C Flow/Temperature in Tailrace (powerhouse) - 800 cfs/11.2 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
#1	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	1	0	0	0	1	0	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0
#6	0	0	0	1	0	0	0	0	0	0	10	2	0	0	2	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	8	0	0	35	3	0	0	3	0	0	0	0	0	0	0	0
Total	0	3	0	2	0	1	0	8	0	0	84	14	0	0	6	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
5/16/2012 Flow/Temperature in Channel - 393 cfs/17.3 C Flow/Temperature in Tailrace (powerhouse) - 2230 cfs/16.8 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	2660	10	0	14	0	3	0	4	0	0	0	3	75	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	14	0	3	0	0	0	0	1	0	1	0	0	0
#2	0	0	0	2	0	0	0	0	0	0	343	0	1	0	5	0	0	0	0	0	4	4	4
#3	0	0	0	2 (12", Tripl.)	0	0	0	287	50	0	28	0	4	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	2 (12", Tripl.)	0	0	3	228	0	0	52	0	1	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	4	660	200	0	100	0	4	0	1	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	787	100	0	107	0	9	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	3	0	0	0	0	0	0	680	0	10	0	6	0	0	0	0	0	0	0	0
Total	0	0	0	9	0	0	7	4622	360	0	1338	0	35	0	16	0	1	3	76	4	4	4	4

Chelan River Habitat Channel Snorkel Fish Survey																							
6/20/2012 Flow/Temperature in Channel - 3261 cfs/16.8 C Flow/Temperature in Tailrace (powerhouse) - 2300 cfs/16.6 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	239	46	0	24	20	0	0	11	0	0	3	2	40	0	25	400
Habitat Channel	0	0	0	0	0	0	0	0	0	0	0	7	0	0	55	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	239	46	0	24	27	0	0	66	0	3	2	40	0	25	400	400

JULY SURVEY CANCELLED - HIGH SPILL

AUGUST REACH 1-3 SURVEYS CANCELLED - SAFETY POLICY ISSUES REGARDING ACCESS/SPILLWAY TAGOUTS

Chelan River Habitat Channel Snorkel Fish Survey																							
8/24/2012 Flow/Temperature in Channel - 83 cfs/19.7 C Flow/Temperature in Tailrace (powerhouse) - 2410 cfs/21.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	1	0	0	0	0	0	0	0	0	0	1	111	23	0	1005	0	0	0	1 (20")	0	0	0	0
Habitat Channel	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Pool	1	0	0	3 (18")	0	0	0	0	0	0	16	0	6	0	0	0	0	0	0	0	0	0	0
Total	3	0	0	3	0	0	0	0	0	0	21	111	29	0	1005	0	0	0	1	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
9/12/2012 Flow/Temperature in Channel - 84 cfs/16.9 C Flow/Temperature in Tailrace (powerhouse) - 2420 cfs/18.8 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Channel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1 (12"-15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
11/15/2012 Flow/Temperature in Channel - 338 cfs/10.8 C Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/11.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Habitat Channel	36	0	3	10 (8"-14")	0	6 (12"-18")	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	36	0	3	10	0	6	0	0	0	0	25	1	0	1	0	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
3/11/2013 Flow/Temperature in Channel - 84 cfs/6.2 C Flow/Temperature in Tailrace (powerhouse) - 843 cfs/7.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	1	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Channel	0	3	0	2 (14"-18")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	4	0	2	0	0	0	1	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
4/10/2013 Flow/Temperature in Channel - 342 cfs/10.4 C Flow/Temperature in Tailrace (powerhouse) - 2368 cfs/10.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	1	0	0	0	0	0	25	0	0	54	1	0	0	0	0	0	0	0	0	0	0	0
#1	0	2	0	1 (12"-16)	0	0	0	0	0	0	110	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	2	0	0	0	0	0	0	0	0	72	1	0	0	0	0	0	0	0	0	0	0	0
#3	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	1	0	1 (12"-16)	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1 (12"-16)	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	3	0	4 (12"-16)	0	0	0	5	0	0	158	1	1	0	1	1	0	0	0	0	0	0	0
Total	0	10	0	7	0	0	0	30	0	0	418	3	1	0	1	1	0	0	0	0	0	0	0

