ORIGINAL



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March 17, 2006

FILED
OFFICE OF THE SECRETARY
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Ms. Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, D.C. 20426

Subject: Rocky Reach Hydroelectric Project FERC No. 2145-060
Offer of Settlement

Dear Secretary Salas:

The Public Utility District No. 1 of Chelan County, Washington, has reached a settlement with the U.S. Fish and Wildlife Service, Washington Department of Ecology, U.S. National Park Service, U.S. Bureau of Land Management, Washington Department of Fish and Wildlife, Washington State Parks and Recreation Commission, City of Entiat, Entiat Coalition, and Alcoa Power Generating Inc. (Parties) regarding the issuance of a new license for the Rocky Reach Project. Enclosed is the "Offer of Settlement," containing the agreement executed by the Parties, proposed license articles, and the Rocky Reach Comprehensive Plan.[1] As per Section 1.2 of the Settlement Agreement, additional entities may also sign the Agreement within 60 days after the effective date of the Agreement.

By copy of this letter, all participants are hereby notified, in compliance with Rule 602(d)(2) of the Federal Energy Regulatory Commission's (Commission) Rules of Practice and Procedure (18 C.F.R. § 385.602), that comments on the Offer of Settlement may be filed not later than 20 days after the filing of the Offer of Settlement and reply comments may be filed not later than 30 days after the filing of the Offer, unless otherwise provided by the Commission.

Sincerely,

Gregg Carrington
Director of Hydro Services

cc: FERC Service List, FERC Portland Regional Office, Settlement Parties
Enclosures: Original, one hard copy, 8 CDs

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[1] In order to protect sensitive cultural information, Chelan PUD is requesting that Chapter 8: Rocky Reach Historic Properties and Cultural Resources Management Plan be placed in FERC's non-public file. This plan will be submitted separately.

ROCKY REACH COMPREHENSIVE SETTLEMENT AGREEMENT

Final

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

February 3, 2006

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

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Wenatchee, Washington

Rocky Reach Hydroelectric Project
Offer of Settlement

FINAL

Introduction

On February 3, 2006, Public Utility District No. 1 of Chelan County Washington (Chelan PUD) and participants in the alternative relicensing process for the Rocky Reach Project, FERC No. 2145 (Project), finalized a Comprehensive Settlement Agreement (Agreement). The Agreement encompasses all matters addressed in the Rocky Reach relicensing process, including the water quality certification, which is expected to be issued by the Washington Department of Ecology (Ecology) in March, 2006 under Section 401 of the Clean Water Act, as well as the Biological Opinions to be issued under the Endangered Species Act by NOAA Fisheries and the U.S. Fish and Wildlife Service. Pursuant to Section 8 of the Agreement, and in conformity with the Commission's Rules of Practice and Procedure, Rule 602 (18 C.F.R. § 385.602), Chelan PUD hereby submits this Offer of Settlement to the Commission for review and incorporation of the Proposed License Articles (Attachment A of the Agreement) into the new license for the Project. The development of the Agreement, its submission to the Commission, and this request to incorporate the agreed-upon license conditions into the new license are in accordance with the alternative relicensing procedures described by the Commission in its Order 596, Regulations for Licensing of Hydroelectric Projects, 81 FERC ¶ 61,103 (1997) and meet the goal of resolving relicensing issues through a collaborative process involving affected stakeholders.

Background

The initial license application for Project No. 2145 was filed January 13, 1956. The license was issued by order dated July 11, 1957, and made retroactive to July 1, 1956. The Rocky Reach Dam commenced operation in 1961 with seven generating units. On September 1, 1966, Chelan PUD filed an application with the Federal Power Commission to amend the Project license for the addition of four generating units. The Federal Power Commission issued the license amendment May 23, 1968. The second phase of construction began April 22, 1969, and was completed December 1, 1971. Eight applications to amend the initial license have been approved since 1956, the most recent being incorporation of the Rocky Reach Anadromous Fish Agreements and Habitat Conservation Plan (HCP).107 FERC ¶ 61,281. The original license expires on June 30, 2006.

On October 25, 1999, FERC approved Chelan PUD's request to use the collaborative alternative relicensing procedures for the preparation of its license application, and to use an applicant-prepared preliminary draft environmental assessment in lieu of the Exhibit E environmental report. As part of the collaborative process, a total of 65 working group meetings and 33 full relicensing meetings were held between 1999 and 2003. Chelan PUD then filed an application for a new license for the Project with FERC and an application with Ecology for a Section 401 Water Quality certification on June 29, 2004.

On February 6, 2006, Chelan PUD withdrew its Section 401 Water Quality certification application for the second time (Chelan PUD first withdrew its application on June 13, 2005 while negotiations of a Agreement progressed) so that logistical issues pertaining to coordination with the final Agreement could be addressed by Settlement Parties.

In settlement group meetings held during 2004 and 2005 substantial progress was made in the negotiation of an Agreement regarding a new license for the Project, including substantial progress in resolving the relevant water quality issues. An Agreement was completed on February 3, 2006.

Offer of Settlement

The product of the process described above is the Rocky Reach Comprehensive Settlement Agreement, including Proposed License Articles (Attachment A) and the Rocky Reach Comprehensive Plan (Attachment B). The Agreement establishes measures for the protection, mitigation and enhancement of resources affected by the Project under a new license to be issued by FERC and the Section 401 certification to be issued by Ecology. It also specifies procedures to be used by the Parties to ensure implementation of the new license articles, consistent with this Agreement. Importantly, the Agreement proposes to incorporate the Project's recently-approved HCP into the new license as the agencies' terms and conditions and prescriptions for spring Chinook and steelhead, summer and fall Chinook, sockeye and coho salmon (Plan Species).

It is the intent of the Parties to establish a framework for future collaborative efforts for the protection, mitigation and enhancement of the resources affected by the Project. The Agreement creates a Rocky Reach Policy Committee, a Rocky Reach Recreation Forum, a Rocky Reach Wildlife Forum, a Rocky Reach Cultural Forum, and a Rocky Reach Fish Forum (RRFF). The RRFF is responsible for sharing information, coordinating efforts and making recommendations regarding implementation of license measures pertaining to fish species not covered by the HCP. The HCP Coordinating Committee[1] remains the appropriate forum for resolving matters related to HCP-covered species; however, the settlement Parties anticipate that the RRFF will coordinate appropriately with that body.

The Parties entered into this Agreement under the condition that the Commission issues a new license in conformance with the Agreement. Section 16 of the Agreement outlines how the Parties may withdraw if the Commission issues a new license that is materially inconsistent with any provision contained in the Agreement.

Explanatory Statement

This Offer of Settlement provides protection, mitigation and enhancement measures for shoreline erosion, water quality, white sturgeon, bull trout, Pacific lamprey, resident fish, wildlife, cultural

1 The HCP Coordinating Committee is established under Section 4.1 of the Rocky Reach Anadromous Fish and Habitat Conservation Plan.

resources, and recreation resources. It also, as described above, provides for the incorporation of the Rocky Reach HCP into the new license to address Plan Species. Chelan PUD requests that the Commission issue a 50-year license. A 50-year license is justified because the Agreement provides for extensive enhancement measures, with estimated expenditures of approximately $394 million dollars.[2]

The Offer of Settlement largely reflects the recommendations of FERC staff in the Draft Environmental Impact Statement issued by the Commission on August 31, 2005. As Commission staff will recall, however, several items of particular importance to local stakeholders were not recommended by FERC staff. Chelan PUD would like to take this opportunity to explain to the Commission how the Settlement Group addressed the proposed Recreation Enhancement Fund and Wildlife Habitat funding license articles in the final version of the Agreement.

Recreation Enhancement Fund. This item was removed, per Commission staff's recommendation, and replaced with an alternative that the Settlement Group hopes will meet with the Commission's approval. The Recreation Resources Monitoring and Evaluation Program would replace the REF. Under this approach, Chelan PUD, in consultation with the Rocky Reach Recreation Forum, would review and evaluate information with respect to existing and potential recreational use within the Project boundary every six years of the new license. A report would then be made to the Commission, consistent with FERC Form 80 requirements. Additionally, Chelan PUD would make available, upon receipt of the new license, an initial amount of $500,000 to fund identified and approved recreational projects within the Project boundary. Through this process, Chelan PUD could request that the Commission amend the new license to allow Chelan PUD to fund additional measures to address specific recreation needs, within the Project boundary, as identified through the monitoring and evaluation program. Chelan PUD is confident that this approach addresses the Commission staff's concerns about funding items outside the Project boundary and committing funding for unspecified future expenditures.

Wildlife Management Plan. The Settlement Agreement contains provisions for funding and implementing a Rocky Reach Wildlife Management Plan as part of the Comprehensive Settlement Agreement. Commission staff made a preliminary recommendation in their DEIS not to include certain measures of the Wildlife Management Plan. The Settlement Group was unable to identify alternative opportunities for providing adequate protection, mitigation, and enhancement measures for wildlife within the Project boundary, and, therefore, continues to support the proposed wildlife measures to restore, maintain, and improve the Chelan Wildlife Area (CWA) lands for key indicator wildlife species.

As part of the Wildlife Management Plan, Chelan PUD has agreed to provide a 50-foot shoreline easement to protect riparian habitat on its Sun Cove property as one measure to maintain habitat for key wildlife indicator species. However, the majority of this 160 acre parcel has relatively low value for upland wildlife because it is surrounded by orchards and residential development. Therefore, the Settlement Group elected to focus measures for wildlife on the Chelan Wildlife

[2] This estimate includes expenditures related to HCP implementation, juvenile fish bypass system construction, and two prospective rebuilds of the juvenile fish bypass during the term of the new license.

Area lands where protection, mitigation, and enhancement measures would be the most effective. WDFW's FPA Section 10(j) recommendation asking FERC to require the entire Sun Cove property to be held in a conservation easement is inconsistent with the Settlement Group's decision to include the proposed measures to restore, maintain, and improve CWA lands. The previous rationale, combined with a lack of other protection, mitigation, and enhancement opportunities within the project boundary, favors the inclusion in the license of all measures in the Wildlife Management Plan, and the exclusion of a conservation easement for the entire Sun Cove property.

Conclusion

Notwithstanding the varied interests of the Parties, this Agreement gained the support of all entities that fully participated in the alternative licensing process.[3] The Parties to the Agreement concur that the Offer of Settlement is in the public interest and the record developed to date in this proceeding (and provided in the Comprehensive Management Plan) strongly supports the protection, mitigation and enhancement measures contained in the Agreement and Proposed License Articles.

The Offer of Settlement is clearly in the public interest. Therefore, Chelan PUD respectfully requests that the Commission approve the Offer of Settlement and incorporate without modification the Proposed License Articles in Attachment A of the Settlement Agreement into a new license for the continued operation of the Rocky Reach Project.

Enclosures

Attached as part of this Offer of Settlement are the Settlement Agreement executed by the Parties, Attachment A – the Proposed License Articles, and Attachment B - the Rocky Reach Comprehensive Management Plan.

Respectfully submitted,

PUBLIC UTILITY DISTRICT NO. 1
of CHELAN COUNTY, WASHINGTON

Wayne Wright
Interim General Manager

3 Instead of signing this Agreement, NOAA Fisheries intends to submit a separate letter of support, since its jurisdictional interests are primarily addressed through the executed Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan.

Certificate of Service

I hereby certify that I have this day served the foregoing document electronically and by first class mail upon each party identified in the official service list complied by the Secretary in this proceeding.

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Dated at Wenatchee, Washington, this 17th day of March, 2006

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Phone: (888) 663-8121

ROCKY REACH
SETTLEMENT AGREEMENT

Final

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

February 3, 2006

P.U.D.
CHELAN COUNTY
POWER

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

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Rocky Reach Hydroelectric Project Settlement Agreement

SECTION 1: Parties

1.1 This Settlement Agreement (Agreement) is entered into this 3st day of February, 2006, between and among Public Utility District No. 1 of Chelan County, Washington (Chelan PUD), the U.S. Fish and Wildlife Service (USFWS), the U.S. Bureau of Land Management (BLM), U.S. National Park Service, the Washington State Department of Fish and Wildlife (WDFW), the Washington State Department of Ecology (Ecology), the Washington State Parks and Recreation Commission, the Confederated Tribes of the Colville Reservation (CCT), the City of Entiat, and Alcoa Power Generating Inc.

1.2 The following entities are encouraged to sign this Agreement: the Columbia River Inter-Tribal Fish Commission (CRITFC), the Confederated Tribes and Bands of the Yakama Nation (YN), and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Any of these entities may become Parties to this Agreement by executing a signature page and submitting it to Chelan PUD and to the Federal Energy Regulatory Commission (FERC) within 60 days after the effective date of this Agreement. For the first 60 days after the effective date of this Agreement, each of these entities may participate as members of the forums in the same manner as Parties but shall have no other rights or remedies under this Agreement unless and until they execute a signature page and submit it to Chelan PUD and FERC.

1.3 No later than December 31, 2006, additional entities may become Parties to this Agreement with the unanimous consent of all Parties and by executing a signature page and submitting it to Chelan PUD and FERC.

1.4 This Agreement shall be binding on, and inure to the benefit of, the above-listed Parties and their successors and assigns, unless otherwise specified in this Agreement.

SECTION 2: Recitals

2.1 The Rocky Reach Hydroelectric Project (Project) is located on the Columbia River in Chelan and Douglas Counties, Washington, approximately seven miles upstream of Wenatchee, Washington. The Project generally consists of the Rocky Reach Dam, spillway, powerhouse, non-overflow structures; upstream and downstream fish passage facilities, visitor facilities at the dam, recreational facilities on the Project reservoir, and waters and lands within the Project boundary. The run-of-river concrete gravity dam is 130 feet high and includes a spillway with 12 gates, each 50 feet wide, which regulate the surface elevation of the reservoir. The powerhouse is 1,088 feet long, 210 feet wide and 218 feet high and contains eleven generating units, with an installed capacity of 865.76 megawatts.

2.2 On July 11, 1957, the predecessor to the FERC, the Federal Power Commission, issued the existing 50-year Project license, made retroactive to July 1, 1956. The dam was completed and the initial seven generating units were placed in commercial operation on November 1, 1961. The license will remain in effect until June 30, 2006.

2.3 On September 1, 1966, Chelan PUD filed an application with the Federal Power Commission to amend the Project license for the addition of four generating units. The Federal Power Commission issued the license amendment on May 23, 1968. The second phase of construction was completed on December 1, 1971.

2.4 In March 1979, in response to petitions from tribes and other entities, FERC initiated a consolidated proceeding on juvenile fish protection for the Mid-Columbia hydroelectric projects, including the Project. Under the Mid-Columbia Proceeding, Chelan PUD agreed to a series of interim settlement agreements that provided for spill, hatchery compensation, and studies to improve fish protection. The last interim settlement for the Project, the Fourth Revised Interim Stipulation, expired on December 31, 1996. In 1993, Chelan PUD and others parties to the Mid-Columbia Proceeding began discussing the possibility of developing a long-term, comprehensive program for managing fish and wildlife in the Mid-Columbia River Basin. As a result, in April 2002, Chelan PUD, the National Marine Fisheries Service (NMFS), USFWS, WDFW, and the CCT signed the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan (HCP Agreement).

The HCP Agreement was designed to protect Mid-Columbia River Basin spring Chinook and steelhead, summer and fall Chinook, sockeye, and coho salmon, and intended to "contribute to the rebuilding of tributary habitat production capacity and basic productivity and numerical abundance" of such species (HCP Agreement at 1). The HCP Agreement was submitted to FERC on November 24, 2003, and on June 21, 2004, FERC issued an order (HCP Order, 107 FERC ¶ 61,281) approving the HCP Agreement as an offer of settlement and adopting it as an amendment to the existing Project license. In doing so, FERC found the HCP Agreement "will serve the public interest by putting into place a long term program to aid in the recovery of threatened and endangered species and to help prevent other salmonids from becoming listed." (HCP Order at 1).

2.5 On October 25, 1999, FERC approved Chelan PUD's request to use the collaborative alternative relicensing procedures for the preparation of its license application for the Project, and to use an applicant-prepared preliminary draft environmental assessment (PDEA) in lieu of the Exhibit E environmental report. As part of the alternative licensing process, more than 1600 entities, including the Parties to this Agreement, have requested relicensing-related information from Chelan PUD, and over 60 individuals have directly participated to varying degrees in the settlement process. To manage the process, Chelan PUD and interested stakeholders formed technical working groups to address water quality issues, wildlife and botanical issues, recreation issues, cultural and historic issues, and fisheries issues (including sub-working groups to address resident fish, bull trout, white sturgeon, and Pacific lamprey).

2.6 Settlement negotiations formally began on June 23, 2003. With the assistance of a facilitator selected and approved by the relicensing stakeholders, the Parties were actively engaged in settlement meetings on a regular and increasingly frequent basis throughout 2004 and 2005. In addition to settlement meetings, the technical working groups collectively have held more than 85 meetings since January, 2004, to identify and analyze ongoing Project-related impacts and develop comprehensive management plans to address such impacts.

Chelan PUD filed an application for a New License and a PDEA with FERC on June 29, 2004. On January 12, 2005, FERC issued a notice accepting Chelan PUD's application to relicense the Project. This notice set a 60-day period during which interventions and comments, as well as terms, conditions, prescriptions, and recommendations, could be filed. The following entities filed comments, terms and conditions, prescriptions, recommendations, and/or motions to intervene: U.S. Department of Agriculture (USDA), U.S. Department of the Interior, NMFS, WDFW, the Entiat School District No. 127, City of Entiat, Washington, Alcoa Power Generating Inc., American Rivers, Avista Corporation, CRITFC, CTUIR, Ecology, YN, and Portland General Electric Company.

Chelan PUD filed responses to the comments, terms, conditions, prescriptions, and recommendations on April 27, 2005; May 11, 2005; and July 15, 2005, and FERC issued a Draft Environmental Impact Statement in August, 2005.

SECTION 3: Definitions

3.1 "Adaptive Management" means an iterative and rigorous process used to improve decision-making in the face of uncertainty. In the context of the Rocky Reach relicensing, it is intended to improve the management of natural resources affected by ongoing Project operations, in order to achieve desired goals and objectives as effectively and efficiently as possible, within the provisions of this Agreement. The process has seven steps:

a) Develop initial hypotheses regarding any ongoing Project impacts and potential remedial measures;
b) Develop goals and objectives for addressing any such impacts;
c) Develop and implement appropriate and reasonable measures in accordance with an established schedule;
d) Develop or identify monitoring and evaluation methodologies for determining whether such goals and objectives have been achieved;
e) Monitor and evaluate the implementation of such measures and their effectiveness toward achieving such goals and objectives;
f) Review monitoring and evaluation efforts; and
g) Confirm that such goals and objectives have been achieved or, if not achieved, evaluate additional or revised measures, including those

previously considered in the Comprehensive Plan, and implement any additional or revised appropriate and reasonable measures, or explain why such goals and objectives cannot be achieved. If such goals and objectives have not been achieved, the Rocky Reach Fish Forum (RRFF; see Section 15) may reevaluate and revise such goals and objectives.

3.2 "Agency" or "Agencies" means USFWS, WDFW, BLM, and Ecology.

3.3 "Agreement" means this document, as well as the Proposed License Articles attached as Attachment A, the Comprehensive Plan, attached as Attachment B, and the Clean Water Act (CWA) Section 401 certification issued by Ecology. In the event of a conflict between this document and either the Proposed License Articles or the Comprehensive Plan, this document shall control. In the event of a conflict between the Proposed License Articles and the Comprehensive Plan, the Comprehensive Plan shall control.

3.4 "Comprehensive Plan" means the comprehensive plan proposed by the Parties to FERC in this Agreement, and contained in Attachment B hereto.

3.5 "Consensus" is defined in Section 15.1.6 and 15.6.6.

3.6 "Estimated Cost" means an amount of money that the Parties anticipate will be necessary to complete an identified activity or measure. The dollar figure provided shall be adjusted for inflation and serve as one of the guides to the scope of work intended by the Parties, in the event that the Parties disagree as to the intended scope of work during the term of this Agreement. The Estimated Cost does not define the total cost of the work, establish a limit on the costs necessary to accomplish the intended scope of work, or limit the Parties' obligations to comply with this Agreement.

3.7 "FERC" means the Federal Energy Regulatory Commission.

3.8 "HCP Agreement" means the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan approved by FERC on June 21, 2004, (HCP Order, 107 FERC ¶ 61,281) as an amendment to the original Project license.

3.9 "Licensee" means Public Utility District No. 1 of Chelan County, Washington or any successor to whom the New License is transferred.

3.10 "Make available" means that Chelan PUD shall provide funds to an Agency or other specified entity pursuant to a mutually acceptable payment agreement entered into pursuant to the requirements of Section 18.

3.11 "New License" means the license to be issued by FERC for the continued operation and maintenance of the Project, pursuant to the Federal Power Act (FPA).

3.12 "Parties" means the entities that sign this Agreement.

3.13 "Plan Species" means spring, summer and fall Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*).

3.14 "Project" means the Rocky Reach Hydroelectric Project, licensed to Chelan PUD by FERC as Project No. 2145.

3.15 "Proposed License Articles" means license articles proposed by the Parties to FERC in this Agreement, and contained in Attachment A hereto.

SECTION 4: Purpose, Effect, and Limitations of this Agreement

4.1 **Purpose**. The Parties agree that the purpose of this Agreement is to resolve all issues related to compliance with all federal and state law applicable to the issuance of a New License for the Project. Subject to the reservations of authority in Section 11 of this Agreement, this Agreement establishes Chelan PUD's obligations for the protection, mitigation, and enhancement of resources affected by ongoing Project operations under the New License and its obligations to comply with all federal and state law applicable to the issuance of the New License for the Project. It also specifies procedures to be used by the Parties to ensure that the New License is implemented consistent with this Agreement and other law. The Parties agree that this Agreement is fair, reasonable, and in the public interest within the meaning of FERC Rule 602, 18 C.F.R. § 385.602(g)(3).

4.2 **Effect: Satisfaction of Relicensing Requirements**. Subject to the reservations of authority in Section 11 of this Agreement, the Parties intend that Chelan PUD's performance of its obligations under this Agreement and the CWA Section 401 certification will satisfy all federal and state law applicable to the issuance of a New License for the Project.

4.3 **Limitations.**

4.3.1 **No Precedent.** The terms of this Agreement establish no precedent regarding any other pending or future licensing proceeding in which any Party may participate, and this Agreement shall not be offered in evidence in any pending or future proceeding in which a Party participates, except in a proceeding to establish the existence or validity of, or to defend, implement, or enforce, this Agreement. This Section 4.3.1 shall be binding on any Party that withdraws from this Agreement, and shall survive termination of this Agreement.

4.3.2 **Federal Trust Responsibility and Treaty Rights.** Nothing in this Agreement abridges, limits, creates, expands, diminishes, abrogates, adjudicates, acknowledges, or resolves any Tribal or Indian right reserved or protected in any treaty, executive order, statute, court decree, federal trust responsibility, or other federal law.

4.3.3 **Federal Water Rights.** Nothing in this Agreement affects any federal reserved or state-based water rights that the United States may have in the Columbia River or its tributaries.

4.3.4 **Disclaimer.** The Parties have conducted a sufficient review of the facts to execute and support this Agreement consistent with their statutory obligations. However, the Parties do not necessarily approve of all the statements or analyses (including, without limitation, interpretations of data, studies, and law) contained in the Comprehensive Plan and documents referenced therein. This disclaimer does not provide any Party a basis for withdrawing from or seeking to modify this Agreement.

4.3.5 **No Predetermination of Outcome.** This Agreement shall not be interpreted to predetermine the outcome of any Agency's environmental review or regulatory process.

4.3.6 **Trial-Type Hearing.** Each Party reserves any right it may have to a trial-type hearing pursuant to Sections 4(e) and 18 of the FPA, or to propose alternative conditions or prescriptions under Section 33 of the FPA, if an Agency (a) exercises any authority it may have under Sections 4(e) or 18 of the FPA in a manner that is materially inconsistent with this Agreement, or (b) exercises any reserved authority it may have under Sections 4(e) or 18 of the FPA after the New License is issued. However, no Party may propose alternative conditions or prescriptions pursuant to Section 33 of the FPA as to terms and conditions that are consistent with this Agreement. In addition, no Party may seek a trial-type hearing regarding material facts relating to any condition or prescription that is consistent with this Agreement. Upon submittal of this Agreement to FERC, Chelan PUD's Alternative Section 18 Prescription to the Department of the Interior, dated December 19, 2005, shall be deemed withdrawn.

SECTION 5: Term of License and this Agreement

Chelan PUD will seek a license term of 50 years. The Parties other than Chelan PUD agree to support a license term of 47 years, and to not oppose a license term longer than 47 years. The term of this Agreement shall be the same as the term of the New License (including any subsequent annual licenses), unless this Agreement is terminated sooner pursuant to Section 16.

SECTION 6: Effective Dates

6.1 **Effective Date of the Agreement.** Sections 8, 9, 15, 16.1 and 17 of this Agreement shall take effect immediately upon the signature of all Parties listed in Section 1.1, and the remaining provisions of this Agreement shall take effect upon the effective date of the New License.

6.2 **Effective Date of the New License.** The effective date of the New License shall be the date that FERC issues the New License, unless the order issuing the New License or any part thereof is later stayed, in which case the effective date of the New License or that part which was stayed shall be the date such stay is lifted, unless otherwise specified by FERC.

SECTION 7: Parties Bound

The Parties shall be bound by this Agreement for the term of the New License, including any subsequent annual licenses, unless this Agreement is sooner terminated pursuant to Section 16. A Party that withdraws from this Agreement shall not be bound following such withdrawal, except as provided in Section 4.3.1.

SECTION 8: Licensee Obligations to Support this Agreement

Within 30 days after the effective date of this Agreement, Chelan PUD shall file with FERC an offer of settlement pursuant to Rule 602 consisting of a fully executed copy of this Agreement and an explanatory statement. Chelan PUD shall request that FERC incorporate, without modification, the Proposed License Articles contained in Attachment A to this Agreement as conditions of the New License. Chelan PUD shall use reasonable efforts to obtain a FERC order approving this Agreement and issuing the New License in a timely manner. Chelan PUD shall also: (a) submit a statement in support of this Agreement to NMFS and USFWS, as part of any comments in the Endangered Species Act (ESA) Section 7 consultation process; (b) ensure that any supplemental information, comments, or responses to comments filed by it with FERC in the context of the relicensing process are consistent with this Agreement; (c) in the event of an appeal of the Project's CWA Section 401 certification, submit a statement in support of this Agreement to the Washington Pollution Control Hearings Board (PCHB) and any court reviewing a decision of the PCHB; and (d) actively support incorporation of the Proposed License Articles into the New License in all other relevant regulatory proceedings.

SECTION 9: Party Obligations to Support this Agreement

9.1 Except as provided in Sections 4.3.5, 9.2, 9.3, 9.4 and 11.3, each Party shall support this Agreement by ensuring that all documents filed by it with FERC or any other agency or forum are consistent with this Agreement. Such documents include:
   - (a) Any recommendations, conditions and/or prescriptions, or any terms and conditions;
   - (b) As to Parties other than the USFWS, any ESA Section 7 consultation documents or comments on such documents;

(c) As to USFWS, any ESA Section 7 consultation documents, or comments on such documents, or any biological opinions, shall be consistent with Section 11.3; and

(d) Any supplemental information, comments, or responses to comments.

9.2 In the event that a Party receives or develops new information, data, or analyses that it intends to file with FERC or any other agency or administrative body, such Party shall consult with the appropriate forum pursuant to Section 15 of this Agreement, to the extent practicable, and shall notify all Parties as soon as practicable.

9.3 If, prior to the effective date of the New License, a Party proposes a condition and/or prescription based upon new information, data, or analyses that would create a material change to the terms of this Agreement, any affected Party may initiate dispute resolution pursuant to Section 17.

9.4 If, after the effective date of the New License, a Party proposes a license condition and/or prescription based upon new information, data, or analyses, the Party must comply with the procedures of Section 11.

SECTION 10: Relationship of this Agreement to the Habitat Conservation Plan

10.1 **Effect of Signing.** By signing this Agreement, the Parties agree to support the inclusion of proposed License Articles attached as Attachment A, including Proposed License Article 10, in the New License. However, signing this Agreement does not make such Party a signator to the HCP Agreement, nor does it confer on such Party any of the rights or responsibilities conferred on signators to the HCP Agreement.

10.2 **Decision-making Authority**. As provided in the HCP Agreement, the decision-making authority of the HCP Coordinating Committee, the HCP Tributary Committee, and the HCP Hatchery Committee shall be limited to matters relating to Plan Species (as defined in Section 13.20 of the HCP Agreement). Other species shall be the responsibility of the RRFF, pursuant to the provisions of this Agreement.

10.3 **Coordination.** The RRFF shall coordinate with the HCP Committees to achieve common objectives in any manner they deem appropriate.

(a) In the event that a conflict arises between actions required under this Agreement for non-plan species and actions required under the HCP Agreement for Plan Species, the RRFF shall request to meet with the HCP Coordinating Committee as soon as practicable to address such conflict and seek to reach a resolution that is acceptable to both the RRFF and the HCP Coordinating Committee, and is consistent with applicable law.

(b) If a resolution between the HCP Coordinating Committee and the RRFF is not reached within 20 days of the initial meeting, any member of either entity may request that the matter be referred to a joint meeting of the RRPC and the HCP Policy Committee, which shall be convened within 30 days;

(c) If a resolution between the RRPC and the HCP Policy Committee is not reached within 60 days of the initial meeting of the policy committees, any Party may pursue any other rights or remedies as may be available.

SECTION 11: Reservations of Agency Authority

11.1 **Federal Power Act.**

11.1.1 **FPA Sections 4(e), 10(j), and 10(a).** Each Party reserves any authority it may have pursuant to Sections 4(e), 10(j), and 10(a) of the FPA in the event that: (a) this Agreement is not filed with FERC; (b) the Party withdraws from this Agreement pursuant to the procedures set forth in Section 16; or (c) this Agreement is terminated pursuant to Section 16. Chelan PUD reserves the right to contest the existence and/or exercise of any such authority.

11.1.2 **FPA Section 18.**

(a) USFWS may exercise its reserved authority under Section 18 of the FPA regarding Plan Species covered by the HCP Agreement only as provided in the HCP Agreement. In the event that the HCP Agreement is terminated and NMFS or USFWS exercise authority under Section 18 of the FPA regarding Plan Species, the RRFF shall consider whether the exercise of that authority is consistent with measures in this Agreement. In addition, the RRFF may make recommendations to NMFS and USFWS regarding how the exercise of such authority can be accomplished in a manner consistent with this Agreement. In the event that the RRFF does not reach consensus regarding such recommendations, the dispute resolution provisions of Section 17 of this Agreement shall apply.

(b) To the extent practicable, USFWS shall provide notice to the RRFF before exercising any reserved authority under Section 18 of the FPA regarding species covered by this Agreement (i.e., species other than Plan Species), and the RRFF may then make recommendations to USFWS regarding how the exercise of such authority can be accomplished in a manner consistent with this Agreement. In the event that the RRFF does not reach consensus regarding such recommendations, the dispute resolution provisions of Section 17 of this Agreement shall apply.

(c) In the event that either NMFS or USFWS exercises its authority under Section 18 of the FPA regarding Plan Species while the HCP Agreement remains in effect, or exercises such authority regarding either Plan Species or species other than Plan Species in a manner that is materially inconsistent with this Agreement, any other Party may withdraw pursuant to Section 16 of this Agreement.

11.2 **Clean Water Act.**

11.2.1 **Reservation of Authority**. Nothing in this Agreement affects any authority Ecology may have to enforce the CWA Section 401 certification, state water quality standards, or other appropriate requirements of state law, or to amend the Section 401 certification. Chelan PUD reserves the right to contest the existence and/or exercise of any such authority.

11.2.2 **Procedure for Exercise of Authority**. In exercising any authority reserved in Section 11.2.1, Ecology shall consider any conflicts that arise between or among designated and/or existing beneficial uses, and reconcile such conflicts consistent with applicable state and federal law. Prior to issuing an order exercising such authority, Ecology agrees to issue a notice of intent to exercise its authority unless it determines, in its sole discretion, that the situation requires expeditious action to maintain and protect water quality, including existing, designated, or beneficial uses. An Agency with relevant authority or Chelan PUD may, within 30 days of the issuance of a notice of intent, or within 30 days of the issuance of an order if no notice of intent is issued, initiate dispute resolution pursuant to Section 17 of this Agreement. However, Ecology's authority to proceed with issuance and/or enforcement of an order shall not be affected by the dispute resolution process if it does not participate in, or withdraws from, such process pursuant to Section 17.9 of this Agreement. Prior to exercising any such authority, Ecology may seek public comment.

11.3 **Endangered Species Act (ESA).** This Agreement does not affect the terms of the HCP Agreement regarding the authority of NMFS or USFWS under the ESA regarding Plan Species, nor does it affect the authority of either Agency to take any action it may deem necessary to meet its obligations under the ESA regarding species other than Plan Species. However, the Parties have worked collaboratively to develop measures in this Agreement to address the specific needs of ESA-listed species. USFWS anticipates that the measures in this Agreement will be adequate to avoid a jeopardy finding, and to minimize incidental take of ESA-listed species covered by this Agreement. In addition, USFWS shall use reasonable efforts to exercise its authority under the ESA in a manner that allows this Agreement to be fulfilled. If FERC requests a draft biological opinion, the USFWS shall provide one to FERC. If, in its consultation with FERC pursuant to Section 7 of the ESA, the USFWS requests any measures that are materially inconsistent with the terms of this Agreement, any Party may invoke the dispute resolution provisions of Section 17 of this Agreement.

11.4 **Reservation of Authority.** In the event that FERC, on its own initiative, includes a standard reservation of authority for fishways for the Department of Interior, or includes the reservation of authority for the Department of the Interior submitted by USFWS in its June 1, 2005 fishway prescriptions, the inclusion of such a license article shall not be considered to be materially inconsistent with this Agreement; provided that each Party shall be deemed to have reserved the right to contest the exercise of such authority at any time in the future. If FERC includes such standard reservation of authority, USFWS shall exercise its reserved authority only in a manner consistent with its June 1, 2005 fishway prescriptions and this Agreement.

SECTION 12: Licensee Responsibility for Operations and Costs of Project

By signing this Agreement, none of the Parties, except for Chelan PUD, accept any responsibility for the operation or costs of the Project.

SECTION 13: Availability of Funds

Implementation of this Agreement by the federal Agencies is subject to the requirements of the Anti-Deficiency Act, 31 USC §§ 1341-1519, and the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury. The Parties acknowledge that the federal Agencies shall not be required under this Agreement to expend any appropriated funds unless and until an authorized official of the relevant federal Agency affirmatively acts to commit to such expenditures in writing. Implementation of this Agreement by the state Agencies is subject to the availability of appropriated funds. Nothing in this Agreement is intended or shall be construed to require the obligation, appropriation, or expenditure of any money from the Treasury of the State of Washington. The Parties acknowledge that the state Agencies shall not be required under this Agreement to expend any appropriated funds unless and until an authorized official of the relevant state Agency affirmatively acts to commit to such expenditures in writing.

SECTION 14: Force Majeure

14.1 **No Liability for Force Majeure**. No Party shall be liable to any other Party for breach of this Agreement as a result of a failure to perform or for delay in performance of any provision of this Agreement if, based on evidence provided by the non-performing Party to the other Parties, such performance is delayed or prevented by Force Majeure. In the event of an enforcement action, the non-performing Party bears the burden of proving by a preponderance of the evidence the existence of Force Majeure, including the absence of negligence. The term "Force Majeure" means any cause reasonably beyond the performing Party's control, which could not be avoided with the exercise of due care, and which occurs without the fault or negligence of the Party whose performance is affected by the Force Majeure. Force Majeure events may be unforeseen, foreseen, foreseeable, or unforeseeable, including without limitation natural events; labor or civil disruption; breakdown or failure of Project works not caused by failure to properly design, construct, operate, or maintain; new regulations or laws that are applicable to the Project; orders of any court or agency having jurisdiction over the Party's actions; delay in a FERC order becoming final; or delay in issuance of any required permit. Ecology is reviewing the use of Force Majeure in future agreements and this provision should not be viewed as precedent for other future agreements.

14.2 **Process for Responding to Force Majeure Event.**

14.2.1 **Notice.** The Party whose performance is affected by Force Majeure shall notify the other Parties in writing within 24 hours, or as soon thereafter as practicable, after becoming aware of any event that such Party contends constitutes Force Majeure. Such notice shall identify the event causing the delay or anticipated delay, estimate the anticipated length of delay, state the measures taken or to be taken to minimize the delay, and estimate the timetable for implementation of the measures. The affected Party shall make all reasonable efforts to promptly resume performance of this Agreement and, when able, resume performance of its obligations and give the other Parties written notice to that effect.

14.2.2 **Dispute Resolution.** Any Party may request that the Parties engage in dispute resolution under Section 17 of this Agreement to formulate an appropriate response to the circumstances created by the Force Majeure event.

14.2.3 **Chelan PUD to Confer with USFWS.** If Chelan PUD is unable to perform any obligation pursuant to any provision of this Agreement as a result of Force Majeure and that inability to perform has the potential to effect species listed as endangered or threatened, it shall, within three business days after notifying the other Parties of the existence of an event constituting Force Majeure, confer with USFWS to avoid jeopardy and minimize any incidental take of such listed species. In the event the circumstances resulting from the Force Majeure event cannot be resolved without amendment to this Agreement, amendment of the New License, or re-initiation of consultation pursuant to 50 C.F.R. § 402.16, Chelan PUD shall notify all Parties and seek agreement regarding actions or measures needed to address the circumstances arising from the Force Majeure event, using the dispute resolution procedures contained in Section 17 of this Agreement.

SECTION 15: Resource Forums & Policy Committee

15.1 **Rocky Reach Forums.** Within 90 days of the effective date of this Agreement, Chelan PUD shall establish four forums: the RRFF, the Rocky Reach Wildlife Forum (RRWF), the Rocky Reach Recreation Forum (RRRF), and the Rocky Reach Cultural Forum (RRCF).

15.1.1 **General Forum Responsibilities and Authorities.** The forums shall serve as the primary means of coordination between Chelan PUD and other Parties regarding the implementation of the Comprehensive Plan. The forums shall meet to share information, coordinate efforts, make recommendations and decisions, and periodically review the relevant chapters of the Comprehensive Plan as necessary to implement the Comprehensive Plan during the term of the New License and any subsequent annual licenses. Each forum shall also have the responsibility and authority to resolve disputes, as provided for in Section 17 of this Agreement. After the effective date of the New License, Chelan PUD shall consult with each forum during development of the annual work plans, due by October 1st of each year. The annual work plans shall describe the scope of work for the following year, based on the relevant chapters of the Comprehensive Plan; establish the corresponding schedule for the proposed scope of work; and include a tentative forum meeting schedule for the upcoming year. Chelan PUD shall also consult with each forum during preparation of the annual progress reports, due by February 1st of each year following the first year after the effective date of the New License. The annual progress reports shall describe the progress toward meeting the objectives set forth in the Comprehensive Plan. Such annual progress reports shall be filed with FERC by Chelan PUD, and provided to Forum members.

15.1.2 **Membership.** Except as provided in Section 15.5 for the RRCF, all Parties are eligible to be members of any forum. Each eligible Party that elects to participate in a forum shall designate a forum representative, and an alternate, to speak on behalf of its organization.

15.1.3 **Participation.** Except as provided in Section 15.5 for the RRCF, all forum meetings shall be open to the public, and any individual may attend and participate in the discussions. Any member of the forum may request the opportunity to caucus in private with other forum members.

15.1.4 **Meetings.** The initial organizational meeting of each forum shall be convened by Chelan PUD within 180 days of the effective date of the Agreement. After the effective date of the New License, each forum shall meet as necessary to conduct its business and to resolve disputes, as provided for in Section 17 of this Agreement. Chelan PUD shall provide administrative staff support and space for forum meetings. At its initial meeting, each forum shall select an acting chair to conduct such meeting and any subsequent forum meetings until a chair is selected. Whenever requested by Chelan PUD or in writing by any other two members of the forum, the chair shall convene a meeting within 21 days or as soon thereafter as practicable. The chair shall be responsible for ensuring that agendas are distributed at least seven business days prior to each meeting. Agendas shall include a description of any issues upon which the forum members will be asked to make a decision or recommendation at the meeting. The chair shall be responsible for ensuring that meeting notes document all decisions, recommendations, assignments, scheduling matters, and action items discussed at forum meetings. The chair shall be responsible for preparing and distributing meeting notes to each member of the forum within 10 business days of the meeting. When a forum member is unable to have either its designated representative or alternate at a meeting, or needs additional time to determine its organization's position on a proposed decision or recommendation, the chair may reschedule final action, one time for each member, on any such decision or recommendation. Each forum may adopt such additional procedural rules for conducting its business as it deems necessary and appropriate.

15.1.5 **Decision-Making.** The forums shall make such decisions or recommendations by consensus. For the purposes of the forums, consensus means the unanimous consent of all forum members. A member's abstention or non-participation regarding the decision or recommendation shall not preclude consensus. When the chair of a forum determines it would be helpful in reaching a consensus or avoiding a dispute, the chair may call a special meeting, or form subgroups, to develop recommendations for the full forum.

15.1.6 **Initiation of Dispute Resolution Process.**

(a) If the chair determines it is not possible to reach a consensus in a timely manner, the chair, after consulting with the forum members, shall declare an impasse, initiate the dispute resolution process provided in Section 17 of this Agreement, and prepare a written statement describing the disputed issue and the apparent differences among the forum members. The chair's statement shall be distributed to all members of the forum within 10 days of the declaration of an impasse.

(b) If any forum member is unable to join in a decision or recommendation concurred in by at least a majority of the forum when such action is formally called for by the chair, and is sufficiently concerned about, and impacted by, the issue, it may notify the chair within 10 business days of receiving the meeting notes. The notification must: (i) be in writing, on the organization's official letterhead; (ii) be addressed to the chair and distributed to all members of the forum; and (iii) set forth the reasons the organization is unable to join in such decision or recommendation concurred in by the majority. Upon receipt of such notice, the chair shall initiate the formal dispute resolution process as provided in Section 17 of this Agreement. The failure by any forum member to so notify the chair within 10 business days of receipt of the meeting notes shall be deemed to constitute consent to such decision or recommendation.

(c) Where there is a lack of consensus at the forum level, and Chelan PUD and the members of the forum who are also members of the Rocky Reach Policy Committee (RRPC) determine that delay could be deleterious to the achievement of one or more Comprehensive Plan objectives, Chelan PUD, or the Agency needing a proposed action to occur, may proceed with a proposed action pending the outcome of the dispute resolution process.

15.2 **Rocky Reach Fish Forum (RRFF).** In addition to the provisions of Section 15.1, the following requirements apply to the RRFF.

15.2.1 **Specific Responsibilities and Authorities.** The RRFF shall be responsible for meeting to share information, coordinate efforts, and make recommendations and decisions regarding implementation of Chapters 2, 3, 4, 5, and 6 of the Comprehensive Plan, relating to Water Quality, White Sturgeon, Bull Trout, Pacific Lamprey, and Resident Fish, respectively. The RRFF shall also assist Chelan PUD in coordinating Chelan PUD's work plans and efforts with the HCP Coordinating Committee through joint membership and/or other such arrangements as the RRFF and the HCP Coordinating Committee may mutually devise. The RRFF will be responsible for participating in and implementing the Adaptive Management approach employed in the applicable Chapters of the Comprehensive Plan.

In determining whether it is appropriate and reasonable for Chelan PUD to implement a measure, the RRFF shall consider, among other relevant factors: 1) the likelihood and degree to which the biological objectives, other objectives, or water quality or other regulatory standards will be met; 2) the time required to implement the measure; 3) the cost-effectiveness of the measure; and 4) the potential impact of the measure on other resources.

15.2.2 **Chair.** The RRFF shall select an independent third party to serve as chair. For the first 10 years of the New License, Chelan PUD shall fund the chair's position as a part-time position compensated on a time and materials basis. The RRFF shall evaluate the chair's performance at least once every three years and may agree, by consensus, to replace the chair as it deems necessary. At the end of 10 years, the RRFF may agree, by consensus, that a chair is still necessary; if that determination is made, the RRFF shall work together to determine how the chair's position should be funded. If the RRFF cannot agree on funding, the RRFF may select an unfunded, volunteer chair; however, if an unfunded, volunteer chair cannot be agreed upon or enlisted, the RRFF shall move forward without a chair or with an acting chair designated from among the RRFF's members.

15.3 **Rocky Reach Wildlife Forum (RRWF).** In addition to the provisions of Section 15.1, the RRWF shall be responsible for meeting to share information, coordinate efforts, and make recommendations and decisions regarding implementation of Chapter 7 of the Comprehensive Plan, relating to wildlife resources within and adjacent to the Project Boundary.

15.4 **Rocky Reach Recreation Forum (RRRF).** In addition to the provisions of Section 15.1, the RRRF shall be responsible for meeting to share information, coordinate efforts, and make recommendations and decisions regarding implementation of Chapter 9 of the Comprehensive Plan, relating to recreational resources within the Project reservoir and its tributaries.

15.5 **Rocky Reach Cultural Forum (RRCF).** In addition to the provisions of Section 15.1, the following requirements apply to the RRCF:

15.5.1 **Specific Responsibilities and Authorities.** The RRCF shall be responsible for meeting to share information, coordinate efforts, and make recommendations and decisions regarding implementation of Chapter 8 of the Comprehensive Plan, relating to historic properties and cultural resources within the area of potential effect defined in Chapter 8 of the Comprehensive Plan.

15.5.2 **Membership.** The following entities may designate a member to the RRCF: National Park Service, USDA Forest Service, BLM, Bureau of Indian Affairs, Washington State Parks, YN, CCT, the Washington State Office of Archaeology and Historic Preservation, FERC, and Chelan PUD.

15.5.3 **Confidentiality.** Due to the confidential nature of the information discussed by the RRCF, only members of the RRCF may attend meetings. Nonmembers may attend with permission from the RRCF and upon signing a confidentiality agreement. Meeting times and dates will be recorded and made available to the public; however the substance of the meeting will not be disclosed unless the RRCF agrees to do so. All meeting minutes will be marked confidential.

15.6 **Rocky Reach Policy Committee (RRPC).** Within 180 days of the effective date of this Agreement, Chelan PUD shall establish a RRPC.

15.6.1 **Responsibilities and Authorities.** The RRPC shall be responsible for reviewing and commenting on the annual work plans and progress reports developed by each of the forums, and for reviewing the progress made in implementing the Comprehensive Plan. The RRPC shall serve as the policy-level forum for discussion and resolution of issues and problems that may arise during implementation of this Agreement, including (a) issues that cannot be resolved within the context of a forum; (b) issues arising outside the context of a specific forum; and (c) issues related to coordination with the HCP Policy Committee regarding actions that could have an impact on Plan Species and HCP Agreement programs. The RRPC's role in resolving disputes is provided in Section 17 of this Agreement.

15.6.2 **Membership.** The membership of RRPC shall be comprised of one designated representative from each of the following: (a) Chelan PUD; (b) each Agency; and (c) each Tribe that is a Party. Designated representatives shall be individuals more senior within their respective organizations than the representatives serving on the forums, and shall have the authority to direct necessary resources within their organizations to meaningfully participate in the implementation of this Agreement. Each member of the RRPC shall designate an alternate, who shall not be a member of a forum. Each member of the RRPC shall also designate a senior executive, who shall be an individual more senior within the organization than the RRPC representative, and who will be responsible for resolving disputes related to this Agreement should the RRPC fail to do so. Notice of all designations under this Section shall be provided in writing to all Parties.

15.6.3 **Participation.** Other entities may attend and, upon request, participate in discussions of the RRPC. The RRPC may also invite representatives of other governments, agencies, or entities to participate in its discussions as it deems necessary and appropriate. However, any member of the RRPC or the chair may request the opportunity to meet in private with other RRPC members. When the RRPC is acting in its dispute resolution capacity, it may, at the discretion of the chair, conduct its deliberations in a session closed to non-Parties.

15.6.4 **Meetings.** The initial organizational meeting of the RRPC shall be convened by Chelan PUD within 180 days of the effective date of this Agreement. After the effective date of the New License, the RRPC shall meet as necessary, but at least once per year in February, to review and comment on the annual work plans and progress reports specified in Section 15.1.1, to review the progress made in implementing the Comprehensive Plan, and to resolve disputes as provided for in Section 17 of this Agreement. Chelan PUD shall provide administrative staff support and space for meetings of the RRPC.

15.6.5 **Procedures.** At its initial meeting, the RRPC shall select an acting chair to: (a) conduct the initial meeting; (b) convene subsequent meetings until the RRPC chair is designated; and (c) receive any notices of disputes that may be forwarded by a forum to the RRPC prior to the designation of an RRPC chair. The RRPC may request that the chair of the RRFF serve as the chair of the RRPC, in which case the funding provided by Chelan PUD for the RRFF chair's position during the first 10 years of the New License shall also include sufficient funding to compensate for the activities of chairing the RRPC. The RRPC may adopt such additional procedural rules for conducting its business as it deems necessary and appropriate.

15.6.6 **Decision-Making.** The RRPC shall make decisions by consensus. For the purposes of the RRPC, consensus means the unanimous consent of all members of the RRPC. A member's abstention or non-participation regarding a decision shall not preclude consensus.

SECTION 16: Withdrawal Procedure If Agreement or Proposed License Articles Are Materially Changed.

16.1 **Right to Withdraw Prior to the Effective Date of the New License.** Prior to the effective date of the New License, a Party may withdraw from this Agreement under the following circumstances:

16.1.1 If any of the following actions occur and cannot be resolved after complying with the procedures set forth in section 16.3:

a) FERC issues a New License that is materially inconsistent with this Agreement;
b) An Agency or NMFS files final terms and conditions under the FPA that are materially inconsistent with the Agreement;
c) The CWA Section 401 certification is appealed and/or amended, resulting in a certification that is materially inconsistent with this Agreement;
d) A biological opinion developed pursuant to the ESA requires measures materially inconsistent with this Agreement; or
e) A Total Maximum Daily Load (TMDL) determination is issued that has the effect of requiring measures that are materially inconsistent with this Agreement;

16.1.2 A Party takes any other action that is materially inconsistent with this Agreement and the inconsistency cannot be resolved after completion of the dispute resolution process provided in Section 17 of this Agreement; or

16.1.3 Unsuccessful completion of the dispute resolution process described in Section 17 of this Agreement regarding any other issue not related to a material inconsistency.

16.2 **Right to Withdraw After the Effective Date of the New License.** After the effective date of the New License, a Party may withdraw from this Agreement under the following circumstances:

16.2.1 If any of the following actions occur and cannot be resolved after complying with the procedures set forth in Section 16.3:

a) FERC issues a New License that is materially inconsistent with this Agreement;
b) A rehearing or judicial review regarding the FERC order issuing the New License results in an order that is materially inconsistent with this Agreement;
c) The CWA Section 401 certification is appealed and/or amended, resulting in a certification that is materially inconsistent with this Agreement;
d) A biological opinion developed pursuant to the ESA requires measures materially inconsistent with this Agreement;
e) A TMDL determination is issued that has the effect of requiring measures that are materially inconsistent with this Agreement; or
f) FERC, a federal or state agency other than FERC, or a federal or state court, issues an order that is materially inconsistent with this Agreement;

16.2.2 A Party takes any other action that is materially inconsistent with this Agreement or the New License and the inconsistency cannot be resolved after completion of the dispute resolution process provided in Section 17 of this Agreement;

16.2.3 Unsuccessful completion of the dispute resolution process described in Section 17 of this Agreement regarding any other issue not related to a material inconsistency; or

16.2.4 Alcoa Power Generating Inc. may withdraw from this Agreement effective 30 days after providing written notice to the Parties of its intent to do so. Alcoa Power Generating Inc.'s withdrawal from this Agreement shall not be grounds for any other Party to withdraw from this Agreement.

16.2.5 If FERC issues the New License for a term of between 47 and 50 years, such term shall not constitute a material inconsistency to this Agreement, and shall not provide a basis for withdrawal from this Agreement.

16.2.6 If FERC partially or wholly omits Proposed License Articles 7 (a) and (b) from the New License, or modifies the measures contained in such articles to reduce the level of protection, mitigation, or enhancement, such omission or modification shall not provide a basis for withdrawal from this Agreement.

16.3 **Procedures for Responding to Material Inconsistencies.** Subject to Section 16.4, if any of the actions listed in section 16.1 or 16.2 occur, this Agreement shall be deemed modified to conform to the action unless a Party provides written notice to the other Parties within 30 days that it objects to the material inconsistency and initiates the dispute resolution procedures under Section 17.

16.4 **Provisions Omitted from New License.** If FERC partially or wholly omits from the New License any of the protection, enhancement, or mitigation measures (including monitoring or studies that relate to such measures) included in the proposed License Articles, or modifies such measures to reduce the level of protection, mitigation, or enhancement, the Parties agree to be bound by the entire Agreement, including the provisions omitted or modified by FERC, unless a Party provides written notice within 15 days that the omitted or modified measures create a material inconsistency with this Agreement or, in the case of Chelan PUD, that it lacks authority under state law to implement measures omitted from the New License. If such notice is given and a Party requests that a rehearing petition be filed, Chelan PUD and the affected Parties shall work together in an effort to restore the omitted or modified measures through a request for rehearing to FERC. Upon the request of one or more members of the RRPC, Chelan PUD shall participate in a further appeal of a rehearing order to the court of appeals to restore the omitted or modified measures. Such participation shall include, at Chelan PUD's option, joining in such appeal and/or providing a brief in support of such appeal. Upon the request of one or more members of the RRPC, a Party other than Chelan PUD shall also participate in a further appeal of a rehearing order to the court of appeals to the extent practicable. Such participation shall include, at a minimum, making reasonable efforts to obtain the necessary authorization to register its official support for the appeal through a joint or separate filing at the court of appeals. If, at the conclusion of such effort, any such measures (other than those identified in Section 16.2.6) remain omitted or modified, any Party may withdraw from this Agreement after completion of the dispute resolution process provided in Section 17, and this Agreement shall be deemed modified for the remaining Parties.

16.5 **Stay of New License or Extension of Time to Resolve Material Inconsistency.** Except as provided in Section 16.6, in the event FERC issues a New License that is materially inconsistent with this Agreement, any Party that has filed or intends to file a motion to stay such New License, or any part thereof, or an extension of time to perform any obligation under the New License, may request in writing that other Parties confer (either in person or by phone) with such Party within 10 business days regarding the willingness of such other Parties to support such motion for stay or for extension of time.

16.6 **Deferral of Capital Expenditures Pending Rehearing or Judicial Review.** If FERC issues a New License but the order issuing the New License is the subject of rehearing or judicial review, and such rehearing or judicial review could result in a material inconsistency with this Agreement, the Parties shall, at the request of Chelan PUD, work together to agree on a plan to defer major capital expenditures by Chelan PUD (as well as associated annual funding made available by Chelan PUD) during the pendency of such rehearing or judicial review. The deferral plan shall be limited to Chelan PUD expenditures in an amount approximately equal to the additional costs that could reasonably be expected to be imposed as a result of the rehearing or judicial review, and such deferral plan shall continue in effect until such rehearing or judicial review is concluded. If the Parties cannot reach agreement on a deferral plan within 30 days of such request, the matter shall be subject to dispute resolution pursuant to Section 17. If, pending such rehearing or judicial review, Chelan PUD has filed or intends to file a motion to stay the New License, or to extend the time to perform any obligation under the New License, the Parties shall support such motion with respect to deferrals agreed to in the plan.

16.7 **CWA Section 401 Certification Issued; With Appeal.** If Ecology's CWA Section 401 certification, or an amendment thereto, is appealed to the PCHB, and such appeal, or any subsequent court appeal, leads to a result that is materially inconsistent with this Agreement, the Parties shall then work together in an effort to resolve the issue through the dispute resolution process provided in Section 17. During this process, a Party may seek reconsideration of the PCHB order, or rehearing of a court order, to meet procedural time limits; however, the request for such reconsideration or rehearing shall be withdrawn if consensus is reached on modifying this Agreement to conform to the order. Any Party may also seek judicial review of a PCHB decision that is materially inconsistent with this Agreement.

16.8 **Effect of Withdrawal.** In the event that a Party other than Chelan PUD withdraws from this Agreement, the remaining Parties may choose to continue to be bound by this Agreement. Alternatively, except as provided in Section 16.2.4, any remaining Party may choose to withdraw from this Agreement, following: (1) written notice to the other Parties of the intention to withdraw and, (2) if requested by any other Party, completion of the dispute resolution process provided in Section 17. If Chelan PUD withdraws, this Agreement shall be deemed null and void.

SECTION 17: Dispute Resolution

17.1 **Good Faith Commitment to Resolving Disputes.** The Parties agree to devote such time, resources, and attention as are needed to attempt to resolve disagreements concerning this Agreement at the earliest time possible. In the event that any disagreement arises among the Parties concerning this Agreement, including disagreements regarding the meaning of, or any Party's compliance with, this Agreement, or any proposed decision or recommendation pending before a forum, the Parties shall first attempt to resolve such disagreements on an informal basis. Each Party participating in formal dispute resolution shall cooperate in good faith to promptly schedule, attend, and participate in the dispute resolution process to the extent resources allow.

17.2 **Dispute Resolution Process.**

17.2.1 **Disagreements Arising Within a Forum.** In the case of disagreements arising within a forum, the dispute resolution process may be initiated as provided in Section 15.1.6 of this Agreement. Once initiated pursuant to such Section, the forum chair may convene one or more meetings within 21 days, open only to forum members, in a focused attempt to resolve the dispute. If the chair determines that the forum is unable to reach consensus in resolving a dispute after such meeting or meetings, or if the chair, after consulting with the forum members, elects to not hold such a meeting because the chair determines that the RRPC is the appropriate entity to consider and resolve the dispute, the disagreeing Party or Parties shall provide notice to all Parties within three business days after such determination by the chair. The notice must: (a) be in writing, on the organization's official letterhead; (b) be addressed to the chair of the RRPC and distributed to all members of the RRPC and all other Parties; and (c) describe the issues in dispute.

17.2.2 **Disagreements Arising Outside a Forum.** In the case of any other disagreement arising outside the context of a forum, any Party may initiate the formal dispute resolution process provided in this section if the relevant Parties cannot resolve the disagreement informally after good faith efforts to do so. To initiate the formal dispute resolution process, a requesting Party shall provide notice to all Parties. The notification must: (a) be in writing, on the organization's official letterhead; (b) be addressed to the chair of the RRPC and distributed to all members of the RRPC and all other Parties; and (c) describe the issues in dispute.

17.3 **Elevated Formal Dispute Resolution Process.**

17.3.1 **RRPC.** Upon receiving notice of a formal dispute, the chair of the RRPC shall convene a meeting of the RRPC within 30 days, or as soon thereafter as practicable, to consider the dispute. All Parties shall be allowed to participate in RRPC dispute resolution discussions, pursuant to Section 15.6.3, but decisions regarding resolution of disputes shall be made by consensus of the members of the RRPC. At its initial meeting to consider the dispute, the RRPC may: (a) resolve any or all issues in dispute; (b) refer any or all issues in dispute back to the originating forum with specific instructions and a deadline for reporting back to the RRPC; or (c) institute any other alternative dispute resolution procedures it deems useful under the circumstances, including using a neutral mediator or facilitator, initiating a fact-finding process, or seeking the advice of consultant(s) and/or expert(s). The RRPC shall agree on the terms and a time limit for any such alternative dispute resolution procedures it undertakes. If the RRPC, or the forum to which it remanded the dispute, fails to resolve the dispute within 30 days of the meeting convened to consider the dispute, or within the time period designated by the RRPC, the RRPC shall prepare a revised statement of the outstanding issues for submission to the RRPC members' executives as soon as practicable.

17.3.2 **RRPC Members' Executives.** Upon receipt of the revised statement of the outstanding issues from the RRPC, or upon determination by the chair of the RRPC that no such revised statement will be forthcoming within a reasonable time period, the chair of the RRPC shall schedule a meeting or conference call of the RRPC members' designated executives, designated pursuant to Section 15.6.2, to be held within 30 days of referral from the RRPC, or as soon thereafter as practicable. The RRPC members' designated executives may: (a) resolve any or all issues in dispute by consensus; (b) refer any or all issues in dispute back to the RRPC with specific instructions and a deadline for reporting back to the designated executives; or (c) institute any other alternative dispute resolution procedures they deem useful under the circumstances. The designated executives shall agree on the terms and a time limit for any such alternative dispute resolution procedures they undertake. Abstention or non-participation by a designated executive in a decision resolving a dispute shall not preclude consensus of the remaining designated executives.

17.4 **Completion of Dispute Resolution Process.** In the event the RRPC members' designated executives fail to confer or schedule a meeting within 30 days of referral, or a dispute is not resolved within the time period established by the designated executives, the dispute resolution process shall then be deemed completed and any Party may withdraw from this Agreement. Upon completing the dispute resolution process, the designated executives shall prepare a joint statement of the remaining issues in dispute, which may also include a discussion of how to resolve such issues consistent with this Agreement.

17.5 **Miscellaneous.** In the event the chair of the RRPC fails to convene a meeting as required by Section 17.3.1, 17.3.2, or 17.8, any member or members of the RRPC may convene such meeting. Any of the time periods specified in this section may be reasonably extended or shortened by agreement of the disputing Parties, or as necessary to conform to the procedure of FERC or any court with jurisdiction over the dispute or to respond expeditiously to time-sensitive issues. Unless otherwise agreed among the Parties, each Party shall bear its costs for its own participation in any alternative dispute resolution process selected by the Parties and shall equally share the costs of any neutral mediator, facilitator, or other consultant(s) and/or expert(s) engaged to assist in the resolution of disputes. Pending resolution of any dispute, and subject to the authority of FERC or other Agency to order otherwise, Chelan PUD may continue operating the Project in the manner it was operating prior to the time the dispute arose.

17.6 **Actions after Dispute Resolution.** Each Party shall promptly implement all final agreements reached through the dispute resolution process, consistent with its applicable statutory and regulatory responsibilities. For disputes within FERC's jurisdiction that remain unresolved at the completion of the dispute resolution process, any Party may file such unresolved dispute with FERC. For disputes not within the jurisdiction of FERC (other than disputes arising under the CWA Section 401 certification) that remain unresolved after completion of the dispute resolution process, any Party may choose to seek judicial, administrative, or other enforcement of the terms of this Agreement. As to disputes arising under the CWA Section 401 certification or Ecology's reservation of authority under Section 11.2 of this Agreement, Chelan PUD and Ecology reserve their right to make their respective legal arguments regarding the entities or legal fora with authority or jurisdiction to resolve such disputes.

17.7 **Relationship of Dispute Resolution to Rehearing or Judicial Review.** The dispute resolution process shall not preclude any Party from timely filing for and seeking administrative rehearing or judicial review if the New License, or any FERC order or action by an Agency, is materially inconsistent with this Agreement. However, the Parties shall follow the dispute resolution process provided in this section to the extent reasonably practicable while such rehearing or judicial review is being pursued. In the event the Parties subsequently agree unanimously to modify this Agreement to conform to the materially inconsistent New License or FERC order, or to resolve the inconsistency between this Agreement and the agency action, the filing Party or Parties shall withdraw the request for rehearing or judicial review, or shall recommend such withdrawal, as appropriate.

17.8 **Expedited Dispute Resolution.** Any member of the RRPC may initiate an expedited review of a particular issue, by notifying the RRPC chair that an emergency condition exists. The requesting member must provide the chair a statement, on official letterhead, describing the outstanding issue and the basis of the emergency. This expedited review will be directed to and initiated by the chair to the RRPC Members' executives as constituted pursuant to Section 15.6.2. The chair will convene the executives to consider the outstanding issue expeditiously but no later than 10 business days after receiving the statement of the outstanding issue and the basis of the emergency from the requesting member. In the event the designated executives fail to convene and resolve the matter within 10 business days of receiving such statement, or within such other time period established by the designated executives, the dispute resolution process shall be deemed completed and any Party may withdraw from this Agreement. Upon completing the dispute resolution process, the designated executives shall prepare a joint statement of the remaining issues in dispute, which may also include a discussion of how to resolve such issues consistent with this Agreement.

17.9 **Ecology Right to Not Participate in or to Withdraw from Dispute Resolution.** Ecology reserves the right not to participate in, or to withdraw from, dispute resolution under this Agreement if it determines, in its sole discretion, that the situation requires expeditious action to maintain and protect water quality, including existing, designated, or beneficial uses. Ecology further reserves the option to not participate in, or to withdraw from, a dispute resolution initiated pursuant to Section 16.7 if it determines that the Parties have failed to reach agreement after previously completing the dispute resolution process regarding substantially the same issue, and no new significant information has become available since that time. A decision by Ecology not to participate in or to withdraw from, dispute resolution under this Agreement shall not be contested by the other Parties; however, all Parties (other than Ecology) reserve the right to contest any such action taken by Ecology. Ecology shall provide notice of its decision on letterhead, signed by its executive as designated under Section 15.6.2, to not participate in, or to withdraw from, dispute resolution to Chelan PUD prior to or contemporaneous with taking such action, and to other Parties within 10 business days after taking such action.

SECTION 18: Payments

18.1 Unless otherwise specified, all costs, balances, or payment amounts specified in dollars shall be deemed to be stated as of the year 2005, and Chelan PUD shall adjust such sums as of January 31 if each following year (starting in the first January after the effective date of the New License), or upon publication of, and in accordance with, the Consumer Price Index for all Urban Consumers, U.S. City Averages, All Items, Not Seasonally Adjusted. Such Consumer Price Index is published by the U.S. Department of Labor, Bureau of Labor Statistics. If the publication of such Consumer Price Index is discontinued, the Parties shall select an appropriate alternative index to achieve the same economic effect.

18.2 Chelan PUD shall enter into a mutually acceptable agreement with any Party to which payments are due pursuant to the New License.

18.3 The mutually acceptable payment agreements entered into pursuant to subsection 18.2 shall, consistent with applicable federal and state law, provide for the method and timing of payments, documentation of the amount and cost of work completed, a certification that such work was performed in a manner consistent with this Agreement, provisions for addressing liability, and a process for handling disputes regarding documentation, payment, or related matters. Payments shall be made on a reimbursement basis. Within 180 days of entering into a payment agreement pursuant to subsection 18.2, the Agency or other entity requesting payment shall provide an initial planning report to Chelan PUD. The initial planning report shall include a detailed description of the work to be undertaken in the first year for which payment will be sought, and the estimated costs of such work. Subsequent planning reports shall be submitted to Chelan PUD by the Agency or other entity requesting payment by January 31 of each year during the term of the New License and any subsequent annual licenses, in which the Agency or entity intends to seek payment. Such planning reports shall contain: (a) a detailed description of the work to be undertaken in the current year, and a detailed estimate of the costs of such work; (b) a general description of the work to be undertaken in the following year or next phase of the project, if any, and a preliminary estimate of the costs of such work. A draft of such planning reports shall be submitted by the Agency or other entity to Chelan PUD by September 1 of the preceding year. If there is a disagreement regarding a payment, or implementation of a measure for which payment is being sought, such disagreement shall be resolved using the dispute resolution process pursuant to Section 17.

18.4 For the term of the New License, and any subsequent annual licenses, Chelan PUD shall make available an annual statement indicating the status of all funding required by Chelan PUD under the New License, including the amount of funding provided and the amount of funding remaining available.

18.5 For the purpose of facilitating the solicitation of matching funds by an Agency or other entity, Chelan PUD shall provide a letter of intent upon request by such Agency or other entity stating that it will make available a certain amount of funds on a certain schedule, subject to the terms and conditions of the New License and consistent with the Comprehensive Plan.

18.6 The dollar amount of funding made available on an annual basis under this Agreement shall be adjusted pursuant to subsection 18.1 in the year it is made available, and any remaining balance, less any outstanding billings, shall be so adjusted each succeeding year of the New License term, including any subsequent annual licenses. Unless otherwise provided in the Comprehensive Plan, such amounts, as adjusted, shall remain available during the term of the New License, including any subsequent annual licenses. In the event that any carry-over funding remains available at the expiration of the New License, including any subsequent annual licenses, such funding shall no longer be available.

SECTION 19: General Provisions

19.1 **Entire Agreement.** This Agreement sets forth the entire agreement of the Parties with regard to the subject matters addressed in this Agreement related to the relicensing of the Project. This Agreement is made on the understanding that each term is in consideration and support of every other term, and that each term is a necessary part of the entire Agreement.

19.2 **No Third-Party Beneficiaries.** Without limiting the applicability of rights granted to the public pursuant to applicable law, this Agreement shall not create any right or interest in the public, or any member of the public, as a third-party beneficiary of this Agreement, and shall not authorize any non-Party to maintain a suit at law or equity pursuant to this Agreement. The duties, obligations, and responsibilities of the Parties with respect to third parties shall remain as imposed under applicable law.

19.3 **Modification of Agreement.** This Agreement may be modified by unanimous written consent of all Parties at any time during the term of the New License, including subsequent annual licenses. If such modification requires the approval of FERC, Chelan PUD shall submit such modification to FERC for approval, and no actions relating to such modification shall be undertaken until such approval is received.

19.4 **Successors, Transferees and Assigns.** This Agreement shall apply to and be binding on the Parties and their successors and assigns. Upon completion of a succession, transfer or assignment, the initial Party shall no longer be a Party to this Agreement. No change in ownership of the Project or transfer of the New License by Chelan PUD shall in any way modify or otherwise affect any other Party's interests, rights, responsibilities or obligations under this Agreement.

SECTION 20: Notice and Communication

20.1 **Notices, Meeting Notes, and Statements of Disputed Issues.** All written notices to be given pursuant to this Agreement shall be sent by electronic mail and first class mail or overnight express service, postage prepaid, to each Party at the addresses listed below or such subsequent address as a Party shall provide. Notices shall be deemed received three business days after the date of mailing, or on the date of receipt if overnight express or other receipt-notification service is used. All forum meeting notes and written statements of disputed issues required under Section 15 shall be posted to a designated Internet website and electronically mailed to each Party at the electronic mail address provided by the Party. Such notes and statements shall also be mailed by first class mail or overnight express service, postage prepaid, to any Party unable to receive electronic mail or requesting such service, and shall be deemed received on the date of electronic mailing (or, where applicable, three business days after first class mailing or on the date of receipt if overnight express or other receipt-notification service is used).

20.2 For purposes of implementing this Agreement, the Parties agree that the following individuals shall be designated to be the primary contact persons, and all written notices, forum meeting notes, and written statements of disputed issues shall be posted to the individuals listed below. Notification of changes of contact persons shall be made in writing and posted to the contact persons of all other Parties.

List of Contact Persons:

Chelan County PUD
Director of Hydro Services
Gregg Carrington
327 N Wenatchee Avenue
Wenatchee, Washington 98801
Phone: (509) 661-4178
Fax: (509) 661-8155
Email: gregg@chelanpud.org

Washington State Department of Ecology
Central Regional Office Director
Derek Sandison
15 West Yakima Ave -- Suite 200
Yakima, WA 98902-3452
Phone: (509) 457-7120
Fax: (509) 575-2809
Email: dsan461@ecy.wa.gov

Washington State Department of Fish and Wildlife
Regional Director, Dennis Beich
1550 Alder Street NW
Ephrata, Washington 98823-9699
Phone: (509) 754-4624
Fax: (509) 754-5257
Email: beichdvb@dfw.wa.gov

United States Fish and Wildlife
Supervisor, Mark Miller
215 Melody Lane
Wenatchee, Washington 98801
Phone: (509) 665-3508
Fax: (509) 665-3509
Email: mark_miller@fws.gov

City of Entiat
Mayor, Wendell Black
P.O. Box 228, 14070 Kinzel Street
Entiat, Washington 98822
Phone: (509) 784-1500
Fax: (509) 784-1112
Email: city@entiat.org

Alcoa Power Generating Inc.
NW Vice President for Government and Energy Affairs, Jack Speer
6200 Malaga Alcoa Highway
Malaga, WA 98828-9728
Phone: (509) 663-9331
Fax: (509) 663-9399
Email: jack.speer@alcoa.com

Bureau of Land Management
Acting Area Manager, Neal Hedges
915 Walla Walla Avenue
Wenatchee, WA 98801
Phone: (509) 665-2100
Fax: (509) 665-2116
Email: neil_hedges@or.blm.gov

National Parks Service
Pacific Northwest Region
Susan Rosebrough
909 First Avenue
Seattle, WA 98104
Phone: (206) 220-4121
Email:susan_rosebrough@nps.gov

Confederated Tribes of the Colville Reservation
Joe Peone, Fish & Wildlife Director
Rural Route 1, Box 150
Nespelum WA 99155
Phone: (509) 634-2113
Fax: (509) 634-2126
Email: joe.peone@colvilletribes.com

SECTION 21: Signatures

21.1 **Signatory Authority.** Each signatory to this Agreement certifies that he or she is authorized to execute this Agreement and to legally bind the Party he or she represents, and that such Party shall be fully bound by the terms hereof upon such signature without any further act, approval, or authorization by such Party.

21.2 **Signing in Counterparts.** This Agreement may be executed in any number of counterparts, and each executed counterpart shall have the same force and effect as an original instrument as if all the signatory Parties to all of the counterparts had signed the same instrument. Any signature page of this Agreement may be detached from any counterpart of this Agreement without impairing the legal effect of any signatures, and may be attached to another counterpart of this Agreement identical in form having attached to it one or more signature pages.

Dated this 3rd day of February, 2006.

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY

By: ______________________
Wayne Wright, Interim General Manager

US FISH & WILDLIFE SERVICE

By: ______________________
Susan Martin, Project Leader

U.S. BUREAU OF LAND MANAGEMENT

By: Elaine Marquis-Brong
Elaine Marquis-Brong, State Director

US NATIONAL PARK SERVICE

By: ______________________
Jonathan B. Jarvis, Regional Director
Pacific West Region

WASHINGTON DEPARTMENT OF FISH & WILDLIFE

By: ______________________

Jeff Koenings, Ph.D., Director

WASHINGTON DEPARTMENT OF ECOLOGY

By: ______________________
Derek Sandison, Central Regional Director

CONFEDERATED TRIBES OF THE COLVILLE RESERVATION

By: ________. ______________________ Colville Business Council
Harvey Moses, Jr., Chairman Colville Business Council

(In a letter submitted by the Confederated Tribes of the Colville Reservation to Chelan PUD dated February 28, 2006, the Committee Chair explained that final review and action on the settlement agreement will require additional committee discussion, followed by a meeting of the full Business Council on or about mid-March before submitting its signature.)

CITY OF ENTIAT

By: ______________________
Wendell Black, Mayor

WASHINGTON PARKS AND RECREATION COMMISSION

By: ______________________
Rex Derr, Director

ALCOA POWER GENERATING INC.

By: ______________________
Marc Pereira, Vice President Energy and Procurement

OTHER SIGNING PARTIES

Party: **Entiat Coalition**

- Entiat Watershed Planning Unit
- Entiat Landowners Association
- Chelan County Fire District #8
- Entiat Irrigation District

By: Keith Vradenburg

Keith Vradenburg

ROCKY REACH
LICENSE ARTICLES

Attachment A to the
Rocky Reach Settlement Agreement

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

February 3, 2006

P.U.D.
CHELAN COUNTY
POWER

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

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Attachment A
Rocky Reach Hydroelectric Project
License Articles

Article 1. Shoreline Erosion Management Plan

Public Utility District No. 1 of Chelan County (Chelan PUD) shall implement the Shoreline Erosion Management Plan, as described in Chapter 1 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Erosion control demonstration projects.** Chelan PUD shall perform erosion control work at four demonstration sites selected by Chelan PUD to educate the public about appropriate erosion control techniques, as described in Section 4.1 of Chapter 1 of the Comprehensive Plan.

Within five years after the effective date of the New License, Chelan PUD shall select an initial demonstration site and perform erosion control work, as described in Section 4.1 of Chapter 1 of the Comprehensive Plan. Chelan PUD shall select a second, third, and fourth site, and shall perform erosion control work on such demonstration sites within 10, 15, and 20 years, respectively, after the effective date of the New License.

(b) **Information distribution.** During the first 20 years of the New License, Chelan PUD shall make available to the public current information on erosion control techniques, updating such information no less frequently than every five years, as described in Section 4.2 of Chapter 1 of the Comprehensive Plan.

(c) **Monitoring.** (1) Chelan PUD shall conduct an inventory of shoreline erosion in years 20 and 40 of the New License to determine changes in erosion, and to monitor the effectiveness of repairs, as described in Section 4.3.1 of Chapter 1 of the Comprehensive Plan.

(2) Chelan PUD shall select four to six representative erosion sites to monitor every five years, as described in Section 4.3.2 of Chapter 1 of the Comprehensive Plan.

(3) Chelan PUD shall conduct an inventory of shoreline erosion after unusually high flows or other events which could lead to unusual shoreline erosion, as described in Section 4.3.3 of Chapter 1 of the Comprehensive Plan.

Article 2. Water Quality Management Plan

Chelan PUD shall implement a Water Quality Management Plan to address Project effects on water quality, as described in Chapter 2 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Total dissolved gas (TDG) management.** Chelan PUD shall implement the following measures to address ongoing Project-related impacts to aquatic life, if any, and water quality impacts resulting from TDG produced during spill at the Project. Chelan PUD shall submit to Ecology for review and approval, by April 1 of the year of implementation, a gas abatement plan (GAP) describing the anticipated use of these gas abatement measures, including new or improved information and technologies. The GAP shall be accompanied by an up-to-date operations plan, a fisheries management plan, physical monitoring plan, and biological monitoring plan.

(1) **TDG monitoring.** Chelan PUD shall maintain two fixed monitoring stations at Rocky Reach Dam to monitor TDG levels annually from April through August, one in the forebay and one in the tailrace, for the term of the New License and any subsequent annual licenses or until such monitoring is no longer required by Ecology, whichever occurs sooner. The monitoring point for TDG in the tailrace shall be moved to a location at or near the Juvenile Bypass System outfall as soon as practicable, but no later than year two of the New License. If it is not feasible to conduct TDG monitoring at this site, an alternate location may be developed provided that if such alternate location is not representative of levels of TDG from spillway flows in the tailrace, measurements at the alternate location shall be indexed to the actual TDG levels in the tailrace below the spillway.

(2) **Measures to meet TDG numeric criteria.** Chelan PUD shall implement the following measures, as needed, in an effort to continue meeting the numeric criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting survival standards as set forth in the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan (HCP) and in the fish management plans contained within the Comprehensive Plan:

(A) **Fish passage spill management.** Manage voluntary spill levels provided for fish passage in real time in an effort to continue meeting TDG numeric criteria, using the Operational Plan for TDG;

(B) **Minimize voluntary fish passage spill.** Minimize voluntary spill;

(C) **Minimize spill due to maintenance.** Minimize spill, to the extent practicable, by scheduling maintenance based on predicted flows;

(D) **Avoid spill past unloaded units.** Avoid spill by continuing to participate in the 1997 Agreement for the Hourly Coordination of Projects on the mid-Columbia River (Hourly Coordination Agreement), or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG;

(E) **Additional operational TDG abatement options.** Implement reasonable and feasible alternative powerhouse and spillway operational measures, as needed to meet TDG numeric criteria. These measures include maximizing powerhouse discharge, as appropriate, up to 212 kcfs, and implementing alternative spillway operations with additional gates, using any of gates 2 through 12, to determine, in consultation with the

RRFF and HCP Coordinating Committee, whether TDG levels can be reduced without adverse effects on fish passage and if effective, implement to reduce TDG.

(3) **Monitoring of aquatic life for gas bubble trauma (GBT).** Chelan PUD shall prepare and implement a study of GBT. Such study may be included as part of the biological study for the GAP. The proposed study plan (including scope) and study results should be closely coordinated with the RRFF and the HCP Coordinating Committee and subject to Ecology approval. The final study plan and final study report will be peer-reviewed by recognized experts.

(4) **Determination of TDG compliance.** In year five of the effective date of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. If Ecology concludes, upon reviewing such report and other applicable information, that the Project complies with the applicable TDG numeric criteria, Ecology, in consultation with Chelan PUD, will determine which measures will be continued for the term of the New License to maintain such compliance. If Ecology concludes that compliance with the TDG numeric criteria has not been attained, Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD shall submit these reports to Ecology, members of the RRFF, and members of the HCP Coordinating Committee.

(5) **Actions if TDG numeric criteria not achieved.** If compliance with numeric TDG criteria has not been achieved within five years of the effective date of the New License, and if determined necessary by Ecology based on an analysis of the water quality standard for TDG from the perspective of attainability and biological necessity, Chelan PUD shall continue efforts to comply with the numeric criteria for an additional period of time specified by Ecology, as described in subsections (A) and (B), below:

(A) **Aquatic life adversely affected.** Upon receipt of the reports in (a)(4), Ecology will determine, based on the monitoring data and analysis provided by Chelan PUD, as may be supplemented by the RRFF and/or HCP Coordinating Committee, whether aquatic life has been adversely affected, or insufficient information exists to conclude that it has not been adversely affected, by TDG resulting from ongoing Project operations. If Ecology determines an effect has occurred or insufficient information exists, then Chelan PUD will consult with Ecology and the RRFF to determine whether additional reasonable and feasible measures exist to further reduce TDG without significant adverse impact to fish species, and, if so, Chelan PUD shall begin, upon receiving any necessary approvals from FERC, implementation of such additional measures, which may include structural modifications. If no reasonable and feasible TDG abatement measures exist, Chelan PUD may petition Ecology to modify the standards to eliminate any non-compliance with such standards, by filing a timely and scientifically robust petition. Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and the Section 401 Certification for the Project.

(B) **Aquatic Life Not Adversely Affected.** If Ecology determines, in consultation with the RRFF and the HCP Coordinating Committee, that aquatic life has not been adversely affected by TDG resulting from ongoing Project operations, Chelan PUD shall consult with Ecology and the RRFF to determine if additional reasonable and feasible measures may exist to meet the TDG standards. If Chelan PUD concludes that no other additional reasonable and feasible measures exist to reduce TDG, Chelan PUD may petition Ecology to modify the standards to eliminate any non-compliance with such standards, by filing a timely and scientifically robust petition. Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and the Section 401 Certification for the Project.

(b) **Water temperature measures.** Chelan PUD shall implement the following measures to address the Project's responsibilities, if any, regarding increased water temperature.

(1) **Water Temperature Monitoring.** Chelan PUD shall monitor hourly water temperatures in the forebay and tailrace annually from April through October for the term of the New License, and any subsequent annual licenses or until such monitoring is no longer required by Ecology, whichever occurs sooner. Chelan PUD shall monitor water temperatures in the Juvenile Bypass System and upstream fishway for one year, unless Ecology determines, in consultation with the RRFF, that additional monitoring is required. Chelan PUD shall also compile hourly water temperature data from the Wells dam tailrace for the term of the license or any subsequent annual licenses or until such data collection is no longer required by Ecology, whichever occurs sooner.

(2) **Temperature Modeling to Confirm Compliance**. Chelan PUD shall collect or compile meteorological and water temperature data, including hourly water temperature data from the Wells dam tailrace, for at least the first five years of the New License; such data shall be of sufficient quality to meet technical peer review group standards for running the CE-QUAL-W2 model. Using the data collected in the first five years of the New License, Chelan PUD shall run the CE-QUAL-W2 model to evaluate the Project compliance with numeric temperature criteria. Chelan PUD shall evaluate, as feasible, the causes of any modeled exceedances. Chelan PUD shall provide a report to Ecology in year six of the New License summarizing the results of the ten years of monitoring and modeling (first five years of the new License plus five previous years). The input data, modeling, and results shall be subject to a peer review and review by Ecology. If Ecology concludes that the Project is in compliance with numeric temperature

criteria, Chelan PUD may reduce or eliminate the aforementioned monitoring and or analysis requirements with the approval of Ecology.

If the Project is out of compliance with numeric temperature criteria, Chelan PUD shall submit to Ecology and FERC documentation to identify how it intends to come into compliance. However, in lieu of submitting such documentation, Chelan PUD may, upon a showing to Ecology that no reasonable and feasible improvements exist, request a change to water quality standards as appropriate and consistent with legal requirements. In evaluating whether all reasonable and feasible measures have been taken, Ecology will consider, among other relevant factors, information regarding biological impacts of temperature non-compliance caused by the Project and the extent to which the Project has achieved the Biological Objectives. If Chelan PUD petitions Ecology to modify the standards to eliminate any non-compliance with such standards, by filing a timely and scientifically robust petition, Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and, if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for water temperature violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the Section 401 Certification for the Project.

(3) **Participation in Development and Implementation of EPA Water Temperature TMDL**. Chelan PUD shall maintain the calibrated CE-QUAL-W2 model and data used for the 10-year analysis and make the data available to EPA, Ecology, affected tribes and other entities involved in the TMDL implementation program. Chelan PUD shall participate and cooperate with the parties implementing the TMDL.

(4) **Participation in Tributary Water Temperature Improvement Planning.** Chelan PUD, as part of its participation in tributary restoration planning and implementation under the HCP, will help identify opportunities to improve water temperature in the tributaries.

(c) **Project Operations Consistent with Existing Agreements.** Chelan PUD shall continue to operate the Project under the Hourly Coordination Agreement and the Hanford Reach Fall Chinook Protection Agreement, or successor agreements to which Chelan PUD is a party.

(d) **Water Quality in Macrophyte Beds.** Chelan PUD shall develop a one-year sampling program, in consultation with Ecology, to determine if the water quality criteria for dissolved oxygen, temperature, and pH are met in shallow water habitats, including macrophyte beds, in the Reservoir. If measurements reveal non-compliance with water quality numeric criteria or potential problems for designated uses, further sampling will be conducted, in coordination with the RRFF and Ecology, to determine the impact on aquatic habitat and associated biota. If such impacts are found to be significant and caused by the Project, Chelan PUD shall consult with the RRFF and Ecology to determine what actions may be reasonable and feasible to protect aquatic life. This additional sampling shall be coordinated with any concurrent resident fish monitoring that may be developed by Chelan PUD, in consultation with the RRFF. If Project impacts to water quality in shallow water habitats, which also may have macrophyte beds, create conditions in which site-specific impact to resident or anadromous fish are attributed to direct adverse water quality effects. Chelan PUD will consult with the RRFF and Ecology to determine what actions may be reasonable and feasible to protect aquatic life.

(e) **Aquatic Invasive Species.** Within one year of the effective date of the new license, in consultation with the RRFF, Chelan PUD shall develop and begin implementation of an AIS Monitoring and Control Plan (Monitoring Plan) for the Project to monitor for presence of new invasive species at or near Project facilities, as described in Section 4.5 of Chapter 2 of the Comprehensive Plan.

(f) **Spill Prevention Control and Countermeasure (SPCC) Plan and Columbia-Snake River Spill Response Initiative (CSR-SRI).** Chelan PUD shall operate the Project in accordance with the SPCC Plan, which shall be updated and revised periodically, as required in 40 CFR 112.5(b). Chelan PUD shall continue to implement the applicable portions of the CSR-SRI for which it is responsible.

Article 3. White Sturgeon Management Plan

Chelan PUD shall implement the White Sturgeon Management Plan to achieve the goal and objectives contained in Chapter 3 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Brood stock planning and collection**. Within one year of the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, prepare a brood stock collection plan that considers such factors as genetics and questions of imprinting. Chelan PUD shall begin collection of white sturgeon brood stock after the RRFF has selected a source of such fish, as described in Section 4.1.1 of Chapter 3 of the Comprehensive Plan.

(b) **Juvenile white sturgeon stocking**. Chelan PUD shall initiate a white sturgeon stocking program as described in Section 4.1.2 of Chapter 3 of the Comprehensive Plan.

(1) **Initial stocking of yearling white sturgeon.** Within three years of the effective date of the New License, Chelan PUD shall release up to 6,500 yearling white sturgeon into the Reservoir annually for three years.

(2) **Adjustments to stocking levels**. Following the third year of supplementation, Chelan PUD shall, in consultation with the RRFF, stock juvenile white sturgeon annually during the term of the New License, at an age class and stocking level determined by the results of the monitoring program, as described in Section 4.2.1 of Chapter 3 of the Comprehensive Plan. On a schedule developed in consultation with the RRFF, Chelan PUD shall implant active tags in a percentage of such fish, in anticipation of future monitoring efforts described in Section 4.2.2 of Chapter 3 of the Comprehensive Plan.

(3) **Long-term production.** By year seven of the New License, Chelan PUD shall, in consultation with the RRFF, determine a long-term source of fish to be used for continuing the

supplementation program for the term of the New License, as described in Section 4.1.3 of the Comprehensive Plan.

(c) **Determine the effectiveness of the supplementation program**. Chelan PUD shall conduct a monitoring program for the purpose of assessing the effectiveness of the supplementation program, as described in Section 4.2 of Chapter 3 of the Comprehensive Plan.

(1) **Index monitoring program**. In years four, five and six of the New License, Chelan PUD shall conduct an initial index monitoring program for juvenile and adult sturgeon in the Reservoir to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon, as described in Section 4.2.1 of Chapter 3 of the Comprehensive Plan. Beginning in year eight of the New License, Chelan PUD shall conduct index monitoring for a duration of one year, every third year, over the term of the New License, or on a schedule determined by the RRFF.

(2) **Investigation of emigration rate and habitat use of supplemented population**. In years five, six and seven of the New License, Chelan PUD shall conduct tracking surveys of juvenile white sturgeon that were released with active tags, as described in Section 4.2.2 of Chapter 3 of the Comprehensive Plan, to determine emigration rates and habitat use. Chelan PUD shall conduct additional such surveys in years 14 and 20 of the New License, or on a schedule determined by the RRFF.

(3) **Supplementation program review**. As described in Section 4.2.3 of Chapter 3 of the Comprehensive Plan, Chelan PUD shall compile information on other white sturgeon supplementation programs in the Columbia River Basin in order to assess whether the supplementation program described in sections (a) and (b) of this Article is consistent with similar regional programs; whether improvements can be made; and if economies can be achieved in meeting the objectives of the monitoring program through utilization of research developed at other hydroelectric projects. Such information shall be included, and updated as new information becomes available, in the annual reports to the RRFF described in section (e) of this Article.

(d) **Determine natural reproduction potential and adjust supplementation program accordingly**. Chelan PUD shall track reproductively viable adult sturgeon that were captured and implanted with active tags during the index monitoring program for the purpose of identifying potential spawning locations. As described in Section 4.4 of Chapter 3 of the Comprehensive Plan, five additional annual surveys of natural reproduction shall occur between years 8 through 18 of the New License, as recommended by the RRFF, based on flow conditions or other data.

(e) **Reporting**. Chelan PUD shall provide a report to the RRFF and FERC each year that summarizes its activities undertaken pursuant to this Article, as described in Section 4.5 of Chapter 3 of the Comprehensive Plan.

Article 4. Bull Trout Management Plan

Chelan PUD shall implement the Bull Trout Management Plan to identify, monitor, and address on-going Project effects on bull trout, as described in Chapter 4 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Operate upstream fishway and downstream bypass.** (1) Chelan PUD shall continue to provide upstream passage for adult bull trout through the existing upstream fishway and downstream passage for adult and sub-adult bull trout through the existing downstream bypass. Chelan PUD shall continue to operate such upstream fishway and downstream bypass in accordance with the criteria for anadromous salmonids set forth in the HCP and the annual Rocky Reach Fish Passage Plan (FPP), as approved and/or amended by the Rocky Reach HCP Coordinating Committee.

(2) **Upstream fishway counts.** Chelan PUD shall continue to conduct video monitoring in the upstream fishway, except during the annual fishway maintenance period, to count bull trout passing through the fishway and provide information on the size, age, and condition of bull trout.

(b) **Adult bull trout upstream and downstream passage evaluation.**
(1) Beginning in year 10 of the New License and continuing every 10 years thereafter during the term of the New License, Chelan PUD shall conduct a one-year adult bull trout monitoring program for the purpose of determining whether Chelan PUD remains in compliance with the Project's allowable level of incidental take of bull trout due to upstream and downstream passage. If the Project's allowable level of incidental take for the Project is exceeded during one such monitoring year, Chelan PUD shall conduct monitoring in the succeeding year. If the Project's allowable level of incidental take for the Project is exceeded during the succeeding monitoring year, Chelan PUD shall develop and implement a plan, in consultation with the RRFF and agreed to by the United States Fish and Wildlife Service (USFWS), to identify and address the factors contributing to exceedance of the allowable level of incidental take.

(2) **Report and correlation analysis.** Chelan PUD shall prepare a report on results gathered during each of the one-year periods described in section (b)(1) of this Article. Such annual report shall also examine whether a correlation exists between upstream and downstream passage times and Project operations.

(c) **Sub-adult bull trout monitoring methods.** Upon the recommendation of the RRFF, Chelan PUD shall implement appropriate and reasonable methods for monitoring sub-adult bull trout at the Rocky Reach Dam.

(d) **Implement appropriate and reasonable measures.** Chelan PUD shall identify and implement appropriate and reasonable measures, in consultation with the RRFF and agreed to by the USFWS, to modify the upstream fishway and downstream bypass or operations to reduce the identified impacts to bull trout passage, if any.

(e) **Participate in development and implementation of the USFWS Recovery Plan.** (1) Chelan PUD shall continue to attend meetings of the Upper Columbia River Bull Trout Recovery Team, as scheduled by the USFWS, until completion of the Bull Trout Recovery Plan. Chelan PUD will participate, as appropriate, in implementation of such Bull Trout Recovery Plan once it is completed by the USFWS.

(2) **Tributary enhancement.** Chelan PUD shall consider the feasibility of collecting and hauling large woody material that is captured at Rocky Reach Dam for placement in tributaries for use as fish habitat in projects funded by the Tributary Conservation Plan contained in the HCP.

(3) **Funding collection of tissue samples for genetic analysis.** Beginning in year 10 of the New License, and continuing every 10 years thereafter for the term of the New License, Chelan PUD shall, if recommended by the RRFF, collect up to 30 adult bull trout tissue samples and up to 40 sub-adult bull trout tissue samples over a period of one year, and fund their genetic analysis.

(4) **Information exchange and regional monitoring efforts.** During the term of the New License, Chelan PUD may continue to participate in information exchanges with other entities conducting bull trout research and regional efforts to explore methods to monitor upstream and downstream movement of sub-adult bull trout in the mainstem Columbia River. If monitoring methodologies become available, Chelan PUD shall work with the RRFF to identify and implement appropriate and reasonable measures for monitoring sub-adult bull trout at the Rocky Reach Dam.

Article 5. Pacific Lamprey Management Plan

Chelan PUD shall implement the Pacific Lamprey Management Plan to measure and address any ongoing Project impacts on Pacific lamprey and to achieve No Net Impact (NNI), as described in Chapter 5 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Adult upstream passage.** Chelan PUD shall measure and address ongoing Project impacts on upstream passage of adult Pacific lamprey, if any.

(1) **Fishway operations.** Chelan PUD shall continue to operate the upstream Project fishway in accordance with anadromous fish criteria described in the annual FPP, except as provided in section (a)(4) of this Article.

(2) **Adult upstream passage counts.** Chelan PUD shall maintain, using the most current technology, annual adult Pacific lamprey upstream passage counts in the Project fishway for the term of the New License and any subsequent annual licenses.

(3) **Upstream passage improvement literature review.** Within one year of the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, complete a literature review of the effectiveness of upstream lamprey passage measures implemented at other hydroelectric projects in the Columbia and Snake rivers, and evaluate whether it would be appropriate and reasonable to implement similar measures at Rocky Reach Dam.

(4) **Modifications to improve upstream passage.** As soon as practicable, but no later than five years after the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, design and implement appropriate and reasonable upstream passage improvement measures identified in section (a)(3) of this Article, if any.

(5) **Evaluation of upstream passage modifications.** Within one year following the implementation of any upstream passage improvement measure at Rocky Reach Dam required under section (a)(4) of this Article, Chelan PUD shall, in consultation with the RRFF, monitor the effectiveness of such measures for an appropriate period of time, using radio telemetry or other appropriate and reasonable methods. If, as determined by the RRFF, the results of the monitoring indicate that passage has not significantly improved as a result of such measure, Chelan PUD shall, in consultation with the RRFF, develop and implement a plan to identify additional appropriate and reasonable passage improvement measures, if any. Measures described in (a)(3), (a)(4) and (a)(5) will be repeated, as necessary, until adult Pacific lamprey passage at the Project is similar to the best passage rates found at other hydroelectric projects on the mainstem Columbia and Snake rivers.

(6) **Adult downstream passage.** If Chelan PUD, in consultation with the RRFF, determines that additional significant ongoing Project effects on adult downstream passage have been identified through the investigations described in sections (a)(3), (a)(4) and (a)(5) of this Article, Chelan PUD shall, in consultation with the RRFF, develop a plan and implement appropriate and reasonable measures to address such effects.

(7) **Periodic monitoring.** Once adult passage at the Project is determined under section (a)(5) of this Article to be similar to the best passage rates found at other hydroelectric projects on the mainstem Columbia and Snake rivers, then every 10 years during the term of the New License, or on a schedule agreed to by the RRFF, Chelan PUD shall, in consultation with the RRFF, monitor adult lamprey passage through the Project fishway, for an appropriate period of time, using radio telemetry or other appropriate and reasonable methods. Chelan PUD, in consultation with the RRFF, will evaluate the results of such monitoring to identify and implement any appropriate and reasonable measures to contribute toward achieving NNI.

(b) **Juvenile downstream passage improvement measures.** Chelan PUD shall measure and address potential ongoing Project-related impacts on downstream passage of juvenile Pacific lamprey, if any.

(1) **Operate downstream passage facilities.** Chelan PUD shall operate the Project's downstream fish passage facilities in accordance with the operation criteria for anadromous salmonids and compatible bull trout migration guidelines set forth in the HCP and the annual FPP, as approved and/or amended by the Rocky Reach HCP Coordinating Committee.

(2) **Juvenile lamprey impingement monitoring and reporting.** Chelan PUD shall monitor and report annually to the RRFF any lamprey impingement on turbine intake screens, until such time as the RRFF recommends that monitoring is no longer necessary. If significant ongoing Project effects are identified through the investigations described in this section, Chelan PUD shall, in

consultation with the RRFF, develop a plan and implement appropriate and reasonable measures to address such effects.

(3) **Measurement of impacts on juvenile downstream passage.** Between years two and five of the New License, Chelan PUD shall continue to measure the type and magnitude of on-going Project impacts on the downstream passage of juvenile lamprey, using appropriate and reasonable methodologies.

(c) **Measure and address ongoing Project impacts on juvenile lamprey rearing habitat.** Within three years of the effective date of the New License, Chelan PUD shall measure juvenile lamprey presence and relative abundance in habitat areas that may be impacted by ongoing Project operations. Chelan PUD shall, in consultation with the RRFF, develop a plan and implement appropriate and reasonable measures, if any, to address such impacts.

(d) **Identify and implement measures to address unavoidable impacts in order to achieve No Net Impact (NNI).** Within two years of the effective date of the New License, Chelan PUD shall collect and compile information regarding Pacific lamprey distribution, population status and trends, and juvenile downstream migration timing, to identify and implement appropriate and reasonable measures in order to achieve NNI. Chelan PUD shall also develop sampling and collection protocols and collect tissue samples and other relevant biological information from adult and juvenile lamprey populations that pass through the Project. Chelan PUD shall, in consultation with the RRFF, identify, consider, and implement appropriate and reasonable measures to address unavoidable losses at the Project in order to achieve NNI. In year five of the New License, and every five years thereafter, for the term of the New License and any subsequent annual licenses, Chelan PUD shall provide a report to the RRFF and FERC on the status of the Adaptive Management process regarding unavoidable impacts to Pacific lamprey.

Article 6. Resident Fish Management Plan

Chelan PUD shall implement a Resident Fish Management Plan to address potential Project effects to resident fish, as described in Chapter 6 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Fish rearing.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall make available funding for a fish rearing program conducted by the Washington State Department of Fish and Wildlife (WDFW) to rear approximately 30,000 pounds of rainbow trout, or other fish at a comparable production cost, for annual planting in water bodies in Chelan and Douglas counties, as described in Section 4.1.1 of Chapter 6 of the Comprehensive Plan.

(b) **Resident fish enhancement measures.** (1) During years 1 through 10 of the New License, Chelan PUD shall, in consultation with the RRFF, be responsible for implementing resident fish enhancement measures described in Section 4 of Chapter 6 of the Comprehensive Plan.

(2) During years 11 through the term of the New License, and any subsequent annual licenses, Chelan PUD shall, in consultation with the RRFF, be responsible for implementing resident fish enhancement measures described in Section 4 of Chapter 6 of the Comprehensive Plan.

(c) **Recreational Fishing Evaluation.** Within one year of the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, evaluate the creation of additional recreational fishing opportunities in the Reservoir that is compatible with existing fish resources.

(d) **Resident fish monitoring** (1) Within one year following the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, initiate implementation of a one-year comprehensive evaluation of resident fish in the Rocky Reach Reservoir focusing on predatory fish species.

(2) If, based on the comprehensive evaluation results, Chelan PUD determines, in consultation with the RRFF, that the predatory fish population adversely affects the achievement of HCP Plan Species survival standards in the Reservoir, Chelan PUD shall, in consultation with the HCP Coordinating Committee, develop and implement predator control measures as necessary to achieve such standards. Following implementation of any such predator control measures in the Reservoir, Chelan PUD shall conduct: 1) an additional one-year follow-up comprehensive evaluation, using the same methodology as for the initial evaluation (unless modified by the RRFF), to determine the efficacy of predator control measures undertaken in the Reservoir; and 2) an additional one-year monitoring survey to assess any changes in abundance or species composition of the resident fish populations in the reservoir. The timing and methodologies for the monitoring survey shall be developed by Chelan PUD in consultation with the RRFF.