Chelan River Habitat Channel Snorkel Fish Survey																							
5/15/2013 Flow/Temperature in Channel - 240 cfs/16.9 C Flow/Temperature in Tailrace (powerhouse) - 2281 cfs/16.6 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	9000	0	0	55	0	15	0	0	3	0	0	0	0	229	0	0
#1	0	0	0	2 (12"-16)	0	0	0	0	0	0	200	0	0	0	0	5	0	0	0	30	0	0	0
#2	0	0	0	1 (12"-16)	0	0	0	980	10	0	425	0	0	0	0	1	0	0	0	0	0	0	0
#3	0	0	0	2 (Notes)	0	0	0	940	0	0	90	0	1	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	5 (Notes)	0	0	0	1294	1	0	150	0	0	0	1	0	0	0	0	0	0	0	0
#5	0	0	0	2 (12"-16)	0	0	0	380	1	0	100	1	1	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	2 (12"-16)	0	0	225	13	0	225	0	7	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	1 (12"-16)	0	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	2 (12"-16)	1 (12"-16)	0	0	21	9	0	825	0	18	0	0	18	0	0	0	0	0	9	0
Total	0	0	0	15	3	0	0	12841	34	0	2076	1	42	0	1	27	0	0	8	259	0	9	0
Notes	Rainbow Notes - Section3 = 1 Triploid 18", 1 RB 12"-16"; Section 4 = 2 Triploid 18", 1 possible Steelhead presmolt < 6", 2 RB 12"-16"																						
	Chinook Fry Notes - Salmonid fry (assumed Chinook) have been using the leakage water and tailrace backwater in the spill overflow since early April. This area is too shallow to snorkel																						

Chelan River Habitat Channel Snorkel Fish Survey																							
6/14/2013 Flow/Temperature in Channel - 203 cfs/19.1 C Flow/Temperature in Tailrace (powerhouse) - 2387 cfs/18.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	5	0	0	81	0	25	0	0	40	0	0	3	0	0	0	0
#1	0	0	0	1 (12"-16)	0	0	0	0	0	0	20	0	0	0	0	30	0	0	0	0	0	0	0
#2	0	0	0	1 (12"-16)	0	0	0	0	0	0	250	0	0	0	0	700	0	0	0	0	0	0	0
#3	0	0	0	4 (12"-16)	0	0	0	0	0	10	20	0	0	0	0	100	30	0	0	0	0	0	0
#4	0	0	0	1 (12"-16)	0	0	0	0	0	20	130	0	0	0	0	110	40	0	0	0	0	0	0
#5	0	0	0	2 (12"-16)	1 (12"-16)	0	0	0	0	50	125	0	2	0	0	110	30	0	0	0	0	0	0
#6	0	0	0	3 (12"-16)	1 (12"-16)	0	0	0	0	13	70	0	3	0	0	50	20	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	1	0	24	335	2	0	0	0	753	0	0	0	0	0	0	0
Pool	0	0	0	1 (12"-16)	3 (12"-16)	0	0	1	0	139	236	10	14	0	0	202	0	0	0	0	0	4	0
Total	0	0	0	13	5	0	0	7	0	256	1267	12	44	0	0	2095	120	0	3	0	0	4	0
Notes	1 Tench in Pool, numerous smallmouth fry in pool and throughout Habitat Channel																						
	Rainbow/steelhead Fry - 40mm-80mm size range with most near the 40mm part of range - inhabiting very shallow cobble/boulder habitat at stream margins																						
	Pikeminnow on Section 7 were moving back and forth between pool, under log structure and Section 7 - may have double counted																						

**Chelan River Habitat Channel Snorkel Fish Survey**  
**7/18/2013** Flow/Temperature in Channel - 82 cfs/20.1 C Flow/Temperature in Tailrace (powerhouse) - 2428 cfs/21.0 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	1	0	0	1 (12")	0	0	0	0	0	0	78	1943	30	0	0	2	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	12	0	5	8	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
#3	1	0	0	0	0	0	0	0	0	14	0	88	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	2 (<10")	0	0	0	0	1	18	10	8	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1 (16")	1 (12")	0	0	0	0	9	38	54	3	0	0	17	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	3	0	0	5 (2-18",3-16")	1 (12"-16")	0	0	1	0	0	48	34	9	0	0	54	0	0	0	0	0	0	0
Total	5	0	0	9	2	0	0	1	1	87	174	2133	50	0	0	73	0	0	0	0	0	0	0
Notes	Chinook in tailrace was a jack, one sculpin counted in Section 3											Rainbow/steelhead Parr - 30mm-60mm size range inhabiting mid stream areas behind largecobble/boulder riffle mex substrate, distinctive parr marks											