(3) If, based on the initial comprehensive evaluation results, Chelan PUD determines, in consultation with the RRFF, that a predator fish predation problem does not exist in the Reservoir, Chelan PUD shall conduct three, one-year monitoring surveys to monitor any changes in abundance or species composition in the resident fish populations in the Reservoir. The timing and methodologies for the monitoring surveys shall be developed by Chelan PUD in consultation with the RRFF.

Article 7. Wildlife Management Plan

Chelan PUD shall implement its responsibilities under the Rocky Reach Wildlife Habitat Plan, as described in Chapter 7 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Restore, maintain, or improve Chelan Wildlife Area lands.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall make available funding to WDFW to restore, maintain, or improve WDFW lands within the Chelan Wildlife Area, as described in Section 4.1.2 of Chapter 7 of the Comprehensive Plan.

(b) **Habitat restoration on WDFW lands.** (1) Within 180 days of the effective date of the New License, Chelan PUD shall make available to the WDFW funding to restore 1,300 to 1,400 WDFW acres in the Chelan Wildlife Area that were previously under cultivation or in need of restoration, as described in Section 4.2.1 of Chapter 7 of the Comprehensive Plan.

(2) Within 180 days of the effective date of the New License, and by January 31st of years two through six of the New License, Chelan PUD shall make available funding to WDFW for the habitat restoration of WDFW's agricultural lands in the Chelan Wildlife Area.

(3) During years 10 through 50 of the term of the New License, Chelan PUD shall make available funding to WDFW to restore, maintain, or improve the Chelan Wildlife Area.

(c) **Habitat restoration on Bureau of Land Management (BLM) lands.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall make available funding to the BLM to restore, maintain, or improve BLM lands within the Chelan Wildlife Area, as described in Section 4.2.2 of Chapter 7 of the Comprehensive Plan.

(d) **Habitat restoration on United States Department of Agriculture (USDA) Forest Service lands.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall make available funding to the USDA Forest Service to restore, maintain, or improve USDA Forest Service lands within the Chelan Wildlife Area, as described in Section 4.2.3 of Chapter 7 of the Comprehensive Plan.

(e) **Sun Cove property conservation easement.** Within 180 days of the effective date of the New License, Chelan PUD shall enter into a contract with the Chelan-Douglas Land Trust, or another organization mutually agreed upon by Chelan PUD and WDFW, for the acquisition of a conservation easement in perpetuity, at no cost to the acquiring entity, on the Sun Cove property owned by Chelan PUD in Douglas County, Washington, for the purpose of protecting riparian habitat, as described in Section 4.2.4 of Chapter 7 of the Comprehensive Plan.

(f) **Integrated noxious weed control program.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall implement an integrated noxious weed control program, as described in Section 4.2.5 of Chapter 7 of the Comprehensive Plan.

(g) **Wildlife surveys.** Chelan PUD, in coordination with the Rocky Reach Wildlife Forum (RRWF), shall conduct wildlife surveys for species selected by the RRWF, during each year of the New License, and any subsequent annual licenses. Chelan PUD shall conduct such surveys and provide results in an annual report to the RRWF on a schedule determined by the RRWF, as described in Section 4.2.6 of Chapter 7 of the Comprehensive Plan.

(h) **Noxious weed control for *Spiranthes* or other botanical species of concern.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall implement a noxious weed control program focusing specifically in areas where Ute ladies'-tresses (*Spiranthes diluvialis*) occur on public lands adjacent to the Rocky Reach Reservoir, as described in Section 4.3.1 of Chapter 7 of the Comprehensive Plan.

(i) ***Spiranthes* monitoring program.** Within 180 days of the effective date of the New License, and by January 31st of each subsequent year of the New License and any subsequent annual licenses, Chelan PUD shall implement an annual monitoring program to evaluate the status of *Spiranthes populations* in the Project boundary, as described in Section 4.3.2 of Chapter 7 of the Comprehensive Plan.

(j) **Conservation easement.** Within two years of the effective date of the New License, Chelan PUD shall pursue, on a willing-seller basis, a conservation easement on a parcel of private land where *Spiranthes* occurs, as described in Section 4.3.3 of Chapter 7 of the Comprehensive Plan.

Article 8. Historic Properties and Cultural Resources Management Plan

Chelan PUD shall implement a Historic Properties and Cultural Resources Management Plan (HPCRMP), as described in Chapter 8 of the Comprehensive Plan (a confidential document), which is incorporated herein by reference, and the Programmatic Agreement between the FERC and the Washington State Historic Preservation Officer. Specifically:

(a) **Rocky Reach Cultural Forum.** Chelan PUD shall convene the Rocky Reach Cultural Forum (RRCF) within one year of the effective date of the New License and twice annually during the term of the New License and any subsequent annual licenses, or on a scheduled agreed to by the RRCF.

(b) **Consultation and permitting.** During the term of the New License and any subsequent annual licenses, Chelan PUD shall adhere to the consultation and permitting guidelines provided in the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act, 36 CFR Part 800, and other applicable cultural resources laws and regulations.

(1) **Tribal consultation.** Chelan PUD shall contact the Tribal Historic Preservation Officer of the Confederated Tribes of the Colville Reservation (CCT) and the cultural resources manager of the Yakama Nation (YN) during the third quarter of each year of the New License, and any subsequent annual licenses, to discuss the status of the HPCRMP, as described in Section 3.3 of Chapter 8 of the Comprehensive Plan. Chelan PUD shall consult with the CCT and the YN regarding its undertakings that may affect cultural resources within the Area of Potential Effect (APE) of the Project.

(2) **Agency consultation.** Chelan PUD shall consult with the relevant federal and state agencies regarding its undertakings that may affect cultural resources within the APE of the Project, as described in Section 3.4 of Chapter 8 of the Comprehensive Plan.

(3) **Private property.** Chelan PUD shall obtain landowner permission prior to undertaking any activities on private lands.

(4) **Annual report.** Each year of the New License, and any subsequent annual licenses, coordinated with the annual FERC reporting schedule, Chelan PUD shall provide an *Annual Report on the Implementation of the Historic Properties and Cultural Resources Management Plan* to FERC and the RRCF, as described in Section 3.5 of Chapter 8 of the Comprehensive Plan.

(c) **Site surveys.** Chelan PUD shall survey the APE for cultural resources every 15 years of the New License, or when the RRCF determines that new surveys are needed after high-flow or during unusually low water events, in accordance with Section 5.1 of Chapter 8 of the Comprehensive Plan. Chelan PUD shall ensure that field methods used in such inventories are comparable with those used in the baseline study, as described in Section 4.2 of Chapter 8 of the Comprehensive Plan.

(d) **Inadvertent Discovery.** In the event that archaeological deposits or human remains are inadvertently encountered during any Project-related activity during the term of the New License, and any subsequent annual licenses, Chelan PUD shall cease such activity and shall follow the protocol described in Section 4.4 of Chapter 8 of the Comprehensive Plan.

(e) **Evaluation.** Chelan PUD shall be responsible for the evaluation of sites within the APE during site surveys or inadvertent discoveries described in section (c) and (d) of this Article for possible inclusion in the National Register of Historic Places, as provided in Section 4.5 of Chapter 8 of the Comprehensive Plan. After review of new site data with the RRCF, Chelan PUD shall follow the NHPA evaluation procedures, as appropriate.

(f) **Site treatment.** (1) During the term of the New License, and any subsequent annual licenses, Chelan PUD, in consultation with the RRCF, shall conduct site treatment measures for Historic Properties currently and subsequently identified within the APE, as described in Section 3.2 of Chapter 8 of the Comprehensive Plan.

(2) **Site monitoring.** During the term of the New License and any subsequent annual licenses, Chelan PUD, in consultation with the RRCF, shall monitor the Historic Properties identified in the APE and update site information using a rotation system that prioritizes sites based on current assessments of ongoing Project effects. Chelan PUD shall revisit sites every one, three, five or fifteen years, as described in Section 5.2 of Chapter 8 of the Comprehensive Plan.

(3) **Site monitoring report**. Chelan PUD shall document results of site monitoring under section (f)(2) in an annual site monitoring report to the RRCF.

(g) **Traditional Cultural Properties Management Plan.** Within one year of the effective date of the New License, Chelan PUD shall initiate development and implementation of a Traditional Cultural Property (TCP) management plan, as described in Section 5.3 of Chapter 8 of the Comprehensive Plan, that includes a confidential map identifying known TCPs, recorded archaeological sites, documented ethnographic sites, and a treatment plan for identified TCPs within the APE. Chelan PUD's treatment plans for identified TCPs within the APE shall be developed in consultation with the responsible agency and the CCT and the YN.

(h) **Curation.** Chelan PUD shall adhere to all applicable federal and state curation standards and implement Section 5.4 of Chapter 8 of the Comprehensive Plan regarding any storage or curation of artifacts collected by Chelan PUD in the course of Project-related activities during the term of the New License and any subsequent annual licenses. The following subsections apply to artifacts and archival records for which Chelan PUD is responsible as of the effective date of the New License:

(1) Within one year of the effective date of the New License, Chelan PUD shall develop a collections assessment report that contains information about the location and volume of cultural resources for which Chelan PUD is responsible, and identifies potential repositories for storage of these items.

(2) Within three years of the effective date of the New License, Chelan PUD shall complete an initial collections inventory of known artifacts, reports, documentation, photographs, and maps relating to the APE.

(3) Within three years of the effective date of the New License, Chelan PUD shall ensure that all artifacts in its possession are curated according to applicable federal and state standards.

(i) **Information management.** Chelan PUD shall develop an integrated cultural resource information management system that includes cultural resource data for the Project, as described in Section 5.5 of Chapter 8 of the Comprehensive Plan.

(j) **Cultural Resources Coordinator.** Within 180 days of the effective date of the New License, Chelan PUD shall appoint a Cultural Resources Coordinator to oversee implementation of Chapter 8 of the Comprehensive Plan. The Cultural Resources Coordinator shall be the primary point of contact for all cultural resource tasks undertaken by Chelan PUD during the term of the New License and any subsequent annual licenses, as described in Section 5.7 of Chapter 8 of the Comprehensive Plan. The Cultural Resources Coordinator shall receive training to maintain current knowledge of cultural resource laws, regulations, and management practices every three years during the term of the New License and any subsequent annual licenses.

(k) **Public Education.** Within five years of the effective date of the New License, Chelan PUD shall develop and implement an interpretive plan and educational program during the term of the New License and any subsequent annual licenses, as described in Section 5.6 of Chapter 8 of the Comprehensive Plan.

Article 9. Recreation Resources Management Plan

Chelan PUD shall implement its responsibilities under the Recreation Resources Management Plan, as described in Chapter 9 of the Comprehensive Plan, which is incorporated herein by reference. Specifically:

(a) **Ownership and operation of existing parks.** For the term of the New License and any subsequent annual licenses, Chelan PUD shall continue to ensure the operation of Rocky Reach Park and Visitor Center, Beebe Bridge Park, Lincoln Rock State Park, Daroga State Park, Entiat Park, Chelan Falls/Powerhouse Park. Chelan PUD shall continue to ensure the operation and maintenance of the portion of Orondo Park that it owns.

(b) **Renovation and enhancement of Lincoln Rock State Park and Daroga State Park.** Within one year of the effective date of the New License, Chelan PUD, in consultation with Washington State Parks, shall begin implementation of major renovations of, and minor improvements to, existing facilities and enhancements at Lincoln Rock State Park and Daroga State Park.

(c) **Trail link from Lincoln Rock State Park to a fish bypass viewing station.** Within 180 days of the effective date of the New License or after notification from Washington State Parks that it has obtained all necessary permits, whichever comes later, Chelan PUD shall be responsible for the construction of a paved one mile trail, including interpretative signs, benches, and other trail amenities, on land owned by Chelan PUD from Lincoln Rock State Park to a fish bypass viewing station approximately 300 feet downstream of Rocky Reach Dam, as described in Section 4 of Chapter 9 of the Comprehensive Plan.

(d) **Irrigation system in Orondo Park.** Within 180 days of the effective date of the New License, Chelan PUD shall begin design and construction of an upgraded irrigation system in Orondo Park.

(e) **Revitalization of Entiat Park.** Within one year of the effective date of the New License, Chelan PUD shall begin implementation of the Entiat Park Revitalization Plan, in accordance with Section 4.5 of Chapter 9 of the Comprehensive Plan.

(f) **Update Recreation Use Needs Analysis/Forecast.** No later than year 23 of the New License, Chelan PUD shall, in consultation with the Rocky Reach Recreation Forum (RRRF), update the needs analysis/forecast to assess recreational use and needs within the Project boundary.

(g) **Recreation Resources Monitoring and Evaluation Program.** Every six years throughout the life of the New License and any subsequent annual licenses, Chelan PUD, in consultation with the RRRF, shall review and evaluate information with respect to existing and potential recreational use within the Project boundary. A report shall be made to FERC consistent with FERC Form 80 requirements. Upon receipt of the New License, or in 2009, whichever comes second, Chelan PUD shall make available $500,000 to address recreational needs within the Project boundary as approved by Chelan PUD Commissioners and FERC.

(h) **Completion of construction.** New construction projects described in sections (b), (c), (d) and (e) of this Article shall be completed by Chelan PUD within 10 years of the effective date of the New License, subject to necessary permitting.

Article 10. Habitat Conservation Plan

(a) Chelan PUD shall carry out its obligations as set forth in the 50-year HCP Agreement for the Rocky Reach Hydroelectric Project No. 2145, filed with FERC on November 24, 2003, approved by the Commission at 107 FERC ¶ 61,280 and ¶ 61,281, and prescribed by National Marine Fisheries Service (NMFS) and USFWS pursuant to Section 18 of the Federal Power Act. Further, the licensee shall file with the Commission: (1) the final annual and comprehensive progress reports developed pursuant to the HCP; and (2) the final results of all studies and testing pursuant to the HCP.

(b) Prior to taking any action pursuant to the HCP that requires a change in the authorized project facilities or operations not specifically identified in the HCP, the licensee shall file a license amendment application.

(c) The licensee shall file design drawings prior to the implementation of any modification or addition to project works that is necessary to implement the HCP. The licensee shall file such design drawings for Commission approval at least 90 days prior to the start of construction or modification. The licensee will file as-built drawings with the Commission within six months after completion of construction or modification.

ROCKY REACH COMPREHENSIVE PLAN

Attachment B to the Rocky Reach Settlement Agreement

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

February 3, 2006

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

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GLOSSARY OF ACRONYMS AND DEFINED TERMS USED IN THE ROCKY REACH COMPREHENSIVE PLAN

Acronym, Abbreviation, or Term	Definition
7Q10	seven-day, ten year frequency flood
Adaptive Management	An iterative and rigorous process used to improve decision-making in the face of uncertainty. See more complete definition of Adaptive Management in Section 3.1 of the Rocky Reach Settlement Agreement.
Agency or Agencies	US Fish and Wildlife Service, Washington Department of Fish and Wildlife, Bureau of Land Management, and Washington State Department of Ecology
Agreement	The Settlement Agreement and associated Attachments A & B, the Clean Water Act Section 401 certification. See more complete definition of Agreement in Section 3.1 of the Rocky Reach Settlement Agreement.
AIS	aquatic invasive species
APE	Area of Potential Effect: Includes land within the Rocky Reach Project boundary and land outside the Project boundary where Project operations may affect the character or use of Historic Properties and/or Traditional Cultural Properties.
ARMA	Aquatic Resource Mitigation Act
AWS	Attraction Water System
BLM	Bureau of Land Management
BO	Biological Opinion
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
BTMP	Bull Trout Management Plan
BTU	British thermal unit
CCT	Confederated Tribes of the Colville Reservation
CFC	chlorofluorocarbon
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
COE	United States Army Corps of Engineers

Acronym, Abbreviation, or Term	Definition
Comprehensive Plan	The comprehensive plan proposed by the Parties to the Federal Energy Regulatory Commission in the Settlement Agreement, and associated Attachment B.
Consensus	Defined in Section 15.1.6 and 15.6.6 of the Rocky Reach Settlement Agreement.
CRITFC	Columbia River Inter-tribal Fish Commission
CSR-SRI	Columbia-Snake River Spill Response Initiative
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Chelan Wildlife Area
DFMS	downstream fixed monitoring site
DNR	Washington State Department of Natural Resources
DO	dissolved oxygen
DPS	Distinct Population Segment
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
Estimated Cost	An amount of money that the Parties anticipate will be necessary to complete an identified activity or measure. See more complete definition of Estimated Cost in Section 3.1 of the Rocky Reach Settlement Agreement
EWG	Erosion Working Group
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
FPC	Fish Passage Center
FPP	Fish Passage Plan (Rocky Reach)
GAP	gas abatement plan
GBT	gas bubble trauma
Hanford Reach Agreement	Hanford Reach Fall Chinook Protection Program Agreement
HCFC	hydro-chlorofluorocarbon
HCP	Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan approved by the Federal Energy Regulatory

Acronym, Abbreviation, or Term	Definition
	Commission on June 21, 2004, (HCP Order, 107 FERC ¶ 61,281) as an amendment to the original Project license
HLK Dam	Hugh L. Keenleyside Dam
Hourly Coordination Agreement	1997 Agreement for Hourly Coordination in the Mid-Columbia
HPCRMP	Historic Properties and Cultural Resources Management Plan
IAC	Washington State Interagency Committee for Outdoor Recreation
IDFG	Idaho Department of Fish and Game
JBS	Juvenile Bypass System
kcfs	thousand cubic feet per second
KTH	Kootenay Trout Hatchery
KTOI	Kootenai Tribe of Idaho
KTOIH	Kootenai Tribe of Idaho Hatchery
Lake Entiat	Rocky Reach reservoir
LCFF	Lake Chelan Fishery Forum
Licensee	Public Utility District No. 1 of Chelan County, Washington or any successor to whom the New License is transferred.
m	meter
Make Available	Public Utility District No. 1 of Chelan County, Washington shall provide funds to an Agency or other specified entity pursuant to a mutually acceptable payment agreement entered into pursuant to the requirements of Section 18 of the Rocky Reach Settlement Agreement.
MASS1	Modular Aquatic Simulation System 1
mg/L	milligram per liter
ml	milliliter
Monitoring Plan	Aquatic Invasive Species Monitoring and Control Plan
MW	megawatt
MWH	Montgomery Watson Harza
New License	The license to be issued by the Federal Energy Regulatory Commission for the continued operation and maintenance of the Project, pursuant to the Federal Power Act.
NHPA	National Historic Preservation Act

Acronym, Abbreviation, or Term	Definition
NLPE	Net Ladder Passage Efficiency
NMFS	National Marine Fisheries Service
NNI	No Net Impact
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPS	National Parks Service
NRPA	National Recreation and Parks Administration
NRWG	Natural Resources Working Group
NTU	nephelometric turbidity unit
NWPCC	Northwest Power and Conservation Council
O.G.s	orifice gates
Parties	Entities that sign the Rocky Reach Settlement Agreement.
PCB	polycyclic chlorinated biphenyl
PCHB	Pollution Control Hearing Board
PDEA	Preliminary Draft Environmental Assessment
PIT tag	Passive Integrated Transponder
Plan Species	Spring, summer and fall Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*)
PLMP	Pacific Lamprey Management Plan
PLTG	Pacific Lamprey Technical Group
PMEs	Protection, Mitigation and Enhancement measures
PNCA	Pacific Northwest Coordination Agreement
Project	Rocky Reach Hydroelectric Project, licensed to Chelan PUD by FERC as Project No. 2145 or Rocky Reach Project
Proposed License Articles	License articles proposed by the Parties to FERC in the Rocky Reach Settlement Agreement, and contained in the associated Attachment A.
Reservoir	Rocky Reach Reservoir or Rocky Reach Hydroelectric Project Reservoir
RFMP	Resident Fish Management Plan
RFTG	Resident Fish Technical Group

Acronym, Abbreviation, or Term	Definition
RRCF	Rocky Reach Cultural Resources Forum
RRFF	Rocky Reach Fish Forum
RRMP	Recreation Resources Management Plan
RRPC	Rocky Reach Policy Committee
RRRF	Rocky Reach Recreation Forum
RRWF	Rocky Reach Wildlife Forum
SARA	Species at Risk Act (Canadian regulation)
SCORP	State Comprehensive Outdoor Recreation Planning Document
SEMP	Sediment Erosion Management Plan
SNTEMP	Stream Network Temperature Model
SPCC	Spill Prevention, Control, and Countermeasure Plan
SSWG	Social Sciences Working Group
TCP	traditional cultural places
TDG	total dissolved gas
TL	total length
TMDL	total maximum daily load
TSI	trophic state index
UCWSRI	Upper Columbia White Sturgeon Recovery Initiative
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
Washington State Parks	Washington Department of Parks and Recreation Commission
WDFW	Washington Department of Fish and Wildlife
WDG	Washington Department of Game (predecessor to WDFW)
WEST	WEST Consultants, Inc.
WMP	Wildlife Management Plan
WSDOT	Washington State Department of Transportation
WSMP	White Sturgeon Management Plan
WSTG	White Sturgeon Technical Group
WTG	Wildlife Technical Group

Acronym, Abbreviation, or Term	Definition
WY	water year
YN	Yakama Nation
YOY	Young of the Year
μg/L	microgram per liter

CHAPTER 1: ROCKY REACH SHORELINE EROSION MANAGEMENT PLAN

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EXECUTIVE SUMMARY

As part of a relicensing study in the spring and summer of 2000, Chelan PUD conducted inventory fieldwork, identifying and mapping 48 erosion sites around the Rocky Reach Project reservoir (Lake Entiat). The sites had a combined length of approximately 7.3 miles, or about 8.5 percent of the shoreline. The inventory determined that shoreline erosion at most sites is progressing relatively slowly. However, the Rocky Reach relicensing Erosion Working Group (EWG) considered erosion a significant problem at some sites.

Chelan PUD purchased flowage easements around the reservoir except on sites federally owned at the time of Project development. These easements cover damage in perpetuity to land within the Project boundary and to adjoining lands, by "seepage, erosion or similar causes...." Of the 48 sites inventoried, only two outside of the PUD's public park system were not covered by easements, and only one of those two sites is within the Project boundary. Chelan PUD will be addressing that site under the Rocky Reach Comprehensive Historic Properties and Cultural Resources Management Plan.

Three other Protection, Mitigation and Enhancement measures (PMEs) were also developed by the EWG to address the incidence of shoreline erosion along the Rocky Reach reservoir. Specifically, the Shoreline Erosion Management Plan (SEMP) calls for Chelan PUD to implement the following PMEs:

1) Demonstrate appropriate erosion control techniques by performing erosion control work at four sites.

2) Distribute information that includes suggested repair methods to assist the public in efforts to control shoreline erosion around the reservoir.

3) Monitor future shoreline erosion.

SECTION 1: INTRODUCTION

During the relicensing effort for the Rocky Reach Hydroelectric Project (Project), representatives from Chelan PUD, the USDA Forest Service, the Washington State Department of Fish and Wildlife (WDFW), and the community council of the city of Monitor formed an Erosion Working Group (EWG). The group developed a Rocky Reach Comprehensive Shoreline Erosion Management Plan (SEMP) for the Project. The EWG does not intend to continue as a resource forum once the New License is issued, though implementation of the SEMP will by conducted in coordination with the relevant management agencies, as described in Section 4 of this Chapter.

This SEMP contains sections highlighting the background of erosion occurring along the shore of the Rocky Reach reservoir (Section 2); a relicensing inventory conducted to identify erosion sites (Section 3); and specific Protection, Mitigation, and Enhancement measures (PMEs) to address shoreline erosion that Chelan PUD will implement through the term of the New License for the Rocky Reach Project (Section 4).

SECTION 2: BACKGROUND

Erosion is occurring along the shore of the Rocky Reach reservoir (Lake Entiat). Various landowners and agencies, including Chelan PUD, have put a substantial amount of effort into erosion control work where residential or recreational development has taken place along the shoreline, or where railroad or highway right of way bounds the reservoir. Less work has been done where the shoreline is used for agricultural purposes or remains undeveloped.

The valley and the shoreline area have been formed by erosion processes still in progress, making the influence of the Rocky Reach Project difficult to determine; however, the Project influences the location of active shoreline erosion. The extent of Project responsibility for shoreline erosion is unclear, due to a variety of factors, and is limited by flowage easements obtained on private and public lands (except federal lands) to accommodate Project operations. Easements purchased by Chelan PUD at the time of Project development release the Project from responsibility for damages caused by Project operations, including erosion. These easements apply to all shoreline lands not owned by the federal government.

The EWG agreed that most of the erosion features found along the reservoir predate Project construction. Moreover, due to operation of the reservoir, the shoreline now experiences lower flow velocities and a smaller range of water level fluctuations, both of which lead to less erosion. For example, in the case of erosion at the toe of alluvial fans, the current erosion faces are higher on the fan, but probably much smaller than the similar faces present before Project development. On the other hand, in some areas waves reaching the shoreline are now somewhat larger, due to a longer fetch over which they can develop. The consensus of the relicensing EWG, however, was that, on balance, shoreline erosion is less prevalent now than prior to Project development.

SECTION 3: STUDIES AND EVALUATION OF PROJECT EFFECTS

As part of a relicensing study in the spring and summer of 2000, Chelan PUD conducted inventory fieldwork, identifying and mapping 48 erosion sites around the Project reservoir (Lake Entiat). The results of this study were reported in the *Inventory of Shoreline Erosion, Lake Entiat* (Chelan PUD, 2001). Sites were inventoried if they showed signs of active erosion and were at least 50 feet long, or appeared to have potential for growing substantially or threatening important site features. The sites had a combined length of approximately 7.3 miles, or about 8.5 percent of the shoreline.

The inventory determined that shoreline erosion at most sites appears to be progressing relatively slowly, but that the average rate of recession could not be precisely estimated based on the information collected. At many sites, there appears to be little need for erosion control measures because the slowly progressing erosion does not threaten critical site features. Nevertheless, the Rocky Reach relicensing EWG considered erosion a significant problem at some sites.

There were 48 sites inventoried. Of these sites, all but two were either in Chelan PUD parks or covered by flowage easements. Only one of those two sites is within the Project boundary; therefore, Chelan PUD has no legal requirement to correct erosion problems at 47 of the 48 sites. However, the EWG still supported an erosion control program that incorporated public education and demonstration of appropriate erosion control methods so that local governments and individual landowners could successfully repair sites or reduce future impairments. As outlined in Section 4.1, Chelan PUD, as the landowner, will implement an erosion control education and demonstration program.

The one inventoried site not covered by easements and within the Project boundary is also a site of significance to the Cultural Resources Working Group. Chelan PUD will conduct erosion control work at this site; however, treatment of the site will be included in the Historic Properties and Cultural Resources Management Plan rather than in this plan, to protect the site. The remaining non-easement site is identified as site 31 in the *Inventory of Shoreline Erosion*. It is within Douglas County PUD's Wells Project boundary and outside the Rocky Reach Project boundary, so no plans for erosion control work at site 31 are included herein.

SECTION 4: PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

The overall goal of the Shoreline Erosion Management Plan (SEMP) is to address and improve the incidence of shoreline erosion along the Rocky Reach reservoir, from the Rocky Reach Project boundary where it crosses the tailrace of Wells Dam to the tailrace of Rocky Reach Dam. The Erosion Working Group (EWG) developed the following objectives and activities to meet this goal.

4.1 Objective 1: Demonstrate Appropriate Erosion Control Techniques

During the first 20 years of the license term, Chelan PUD will select four sites at which to perform erosion control work with the intent of demonstrating a variety of appropriate, permissible techniques to the public. Chelan PUD will select and perform work at one such erosion control demonstration site within years 5, 10, 15 and 20, respectively, of the New License, though it could elect to conduct the work sooner. The techniques will emphasize bio-engineering to the extent feasible. A potential demonstration project of particular interest to WDFW, for example, is an area of riprap which could be modified to improve its habitat value.

When selecting a site to be one of the four erosion control demonstration projects, Chelan PUD will consider the following criteria:

- Does the site help ensure that the program as a whole will include a variety of site configurations? Sites chosen for the demonstration program should facilitate demonstration of methods suited to different shoreline conditions found near the reservoir (e.g. high, steep slope vs. low, gentle slope).

- Is the site accessible to the public, such as a public park?

- Would the proposed work occur in an area for which Chelan PUD has obtained a flowage easement? Chelan PUD will not perform erosion control work within areas covered by flowage easements.

Chelan PUD will design the demonstration projects, and work with WDFW to obtain the necessary permits in an expedited manner, to the extent feasible. As part of the work at each of the four erosion control demonstration sites, Chelan PUD will post an interpretive sign at each site explaining the method or methods being used to control erosion and referring the public to sources of additional information, such as the material described in Section 4.2. Chelan PUD will provide an opportunity for WDFW to provide input on to designs and sign content. Chelan PUD will maintain the signs for the duration of the license and any subsequent annual licenses, unless the methods used become outdated and the associated information is no longer beneficial.

Chelan PUD will spend an amount not to exceed $200,000 for demonstration site repairs and sign maintenance during the 50-year term of the New License and any subsequent annual licenses. Chelan PUD will select and perform erosion control work at the rate of one or more sites per five-year period, after the effective date of the New License.

4.2 Inform the Public About Erosion Control Methods

Chelan PUD will seek opportunities to distribute information to assist the public in efforts to control shoreline erosion. The information may include technical information on suggested repair methods and/or reference and contact information that will allow landowners to readily find suitable technical information. Distribution may take place through county offices responsible for building or shoreline development permits, and/or through the Chelan PUD staff responsible for arranging electrical service to sites along the reservoir. Information may also be distributed directly to owners of erosion sites continuing to have erosion problems or noted to have changed substantially since the 2000 *Inventory of Shoreline Erosion* or subsequent monitoring described in Section 4.3. Chelan PUD will update the information no less than every five years of the first 20 years of the new license, or commensurate with the completion of a demonstration project under Section 4.1 of this Chapter.

Chelan PUD will spend an amount not to exceed $25,000 on this effort during the 50-year term of the New License and any subsequent annual licenses.

4.3 Monitor Future Shoreline Erosion

4.3.1 Shoreline Erosion Monitoring in Year 20 and Year 40 of the New License

Chelan PUD will complete and carry out a plan for monitoring the progress of shoreline erosion for changes in condition or trend, and for monitoring the effectiveness of repairs in years 20 and 40 of the New License. The goal of the monitoring plan is to obtain, and make available to affected landowners and park operators, current information on the status of erosion along the reservoir, on both public and private lands. The study area will include all shoreline areas within the Project boundary. Chelan PUD will consult with the affected landowners regarding new or existing non-easement sites on which Chelan PUD determines that erosion has become significantly worse and will perform appropriate repairs.

Under this SEMP, Chelan PUD will inventory erosion sites in the reservoir by boat. The inventory will include erosion sites along the reservoir shoreline greater than 50 feet in length which are experiencing relatively active erosion, or less than 50 feet in length, but which appear to pose an immediate threat to structures or other important site features. The inventory will include an initial screening of sites to select those more active sites for which descriptions are desired. The selected sites will be photographed, located for mapping purposes, and described in writing for inclusion in the inventory. Written descriptions will include information about slope angle, material types, stability, activity level and erosion rate, any previous site work and performance of those repairs, any affected site features, and any factors contributing to the erosion.

4.3.2 Baseline Monitoring for Selected Sites

Chelan PUD will select four to six representative erosion sites not selected as demonstration projects in Section 4.1 and for which no repair work is planned for more frequent monitoring. Chelan PUD will install survey monuments or otherwise equip these sites in order to monitor the rate of erosion at five-year intervals. Written descriptions of these sites will be made available to the appropriate managing agency, if any, and include the information described in the previous paragraph.

4.3.3 High Flow or Event Monitoring

In addition to the planned shoreline erosion monitoring described above, Chelan PUD will also inspect the reservoir shoreline for new erosion sites or substantial changes to existing sites after exceptionally high flows (e.g. 100-year level flood flows) through the reservoir or other events which could lead to unusual shoreline erosion, as determined by Chelan PUD. Shoreline monitoring under such special circumstances will be conducted similar to the year 20 and year 40 shoreline erosion inventories.

4.3.4 Monitoring Costs

The estimated cost of monitoring for the 50-year term of the license is $180,000.

SECTION 5: LITERATURE CITED

Chelan PUD, 2000. Shoreline Erosion Study Plan - final, Rocky Reach Hydroelectric Project, FERC Project No. 2145. Chelan PUD. January 15, 2000. 13 pp.

Chelan PUD, 2001. Inventory of Shoreline Erosion, Lake Entiat - final, Rocky Reach Hydroelectric Project, FERC Project No. 2145. Chelan PUD, Wenatchee, Washington. June 1, 2001. 66 pp.

CHAPTER 2: ROCKY REACH WATER QUALITY MANAGEMENT PLAN

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Section 401 of the Clean Water Act (CWA; 33 USC Chapter 26 § 1251 *et seq.*) requires that applicants for a hydroelectric project license from the Federal Energy Regulatory Commission (FERC) also apply for Section 401 Certification to comply with water quality standards and other appropriate requirements of state law. The Washington State Department of Ecology (Ecology) is responsible for issuing or denying the Section 401 certification for the Rocky Reach Hydroelectric Project (Project), or waiving such certification if it is not issued within a reasonable period of time, not to exceed one year.

Ecology is a participant in the Settlement Group negotiating conditions for relicensing of the Project, and has requested that Public Utility District No. 1 of Chelan County (Chelan PUD) help provide the scientific and biological basis for Ecology's Section 401 certification. The Settlement Group has developed a Comprehensive Plan that provides the rationale and details behind proposed license articles that the Settlement Group will recommend for inclusion in the New License to be issued by FERC. The Rocky Reach Water Quality Management Plan is in response to Ecology's request and is contained in this chapter of the Comprehensive Plan.[1]

Section II of this Executive Summary explains what it means to comply with the water quality standards and other appropriate requirements of state law. Section III describes the relationship of the Rocky Reach Water Quality Management Plan to the other chapters of the Comprehensive Plan. Section IV describes the existing agreements that support existing beneficial and designated fish uses. Section V addresses the issue of compliance with the numeric criteria for total dissolved gas (TDG) saturation and temperature, the only two water quality parameters that sometimes exceed numeric water quality criteria in the Mid-Columbia Rivers. Finally, Section VI describes the Adaptive Management plan that will be implemented pursuant to the Section 401 certification.

Chelan PUD's pending license application to FERC will be the second license for operation of the Project, but it will be the first time a Section 401 certification is required because the Project received its first license in 1956, before the CWA was enacted. However, Chelan PUD has voluntarily been operating the Project in compliance with several permits and plans related to specific Ecology water quality concerns, such as Spill Prevention Control and Countermeasure (SPCC) Plans, National Pollution Discharge Elimination System (NPDES) permits, and TDG abatement plans. This Rocky Reach Water Quality Management Plan assumes that those existing plans and permit conditions will be incorporated into Ecology's Section 401 certification.

[1] This plan is also submitted as a "mitigation plan" pursuant to the Washington State "Aquatic Resources Mitigation Act" (RCW 90.74.005 to RCW 90.74.030).

II. Reasonable Assurance of Compliance with Water Quality Standards and Other Appropriate Requirements of State Law

Before discussing the ability of the Project to meet specific numeric water quality criteria for TDG and temperature, it is important to briefly describe the legal context within which those criteria exist. First, water quality standards are established to protect water quality needed for specified uses, and those uses include fish and wildlife, recreation, and industrial (including hydropower). See WAC 173-201A-030; 40 C.F.R. § 131.10(a).

Second, water quality standards consist of two types of criteria: numeric and narrative. Numeric criteria establish specific values for certain parameters (e.g., TDG, temperature, turbidity, dissolved oxygen (DO)) that, if achieved, will provide favorable conditions for the most sensitive existing and designated aquatic life uses. Narrative criteria more generally require that other essential water quality conditions for which numeric criteria do not exist (e.g., flow, fish passage, habitat) be protected. Narrative criteria must also include an anti-degradation policy, requiring that designated and existing uses be "maintained and protected." § 131.12(a), WAC 173-201A-070(1), 40 CFR §§ 131.6, 12(a); WAC 173-201A-030. For example, instream designated and existing fish and wildlife uses must be maintained and protected

Third, the Washington State Pollution Control Hearings Board (PCHB) recognized in its 2004 decision upholding Ecology's Section 401 certification for the Lake Chelan Hydroelectric Project that reasonable assurance can exist even where numeric criteria are not being met, if a rigorous adaptive management plan will result in compliance, either by meeting the existing numeric criteria or by modifying that criteria through a rulemaking or similar process.

The PCHB stated that "the primary aim of the § 401 certification ... is to meet water quality standards *by complying with the intent and the substance of the standard rather than its numeric form*." PCHB No. 03-075, Final Order, at 15. (*emphasis added*) It found that an adaptive management plan containing specific enforceable biological objectives can provide reasonable assurance of compliance with water quality standards, including the anti-degradation requirements.

The PCHB found further support for its approach in the Aquatic Resources Mitigation Act (ARMA), which authorizes Ecology to issue a Section 401 certification for a hydroelectric project that mitigates for impacts providing "equal or better biological functions and values, compared to existing conditions." RCW 90.74.020(3). In its decision, the PCHB cited the fact that the water quality plan in that case was submitted to Ecology as a "mitigation plan" pursuant to ARMA, and this Chapter is being submitted to Ecology in the same manner.

Fourth, Ecology's new water quality standard for dams provides that for "dams that cause or contribute to a violation of the water quality standards" the dam owner must identify "all reasonable and feasible improvements that could be used to meet standards...." WAC 173-201A-510(5)(b). The standard also requires the dam owner to develop "a water quality attainment plan that provides a detailed strategy for achieving compliance." The plan must include a compliance schedule that does not exceed ten years.

Finally, the Section 401 certification cannot require the Project to remedy or mitigate water quality problems it did not cause. "With respect to Federal Energy Regulatory Commission licensed hydropower projects, the department [Ecology] may only require a person to mitigate or remedy a water quality violation or problem to the extent there is substantial evidence such person has caused such violation or problem." RCW 90.48.422(3).

Within this context, this Chapter has been developed to provide monitoring, evaluation, and control of TDG and temperature increases caused by the operation of the Project. The goal is to employ reasonable and feasible measures, through an Adaptive Management process, in an effort to continue complying with water quality numeric criteria, to the extent that the Project is causing a violation of those criteria. In the event that compliance cannot be achieved through the use of all reasonable and feasible measures, then Chelan PUD may propose an alternative to achieve compliance with standards under WAC 173-201A-510(5). Ecology will evaluate Chelan PUD's proposal. If Ecology determines that no additional reasonable and feasible measures exist, then Ecology will provide Chelan PUD with a schedule for completing the process of analyzing and responding to Chelan PUD's proposed alternatives to achieve compliance (WAC 173-201A §430-450).

It is also important to note that Ecology's water quality standards are in the process of revision. Effective August 1, 2003, Ecology revised its water quality standards (Surface Water Quality Standards, Chapter 173-201A WAC, July 2003). Revised water quality standards, however, are not effective for federal CWA programs until they have been approved by Environmental Protection Agency (EPA); during the interim period, the previous water quality standards remain applicable

On January 12 and February 14, 2005, EPA approved some of the 2003 water quality standards, but did not take action on others because of a need for more evaluation, as well as tribal consultation, Endangered Species Act (ESA) consultation, and essential fish habitat consultation under the Magnuson-Stevens Act. It is unclear whether EPA will complete this additional evaluation and consultation before the Section 401 certification is issued for the Project. However, the Compliance Schedules for Dams section in the 2003 water quality standards (discussed above) is in effect at this time because EPA determined that it is an enforcement provision, rather than a water quality standard subject to EPA approval.

III. Relationship of the Water Quality Management Plan to the Other Chapters of the Comprehensive Plan

The Rocky Reach Water Quality Management Plan is intended to work in coordination with the measures undertaken pursuant to other chapters of the Rocky Reach Comprehensive Plan, each of which support beneficial and designated uses recognized under the CWA. For example, Chapter 4, the Comprehensive Bull Trout Management Plan, is aimed at identifying and minimizing any negative Project-related impacts on bull trout passage (both adult and sub-adult) through the term of the New License. If a monitoring program identifies impacts, Chelan PUD will collaborate with the Rocky Reach Fish Forum to identify reasonable and feasible options to modify upstream and downstream passage facilities or operations that reduce the identified impacts.

Similarly, Chapter 5, the Comprehensive Pacific Lamprey Management Plan, Chapter 3, the Comprehensive White Sturgeon Management Plan, and Chapter 6, the Comprehensive Resident Fish Management Plan, would support the beneficial and designated use of the Columbia River for these species

Chapter 9, the Comprehensive Recreation Resources Management Plan, builds upon the foundation of Chelan PUD's seven existing parks to meet the growing need for recreation in the area. For example, Chelan PUD will design and implement upgrades to Entiat Park, which provides access to water recreation

IV. Existing Agreements Supporting Beneficial and Designated Uses

This Rocky Reach Water Quality Management Plan and the accompanying Section 401 certification must work in concert with three existing agreements that already support beneficial and designated uses in the Columbia River. First, Chelan PUD is a party to the historic Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Rocky Reach Project, along with the US Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS, presently National Oceanic Atmospheric Administration (NOAA) Fisheries), the Washington Department of Fish and Wildlife (WDFW), and the Confederated Tribes of the Colville Reservation (CCT). The object of the HCP is to achieve no net impact of the Project on anadromous species of salmon and steelhead and to contribute to recovery. To that end, Chelan PUD in 2003 completed a $110 million downstream Juvenile Fish Bypass system (JBS) to increase the survival of downstream migrating salmon and steelhead.

Second, Chelan PUD is a party to the 1997 Agreement for the Hourly Coordination of Projects on the mid-Columbia River (Hourly Coordination Agreement), along with Douglas PUD, Grant PUD, and the Bonneville Power Administration (BPA). Under the terms of this agreement, the five non-federal dams on the Columbia River (Rock Island, Rocky Reach, Priest Rapids, Wanapum, and Wells), as well as the Grand Coulee and Chief Joseph federal projects, are operated in a coordinated manner to optimize water use through this stretch of the Columbia River.

Because these seven projects are the primary source of electricity load regulation for the entire Pacific Northwest, the primary aim of the Hourly Coordination Agreement is to meet the region's peak energy needs while maintaining Reservoir levels as stable and full as possible. From the perspective of fish health, the fact that the Rocky Reach Reservoir and tailrace are more stable than they would be without the Hourly Coordination Agreement means that there is less need for involuntary spill, thereby reducing levels of TDG.

Third, the Hanford Reach Fall Chinook Protection Program Agreement (Hanford Reach Agreement) commits the Project to support Grant PUD's efforts to stabilize water levels for the protection of fall Chinook salmon during spawning, incubation, and early rearing. These agreements are described in more detail in Section 2.2, Project Flow Regulation and Generation.

V. The Project Compliance History

The Project complies with most narrative standards and numeric criteria, including those established for DO, pH, turbidity, fecal coliform, nutrients/trophic level toxic or deleterious materials, and aesthetics This conclusion is documented in Section 2.3 – Water Quality Baseline, and Section 2.6 - Oil and Grease Containment and SPCC Plan.

However, at times, the Columbia River within the Project boundary does not meet the numeric criteria for two parameters, TDG and water temperature; therefore, they are the main focus of the Water Quality Management Plan contained in this Chapter. This Chapter discusses the Project's effects, if any, on these parameters, potential actions to mitigate any Project effects, and an Adaptive-Management plan to manage any ongoing Project effects over time.

A. Total Dissolved Gas

As discussed in more detail below, the Project has a relatively minor effect on TDG levels, and those effects are already being alleviated by reducing spill. Based on a recent analysis of the TDG characteristics and operational measures that have been or could be implemented, there is reasonable assurance that the Project will comply with TDG numeric criteria under the New License. In addition to reducing spill through operational changes, there may be some potential to further reduce TDG through structural modifications, but those steps could adversely affect the survival of salmon and steelhead passing through the spillway. The estimated cost of potential structural modifications ranges from $21 million to greater than $63 million. The Project's current design is already equivalent in TDG abatement to the TDG response observed at other Columbia River hydroelectric projects after they were structurally modified, and additional operational measures have been identified that are anticipated to make it possible to meet standards or special conditions criteria at all times. Moreover, there is no evidence that the current TDG levels are causing significant impacts on fish and other aquatic biota.

i. The Numeric TDG Criteria

The numeric criteria for TDG is that it shall not exceed 110%, although that level may be exceeded when water is being spilled to aid fish passage, pursuant to a Ecology-approved gas abatement plan. Under such a plan, the average TDG level (highest 12 hours in a day) may not exceed 120% in the tailrace of each dam, and may not exceed 115% as measured in the forebay of the next downstream dam. The TDG limits do not apply when the stream flow exceeds the seven-day, ten-year frequency flood (7Q10).

ii. The Project Effect on TDG

The Columbia River did not always meet the numeric criteria for TDG before the Project existed, and would not always meet them even if the Project was removed. This is due to the modifications to the river caused by the construction of upstream hydroelectric and storage projects, which result in elevated TDG levels before the water enters the Project boundary.

The Project has an effect on TDG when spilling water, but the effect differs depending on the circumstances. Years of monitoring show that when TDG levels in water reaching the Project are near or below 110%, the Project's spill operations typically increase the TDG level at the downstream fixed monitoring site (DFMS), located four miles downstream of the Project, by 1-3%. When TDG levels arriving at the Project are between 115-120%, spill operations at the Project generally do not affect the average TDG levels at the downstream Rock Island Project. When TDG levels arriving at the Project exceed 120%, the Project's spill operations typically reduce TDG levels arriving at the Rock Island Dam. Regression analysis indicates that the Project can meet TDG numeric criteria at all flows up to the 7Q10 flow.

The Project has reported exceedances of the TDG criteria since 1997 (Table 2-1). Over that time period, exceedances were infrequent except during high flow events in 1997 and 2002, when flows frequently exceeded 200,000 cubic feet per second (cfs). However, only a small number of those exceedances were caused by the Rocky Reach Project. This record demonstrates that during high flow periods when upstream dams raise TDG levels above 120%, presenting the most potential risk to fish, the Project either has no effect on TDG or reduces TDG levels in the Columbia River downstream from the Project.

The record of TDG exceedances demonstrates that the level of spill used by the Project to increase downstream fish passage survival has been successfully managed to meet water quality numeric criteria. From 1997 to 2004, there have been 140 exceedances of TDG in water arriving at the Project's forebay. Although Rocky Reach was also spilling when these exceedances occurred, the number of exceedances was lower at the Rocky Reach Project's DFMS (102) and at the Rock Island Project's forebay (137). An analysis of the exceedances below the Project during these years found that only 11 of the 102 exceedances of the 120% criterion at the DFMS and 17 of the 137 exceedances of the 115% Rock Island forebay criterion were caused by the Project's spill operations. The other exceedances were all caused by the high TDG levels arriving at the Project, and would have occurred even if the Project had not been spilling. Since construction in 2003 of the JBS, voluntary fish spill has not caused any exceedances. The Project's compliance with TDG numeric criteria is expected to continue because the JBS reduces the need for fish passage spill.

Spill in 2003 was provided at higher levels than expected in the future (15 - 25% of daily average river flow) during this first year of operation of the JBS to assure that HCP fish survival objectives would be met. Based on the efficacy of the JBS to meet fish survival objectives, less spill was needed in 2004 and 2005, although the highest level of spill (24% of daily average) was still used for protection of sockeye salmon, with nighttime spill levels often exceeding 50% of the flow. Even during the 24% spill level in 2004, the TDG level never exceeded 113.1%. During summer spill of 9%, the TDG level at the DFMS never exceeded 114.6%, although water arriving at the Project reached 114.3% TDG levels. This experience and expected future reduction in the need for voluntary spill by improving the efficacy of the JBS provide reasonable assurance that the Project will comply with the TDG criteria in the future.

iii. Potential Measures to Further Reduce TDG

The Project complies with the TDG numeric criteria. Nevertheless, in the course of its analysis, Chelan PUD voluntarily evaluated whether further abatement of TDG is reasonable and feasible at the Project. In addition, Chelan PUD studied the effect of current TDG levels on aquatic organisms below the Project. The most effective method to reduce the level of TDG caused by the Project is to reduce or eliminate spill.

Voluntary spill for fish passage has been reduced with the completion of the JBS and future actions are planned to continue this effort. Involuntary spill, caused primarily by high flows, is minimized by the Project's participation in the Hourly Coordination Agreement, and by careful planning of turbine unit outages and other activities to avoid reducing hydraulic capacity of the powerhouse during time periods when inflows to the Project are highest.

Based on studies, Project personnel adjust spillway settings and operations to minimize increases in TDG levels. Project personnel monitor TDG levels and follow an established protocol to reduce spill, if possible, to avoid exceedance of criteria.

The potential to further reduce TDG during spill through additional changes to operations or structural modifications was investigated by independent experts with the Engineer Research and Development Center, US Army Corps of Engineers (ERDC). The investigation determined, for high spill levels, that use of more gates to reduce flow per gate could decrease TDG by a small amount, but would possibly affect upstream passage of adult salmon seeking entrance into the upstream fishways.

A detailed technical assessment of the TDG exchange characteristics of Rocky Reach Dam was conducted for current conditions and nine different operational and structural TDG management alternatives. This analysis was based on direct observations of TDG exchange at Rocky Reach Dam and at other projects with a wide range of TDG management alternatives. In addition to a review of physical data, the theoretical basis for TDG gas transfer and best engineering judgment was employed to develop an assessment of the potential TDG management alternatives at Rocky Reach Dam.

The assessment concluded that one operational and two structural alternatives would potentially decrease TDG in the river. The operational alternative was to investigate the impact of changing the spill pattern from the standard method of using gates 2 through 8 to a uniform spill from gates 2 through 12. This potential operational change has the risk of adversely affecting the upstream passage of adult salmonids and steelhead, so it would have to be evaluated carefully prior to implementation. The findings from a limited number of test conditions indicates a potential reduction in the average TDG levels of up to 2% using gates 2 through 12.

The two structural alternatives identified were the construction of an entrainment wall that would keep the spill separated from the powerhouse flows, and a combination of raising the tailrace and constructing spillway flow deflectors.

An entrainment wall would not reduce TDG levels in the tailrace. However, it would reduce average TDG levels in the river downstream of the Project. Without an entrainment wall, up to 20% of powerhouse flow is drawn into the spillway area, where it absorbs TDG as if it had been spilled. The entrainment wall keeps powerhouse flows separated from the spillway area, thereby preventing the absorption of TDG. The initial investigation indicates the wall could reduce TDG level in the mixed flow by up to 0.8% to 1.0%.

The combination of a raised tailrace channel, to promote the stripping of TDG, and spillway flow deflectors to minimize the initial plunge of entrained air may result in an improvement in TDG management. Initial estimates indicate that TDG level may be reduced by 1.7 to 1.9%, and 4.0 to 4.2% in the mixed flow and tailrace, respectively, under worst case conditions. However it is not certain that these estimated reductions can be achieved at Rocky Reach Dam. For example, it is likely that the tailrace channel would need to be armored to withstand the large hydraulic forces associated with spill delivered downstream of the stilling basin due to the installation of spillway flow deflectors. Extensive hydraulic model studies would be required to develop a design that provides safe stilling action of spill, accommodates the guidance of adult and juvenile salmonids, and effectively reduces TDG.

As previously stated, the estimated cost of potential feasible structural modifications ranged from $21 million to greater than $63 million, and such modifications may adversely affect fish survival. The Project has a unique spillway stilling basin design that was found to have innate TDG abatement characteristics. The Project's current design is equivalent in TDG abatement to the TDG response observed at other Columbia River hydroelectric projects after they were structurally modified with TDG abatement measures, such as spillway deflectors and training walls. Spill management at the Project in 2003 and 2004 held TDG levels downstream of the Project much lower than allowed by the 120%/115% criteria. Implementing spill in a uniform pattern from gates 2 through 12 was identified by ERDC as the best alternative to reduce TDG levels during spill.

As previously stated, there is reasonable assurance that the Project will comply with TDG numeric criteria at all flows up to the 7Q10 flow of 252,000 cfs, as required by the water quality standards (Table 7). The implementation of operational measures (Section 4) provides further assurance that the Project will be able to demonstrate compliance by year 5 of the New License.

iv. Biological Effects of Elevated TDG Levels

Biological studies of the effects of elevated TDG levels on aquatic organisms, including studies of juvenile salmon and steelhead, resident fish species, and benthic macroinvertebrates, found very little evidence of any adverse effects on these organisms, even when TDG levels were higher than normal. Juvenile salmon and steelhead have been monitored for gas bubble trauma (GBT), which is caused by exposure to high TDG levels, at the Rock Island fish bypass trap.

Even though the Rock Island fish bypass trap induces GBT by holding fish in shallow troughs overnight prior to examination, the percentage of fish exhibiting GBT symptoms has remained below 5% of the fish sampled since the JBS was constructed. By comparison, the NOAA Fisheries' Federal Columbia River Power System (FCRPS) Biological Opinion requires the continuation of voluntary spill until GBT symptoms are exhibited in greater than 15% of fish sampled.

The level of GBT in resident fish and benthic macroinvertebrates captured below the Project was studied in 2001 and 2002. TDG levels were low in 2001 because there was no spill, but in 2002 TDG levels were the highest observed in a decade. The high TDG came from hydroelectric projects upstream from Rocky Reach Dam. Nevertheless, there was no difference in the levels of GBT symptoms observed in fish and macroinvertebrates in the spring of 2001 (no TDG exceedances) as compared with the spring of 2002 (TDG levels ranged from 103% to 127%). None of the resident fish collected in 2001 (3,777 fish examined) and during spring 2002 (2,134 fish examined) exhibited signs of GBT, despite the fact that they were collected from shallow water where exposure to TDG is most likely to result in GBT.

Similarly, benthic macroinvertebrates did not show signs of GBT, with only two of 7,405 organisms examined having GBT in 2001 and two of 9,885 organisms examined having GBT in 2002. Even an attempt to induce GBT in macroinvertebrates in 2002 by suspending organisms at a depth of one meter for seven days failed to produce any evidence of GBT in the 404 organisms examined.

Only during the first part of the 2002 summer sampling season, when TDG levels arriving at the Project exceeded 130%, were GBT symptoms observed in resident fish sampled below the Project. GBT was observed in 160 of the 866 fish examined from July to August. However, even with the extreme exposure to TDG levels exceeding 130%, most of the fish only exhibited minor GBT impacts.

From this evidence, it is clear that the Project not only meets the numeric TDG criteria but also does not cause adverse GBT effects to migrating salmon and steelhead, resident fish, or macroinvertebrates.

B. Water Temperature

i. The Numeric Temperature Standard

Under the 1997 Class A numeric temperature criteria, temperatures shall not exceed 18°C due to human activities. When natural conditions exceed 18°C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C.

ii. Project Effects on Temperature

Water temperatures in the Columbia River exceed 18°C during the summer months. In the Reservoir, water temperatures typically exceed 18°C from late July to mid-September. These warm water temperatures are partly natural and partly the result of the storage dams upstream of the Project, such as the Grand Coulee Project.

The EPA has conducted a water temperature model study of the Columbia River, using a 30-year period of weather and water temperature records. The EPA model found that the temperature regime in the upper Columbia River, including the Reservoir, is largely determined by the temperature of water released from Grand Coulee Dam. Compared to pre-dam temperatures, water released from Grand Coulee Dam is cooler in spring and early summer, and warmer from late summer through winter.

Run-of-river hydroelectric projects, such as the Rocky Reach Project, have a de minimis effect on water temperatures. The EPA determined that the Project's effect on water temperatures, on average over a 30-year period, was to slightly increase the tendency of water to warm up during the hot weather of summer and slightly increase the rate at which the water cools in fall and winter. The EPA's modeling effort could not precisely determine the Project's effect because the margin of error in EPA's model was greater than the measurable effect of the Project. However, EPA's model did determine that the Project's effect on water temperatures in the Columbia River is likely less than a 0.1°C increase in daily average water temperatures during hot weather in summer. By contrast, after August the Project has a beneficial cooling effect, reaching a maximum of 0.2°C of cooling in late October, when Chinook salmon begin spawning in the mainstem Columbia River.

EPA also modeled the effect of the continued existence of the Project on water temperatures at the downstream McNary Project. The Project's contribution to the cumulative downstream effect was less than a 0.05°C increase in average daily water temperature in summer and 0.1°C decrease in fall and winter.

The EPA model was designed to assist in the long-term management of the Columbia River. However, for purposes of Section 401 Certification, the Washington State water quality standards are based on the daily maximum water temperature, rather than the daily average water temperature, and the time period is daily or weekly, rather than an average of effects over a 30-year period. Therefore, additional water temperature modeling was needed for Ecology to meet its mandate to determine if the Project meets the criteria for water temperature. Since the water temperature exceeds 18°C during the summer, the most relevant criterion in the water quality standards is the limitation of allowable increase due to the Project of 0.3°C above "natural" conditions.[2]

Ecology regulations define "natural conditions", for the purposes of its surface water quality standards, as "surface water quality that was present before any human-caused pollution." WAC 173-201A-020. In the case of Rocky Reach Project relicensing this means the water quality that would exist in the absence of the Project because the purpose and scope of the relicensing proceeding is to determine the future of the Rocky Reach Project itself, not whether to return the Columbia River basin to a pre-human condition. In addition, any model that could be developed to estimate the impact of the Project on a hypothetical Columbia River with no human influences would be so speculative as to likely be an insufficient evidentiary basis to either determine compliance or impose water quality measures on the Project. Moreover, to the extent such an approach resulted in the imposition of requirements on the Rocky Reach Project "to mitigate or remedy a water quality violation or problem" caused by others, it would be a violation of Washington law. RCW 90-48-422(3).

For this reason, Ecology chose to use the existing water temperature and flow regimes entering the Project's boundary as the "natural" baseline temperature to determine whether the Project increases daily maximum water temperatures above the allowable incremental increase. To make this determination, a water temperature model study was conducted by an independent consultant, WEST Consulting, Incorporated (WEST), in collaboration with Ecology, Chelan PUD, a peer review group of water temperature modeling experts, and a subcommittee of stakeholders in the relicensing settlement process, the Water Quality Technical Group. The study was funded by Chelan PUD.

The water temperature model used was a public-domain model, CE-QUAL-W2, Version 3.2, which is widely used to measure the effects of reservoirs on water temperatures and is being used

2 Measures on the Project, moreover, to the extent such an approach resulted in the imposition of requirements on the Rocky Reach Project "to mitigate or remedy a water quality violation or problem" caused by others, it would be a violation of Washington law. RCW 90.48.422(3).

to evaluate water temperature effects and mitigative actions in other parts of the Columbia River Basin

The model was developed, calibrated, and subjected to a rigorous peer review. Once the model was found to be acceptable, empirical climatic data from 2000 through 2004 were input and water temperatures simulated, both with and without the Project. For further assurance, the model output was compared to another widely-used temperature model, Modula Aquatic Simulation System 1 (MASS 1), using data from 2000 and 2001. The models yielded results that correlated within 0.2°C.

The total error of the comparison of with and without Project simulations is approximately 0.3 to 0.4°C. A comparison of the with and without Project flow-weighted daily maximum hourly temperatures was made at each of three locations (Beebe Bridge, Daroga Park, and in the forebay) and subjected to the acceptability criteria described in the 1997 water quality standards

At no time during the five years did the simulated impacts exceed the acceptable increase at Beebe Bridge. On 22 days, the simulated impact at the forebay was greater than acceptable increases. However, only one day exhibited a difference between the allowable increase and the simulated increase that exceeded the combined margin of error of the models.

The model was also used to compare the Project impact to the 2003 proposed water quality standards, which consider a seven-day average of daily maximum temperatures and a criterion temperature of 17.5°C instead of the 18°C. On only two occasions was the simulated project impact greater than the acceptable incremental increase in years 2000 through 2004

The model results were independently analyzed for statistical significance of predicted temperature increases by biometricians from the University of Washington School of Aquatic and Fishery Sciences. This analysis concluded that the frequency of predicted exceedances was not statistically significant since it was less than expected by chance alone, due to the random error inherent in the model predictions.

The long-term management goal for the Columbia River is to reduce high summer water temperature to the extent reasonable and feasible. The EPA will be issuing a Total Daily Maximum Load (TMDL) for water temperatures on the Columbia River in the future, and it will be incumbent upon Ecology and other regulatory agencies to develop a detailed implementation plan for making reasonable and feasible improvements to reduce water temperatures for the benefit of salmon, steelhead, and other sensitive beneficial and designated uses.

This Rocky Reach Water Quality Management Plan investigated whether there were any reasonable and feasible actions that could be taken at the Project to reduce water temperatures during the summer months (Section 3.2, Temperature). A number of potential operational changes (increase daytime flows through release from active storage, operate at minimum pool), structural measures (selective withdrawal, solar barriers on fishways, cooling towers and chillers) and shade from shoreline vegetation were examined for feasibility in reducing water temperatures.

These potential measures were either infeasible or would not provide a measurable benefit The operational measures would not have a measurable effect on water temperatures and would cause environmental damage by reducing Reservoir habitat for fish and other aquatic organisms. The structural measures would either not have a measurable effect on temperature, or, in the case of cooling towers and chillers, were both massive in scale and would create a new, large consumptive use of water lost to evaporation.

For example, a cooling tower would not only be ineffective during much of the summer, to cool the river by 0.3°C would result in an estimated evaporation loss of 107 acre-feet of water per day, which is equivalent to a large municipal water supply A chiller with the same temperature reduction capability would require 15 million feet of 2-inch pipe to transfer the same heat load (a 0.3°C temperature reduction) from the river to the coolant system. Then the coolant would still need an evaporation-based heat exchanger on land to cool the refrigerant.

Due to the width of the Reservoir, which averages over 1,500 feet, even the tallest trees would not provide enough shade to have a measurable effect on water temperature. The only actions that could improve water temperature for migrating adult salmon and steelhead are riparian vegetation and flood-plain reconnectivity projects that would reduce water temperatures in the tributaries. These projects, which could be funded by the HCP Tributary Fund, would improve conditions for these sensitive species and provide a de minimis reduction in the heat load to the Columbia River.

IV. The Adaptive Management Plan

This Rocky Reach Water Quality Management Plan lays out an outcome-based Adaptive Management program for long-term protection of water quality and support for beneficial and designated uses that rely upon water quality and water-based habitat or access (Section 4.0 – Protection, Mitigation and Enhancement Measures). As previously documented, the Project has no adverse effect on most water quality parameters, and no actions are contemplated that would affect future compliance for these parameters.

The Project will continue to operate under agreements that support water quality and protection of beneficial and designated uses, including the Hourly Coordination Agreement, the HCP, and Hanford Reach Agreements, as well as any successors to these agreements to which Chelan PUD is a party. The Project will also continue to operate in accordance with the SPCC Plan, which will be revised and updated as necessary to assure that water quality for toxic and deleterious substances is not adversely affected by operation of the Project.

The Project currently meets the TDG standard, and future actions are planned to assure that compliance continues throughout the term of the New License. The narrative requirements of the TDG standard require the Project to follow a gas abatement plan when providing voluntary spill for fish passage. In addition, Ecology has issued a TMDL for TDG in the mid-Columbia River and Lake Roosevelt, which incorporates current actions at the Project to meet the TDG criteria as the initial actions and states that future actions will be specified in the Section 401 certification process for the Project.

The Adaptive Management program for compliance with TDG water quality criteria and standards incorporates four actions. First, the use of voluntary spill for fish passage will be minimized by optimizing the efficacy of the JBS and other measures, such as predator management, in meeting the HCP survival standards. Voluntary fish passage spill will continue to be managed to prevent exceedances, as was the case in 2004 when TDG levels never exceeded 113.1% at the downstream compliance location and 112.6% at the Rock Island Project's forebay, well below the allowable criteria of 120% and 115%, respectively.

Second, involuntary spill due to reduced hydraulic capacity will be minimized throughout the year by continuing to manage maintenance outages, scheduling work to avoid periods of high flows, when reduced hydraulic capacity could result in involuntary spill to pass excess inflow. Involuntary spill while generation units are idle will be minimized throughout the year by continual improvement in the management of flows and loads within the Hourly Coordination Agreement, regional load planning, and power marketing arrangements during high flow years. Involuntary spill has been effectively prevented by these methods, with only 11 hours of involuntary spill occurring in 2004.

The fourth action in the outcome-based TDG Adaptive Management plan will be monitoring of GBT biological effects in salmon and steelhead, resident fish and macroinvertebrates to assure that the Project's TDG management is fully protecting the aquatic resources and preventing measurable harm from the Project's operation

At the fifth year of the New License, the Project's performance on TDG abatement and prevention of GBT effects on aquatic resources will be evaluated to determine if the resources have been adequately protected. If not, then Chelan PUD will determine, in consultation with Ecology, if additional reasonable and feasible actions are available for implementation in an additional adaptive management period. If Chelan PUD determines that reasonable and feasible actions to reach compliance are not available or otherwise provides adequate justification to modify existing standards, then Chelan PUD may petition Ecology to initiate a process to modify the applicable water quality standards to eliminate any non-compliance with such standards.

The EPA TMDL for water temperature will establish load allocations and best management practices for operation of the hydroelectric projects on the Columbia River. Chelan PUD proposes to participate in water temperature monitoring, in conjunction with TDG monitoring, as its responsibility under TMDL implementation. Also, the CE-QUAL-W2 model developed for the Project will be made available to EPA and other entities involved in the TMDL implementation program.

Chelan PUD will participate and cooperate with the parties implementing the temperature TMDL. In particular, it will participate in tributary watershed restoration planning and TMDL implementation planning to assure that the HCP tributary fund includes consideration of projects that improve water temperature in the tributaries.

In addition to these specific water quality actions, the Project will proceed with the Adaptive Management plans developed to support sensitive aquatic species that depend on the aquatic environment for their habitat. The outcome-based objectives developed in other chapters of the

Comprehensive Plan for these species will further support and enhance these beneficial and designated uses consistent with the goals and requirements of water quality standards.

SECTION 1: INTRODUCTION

Section 401 of the CWA requires that license applicants apply for state certification of compliance with water quality standards and other appropriate requirements of state law. The fundamental purpose of the Section 401 process is to protect the beneficial and designated uses of state waters. Ecology is responsible for issuing or denying the Section 401 certification for the Project, or waiving such certification. The certification process considers the Project's compliance with the CWA, water quality standards, and other appropriate requirements of state law, including what measures can be employed to protect the beneficial and designated uses of the waters associated with the Project. These uses include fish and wildlife habitat, recreation, generation of electricity, water supply and irrigation. The Ecology, through the Section 401 certification, may require that certain specific actions or measures be included in the Project's license to support beneficial and designated uses.

Chelan PUD applied for Section 401 certification in a letter dated June 29, 2004. This request was submitted to FERC with the license application. Because the Comprehensive Settlement Agreement was not complete by June 20, 2005, Chelan PUD withdrew and reapplied on June 16, 2005. In the new application, Chelan PUD requested that the application not lead to another year of negotiations, but that rather 60-90 more days should be sufficient to complete the Settlement process. This Chapter is the principal supporting document that has been submitted to be part of the Section 401 certification application. The other chapters in the Comprehensive Plan provide additional information and proposed actions to support beneficial and designated uses that also apply to the Section 401 certification.

In development of this Chapter, Chelan PUD has conducted an extensive outreach to consult with federal and state management agencies, Native American tribes, municipal and county governments, environmental and recreation non-governmental organizations, and other interested parties. In this outreach, there have been numerous meetings conducted by Chelan PUD and Ecology, including relicensing water quality technical group meetings and public meetings.

SECTION 2: BACKGROUND

2.1 Project Setting and Operations

The Rocky Reach Project, the eighth dam upstream from the mouth of the Columbia River, is a run-of-river hydroelectric project with limited ability to modify river flows The Project has an allowable forebay fluctuation of four feet, with minimum forebay elevation of 703[3] and maximum of 707 feet for normal operation (710 under special flood control operation). However, in consideration of system reliability for the regional electric grid, the Project rarely allows the forebay elevation to drop below 704 feet. The forebay elevation is usually maintained between 706 and 707 feet. The forebay elevation has been above 706 feet over 73% of the time and within two feet of elevation 707 approximately 98% of the time, with average forebay elevation at 706.22 feet over a ten year period (1992-2001) The Project's tailrace elevation averaged 617.59 over the same time period The maximum tailwater elevation during this period was 635.2 feet (June 12, 1997) and minimum was 610.7 feet (April 21, 1998). Tailwater elevation is determined primarily by Project discharge, which is managed under the 1997 Agreement for the Hourly Coordination Agreement, as described later in this Section. On a daily basis, minimum and maximum discharge is related to the fluctuation in flows released from upstream federal dams, the Grand Coulee Project and Chief Joseph Project.

The Rocky Reach Reservoir (Reservoir) is 43 miles long, with an annual average flow of 113,200 cfs (1973-2001) since completion of Canadian storage reservoirs. The minimum daily average flow from 1973-2001 was 25,100 cfs (November 11, 1973) and the maximum daily average flow was 358,000 cfs (June 12, 1997) The surface area of the Reservoir is approximately 8,235 acres at a flow of 100,000 cfs and forebay elevation of 707 feet. The gross storage capacity of the Reservoir at 100,000 cfs is 387,500 acre-feet. The volume of water that the Reservoir can contain between the minimum and maximum forebay elevation is 36,400 acre-feet. This storage is useable for capturing or augmenting flow on an hourly basis. If inflow to the Project ceased, the Reservoir's useable storage would be sufficient only to run the plant for about two hours.

The inflow to the Project is primarily determined by operations of the FCRPS, which is composed of the federal dams and the accompanying electrical system on the Columbia and Snake Rivers in Oregon, Washington, and Idaho. The dams are operated by Reclamation and the U.S. Army Corps of Engineers (COE), and generate hydropower that is marketed by the Bonneville Power Administration. The FCRPS is managed for a number of objectives, the primary being flood control, power production, protection of fish resources, recreation, and irrigation. In general, the FCRPS is operated to fill upstream storage reservoirs in June, then provide augmented flows for fish passage and power production through the summer. The FCRPS drafts storage reservoirs to meet power demand and salmon spawning requirements through the fall and winter. Depending on snow accumulations and runoff forecasts, during the spring the reservoirs may be further drafted for flood control and to meet flow targets for

[3] All elevations of structures and water levels are in feet above mean sea level using national geodetic vertical datum (NGVD) 29 datum.

downstream juvenile salmon migration periods. FCRPS operations from late May to July focus on managing reservoir levels to meet June refill targets and to be full at the end of July. The FCRPS manages for these objectives using storage releases that pass through the Grand Coulee and Chief Joseph projects and adjusting for inflow from tributary streams above (the Okanogan, Methow and Entiat rivers) and below (Wenatchee and Snake rivers) the Rocky Reach Project. The FCRPS water management determines the daily, weekly and monthly average flows through the Rocky Reach Project.

Hourly flows at the Rocky Reach Project are also largely governed by hourly flow releases from Grand Coulee and Chief Joseph projects. However, the 36,400 acre-feet of useable storage at Rocky Reach, as well as useable storage at the Wells, Rock Island, Wanapum and Priest Rapids projects, is coordinated through operating agreements with the FCRPS to manage flow releases from Grand Coulee Dam for both power production and fish resource protection.

The primary operating agreement is the Hourly Coordination Agreement The primary objective of the Hourly Coordination Agreement is to coordinate the hydraulic operation of the seven mid-Columbia hydroelectric projects (Priest Rapids, Wanapum, Rock Island, Rocky Reach, Wells, Chief Joseph, and Grand Coulee) in order to optimize the amount of energy generated from the available water consistent with the needs to both adjust the total actual generation to match the total generation requested to meet regional energy loads, and to operate within each hydroelectric project's power and non-power requirements. The effect of the Hourly Coordination Agreement is to optimize the operation of the seven projects for power production and other objectives, including fish protection. The framework of the Hourly Coordination Agreement is used to enable fish protection operations for fall Chinook salmon in the Hanford Reach of the Columbia River. A separate agreement, the Hanford Reach Agreement (formerly the Vernita Bar Agreement), sets flow management operations for the Priest Rapids Hydroelectric Project, including requirements for the other mid-Columbia projects, to provide flow and storage operations that support and enable the Priest Rapids Project to provide minimum flows and manage flow fluctuations as necessary to protect fall Chinook eggs and juveniles in the Hanford Reach.

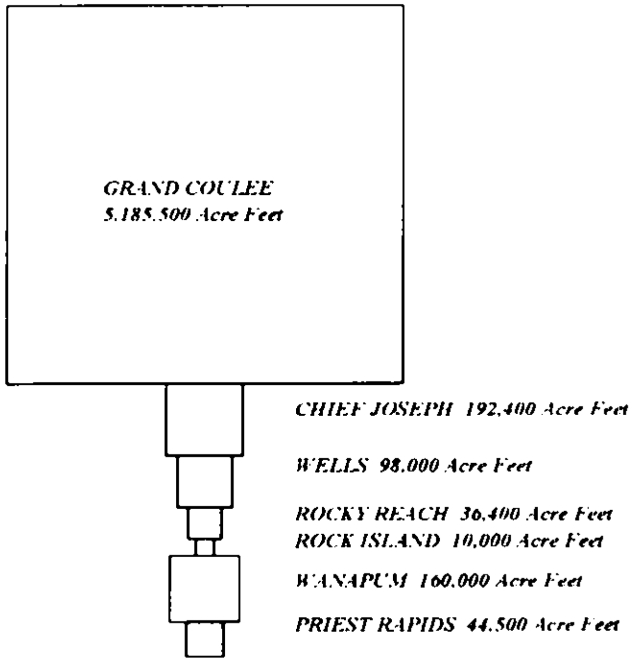


Figure 2-1: Mid-Columbia River Usable Storage

A more detailed discussion of how the Project is operated and the various agreements that influence the Project's operations follows in the next Section of this Rocky Reach Water Quality Management Plan and in Appendix A. Additional background information on the Rocky Reach Project's relationship to the hydrology of the Columbia River, including additional discussion of the Project's flows, backwater effects, useable storage and flow management capabilities, is contained in Appendix B.

2.2 <u>Project Operations for Power and Fish Resource Protection</u>

2.2.1 Overview of Project Flow Regulation and Generation

The amount of flow that enters the Rocky Reach Project is regulated by releases from the federal Grand Coulee Project, which essentially dictates the flowage curve for all downstream projects on the Columbia River hydropower system. Seasonal demand for hydroelectric generation is governed by the Pacific Northwest Coordination Agreement (PNCA);[4] however, non-power constraints such as flood control operations and the FCRPS Biological Opinion also dictate flow releases from the Grand Coulee Project. In the mid-Columbia, five non-federal hydroelectric projects (Wells, Rocky Reach, Rock Island, Wanapum and Priest Rapids projects) cooperate with each other and with the federal projects immediately upstream (Grand Coulee and Chief Joseph projects) through the Hourly Coordination Agreement to efficiently manage these releases to meet power demand and non-power operations for fish protection under the Hanford

[4] Grand Coulee Project releases are governed by the Pacific Northwest Coordination Agreement (PNCA). All generating utilities in the Northwest, with the exception of Idaho Power Company, are parties to the Agreement. The Agreement, in conjunction with the Canadian Treaty of 1964, provides a plan for optimizing water releases to meet power and non-power requirements on a seasonal basis.

Reach Agreement. The Hourly Coordination Agreement is set up to meet the daily demands of power load peaking while maintaining reservoir levels as stable and full as possible These seven projects are the primary source for electricity load regulation for the entire Northwest.

Hydropower is a unique energy resource because of its ability to start and stop with relative ease compared to other energy sources, such as coal or natural gas, which require hours or days to bring additional capacity online to meet increased demand. If generation and load requirements do not match, the electrical system becomes unstable. Load regulation is the ability to adjust generation as often as every four seconds so that at every moment in time, the generation of the interconnected electrical system matches the load requirements being placed upon it by customer demand. The BPA uses the Grand Coulee and Chief Joseph projects as its primary tools to align supply with demand signals, while all major Northwest investor-owned and some public power utilities have shares of the generation output of the five mid-Columbia non-federal projects. These projects are used for load regulation because of their abilities to regulate river flows on a daily or hourly basis (Grand Coulee and Chief Joseph) or, in the case of the Rocky Reach Project, for a unique ability to adjust to changes in power demand on a real-time basis.

The Rocky Reach Project License provides for drafting the Reservoir to the 703 elevation in anticipation of advancing floodwaters. However, Chelan PUD does not initiate this draft for flood control until signaled to do so by the COE. When the floodwaters do arrive, COE can ask for the Reservoir elevation to be operated at 710 feet. The COE would coordinate this drawdown and/or filling of the Reservoir with all of its other flood control operations and obligations This flood control operation has not occurred since 1972 and the COE has not ordered this operation since completion of Canadian storage in 1973.

Operation of the Rocky Reach Project is completely automated, including decisions to start, stop and adjust the output of the 11 generating units to achieve maximum efficiency. The automated functions are backed up with around-the-clock on-duty plant operators who monitor operations and can over-ride computer control if needed. When a generation request is transmitted from the central computer to the Rocky Reach Project's on-site computers, the most efficient way to meet the request is determined and implemented. Units 1 through 11 are adjustable blade Kaplan units and are efficient over a wide range of operating conditions. During the downstream juvenile salmon migration, the plant operations are adjusted to assure that turbine units 1-2, which support the JBS, are operating at all times and other units near the JBS are operated in preference to turbines further from the bypass entrance.

Spillway releases to pass water in excess of turbine capability or load requirements, or for fish passage, are also controlled by computer. When the headwater level exceeds operator-set maximum points, gates are automatically opened to pass the excess flow. During fish passage operations, the sequence and amounts of gate opening can also be adjusted to maximize the effectiveness of the water being spilled for fish passage. During high water years, the Project operates at a higher plant factor and is more often subject to spill to pass flows in excess of plant turbine capacity. A higher plant factor implies that the Project is able to operate at or near full load for longer periods of time without drafting the storage from the Reservoir. As flows increase, tailwater effects reduce plant capacity due to higher tailwater levels and lower available gross head. Under lower water supply conditions, the number of hours that the plant can sustain operations at or near peak load diminishes.

While the Rocky Reach Project has little control over river flow, operations do have some immediate impact on control of hourly fluctuations in Reservoir level and discharge. The Rocky Reach Project is managed in accordance with the resource optimization framework set up through the Hourly Coordination Agreement. The history and purpose of the Hourly Coordination Agreement is described below.

2.2.1.1 Mid-Columbia Hourly Coordination Agreement

The hydroelectric projects on the mid-Columbia River were built between 1930 and 1967, with the first project (Rock Island Hydroelectric Project) being completed in 1932. Grand Coulee, the main storage facility on the river, was completed in 1942. The Rocky Reach Project did not commence operation until 1961, while the last project on the mid-Columbia, the Wells project, was completed in 1967. Until 1974, each of these projects operated independently, following demand signals by drafting and filling their reservoirs.

Prior to the Hourly Coordination Agreement, each project peaked (i.e. generated the daily maximum power which results in releasing the highest daily volume of water through the turbines) at different times to meet the requirements of its power purchasers. As the Wells Project peaked, water then moved down to the Rocky Reach Project which, by the time it arrived, did not need to peak, resulting in spill at the Project. The Wells Project, on the other hand was left drafted with insufficient inflow to refill until the next day or late evening. This uncoordinated operation resulted in a number of problems, ranging from inefficient power management to an inability to meet certain flow requirements for fish. Specifically, uncoordinated project operation led to:

1. Large headwater fluctuations at each project associated with each operator's independent attempts to meet load and purchaser demand at an individual project;

2. Large fluctuations in flow below Priest Rapids Project as a result of the uncoordinated drafting and filling of reservoirs being operated in an uncoordinated manner (typically, the reservoirs would draft during the weekend and then gradually fill early in the week as flows from the upstream federal reservoirs increased to meet Monday morning loads). The resulting lag left the lower Columbia short on water early in the week, potentially affecting spawning habitat, particularly in the Hanford Reach;

3. Loss of potential energy due to head loss, increased spill, and inefficient use of plant capabilities;

4. An inability to meet any fish protection flow requirements below Priest Rapids project;

5. Additional drafting of already low reservoirs to meet the 36,000 cfs minimum flow at Priest Rapids Project required by the Department of Energy for the Hanford Reach (related to cooling water for the Hanford Nuclear Reservation).

The mid-Columbia projects use the same water as it moves down the river and are intrinsically interdependent. Because they are affected by both upstream and downstream water management, operators soon realized that individual operation of the projects did not result in maximum efficiency for the system as a whole. This realization resulted in the first Hourly Coordination Agreement.

The Hourly Coordination Agreement was first signed in 1974 as a one-year agreement. It was then renewed in a series of longer-term agreements. The current agreement was signed in 1997 and extends until June 30, 2017. The Hourly Coordination Agreement is signed by the project owners (Chelan PUD, Douglas PUD, Grant PUD, COE, and the U.S. Bureau of Reclamation), as well as all purchasers and participants of the projects, including the BPA. The Hourly Coordination Agreement sets forth terms for operating the five non-federal mid-Columbia hydroelectric projects and two upstream federal projects, Grand Coulee and Chief Joseph, in a coordinated manner through the "middle" stretch of the Columbia River.

The objectives of the Hourly Coordination Agreement are to: (1) coordinate the hydraulic operation of the projects to optimize the amount of energy from the available water consistent with the needs to both (i) adjust the total actual generation to match the total requested generation, and (ii) operate within all parties' power and non-power requirements; (2) provide flexibility and ease of scheduling generation for the projects through centralized coordinated scheduling and to provide flexibility in scheduling project generation; and, (3) to minimize unnecessary project generation changes, including unit starts and stops to the extent this objective is consistent with the other objectives of the Hourly Coordination Agreement.

Under the Hourly Coordination Agreement, the system's federal and non-federal hydroelectric projects cooperate to efficiently manage Grand Coulee Project flow releases in order to meet the daily demands of power load peaking while maintaining reservoir levels as stable and full as possible. The operating strategy under the Hourly Coordination Agreement includes specific algorithms related to reservoirs for power production, spill prevention, and downstream reservoir refill. In general, spill is avoided unless necessary for fish survival, since it wastes energy. To prevent spill, the total system of projects attempts to meet load by drafting from the project on the system that results in the least head loss. Spill is reduced or prevented where possible, by drafting a project downstream of the point of spill and reducing discharge above the point of spill, if it is anticipated that the drafting project's reservoir can refill within a prescribed time interval. Additional generation produced by the downstream draft is intended to reduce the coordinated request upstream of the point of spill, thereby reducing the inflow to the project being forced to spill. The net effect of this operation is to reduce involuntary spill, where hourly inflow to a project could exceed the hydraulic capacity of the powerhouse, thus forcing the project to spill water. This minimization of spill is desirable from a water quality standpoint, in that it minimizes the occurrence of elevated levels of TDG to only years with high flows and to voluntary spill provided to improve fish survival.

Each project on the system generates the most power when a release from Grand Coulee Project moves into its reservoir. The Project receiving the flow of water moving through the system generates at the highest plant factor necessary to provide as much power as possible, regardless of whether that particular project's customers are making the request at that time. All power requests and non-power requirements are collected and tracked by a computer at Grant PUD's headquarters (Ephrata, Washington) which serves as "Central" to the operation. This computer optimizes movement of water to maximize generation while keeping the reservoirs as full as possible. Participants in the Hourly Coordination Agreement make requests for power from the central system in real time. The computer assigns each project a desired generation level so that all load requests are satisfied in a manner that optimizes the combined operational efficiency of all of the participating projects. This means that a power purchaser with an agreement with the Rocky Reach Project may actually be receiving power generated at Priest Rapids Project at a certain time of the day. The situation may be reversed when it is more efficient to a Grant PUD's purchaser to receive power generated at the Rocky Reach Project. The programming for the computer has evolved through many years of refinements and is intended to achieve the highest overall level of efficiency for the participating projects.

The Hourly Coordination Agreement reduces water level fluctuations that would otherwise occur in both the reservoirs and tailraces of projects, because the higher efficiency is achieved by keeping the reservoirs as full as possible. Most of the mid-Columbia reservoirs have some backwatering (encroachment) effect on the tailrace of the project upstream, and the backwatering also reduces the magnitude of water level fluctuations in the tailwater that result from changes in plant discharge. In the absence of the Hourly Coordination Agreement, the tailwater levels at each plant would fluctuate based on discharge of inflows originating from the Grand Coulee Project, potentially exacerbated by additional fluctuation as individual projects drafted and refilled their useable storage while meeting load requests that are not synchronized with the flow of water through the mid-Columbia River. The Hourly Coordination Agreement prevents compounding effects and actually reduces water level fluctuations by dampening the effect of daily swings in flow releases from Grand Coulee Project.

While the Hourly Coordination Agreement allows participants to take advantage of these resource efficiencies in real time, it also ensures that each participant receives such power benefits in accordance with its rights to the generating assets. The computer keeps accounting records that recognize the varying generation obligations of each participating project. The computer's accounting programming permits the shifting in time of actual generation from one project to another by means of "coordinated exchange." As a result, each project generates when and at the level that is most efficient, and the contractual obligations of each project are met in the most cost-efficient manner possible. A paper account tracks when a project is generating less or more power than it needs to fill its obligations. In any 24-hour period, each project will have generated more than its customers require at certain times of the day and less than its customers require at other times of the day. Over approximately a 24-hour period, there is essentially no discrepancy between a single project's actual generation under the Hourly Coordination Agreement and the customer demand it has worked to fulfill

2.2.1.2 Role of Rocky Reach and Other Mid-Columbia Projects in Meeting Regional Energy Requirements

Federal hydropower projects throughout the Columbia and especially the Snake River system are subject to many operational restrictions intended to protect fish resources. These restrictions have prevented some projects from fluctuating power generation significantly in order to meet regional power demand. In response, the BPA relies almost entirely on the ability of the mid-

Columbia projects to respond to demand through regional load following outlined in the Hourly Coordination Agreement. Essentially, the seven mid-Columbia projects perform all of the load regulation for the Northwest electrical system. The operational restrictions placed on Grant PUD projects through the Hanford Reach Agreement shifts the burden of regional load following even more heavily onto the Rocky Reach and Wells projects.

The main role of the Rocky Reach Project in the Hourly Coordination Agreement is to utilize ramping (change in generation output) to meet the burden of regional load following. However, despite the system's heavy reliance on Rocky Reach's ramping capability, the Project manages to perform this role with the second smallest amount of useable reservoir storage on the system and a maximum reservoir fluctuation of only four feet.

The Rocky Reach project is fulfilling its appropriate role under the Hourly Coordination Agreement from the perspective of both fish and power obligations. It follows load in a manner that cannot be duplicated by the Wanapum and Priest Rapid projects (due to Hanford Reach Agreement considerations), thereby allowing those projects to manage their reservoirs in order to meet obligations for fish. If Rocky Reach were similarly restricted in operation, there would be implications for the entire Northwest electricity market, which would demand replacement power. This could be problematic in other environmental respects, given the amount and likely sources of replacement power. Hydro units are able to adjust to meet load much more quickly than thermal (gas, oil, coal, or nuclear) systems, and much more efficiently. Hydropower units can start and stop quickly, matching load demands on a four-second basis and reducing the need for significant reserves. If the load regulating ability of the mid-Columbia was lost due to restrictions, new generating facilities would need to come online to replace the hydropower system's ability to respond to load on a four-second basis. In order to replace this kind of flexible resource in a manner that would provide sufficient reserves for immediate response to regional load, as much as 2,000 megawatts of additional thermal generation would be required. These plants would be operated much more inefficiently, have negative air quality impacts and increase greenhouse gas emissions.

2.2.2 Current Operations

Chelan PUD operates the Reservoir with a normal maximum headwater elevation of 707 feet. The minimum allowable headwater level is 703, but drafting of headwater below 705 feet is infrequent (less than 2% of the time). Although the Project has a total useable storage of 36,400 acre-feet between headwater 707 and 703 feet, not all the storage is used, except in an emergency. Standard procedure is to not reduce forebay elevation below 704 feet because the bottom foot of storage is needed in reserve to maintain stability in the power grid. The Reservoir's total useable storage is sufficient to run the plant for about two hours (at average flows) without additional inflows. In normal operations, this storage can be used to increase outflow over the inflow by about 10,000 cfs over a full day.

During a normal water year, the plant operates at a plant factor of 55% (average flows are only sufficient to operate at 55% of the Project's maximum generating capacity). During high water years, the Project operates at a higher plant factor but is also more often subject to spill to pass flows in excess of plant turbine capacity.[5] When operating at a higher plant factor, the Project is able to operate at or near full load for longer periods of time without drafting the storage from the Reservoir. Under lower water supply conditions, the number of hours that the plant can sustain operations at or near peak load diminishes.

2.2.3 Hanford Reach Fall Chinook Protection Program

Chelan PUD has participated since 1988 in flow management operations for the protection of fall Chinook salmon that spawn in the Hanford Reach of the Columbia River. These joint operations were originally specified in the Vernita Bar Agreement, which provided protective operations from the beginning of spawning activity (late October) through incubation until the end of the emergence period (late April to early May). The Vernita Bar Agreement was scheduled to expire in 2005, concurrent with the expiration of Grant PUD's License for the Priest Rapids Project

Research in the late 1990s found that flow fluctuations in the Hanford Reach can also adversely affect survival of fall Chinook fry during the first few weeks after emergence. Due to the extensive areas of backwater channels and shallow gravel bars in the Hanford Reach, changes in river elevation associated with daily and weekly flow fluctuations can cause fish to be stranded in areas where they are exposed to mortality from dewatering, or heat stress and predation in shallow pools that become isolated from the main river channel. To address these issues, Chelan PUD has voluntarily cooperated with Grant PUD, BPA and Douglas PUD to enable Grant PUD to operate the Priest Rapids Project to reduce flow fluctuations. These voluntary operations, initiated in 1999, included research covering alternative operating methods that resulted in development of a long-term operating plan has replaced and improved upon the Vernita Bar Agreement.

The new agreement, the Hanford Reach Agreement, Appendix C, has been executed by most of the original parties to the Vernita Bar Agreement. In addition to Chelan PUD, this new agreement includes the following parties; Grant PUD, BPA, Douglas PUD, WDFW, NOAA Fisheries, and the CCT. The new agreement includes operations for the protection of fall Chinook salmon from the beginning of spawning through the early rearing period when Chinook fry are susceptible to stranding. The new agreement requires the same actions from Chelan PUD as the original Vernita Bar Agreement, but includes the additional time period that extends from April into June. This includes supporting Grant PUD's operations through the Hourly Coordination Agreement and providing up to one foot of draft from the Reservoir. Grant PUD has submitted the new Hanford Reach Agreement to the FERC as part of its application to relicense the Priest Rapids Project. Under the terms of the Hanford Reach Agreement, the parties have implemented the agreement pending action by FERC.

2.2.4 Anadromous Fish Agreement and Habitat Conservation Plan (HCP)

A 50-year agreement regarding protection of anadromous salmon and steelhead at the Project has been incorporated into the Project's existing license and will be the incorporated into the New License for the Project. The Project has special operations and facilities that are used to meet the survival objectives of the HCP, which are 93% survival for juveniles passing the Project and

[5] However, as explained elsewhere, a series of steps will be taken to prevent or minimize spill, even during a high water year.

91% combined survival of juvenile and adult salmon and steelhead passing the Project. Operations for the Project under the HCP use the JBS, installed in 2003, as the primary method for safely passing juvenile salmonids. Under the HCP, Chelan PUD continuously operates the JBS system from April 1 to August 31 each year. The spillway is also used, when needed to supplement the JBS, to provide a safe passage route. Spill levels are set by the HCP Coordinating Committee based on results of a 2003 downstream juvenile fish passage efficiency study and ongoing survival studies. Due to the performance of the JBS in passing yearling Chinook and steelhead, spill is not currently needed to meet survival standards for these species. Spills will continue to be used for passing sockeye and subyearling Chinook salmon until such time that the JBS or other tools for improving fish survival have met the survival standards. Spill, when required, is provided over a time period that encompasses 95% of each species' downstream migration. Spill levels in 2004 were 24% and 9% of the estimated daily average flow for sockeye and subyearling Chinook, respectively. Spill in 2005 will be provided on alternating days for sockeye in order to evaluate its effect on sockeye passage rates through the JBS. After completion of survival studies, spill will supplement the JBS as necessary to achieve the survival standards. Spill is managed to reduce adverse effects on water quality and meet water quality standards for TDG.

In addition to the use of the JBS and spill to pass juvenile salmon and steelhead, the spillway and powerhouse are operated to promote upstream passage of adult fish via the upstream passage fishways. These operations include spillgate sequences that are believed to help fish find the fishway entrances and powerhouse turbine loading preferences for the same purpose. The powerhouse turbine loading is also adjusted to promote downstream juvenile salmon and steelhead passage through the JBS system during its operating season.

2.2.5 Continuation of Beneficial Operations

The agreements that have been discussed, and other treaties, agreements and federal decisions that affect the Project's operations, establish the environmental setting for Columbia River flows that determines how the Project affects water quality and associated beneficial and designated uses that are dependent on water quality and aquatic habitat. In order to predict the future of the Project's compliance with water quality standards, it is necessary to be assured that the Columbia River flow management and the Project's operations that are necessary today to meet water quality standards will continue into the future. In other words, there is a need for assurance that should agreements expire, new agreements or other mechanisms will, at a minimum, maintain the water quality and aquatic habitat levels that currently exist. There is little reason to believe that there will be any steps backward in water quality compliance in the future. The HCP specifically states that, should the agreement terminate, the measures previously agreed to by the parties shall remain in effect. In addition, the Project's New License is expected to contain articles that require the Project to maintain measures that have been necessary components of the HCP and Hanford Reach Agreement for the protection of anadromous salmon and steelhead. Similarly, regulations that govern operation of the FCRPS will continue to support water quality and protection of aquatic resources. The effective actions in agreements that promote efficient power generation, such as the PNCA and the Hourly Coordination Agreement will also continue into the future since no parties are likely to desire reduced efficiency. A more detailed discussion of these agreements and other major agreements, including their expiration dates and affects on Project operations, is contained in Appendix A.

2.3 Water Quality Background Conditions

The water quality of the Reservoir was assessed to determine if these waters were in compliance with the 1997 Washington State Water Quality Standards for Class A waterbodies. The assessment included basic limnological information on productivity. The sampling was conducted from October 1999 to September 2000 (water year 2000). The results, which included assessment of water quality parameters, plankton, and attached benthic algal sampling, are reported in Parametrix and Rensel, 2001, and summarized in the Preliminary Draft Environmental Assessment (PDEA) (Chelan PUD, 2004). The objectives of this study were to compare existing water quality to the water quality standards, identify the appropriate methods and approach for monitoring key parameters; relate the monitoring results to fisheries concerns and other uses of the Reservoir; compare and contrast results to upstream and downstream conditions from other studies; and to determine the nature of any ongoing project-related impacts to water quality. A summary of the findings of the water quality assessment follows.

2.3.1 Upstream Water Sources Establish Background Water Quality

The water quality of the Reservoir is primarily influenced by the water quality arriving from upstream sources. The Reservoir is a run-of-the-river reservoir of approximately 8,235 surface acres at 100,000 cfs (maximum 9,860 acres at flood flows). Its 43-mile length is second longest among mid-Columbia River reservoirs behind Rufus Wood Lake, created by Chief Joseph Dam However, due to its narrow width, the Reservoir is one of the smallest in total volume of the seven mid-Columbia River reservoirs. The average depth is approximately 42 feet, with a maximum depth of about 180 feet. The water retention rate varies from less than one day at high flows to over three days at low flows, and averages about 1.8 days. This is a very low retention rate for a reservoir, but typical of other mid-Columbia run-of-the-river reservoirs that have similarly low water retention rates when compared to storage projects (Rensel, 1993). The source water for Reservoir is the Wells Reservoir, which receives flow from Chief Joseph Dam (Lake Rufus Woods) and the Methow and Okanogan Rivers. The primary influence on water quality from Lake Rufus Woods is the limnology of Lake Roosevelt, which is formed by Grand Coulee Dam. Lake Roosevelt is a major storage reservoir with a mean retention time of well over one month. The operation of Lake Roosevelt has a major influence on not only water quality, but biotic qualities of downstream reservoirs such as the supply of phytoplankton and zooplankton stocks (Beckman et al., 1985; Stober et al., 1981).

2.3.2 Summary of Water Quality Parameters in Compliance with Numeric Standards and Criteria

The Rocky Reach Project generally has no adverse effect on the objectives and narrative requirements of the water quality standards. The Project and the Reservoir maintain the water quality, habitat and accessibility necessary to support all the existing beneficial and designated uses included in the standards for Class A waterbodies. These uses include primary contact recreation, aesthetic enjoyment, sports fishing, boating, water supply for domestic, industrial and agricultural uses, and fish and wildlife habitat, including habitat for spawning, rearing and migration of cold-water salmonid species. The Reservoir has clean, clear water with high water transparency, very low fecal coliform content, and high DO concentrations.

The Reservoir meets water quality standards numeric criteria for DO, pH, turbidity, and fecal coliform (Chelan PUD, 2004; Table 7 in PDEA). The mid-Columbia River, including the

Reservoir, is currently listed as impaired for TDG and water temperature with five sites on or near the Reservoir that are listed in the 2002/2004 candidate list (Section 303(d) of the CWA). Water comes into the Reservoir at times with temperatures or TDG levels that exceed the numeric criteria. The existence of the Project does have the potential to increase water temperatures during the summer due to the effects of the Reservoir on total water surface area and travel time of water moving through the Reservoir. Spill operations at the Project can increase TDG levels in the Columbia River below the Project. The effect of the Project on these parameters is discussed in greater detail in separate Sections.

2.3.2.1 Dissolved Oxygen

The water quality standards for DO state that concentrations "shall have a one-day minimum 8.0 milligrams per liter (mg/L)". All measurements taken in the Reservoir complied with that standard (Figure 2-2). Increasing DO concentrations were measured from upriver to downriver each month. The lowest DO measured in water year (WY) 2000 was 8.26 mg/L in September at the Wells Dam tailrace. Average DO concentrations were commonly over 10 mg/L for all categories of stations. The DO levels increased as water moved downstream through the Reservoir and the same increasing trend was observed, for all months except May, when comparing DO at the Rocky Reach Dam tailrace to the Wells Dam tailrace. These differences averaged 0.35 mg/L for all months, with largest differences in October, February, and May. Generally, littoral DO concentrations were greater than at pelagic stations, but the average differences were less than 0.15 mg/L. One-meter DO monthly profiles show little variability among categories (littoral, pelagic or tailrace) of stations.

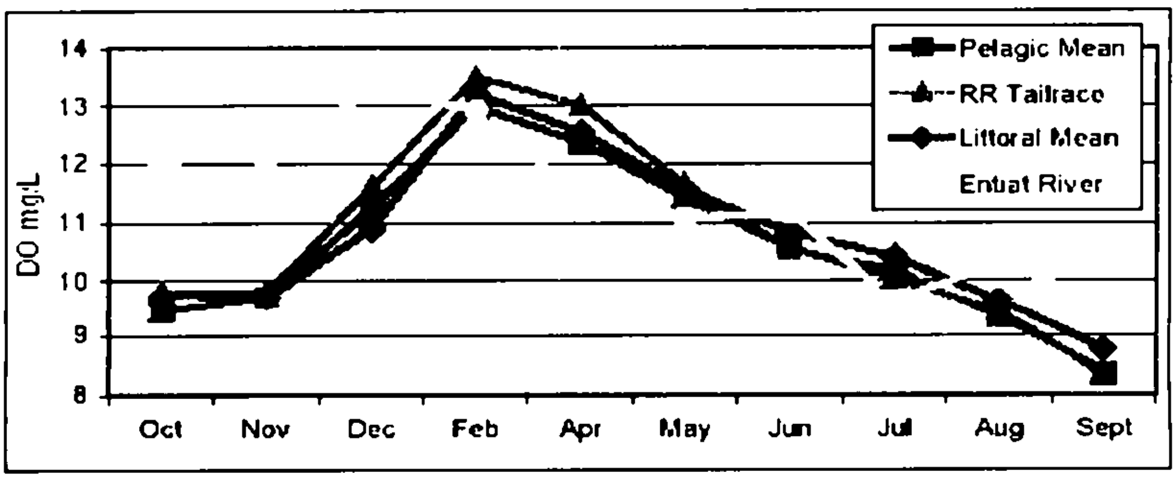


Figure 2-2: Dissolved Oxygen Profiles for Categories of Stations from Rocky Reach Reservoir and the Entiat River, WY 2000 (Parametrix and Rensel, 2001)

2.3.2.2 pH

The water quality standards for pH state that "pH shall be within the range 6.5 to 8.5 with human-caused variation within the above range of less than 0.5 units". A similar standard exists for Class AA waters but only 0.2 units of variation are allowed due to human causes. Those standards were met for the Reservoir during this study. Littoral stations had slightly higher pH compared to pelagic stations, beginning in spring and more so in summer (Figure 2-3). Higher pH near shore could be attributed to photosynthesis of macrophyte populations that typically have peak biomass in August. Rensel (1993) previously found that the mid-Columbia River's average annual pH ranges from about 7.5 to 8.1 at Grand Coulee Dam and about 7.5 to 8.3 at Rock Island Dam. Summer pH was similar, but showed more variation. Rocky Reach WY 2000 pelagic station measurements were virtually the same, ranging from 7.7 to 8.1.

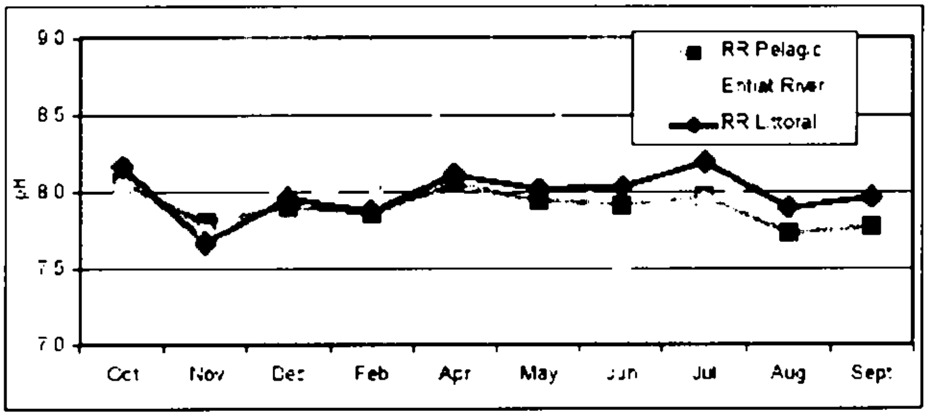


Figure 2-3: Plot of Monthly pH at 1-m Depth from Selected Stations, Water Year 2000 (Parametrix and Rensel, 2001)

2.3.2.3 Turbidity

The water quality standards for turbidity allows for no more than a 5 nephelometric turbidity unit (NTU) increase over background when background turbidity is 50 NTU or less and a 10% increase in turbidity when the background turbidity is more than 50 NTU. Turbidity was very low at all times and locations during WY 2000, averaging 1.9 to 2.2 NTU, depending on the category of the station. Maximum turbidity was noted during peak flows in April and May, but not exceeding 3.3 NTU. Low turbidity in the mid-Columbia River is in part a byproduct of large upstream storage reservoirs that allow all but the finest solids to settle out. The survey did not detect any significant Project-related sources of turbidity (Parametrix and Rensel, 2001).

2.3.2.4 Fecal Coliform

The water quality standards for freshwater state that fecal coliform "shall both not exceed a geometric mean value of 100 colonies/100 milliliter (ml) and not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 ml." Fecal coliform samples were collected at three pelagic stations in the Reservoir. Levels of fecal coliform were well within the above criteria, ranging from 1-10 colonies and averaging 2.7, 1.5, and 1.5 colonies from sampling stations at Beebe Bridge, Rocky Reach forebay and tailrace, respectively. Results of the sampling show very low or undetectable results at all times except in November and December (10 colonies at Beebe Bridge) when levels were slightly elevated. The cause of this minor elevation was unknown, but larger numbers of ducks and geese on or near the Reservoir were evident during this time period (Parametrix and Rensel, 2001).

2.3.3 Reservoir Limnology Supports Class A Beneficial and Designated Uses

The water quality standards requirements for Class A waterbodies do not have specific numeric criteria regarding nutrients and other limnological characteristics. However, the limnology of the Reservoir is supportive of Class A beneficial and designated uses (clear and clean for recreation, trophic level consistent with cold water aquatic life uses). Parametrix and Rensel (2001) reported that lake enrichment classifications suggest the Reservoir water column would be rated "lower mesotrophic" or on the low end of moderately enriched. The Trophic State Index (TSI) is an indication of the degree of enrichment of a lake using measurements of water transparency (Secchi disk depth), total phosphorus concentrations and chlorophyll-a concentrations during the summer (June to September) months. The TSI rating must be qualified, as the system is more suitable for lakes with longer retention times and turbidity due to plankton, not solids. There are no highly suitable rating systems for mid-Columbia River reservoirs. By TSI component, the Reservoir is oligotrophic with respect to water clarity but mesotrophic with respect to total phosphorus and chlorophyll-a concentrations. This trophic level is consistent with the limnological characteristics of other Columbia River reservoirs.

Transparency averaged 6.4 meters (m) in the summer months, steadily increasing from June to September in a pattern seen in other mid-Columbia River reservoirs (Parametrix and Rensel, 2001). Total phosphorus, a widely used indicator of trophic state, averaged 18.7 micrograms per liter (μg/L) at pelagic stations in the summer, and was positively correlated with hourly flow during sampling. Orthophosphate concentrations were minimal year-round, and during the summer averaged only 1.7 μg/L, similar to upstream conditions and below the detection limits of many laboratories. This measure is only a general indicator of trophic state, as phosphorus cycles quickly and true nutrient depletion for algal growth must be determined by other means. Ratios of dissolved inorganic nitrogen to orthophosphate were very high at all times, suggesting the possibility of summer phosphorus limitations to primary productivity and indicating that nitrogen concentrations were relatively high (Parametrix and Rensel, 2001).

Parametrix and Rensel (2001) reported that biological productivity in the Reservoir was similar to other mid-Columbia River reservoirs. Chlorophyll-a concentrations ranged from relatively low to moderate during WY 2000. During the late fall and winter levels were less than about 2.5 μg/L and from April onward were somewhat higher. April through July samples reflected average concentrations slightly less than 4 μg/L. Overall chlorophyll-a concentrations increased only very slightly within the Reservoir, averaging 0.15 μg/L greater in the pool than at the Wells Dam Tailrace. Rocky Reach tailrace had lower concentrations than pelagic stations in the Reservoir.

Upstream measurements of chlorophyll-a in Rufus Wood Lake during the summer of 2000 averaged 1.9 μg/L but downstream at the Brewster Bridge in Lake Pateros and throughout the Reservoir pelagic stations increased to approximately 3 μg/L. Summer mean chlorophyll-a in Priest Rapids Dam area in 1999 was also about 3 μg/L, with little variation among months (Normandeau Associates, 2000).

Littoral attached benthic algae in the Reservoir was high with the overall mean of 89.7 milligrams per meters squared monochromatic chlorophyll-a in the eutrophic range. Values were in the range of the mesotrophic/eutrophic lower Snake River Attached benthic algae peaked in April; annual lows were in August.

Diatoms were the dominant phytoplankton species in terms of abundance and biovolume in the water column, followed by cryptophytes (small unicellular flagellates) and representatives of several other major taxa. In freshwater lakes of the northern hemisphere and many other places of the world diatoms are considered desirable because of their value as food sources for the rest of the aquatic food web. Total phtytoplankton biovolume was relatively large all year, with a prolonged spring peak and a lower summer stanza. No prolonged differences were seen among stations or types of stations Overall, the biovolume of phytoplankton in these results was high compared with other regional (non-mainstem) lakes or reservoirs.

Zooplankton biomass was dominated by rotifers in most months Crustacean zooplankton was relatively scarce compared to regional lakes that are truly mesotrophic, but within the abundance or biomass range found in downstream reservoirs in recent years Large biovolume and relative size of the preferred fish prey species Daphnia were observed from July to September. Lower biovolume and mean size of Daphnia was noted at other times. There were no pronounced differences among biomass estimates for pelagic and littoral stations, with the possible exception of lower to mid reservoir areas in the fall of 1999 and summer of 2000.

In summary, the limnology of the Reservoir has the appropriate nutrient levels, biological productivity and availability of fish food organisms to support native coldwater and cool-water fish communities. There is no indication of nutrient enrichment or other anthropogenic changes to limnological factors that degrade the water quality or otherwise impair the Reservoir's ability to provide suitable habitat and food sources for support of balanced indigenous populations of aquatic organisms.

2.3.4 Water Quality and Fish Habitat in Littoral Macrophyte Beds

Macrophyte (aquatic plant) beds are the second most abundant cover type observed in the in the Reservoir during aquatic habitat mapping (DES, 2001a) At 220,000 cfs flows, cover habitat comprised 16% of the wetted area represented by transects, with boulders accounting for 90% of the cover, with submerged aquatic vegetation and terrestrial grasses providing the remaining cover. At lower flows, only the boulder and aquatic vegetation cover types are available. Macrophyte beds occurred in shallow, near-shore environments throughout the length of the Reservoir. Large macrophyte beds extended well out from shore in the vicinity of Turtle Rock Island and areas approximately 2.5 miles and about 4.5 miles north of Turtle Rock Island. Large macrophyte beds extend out to mid channel in an area just downstream of Daroga Park The total area of macrophyte beds in the Project boundary, including pools isolated from the Reservoir by highways, was 386 acres in 1999. The most abundant macrophyte species were Eurasian watermilfoil (the dominant species in 30% of the beds), native pondweeds and curly pondweed, in that order (DES, 2001a)

Macrophyte beds are important habitat for a variety of fish species, providing both food and cover. The juveniles of most of the species of resident fish that were abundant in the Reservoir were observed to use macrophyte beds as habitat (DES, 2001b). Although sampling in macrophyte beds was not extensive, Chinook salmon were observed using macrophyte beds in the Reservoir (John Blum, EES (formerly DES), personal communication).

Areas that are shallow, with low flow velocities and dense macrophyte growth, are where water quality exceedances are most likely to occur. However, these areas also provide suitable habitat for Chinook salmon, the primary sensitive species that would use this habitat type. The aquatic habitat map layers (DES, 2001a) have been processed to show the locations where these three habitat features (shallow - less than 10 feet deep, velocities less than 0.1 feet per second, with dense macrophyte growth) are present (Appendix D).

DO levels in dense macrophyte beds may fluctuate widely throughout the day, at times falling below the water quality criterion of 8.0 mg/L. During the day, aquatic plants produce oxygen while undergoing photosynthesis, which results in high DO levels that can exceed saturation levels. However, at night the macrophytes consume oxygen during their respiration cycle, and DO levels can drop below 8.0 mg/L, particularly in areas with minimal water circulation. Ecology has expressed concern that fish habitat in areas of dense macrophyte growth may not meet water quality standards for salmon and other sensitive species. Similarly, water temperature and pH may also fluctuate on a daily cycle in these areas of the Reservoir. Reduction of macrophyte growth in these areas may be a feasible method to improve water quality, if exceedances occur. However, the removal of macrophytes may also diminish the value of the habitat for fish species.

2.4 <u>Total Dissolved Gas</u>

2.4.1 Water Quality Standard for TDG

The mid-Columbia River, including the Reservoir and tailrace, is listed as impaired for exceedances of TDG numeric criteria. The water quality standards for TDG is "Total dissolved gas shall not exceed 110% of saturation at any point of sample collection," with an exception for flood conditions and a special condition for fish passage at Columbia River dams. The water quality criteria established for TDG does not apply when the stream flow exceeds the seven-day, ten-year frequency flood (7Q10), and the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with a gas abatement plan approved by the Ecology. The gas abatement plan must be accompanied by fisheries management and physical and biological monitoring plans.

The special fish passage criteria for the Snake and Columbia rivers apply when spilling water at dams is used to aid fish passage. The fish passage allowances for TDG are: The TDG level must not exceed an average of 115% as measured in the forebay of the next downstream dam and must not exceed an average of 120% as measured in the tailrace of each dam (these averages are measured as an average of the twelve highest hourly readings in any one day, relative to atmospheric pressure); and a maximum tailrace TDG one hour average level of 125% must not be exceeded.

2.4.2 Total Dissolved Gas Levels Measured in Project Waters

2.4.2.1 Historical Overview

Chelan PUD has been spilling water for downstream fish passage at the Rocky Reach Hydroelectric Project since 1976. Spill is a tool used for improving survival of anadromous salmonids during their downstream migration and is part of the "tool box" being implemented to meet HCP survival standards. Spill can also occur when high stream flows exceed the hydraulic capacity of the powerhouse or, occasionally, when energy demand is low and river flows are high. In the Columbia River basin, a regional effort has been undertaken to monitor and control TDG and its biological effects. Chelan PUD has participated in that regional effort since 1982.

Monitoring of TDG was only at a forebay station from 1982-1995. Chelan PUD upgraded monitoring of TDG levels in the forebay and attempted to add a site below the tailrace of the Rocky Reach Hydroelectric Project in 1996 in order to voluntarily comply with the terms of the special condition for fish passage. The tailrace monitoring site, a barge anchored mid-river, could not be kept anchored under high flows. In 1997, the downstream fixed monitoring site (DFMS) was established approximately four miles downriver at the Odabashian Bridge on Highway US 97. In the majority of the historical documents, this location was referred as the tailrace. Under current TDG abatement plans, the DFMS has been used to represent the tailrace; however, future compliance requirements may mandate that the monitoring site be moved much closer to the spillway. When historical information is referenced, the term DFMS will be used (in place of the terminology in the original document) when data from this monitoring location is cited. The TDG measured at the DFMS is a mixture of powerhouse flow, with TDG levels that arrived at the Project's forebay from upstream dams, and spillway flow, with TDG levels that are the result of the Project's spill operations. The study methods and results for the initial physical monitoring programs conducted to voluntarily meet the special condition requirements are reported in McDonald and Priest (1997) and Koehler and McDonald (1997, 1998). The Project conducted fish spill annually to provide fish passage in accordance with FERC requirements. The TDG study objectives at that time were to:

(1) Determine if the Chelan PUD's fish spill program was in compliance with the special condition requirements for supersaturation;
(2) Examine possible relationships between the percent of total river flow spilled and total volume spilled on changes in TDG levels, and
(3) Verify that TDG levels recorded by the DFMS were representative of the entire tailrace flow.

The level of TDG present in both the forebay and at the DFMS has varied from year to year, depending on the streamflow, operations at upstream hydroelectric projects, and the amount and manner of spill at Rocky Reach Dam. TDG levels in the forebay and at the DFMS also vary throughout the spring and summer within the same year. This variation was mostly attributable to incoming TDG levels associated with projects upstream and, in part, to changing spill volumes at Rocky Reach. The highest flows and spill levels experienced since the completion of upstream storage projects occurred in 1997 (Figure 2-4). TDG levels recorded in 1997 were the highest recorded at Rocky Reach Dam since monitoring began at the DFMS (Figure 2-5).

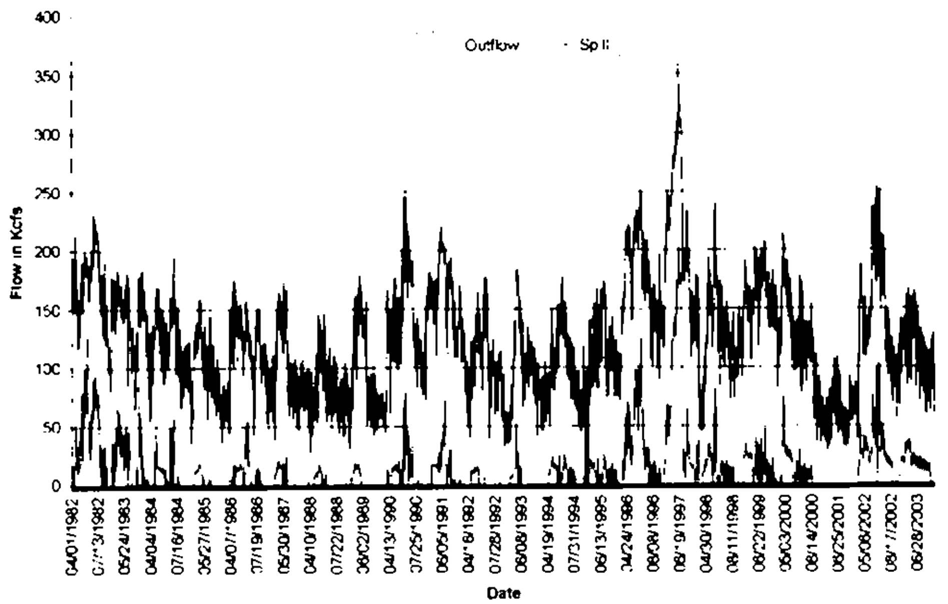


Figure 2-4: Total Outflow and Spill Discharge at Rocky Reach Dam, 1982-2003

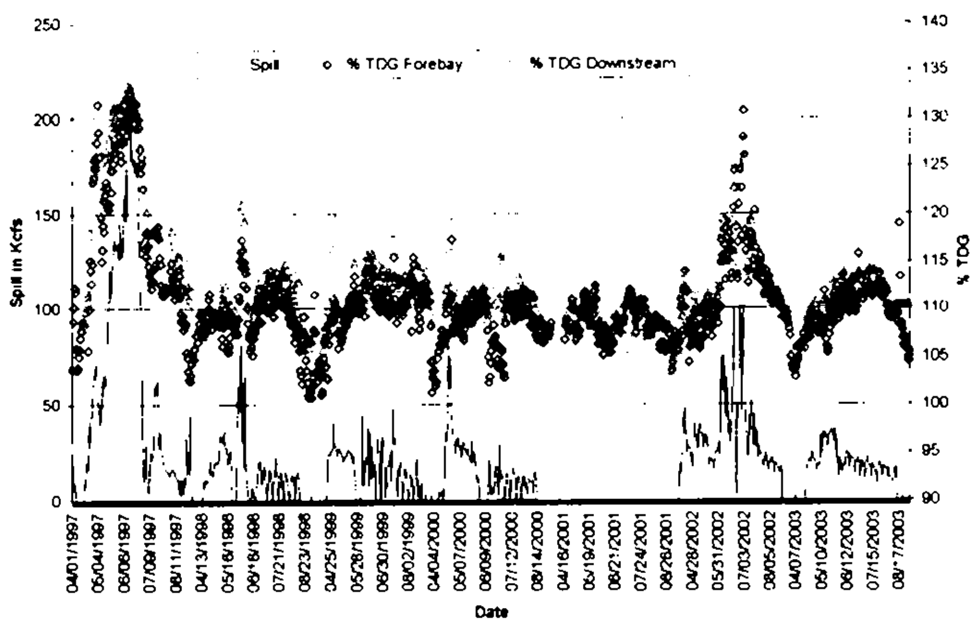


Figure 2-5: Rocky Reach Spill Discharges and Percent TDG Measured in the Forebay and at the DFMS, 1997-2003

The level of TDG measured at the Rocky Reach DFMS from 1996-1998 was primarily the result of high TDG levels arriving in the Project forebay, rather than a result of spill operations at the

Project. McDonald and Priest (1997) and Koehler and McDonald (1997, 1998) used regression analysis to evaluate the relationship between the change in TDG levels from the forebay to at the DFMS and the total volume spilled in thousand cubic feet per second (kcfs), as well as percent of river spilled. Data were stratified by spring and summer. Generally, the effect on TDG level did not correlate with either total volume spilled or percent of river flow spilled, except during the spring of 1998 when moderate causal relationships were determined (correlation coefficient r^2 = 0.5 for total volume spilled and r^2 = 0.41 for percent of flow spilled). These relationships did not hold for 1997 nor summer 1998 data. As seen in Figure 2-5, during the high flows in 1997 the TDG levels coming into the Rocky Reach Hydroelectric Project forebay were high and likely above the equilibrium level for TDG entrainment in the Rocky Reach Project spillway. The Project's spill operations appeared to have reduced TDG levels at times in 1997

Transect measurements near the Rocky Reach Project DFMS consistently indicated highest readings in the east channel, with a downward gradient in TDG levels in the direction of the west channel. Koehler and McDonald (1997) found a gradual descent in TDG with distance downstream from the Project during high spills in 1997, but a similar trend was less apparent in 1998 when spill volumes were lower (Koehler and McDonald, 1998). The downstream monitoring location at the Odabashian Bridge (the DFMS) was placed in a location representative of the average TDG level across the river channel. Transect measurements over four years typically find that TDG at the DFMS is within 1-2% TDG of the highest level measured during the transect study.

Comparison of forebay to DFMS data showed an increase in TDG levels even when there was little or no spill. Although TDG levels generally increased with greater spill, the increase in TDG from forebay to DFMS when no spill occurred leads to the conclusion that factors other than spill may also influence TDG, or there are potentially undetected vertical and/or horizontal gradients in TDG across the river which are not accounted for with a fixed station monitor.

2.4.2.2 TDG Analysis 1997-2000

Early in the relicensing process, Chelan PUD funded a review of TDG monitoring and project operations data for the years 1997-2000. This study (Parametrix, 2000), which was submitted to the Natural Sciences Working Group for review and comment, examined the relationships between incoming levels of TDG, total flow, spill volumes and spillgate configurations at Rocky Reach, and the levels of TDG recorded at the downstream monitoring site and at the forebay of Rock Island Dam. The analysis of monitoring data determined that spill at Rocky Reach Hydroelectric Project has a lower TDG entrainment effect than is observed at most other Columbia River projects. Parametrix (2000) concluded: "Spill at Rocky Reach dam only produces minor increases in TDG levels. During the years of 1998-2000 TDG levels increased only slightly during the spill period (1-3% of saturation on average, range -5% to +15%). Average TDG levels during 1998-2000 remained below 110% of saturation, although point measurements ranged from 100% to 120% of saturation. These conditions occurred with total river flows ranging from less than 100,000 cfs to about 275,000 cfs. Increases in TDG levels were only slightly greater at higher river flows."

The analysis determined that the TDG level below the Rocky Reach Hydroelectric Project is more influenced by the TDG level arriving at the Project than by the level of spill at the Project.

confirming the earlier observations from the annual reports between 1996 and 1998. During the high flow and high spill conditions in 1997, the spill at the Project did not increase the mean TDG level above the TDG level of water arriving at the dam. The variation in the change in the TDG concentration over the Project was substantial, depending primarily on the incoming TDG concentration, not on the total flow rate (Figure 2-6). However, the incoming TDG concentrations to the forebay of the Project tended to be higher with higher water flow, lending to higher concentrations at the DFMS.

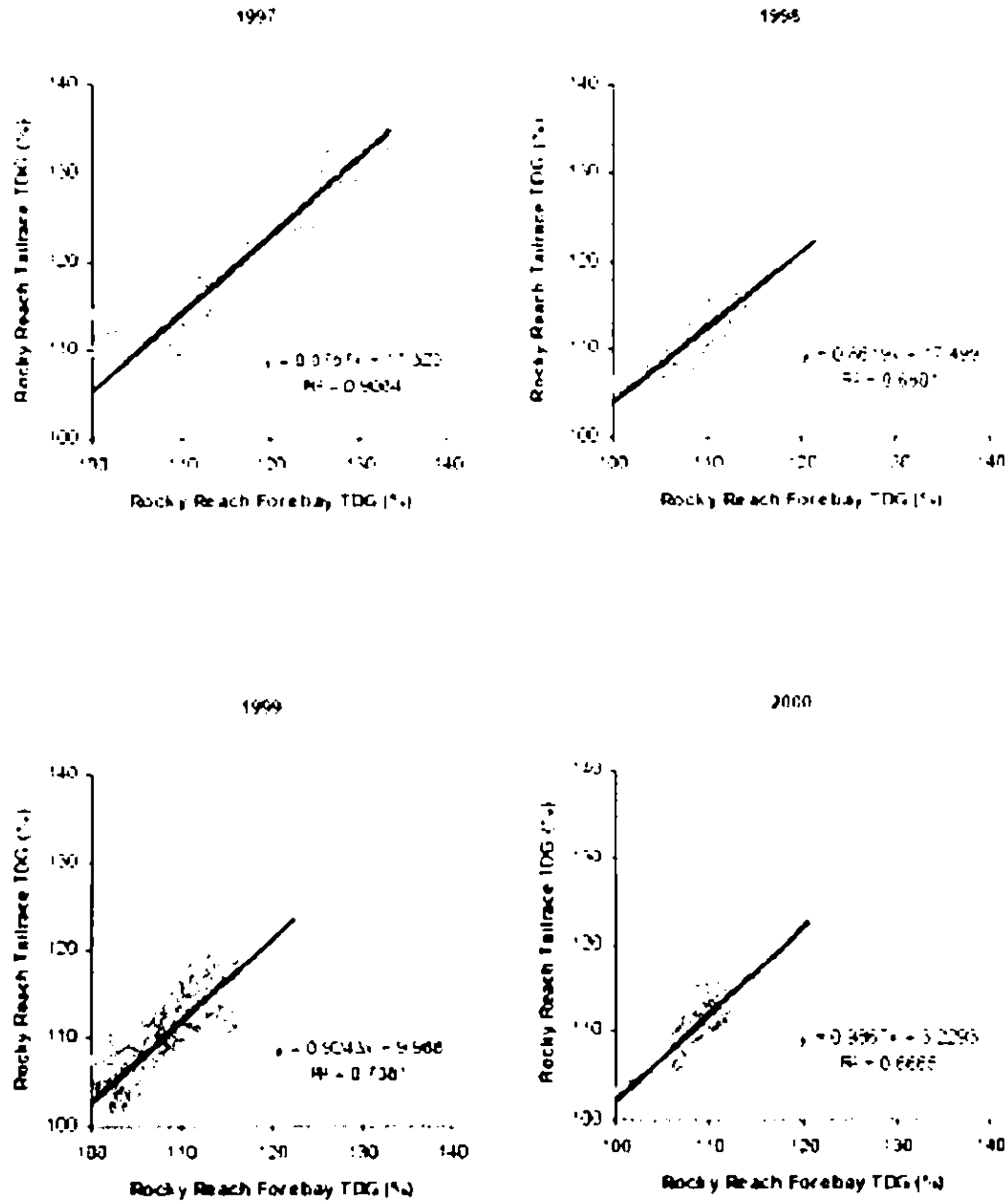


Figure 2-6: Change (Delta) in Percent TDG Relative to Total River Flow at Rocky Reach Dam 1997, 1998, 1999, and 2000

The analysis indicated that different types of spill operations can affect the entrainment of air and resultant TDG level. Parametrix (2000) reported: "Evaluations of different spillgate configurations used at Rocky Reach dam suggest that configurations using a greater number of gates tend to minimize the increases in TDG from the forebay to the tailrace [DFMS]." The analysis could not give a more precise description of the difference in TDG increases for different gate configurations due to the confounding effects of the levels of TDG arriving at the project and the variability in the degree of mixing between powerhouse flows and spillway flows at the downstream sampling location. The analysis also determined that TDG levels dissipate somewhat when traveling through the Reservoir, with more reduction in TDG at lower flows than higher flows (Parametrix, 2000).

2.4.2.3 TDG Operations and Reduction in Exceedances

The analysis of TDG levels with different spillgate settings and at different spill levels has been used by Chelan PUD to refine operations to achieve fish survival objectives, while reducing TDG levels. As noted in the Parametrix (2000) report, the exceedances are not typically observed at the Project DFMS during spill unless they were present in the forebay. The level of TDG arriving at the Project has the greatest influence on the level of TDG both at the DFMS and arriving at the forebay of Rock Island Dam, particularly when the TDG level is high. Chelan PUD has recorded statistics on exceedances of the TDG standards since 1997 (Table 2-1).

Table 2-1: Total TDG Exceedance Record for Rocky Reach Dam

Year	RR[6] Forebay (> 115%)	RR Tailrace* (> 120%)	RI Forebay (> 115%)	Notes - All exceedances based on the average of the highest 12 hours recorded in a day
1997	83	69	75	All exceedances in Rocky Reach Tailrace* and Rock Island Forebay were coincidental with exceedance TDG levels arriving at Rocky Reach from upstream dams.
1998	6	5	9	
1999	2	1	1	
2000	1	2	1	
2001	0	0	0	No Spill at Rocky Reach or upstream projects
2002	43	25	48	Only 6 Rock Island Forebay exceedances were not coincidental with exceedance TDG levels arriving at Rocky Reach from upstream dams
2003	5	0	3	
2004	0	0	0	No HCP spill needed until May 6.

* Tailrace measurements were made at the DFMS.

As noted in Table 2-1, in both years with high numbers of exceedances (1997, 2002), the level of TDG was already high in the Columbia River as it entered the Rocky Reach Project. Columbia River flows were also high, exceeding 200,000 cfs during the times the majority of exceedances occurred, and frequently exceeding the 7Q10 flow. When the TDG level of water reaching the forebay exceeds the 115% criterion, as in 1997 and 2002, the additional spill from the Rocky Reach Project generally does not result in an increase in TDG at the Rock Island Project's forebay. This is evident in Figure 2-7 and Figure 2-8, where it can be seen that the Rock Island forebay TDG levels were generally lower than or about the same as the TDG levels in the Rocky

6 This reflects TDG levels of water as they arrive at Rocky Reach and does not indicate a project impact on TDG.

Reach forebay, despite high spill volumes at Rocky Reach. When TDG levels in the Rocky Reach forebay exceed 120%, the spill operations at Rocky Reach generally reduce the TDG level arriving at Rock Island forebay, as was seen in 1997 and 2002 when the TDG level arriving at Rocky Reach was greater than 120%. Thus, during high flow periods approaching the 7Q10 flow, the Rocky Reach Project either has no net effect or may even reduce the TDG level in the Columbia River, as measured at the DFMS and the forebay of the Rock Island Dam.

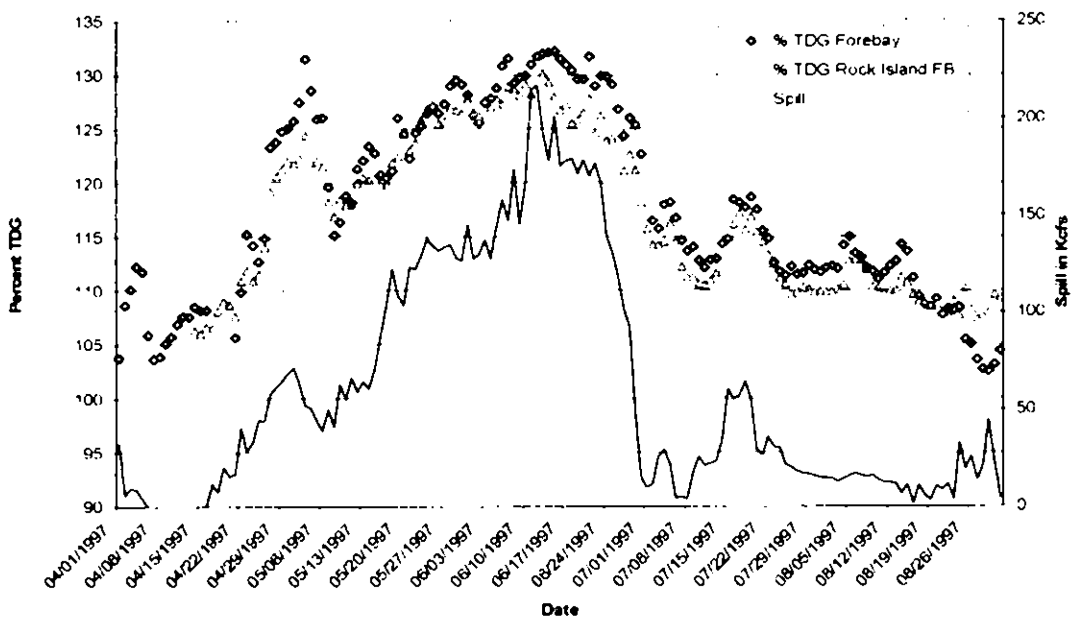


Figure 2-7: TDG Levels in the Rocky Reach and Rock Island Project Forebays in 1997

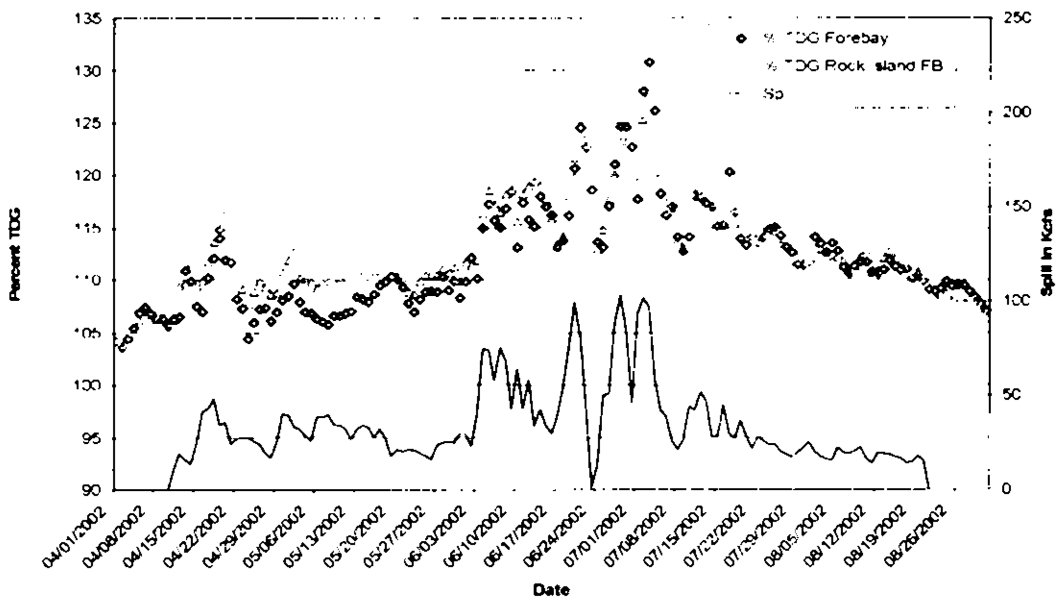


Figure 2-8: TDG Levels in the Rocky Reach and Rock Island Project Forebays in 2002

The contribution of the Rocky Reach Project to TDG exceedances has been very low during the past eight years. When the forebay TDG level arrived at or below 115%, the additional TDG levels caused by the spill at Rocky Reach Dam rarely exceeded the criteria for the fish passage special condition. From 1997-2004, there were 140 exceedances of TDG in water arriving at the Project's forebay (Table 2-1). Although Rocky Reach was also spilling, the number of exceedances was lower at the Rocky Reach Project DFMS (tailrace; 102) and at the Rock Island Project's forebay (137) despite the high TDG levels arriving at the Project.

Table 2-2 shows the number of times that criteria downstream from the Project have been exceeded when TDG levels arriving at Rocky Reach were no more than 1% above the 115% criterion for the Project's forebay. There were only 11 exceedances of the 120% tailrace criterion and 17 exceedances of the 115% Rock Island Dam forebay criterion that were caused by the Project's spill operations. The other exceedances in Table 2-1 were all caused by the high TDG levels arriving at the Project and would have occurred even if the Project had not been spilling. Since construction in 2003 of the JBS, voluntary fish spill has not caused any exceedances below the Project even though there were five exceedances of 115% criterion in water arriving at the Project's forebay in 2003

Table 2-2: TDG Exceedances Caused by Spill at Rocky Reach Dam

Year	RR Tailrace* (> 120%)	RR Tailrace* (> 125%)	RI Forebay (> 115%)	Notes 120% and 115% exceedances based on the average of the highest 12 hours recorded in a day. The 125% exceedance is for a single hour.
1997	0	0	0	Incoming TDG high at all times
1998	5	3	9	
1999	1	1	1	
2000	1	1	1	
2001	0	0	0	No Spill at Rocky Reach
2002	4	1	6	Incoming TDG level almost always > 115%
2003	0	0	0	HCP spill 25% of daily flow for sockeye, 15% in summer
2004	0	0	0	No HCP spill needed until May 6

* Tailrace measurements were made at the DFMS.

The improvement in TDG compliance, as well as TDG management in general, is evident by comparing TDG levels 1998-2000 to 2003-2004. The level of voluntary spill provided to meet HCP fish survival standards increased in 2003. Fish passage spill prior to 2003 averaged 15% of total river flow in spring and 10% in summer, whereas spill levels in 2003 included 21 days of spring spill at 25% of total river flow and a 15% spill level from early June to late August. Despite increased spill levels in 2003, TDG levels at the Rocky Reach DFMS and arriving at Rock Island Dam forebay remained near 110% until the 25% spill level began, mostly stayed below 113% through May, and then closely mirrored the level of TDG arriving at the Rocky Reach forebay through the summer. In contrast, Rocky Reach spill operations in 2000 tended to have higher TDG levels in the Rocky Reach tailrace at the DFMS than in the Rocky Reach forebay during the summer, even though the spill level was lower (Figure 2-9). These results are a direct effect of the TDG levels in the forebay of the Rocky Reach dam

Fish passage spill was reduced in 2004, based on the efficacy of the JBS. There were no TDG exceedances in 2004, since the TDG level arriving at Rocky Reach Dam never exceeded 115% and spill management procedures maintained low TDG levels at the DFMS. The 2004 spring spill operations at the Project, where an average of 24% of the river flow was spilled, only increased TDG levels at the DFMS by an average of 2.4% over forebay levels (range 0% to 3.5%). The hourly DFMS TDG level never exceeded 113.1%, well below the 120% criterion. Summer spill of 9% of the river flow, which began June 7 and ended August 21, resulted in an average increase in TDG level of only 0.7% (range -0.2% to 1.5%). The TDG level at the DFMS never exceeded 114.6%, even though TDG level from upstream projects reached 114.3% in the Rocky Reach forebay.

The benefits to water quality of the HCP's outcome-based approach to meeting fish survival goals are evident in the past two year's decisions on spill levels. Rather than "spilling to the gas cap" to meet fish survival objectives, the JBS was constructed and studies are underway to optimize its effectiveness in meeting the survival objectives. Studies in 2004 demonstrated higher fish survival for fish that used the JBS compared to fish using other passage routes, including the spillway. In 2005, studies are planned to evaluate the effect of spill on JBS passage efficiency, as well as the relative contribution of spill to meeting the survival objective for sockeye The results of these 2005 studies may lead to further changes in the volume of spill needed for fish passage, which could further reduce the Project's effect on TDG levels. Chelan PUD will continue to study and refine the JBS' effectiveness with the goal to reduce or eliminate the need to spill to meet fish survival objectives.

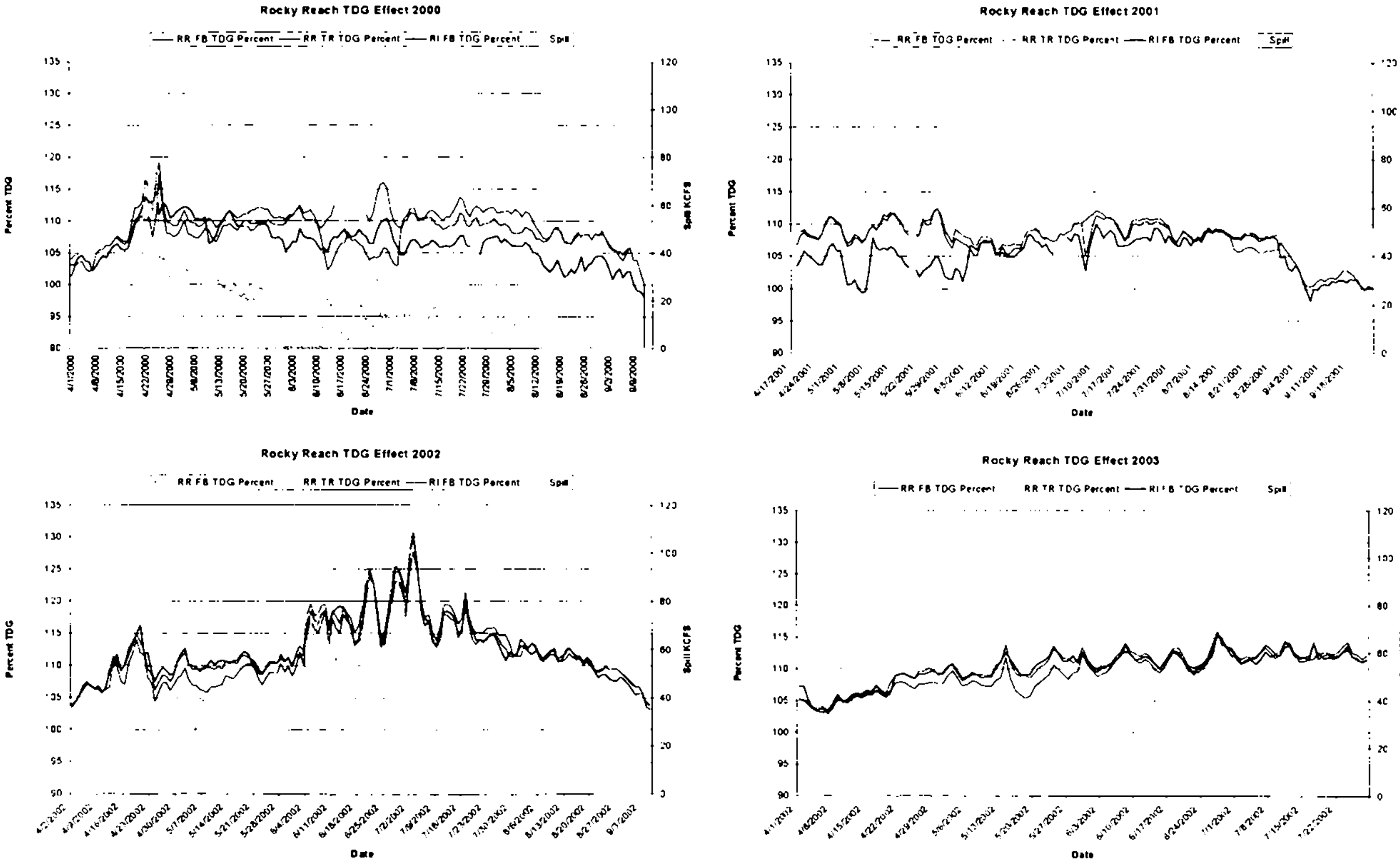


Figure 2-9: Improvement in TDG Management from 2000 to 2003, Despite Increased Spill in 2003 to Meet HCP Survival Goals

2.4.2.4 Near-Field Effects Study

A study of near-field effects of specific spillgate and powerhouse operations on TDG levels was conducted in 2002 (Total Dissolved Gas Exchange During Spillway Operations at Rocky Reach Dam, April 26-May 3, 2002; COE, 2003) to improve the understanding of how different gate settings affect the level of TDG produced for specific volumes of spill. Near-field refers to the close proximity of the TDG measurements to the Project structures, in contrast to fixed-monitoring stations that are located some distance downstream of the tailrace. The near-field effects study avoids the compounding effects of TDG levels in the water arriving at the Project and variability associated with mixing spill and powerhouse flow under different flow volumes. The study included a number of TDG monitoring devices placed in both mixed and unmixed zones below the Project (Figure 2-10).

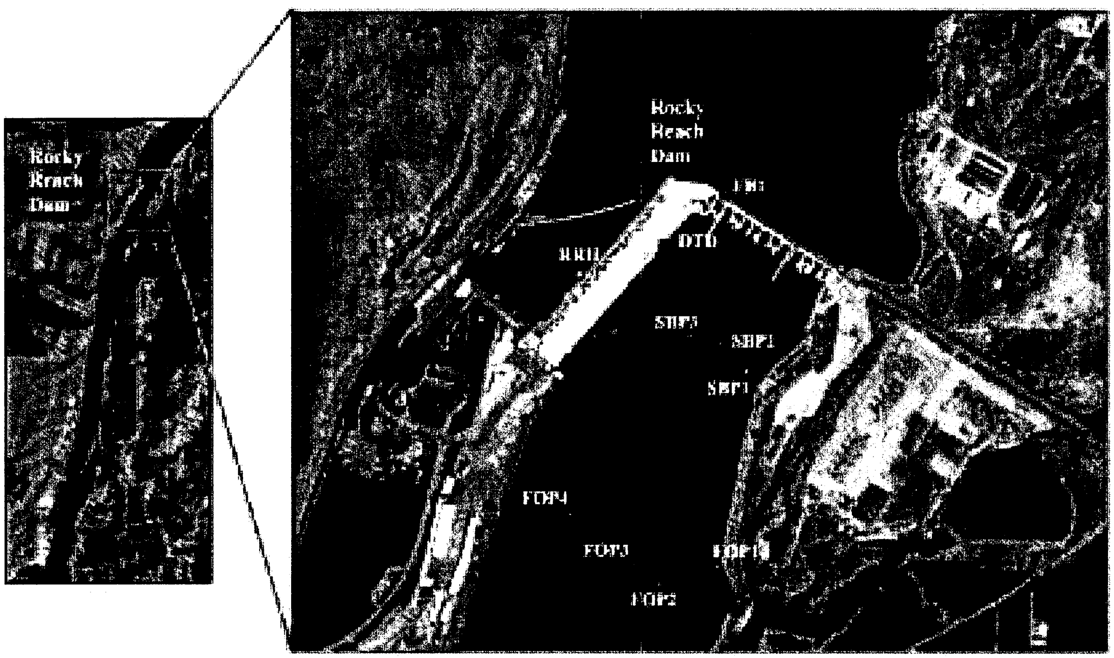


Figure 2-10: Near-field TDG Sampling Stations at Rocky Reach Dam (COE, 2002)

A number of different spillgate configurations were tested to determine how best to manage spill operations to limit TDG levels. The spillway flow ranged from 10.6-61.0 kcfs during the study. In addition, two different modes of powerhouse loading were tested by concentrating discharge through either the south or north end of the powerhouse. The normal (standard) spill pattern uses a variable number of spillgates, three spillgates (4, 6 and 8) for total spill volumes below 20,000 cfs, increasing the number of spillgates as needed up to 7 spillgates (2 through 8) for spill volumes above 50,000 cfs. The standard spill pattern was developed to create tailwater conditions generally conducive to upstream salmon passage (a V-shaped margin of aerated water leading to upstream fishway entrances). Discharge through individual spillgates ranged from about 4,000 to 10,000 cfs for total spillway flows of about 10 to 60 kcfs, but discharge was not evenly distributed through the spillgates. Alternative spillgate configurations included spreading spill evenly over seven spillgates, evenly over 11 spillgates, and concentrating spill into three different locations on the spillway (2 to 5, 5 to 8 and 9 to 12).

The study concluded that spillway operations at the Rocky Reach Hydroelectric Project increased average TDG level in the Columbia River below the spillway by 1.8 to 8.6% over levels arriving at the Project. However, this study was conducted when the TDG level in the forebay was below 110%, which is rarely the case during the fish migration season. As discussed previously, the increase in TDG level at the DFMS ranged from 0 to 3.5% TDG during spring spill in 2004. Thus the increase in TDG level was greater than typically occurs during the fish migration season. Because TDG levels in the forebay were low, there was little opportunity to study the degassing effect of the Project's spillway, which can occur when forebay TDG levels exceed 120%.

The standard spill pattern and a uniform pattern using spillgates 2 through 12 had the lowest TDG of the spillgate configurations tested. The uniform spill pattern (spillgates 2 through 12) produced slightly less TDG than the standard pattern for total spill levels of about 50,000 cfs. However, the powerhouse discharge was significantly higher during tests under the standard spill pattern, and mixing of powerhouse flow may have prevented observation of a greater difference between these spillgate configurations at the lower spill levels.

The entrainment of powerhouse flows, mixing with spillway discharge, influenced TDG levels. Increases in powerhouse discharge while spill discharge was held constant resulted in a decrease in the maximum TDG level, which is likely due to mixing of powerhouse flow with the spillway flow. Although the mixing effect reduces the maximum TDG level measured, the entrainment of powerhouse flows into the highly aerated spill discharge results in a greater total volume of flow having elevated TDG levels. Powerhouse flow entrainment resulted in an increase of 1.1% in the average TDG level at sampling transect LD, which was located downstream of transect FO in Figure 2-10. TDG transfer from spilled water to powerhouse discharge flows could be minimized by spilling at spillgates farther from the powerhouse (by using spillgates 2 through 12) and by maintaining a downstream powerhouse priority for unit operations. During the fish migration season, the downstream powerhouse priority for unit operations is already in effect as a measure to guide fish to the JBS.

The relationship between total spill discharge and TDG at the end of the aerated zone (transect SB) for each spill pattern was linear at the spill levels tested (Figure 2-11). The linear regression line for the standard spill pattern intercepts a TDG level of 120% at a spill discharge of 56,000 cfs. Assuming a hydraulic capacity of the powerhouse at Rocky Reach Dam of 204,000 cfs, the spillway discharge during the 7Q10 flow using the standard spill pattern would be less than a TDG level of 120% based on these findings. Since TDG continues to decline below the aerated zone, the TDG level at the DMFS is lower than 120% at this spill level.

In addition to the analysis of different spill patterns, the study evaluated whether the existing fixed monitoring sites (forebay and DMFS) accurately represents the TDG levels in the river. The forebay monitoring site did represent TDG levels in the Columbia River arriving at the Project. The DMFS was found to underestimate the average TDG level across the river channel at that location by about 1%. Transects conducted during yearly monitoring find the DMFS is typically within 1% to 2% of the highest TDG level across this transect location

The COE compared the TDG exchange (gas sorbing into and out of water) of the Rocky Reach spillway to other Columbia River hydroelectric projects. They concluded that TDG exchange at the Rocky Reach Hydroelectric Project dam is similar to TDG exchange at Lower Granite Hydroelectric Project dam, which has been equipped with gas abatement technology (spill flow deflectors). At Lower Granite Dam during the 2002 spill season, the TDG level in spillway releases reached 115% for a spill discharge of about 32,000 cfs (38% of a 7Q10 flow (84,000 cfs) if the powerhouse is running at full capacity), and 120% for a spillway discharge of about 53,000 cfs (63% of a 7Q10 flow if the powerhouse is running at full capacity). The TDG response for a comparable spill discharge at Rocky Reach Dam was similar to conditions observed at Lower Granite Dam after installation of spillway flow deflectors. The TDG level at Rocky Reach, using the standard spill pattern, reached 120% in the tailrace, at a spillway discharge of 62,700 cfs (131% of a 7Q10 flow if the powerhouse is running at full capacity, or 96% if a small turbine is down; Figure 2-11). However, the Lower Granite Dam powerhouse hydraulic capacity is much lower in relationship to the 7Q10 flow for the Snake River, thus during high flow years the spill level at Lower Granite Dam will cause much higher TDG levels than will occur at Rocky Reach Dam in high flow years.

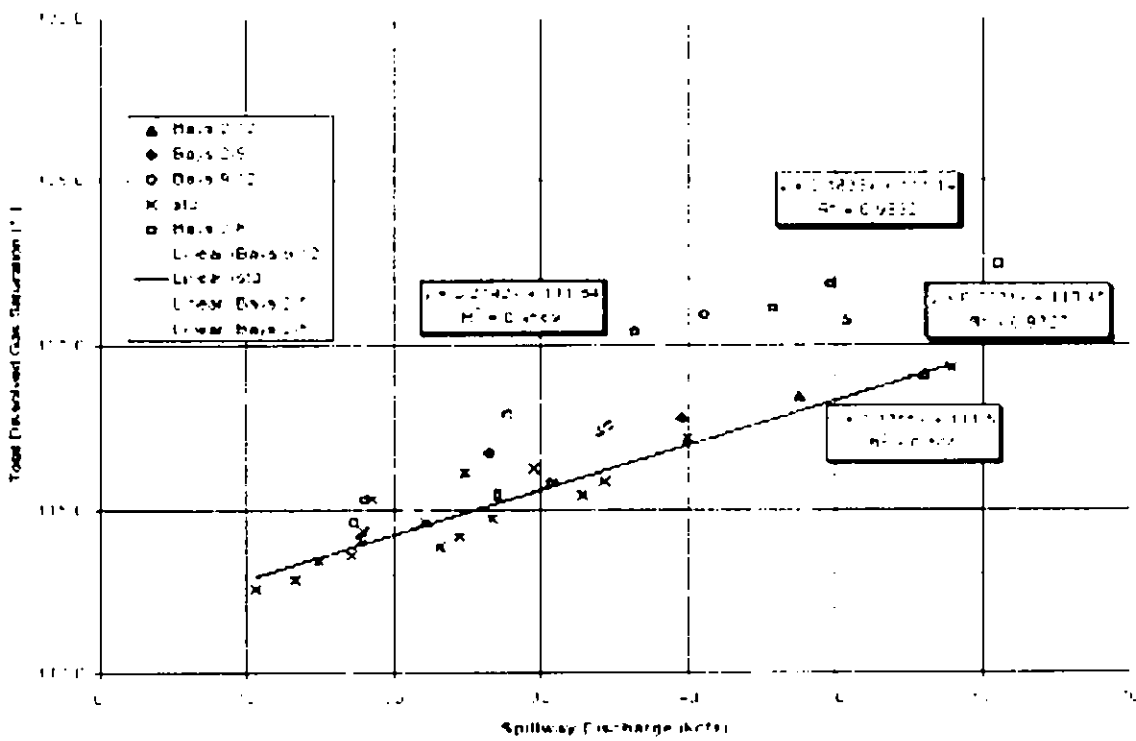


Figure 2-11: Maximum TDG in the Tailrace as a Function of Total Spill Flow, April 26 – May 3, 2002

At many federal projects on the Columbia River, a predictive model, SYSTDG, is one of the tools used to manage spill and prevent exceedances. The standard spill pattern TDG regression was tested with the SYSTDG model to evaluate its applicability to spill management at the Rocky Reach Project. SYSTDG predicted the TDG exchange at Rocky Reach Dam as a function of the forebay, background TDG level and Rocky Reach project operations. High forebay TDG pressures reduce the allowable spillway discharge to avoid leading to excessive TDG at the fixed monitoring sites downstream of the dam. A review of historic records of TDG levels indicated that the 115% criterion for the forebay of Rock Island Dam, rather than the 120% criterion for the tailrace monitoring station, will be the location where exceedances are most likely to occur. This is particularly true when the TDG level arriving at the Rocky Reach forebay is high. The predictive error of the SYSTDG model was within a TDG level 0.3% over 90% of the study period (April 26-May 3, 2002). The SYSTDG model could be used as an additional tool to manage spill and prevent exceedances downstream from the Project.

2.5 Water Temperature

2.5.1 Water Quality Standard for Water Temperature

The 1997 Class A water quality standards for water temperature applicable to the Columbia River at the Project include both narrative requirements and numerical criteria. Those water quality standards most pertinent to the Project, and relevant to the daily maximum temperature, are:

- Temperature shall not exceed 18.0°C due to human activities.
- When natural conditions exceed 18.0°C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C. When temperature is below 18.0°C, the incremental temperature increase described below governs.
- "Natural conditions" or "natural background levels" means surface water quality that was present before any human-caused pollution.
- Incremental temperature increases resulting from point source activities shall not, at any time, exceed t=28/(T+7). For purposes hereof, "t" represents the maximum permissible temperature increase measured at a mixing zone boundary; and "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.

2.5.2 Water Temperatures Measured in Project Waters

The temperature of water flowing into and through the Reservoir typically begins warming in March, reaches peak annual temperatures in late July through early September (monthly average daily temperature for August at the forebay is 17.7°C) then cools again during the fall and winter months to average temperatures in the 3°C to 4°C range (Figure 2-12). Daily variability is typically less than 0.5°C but can range as much as 1°C diurnally during summer. The Reservoir is not known to stratify (Chelan PUD, 1991; Johnstone and Mih, 1987). The forebay monitoring site, which is the same as the TDG forebay fixed monitoring site, measures water temperatures at the face of the dam at a depth of about 15 feet. The total depth at this location is 120 feet (36.5 meters).

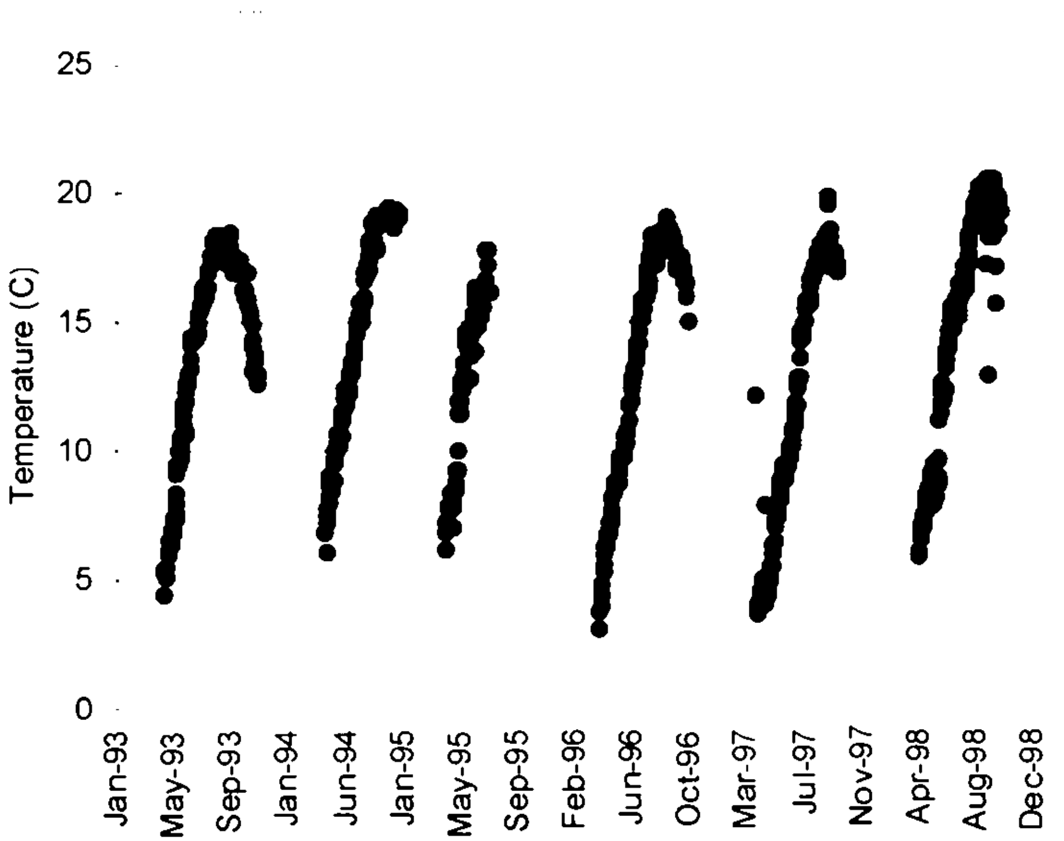


Figure 2-12: Daily Water Temperatures at Rocky Reach Hydroelectric Project Forebay 1993-1998 (PDEA)

Chelan PUD funded a detailed study of water temperatures in the Reservoir in a drought year, 2001 (Parametrix and TRPA, 2002). Under the low flow conditions prevalent in this year, water temperatures exceeded 18.0°C for most of the period from late August through September (Figure 2-13).

Agency stakeholders had expressed an interest in better defining temperature gradients longitudinally, transversely, and vertically. Temperature profiles were measured at three-meter depth intervals across eight transects in the middle and lower portions of the Reservoir. The lateral, (cross-channel) temperature profiles (transects) were collected on September 1 and 2, 2001. At each site, transect data were collected in the morning and again in the afternoon. Transects were run from the west bank to the east bank of the Reservoir. Ten or eleven monitoring stations were distributed across each transect at approximately equal spacing, with the end stations placed within one meter of shore. The maximum depth measured at deeper stations, which corresponded to the maximum depth of the river at each location, was approximately 35 to 40 meters (115 to 131 feet).

The lateral temperature data indicated that the mainstem flow of the river is very well mixed with regard to temperature. The warmest temperatures were observed in shallower water at either end of the transects, and in near-surface waters measured during the afternoon. Temperature differences between the near-surface readings and bottom readings at most stations ranged between -0.1 and 0.3°C in the morning, and between 0.0 and 1.1°C in the afternoon. This pattern indicated afternoon warming of the near-surface waters. The daily heating effect of solar radiation was demonstrated by the differences between maximum and minimum temperatures for each transect. For most transects these differences between the highest and lowest temperature observed throughout a given transect (not within one station, but across the transect stations) ranged between 0.2 and 0.6°C in the morning and from 0.8 to 2.1° C in the afternoon.

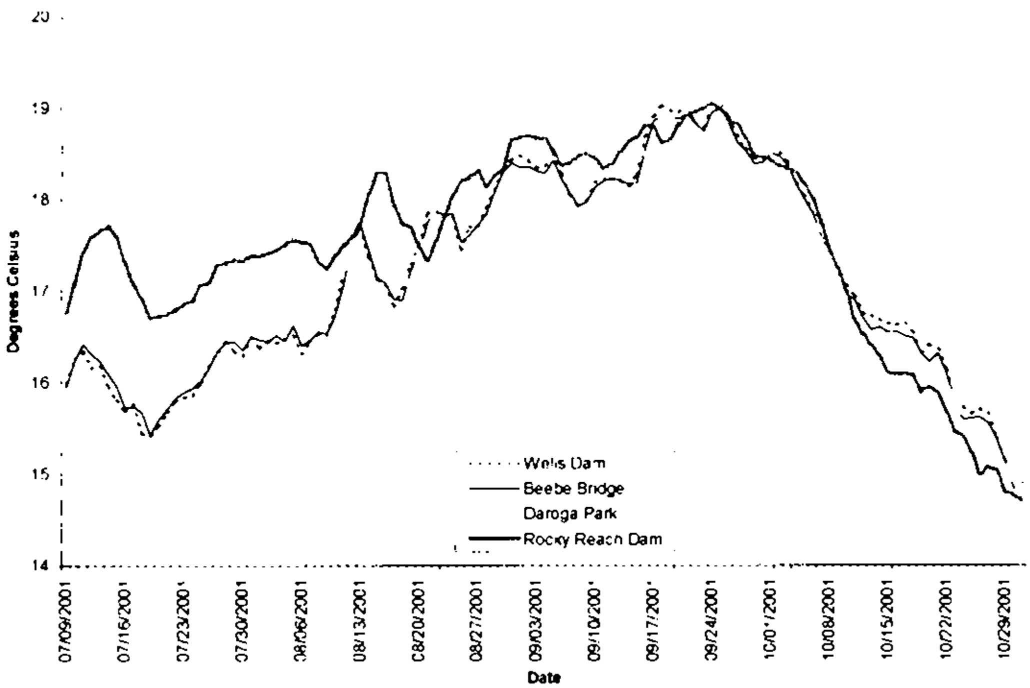


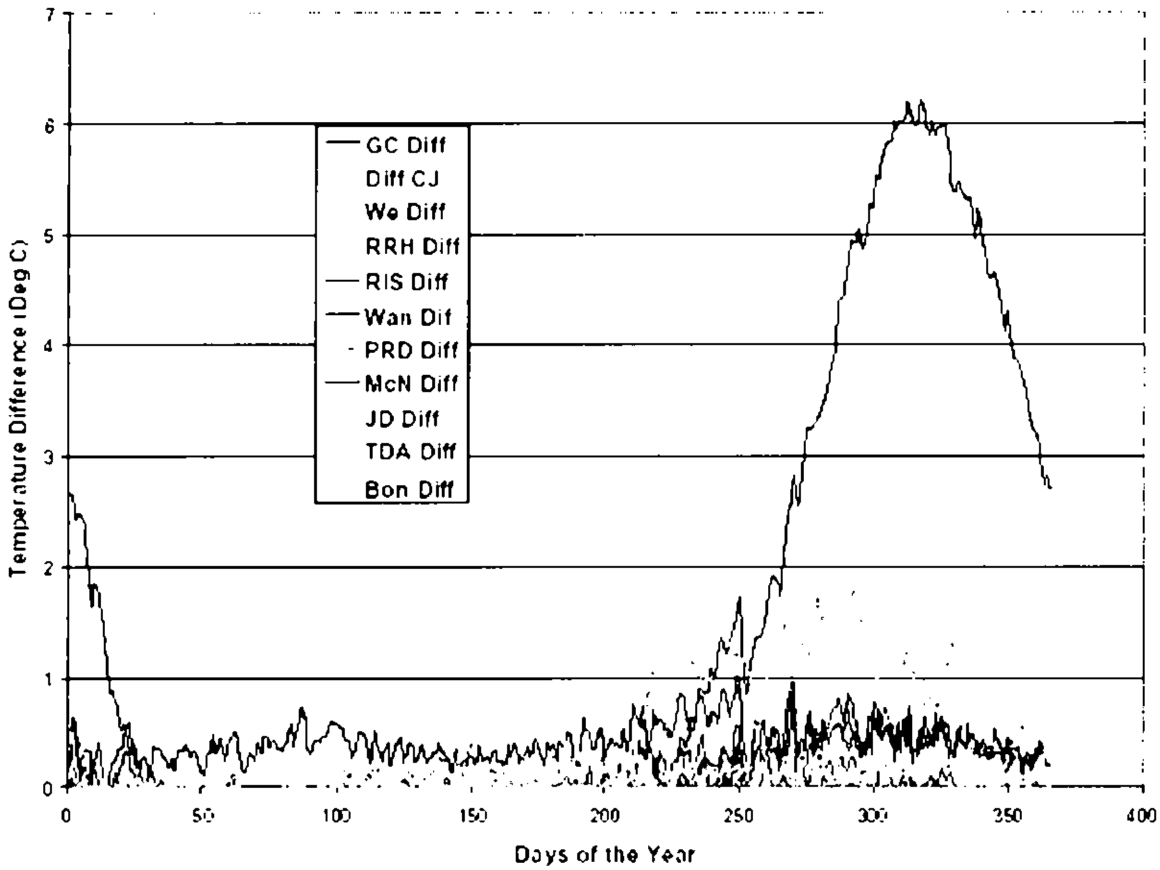
Figure 2-13: Water Temperatures Observed in the Rocky Reach Reservoir in 2001 (Parametrix and TRPA, 2002)

2.5.3 Project Effect on Water Temperatures Estimated from Model Studies

The effect of the Rocky Reach Project on water temperatures has been evaluated by four different model studies. All these model studies have demonstrated that the Project has a small effect on water temperature, but that most of the factors affecting Columbia River water temperatures are outside the control of the Project. For example, the existence of major storage projects above the Project have changed both the water temperatures arriving at the Project and the volume of Columbia River flows passing through the Project. These are major factors that influence the thermal effect of the Project and define the limitations that any measures taken at the Project would have on the water temperature in the Columbia River. Historically, the Columbia River exceeded the 18.0°C temperature criterion under natural conditions in the Rocky Reach Hydroelectric Project area. Data from the Rock Island Hydroelectric Project demonstrate frequent exceedances of 18.0°C prior to construction of any other hydroelectric project dams upstream. Studies by Sylvester (1957), Davidson (1969) and EPA, as summarized by Parametrix and Rensell Associates (2001), have all shown that the Columbia River typically exceeded 18.0°C during the month of August. However, the temperature regime changed following construction of Grand Coulee Hydroelectric Project dam and other large storage reservoirs in the upper Columbia River. This altered river environment is the background condition for any practical consideration of water temperature management plans and the effect of the Rocky Reach Project must be considered in the context of the developed Columbia River Basin.

2.5.3.1 EPA Temperature TMDL Model Analysis with RB10 (One-Dimensional Model)

EPA water temperature modeling, using a one-dimensional model and 30 years of data (RB10 model; Yearsley, 1999), indicated that generally the Columbia River increases in temperature through spring and summer at about the same rate as before construction of the hydroelectric projects. However, the river without reservoirs had much lower flow rates in late summer and water temperature was much more variable in response to changes in climatic conditions. Peak temperatures during hot weather were often higher than today, but on average the river exceeded 18.0°C for a shorter duration before the hydroelectric project dams were constructed (EPA, 2001). EPA has issued a review draft TMDL for temperature on the Columbia River. Supporting data presented by EPA at public workshops and in the draft TMDL's appendices show that most of the temperature changes due to human effects are the result of large storage reservoirs. Smaller run-of-river projects, including Rocky Reach Hydroelectric Project, have much less of an effect on water temperatures. The results of comparing the 30-year average temperature shows that the individual temperature effects of Rocky Reach and other small run-of-river projects is quite small compared to the projects with larger reservoirs (Figure 2-14). The EPA modeling results also show that the Reservoir, when compared to a theoretical river segment with the Reservoir removed and all upstream dams removed, has the tendency to increase the cooling of water temperatures from October-June, and increase the heating of water from July-September (Figure 2-15). As seen in Figure 2-15, the Project's effect on water temperature, averaged over 30 years and assuming that Wells and Chief Joseph dams were removed, is generally less than 0.2°C. As demonstrated by the jagged appearance of the line in Figure 2-15, the RB10 model's precision is insufficient to predict if the Reservoir's effects on water temperature are always within 0.3°C of water temperatures that would occur if the Project did not exist. The RB10 model does have sufficient precision to predict trends and long-term averages, thus the prediction that the Rocky Reach Project would, on average, have less than a 0.2°C effect of increasing local water temperatures if there were no dams below Grand Coulee Dam is statistically valid.



(Acronyms for individual dams are GC (Grand Coulee), CJ (Chief Joseph), We (Wells), RRH (Rocky Reach), RIS (Rock Island), Wan (Wanapum), PRD (Priest Rapids), McN (McNary), JD (John Day), TDA (The Dalles) and Bon (Bonneville). Rocky Reach is represented by the light blue line close to the X-axis.)

Figure 2-14: Effects of Individual Hydroelectric Project Dams on Daily Cross-Sectional Average Temperature in the Columbia River (EPA, 2000)

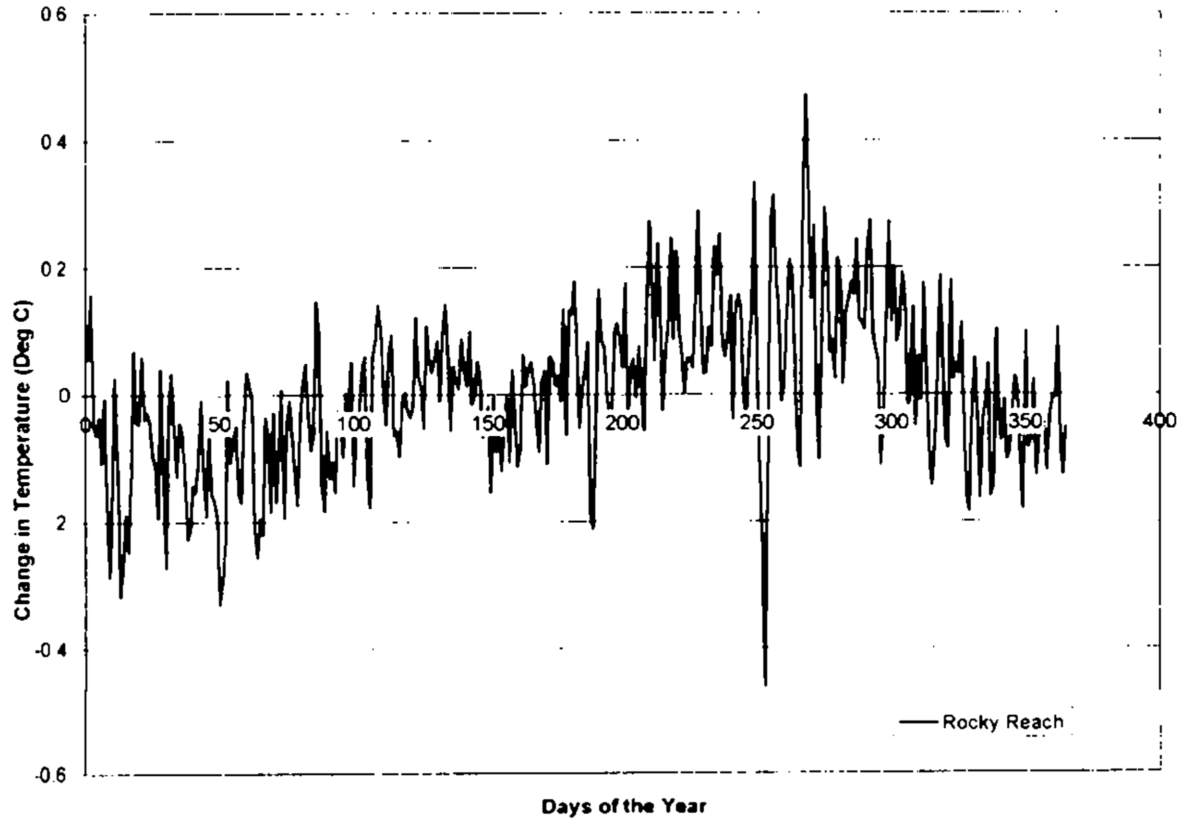


Figure 2-15: Estimated Effect of Rocky Reach Reservoir on Water Temperature, Using EPA RB10 Model and a 30-Year Period (EPA, 2000)

In a later analysis, EPA estimated the effect of the Reservoir on the current Columbia River condition, with Wells Dam and the other upstream projects still in place (Figure 2-16). The effect of the Rocky Reach Project on water temperatures in this situation is much less, since water temperatures arriving at the site have already been buffered from daily climatic conditions by the upstream projects (primarily influenced by Grand Coulee Project). In general, the continued existence of the Rocky Reach Project would tend to keep the daily maximum water temperature cooler, if averaged for the entire year, by preventing the warming that would occur if the Reservoir were removed (Figure 2-16). The greatest warming effect, from July to mid-August, would typically be less than 0.1°C change in the daily average temperature with the Reservoir in place. The existence of the Reservoir has a cooling effect on the impounded river system after mid August. The EPA analysis also examined the downstream, or cumulative effect, of the Rocky Reach Project on temperatures in the McNary Reservoir under the impounded river condition (Figure 2-17). The cumulative heating effect was less than 0.05°C in summer, with a beneficial cooling effect reaching 0.1°C by mid-October when Chinook salmon begin spawning in the Columbia River.

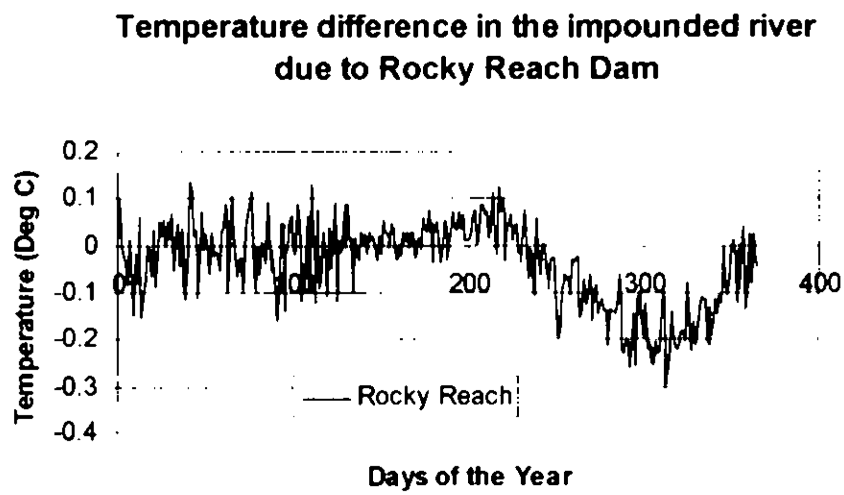


Figure 2-16: EPA Model's Estimated Local Temperature Effect of Rocky Reach Project in the Impounded Columbia River (EPA, 2000)

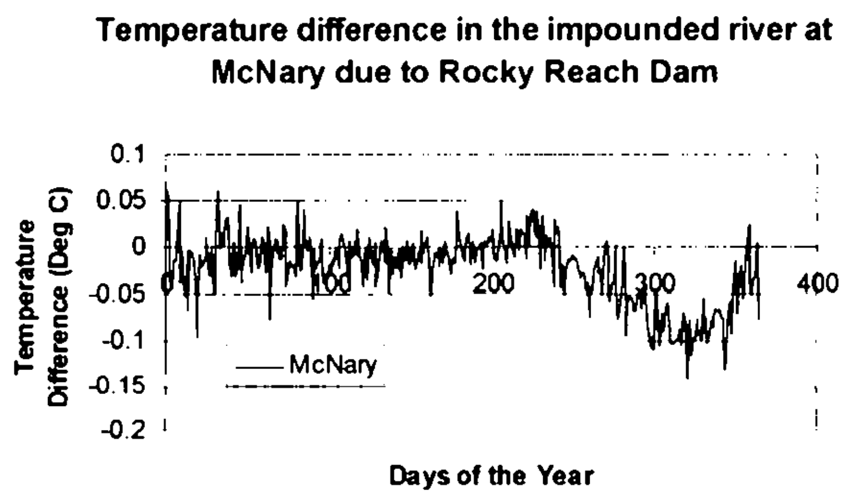


Figure 2-17: EPA Model's Estimated Downstream Effect of Rocky Reach Project in the Impounded Columbia River (EPA, 2000)

2.5.3.2 <u>Model Study Using SNTEMP for 2000 and 2001 (One-Dimensional Model)</u>

Parametrix and TRPA (2002) estimated the effect of the Reservoir on water temperature during the 2001 drought year, using the Stream Network Temperature Model (SNTEMP). Data available prior to model selection and for 2000, which was for years with normal summer flows, indicated little vertical or lateral stratification of the Reservoir (which supported the use of SNTEMP). However, 2001 was a year of extreme low summer flows and significant longitudinal stratification, a difference in temperature from upstream to downstream, was observed in the data. A problem encountered in applying SNTEMP to the Project was related to model reliance on daily time steps with no "carry-over" of heat transport across days. During the low flows in 2001, the daily time step did not adequately represent the transfer of water through the Reservoir. For low flow years, such as 2001, different models such as CE-QUAL-W2, MASS 1 or MASS 2 (Modular Aquatic Simulation System 1D and 2D) were determined to be better predictors of quantitative temperature changes as a result of the project.

To compensate for the low flows in 2001, the SNTEMP model was adapted to these conditions by treating the Reservoir as three separate stream segments. In the process of calibrating the SNTEMP model, the simulated temperatures under the measured climatological and hydrological conditions in 2001 were as expected for the upper portion of the Reservoir (Beebe Bridge), but time lags of one day in the middle of the Reservoir (Daroga Park) and two days at Rocky Reach Dam were observed. To determine the cause of this time lag, Chelan PUD applied the FloodWav model to Reservoir in 2001 to determine water travel times. FloodWav, maintained by the National Weather Service, computes water travel times in a depth and width-averaged manner (i.e., one-dimensional, plus-time scale), and predicted travel time from Wells Dam under the average 2001 study period flow of 60,000 cfs (extreme drought conditions). The predicted water travel times from Wells Dam were 0.44 days to Beebe Bridge, 1.56 days to Daroga Park, and 3.51 days to Rocky Reach Dam. This simulated delay in water movement within the Reservoir generally matched the downstream temperature data recorded by the installed thermographs.

This water travel time information was used to modify the study by segmenting the Reservoir into three sections. This effort partially compensated for the one-dimensional limitations of the SNTEMP model. However, even though the Reservoir was segmented into three sub-reach SNTEMP models (and starting temperatures for each sub-reach used observed temperatures at their upstream boundaries), the delayed transport of warmed (or cooled) water from upstream still prevented accurate temperature simulation that would correspond to the observed temperatures on a daily basis. An additional factor may have been the increasing water volume closer to the dam (in relation to total flow) that retains heat energy with less potential for water surface/atmospheric interchange. Still, some conclusions can be drawn from the SNTEMP model study that support and expand on information developed with EPA's RB10 model.

To assess the warming or cooling effect of the Reservoir on Columbia River temperatures, a pre-dam alternative was simulated by modifying the previously calibrated SNTEMP model. Water surface elevations, channel widths, and topographic shade were the key structural data changed within the model to allow for a simulation under 'natural' conditions. The pre-dam alternative was used to simulate stream temperatures within the three study reaches using 2001 and 2000 meteorological and hydrologic data. At Beebe Bridge, in both 2001 and 2000, the dam exhibited minimal influence on water temperatures. Under 2001 conditions (drought), at Daroga Park, there is more evidence that the Reservoir was having a warming effect earlier in the season. This effect held until late September when simulated without-dam temperatures were warmer than with-dam temperatures. This same relationship held true under 2000 conditions (normal flow year), but the crossover occurred earlier, in early August. At the Rocky Reach Dam (lower

Reservoir sub-reach) the same relationships held true in both years, except the magnitude of the temperature differences was amplified.

In the broadest sense, the Reservoir appears to influence some warming of the river during July and early August and some cooling during later August, September, and October. This seasonal effect is most apparent downstream in the Reservoir near the dam, and both the magnitude and timing of the effect is influenced by river flow. However, accurate quantification of the effect is limited with the SNTEMP model.

The SNTEMP model was sufficiently accurate to make general predictions about the relative effect of the Project on water temperatures under different flows and climatic conditions. Figure 2-18 and Figure 2-19 show the simulated effect of the Project on water temperatures under the actual climate and flow conditions experienced in 2000 and 2001. The flows used in the without-dam simulation were not "natural" flows, rather the flow was augmented during the summer as set by the FCRPS Biological Opinion and power demand. Temperature differentials between the with-dam and simulated without-dam alternatives were lower during 2000 than during the drought year of 2001. Maximum temperature warming effect of the Project would occur during a combination of low river flow, high air temperature, and greatest day length. Maximum temperature cooling attributable to the project would also occur during low river flow, but with a low air temperature and shorter day length. Because 2001 was a year of extreme drought, conditions on two days in 2001 were representative of maximum heating and cooling effect of the Project. The SNTEMP model predicted about a 0.5°C increase in water temperature on July 12, 2001, when flow was 40,000 cfs and air temperature was 27°C and day length was long. A temperature decrease of 0.4°C was predicted for October 27, 2001, when flow and air temperature were also low and day length shorter. These predicted temperature effects for extreme conditions are reasonable in comparison to the predictions made with the EPA RB10 model (0.2°C average Project effect over 30 years).

There were several important trends to note from the SNTEMP study (Figure 2-18 and Figure 2-19). There was very little daily effect on water temperatures in 2000, whereas temperatures in 2001 were more affected in July before the river reached peak temperatures. The Project had no consistent effect on the peak temperatures in August and September of 2001; sometimes the without-dam simulations had higher temperatures than the with-dam simulation. The Project contributed to accelerated cooling of water in early October, when Chinook salmon begin mainstem spawning in the Reservoir and the Hanford Reach of the Columbia River. This finding was also consistent with the EPA RB10 model. Total flow volume in the Columbia River appears to be the principal factor determining the magnitude of the effect of Rocky Reach Dam on water temperature. The greatest Project effect, whether heating or cooling, occurs during low flows.

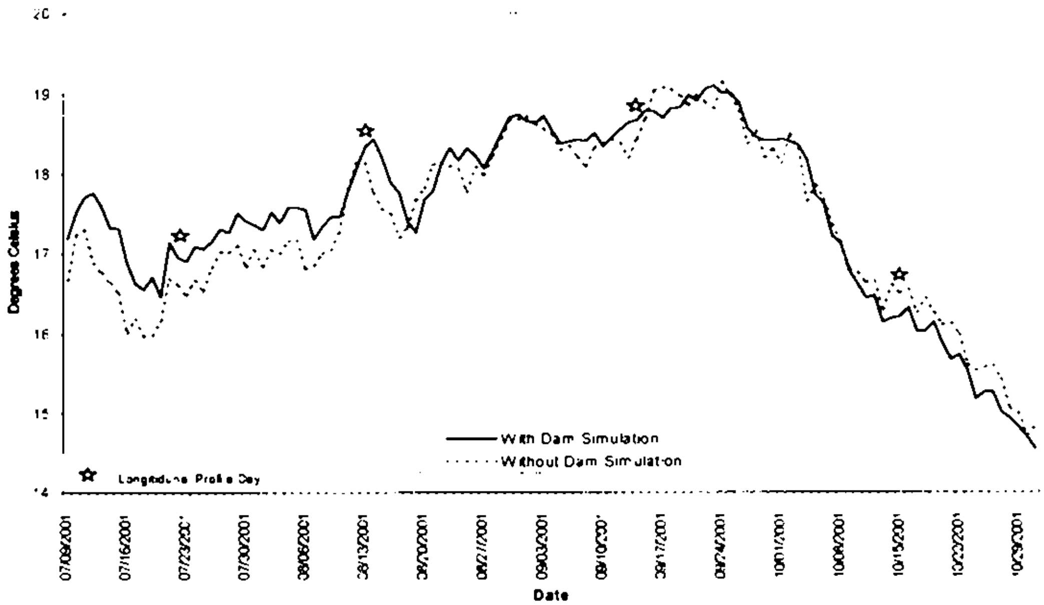


Figure 2-18: Daily Average Summer Water Temperature Simulations at the Location of Rocky Reach Dam, With and Without the Project, for the Low Flow Drought Year 2001

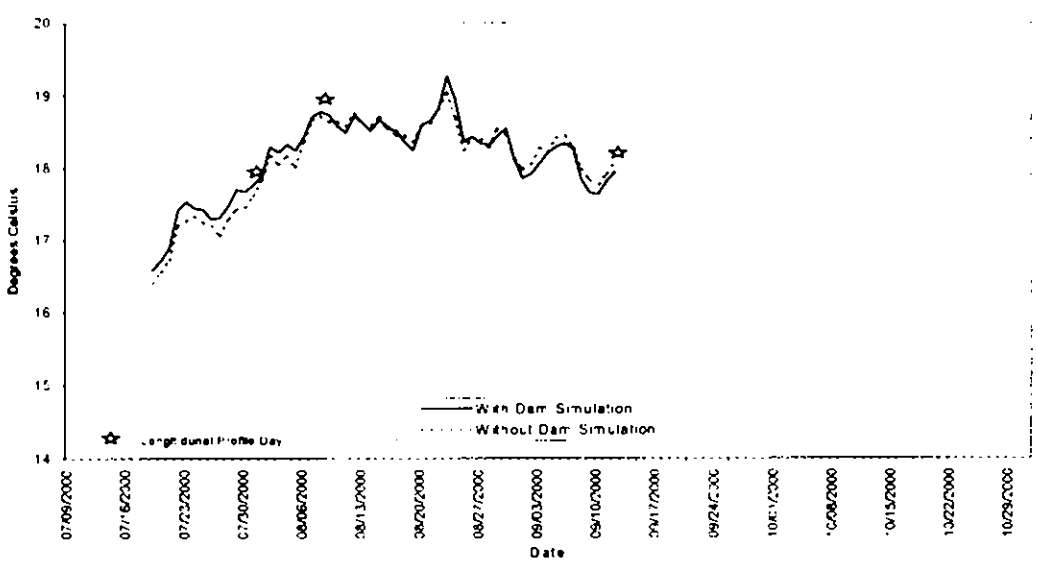


Figure 2-19: Daily Average Summer Water Temperature Simulations at the Location of Rocky Reach Dam, With and Without the Project, for the Average Flow Year 2000

2.5.3.3 Model Analysis Using CE-QUAL-W2 (Two-Dimensional Model)

The water temperature model chosen to provide a two-dimensional (longitudinal-vertical) model of the Reservoir was a public-domain model, CE-QUAL-W2 Version 3.2, which is widely used to measure the effects of reservoirs on water temperatures and is being used to evaluate water temperature effects and mitigative actions in other parts of the Columbia River Basin. CE-QUAL-W2 is a water quality and hydrodynamic model for rivers, estuaries, lakes, reservoirs and river basin systems. This model has an automatic timestep, so it calculates the maximum allowable timestep and self-adjusts to ensure that hydrodynamic stability requirements are not violated. This feature makes the model equally robust across a large variety of flow regimes, compensating for the shortcomings of SNTEMP.

WEST was selected to prepare the model of the Project. The modeling and review process was funded by Chelan PUD, and conducted in collaboration with Ecology, a peer review group of water temperature modeling experts, including the developers of the model, and a subcommittee of stakeholders in the relicensing settlement process, the Water Quality Technical Group.

Input data for the CE-QUAL-W2 model of the Project included bathymetry, flows, inflow water temperatures, meteorology, and in-pool temperatures for model calibration (WEST, 2006). Initially, Chelan PUD selected the summers of 2000 and 2001 for the CE-QUAL-W2 model calibration and simulation periods based on available data collected during water quality studies done in these years. WEST collected input model data for all of 2000 and 2001 to ensure that sufficient time was included in the model to ensure that the initial conditions were not affecting results. The model calculated a residence time of approximately two days assuming a level pool elevation between 703 and 707 feet.

Once the model was developed and calibrated it was subjected to rigorous review by the peer review panel described above. When it was determined to be acceptable, two entire years of hourly, or equivalent, empirical climatic and flow data from 2000 and 2001 were input and water temperatures simulated for with and without Project conditions

At the conclusion of the simulation of years 2000 and 2001, the Water Quality Technical Group determined that it was important to model more than two years, and that years that represent very low flow or very warm climate (worst case) should be represented in the years modeled in order to conservatively define the Project impact. Comprehensive, empirical, hourly climatic and flow input data are available for the years of 2000 through 2004. The climatic data were evaluated for each of these years to determine if low probability, worst-case years were present during this time period. It was determined that these five years include low probability, worst case conditions (Chelan PUD, 2005). Specifically, the average summer (June through August) ambient air temperatures of 2003 and 2004 were very warm years with only a 6% probability that a year would have a warmer summer. The Water Quality Technical Group decided that 2002 through 2004 should be modeled to determine if the Project exceeded water quality standards during those years and that the findings would conservatively describe the overall Project impact.

Ecology has chosen to use the existing water temperature and flow regimes entering the Project's boundary as the background condition for the Section 401 Certification analyses to determine whether the Project increases daily maximum water temperatures above the allowable incremental increase.

The simulated with-Project results were compared to the observed data for each year. The absolute mean error of the with-Project simulation was calculated and is presented in Table 2-3.

Table 2-3: Absolute Mean Error Simulated With-Project Temperatures

Location	Absolute Mean Error (°C)				
	2000	2001	2002	2003	2004
Rocky Reach Forebay	0.2	0.2	0.2	0.2	0.3
Rocky Reach Tailrace	0.1	0.1	0.1	0.1	0.1

The CE-QUAL-W2 model was used to simulate the without-Project condition, but empirical data does not exist for calibration of the without-Project model. To provide assurance that the CE-QUAL-W2 model provided an unbiased estimate of the without-Project condition, the CE-QUAL-W2 simulated model output was compared to output from simulations performed using a different model with an independent approach for simulating the without-Project hydrologic conditions. MASS1, a one-dimensional hydrodynamic and water quality model (Battelle, 2005), was chosen for this comparison. MASS1 has previously been applied to the middle Columbia River to simulate temperature for both impounded and free-flowing conditions, and calculates water surface elevation, discharge, and water temperature as a single cross sectional average value at each computational point in the system. Simulations of Columbia River temperatures with MASS1 have been used to simulate the free-flowing conditions in the Hanford Reach where empirical data for calibration does exist, and to simulate conditions downstream of Rock Island Dam prior to construction of the Priest Rapids Project.

The comparison of the CE-QUAL-W2 and MASS1 models match within 0.2°C for the impounded scenario (Figure 2-20) and within 0.1°C for the without-project scenario (Figure 2-21). The slightly larger errors for the impounded scenario are expected and are due the weak stratification in the Reservoir, which is not captured by the one-dimensional MASS1. For the without-project scenario when the river is not stratified, the two models generate almost identical water temperature results.

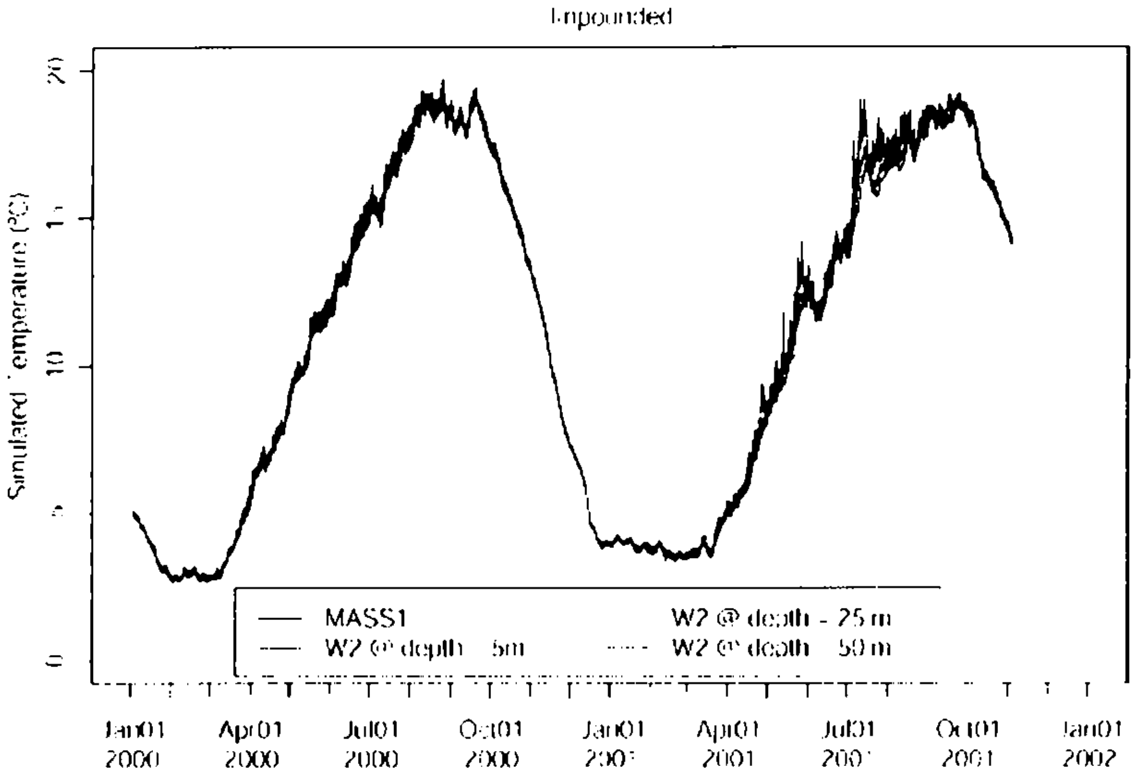


Figure 2-20: CE-QUAL-W2 versus MASS 1 with-Project simulations

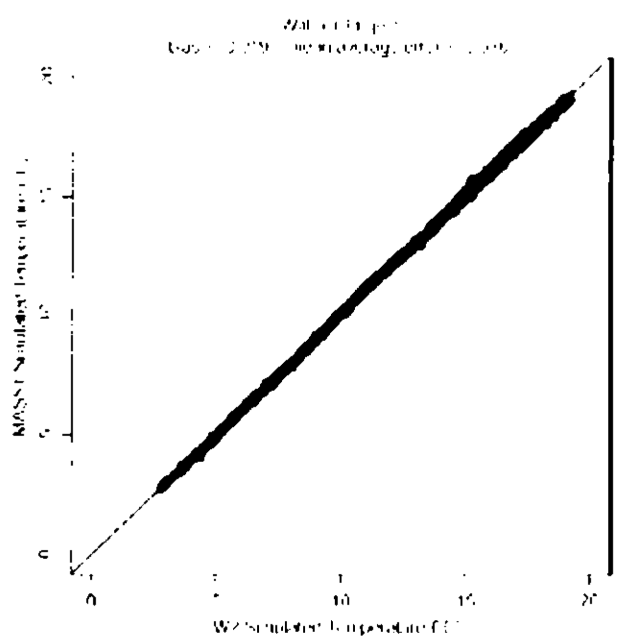


Figure 3 Without-project comparison: Scatter plot

Figure 2-21: CE-QUAL-W2 versus MASS 1 without-Project simulation comparison

A comparison of the with and without Project daily maximum temperatures was made at each of three locations (Beebe Bridge, Daroga Park, in the forebay) and subjected to the acceptability criteria described in the 1997 water quality standards and proposed standards. As stated above, 1997 criteria Class A water quality criteria state that water temperature will not exceed 18°C due to human effects. When natural conditions exceed 18°C, no temperature increases due to human effects will be allowed which will raise the water temperature by more than 0.3°C. Additionally, incremental temperature increases from human effects in waters below 18°C will not exceed $t = 28 / (T - 7)$ where T is the background temperature.

The proposed water temperature criteria are similar to the 1997 criteria except that a seven day maximum daily average is used as the basis of comparison, rather than the daily maximum temperature and the base temperature is set at 17.5°C is used instead of 18°C.

To compare the water temperatures at the forebay under the with-Project scenario to the same location without the Project, daily maximum flow-weighted and volume-weighted averages were calculated from the hourly data. The resulting comparison of the simulated project impact to allowable increases is presented in Table 2-4.

The flow-weighted average more accurately depicts the temperature of the main body of flow moving through the Project. Low velocity shoreline areas, shallows, embayments and back eddys represent a small proportion of the daily flows passing through the Project, but are likely to be warmer than the main river channel. The volume-weighted average is biased, placing greater weight on these areas than they contribute to the actual mass transport of heat through the Project. For this reason, the discussion presented will focus on the findings of the flow-weighted values. The volume-weighted results are presented in Table 2-4, for comparison.

Three cross-sections were evaluated along the Reservoir. These include the forebay of the Rocky Reach Dam, Daroga Park, and Beebe Bridge. The simulated temperature effect of the Project was below the acceptable increase (based on 1997 criteria) for all simulations (spanning from January 2000 through December 2004) at Beebe Bridge and Daroga Park. At the forebay, three to six days per year yielded simulated differences between with-and without-Project temperatures greater than the allowance. Typically, the difference between the simulated Project effect and the acceptable increase was less than the accuracy of the temperature probe (±0.2°C) that was used to provide the observed data that was used to calibrate the model. At the forebay, the simulated difference was larger than the allowance on 20 days between 2000 and 2004, but one of those events (December 13, 2003) appears to be an anomaly from inaccurate input data rather than a real simulated value. For all but five of these occurrences, the simulated and allowable increases were less than the measurement error of observed data; therefore they were *not* statistically significant.

Table 2-4: Comparison of Simulated Project Impact to Allowable Increases

		Comparison to 1997 Criteria					Comparison to Proposed
Location / Output Type		2000[a]	2001[a]	2002[a]	2003[a]	2004[a]	2000 through 2004[a]
Flow-weighted	Beebe Bridge	None	None	None	None	None	None
Flow-weighted	Daroga Park	None	None	None	None	None	None
Flow-weighted	Forebay	8/26/00 (0.7/0.3) 8/27/00 (0.4/0.3) 9/01/00 (0.4/0.3)	8/15/01 (0.6/0.3) 8/16/01 (0.8/0.5) 8/26/01 (0.4/0.3)	7/31/02 (0.4/0.3) 8/1/02 (0.4/0.3) 8/16/02 (0.5/0.3)	7/17/03 (0.5/0.3) 7/18/03 (0.5/0.3) 7/30/03 (0.5/0.3) 10/11/03 (0.4/0.3) 12/13/03 (2.5/1.9)	7/19/04 (0.4/0.3) 7/26/04 (0.4/0.3) 7/27/04 (0.6/0.3) 7/28/04 (0.4/0.3) 8/11/04 (0.4/0.3) 8/12/04 (0.5/0.3)	8/16/01 (0.4/0.3)
Volume-weighted	Beebe Bridge	None	None	None	None	None	None
Volume-weighted	Daroga Park	None	8/12/01 (0.4/0.3) 9/17/01 (0.4/0.3)	None	None	None	None
Volume-weighted	Forebay	8/26/00 (0.7/0.3) 8/27/00 (0.4/0.3) 9/01/00 (0.5/0.3)	8/15/01 (0.7/0.3) 8/16/01 (0.8/0.5) 8/26/01 (0.5/0.3)	7/31/02 (0.4/0.3) 8/01/02 (0.4/0.3) 8/02/02 (0.4/0.3) 8/16/02 (0.5/0.3) 9/19/02 (0.4/0.3)	7/17/03 (0.5/0.3) 7/18/03 (0.5/0.3) 7/30/03 (0.6/0.3) 10/11/03 (0.4/0.3) 12/13/03 (2.5/1.9)	7/19/04 (0.4/0.3) 7/26/04 (0.4/0.3) 7/27/04 (0.7/0.3) 7/28/04 (0.5/0.3) 8/11/04 (0.5/0.3) 8/12/04 (0.4/0.3)	8/15/01 (0.4/0.3) 7/27/04 (0.4/0.3)

a) Values given are the date, followed by the model predicted increase and the allowable increase.

On three of the five days, the difference between the simulated difference and the acceptable increase was 0.3°C. On one day (August 26, 2000) the model simulated a difference of 0.7°C, which was 0.4°C above the allowable increase of 0.3°C. These few occurrences of simulated Project effects greater than 0.2°C above the allowable increase are unlikely to be true indicators of the Project failing to meet numeric criteria for two reasons. First, the known potential sources of error in the model include the temperature probe that provided the observed data (accuracy of ±0.2°C) and the combined effects of the model's predictive error. The with-Project simulation (error of 0.2-0.3°C at the forebay; WEST, 2006), and the without-Project simulation (unknown, but assumed to be the same as the with-Project error) have a combined predictive error that is greater then either model by itself. The instrument error is not independent of the with-Project error, however, the with-Project and without-Project error should be independent. The joint error of the with- and without-Project models is approximately 0.3-0.4°C. Based on these sources of error, it is unlikely, given the single occurrence, that 0.7°C is statistically different than 0.3°C in this instance. The second reason that these five occurrences probably are not statistically significant is because there was only one case where the seven day average also had a difference that exceeded the allowable increase. The other occurrences were not part of a trend, which would be expected to occur if the event were a real Project-caused temperature exceedance.

On December 13, 2003, the model simulated a Project increase of 2.5°C when the allowable increase was 1.9°C. Because the simulation indicated that the Project had a difference of -2.5°C one week prior and a high variability of data surrounding these dates, this occurrence seemed to be the result of a discrepancy (Figure 2-22). Upon analysis, it was discovered that there was an anomalous spike in the input data. The incoming water temperature observed at Wells Dam increased by 2.4°C between December 4th and 6th, 2003. The temperature decreased by 2.7°C in one day from December 11th to 12th, 2003. Because Beebe is located very close to the Wells Dam, this spike did not create a temperature difference at Beebe because the warm spike reached Beebe at the same time under each scenario. However, due to the retention time of the entire Reservoir, this spike reached the forebay a day or two earlier under the without Project than with Project, causing a temperature difference between the two scenarios. It is highly unlikely that this temperature spike was real; rather, it was likely the result of faulty input data, collected in the winter months when data are not as rigorously evaluated.

The model was also used to compare the Project impact to the 2003 proposed water quality standards, which consider a seven-day average of daily maximum temperatures and a criterion temperature of 17.5°C. On only one occasion between 2000 and 2004, August 16, 2001, was the simulated project impact of the flow-weighted average greater than the acceptable incremental increase. The simulated Project effect was 0.4°C; the acceptable increase on that day was 0.3°C.

The model results were independently analyzed for statistical significance of predicted temperature increases by biometricians from the University of Washington School of Aquatic and Fishery Sciences. This analysis concluded that the frequency of predicted exceedances was not statistically significant (was less than expected by chance alone due to the random error in the model predictions).