**Chelan River Habitat Channel Snorkel Fish Survey**  
**8/15/2013** Flow/Temperature in Channel - 87 cfs/22.2 C Flow/Temperature in Tailrace (powerhouse) - 2420 cfs/23.7 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	1 (12"-16")	0	0	0	0	0	0	0	13	27	0	0	0	0	0	0	0	17	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	3	0
#2	0	0	0	0	0	0	0	0	0	3	0	3	22	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	2	0	0	21	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	4	4	1	9	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	2 (12"-16")	0	0	0	0	0	0	11	14	5	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2 (12"-16")	0	0	0	0	0	0	13	2	32	0	0	0	0	0	0	0	0	2	0
Pool	0	0	0	0	0	0	0	0	0	0	2	0	7	0	0	0	0	0	0	0	0	3	0
Total	0	0	0	5	0	0	0	0	0	5	31	33	148	0	0	0	0	0	0	0	17	0	8
Notes																							

**Chelan River Habitat Channel Snorkel Fish Survey**  
**9/10/2013** Flow/Temperature in Channel - 85 cfs/20.2 C Flow/Temperature in Tailrace (powerhouse) - 2450 cfs/22.0 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry	
Tailrace	4	0	0	0	0	0	0	0	0	0	0	126	21	0	0	0	0	0	0	0	0	30000	3	0
#1	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	200	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	50	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	40	0	0
#6	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	10	0	0
#7	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	1000	0	0
Pool	1	0	0	2 (6"-8")	0	0	0	0	0	0	17	12	2	0	0	0	0	0	0	0	0	1340	0	0
Total	5	0	0	2	0	0	0	0	0	0	18	191	23	0	0	0	0	0	0	0	0	32640	3	0
Notes	Turbid due to gravel relocation in progress																							

**Chelan River Habitat Channel Snorkel Fish Survey**  
**10/3/2013** Flow/Temperature in Channel - 84 cfs/15.7 C Flow/Temperature in Tailrace (powerhouse) - 2470 cfs/16.6 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry	
Tailrace	20	0	0	0	0	0	0	0	0	0	0	29	3	12	0	0	0	0	0	0	0	15000	2	0
#1	2	0	0	2 (>6")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
#2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	600	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	0
#4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	90	0	0
#5	0	0	0	1 (>6")	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	510	0	0
#6	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0
#7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	45	0	0	2 (>6")	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	550	0	0
Total	70	0	0	5	0	0	0	0	0	0	48	29	4	13	0	0	0	0	0	0	0	16781	2	0
Notes	Two sockeye in pool																							

**Chelan River Habitat Channel Snorkel Fish Survey**  
**11/5/2013** Flow/Temperature in Channel - 85 cfs/11.4 C Flow/Temperature in Tailrace (powerhouse) - 2390 cfs/13.0 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
#1	42	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
#2	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#3	58	0	0	0	0	2 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	77	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	46	5	0	2 (>12")	0	1 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	48	0	0	1 (>12")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	442	6	0	3	1	3	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0
Notes																							

Chelan River Habitat Channel Snorkel Fish Survey																							
3/13/2014 Flow/Temperature in Channel - 82 cfs/7.1 C Flow/Temperature in Tailrace (powerhouse) - 1260 cfs/7.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	3	0	5	0	0	0	0	0	0	154	0	0	0	0	8	0	0	0	0	0	0	
#1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pool	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	3	0	5	0	0	0	0	0	0	154	0	0	0	0	8	0	0	0	0	0	0	