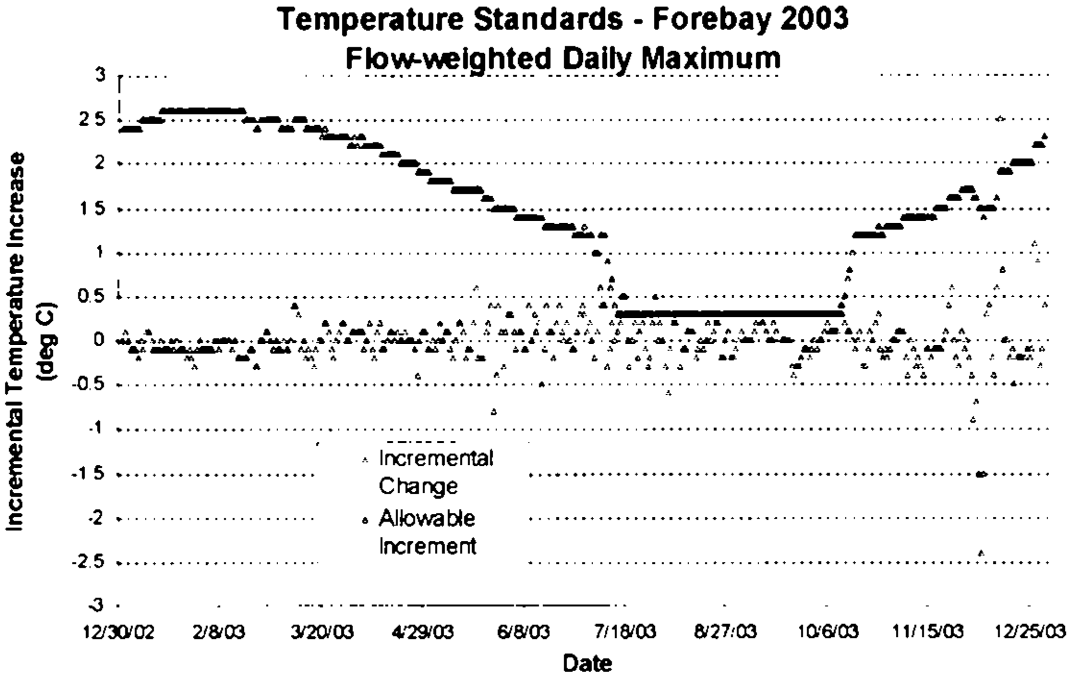


Figure 2-22: Temperature increase versus allowed for 2003 forebay simulation

2.6 Oil and Grease Containment and Spill Prevention Control and Countermeasure Plan

2.6.1 Oil and Grease Containment

The Rocky Reach Project has installed oil/water separation facilities on wastewater sources, which are maintained and periodically upgraded to current technology standards. There are no polychlorinated biphenyls (PCB)-contaminated oils used on the Project. All powerhouse drains that have the possibility of being contaminated with oil flow into one principal collection system, the unwatering gallery. This gallery runs the length of the powerhouse at the 564 elevation. The unwatering gallery has two channels to separate oily and clean water. The clean water channel receives drainage from the draft tube doors, the service bay in the powerhouse, and spillgate sill drains. All floor drains near the units flow into the oily water channel.

Oil sources which can enter the powerhouse substructure drainage system are as follows:

- Generator thrust bearing pots - (4,000 to 5,600 gallons per unit);
- Turbine guide bearings - (50 to 75 gallons per unit);
- Governor sumps and accumulator tanks - (2,500 to 4,500 gallons per unit); and
- Governor wicket gate servomotors - (300 to 375 gallons per unit).

An oil skimmer and an oil separator are installed in the oily water channel at the south end of the powerhouse. A weir prevents oil from reaching the end of the channel. Ahead of the weir, the skimmer sucks collected oil into the separator. Water behind the weir flows into the clean water channel. Following separation, additional water enters the clean water channel while the oil is pumped up to a holding tank on the 630 elevation. Once water is separated, waste oil is pumped to two 4,500-gallon storage tanks equipped with alarms. The clean water channel has a 16-inch drain at its southern end which leads to the station sump, then the river. All other sites where oil is used or stored are either equipped with site-specific containment facilities or otherwise prevented from leaking oil into the waterways through best management practices, as described in the SPCC Plan.

A new Ecology initiative, the Columbia-Snake River Spill Response Initiative (CSR-SRI), was proposed to the Chelan PUD in the fall of 2004. Chelan PUD understands this initiative to be a uniform means for hydroelectric projects to identify appropriate sites and subsequently implement additional spill abatement technologies for oil, as needed. To date, Chelan PUD has conducted a preliminary investigation of the sites discussed during the initial Ecology proposal. A feasibility study is underway with the expectation that one site will be implemented by year end. Chelan PUD is still not entirely certain of the intent and sideboards of this initiative, and further guidance will be requested from Ecology as needed. As the plan is further developed, it will be included as an appendix to the SPCC Plan.

2.6.2 SPCC Plan

The Project has a SPCC Plan, which was last revised in July 2005 (available upon request). This SPCC Plan has been developed to address the storage and management of petroleum products at the Project to fulfill the requirements of 40 CFR 112, EPA Oil Pollution Prevention Regulations. The plan describes practices, procedures, structures, and equipment at the facility to prevent spills and to mitigate or preclude any adverse impact on the environment. The Oil Pollution Prevention Regulations (40 CFR 112) which became effective in 1974, were established for the prevention of water pollution by oil discharged from "non-transportation related onshore and offshore facilities." According to this regulation "non-transportation-related onshore and offshore facilities" include

> "Industrial, commercial, agricultural, or public facilities which use and store oil, but excluding any terminal facility, unit, or process integrally associated with the handling or transferring of oil in bulk to or from a vessel."

The Project is included under these regulations as a "non-transportation-related onshore facility" (Sections 112.1(b)), located on the Columbia River. Secondarily, the Project stores greater than 1,320 gallons of oil in above ground storage tanks (Section 112.1(d)(2)).

It is the policy of Chelan PUD and all its contractors to recognize that oil contamination of the waters of the State of Washington is harmful. Therefore it is required that emphasis be placed on oil spill prevention, and that the latest engineering and safety procedures be used at all times when dealing with oil storage devices and associated equipment. In accordance with 40 CFR 112.5(b), a review and evaluation of this SPCC Plan is conducted at least once every five years. Chelan PUD will amend the SPCC Plan within six months of the review to include more effective prevention and control technology if: (1) such technology will significantly reduce the likelihood of a spill event from the facility, and (2) if such technology has been field-proven at the time of review. Additionally, the Plan will be modified if a spill larger than 1,000 gallons occurs, or more than one spill of more than 42 gallons occurs within any twelve month period, or if there is a change in the facility design, construction, operation or maintenance that materially affects its potential for a discharge. Any technical amendment to the SPCC Plan shall be certified by a Washington State Professional Engineer within six months after a change in the facility design, construction, operation, or maintenance occurs which materially affects the facility's potential for the discharge of oil into or upon the navigable waters of the United States or adjoining shorelines.

SECTION 3: MANAGEMENT CONSIDERATIONS AND OPTIONS INVESTIGATED

3.1 Total Dissolved Gas

3.1.1 Operations to Limit Gas Uptake

Spill operations are managed for the purposes of promoting fish survival, upstream passage efficiency, and limiting TDG entrainment. Spill is used as a tool in meeting the HCP survival objectives for downstream migrant salmon and steelhead. Spill is not the preferred tool because it has low fish passage efficiency and it is very expensive. However, at this time spill is considered necessary to augment the fish survival benefits of the JBS. Future use of spill as a HCP fish survival tool is discussed further in Section 3.1.4. In 2003, fish passage spill was provided to cover 95% of the time period of the run of each species. Spill levels in 2003 were 15% of the daily average flow for spring and summer migrant Chinook and steelhead and 25% of the daily average flow for sockeye. These daily average spill percentages were shaped to provide greater volumes of spill during the afternoon and evening, when most fish pass the project, and less spill from late night-early morning, when fewer fish are passing (Table 2-5.) The actual volume of flow is set ahead of time based on projected daily average flows, thus the actual instantaneous flow distribution between the powerhouse and spillway varies from the percentages in Table 2-5 as total river flow varies from hour to hour.

Table 2-5: HCP Downstream Juvenile Fish Passage Spill as Percent of Flow in 2003

Time of Day (hour period)	Early Season (4/20-5/8) (Chinook & steelhead)	Mid Season (5/9-5/29) (25% spill for Sockeye)	Late Season (5/30-8/14) (Chinook & steelhead)
0000-0100	15%	25%	15%
0100-0900	10%	15%	10%
0900-1600	15%	25%	15%
1600-2400	20%	35%	20%

Reduced spill levels were set for 2004 because the JBS met the performance levels expected to achieve the HCP survival objectives of 95% with less spill. Spill in 2004 was set at 0% of the daily average flow for spring Chinook and steelhead, 24% for sockeye and 9% for subyearling Chinook. The same spill levels are planned for 2005, except that a test comparing spill and no spill will be conducted during the sockeye migration. Depending on results of the sockeye spill study, the same spill level may continue for three years during survival tests. However, spill may be further reduced or increased in the future based on results of the sockeye study and survival studies that will indicate if the HCP survival objectives are being met.

Spill, when necessary, is initiated and concluded based on the timing of the migration of each fish species. Sockeye spill (24% of flow) begins when 2.5% of the run has passed the Project, which typically occurs between the last week in April and the second week in May. Sockeye spill levels then continue until 97.5% of the run has passed the project, which usually is 25 days or more. Spill for subyearling Chinook begins at the end of sockeye spill or when the first subyearling Chinook is captured, then continues until 95% of the run has passed the Project (late July to early August).

The spillgate pattern used during the upstream, adult fish passage season (March November) is designed to provide proper conditions in the tailrace to prevent delay of adult salmon and steelhead finding the entrances to the upstream fishway. This spillgate pattern, referred to as the "standard" spill pattern in the near-field effects study (COE, 2003), uses spillgates 2-8 opened at different settings in order to create an inverted "V" of aerated water and water velocities projecting downstream from the spillway. Radio telemetry studies of adult salmon and steelhead have shown that this flow pattern prevents fish from being lead away from the fishway entrances by false attraction to spillway flows and, when properly shaped, prevents cross currents from confusing fish and creating a hydraulic barrier in the vicinity of fishway entrances. The standard spillgate pattern uses three gates at spill levels up to 20,000 cfs, and then adds gates one at a time until all seven gates (2-8) are open. The setting of the individual gates is adjusted for each incremental increase in spill discharge to maintain the desired flow characteristics in the tailrace. The individual gate settings used during the near-field effects study are shown in Figure 2-23

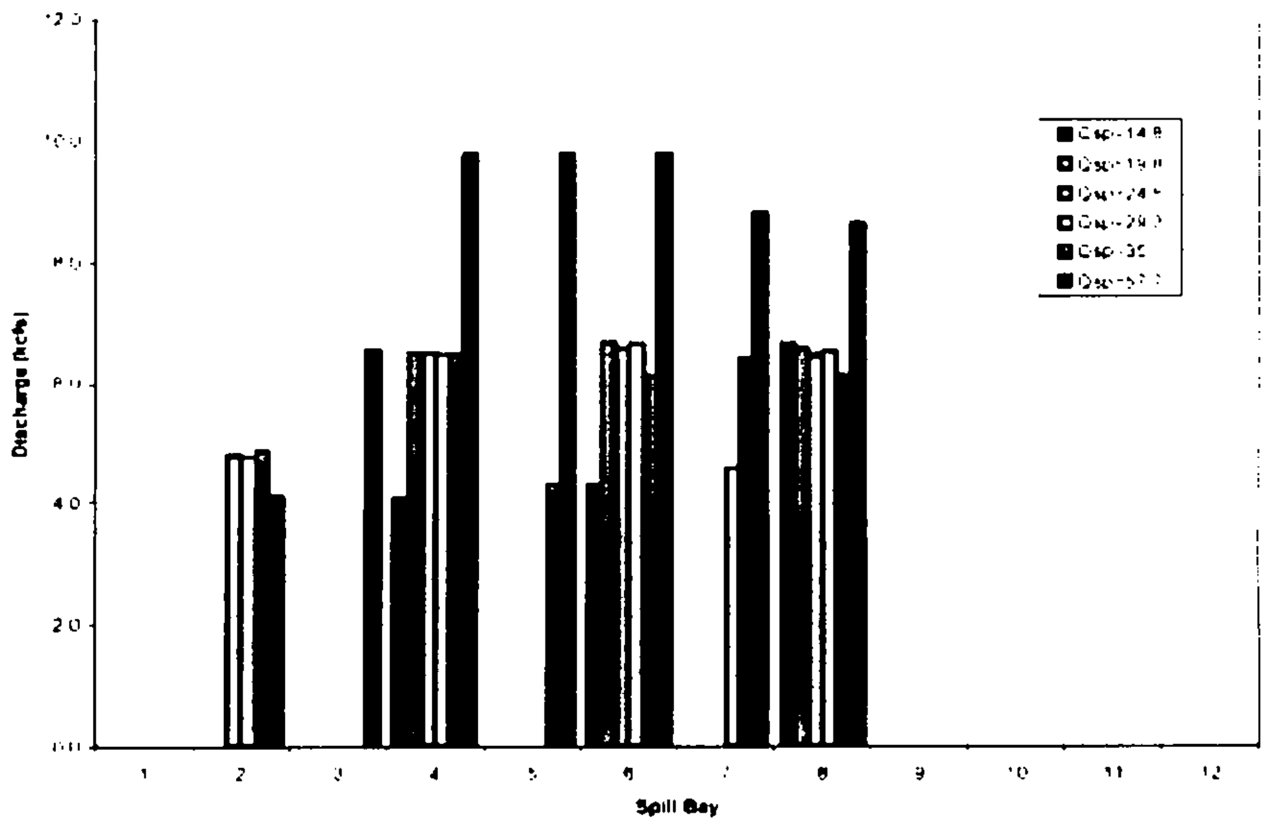


Figure 2-23: Standard Spill Pattern at Rocky Reach Dam Used During the Fish Passage Season (Flow Levels Indicated by Color Bars Are the Total Spillway Flows in kcfs That Were Used in the Near-Field Effects Study)

The spill level that is set for fish passage survival is subject to real-time modification to meet TDG standards, in accordance with a real-time operational plan (Section 4.1.2). The Project operators are instructed to monitor the tailrace TDG level and reduce spill if TDG levels specified in the TDG Operational Plan are exceeded. The operators at the Rock Island Hydroelectric Project are also instructed to inform the operators at Rocky Reach when the Rock Island forebay TDG level exceeds 115%. In 2003, these operations prevented any exceedances of the TDG criteria for the tailrace and no exceedances in the Rock Island forebay that were caused by spill from the Rocky Reach Project. There were two exceedances of 115% in the Rock Island forebay, but both were concurrent with exceedances in water arriving at the Rocky Reach forebay. As previously discussed in Section 2.4.2.3, this real-time response to spill management has also contributed to low TDG levels at the Rocky Reach downstream and Rock Island forebay fixed monitoring sites. The TDG levels in 2004 at the downstream fixed monitoring site remained below 113.1% during the 24% sockeye spill period, and below 114.6% during the 9% summer spill period. Fish passage spill ranged from 15-45 kcfs during the sockeye spill period and 5-20 kcfs during the summer spill.

3.1.2 Biological Effects of TDG

The biological effects of TDG on aquatic life are monitored as part of the regional effort to control TDG throughout the Columbia River. The Fish Passage Center (FPC) administers the program, which samples downstream migrant juvenile salmon and steelhead and monitors several aspects of the fish migration, including the incidence of GBT. The FPC summarized the results of the past seven years of monitoring for GBT in a recent letter (FPC, 2003), as follows. "Based on seven years of data from the biological monitoring program, the average incidence of gas bubble disease signs has been low, although the state-allowed maximum TDG due to spill was 120% in the tailrace and 115% in forebays during periods of voluntary spill. A high percentage of the spill that did occur in some years was involuntary and often resulted in dissolved gas levels above the 120% waiver. The following graphs (Figure 2-24 and Figure 2-25) depict the incidence and severity of signs of GBT in fish collected for observation over the seven years, grouped in 5% TDG levels. Increases in the incidence of signs were observed with increases in the levels of TDG. The severity of signs also increased, but not until dissolved gas levels were above the 120 to 125% level. These data suggest that TDG concentrations above 125% may have had a negative impact on survival. These high TDG measurements are a function of uncontrolled spill that occurred in the hydro system because of flow in excess of the hydraulic capacity of the project, or due to spill in excess of generation needs. They are not caused by the implementation of the Biological Opinion Spill Program. All of the information collected to-date of survival and the benefits associated with spill indicate that spill provides a significant benefit to juvenile survival at levels up to 125% in the tailrace of the dam." This benefit to survival is based on the observations in the region that juvenile salmon passing through spillways typically have a survival rate of better then 98%, whereas the survival rate for juvenile salmon passing through powerhouses is often less than 95%. Since no mortality to salmon migrating in the river has been observed at TDG levels below 125%, there is a survival benefit. In Figure 2-24 and Figure 2-25, the GBT symptoms are classified by rank. Rank 1 is if 1 to 5% of the fin or eye is covered with bubbles; rank 2 is assigned for 6 to 25 % area covered; rank 3 for 26 to 50 % area covered, and rank 4 for greater than 50 % area covered. A "ST Rank" is a steelhead ranking.

The NMFS (presently NOAA Fisheries) conducted risk assessments of the fish passage TDG criteria (120% tailrace, 115% forebay of dams) in 1995 and 2000 in support of the FCRPS Biological Opinion. In the 2000 risk assessment (NMFS, 2000), the results of field and laboratory studies were reviewed and compared to the results of GBT monitoring and other research evaluating the biological effects of the spill levels and resultant TDG levels from 1995-1999. The analysis was focused on determining whether there was any adverse effect on fish survival resulting from the additional 10% in TDG levels from spilling up to the 120% "gas cap" of the FCRPS Biological Opinion. The accumulated data on GBT in Chinook and steelhead indicated that few GBT signs were observed when TDG level was below 120%. When fish with GBT symptoms are exposed to TDG levels greater than 120%, there is an increasing trend in incidence and severity of GBT. However, only a few fish with severe signs were detected until TDG levels approached 130% and GBT symptoms do not begin to increase in prevalence until TDG level is between 121-125% For adult salmon and steelhead, generally no fish or very few fish were observed to have GBT symptoms when TDG levels were below 120%. NOAA Fisheries found little evidence that the survival benefit from the spill program would be reduced at all due to GBT-related mortality (NMFS, 2000). NOAA Fisheries concluded that the apparent inconsistency between the national 110% TDG criterion and the lack of adverse effects observed at a TDG level of 120% is due to the effect of depth compensation resulting from the observed migrating depth of adult and juvenile salmonids

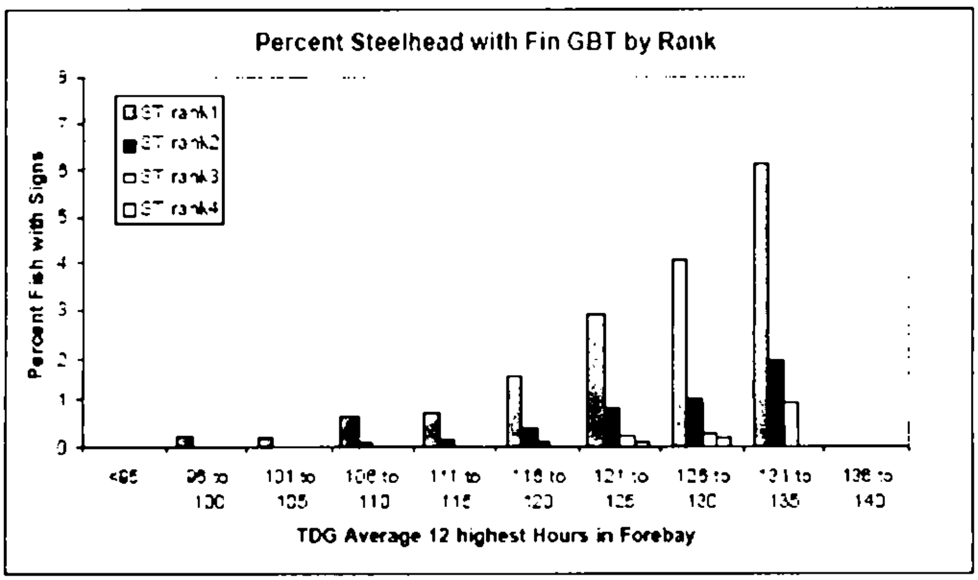


Figure 2-24: Incidence of Steelhead Smolts with GBT Over Seven Years of Monitoring at Federal Hydroelectric Projects (FPC, 2003)

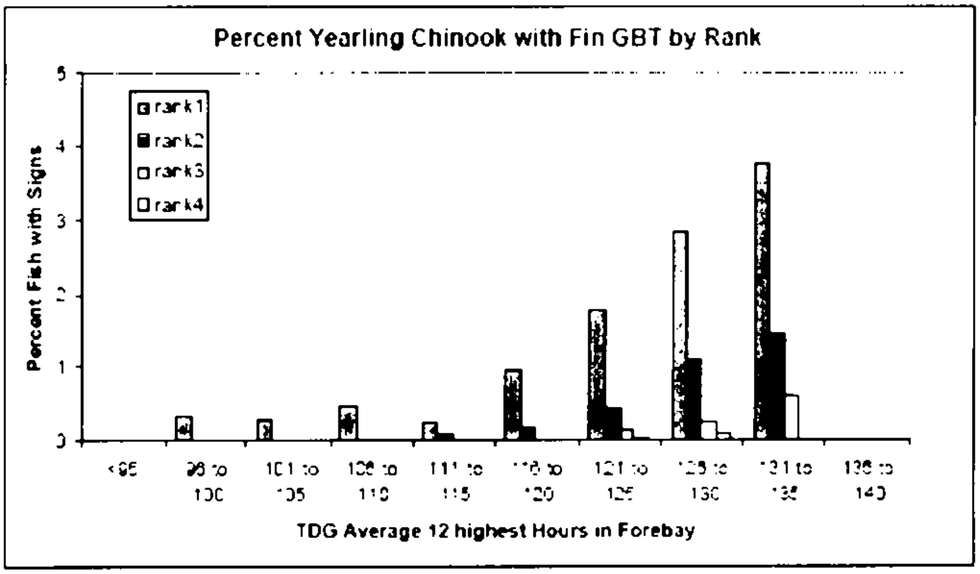


Figure 2-25: Incidence of Chinook Smolts with GBT Over Seven Years of Monitoring at Federal Hydroelectric Projects (FPC, 2003)

Chelan PUD's contribution to the regional effort is to provide the facilities and support for the FPC smolt monitoring program at Rock Island Dam The incidence of GBT has been monitored at Rock Island Dam since 1985, and is reported by the FPC. Due to the nature of the trapping facility, the Rock Island monitoring site typically has higher incidences of GBT than at other sampling locations due to fish being trapped over a 24-hour period and held in a shallow flume. Even though this monitoring site is known to induce GBT by holding fish in shallow troughs overnight prior to examination, the level of GBT symptoms observed in 2003 remained below 5% (GBT at other Columbia River sites in 2003 averaged less than 1%). The GBT monitoring at Rock Island Dam has consistently reflected the trends noted in the other regional GBT monitoring programs, with no significant increases in GBT or incidence of severe GBT symptoms until TDG levels approach or exceed 125%.

NOAA Fisheries' criteria in the FCRPS biological opinion for the level of GBT symptoms that trigger action to reduce voluntary spill and lower TDG levels are when either 15% of the fish sampled have low level GBT symptoms in the fins or when 5% of the fish sampled show severe symptoms (25% of fish area has bubbles). Since 2000, GBT symptoms have been seen in less than 1% of the fish at the lower Columbia and Snake River sampling sites. In 2003, only 2.2% of 2308 fish sampled at the Rock Island Bypass Trap suffered GBT symptoms, despite the fact that the Trap holds them for up to 24 hours in shallow water.

The effect of TDG levels on other fish species besides salmonids has also been studied NOAA Fisheries (NMFS, 2000) reported that the sensitivity of resident fishes and invertebrates to TDG levels greater than 110% was investigated in the early 1990's. Fish species observed for GBT signs included suckers, sculpins, sticklebacks and several minnows as well as crayfish, clams, and insect larvae. Gas exposure levels ranged from 117 to 130%. Only rarely were GBT signs observed. It was concluded that resident fishes and invertebrates are relatively tolerant of elevated TDG.

The biological effect of TDG on resident fish and benthic invertebrates below Rocky Reach Dam was studied in 2001 and 2002. Since there was no spill at Rocky Reach in 2001, the results from that year provided a good baseline for the study in 2002, when TDG levels reached 120% and briefly exceeded 130% in the tailrace. Since only a few hours of exposure to TDG levels above 120% can result in GBT symptoms in fish, the results of the 2002 study would have been expected to show high GBT if the resident fish and benthic invertebrates inhabited shallow waters or the fish preferred to reside near the water surface. Fish and invertebrates inhabiting deeper water (less than 10 feet depth) generally would not be exposed to elevated TDG because of compensation from hydrostatic pressure. The incidence of GBT in resident fish and benthic invertebrates was very low in both 2001 and 2002 (Parametrix and RL&L, 2003). In 2001, there were no signs of GBT in the 3,777 resident fish examined, and only two cases of GBT in the 7,405 invertebrates examined.

In 2002, a total of 2,134 resident fish were examined during weekly sampling events during the spring monitoring period (April 19 to June 26, 2002). None of the fish exhibited any signs of GBT, despite being collected from shallow water where the maximum effects of TDG supersaturation are expected. The TDG levels during the spring spill season ranged from 103 to 127%.. The first signs of GBT occurred during the first summer sampling event (on July 9), conducted about a week after the peak TDG levels occurred (134%). Most of the signs consisted of slight hemorrhaging between the fin rays, at the base of the fins and in the lateral line. A total of 866 resident fish were examined for GBT signs during the summer monitoring period (July 9 to August 21), of which 160 (18%) exhibited GBT signs. However, some fish exhibited more severe signs such as subcutaneous hemorrhaging and swelling of the caudal peduncle and opercle, as well as hemorrhaging in multiple fins. Despite the relatively high incidence of hemorrhaging, actual bubbles were observed in only one fish (in the branchiostegal of a stickleback).

In 2002, benthic macroinvertebrates were collected from six sites downstream from the Project to assess the incidence of GBT and to evaluate the potential effects on community structure. With one exception, these sampling sites were similar to those sampled in 2001. Samples were collected during early April, early June, and early August. The sampling design incorporated dual sampling depths to collect benthic invertebrates from (1) potentially high TDG and low hydrostatic water pressure (shallow depth) habitats (0.5 m depth), where GBT is most likely to occur, and (2) areas where hydrostatic water pressure would compensate for TDG levels of up to 130% (3 m depth). One bristle worm and one mayfly (Ephemeroptera; Ephemeridae, Hexagenia) from Sites 3 and 6, respectively, exhibited signs of GBT. These animals comprised 0.02% of the total number of specimens examined (n = 9,885), and were collected from the 3 m sampling depth during the August and June sampling events, respectively. These results were surprising because the specimens showing signs of GBT were collected from a depth where the effects of the increased total gas pressure were not expected to occur, due to the hydrostatic pressure compensation provided by depth. The results obtained in the present study were comparable with the Rocky Reach TDG studies conducted in 2001 and by other researchers. Specifically, low incidences of GBT were observed in benthic macroinvertebrates under a considerable range of gas saturation levels.

A preliminary assessment was also conducted in 2002 to examine the 'worst-case' scenario for the development of GBT in macroinvertebrates. Single replicate artificial substrate baskets (previously colonized) were suspended at 1 m depth for up to seven days during the June and August field sampling programs. These samples represented the 'worst case' condition, because of their constant exposure to elevated TDG levels. In contrast, artificial substrates placed on the river bottom could periodically be exposed to lower TDG levels due to hydrostatic gas pressure compensation resulting from fluctuating water levels. However, none of the 404 invertebrates examined from the substrates suspended at 1 m depth exhibited signs of GBT. These findings imply that benthic macroinvertebrates are highly resistant to the effects of elevated levels of TDG.

The results of GBT monitoring and studies in the areas downstream of the Project have demonstrated that there is little, if any, adverse biological effect to migrant salmonids, resident fish species or macroinvertebrates at the TDG criterion level of 120%. These findings are consistent with research and monitoring conducted at other hydroelectric projects in the Columbia and Snake rivers. A GBT monitoring program is an effective method to assure that management of spill and TDG levels to meet the fish passage TDG criteria is protecting the aquatic life below the Project.

3.1.3 Operational and Structural Modifications Considered

3.1.3.1 <u>Initial Investigation</u>

Chelan PUD funded a review and synthesis of operational and structural methods used in TDG abatement efforts at other hydroelectric projects and an assessment of the applicability of those structural methods to the Rocky Reach Project (Montgomery Watson Harza [MWH], 2003). Subsequently, Chelan PUD funded a study by the ERDC to further evaluate the efficacy of the options identified by MWH (Schneider and Wilhelms, 2005). These assessments were made by experienced personnel from ERDC who have conducted most of the research on TDG levels before and after TDG abatement measures have been taken at the COE dams and other hydroelectric projects on the Columbia and Snake rivers, including the near-field effects study conducted at Project in 2002.

The MWH review included examination of TDG structural abatement actions studied by the COE, in their extensive program for dissolved gas abatement at federal dams on the Columbia and Snake rivers, structural abatement studies at other hydroelectric projects, and interviews with regional and national experts on TDG abatement methods. The synthesis consolidated the body of work into general types of abatement structural approaches, alternatives that prevent entrainment of air in the discharge, different spillway designs, designs to keep turbulent, aerated water near the surface, and alternatives to limit mixing of aerated water with other waters in the tailrace. The potential to apply these methods to the Project was described and each approach was evaluated in regard to a matrix of seven criteria. These criteria were: potential for TDG reduction; safety for downstream migrant fish passage; potential effects on upstream fish passage; feasibility for maintaining project safety by passing probable maximum flood; impacts to generating capacity; impacts to public recreational use of the river; and impacts to operation and maintenance costs. The capital cost of construction was also estimated. Operational approaches consisted of limiting spill by maximizing powerhouse hydraulic capacity and reducing the need for fish passage spill and reducing the spill per individual spillgate, as described in the near-field effects study (COE, 2003).

The alternatives identified by MWH that prevented the entrainment of air in the discharge, which involved a pressurized discharge, were submerged outlets (S2, S3), new spillway spillgates (S12), convert turbines to sluices (S13) and adding a new powerhouse (S16). All of these alternatives were very expensive and exposed downstream migrating fish to possible injury. Some also had limited feasibility for structural or other reasons. Of these, only the additional powerhouse, which could be equipped with a fish bypass system or fish-friendly turbines, was considered remotely feasible from a technological perspective (but not from a financial perspective). However, an additional powerhouse was not recommended by MWH for further study because other alternatives show more promise.

Alternatives to add additional spillways, or replace existing spillways with different designs, were baffled spillway (S4), side channel spillway (S5, S6), and V-shaped spillway (S15). All but one of these alternatives would involve a channel around the left abutment, extending downstream for distances up to 1,000 feet or more. The V-shaped spillway would require replacement of the existing spillway. These alternatives all had extremely high construction costs (more than $100 million), the downstream fish passage survival or passage efficiency is unknown for these hypothetical spillways, and all these options are likely to adversely affect upstream passage. For these reasons, MWH did not consider these options to be feasible.

The alternative to prevent mixing of powerhouse flow with aerated water from the spillway, a divider wall between the powerhouse and spillway (S17), was judged to be very costly. The limited TDG abatement would only reduce average TDG levels below the Project's tailrace by a small amount and would not improve TDG levels in the spillway flow.

The alternatives that keep turbulent, aerated water near the surface or reduce air entrainment, which included abatement options employed or considered for use at federal dams on the Columbia and Snake rivers, were spillway deflectors (S1), raised stilling basin (S8), raised stilling basin with deflectors (S9), raised tailrace (S10), raised tailrace with deflectors (S11) and removal of the nappe deflectors (S18). The MWH report recommended that these alternatives be considered for further evaluation because they are technically feasible, although several would change the energy dissipation characteristics of the stilling basin, which could affect the tailrace hydraulics to the detriment of project structure erosion and upstream fish passage attraction to fishway entrances. The main factor that MWH could not quantify about these alternatives relates to the potential improvement in TDG that would be achieved from implementation of these options. The spillway design at Rocky Reach already has a very shallow stilling basin and tailrace and the energy dissipation characteristics of the stilling basin may already accomplish as much TDG abatement as would the addition of deflectors. The Project already has a low TDG exchange relationship, comparable to the TDG exchange seen at federal projects after they have been equipped with spillway deflectors and other abatement technology. Also, the Rocky Reach stilling basin and tailrace are shallow in comparison to most dams on the Columbia River, with only The Dalles Project having a similar stilling basin and tailrace depth. At the Columbia and Snake River projects operated by the COE, the use of spillway deflectors is widespread at projects with deep stilling basins, but the COE decided not to install deflectors at The Dalles Project because its shallow stilling basin has good gas characteristics (Rock Peters, personal communication in MWH, 2003). The Rocky Reach shallow stilling basin and tailrace are comparable to the situation at The Dalles Hydroelectric Project (where TDG levels are low due to shallow stilling basin), thus the incremental benefit of raising the stilling basin and tailrace on abatement of TDG may be too small to be meaningful.

3.1.3.2 Additional Studies

The operational and structural alternatives recommended for further study by MWH were further analyzed by ERDC (Schneider and Wilhelms, 2005) to estimate the potential TDG reduction that could result from each option and if implementation would pose a risk of injury to juvenile salmon smolts passing through the spillway. Neither TDG abatement potential nor fish injury potential can be accurately predicted from model studies. However, there is considerable experience available from other Columbia and Snake River projects where these types of spillway modifications have been installed, or where the physical characteristics of the other project mimic the characteristics of the alternatives recommended for further consideration. The following analysis is based on a review of gas abatement achievements at other projects and best professional judgment about potential reduction in TDG levels that could be attained at Rocky Reach.

The ERDC technical assessment of the TDG management potential of the proposed operational and structural alternatives focused on the alternatives recommended by MWH and further analysis of an entrainment cutoff wall to partition powerhouse flows from the highly aerated spillway flows. The list of alternatives (MWH's option identifiers in parenthesis) reviewed by ERDC were as follows:

1. Maximize Powerhouse Flows (O1)
2. Spill from Spillgates 2 through 12 (O2)
3. Spillway Deflectors (S1)
4. Entrainment Cutoff Wall (S17)
5. Raised Stilling Basin (S8)
6. Raised Tailrace (S10)
7. Raised Stilling Basin with Deflectors (S9)
8. Raised Tailrace with Deflectors (S11)
9. Remove Nappe Deflectors (S18)

The configuration of the spillway and associated features dictates the level of TDG entrainment that is created by a given project. The bathymetry and hydraulics of the system downstream of the dam dictate the degassing that occurs in the tailrace. Some of the alternatives impact the gassing of the water, others the degassing in the tailrace and a few impact both. Below is a summary adapted from Schneider and Wilhelms (2005) that presents each of the identified options, described in brief, and the outcome of the ERDC evaluation.

Maximizing powerhouse flows reduces spill because more of the total water flow is passed through the powerhouse, with static TDG levels. The current operating regime includes consideration for maximizing flows to reduce spill while operating for peak efficiency. Under the HCP, voluntary fish spill quantities are mandated based on the efficiency of the JBS. Hourly Coordination is optimized to reduce spill at each of the affiliated projects. These and any future identified opportunities to reduce spill will be implemented, as described in Section 4.

Currently at Rocky Reach, the standard spill pattern consists of spilling water in varying volumes from spillgates 2-8 (Figure 2-23). The second alternative evaluated would change the flow pattern during high flows from that standard spill configuration to spread release of water from spillgates 2-12. The specific spillway discharge, or discharge per foot of lateral distance, has been found to be an important determinant to TDG exchange at many projects in the Columbia River Basin. A comparison was made of 56 kcfs spill from spillgates 2-12 to 57.8 kcfs spilled using the standard spill pattern (spillgates 2-8). The powerhouse discharge was higher and the forebay TDG concentration lower when spill occurred using the standard spill pattern (spillgates 2-8), than during the spill through spillgates 2-12. If the two spill patterns were the same, the dilution of the powerhouse waters should have yielded a lower TDG in the mixed flow for the standard spill pattern (spillgates 2-8) than for the spill through spillgates 2-12; however, the reverse was observed, indicating that spilling from spillgates 2-12 may reduce the TDG levels in the mixed flow. Based on observations, it has been estimated that spilling from spillgates 2-12 may reduce TDG levels in the mixed flow by up to 2%.

This reduction in the TDG loading from Rocky Reach Dam was apparent in the average cross-sectional TDG levels measured below the dam. The peak TDG levels, as observed at station FOP1, were similar for the standard spill pattern (spillgates 2-8) and the spillgate 2-12 spill pattern sampled during this field study. Spilling from spillgates 2-12 may have greater applicability during forced spill events when spillway discharge exceeds 50 kcfs and the powerhouse is fully loaded at about 200 kcfs. The quantitative TDG abatement potential of spilling from spillgates 2-12 instead of using the standard spill pattern (spillgates 2-8) remains to be evaluated. Additional field-testing was recommended to further identify the TDG abatement benefits of applying a spill pattern through spillgates 2-12.

The third alternative evaluated was the use of spill deflectors. Spillway flow deflectors have been one of the primary methods for TDG management on lower Snake and Columbia River dams. Ideally, deflectors are positioned on the spillway to redirect flow across the surface of the tailwater. This reduces the plunging action by which the spillway flow transports entrained air to the full depths of the stilling basin. By reducing the mean depth to which entrained air is transported, the level of TDG absorption can be reduced.

Although the addition of spillway flow deflectors has provided significant TDG abatement benefits at many mainstem Columbia and Snake River dams, it appears to have a limited potential TDG benefit at Rocky Reach Dam. The TDG exchange properties at Rocky Reach Dam are comparable with, and in many cases superior to, the TDG exchange attributes observed at Lower Granite Dam, a project with spillway flow deflectors properly functioning on all eight spillbays. The relatively low rates of TDG exchange observed at Rocky Reach Dam can be attributed to the shallow stilling basin, high rate of energy dissipation, relative size of the spillway, and influence of the sloped end sill. It is possible that a spillway flow deflector could increase the TDG exchange properties at Rocky Reach Dam by extending the zone of highly turbulent aerated flow conditions into the deeper tailrace channel below the stilling basin. Schneider and Wilhelms (2005) concluded that the spillway flow deflector alternative for Rocky Reach Dam has a low probability for providing effective TDG management.

The fourth option evaluated was the implementation of an entrainment cutoff wall. This option was not recommended by MWH, but was included by Schneider and Wilhelms, based on their observations of the Project and experience. The orientation of powerhouse and spillway discharges at Rocky Reach Dam has a strong potential to interact quickly within the stilling basin and adjoining tailwater channel. The powerhouse discharge is directed laterally across the channel and into the path of highly aerated spillway releases. A return current flowing from the powerhouse discharge into the stilling basin was evident during spillway release TDG testing conducted in 2002. A depression of the tailwater stage within the stilling basin was noted during these spill events resulting in a strong current being directed into the stilling basin downstream of spillgate 2. The turbulent energy contained in spillway releases has a large potential to entrain nearby water from powerhouse releases.

If the entrainment of powerhouse flows into spillway flows occurs in highly aerated and turbulent flow, the resultant TDG loading can be increased significantly. The component of powerhouse flow entrained into aerated spillway flows will be exposed to the exchange of atmospheric gasses resulting in TDG supersaturation. The powerhouse flow not entrained, which typically contains lower TDG pressures than spillway releases, will be reduced and less able to dilute spillway releases downstream of the Project. A wall constructed between the powerhouse and spillway can prevent a substantial portion of powerhouse flows from becoming entrained and aerated within the spillway's stilling basin and tailwater channel. The resulting partitioning of project flows could also provide a larger volume of powerhouse discharges at a lower TDG level to dilute the high TDG pressures generated during spillway operations within the developing mixing zone. This alternative does not reduce the level to which the spill flows become saturated with dissolved gasses but reduces the total volume of flow exposed to aeration and elevation of TDG pressure. In this way, it reduces the total mass of TDG produced by spill.

The entrainment cutoff wall could provide the greatest degree of improvement when there is a large entrainment of powerhouse flow into the aerated spillway discharge and the ambient background TDG pressures are low. If the entrainment of powerhouse flows is small or background TDG levels high, the benefits of partitioning project flows with an entrainment cutoff wall will be small or negative. The reductions in average TDG level resulting from the entrainment cutoff wall for total river flows of 200 and 250 kcfs were 1.3 and 1.6 %, respectively. Determination of the detailed performance of an entrainment cutoff wall would require further study. An entrainment cutoff wall would likely reduce the total head for turbines at the north end of the powerhouse. The separation wall would need to be properly designed and constructed with adequate consideration for guidance of adult salmonids and steelhead because the main upstream fishway entrance would be affected by changes in tailrace flow patterns.

The fifth option evaluated was raising the stilling basin floor. Raising the stilling basin apron reduces the depth to which aerated spillway flow can plunge, thereby reducing the hydrostatic pressures that the air bubbles experience. As a consequence, TDG concentrations in the stilling basin are reduced. The variation in elevation of the stilling basin floor at Rocky Reach Dam provides an opportunity to evaluate the influence of stilling basin depth on TDG exchange and hence the potential TDG benefits associated with raising the stilling basin floor. The stilling basin floor associated with spillgates 9-12 at Rocky Reach dam at elevation 590 is about 5 feet higher than the stilling basin floor associated with spillgates 2-5. The maximum TDG levels observed below the spillway at station FOP1 for uniform spill through spillgates 2-5 were consistently lower than conditions observed during uniform spill through spillgates 9-12. In general, the TDG level during spill through spillgates 9-12 was from 1 to 2% higher than comparable spill through spillgates 2-5 even though the stilling basin average depth of flow was less during the uniform spill through spillgates 9-12. These observations suggest that simply raising the stilling basin floor may not have the intended effect of reducing the TDG level of spillway flows. The circulation pattern and air entrainment influenced by the nappe deflectors, impact baffles, and sloped end sill override the importance of the elevation of the stilling basin floor at Rocky Reach Dam.

The alternative of raising the elevation of the stilling basin at Rocky Reach Dam is likely to have a relatively small impact on the TDG exchange properties during spillway operations based on TDG exchange observations at Rocky Reach Dam as compared to similar observations at The Dalles Dam. Further consideration of this alternative was not recommended as an effective TDG management alternative at Rocky Reach Dam. Further consideration of this alternative would require a physical model study to assess the hydraulic performance of a modified stilling basin for a range of discharges and tailwater elevations up to the maximum probable flood flow.

The sixth alternative evaluated was raising the tailrace channel. A rapid and substantial desorption of supersaturated dissolved gas takes place in the tailwater channel immediately downstream of the stilling basin. As the entrained air bubbles are transported downstream, they rise above the compensation depth in the tailwater channel. Air bubbles rising through the water column will strip supersaturated dissolved gas from water when above the compensation depth. Field studies have shown that gas absorption occurs in the stilling basin and significant degassing occurs in the first 200-300 feet downstream of the stilling basin

Raising the tailrace channel bottom at Rocky Reach Dam is likely to be an ineffective measure of TDG management because most of the TDG exchange occurs in the surface oriented jet exiting the stilling basin, which is not limited by the tailwater channel depth and associated depth of plunging flows. Adopting this alternative would also require a physical model study to assess the hydraulic performance of the tailrace for a range of discharges and tailwater elevations up to the maximum probable flood flow. Since the tailrace fill material would require protection from scour, riprap or other protection would have to be considered.

The seventh alternative evaluated was raising the stilling basin floor combined with installation of spillway flow deflectors. A raised stilling basin with spillway flow deflectors is a combination of alternatives that individually were identified to have limited application at Rocky Reach Dam to manage TDG level in spillway flows. The addition of spillway flow deflectors that create a surface jet would negate the effects of raising the stilling basin floor by preventing the transport of entrained air to depth. The effectiveness of a raised stilling basin floor would become influential when spill discharges begin to override the flow deflector, creating a plunging aerated jet. Typically, flow deflectors become ineffective only at very large specific discharges, which would be much greater than the spill discharge range targeted at Rocky Reach Dam to manage TDG exchange up to the 7Q10 flow. As a consequence of these factors, the raised stilling basin with spillway flow deflectors is identified as having very limited potential to effectively manage TDG exchange at Rocky Reach Dam.

The eighth alternative evaluated was raising the tailrace channel combined with installation of spillway flow deflectors. The combination of spillway flow deflectors to minimize the initial plunge of entrained air in the stilling basin and a raised tailrace channel that promotes the stripping of TDG pressures has proven to be an effective TDG management feature. The construction of spillway flow deflectors with a raised tailrace channel at Rocky Reach Dam may result in an improvement in TDG management of the Columbia River. The ability to implement this alternative would require a substantial modification to the stilling basin and tailrace channel at Rocky Reach Dam. Nappe deflector removal would be required to properly site the spillway flow deflectors. This alteration would greatly reduce the energy dissipation properties of the stilling basin. The tailrace channel would probably need to be armored to withstand the large hydraulic forces associated with spillway flow deflectors in place. The tailrace channel would have to be raised to elevation 608 to achieve the depths and TDG exchange performance demonstrated at Ice Harbor Dam, the dam that exhibits the lowest TDG exchange properties of dams actively spilling for fish passage in the Columbia River Basin. The raised channel would need to extend about 300 feet below the stilling basin at Rocky Reach Dam and would be located downstream of spillgates 2-12. The change in energy dissipation at the stilling basin would alter flow characteristics during spill, which could change the effectiveness of attraction flows at the entrances to the upstream fish passage facilities. Flow characteristics at the bypass outfall to the JBS would also change due to the raised elevation of the tailrace, forcing powerhouse discharge closer to the west shoreline, which could adversely affect the dispersion of bypassed fish below the outfall location. The outfall was placed at the present location to prevent bypassed fish from being carried into predator feeding areas by currents from the powerhouse. The large boulder material that would be needed to armor the raised tailrace could provide holding areas for predatory fish and the shallower tailrace could place fish nearer the surface, increasing exposure to avian predators. The combination of these factors could increase the predation rate on juvenile salmon passing through the powerhouse, spillway and JBS.

The final alternative evaluated was the removal of the nappe deflectors. The alternative of removing the nappe deflectors as a means of TDG management at Rocky Reach Dam was based on the concept of reducing the amount of air entrained into the spillway release. Although it is likely that a fully aerated nappe has the potential to entrain higher rates of air at the plunge point compared to a spill bound by the spillway channel, it is uncertain whether this higher air to water ratio results in an increase in the net mass transfer.

Bay 1 at Rocky Reach Dam does not contain a nappe deflector and could be used to test the TDG properties of this structural configuration. However, The Dalles dam has a standard ogee spillway with a stilling basin depth similar to Rocky Reach Dam. The resultant TDG exchange at The Dalles Dam was considerable higher than observed at Rocky Reach Dam over the full range of operations. The peak TDG level in spillway flow was anywhere from 2 to 10% less at

Rocky Reach Dam when compared to a similar specific spillway discharge at The Dalles Dam. The hydraulic action caused by the upstream baffle and end sill at Rocky Reach Dam are probably responsible to the different TDG exchange attributes between these projects.

The above reviews of operational and structural alternatives, consolidating the options identified by MWH and the analysis of ERDC are summarized in Table 2-6. This table includes the final assessment of feasibility based on efficacy, as determined by the ERDC (Schneider and Wilhelms, 2005).

Table 2-6: Review of Operational and Structural Concepts for TDG Abatement

	Alternative	1) TDG Reduction *	2) Downstream Fish Passage **	3) Upstream Fish Passage **	4) Maintaining Design Spillway Capacity **	5) Impact on Generating Capacity **	6) Use of River **	7) Operation and Maintenance **	8) Capital Cost ($1,000) **	MWH * Recommended for Further Investigation	ERDC Recommended for Further Investigation	Remarks
O1	Maximize Powerhouse Flows	+	0	0	0	0	0	0	$0	✓	✓	[illegible]n be implemented Sept – Mar and, if [illegible] system meets survival standard, Apr – May
O2	Spill from Gates 2 through 12	+	0	0	0	0	0	0	$0	✓	✓	Requires agency approval of new spillway operating plan
S1	Spillway Deflectors	P	-	0	0	0	-	0	$14,279	✓	-	Removal of nappe deflector is included in the cost
S2	Submerged Outlets	F		-	0	0	-	-	$21,587	-	-	
S3	Submerged Outlets with Deflectors	+	-	-	0	0	-		$35,866	-		Cost of S1 plus S2. Removal of the nappe deflector is included in the cost
S4	Baffled Spillway	F	-	0	0	0	-	-	$220,952			
S5	Side Channel Spillway	+	0	0	0	0	-	-	$200,173			
S6	Side Channel Stepped Spillway	F	-	0	0	0	-	-	$168,718			
S7	Additional Spill Bays											Not Practical
S8	Raised Stilling Basin	P	-	0	0	0	-	0	$28,292	✓		Minimal spillway extension in cost
S9	Raised Stilling Basin with Deflectors	P		0	0	0	-	0	$36,998	✓		Cost of S1 plus S8
S10	Raised Tailrace	P	0	0	0	-	-	0	$6,966	✓		Might be slight impact on generating capacity
S11	Raised Tailrace with Deflectors	+	-	0	0	-	-	0	$21,245	✓	✓	Cost of S1 plus S10
S12	New Spillway Gates	F	-	-	0	0	-	-	>$100,000			No cost estimate available
S13	Convert Turbines to Sluices	F	-	-	0	-	-	-	>$100,000			No cost estimate available
S14	Hydrocombine Powerhouse	+	-	0	0	0	-	-	>$100,000			No cost estimate available
S15	V-Shaped Spillway	F	-	0	0	0	0	-	>$100,000			No cost estimate available
S16	Additional Powerhouse	F	0	0	0	-	-	-	>$100,000			No cost estimate available
S17	Divider Wall between Powerhouse and Spillway	+	0	-	0	-	0	0	$63,787		✓	TDG benefit for this alternative only at Rock Island Forebay compliance location
S18	Remove Nappe Deflectors	P	0	0	0	0	0	2	$7,388	✓		There may be a need to modify the stilling basin, which is not included in the cost

* Note 1

Score	Description
0	TDG remains the same as at present
+	TDG is improved over present conditions
F	TDG would be [illegible]

** Note 2

Score	Description
-	Less desirable than present conditions
0	Same as present conditions
+	More favorable than present conditions

MWH = Montgomery, Watson, Harza
ERDC = United State Army Corps of Engineers Research and Development Center (Schneider and Wilhelms, 2005)

3.1.4 Evaluation of Identified Operational Options in Meeting TDG Criteria

To provide reasonable assurance that the water quality standards for TDG will be met, a "worst case" analysis was conducted. This analysis assumed that powerhouse capacity was reduced due to an extended outage of one turbine for maintenance during a period of very high flows, just below the 7Q10 flow level. This analysis compares the TDG level that would result, with one turbine out of service, at the 7Q10 flow (252 kcfs) with current operations (base), using the standard spill pattern, to TDG levels that are projected to result if additional operational or structural measures were implemented. This analysis (Table 2-7) shows that the Project is likely to meet numeric criteria without implementation of any additional measures. However, the analysis also provides additional assurance that implementation of the following operational measures, if necessary, would meet the TDG numeric criteria.

3.1.5 Reduction in Use of Spill for Fish Passage

The HCP survival standard of 95% juvenile dam passage survival and 91% project survival (juveniles and adults combined) will be achieved by Chelan PUD through use of a number of tools. The principle method for meeting the juvenile survival standard is the JBS, completed in spring of 2003. Other tools include predator control, turbine operations set to maximize JBS and minimize fish passage mortality, and spill, when necessary to supplement the other tools. The JBS met expectations in its first year of operation; with fish bypass efficiencies for spring migrant Chinook and steelhead that are expected to achieve the survival standards without use of spill as a supplemental measure. In 2004, survival was measured for these species without spill and the survival rates met the standard. The JBS achieved higher fish bypass efficiencies for sockeye and summer migrant Chinook than the prototype system it replaced, but Chelan PUD expects to improve on that performance as the operation of the JBS is fine-tuned through experience. The level of spill, if any, that will be necessary to achieve the survival standard for any species, particularly for summer migrant Chinook and sockeye, will be defined based on the results of survival studies initiated in 2004 and the fish bypass efficiencies and survival rates achieved through both the JBS and the spillway. A study of sockeye passage, with and without spill, and survival studies for yearling Chinook and steelhead were conducted in 2005. Results of these studies will be available in spring, 2006

Phase I of the HCP is the period that Chelan PUD has to implement its choice of tools and demonstrate achievement of the survival standards. Three years of survival studies for each species, each with valid statistical precision, are required to confirm that the survival standard has been achieved. Chelan PUD has set out an aggressive schedule to complete this confirmation period by 2007 or 2008, assuming that natural events (drought or flood river flows), inability to obtain test fish for the studies, or other problems do not prevent accomplishing the three years of study for each species. At the end of the studies, the HCP phase will change. If any of the survival standards are achieved, the HCP phase will be Phase III, survival standards achieved, Phase III provisional review, or Phase III additional juvenile studies. If none of the survival standards are achieved, the HCP will enter Phase II, survival not achieved. In Phase II, implementation of additional tools will begin and continue until the survival standard is achieved and Phase III is reached for that species. Additional tools could include more turbine intake

Table 2-7: Rocky Reach TDG Compliance Table

Gas Reduction Scenarios	Estimated date of completion	September - March % of time TDG criterion is met at FOP1		April-August Tailrace criterion: %TDG at FOP1[a]	April-August %TDG at Rocky Reach LD Transect (mixed flow)[a]	April-August Forebay criterion: %TDG at Rock Island Forebay	April-August Instantaneous: %TDG at FOP1[b]
		Criterion: 110%		*Criterion: 120%*	*Criterion: 120%*	*Criterion: 115%*	*Criterion: 125%*
Base Conditions	Current Operations	Years 1995-1999 93.4% (Lg. down) 95.4% (Sm. down) 94.6% (weight. avg.)	Years 2000-2004 99.5% (Lg. down) 99.6% (Sm. down) 99.6% (weight. avg.)	120.3% (Sm. down) 120.9% (Lg. down)	117.2% (Sm. down) 117.6% (Lg. down)	Averages > 115%	0%
Maximum Powerhouse Discharge	Effective Date of New License	Years 1995-1999 96.1% (Lg. down) 96.7% (Sm. down) 96.4% (weight. avg.)	Years 2000-2004 99.7% (Lg. down) 99.8% (Sm. down) 99.8% (weight. avg.)	119.3% (Sm. down) 119.9% (Lg. down)	116.7% (Sm. down) 117.0% (Lg. down)	Averages < 115%	0%
Spill from Gates 2 through 12	Testing <1 year of high water year	Same as base condition		Unknown, likely around 2% below base.	Unknown, likely around 2% below base	Unknown, likely slightly lower than base case	0%
Entrainment Cutoff Wall	If TDG and GBT adverse biological effect. <10 years	Same as base condition		Same as base condition 120.3% (Sm. down) 120.9% (Lg. down)	116.4% (Sm. down) 116.6% (Lg. down)	Averages <115%	0%
SD&RTW	TDG and GBT adverse biological effect<15 years	Unknown, likely the same as base condition		116.3% (Sm. down) 116.7% (Lg. down)	115.5% (Sm. down) 115.7% (Lg. down)	< 115%	0%

General Assumptions Worst Case:

1) 7Q10 flow of 252 kcfs.
2) The highest discharge for base condition within turbine efficiency curve is 204 kcfs. The capacity for the turbines is approximately 17.15 and 21 kcfs for the small (units 1-7) and large (8-11) turbines, respectively. Spill under 7Q10 flow then (calculated by subtracting the missing turbine capacity from the base 204 kcfs and then subtracting that quantity from the 7Q10 flow of 252 kcfs) is 65.2 and 69 kcfs for a small and large turbine down, respectively.
3) Maximum Powerhouse discharge is 212 kcfs. The capacity for the turbines is approximately 17.8 and 21.85 kcfs for the small (units 1-7) and large (8-11) turbines, respectively. Spill under 7Q10 flow is 57.8 and 61.9 kcfs for a small and large turbine down, respectively.
4) For the purpose of the calculations forebay TDG levels never exceeds 110% from September to March or 115% from April to August, which match the forebay criteria. FOP1 is monitoring location approximately 1600 feet downstream from the dam, which is consistent with the required TMDL measurement location.

NOTES:

[a]Values are estimated using regressions. The TDG at FOP1 is calculated at 0.1355 times the discharge plus 111.5. The TDG at the LD transect is calculated by multiplying the TDG in the forebay by the volume of water through the powerhouse and adding to the TDG calculated in the spill times the volume of water passed through the spillgates. The TDG at LD transect is calculated by multiplying the flow by 0.1509 and adding 111.61. The values provided have a known error of ±0.6% associated with them due to the error of the regressions used to generate them.

[b]Using Schneider's regression, 99.6 kcfs of spill are required. This would require 7Q10 flow and 2 turbines down which exceeds worst case assumptions and therefore can be assumed as 0%.

screens, additional spill, and other bypass technologies that may be developed. When Phase III is reached for a species, then the level of spill necessary to maintain achievement of the survival standard will be set and the Project will operate in that mode until such time that improvement in the efficiency of the JBS or the implementation of other tools accomplishes equivalent fish survival benefits. It is Chelan PUD's goal to pursue non-spill alternatives to achieve the survival standard for all species, to the extent that reasonable and feasible methods can be implemented. When Phase III is set for a species, the level of fish passage spill will be known and operations and other measures necessary to maintain compliance with water quality standards for TDG can be determined.

Chelan PUD's preliminary results from HCP survival studies and acoustic tag studies indicate that no spill is necessary to meet the HCP survival standards for yearling Chinook and steelhead migrants. These species migrate from April to mid-June, thus no voluntary spill is expected to be needed during April and early May if the survival studies confirm the 2004 results. Whether voluntary spill will be needed for sockeye and subyearling Chinook will be determined by the end of Phase I of the HCP (2013). Preliminary results in 2004 for these species are not considered reliable at this time due to possible experimental bias from the effects of the tag and other aspects of the study. However, the acoustic tracking study did show that spill may not be an effective tool for meeting the HCP survival standards. Comparison of the relative survival for the surface collector and the spillway suggest that survival of fish passing through the surface collector is higher. In 2004, the proportion of sockeye and subyearling Chinook using the spillway route was low, despite the 24% spill level for sockeye and 9% spill level for subyearling Chinook. For these reasons, the primary emphasis for increasing fish survival under the HCP will be to increase the efficiency of the JBS, rather than increasing spill. In 2005, a study of sockeye passage and survival, with both a spill and no spill condition, was conducted to evaluate the benefits of the 24% spill level and to determine if spill adversely affects fish passage efficiency of the surface collector. Future studies will better define the utility and levels of voluntary spill necessary to meet HCP survival standards for subyearling Chinook.

Voluntary spill levels for 2004 and 2005 were 0% spill for yearling Chinook and steelhead, 24% spill for sockeye (but with no spill on 12 days during the spill/no spill study in 2005), and 9% for subyearling Chinook. These spill levels in 2004 and 2005 were successfully managed to keep TDG levels well below the numeric criteria allowed for voluntary fish passage spill in the water quality standards (Table 2-8). These TDG levels are much lower than the TDG levels produced at the FCRPS projects that are managed to maintain a TDG level just below the 120% criterion.

Table 2-8: TDG Levels During Current HCP Fish Passage Spill Levels

HCP Fish Spill Period	TDG Increase (%) DFMS - Forebay Average, (Range)	DFMS TDG (%) Average, (Range)	Rock Island Forebay TDG (%) Average, (Range)
2004 Spring (May 6 – June 6)	2.4 (0 – 3.5)	111.4 (109.3 – 113.1)	111.1 (107.8 – 112.6)
2004 Summer (June 7 – August 3)	0.7 (-0.2 – 1.5)	112.0 (107.6 – 114.6)	111.3 (108.1 – 113.4)
2005 Spring (May 10 – June 7)	1.5 (-1.3 – 8.4)	112.1 (107.5 – 117.8)	111.4 (107.9 - 117.5)
2005 Summer (June 8 - August 15)	0.5 (-2.6 – 4.8)	111.3 (109.0 – 113.8)	111.2 (109.2 – 112.8)

Average spill levels are for the 12 highest hourly readings in a day

A spill rate of 24% is the highest voluntary spill currently required by the HCP. Under a 7Q10 flow, this would require spilling an average of 63 kcfs. According to a regression developed by Schneider (2005) this level of spill, with no changes in operations would result in a TDG level of 120.3% in the tailrace at FOP1.

3.1.6 Measures to Minimize Involuntary Spill

Chelan PUD has implemented operational improvements that reduce involuntary spill, both during the fish migration season (April-August) and during the rest of the year, when the TDG numeric criterion is 110%. The track record for TDG abatement by reducing spill through operational measures at the Project has shown continuous improvement over the past five years. In response to requests from Ecology, Chelan PUD has prepared summaries of the incidence of spill since 1995 (Table 2-9 and Table 2-10). Flows prior to 1995 are not included because operations of upstream storage projects were modified by the FCRPS 1995 Biological Opinion. These tables show that flows arriving at the Project will rarely exceed the hydraulic capacity of the powerhouse during the September-March period. Also, even low levels of spill will cause exceedance of the 110% criterion. Thus, avoidance of spill during this time of year is the most viable means to comply with the water quality standards. During the April-August fish migration season, the Project can comply with 120/115% criteria up to the level of the 7Q10 flow.

Spill has been very infrequent, since 2000, during the September to March period, when the TDG criterion is 110%. Also, the hourly project discharge has rarely exceeded the hydraulic capacity of the powerhouse since 2000. Hourly total project discharge and spill volumes are shown by month in Appendix E. Three factors have contributed to the reduction in spill and spikes in hourly discharge during these months.

Table 2-9: Rocky Reach Projected TDG for Flows above Maximum Turbine Flow for Months during the Fish Passage Season, Assuming No Spill Is Being Used for Fish Passage (1995 – 2003)

Spill Level (flow) (Flow-201kcfs)	% TDG	April % of hours	May % of hours	June % of hours	July % of hours	August % of hours
<-10 kcfs (201-211 kcfs)	112.86	1.91	2.76	4.06	3.36	0.21
10 - 20 kcfs (211 - 221 kcfs)	114.21	1.60	2.05	3.72	2.99	0.19
20 - 30 kcfs (221 - 231 kcfs)	115.57	1.28	2.11	2.65	1.49	0.03
30 - 40 kcfs (231 2341 kcfs)	116.92	0.94	1.75	2.36	0.79	0.01
40 - 50 kcfs (241 - 251 kcfs)	118.28	0.66	2.18	2.62	0.43	0.00
> 50 kcfs (>251 kcfs)	NA	0.62	5.97	12.47	0.48	0.01
Total Spill Frequency		7.02	16.82	27.89	9.54	0.46

TDG is for edge of aerated zone (non-fish spill compliance zone)
TDG estimated from spill regression (TDG = 0.1509 x + 111.61) at the FOP1 site

Table 2-10: Rocky Reach Projected TDG for Flows above Maximum Turbine Flow for Months Outside of the Fish Passage Season (1995 – 2003)

Spill Level (Flow-201kcfs)	% TDG	September % of hours	October % of hours	November % of hours	December % of hours	January % of hours	February % of hours	March % of hours
<= 10 kcfs (201 - 211 kcfs)	112.86	0.03	0.01	0.00	0.33	0.79	1.57	1.03
10 - 20 kcfs (211 - 221 kcfs)	114.21	0.00	0.00	0.00	0.03	0.39	0.69	0.60
20 - 30 kcfs (221 - 231 kcfs)	115.57	0.00	0.01	0.00	0.03	0.15	0.59	0.37
30 - 40 kcfs (231 - 241 kcfs)	116.92	0.00	0.00	0.00	0.01	0.03	0.64	0.21
40 - 50 kcfs (241 - 251 kcfs)	118.28	0.00	0.00	0.00	0.00	0.01	0.64	0.21
> 50 kcfs (> 251 kcfs)	NA	0.00	0.00	0.00	0.00	0.01	0.95	0.01
Total Spill Frequency		0.03	0.03	0.00	0.40	1.39	5.09	2.43

TDG is for edge of aerated zone (non-fish spill compliance zone)
TDG estimated from spill regression (TDG = 0.1509 x + 111.61) at the FOP1 site

The almost complete absence of spill since 2001, other than for fish passage, has been accomplished through implementation of a rigorous planning process that schedules routine maintenance, turbine and generator replacement, and other construction work into time periods when flows are not going to exceed the hydraulic capacity of the available turbine units. Previously, the most frequent and highest volumes of flows that caused spill were in January to March of 1996. Flows were much higher than normal that year because of major flood events in late December of 1995 and further above-normal precipitation through the winter. These spills were also caused by construction activities for the prototype JBS that required shutting off several powerhouse turbines while pilings were placed in front of the intakes. This construction activity, because of its magnitude, was a one-time occurrence and future construction will not require such extensive powerhouse outages. In fact, construction of the permanent JBS, which included removal of the prototype, was accomplished without similar turbine outages in 2003.

In order to reduce the frequency involuntary spill, Chelan PUD has analyzed the potential for further improvement in operations. The options considered included continuous improvement in scheduling of maintenance outages to avoid spill, refinement of operations under the Hourly Coordination Agreement to minimize high flow levels and involuntary spill past unloaded units, and the potential to operate the Project's turbines at maximum hydraulic capacity when necessary to avoid spill levels that could exceed the TDG numeric criteria.

3.1.6.1 Scheduling of Maintenance to Avoid High Flow Periods

Chelan PUD began an aggressive program in 2000 to limit the incidence of spill due to maintenance outages during periods of the year and times of day when river flows approach the hydraulic capacity of the powerhouse. The hydraulic capacity of the powerhouse, when all 11 turbines are operating, is 204,000 cfs at the most efficient operating point and 212,000 cfs can be passed without needing to spill. Typically, these flow levels are not reached during river management for power generation. The hydraulic capacity of the powerhouse, when 10 turbines are available, is reduced to either 182,000 cfs or 187,000 cfs, depending on the type of turbine out of service for maintenance The planning process schedules lengthy maintenance outages to the months in the year when flow releases from Grand Coulee and power demand are typically the lowest, with most turbine overhaul scheduled for March to mid-May or September to mid-November. Short duration outages, such as inspections, trash rack cleaning and smaller repair jobs are either scheduled for nighttime and weekends or, if scheduled during the day, are of a nature that work can be suspended or postponed to avoid spill if river flows approach the hydraulic capacity. Outage planning is focused on the shape of the daily flow pattern. The use of the Hourly Coordination Agreement gives the project operations personnel sufficient advance warning to cancel planned outages and avoid spill if the flow pattern changes to higher levels than predicted.

3.1.6.2 Operations to Avoid Spill Past Unloaded Units

Under normal operating and flow conditions, water flows and generation requests for Rocky Reach and the other projects under the Hourly Coordination Agreement are managed to prevent spill and meet load demand with the most efficient use of water released from storage. The Hourly Coordination Agreement centralized control of generation requests works well, but it depends on the timely scheduling of load requests by the power purchasers with contractual rights to the mid-Columbia PUD projects. In the past, spill sometimes occurred due to errors or untimely load requests to the coordinated system The cost (power loss) resulting from this type of spill was originally shared by all the participants. Recent revisions to the Hourly Coordination Agreement now identify the participant whose actions caused the spill and that power loss is deducted from just that participant's account. Spill past unloaded units was uncommon in the past, but this change in the Hourly Coordination Agreement has practically eliminated the incidence of spill past unloaded units. Regional load planning and displacement of higher cost thermal energy sources, such as combustion turbines, has provided markets for energy produced during high flow years and reduced the incidence of spill past unloaded units even when river flows are at or above the hydraulic capacity of the Project.

The types of spill (voluntary fish spill, spill when flows exceed hydraulic capacity (forced spill), and spill past unloaded units) are tabulated and tracked in benchmarking records for the Project. The amount of spill from each category, for the April to August period, has been reported by Chelan PUD in the annual dissolved gas management reports that Chelan PUD has been submitting to Ecology. The April-August spill reported since 2000 has been predominately voluntary spill for fish passage (81%), with forced spill (15%) and spill past unloaded units (4%) being infrequent and low volumes. In 2004, there were only 11 hours of spill that were not fish passage spill (6 in January, 1 in March and 4 on August 31-September 1) and fish passage spill was 99.4% of the total volume of spill for the year.

3.1.6.3 Operation of Turbines at Maximum Hydraulic Capacity

Normally, the Project controls the operation of the turbines to stay within peak power production efficiencies for a given head and power output by regulating discharge. This operating procedure results in maximum conversion of turbine discharge into power output and also avoids undue stress on the turbines due to cavitation. However, the turbines can be operated to maximize water discharge for a given head while still preventing damage to the runners from cavitation. At full powerhouse operation, the difference between operation at peak efficiency for power production (204 kcfs) and peak hydraulic discharge capacity (212 kcfs) is approximately the equivalent of one-half the hydraulic capacity of one of the Project's units 1-7. The additional hydraulic capacity gained by operating for peak hydraulic discharge could be used to avoid forced spill during the September – March period and to reduce forced spill in April – August on those occasions when total river flow approaches the 7Q10 discharge.

3.1.6.4 Operation of Spillway Gates 2 through 12

The use of additional gates for spill operations is both feasible and can be implemented readily. Once the TDG monitoring station for the tailrace is moved to the JBS location, more accurate evaluations can be conducted of different spillway gate settings to minimize TDG levels. Fine-tuning of gate settings and use of additional spillway gates during high spill levels can be evaluated and managed to meet TDG numeric criteria during in-season operations to control TDG levels.

3.1.7 Evaluation of Identified Structural Options in Meeting TDG Criteria

There were only two structural options that ERDC determined had limited potential to reduce TDG levels during spill at the Project. These options both alter the flow characteristics in the tailrace in a manner that could adversely affect adult and juvenile salmonid passage and survival. These options would also require extensive modification to the Project's structures, thus several years of design and model testing would be required before either option could be implemented.

3.1.7.1 Entrainment Cutoff Wall

Equations were developed by ERDC (Schneider and Wilhelms, 2005) to estimate the reduction in TDG loading provided by a properly designed entrainment cutoff wall. The TDG level measured below the spillway at the JBS monitoring location will not change with the implementation of an entrainment wall because the TDG level of spilled water is not affected. An entrainment wall could reduce the amount of powerhouse discharge that gets drawn into the spillway discharge, thus reducing the average TDG loading across the entire river channel downstream from the tailrace. The effect of an entrainment wall has been calculated as a reduction in the TDG level in the mixed flow at the LD transect by 0.8% to 1.0% (±1.2%) for a small and large turbine being off line, respectively (Table 2-7). The effects of this option on fish passage must also be evaluated prior to implementation.

3.1.7.2 Spill Deflectors and Raised Tailrace

ERDC used the TDG exchange relationship developed for Ice Harbor Dam to estimate the TDG level in spillway flows for Rocky Reach. This relationship was used to determine the reduction in TDG estimated by the implementation of this alternative in Table 2-7. Calculations (at 7Q10 flow and one turbine out of service) indicate that this alternative would reduce TDG in spill by 4.0 to 4.2 ± 1.2 %. There remains considerable uncertainty in the estimates of TDG exchange associated with this alternative as applied to Rocky Reach Dam. The interaction of both the continuous baffles and the stilling basin end sill will interfere with the deflected surface jet and may alter the trajectory and TDG exchange properties of this alternative.

This option would only be needed during high flows and would only be effective if the deflectors are designed to function under high tailwater conditions. Under normal and low tailwater conditions, studies of fish survival at Ice Harbor Dam and other dams have shown that spill deflectors may decrease the survival of juvenile salmon passing through the spillway. Most of the spill at the Project is voluntary spill for fish passage, which occurs when flow is below 200 kcfs. Spillway deflectors would only be needed to abate TDG when flows approach the 252 kcfs level, but would affect fish survival during any spill, including voluntary fish passage spill. Thus, protection of downstream migrating salmonids may preclude implementation of this option.

3.2 Temperature

3.2.1 Operations Options Considered

The CE-QUAL-W2 simulations of the Reservoir indicated that the Project generally met the current 1997 numeric criteria for water temperature during 2000-2004, the five-year period that was modeled. The difference in temperature increase between the with-Project and without-Project models was typically well below the allowable increase for human effects, as calculated on a daily basis. In only one case, using the 2003 proposed criteria (seven-day average of the daily maximum temperature) did the difference between the with- and without-Project exceed the criteria. The Project, as previously discussed, has only a small effect on the thermodynamics of heat exchange between the water in the Reservoir and the influences of climate and solar radiation.

At other Columbia River projects, there are two operational options that have been considered for reducing the uptake of heat energy in their reservoirs. These options are related to increasing water velocity, thus reducing water residence in the Reservoir, and reducing water levels, which affects both water velocity and surface area. The FCRPS has the option to increase river flow by releasing water from storage projects, such as Grand Coulee Dam. The benefits of increased water velocities are then experienced at all downstream projects. Another option is to reduce the Reservoir level, thus reducing surface area (exposure to contact with air and solar radiation) and increasing flow velocities, which reduces the length of time that water remains in the Reservoir and is exposed to heating. These options have been considered for the Rocky Reach Project, but neither of them is feasible or beneficial for the reasons described below.

***3.2.1.1* Increase River Flow through Storage Release**

The amount of storage available from the Project is too limited to create a sustained increase in river flow that would be sufficient to affect water temperatures. Even if the Reservoir could be drafted to minimum pool on a daily basis to increase flows during the daytime, the resulting flow increase would be less than 40,000 cfs. Further, these flows would not be experienced in the Reservoir, but in the downstream Rock Island Reservoir. The Wells Project would have to operate in the same manner to produce a similar effect in the Reservoir. Daily drafting and refilling of the Reservoir would also have adverse ecological and aesthetic impacts. Further, this operation would void the benefits of the Hourly Coordination Agreement at a tremendous financial cost to the Northwest regional electricity system. The current operations under the Hourly Coordination Agreement already provide increased daytime flow rates greater than could be provided through use of individual storage releases from the run-of-river projects, such as the

Rocky Reach Project The FCRPS system currently provides augmented flow releases from Grand Coulee Dam during the spring and summer juvenile salmon migration, which has beneficial effects on water temperatures at all the downstream projects, including the Rocky Reach Project. Only a regional decision to increase summer flow releases from FCRPS storage projects could create a sustained increase in flows that could affect temperature increases through the Columbia River hydroelectric system. The small, run-of-river projects, such as the Rocky Reach Project, do not have this capability.

3.2.1.2 Operate at Minimum Operating Pool

The surface area of the Reservoir would be slightly reduced and average velocity of water passing through the Reservoir could be increased slightly if the Reservoir were operated at minimum elevation (704 for project safety and reliability). However, this three foot difference in the Reservoir elevation would not be sufficient to produce a measurable reduction in water temperatures. The increase in daily average temperature from creation of the Reservoir has been predicted by both the EPA RB10 model and the SNTEMP model to be typically less than 0.1°C (Figure 2-16) and no greater than 0.5°C under extreme conditions of low flow and high air temperatures. The CE-QUAL-W2 modeling indicated that the Project generally causes less than a 0.3°C increase to the daily maximum water temperature when the temperature is at or above 18°C. The pre-Project surface area of the Reservoir's 43-mile reach of the Columbia River is estimated at 3,643 acres during summer flows, whereas the current surface area, with forebay at 707 elevation and 100,000 cfs flow, is approximately 8,235 acres. The Reservoir surface area for the same flow at 704 forebay elevation is about 300 acres less than at 707. Thus, if creation of the Reservoir caused less than a 0.1°C increase in daily average water temperature through an increase in surface area of 4,592 acres, then a reduction of 300 surface acres would proportionately yield less than a 0.007°C reduction in water temperature effects. Even during the extreme conditions of low flow and high temperature, operation at 704 would yield no more than a 0.03°C reduction in the daily average temperature effect of the Project. Therefore, operation at minimum pool would not substantively reduce water temperatures at the Project.

3.2.2 Structural Options Considered

3.2.2.1 Selective Withdrawal

At many hydroelectric projects, particularly those with high storage capacities relative to their discharge, the water in the forebay is thermally stratified at depth. At these projects it is feasible to modify the turbine intakes to allow water to be withdrawn from specific depths at different times of year. This type of structural modification, a selective withdrawal system, is a common method used to mimic natural temperature regimes in the powerhouse discharge or provide cooler water to benefit fish populations. The feasibility of this approach requires that the water in the forebay have a temperature gradient and that the turbine intakes be suitable for structural modifications to limit the water withdrawal to specific depths in the forebay.

At some hydroelectric projects, the Reservoir in the vicinity of the forebay may have different temperatures on one side of the river than the other. This may occur when a major tributary (such as the Snake River upstream from McNary Dam) is warmer than the main channel and mixing of the two flow sources has not occurred. Lateral differences in water temperature profiles can also occur when one side of the river channel is out of the main flow, allowing greater warming due to a longer retention time.

At the Project, neither of these situations occurs. The water in the Project's forebay does not stratify and exhibits no temperature gradient except some limited afternoon warming of the surface waters (upper 3 m). Also, there are no apparent lateral differences in water temperatures across the Reservoir upstream from the forebay. The lateral temperature data (Parametrix and Rensel, 2001; Parametrix and TRPA, 2002) indicate that the mainstem flow of the river is very well mixed with regard to temperature. In 2000, the water temperature was measured in vertical profiles at the thermograph locations on the Reservoir, which included a station at the upstream extent of the forebay. In addition, lateral transects of vertical temperature profiles were taken at thermograph locations on August 17. In 2001, similar measurements were taken at similar locations. In 2001, the lateral transects of vertical temperature profiles were taken on September 2. The warmest temperatures were observed in shallower water in near-surface waters measured during the afternoon (Figure 2-26, Table 2-11.)

The Rocky Reach turbine intakes withdraw water from the forebay below the depth of 40 feet below the full pool elevation of 707. An ice-trash curtain wall at the face of the turbine intakes extends to elevation 666, thus reducing the availability of water in the upper 40 feet from entering the turbines. In essence, the structure of the turbine intakes is a selective withdrawal in that any surface water subject to daytime warming is not directly able to enter into the turbine intakes. Thus, there is no potential for structural modifications to the powerhouse that would reduce the water temperature of the powerhouse discharge. The powerhouse discharge already selects the coolest water available from the forebay. Similarly, the spillway draws water from a depth of about 50 feet at normal gate openings of 2-12 feet per gate. The spillway gates open from the bottom, allowing water from the ogee elevation of 649.6 to the elevation of the bottom of the gate (determined by the amount the gate is opened).

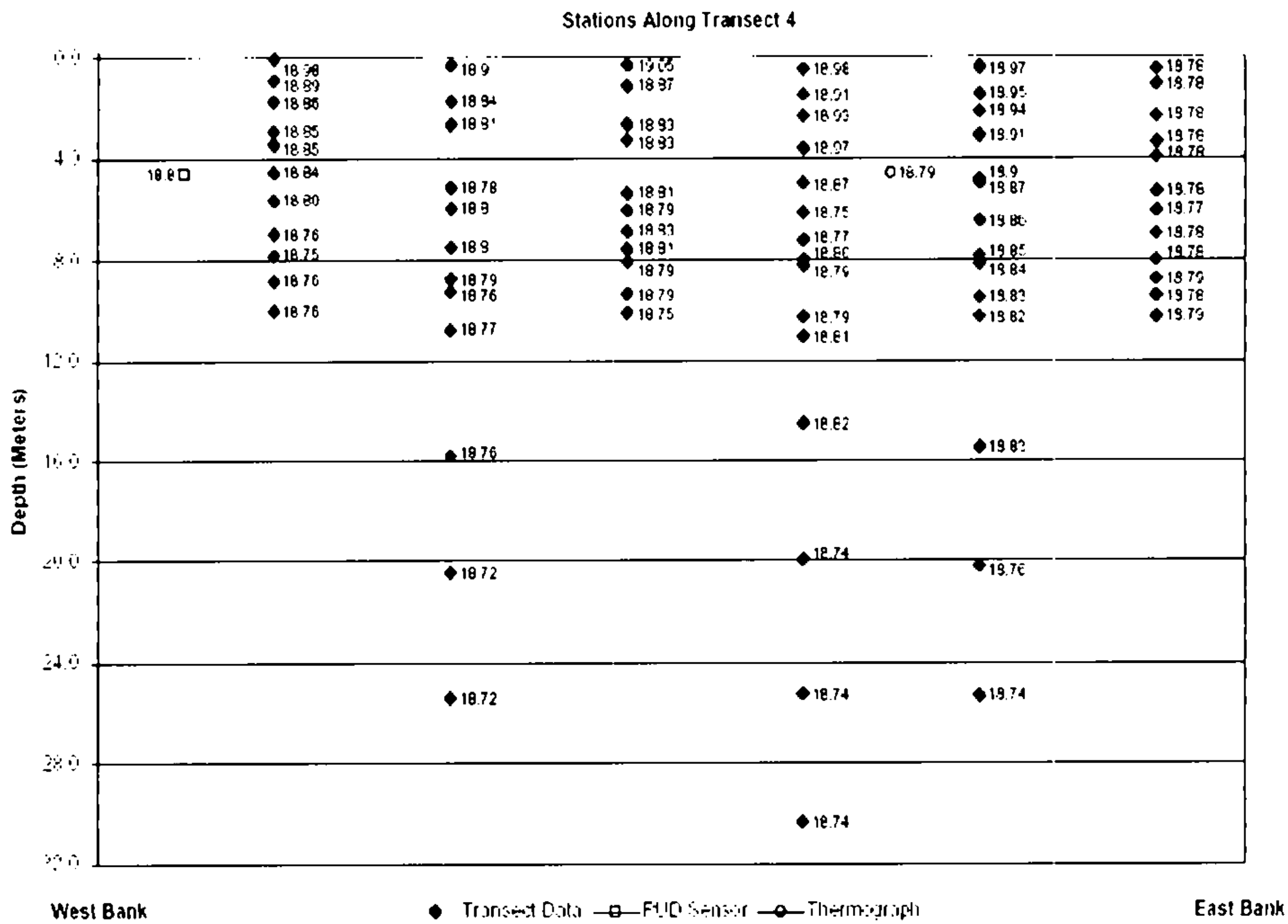


Figure 2-26: Water Temperature Transect Measurements at Rocky Reach Forebay Compared to Thermograph and Temperature Sensor Results; August 17, 2000

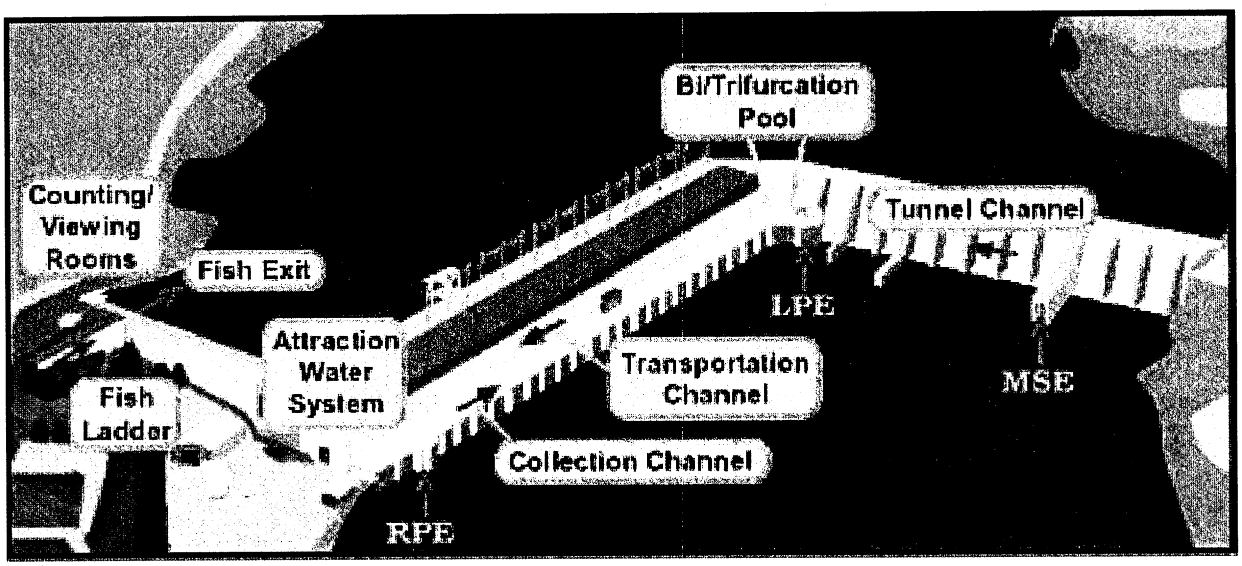
Table 2-11: Summary of Water Temperature Transect Measurements in Rocky Reach Forebay; September 2, 2001

	Transect 8 - Morning				Transect 8 - Afternoon			
Station	Depth (Meters)	Temperature (°C)	Temperature Difference (°C)	Mean Temperature (°C)	Depth (Meters)	Temperature (°C)	Temperature Difference (°C)	Mean Temperature (°C)
1	0	18.4	0.2	18.3	0.1	19.6	0.8	19.3
	1.3	18.2			2.8	18.9		
2	0	18.5	0.0	18.5	0.1	19.7	1.1	18.7
	25	18.5			25.3	18.6		
3	0	18.5	0.0	18.5	0	19.2	0.6	18.6
	30.8	18.5			37.1	18.5		
4	0	18.5	0.0	18.5	0	19.3	0.9	18.6
	38.8	18.5			39.8	18.5		
5	0	18.5	0.0	18.5	0	19.3	0.8	18.6
	38.9	18.5			38.2	18.5		
6	0	18.5	0.0	18.5	0.1	19.3	0.8	18.6
	37.1	18.5			38.3	18.5		
7	0	18.5	0.0	18.5	0	19.3	0.8	18.6
	33.6	18.5			34	18.5		
8	0	18.5	0.0	18.5	0	19.2	0.7	18.6
	37.8	18.5			38.1	18.5		
9	0	18.5	0.0	18.5	0.1	19.3	0.8	18.6
	28.6	18.5			25.2	18.5		
10	0	18.4	0.1	18.4	0	20.0	1.3	19.3
	4.8	18.4			2.7	18.7		

3.2.2.2 Modifications to Fishway Intakes / Sun Barriers

The Project has two fishway systems that draw water from the forebay and pass that water to the tailrace. These fishways are the upstream, adult fishway and the JBS. At some projects on the Columbia River there have been documented instances where the water in the upstream fishway has been shown to increase in temperature during transit through the fishway. In other instances, the structures that draw water into either an upstream or a downstream fishway have withdrawn surface waters that are warmer than the predominant water temperature in the forebay of the project. Although the quantity of flow in fishways is too small to have a significant warming effect on water temperatures in the Columbia River, the fishways have the potential to increase the exposure of salmonids and other cold-water fish to harmful warm water temperatures. In fact, fish mortality has been observed at McNary Dam, where warm surface waters were concentrated in the JBS and turbine intake gatewells.

The Rocky Reach upstream fishway is comprised of a fish exit, a fish ladder (which contains 67 cfs of flow), a lower fishway (comprised of a transportation, tunnel, and collection channels and bi/trifurcation pool), and three entrances and an associated attraction water system). A total of four sources of water, including both gravity-fed and pumped components provide water to the system (Table 2-12). These include two inflows from the forebay to the ladder that provide water to the ladder and two inflows to the lower fishway that act as attraction water sources for each of the three entrances



Note: (RPE = right powerhouse entrance, LPE = left powerhouse entrance, MSE = main spillway entrance).

Figure 2-27: Upstream Fishway System

Table 2-12: Upstream Fishway Water Sources

Source of Water	Location of Input in System	Depth of Withdrawal	Quantity of Water
Gravity-fed from forebay, directly	Top of fish ladder at exit	Evenly from surface to depth of 13 feet when forebay full	About 60% of 67 cfs, or up to 40 cfs; when forebay is full
Gravity-fed from forebay conduit	Upper end of fish ladder at first overflow weir	Evenly from surface to depth of 57 feet from bypass system pump station	About 40% of 67 cfs, or 27 cfs; when forebay is full
Pumped from the tailrace	Throughout transportation and collection channels	Majority from the tailrace, approximately 10% from surface to 25 feet when forebay full	Up to 375 cfs from forebay, 3900 cfs from tailrace
Gravity-fed from spillway between bays 8 and 9	Upstream from spillway entrance	20 feet of depth when forebay full	75-150 cfs of attraction flow

At the upper end of the fishway at the forebay (the exit from the fish's point of view), flow enters the fish ladder via gravity flow, both directly from the forebay into the fishway exit and additional water that is withdrawn from the forebay through a conduit and introduced to regulate flow levels at the pool-and-weir (ladder) section of the fishway The pool and weir section, which is above the lower fishway, has a flow of 67 cfs, which is held constant by holding a head differential of 1.0-1.2 feet over each weir. Water entering through the fishway exit is evenly distributed from the water surface to the floor of the fishway exit at elevation 694, a depth of 13 feet below maximum forebay elevation of 707. The volume of flow entering by this route is variable, depending on forebay elevation. When the forebay is full, at elevation 707, the flow entering from the fishway exit is about 60% of the fishway flow. The remaining flow (make-up water) is provided from the conduit, which measures 6 feet high by 4 feet wide, with its centerline at elevation 692.5 This make-up water is thus drawn from a depth of about 12 to 17 feet below the forebay water surface. Prior to construction of the JBS (completed in 2003), the development of a warm surface layer would have been undisturbed by turbulence. Since 2003, the water discharged from the JBS pump station mixes with the forebay water, introducing water drawn from the forebay at depths up to 57 feet. The make-up water conduit is now supplied from water discharged from the JBS pump station.

Water is supplied to the lower fishway in two locations, one pumped and the other through a gravity-fed intake. The gravity-fed intake, located at the spillway between bays 8 and 9, is used to supply 75-150 cfs or more, depending on tailwater elevation, of attraction flows to the spillway entrance. This intake is located at an elevation of 687, or approximately 20 feet below the full forebay elevation

The pumped water is the main source of attraction water for the powerhouse fishway entrances. It is provided by three direct-drive turbine pumps, which can each withdraw up to 1,300 cfs from the tailrace near the south end of the powerhouse. Three forebay intakes provide 125 cfs flow, required to drive turbine pumps, which is drawn from the forebay through an intake that extends from the water surface to a depth of 25 feet. That intake is provided with traveling water screens to prevent the entrainment of fish.

Water temperatures within the upstream fishway were recorded hourly with five probes at each of four locations from May 29 to October 19, 2001 and with eight probes at each of seven locations from August 19 to October 7, 2004 (two depths were monitored at one location; see Figure 2-28). During the low flow year of 2001, fishway water temperatures would be more likely to demonstrate any tendency to either collect warm water from stratified surface layers or warming within the fishway than would be likely during years with higher river flows. The collection of warm water is the withdrawal from a localized warmer area as opposed to a uniform draw over a mixed flow. During the high ambient air temperature of 2004, the net heat available to increase the water temperature is greater than in cooler years.

In 2001 the temperatures were recorded within the fishway in the source water at the exit at shallow depth (108 inches from the bottom), the exit at deep depth (16 inches from the bottom), in the third pool downstream of the make-up water (22 inches from the bottom), at the beginning of the diffusion pools (42 inches from the bottom) and in the trifurcation pool (84 inches from the bottom). These measurements show if any warm water was collected from the forebay (represented by the exit locations) and whether the water warmed during transit through the pool and weir section of the fishway. In 2004, the same locations were monitoring but four additional locations were added including: at the powerhouse entrance, within the transportation channel at the right powerhouse entrance, in the middle of the transportation channel, at the left powerhouse entrance and at the spillway entrance. Each of these locations was monitored at a depth of six and one-half to eight feet from the bottom.

The pool and weir section is the only part of the fishway exposed to solar warming. Water temperatures were also recorded at the trifurcation pool, where attraction water pumped from the tailrace makes up the majority of the fishway flow. The difference in temperatures between measurement points averaged less than 0.1°C between comparisons of each pair of measurement locations. The maximum difference in any comparison was less than 0.5°C for all locations within the 67 cfs ladder flow. The maximum difference between the trifurcation pool location and the 67 cfs portion of the fishway was 1.0°C for one hourly reading on July 12, 2001, and 0.4°C on several days in 2004. However, the water temperature in the 67 cfs portion of the fishway was typically within 0.1°C of the temperature at the trifurcation pool, which was supplied with thoroughly mixed water discharged from the turbines into the tailrace.

The average water temperature in the upstream fishway during the 2001 study was 16.5°C at all locations and the maximum temperature, 19.3°C on September 23, was also recorded to be within 0.1°C at all locations. The average water temperature in the upstream fishway during the 2004 study (limited to the hot months of August and September) was 19.2°C at all locations and the maximum temperature, 20.3°C on each five days, was recorded to be within 0.3°C at all locations. These differences in water temperature measurements are less than the precision of the temperature recording devices, thus there was no measurable difference in temperature between any locations, just measurement error. The findings of a statistical evaluation using matched pairs are presented in Table 2-13 and Table 2-14 for 2001 and 2004, respectively. In 2001, the exit locations represent any surface warming that might have occurred in the forebay. In 2004, after the installation of a surface collector that introduces vertically mixed forebay water to the fishway exit, the downstream data represents the Columbia River. No significant differences are noted. This evidence demonstrates that there is no significant difference in water temperatures within the upstream fishway and no evidence that the fishway concentrates warmer surface waters from the forebay. There is no evidence that shielding the pool and weir section of the fishway from solar radiation would have any beneficial effect of reducing water temperatures in the fishway.

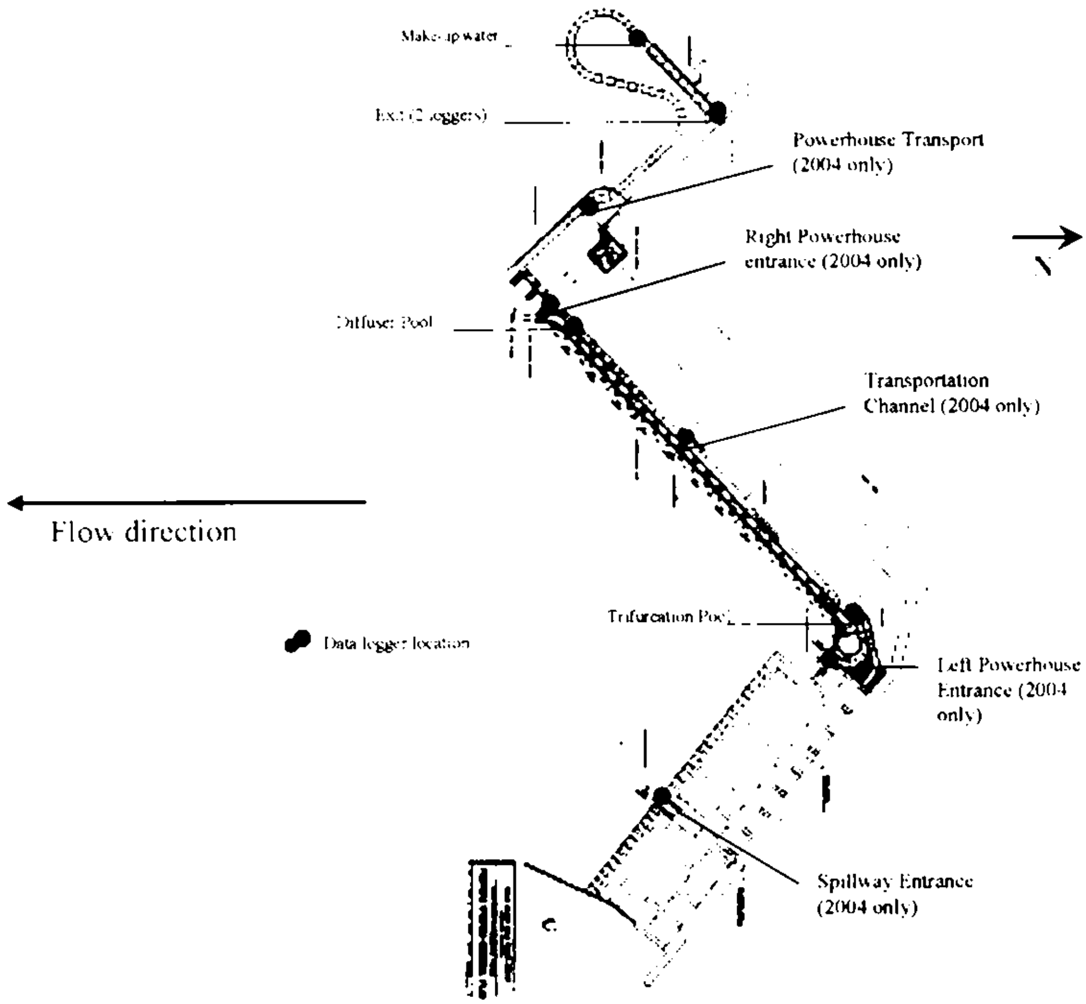


Figure 2-28: Fishway Temperature Monitoring Locations

Table 2-13: Mean Fishway Temperatures and Probabilities of Similarity May 29 – Oct. 19, 2001

Monitoring Locations	Mean Temp. (degrees C)	T-test Probability Value*				
		Exit Shallow	Exit Deep	Makeup	Trifurcuration	Diffuser
Exit Shallow	16.5	----	0.9995	0.99934	0.99884	0.99905
Exit Deep	16.6	----	----	0.99917	0.99894	0.99906
Makeup	16.5	----	----	----	0.99867	0.99909
Trifurcuration	16.4	----	----	----	----	0.9988
Diffuser	16.5	----	----	----	----	----

Note: The accuracy of the measuring equipment is 0.2°C.
* A value of one means the two sets are identical, a value <0.05 means that the difference is significant.

Table 2-14: Mean Fishway Temperatures and Probabilities of Similarity Aug. 19 – Oct. 7, 2004

Monitoring Location	Mean (°C)	T-test Probability									
		Down Stream	Exit Deep	Exit Shallow	Makeup Water	Transportation Channel	Trifurcation Pool	Powerhouse Transport	Powerhouse Entrance	Middle Entrance	Spillway Entrance
Down Stream*	19.2	---	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Exit Deep	19.1	---	---	0.97	0.98	0.95	0.97	0.99	0.96	0.98	0.96
Exit Shallow	19.1	---	---	---	0.95	0.95	0.95	0.97	0.99	0.95	0.95
Makeup Water	19.2	---	---	---	---	0.95	0.98	0.98	0.95	0.99	0.97
Transportation Channel	19.2	---	---	---	---	---	0.95	0.95	0.96	0.95	0.96
Trifurcation Pool	19.1	---	---	---	---	---	---	0.97	0.95	0.99	0.97
Powerhouse Transport	19.1	---	---	---	---	---	---	---	0.96	0.98	0.96
Right Powerhouse Entrance	19.1	---	---	---	---	---	---	---	---	0.95	0.95
Left Powerhouse Entrance	19.2	---	---	---	---	---	---	---	---	---	0.97
Spillway Entrance	19.2	---	---	---	---	---	---	---	---	---	---

* Downstream represents the Columbia River at the DFMS, not flow in the Fishway.

The JBS draws water from two different structures, the surface collector and turbine intake gate slots. The surface collector draws 6,000 cfs into two entrances that are each 20 feet wide and 57 feet deep. A majority of the flow entering the surface collector is drawn off through screen panels and returned to the forebay by pumps, with 240 cfs flowing over two weir gates and into the bypass pipe. The water flowing over the weir gates is somewhat mixed, but likely predominately originating from the surface waters entering the surface collector from the forebay (in the upper 57 feet). The weir gates operate with a submergence averaging two feet below the water surface. In addition to the 240 cfs from the surface collector, the turbine intake screen and gatewell collection system adds 120 cfs to the bypass pipe. The flow in the turbine intake gatewells comes from the water drawn into the upper portion of the turbine intake, which comes from a depth of 70-90 feet deep in the forebay. The gate slots at the Project are narrow and the water residence time is very short, thus there is no potential for exposure of fish to warm surface waters concentrated in the gatewells, such as has been reported at McNary Dam.

The water in the JBS is not warmer than ambient water temperatures in the Columbia River and it does not increase in temperature during transit, which takes approximately six to eight minutes. Water in the bypass pipe is largely shielded from solar radiation and warming from exposure to warm air because the pipe provides shade, there is some evaporative cooling within the pipe and the water flows through the pipe very rapidly. Although the 240 cfs entering from the surface collector is primarily from the surface of the forebay (the upper five feet), the pump station discharge mixes the 5,760 cfs from the lower depths (57 to 62 feet) that enters the surface collector with the forebay surface waters, thus preventing even short periods of near-surface thermal differentials in the forebay. Additional research to definitively describe the thermal conditions is ongoing.

3.2.2.3 Cooling Towers

Cooling towers use the process of evaporation, whereby the heat of vaporization (a means of removing heat) cools the water remaining in the liquid phase to a lower temperature. Cooling towers fall into two major types, natural draft and mechanical draft. Natural draft designs use very large concrete chimneys to introduce air into contact with falling water, whereas mechanical draft designs use large fans to force air through circulated water. Natural draft towers, typical of many nuclear and other thermal power plants, are very large (for example, 500 feet high and 400 feet in diameter at the base) and are generally used for water flow rates above 200,000 gallons per minute. This type of tower is often a counter-current design. In counter-current cooling towers the liquid water stream is introduced at the top of the tower and falls over packing material and is exposed to air that is flowing upward through the tower. Once in contact, the water at the gas-liquid interface evaporates into the air stream. Latent heat of evaporation is carried into the bulk air by the water vapor. Thus, the temperature of the water is lowered. Therefore, the water flow rate and the water temperature decrease as the humidity of the air increases from evaporation. This process also known as humidification involves the simultaneous transfer of mass and heat.