Chelan River Habitat Channel Snorkel Fish Survey																							
4/23/2014 Flow/Temperature in Channel - 287 cfs/11.3 C Flow/Temperature in Tailrace (powerhouse) - 1270 cfs/11.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	4090	0	0	1	2	0	0	0	8	0	0	0	0	6	0	0
#1	0	0	0	1 (>12")	0	0	0	25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	1400	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	1 (>12")	0	0	0	2700	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	1700	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	3070	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	1650	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2 (>12")1 (<12)	0	0	0	490	0	0	22	0	20	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1 (12")	0	0	0	2600	0	0	125	0	2	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	6	0	0	0	17725	0	0	404	2	22	0	0	8	0	0	0	0	6	0	0
Notes	19 Hatchery Chinook smolts in the swim area																						

Chelan River Habitat Channel Snorkel Fish Survey																							
5/21/2014 Flow/Temperature in Channel - 205 cfs/17.2 C Flow/Temperature in Tailrace (powerhouse) - 2500 cfs/16.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	3000	0	0	2	0	0	0	0	0	0	0	0	200	3000	0	0
#1	0	0	0	0	0	0	0	0	0	0	1200	0	0	0	9	0	0	0	0	3	0	0	0
#2	0	0	0	0	0	0	0	3110	0	0	100	0	2	0	0	2	0	0	0	0	0	0	0
#3	0	0	0	0	1	0	0	550	0	0	37	0	3	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	1 (12")2 (14)	2	0	0	750	0	0	60	0	2	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	100	0	0	300	0	6	0	0	12	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	200	0	0	30	0	6	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	1	0	0	0	0	0
Pool	0	0	0	0	0	0	0	22	0	0	325	0	11	0	0	17	0	0	0	0	0	0	0
Total	0	0	0	3	3	0	0	7732	0	0	2114	0	30	0	9	31	0	1	0	203	3000	0	0
Notes	300 Chinook fry in the swim area																						

Chelan River Habitat Channel Snorkel Fish Survey																							
6/17/2014 Flow/Temperature in Channel - 207 cfs/17.1 C Flow/Temperature in Tailrace (powerhouse) - 2510 cfs/16.7 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	6	2	6	0	0	2	0	0	6>24"	108	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	30	5	3	0	0	65	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0
#3	0	0	0	4 (16")	0	0	0	0	0	0	100	6	5	0	0	400	0	0	0	0	0	0	0
#4	0	0	0	1 (8")	1	0	0	0	0	0	200	800 fry	2	0	0	500	0	0	0	0	0	0	0
#5	0	0	0	1 (12")	0	0	0	0	0	0	400	0	3	0	0	1000	0	0	0	0	0	0	0
#6	0	0	0	3 (12")1 (18")	0	0	0	0	0	3 parr	150	2, 1000 fry	0	0	0	150	0	0	0	0	0	0	0
#7	0	0	0	12 (12")	1	0	0	0	0	0	500	5, 1000 fry	0	0	0	500	0	0	0	0	0	0	0
Pool	0	0	0	1 (16")	1	0	0	0	0	0	700	15	25	0	0	550	0	0	0	0	0	0	0
Total	0	0	0	23	3	0	0	0	0	3	2086	35	44	0	0	4167	0	0	6	108	0	0	0
Notes	Swim Area-12 smallmouth<12", 4>12", 12 Bluegill, 3 Tench, stickleback Rainbow Notes - Section 6 = 18" was Triploid Smallmouth plus 2800 fry																						

Chelan River Habitat Channel Snorkel Fish Survey																							
7/9/2014 Flow/Temperature in Channel - 1003 cfs/22.0 C Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/21.6 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	53	0	0	0	0	0	0	0	0	0	18	6	15	0	0	5	0	0	9	0	1 school	0	0
#1	0	0	0	0	0	0	0	0	0	0	400	2	5	0	0	1500	500	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	1 parr	0	0	210	5, 50 fry	1	0	0	500	200	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	400	3	1	0	0	200	250	200	0	0	0	0	0
#4	0	0	0	4 (4")	0	0	0	0	0	0	50	1	1	0	0	800	0	0	0	0	0	0	0
#5	0	0	0	3 (8")	1 (10")	0	0	0	0	0	70	0, 400 FRY	9	0	0	5	0	0	0	0	0	0	0
#6	0	0	0	3 (<12")	0	0	0	0	0	0	100	4, 200 fry	18	0	0	420	500	1000	0	0	0	0	0
#7	0	0	0	1	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Pool	7	2	0	0	0	0	0	0	0	0	800	0	10	0	0	800	0	0	0	0	0	0	0
Total	60	2	0	11	1	0	0	1	0	0	2048	21	66	0	1	4230	1450	1200	9	0	1 school	0	0
Notes	Swim Area-7 smallmouth<12", 1>12" Smallmouth plus 650 fry																						