There are many factors that contribute to the design of cooling towers, but for the purpose of reducing water temperatures in the Columbia River there are three critical factors that determine the feasibility of cooling tower technology. These key factors are the desired water temperature, the difference between the desired water temperature and incoming water temperature, and the difference between desired water temperature and the heat content of ambient air. The heat content of ambient air (in effect the cooling capability of the air) is indexed by the typical wet bulb temperature of the air. In cooling tower design, the wet bulb temperature of the air must be lower than the desired water temperature to cool the water. This difference between the desired cool water temperature achieved and typical wet bulb temperature is called the approach.. Cooling tower size requirement varies inversely with approach, thus a smaller approach requires a larger tower and, at 5°F (2.8°C) approach, the effect upon tower size begins to become asymptotic (Figure 2-29). In other words, if the wet bulb temperature is, for example 60°F (15.6°C), the coolest the water can be coming from the cooling tower is 65°F (18.4°C). Thus, for cooling towers to be a feasible technology for a desired water temperature, the difference between the desired water temperature and the ambient wet bulb temperature must be greater than 5°F (2.8°C).

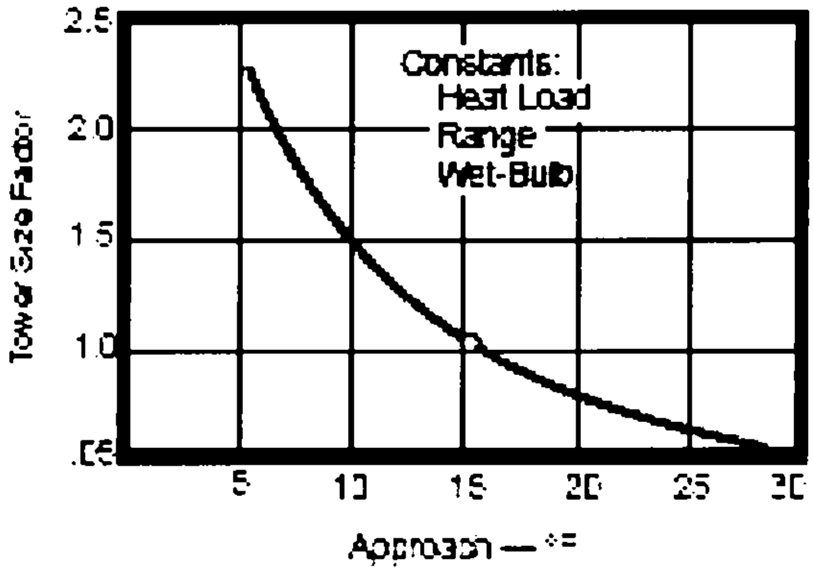


Figure 2-29: Relationship between Cooling Tower Size and Approach Temperature

There are two conceptual applications for use of cooling technology to mitigate the effects of water temperature on aquatic species at the Project. One concept would be to build a massive cooling tower to reduce the temperature of Columbia River water to mitigate for temperature increases resulting from existence of the Reservoir. This cooler water could then be returned to the Columbia River as either a mixing discharge or as a cool water plume intended to provide a cool water refugium. Another concept is to use a smaller cooling tower to reduce the water temperature in the fishway for upstream migrant salmon and other fish. Both concepts would be employed in the summer months, when water temperatures in the Columbia River reach 18°C (64.4°F). The desired cool water temperature would be something cooler than 18°C, for example 16°C (60.8°F). Thus, for cooling tower technology to be feasible for this application, the approach must be at least 5°F and therefore the wet bulb temperature of ambient air must be less than 56°F to achieve a cool water result of 16°C. In typical design of cooling systems, the tower is built to meet the desired objective most of the time, defined as the percentage of the time a given temperature doesn't provide adequate cooling. The wet bulb temperatures are typically reported at 0.1, 0.5, and 2% levels, corresponding to temperatures in above the reported value 9, 44, and 175 hours of the year, respectively. The lower the percentage, the higher the wet bulb temperature reported. The American Society of Heating, Refrigeration and Air Conditioning Engineers has published design data for Washington State and they report the 2% wet bulb exceedance for Wenatchee to be 64°F (17.8°C) during the summer (Puget Sound Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1986). In effect, the water sent through a cooling tower could not effectively be cooled below 69°F (20.6°C) during 175 hours of the year.

Data recorded at the U.S. Department of Agriculture Forest Service weather station at Entiat show that the daily mean wet bulb temperature during July-August is frequently above 56°F (13.3°C; Figure 2-30), thus a cooling tower would frequently fail to provide significant cooling of water during these summer months (given that at an approach of 5°F, the water couldn't be expected to be cooled below 61°F or 16.1°F). Even cooling of fishway water temperatures would be infeasible because the wet bulb temperature is often so high that little, if any, cooling of water would occur during the months of July-August.

Even if the approach temperature was within the feasible range for cooling tower technology, there are other reasons why cooling towers are not a feasible means to reduce water temperatures in the Columbia River. First, there is the massive quantity of water that needs to be cooled. Assuming an average Columbia River flow of 100,000 cfs, the number of British Thermal Units (BTU) of cooling capacity needed to reduce the water temperature by 0.3°C (the allowable human effect in the water quality standards) is approximately 202 million BTU per minute. Most of the heat reduction in a cooling tower is due to evaporation, with approximately one pound of water evaporated for every 1,000 BTU of heat removed from the remaining water. Thus, to cool the Columbia River by 0.3°C, the consumptive use of water lost to evaporation would be approximately 202,000 pounds of water per minute, which is equivalent to 107 acre-feet per day. Assuming the cooling tower was operated from July-September, approximately 90 days per year, the annual consumption of Columbia River water would be 9,640 acre-feet. This estimate is conservative because it does not account for water loss from blowdown and windage. Blowdown wastewater needed to clean media, the internal components of the tower, is both a water loss and a potential disposal issue. Another water loss results from windage or drift. Windage is the loss of water, as droplets, carried away by the air flow (not adequately represented by the humidity calculations). Windage loss is typically in the 0.1% to 0.3% range for mechanical draft towers

The water loss from a cooling tower would be equivalent to approximately one third of the future consumption allowed in a water withdrawal permit issued by Ecology to the Quad Cities (Richland, Kennewick, Pasco and West Richland) in November 2002. Due to concerns about the potential effects of reduced Columbia River flows on migrating salmon and steelhead, Ecology required mitigation for this municipal water allocation in the form of conservation and acquisition and transfer of other water rights. It would make little sense to attempt to reduce water temperatures in the Columbia River with technology that creates a consumptive use of water that rivals major metropolitan water use, and further, reduces river flows downstream which leads to increased heat uptake and temperature increases in the downstream reaches of the river.

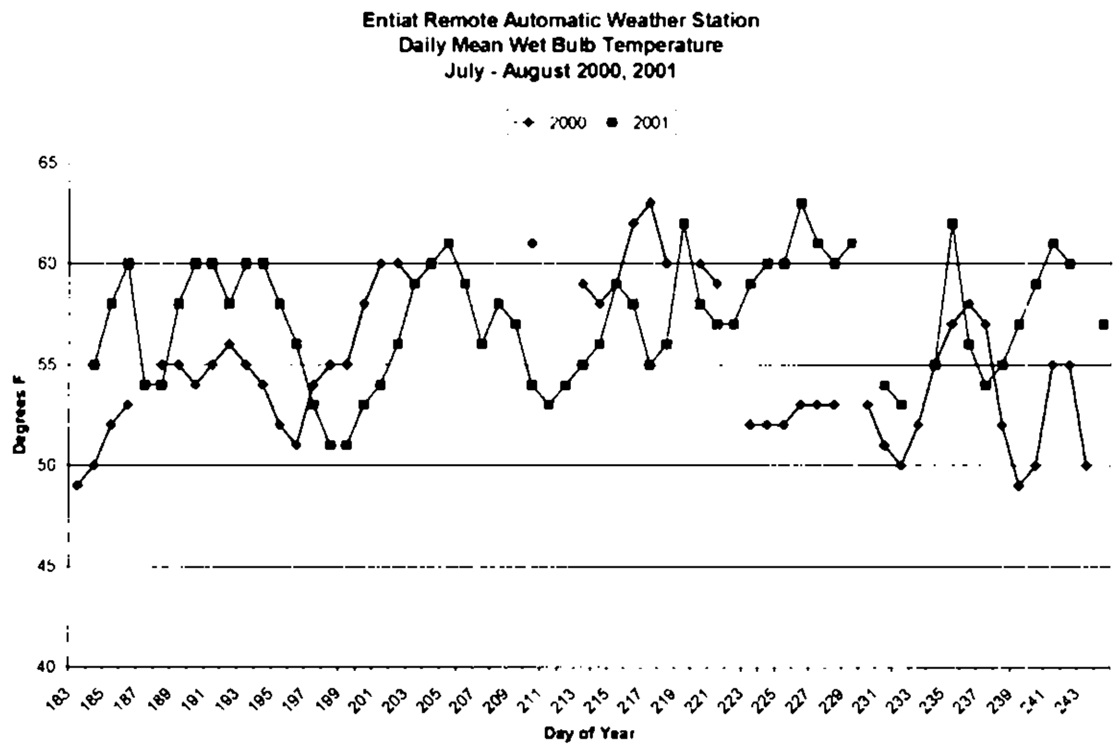


Figure 2-30: Daily Mean Wet Bulb Temperature at Entiat Remote Automatic Weather Station, July to August, 2000, 2001

3.2.2.4 Chillers

Chillers use the process of refrigeration to transfer heat from a low-temperature area to a high-temperature area. In a refrigeration cycle, work is the input to get the desired cooling effect. Since heat flows naturally only from high- to low-temperature areas, refrigeration needs an external energy source to force heat transfer to occur. This energy source is a pump or compressor that does work in compressing the refrigerant. It is necessary to perform this work in order to get the system to discharge energy (heat) to the high temperature area. Refrigerants are the transport fluids which convey the heat energy from the low-temperature area to the high-temperature area.

General refrigeration devices consist of a coil (the evaporator) that absorbs heat from the low-temperature area, a condenser that rejects heat to the high-temperature area, a compressor, and a pressure reduction device (the expansion valve or throttling valve). In operation, liquid refrigerant passes through the evaporator where it picks up heat from the low-temperature area and vaporizes. The vaporized refrigerant is compressed by the compressor and, in so doing, increases even more in temperature. The high-pressure, high-temperature refrigerant passes through the condenser coils, and being hotter than the high-temperature environment, loses energy (heat). Finally, the pressure is reduced in the expansion valve, where some of the liquid refrigerant also flashes into vapor further reducing the temperature of the refrigerant.

There are many factors that must be evaluated in the design of a chiller. Two key aspects of the design are the refrigerant used and the method of applying the refrigeration to the area to be cooled. The refrigerant used depends on the temperatures of the low- and high-temperature area, as well as on the power of the compressor. There are environmental impacts associated with the use of most refrigerants. Although there are more than a hundred commercial refrigerants commonly available, fluorinated hydrocarbons (e.g., freon or chlorofluorocarbon [CFC] chemicals) are currently used (at least where they are not banned) for most commercial applications. Recent evidence indicates that much of the damage to the atmospheric ozone layer is the result of decomposition of CFC chemicals. An international agreement known as the Montreal Protocol took effect in 1989 and a new Clean Air Act was signed into law in 1990 to limit the production and regulate the use and disposal of CFCs. Prior to the Montreal Protocol, refrigerants R-11, R-12 and R-22, in pure form or blends, were the traditional choices for most systems. Chiller designs historically use R-11 which is now being replaced by hydrochlorofluorocarbon (HCFC)-123 a refrigerant that has a much lower ozone-depleting effect. In contrast, the toxicity limit of HCFC-123 is much lower than the original R-11 refrigerant (meaning that risk from exposure is encountered at lower levels of concentration).

The method of applying refrigeration is another matter to consider. In direct expansion systems the evaporator is placed in the area which is to be cooled. In indirect systems a secondary fluid (brine) is cooled by contact with the evaporator surface, and the cooled brine goes to the region which is to be refrigerated. Brine systems require 40 to 60% more surface area than do direct expansion. Brine systems are safer for systems where the refrigerant effect must be carried considerable distance or widely distributed. Due to safety concerns, direct expansion systems are not feasible for this application. Brines used for industrial refrigeration are usually aqueous solutions of calcium chloride, ethylene glycol, propylene glycol or undiluted methylene chloride and silica-based alkylated fluids. Corrosion by brine is increased by the presence of oxygen, air or carbon dioxide and by galvanic reaction between dissimilar metals. Corrosion inhibiters can be used to offset this affect to some extent.

The application of chiller technology to cool the temperature of the Columbia River water has some potential pitfalls due to the enormous cooling load required. Using the same calculations as for cooling towers, cooling a river flow of 100,000 cfs by 0.3°C requires a cooling capacity of 202 million BTU per minute. Refrigeration capacity is defined in terms of the "ton", where a ton of refrigeration is equal to 200 BTU per minute (which is roughly the equivalent amount of heat to melt a ton of ice in one day). Therefore, chillers would need to be sized to provide approximately 1,010,000 tons of refrigeration. To place this in perspective a typical household will require 1 to 5 tons of refrigeration or a multi-story office building can require from 500 to 2,000 tons of refrigeration. Thus in a best case, the cooling load is equivalent to about 500 large multi-story office buildings. The refrigeration plant would likely be equivalent in scale to the existing powerhouse and require a cooling tower to reject the heat load from the cooling system. The heat load would be equivalent to the cooling tower scenario with the addition of the heat generated from the compressors and all the associated problems previously discussed regarding cooling towers.

Another issue centers on the heat exchange between the chiller system and the river water. As discussed previously a brine system (indirect expansion) would limit the potential of refrigerant leaks directly to the river and provide the best means to distribute over a large area. The brine system is a secondary loop between the river water and the chiller systems. The heat exchange can then be applied by either drawing off a percentage of the river and passing it through a heat exchanger or by employing banks of tubing immersed directly in the river. If a heat exchanger is used only a small percentage of the flow can be directly treated, due to the need to filter out the large particulate from the river water, then the treated water would be mixed back into the river flow in some manner. This approach would also require fish screening of the intake. The other option is to use banks of piping immersed directly into the river. Either application is very similar to a double pipe cooler which typically requires 15 to 20 feet of two-inch pipe for each ton of refrigeration needed. Using the minimum of 15 feet of pipe, this translates to approximately 15 million feet of two-inch pipe needed to transfer the heat from the river to the brine system.

There are no other known suitable technologies for directly cooling the Reservoir or powerhouse discharge. The alternative approach is to prevent heat from entering the river by altering the heat transfer dynamics of the river. Wind towers could be placed in numerous locations along the Reservoir and directed at the water, thus increasing evaporation and reducing water temperatures. The CE-QUAL-W2 has a wind sheltering coefficient, which is a factor that the measured wind must be multiplied to help calibrate the wind speed input value. By varying this coefficient and observing the effect, it is possible to determine how much wind is necessary to cool the water. In a sensitivity analysis of the effect of wind levels on water temperatures (personal communication, Todd Bennett, WEST Consultants, 2005), the wind sheltering coefficient of the CE-QUAL-W2 temperature model had to be set to a multiplier of two to create a measurable change in the surface water temperatures. This implies that wind twice that of normal, or up to 20 meters per second, would likely be necessary to cool the Columbia River by a measurable amount. It is unlikely that wind towers could replicate the level of additional wind that would be necessary.

3.2.3 Other Options Considered to Limit Heating of the Reservoir

Increased shade through establishment of riparian vegetation, especially trees, along the shoreline is often the focus of actions to control water temperatures on smaller streams. In the case of the Project, the amount of shade that could be provided from shoreline vegetation is insignificant in relationship to the total amount of reservoir surface exposed to solar radiation. The Reservoir is typically more than 1,000 feet wide in the narrow sections and from 2,000-3,000 feet wide in the broad sections. Even when directly aligned with the sun's position for maximum shade, a 100-foot tall tree, planted right at the waters edge, will project a shadow of only about 45 feet during the middle of the day in August. Thus, even if the shoreline was thickly planted with tall cottonwood and pine trees, there would be no measurable reduction in water temperatures.

As mentioned previously, increased wind, decreased humidity, increased cloud cover and other climatic factors affect water temperatures. However, there are no practical methods available to modify these factors. The rate of flow in the Columbia River does influence the water temperature, at least as far as the amount of heat uptake that occurs within a single reservoir

However, as previously discussed (Section 3.2.1.1), the Project does not have sufficient useable storage to change river flows on a daily and weekly basis. The use of storage from Grand Coulee Dam to modify flow rates during the summer is already being done under the FCRPS Biological Opinion. The management of the FCRPS for improvement of water quality, including temperature, is being addressed in the implementation of the FCRPS Biological Opinion. Summary of Project Effects and Mitigation Options

The CE-QUAL-W2 modeling of years 2000 through 2004, which includes worst case years, did not yield any simulated impacts that were statistically greater than the allowable incremental temperature increases for human effect under the 1997 water quality criteria. The largest simulated Project impact during the summer months (defined as when the simulated background water temperature was 17.7°C or higher) was approximately 0.7°C. In no case was the simulated project impact, when calculated using the proposed water quality criteria, greater than the allowable increment. The overall Project impact on water temperature, therefore, appears to be quite small. The ability to measure the water temperature more accurately (the current instrument provide an accuracy of 0.2°C) is required before it would be possible to determine if any potential mitigation option is effective once implemented.

The above review explored a broad range of conceivable methods and technologies for reducing water temperatures or limiting uptake of heat from solar and atmospheric sources that were potentially within control of the Project. None of these methods would produce a measurable effect or were technically feasible. The amount of temperature increase resulting from the existence of the Project is related to the river flow, but that potential means to lower temperatures is not within the Project's control. The fish species most sensitive to water temperatures are migrating adult salmon, which during the warmest summer months are seeking entry into the tributary streams where they spawn. These tributary streams (Entiat, Methow and Okanogan rivers) all have elevated water temperatures in the summer. In fact, the water temperature in these streams often exceeds the water temperature in the Reservoir. Under these conditions, salmon may delay entry into the tributaries and use the Columbia River as a thermal refuge. The tributary streams are small enough to accomplish some temperature reductions through increased shade from riparian vegetation and improved streamflows during the hot weather from July to September. Chelan PUD has provided funding for improvement in tributary habitat under the HCP and typically these habitat improvements include components that improve water temperature. Typical habitat improvement measures that also improve water temperatures include restoration of shoreline riparian habitat, restoration of floodplain and side channel connectivity, and increases in instream flows through water conservation, water rights leases and other measures. All three of the tributary streams have ongoing watershed planning and improvement efforts which will eventually result in reduced water temperatures and improved access to these streams by adult salmon migrants. The Chelan PUD funded HCP tributary projects will contribute to these water temperature reductions in the tributaries

SECTION 4: PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

The goal of the following protective, mitigation, and enhancement measures (PMEs) are to provide Ecology with reasonable assurance that the Project will comply with water quality standards and other appropriate requirements of state law under the New License. The scientific evidence presented in the previous Sections of this Chapter demonstrates that the Project will be in compliance with these standards and requirements. The following PMEs are summarized in Table 2-15.

4.1 Measures to Meet TDG Numeric Criteria and Standards

Chelan PUD will implement the measures in Section 4.1.1 through 4.1.6, as needed, in an effort to continue meeting the numeric criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting survival standards as set forth in the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan (HCP) and in the fish management plans contained within the Comprehensive Plan. Chelan PUD shall submit to Ecology for review and approval, by April 1 of the year of implementation, a gas abatement plan (GAP) describing the anticipated use of these gas abatement measures, including new or improved information and technologies. The GAP shall be accompanied by an up-to-date operations plan, a fisheries management plan, physical monitoring plan (Section 4.1.1), and biological monitoring plan (Section 4.1.7). The measures in 4.1.1 - 4.1.6, the annual GAP, and compliance with the Section 401 certification are intended to serve as the Rocky Reach Project's portion of the Detailed Implementation Plan (DIP), which will satisfy requirements of the *Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt*.

As previously discussed, the Project currently manages spill to comply with the 125/120/115% numeric criteria during the April through August fish passage season. Since 2001, the Project has complied with the 110% numeric criterion from September to March by avoiding spill, both through the Hourly Coordination Agreement and by managing the timing of turbine maintenance to maintain hydraulic capacity during peak flow periods.

Using this approach, there have been few exceedances of TDG numeric criteria over the past eight years (Table 2-2). Consequently, the beneficial and designated aquatic life uses are being protected by meeting HCP survival standards while reducing the incidence and magnitude of spill events. More specifically, TDG is being managed during spill, and will be managed in the future by using operations and real-time monitoring in the tailrace at the JBS outfall structure (location FOP1) and in the forebay of Rock Island Dam.

To confirm compliance with the TDG numeric criteria, Chelan PUD will report the results of TDG monitoring, the use of any gas abatement measures, and spill levels annually to Ecology for the term of the license or until no longer required by Ecology, whichever occurs sooner

At Year 5 of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and determine whether compliance has been attained. If TDG compliance has been achieved, Chelan PUD and Ecology will determine which measures will be continued for the term of the New License to maintain compliance. If compliance with the TDG numeric criteria has not been attained, the report shall include an evaluation of what methods (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring (Section 4.1.7) and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD shall submit these reports to Ecology, the Rocky Reach Fish Forum (RRFF), and the HCP Coordinating Committee. If no reasonable and feasible TDG abatement measures are identified, Chelan PUD will petition Ecology to initiate a process to modify the applicable water quality standards to eliminate any non-compliance with such standards.

Table 2-15: Summary of PME Measures

PME Measure	PME Components	Effective Date	Frequency	Duration	Reporting Requirement
4.1	*Measures to Meet TDG Numeric Criteria and Standards*	*Effective Date of License*	*Annually*	*Term of License*	*Annual Report to Ecology* *Annual Gas Abatement Plan to Ecology*
4.1	Gas Abatement Plan (GAP)	Effective Date of New License	Annually	Term of License	GAP
4.1.1	TDG Monitoring (Forebay and Tailrace at JBS Outfall; Data from Rock Island Dam Forebay). Relocate tailrace monitor.	Monitoring begins on the Effective Date of New License and tailrace monitor to be relocated by Year 2 of New License	Hourly from April - August during fish spill. As directed, outside fish spill	Term of License or until Ecology no longer requires	Daily during April-May to Chelan PUD website. In Annual Report
4.1.2	Operation Plan for Fish Passage Spill Management (*- to the extent consistent with the survival standards in the HCP and Fish Management Plans)	Effective Date of New License	During fish spill	Term of License	In GAP
4.1.3	Minimize Voluntary Fish Passage Spill. *	Effective Date of New License	During fish spill	Term of License	In Annual Report
4.1.4	Minimize Spill Due to Maintenance *	Effective Date of New License	January - December	Term of License	In Annual Report
4.1.5	Avoid Spill Past Unloaded Units *	Effective Date of New License	January - December	Term of License	In Annual Report
4.1.6 1	Maximize Powerhouse Discharge, Manage Active Storage *	Effective Date of New License	January - December, when flows exceed 200 kcfs	Term of License	In Annual Report

Table 2-15: Summary of PME Measures

PME Measure	PME Components	Effective Date	Frequency	Duration	Reporting Requirement
4.1.6.2	Spill From Gates 2-12 *	Effective Date of New License	April – August, evaluate when flows exceed 200 kcfs	Term of License	In Annual Report
4.1.7	Monitoring of Aquatic Life for GBT (salmon, resident fish and macroinvertebrate studies)	Effective Date of New License	RI Dam for salmon annually April – August. Resident fish studies during high spill periods (May – July) in high flow years. Or as modified subject to Ecology approval.	Salmon Monitoring for five years. Resident fish and macroinvertebrate studies for 1-2 years or until database adequate to conclude either no effect or that TDG levels harm designated uses. Or as modified by peer review group.	Annual Report after each study.
4.1.8	Determination of TDG Compliance	Year 5	Once	Five years	Sixth Annual Report
4.1.8.1	Additional actions, which may include structural modification feasibility studies	Year 6, if criteria not met. If appropriate, begin feasibility studies by Year 6.	Not Applicable	If Implemented, Permanent Structure	Feasibility, value engineering, design, construction, and final assessment reports
4.1.9	Actions if TDG Compliance Not Achieved	Year 6			
4.1.9.1	Aquatic Life Adversely Affected. Reasonable and feasible additional actions, which may include structural modification	Year 6	Annually	New Term of Compliance Schedule for Dams	As determined by Ecology

Table 2-15: Summary of PME Measures

PME Measure	PME Components	Effective Date	Frequency	Duration	Reporting Requirement
4.1.9.2	Aquatic Life Not Adversely Affected. If no reasonable and feasible actions, Chelan PUD may petition Ecology for rule modification.	Year 6	Once	As Needed to Complete	As determined by Ecology
4.2	*Water Temperature Measures*	*Effective Date of License*	*On going*	*Term of License*	
4.2.1	Water Temperature Monitoring during TDG Monitoring (Forebay and Tailrace; Rock Island Dam Forebay; record Wells Tailrace)	Effective Date of License	Hourly during April - October	Term of License or until Ecology no longer requires	Daily during April-October to Regional Database. Annual Report
4.2.1	Temperature Monitoring in Fishways and JBS	Effective Date of License	Hourly during April - October	One Year unless Ecology determines additional monitoring is required	Annual Report
4.2.2	Temperature Modeling to Confirm Compliance	Effective Date of New License; modeling report due in year six	Once, unless compliance not confirmed	At end of first five years.	Sixth Annual Report
4.2.3	EPA Water Temperature TMDL Participation	Upon Implementation of TMDL	As needed	Term of License	As Required
4.2.4	Tributary Watershed Participation and HCP Tributary Committee	Effective Date of New License	Annually	Term of License	Not Applicable

Table 2-15: Summary of PME Measures

PME Measure	PME Components	Effective Date	Frequency	Duration	Reporting Requirement
4.3	*Project Operations*	*On going*	*Annually*	*Term of License*	*Not Applicable*
4.3	Hourly Coordination	Effective Date of New License	On-going	Term of License	Annual status report
4.3	Hanford Reach Agreement	Effective Date of New License	On-going	Term of License	Annual status report
4.4	*Water Quality Monitoring*	*Effective Date of New License*	*In the initial year.*	*One year, unless RRFF determines additional monitoring is needed.*	*Annual Report*
4.5	*Aquatic Invasive Species Monitoring and Control Plan*	*Effective Date of New License*	*Annually*	*Term of License*	*Annual Report*
4.6	*SPCC Plan & Columbia-Snake River Spill Response Initiative*	*Effective Date of New License*	*On-Going, updated as required*	*Term of License*	*As required by SPCC regulation*

4.1.1 TDG Monitoring

Chelan PUD shall maintain two fixed monitoring stations at Rocky Reach Dam to monitor TDG levels annually from April through August in the forebay and tailrace for the term of the New License and any subsequent annual licenses, or until such monitoring is no longer required by Ecology, whichever occurs sooner. The monitoring point for TDG in the tailrace shall be moved to a location at or near the Juvenile Bypass System outfall as soon as practicable, but no later than year two of the New License. If it is not feasible to conduct TDG monitoring at this site, an alternate location may be developed, provided that if such alternate location is not representative of levels of TDG from spillway flows in the tailrace, measurements at the alternate location shall be indexed to the actual TDG levels in the tailrace below the spillway. TDG will be monitored hourly from April through August at those two stations and data will be posted on a daily basis to Chelan PUD's web page and various web-accessible databases used by Ecology and regional fish management agencies.

4.1.2 Operation Plan for Fish Passage Spill Management

Chelan PUD will manage voluntary spill levels provided for fish passage in real time in an effort to continue meeting TDG numeric criteria, using the Operational Plan for TDG (defined in this Section), while meeting the HCP survival objectives. The Operational Plan for TDG has been in effect for several years and has been effective in preventing TDG exceedances due to voluntary spill. If necessary, the Operational Plan for TDG may be modified by Chelan PUD, in consultation with Ecology, to improve its efficacy based on results of TDG monitoring (Section 4.1.1).

Under the Operational Plan for TDG, the Project's operations personnel will monitor the TDG levels hourly. If the previous six-hour average TDG level in the tailrace at the JBS outfall is at or above 120%, or the instantaneous TDG level is at or above 125%, the voluntary spill volume will be reduced by 3 kcfs, or as necessary to achieve an instantaneous TDG level below 120%. The new spill volume will be monitored for an hour. If the next six-hour average TDG level is not less than 120%, the spill will be reduced by another 2 kcfs and monitored for an hour. The cycle continues, with the spill reduced by 2 kcfs until the average TDG level of the previous six-hour period is less than 120% and remains at less than 120% through the next full hour. If the instantaneous TDG drops below 118% for one full hour, the spill will be increased by 2 kcfs and monitored. The objective is to maintain as much of the spill level scheduled for fish passage operations as possible, without exceeding the tailrace TDG numeric criteria.

If the TDG level in the forebay of Rock Island Dam exceeds 115%, the Rock Island operations personnel will notify Rocky Reach operations personnel immediately. If the TDG level in the Rock Island forebay is greater than 115% and the TDG level in the forebay of Rocky Reach is less than 115%, the voluntary spill volume at Rocky Reach will be reduced by 3 kcfs for two hours. If, after two hours of reduced spill, the Rock Island forebay TDG levels are still above 115%, the spill will be reduced another 2 kcfs. If, subsequently, the instantaneous TDG level in the forebay of Rock Island is less than 113%, spill will be increased to the level necessary to comply with the TDG level of 115%. Since the TDG level in the Rock Island forebay is affected by mixing of powerhouse flows with spillway flows at the Rocky Reach Project, Rocky Reach operations personnel may develop additional protocols to adjust spill levels based on changes in powerhouse flow levels.

4.1.3 Minimize Voluntary Fish Passage Spill

Chelan PUD will minimize voluntary spill by implementing the HCP Agreement to meet survival objectives, using measures other than spill, such as the JBS, as much as practicable. Minimizing the use of spill to meet survival objectives will reduce the TDG levels caused by the Project. Reducing the use of voluntary spill is the most effective way to reduce TDG levels, as evidenced by the low TDG levels observed in 2004. Chelan PUD will provide Ecology with an annual plan for use of voluntary fish passage spill that is approved by the HCP Coordinating Committee.

4.1.4 Minimization of Spill Due to Maintenance

Chelan PUD will minimize spill, to the extent practicable, by scheduling maintenance bsased on predicted flows. The objective throughout the year will be to maintain adequate hydraulic capacity to pass expected inflows through the powerhouse. The Project rarely spills for lack of hydraulic capacity (Table 2-9 and Table 2-10). The continued improvement in maintenance planning to assure turbine unit availability during high flow periods is the most effective action that can be taken to prevent unplanned spill and meet the TDG numeric criteria. The Project has not had any incidences of spill between September through March due to unit outages or lack of hydraulic capacity since early 2000.

4.1.5 Avoidance of Spill Past Unloaded Units

Chelan PUD will avoid spill by continuing to participate in the Hourly Coordination Agreement, or any successive agreements to which Chelan PUD is a party, to the extent it reduces TDG, and manage its operations in an effort to minimize spill past unloaded turbine units caused by imbalances between upstream flow releases and projected power demand. Continued improvement in the efficient operation of the coordinated system is an ongoing priority for Chelan PUD. This effort will continue to reduce the already very low incidence of involuntary spill, resulting in a reduction in TDG. Spill past unloaded units is infrequent and usually the result of problems with coordination of load requests and movement of water through the coordinated system. The recent improvements in the computer program that implements the Hourly Coordination Agreement, as well as the changes to the allocation of the costs resulting from this type of spill will reduce the incidence of spill past unloaded units. The Project has spilled only minimal amounts, less than 0.02% of flow, during the September through March period since early 2000.

4.1.6 Additional Operational TDG Abatement Options

Chelan PUD shall implement reasonable and feasible powerhouse and spillway operational measures, as needed to meet TDG numeric criteria. These measures include maximizing powerhouse discharge, as appropriate, up to 212 kcfs, and implementing alternative spillway operations with additional gates, using any of gates 2 through 12, to determine, in consultation with the RRFF and HCP Coordinating Committee, whether TDG levels can be reduced without adverse effects on fish passage and if effective, implement to reduce TDG. Chelan PUD intends to meet the TDG criteria through the implementation of the measures described in 4.1.1 through 4.1.5. Past performance and projected future operations indicate that the Project will meet numeric criteria even under ordinary operations and the additional measures provide further assurance.

4.1.6.1 Maximum Powerhouse Discharge

Chelan PUD will operate the powerhouse at maximum hydraulic capacity when necessary to maintain compliance with TDG criteria. At flows near the 7Q10 level and with one turbine out of service for maintenance, the 120% TDG criterion could be slightly exceeded (Table 2-7). When operated under peak efficiency, turbines C1 though C7 will each pass up to 17,150 cfs of water and turbines C8 though C11 will each pass up to 21,200 cfs of water, for a total powerhouse hydraulic capacity of 204,000 cfs. The turbine flows can be increased to a total plant hydraulic capacity of 212,000 cfs for several hours, if necessary to control TDG loading (Table 2-7). To do so would bring the Project into compliance at the tailrace for all flows under the 7Q10 flow. During the rare events where flows exceed normal powerhouse capacity during the September through March time period, this same operation could be used in addition to management of active storage to avoid spill. Chelan PUD will regulate forebay levels, using active storage (the 36,400 acre-feet of storage between minimum and maximum forebay levels allowed by the FERC license) to minimize spill events from September through March, to the extent practicable under the Hourly Coordination Agreement.

4.1.6.2 Spill from Gates 2 Through 12

Chelan PUD will evaluate alternative spillway operations that use additional gates, using any of gates 2 though 12, to determine if TDG levels can be reduced without adverse effects on the upstream passage of adult salmon and steelhead. In 2002, limited testing was conducted of a spill configuration using gates 2 through 12. That testing indicated some potential to use that gate configuration to reduce TDG levels during high spill volumes (COE, 2003). The findings from the limited number of test conditions indicated a potential reduction in average TDG levels of up to 2% (Schneider and Wilhelms, 2005). Alternative spillway configurations will be used, as needed, in an effort to meet TDG numeric criteria.

4.1.7 Monitoring of Aquatic Life for GBT

Chelan PUD shall prepare and implement a study of GBT. Such study may be included as part of the biological study for the GAP. The proposed study plan (including scope) and study results will be coordinated with the RRFF and the HCP Coordinating Committee, subject to Ecology approval. The final study plan and final study report will be peer-reviewed by recognized experts selected by Ecology and Chelan PUD.

Chelan PUD will continue to evaluate the biological effects of TDG at the levels allowed in the Washington State Special Condition water quality standards for TDG (120% below dams and 115% in the next dam's forebay). Chelan PUD will use biological monitoring of salmonids, resident fish, and macroinvertebrates to assure that the Project's spill operations do not impair aquatic organisms by causing harmful levels of TDG that result in GBT symptoms.

Chelan PUD intends to continue to monitor GBT in salmonid smolts at the Rock Island Bypass Trap, and supplement the monitoring with sampling in the Rock Island reservoir. Similarly, Chelan PUD proposes to replicate and expand the studies of GBT in non-salmonid resident fish and aquatic macroinvertebrates that were conducted in 2001 and 2002. A study plan will be developed by Chelan PUD in consultation with the RRFF, and peer reviewed by outside experts selected by Ecology and Chelan PUD.

Chelan PUD will use the NOAA Fisheries GBT criteria for fish and macroinvertebrates sampled from the Rocky Reach tailrace and Rock Island reservoir as the biological objective for assuring that management of TDG has fully protected aquatic organisms. Of course, if GBT criteria are exceeded because of high TDG levels above numeric criteria arriving at the Rocky Reach Project from upstream dams, those GBT exceedances would not be considered a Rocky Reach Project effect.

4.1.8 Determination of TDG Compliance

In year five of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. If Ecology concludes, upon reviewing such report and other applicable information, that the Project complies with the applicable TDG numeric criteria, Ecology, in consultation with Chelan PUD, will determine which measures will be continued for the term of the New License to maintain such compliance. If Ecology concludes that compliance with the TDG numeric criteria has not been attained, Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD shall submit these reports to Ecology, members of the RRFF, and members of the HCP Coordinating Committee.

4.1.9 Actions if TDG Compliance Not Achieved

If compliance with numeric TDG criteria has not been achieved within five years of the effective date of the New License, and if determined necessary by Ecology based on an analysis of the water quality standard for TDG from the perspective of attainability and biological necessity, Chelan PUD shall continue efforts to comply with the numeric criteria for an additional period of time specified by Ecology, as provided in subsections 4.1.9.1 and 4.1.9.2.

4.1.9.1 Aquatic Life Adversely Affected

Upon receipt of the reports in section 4.1.8, Determination of TDG Compliance, Ecology will determine, based on the monitoring data and analysis provided by Chelan PUD, as may be supplemented by the RRFF and the HCP Coordinating Committee, whether aquatic life has been adversely affected, or insufficient information exists to conclude that it has not been adversely affected, by TDG resulting from ongoing Project operations. If Ecology determines an effect has occurred or insufficient information exists, then Chelan PUD will consult with Ecology and the RRFF to determine whether additional reasonable and feasible measures exist to further reduce TDG without significant adverse impact to fish species, and, if so, Chelan PUD shall begin, upon receiving any necessary approvals from FERC, implementation of such additional measures, which may include structural modifications.

If no reasonable and feasible TDG abatement measures are identified, Chelan PUD may petition Ecology to modify the standards to eliminate any non-compliance with such standards by filing a timely and scientifically robust petition. Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and the Section 401 Certification for the Project.

4.1.9.2 Aquatic Life Not Adversely Affected

If Ecology determines, in consultation with the RRFF and/or the HCP Coordinating Committee, that aquatic life has not been adversely affected by TDG resulting from ongoing Project operations, Chelan PUD shall consult with Ecology and the RRFF to determine if additional reasonable and feasible measures may exist to meet the TDG standards. If Chelan PUD concludes that no other additional reasonable and feasible measures exist to reduce TDG, Chelan PUD may petition Ecology to modify the standards to eliminate any non-compliance with such standards, by filing a timely and scientifically robust petition. Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and the Section 401 Certification for the Project.

4.2 Water Temperature Measures

Chelan PUD will continue monitoring water temperature in conjunction with its monitoring program for TDG, continuing through October, as its responsibility for temperature management at the Project. Also, the CE-QUAL-W2 model will be used to evaluate compliance with water quality criteria for years 1-5 of the New License. The model will be made available to EPA and other entities involved in the TMDL implementation program. Chelan PUD will participate and cooperate with the parties implementing the TMDL. Chelan PUD will also participate in tributary restoration planning and TMDL implementation planning to assure that opportunities to improve water temperature in the tributaries in conjunction with HCP tributary habitat projects are not lost.

4.2.1 Water Temperature Monitoring

Chelan PUD shall monitor hourly water temperatures in the forebay and tailrace annually from April through October for the term of the New License and any subsequent annual licenses, or until such monitoring is no longer required by Ecology, whichever occurs sooner. Chelan PUD shall also compile hourly water temperature data from the Wells dam tailrace for the term of the license or any subsequent annual licenses or until such data collection is no longer required by Ecology, whichever occurs sooner. Temperature data collected from April through October will be reported daily to regional databases, and included in an annual report that will be submitted to Ecology. Temperature data reported by Douglas PUD's Wells Project and data from the forebay of the Rock Island Project will also be included in the annual report.

Chelan PUD shall monitor water temperatures in the juvenile bypass system and upstream fishway for one year, unless Ecology determines, in consultation with the RRFF, that additional monitoring is required.

4.2.2 Temperature Modeling to Confirm Compliance

Chelan PUD shall collect or compile meteorological and water temperature data, including hourly water temperature data from the Wells Dam tailrace, for at least the first five years of the New License, such data shall be of sufficient quality to meet technical peer review group standards for running the CE-QUAL-W2 model. Using the data collected in the first five years of the New License, Chelan PUD shall run the CE-QUAL-W2 model to evaluate Project compliance with numeric temperature criteria. Chelan PUD shall evaluate, as feasible, the causes of any modeled exceedances. Chelan PUD shall provide a report to Ecology summarizing the results of the ten years of monitoring and modeling (first five years of the New License plus five previous years). The input data, modeling, and results shall be subject to peer review, by recognized experts selected by Ecology and Chelan PUD, and review by Ecology. Chelan PUD shall provide the results to Ecology in year six. If Ecology concludes that the Project is in compliance with numeric temperature criteria, the aforementioned monitoring and or analysis requirements may be reduced or eliminated by Ecology.

If the Project is out of compliance with numeric temperature criteria, Chelan PUD shall submit documentation to identify how it intends to come into compliance. However, in lieu of submitting such documentation, Chelan PUD may, upon a showing to Ecology that no reasonable and feasible improvements exist, request a change to water quality standards as appropriate and consistent with legal requirements. In evaluating whether all reasonable and feasible measures have been taken, Ecology will consider, among other relevant factors, information regarding biological impacts of temperature non-compliance caused by the Project and the extent to which the Project has achieved the Biological Objectives listed in Table 2-16. If Chelan PUD petitions Ecology to modify the standards to eliminate any non-compliance with such standards by filing a timely and scientifically robust petition, Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and, if granted, for submission of its proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for water temperature violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the Section 401 Certification for the Project.

4.2.3 Participation in Development and Implementation of EPA Water Temperature TMDL

Chelan PUD will participate in EPA Region 10's development of a TMDL for the Columbia River below the Canadian border. The TMDL is expected to address the water temperature effects of dams and other human actions, using model analyses. The most recent technical analysis made available by EPA indicates that the Rocky Reach Project will likely receive a load allocation that is equivalent to the Project's current effect on water temperature. The final load allocation will not be available until the TMDL is completed.

Chelan PUD shall maintain the calibrated CE-QUAL-W2 model and data used for the 10-year analysis and make the data available to EPA, Ecology, affected tribes and other entities involved in the TMDL implementation program. Chelan PUD shall participate and cooperate with the parties implementing the TMDL.

4.2.4 Participation in Tributary Water Temperature Improvement Planning

Chelan PUD, as part of its participation in tributary restoration planning and implementation under the HCP, will help identify opportunities to improve water temperature in the tributaries.

4.3 Project Operations

Chelan PUD shall continue to operate the Project under the Hourly Coordination Agreement and the Hanford Reach Fall Chinook Protection Agreement, or successor agreements to which Chelan PUD is a party. Operating the Project under the Hourly Coordination Agreement (attached as Appendix A) will result in continued minimization of forebay fluctuations, maintaining a stable reservoir beneficial to aquatic resources, recreation, and aesthetics. The Hourly Coordination Agreement also minimizes spill, thus minimizing TDG that could result from spill outside of the fish migration window. The Hanford Reach Agreement (attached as Appendix C) provides useable storage when needed to supplement flows to prevent stranding of fall Chinook in the Hanford Reach of the Columbia River.

4.4 Water Quality in Macrophyte Beds

Chelan PUD shall develop a one-year sampling program, in consultation with Ecology, to determine if the water quality criteria for DO, temperature, and pH are met in shallow water habitats, including macrophyte beds, in the Reservoir. If measurements reveal non-compliance with water quality numeric criteria or potential problems for designated uses, further sampling will be conducted, in coordination with the RRFF and Ecology, to determine the impact on aquatic habitat and associated biota. If such impacts are found to be significant and caused by the Project, Chelan PUD will consult with the RRFF and Ecology to determine what actions may be reasonable and feasible to protect aquatic life. This additional sampling shall be coordinated with any concurrent resident fish monitoring that may be developed by Chelan PUD, in consultation with the RRFF. If Project impacts to water quality in shallow water habitats, which also may have macrophyte beds, create conditions in which site-specific impact to resident or anadromous fish are attributed to direct adverse water quality effects, Chelan PUD will consult with the RRFF and Ecology to determine what actions may be reasonable and feasible to protect aquatic life.

4.5 Aquatic Invasive Species (AIS)

Within one year of the effective date of the new license, in consultation with the RRFF, Chelan PUD shall develop and begin implementation of an AIS Monitoring and Control Plan (Monitoring Plan) for the Project to monitor for presence of new AIS at or near Project facilities. The Monitoring Plan shall be coordinated with the Ecology's Freshwater Aquatic Weed Control Program. The Monitoring Plan and implementation shall include the following components: signage at boat launches and distribution of educational materials and boater questionnaires to voluntary participants at Rocky Reach Reservoir boat launch sites during the peak boating season (May 1 – October 30 each year) to increase boater awareness of the dangers of spreading AIS, including the methods one can take to decrease the spread of AIS (e.g., clean the weeds off the boat and drain the live well before going to a new waterbody); methodology and schedule of prevention, monitoring and control measures regarding the presence and movement of AIS at or near Project facilities; and an annual report of monitoring and educational activities conducted in the preceding year.

4.6 SPCC Plan and Columbia-Snake River Spill Response Initiative (CSR-SRI)

Chelan PUD shall operate the Project in accordance with the SPCC Plan, which shall be updated and revised periodically, as required in 40 CFR 112.5(b) and described in Section 2.6.

Chelan PUD shall continue to implement the applicable portions of the CSR-SRI for which it is responsible. The CSR-SRI was proposed to Chelan PUD in the fall of 2004. Chelan PUD understands this initiative to be a uniform means for hydroelectric projects to identify appropriate sites and subsequently implement additional spill abatement technologies for oil, as needed. To date, Chelan PUD has conducted a preliminary investigation of the sites discussed during the initial Ecology proposal. A feasibility study is underway, with the expectation that one site will be implemented in 2006. Chelan PUD is still not entirely certain of the scope and intent of this initiative, and further guidance will be requested from Ecology as needed. As the plan is further developed, it will be included as an appendix to the SPCC Plan.

4.7 Comprehensive Plans for Sensitive Aquatic Organisms

The Agreement and the HCP Agreement, with associated terms and conditions in the New License, provide the basis for compliance with the narrative components of the water quality standards as they relate to the protection of beneficial and designated uses and habitat. Seven species of fish, Chinook salmon, sockeye salmon, coho salmon, steelhead trout, bull trout, white sturgeon and lamprey, have been identified in the relicensing process and in ESA consultations as sensitive aquatic organisms. These species provide an appropriate bellwether for measuring whether the Project meets the water quality requirements to support the beneficial and designated use of habitat for fish rearing and migration. The needs of other resident fish will be evaluated by the RRFF. This Comprehensive Plan has chapters specific to each of these species, with Adaptive Management plans for the achievement of the Biological Objectives. The major biological objectives from the Comprehensive Plan are summarized below. This table is intended to be consistent with the tables in the respective fish management plans.

Table 2-16: Biological Objectives in the Comprehensive Plan to Support Beneficial and Designated Uses

Beneficial and Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Salmonid Migration	HCP Plan Species (Chinook, Steelhead, Sockeye, Coho) 91% Project Passage Survival	By 2013	Maintain Action.	Additional Tools (Bypass modifications, spill, other)	HCP Sections 3 and 5
Salmonid Harvest	HCP Plan Species No net impact (NNI) Hatchery Production Achieves 7%	By 2013	Maintain Action. Adjust 7% Production Level Every 10 Years	Modify hatchery facilities or use other method for artificial production (lake outplants)	HCP Sections 3 and 8
Salmonid Rearing	HCP Plan Species Tributary Fund Implements Habitat Improvements For NNI	By 2013	Maintain Action.	Modify type of projects funded	HCP Sections 3 and 7
Salmonid Spawning	HCP Plan Species Adult Passage Survival Included in 91% Project Passage Survival.	By 2013	Maintain Action.	Additional Tools	HCP Sections 3 and 5
Bull Trout Adult Upstream Passage	Take does not exceed 2% through the upstream fishway.	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Three Sections 4.1.1-4.1.3
Bull Trout Adult Downstream migration	Take does not exceed 5% passing through turbines; 2% passing through spillways; and 2% passing through the downstream bypass.	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Three Section 4.1.2
Bull Trout Adult Rearing in the Reservoir	Take does not exceed 2 fish for the fish predator control program.	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Three Section 4.1.2
Bull Trout Sub-adult Downstream migration	Take does not exceed limits when established by USFWS.	As recommended by the RRFF	Maintain Action. No additional action needed.	Pursue feasibility of Project operations of fishway/bypass if migration problems are identified	Chapter Three Sections 4.1.1-4.1.3

Table 2-16: Biological Objectives in the Comprehensive Plan to Support Beneficial and Designated Uses

Beneficial and Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Bull Trout Sub-adult Rearing in the Reservoir	Take does not exceed limits when established by USFWS	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s).	Chapter Three Section 4.1.2
White Sturgeon Natural Recruitment	Natural reproduction potential	Years 8-10, 13, and 18	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s).	Chapter Four Section 4.4
White Sturgeon Population at Carrying Capacity	Increase the white sturgeon population in the Reservoir through supplementation to a level commensurate with available habitat	Years 3-5, adjust stocking level; years 6 - 50	Maintain Action. No additional action needed.	RRFF to recommend stocking level, broodstock source. Develop and implement a plan, in consultation with the RRFF, to address identified problems	Chapter Four Sections 4.1-4.3; 4.6
White Sturgeon Harvest	Success in creating population with a stable age-structure that allows for appropriate and reasonable harvest rate	Years 20 - 50	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Four Sections 4.1-4.6
Pacific Lamprey Adult Upstream and Downstream Migration	Success similar to best experience at other similar projects (Adult upstream fish passage as defined by the RRFF)	By Year 5	Continuous reassessment every 10 years	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Five Sections 4.1.1-4.1.7 and 4.4
Pacific Lamprey Juvenile Downstream Migration	Maintain safe, effective, and timely volitional passage Criteria (as defined by the RRFF)	TBD by RRFF with 5 year review by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Five Sections 4.2.1-4.2.2 and 4.4
Pacific Lamprey Rearing	Avoid and minimize Project impacts on rearing habitat	By Year 5	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Five Sections 4.3 and 4.4

Table 2-16: Biological Objectives in the Comprehensive Plan to Support Beneficial and Designated Uses

Beneficial and Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Pacific Lamprey Overall Combined Goal	No Net Impact	TBD by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Five Section 4
Native, Non-Stocked Resident Fish Species	No negative impacts caused by ongoing Project operations.	Years 1-4, with subsequent surveys determined by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Chapter Six Section 4.2

4.8 Timeline for Water Quality Management Plan and Sensitive Aquatic Organism Comprehensive Plans

The PMEs detailed in this Section of the Water Quality Management Plan, combined with the plans developed for sensitive aquatic species and the HCP Agreement, constitute reasonable assurance that the Project will comply with all applicable water quality standards. In Ecology's 2003 water quality standards, the dam compliance section provides that:

> "If the department [Ecology] is acting on an application for a water quality certification, the approved water quality attainment plan may be used by the department in its determination that there is reasonable assurance that the dam will not cause or contribute to a violation of the water quality standards."

Although Chelan PUD believes the Project complies with all water quality standards at this time, the actions proposed for TDG and water temperature will serve to confirm that compliance has been achieved. In addition, implementation of the actions in the plans for sensitive aquatic species and continued implementation of the HCP Agreement over the next several years will provide additional assurance that the beneficial and designated uses of the Project's waters have been supported.

The year 2013 is a pivotal year for achievement of survival standards in the HCP Agreement, with likely conclusion of survival studies for yearling Chinook and steelhead in 2007, and determination of long-term requirements for fish passage spill by 2011. Similarly, the early results of implementation of a new Project license will potentially also be available by 2011. With these dates in mind, Ecology is basing its Section 401 Certification on implementation of a compliance schedule, including actions, review of results and documentation of compliance with water quality standards.

This schedule, Figure 2-31, incorporates checkpoints for three lines of evidence in support of beneficial and designated uses. These are: (a) achievement of HCP survival standards; (b) implementation of the plans for sensitive aquatic species; and, (c) monitoring and other actions under the Section 401 Certification. Milestones are identified in 2007, when issuance of the New License is expected, 2011, when it is expected that HCP survival standards will be achieved, Section 401 Certification actions, monitoring, and evaluation results will be available, and the implementation of the New License will be well underway. The timeline incorporates an additional window of time, until 2015, to track results and implement additional actions for water quality standard compliance, if necessary. If there is a failure to confirm compliance with water quality standards by 2015, then there is a two year window to pursue other means to achieve compliance within ten years of the issuance of the New License. If the New License isn't issued by 2007, then time schedules will be adjusted to match the timing of actions authorized by the New License. These other actions could include a process to modify the applicable standards through rulemaking or such alternative process that may otherwise be authorized under applicable state and federal law.

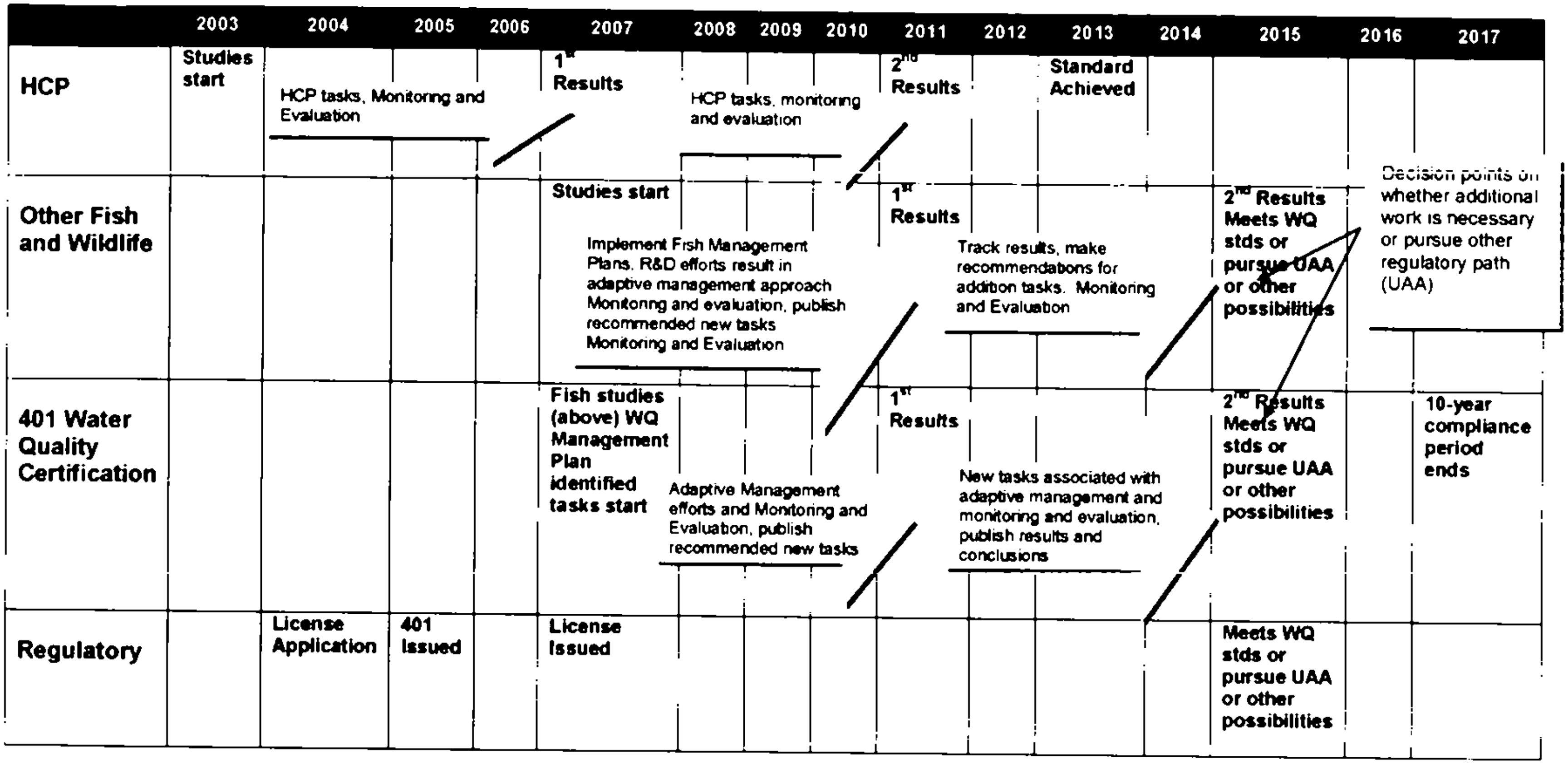


Figure 2-31: Draft Conceptual Approach and Timeline for Compliance with Water Quality Standards (Ecology, January 2005)

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APPENDIX A: MAJOR AGREEMENTS AFFECTING COLUMBIA RIVER HYDROPOWER OPERATIONS

MAJOR AGREEMENTS AFFECTING COLUMBIA RIVER HYDROPOWER OPERATIONS

Overview

ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145

October 20, 2004

CHELAN COUNTY P.U.D. POWER

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

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INTRODUCTION

There are 15 major dams on the 1,214 mile long Columbia River, including four storage facilities on the Upper-Columbia River in Canada. The Rocky Reach Hydroelectric Project, located on river mile 473.7, is the eighth dam upstream from the river's mouth and one of four non-federal installations located on the Mid-Columbia River (Figure 1). The operation of these Mid-Columbia dams is managed in accordance with international and regional agreements to address everything from flood control and environmental priorities to management of electric generation in a manner that ensures the most efficient use of coordinated resources. These agreements, in conjunction with the location and design of the run-of-river Rocky Reach dam, relegate it to a largely passive role in river operations. This paper provides an overview of these agreements and defines how Rocky Reach Project system operations are influenced by the requirements of each.

Figure 1: Columbia River Basin. Source: http://www.nwd.usace.army.mil/ps/colrvbsn.htm

COLUMBIA RIVER TREATY

Agreement Summary

The Columbia River Treaty was signed by Canada and the United States in 1961 after 15 years of preliminary investigation by an International Joint Commission and a year of international negotiations. Under the 60-year treaty, Canada agreed to provide 15,500,000 acre-feet of usable storage in the Columbia River basin in Canada for improving the flow of the Columbia River to maximize power generation and flood control. In return, the United States paid Canada to build the dams that would provide the flood protection that the U.S. would enjoy over the treaty's 60-year life. It also gave Canada title to half the power produced from downstream benefits of these Canadian Storage Projects. This aspect of the agreement is also commonly referred to as the "Canadian Entitlement." Though signed in 1961, the treaty was not ratified until 1964, due to a controversy between the federal Canadian government and the British Columbian provincial government over the province's decision to sell U.S. utilities the right to the first 30 years of downstream power benefits for a lump sum prepayment.[1] The first 30 years of "downstream benefit" sales began to expire in 1998, and British Columbia is now receiving the downstream benefits sales revenues for the remaining 30 years of the Treaty.

Parties

The Columbia River Treaty is carried out by the Canadian Entity (B.C. Hydro) and U.S. Entity (represented by the Corps of Engineers and Bonneville Power Administration). As a result of the Canada Treaty, BC Hydro developed three upper Columbia River Basin storage dams: Duncan (1967), Keenlyside (1968), and Mica (1973).[2] As provided as an option under the Treaty, in 1973 the United States built Libby Dam in Montana.

Operational Planning

A Columbia River Treaty Operating Committee comprised of representatives of the Canadian and U.S. Entities are charged with preparing and implementing "Assured Operating Plans" (AOP) and "Detailed Operating Plans" (DOP) for the Treaty Projects. Each year hydro computer regulations are run to determine operations for the Columbia River system. Under Treaty requirements, the U.S. and Canadian Entities use these regulations to develop the AOP plan six years in advance so that the downstream power benefits attributed to Canada can be determined. The plan is derived from the latest project data curves, and is used to estimate future changes in system load, flood control criteria, and other pertinent project data. The long-term AOP is then used to develop annual DOPs for use in actual operations that consider not only the AOP, but also current U.S. System loads and requirements and any changes agreed to by the U.S. and Canadian Entities. The DOP is the basis for weekly flow requests from the Canadian Treaty Projects.

[1] Canada sold its share of downstream power benefits for 30 years for $254 million to the Columbia Storage Power Exchange, a non-profit corporation of 11 Northwest utilities, including Chelan PUD.

[2] The fourth Upper-Columbia River dam, Revelstoke, was developed in 1984. It operates in balance with the Mica reservoir, but was not constructed under the terms of the 1964 Columbia River Treaty with the U.S.

Expiration and Renewal or Replacement Expectations

The Columbia River Treaty expires in 2024. After expiration, it is likely that the Canada Treaty would be extended or replaced by a similar agreement that includes calculation of downstream benefits.

Impacts on the Rocky Reach Project

The Treaty dams more than doubled the storage capacity of the Columbia hydroelectric system, greatly increasing the ability to regulate flows in the Columbia and the average annual generation at the five Mid-Columbia projects. Therefore, the Mid-Columbia projects, including Rocky Reach, and the federal mainstem Columbia projects are responsible for generating the Canadian and U.S. share of power benefits attributed to Treaty projects. Because of these obligations, the Canadian Treaty influences Rocky Reach Project from a power management perspective. In addition, like all U.S. installations on the Columbia River, Rocky Reach Project operations are impacted in the broadest sense by the Canadian Treaty, since seasonal flows are managed via the Canadian Storage projects. However, while the Canadian Treaty ensures that water resources can be available to downstream projects during times of seasonal demand, the monthly, weekly and daily operation of U.S. Projects downstream are dictated by additional agreements.

PACIFIC NORTHWEST COORDINATION AGREEMENT

Agreement Summary

Though river operators had attempted to coordinate the system during the 1950s, there had been no commitment to coordinate. The informal approach was not sufficient under the new Treaty, since the Canadian Entity wanted assurance that the downstream benefits of Canadian storage would be properly realized. In response, the Pacific Northwest Coordinating Agreement (PNCA) was established as an outgrowth of the Columbia River Treaty. This agreement enabled coordinated operations among federal, public and private owners.

The PNCA is based on the concept that the Columbia River basin power system is both hydrologically and electrically connected and that upstream storage operations therefore affect downstream generation. Under the PNCA, coordinated operation of hydroelectric facilities enables each individual generator to benefit more as part of a system than if it were acting on its own. Specifically, the parties to the PNCA coordinate the operation of their respective systems "so as to make available to each System its optimum Firm Load Carrying Capacity, to provide optimum Firm Load Carrying Capability for the Coordinated Systems, and, consistent with these objectives, to produce the optimum amount of usable secondary energy for each System."

The goal of the PNCA is to determine the aggregate firm load that can be met and then to carry this load in a manner that optimizes the hydroelectric resources of all parties. The agreement provides for power transfers that take advantage of the diverse advantages of projects throughout the system. Energy is exchanged to ensure that each party can maintain its firm energy load carrying capacity, and reservoir storage is employed for the benefit of the whole system. An extremely complex contractual agreement tracks each party's entitlement. Planning under the PNCA is based on the firm load carrying capability of all the parties, which is determined by calculating the amount of energy that the parties could provide during a period of adverse streamflows, or "critical period."[3]

Parties

The PNCA was signed in 1964 by the U.S. Bureau of Reclamation, the Bonneville Power Administration, the U.S. Army Corps of Engineers, and 15 public and private generating utilities. Its purpose is to govern the release of stored water at major U.S. generating facilities as if they belonged to a single owner in order to maximum usable energy (and therefore also to maximize the Canadian Entitlement). By 1992, the PNCA covered 120 hydroelectric projects in Washington, Idaho, Oregon, and Montana.

Operational Planning

Each year, an annual operating plan (commencing August 1 and concluding July 31) is drawn up for the entire Columbia River basin. The plan is developed by representatives from each

[3] The PNCA critical period is calculated on the projected recurrence of the lowest sequence of streamflows in the 50-year record used in PNCA studies. It used to be the adverse streamflows between September 1928 and February 1932. Currently the critical period is between September 1936 and February 1937.

participating utility under the auspices of the Northwest Power Pool, which also helps coordinate transmission concerns. Each PNCA party is responsible for submitting annual data about its projected load and hydraulic resources. For example, the Treaty Entities' DOP for the Canadian Storage Projects is considered as part of this broader management program for the entire river system carried out under the PNCA.

Studies conducted during plan development determine system firm energy load carrying capability (and required levels for each storage reservoir to assure meeting firm load); energy exchanges among PNCA participants; headwater benefits; and rights and obligations of each party for use of headwater project storage. During real-time operations, twice-monthly studies called the "Actual Energy Regulation" are used to change system operation and update draft rights in response to new streamflow forecasts.

Though the PNCA's purpose is coordinated use of resources for power generation, it operates within a framework of other obligations previously committed to by the various parties. Individual project licenses or federal authorizing legislation may impose requirements for use of a certain amount of each project's power, or could mandate water levels for navigation, flood control, water supply, recreation, and fish protection. In addition, other nonpower requirements (NPRs) can affect individual project operations as reservoir owners attempt to comply with regional processes such as the Northwest Power Planning Council's salmon recovery program. Individual projects may also be committed to other fish and wildlife agreements that require specific project operations. Power optimization takes place only after NPRs are accommodated. Non-power uses of the river are further discussed under the **2000 Federal Biological Opinion** described below.

Expiration and Renewal or Replacement Expectations

Execution of the original PNCA began in August 1964 and terminated on June 30, 2003. A new PNCA was signed on June 18, 1997 (with an implementation date of August 2003) and expires September 15, 2024. The 1997 PNCA agreement replaces the 1964 agreement and is substantively the same.

Impact on the Rocky Reach Project

The PNCA manages the system-wide use of monthly flows released from the Canadian Storage Projects. From a Mid-Columbia perspective, it directly impacts the timing of flows entering Grand Coulee Dam. Grand Coulee has sufficient storage capability to re-regulate flows available to the Mid-Columbia Projects, at least on a weekly and daily basis. The Rocky Reach Project receives released flows from Grand Coulee and is obligated to pass most of that water on a real-time basis, since the Rocky Reach is operated as a run-of-river project due to the relatively small storage volume available (Figure 2). With its limited storage, the Rocky Reach Project's operational flexibility is essentially limited to daily load following and can only alter flows on an hourly basis. While the PNCA establishes seasonal and monthly operating guidelines for each project's storage, for the Mid-Columbia Projects, day to day operations are dictated by the **Mid-Columbia Hourly Coordination Agreement** (described below).

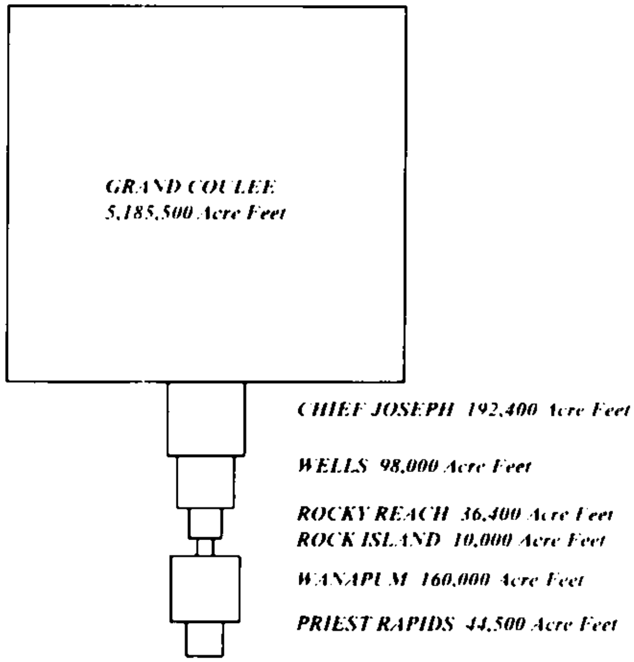

Figure 2: Mid-Columbia River Usable Storage

2000 FEDERAL COLUMBIA RIVER BIOLOGICAL OPINION

The 1993 listing of salmon and steelhead under the Endangered Species Act in 1993 set the stage for the most significant NPRs on the Columbia River. NOAA Fisheries' Federal Columbia River Power System Biological Opinion (FCRPS BiOp) was first issued in 1995, supplemented in 1998, 1999 and February of 2000. A new FCRPS Biological Opinion that superceded all of the previous FCRPS BiOps was issued in December, 2000.[4]

The 2000 BiOp found that the action proposed by the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and the Bonneville Power Administration (collectively the "Action Agencies") in their 1999 Biological Assessment of FCRPS operations was likely to jeopardize eight listed species of Columbia Basin salmon and steelhead and their designated critical habitats. To ensure that the FCRPS avoided jeopardy and protected critical habitat for the next ten years, the BiOp proceeded to set forth a "reasonable and prudent alternative", or (RPA) that included a program of operations at the FCRPS projects, non-hydro mitigation, and research, monitoring, and evaluation.

In general, the hydropower system actions included spillway improvements to facilitate increased spill without exceeding high TDG levels; improved flow management; improvements to juvenile and adult fish passage facilities; increased barge use and less truck use for summer migrant transport; and continued spill at collector projects for in-river migrants.[5]

To manage these hydro system operations and the other aspects of the RPA, NOAA Fisheries recommended a list of default actions. However, the RPA also provided an adaptive management framework in which the Action Agencies were allowed to substitute alternative actions if they were at least equally as effective as the replaced default action. Because of this, the default RPA actions in the 2000 BiOp do not represent the most current or accurate description of hydropower system operations. Instead, a Technical Management Team (TMT) is responsible for implementing the adaptive management of FCRPS operations.

Parties

The TMT consists of representatives from the federal fish managers (NOAA Fisheries and the U.S. Fish and Wildlife Service); affected states (Washington, Idaho, Oregon, Montana and Alaska); the federal dam operators or "Action Agencies" (the Bureau of Reclamation, the Bonneville Power Administration, and the U.S. Army Corps of Engineers) and 13 sovereign Indian tribes. It meets at least weekly during the migration season and provides a forum for the federal action agencies to receive and discuss recommendations from federal, state, and tribal fishery interests.

[4] NOAA Fisheries recently released a new FCRPS BiOp, but for the purposes of the 401 water quality certification and new license application, Chelan PUD is assuming that the FCRPS will be operating under the 2000 BiOp.
[5] 2000 FCRPS Biological Opinion, December 21, 2000. Section 9.1.2

Operational Planning

Through the TMT, the Action Agencies develop one and five-year water management plans and in-season action plans for the operation of the FCRPS. In addition, the TMT is the forum through which more detailed spring/summer and fall/winter action plans are developed that address spring runoff, summer flow augmentation, fall spawning, and winter incubation seasons. The TMT is the forum through which many nonpower requirements are established for FCRPS operations. The Rocky Reach Project is most affected by the annual Water Management Plan, which determines how flow releases from Grand Coulee will be managed. The Water Management Plan can be viewed at http://www.nwd-wc.usace.army.mil/tmt/documents/wmp .

Expiration and Renewal Expectations

On May 7, 2003, the District Court found the 2000 BiOp invalid because NOAA Fisheries could not provide reasonable assurance that habitat enhancements and upgrades to hatchery and dam operations to prevent jeopardy would actually occur. The biological opinion was remanded to NOAA Fisheries on June 2, 2003 so that the agency could consider revisions consistent with the Court's opinion. In the meantime, the Court decided that the 2000 BiOp should remain in effect. On September 9, 2004, NOAA Fisheries filed a revised biological opinion based on an updated proposed action by the Action Agencies. This biological opinion considers FCRPS dams part of the environmental baselines and concludes that continued operation of the system does not result in jeopardy to salmon if the Action Agencies implement recommendations amounting to approximately $600 million annually for the next 10 years.

NOAA Fisheries is currently seeking comments. The agency is obligated to use a final revised FCRPS biological opinion by November 30, 2004. In any event, the TMT will continue to develop Water Management Plans similar to those developed in the past since the 2004 revised BiOp does not significantly change the flow management principals adopted in the 2000 BiOp.

Impact to the Rocky Reach Project

The FCRPS biological opinion affects when and how water is released from Grand Coulee dam, which in turn determines the flow available to the Rocky Reach Project. FCRPS requirements can sometimes result in water levels lower or higher than ideal for Rocky Reach Project operations and obligations. However, the FCRPS biological opinion is focused on the operation of the federal projects. While it will impact system operations as a whole by identifying non-power priorities over the next ten years, Chelan County PUD has already committed to a 100 percent "No-Net-Impact" standard for salmon and steelhead migrating past the Rocky Reach and Rock Island dams via **Mid-Columbia Habitat Conservation Plans** (HCPs) (see below). The Rocky Reach and Rock Island HCPs each received a "no jeopardy" opinion from NOAA Fisheries in August, 2003. These Agreements will dictate Chelan PUD's obligations for endangered salmon and steelhead species.

MID-COLUMBIA HOURLY COORDINATION AGREEMENT

Agreement Summary

With normal maximum and minimum headwater elevations of between 707 and 703 feet mean sea level, the Rocky Reach Project's existing pondage capacity is a mere 36,400 acre feet of usable storage. Actual pondage drawdowns are avoided if possible because they lower operating head and reduce overall efficiency. In fact, the headwater elevation at the dam is within a foot of the normal maximum of 707 feet mean sea level approximately 70 percent of the time, and within two feet approximately 98 percent of the time.[6] If inflow to the project ceased, the reservoir's active storage would be sufficient only to run the plant for about two hours at average flow levels.

With such limited storage, the Rocky Reach Project's operational flexibility is limited to making the most of the water that is made available to it from Grand Coulee and the other upstream projects at any point in time. Therefore, the Rocky Reach Project is utilized for load following on a daily basis. Like seasonal, monthly and weekly flow decisions upriver, maximizing the use of the common resource to meet daily peak power demands necessitated a specific agreement. This time, the agreement would be among the parties in the Mid-Columbia dependent on Grand Coulee flow re-regulation and releases.

Prior to the Mid-Columbia Hourly Coordination (MCHC) agreement, each Mid-Columbia project peaked at the same time to meet the requirements of its power purchasers. As the Wells Project peaked, water then moved down to the Rocky Reach dam which was past peak demand by the time it arrived, resulting in spill at that Project. The Wells Project, on the other hand was left drafted with insufficient inflow to refill until the next day or late evening. This uncoordinated operation resulted in a number of problems, ranging from inefficient power management to an inability to meet certain flow requirements for fish. Mid-Columbia Project operators soon realized that independent daily operation of the projects did not result in maximum efficiency for the Mid-Columbia system as a whole.

The MCHC agreement sets forth terms for operating the five non-federal Mid-Columbia hydroelectric projects and two upstream federal projects, Grand Coulee and Chief Joseph, in a coordinated manner through the "middle" stretch of the Columbia River. Its objectives are to: (1) coordinate the hydraulic operation of the projects to optimize the amount of energy from the available water consistent with the needs to both (i) adjust the total actual generation to match the total requested generation, and (ii) operate within all parties power and non-power requirements; (2) provide flexibility and ease of scheduling generation for the projects through centralized coordinated scheduling and to provide flexibility in scheduling project generation;

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[6] The water level at the dam is most often between 706 and 707 feet with a 10-year average of 706.22 feet. During flood flows in the river, the reservoir can be raised as high as 710 feet at the direction of the U.S. Army Corps of Engineers to minimize the downstream effects of flooding. Although it may be drawn down to a normal minimum elevation of 703 feet, the forebay elevation is rarely below 705 feet.

and, (3) to minimize unnecessary project generation changes, including unit starts and stops to the extent this objective is consistent with the other objectives of the Agreement.[7]

Parties

The Mid-Columbia Hourly Coordination (MCHC or Hourly Coordination) agreement was first signed in 1974 as a one-year agreement. It was then renewed in a series of longer-term agreements. The current agreement was signed in 1997 and extends until June 30, 2017. The MCHC agreement was signed by the project owners (PUD's, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation), as well as all purchasers and participants of the projects, including the Bonneville Power Administration.

Operational Planning

Under Hourly Coordination, the system's federal and non-federal hydroelectric projects cooperate to efficiently manage Grand Coulee dam flow releases in order to meet the hourly demands of power load peaking while maintaining reservoir levels as stable and full as possible. The operating strategy under Hourly Coordination includes specific algorithms related to reservoirs for power production, spill prevention, and downstream reservoir refill. In general, spill is avoided unless necessary for fish survival, since it wastes energy. To prevent spill, the total system of projects attempts to meet load by drafting from the projects on the system which have some available storage.

Each dam on the system generates the most power when a release from Grand Coulee moves into its reservoir. The dam receiving the flow of water moving through the system generates as much power as possible, regardless of whether that particular project's customers are making the request at that time.

All power requests and non-power requirements are collected and tracked by a computer at Grant PUD's headquarters (Ephrata, Washington) which serves as "Central" to the operation. This computer optimizes movement of water to maximize generation while keeping the reservoirs as full as possible. Participants in Hourly Coordination make requests for power from the central system in real time. The computer assigns each project a desired generation level so that all load requests are satisfied in a manner that optimizes the combined operational efficiency of all of the participating projects. This means that a power purchaser with an agreement with Rocky Reach Hydroelectric Project may actually be receiving power generated at Priest Rapids Hydroelectric Project at a certain time of the day; the situation may be reversed when it is more efficient to a Grant County PUD's customer to receive power generated at the Rocky Reach dam. The programming for the computer has evolved through many years of refinements and is intended to achieve the highest overall level of efficiency for the participating projects.

While the MCHC allows participants to take advantage of these resource efficiencies in real time, it also ensures that each participant receives such power benefits in accordance with its rights to the generating assets. The computer keeps accounting records that recognize the varying generation obligations of each participating project. The computer's accounting

[7] 1997 Agreement for the Hourly Coordination of Projects on the Mid-Columbia River.

programming permits the shifting in time of actual generation from one project to another by means of "coordinated exchange." As a result, each project generates when and at the level that is most efficient, and the contractual obligations of each project are met in the most cost-efficient manner possible. A paper account tracks when a project is generating less or more power than it needs to fill its obligations. In any 24-hour period, each project will have generated more than its customers require at certain times of the day and less than its customers require at other times of the day. Over approximately a 24-hour period, there is essentially no discrepancy between a single project's actual generation under Hourly Coordination and the customer demand it has worked to fulfill.

In many ways, Hourly Coordination has been used not only to maximize the efficiency of power production, but also to manage flows and reservoir levels for protection of fisheries resources. Without the efficient dispatch of the water to minimize reservoir fluctuations, many more issues of stranding of both resident and anadromous fish would result. More stable reservoirs and stable and predictable flows allow the Mid-Columbia projects to better meet the needs of all competing uses of the reservoir in a more efficient manner. The leveling out of river fluctuations in particular has helped make possible the protection of spawning and incubating Chinook salmon in the Hanford Reach of the Columbia River, which is affected by flow releases from the Priest Rapids Hydroelectric Project (see **Hanford Reach Fall Chinook Protection Program** below).

Expiration and Renewal Expectations

The Mid-Columbia Hourly Coordination agreement has been renewed several times since the first agreement was signed in 1974. It is anticipated that another similar renewal would occur after the expiration of the current agreement in 2017.

Impact on the Rocky Reach Project

Beyond non-power considerations, the Mid-Columbia Hourly Coordination agreement has the most significant day-to-day impact on generation decisions at the Rocky Reach Project. As described above, the agreement ensures that power load peaking load requests are satisfied in a manner that optimizes the combined operational efficiency of all of the participating projects including Rocky Reach. It works to meet the daily demands of power load peaking while maintaining reservoir levels as stable and full as possible. Hourly Coordination also considers the non-power requirements of participating projects. The framework of Hourly Coordination is also used to enable fish protection operations for fall chinook salmon under the **Hanford Reach Fall Chinook Protection Program**. For example, when the Priest Rapids Project is operating to protect spawning in the Hanford Reach, other projects managed by Hourly Coordination, like Rocky Reach, are called upon to respond to Grant PUD's load requirements. During the juvenile rearing period, the projects upstream from Priest Rapids may be called upon to release flows from storage to maintain stable flows in the Hanford Reach.

HANFORD REACH FALL CHINOOK PROTECTION PROGRAM

Agreement Summary

In 1988, the Vernita Bar Agreement established certain minimum flow schedules to be maintained below the Priest Rapids dam with the cooperation of the operators of the upstream dams owned by Chelan and Douglas County PUDs and the Bonneville Power Administration during the spawning, incubation and emergence periods for fall chinook salmon. Joint operations under the Vernita Bar Agreement provided protective operations from the beginning of spawning activity (late October) through incubation until the end of the emergence period (late April – early May). The Vernita Bar Agreement is scheduled to expire in 2005, concurrent with the expiration of Grant County PUD's license for the Priest Rapids Project.

Research in the late 1990s found that flow fluctuations in the Hanford Reach can also adversely affect survival of fall Chinook fry during the first few weeks after emergence. Due to the extensive areas of backwater channels and shallow gravel bars in the Hanford Reach, changes in river elevation associated with daily and weekly flow fluctuations can cause fish to be stranded in areas where they are exposed to mortality from dewatering or heat stress and predation in shallow pools that become isolated from the main river channel. To address these issues, Chelan PUD has voluntarily cooperated with Grant County PUD, BPA and Douglas County PUD to enable Grant County PUD to operate the Priest Rapids Project to reduce flow fluctuations. These voluntary operations, initiated in 1999, included research covering alternative operating methods that has resulted in development of a long-term operating plan to improve and replace the Vernita Bar Agreement. This agreement is the Hanford Reach Fall Chinook Protection Program Agreement (Hanford Reach Agreement).

Parties

The Hanford Reach Fall Chinook Protection Program Agreement has been executed by most of the original parties to the Vernita Bar Agreement. In addition to Chelan PUD, this new agreement includes the Grant County PUD, the Bonneville Power Administration, Douglas County PUD, Washington Department of Fish and Wildlife, NOAA Fisheries, and the Confederated Tribes of the Colville Indian Reservation. It is the intent of the Parties that the Agreement replace the original June 16, 1988 Vernita Bar Agreement. The Hanford Reach Agreement became effective on April 19, 2004.

Operational Planning

The Agreement includes operations for the protection of fall Chinook salmon from the beginning of spawning through the early rearing period when Chinook fry are susceptible to stranding. In addition to measures carried over from the Vernita Bar Agreement to protect fall Chinook salmon during the spawning, pre-hatch, post hatch and emergence periods, the Parties will work together to provide minimum flows and regulate flow fluctuations in the Hanford Reach during the rearing period.

The Hanford Reach Agreement sets forth criteria and schedules that will be used by Grant County PUD in limiting flow releases from the Priest Rapids dam in order to minimize flow fluctuations and the stranding of salmon fry. It also establishes minimum flow guidelines to be used by BPA during the rearing period to assist Grant in controlling flow fluctuations in the Hanford Reach. In addition, Chelan and Douglas County PUDs must assist Grant County PUD by following certain reservoir operating procedures designed to reduce flow fluctuations during the rearing period.

The Monitoring Team established under the Vernita Bar Agreement continues under the Hanford Reach Agreement with additional duties. It conducts aerial surveys during the spawning period in addition to visual observations to help determine critical elevation levels to be protected by Priest Rapids flows. Beginning in 2011 and continuing through 2013, the Monitoring Team will develop a program to estimate rearing period fry losses.

Expiration and Renewal Expectations

The Hanford Reach Fall Chinook Protection Program will remain in effect for the remainder of the current license for Priest Rapids Project, any annual licenses, and the next new Priest Rapids Project license. Grant PUD filed the Agreement with FERC in October, 2004 as part of its license application. Parties may withdraw from the Agreement within 60 days of a denied rehearing request if FERC makes any material changes to the Agreement when issuing a new license for the Priest Rapids Project. The PUDs or BPA may also withdraw if FERC, the Washington Department of Ecology, or other regulatory authority imposes any measure inconsistent with this Agreement or additional obligations with respect to the protection of fall Chinook and other aquatic resources in the Hanford Reach of the Columbia River.

The Parties have agreed that for the next ten years, implementation of the requirements of Grant PUD, Chelan PUD, Douglas PUD and BPA under this Agreement constitute acceptable protection of fall Chinook in the Hanford Reach. After ten years, a Party may request that FERC impose additional or modified fall Chinook protection measures. However, until such new measure becomes effective, the Parties must continue to implement the Agreement.

Impact on the Rocky Reach Project

Chelan PUD has participated since 1988 in flow management operations for the protection of fall Chinook salmon that spawn in the Hanford Reach of the Columbia River. The new Agreement requires the same actions from Chelan PUD as the original Vernita Bar Agreement, but includes the additional time period that extends from April into June. This includes supporting Grant PUD's operations through Mid-Columbia Hourly Coordination and providing up to one foot of draft from Rocky Reach Reservoir.

MID-COLUMBIA HABITAT CONSERVATION PLANS

Agreement Summary

The Mid-Columbia Habitat Conservation Plans for the Rocky Reach, Rock Island and Wells Hydroelectric Projects are 50-year agreements that commit the Chelan and Douglas Public Utility Districts (PUDs) to a 100 percent "No-Net-Impact" (NNI) standard on salmon and steelhead migrating past the Projects. The five species of Columbia River steelhead and salmon covered under the HCPs include spring and summer/fall chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*) (collectively, the Plan Species).

The HCP provides that NNI on salmon and steelhead runs will be achieved on a specific schedule and be maintained for the duration of the agreement. NNI has two components: 1) 91-percent combined juvenile and adult Project survival achieved by Project improvement measures implemented within the geographic area of the Project; and 2) 9-percent compensation for unavoidable Project mortality provided through hatchery and tributary programs, with 7-percent compensation provided through hatchery programs and 2-percent compensation provided through tributary programs. Since technologies to measure the 91 percent goal depends on development of new technologies to track adult fish survival, parties to the HCP decided that a "juvenile project survival" standard of 93 percent could be used to determine that the HCP survival standard has been achieved. The Parties also determined that if juvenile project survival cannot be measured, then a juvenile dam passage survival standard of 95 percent could be used.

One purpose of the HCP was to secure an incidental take permit from NOAA Fisheries' under the Endangered Species Act for operation of the Rocky Reach and Rock Island dams. In addition to the ESA, however, the HCP addresses Chelan PUD's obligations to protect Plan Species and mitigate for any potential Project-related impacts pursuant to the Federal Power Act, the Fish and Wildlife Coordination Act, the Pacific Northwest Electric Power Planning and Conservation Act, the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act, and Title 77 of the Revised Code of Washington.

Parties

The plans have been signed by NOAA Fisheries, the U.S. Fish and Wildlife Service (USFWS), the Washington State Department of Fish and Wildlife, the Confederated Tribes of the Colville Reservation and the PUDs (Douglas PUD for the Wells HCP and Chelan PUD for the Rocky Reach and Rock Island HCPs). An HCP Coordinating Committee made up of these Parties has been established to oversee HCP activities and to evaluate whether the NNI standard has been achieved. A Hatchery Committee and a Tributary Committee have also been established to help coordinate implementation of the hatchery and tributary components of the agreements.

Operational Planning

The HCP will be implemented in three phases that provide for adjustments to ensure biological success. Under Phase I of the HCP, Chelan PUD began to implement juvenile and adult operating plans and criteria during the 2004 migration season. Following the completion of three years of juvenile survival studies, the HCP Coordinating Committee will determine whether the pertinent survival standard has been achieved for each Plan Species. If a standard has not been achieved for a particular Plan Species, Chelan PUD would proceed to Phase II, under which it has agreed to develop and implement additional measures to meet the pertinent survival standard. The HCP Coordinating Committee will decide on additional tools for Chelan PUD to implement in order to achieve the survival standard.

The HCP Coordinating Committee will select additional tools based on the likelihood of biological success, implementation time, and cost-effectiveness (if alternatives are comparable in their biological effectiveness). Chelan PUD will continue to implement Phase II until the standards are met or until the Coordinating Committee determines the standards are impossible to achieve. If the survival standard is achieved at the end of Phase I or anytime during Phase II, Chelan PUD has agreed to maintain the survival standard for the term of the HCP. Chelan PUD proceeds to Phase III upon a determination by the HCP Coordinating Committee that it has verified compliance with the combined adult and juvenile survival or juvenile survival standard of 93 percent; or has evaluated juvenile Project survival between 91 and 93 percent; or has measured or calculated 95-percent juvenile dam passage survival. Phase III indicates that the appropriate standard has either been achieved or is likely to have been achieved and provides additional or periodic monitoring to ensure that the survival of the Plan Species remains in compliance with the survival standards for the term of the HCP.

Expiration and Renewal Expectations

The HCP sets a requirement for Chelan PUD to achieve the NNI standard by 2013. If Chelan PUD does not meet the standard in the required time frame or the species are not rebuilding and the Project is a significant factor in the failure to rebuild, the agreement provides a mechanism for the fisheries parties to withdraw and pursue other legal remedies. If the HCP terminates early, Chelan PUD will continue to implement the last-agreed-to measures until the Commission orders otherwise, and the USFWS and NOAA Fisheries may exercise their reserved authorities under Section 18 of the FPA for salmon and steelhead.

Impact on the Rocky Reach Project

Operations for the Rocky Reach Project under the Rocky Reach HCP utilize the juvenile fish bypass system (installed in 2003) as the primary method for passing juvenile salmonids. Under the HCP, Chelan PUD continuously operates the juvenile fish bypass system from April 1 to August 3 each year. Spill levels for 2004 through 2006 have been set by the results of a 2003 juvenile fish passage efficiency study. Due to the performance of the bypass system in passing yearling Chinook and steelhead, spill as an additional tool is not needed for these species, as specified in the HCP. Spills at reduced levels will continue in passing sockeye and subyearling Chinook salmon. Spill, when required, is provided over a time period that encompasses 95 percent of each species' downstream migration. Spill levels are 24 percent and 9 percent of the estimated daily average flow for sockeye and subyearling Chinook, respectively. Survival studies will be conducted during this time to assess whether Chelan PUD is meeting or exceeding its HCP survival standards. In 2007 and beyond, spill, if required, will supplement the bypass system as necessary to achieve the survival standards.

CONCLUSION

The operation of the Rocky Reach Hydroelectric Project is highly dependent on the operation of both upstream and downstream projects on the Columbia River because of both hydrological realities and negotiated agreements designed to benefit the entire system. The Mid-Columbia dams use and reuse the same water and, like "links on a chain", are intrinsically interdependent on one another. Within the regional framework, the Rocky Reach Project plays a specific role due to its characteristic abilities and limitations. As a run-of-river project, Rocky Reach receives water from upstream projects, generates power and passes water downstream with only minimal storage capability. This minimal capability is enough to assist downstream projects at critical times for protection of spawning habitat in the Hanford Reach for limited periods of time. It is also sufficient for Rocky Reach to be a primary responder for regional load following. The operational restrictions placed on Grant PUD projects through the Hanford Reach agreement shift the burden of regional load following even more heavily onto the Rocky Reach, Rock Island and Wells Projects. The main role of the Rocky Reach Project is to utilize generation ramping to meet the burden of regional load following. Despite the system's heavy reliance on Rocky Reach's generation ramping capability, the Project manages to perform this role with the second smallest reservoir on the system and a typical reservoir fluctuation of only two feet. Rocky Reach therefore plays a critical role in the regional effort to operate the Columbia River system in a manner that protects fish while maintaining the unique ability of hydropower to follow regional demand.

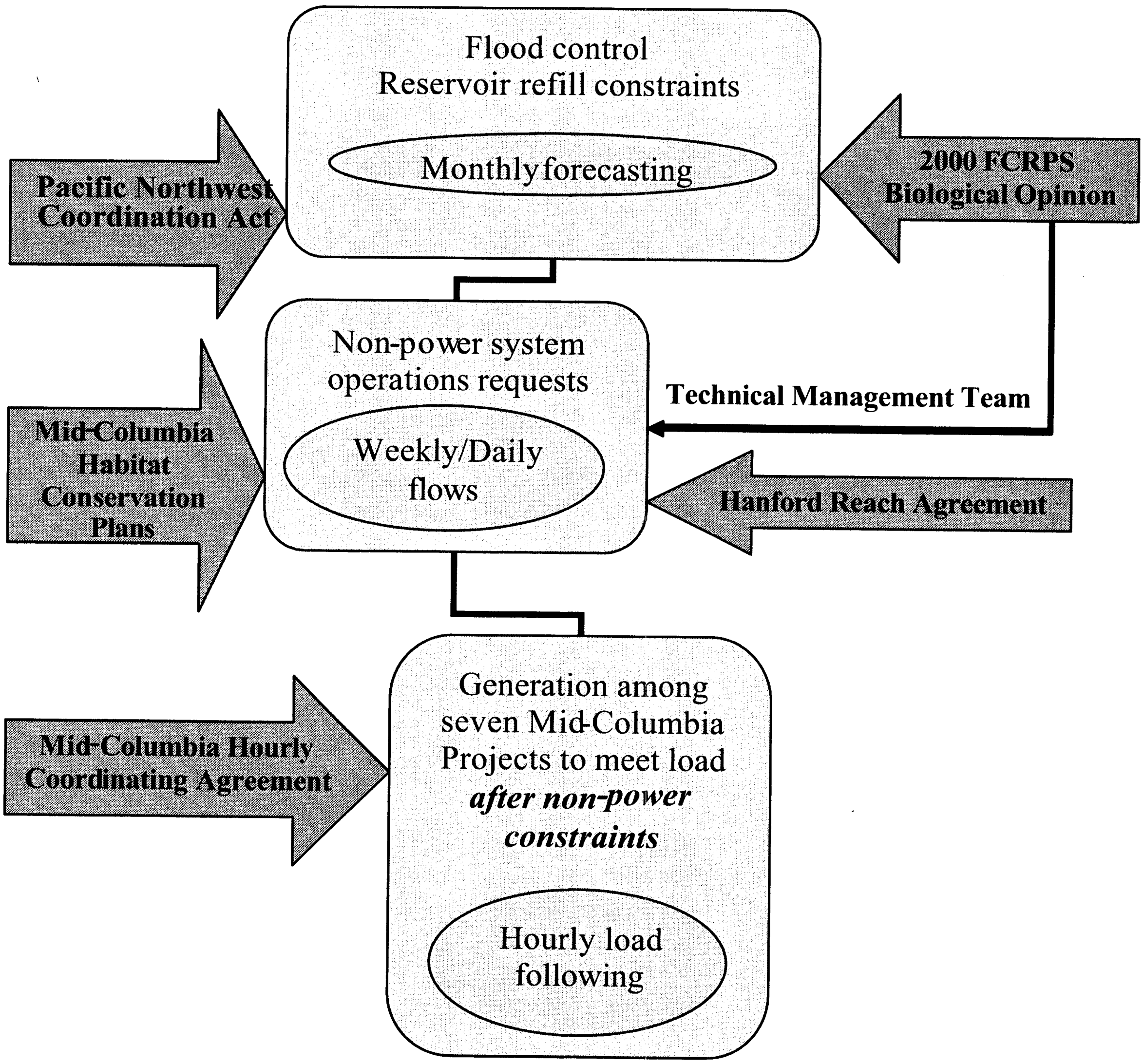

Figure 3: Regional Hydropower Operations Interaction

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APPENDIX B: BACKGROUND INFORMATION ON WATER RESOURCES AND WATER QUALITY FOR THE COLUMBIA RIVER SEGMENT INCLUDING THE ROCKY REACH PROJECT (FROM THE FINAL PDEA, ROCKY REACH HYDROELECTRIC PROJECT)

current Rocky Reach License Article 34. This operation occurs infrequently and has not been implemented in the past 20 years.

Water Use and Quantity

Project Water Rights

In western states, water rights are based on the principle, "first in time, first in right," meaning older claims have precedence over newer ones. In the state of Washington, the Department of Ecology (WDOE) has jurisdiction over issuing permits for water use on the Columbia River.

Chelan PUD currently holds several water rights for various uses. First, it holds two surface water rights of 185,300 cfs and 24,700 cfs for power purposes. A reservoir permit for the Project allows 390,000 acre-feet of water to be impounded. Chelan PUD also holds several other water rights for fish propagation, irrigation, domestic water supply and heat exchange.

In addition to the surface and reservoir rights, Chelan PUD holds 12 groundwater withdrawal permits that cover numerous wells, which are used for domestic and irrigation purposes. Several of the wells are used on a seasonal basis, while others operate year-round. The quantity of withdrawal that is covered by these permits ranges from 5 gpm from a single well, to 7,200 gpm (total) from multiple wells.

Consumptive uses of Project waters

Irrigation

Orchards with apple, cherry, peach, apricot and other fruit trees represent the primary agricultural activity in the Columbia River valley and its tributary valleys throughout North Central Washington. All orchards throughout the area are reliant upon a source of irrigation water for their existence. Within the Project area, irrigation withdrawals constitute the largest segment of consumptive water use. The irrigation season begins in late March or April and continues through October. Peak irrigation use occurs in July and August when temperatures in the region are highest.

Annual irrigation water rights provide for the withdrawal of up to 313 cfs from Rocky Reach Hydroelectric Project reservoir. There are no practical means of determining the level to which these rights might be exercised in a certain year. Because water rights represent maximum withdrawals, it is reasonable to assume that actual annual withdrawals are less than established water rights.

The narrowness of the Columbia River valley through the Project area restricts space available for substantial additions to orchards or other irrigated agricultural activities. Current trends indicate there will be some reduction in irrigated agriculture. Replacement of orchard with residential development will result in a lowering of consumptive withdrawals from Project waters. The majority of consumptive water use within the Project area is non-Project related; consumptive use that is Project related is primarily associated with irrigation of parks.

Domestic

Domestic water supply withdrawals of Project surface waters are limited Some withdrawals for use in irrigating yards and gardens may occur Water withdrawals for drinking water are primarily from groundwater sources, although one municipal domestic water right has been issued. According to WDOE, domestic water rights for groundwater within the Project area are 64 cfs (Chelan PUD, 1991) These domestic water rights are allocated to non-Project related entities. No significant change in the use of Project waters for domestic water supply is anticipated.

Commercial and Industrial

Commercial and industrial use account for only 10 5 cfs, and stockwatering use is at 3 cfs (Chelan PUD, 1991). The majority of this volume is allocated to non-Project related entities

Non-consumptive uses of Project waters

Fisheries and Natural Resources

Chelan PUD holds four water rights for fish propagation – one surface water right for 8 cfs and three groundwater rights for a total of 25,140 gpm, equivalent to 40,539 acre-feet/year (WDOE, 1999).

Power Production

As described earlier, the Project holds two surface water rights for power production purposes – one for 185,300 cfs and another for 24,700 cfs. A reservoir permit allows impoundment of up to 390,000 acre-feet of water (WDOE, 1999).

Existing Maximum Flow Releases and Water Levels

Rocky Reach Hydroelectric Project dam has an average gross head of 88.6 feet (range of 71.4-95.2 feet) and a hydraulic capacity of 201,000 cfs. The Project reservoir is controlled within a 4-foot range from elevation 703 to 707 feet and has 36,400 acre-feet of usable flood control and operations storage at a river flow of 100,000 cfs. The Project does not have any minimum flow requirements.

Water Quality

Applicable Water Quality Standards

The Columbia River at the Project is classified under current Washington State water quality standards as a Class A water body. Water quality of this class must meet or exceed the requirements for all or substantially all uses. The characteristic uses for the Project segment of the Columbia River include propagation of fish and wildlife (including salmonid species), water supply (domestic, irrigation, industrial), recreation, navigation and commerce (including power generation). Table 1 summarizes the standards for Class A water quality.

Table 1. Summary of WDOE water quality standards

Parameter	Class A
Fecal Coliform	Not to exceed geometric mean of 100 col./100 ml, less than 10% of all samples exceeding 200 col./100 ml
Dissolved Oxygen	Must exceed 8.0 mg/l
Total Dissolved Gas	Not to exceed 110%[3,4]
Temperature	Must not exceed 18.0°C[1]
pH	Within 6.5 - 8.5[2]
Turbidity	Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more

[1] Human activities shall not result in more than a 0.3°C increase when water temperatures naturally exceed this maximum criteria. Maximum incremental increase for non-point sources is 2.8°C.
[2] Human caused variation must be within 0.5 units.
[3] Does not apply when stream flow exceeds the 7-day, ten-year frequency flood. (7Q10)
[4] Special condition for this reach of the Columbia River establishes TDG levels above 110% for spill for fish passage (tailrace average of 12 highest hours = 120%, no single hour > 125%)
Source: WAC 173-201 A-030

Water quality in the Columbia River in and near the Project area has met all water quality standards for Class A waters except for the numeric criteria for TDG and temperature on a seasonal basis. Table 2 lists documented historical exceedences of state water quality criteria in the Columbia River in and near the Project area. This table represents exceedences from all sources and should not be construed as a representation of water quality numeric criteria exceedances attributable to the Rocky Reach Hydroelectric Project.

Table 2. Exceedences of water quality numerical criteria in the Columbia River near the Rocky Reach Hydroelectric Project area.

Parameters Exceeding Numerical Criteria	Monitoring Station Location and Study Timeframe	Total Exceedences during Study Timeframe	
Total Dissolved Gas >120% TDG (Average of Highest 12 Hours in Tailrace)	Rocky Reach Dam Tailrace (1997-2002)[1] (TDG measured is from all sources, including upstream dams.)	April: May: June: July: August: March:	7 days 31 days 51 days 13 days None Data not available
Dissolved Oxygen 8 mg/l	WDOE ambient monitoring station (RM 450.9) (1971-1990)[2]	1971: 1 event [below criterion (7.9 mg/l)]	
Temperature >18.0°C[3]	WDOE ambient monitoring station (RM 450.9) (1971 - 1990)[2]	July: August: September October:	10 days 16 days 12 days 3 days
	Rocky Reach Tailrace (1997 - 2002)[1] (using 15 days of data for August 2001)	July: August:	13 days 119 days

Source: [1] Chelan PUD
[2] USGS Database station 12462600 Columbia River below Rock Island dam, Washington (205 grab samples from Columbia River at RM 450.9 - EPA Storet, WDOE Station 1744A070 Columbia River below Rock Island dam)
[3] The water quality numeric criteria for temperature for a Class A water body is either 18.0°C or no more than a 0.3°C increase over natural. Therefore, natural conditions may account for some of the temperatures above 18.0°C referenced in Table 2 and may not, in fact, involve an exceedence of applicable numeric temperature criteria.