Chelan River Habitat Channel Snorkel Fish Survey																							
8/28/2014 Flow/Temperature in Channel - 84 cfs/21.4 C Flow/Temperature in Tailrace (powerhouse) - 2480 cfs/22.9 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	20	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	10	20	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	5	6	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	1(6")	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
#5	0	0	0	3(>12")	0	0	0	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	14	6	6	0	0	0	6	0	0	0	0	0	0
#7	0	0	0	3(12")	1(8")	0	0	0	0	0	1	8	0	0	0	0	0	0	0	0	0	0	0
Pool	161	0	0	1(>12")	0	0	0	0	0	0	18	12	14	0	0	0	0	0	0	0	0	0	0
Total	161	0	0	8	1	0	0	0	0	0	33	54	49	0	0	1	7	0	0	0	20	0	0
Notes	Pool had 2 dead Chinook adults																						

Chelan River Habitat Channel Snorkel Fish Survey																							
9/25/2014 Flow/Temperature in Channel - 87 cfs/18.2 C Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/19.1 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	124	0	0	1(9")	0	0	0	0	0	0	1	4	1	0	0	0	0	0	0	0	800	0	0
#1	1	0	0	1(22")	0	1(24")	0	0	0	0	15	4	0	0	0	0	0	0	0	0	3000	0	0
#2	0	0	0	0	0	0	0	0	0	0	5	4	3	0	0	0	0	0	0	0	150	0	0
#3	1	0	0	2(8")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0
#4	0	0	0	3(8",10",18")	0	0	0	0	0	1 parr	4	3	8	0	0	0	0	0	0	0	50	0	0
#5	0	0	0	2(8"),2(12")	0	0	0	0	0	0	3	4	2	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	5(12")	2(12")	0	0	0	0	0	9	4	3	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	1	0	0
Pool	375	0	0	2(6"), 3(12")	0	0	0	0	0	0	30	6	5	0	0	0	0	0	0	0	0	0	0
Total	501	0	0	22	2	1	0	0	0	1	67	33	26	0	0	0	0	0	0	0	4201	0	0
Notes	Dead Chinook Adults - #1-1, #2-2, Pool-3 Swim Area-18 smallmouth<12", many stickleback																						

Chelan River Habitat Channel Snorkel Fish Survey																							
11/25/2014 Flow/Temperature in Channel - 287 cfs/9.5 C Flow/Temperature in Tailrace (powerhouse) - 2340 cfs/9.6 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	100s+	8	0	0	0	2(13"), 1(15")	3(11")	0	0	0	130	0	0	0	0	0	0	0	0	0	0	0	0
#1	3	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0
#2	5	0	0	1(15"),1(17")	0	1(21")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
#3	1	0	0	1(11")	0	0	2(11")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	1(21")	0	2(15"),1(17")	0	1(17")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	1	1(15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1(11"), 1(13")	0	1(13")	1(15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2(15")	0	0	1(11")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1(15"), 2(19")	0	1(7")	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0
Total	9 + 100s	9	1	14	0	8	7	0	0	0	170	0	16	0	0	0	0	0	0	0	0	0	0
Notes	Swim Area-565 stickleback																						

Chelan River Habitat Channel Snorkel Fish Survey																							
3/10/2015 Flow/Temperature in Channel - 82 cfs/7.2 C Flow/Temperature in Tailrace (powerhouse) - 2360 cfs/8.2 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	3(14",16")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes																							