The WDOE 303(d) list, which is used to identify statewide water quality concerns, recognizes three water quality concerns within the Project area waters. Currently, the segment of the Columbia River that includes the Rocky Reach Hydroelectric Project (portions with Water Resource Inventory Areas 45-47) has sites that are listed for TDG, temperature and water column bioassay. The 2002/2004 303(d) candidate list divides water bodies into five categories: 1) meets standards for all parameters tested; 2) waters of concern, where there is some evidence of a water quality problem, but not enough to require production of a TMDL at this time; 3) no data; 4) polluted waters that do not require a TMDL; and 5) polluted waters that require a TMDL.

There are five sites on or near the Rocky Reach Hydroelectric Project reservoir that are listed as impaired in the 2002/2004 candidate list (listing ID Nos. 36398, 36399, 8429, 8962, and

11287). These listings include three category 5 listings, two for TDG and one for temperature; and two category 2 listings, one for temperature and one for water column bioassay. The listing for water column bioassay is outside the Rocky Reach Hydroelectric Project boundary (about three miles downstream from Rocky Reach Hydroelectric Project dam) and recent samples (2001) "show no evidence of toxicity to Daphnia pulex" (WDOE 303(d) listing ID No 8962).

The WDOE and Region 10 EPA are in the process of developing TMDLs to address the water quality impairments for TDG and temperature on these and other segments of the Columbia River. There are four listings for the Rocky Reach Hydroelectric Project reservoir in category 1 (meets standards), which were for the parameters of ammonia-N, dissolved oxygen, fecal coliform, and pH (listing ID Nos. 11284, 11285, 16837, and 11286).

Existing Water Quality Data

Historical information on water quality that is applicable to the Rocky Reach Hydroelectric Project reservoir and its major tributaries is available from several sources, including recent water quality studies within the Project area (Appendix A), comparable studies at Wells Hydroelectric Project dam conducted by Douglas PUD, and recent data from a monitoring station near the Rock Island Hydroelectric Project. These studies and data show that recent water quality readings within the Project area are comparable to concurrent readings for the Wells and Rock Island hydroelectric projects. For this reason, historical data from the latter projects are considered to accurately reflect historic conditions within the Rocky Reach Hydroelectric Project area, where no historic data exists for some parameters of water quality.

Data from WDOE's water quality monitoring station (No. 21540000 44A70) just downstream of the Rock Island Hydroelectric Project dam are considered to provide the most comprehensive, long-term, historical characterization of water quality relevant to the Rocky Reach Hydroelectric Project. The period of record for monthly grab-sample water quality data from this WDOE station is 1977 to 1990. Table 3 provides average values for monthly water quality data from this source.

Chelan PUD has conducted water quality surveys within Rocky Reach Hydroelectric Project reservoir targeting specific water quality concerns; some of these studies include annual monitoring over multiple years. In coordination with the COE, Chelan PUD has monitored water temperature at the fishway since 1965 and TDG in the forebay since 1982. More intensive monitoring of temperature and TDG was initiated in 1996. The monitoring data sets consist of daily temperature only (1965 - 1981), hourly temperature and TDG in the forebay (April - August, 1982 - present), and hourly TDG and temperature below the tailrace of the Rocky Reach Hydroelectric Project dam (April – August, 1997 - present). TDG monitoring with improved equipment and calibration procedures during the spring and summer seasons was initiated in 1995 for the forebay and 1997 for the tailrace (McDonald and Priest, 1997; Koehler and McDonald, 1997, 1998).

Douglas PUD has conducted comparable studies at Wells Hydroelectric Project dam, which are the headwaters to the Rocky Reach Hydroelectric Project reservoir. Transparency data are available for both the Rocky Reach Hydroelectric Project dam forebay and the Wells Hydroelectric Project dam forebay (1993 – present) as secchi disk readings from the fishways.

Additional information sources include studies done for site-specific projects, including the Daroga Park development (Johnstone and Mih, 1987) and the license amendment application to raise the Project reservoir pool elevation (Chelan PUD, 1991). Regional data for the mid- and upper-Columbia River were also reviewed to provide background descriptions of water quality.

Table 3. Average values for water quality monthly grab samples at WDOE monitoring station below Rock Island Hydroelectric Project dam, 1977-1990

Month	Mean Flow* (cfs)	Mean Temp. (C)	Dissolved Oxygen (mg/l)	Oxygen Saturation (%)	pH	Turbidity (NTU)	Conductivity (UMHO)	Fecal Coliform (MFM-FCBR) per 100 m/l)	Total Suspend Solids (mg/l)	NH_3+NH_4 N Total (mg/l)	Unionized ammonia (mg/l)	NO_2 Nitrite (mg/l)	NO_3 Nitrate (mg/l)	NO_2+NO_3 N-Total (mg/l)	Total Phos-phates (mg/l)	Dis-solved Ortho P (mg/l)
January	135,425	3.6	12.9	98.3	7.9	2	156	12	3	0.02	0.0001	0.010	0.119	0.146	0.033	0.015
February	136,245	4.3	13.5	104.4	7.8	4	165	3	11	0.02	0.0001	0.010	0.176	0.130	0.035	0.018
March	121,100	8.4	13.9	113.0	8.1	3	166	6	33	0.03	0.0003	0.010	0.160	0.188	0.038	0.009
April	132,000	7.6	13.7	116.2	7.9	3	167	8	5	0.03	0.0001	0.010	0.178	0.135	0.035	0.017
May	156,758	10.5	13.1	118.5	8.0	4	156	44	13	0.05	0.0001	0.010	0.160	0.118	0.038	0.010
June	160,567	14.3	11.8	116.7	8.0	5	130	80	10	0.03	0.0002	0.010	0.105	0.057	0.042	0.013
July	141,327	17.6	11.2	118.7	8.0	3	135	124	12	0.04	0.0003	0.010	0.082	0.065	0.029	0.015
August	113,200	19.1	10.2	111.4	8.0	3	140	86	10	0.02	0.0010	0.010	0.089	0.082	0.025	0.017
September	106,745	19.2	10.1	110.3	8.2	2	141	61	5	0.03		0.010	0.117	0.228	0.036	0.017
October	100,979	16.6	10.4	108.1	8.1	2	147	17	4	0.03	0.0006	0.010	0.150	0.137	0.030	0.015
November	103,443	11.8	10.7	99.8	7.9	2	146	33	6	0.02	0.0003	0.010	0.207	0.135	0.035	0.013
December	122,269	6.8	11.4	94.5	7.7	2	161	22	6	0.02	0.0002	0.010	0.163	0.183	0.046	0.015
# Months Sampled		147	147	147	147	142	147	145	142	140	13	82	78	64	136	139
Mean		11.6	11.9	108.8	8.0	2.9	151	40	10	0.03	0.0003	0.010	0.142	0.129	0.035	0.014
Maximum		36.0**	16.3	145.8**	9.2	11	202	700	300	0.26	0.0010	0.010	0.630	0.420	0.140	0.060
Minimum		0.8	7.9	76.5	6.7	1	96	0	1	0.00	0.0001	0.010	0.010	0.010	0.010	0.000
St. Dev. for Sample		6.1	1.7	12.6	0.4	2	20	107	28	0.03	0.0003	0.000	0.098	0.083	0.020	0.009

Notes: *Flow is computed as mean of daily values at which samples were collected.
**These data points may be inaccurate due to instrument error.

Major Tributaries to the Project

The two major tributaries within the Rocky Reach Hydroelectric Project area are the Entiat and Chelan rivers. WDOE and others have conducted water quality studies on these streams.

The Entiat River enters the Columbia River at river mile 483. The initial assessment for the Entiat River by the WDOE (1995) indicates that it occasionally does not meet numeric water quality requirements for pH and temperature. The Entiat River has a category 4 listing for water temperature and category 2 listings for water temperature, TDG and pH.

The Chelan River watershed includes the 50-mile-long Lake Chelan and 4-mile-long Chelan River, which enters the Columbia River at river mile 503. Several water quality reports have been developed for the Chelan River watershed over the years. Lake Chelan has been classified as an ultra-oligotrophic (low biological productivity and high water clarity) lake. Water quality in the lake is generally considered excellent. Documented water quality problems in the lake have included elevated bacterial levels near water supply intakes, apparent metals toxicity in Railroad Creek, and elevated pesticide residues in lake sediments and fish tissue (Chelan PUD, 1998). The Chelan River has category 5 listings for pesticides in fish tissue (DDD, DDE, DDT, BHC and PCBs) and for water temperature, category 2 listing for pH and temperature. The Chelan River is listed as category 1 (meets standards) for a number of other pesticides and chemicals that can concentrate in fish tissue and the water quality parameters of ammonia-N, dissolved oxygen, and fecal coliform.

Rocky Reach Hydroelectric Project Reservoir

Nutrients

The nutrient balance within an aquatic system is an important determinant of the biological and aesthetic quality of an aquatic environment. Nitrogen and phosphorous are the two primary nutrients of concern. Generally, the mid-Columbia River is a low nutrient system; the large volume of water flow and the regional geology, combined with a mostly rural watershed, are factors affecting nutrient levels.

Sources of nitrogen in a water body include precipitation, internal "fixing" by plants, and surface and groundwater drainage. Several forms of nitrogen in aquatic systems include ammonia (NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-) and organic compounds. The availability of various nitrogen forms affects the community composition and abundance of aquatic life. The concentrations of the various nitrogen compounds in aquatic systems usually follow a general seasonal pattern. The biological uptake of nitrogen by aquatic organisms, such as phytoplankton and aquatic plants, lowers the nitrogen level in spring and summer within the photic zone (solar light penetration depth). Releases from the sediments, inflow and precipitation replenish nitrate and sometimes ammonia concentrations during the fall, winter and spring runoff (Wetzel, 1983).

The range of total nitrogen (NH_3^+ and NH_4^+) reported by WDOE at the Rock Island Hydroelectric Project monitoring station is 0 – 0.26 mg/l; average total nitrogen for 1977 through 1990 was 0.03 mg/l (Table 3). Total nitrogen is typically highest in the spring (due to runoff contribution from the watershed) and is low again by August due to primary production utilization. Nitrates (NO_3) are highest in the winter months and at seasonal lows in July and August. Average nitrate level is 0.142 mg/l. Johnstone and Mih (1987) reported comparable nitrate levels for samples collected in the vicinity of Daroga Park in summer 1986 (0.05 mg/l to below detection limit for river and embayment). Nitrate levels in the Daroga lagoon were also low but displayed some localized spikes, possibly due to either groundwater infiltration from fertilizers or trout food in the trout pond. Based on total nitrogen and nitrate levels, the Rocky Reach Hydroelectric Project reservoir would be classified as oligo-mesotrophic (low to moderately low productivity).

Phosphorous can be a powerful nutrient for control of algal and aquatic plant growth, and often limits primary productivity in rivers and lakes (APHA, 1985). Phosphorous sources for aquatic bodies are surface runoff (erosion of soils), internal release from sediments and plants, and anthropogenic contributions.

Total phosphate levels below Rock Island Hydroelectric Project dam, as reported by WDOE, ranged from 0.010 to 0.140 mg/l during 1977 – 1990 (Table 3). The average sample value was 0.035 mg/l total phosphates. Dissolved orthophosphates ranged from 0 mg/l to 0.060 mg/l; average sample value was 0.014 mg/l. As for nitrogen, Rocky Reach Project area waters are oligo-mesotrophic based on phosphates (average .008 mg/l for oligotrophic, .027 for mesotrophic) (Wetzel, 1983). Phosphate concentrations in Daroga Lagoon reported by Johnstone and Mih (1987) as part of development of a swim beach ranged from 0.017 to 0.020 mg/l; these levels indicate phosphate is not a water quality concern within the lagoon. Reported phosphate levels in the Daroga embayment fluctuated more widely (0.015 mg/l to 0.046 mg/l).

Turbidity, light and transparency

The Columbia River generally has low turbidity. The Project area consists of igneous and metamorphic rock at the base of the Cascade Mountains to the west, basaltic material from the lava flows that created the Waterville Plateau to the east, and glacial outwash materials from the deep carving of the river valley itself. The tributaries that feed the mid-Columbia are primarily glacially carved. The result is very low sediment loads.

Turbidity does increase during periods of high inflow from the tributaries. Monthly sampling data from the WDOE monitoring station below Rock Island Hydroelectric Project dam report a range in turbidity of 1.0 NTU (Nephelometric Turbidity Units) to 11.0 NTU; mean value 2.9 NTU, n = 142. Turbidity data collected daily by Chelan PUD and reported by the COE Data Access in Real Time (DART) information system for the Project forebay report a similar range but a slightly higher mean turbidity value of 5.6 NTU (n = 116; data from April – September 1993, April 1994, and April – September 1997). Although the WDOE data (one sample per month) shows no seasonal trend for turbidity and no correlation for turbidity with temperature or discharge, the daily samples collected by Chelan PUD do show seasonal trends. The Chelan PUD/COE daily data for the Rocky Reach Hydroelectric Project forebay indicate higher maximum daily turbidity values in May and July. Turbidity in the forebay is inversely correlated with discharge ($r^2 = 0.67$) and positively correlated with water temperature ($r^2 = 0.71$) Temperature and discharge also autocorrelate which may explain the relationship between turbidity and discharge. It appears that turbidity may increase slightly in May with the onset of spring runoff and then show a slight increase again in July as primary productivity increases. All reported turbidity data are well below the water quality standard for Class A waters.

Secchi disk transparency (visibility) in the reservoir is generally over 12 feet during late summer months, but can be lower during spring and early summer when snowmelt runoff in the tributaries is high. Chelan PUD monitors Secchi disk transparency in the vicinity of the fishway during the fish counting season (April 16 – November 15). Secchi disk readings are rarely below 5 feet in May – June and typically exceed 17 feet beginning in August through the fall. Based on these Secchi disk readings, the Rocky Reach Hydroelectric Project reservoir would be classified as borderline oligotrophic (average 9.9 feet, range 5.4 – 28.3 feet for oligotrophic lakes, Wetzel 1983).

Temperature

Water temperature is a critical factor governing many ecological functions within an aquatic system, including controlling fish egg development and fish growth rates. Water temperature strongly influences primary production of phytoplankton and aquatic plant growth. Water quality standards are established for temperature levels that support designated aquatic species, generally establishing maximum temperature limits. However, the duration of elevated temperatures and the diurnal range can also be important factors affecting the biological response of organisms to temperature regimes.

Water temperature data is collected by Chelan PUD at the forebay and tailrace of Rocky Reach Hydroelectric Project dam. Temperature monitoring in the Rocky Reach Hydroelectric Project forebay was initiated in 1982; since 1984, three to six hourly values were reported daily to the COE until 1997, when continuous recording devices were installed. (Earlier data was collected but not reviewed for this report.) Temperature is generally monitored April through September. The current fixed monitoring station in the forebay is on the west side of the dam. The COE publishes data for this and other Columbia River sites as part of its DART information system on the internet. These records provided the data represented in Figure 2, which was subsequently reviewed and corrected for anomalies (e.g., >2°C change in 24 hour, August 1995 data showed serious stair step pattern which suggested instrument error and has been deleted from data records).

Water temperature in Rocky Reach Hydroelectric Project reservoir begins warming in March, reaches peak annual temperatures in late July through early September (monthly average daily temperature for August at the forebay is 17.7°C) then cools again during the fall and winter months to average temperatures in the 3°C to 4°C range (Figure 2). Daily variability is typically less than 0.5°C but can range as much as 1°C diurnally during summer.

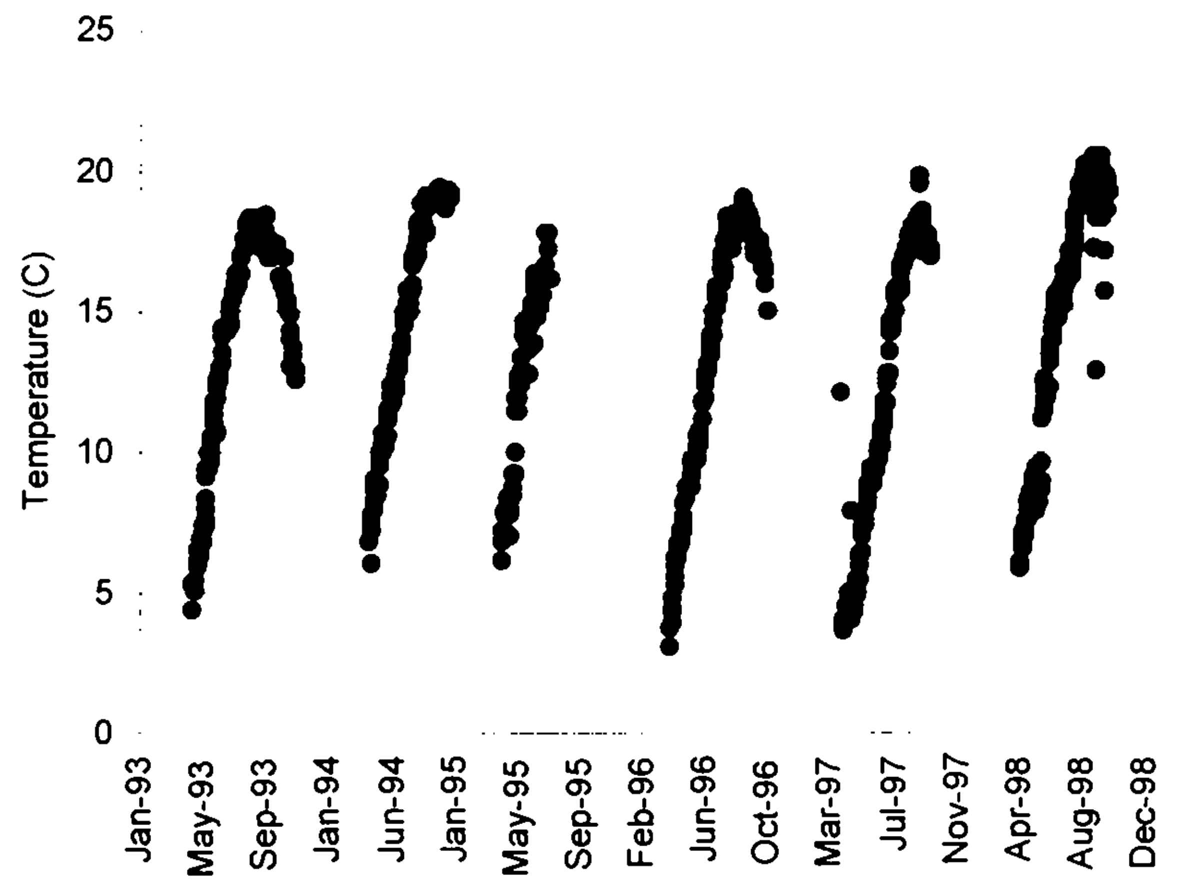


Figure 2. Daily water temperatures at Rocky Reach Hydroelectric Project forebay 1993-1998

The WDOE has established water temperature criteria (temperature shall not exceed 18°C or more than 0.3°C above natural conditions due to human activity) for this reach of the Columbia River. Daily average water temperatures in the Project forebay exceeded the 18°C criterion during 8 percent of the days in July and approximately 44 percent of the days in August and September (1993 to 1998). Similar exceedences also occur above and below the Rocky Reach Hydroelectric Project, as demonstrated from temperatures reported at these sites (DART, 2003). Based on current information available, it is not possible to determine the number of days, if any, that the Project causes a greater than 0.3 °C change in temperature.

Douglas PUD began collecting data in the Wells Hydroelectric Project dam forebay in 1984 and in the Wells Hydroelectric Project dam tailrace at the head of Rocky Reach Hydroelectric Project reservoir in 1998. The Wells Hydroelectric Project dam forebay temperature data is considered representative of the headwaters of the Rocky Reach Hydroelectric Project reservoir based on an average 0.1°C temperature difference between data collected in the forebay and tailrace of Wells Hydroelectric Project dam (DART, 2002). Temperature appears to change very little as water flows through the Rocky Reach Hydroelectric Project reservoir. The average difference in the absolute values for daily temperature between the

Wells Hydroelectric Project dam forebay and the Rocky Reach Hydroelectric Project forebay (1993 to 1998) was 0.4°C. Rocky Reach Hydroelectric Project forebay temperatures are generally slightly cooler than at the head of the Rocky Reach Hydroelectric Project reservoir. However, the precision of the monitoring equipment and lack of cross-calibration make a temperature difference of less than 0.5°C likely to be within the range of measurement error. Daily temperature change between the upper and lower end of the reservoir exhibited no pattern or statistically significant relationship to discharge or percent spill at Rocky Reach Hydroelectric Project. Based on the 1993 – 1998 daily data (sample size 1,282 days), Project operations do not affect water temperature sufficiently to be within the precision of the historical monitoring equipment.

The reservoir is not known to stratify (Chelan PUD, 1991, Johnstone and Mih, 1987). The run-of-river operation of the Project results in a rapid reservoir turnover rate, which likely precludes stratification. At elevation 707 feet, the reservoir turns over in 24.8 hours when the mean discharge is 131,000 cfs (typical flows in May) and in 65.2 hours when the mean discharge is 84,800 cfs (typical flows in July) (Chelan PUD, 1991).

Dissolved Oxygen

Dissolved oxygen (DO) is another important indicator of aquatic eutrophication and a major determinant of cold water fisheries viability. Cold water salmonids are less tolerant of depressed oxygen levels and generally require 7-9 mg/l, while warm water species can tolerate DO levels as low as 3-4 mg/l (EPRI, 1990). As mentioned earlier, the Rocky Reach Hydroelectric Project reservoir does not stratify. Dissolved oxygen levels in the reservoir are favorable for salmonids and provide a healthy aquatic environment throughout the year. WDOE lists the Rocky Reach reservoir as category 1, meaning that it meets standards for dissolved oxygen, in the 2002/2004 303(d) listings.

Historical monthly dissolved oxygen monitoring data is not available for the Rocky Reach Hydroelectric Project reservoir, but information from downstream locations is considered representative of conditions in the Project. The annual average DO at the downstream WDOE monitor station below Rock Island Hydroelectric Project dam is 11.9 mg/l. Annual variation is influenced by water temperature (warmer water contains less oxygen). The reported range in DO below Rock Island Hydroelectric Project dam is 7.9 – 16.3 mg/l (76.5 – 145.8 percent saturation). Monthly DO levels are listed in Table 3.

From 1977 to 1990, a DO level below the water quality standard of 8.0 mg/l has only been noted once at the WDOE gage station at Rock Island. Johnstone and Mih (1987) report similar DO levels within the Rocky Reach Hydroelectric Project reservoir with the water fully saturated at all times. They also note diurnal fluctuation with peak DO at 3 p.m. in summer months. Photosynthesis by aquatic plants may account for the high DO levels and diurnal fluctuation.

pH and Alkalinity

The Columbia River pH level at WDOE's monitoring station below Rock Island Hydroelectric Project dam averages 8.0 pH, which is on the basic side of neutral. Although pH readings varied between 6.7 and 9.2 for 147 monthly readings taken between October 1977 and January 1990, no correlation appears to exist between pH and flow levels, temperature or seasons of the year. Aquatic plant growth can influence pH through the utilization of carbon dioxide for photosynthesis. Areas with heavy plant growth often exhibit alkaline pH. A diurnal variation (7.1 to 8.6) was noted by Johnstone and Mih (1987) for the Columbia River at Daroga Park. This variation was attributed to the effects of photosynthesis. WDOE lists the Rocky Reach reservoir as category 1, meaning that it meets standards for pH, in the 2002/2004 303(d) listings.

Alkalinity, a measurement of the buffering capacity of the water, is associated with pH. Alkalinity of the river measured at Daroga Park (Johnstone and Mih, 1987) ranged from 55 to 66 mg/l as calcium carbonate ($CaCO_3$). This degree of alkalinity is considered to be high, indicating high carbonate concentrations, which promote biological growth. High alkalinity did not necessarily correlate with high pH but did generally correspond with high conductivity measurements.

Conductivity

Conductivity below Rock Island Hydroelectric Project dam averaged 15 micro-ohms (UMHO) for 1977 - 1990. Seasonal trends (Table 3) in this reach of the Columbia River indicate the highest levels occur in the winter months, and lowest levels in the months from June to November. While increased inflow from a watershed generally increases conductivity levels in a water body by introducing dissolved ions from the soil, the exceptionally large inflow volume associated with spring runoff for the Columbia River (peaks in June) is thought to have a diluting effect on ion concentrations resulting in conductivity levels intermediate between the winter highs and summer/fall lows.

Bacterial Contamination

Fecal coliform organisms are present in the intestinal tracts and feces of warm-blooded animals. Their presence and level of concentration is an indicator of human or other warm-blooded animal pollution. The average of 40 fecal coliform organisms per 100 ml sample found at Rock Island Hydroelectric Project dam station on the Columbia River falls within the Class A (Excellent), and even Class AA (Extraordinary) water quality standards criteria. Less than 10 percent of the samples (6.2 percent) exceeded 200 organisms per 100 ml sample, which is within an acceptable range per the standards (EPA STORET, 2002). Although the July average fecal coliform count (Table 3) is above the standard, the reported average is affected by two outlying samples, which had high spikes. The average fecal coliform count for July excluding those two samples is 22 organisms/100 ml. WDOE lists the Rocky Reach reservoir as category 1, meaning that it meets standards for fecal coliform, in the 2002/2004 303(d) listings.

Bacteriological studies conducted for the assessment of Daroga Park (Johnstone and Mih, 1987) reported generally low bacterial counts for enterococci (ENT), total E. coli (TEC) and fecal coliform (FC). Localized high FC counts were found in July followed by relatively low bacterial counts in August. High samples were attributed to concentrated and prolonged activity within the swim area and localized waterfowl usage elsewhere.

The Chelan-Douglas Health District has jurisdiction over individual on-site domestic sewage systems within the two-county area straddled by the Project's reservoir. Since 1981, it has been the policy of the Chelan-Douglas Health District to issue individual on-site sewage disposal permits that require drain field setbacks of 100-feet horizontal from the river, and a 3-foot vertical separation between the bottom of the drain field trench and seasonal high groundwater (Chelan PUD, 1991).

Chelan PUD conducted a survey in 1981 of septic tanks and drain fields in the vicinity of the reservoir. These drain fields predate the 1981 health district policy changes, and some of these drain fields encroach upon the health district's current horizontal and vertical separation criteria. However, based on the very low bacterial counts noted above, it does not appear that these septic systems have caused any detectable contamination of the Rocky Reach Hydroelectric Project reservoir

Two municipal sewage treatment facilities are located near the Project area. The treatment plant at Chelan Falls serves the lower Lake Chelan area, the other at Entiat serves that city. These sewage treatment plants operate under NPDES permits that require treatment to protect water quality in the Columbia River. In addition, a small wastewater treatment facility serves Rocky Reach Hydroelectric Project dam and operates under NPDES Permit No. WA-005079-2

Heavy Metals, Pesticides, and Contaminants

Design considerations within the Rocky Reach Hydroelectric Project have been instituted to minimize potential releases of petroleum products that are necessary to its operation. Spill Prevention, Containment and Countermeasures (SPCC) plans for the Rocky Reach Hydroelectric Project have been prepared and implemented.

The Rocky Reach SPCC plan (June 2002, revised January 2003) is designed to fulfill the requirement of 40 CFR 112, EPA Oil Pollution Prevention Regulations. The plan describes practices, procedures, structures and equipment at the facility to prevent spills and to mitigate or preclude any adverse impact on the environment. The SPCC plan is approved by EPA and is reviewed and revised at least every three years or within 60 days of a spill (a discharge of more than 1,000 U.S. gallons of oil and/or hazardous materials or discharges of oil and/or hazardous material in harmful quantities, as defined in 40 CFR 110, into navigable waters in two reportable spill events within any 12-month period). The SPCC plan provides the locations, quantities and contents of oil products stored at the Project, a description of potential spill situations and control systems, and a detailed list of spill prevention measures associated with specific runoff and other drainage systems, storage locations, oil-containing equipment, maintenance activities and personnel training.

A significant portion of land adjacent to the Project reservoir is in agricultural use, primarily orchard. Fertilizers, pesticides and herbicides are utilized in orchard operation, and, if allowed to enter the river, could have a detrimental effect. Where Chelan PUD has removed orchards along the river to develop parks, soil analyses were conducted. The results showed minimal levels of residual fertilizers and herbicides. Some residual lead-arsenic levels from pre-

World War II orchard operations have been found at depth in heavy clay soils. These levels are below any regulated threshold. Sandy soils have not shown any residual effects.

Tailrace Conditions

Water quality within the Rocky Reach tailrace is, for the most part, comparable to water quality within the reservoir as reported above. Total dissolved gas is an exception, as this parameter can be significantly affected by spill at the dam.

Total dissolved gas

Spilling of water at hydroelectric projects can entrain atmospheric gas in the tailwater, which forces this gas into solution. This leads to supersaturation for total dissolved gas (TDG). High levels of TDG supersaturation can be detrimental to a wide array of aquatic animals and may cause a potentially lethal condition known as gas bubble trauma (GBT) in fish. GBT develops when dissolved gas in the bloodstream of animals comes out of solution and forms bubbles in the internal and external tissues.

Chelan PUD, in coordination with the COE and other Columbia River hydroelectric project operators, has been spilling water for downstream fish passage at the Rocky Reach Hydroelectric Project since 1976. Spill is a tool used for improving survival of anadromous salmonids during their downstream migration. Spill can also occur when high stream flows exceed the hydraulic capacity of the powerhouse or, occasionally, when energy demand is low and river flows are high. In the Columbia River basin, a regional effort has been undertaken to monitor and control TDG supersaturation and its biological effects.

Although the level of TDG that impacts aquatic life has not been definitively established under in-situ conditions within large rivers, Washington State's numeric water quality standards set 110 percent as the upper limit for TDG supersaturation in the Columbia River, except during juvenile salmon migrations. During this migration period, the WDOE water quality standards for the Columbia River allow TDG levels of 120 percent (daily average of highest 12 consecutive hours in the tailrace) associated with spilling water for fish passage at hydroelectric projects, including the Rocky Reach Hydroelectric Project. This special condition in the water quality standards recongnizes the regional importance of coordinated spill programs to aid downstream fish migration. The special condition allows a project to provide fish passage spills, provided that the TDG level in the tailrace shall not exceed 120 percent (daily average of highest 12 consecutive hours), with no single hourly TDG level exceeding 125 percent. In addition, the spill must be controlled so that the TDG level in the forebay of the next dam downstream does not exceed 115 percent.

In coordination with the COE, Chelan PUD has monitored TDG in the forebay since 1982. The monitoring data sets consist of hourly TDG in the forebay (April - August, 1982 - present), and hourly TDG below the tailrace of Rocky Reach Rocky Reach Hydroelectric Project dam (April – August, 1997 - present). Some tailrace data from a barge in the tailrace is available for 1996. TDG monitoring with improved equipment and calibration procedures during the spring and summer seasons was initiated in 1995 for the forebay and 1997 for the site below the tailrace.

Chelan PUD has reported TDG levels in the forebay and below the tailrace of the Rocky Reach Hydroelectric Project in compliance with WDOE's special condition. Study methods and results are reported in McDonald and Priest (1997), Koehler and McDonald (1997, 1998), Perleberg and McDonald (1999) and in annual compliance reports submitted to WDOE since 2000 (Grassell et al., 2000; Grassell and Hampton, 2001, and Hampton 2002, 2003). TDG, temperature and barometric pressure are recorded every 15 minutes, and the average for the hour is stored in a database and transmitted to the COE. The data are measured at a fixed station located in the forebay with the instrument probe deployed at a depth of approximately 15 feet. A tailrace monitor has been installed approximately four miles downstream from the Project dam at the Odabashian Bridge. Recent study objectives have been to:

1) determine if the Chelan PUD is in compliance with the special condition requirements for supersaturation;
2) examine possible relationships between the percent of total river flow spilled and total volume spilled on changes in TDG levels; and
3) verify that TDG levels recorded by the monitoring station below the tailrace are representative of the entire river channel downstream from the Project.

TDG levels in the forebay and tailrace vary throughout the spring and summer. This variation is attributable in part to changing spill volumes and upstream TDG levels associated with spills at upstream projects. The effect of the Rocky Reach Project on TDG levels is shown in Table 4. The average TDG at the site below the tailrace is generally only about two percentage points higher than the TDG level measured in the forebay (the 1996 tailrace data, which was measured much closer to the spillway, shows a greater increase averaging 5-7 percentage points). The highest TDG levels recorded above and below the Project were in 1997, due to high river flows and spill levels in that year, which had the highest streamflows since 1970.

Table 4. Total dissolved gas as percent saturation in the forebay and below the tailrace at Rocky Reach Hydroelectric Project dam, 1996 – 2003

Year	Spring[1] (average and range of hourly measurements)		Summer[1] (average and range of hourly measurements)	
	Forebay	Below Tailrace	Forebay	Below Tailrace
1996	114.7 (103.5 - 126.6)	121.2 (108.9 - 140.5)	109.5 (103.4 - 116.7)	115.1 (108.9 - 128.6)
1997	123.7 (98.5 - 133.5)	126.0 (108.1 - 138.3)	111.0 (99.8 – 120.8)	113.1 (106.8 - 128.3)
1998	108.8 (100.4 - 121.3)	111.3 (105.8 - 127.6)	108.1 (97.9 - 114.8)	110.9 (105.3 - 118.9)
1999	108.8 (97.3 - 116.4)	110.1 (101.7 - 127.3)	110.6 (103.6 - 122.4)	112.7 (108.0 - 124.5)
2000	107.6 (100.1 - 120.5)	110.7 (102.9 - 132.2)	108.6 (101.6 - 112.7)	110.1 (105.3 - 114.6)
2001[2]	107.9 (104.1 - 113.3)	108.3 (104.6 - 113.0)	108.8 (104.1 - 113.4)	109.1 (105.5 - 112.1)
2002	110.6 (104.2 - 128.0)	112.5 (105.2 - 127.6)	114.9 (108.5 - 135.7)	115.6 (108.7 - 132.2)
2003	107.6 (103.7 - 112.5)	108.9 (104.0 - 113.8)	110.8 (104.6 - 118.9)	112.1 (109.6 - 116.0)

[1] The periods of time defined as spring and summer have varied from year to year. The spring period was approximately April 1 – June 30 for 1996 – 2001, April 14 – June 21 for 2002, and April 3 - May 31 for 2003. The summer period was approximately July 1 - August 31 for 1996 – 2001, June 22 – August 25 for 2002 and June 1 – August 31 for 2003.

[2] There was no spill at Rocky Reach Project in 2001. Thus, data for this year serves as a baseline for TDG levels with no TDG effect from the Rocky Reach Project.

Chelan PUD used regression analysis to evaluate the relationship between the change in TDG levels from forebay to tailrace and the total volume spilled (kcfs) as well as percent of river spilled. Data were stratified by spring and summer. The correlation between TDG level and spill level has been highly variable, typically with correlation coefficients (r^2 values) well below 0.5 for both total volume spilled and percent of river flow spilled. This poor correlation is because spill at the Project does not greatly increase TDG when the TDG level in the forbay is above 110 percent. The highest correlation coefficients reported were in 2003, when the $r^2 = 0.80$ for total volume spilled and $r^2 = 0.56$ for percent of river flow spilled.

TDG transects below Rocky Reach Hydroelectric Project dam indicate that, in general, there is a slight trend toward decreasing TDG levels from the east channel to the west. This observation has been consistent over eight years of transect monitoring (McDonald and Priest 1996; Koehler and McDonald, 1997 and 1998; Perleberg and McDonald, 1999; Grassell, et al., 2000; Grassell and Hampton, 2001; and Hampton, 2002, 2003). Rocky Reach Hydroelectric Project dam consists of a powerhouse parallel to the river flow, located on the west bank of the river and a spillway perpendicular to the flow located on the east bank of the river. It is to be expected that during periods of spill, TDG levels in the east channel below the spillway would be greater than the TDG levels below the powerhouse.

Comparison of forebay to tailrace data showed an increase in TDG levels when there was little or no spill. The increase in TDG from forebay to tailrace when no spill occurred leads to the conclusion that factors other than spill may also influence TDG, or there are potentially undetected vertical and/or horizontal gradients in TDG across the river that are not accounted for with a fixed station monitor.

The results of eight years of TDG monitoring have not demonstrated a strong causal relationship between spill volume at Rocky Reach Project and TDG levels in the forebay of Rock Island Dam. The level of TDG arriving at the Rocky Reach Project has a greater influence on TDG levels reaching the Rock Island forebay. In 1998, the spill pattern for fish passage at Rocky Reach Hydroelectric Project generally resulted in an increase in TDG levels from the forebay at Rocky Reach Hydroelectric Project dam to the forebay at the downriver Rock Island Hydroelectric Project dam (Koehler and McDonald, 1998). Similar findings were reported for 1996 (McDonald and Priest, 1997). In 1997, the spill was distributed across either seven or 11 spillway bays, and the TDG data showed decreasing trends from the Rocky Reach Hydroelectric Project to the Rock Island Hydroelectric Project. However, in recent years using different spill patterns, the TDG level arriving at Rock Island Dam has been only slightly higher, and sometimes lower, than the TDG level in the forebay of the Rocky Reach Project.

Groundwater

Groundwater in the study area is contained in shallow, unconfined aquifers composed of glacial drift deposits overlying basalt. In the vicinity of the Rocky Reach Hydroelectric Project reservoir, the depth to high water table is more than 6 feet. The principal water-bearing units consist of sand and gravel in glacial outwash and glacial till. Well depths range from 50 to 250 feet. The water-yielding capability of the glacial drift aquifer can be highly variable due to the spatial variability of the constituent materials.

Groundwater from the glacial drift aquifer is used as a source of domestic water supply in the region surrounding Rocky Reach Hydroelectric Project reservoir. Groundwater quality in the glacial drift aquifer is generally good, with some problems related to contamination from agricultural practices, including high levels of nitrates, phosphorus and coliforms (FERC, 1996).

Minimal levels of residual fertilizers and herbicides were detected near the surface in soils within the Project area. Residual lead-arsenic levels from pre-World War II orchard operations were found at depth in heavy clay soils. The measured levels, however, were below the regulated thresholds and have not been shown to affect groundwater quality in the Project area.

The Columbia River Basalt aquifer underlies the glacial drift aquifer and consists of alternating layers of dense but locally fractured basalt and interbeds of unconsolidated sand and gravel. Groundwater from the Columbia River Basalt aquifer is used predominantly for irrigation. Well depths range from 50 to 750 feet but may exceed 900 feet (FERC, 1996).

b. Environmental Impacts and Recommendations:

Water Use and Quantity

Water quality can be affected when water use is consumptive or when a non-consumptive use takes water out of the river channel over some distance, reducing flows in a bypassed reach. Water quality can also be affected when water is used for processes that contaminate the water with pollutants. The Rocky Reach Hydroelectric Project does not take water away from the river channel for power generation and there is no bypassed reach. The amount of water used for

APPENDIX C: HANFORD REACH FALL CHINOOK PROTECTION PROGRAM

Hanford Reach Fall Chinook Protection Program

This Agreement is made and entered into this 5th day of April, 2004, between and among Public Utility District No. 2 of Grant County, Washington ("Grant"), Public Utility District No. 1 of Chelan County, Washington ("Chelan"), Public Utility District No. 1 of Douglas County, Washington ("Douglas"), the United States Department of Energy acting by and through the Bonneville Power Administration ("BPA"), NOAA Fisheries ("NOAAF"), the Washington Department of Fish and Wildlife ("WDFW") and the Confederated Tribes of the Colville Indian Reservation ("CCT"). Each of the above entities may be referred to individually as a "Party" or collectively as the "Parties"; NOAAF, WDFW and CCT may be referred to individually as an "Agency Party" or collectively as the "Agency Parties"; Grant, Chelan, Douglas and BPA may be referred to individually as an "Utility Party" or collectively as the "Utility Parties".

A. DEFINITIONS

"BPA's Friday Priest Rapids Outflow Estimates" – estimate of Priest Rapids Outflow for Saturday and Sunday provided by BPA on Friday afternoon based on expected operations at Chief Joseph Dam plus Side Inflows.

"Chief Joseph" – the Chief Joseph Dam located on the Columbia River System.

"Chief Joseph Uncoordinated Request" – the generation request which BPA determines is the desired output in megawatts of Chief Joseph at any time. Through the operation of Mid-Columbia Hourly Coordination, the Chief Joseph actual generation may be higher or lower than the Chief Joseph Uncoordinated Request. At any time, Chief Joseph Uncoordinated Request plus Chief Joseph bias must equal Chief Joseph actual generation.

"Corps of Engineers" – the United States Army Corps of Engineers.

"Critical Elevation" – the elevation on Vernita Bar at which the Protection Level Flow will be established as provided in subsection C.6.

"Critical Runoff Volume" – the volume of runoff for the January through July period at Grand Coulee for the year 1929 (42.6 million acre feet).

"Daylight Hours" – the time period from one hour before sunrise to sunset at Priest Rapids Dam.

"Emergence" – the point at which the water over eggs in Redds at Vernita Bar or other areas designated in Exhibit A have accumulated 1,000 (°C) Temperature Units after the Initiation of Spawning.

"Emergence Period" – the time period beginning with Emergence and continuing thereafter until 1,000 (°C) Temperature Units have been accumulated at Vernita Bar after the end of the Spawning Period.

"Hanford Reach" – an approximately 50-mile long section of the Columbia River extending from downstream of Priest Rapids Dam to just north of Richland, WA.

"Hatching" – the point at which the water over eggs in redds at Vernita Bar has accumulated 500 (°C) Temperature Units after the Initiation of Spawning.

"Holiday" – means any day designated as a national holiday in the Northwest Power Pool accounting procedures.

"Initiation of Spawning" – the Wednesday before the weekend on which the Monitoring Team first identifies five (5) or more Redds pursuant to subsection C.6. Separate dates for Initiation of Spawning will be set for the 36-50 kcfs zone and for the zone above 50 kcfs within areas identified in Exhibit A and in areas of the Hanford Reach below the 36kcfs level and/or outside the area specified in Exhibit A.

"kcfs" – thousand cubic feet per second.

"kcfs elevation" – the level along Vernita Bar reached by a specific rate of flow measured in kcfs.

"kcfs zone" – the area inundated by a specific rate of flow past Vernita Bar as measured in kcfs.

"kcfsh" – volume of water in thousand cubic feet per second hours.

"Mid-Columbia Hourly Coordination" – the operation of Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids pursuant to the "Agreement For The Hourly Coordination Of Projects On The Mid-Columbia River", effective July 1, 1997 through June 30, 2017, as such may be amended, extended, or replaced.

"Monitoring Team" – a group of three individuals composed of one fishery biologist designated by each of the following: (1) Grant PUD; (2) Washington Department of Fish and Wildlife; and (3) a signatory fishery agency or tribe.

"Post-Hatch Period" – the time period between Hatching and Emergence.

"Pre-Hatch Period" – the time period between the Initiation of Spawning and Hatching.

"Previous Day's Average Weekday Wanapum Inflow" – the total volume of water discharged into the Wanapum development measured as a daily average discharge from Rock Island Dam. This measure is used from Monday to Friday to determine the allowable flow fluctuation during the Rearing Period and will be calculated based on data available to Grant that is reported on the Corps of Engineers website [http://nwd-wc.usace.army.mil/report/projdata.htm].

"Priest Rapids Project" – the Priest Rapids and Wanapum hydroelectric developments located on the Columbia River System.

"Priest Rapids" – the Priest Rapids Dam located on the Columbia River System.

"Priest Rapids Outflow" – the total volume of water discharged by Priest Rapids in any hour from all sources, measured in kcfs. For the purposes of the Spawning Period, Pre-Hatch Period, Post-Hatch Period and Emergence Periods, Priest Rapids Outflow shall be measured at the USGS station below Priest Rapids when possible. When USGS station data are not available and for the purposes of the Rearing Period, it will be calculated at Priest Rapids based on data available to Grant that are reported on the Corps of Engineers website [http://www.nwd-wc.usace.army.mil/report/projdata.htm].

"Priest Rapids Weekday Outflow Delta" – this is the difference between minimum Priest Rapids Outflow and maximum Priest Rapids Outflow over a 24 hr period beginning at 0001 hrs and extending to 2400 hrs. Priest Rapids Weekday Outflow Delta will be calculated at Priest Rapids based on data available to Grant that are reported on the Corps of Engineers website [http://www.nwd-wc.usace.army.mil/report/projdata.htm].

"Priest Rapids Weekend Outflow Delta" – this is the difference between minimum Priest Rapids Outflow and maximum Priest Rapids Outflow over a 48-hr period beginning at 0001 hrs on Saturday morning and extending to 2400 hrs on Sunday night. Priest Rapids Weekend Outflow Delta will be calculated at Priest Rapids based on data available to Grant that is reported on the Corps of Engineers website [http://www.nwd-wc.usace.army.mil/report/projdata.htm].

"Protection Level Flow" – the amount of water flowing over Vernita Bar which is needed to provide protection to Redds as specified in subsections C.2 through C.4 of this Agreement.

"Rearing Period" – the time period beginning with the start of the Emergence Period and continuing thereafter until 400 (°C) Temperature Units have been accumulated at Vernita Bar after the end of the Emergence Period.

"Redds" – defined area of riverbed material containing salmon eggs.

"Reverse Load Factoring" – the intentional reduction of power generation during Daylight Hours and the corresponding increase in power generation during hours of darkness for the purpose of influencing the location of Redds on Vernita Bar. Reverse Load Factoring does not include spilling at night to allow lower daytime flows.

"Rocky Reach" – the Rocky Reach Dam located on the Columbia River System.

"Side Inflows" – the algebraic sum of the flow rates of water entering or leaving the Columbia River from all sources between Chief Joseph and Priest Rapids as calculated by the method presently specified by Mid-Columbia Hourly Coordination.

"Spawning Period" – the time period beginning with the Initiation of Spawning and continuing until 2400 hours on the last Sunday prior to Thanksgiving.

"Temperature Unit" – one degree Celsius of water temperature above freezing (0°C) for 24 hours.

"Vernita Bar" – the gravel bar located in the Columbia River approximately four miles downstream from Priest Rapids.

"Wanapum" – the Wanapum Dam located on the Columbia River System.

"Wanapum Inflow" – the daily average flow rate for water flowing into the Wanapum reservoir calculated at Rock Island based on data available to Chelan.

"Wells" – the Wells Dam located on the Columbia River System.

B. SCOPE AND DURATION

1. Purpose of Agreement and Relationship to Prior Agreement

This Agreement establishes the obligations of the Parties with respect to the protection of fall Chinook in the Hanford Reach of the Columbia River. The Parties agree that during the term of the Agreement these flow regimes address all issues in the Hanford Reach with respect to fall Chinook protection and the impact of operation of the seven dams operating under Mid-Columbia Hourly Coordination, including the obligations of Grant, Chelan, and Douglas under any new licenses issued by the Federal Energy Regulatory Commission (FERC).
It is the intent of the Parties that this Agreement replaces and supersedes the original **June 16, 1988** Vernita Bar Agreement.

2. Term, Effectiveness, and Regulatory Approvals

(a) This Agreement shall become effective on the date of execution of this Agreement by all Parties and shall continue for a period equal to the remainder of the current license for Priest Rapids Project No. 2114, plus the term(s) of any annual license(s) and the next new Priest Rapids Project license which may be issued thereafter.

(b) By signing this Agreement, the Agency Parties represent that they have assembled and reviewed substantial evidence, and that based on that substantial evidence, they will recommend to FERC that this Agreement be approved in its entirety.

(c) Promptly after the execution of this Agreement, Grant shall file it with the FERC and request that FERC include appropriate conditions in the new license for the Priest Rapids Project reflecting the terms and conditions of this Agreement. All Parties agree to submit a statement of support of this Agreement to FERC within a reasonable time of Grant's filing. The Parties, however, shall, without limitation or qualification, commence implementation of this Agreement at the beginning of the 2004 Rearing period.

(d) In the event that FERC shall issue an order which makes any material modification to the terms of this Agreement, either by additions to or omissions from its terms, any Party may, within 60 days following the issuance of a FERC order denying a request for rehearing, withdraw from this Agreement after giving the other Parties 30 days written notice of its intention to do so and of the reasons for its decision to withdraw.

(e) The Agency Parties represent and stipulate that this Agreement shall constitute the agency Parties terms, conditions and recommendations for any FERC licensing process of the Utility Parties; including any such necessary filings with the Washington Department of Ecology Section 401 certification process with respect to protection of fall Chinook in the Hanford Reach of the Columbia River.

(f) The Parties represent and stipulate that all submittals and recommendations to FERC, including those to Washington Department of Ecology, for inclusion in the new licenses for the Priest Rapids Project, the Rocky Reach Project and the Wells Project will in all respects be consistent with the terms and conditions of this Agreement.

(g) An Utility Party may, upon 30-days notice, withdraw from this Agreement and be relieved of all obligations under this Agreement in the event FERC, the Washington Department of Ecology, or other regulatory authority imposes on such Party any measure inconsistent with this Agreement or additional obligations with respect to the protection of fall Chinook and other aquatic resources in the Hanford Reach of the Columbia River.

(h) Nothing in this Agreement will limit or prohibit any action by any Party based on non-compliance with this Agreement.

3. Reopener Limitation/Withdrawal

(a) No Party may petition the FERC directly, or through the Washington Department of Ecology, to modify any provision of this Agreement or request any flows, minimum flows or other operation that is inconsistent with this Agreement, until ten years from the effective date of this Agreement, unless such modification is jointly requested by all Parties.

(b) Ten years following the effective date of this Agreement, a Party may:

(1) Request reopening of this Agreement and the imposition by the FERC of different, additional or modified fall Chinook protection measures for the Hanford Reach;

(2) Bring any cause of action, raise any defense (including exhaustion of administrative remedies at the FERC) or claim, or rely on any theory in any appropriate forum;

(3) Petition any other appropriate administrative agency or political body for relief, including the deletion of one or more measures otherwise in effect under this Agreement, or;

(4) Take other appropriate action relating to any issue or matter addressed by this Agreement that could have been addressed by this Agreement or the Parties with respect to protection of aquatic resources in the Hanford Reach.

(c) In any action under this subsection B.3(b) the petitioning Party shall have the burden of proof. The Parties will continue to implement this Agreement until the relief sought becomes effective by operation of law, unless otherwise agreed.

(d) With respect to any petition or suit filed pursuant to this subsection B.3(b) and any subsequent judicial review thereof, nothing in this Agreement shall bar, limit or restrict any Party from raising any relevant issue of fact or law, regardless of whether such issue is or could have been addressed by this Agreement.

(e) Notwithstanding any other provisions of this subsection B.3(b) any Party may participate in any legislative or administrative proceeding dealing with fish protection or compensation issues; provided that no Party may contend on its own behalf, or support any contention by other persons in any proceeding or forum, including the Northwest Power and Conservation Council, the Washington Department of Ecology Section 401 certification process, and/or Congress, that additional or different measures for protection of fall Chinook salmon in the Hanford Reach should be imposed on any Party until a period of ten years following the effective date of this Agreement has passed.

4. Stipulation of Adequacy

For ten years from the effective date of this Agreement, the Parties stipulate as follows:

(a) Performance of the requirements of Grant, Chelan, Douglas and BPA under this Agreement shall constitute acceptable protection of fall Chinook in the Hanford Reach, taking into account both hydropower and fishery needs.

(b) Performance by any Utility Party of its obligations under this Agreement satisfies the obligations of such Party with respect to protection of fall Chinook salmon in the Hanford Reach arising under applicable laws and regulations, including but not limited to the Endangered Species Act, the Federal Power Act as amended by the Electric Consumers Protection Act of 1986, the Pacific Northwest Electric Power Planning and Conservation Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fisheries Conservation and Management Act. In any and all disputes, proceedings and hearings under the above applicable laws and regulations, the Parties will support the adequacy of protection for fall Chinook salmon in the Hanford Reach pursuant to this Agreement.

(c) Performance by any Party of its obligations under this Agreement shall constitute compliance with the applicable provisions of the Northwest Power and Conservation Council's Fish and Wildlife Program as currently written.

C. HANFORD REACH FALL CHINOOK PROTECTION

Subject to the limitations and conditions set out in this Agreement, Grant, Chelan, Douglas and BPA shall provide the following flow regimes for the Spawning through Rearing Period for Hanford Reach fall Chinook salmon in the Hanford Reach of the Columbia River.

1. Spawning Period

(a) All Parties agree that flows maintained during the Spawning Period and escapement levels are factors influencing the placement of Redds. The flow manipulation under this subsection C.1 is directed to minimize formation of Redds above the 70 kcfs elevation. Minimizing formation of Redds above the 70 kcfs elevation in turn is a key factor influencing the success of the flow regime under subsection C.4 during the Emergence Period.

(b) During the Spawning Period(s) of 2005 and 2006, Grant will experiment with alternative operations for flow manipulation. The requirement of the alternative operations will be to ensure that Priest Rapids Outflows are not higher than 70 kcfs and not lower than 55 kcfs for a continuous period of at least 12 hours out of each day during the Spawning Period. Grant will provide continuous monitoring of Redd formation during these tests and report the results weekly. These experiments may continue as long as no more than 31 Redds are located above the 65 kcfs elevation on Vernita Bar. If Redd counts reveal that more than 31 Redds are located above the 65 kcfs elevation, Spawning Period operations will default to the procedures of C.1(c) below. If Redd counts show that alternative Spawning Period operations can limit the formation of Redds above 70 kcfs, then Grant shall be allowed to choose between use of C.1(b) or C.1(c) as guidelines for operational parameters during the Spawning Period of future years.

(c) If the experimental operations testing during C.1(b) above are unsuccessful in minimizing formation of Redds above the 70 kcfs elevation, Grant's operations will revert to the default operation specified in this paragraph. During the Spawning Period, Grant will operate Priest Rapids Project No. 2114 to the extent feasible through use of the Mid-Columbia Hourly Coordination and Reverse Load Factoring to produce a Priest Rapids Outflow during Daylight Hours that can range from 55 to 70 kcfs. The goal during the Spawning Period is to limit spawning to the area below the 70 kcfs elevation on Vernita Bar. In the event physical changes are made at the Priest Rapids Project which affect Grant's ability to provide Reverse Load Factoring, Grant agrees to meet with the Parties to this Agreement to determine what adjustments to Grant's obligation under this subsection C.1(c) shall be made, notwithstanding the provisions of subsections B.4 and B.5.

(d) The Parties agree that BPA has no obligation under this Agreement to limit fall flows to influence Redd location. This is, however, without prejudice to the rights of any Party to assert, except before the FERC prior to ten years from the effective date of this Agreement, that BPA may have an obligation apart from this Agreement to limit such flows and the rights of any Party to request cooperation of BPA, the Bureau of Reclamation and the Corps of Engineers to limit such flows. The Parties agree to work together to obtain the cooperation of BPA, the Bureau of Reclamation and the Corps of Engineers to achieve the desired flow regime.

2. Pre-Hatch Period

During the Pre-Hatch Period the Priest Rapids Outflow may be reduced to 36 kcfs for up to 8 hours on weekdays and 12 hours on weekends (with no two consecutive minimum periods). All Parties recognize that utilization of the 36 kcfs minimum may have to be limited to achieve the Priest Rapids Outflow goal during the Spawning Period.

3. Post-Hatch Period

(a) After Hatching has occurred at Redds located in the 36 to 50 kcfs zone, the Protection Level Flow shall be maintained over Vernita Bar so that the intergravel water level is no less than 15 cm below the 50 kcfs elevation.

(b) After Hatching has occurred at Redds located in the zone above the 50 kcfs elevation, the Protection Level Flow shall be maintained over Vernita Bar through the Post Hatch Period so that the intergravel water level is no less than 15 cm below the Critical Elevation.

4. Emergence Period

(a) During the Emergence Period, after Emergence has occurred in the 36 to 50 kcfs zone, the Protection Level Flow shall not be less than necessary to maintain water over Vernita Bar at the 50 kcfs elevation.

(b) During the Emergence Period, after Emergence has occurred above the 50 kcfs elevation, the Protection Level Flow shall be maintained at or above the Critical Elevation.

5. Rearing Period

(a) All Parties recognize that flow fluctuations during the Rearing Period may impact juvenile Hanford Reach fall Chinook. The Parties also recognize that elimination of all flow fluctuations is not physically possible without severely impacting the ability of Mid-Columbia Operators to produce a reliable supply of electricity. The goal during the Rearing Period is to provide a high level of protection for juvenile Hanford Reach fall Chinook rearing in the Hanford Reach by limiting flow fluctuations while retaining operational flexibility at each of the seven dams on the Mid-Columbia River.

(b) During the Rearing Period, Grant will operate Priest Rapids Project No. 2114 to the extent feasible through use of the Mid-Columbia Hourly Coordination to produce a Priest Rapids Outflow that limits flow fluctuations according to the following criteria:

(1) When the Previous Day's Average Weekday Wanapum Inflow is between 36 and 80 kcfs limit Priest Rapids Weekday Outflow Delta to no more than 20 kcfs. When the average of BPA's Friday Chief Joseph Outflow Estimates plus side flow estimates for Saturday and Sunday is between 36 and 80 kcfs limit the Priest Rapids Weekend Outflow Delta to no more than 20 kcfs.

(2) When Previous Day's Average Weekday Wanapum Inflow is between 80 and 110 kcfs limit Priest Rapids Weekday Outflow Delta to no more than 30 kcfs. When the average of BPA's Friday Chief Joseph Outflow Estimates plus side flow estimates for Saturday and Sunday is between 80 and 110 kcfs limit the Priest Rapids Weekend Outflow Delta to no more than 30 kcfs.

(3) When Previous Day's Average Weekday Wanapum Inflow is between 110 and 140 kcfs limit Priest Rapids Weekday Outflow Delta to no more than 40 kcfs. When the average of BPA's Friday Chief Joseph Outflow Estimates plus side flow estimates for Saturday and Sunday is between 110 and 140 kcfs limit the Priest Rapids Weekend Outflow Delta to no more than 40 kcfs.

(4) When Previous Day's Average Weekday Wanapum Inflow is between 140 and 170 kcfs limit Priest Rapids Weekday Outflow Delta to no more than 60 kcfs. When the average of BPA's Friday Chief Joseph Outflow Estimates plus side flow estimates for Saturday and Sunday is between 140 and 170 kcfs limit the Priest Rapids Weekend Outflow Delta to no more than 60 kcfs.

(5) When Previous Day's Average Weekday Wanapum Inflow is greater than 170 kcfs Priest Rapids Outflow for the following weekday will be at least 150 kcfs. When the average of BPA's Friday Chief Joseph Outflow Estimates plus side flow estimates for Saturday and Sunday is greater than 170 kcfs, Priest Rapids Outflow for Saturday and Sunday will be at least 150 kcfs.

(6) On four consecutive Saturdays and Sundays that occur after 800 TUs have accumulated after the end of the Spawning Period, Priest Rapids Outflow will be maintained to at least a minimum flow calculated as the average of the daily hourly minimum flow from Monday through Thursday of the current week.

(c) All Parties agree that perfect compliance with the flow constraints of C.5(b) is not possible. Conditions related to inflow, reservoir elevation, accuracy of BPA estimates, emergencies and human error can contribute to exceeding the Priest Rapids Outflow Delta or Priest Rapids Outflow dropping below minimums specified. Grant will make every effort to meet the operating constraints.

(d) On Monday, following lower flows from the weekend it is not considered a violation of the provisions in C.5(b) when Monday inflows require increasing the Priest Rapids discharge above the upper limit established at midnight on Sunday. If the upper limit is raised on Monday, the lower limit must be raised to allow the difference between the maximum and new minimum flow to remain within the applicable Priest Rapids Weekday Outflow Delta limit.

(e) Problems can be expected from time to time. Grant will detail the circumstances associated with its inability to meet these constraints in the annual report described under C.6(c). In addition to annual reporting, the Parties agree to use the dispute resolution process described under E.9 whenever any Party claims excessive non-compliance.

6. Monitoring Team

For purposes of determining the Protection Level Flow during the Post Hatch and Emergence Periods, a Critical Elevation shall be determined each year as follows:

(a) The Monitoring Team will survey Redds on Vernita Bar in the area specified on Exhibit A for the purpose of determining the Initiation of Spawning, the location of Redds and the extent of spawning. The Monitoring Team will also provide a concurrent aerial survey of the Hanford Reach on the same weekend(s). The aerial survey(s) will be utilized to determine if Initiation of Spawning in areas of the Hanford Reach below the 36 kcfs level and/or outside the area specified on Exhibit A occurs prior to Initiation of Spawning within the Exhibit A area above the 36 kcfs level. Once an initiation of Spawning date has been determined, based upon the presence of 5 or more redds in an individual survey, the aerial surveys maybe discontinued for that year. The surveys will be conducted on weekends beginning on the weekend prior to October 15 of each year.

(b) The Monitoring Team will make a final Redd survey the weekend prior to Thanksgiving to determine the Critical Elevation. The Monitoring Team may also make a supplemental Redd survey the weekend after Thanksgiving to determine if additional Redds are present above the 50 kcfs elevation. A preliminary estimate of the Critical Elevation will be made following the final Redd survey and will be confirmed or adjusted based on the supplemental survey. The Critical Elevation will be set as follows: (Elevations must be in 5 kcfs increments beginning at the 40 kcfs elevation.)

(1) If 31 or more Redds are located above the 65 kcfs elevation, the Critical Elevation will be the 70 kcfs elevation.

(2) If there are 15 to 30 Redds above the 65 kcfs elevation, the Critical Elevation will be the 65 kcfs elevation.

(3) If there are fewer than 15 Redds above the 65 kcfs elevation, then the Critical Elevation will be the first 5 kcfs elevation above the elevation containing the 16th highest Redd within the survey area on Vernita Bar (see Table 1 below for examples of the application of these counts).

Table 1. Examples illustrating theoretical final Vernita Bar Redd counts and the resulting Critical Elevations, elevations are provided in kcfs ranges.

	36-50 kcfs	50-55 kcfs	55-60 kcfs	60-65 kcfs	65-70 kcfs	70+ kcfs	Resulting Critical Elevation
Example 1	836	418	148	71	48	34	70
Example 2	283	94	65	28	16	4	65
Example 3	105	35	10	3	1	0	55

(c) Additional activities of the Monitoring Team will include calculation of Temperature Units, determination of the dates of Initiation of Spawning, Hatching, Emergence, the end of the

Emergence Period and the end of the Rearing Period. The Monitoring Team may also make non-binding recommendations to any of the Parties to this Agreement, including non-binding recommendations to protect Redds above the Critical Elevation or to address special circumstances. By September 1 of the following year, Grant will submit an annual report to the Monitoring Team and BPA. The annual report will include, but not be limited to: 1) Vernita Bar Redd Counts, 2) dates on which the Hatching, Emergence, End of Emergence and End of Rearing Periods occurred, 3) a record of Columbia River flows through the Hanford Reach based on Priest Rapids discharges, and 4) a description of the actual flow regimes from the Initiation of Spawning through the Rearing Period based on available data. During the rearing period, Grant will provide a weekly operations report to the Parties. After review by the Monitoring Team, the final report will be sent to all Parties. During the Rearing Periods of 2011, 2012 and 2013, the Parties will also meet to develop a follow-up monitoring program to estimate fry losses. This monitoring program will be designed according to protocols developed from 1999 to 2003 or alternatively with different methods developed by the Parties.

(d) If from time to time, disputes arise regarding activities of the Monitoring Team, the Parties agree to use the dispute resolution process described under E.9 below.

7. Redds Above Critical Elevation

This Agreement is not intended either to preclude or require protection of Redds above the Critical Elevation. The Parties shall meet annually to determine if there are measures that, in the joint discretion of Grant, Chelan, Douglas and BPA, can be taken to protect any Redds located above the Critical Elevation.

D. RIVER OPERATIONS

In order to achieve the required Protection Level Flows during the Post Hatch and Emergence Periods and to provide the desired flow regimes during the Rearing Period, Grant, Chelan, Douglas and BPA agree to the following:

1. Weekday Request

On any day other than a Saturday, Sunday or Holiday, BPA shall provide a Chief Joseph Uncoordinated Request that will, on a daily average basis and when converted from megawatts to Chief Joseph discharge, be not less than the Protection Level Flow minus Side Inflows. For example, if the Critical Elevation is established at 65 kcfs, BPA shall be required to submit a Chief Joseph Uncoordinated Request during the periods described in subsections C.3(b) and C.4(b) which is not less than (but nothing in this Agreement shall require the request to be greater than) 65 kcfs minus Side Inflows on a daily average basis. For Saturdays, Sundays, and Holidays, the Chief Joseph Uncoordinated Request shall not be less than the amounts set out in subsections D.2 and D.3 below.

2. Saturday Request

Beginning 0000 hours on any Saturday, BPA may reduce the Chief Joseph Uncoordinated Request so long as the Saturday midnight accumulation of the difference between the resulting Chief Joseph discharge and the Protection Level Flow minus the Side Inflows does not exceed 925 kcfsh. The accumulated difference calculated above will be identified as the Chief Joseph Accumulated Deficiency (CJAD).

3. Sunday or Holiday Request

On any Sunday or Holiday, BPA may reduce the Chief Joseph Uncoordinated Request so long as the midnight CJAD does not exceed 854 kcfsh.

4. Post-Sunday or Holiday Deficiency

Following any Sunday or Holiday, BPA shall provide a Chief Joseph Uncoordinated Request so that CJAD does not exceed at midnight on any day the CJAD of the preceding midnight. On any weekend or holiday weekend when CJAD exceeds 0, BPA shall provide Chief Joseph Uncoordinated Requests such that CJAD will return to zero by 1200 hours on Wednesday of the following week.

5. Weekends During the Rearing Period

(a) BPA will provide flows necessary to meet the four weekend minimum flows as provided in C.5(b)(6). However, on any Saturday and Sunday of the prescribed four weekends BPA may reduce the Chief Joseph Uncoordinated Request so long as the resultant Sunday midnight accumulation of the difference between the resulting Chief Joseph discharge and the established weekend minimum flow minus the side inflows does not exceed the following criteria: 1) 925 kcfsh on Saturday at midnight, 2) 854 kcfsh on Sunday or any holiday at midnight.

(b) The accumulated difference calculated above will be identified as the Chief Joseph Accumulated Deficiency – II (CJAD-II). On all four designated weekends when CJAD-II exceeds 0, BPA shall provide Chief Joseph Uncoordinated Requests such that CJAD-II will return to zero by 1200 hours on Wednesday of the following week.

6. Grant, Chelan, Douglas and BPA Drafts and Refill

(a) Spawning through Emergence Period provisions are as follows:

(i) Grant, Chelan and Douglas shall utilize the actual discharges from the Chief Joseph Project and Side Inflows to meet the required Protection Level Flow. To the extent that actual discharges from the Chief Joseph Project, together with Side Inflows, are insufficient to meet the Protection Level Flow, Grant, Chelan and Douglas shall make up the deficiency by drafting their reservoirs in the following order and quantities to the extent required to comply with the flow regimes specified in this Agreement: 1) Grant will draft up to 3 feet from Priest Rapids, 2) Grant will draft up to 2 feet from Wanapum,

3) Chelan will draft up to 1 foot from Rocky Reach, (4) Douglas will draft up to 1 foot from Wells, and 5) Grant will draft up to 0.7 feet from Priest Rapids; provided, that in lieu of so drafting their reservoirs, Grant, Chelan and Douglas may, upon their agreement, draft their reservoirs in any alternative manner which provides the equivalent amount of total draft. Subsequent refill of the reservoirs shall be accomplished in the reverse order of draft (i.e., 0.7 feet at Priest Rapids, 1 foot at Wells, 1 foot at Rocky Reach, 2 feet at Wanapum and 3 feet at Priest Rapids) or in an alternative manner by agreement of Grant, Chelan and Douglas.

(ii) After BPA has met its Chief Joseph Uncoordinated Request obligations, and after Grant, Chelan and Douglas have provided the drafts described above, additional water may still be required from time to time on a short-term basis to meet the flow regimes specified in this Agreement. Such additional water may be required to the extent that: 1) actual discharges from the Chief Joseph Project differ from Chief Joseph discharges which would have resulted from Chief Joseph Uncoordinated Requests, and/or 2) the CJAD exceeds, from time to time, 925 kcfsh. Whenever such additional water is required on a short-term basis, it will be provided by the draft of all seven dams associated with the operation of Mid-Columbia Hourly Coordination in proportion to 50% Federal and 50% Non-Federal contribution on a content basis.

(b) During the Rearing Period prescribed in C.5 Grant will operate Priest Rapids Project No. 2114 to limit flow fluctuations and maintain a minimum flow for the four designated weekends as described in C.5(b) through the following provisions:

(i) After drafts of 1 foot from each of Wanapum and Priest Rapids (or combination thereof) have been provided, Chelan and Douglas will provide drafts of up to 1 foot from Rocky Reach and Wells Projects. All drafts will be measured from a pre-determined baseline.

(ii) After conditions under (i) above have been provided, Grant will draft Wanapum and/or Priest Rapids beyond 1 foot each as necessary to meet the rearing requirements under C.5., limited to a total equivalent draft of 3.7 feet at Priest Rapids and 2 feet at Wanapum.

(iii) Chelan, Douglas and Grant, upon their agreement may draft their reservoirs in any alternative manner, which provides an equivalent amount of total draft.

(iv) After BPA has met its Chief Joseph Uncoordinated Request obligations, and after Grant, Chelan and Douglas have provided the drafts described above, additional water may still be required from time to time on a short-term basis to meet the flow regimes of C.5. Such additional water may be required to the extent that: 1) actual discharges from the Chief Joseph Project differ from Chief Joseph discharges which would have resulted from Chief Joseph Uncoordinated Requests, and/or 2) the CJAD-II exceeds, from time to time, 925 kcfsh. Whenever such additional water is required on a short-term basis, it will be provided by the draft of all seven dams associated with the operation of Mid-Columbia Hourly Coordination in proportion to 50% Federal and 50% Non-Federal contribution on a content basis.

7. BPA Request Requirements

BPA shall provide sufficient generation requests and hourly coordination operating parameters for Grand Coulee and Chief Joseph via Mid-Columbia Hourly Coordination such that the discharge from Chief Joseph, which would result absent modification by non-Federal generation requests via Mid-Columbia Hourly Coordination, would not be less than the flows required in subsections D.1 through D.5 above.

8. Relationship to Section C

Nothing in the foregoing subsections D.1 through D.7 shall limit or diminish the obligations of the Parties under Section C.

9. Draft at Mid-Columbia Projects

Notwithstanding any other provision of this Agreement, Grant, Chelan and Douglas shall not be required to draft their respective reservoirs in a manner which would be inconsistent with the requirements of any applicable FERC license or to a level less than one (1) foot above the applicable FERC license minimum reservoir elevation. At any time that a reservoir is within one (1) foot above the applicable FERC license minimum reservoir elevation, that project shall have no further obligation under this Agreement except to pass the inflow entering that project's reservoir.

Whenever the sum of the remaining pondage in Priest Rapids, Wanapum, Rocky Reach, and Wells is less than 1500 kcfsh, Grant, Chelan, Douglas and BPA shall confer to coordinate operations regarding the maintenance of the Protection Level Flow or operations necessary to meet Priest Rapids Weekday and Weekend Outflow Delta limits during the Rearing Period.

10. Excuse of Performance

In the event any performance by any Party is rendered impossible by an act of the Bureau of Reclamation or the Corps of Engineers which is beyond the control of such Party, such performance shall be excused until the cause of such impossibility is removed or eliminated.

11. Adverse Water Conditions

When the National Weather Service/Soil Conservation Service Joint official March 1, January-July volume of runoff forecast at Grand Coulee is less than the Critical Runoff Volume, the Parties will meet prior to any reductions and discuss an allocation of available flows between power interests, fishery interests at the Hanford Reach and other nonpower interests. After such discussions, BPA may reduce its flow requests below those required under Section D resulting in a proportional reduction in the Protection Level Flow and Critical Elevation, provided that such reductions are approximately proportional to the adverse impact on Columbia River firm hydropower generation from the reduced flow volume, and provided that failure to refill shall not be the determining factor in measuring such adverse impacts. In no event shall the effect of this paragraph result in a reduction in the Protection Level Flow of greater than 15% or below 50 kcfs, whichever provides for a higher Protection Level Flow.

12. Instantaneous Minimum Flow for the Hanford Reach

The Parties further agree that a minimum instantaneous release of 36 kcfs from Priest Rapids Dam as measured at USGS gauge No. 12472800 will be maintained during all time periods except for those times when maintenance of the Protection Level Flow and Rearing Period operation constraints require a higher instantaneous minimum flow. The Parties agree that this minimum flow was historically intended to provide general protection for aquatic resources, water quality, recreation, and operation of water intakes of the Hanford Reservation and other beneficial uses of the Hanford Reach of the Columbia River.

E. MISCELLANEOUS

1. No Prejudice

All Parties stipulate that, except as expressly provided herein neither FERC approval nor any Party's execution of this Agreement shall constitute approval or admission of, or precedent regarding, any principle, fact or issue in any FERC or in any other administrative or judicial proceeding, including subsequent modification proceedings under Section B of this Agreement.

2. Waiver of Default

Any waiver at any time by any Party hereto of any right with respect to any other Party or with respect to any matter arising in connection with this Agreement shall not be considered a waiver with respect to any subsequent default or matter.

3. Entire Agreement—Modifications

All previous communications between the Parties hereto, either verbal or written, with reference to the subject matter of this Agreement are hereby abrogated, and this Agreement duly accepted and approved, constitutes the entire Agreement between the Parties hereto, and no modifications of this Agreement shall be binding upon any Party unless executed or approved in accordance with the procedures set forth in Section B.

4. Successors and Assigns

This Agreement shall be binding upon and inure to the benefit of the Parties hereto and their successor and assigns.

5. Force Majeure

No Party shall be liable for failure to perform or for delay in performance due to any cause beyond its control. This may include, but is not limited to, fire, flood, terrorism, strike or other labor disruption, act of God or riot. The Party whose performance is affected by a force majeure will make all reasonable efforts to promptly resume performance once the force majeure is eliminated.

6. Execution

This Agreement may be executed in counterparts. A copy with all original executed signature pages affixed shall constitute the original Agreement. The date of execution shall be the date of the final Party's signature.

7. Authority

Each Party to this Agreement hereby represents and acknowledges that it has full legal authority to execute this Agreement and shall be fully bound by the terms hereof.

8. Captions

Captions and titles used to identify sections of this Agreement are for the convenience of the Parties and shall not have any substantive meaning.

9. Dispute Resolution

(a) Disputes covering issues associated with the implementation of this Hanford Reach Fall Chinook Protection Program shall be subject to the dispute resolution procedures.

(b) In the event that a dispute arises over an issue associated with the implementation of the Hanford Reach Fall Chinook Protection Program, the Party raising the issue shall provide written notice of the issue and the supporting rationale to each Party to the Agreement. Within five days of receipt of such notice, the Parties shall develop a subcommittee to review the disputed issue(s). The subcommittee shall be composed of one (1) representative of each Party. Within twenty (20) days of receipt of notice of a dispute, the subcommittee shall seek to resolve the dispute. Parties shall endeavor in good faith to reach a resolution of the dispute using the best available information.

(c) At the end of the twenty-(20) day period, the appropriate subcommittee shall provide a report to the Parties describing the outcome of their efforts under Section C.8(b), above. In the event that the subcommittee has identified a proposed resolution that is consistent with terms of the Hanford Reach Fall Chinook Protection Program, the report shall describe the proposed resolution, the basis for the proposed resolution, and such additional information as may be necessary to support the proposed resolution. In the event that the subcommittee was unable to resolve the dispute, the report shall describe the remaining issues in dispute, the efforts to resolve them, and any additional information pertinent to resolving the outstanding issues in a timely manner.

(d) Upon receipt of a report described above, the Parties, within thirty (30) days, will approve or disapprove the proposed resolution. In the event that it approves the proposal, the Parties will implement the resolution as accepted. In the event that the resolution requires the regulatory approval of FERC or another regulatory entity, Grant PUD, with the support of the Parties, shall seek prompt approval of the resolution by FERC or the relevant regulatory authority, and the appropriate Party or Parties shall proceed with its implementation upon receipt of the required approval. In the event that the report identifies unresolved issues, the Parties shall undertake to resolve the matter according to procedures identified in the Alternative Dispute Resolution section below.

(e) Alternative Dispute Resolution: The Parties may use non-binding alternative dispute resolution (ADR) procedures involving a third-party mediator and in cooperation with FERC representatives to seek a resolution of an outstanding dispute that could not be resolved by the designated subcommittee. The Parties shall cooperate in good faith to promptly schedule, attend and participate in the ADR, and to devote the time, resources and attention to the ADR as may be necessary to attempt to resolve the dispute as promptly as possible.

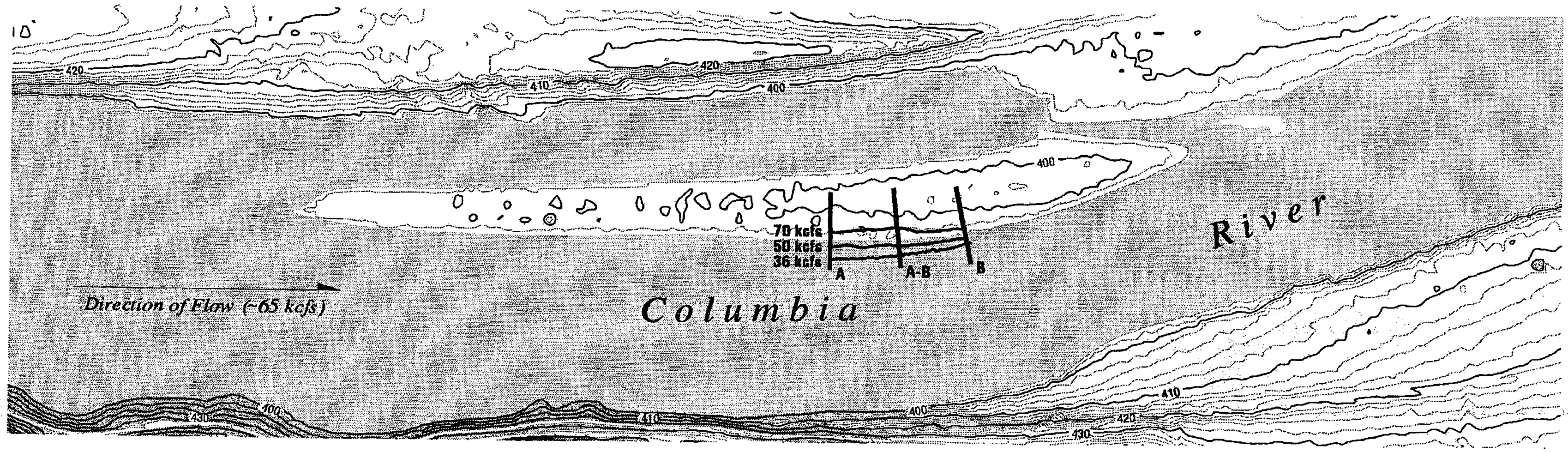
(f) Final Action: If, by the end of the thirty (30) day period (or the period otherwise agreed to), the Parties have not resolved the dispute, any Party may petition FERC for a remedy.

10. Relationship to Mid-Columbia Hourly Coordination

This Agreement is not intended to prohibit Grant, Chelan, Douglas or BPA from exercising their rights to give notice of termination of the Agreement for Hourly Coordination of Projects on the Mid-Columbia River according to its terms. The termination of that agreement shall not relieve any Party from its obligations under this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Agreement the day and year first written above.

Exhibit A. Map of Vernita Bar showing location of monitoring area.



Base map prepared by Parametrix, February 04, 2004.
File: grantpud/other_maps/plots/nc_10_17_03.gra

NOTES:
1) Water level presented is at approximately 396 feet elevation. Water level varies with river flow.
2) Elevation contours presented are based on the NGVD29 vertical datum.

0 500 1000 Feet

Vernita Bar,
Columbia River,
River Mile 393

Dated January 26, 2004

Public Utility District No. 2 of Grant County

By Timothy J. Culbertson

Name: Timothy J. Culbertson

Title: Interim Manager

Dated January 27, 2004

Public Utility District No. 1 of Chelan County

By Charles J. Hosken

Name: Charles J. Hosken

Title: General Manager

Dated January 19, 2004

Public Utility District No. 1 of Douglas County

By Wm C Dobbins

Name: William C. Dobbins

Title: CEO/Manager

Dated April 5, 2004

United States Department of Energy
Bonneville Power Administration

By [signature]

Name: Stephen J. Wright

Title: Administrator/CEO

Dated 3/22/, 2004

United States Department of Commerce
National Oceanic and Atmospheric Administration Fisheries

By D. Robert Lohn

Name: D. Robert Lohn

Title: Regional Administrator, Northwest Region

Dated 1-27, 2004

State of Washington
Department of Fisheries and Wildlife

By ______________________

Name: Jeffrey P. Koenings, Ph.D.

Title: Director

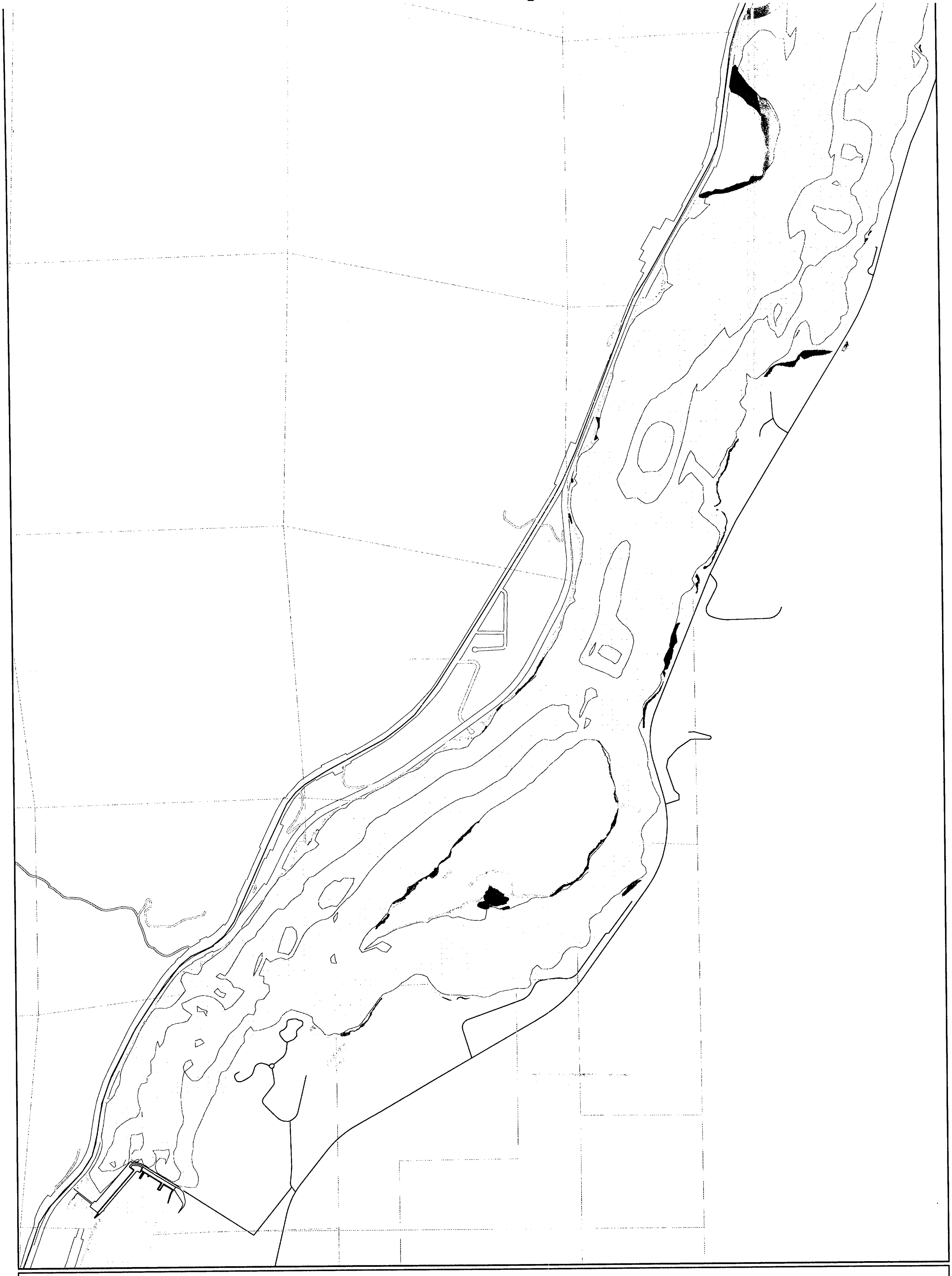
Dated 2-6, 2004

Confederated Tribes of the Colville Indian Reservation

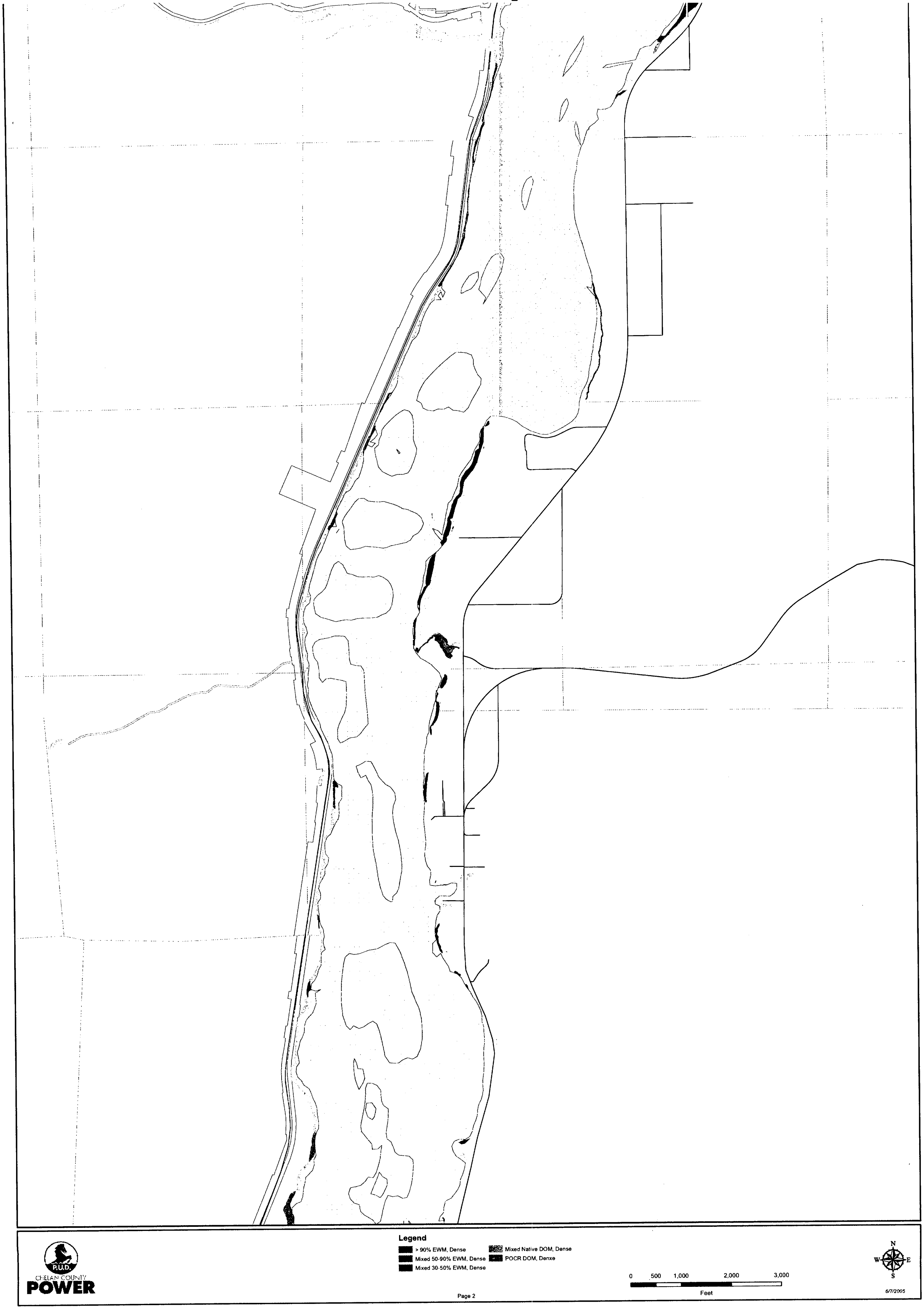
By Joseph A. Pakootas

Name: Joseph A. Pakootas

APPENDIX D: SHALLOW, LOW VELOCITY HABITATS WITH DENSE MACROPHYTE BEDS



CHELAN COUNTY POWER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Mixed 50-90% EWM, Dense
Mixed 30-50% EWM, Dense
Mixed Native DOM, Dense
POCR DOM, Dense
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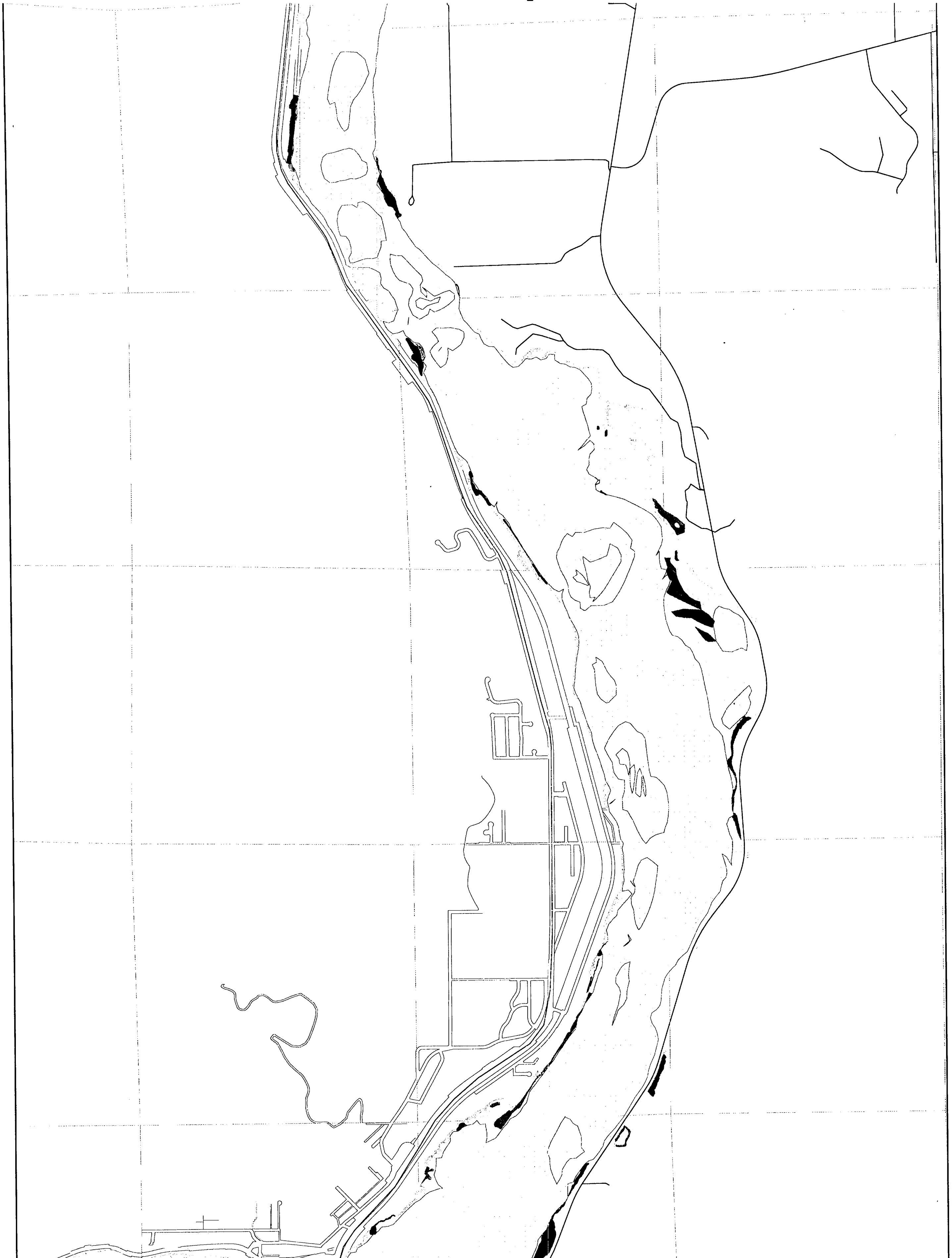
6/7/2005
P.U.D.
CHELAN COUNTY
POWER



P.U.D.
CHELAN COUNTY
POWER

Legend

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- Mixed 50-90% EWM, Dense
- Mixed 30-50% EWM, Dense
- Mixed Native DOM, Dense
- POCR DOM, Denxe

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Feet

6/7/2005


Legend
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Mixed 50-90% EWM, Dense
Mixed 30-50% EWM, Dense
Mixed Native DOM, Dense
POCR DOM, Denxe
P.U.D.
CHELAN COUNTY
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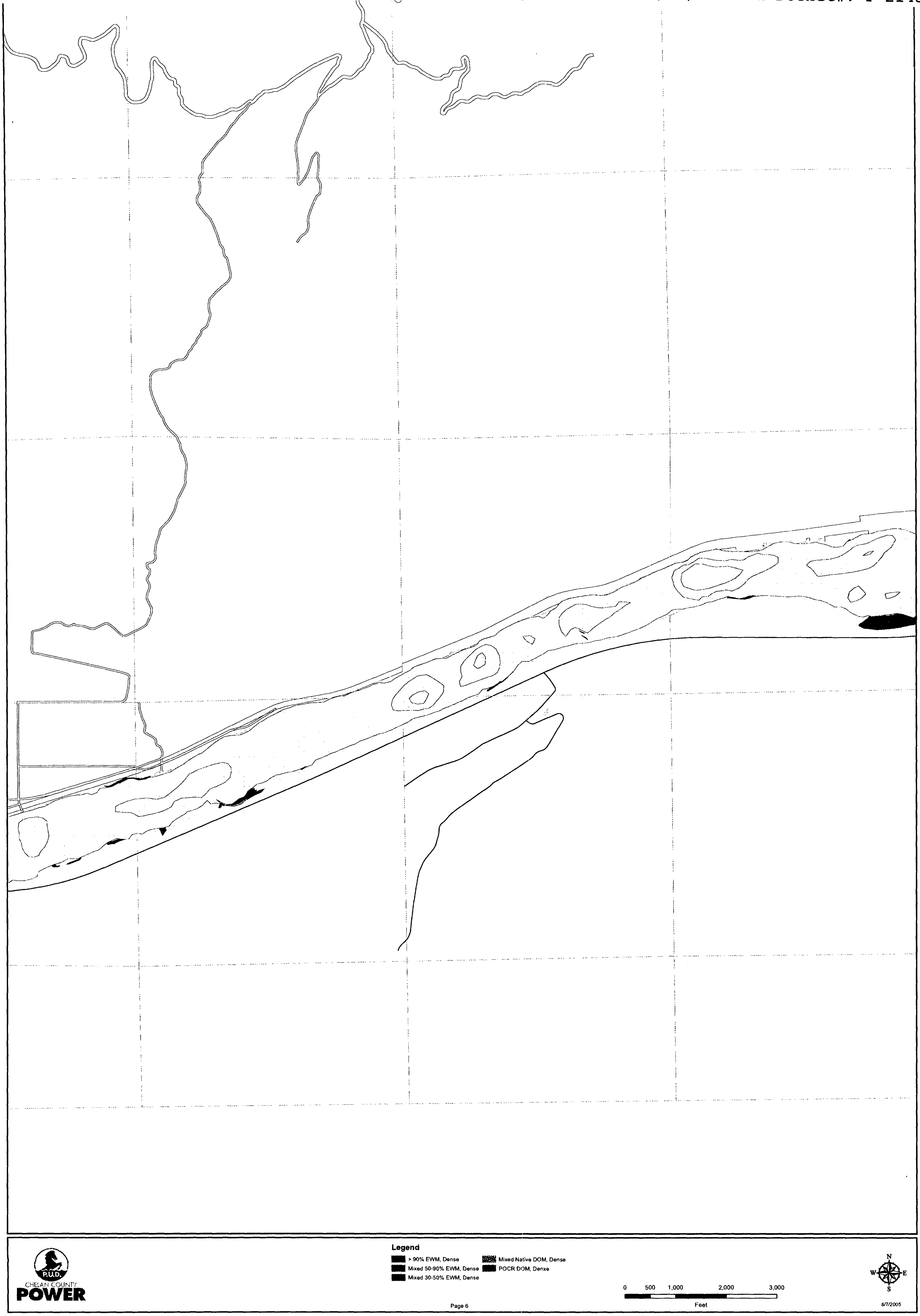
6/7/2005

CHELAN COUNTY
POWER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CHELAN COUNTY
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Mixed 30-50% EWM, Dense
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Page 6
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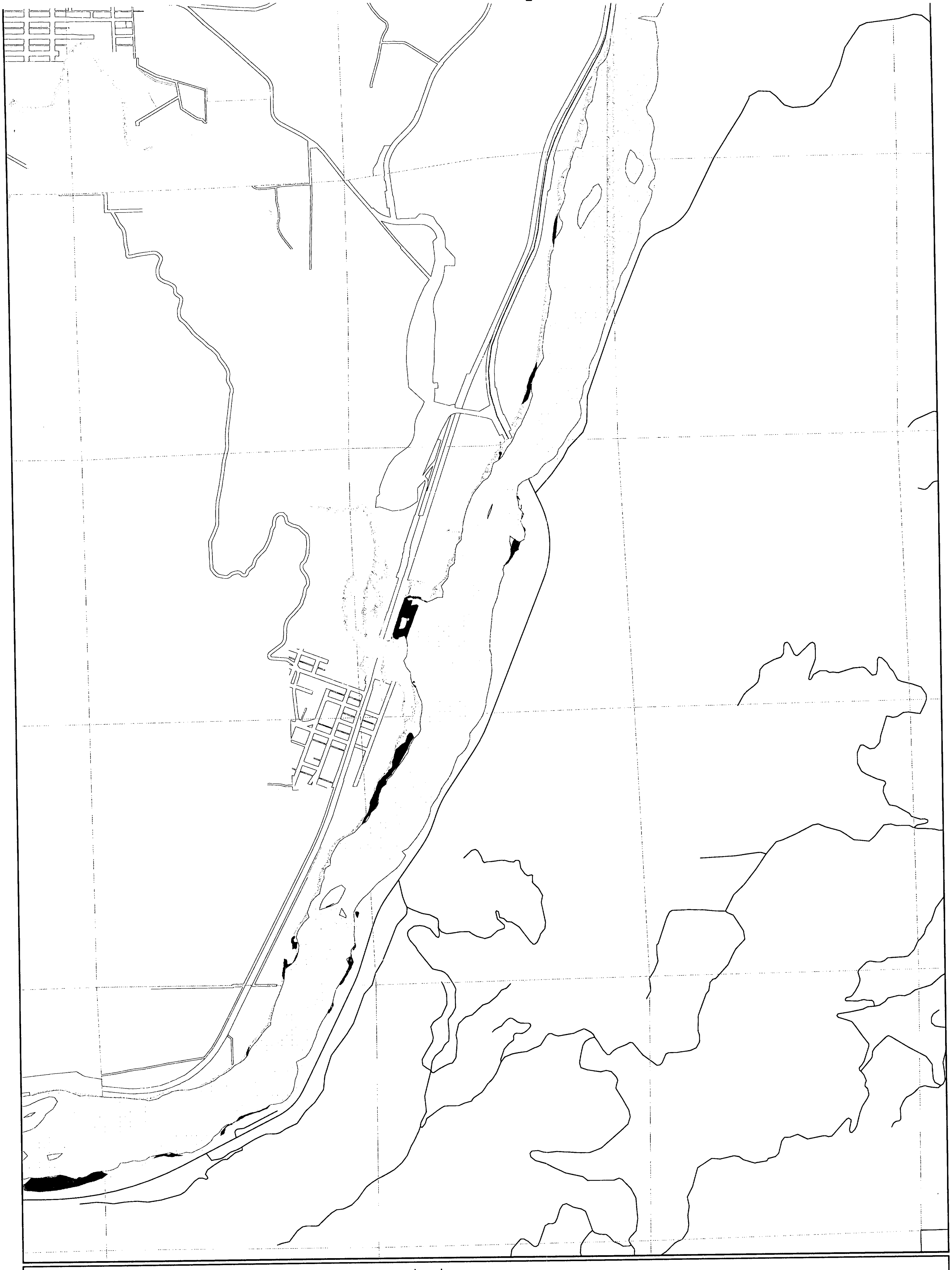