Chelan River Habitat Channel Snorkel Fish Survey																							
4/15/2015 Flow/Temperature in Channel - 287 cfs/9.7 C Flow/Temperature in Tailrace (powerhouse) - 2360 cfs/10.0 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	50	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	2	0	0	0	0	0	595	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	473	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	1	0	0	0	0	0	205	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	800	0	0	25	0	1	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	2(12"-14")	0	0	0	0	0	0	47	1	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	1	0	0	0	0	0	0	0	0	190	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	4	0	2	0	0	0	2123	0	0	377	1	2	0	0	0	0	0	0	0	0	0	0
Notes																							

Chelan River Habitat Channel Snorkel Fish Survey																							
5/20/2015 Flow/Temperature in Channel - 85 cfs/16.0 C Flow/Temperature in Tailrace (powerhouse) - 2360 cfs/15.3 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	100	0	0	536	5	3	0	0	36	0	0	3	41	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0
#2	0	0	0	0	1(12")	0	0	20	0	0	261	0	3	0	0	6	1	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	112	0	5	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	6(10"-14"),1T	0	0	0	0	0	0	90	0	13	0	0	44	0	0	0	0	0	0	0
#5	0	0	0	4(10"-14")	1(12")	0	0	25	0	0	107	0	14	0	0	22	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	50	0	0	53	0	14	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	3(10"-16")	0	0	0	0	0	6	0	6	0	0	0	0	0	0	0	0	0	0
Pool	0	1	0	3(10"-14")	1(13")	0	0	393	0	0	500	0	34	0	0	5	0	0	0	0	0	0	0
Total	0	1	0	13	6	0	0	588	0	0	1667	5	92	0	0	113	1	0	3	44	0	0	0
Notes	The 1 T in #4 was a triploid >16"																						

Chelan River Habitat Channel Snorkel Fish Survey																							
6/17/2015 Flow/Temperature in Channel - 139 cfs/20.4 C Flow/Temperature in Tailrace (powerhouse) - 1250 cfs/21.8 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	1	0	0	0	0	0	0	830	7	2	0	0	2200	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	3	4	4	0	0	250	525	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	720	1	5	0	0	2500	30	0	0	0	0	0	0
#3	0	0	0	0	1	0	0	0	0	0	575	0	1	0	0	1500	1500	1	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	1500	2	2	0	0	1000	20	3	0	0	0	0	0
#5	0	0	0	1	0	0	0	0	0	0	320	0	3	0	0	300	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	350	4	13	0	0	350	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	20	0	1	0	0	20	0	0	0	0	0	0	0
Pool	0	0	0	2	0	0	0	0	0	0	800	0	24	0	0	1300	0	1	0	0	0	0	0
Total	0	0	0	4	1	0	0	0	0	0	5118	18	55	0	0	9420	2075	5	0	0	0	0	0
Notes	Electroshock 2 steelhead fry 2150 bass fry snorkel count																						

Chelan River Habitat Channel Snorkel Fish Survey																							
7/15/2015 Flow/Temperature in Channel - 139 cfs/22.8 C Flow/Temperature in Tailrace (powerhouse) - 1240 cfs/24.0 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	49	51	29	0	0	243	0	0	1(24")	12	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	200	13	1	0	0	265	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	20	0	9	0	0	5	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	87	1	1	0	0	17	0	0	0	0	0	0	0
#5	0	0	0	0	2(7")	0	0	0	0	0	74	4	2	0	0	2	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	55	30	6	0	0	6	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	25	3	0	0	0	25	0	0	0	0	0	0	0
Pool	0	0	0	0	1(5")	0	0	0	0	0	94	27	28	0	0	114	2	0	0	0	0	0	0
Total	0	0	0	0	3	0	0	0	0	0	606	134	76	0	0	677	2	0	1	12	0	0	0
Notes	1 adult sockeye in pool 8 pumpkinseeds																						