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CHELAN COUNTY
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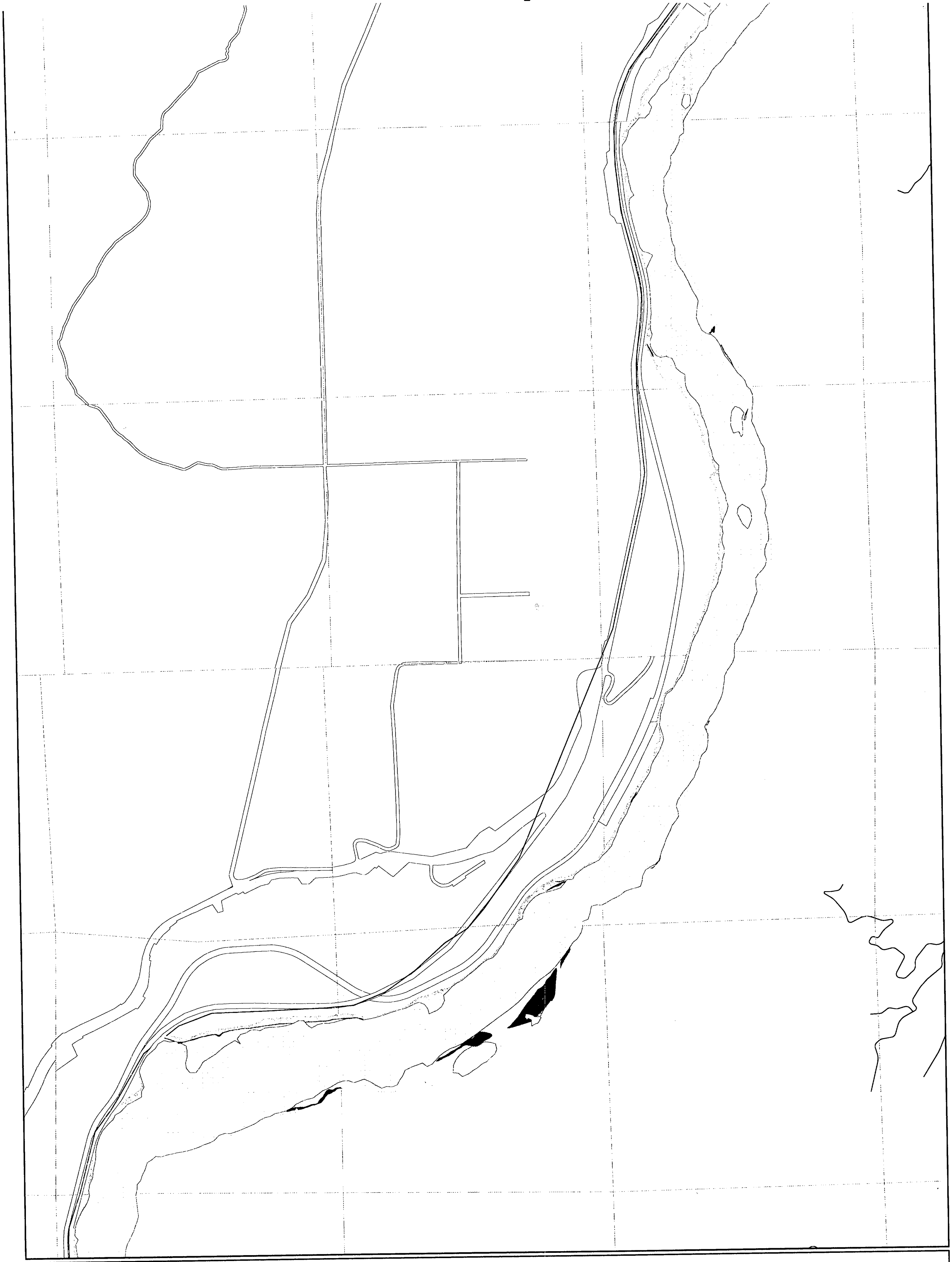

P.U.D.
CHELAN COUNTY
POWER

Legend

- > 90% EWM, Dense
- Mixed 50-90% EWM, Dense
- Mixed 30-50% EWM, Dense
- Mixed Native DOM, Dense
- POCR DOM, Denxe

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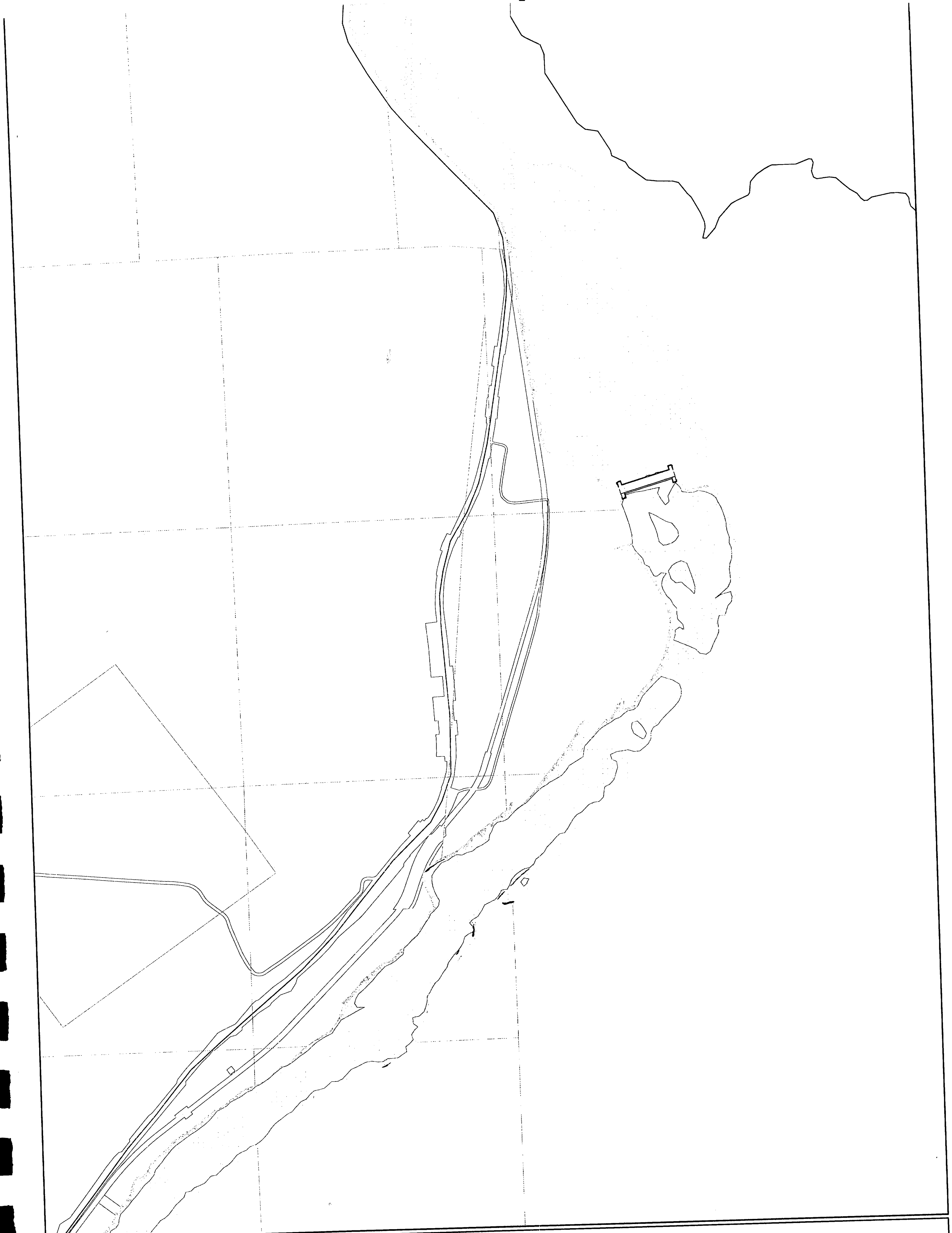
Feet

N W E S

6/7/2005



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- Mixed 50-90% EWM, Dense
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- Mixed Native DOM, Dense
- POCR DOM, Denxe

0 500 1,000 2,000 3,000

Feet

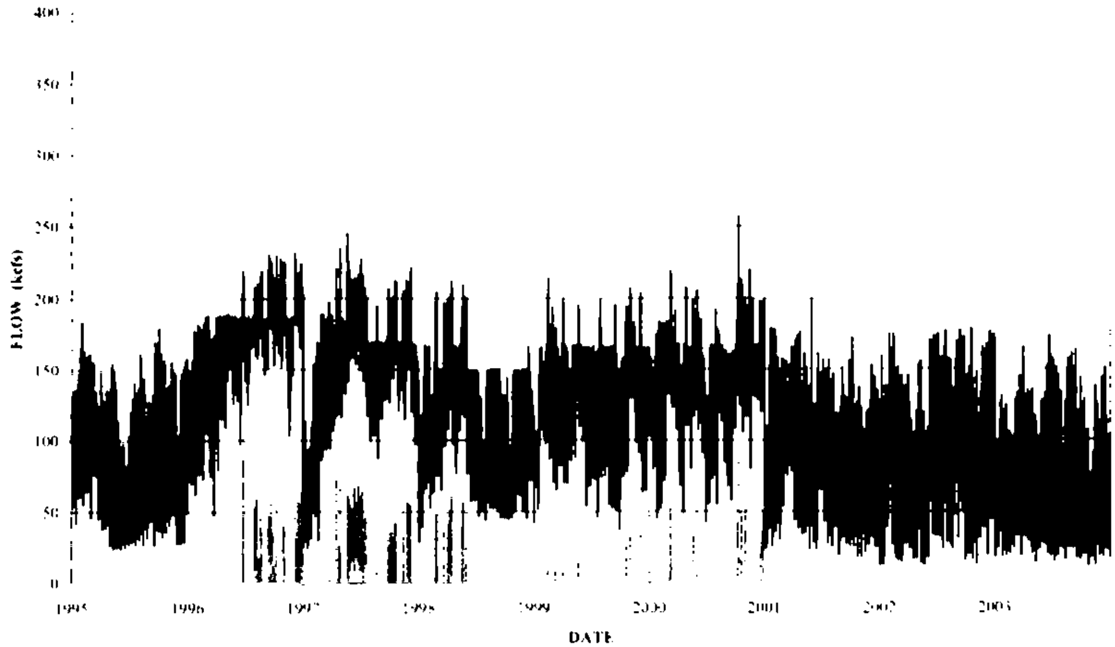
N W E S

6/7/2005

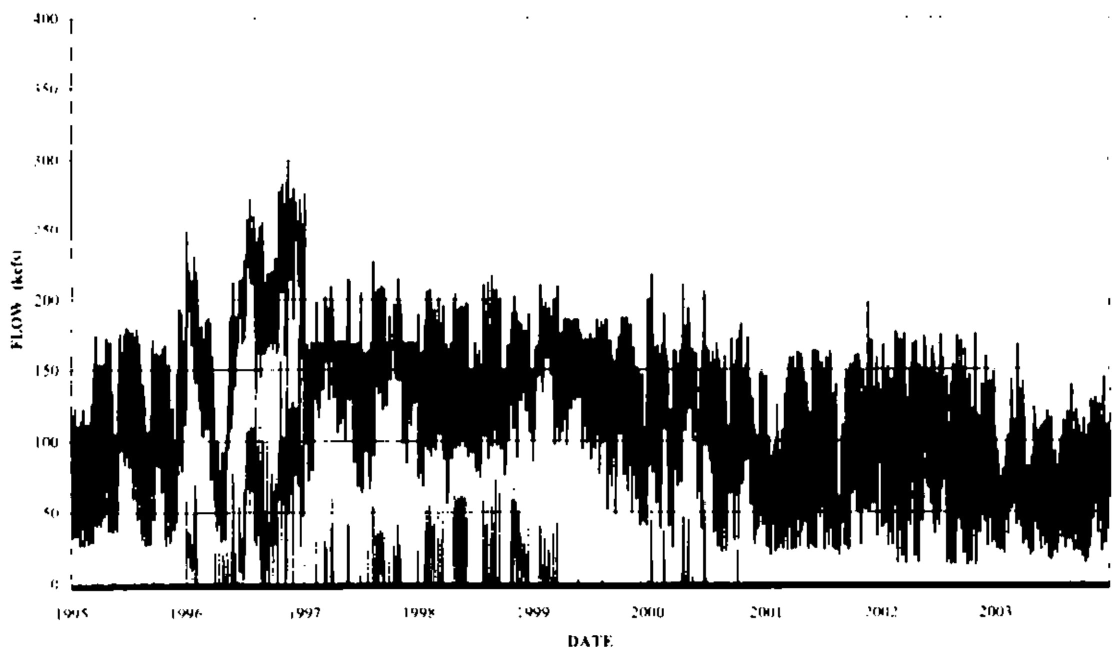
P.U.D. CHELAN COUNTY POWER

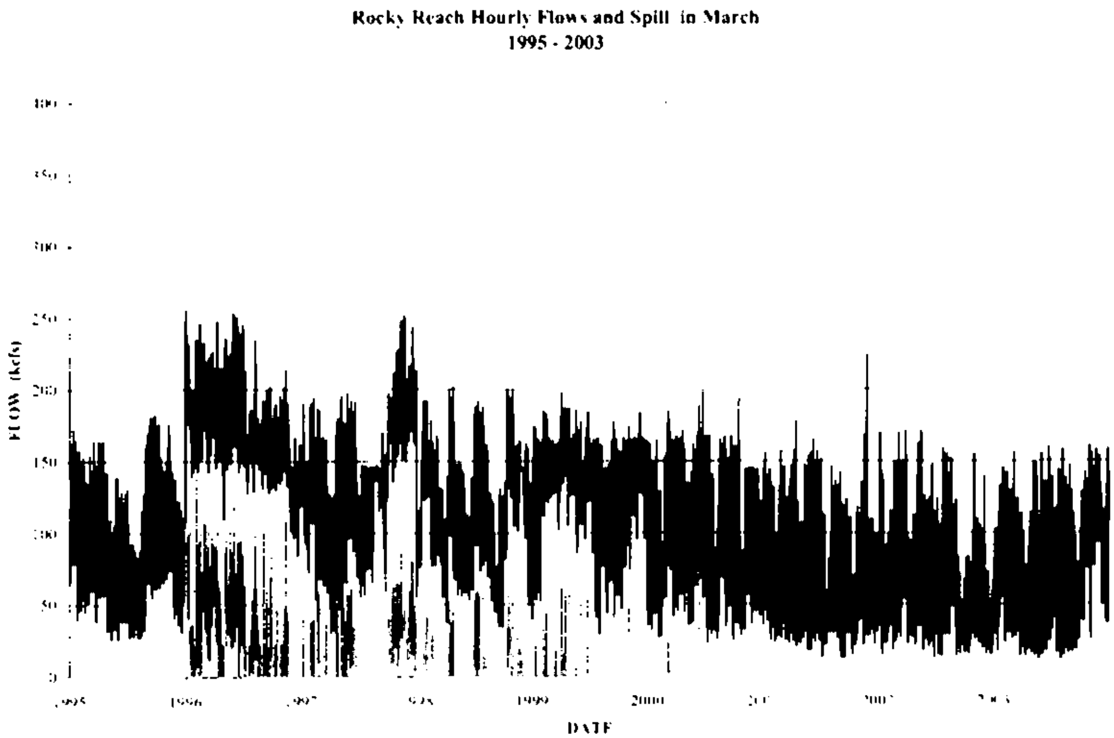
APPENDIX E: SPILL FREQUENCY AT ROCKY REACH PROJECT BY MONTH

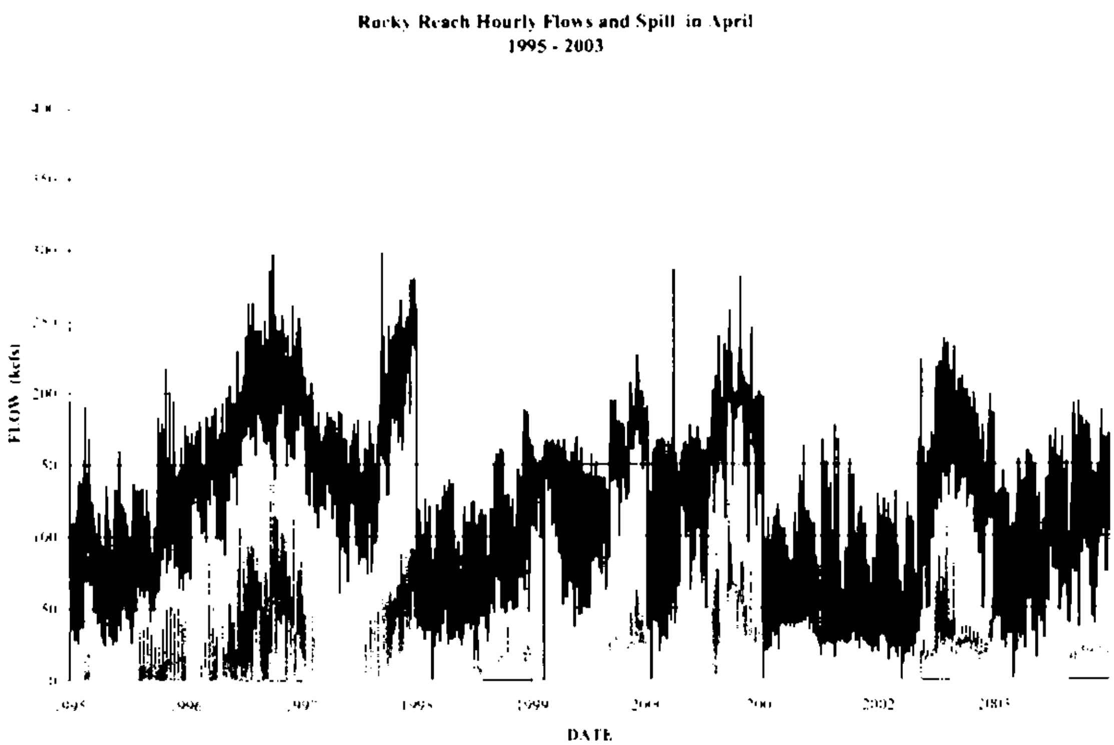
Rocky Reach Hourly Flows and Spill in January
1995 - 2003



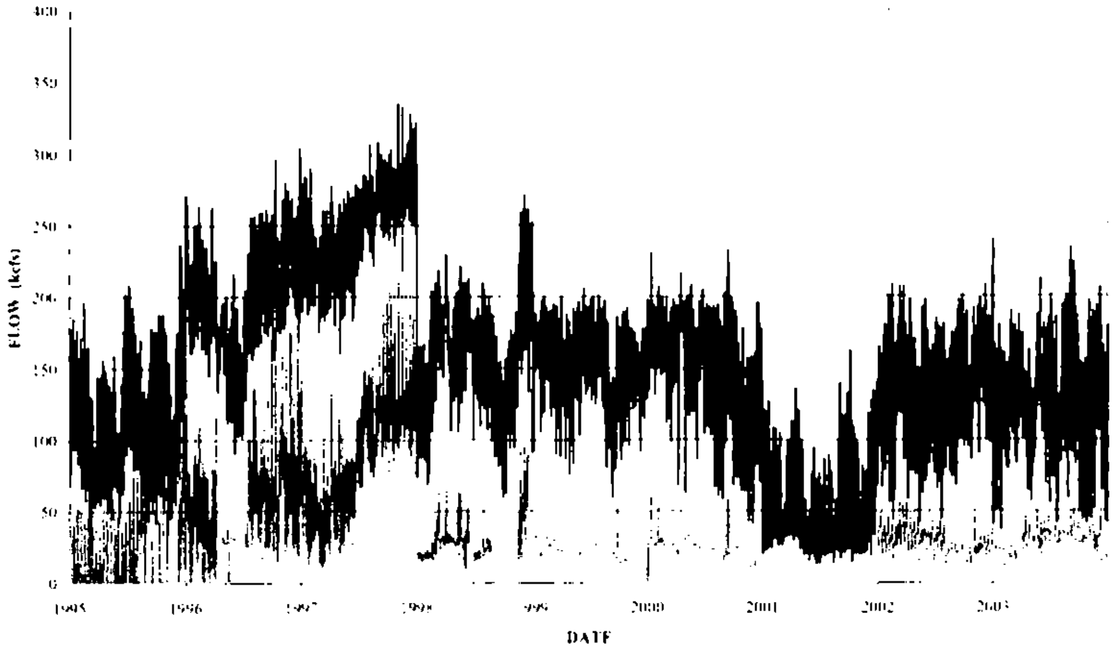
Rocky Reach Hourly Flows and Spill in February
1995 - 2003



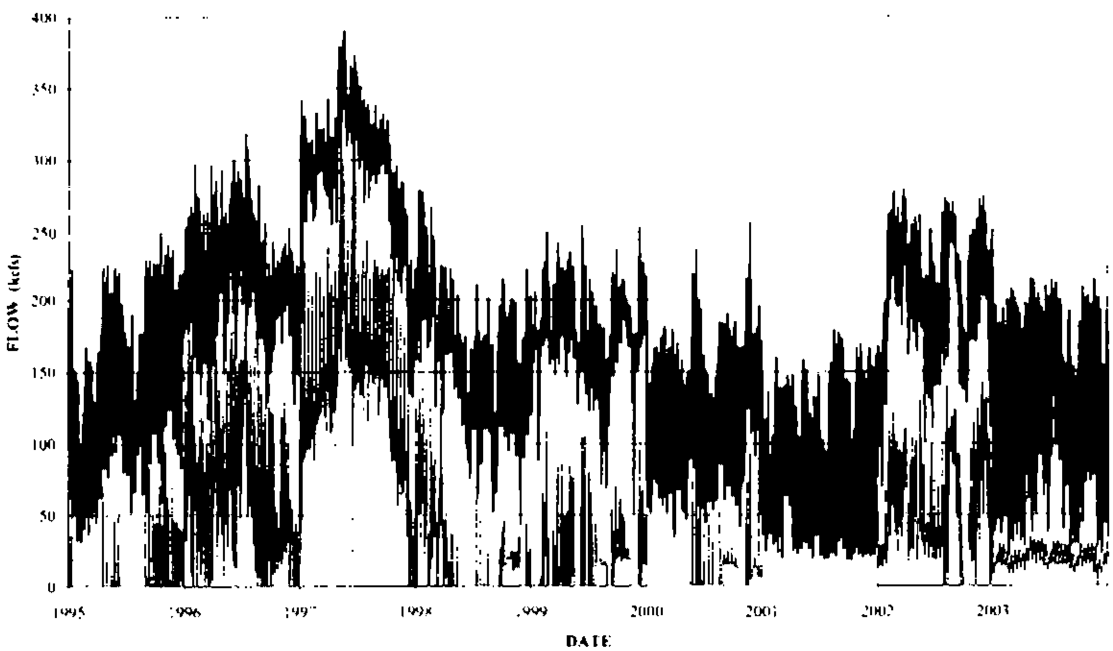

Rocky Reach Hourly Flows and Spill in March
1995 - 2003
FLOW (kcfs)
DATE


Rocky Reach Hourly Flows and Spill in April
1995 - 2003
FLOW (kcfs)
DATE

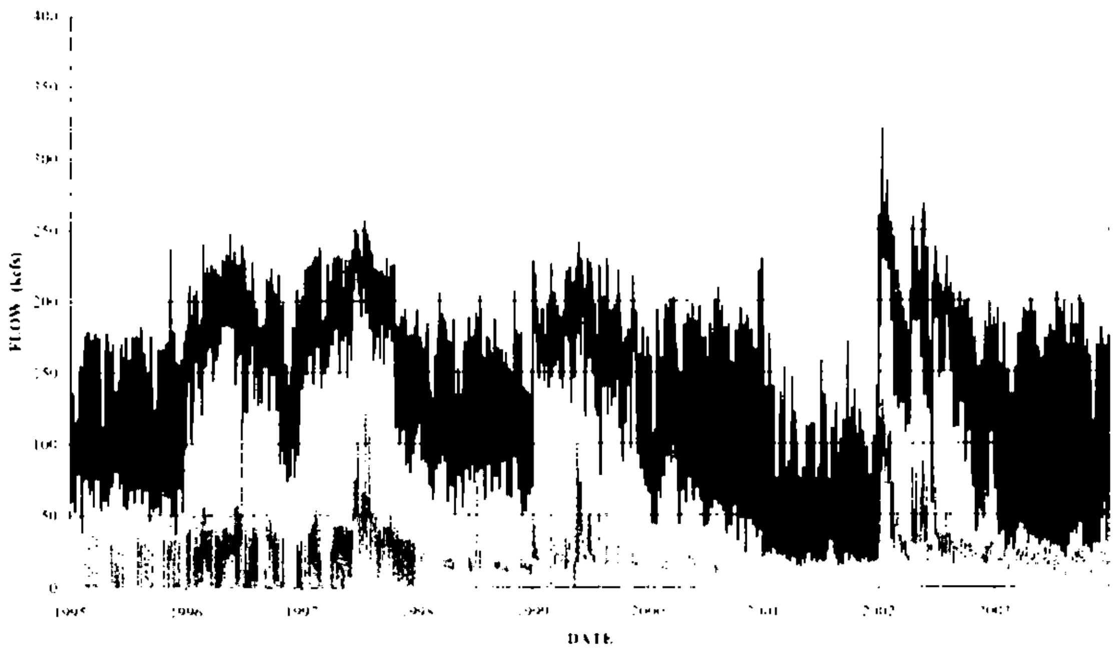
Rocky Reach Hourly Flows and Spill in May
1995 - 2003



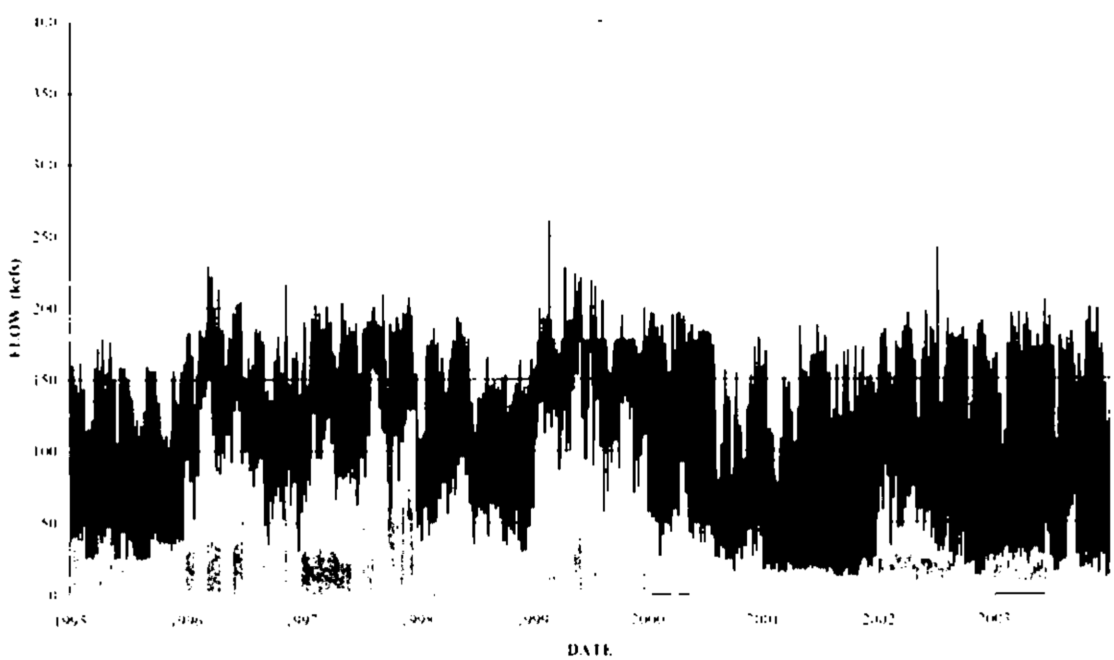
Rocky Reach Hourly Flows and Spill in June
1995 - 2003



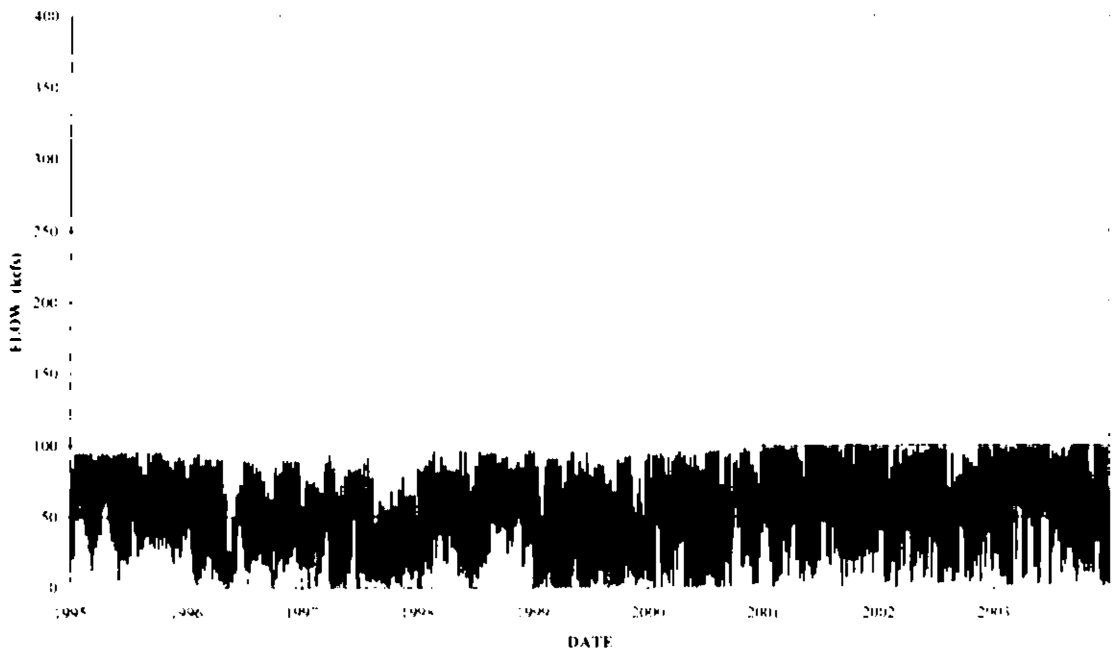
Rocky Reach Hourly Flows and Spill in July
1995 - 2003



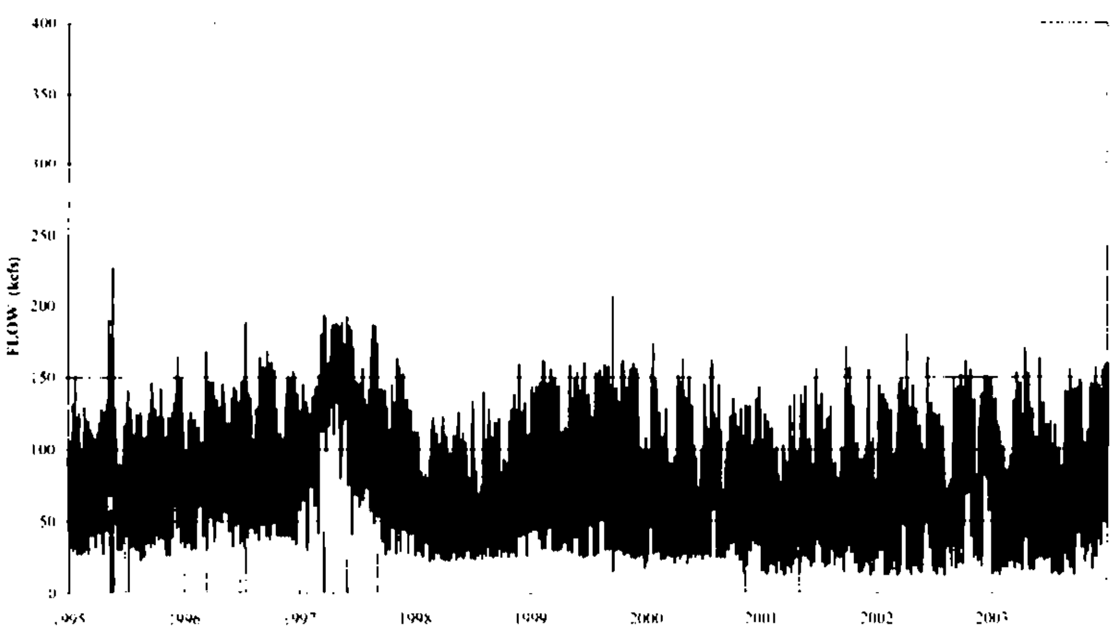
Rocky Reach Hourly Flows and Spill in August
1995 - 2003



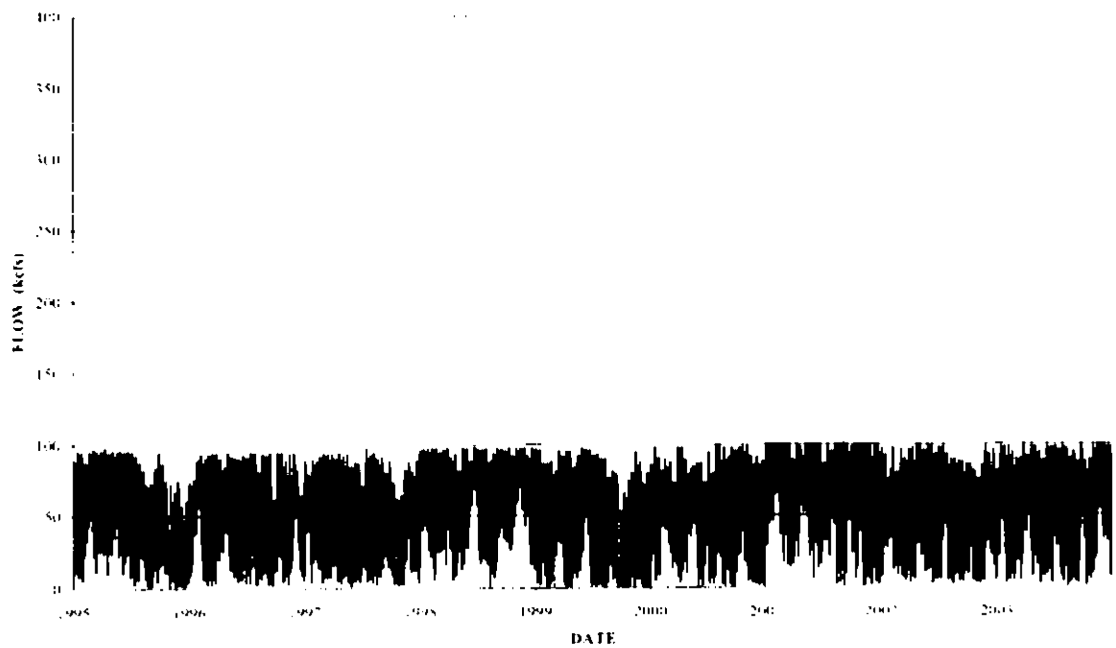
Rocky Reach Hourly Flows and Spill in September
1995 - 2003



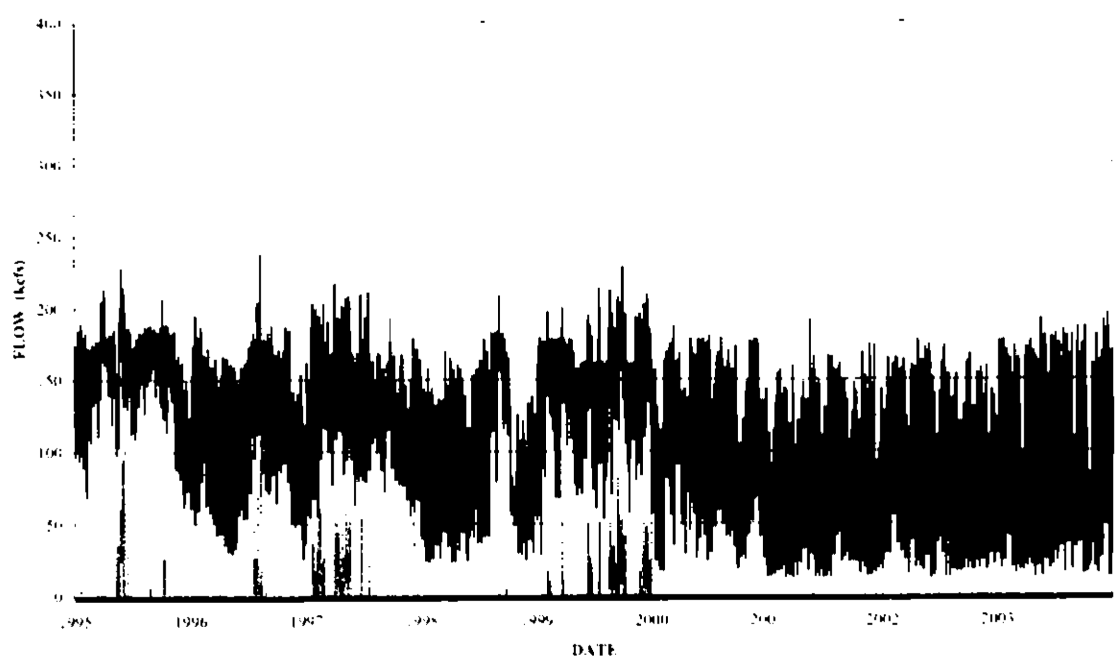
Rocky Reach Hourly Flows and Spill in October
1995 - 2003



Rocky Reach Hourly Flows and Spill in November
1995 - 2003



Rocky Reach Hourly Flows and Spill in December
1995 - 2003



CHAPTER 3: ROCKY REACH WHITE STURGEON MANAGEMENT PLAN

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LIST OF TABLES

EXECUTIVE SUMMARY

Biologists believe that construction of the dams along the middle reaches of the Columbia River has created "isolated" populations of white sturgeon in the mid-Columbia River Basin. However, the population dynamics and factors regulating production of white sturgeon within these isolated populations have been poorly understood. Therefore, Douglas, Chelan, and Grant Public Utility Districts (Mid-Columbia PUDs) each initiated studies of white sturgeon through, or in preparation for, the process of relicensing of their respective hydroelectric dams (Golder Associates 2003a, Shane Bickford, personal communication). The information gathered from these studies was intended to help relicensing decision-makers understand basic white sturgeon life history information, distribution, and current population sizes in the mid-Columbia region.

In 2001, Chelan PUD contracted with R.L. & L. Environmental Services Ltd. (now Golder and Associates) to conduct a white sturgeon investigation in the Rocky Reach Hydroelectric Project Reservoir (Reservoir). The objectives of the investigation were to determine the presence or absence of white sturgeon in the Reservoir, and to investigate general characteristics of any white sturgeon population identified in the Reservoir, including distribution, growth rate, size and age-class composition, weight, sex ratio, genetic characteristics, and relative abundance.

In 2002, Chelan PUD commissioned a more detailed, systematic study of white sturgeon in the Reservoir (Golder, 2003a). For the combined 2001 and 2002 studies, 24 white sturgeon were marked in the Reservoir. Because only four sturgeon captured in 2001 were recaptured in 2002, it was only possible to estimate the total population in the Reservoir within a broad range. Consequently, Golder and Associates estimated that there are 50-115 white sturgeon in the Reservoir, and unlikely that there are more than 300.

The overall goal of this Rocky Reach White Sturgeon Management Plan (WSMP) is to promote white sturgeon population growth in the Reservoir to a level commensurate with the available habitat based on monitoring results. This is to be accomplished by meeting the following objectives: 1) increasing the population of white sturgeon in the Reservoir through implementing a supplementation program to a level commensurate with available habitat and allowing for appropriate and reasonable harvest; 2) determining the effectiveness of the supplementation program; 3) determining the carrying capacity of available habitat in the Reservoir; and 4) determining natural reproduction potential in the Reservoir, and then adjusting the supplementation program accordingly.

The WSMP calls for Chelan PUD to implement the following Protection, Mitigation, and Enhancement measures (PMEs), described in Section 4:

1) Prepare a brood stock collection plan within year one of the effective date of the New License and, if feasible, begin brood stock collection in year two of the New License;

2) Implement a white sturgeon supplementation program by releasing up to 6,500 yearling white sturgeon into the Reservoir each year for three years, with subsequent annual release levels to be determined by the RRFF, based on monitoring results;

3) By year seven of the New License, in consultation with the RRFF, determine a long-term source of fish to be used for continuing the supplementation program throughout the term of the New License;

4) Conduct an initial three-year index monitoring program for juvenile and adult sturgeon in the Reservoir to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon;

5) Continue index monitoring every third year over the term of the New License to monitor age-class structure, survival rates, abundance, density, condition factor, growth rates; identify distribution and habitat selection of juvenile sturgeon; and direct the supplementation program strategy;

6) Conduct tracking surveys of juvenile white sturgeon released with active tags as part of the supplementation program to determine emigration rates from the Reservoir;

7) Compile information on other white sturgeon supplementation programs in the region; and

8) Capture, insert active tags, and track reproductively viable adult white sturgeon for the purpose of identifying potential spawning locations, or, if no viable adult spawning white sturgeon are active-tagged as part of indexing program, place egg collection mats below Wells Dam to evaluate spawning activity and habitat utilization.

SECTION 1: INTRODUCTION

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries agencies, tribes, and interested parties together in a Natural Resources Working Group (NRWG) that provided an opportunity for comprehensive review of current and future management priorities for fish resources potentially impacted by ongoing Project operations. The NRWG was established to identify issues, develop study plans, review study reports, and develop long-term management plans for fish and wildlife species. The NRWG consisted of representatives from the USDA Forest Service, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), the U.S. Bureau of Land Management (BLM), Colville Confederated Tribes (CCT), Yakama Nation (YN), Columbia River Inter-Tribal Fish Commission (CRITFC), and other interested parties.

Technical groups were formed for each comprehensive plan e.g., white sturgeon, bull trout, Pacific lamprey, resident fish, and wildlife due to the complexity of issues surrounding each species and so that agency experts could focus on meetings pertaining to their specific expertise. A subgroup of the NRWG, the White Sturgeon Technical Group (WSTG), comprised of the USFWS, Ecology, WDFW, YN, CRITFC, and Chelan PUD, completed this White Sturgeon Management Plan (WSMP). Upon the effective date of the New License, the Agreement's Rocky Reach Fish Forum (RRFF) will assume responsibility for meeting to share information, coordinate efforts, and make recommendations and decisions regarding the implementation of this WSMP, which will be reviewed, in consultation with the RRFF, on a periodic basis to allow for planning and future adjustments during the term of the New License and any subsequent annual licenses.

The WSTG collaborated during 2004 and 2005 on the development of goals and objectives, and, subsequently, developed Protection, Mitigation, and Enhancement measures (PMEs) to address white sturgeon within the Project boundary. During this process, the WSTG determined that white sturgeon life history characteristics and the limited number of fish estimated to exist in the Reservoir made it impractical to complete a definitive assessment of ongoing Project effects on white sturgeon. Therefore, the WSTG concluded that efforts should focus, initially, on increasing the number of fish in the existing population through supplementation, assessing natural recruitment, and then investigating the potential for natural reproduction once a population of sexually mature white sturgeon is established in the Reservoir.

This WSMP contains sections that describe the background knowledge of white sturgeon (Section 2); the relicensing and other studies conducted to determine ongoing Project-related impacts, if any, on white sturgeon (Section 3); and PMEs developed for achieving the goals and objectives to be implemented during the term of the New License and any subsequent annual licenses (Section 4).

SECTION 2: BACKGROUND

White sturgeon are the largest freshwater fish in North America. They occur throughout the U.S. portion of the Columbia River and in many of its larger tributaries. Historically, white sturgeon moved throughout the mainstem Columbia River from the estuary to the headwaters, although passage was probably limited at times by large rapids and falls (Brannon and Setter 1992).

Dam construction has created what biologists believe to be "isolated" populations of white sturgeon. Beginning in the 1930s, with construction of Rock Island, Grand Coulee, and Bonneville dams, migration was disrupted because white sturgeon generally do not pass upstream through fishways that were built for salmon, although they do pass downstream through dams (Lepla et al. 2001). Construction of hydroelectric projects in the mid-Columbia region, such as the Rocky Reach Dam, has affected upstream movement of white sturgeon. Current populations in the Columbia River Basin can be divided into three groups: fish below the Bonneville Dam, with access to the ocean; fish isolated functionally, but not genetically, between dams; and fish in several large tributaries. However, the population dynamics and factors regulating production of white sturgeon within these isolated populations are poorly understood.

2.1 White Sturgeon Management Plans in the Columbia Basin

Management programs to protect white sturgeon in the Kootenai River and the upper Columbia River are on-going and provide a relevant framework for white sturgeon management programs in the Reservoir. These recovery programs were initiated to protect and restore white sturgeon populations before they became extinct (i.e., Kootenai population) or were extirpated (i.e., Columbia population). While little is known about the white sturgeon population in the Reservoir, these other programs have provided important information that helped shape this WSMP. Relevant information on these programs is provided in the following sections.

2.1.1 Kootenai River White Sturgeon Recovery

Studies in the late 1970s and early 1980s confirmed that white sturgeon in the Kootenai River in Idaho (spelled Kootenay in Canada) had decreased in abundance compared to data collected in the previous two decades (Partridge 1983). Of greater concern, however, was the relative absence of younger age-classes. Starting in the early 1980s, fisheries management staff in British Columbia also documented an apparent reduction in adult white sturgeon abundance, as well as a reduction in the numbers of young fish. A detailed monitoring program was instituted in the early 1990s by Idaho Department of Fish and Game (IDFG) to provide further empirical information about the status of this species (Apperson and Anders 1991). With funding from IDFG, the BC Ministry of Environment also started a comparable monitoring program in 1989 in the Canadian portion of the Kootenay River, as well as in Kootenay Lake.

By the mid to late 1980s, it was obvious that the near total recruitment failure of what is termed the "Kootenai White Sturgeon" stock (which includes the British Columbia portion of the drainage, i.e., the lower Kootenay River above Kootenay Lake, Kootenay Lake and the Kootenay River downstream of Nelson to Bonnington Falls) required aggressive intervention to ensure that this species did not disappear (US Fish and Wildlife Service 1999). A pilot hatchery was designed and constructed near Bonners Ferry, Idaho, with funding provided by the Bonneville

Power Administration (BPA). This mini-hatchery was run by the Kootenai Tribe of Idaho (KTOI), with technical direction provided by the IDFG.

In 1994, the US Fish and Wildlife Service (USFWS) listed the Kootenai stock of white sturgeon as endangered, which introduced a higher level of management and control by various authorities in the drainage and region. A Recovery Team was established to provide technical direction regarding the numbers of fish produced at the hatchery, release numbers, and breeding (to address genetic introgression issues). A final "Kootenai White Sturgeon Recovery Plan," which had undergone public and agency review in both the United States and Canada, was signed by the USFWS in 1999.

A major habitat restoration focus of the Kootenai White Sturgeon Recovery Plan has been to increase the extent and duration of spring freshet flows in the Kootenai River. Essentially, this is provided through releases from the US Army Corps of Engineer's Libby Dam in Montana. To date, the results of these increased flows have been inconclusive; i.e., there is as yet no indication that high flows during the spring translates into increased survival of white sturgeon eggs and/or fry (J. Hammond, pers. comm., 2003). This assessment must be tempered, however, because of the difficulties of sampling young-of-the-year (YOY) white sturgeon fry. At present, white sturgeon must be a minimum of one to two years of age before they can be captured adequately by standard sampling gear (C. Spence, pers. comm., 2002). As a consequence, it is difficult to assess the relationship between flows and recruitment.

The KTOI Hatchery (KTOIH), which experienced significant challenges during the early years of its operation, now produces high-quality juvenile white sturgeon for a directed stocking program. In addition, there is a fail-safe hatchery for Kootenai sturgeon at the Kootenay Trout Hatchery (KTH) at Wardner, B.C. Every year, half of all the fertilized eggs produced at the KTOIH are transported to the KTH in case either facility should experience a major problem with egg and/or fry survival.

One of the ongoing issues regarding the Kootenai White Sturgeon Recovery Plan is potential genetic swamping of the "wild" sturgeon by those produced and stocked from the hatchery. A breeding plan was developed in the mid-1980s that focused on determining an appropriate method of breeding fish to maximize the genetic diversity of hatchery-produced fish (Kincaid 1993). The approach was based on conservative estimates of survival, distribution, sexual maturity, and availability of breeding fish. Some of these assumptions have since been judged as either erroneous or overly conservative. As a consequence, the Kootenai White Sturgeon Recovery Plan was rewritten in order to incorporate the newest and best available data.

Another major uncertainty in the Kootenai White Sturgeon Recovery Plan implementation centers on stocking rates and fish size at release. In the absence of empirical data or, at a minimum, acceptable biostandards, these uncertainties cannot be resolved since "historical" levels of white sturgeon abundance and recruitment in the river and the lake are unknown. Changes to the Kootenai River ecosystem from regulation by Libby Dam further complicate this problem. To date, the approach has been to annually revisit the stocking number and fish size issue based on the most up-to-date information on juvenile survival and growth rates. This type of adaptive management approach also incorporates new information on natural spawning success collected during annual monitoring programs.

2.1.2 Upper Columbia River White Sturgeon Recovery

White sturgeon populations in the Canadian (upper) portion of the Columbia River between the United States-Canada Border and Hugh L. Keenleyside Dam (HLK) were initially studied in the early 1980s. General fish inventory studies conducted in this area in the early 1990s demonstrated that the size-class distribution of white sturgeon had shifted significantly in the interim from a population dominated by younger white sturgeon (less than 1.0 m total length (TL)) in the 1980s to one dominated by adults (greater than 1.5m TL) in the 1990s (Hildebrand et al 1999). Based on this information, the white sturgeon population in the Columbia River in Canada was listed by the B.C. Conservation Data Centre as endangered in 1996, and the fishery for this species (recreational and guided) was closed. Subsequent studies of the white sturgeon population that resides in the Columbia River between Hugh L. Keenleyside Dam and Grand Coulee Dam have supported the initial assumption that recruitment to this trans-boundary population is extremely limited and the remaining population is aging and declining in abundance.

Due to conservation concerns about upper Columbia white sturgeon, and in response to the provincial listing of the upper Columbia River white sturgeon population and the new Species At Risk Act (SARA) being drafted by the Canadian federal government, a decision was made by Canadian organizations in 1996 to develop a recovery plan. The process was built upon a Canadian Columbia River white sturgeon stock stabilization report (Hildebrand and Birch 1996) that was based on the Kootenai River White Sturgeon Recovery Plan.

A joint commitment to a recovery program was formalized by the Department of Fisheries and Oceans Canada, B.C. Environment, B.C. Fisheries, and BC Hydro in an August 17, 2000 Letter of Understanding. The letter outlined the approach for recovery planning and described agreements on funding for the development and delivery of a recovery strategy. The agreement also defined a process for engaging First Nations and stakeholders (interested parties) in recovery planning in order to build understanding and support for the plan and to explore possible sources of funding for full implementation of the plan. Since this trans-boundary stock was not listed (and presently remains unlisted) under the U.S. Endangered Species Act, the recovery of this population required the effective inter-jurisdictional coordination of Canadian and U.S. recovery efforts. This process led to active U.S. participation by the Spokane Tribe, Colville Tribes, USFWS, the BPA, and the State of Washington.

In 2002, a bi-national technical Recovery Team, termed the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI), finalized the Upper Columbia White Sturgeon Recovery Plan (UCWSRI 2002). This plan was a cooperative effort that involved Canadian and U.S. governmental, aboriginal, industrial, and environmental organizations, as well as individual citizens. Plan development also involved an Action Planning Group, with representation by the Province, Department of Fisheries and Oceans Canada, regional governments, First Nations, members of the public, environmental and industrial stakeholders, and U.S. regulatory and tribal agencies. A Recovery Team consisting of technical representatives from Federal, Provincial, and State resource management agencies and from Canadian and U.S. tribes directs the recovery program.

Owing to the near total recruitment failure in the last two decades, a decision was made early in the recovery planning process to move immediately to development of a hatchery program to produce juvenile sturgeon for stocking into the Columbia River downstream of the Hugh L. Keenleyside Dam. Using the Kincaid (1993) breeding plan developed for the Kootenai sturgeon program as a model, a breeding plan was developed for upper Columbia sturgeon. Originally housed at the Hill Creek Hatchery at the upper end of the upper Arrow Lakes Reservoir, the rearing of all fish now occurs at the KTH (owing to operating efficiencies, staffing, and reliability of water supply).

A monitoring program is ongoing (on both sides of the international border), and the main focus is the development of a juvenile index monitoring program to assess growth, survival, health, distribution, and relative abundance of released juveniles. The information collected by this program is essential to monitor the success of the hatchery stocking program and provide information on any natural recruitment that may occur.

2.2 Status and Information Needs for the Rocky Reach Reservoir

Historical angler reports indicated that white sturgeon were previously captured in the upper portion of the Rocky Reach Reservoir, above the confluence of the Chelan River. More recently, the presence of white sturgeon in the Rocky Reach Reservoir was confirmed below Wells Dam, based on captures of this species during northern pikeminnow control activities conducted by Douglas County in the upper portion of the Reservoir (Golder 2003a).

Since little information existed on the status of white sturgeon populations in the mid-Columbia, Chelan, Douglas, and Grant County PUDs each initiated studies of white sturgeon through their current or upcoming process of relicensing their hydroelectric dams. (Golder Associates 2003a, Shane Bickford, personal communication). The information gathered from these studies is intended to help relicensing decision-makers understand basic white sturgeon life history information, distribution and current population sizes in the mid-Columbia region. Study results are discussed in the Section 3.

SECTION 3: STUDIES AND EVALUATION OF PROJECT EFFECTS

The presence of white sturgeon within the Reservoir was first confirmed during northern pikeminnow control activities conducted by Douglas PUD in the upper portion of the Reservoir, in the Wells Dam tailrace (Golder 2003a). Additionally, historical angler reports indicated that white sturgeon were captured previously in the upper portion of Reservoir above the confluence of the Chelan River. The available information, however, is not sufficient to assess accurately the status of the populations within the Reservoir, or to comprehensively determine what effects ongoing Project operations may have on the health of those white sturgeon populations.

Since available data on the status of the white sturgeon population were very limited, the NRWG identified data collection as a priority for the relicensing process.

3.1 ***Relicensing Studies***

In 2001, Chelan PUD contracted with R.L. & L. Environmental Services Ltd. to conduct a white sturgeon investigation in the Reservoir (R.L. & L. 2001). The objectives were to determine the presence/absence of white sturgeon in the Reservoir and to investigate general population characteristics of the white sturgeon observed, including distribution, growth rate, size and age-class composition, weight, sex ratio, genetic characteristics, and relative abundance.

An extensive capture effort in 2001 consisted of 153 total overnight net sets at 75 stations over three seasons (spring, summer, and fall). These efforts resulted in the capture of 18 white sturgeon, ranging in age from four to 48 years. Seven of these fish, ranging in age from four to six years, were identified as juveniles. All of the fish were tagged with Passive Integrated Transponder (PIT) tags, and five were tagged with sonic tags. The significant percentage of juveniles (39 percent) collected indicated some level of recent recruitment to the Reservoir population. These data suggest that one, or both, of the following has occurred: 1) spawning in the Reservoir; or 2) downstream movement of juveniles from points upstream of Wells Dam.

In 2002, Chelan PUD commissioned more detailed, systematic studies of white sturgeon in the Reservoir (Golder, 2003a). The 2002 study plan was based on the R.L. & L. study from the previous year. The objectives of the 2002 investigation were to systematically survey the distribution of white sturgeon throughout the Reservoir, and to obtain additional information on the general characteristics of the Reservoir population.

During the 2002 white sturgeon study, Chelan PUD contractors spent approximately 130,000 hook-hours of set line sampling effort in the Reservoir. This effort resulted in the capture of 10 white sturgeon that ranged in age from five to 24 years. Eight of these fish were identified as juveniles. Fork length of the ten fish captured ranged from 37 to 94 inches, and weights ranged from nine to 185 pounds.

For the combined 2001 and 2002 studies, 28 white sturgeon were marked. The number of recaptures was very low (n=4), or approximately 16 percent. As a result, population estimates exhibited wide confidence intervals. Mark-recapture data were used to generate a preliminary population estimate for white sturgeon in the Reservoir.

3.1.1 Population Characteristics

Using the Schnabel population estimation method (Krebs, 1989), the white sturgeon population in the Reservoir was estimated within a range of 50 to 115 fish, with a 95-percent confidence interval of 23 to 698 fish (Golder, 2003a). While the accuracy of this estimate is very uncertain, comparisons with other reservoir-based populations in the middle Columbia River suggest it is unlikely that the population is greater than 300 fish.

Juveniles are much more abundant in the Reservoir than they are in either the upper Columbia River or in the nearby downstream Wanapum and Priest Rapids reservoirs. This could be the result of successful spawning by the population residing in the Reservoir, but that has not yet been verified.

3.1.2 Sex Ratio and Reproductive Potential

The sex ratio of white sturgeon sampled in the Reservoir was 1:1; this was similar to sex ratios reported for white sturgeon populations in the free-flowing section of the Columbia River below Bonneville Dam (a non-impounded reach; DeVore et al., 1993), in the Wanapum Hydroelectric Project reservoir on the middle Columbia River (Golder, 2003c), and in the lower Snake River (Lepla et al., 2001).

Of the eight ovaries examined in the Reservoir, 37% were classified as non-reproductive, 37% as pre-vitellogenic (pre-productive), 13% as early vitellogenic (the early stages of productive), and 13% as ripe (productive). Similar proportions of ripe females were observed within the present white sturgeon population and populations on the Kootenai and lower Snake rivers.

Male white sturgeon mature at different rates and spawn over different intervals compared to females, and on average spawn every one to three years (Chapman 1989, Beamesderfer et al., 1995). Welch and Beamesderfer (1993) reported that large females (i.e., greater than 166 cm/65 in. FL) appear physiologically capable of spawning about every three years, with the spawning cycle consisting of a two-year period of oocyte development and a one-year resting period prior to re-initiation of gonadal development. Based on banding patterns on bony structures, other researchers have suggested five to seven year maturation intervals for female white sturgeon (Semakula and Larkin 1968, Chapman 1989, Beamesderfer et al. 1995). Based on this information, the number of females capable of spawning each year in the Reservoir is likely low.

3.1.3 Spawning and Recruitment

Assuming a maximum population size of 300 fish (of which 50% are mature) and a sex ratio of 50% females, there could be up to 75 mature females in the Reservoir population. Estimates of the annual proportion of females in a population that are capable of spawning (ripe) in a given year range from 2% in the unimpounded section of the Columbia River below Bonneville Dam to 13% in the Kootenay River. Applying this range to a population of 75 mature females suggests that potentially between two and ten females could be capable of spawning in any given year.

Based on percentages of ripe females recorded in other Columbia River populations (that range from 2% to 4%), the 2% estimate is more likely. Information from the results of spawning activities for white sturgeon populations in the Kootenai River in Idaho and the upper Columbia

River between HLK and Grand Coulee dams suggests that this level of spawning activity does not provide the strong recruitment pulse observed for the Rocky Reach Reservoir population during the late 1990s. The Kootenai River and upper Columbia River populations, which consist of approximately 900 to 1100 fish, are composed primarily of adults and exhibit annual spawning activity (Golder, 2002). The levels of recruitment observed in these two more northerly populations have never approached the recruitment pulse recorded in late 1990s in the Rocky Reach Reservoir. In Grant County PUD's Wanapum Reservoir, approximately 21 miles downstream from the Rocky Reach Dam, a recruitment pulse was observed in the 1990s. This pulse, however, was one third the magnitude of the white sturgeon population recruitment pulse (i.e. an influx of fish into a geographic area) observed in the Rocky Reach Reservoir.

Another possible explanation for the high levels of recent recruitment in the Rocky Reach Reservoir may be related to juvenile immigration. These juveniles would most likely originate from populations in upstream reservoirs. Limited support for this hypothesis was provided by the documentation of one sonic-tagged juvenile white sturgeon that moved downstream from the Rocky Reach Reservoir through Rocky Reach Dam and into the upper section of the Rock Island Reservoir. The passage route of this fish through Rocky Reach Dam (i.e., spillway, turbine, or upstream fishway) was not determined. White sturgeon have been documented to use upstream fishways at lower and mid-Columbia River dams for both upstream and downstream passage, but, for reasons that are still poorly understood, the use of these fishways is highly variable among dams even though the fishways are similarly designed (Lepla et al., 2001). Juvenile white sturgeon have been documented to migrate downstream during winter and early spring months; these movements may be related to feeding activities (Bajkov, 1951).

Based on available data, recruitment to the Reservoir population has been sporadic and apparently limited to a strong recruitment period between 1995 and 1997 (and particularly 1997), and a lesser degree of recruitment between 1982 and 1987. Higher levels of recruitment may be associated with high flow events that transport young sturgeon into the Reservoir from upstream spawning areas. Flows in excess of 200,000 cubic feet per second were released from upstream projects in 1981, 1982, 1990, 1991, 1996, and 1997. High flows in these years could have transported young sturgeon produced in upstream reservoirs to the Reservoir. Such occurrences would also be dependent on strong recruitment from natural reproduction in these upstream habitats in the years during or preceding the high flow events. In addition, high flows could be associated with sporadic periods of successful reproduction of sturgeon within the Reservoir. In either case, the incidence of high flow years has been more frequent than the incidence of high recruitment of sturgeon to the reservoir. Whether from immigration or reproduction within the Reservoir, or both, the years with strong recruitment and gaps in recruitment are not entirely explained by flow conditions.

Historical recruitment trends based on assigned ages of white sturgeon should be interpreted with caution, since the use of fin rays to age white sturgeon is not very precise or accurate for larger individuals, and assigned ages tend to underestimate their true age (Rien and Beamesderfer 1994). However, since aging methods for younger sturgeon are more precise, the identification of the strong 1997 year-class in the Reservoir has a high probability of being accurate. The large number of fish captured during the present study from the 1997 year-class corresponds to the highest flow year on record since 1961 (Golder 2003a); this may suggest that high water years increase the survival and recruitment of juvenile white sturgeon, possibly because high flows provide increased turbidity or water volume, which enhances predator avoidance or improves the quality or quantity of rearing habitat. However, since it is not known if spawning occurs in the Reservoir, the strong year-class may be from reproduction that occurred in upstream reservoirs and reflected high flows that flushed young white sturgeon out of upstream habitats.

3.1.4 Growth

Information on growth of white sturgeon in the Reservoir was limited to one recaptured juvenile white sturgeon (82.0 cm/32.3 in. FL; age-5 at initial capture). This individual exhibited an incremental growth-rate of 23.5 cm (9.3 in.) after approximately one year at-large. Observed growth-rates tend to be higher for smaller-sized white sturgeon and vary depending upon age. For example, growth-rates of older juvenile white sturgeon below Hells Canyon on the Snake River averaged between 3.3 and 9.0 cm (1.3 and 3.5 in.) per year (Lepla et al., 2001), whereas hatchery-raised juvenile white sturgeon (age-1) released into the upper Columbia River below Keenleyside Dam demonstrated an average growth of approximately 0.1 cm (0.04 in.) per day for an average of 127 days at-large (summer and fall seasons only; Golder 2003c). In comparison, average growth-rates for older fish (sub-adults and adults) were 10.0 cm (3.9 in.) and 6.5 cm (2.6 in.) per year in the Bonneville and Wanapum hydroelectric project reservoirs, respectively.

Significant, observed changes in growth rate, called inflection points in the growth curves of fish, are commonly associated with changes in physiology, habitat, and food resources (Moreau 1987). For white sturgeon in the Reservoir, the inflection point in the growth curve was obscured and could not be determined because intermediate age-classes were not well represented in the sample, and because of the wide variation in length-at-age for younger year-classes. Inflection points in the Wanapum Reservoir on the mid-Columbia River (Golder 2003c) and on the Snake River were identified at age 10 (Lepla et al. 2001). Tracy and Wall (1993) found an inflection point at age eight for a population of white sturgeon below Bonneville Dam, and indicated that the von Bertalanffy growth functions were not well represented for fish under eight years old.

3.1.5 Movements

Movement information recorded for sonic tagged white sturgeon in the Reservoir is considered preliminary since observations were based on only one early overwintering period (October 2002 to January 2003). Sonic-tagged (tags that emit a signal that can be detected from long distances) white sturgeon used overwintering habitats located downstream of the Entiat River (RM 482.4), upstream of the Chelan River (RM 506.0), and downstream of Wells Dam (RM 513.0). Approximately 60% of sonic tagged fish were relatively inactive over the duration of this early overwintering period; these fish did not move more than 0.2 miles and usually remained in the same general area. Two males, however, moved approximately 30 miles between adjacent overwintering areas, possibly in response to changes in water temperature or food supply.

Studies conducted in other mid-Columbia River reservoirs (e.g., Priest Rapids, Wanapum, and McNary) also indicated that fish remained relatively inactive (i.e., did not move more than 0.2 miles) during the overwintering period, and few movements were observed between adjacent overwintering areas (Haynes et al. 1978, Golder 2003c). In the upper Columbia River (i.e., Lake Roosevelt, WA, and downstream of HLK Dam, British Columbia) and in free-flowing sections of the Snake River, between 60% and 90% of sonic tagged white sturgeon also selected specific overwintering areas and generally remained in these areas all winter (R.L.&L. 1994, Whittmann-Todd et al., 2001).

3.2 Findings to Date

The two years of white sturgeon study conducted for relicensing in the Reservoir in 2001 (R.L. & L. 2001) and 2002 (Golder 2003a) and review of existing information resulted in the following key findings:

- The white sturgeon population in Reservoir is currently low, estimated a range of 50-115 fish (95% confidence interval (CI) = 23-698);
- White sturgeon have not been observed in the Rocky Reach Dam upstream fishways (no documented upstream movement);
- Juveniles pass downstream through Rocky Reach Dam via the spillway, the powerhouse, and/or the juvenile bypass system;
- Multiple age classes (7 - 50 years old) are present in the Reservoir; and
- Age and growth in the Reservoir are within the range reported for populations in other parts of the Columbia River Basin, although data available on these factors is limited.

SECTION 4: PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

The goal of the WSMP is to promote growth of the white sturgeon population in the Reservoir to a level that is commensurate with the available habitat by year 30 of the New License. To meet this goal, Chelan PUD is proposing a supplementation program to increase the population through use of hatchery-reared fish or fish that have been trapped in the lower Columbia River for direct release into the Reservoir (trap and haul), or other methods recommended by the RRFF. The PMEs of the WSMP are designed to meet the following objectives:

Objective 1: Increase the white sturgeon population in the Reservoir through supplementation to a level commensurate with available habitat and allowing for appropriate and reasonable harvest;

Objective 2: Determine the effectiveness of the supplementation program;

Objective 3: Determine the carrying capacity of available habitat in the Reservoir and;

Objective 4: Determine natural reproduction potential in the Reservoir, and then adjust the supplementation program accordingly.

This WSMP will use Adaptive Management and is also intended to be consistent with other white sturgeon management plans in the mid-Columbia region, as well as any future white sturgeon management plans created by the WDFW.

The WSTG developed the objectives and activities described in this section. The effectiveness of each strategy will be determined through the monitoring and evaluation program. Once the results of the monitoring and evaluation program have been considered, Chelan PUD shall determine, in consultation with the RRFF, any appropriate and reasonable next steps, which may include adjusting the supplementation level.

Due to the adaptive nature of this program, the schedule for implementation of specific measures can only be estimated at this time. Table 3-1 provides an estimated schedule for implementing each activity, which will be adjusted through consultation with the RRFF, as new information becomes available.

4.1 Objective 1: Increase the White Sturgeon Population in the Rocky Reach Reservoir

Chelan PUD shall, in consultation with the RRFF, initiate an Adaptive Management, long-term, white sturgeon supplementation program in the Reservoir within one year after the effective date of the New License. Primary components of the proposed supplementation program are developing and implementing a broodstock collection plan, stocking juvenile white sturgeon in the Reservoir, determining long-term supplementation program production goals and facilities, establishing an appropriate and reasonable harvest rate, and implementing a rigorous monitoring program to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of stocked juvenile sturgeon, emigration rate from the Reservoir, Reservoir carrying capacity, supplementation program efficacy, and natural reproduction potential. The stocking program is intended to be commensurate with the available habitat, and is not intended to create a "put-and-take" fishery. The following sections describe the components, timing of implementation, and decision-making process of the proposed supplementation program in detail.

4.1.1 Brood Stock Planning and Collection

Due to the low population estimates indicated by the 2001 and 2002 white sturgeon investigations, there is a low probability that brood stock from the Reservoir can be utilized as the basis for a long-term supplementation, so other sources of fish must be considered to increase the white sturgeon population (Golder 2003b). Within one year of the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, prepare a brood stock collection plan that considers such factors as genetics and questions of imprinting. Possible sources of brood stock fish include:

- Brood stock collected from the Rocky Reach Reservoir and nearby reservoirs (Priest Rapids, Wanapum, or above McNary) and used in a hatchery supplementation program;
- Brood stock collected from the Columbia River below Bonneville Dam and used in a hatchery supplementation program;
- Excess juvenile production from other compatible supplementation programs;
- Juveniles purchased from a commercial facility for direct release into the Reservoir; and
- Juveniles from new or existing Chelan PUD-funded hatchery facilities retrofitted to accommodate white sturgeon brood stock, egg incubation, and juvenile rearing.

The initial source of brood stock will be determined by the RRFF within one year of the effective date of the New License, and collection will begin in year two of the New License, if fish are available and the RRFF determines that brood stock collection within such a timeframe is feasible (see Table 3-1, footnote 1). If collection is not feasible in year two of the New License, Chelan PUD shall proceed on a schedule to be determined by the RRFF, using Adaptive Management, as reflected in Table 3-1. The intent of brood stock collection is to use the progeny of the initial source of brood stock, if feasible, in the future for the white sturgeon stocking program.

4.1.2 Juvenile White Sturgeon Stocking

By year three of the effective date of the New License, Chelan PUD shall begin releasing up to 6,500 yearling white sturgeon into the Reservoir annually for three years. In consultation with the RRFF, yearling fish will be acquired through one or more of the following: 1) production from a Chelan PUD hatchery or cooperative mid-Columbia hatchery, 2) excess yearling fish production from other compatible supplementation programs, 3) purchase from a commercial hatchery, or 4) other measures identified by the RRFF. Extenuating circumstances, such as problems with hatchery siting, disease, etc., could result in a failure to meet the three year deadline. Chelan PUD shall meet with the RRFF to discuss any circumstances where the deadline will not be met, and, if necessary, alternatives will be developed by Chelan PUD and the RRFF and implemented by Chelan PUD (see Table 3-1, footnote 2).

Chelan PUD shall ensure that all hatchery-reared juvenile white sturgeon released into the Reservoir are marked with Passive Integrated Transponder (PIT) tags (tags that do not emit a signal and must be activated by a reader at very close range, i.e. the fish must be in hand) and year-specific scute marks for monitoring purposes described in Section 4.2 of this plan. In order to allow for tracking of juvenile white sturgeon emigration described under Section 4.2.2, Chelan PUD shall ensure that up to one percent (or a maximum of 65) of the juvenile white sturgeon released into the Reservoir are large enough to allow implantation of an active tag prior to release.

The number of yearlings released in subsequent years (after the initial three year stocking period) will range from 0 – 6,500, based on the results of the indexing program (Section 4.2.1) and/or the evaluation of spawning potential (Section 4.4) and could be adjusted after the evaluation period, in consultation with the RRFF (also see Table 3-1, footnotes 2 and 3).

In addition, following the third year of supplementation (unless Chelan PUD, in consultation with the RRFF, determines more analysis is required), Chelan PUD may elect to release juveniles at an earlier or later life stage in order to compare success of fish released at varying life stages. For example, based on consultation with the RRFF, Chelan PUD may elect to have a proportion of the hatchery-reared juveniles released at differing size intervals (with the minimum size being that which permits PIT tagging), in order to monitor potential differences in survival and growth during future indexing periods (see Section 4.1.1). On a schedule developed in consultation with the RRFF (see Table 3-1), Chelan PUD shall implant active tags in a percentage, to be recommended by the RRFF, of juvenile white sturgeon released as part of the supplementation program, in anticipation of future emigration rate and habitat use tracking surveys (Section 4.2.2).

Annual stocking levels of yearlings or possibly younger age-classes will be adjusted based on monitoring results in any given year. Methods for determining production goals, stocking locations, and breeding plans are described in Appendix A to this Chapter.

4.1.3 Long-term Production

By year seven of the New License, Chelan PUD shall, in consultation with the RRFF, determine a long-term approach (e.g. construct hatchery facilities, long-term contract, other approaches identified by the RRFF) to be used for continuing the supplementation program for the term of the New License. If the RRFF determines that insufficient information is available to determine a long-term decision by year seven, the RRFF will establish an additional evaluation period prior to making such a determination.

4.2 Objective 2: Determine the Effectiveness of the Supplementation Program (Monitoring)

Chelan PUD shall conduct a monitoring program within the Project boundary for the purpose of assessing the effectiveness of the supplementation program described in Section 4.1 and outlined in Table 3-1. Monitoring will include both an indexing program (Section 4.2.1.1) and assessments of emigration rates from the Reservoir, habitat use, and spawning locations through tracking of active-tagged white sturgeon (Section 4.2.2; also Table 3-1, footnotes 3 and 4).

Chelan PUD shall also investigate other white sturgeon recovery programs (e.g., Upper Columbia River, Kootenai River, etc.), that are collecting information regarding white sturgeon supplementation, and use the data to refine the implementation of the monitoring program. The results of this information will assist Chelan PUD and the RRFF to adjust future stocking rates.

4.2.1 Index Monitoring Program

In year four of the New License, or within one year following the initial stocking of juveniles in the Reservoir, whichever comes sooner, Chelan PUD shall begin conducting an initial three-year index monitoring program for juvenile and adult sturgeon in the Reservoir to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon. The indexing methods will include using gillnets or other appropriate recapture methods for juveniles and set lines for adults. As a component of the indexing program, Chelan PUD shall implant active tags in a percentage, to be recommended by the RRFF, of captured and released juvenile and adult sturgeon to facilitate the monitoring activities described in Section 4.2.2 (emigration and habitat use tracking of juvenile sturgeon) and Section 4.4 (evaluation of spawning potential of adult sturgeon).

Beginning in year eight of the New License, Chelan PUD shall continue to conduct one year of index monitoring every third year over the term of the New License, or on a schedule determined by the RRFF. The purpose of the continued index monitoring is to monitor age-class structure, survival rates, abundance, density, condition factor, growth rates; identify distribution and habitat selection of juvenile sturgeon; and direct the supplementation program strategy (see Table 3-1).

4.2.2 Investigation of Emigration Rate and Habitat Use of Supplemented Population

Beginning in year five of the New License, Chelan PUD shall conduct three-year tracking surveys of the juvenile white sturgeon that were released in each of the fifth, sixth, and seventh years of the New License with active tags as part of the supplementation program. This will require one percent of each of the first three annual classes of juvenile sturgeon (up to a maximum of 65 fish each year) to be reared large enough to implant an active tag for tracking purposes. The purpose of tracking active-tagged fish is to determine juvenile white sturgeon emigration rates out of the Reservoir, as well as, habitat use within the Reservoir.

Chelan PUD shall repeat the tracking survey for one additional year in years 14 and 20 of the New License, or as recommended by the RRFF (see Table 3-1, footnote 4). Such later year surveys shall track: 1) active tags implanted in a percentage of juvenile fish reared old enough to be released with such tags in the three years preceding the survey (tag life is estimated to be three years); and 2) any juvenile and adult fish implanted with active tags during the last indexing period preceding the survey.

4.2.3 Supplementation Program Review

During the term of the New License, Chelan PUD shall compile information on other white sturgeon supplementation programs in the Columbia River Basin in order to assess whether: 1) Chelan PUD's supplementation program is consistent (e.g. stocking rates, release age and size, brood stock source, and monitoring program) with similar regional programs; 2) improvements to the Chelan PUD program for the Project can be made; and 3) monitoring objectives can be met more economically.

4.3 Objective 3: Determine Carrying Capacity of Available Habitat in Rocky Reach Reservoir

Chelan PUD expects to gather sufficient information through the monitoring activities described in Section 4 to determine, in consultation with the RRFF, the carrying capacity of the Reservoir.

4.4 Objective 4: Determine Natural Reproduction Potential, and Adjust Supplementation Program Accordingly

Chelan PUD shall track reproductively viable adult sturgeon that were captured and implanted with active tags under Section 4.2.1 for the purpose of identifying potential spawning locations. Five additional annual surveys of natural reproduction will occur between years 8 through 18 of the New License, as recommended by the RRFF, based on flow conditions or other data.

An important component of the WSMP is to determine recruitment limiting factors. Methods to determine limiting factors may include:

- Capture, tag, and track reproductively viable adult sturgeon to locate potential spawning locations.

- Conduct spawning surveys. If viable spawning adults cannot be obtained for tagging per the previous task, or if spawning movements cannot be observed, egg collection mats will be placed below Wells Dam (which is a potential spawning area based on habitat conditions) to attempt collection of eggs.

An understanding of habitat limitations that affect the natural population structure (e.g., year/class and age distribution) within the Reservoir is needed to determine the numbers of white sturgeon that should be released to meet habitat carrying capacity.

4.5 Reporting

Each year, Chelan PUD shall provide a report to the RRFF summarizing the year's activities under this WSMP. Such a report shall include a summary of stocking levels, indexing and tracking survey results (if such activities were conducted in such year), and other significant decisions or evaluations made pursuant to this WSMP. The supplementation program review described in Section 4.2.3 shall also be contained in this report, with periodic updates included as appropriate.

4.6 Adaptive Management Implementation Schedule

Chelan PUD and the RRFF shall coordinate during the term of the New License to ensure that the juvenile white sturgeon stocking program, indexing program and associated use of active tags (with limited lives) are coordinated to most effectively meet the overall monitoring goals and schedule. Table 3-1 demonstrates an estimated long-term schedule, subject to Adaptive Management by Chelan PUD, in consultation with the RRFF, to coordinate release, survey, tagging, and monitoring activities. Biological objectives for supporting designated uses for white sturgeon are shown in Table 3-3: 2, and a summary of criteria for achievement of objectives for white sturgeon is shown in Table 3-3: 3.

Table 3-1: Rocky Reach White Sturgeon Monitoring and Evaluation Program

New license year	Collect brood stock[1]	Release fish in Rocky Reach[2]	Indexing[3]	Track marked fish[4]	Assess Natural Production[5]
1					
2	x				
3	x	x			
4	x	x	x		
5	x	x	x	x	
6	x	TBD[2]	x	x	
7	x	"		x	
8	TBD[2]	"	x		TBD
9	"	"			"
10	"	"			"
11	"	"	x		
12	"	"			
13	"	"			"
14	"	"	x	x	
15	"	"			
16	"	"			
17	"	"	x		
18	"	"			"
19	"	"			
20	"	"	x	x	
21	"	"			
22	"	"			
23	"	"	x		
24	"	"			
25	"	"			
Repeat years 23 to 25 through end of license					

1 Collection of brood stock may include capture of mature adults from the lower Columbia River or in the mid-Columbia or Snake River where appropriate and reasonable. The initial source of brood stock will be determined in year one of the program, and collection will begin in year two.

2 A total of 6,500 yearlings will be released in the Reservoir during each of the first three years. Total yearlings released in subsequent years will range from 0 - 6,500, based on the results of the indexing program. Hatchery fish will be acquired through purchase from a commercial hatchery, production from a Chelan PUD hatchery or cooperative mid-Columbia hatchery, or other measures. Breeding plans for all options will be developed, in consultation with the RRFF.

3 Indexing will include monitoring of age, growth, habitat, survival, and condition factors of juvenile and adult sturgeon. Results will be used to determine future stocking rates, locations, and timing. The frequency of indexing may be adjusted in consultation with the RRFF.

4 Active-tagged juvenile and adult sturgeon will be tracked to assess emigration, habitat use, and potential spawning locations.

5 Conduct spawning surveys, as recommended by the RRFF, to identify natural production in the Reservoir. The RRFF may adjust surveys based on flow conditions or other data.

Table 3-2: Biological Objectives for Supporting Designated Uses for White Sturgeon

Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
White Sturgeon Natural Recruitment	Natural reproduction potential	Years 8-10, 13, and 18	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.4
White Sturgeon Population at Carrying Capacity	Increase the white sturgeon population in the Reservoir through supplementation to a level commensurate with available habitat	Years 3-5, adjust stocking level; years 6 - 50	Maintain Action. No additional action needed.	RRFF to recommend stocking level, broodstock source. Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Sections 4.1-4.3; and 4.6
White Sturgeon Harvest	Success in creating population with a stable age-structure that allows for appropriate and reasonable harvest rate	Years 20 - 50	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Sections 4.1-4.6

Table 3-3: Summary of Criteria for Achievement of Objectives for White Sturgeon

Use/ Action	Objective	Measured Parameter	Schedule	Actions if Objective Achieved	Actions if Objective Not Achieved	Plan Action
Juvenile White Sturgeon	Increase white sturgeon population in Rocky Reach Reservoir	Stock 6,500 yearlings	years 3-5, each year	Maintain action. No additional action needed.	Adjust stocking level; alternative broodstock; excess production	Section 4.1.2
	Increase white sturgeon population in Rocky Reach Reservoir	Stock 0-6,500 yearlings	years 6-50	Maintain action. No additional action needed.	RRFF to recommend stocking level	Section 4.1.2
Juvenile and Adult White Sturgeon	Determine supplementation program effectiveness	Indexing: age class structure; survival rates; abundance; density; conditi0on factor; growth rates; tag and track fish; distribution; habitat selection, use, availability, and suitability	years 4-6	Maintain action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.2.1
	Determine supplementation program effectiveness	Indexing: age class structure; survival rates; abundance; density; conditi0on factor; growth rates; tag and track fish; distribution; habitat selection, use, availability, and suitability	year 8 and then annually every 3rd year for term of license	Maintain action. No additional action needed.	Use Adaptive Management to adjust supplementation program strategy in consultation with the RRFF	Section 4.2.1
	Determine supplementation program effectiveness	Emigration rate and habitat use; track marked fish	years 5-7, 14, and 20	Maintain action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.2.2
	Supplementation program review	Compile additional information from other programs	years 3-50	Maintain action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.2.3
	Determine Reservoir carrying capacity	Indexing results, emigration rate results	years 3-50	Maintain action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.3
Adult White Sturgeon	Natural reproduction potential	Tag adults and monitor through indexing; egg mat placement	years 8-10, 13, and 18	Maintain action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.4

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APPENDIX A: AUGMENTATION STRATEGIES FOR ROCKY REACH

Brood Stock Collection

The effect of a supplementation/augmentation program on the genetics of wild sturgeon populations is a key consideration when the program goals and operations are planned. Existing programs maintain the genetic integrity of the populations through the use of brood stock obtained directly from the target population and then breeding these individuals according to genetically based breeding plan. Although utilizing brood stock from within Rocky Reach Reservoir would be the preferred option, the Rocky Reach Reservoir has a small resident adult population (Golder 2003a), providing for a low probability that an adequate number of individuals in spawning condition could be obtained.

Seven evolutionary significant units (ESUs) for white sturgeon have been defined (UCRWSRI 2002). The Columbia River white sturgeon population represents two ESUs for white sturgeon in Pacific North America:

i) the upper Columbia River population in Canada and the United States and,
ii) the lower/middle Columbia River in the United States.

Since the lower and mid-Columbia populations are considered to be the same ESU, this provides Chelan PUD with additional options to obtain brood stock. The following is a list of options that will be decided upon through collaboration with the Chelan PUD and the Rocky Reach Fish Forum (RRFF).

1. Collect brood stock from nearby reservoirs (Priest Rapids, Wanapum, McNary) and begin a hatchery supplementation program.

2. Collect brood stock from the lower Columbia River and begin a hatchery supplementation program.

3. Purchase juveniles from a commercial facility for direct release into the Rocky Reach Reservoir.

4. Build or retrofit existing hatchery facilities to accommodate brood stock, egg incubation and juvenile rearing.

5. Trap and haul adult or juvenile sturgeon from the lower Columbia River for direct release into the Rocky Reach Reservoir.

Breeding Plan

The following section outlines a breeding strategy for possible use in the Rocky Reach Reservoir white sturgeon conservation fish culture program from brood collection to juvenile releases. Many of the concepts in this plan are based on the "Breeding Plan to Preserve the Genetic Variability of the Kootenai River White Sturgeon" (Kincaid 1993) and incorporated into the breeding plan for the Upper Columbia White Sturgeon Recovery Plan (UCWSRI 2002) but have been adapted as required to suit the specific population characteristics of white sturgeon in the middle Columbia River. The duration of the supplementation program will be determined by the results of the monitoring and evaluation program and in collaboration with the Rocky Reach stakeholders. The recruitment goal will be set according to what is supportable by the current available habitat.

Brood Stock Targets

In the initial stages of the WSMP (i.e. years 2-4), the goal will be to release up to 6,500 juveniles. After the third year of releases, the target will be revaluated and adjustments made. For the initial stages of the supplementation program, juvenile fish will be acquired through either production from a Chelan PUD hatchery or cooperative mid-Columbia hatchery, excess juvenile production from other compatible supplementation programs, purchase from a commercial hatchery, or other measures recommended by the RRFF. When the decision to acquire brood stock is made, the target will be determined by the number of juveniles required to meet the supplementation program goals.

In the upper Columbia and Kootenai populations, spawning locations are known and obtaining spawners is relatively straightforward (but not guaranteed). The Kootenai program captures and holds only females at the hatchery facility; the males are captured on an as-needed basis during the spawning season with milt being collected on the river and transported to the hatchery. The upper Columbia breeding program captures both males and females and transports both sexes back to the hatchery for spawning; flowing males are typically easier to obtain than ripe females. Some spawning failures, due to poor egg viability or the inability to stimulate ovulation, have been recorded by both the upper Columbia and Kootenai programs. Therefore, Chelan PUD should consider collection of additional females over and above the target number. The collection of additional males also may be warranted, although cryopreservation is a viable option to preserve any excess milt available.

At present, the number of fish that will contribute to spawning activities each year of the program cannot be predicted. For example, a substantial proportion (30-40%) of non-ripe females brought into captivity may not progress to ripe stage because of physiological changes associated with the stress of capture (Conte et al. 1988). As mentioned above, failure to induce ovulation has frequently occurred in both the upper Columbia and Kootenai programs, although the exact reasons for this remain unclear. For reference, fertilization and hatching rates at the KTOIH have ranged from 6% to >99% and 1% to 90%, respectively. Average egg to larval survival rates range from less than 1% to 73%, the higher values occurring in more recent years (Kootenai Tribe of Idaho, unpublished data).

A secure, short-term holding facility for spawners is required to induce spawning. Induction involves a combination of temperature/photoperiod/hormone treatments and requires a fairly sophisticated physical plant/hatchery facility and a high degree of technical expertise, with the support of professional fish culture biologists, technicians and managers, to succeed.

Mating

Mating schemes are designed to reduce the likelihood of inbreeding by maximizing the genetic effective population size N_e. A primary goal is to equalize genetic contributions of all spawners. This is accomplished by a 1:1 spawning where each male and each female are only used once. However, where gamete viability is variable or unknown, sex ratios are unequal, or numbers are critically lower than facility capacity (e.g. each individual represents >10% of the total brood stock), variations on the 1:1 plan are required.

Due to failures associated with egg viability in other culture programs, gamete splitting is often used to ensure that each male and female has more than one opportunity to reproduce. Such designs can create a number of half-sib families in offspring that could potentially increase inbreeding levels in the next generation if the half-sibs were to mate. However, this risk is considered acceptable if maximizing the total number of contributing individuals each year is the most important goal. In addition, the possibility of hatchery half-siblings actually mating in the future is probably very low given the life history characteristics of white sturgeon and may be similar to rates that actually occur in the wild. Both sexes of white sturgeon have different spawning periodicities, are iteroparous, have highly overlapping generations and are broadcast, communal spawners. These traits increase the effective population size of spawners for any given year and reduce the likelihood of half-sib matings.

All brood stock should be permanently marked, sampled for tissue (for DNA identification) and released back into the wild once they have been spawned (although reconditioning, including return to a fish-based diet, should be conducted if spawners were taken off a natural fish diet). Given that white sturgeon have the potential to contribute to the next generation multiple times throughout their life span, re-captures in future brood stock collections can be considered for brood stock after 5 years (Kincaid 1993) if no other fish are available. Ideally, no individual fish should be spawned more than twice throughout the duration of the program to ensure genetic contributions to the next generation are equalized as much as possible (Kincaid 1993).

The following guidelines were initially adapted for the upper Columbia program based on work done by Kincaid (1993), and Miller and Kapuchinski (in press). Ideally, families were equalized (to plus or minus 20%) prior to mixing and release to ensure equal genetic contribution of families to the next generation. This was intended to maximize the genetic effective population size N_e.

Depending on a number of factors, however, family equalization may actually compromise some objectives of a supplementation program. Equalization can reduce the total number of fish available for release, which can reduce the ability to accurately determine survival rates of hatchery produced progeny released into the wild. In addition, the number of individuals that are available for release once equalization has been completed may consistently fall short of annual targets required to meet the long-term population goals.

Recent thinking among the upper Columbia and Kootenai recovery teams has shifted as to the relative risks of unequal family releases versus the culling of potential fish for stocking. A greater importance is being placed on the need to maximize the genetic contributions of the existing population and to ensure sufficient numbers of juveniles are stocked to achieve adult population targets and evaluation goals. For the white sturgeon supplementation program in the Reservoir, concerns regarding family equalization need to be balanced against more immediate priorities of ensuring that adequate numbers of individuals contribute genetically to the next generation and that sufficient numbers of juveniles are stocked to meet short-term research needs and long-term population targets.

The following recommendations on mating scenarios have been excerpted from the breeding plan of the UCWSRI and assume that maturation of most fish can be synchronized artificially with hormone injections of LHRHa (luteinizing hormone releasing hormone analogue). However, if synchronization is impossible, each group of spawners will have to be treated separately. Techniques to store milt over the spawning period as a means to facilitate these scenarios, are presently being investigated and should be incorporated into the final Plan.

Mating Scenarios

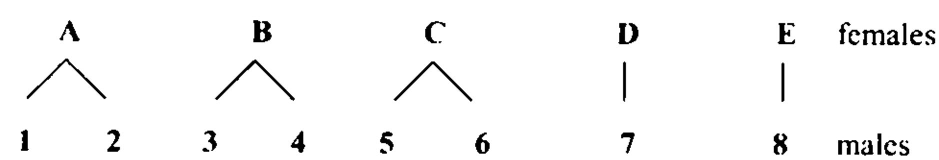
- *10 or more males and females available*

Conduct 1:1 matings unless more than 20% of either sex is expected to be infertile. If males exceed females, split eggs of females so that each male contributes at least once. Similarly, if females exceed males, split milt so that each female contributes at least once. If infertility of either sex exceeds 20%, split both milt and eggs to create a minimum of two half-sib families per parent.

- *5-9 males and 5-9 females*

Conduct 1:1 matings unless more than 10% of either sex is infertile. If males exceed females, split eggs of each female so that each male contributes once. If infertility of either sex exceeds 10%, both milt and eggs should be spilt to create a minimum of two half-sib families per parent.

e.g. 8 males, 5 females



- *5-8 males, 3-4 females*

Ensure that each female's eggs are split at least twice and use each male at least once. If there is a concern regarding using some males more than once (over-contribution), wait to see if there are any infertility issues and if no problems occur, or if space is an issue, destroy half-sib families.

e.g. 6 males, 4 females (could destroy A2 and D1 if no infertility issues arise)

A **B** **C** **D** females

1 **2** **3** **4** **5** **6** **1** **2** males

Note: Kincaid (1993) recommends that males be used only once in each case, even when numbers are extremely low. However, Kincaid's plan was based on the fact that the capture of ripe males was fairly straightforward. For the upper Columbia program, it was deemed too risky at present to assume that every male will successfully spawn or that more ripe males could easily be obtained in-season.

- *Equal sex ratio – 3-4 of each sex*

To ensure all individuals have at least one chance to contribute, a number of half-sib families can be created by splitting each egg batch in half and fertilizing with a different male. Each individual makes an equal contribution.

e.g. 3 males, 3 females

A **B** **C** females

1 **2** **3** **1** **2** **3** males

e.g., 4 males, 3 females

Split eggs so that each male can make contributions to at least 2 females' eggs.

A **B** **C** females

1 **2** **3** **4** **1** **2** **3** **4** males

or

A **B** **C** females

1 **2** **3** **4** **1** **2** males

In both cases, once fertility for all families is confirmed, extra half-sib families may be destroyed after incubation so each male only contributes once if over-contribution of males is a concern or space is an issue.

- *Equal (1-2 of each sex) or skewed ratio (only 1 or 2 females)*

Ensure each female mates with each male. Kincaid (1993) recommends no spawning when only one female is available. For the upper Columbia program, given the uncertainty with obtaining spawners, spawning will be attempted for each year even if only one female is obtained.

e.g. 2 males, 1 female

A female

1 2 male

Asynchrony in Spawners

The results of the brood stock collections for the upper Columbia, indicate that it is unlikely that all brood stock will be ready to spawn at the same time and that the limiting factor will be the females. Therefore, to simplify the spawning design, efforts should be made to synchronize spawning. However, if this is not possible, spawning can be modified using the above scenarios depending on the number of males and females available.

Sperm can be kept viable for 4-5 days using refrigeration and oxygen. Mature females take 20 to 40 hours to spawn after induction (Conte et al. 1988). In theory, mature captive female sturgeon should not be induced to spawn until preferably two (although one, in an extreme case) ripe males can be confirmed. Realistically, is often difficult or impossible to get successful ovulation at the desired time. For example, the two females used in the Upper Columbia program in 2001 were spawned almost a month apart (July 30 and August 23; R. Ek, pers. comm., 2002). This component requires further experimentation and consultation with other experts.

Rearing and Release

Each family should be reared separately until early mortality tails off, at which point inventory reduction should take place to begin to equalize families within the constraints discussed above.

For the Kootenai Hatchery fish, captive fitness traits (including size and growth rate) do not appear to correlate with post-release survival (R. Beamesderfer, pers. comm., 2003). This is important because it demonstrates that selective pressures associated with captivity are different from natural selection pressures in the wild. This observation emphasizes the need to avoid selective culling procedures (removing small, slow-growing fish) and to maximize the survival of all individuals (e.g. rear separately according to size).

Individual families should be tracked to compare early survival rates, variance in male and female fertility, growth rates and other performance measures. Once fish reach approximately 20 grams, individual fish/families can be PIT-tagged and scutes can be removed (to visually identify hatchery year class). After tagging, sturgeon can be pooled into larger holding facilities. This assumes that variance in mortality rates among families after this time will be minimal. Prior to pooling, family numbers should be documented.

Ideally, juvenile releases for conservation purposes should maximize genetic contributions from the available adult population. In addition, sufficient numbers should be released to achieve long-term population targets based on conservative assumptions. This approach is best accomplished by achieving the production goals through the use of more families and smaller family sizes as opposed to fewer, larger families. Family equalization should be considered in the release strategy but not at the expense of achieving the first two objectives. Optimization of actual stocking rates will be a process that occurs over several years as better information on survival rates and recruitment bottlenecks become available through the monitoring program. To date, the Kootenai program has released a range of ages from 3 to 12 day old larvae to 4 year old fish. Average survival rates for the Kootenai program are approximately 60% for first year post-release and 90% per year for subsequent years.

In summary, the number of juveniles per family to maintain and release will depend on:

- Early survival in captivity;
- Post-release survival to maturity;
- Numbers of families raised;
- Numbers required for experimental purposes; and,
- Annual recruitment goal for the next generation.

Until many of the questions regarding juvenile post-stocking survival are addressed, it may be most appropriate to rear as many fish as possible from as many families within the limits dictated by facility constraints. Future adjustments can be made to either reduce juvenile populations in the event survival is better than predicted or to correct possible genetic effects due to over-stocking of some families. If fish are individually marked or marked to family, selected individuals can be re-captured from the population and culled (either through a research program or a directed fishery). As more information is obtained in the future, the program may be able to adopt a stronger emphasis on family equalization.

Record Keeping and Monitoring

Given the experimental nature of this program, detailed records of all stages of brood stock collection, mating, culture and releases must be kept. The program should be monitored with regular updates to evaluate short-term (yearly) and long-term goals of the program.

All wild-caught brood stock should be individually tagged to track contributions over time. In addition, lengths, ages and a tissue sample (for DNA characterization) should be collected from each individual. Similarly, all juvenile fish released should be tagged and length, weight, age, and release location recorded to assist with post-release evaluation programs.

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CHAPTER 4: ROCKY REACH BULL TROUT MANAGEMENT PLAN

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EXECUTIVE SUMMARY

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries agencies, tribes, and interested parties together in a Natural Resources Working Group (NRWG) and provided an opportunity for comprehensive review of current and future management priorities for fish resources potentially impacted by on-going Project operations. The NRWG was established to identify issues, develop study plans, review study reports, and develop long-term management plans for fish and wildlife species. The development of this Rocky Reach Bull Trout Management Plan (BTMP) was an integral part of the relicensing process.

Bull trout are listed as threatened under the Endangered Species Act (ESA). Due to the listing of bull trout under the ESA within the mid-Columbia River Basin, and the possibility that the operation of hydroelectric projects owned and operated by Chelan, Douglas, and Grant PUDs (Mid-Columbia PUDs) may have some effect on them, the Mid-Columbia PUDs decided to evaluate the status of bull trout in the mid-Columbia River Basin. Prior to relicensing studies, little was known about the life-history characteristics (e.g., movements, distribution, habitat use) of bull trout in the mid-Columbia Basin.

A radio telemetry study was initiated in 2001, where radio tags were inserted into adult bull trout collected at Rocky Reach, Rock Island, and Wells dams. These fish were tracked to describe their movements and migration patterns within the mid-Columbia Basin. The radio telemetry study did not detect any adverse effects from operation of those dams on movement or survival of tagged bull trout (BioAnalysts 2002; 2004). There have been no documented cases to date of tagged adult bull trout being injured during upstream or downstream passage through these dams. Relicensing baseline studies did not demonstrate a reduction in suitable habitat or density of forage species used by bull trout to overwinter and grow in the Rocky Reach Reservoir.

The goal of the BTMP is to identify, develop, and implement measures to monitor and address impacts, if any, on bull trout passage resulting from ongoing Project operations, in a manner consistent with the US Fish and Wildlife Service (USFWS) draft Bull Trout Recovery Plan.[1] The BTMP goal will be accomplished through implementing measures described in sections 3 and 4. More specifically, sections 3.5, 3.6, and 3.7 identify impact minimization and reasonable and prudent measures required by the USFWS Biological Opinion (USFWS 2004 BO) dated May 12, 2004,[2] on Chelan PUD's Anadromous Fish Agreement and Habitat Conservation Plan (HCP Agreement) for the Rocky Reach Project. These measures, to be implemented prior to issuance of the New License, are:

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[1] U.S. Fish and Wildlife Service. 2002. Chapter 22, Upper Columbia Recovery Unit, Washington. 113p. *In*: U.S. Fish and Wildlife Service. Bull Trout *(Salvelinus confluentus)* Draft Recovery Plan. Portland, Oregon.

[2] U.S. Fish and Wildlife Service. Biological Opinion and Conference Opinion for the License Amendments to incorporate the Rocky Reach, Rock Island, and Wells Anadromous Fish Agreements and Habitat Conservation Plans. FWS Ref. No. 04-W0203, submitted to FERC on February 25, 2005 in accordance with Article 411 of the Orders Amending License on June 21, 2004 (107 FERC 61,281).

1) Conduct video monitoring and take digital photographs of bull trout in the upstream fishway (fishway counts);

2) Conduct radio-telemetry monitoring for continued identification of potential ongoing Project impacts on upstream and downstream passage of adult bull trout for the purpose of assessing Incidental Take;

3) Correlate bull trout passage with the upstream fishway, downstream bypass, and ongoing Project operations;

4) Operate upstream fishway in accordance with Chelan PUD's Fish Passage Plan (Grassell 2005) criteria;

5) Investigate feasibility of video monitoring adult fish at the downstream bypass adult separator;

6) PIT tag sub-adult bull trout to monitor movement past the Dam;

7) Assess sub-adult bull trout condition at the downstream bypass sampling facility;

8) Investigate the potential stranding and entrapment of sub-adult bull trout in the Project Reservoir (Reservoir);

9) Participate in development and implementation of the USFWS Recovery Plan;

10) Expand off-season (Nov. 15-Apr. 14) upstream fishway passage counts;

11) Consider collection and hauling of woody debris for tributary enhancement;

12) Participate in information exchanges with other entities conducting bull trout research and regional efforts to explore methods to monitor upstream and downstream movement of sub-adult bull trout in the mainstem Columbia River; and

13) Fund genetic analysis of bull trout tissue samples.

Generally, the above measures focus on Chelan PUD's efforts to monitor bull trout over several years (2005 through 2008 or 2006 through 2009, depending on the activity) to ensure that incidental take does not exceed the allowance set forth in the USFWS 2004 BO.

This BTMP has four objectives: 1) continue operating the upstream fishway and downstream bypass; 2) identify any adverse ongoing Project-related impacts on adult and sub-adult bull trout passage through monitoring; 3) implement appropriate and reasonable options to modify the upstream fishway, downstream bypass, or operations if adverse impacts on bull trout are identified; and 4) participate in the development and implementation of the USFWS Bull Trout Recovery Plan, including information exchange and genetic analysis. Measures outlined in Section 4 are the continuation of commitments made under the USFWS 2004 BO and are intended to meet the requirement that Chelan PUD monitor and minimize the effect of any incidental take for the term of the New License. To meet the objectives, the BTMP calls for Chelan PUD to implement the following protection, mitigation, and enhancement (PME) measures during the term of the New License:

1) Continue to provide upstream passage for adult bull trout through the existing upstream fishway and downstream passage of adult and sub-adult bull trout through the existing downstream bypass;

2) Continue counting bull trout in the upstream fishway (fishway counts) at Rocky Reach Dam;

3) Continue operation of the adult fishways at Rocky Reach Dam in accordance with Chelan PUD's Fish Passage Plan anadromous fish criteria;

4) Conduct an adult bull trout telemetry program (every 10 years) to continue monitoring upstream and downstream passage;

5) Identify and implement appropriate and reasonable options to modify the upstream fishway, downstream bypass, or operations to reduce identified impacts on bull trout passage;

6) Participate in the development and implementation of the USFWS Recovery Plan;

7) Consider woody debris collection and hauling for tributary enhancements;

8) Fund collection of bull trout tissue samples and genetic analysis; and

9) Participate in information exchanges with other entities conducting bull trout research and regional efforts to explore methods to monitor upstream and downstream movement of sub-adult bull trout in the mainstem Columbia River.