Chelan River Habitat Channel Snorkel Fish Survey																								
9/18/2015 Flow/Temperature in Channel - 83 cfs/17.0 C Flow/Temperature in Tailrace (powerhouse) - 1150 cfs/18.7 C																								
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry	
Tailrace	70	0	0	1(11"), 1 Trip	0	0	0	0	0	0	2	92	6	0	0	1	2	0	0	0	0	4050	0	0
#1	0	0	0	1(12"), 1 Trip	0	0	0	0	0	0	4	50	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	1(8")	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
#4	1	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
#5	1	0	0	1(14")	1(10")	0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1(12")	0	0	0	0	0	0	36	1	7	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2(10",18")	0	0	0	0	0	0	0	3	7	0	0	0	0	0	0	0	0	0	0	0
Pool	132	0	0	0	1(14")	0	0	0	0	0	5	3	13	0	0	0	0	0	0	0	0	5000	0	0
Total	204	0	0	9	2	0	0	0	0	0	47	161	53	0	0	1	2	0	0	0	0	9050	0	0
Notes	14 adult sockeye in pool, 1 in #6 Triploid in #1 >10 lbs. estimated																							

Chelan River Habitat Channel Snorkel Fish Survey																							
10/16/2015 Flow/Temperature in Channel - 84 cfs/16.0 C Flow/Temperature in Tailrace (powerhouse) - 2410 cfs/16.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#1	1	0	0	0	0	0	0	0	0	0	8	0	1	0	0	0	0	0	0	0	0	0	0
#2	26	1	0	0	0	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
#3	17	0	0	1(13")	0	1(13")	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
#4	8	0	0	1(14")	0	1(14")	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
#5	6	0	0	0	2(12")	1(18")	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
#6	16	1	0	1(10")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	3	0	0	3(10",13",13")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	77	0	0	1 Trip(20")	2(10")	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0
Total	158	2	0	7	4	4	0	0	0	0	33	10	4	0	0	0	0	0	0	0	1	0	0
Notes	2 adult sockeye in pool, 1 in #3																						

Chelan River Reach 1-3 Snorkel Fish Survey																							
3/20/2012 Flow/Temperature in River - 83 cfs/6.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 3	1	0	0	5	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	12	8	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Chelan River Reach 1-3 Snorkel Fish Survey																							
11/13/2012 Flow/Temperature in River - 84 cfs/10.9 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	12 (10"-15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelan River Reach 1-3 Snorkel Fish Survey																							
4/9/2013 Flow/Temperature in River - 83 cfs/11.2 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	5 (10"-15")	5 (10"-15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 3	0	0	0	5 (10"-15")	3 (10"-15")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	10	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Chelan River Reach 1-3 Snorkel Fish Survey																							
8/16/2013 Flow/Temperature in River - 87 cfs/22.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 3	0	0	0	0	2 (>6")	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes																							
Chelan River Reach 1-3 Snorkel Fish Survey																							
11/5/2013 Flow/Temperature in River - 85 cfs/14.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	1 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	7 (12"-14")	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Reach 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	8	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Notes																							
Chelan River Reach 1-3 Snorkel Fish Survey																							
4/22/2014 Flow/Temperature in River - 88 cfs/12.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	5 (6"->12")	19 (8"- 18")	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	5 (12"-16")	2 (12"-14")	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	10	21	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Notes																							
Chelan River Reach 1-3 Snorkel Fish Survey																							
8/25/2014 Flow/Temperature in River - 85 cfs/22.1 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	58 (>6")	6(<6")5(>6")	0	0	0	0	0	0	125	2	0	10	0	0	0	0	0	0	0	0
Reach 2	0	0	0	39 (>6")	2 (>6")	0	0	0	0	0	0	70	4	0	0	0	0	0	0	0	0	0	0
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	97	13	0	0	0	0	0	0	195	6	0	10	0	0	0	0	0	0	0	0
Notes	1 Tench >6"																						
Chelan River Reach 1-3 Snorkel Fish Survey																							
11/24/2014 Flow/Temperature in River - 83 cfs/9.4 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	51	20	0	0	0	0	0	0	7	0	0	0	1	0	0	0	0	0	0	0
Reach 2	0	0	0	32	1(9")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	83	21	0	0	0	0	0	0	7	0	0	0	1	0	0	0	0	0	0	0
Notes	5 Tench >6"; Rainbow Reach 1 - 1-7",6-9",15-11",1-12",7-13",6-15", 15>12"; Cutthroat Reach 1 - 2-7",4-9",4-11",8-13",2-15" Reach 2 survey incomplete - too dark; Rainbow Reach 2 - 2-9",2-11",25-13",3-15"																						

Chelan River Reach 1-3 Snorkel Fish Survey																							
4/16/2015 Flow/Temperature in River - 85 cfs/11.3 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	11	20	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Reach 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	11	20	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Cutthroat - 16 (>12"), 4 (8"-12") Rainbow - 10 (>12"), 1 (8"-12") 3 Tench >6"																							

Chelan River Reach 1-3 Snorkel Fish Survey																							
9/17/2015 Flow/Temperature in River - 83 cfs/17.0 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	24	24	0	0	0	0	0	0	111	143	0	10	0	0	0	0	0	0	0	0
Reach 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	24	24	0	0	0	0	0	0	111	143	0	10	0	0	0	0	0	0	0	0
Notes Cutthroat - 4 (>12"), 20 (8"-12") Rainbow - 14 (>12"), 10 (8"-12")																							

Chelan River Reach 1-3 Snorkel Fish Survey																							
11/9/2015 Flow/Temperature in River - 84 cfs/12.5 C																							
Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	46	22	0	0	0	0	0	0	14	21	0	0	0	0	0	0	0	0	0	0
Reach 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	0	0	0	46	22	0	0	0	0	0	0	14	21	0	0	0	0	0	0	0	0	0	0
Cutthroat - 5 (>12"), 17 (≤12") Rainbow - 11 (>12"), 35 (≤12")																							

***APPENDIX B: SNORKEL SURVEYS IN THE CHELAN FALLS  
HABITAT CHANNEL AND TAILRACE, AND REACH 1 OF THE  
CHELAN RIVER, WA - 2016***

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**Snorkel Surveys in the Chelan Falls Habitat Channel and Tailrace,  
and Reach 1 of the Chelan River, WA - 2016**

**This report has been issued for review by the CRFF**

***APPENDIX C: MACROINVERTEBRATE INVESTIGATION CHELAN  
RIVER, WASHINGTON***

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- **DRAFT REPORT 12/20/16**

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- **MACROINVERTEBRATE INVESTIGATION:**

- **CHELAN RIVER, WA**

- **DECEMBER 2016**

**This report will be issued for review by the CRFF in March 2017**

***APPENDIX D: CONSULTATION RECORDS***

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Chelan PUD is providing a draft of the 2017 Chelan River Biological Objectives Status Report to Ecology and members of the CRFF in accordance with the requirements of the May 19, 2010, FERC Order granted a time extension, which set the date for the third report to be due April 30, 2017.

The following individuals were sent draft copies for a 30-day review period.

<i>NAME</i>	<i>AGENCY</i>	<i>Comments</i>
Zimrman, Breean	Washington State Department of Ecology	-
Peterschmidt, Mark	Washington State Department of Ecology	-
Bowen, David	Washington State Department of Ecology	
Pacheco, Jim	Washington State Department of Ecology	
Korth, Jeffrey	Washington State Department of Fish and Wildlife	-
Simon, Graham	Washington State Department of Fish and Wildlife	-
Maitland, Travis	Washington State Department of Fish and Wildlife	-
Grover Wier, Kari	United States Department of Agriculture – Forest Service	-
Willard, Paul	United States Department of Agriculture – Forest Service	-
Johnson, Emily	United States Department of Agriculture – Forest Service	
Martinez, Alex	United States Department of Agriculture – Forest Service	
Rawhouser, Ashley	National Park Service	-
Anthony, Hugh	National Park Service	-
Lewis, Steve	United States Fish and Wildlife Service	-
Yeager, Justin	National Marine Fisheries Services	-
Domingue, Richard	National Marine Fisheries Services	-
Hossack, Bonnie	National Marine Fisheries Services	
Towey, Bill	Confederated Tribes of the Colville Reservation	-
Rose, Bob	Yakama Indian Nation	-
Merkle, Carl	Confederated Tribes of the Umatilla Indian Reservation	-
Cooney, Mike	City of Chelan	-
Archibald, Phil	Lake Chelan Sportsman Association	-
Elwell, Nick	United States Geological Survey	-
Ernsberger, Tom	Washington State Parks and Recreation Commission	-
Snell, Nona	Washington State Recreation and Conservation Office	-
Uhlhorn, Richard	Lake Chelan Recreation Association	-
O'Keefe, Thomas	American Whitewater	-