In addition to the four objectives stated previously, this BTMP is intended to satisfy the requirements of the USFWS 2004 BO on operation of the Project, consistent with the HCP Agreement, be consistent with USFWS draft (and ultimately final) Bull Trout Recovery Plan, and comprise the minimization measures that are anticipated as necessary to minimize the effect of any incidental take under a New License.

SECTION 1: INTRODUCTION

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries

Bull Trout Management Plan

SECTION 2: BACKGROUND

2.1 Geographic Range and Biology

Bull trout are native to northwestern North America, historically occupying a large geographic range extending from California north into the Yukon and Northwest Territories of Canada, and east to western Montana and Alberta (Cavender 1978). They are generally found in interior drainages, but also occur on the Pacific Coast in Puget Sound and in the large coastal drainages of British Columbia.

Bull trout currently occur in lakes, rivers and tributaries in Washington, Montana, Idaho, Oregon, Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997). The remaining distribution of bull trout outside of these geographic areas is highly fragmented.

Bull trout are members of the char group, within the family Salmonidae. Bull trout closely resemble Dolly Varden (*Salvelinus malma*), a related species. Genetic analyses indicate, however, that bull trout are more closely related to an Asian char (*Salvelinus leucomaenis*) than to Dolly Varden (Pleyte et al. 1992). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal-Puget Sound region of Washington State.

2.2 Life History

Bull trout exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. The resident, fluvial, and adfluvial forms exist throughout the range of the bull trout (Rieman and McIntyre 1993). These forms spend their entire life in freshwater. The anadromous life history form is not known to occur outside the Coastal Puget Sound region within the coterminous United States (Volk 2000; Kraemer 1994; Mongillo 1993), and does not occur in the Columbia River. Multiple life history types may be expressed in the same population, and this diversity of life history types is considered important to the stability and viability of bull trout populations (Rieman and McIntyre 1993). For adfluvial bull trout, growth and maturation occurs in lakes or reservoirs, and for fluvial bull trout, it occurs in large river systems. Resident bull trout populations are generally found in small headwater streams, where these fish remain their entire lives.

For migratory life history types, sub-adults[3] tend to rear in tributary streams for one to four years before migrating downstream into a larger river or lake to mature (Rieman and McIntyre 1993).

margins, and pools with suitable cover (Sexauer and James 1993), and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

Bull trout are believed to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon habitat characteristics such as cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout may exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman et al. 1997).

Bull trout are present in the Rocky Reach, Rock Island and Wells reservoirs, including the Wenatchee, Entiat, and Methow rivers. Three life history forms, adfluvial, fluvial, and resident, are believed to occur in the mid-Columbia basin. Both adult and sub-adult bull trout are routinely observed and counted by Chelan PUD employees while passing through the upstream fishways at Rocky Reach and Rock Island dams. Sub-adult bull trout have been observed in the juvenile fish sampling facilities at both dams as well, although infrequently. Sub-adult bull trout were sampled in the Rocky Reach Dam prototype downstream bypass in 1998, 1999, 2000, 2001, and 2002, with 23, 30, 8, 4, and 5 fish observed, respectively. In 2003 and 2004, no sub-adult bull trout were sampled at the new Rocky Reach Dam downstream bypass sampling facility, likely because sampling periods were greatly reduced (down to two hours per day), compared to much longer periods for the previous prototype bypass.

Chelan PUD began counting bull trout using the upstream fishway in 1998. A total of 83 bull trout passed Rocky Reach Dam between May 3 and July 31 of that year (Chelan PUD, 2002a unpublished data). In 1999, 2000, and 2001, counts of bull trout using the fish ladder from May 1 through July 31 were 93, 183, and 176, respectively. In 2000 and 2001, counts of bull trout using the fish ladder from April 14 through November 14 were 212 and 204, respectively (BioAnalysts 2004). In 2002, a total of 204 bull trout passed Rocky Reach Dam from April 14 to November 14, with the most (177) passing from May 1 to July 31. In 2003 (April 14 – November 14), 248 bull trout passed Rocky Reach Dam during the normal anadromous counting period. Experimental off-season fish counts conducted between November 15 and December 27, 2003 recorded another 70 bull trout passing Rocky Reach Dam, for a total count of 318 bull trout in 2003 (April 14 – December 27). In 2004, 161 bull trout passed Rocky Reach Dam during the normal anadromous counting period (April 14 – November 14). Experimental off-season fish counts, conducted between November 15 and December 27, 2004, recorded another 7 bull trout passing Rocky Reach Dam, for a total count of 168 bull trout in 2004 (April 14 – December 27). In all years on record (1998-2004), the majority of the bull trout passed the Project in May and June (75 to 90 percent). Although the full extent of bull trout passage at other times of the year is unknown, bull trout do use the upstream fishway to pass Rocky Reach Dam in September through December. The general anadromous fish counting season ends around November 15 each year.

2.3 Upstream Fishway Operations

The Rocky Reach Dam upstream fishway is operated continuously for adult fish passage from approximately March 1 to the last week of December. The only exceptions to this continual operation would be unanticipated mechanical/electrical breakdown in the fishway requiring an immediate outage (dewatering may also be necessary), or removal of excessive milfoil/debris from attraction water system (AWS) pump intake screens/trashracks (dewatering is not required; however pumps must be shut off from four to six hours). A buildup of milfoil on the AWS intake screens/trashracks will reduce the pumping efficiency and prevent the fishway from maintaining the required operational criteria. Two to three AWS pump outages may occur over the months of August and September (depending on milfoil production).

Between the last week of December and March 1, the fishway undergoes an annual maintenance period to keep the fishway operating in an optimum and prescribed manner. During the maintenance period, 1) the entire fishway is inspected and cleaned by fishway attendants; 2) worn or broken equipment is replaced and/or repaired by mechanics and wiremen; and 3) critical operating equipment (e.g. AWS pumps, motorized operating valves, etc.) are thoroughly evaluated to confirm their readiness for the upcoming fish season. In some instances, depending on the maintenance schedule and operational demands, an overhaul of this critical equipment may be necessary.

SECTION 3: STUDIES & EVALUATION OF ONGOING PROJECT EFFECTS

Due to the listing of bull trout under the ESA within the mid-Columbia River Basin, and the possibility that operation of hydroelectric projects owned and operated by the mid-Columbia PUDs may have some effect on them, the mid-Columbia PUDs decided to evaluate the status of bull trout in the mid-Columbia River Basin. Prior to these relicensing studies, little was known about the life-history characteristics (e.g., movements, distribution, habitat use) of bull trout in the mid-Columbia Basin.

3.1 Relicensing Studies

A radio telemetry study was initiated in 2001 where radio tags were inserted into adult bull trout collected at Rocky Reach, Rock Island, and Wells dams. These fish were tracked to describe their movements and migration patterns within the mid-Columbia Basin (Figure 4-1) (BioAnalysts, 2002, 2004). The goal of the study was to assess the operational effects of hydroelectric projects on adult bull trout and adult bull trout migratory behavior in the mid-Columbia Basin.

The objectives for this three-year study were to: 1) describe the movements and migration patterns of adult bull trout in the mid-Columbia Basin; and 2) assess the on-going effects, if any, of hydroelectric operations on the movement and migration patterns of adult bull trout in the mid-Columbia River.

As part of the study, a total of 79 bull trout were tagged in 2001 and 2002 (15 fish at Rock Island Dam, 45 fish at Rocky Reach Dam and 19 fish at Wells Dam). Approximately half of the fish were released upstream of the dam where they were captured, and the other half were released downstream of the respective project.

3.1.1 Movement and Migration Patterns

Study results indicate that some bull trout reside for considerable periods of time in the Columbia River mainstem reservoirs, and then pass upstream through the upstream fishway in late spring and early summer to enter tributaries. All of the tagged fish, regardless of their release location, migrated into the Wenatchee, Entiat, or Methow rivers, presumably to spawn. Only one fish entered the Okanogan River for a brief period. It exited, swam downstream and entered the Methow River. Most of the tagged bull trout had entered tributaries by mid to late June in both years (BioAnalysts, 2002, 2004). Of the 79 bull trout tagged during the study, nine fish moved downstream past the Dam (5 fish in 2002 and 4 in 2003) after being released, and 10 fish moved downstream past Rock Island Dam after an extended stay in tributaries (BioAnalysts, 2004).

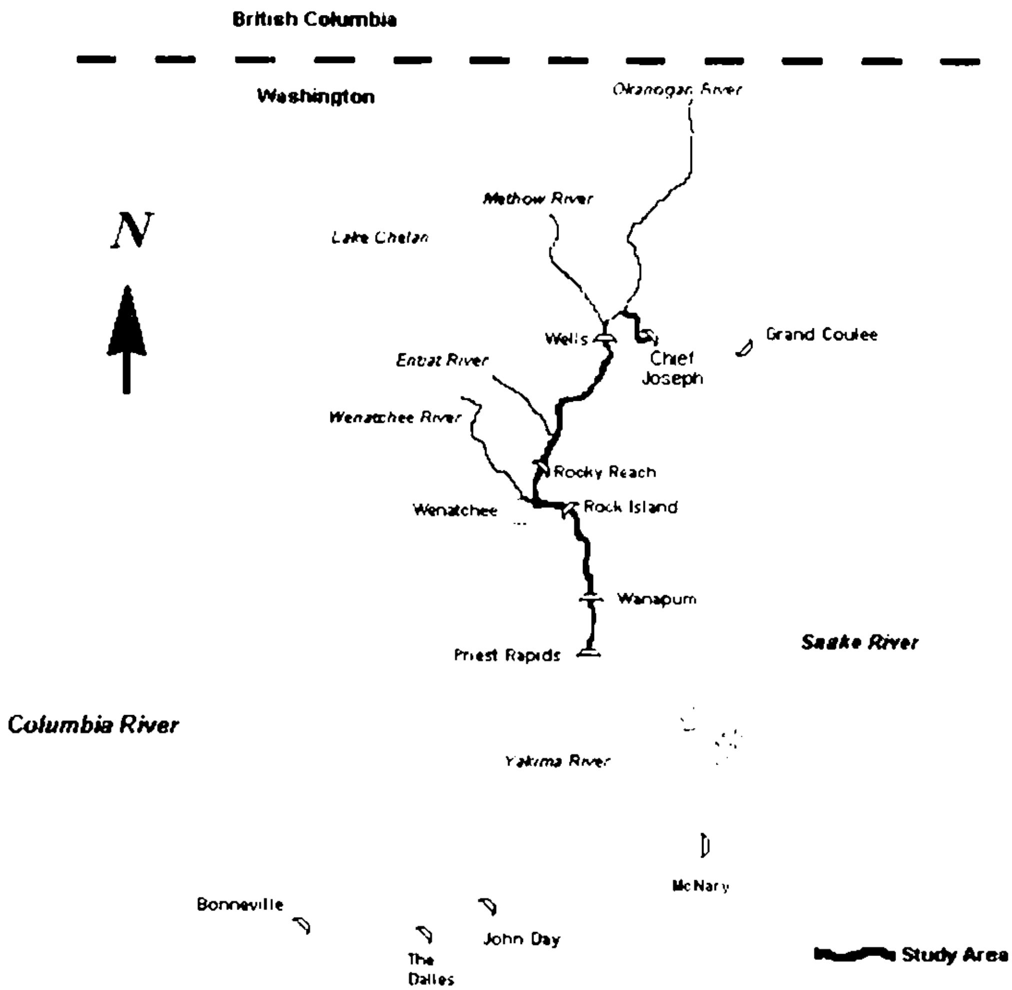

Figure 4-1: Study Area for Assessing Migration Patterns of Bull Trout in the Mid-Columbia River

After exiting tributaries in late fall, a few of the tagged bull trout moved downstream of Rocky Reach Dam through the turbines. One fish passed downstream through the turbines at both Rocky Reach and Rock Island dams, after exiting the Entiat River in November 2001. This fish over-wintered downstream of Rock Island dam, then migrated back through upstream fishways at Rock Island and Rocky Reach in May of 2002. Again, it entered the Entiat River in mid-June 2002, three days later than it did in 2001.

The frequency, timing, and route of downstream passage by sub-adult bull trout through Rocky Reach Dam are not known because sub-adults cannot be radio-tagged with existing technology. Sub-adult downstream passage may occur any time, and the routes available to sub-adult fish is dependent on the time of year. From results of telemetry studies, adult bull trout in the Reservoir are more likely to move downstream of the Dam in the mid to late fall, after spawning and re-entering the mainstem Columbia River from tributaries. Because Columbia River migratory bull trout are present in very low densities compared with other fish species, and they have relatively unpredictable migration behavior (especially sub-adults), effective study methods to evaluate downstream passage have not been developed. As described in Section 3.6.3.2 below, however, Chelan PUD will participate in information exchanges and regional efforts to explore effective study methods.

3.1.2 Project Effects on Movement

The radio telemetry study identified no apparent adverse effects on movement or survival of tagged bull trout. (BioAnalysts, 2002, 2004). It appears that none of the tagged adult bull trout were injured during upstream or downstream passage through Rock Island, Rocky Reach, or Wells dams, even when they passed through the turbines. Of the 79 bull trout tagged in 2001 and 2002, only one mortality was verified to have occurred in the mainstem Columbia, and it was not related to Project operations.

Downstream passage routes available to bull trout include: 1) passage over spillways during spill periods (generally between April 20 and August 15); 2) the downstream bypass, comprised of one surface collector entrance (6 kcfs flow) and screened turbine units number 1 and 2 (generally operated April 1 to August 31); 3) one adult fish ladder; and 4) turbine units 1 through 11. Upstream passage is provided by a single fish ladder with three separate entrances in the tailrace, and a single exit in the forebay.

3.1.3 Project Effects on Habitat

Age, length, and weight measurements taken during the study suggest that fish captured at Rocky Reach Dam are large for their age relative to other Columbia River bull trout populations, and their condition factor (weight/length^3)[5] is high. These data strongly suggest that the bull trout forage base is adequate in the Reservoir. Digital photographs of bull trout passing by the counting windows at Rocky Reach Dam in 2003 and 2004 also confirm that these fish are in excellent condition (Chelan PUD, unpublished data, 2003, 2004).

The mainstem Columbia River does not contain all of the necessary habitat elements to sustain the entire life history of bull trout. Based on life history requirements, it is unlikely that the

5 This formula is the Fulton's Condition Factor Formula.

mainstem Columbia River ever contained spawning habitat for bull trout. The Reservoir does provide other important habitat features, such as a productive forage base, a migration corridor, and a more stable, deep-water environment for safe over-wintering. Therefore, it is important that these habitat elements be maintained through the term of the New License.

3.2 Findings to Date

The following key findings were developed based on data collected during relicensing studies and from other information sources:

- Radio-tagged migratory adult bull trout move successfully both upstream and downstream past the Project. Total upstream fishway counts at Rocky Reach Dam in 2003 were 318 bull trout (April 14 – December 29). From the 79 bull trout radio tagged in 2001 and 2002, four bull trout passed downstream through turbines at Rocky Reach Dam, with no mortalities. Eight downstream passage events occurred at Rock Island Dam through turbines from 2001 to 2003, with no mortalities.

- Adult bull trout make migrations upstream through Rocky Reach Dam from April through December, with peak movement in May and June. Upstream fishway counts have not been conducted in January and February due to required annual fishway maintenance. Extended fishway counts in November and December 2003 and March 2004 identified movement of bull trout during November and December, but not in March 2004.

- Median travel times (from the tailrace to the top of the upstream fishway) during the telemetry study for Rocky Reach in 2001-2003 were 3.79, 4.66, and 4.68 days, respectively. For comparison, travel times at Rock Island Dam for the same years were 2.28, 5.90, and 5.10 days, respectively. Median travel times (from fishway entrance to fishway exit) for bull trout at Rocky Reach were 1.92, and .28 days respectively in 2001 and 2002. In 2003, the upstream fishway entrance was not monitored, but the median time for dam passage (from the tailrace to top of the fishway) was 4.68 days.

- Radio-tagged adult bull trout that pass upstream through the Rocky Reach upstream fishway arrive at spawning areas from June through October (BioAnalysts 2002, 2004). Ninety-two percent (84 of 91 total events, 2001-2003) of the bull trout that entered the tributaries did so before July 1. These observations are consistent with other migratory populations reported for the Columbia River Basin (Fraley and Shepard, 1989; Goetz, 1989, 1991; Pratt and Houston, 1993).

- Sub-adult bull trout use the Rocky Reach Dam upstream fishway to move upstream past the Project.

- Bull trout move downstream through the downstream bypass at Rocky Reach Dam. Sub-adult bull trout were sampled in the prototype downstream bypass from 1998 through 2002 with 23, 30, 8, 4, and 5 fish sampled, respectively. No bull trout were observed in 2003 and 2004, possibly because sampling frequency was greatly decreased from previous years to reduce incidental take of listed anadromous species.

- A correlation appears to exist between the number of bull trout passing Rocky Reach Dam in May through July and the number of bull trout redds counted in the Mad River, a tributary to the Entiat River. The highest redd counts in the Mad River occurred in 2000 (45 redds) and 2003 (52 redds) (USFS, unpublished redd count reports, 2003), corresponding to the highest bull trout upstream fishway counts (May through July) of 198 and 186, respectively, at Rocky Reach (Chelan PUD unpublished fishway counts, 2000, 2003).
- Adult and sub-adult bull trout utilize the reservoirs during all seasons (Rocky Reach Dam upstream fishway observations April – December; radio telemetry detections 2001-2004).
- No radio tagged bull trout mortality was documented at Rocky Reach Dam or in the Reservoir during telemetry monitoring in 2001, 2002, and 2003.

3.3 Relationship of this Plan to the May 12, 2004 USFWS Biological Opinion

On May 12, 2004, the USFWS issued a biological opinion (USFWS 2004 BO) analyzing any potential effect on bull trout of operating the Project consistent with the HCP Agreement. Bull trout are not covered by the HCP Agreement. The USFWS concluded that such operations are not likely to jeopardize the continued existence of the Columbia River distinct population segment of bull trout, and are not likely to destroy or adversely modify proposed critical habitat for bull trout. The USFWS 2004 BO, as part of the proposed action, included impact minimization measures for bull trout to be implemented by Chelan PUD. In addition to the USFWS 2004 BO, the USFWS issued an accompanying incidental take statement that includes reasonable and prudent measures and terms and conditions designed to minimize any incidental take of bull trout at the Project.

In response to FERC's requirement that Chelan PUD submit a BTMP in accordance with the USFWS 2004 BO, Chelan PUD submitted a draft BTMP to FERC on February 25, 2005.[6] The draft BTMP was approved on April 19, 2005.[7] The purpose of that draft BTMP was to describe the measures Chelan PUD is or will be implementing for bull trout under the current license as amended by the HCP Agreement (i.e. prior to the issuance of a New License for the Project). Generally, those measures focus on Chelan PUD's efforts to monitor bull trout over several years (2005 through 2008 or 2006 – 2009, depending on the activity) to ensure that incidental take does not exceed the allowance set forth in the USFWS 2004 BO.[8]

As anticipated in the USFWS 2004 BO, Chelan PUD and the USFWS continued to work together through the relicensing process to further refine the BTMP for the purposes of the New License for the Project.[9] Measures outlined in Section 4 are the continuation of commitments made under the USFWS 2004 BO for the term of the New License, and are intended to comprise the PME measures necessary to monitor and minimize the effect of any incidental take under a New License.

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6 *See* footnote 2.

7 Order approving Bull Trout Management Plan under Article 411, April 19, 2005.

8 See pages 84 – 87 of the USFWS 2004 BO for a description of the incidental take allowance for the Rocky Reach Project.

9 The February 25, 2005 draft BTMP reflects some of these early discussions in section 4 of that version.

This Chapter has been further refined to describe, as clearly as possible, the relationship between measures implemented under the USFWS 2004 BO, and measures that are herein being proposed under a New License for the Project. To that end, sections 3.5, 3.6, and 3.7 list those measures that are currently being implemented under the USFWS 2004 BO; and Section 4 lists those measures proposed for inclusion in the New License. Where appropriate, measures that appear in more than one section are cross-referenced.

3.4 Summary of Measures Included in the USFWS May 12, 2004 Biological Opinion

The USFWS 2004 BO included six impact minimization measures, two reasonable and prudent measures, and four terms and conditions (which implement the reasonable and prudent measures) in the USFWS 2004 BO,[10] including:

Impact minimization measures (Section 3.5)

1) Document sub-adult fish condition during passage;

2) Complete a Bull Trout Management Plan;[11]

3) Implement a bull trout monitoring and evaluation program upon completion of a signed and executed Settlement Agreement for relicensing of the Rocky Reach Project;[12]

4) Monitor adult passage, including:
   - Continued upstream fishway counts,
   - Maintenance of the upstream fishway in accordance with anadromous fish criteria, experimentally expand video counts to the off-season, and
   - Investigate the feasibility of providing video monitoring of the adult separator at the Rocky Reach Project downstream bypass;[13]

5) Participate in development and implementation of the USFWS recovery plan; and

6) Consider collecting and hauling woody debris from Rocky Reach Dam for use in tributaries under the HCP Tributary Conservation Plan.

Reasonable and prudent measures (RPM) (Section 3.6)

1) Develop and implement appropriate measures to reduce upstream and downstream passage impediments for adult and sub-adult bull trout at Rocky Reach Dam and its associated reservoir;

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10 See pages 22, 87 and 88 of the USFWS 2004 BO, respectively.

11 This measure is fulfilled by the development of the February 25, 2005 BTMP.

12 This refers to the implementation of this BTMP and its components.

13 Chelan PUD did investigate the feasibility of providing video monitoring of the adult fish separator at the downstream bypass in 2003 and determined that it is infeasible due to extremely low light and poor visibility.

2) Monitor any adverse effects resulting from the proposed action; assess the actual level of incidental take and detect exceedances; and determine the effectiveness of reasonable and prudent measures and terms and conditions.

Terms and conditions (Section 3.7)

1) To implement RPM 1, develop a list of prioritized monitoring efforts necessary to evaluate the effects of the Project on the upstream and downstream passage needs of bull trout at Rocky Reach Project by February 28, 2005; then initiate studies to assess Project impacts and, if necessary, implement modifications to the upstream fishway, downstream bypass, or operations to reduce the take of bull trout;

2) To implement RPM 1, develop a prioritized list of monitoring efforts necessary to determine the extent of bull trout entrainment through Rocky Reach Dam turbines by February 28, 2005; then initiate studies to assess the extent of bull trout entrainment through the turbines at Rocky Reach Dam and, if entrainment is determined to be significant, explore techniques to minimize entrainment;

3) To implement RPM 2, develop and implement a bull trout monitoring program that includes sufficient radio-tagged bull trout to enable monitoring of bull trout utilizing Rocky Reach Dam and Reservoir system and tracking of incidental take; and

4) Implementation of interim measures.[14]

3.5 Specific Actions to Implement the Impact Minimization Measures

To implement the measures described in the USFWS 2004 BO (if not already completed by the February 28, 2005 BTMP submission), Chelan PUD and the USFWS agreed to implement the following specific actions under the original license.[15]

3.5.1 Sub-adult Fish Condition Monitoring

Chelan PUD shall document age-group, year-class, length-weight information, and degree and frequency of descaling for all sub-adult bull trout that are observed in the downstream bypass sampling facility for years 2005 though 2008. Results of observations will be reported annually, as described in Section 3.6.2.

3.5.2 Adult Passage Monitoring

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[14] These measures were implemented prior to the approval of the February 28, 2005 plan per agreement between USFWS and Chelan PUD in a February 19, 2004 meeting. These measures included 1) a one-year extension of the upstream fishway monitoring period to assess adult bull trout utilization of existing fishways outside of the traditional migratory timeframes; 2) continued coordinated telemetry monitoring of radio-tagged bull trout; 3) compilation of Project operational data linked to timeframes when adult migratory bull trout pass the Project powerhouse and/or spill gates; 4) cost-shared funding with the USFWS for analysis of genetic samples from fluvial bull trout sampled during the first year of the Mid-Columbia Bull Trout Study; and 5) participation in a coordinated effort with the USFWS to increase the informational database for adult bull trout that utilize the Methow/Twisp River system. Reports on these actions were included in the 2005 annual report summary required by the USFWS 2004 BO, and will be included, as appropriate, in the 2006 report.

[15] As amended by Article 411.

Chelan PUD shall implement a monitoring program to identify potential Project-related impacts on upstream and downstream passage of adult bull trout through the Rocky Reach Dam for the purpose of identifying any incidental take of bull trout.

3.5.2.1 Upstream Fishway Counts

Chelan PUD shall conduct video monitoring in the upstream fishway, except during the annual fishway maintenance period, at Rocky Reach Dam to count fish species passing through the ladder and take digital photographs of bull trout to provide information on the size, age, and condition of bull trout that move upstream via the upstream fishway.

3.5.2.2 Upstream Fishway Operations Criteria

Chelan PUD shall continue to operate the upstream fishway at Rocky Reach Dam in accordance with anadromous fish criteria described in the Chelan PUD's annual Fish Passage Plan.

3.5.2.3 Off-season Passage Counts

Chelan PUD shall determine off-season (November 15 – April 13, except for upstream fishway maintenance period) bull trout passage[16] (numbers and passage dates) at the Project for an experimental period 2003 - 2006. Specifically, for an experimental three-year period, from November 2003 through March 2006, Chelan PUD will implement off-season video counts of the Rocky Reach Dam upstream fishway for the purpose of determining bull trout passage. Video counts will be conducted between November 15 and April 13 of each year, except during upstream fishway maintenance periods. Count results will be evaluated by Chelan PUD to determine whether passage trends exist and to identify when upstream fishway maintenance would have the least impact on bull trout passage. If trends are identified, Chelan PUD will investigate the most appropriate and reasonable times for upstream fishway maintenance activities during low-usage periods for bull trout that also do not conflict with adult anadromous fish passage.

The estimated cost for Section 3.5.2.3 is $45,000 for the three years.

3.5.3 Participate in the USFWS Recovery Plan

Chelan PUD is a member of the Upper Columbia River Bull Trout Recovery Unit Team. Chelan PUD shall continue to attend meetings of this team, as scheduled by the USFWS, to participate in developing and finalizing the USFWS Bull Trout Recovery Plan.

3.5.4 Tributary Enhancement

Chelan PUD shall consider the feasibility of collecting and hauling large woody material that is captured at Rocky Reach Dam for placement in tributaries for use as fish habitat in projects funded by the Tributary Conservation Plan contained in the HCP Agreement.

3.5.5 Genetics Analysis[17]

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[16] Chelan PUD will record information for both adult and sub-adult bull trout under this measure.

[17] While genetic sampling was not included as a measure in the USFWS 2004 BO, Chelan PUD voluntarily agreed to include it as a conservation recommendation in the BTMP per a subsequent request by the USFWS. The measure also appears in section 4.4.3 as a proposed PME during the term of the New License.

To assist the USFWS in identifying the core areas and local populations of bull trout affected by Rocky Reach Dam, Chelan PUD shall collect and fund genetic analysis of tissue samples taken from up to 30 adult bull trout per year for three years (up to 90 samples total) at Rocky Reach Dam, 2005 through 2007. Samples will be submitted to the USFWS Central Washington Field Office in Wenatchee, WA.

Chelan PUD shall collect and fund analysis of tissue samples taken from sub-adult bull trout that are PIT tagged at the Rocky Reach downstream bypass, and at smolt and broodstock traps funded by Chelan PUD (four sites, up to 10 fish per site, 2005 - 2007), under 3.6.3.1 of this plan. Up to 40 genetic samples per year for three years will be the combined total for the Rocky Reach BTMP. Genetic samples will be submitted to the USFWS Central Washington Field Office in Wenatchee, WA.

The estimated cost of the genetic analyses described in this section is $11,000 for the three year period.

3.6 Specific Actions to Implement the Reasonable and Prudent Measures and Terms and Conditions

To implement the reasonable and prudent measures and terms and conditions described in the USFWS 2004 BO (i.e., those not already completed by the February 28, 2005 BTMP submission), Chelan PUD and the USFWS agreed to implement the following specific actions under the original license.[18]

3.6.1 Adult Bull Trout Upstream and Downstream Passage Evaluation (Adult Bull Trout)

Between May 2005 and July 2007, Chelan PUD shall capture and insert active tags (2 year radio tags, plus PIT tags) in 30 adult bull trout annually (representing about 23% of the average annual ladder count May through July, 1998-2003) from May 2005 through July 2007 (three years of tagging for a total of 90 fish for the three-year period). All tagged fish will be released upstream of Rocky Reach Dam, and each fish will be counted as one successful upstream fishway passage event for the year it is tagged. Because of variable tag retention times in individual fish, and inherent inconsistencies in transmitter battery life, take levels will be calculated using data from only the first year (365 days) of tag life for each tagged fish. Tag detections occurring outside of this period will not be used for take monitoring, but will continue to be compiled (through July 2008) to assist the USFWS in characterizing movements of bull trout in the Columbia River mainstem.

Chelan PUD will use appropriate tracking methods to monitor tagged adults, including installation and maintenance of receiver arrays necessary to adequately monitor upstream and downstream passage through Rocky Reach Dam for a three-year period, 2005 – 2008. The receiver arrays will include fixed receiver sites at the dam and tributary entrances to monitor passage routes through turbines, spillway, and downstream bypass, as well as tributary entrances. Additional mobile tracking methods may include aircraft, boat, and/or vehicle surveys.

[18] As amended by Article 411.

Utilizing these tracking methods, Chelan PUD shall monitor monthly movements of tagged fish for a three-year period from May 2005 through July 2008 while such fish are within the Project boundary until the tagged fish enter a tributary. Tracking will continue for all fish that re-enter the Reservoir.

Tag detection and tracking data from May 2005 through July 2008 will be compiled and evaluated by Chelan PUD to determine the status and location of tagged adult bull trout, tag status, and any need to engage in tag recovery operations. Chelan PUD shall report any Project-related bull trout incidental take within the Project boundary to the USFWS within 48 hours of detection by Chelan PUD, under this section and in subsequent monitoring described in Section 4.1.6.

Chelan PUD will participate in information exchanges and regional efforts to coordinate radio-tag frequencies for bull trout monitoring. Such coordination will help provide consistency among monitoring efforts conducted in the Mid-Columbia River Basin.

The total cost of these studies is estimated to be $480,100.

3.6.2 Passage Results and Incidental Take Reporting for Adult Bull Trout

Chelan PUD shall submit an annual summary report to the USFWS by April 15 of the year following each one-year study period for the purpose of updating the USFWS on the results of adult bull trout monitoring under Section 3.6.1. In these reports, Chelan PUD will include an examination of whether a correlation exists between Project operations and upstream and downstream passage times.

By December 31, 2008, Chelan PUD shall prepare a final report on the passage survival and level of incidental take of adult bull trout for each passage route at the Project during this three-year monitoring period. An annual summary report was prepared by April 15 for year 2005 and will be prepared by April 15 of 2006 and 2007. The upstream and downstream passage results will be analyzed to determine the number of tagged fish known to have passed through each of the four possible routes: the turbines, spillway, downstream bypass, and upstream fishway. Authorized take levels for passage through the spillway, downstream bypass, and upstream fishway are 2 percent, respectively, and 5 percent through turbines per year. Allowable take resulting from pikeminnow predator control activities is two fish per year. The incidental take for each passage route, if any, will be estimated by the number of observed mortalities to tagged fish that are attributable to that passage route divided by the total number of tagged fish known to have passed through that route.

The pooled passage data from the three-year study conducted in 2005 through 2008, and additional data from previous studies conducted in 2001 through 2004, will be statistically analyzed to detect if the level of incidental take for each passage route exceeds the anticipated incidental take level authorized in the USFWS 2004 BO's incidental take statement. The statistical analysis will be a one-tailed test of the hypothesis that the anticipated incidental take level is not exceeded. The passage survival and level of incidental take of bull trout will be assessed annually for each passage route at the Rocky Reach Project. A statistical analysis will be used to detect if the level of incidental take for each passage route exceeds the anticipated incidental take level anticipated in the USFWS 2004 BO.

The statistical analysis will be a one-tailed significance test of the hypothesis that the anticipated incidental take level is not exceeded. The anticipated take level for the turbine passage route is that no more than five percent of radio-tagged bull trout passing through turbines will be killed by turbine operation. A one-tailed test for significance will be used to determine the probability that the observed incidental take is different from what could are occurred by chance if the true take level is $\leq$ five percent. For example, if 20 fish were observed to have passed through the turbines in the first year, incidental take by the turbines would not be exceeded statistically until four fish are killed by turbine operation (binomial probability, test of hypothesis $H_0 \leq 5\%$, 95% significance level, p-value for 1, 2, 3, or 4 fish being killed is .64, .26, .075, and .015, respectively, significant value is bolded). Thus, an experimental result of three fish killed out of 20 passing through the turbines would not exceed the anticipated incidental take level of five percent (alpha + 0.05).

Upon locating any dead, injured or sick bull trout within the Project boundary, Chelan PUD will report the finding to the USFWS Central Washington Field Office within 48 hours.

3.6.2.1 Correlation Analysis

Chelan PUD shall analyze tag detection and tracking data, passage results, and Project operation data from May 2005 through July 2008 to determine whether correlations exist between Project operations and adult bull trout upstream and downstream passage times. The analysis will include a compilation and characterization of Project operations (e.g., spill, turbines, and pool elevations) and upstream fishway operations during times of upstream and downstream passage for tagged adult bull trout. Chelan PUD will provide results of the correlation analysis as part of the annual reports described in Section 3.6.2.

3.6.3 Sub-Adult Bull Trout Monitoring Measures

One objective of this BTMP for sub-adult bull trout is to investigate potential Project-related impacts on upstream and downstream passage of sub-adult bull trout through the Rocky Reach Dam and Reservoir. The stakeholders participating in the RRFF (including USFWS), however, agree that it is not feasible to fully assess sub-adult passage at the Project because of an inability to collect a sufficient sample size. However, Chelan PUD shall implement the following measures to address this objective of the BTMP by: 1) PIT tagging of sub-adult bull trout when incidentally collected at the Project or in tributary traps; 2) participating in information exchanges and regional efforts to develop effective monitoring methods; and 3) determining off-season, sub-adult bull trout passage through the upstream fishway (see Section 3.5.2.3).

3.6.3.4 PIT Tagging

The stakeholders to the HCP Agreement and the Rocky Reach relicensing process agree that because of the inability at this time to collect a sufficient sample size of sub-adult bull trout, it is not feasible to assess sub-adult passage or take at the Project. However, when collected incidentally at the Project, or in tributary traps, sub-adult bull trout will be PIT tagged.

- Chelan PUD shall provide up to 80 PIT tags per year for three years (combined total for both Rocky Reach and Rock Island Plans), equipment and facilitate training to enable PIT tagging of sub-adult bull trout when these fish are collected incidentally during certain fish sampling operations. Fish sampling operations that could result in incidental captures of sub-adult bull trout include the Rocky Reach upstream fishway trap during operations for capture of other species, the Rocky Reach downstream bypass, the Rock Island bypass trap, the adult collection traps at Tumwater Dam, Dryden Dam, and the Chiwawa broodstock trap, and at juvenile fish tributary traps on the Chiwawa River, below Lake Wenatchee, lower Wenatchee River, Entiat River, and Peshastin Creek. Different entities conduct these fish sampling operations, thus the provision of tags, equipment and methodology should be standardized. Chelan PUD will also provide up to 20 PIT tags per year for tagging sub-adult bull trout at the USFWS Entiat and Peshastin smolt traps, 2005 – 2007 (combined total for both the Rocky Reach and Rock Island Bull Trout Plans). Chelan PUD will provide the following for selected sites: 10 PIT tags (or more if appropriate) and tagging syringes and a list of standardized methods developed in consultation and coordination with the USFWS. Chelan PUD will facilitate an annual pre-season coordination meeting with the fish sampling entities. Three years after completion of the Rocky Reach Dam upstream fishway PIT tag detection system, the number of fish tagged and tag recovery data from these sub-adult tagging operations will be reviewed with the USFWS to evaluate whether or not to continue the program.

- Chelan PUD shall install a PIT tag detection system in the upstream fishway at Rocky Reach Dam in early 2006 and monitor upstream movements for PIT tagged, sub-adult (and adult) bull trout at Rocky Reach Dam for an experimental period, 2006 through mid-2009. Three years after completion of the detection system, Chelan PUD will review the number of fish tagged and tag recovery data from these sub-adult tagging operations with the USFWS to evaluate whether or not to continue the program.

- Monitor upstream movements for PIT tagged sub-adult bull trout at Rocky Reach Dam for an experimental period 2006 through 2009.

The cost of these PIT tag programs is estimated to be $15,000 annually.

3.6.3.5 Information Exchange and Regional Monitoring Efforts

Chelan PUD will participate in information exchanges with other entities conducting bull trout research and regional efforts to explore methods to monitor upstream and downstream movement of sub-adult bull trout in the mainstem Columbia River. If new methodologies become available, Chelan PUD will evaluate them in conjunction with the RRFF. Upon the recommendation of the RRFF, Chelan PUD will implement appropriate and reasonable methods for monitoring sub-adult bull trout at Rocky Reach Dam.

3.6.4 Implement Appropriate and Reasonable Options to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull Trout are Identified

Chelan PUD shall continue to operate upstream fishway at Rocky Reach Dam in accordance with anadromous fish criteria described in the annual Chelan PUD Fish Passage Plan (Grassell 2005). However, if upstream or downstream passage problems for bull trout are identified (as agreed to by the USFWS and Chelan PUD). Chelan PUD will identify and implement, in consultation with the RRFF, appropriate and reasonable options to modify the upstream fishway, downstream bypass, or operations in order to monitor or minimize the effect of any incidental take resulting from such impacts to bull trout passage.

3.7 Specific Actions to Implement Terms and Conditions

Measures identified under Terms and Conditions in the USFWS 2004 BO are part of the ongoing studies described in sections 3.5 and 3.6, which will be conducted in years 2005 through 2008.

3.8 Specific Actions to Implement Additional Measures

Measures described in this section are not included in the USFWS 2004 BO. However, Chelan PUD, in consultation with the USFWS through the Rocky Reach relicensing process, has agreed to implement the following measures:

3.8.1 Investigate Reservoir Stranding

Chelan PUD shall investigate Rocky Reach inflow patterns, reservoir elevations, and backwater curves for a three-year period (2005 through 2007) to determine if stranding or entrapment of bull trout, primarily sub-adults, may occur. More specifically, the investigation will include: 1) a review of the Rocky Reach forebay elevations, back-water curves, and historical discharges (daily, hourly) from Wells Dam to determine Rocky Reach Reservoir surface water elevations during low flow periods; 2) a determination of whether backwater locations exist that could lose connectivity to the river during low flows hours; and 3) a determination of backwater area elevations to identify flow scenarios that could result in de-watering or isolation that could result in incidental take.

In the event the evaluation identifies locations that may be dewatered or isolated, Chelan PUD will undertake a appropriate and reasonable fish sampling effort to determine if sub-adult bull trout are using the identified areas during low flow hours. If sampling results show that incidental take of sub-adult bull trout occurs due to stranding or de-watering, Chelan PUD will report study results in the annual report described in Section 3.6.2. Chelan PUD will develop, in consultation with the USFWS and the RRFF, a plan to minimize the effect of such incidental take of sub-adult bull trout.

The cost of these studies is estimated to be $60,000.

3.8.2 HCP Agreement Implementation

Implementation of the HCP Agreement may benefit bull trout by: 1) providing a safe passage route (the downstream bypass) through the Project; 2) providing tributary habitat enhancement, thereby increasing stream productivity; and 3) implementing the hatchery plan, which will increase density of historically important bull trout prey species.

SECTION 4: PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

In addition to the measures that Chelan PUD shall implement through the USFWS 2004 BO described in sections 3.3 through 3.8, Chelan PUD shall implement the following PME measures during the term of the New License to satisfy the goals of identifying, developing, and implementing measures to monitor and address impacts on adult and sub-adult bull trout passage resulting from ongoing Project operations. Through monitoring and implementation of these PME measures, the BTMP for the Rocky Reach Project is designed specifically to meet the following objectives:

Objective 1: Continue operating the upstream fishway and downstream bypass;

Objective 2: Identify any adverse ongoing Project impacts on adult and sub-adult bull trout passage through monitoring;

Objective 3: Implement appropriate and reasonable options to modify the upstream fishway, downstream bypass, or operations if adverse impacts on bull trout are identified; and

Objective 4: Participate in the development and implementation of the USFWS bull trout Recovery Plan.

The measures proposed in this section are intended to be consistent with recovery actions as outlined in the USFWS draft Bull Trout Recovery Plan. Moreover, this section of the BTMP is intended to use Adaptive Management, where strategies for meeting the goals and objectives may be re-worked under a collaborative effort by the RRFF, based on new information and ongoing monitoring results. Biological objectives for supporting designated uses for bull trout (Table 4-1) and a summary of criteria for achievement of objectives for bull trout (Table 4-2) are shown at the end of this section.

The commitments described in this section are intended to serve both as PME measures for bull trout through the term of the New License and to adequately monitor and minimize any incidental take of bull trout consistent with Section 7 of the ESA.

4.1 Objective 1: Continue Operating Upstream Fishway and Downstream Bypass

4.1.1 Provide Upstream and Downstream Passage for Adult and Sub-Adult Bull Trout

Chelan PUD shall continue to provide upstream passage for adult bull trout through the existing upstream fishway, and downstream passage of adult and sub-adult bull trout through the existing downstream bypass;

4.1.2 Upstream Fishway Counts

Chelan PUD shall continue video monitoring in the upstream fishway, except during the annual fishway maintenance period, at Rocky Reach Dam to count bull trout passing through the fishway and provide information on the size, age, and condition of bull trout that move upstream via the upstream fishway.

4.1.3 Upstream Fishway Operations Criteria

Chelan PUD shall continue to operate the upstream fishway at Rocky Reach Dam in accordance with anadromous fish criteria described in the annual Chelan PUD Fish Passage Plan (Grassell 2005).

4.2 Objective 2: Identify Any Adverse Ongoing Project Impacts on Adult and Sub-adult Bull Trout Passage

Chelan PUD will implement a program to identify potential ongoing Project impacts on upstream and downstream passage of adult bull trout through the Rocky Reach Dam and any incidental take of bull trout.

4.2.1 Adult Bull Trout Upstream and Downstream Passage Evaluation

Chelan PUD shall implement an adult bull trout telemetry program to continue to monitor adult upstream and downstream passage through the Dam and Reservoir and implement appropriate and reasonable measures to monitor any incidental take of bull trout (see also Sections 3.5.2 and 3.6.1). Specifically, beginning in year 10 of the New License, and continuing every ten years thereafter during the term of the New License, Chelan PUD will conduct a one-year monitoring study for the purpose of determining whether Chelan PUD remains in compliance with the Project's allowable level of incidental take of bull trout due to upstream and downstream passage, as authorized in the incidental take statement issued as part of the New License. The same study protocols used in monitoring described in Section 3.6.1 will be employed for these monitoring studies.

The estimated cost of a one-year monitoring study is $144,000.

Chelan PUD shall prepare an annual report to the USFWS by April 15 of the year following each of the one-year study periods, for the purpose of updating the USFWS on the results of monitoring under this section.[19] Chelan PUD shall report any Project-related bull trout incidental take within the Project boundary to the USFWS within 48 hours of detection by Chelan PUD. If the authorized incidental take level is exceeded during any one year period, Chelan PUD will conduct additional monitoring in the succeeding year. If the authorized incidental take level is exceeded in the second year, Chelan PUD will develop a plan, in consultation with the RRFF, to address the identified factors contributing to exceedance of the allowable level of incidental take.

Chelan PUD shall analyze tag detection and tracking data, passage results, and Project operation data to determine whether correlations exist between Project operations and adult bull trout upstream and downstream passage times. The analysis will include a compilation and characterization of Project operations (e.g., spill, turbines, and pool elevations) and upstream fishway operations during times of upstream and downstream passage for tagged adult bull trout.

[19] This report shall be similar in scope to the final report described in section 3.5.2, though the report associated with section will reflect only one year of monitoring and will not average incidental take over three years.

Chelan PUD will provide results of the correlation analysis as part of the annual reports described in Section 3.6.2.

4.2.2 Sub-Adult Bull Trout Monitoring Methods

While an objective of this BTMP for sub-adult bull trout is to identify potential ongoing Project impacts on upstream and downstream passage, the stakeholders participating in the RRFF (including the USFWS) agree that it is not feasible to assess sub-adult passage at Rocky Reach Dam, because of an inability to collect a sufficient sample size. Nevertheless, for a one-year period beginning in year 10 of the New License and continuing every 10 years thereafter, upon the recommendation of the RRFF, Chelan PUD shall implement appropriate and reasonable methods for monitoring sub-adult bull trout at Rocky Reach Dam. Specifically, Chelan PUD may continue to provide PIT tags and equipment, and facilitate training, to enable fish sampling entities to PIT tag sub-adult bull trout when these fish are collected incidentally during certain fish sampling operations (see also Section 3.6.3). If PIT tagging is continued under this section during the term of the New License, then the protocols described in Section 3.6.3.1 of this Chapter will be implemented.

If PIT tagging programs are continued, the cost is estimated to be $5,000 annually.

4.3 Objective 3: Implement Appropriate and Reasonable Measures to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull Trout are Identified

Chelan PUD shall continue to operate the upstream fishway at Rocky Reach Dam in accordance with anadromous fish criteria described in the annual Chelan PUD Fish Passage Plan (Grassell, 2005). However, if upstream or downstream passage problems for bull trout are identified (as agreed to by the USFWS and Chelan PUD), Chelan PUD will identify and implement, in consultation with the RRFF, appropriate and reasonable measures to modify the upstream fishway, downstream bypass, or operations to reduce the identified impacts to bull trout passage.

4.4 Objective 4: Participate in the Development and Implementation of the USFWS Bull Trout Recovery Plan

4.4.1 Participate in the Development and Implementation of the USFWS Recovery Plan

Chelan PUD is a member of the Upper Columbia River Bull Trout Recovery Unit Team. Chelan PUD shall continue to attend meetings of this team, as scheduled by the USFWS, until completion of the Bull Trout Recovery Plan. Chelan PUD will participate, as appropriate, in implementation of such Recovery Plan once it is completed by the USFWS.

4.4.2 Tributary Enhancement

Chelan PUD shall consider the feasibility of collecting and hauling large woody material that is captured at Rocky Reach Dam for placement in tributaries for use as fish habitat in projects funded by the Tributary Conservation Plan contained in the HCP Agreement.

4.4.3 Funding Collection of Tissue Samples and Genetic Analysis

Beginning in year 10 of the New License, and continuing every 10 years thereafter for the term of the New License, Chelan PUD shall, if recommended by the RRFF, collect tissue samples from up to 30 adult bull trout and up to 40 sub-adult bull trout over a period of one year and fund their genetic analysis. If genetic analysis is conducted, the annual cost of the analysis is estimated to be $3,700. Samples will be submitted to the USFWS Central Washington Field Office in Wenatchee, Washington.

4.4.4 Information Exchange and Regional Monitoring Efforts

During the term of the New License, Chelan PUD will continue to participate in information exchanges with other entities conducting bull trout research and regional efforts for the purpose of exploring methods to monitor upstream and downstream movement of sub-adult bull trout in the mainstem Columbia River (see also Section 3.6.3.2). If new monitoring methodologies become available, Chelan PUD shall, in consultation with the RRFF, implement appropriate and reasonable measures for monitoring sub-adult bull trout at Rocky Reach Dam.

Table 4-1: Biological Objectives for Supporting Designated Uses for Bull Trout

Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Bull Trout Adult Upstream Passage	Take does not exceed 2% through the upstream fishway	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Sections 4.1.1-4.1.3
Bull Trout Adult Downstream Migration	Take does not exceed 5% passing through turbines; 2% passing through spillways; and 2% passing through the downstream bypass	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.1.2
Bull Trout Adult Rearing in the Reservoir	Take does not exceed 2 fish for the fish predator control program	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.1.2
Bull Trout Sub-adult Downstream Migration	Take does not exceed limits when established by USFWS	As recommended by the RRFF	Maintain Action. No additional action needed.	Pursue feasibility of Project operations of fishway/bypass if migration problem(s) are identified	Sections 4.1.1-4.1.3
Bull Trout Sub-adult Rearing in the Reservoir	Take does not exceed limits when established by USFWS	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.1.2

Table 4-2: Summary of Criteria for Achievement of Objectives for Bull Trout

Use/Action	Objective	Measured Parameter	Schedule	Actions if Objective Achieved	Actions if Objective Not Achieved	Plan Action
Adult Bull Trout	Adult upstream passage	Radio-telemetry study and monitor incidental take	Every 10 years	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.1.3
	Adult upstream passage	Correlate passage and ongoing Project operations	Every 10 years	No additional action needed.	Pursue feasibility of Project operations or fishway/bypass if passage problems are identified	Section 4.1.3
	Verify that Incidental Take does not exceed allowances for adult bull trout	5% of bull trout passing through turbines; 2% passing through spillways; 2% through the downstream bypass; 2% through the upstream fishway; (All of the above will be three year binomial probability analysis for each route); and 2 bull trout (not percent) for the fish predator control program/year (no statistics)	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 3.3
Sub-adult Bull Trout	Sub-adult downstream passage	PIT tagging sub-adults where captured; monitor passage through adult fishway	As recommended by RRFF	Maintain Action. No additional action needed.	Pursue feasibility of Project operations or fishway/bypass if passage problems are identified	Section 4.1.3
	Measure Incidental Take (sub-adult)	Measure potential reservoir stranding or entrapment	2005-2008	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 3.8.1

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CHAPTER 5: ROCKY REACH PACIFIC LAMPREY MANAGEMENT PLAN

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Little specific information is currently known about the life history or status of Pacific lamprey in the vicinity of the Rocky Reach Hydroelectric Project (Project). Pacific lamprey are known to occur in the Wenatchee, Entiat, and Methow rivers, and they migrate through the mainstem Columbia River. Adult passage has been documented at the fishways of the Rocky Reach and Rock Island dams. It is unknown whether lamprey use the mainstem Columbia River for spawning.

Research at other mainstem dams has identified areas within adult fishways that are problematic for lamprey passage. In 2004, during the relicensing process, the Natural Resources Working Group (NRWG) determined that Chelan PUD should conduct a study at the Project to evaluate passage of adult Pacific lamprey through the upstream fishway, and to document any downstream passage from the upstream fishway. The purpose of the study was to identify potential upstream passage impediments in the Rocky Reach Dam's fishway in order to address the goal of the Pacific Lamprey Management Plan (PLMP) stated below. Study results identified several areas where passage impediments appear to exist. Details of the study are located in Section 3 of this plan.

The goal of the PLMP is to provide safe, timely, and effective passage for adult and juvenile Pacific lamprey; and where unavoidable Project impacts are measured, then provide appropriate and reasonable Protection, Mitigation, and Enhancement measures (PMEs) that achieve an overall No Net Impact (NNI) on this population. Objectives to achieve this goal include addressing: 1) potential ongoing Project impacts on upstream passage of adult Pacific lamprey; 2) potential ongoing Project impacts on downstream passage of juvenile Pacific lamprey; 3) potential ongoing Project impacts on the existing reservoir habitat used currently by juvenile Pacific lamprey; and 4) any unavoidable impacts by identifying and implementing measures to achieve No Net Impact (NNI).

The PLMP uses Adaptive Management to resolve critical uncertainties and to achieve the goal and objectives. Accordingly, the PLMP will be reviewed on a periodic basis by the Rocky Reach Fish Forum (RRFF) to allow for planning and future adjustments over the term of the New License. In addition, the PLMP is intended to be consistent with other Pacific lamprey management plans in the mid-Columbia region.

The PLMP calls for Chelan PUD to implement the following PME measures described in Section 4:

1. Continue to provide upstream and downstream passage for Pacific lamprey through the Project's upstream fishway and downstream bypass, in accordance with the operation criteria for anadromous salmonids and compatible bull trout migration guidelines;

2. Conduct upstream fishway passage counts of adult Pacific lamprey;

3. As part of the monitoring program, complete and update a literature review for the effectiveness of lamprey passage measures implemented at other hydroelectric projects in the Columbia and Snake rivers;
4. Investigate and implement appropriate and reasonable upstream fishway modifications to provide safe, timely and effective volitional Pacific lamprey passage;
5. Implement a monitoring program, such as through the use of radio telemetry or other appropriate methods, to evaluate fishway modifications;
6. Develop a plan and implement appropriate and reasonable measures to address ongoing Project effects on downstream adult passage if any effects are identified through the monitoring program;
7. Once adult passage success has been achieved, conduct monitoring every 10 years to confirm the success of any modifications, using radio telemetry;
8. Monitor juvenile Pacific lamprey impingement and implement appropriate and reasonable measures to address ongoing Project effects, if any;
9. Measure the type and magnitude of any ongoing Project impacts on the downstream passage of juvenile lamprey, using appropriate and reasonable methodologies.
10. Determine juvenile Pacific lamprey presence/absence and relative abundance in the Reservoir; and
11. Identify and implement appropriate and reasonable measures to address unavoidable impacts to achieve NNI.

SECTION 1: INTRODUCTION

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries agencies, tribes, and interested parties together in a Natural Resources Working Group (NRWG) that provided an opportunity for comprehensive review of current and future management priorities for fish resources potentially impacted by ongoing Project operations. The NRWG was established to identify issues, develop study plans, review study reports, and develop long-term management plans for fish and wildlife species. The NRWG consisted of representatives from the USDA Forest Service, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), U.S. Bureau of Land Management (BLM), the Colville Confederated Tribes (CCT), Yakama Nation (YN), Columbia River Inter-Tribal Fish Commission (CRITFC), and other interested parties.

Technical groups were formed for each comprehensive plan; e.g., white sturgeon, bull trout, Pacific lamprey, resident fish, and wildlife due to the complexity of issues surrounding each species and so that agency experts could focus on meetings pertaining to their specific expertise. A subgroup of the NRWG, the Pacific Lamprey Technical Group (PLTG), comprised of the USFWS, Ecology, WDFW, YN, CRITFC, and Chelan PUD, prepared this Pacific Lamprey Management Plan (PLMP). Upon the effective date of the New License, the Rocky Reach Fish Forum (RRFF) will assume responsibility for meeting to share information, coordinate efforts, and make recommendations and decisions regarding the implementation of the PLMP, which will be reviewed, in consultation with the RRFF, on a periodic basis to allow for planning and future adjustments during the term of the New License and any subsequent annual licenses.

This PLMP contains sections that describe the background knowledge of the Pacific lamprey (Section 2); the relicensing and other studies conducted to determine ongoing Project-related impacts, if any, on Pacific lamprey (Section 3); and specific Protection, Mitigation, and Enhancement measures (PMEs) developed for achieving the goals and objectives for Pacific lamprey to be implemented during the term of the New License and any subsequent annual licenses (Section 4).

SECTION 2: BACKGROUND

2.1 Life History

The Pacific lamprey (*Lampetra tridentata*) is a jawless anadromous fish widely distributed in western North America and eastern Asia. The fish are indigenous to the Columbia River system. In general, their historic distribution coincides with that of Pacific salmon. The current distribution of Pacific lamprey in the Columbia River extends as far upstream as Chief Joseph Dam, and in the Snake River as far upstream as Hells Canyon Dam. The Pacific lamprey is parasitic on various ocean fishes for one to two years. After maturing in the ocean, they migrate upstream in the Columbia River in the summer/fall and spawn over a gravel nest, up to 2-feet in diameter, in shallow water the following spring. Adults die soon after spawning. Juveniles live in streams for five to six years before entering the ocean to become parasitic. They appear to have little impact on marine fish populations and do not feed when they move into streams to spawn.

2.2 Species Status

Conservation groups filed a lawsuit against the U.S. Fish and Wildlife Service (USFWS) in May 2004 to compel USFWS to act on their January 27, 2003 petition to list four species of lamprey, including Pacific lamprey. On October 1, 2004, the USFWS initiated its 90-day finding process as part of a settlement with the conservation groups. On December 22, 2004, the USFWS announced that a petition to list four species of lamprey did not contain sufficient information to warrant further review at that time. USFWS said it will continue to work with others on efforts to conserve lamprey and their habitat.

Over the past four years, Pacific lamprey adult counts at the mid-Columbia River dams have increased to levels similar to those observed in the 1960s. Counts from the 1960s through the mid-1970s showed a decrease, followed by a leveling off of the counts through the 1990s. Causes of population decline may include: 1) passage problems for adult and juvenile lamprey migrating past dams; 2) declining conditions of spawning and rearing habitat in freshwater; 3) a decline of prey available in the marine environment; 4) industrial and agricultural pollution; 5) urbanization; 6) dewatering of streams; and 7) adult losses at sea (Close, 2002, Moser and Close, 2003a; 2003b).

2.3 Adult Fishway Counts

Pacific lamprey are observed in the upstream fishway and downstream bypass of mid-Columbia River dams, with peak passage typically occurring between March and October. Mid-Columbia River populations of adult lamprey passing Rocky Reach Dam ranged from about 1,000 to 17,000 from 1961 to 1969, then declined to less than 200 by 1976 (Mullan et al., 1986). The number of lamprey counted at Rock Island Dam showed a similar decline, with counts stabilizing at about 400 per year from 1977 to 1982. However, over the past four years, lamprey adult counts at the mid-Columbia River dams, including Rocky Reach Dam, have increased, reaching 767 in 2000, 805 in 2001, 1,842 in 2002, 2,521 in 2003, and 1,043 in 2004. Adult Pacific lamprey counts at Rock Island Dam were 822, 1,460, 4,878, 5,000, and 2,362 for the same years. Chelan PUD began counting 24 hours per day at the Rocky Reach upstream fishway in 1996. Regardless of counting methodology, annual lamprey passage counts have increased in recent years.

2.4 Spawning and Rearing

There is no documentation that Pacific lamprey use the mainstem Columbia River for spawning. However, a literature review conducted during the relicensing process (BioAnalysts, 2000) indicates that juvenile lamprey may use the mainstem for rearing.

SECTION 3: STUDIES AND EVALUATION OF PROJECT EFFECTS

Little specific information is currently known about the life history or status of Pacific lamprey in the vicinity of the Project. They are known to occur in the Wenatchee, Entiat and Methow rivers, and they migrate through the mainstem Columbia River. Adult Pacific lamprey passage is documented at the Rocky Reach and Rock Island Dam fishways.

In 2004, the NRWG determined that Chelan PUD should conduct a study at the Project to evaluate upstream passage of adult Pacific lamprey through the upstream fishway and to document any downstream passage through the Project (Chelan PUD, 2005). The primary purpose of the study was to identify potential upstream passage impediments in the upstream fishway.

3.1 Adult Lamprey Telemetry Study

Research at other mainstem Columbia River dams has identified areas within upstream fishways that are problematic for lamprey passage (Moser et al., 2003). In response to this research, radio-telemetry was used in 2004 to assess adult Pacific lamprey passage behavior and success through the Rocky Reach Dam upstream fishway (Figure 5-1 and Figure 5-2). The telemetry system employed in the study was installed and operational at the tailrace and upstream fishway, as well as the turbine intakes and spillbays. These systems were designed and installed by BioAnalysts, Inc., and have been used previously to assess passage of adult salmonids, primarily bull trout.

The following sections describe briefly the telemetry system, as well as capture and tagging methods employed in the study.

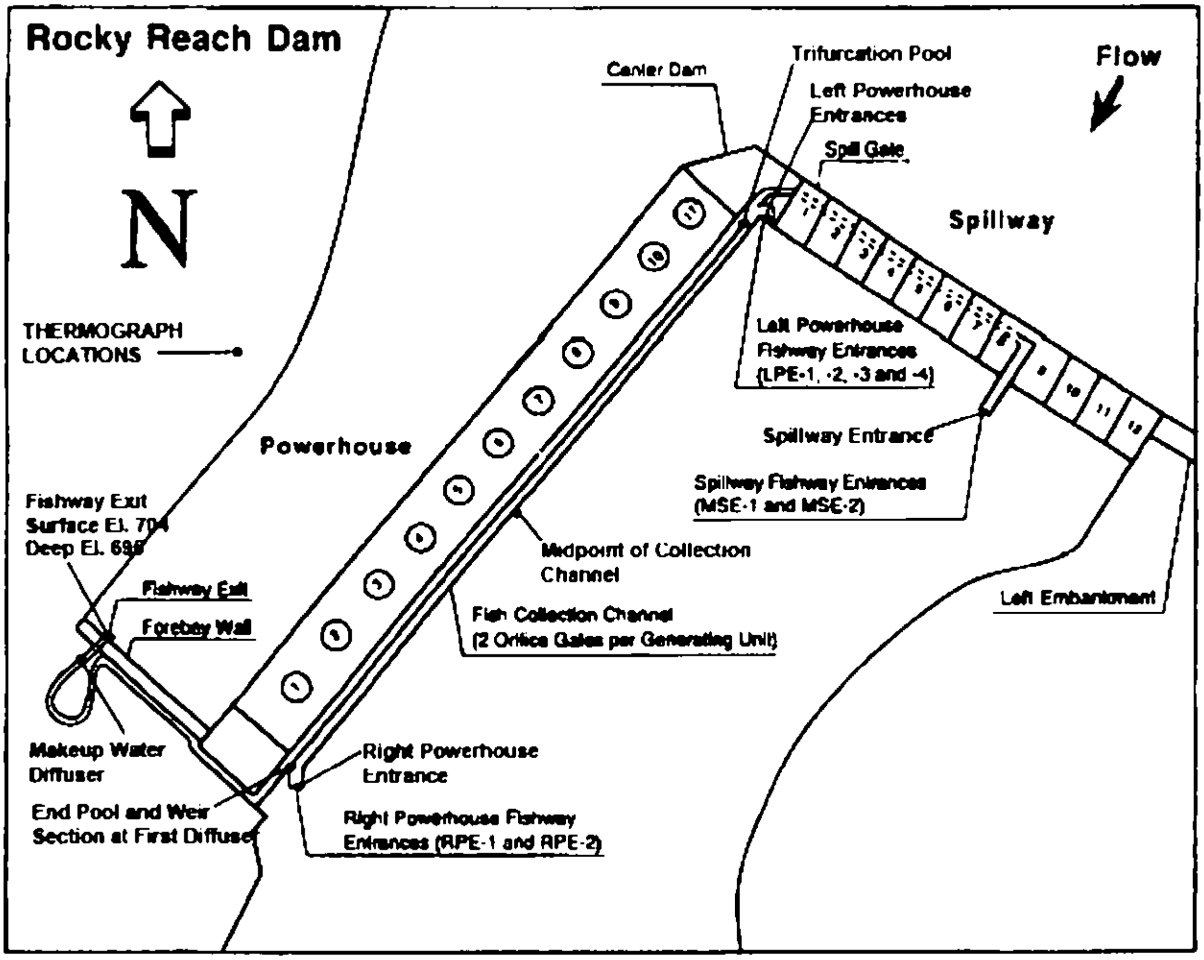
3.1.1 Sample Size

For this study, BioAnalysts released a total of 150 radio-tagged lamprey: 125 downstream of Rocky Reach Dam and 25 within the Rocky Reach Dam fishway. The downstream release provided information on tailrace residence time and passage behavior within the fishway.

3.1.2 Fish Capture

One of the most challenging aspects of this study was the capture of test fish. Throughout the mainstem Columbia River system, a number of capture methods have been employed at different hydroelectric projects, with varying degrees of success. At Bonneville Dam, NOAA Fisheries has been conducting lamprey passage studies since 1996 (Vella et al., 1999a; Vella et al., 2001; Ocker et al., 2001; and Moser et al., 2002a). In those investigations, Pacific lamprey were captured with a passive trap that straddled an overflow weir within the fishway. For Bonneville Dam, this type of trap was effective in capturing an adequate number of test fish.

A similar trap was employed by Grant County PUD in 2001 at Priest Rapids Dam, but with minimal success (Tom Dresser, personal comm.). However, the same traps, borrowed from Grant PUD for this study, deployed in the Rocky Reach Dam fishway proved very effective in capturing sufficient numbers of adult lamprey for tagging.



THERMOGRAPH LOCATIONS IN ROCKY REACH FISHWAY - 2004

Figure 5-1: Rocky Reach Hydroelectric Project Upstream Fishway

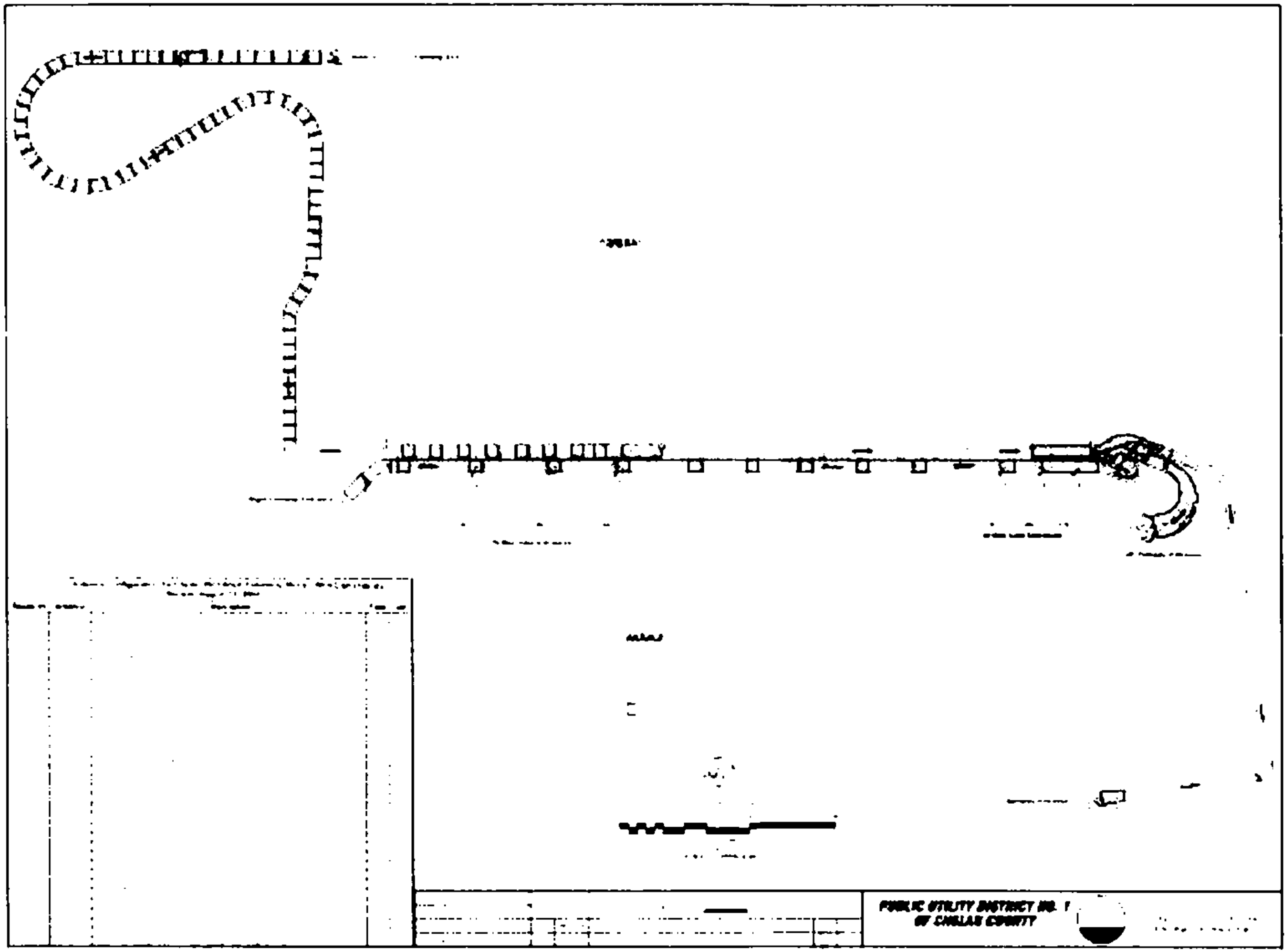


Figure 5-2: Rocky Reach Upstream Fishway Detail

3.1.3 Tagging Techniques

After collection, test fish were transported to the tagging facilities where they were held briefly until tagging. Implantation of transmitters into Pacific lamprey was accomplished surgically, using techniques described by Close et al. (2003), with some modifications based on methods described in Stevenson et al. (2002).

After tagging and transport to the release vessel, lamprey were held throughout the day to facilitate recovery. Based on a morning tagging schedule, this provided six to seven hours of recovery time.

3.1.4 Release of Tagged Fish

For the downstream release, equal numbers of lamprey were released along the east and west shore approximately 4.3 miles downstream of the Rocky Reach Dam, near Confluence State Park. The purpose of releasing the fish well downstream of Rocky Reach Dam was to ensure that they had opportunity to distribute horizontally within the river channel. Adequate mixing horizontally within the channel as fish approach the Project was necessary to eliminate potential bias associated with entrance selection and, possibly, migration rate through the fishway.

For the fishway release, fish were placed back into a 52-quart cooler and transported by hand cart to the release location. The coolers were lowered back into the fishway by rope with the vessel door open, allowing the lamprey to exit.

3.1.5 Monitoring

To assess passage of Pacific lamprey through the upstream fishway, BioAnalysts used a telemetry system currently deployed at the dam as part of the adult bull trout passage study. As noted previously, this system provided tailrace residence time, migration rate through the upstream fishway, and identified downstream passage through the Project.

3.1.6 Tributary Monitoring

While tributary monitoring was not an objective of this study, the migration of Pacific lamprey up both the Wenatchee and Entiat rivers was monitored. This was accomplished using systems that were installed previously to monitor bull trout migration and required little effort to maintain. The Wenatchee River site detected fish that migrated upstream into the Wenatchee basin rather than through the Dam. The Entiat River site detected fish that successfully migrated through the Dam and entered the Entiat basin; this may help corroborate detection data gathered at the Dam.

3.1.7 Mobile surveys

Mobile surveys of the study area were also not an objective of the study. However, BioAnalysts conducted occasional boat surveys within the Rock Island and Rocky Reach reservoirs to locate tagged fish that were not detected by fixed-telemetry sites, or those that had questionable detection histories at the Project. BioAnalysts conducted three surveys during the field study (August-September) period that included all of the Rock Island Reservoir and the Rocky Reach Reservoir upstream to Daroga State Park. These surveys assisted in confirming or refuting potential adult downstream migration past the Project.

3.2 2004 Radio-Telemetry Study

Radio-tagged lampreys were released over the course of nine weeks during the period of August 2 to October 1, 2004 at three different release locations. Release locations R_1 and R_2 were located downstream of Rocky Reach Dam near the Odabashian Bridge, on the east and west shores, respectively. A total of 125 lampreys were released at these downstream locations, with 63 lampreys released at R_1 and 62 at R_2. An additional 25 lampreys were released at R_3 within the upstream fishway approximately 60 m downstream of the upstream fishway exit.

Of the 125 radio-tagged lampreys released approximately 7 kilometers downstream of the Project, 93.6% were detected at the dam. Of those fish, 94% entered the fishway. Both of these estimates are similar to estimates observed at Bonneville, Priest Rapids, and Wanapum dams. Of the fish that entered the Rocky Reach Dam fishway, a total of 55.5% exited the ladder. This estimate was slightly higher than observed at Bonneville Dam during the period of 1997 through 1999, and considerably higher than observed at Priest Rapids in 2001. However, the Rocky Reach estimate was lower than what was observed at Bonneville Dam in 1996, and at Priest Rapids and Wanapum dams in 2002. The fishway release supplemented the downstream release in assessing fallback through the Project. For comparison, at Bonneville Dam, approximately 85% of the fish released downstream of the Project were detected at the dam. Of those detected at the dam, 35 to 40% successfully migrated upstream and were detected at the upstream fishway exits (Vella et al., 1999a; Vella et al., 2001; Ocker et al., 2001; and Moser et al., 2002a).

Of the fish that exited the upstream fishway (n=79), 21.5% passed downstream through the dam on one or more occasion. However, of those fish, 41.2% successfully re-ascended the fishway, and ultimately exited the fishway. Therefore, the net downstream passage rate at Rocky Reach Dam was 12.7%. This rate was higher than what was typically observed at Bonneville, Priest Rapids, or Wanapum dams.

While the indices provided above are useful in ascertaining the location of potential passage concerns, the metric that provides the best overall picture of lamprey passage is the Net Ladder Passage Efficiency (NLPE). Specifically, NLPE is the proportion of fish detected in the tailrace of the dam that exit the upstream fishway, and which adjusts for downstream passage and re-ascent. At Rocky Reach Dam, the NLPE was 47%. While this metric was not reported for passage at Bonneville, Priest Rapids, and Wanapum dams, it can be derived from those reports (Moser et al., 2002a; Moser et al., 2003; Nass et al., 2003). For the five years of Bonneville Dam research where NLPE can be estimated, the NLPE ranged between 25.7 to 42.1%. For Priest Rapids Dam, the NLPE was 29.2% and 62.3% in 2001 and 2002, respectively. For Wanapum Dam in 2002, the NLPE was 48.9%.

For all projects where estimates are available, including Rocky Reach, lamprey generally approach and enter fishways at a relatively high percentage rate (Table 5-1). However, of the fish that enter the fishway, a substantial proportion (>50%) do not ascend and exit the fishway system. Based on final detections, of the 125 fish tagged and released downstream of the Project, 40% were last detected downstream of Rocky Reach Dam (33.6% in the tailrace of the dam, and 6.4% within the Rock Island reservoir). Furthermore, 15.2% were last detected within the Project fishway, with 3.2% of the fish residing within the fishway until their transmitters appeared to have expired. Finally, 0.8% of the tagged fish were last detected within the diffusion conduit beneath the fishway (part of the attraction water system), which provides supplemental water to the upstream fishway.

Table 5-1: Pacific Lamprey Fishway Passage Comparison[1]

Location	Dam Detection	Entered Fishway	Exited Fishway	NLPE[2]
Bonneville Dam	82.4-93.3%	28.6-88.0%	46.1-50.3%	25.7-42.1%
Priest Rapids Dam	96.8%	62.2-80.3%	27.8-85.7%	29.2%-62.3%
Wanapum Dam	91.8%	62.2-80.3%	82.1%	48.9%
Rocky Reach Dam	93.6%	94%	55.5%	47%

Most of the fish last detected downstream of the Project had at some point entered the fishway, but later descended and exited the fishway into the Project tailrace. For the fish last detected within the fishway, it appears that tag expiration may account for a proportion of those fish. However, 12% of the fish last detected within the fishway were last detected prior to the expected expiration date of their transmitters. Possibly, entry of tagged fish into the diffusion conduit may provide an alternative explanation for the disappearance of some of these fish.

At Rocky Reach Dam, for fish that successfully ascended and exited the fishway, the migration rate from release to the tailrace averaged approximately 6.1 k/day. For this same group of fish, the arithmetic mean time spent in the tailrace and fishway were 5.05 and 2.50 days, respectively, and the collective median time from tailrace to the fishway exit was 7.32 days.

For fish that entered any one of the nine potential entrances, three adult and six orifice gate entrances, to the Rocky Reach fishway, median migration rates from the point of entrance to the trifurcation pool ranged between 1.24 meters(m)/minute to 21.09 m/minute. For these segments within the fishway, migration rates were slowest for fish entering orifice gates (O.G.s) 1-3, and fastest for fish entering the spillway entrance. Mean migration rates through the trifurcation pool from the three potential entry points (i.e., collection channel, left entrance and spillway entrance) ranged between 12.64 to 14.76 m/minute. For fish migrating through the transport channel, which extends from the trifurcation pool to the base of the ladder, the median migration rate was 7.23 m/minute. Finally, the last two sections of the fishway, from the base of the ladder to the ladder flow regulation diffuser (located approximately 60 m downstream of the exit) and from that diffuser to the exit, the median migration rates were 1.03 and 0.09 m/minute, respectively. The last section, from the diffuser to the exit, contains a number of structures, including a diffuser, the public viewing windows, a picket barrier, and the fish counting window and station. From the slow migration rate through this section of fishway, it appears that one or more of these structures delays migration.

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1 Tabular data extracted from Evaluation of Adult Pacific Lamprey Passage at Rocky Reach Dam Using Radiotelemetry Techniques, 2004. Final report, March 23, 2005 prepared for Chelan PUD by BioAnalysts, Inc and Columbia Basin Research.

2 Net Ladder Passage Efficiency (NLPE) is the proportion of fish detected in the tailrace of the dam that exit the upstream fishway, and which adjusts for downstream passage and re-ascent.

3.3 Findings to Date

The following key findings have been obtained from the 2004 adult radio-telemetry study, numerous years of observations in the Reservoir and tributaries, and from other information sources:

- Pacific lamprey use the upstream fishway;
- Pacific lamprey spawn in the tributaries;
- Juvenile Pacific lamprey rearing occurs in the tributaries, with juveniles also observed at the Dam and in the Reservoir;
- Since the early 1990s, the trend in the annual number of adults observed passing the Dam has increased;
- Since 1991, fewer than 20 adult Pacific lamprey per year have been found in the Rocky Reach upstream fishway during winter maintenance, indicating few fish overwinter or become trapped in the fishway (Rainey, personal communication 2005);
- Juvenile Pacific lamprey (macropthalmia) have been observed using the downstream bypass;
- It is likely that most juvenile lamprey that pass through the turbine intakes are within 21 feet of the bottom (based on fyke net studies at Rocky Reach), and below the screens on generator units one and two, the only two screened units at the Project;
- Due to physiologic differences, turbine passage may be less likely to cause harm to Pacific lamprey than salmonids. Studies indicate that because Pacific lamprey do not have a swim bladder and have a flexible body shape, with no operculum, the effects of two primary mechanisms that cause mortality to salmonids during turbine passage are minimal to Pacific lamprey;[3] and
- The 2004 telemetry results suggest that adult passage impediments may exist within the Rocky Reach fishway.

3.3.1 Columbia River Basin Lamprey Technical Workgroup

A regional technical workgroup was developed through the Northwest Power and Conservation Council (NWPCC) to identify critical uncertainties of lamprey research throughout the Columbia Basin. A draft document was available at the time of the writing of this PLMP. In the draft *Critical Uncertainties for Lamprey in the Columbia River Basin: Results from a strategic planning retreat of the Columbia River Lamprey Technical Workgroup*, the regional technical workgroup prioritized a list of critical uncertainties for Columbia River Basin lamprey species (CRBTWG 2005).

[3] Tests at the Battelle PNNL showed no immediate external injuries or mortalities for lamprey exposed to rapid changes in pressure, and lamprey did not suffer any ill effects at exposure to levels of high differential velocity that injured and/or killed juvenile salmon and shad. Thus, the effects of turbine passage induced pressure change and fluid shear do not appear to cause injury or mortality to juvenile lamprey. The effects of blade strike or indirect effects, such as increased vulnerability to predation following turbine passage, have not been tested. In studies of mortality to fish volitionally passing through a STRAFLO turbine (Annapolis Tidal Generating Station, head range from 1.4-6.8 m), no mortality or injury was observed in 20 sea lamprey captured in nets deployed in the turbine discharge (Gibson and Myers, 2002. Trans. Am. Fish. Soc. 131:623-633).

The draft document is intended to guide lamprey conservation, management, research, and funding decisions in the Columbia River Basin. The prioritized list of critical needs is presented below.

Table 5-2: Prioritized List of Critical Research Needs for Columbia River Anadromous Lamprey (Source: CRBTWG, 2005)

Ranking	Critical Need	Category
1	Lamprey Status	Imminent
2	Passage	Imminent
3	Population Delineation	Highly Important
4	Limiting Factor Analysis	Highly Important
5	Restoration Activities	Important
6	Biology/Ecology	Important
7	Population Dynamics (Predictive Analyses)	Needed

These priorities helped the Rocky Reach Pacific Lamprey Technical Group develop Section 4.2.2 of this PLMP as part of the relicensing process for the Project.

SECTION 4: PROTECTION, MITIGATION, AND ENHANCEMENT MEASURES

The goal of the PLMP is to achieve No Net Impact (NNI) on Pacific lamprey by measuring ongoing Project-related impacts, if any, on Pacific lamprey; implementing appropriate and reasonable measures to reduce or eliminate such impacts; and implementing on-site or off-site measures to address unavoidable impacts. The PLMP uses Adaptive Management to meet this goal and is intended to be consistent with other management plans in the mid-Columbia region. The following objectives were established to measure any negative impacts on Pacific lamprey from ongoing Project operations and fishways, and, in consultation with the RRFF, to develop PME measures to reduce or eliminate those impacts.

Objective 1: Measure any ongoing Project impacts on upstream and downstream passage of adult Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable;

Objective 2: Measure any ongoing Project impacts on downstream passage of juvenile Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable;

Objective 3: Measure any ongoing Project impacts on the existing reservoir habitat used currently by juvenile Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable; and

Objective 4: Identify and implement appropriate and reasonable measures to address unavoidable impacts to achieve NNI.

The information in this section outlines the proposed PME measures for Pacific lamprey through the term of the New License. The PLMP emphasizes a monitoring program that will necessitate future consultation with the RRFF to evaluate monitoring results and develop recommendations for program direction.

The intent of the PLMP is to measure any impacts of ongoing Project operations on upstream and downstream passage of Pacific lamprey. To fulfill this intent, Chelan PUD shall, in consultation with the RRFF, develop and implement measures to eliminate those impacts, to the extent appropriate and reasonable. The intent of the PME measures contained in this PLMP is to: 1) protect, mitigate, and enhance lamprey resources; 2) ensure that the ongoing operation of the Project will not adversely impact lamprey; 3) minimize the effect of any incidental injury or mortality to lamprey that may occur as a result of impacts on lamprey habitat caused by ongoing Project operations; and 4) ensure adequate monitoring and reporting of results.

4.1 Objective 1: Measure Any Ongoing Project-related Impacts on Upstream and Downstream Passage of Adult Pacific Lamprey, and Eliminate Those Impacts to the Extent Appropriate and Reasonable

The 2004 radio telemetry study indicated that ongoing Project operations are likely to have an effect on Pacific lamprey upstream passage, although more information is necessary before Chelan PUD and the RRFF can measure and implement any appropriate and reasonable modifications to the upstream fishway. The intent of this objective is to achieve, in a timely manner, safe, timely, and effective adult passage through the Project.

As part of this PLMP, Chelan PUD shall undertake the following measures to more specifically measure further passage impediments and determine whether modifications used to facilitate Pacific lamprey passage at other hydroelectric dams in the Columbia River Basin may be applicable to the Rocky Reach Dam. In addition to the updated literature review described in Section 4.1.3, Chelan PUD, in consultation with the RRFF, may elect to gather additional information before implementing fishway modifications recommended by the RRFF.

Under this objective, Chelan PUD will begin to evaluate and implement any appropriate and reasonable improvements to the upstream fishway at Rocky Reach Dam, pursuant to Section 4.1.4 and 4.1.5, as soon as possible, but no later than five years after the effective date of the New License. The measures described in sections 4.1.3 through 4.1.5 may be repeated as necessary to achieve effective upstream passage of Pacific lamprey. Since the proposed long-term monitoring will be repeated every 10 years of the New License, opportunities for future modifications exist if study results suggest they are appropriate and reasonable. Specific activities associated with this objective include:

4.1.1 Fishway Operating Criteria

Chelan PUD shall continue to operate the upstream fishway at Rocky Reach Dam in accordance with anadromous fish criteria described in the annual Chelan PUD fish passage plan (e.g., Grassell, 2005). Chelan PUD shall prepare the annual fish passage plan in consultation with the RRFF.

4.1.2 Adult Upstream Passage Counts

Chelan PUD shall maintain, using the most current technology, annual adult Pacific lamprey upstream passage counts in the Project fishway for the term of the New License and any subsequent annual licenses.

4.1.3 Upstream Passage Improvement Literature Review

Unless the RRFF concludes that it is not necessary, Chelan PUD shall, within one year of the effective date of the New License, complete a literature review of the effectiveness of upstream lamprey passage measures implemented at other hydroelectric projects in the Columbia and Snake rivers, such as plating over grates, improvement in orifices for passage, rounding sharp edges, constructing rest areas in front of submerged orifices, and reducing diffuser grating spacings. Chelan PUD shall, in consultation with the RRFF, evaluate whether it would be appropriate and reasonable to implement similar measures at Rocky Reach Dam.

4.1.4 Modifications to Improve Upstream Passage

As soon as practicable, but no later than five years after the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, design and implement appropriate and reasonable upstream passage improvement measures identified under Section 4.1.3 of this Chapter, if any, at the Project. Passage measures will be designed to eliminate impediments to volitional passage of Pacific lamprey through the fishway. Conceptual design may include modeling or laboratory testing of measures identified in Section 4.1.3 of this Chapter or other measures to address structural features specific to the Project fishway. Passage measures may include an interim trap-and-haul program if other measures do not effectively address ongoing Project impacts.

4.1.5 Evaluation of Upstream Passage Modifications

Within one year following the implementation of any upstream passage improvement measure at Rocky Reach Dam, Chelan PUD shall, in consultation with the RRFF, monitor the effectiveness of such measures for an appropriate period of time, using the methods described in Section 3.1 of this plan. Evaluation of fishway hydraulics at entrances and in sections of the fishway and operational measures (such as reducing fishway flows and velocities during nighttime hours when salmon don't pass ladders) will be included in the assessment of upstream passage improvement measures.

If, as determined by the RRFF, the results of the monitoring indicate that passage has not significantly improved as a result of such measures, Chelan PUD shall, in consultation with the RRFF, develop and implement a plan to identify additional appropriate and reasonable passage improvement measures, if any. Measures described in sections 4.1.3, 4.1.4, and 4.1.5 above will be repeated, as necessary, until adult passage at the Project is similar to the best passage rates found at other hydroelectric projects in the Columbia and Snake rivers.

Biological objectives for supporting designated uses for Pacific lamprey are shown in Table 5-3. A summary of criteria for achievement of objectives for Pacific lamprey, outlined in Table 5-4, include the development of criteria for adult Pacific lamprey passage success. For example, the results of baseline telemetry studies could serve as a building block for evaluating the effectiveness of future appropriate and reasonable modifications. These studies are intended to augment understanding of adult passage through the Project. Data resulting from such evaluations could be considered by the RRFF in determining the efficacy of such modifications.

4.1.6 Adult Downstream Passage

If Chelan PUD, in consultation with the RRFF, determines that additional significant ongoing Project effects have been identified through the investigations described in sections 4.1.3, through 4.1.5, Chelan PUD shall, in consultation with the RRFF, develop a plan and implement appropriate and reasonable measures to address such effects.

4.1.7 Periodic Monitoring

Once adult passage success has been achieved under Section 4.1.5, then every ten years during the term of the New License, or on a schedule recommended by the RRFF, Chelan PUD shall, in consultation with the RRFF, monitor adult Pacific lamprey passage through the Project fishway, for an appropriate period of time, using methods similar to those described in Section 3.1 of this PLMP. If Chelan PUD, in consultation with the RRFF, determines that such monitoring program does not confirm the effectiveness of the passage improvements previously identified by the monitoring conducted under Section 4.1.5, Chelan PUD shall, in consultation with the RRFF, identify and implement additional appropriate and reasonable passage improvement measures, if any.

4.2 Objective 2: Measure Any Ongoing Project-related Impacts on Downstream Passage of Juvenile Pacific Lamprey, and, in a Timely Manner, Eliminate Those Impacts to the Extent Appropriate and Reasonable

Specific activities associated with this objective include:

4.2.1 Downstream Passage of Juvenile Pacific Lamprey

Chelan PUD shall operate the Project's downstream bypass in accordance with the operation criteria for anadromous salmonids and compatible bull trout migration guidelines set forth in the HCP Agreement and the annual Rocky Reach Fish Passage Plan, as approved and/or amended by the Rocky Reach HCP Coordinating Committee.

Table 5-3: Biological Objectives for Supporting Designated Uses for Pacific Lamprey

Designated Use	Biological Objectives	Evaluation timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Pacific Lamprey Adult Upstream and Downstream Migration	Success similar to best experience at other similar projects (Adult upstream fish passage as defined by the RRFF)	By year 5	Continuous reassessment every 10 years	Develop and implement a plan in consultation with the RRFF to address identified problems	Sections 4.1.1-4.1.7; and 4.4
Pacific Lamprey Juvenile Downstream Migration	Maintain safe, effective, and timely volitional passage Criteria (as defined by the RRFF)	TBD by RRFF with 5 year review by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan in consultation with the RRFF to address identified problems	Sections 4.2.1-4.2.2; and 4.4
Pacific Lamprey Rearing	Avoid and minimize Project impacts on rearing habitat	By year 5	Maintain Action. No additional action needed.	Develop and implement a plan in consultation with the RRFF to address identified problems	Sections 4.3 and 4.4
Pacific Lamprey Overall Combined Goal	No Net Impact	TBD by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan in consultation with the RRFF to address identified problems	Section 4

Table 5-4: Summary of Criteria for Achievement of Objectives for Pacific Lamprey

Designated Use	Objective	Measured Parameter	Evaluation Timeframe	Actions if Objective Achieved	Actions if Objective Not Achieved	Plan Action
Adult Lamprey	Assess adult upstream passage	Fishway counts using most current technology	Annual	Maintain Action. No additional action needed.	Research and implement appropriate and reasonable alternative technologies for more accurate counts	Section 4.1.2
	Assess adult upstream passage	Modify fishways if impediments identified	Within 5 years of New License	Maintain Action. No additional action needed.	Investigate and implement appropriate and reasonable technologies shown to be effective at other dams	Section 4.1.3 and 4.1.4
	Assess adult upstream passage	Conduct radio-telemetry monitoring studies	One year after fishway modifications	Maintain Action. No additional action needed.	Investigate, design, and implement appropriate and reasonable technologies shown to be effective at other dams	Section 4.1.5
	Assess adult upstream passage	Conduct radio-telemetry monitoring studies	Every ten years	Maintain Action. No additional action needed.	Develop and implement a collaborative plan to address identified problem(s)	Section 4.1.7
	Assess adult upstream passage	Adult passage success	5 year intervals	Develop criteria for success (e.g. outcome-based standard). Maintain Action. No additional action needed.	Develop and implement a collaborative plan to address identified problem(s)	Section 4.1.5
Juvenile Lamprey	Assess juvenile downstream passage	Monitor turbine intake screens for impingement	Annual	Discontinue monitoring per RRFF. No additional action needed.	Investigate and implement appropriate and reasonable technologies shown to be effective at other dams	Section 4.2.2
	Assess juvenile downstream passage	Monitor passage timing and survival	Between years 2 and 5 of New License	Maintain Action. No additional action needed.	Investigate and implement appropriate and reasonable technologies shown to be effective at other dams	Section 4.2.3
	Assess juvenile reservoir rearing habitat; overall Project impact	Determine reservoir juvenile presence/absence and relative abundance	Within 3 years of New License	Maintain Action. No additional action needed.	Develop and implement a collaborative plan to address identified problem(s) or achieve NNI	Sections 4.3 and 4.4

4.2.2 Juvenile Impingement Monitoring and Reporting

Chelan PUD's current monitoring of turbine intake screens indicates that harm to juvenile lamprey is negligible. As part of this PLMP, Chelan PUD will continue monitoring to assure that this remains the case. During the juvenile lamprey migration period, Chelan PUD shall continue to monitor potential lamprey impingement on turbine intake screens to assure impingement rates remain negligible until such time as the RRFF recommends that monitoring is no longer necessary. This monitoring will include the continued use of video equipment, or other measures as recommended by the RRFF, during weekly intake screen cleaning operations at turbine units 1 and 2, in order to videotape the diversion screens during every deployment of the brush car.

Chelan PUD shall ensure that videos are viewed in real time as the brush car is deployed, and shall notify the RRFF of any substantial incidents of lamprey impingement. All video tapes shall be archived by Chelan PUD. In addition, Chelan PUD shall provide an annual report summarizing any lamprey impingements observed in the videos to the RRFF.

If significant ongoing Project effects are identified through the investigations described in this section, Chelan PUD shall, in consultation with the RRFF, develop a plan and implement appropriate and reasonable measures, if any, to address such effects.

4.2.3 Measurement of Impacts on Juvenile Downstream Passage

Between years two and five of the New License, Chelan PUD shall continue to measure the type and magnitude of any ongoing Project impacts on the downstream passage of juvenile lamprey, using appropriate and reasonable methodologies. Specifically, these methodologies will address juvenile lamprey downstream migration timing and passage survival through the Project. Associated with these methods, Chelan PUD shall, in consultation with the RRFF, develop the means to provide sufficient numbers of juvenile lamprey for these evaluations. Chelan PUD, in consultation with the RRFF, may choose to contribute to other local or regional lamprey investigation programs in order to gain efficiencies in the development of methods for lamprey investigations at the Project. It is anticipated that the initiation and preliminary evaluations of any ongoing Project related impacts will be conducted within the first five years of the New License. The cost for this measure is estimated to be $700,000.

4.3 *Objective 3: Measure Any Ongoing Project Impacts on the Existing Reservoir Habitat Used Currently by Juvenile Pacific Lamprey, and Eliminate Those Impacts to the Extent Appropriate and Reasonable*

Within three years of the effective date of the New License, Chelan PUD shall measure juvenile lamprey presence and relative abundance in habitat areas that may be affected by ongoing Project operations. As part of this measure, Chelan PUD shall use existing aerial photographs, bathymetry, shoreline slope, velocity, and substrate characteristics to segregate habitat types into those areas with high, medium, and low potential for use by juvenile lamprey, and assess presence/absence in areas that may be affected by Project operations using electroshocking sampling (if permitted). If electroshocking is not permitted, alternative measures will be evaluated (Moser and Close, 2003a; 2003b).

Chelan PUD shall, in consultation with the RRFF, develop a plan and implement appropriate and reasonable measures, if any, to address effects determined through evaluations in this subsection. If appropriate and reasonable measures cannot be determined to address such effects, Chelan PUD, in consultation with the RRFF, will identify and implement measures to address unavoidable impacts.

4.4 Identify and Implement Measures to Address Unavoidable Impacts to Achieve NNI

Within two years of the effective date of the New License, Chelan PUD shall collect and compile information regarding Pacific lamprey distribution, population status and trends, and juvenile downstream migration timing, to identify and implement appropriate and reasonable measures in order to achieve NNI. Chelan PUD shall also develop sampling and collection protocols and collect tissue samples and other relevant biological information from adult and juvenile lamprey populations that pass through the Project. Chelan PUD shall, in consultation with the RRFF, identify and implement appropriate and reasonable measures to address unavoidable losses at the Project in order to achieve NNI. Chelan PUD, in consultation with the RRFF, may consider implementation of off-site actions in order to address unavoidable impacts. In year five of the New License, and every five years thereafter, for the term of the New License and any subsequent annual licenses, Chelan PUD shall provide a report to the RRFF and FERC on the status of the Adaptive Management process regarding unavoidable impacts to Pacific lamprey.

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CHAPTER 6: ROCKY REACH RESIDENT FISH MANAGEMENT PLAN

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EXECUTIVE SUMMARY

Under the direction of the Natural Resources Working Group (NRWG), numerous studies relating to resident fish species were conducted during the Rocky Reach Hydroelectric Project (Project) relicensing process, including a creel survey, mapping of aquatic habitat, a study of fish presence and habitat use, benthic analysis, a study of the affects of pool (reservoir) fluctuations on fish, a study of the role of large woody debris as fish habitat, and a re-identification of sport fishing access points along the Wenatchee River. Based on the results of these studies, the Resident Fish Technical Group (RFTG) representatives developed this Rocky Reach Resident Fish Management Plan (RFMP).

The goal of the Resident Fish Management Plan (RFMP) contained in this Chapter is to protect and enhance resident fish and habitat in the Rocky Reach Reservoir (Reservoir), and to enhance recreational fishing opportunities. Chelan PUD has agreed to continue implementing several resident fish Protection, Mitigation, and Enhancement measures (PMEs) as part of this Comprehensive Settlement Agreement, several of which are to continue funding for existing license measures for resident fish and to enhance recreational fishing opportunities. The objectives of these PME measures are: 1) continue to enhance recreational fishing opportunities; and 2) conduct resident fish monitoring to measure relative abundance and species composition in the Reservoir.

Specifically, the RFMP calls for Chelan PUD to implement the following PME measures, as described in Section 4 of this Chapter:

1) Continue to fund a fish rearing program conducted by Washington Department of Fish and Wildlife (WDFW) to produce approximately 30,000 pounds of rainbow trout or other fish species annually during the term of the New License and any subsequent annual licenses;

2) Make available an amount not to exceed $50,000 for resident fish enhancement measures during the first 10 years of the New License;

3) Make available an amount not to exceed $62,000 for resident fish enhancement measures after year 10 of the New License;

4) Make available an amount not to exceed $60,000 to implement the recreational fishing measure of introducing a new species in the Reservoir to enhance recreational fishing; and

5) In consultation with the RRFF, conduct resident fish monitoring in the Rocky Reach Reservoir, with initial focus on predatory fish, to monitor any changes in abundance or species composition in the resident fish populations in the Reservoir.

SECTION 1: INTRODUCTION

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries agencies, tribes, and interested parties together in a Natural Resources Working Group (NRWG) and provided an opportunity for comprehensive review of current and future management priorities for fish resources potentially impacted by ongoing Project operations. The NRWG was established to identify issues, develop study plans, review study reports, and develop long-term management plans for fish and wildlife species. The NRWG consisted of representatives from the USDA Forest Service, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), U.S. Bureau of Land Management (BLM), Colville Confederated Tribes (CCT), Yakama Nation (YN), Columbia River Inter-Tribal Fish Commission (CRITFC), and other interested parties.

Technical groups were formed for each comprehensive plan; e.g., white sturgeon, bull trout, Pacific lamprey, resident fish, and wildlife due to the complexity of issues surrounding each species and so that agency experts could focus on meetings pertaining to their specific expertise. A subgroup of the NRWG, the Resident Fish Technical Group, comprised of the WDFW, Ecology, USFWS, and Chelan PUD, completed this Rocky Reach Resident Fish Management Plan (RFMP). For the purposes of the RFMP, resident fish are defined as non-anadromous fish species inhabiting the Reservoir. Following the effective date of the New License, the Rocky Reach Fish Forum (RRFF) will assume responsibility for meeting to share information, coordinate efforts, and make recommendations and decisions regarding the implementation of the RFMP. The RFMP will be reviewed, in consultation with the RRFF, on a periodic basis to allow for planning and future adjustments over the term of the New License and any subsequent annual licenses.

The RFMP contains sections highlighting the background knowledge of resident fish species (Section 2); relicensing and other studies conducted to determine ongoing Project-related impacts, if any, on resident fish (Section 3); goals and objectives of this management plan (Section 4); and the PME measures for resident fish that Chelan PUD will implement through the term of the New License (Section 4).

SECTION 2: BACKGROUND

2.1 Resident Fish Species

The Reservoir has sufficient spawning habitat, rearing habitat, and food supply to support sizeable populations of native catostomids (suckers), cyprinids (northern pikeminnow, chubs, shiners) and stickleback (Mullan, et al., 1986; Dell, et al., 1975; DES, 2001). Mountain whitefish are also present, although spawning success in the Reservoir is probably limited because of warm temperatures in the fall and early winter (Mullan, et al., 1986).

Rainbow trout are common but not abundant. Historic planting of catchable-sized hatchery rainbow trout in the Entiat River and residualization of hatchery steelhead smolts probably contribute to this population. Bull trout, listed under the Endangered Species Act (ESA) as a threatened species, are present in limited numbers.

A fish presence and habitat use study was completed for the Reservoir in 1999 and 2000 (DES, 2001). The fish population was dominated by non-sport fish species, constituting more than 99 percent of the fish recorded. The major non-sport fish species included, in order of decreasing abundance, threespine stickleback, northern pikeminnow, redside shiner, sucker (various species, primarily largescale sucker), chiselmouth, and peamouth.

The most abundant resident sport fish species recorded was rainbow trout. Lesser numbers of mountain whitefish (native) and smallmouth bass (exotic) were captured. Mountain whitefish and smallmouth bass were relatively minor constituents of the sport fish population; only 10 mountain whitefish and seven smallmouth bass were recorded, compared to 62 resident rainbow trout.

These fish species tend to live in different parts of the Reservoir, primarily due to differences in habitat. The lower section of the Reservoir (Rocky Reach Dam to the Entiat River) is lentic in character, primarily supporting species that prefer low water velocities. The middle section of the Reservoir (from the Entiat River to the Chelan River) is a transition zone between the predominantly slower-moving, deeper habitat in the lower section and the riverine habitat in the upper section. The upper section of the Reservoir (Beebe Bridge to Wells Dam) is narrower, creating higher water velocities.

Rainbow trout were recorded in all three sections of the Reservoir. However, the numbers of this species were highest in the upper section of the Reservoir and declined with increasing distance downstream. Mountain whitefish and smallmouth bass were recorded only in the middle section of the Reservoir.

Northern pikeminnow, redside shiner, and chiselmouth were distributed throughout the Reservoir, but all of these species were most abundant in the lower section of the Reservoir. The numbers of these species recorded declined with increasing distance upstream. Peamouth was also most abundant in the lower portion of the Reservoir, and occurred in low numbers in both the middle and upper sections of the Reservoir. The abundance of threespine stickleback was greatest in the middle section of the Reservoir, and very low in the upper section. Suckers were distributed throughout the Reservoir but were most abundant in the upper section. There was no apparent difference in the abundance of suckers between the lower and middle sections of the Reservoir.

2.2 Species of Concern

2.2.1 Pygmy Whitefish

Pygmy whitefish (*Prosopium coulteri*) are listed as a Washington State sensitive species, indicating that they are vulnerable, thus declining and likely to become endangered or threatened without cooperative management or removal of threats (WDFW, 2002). Pygmy whitefish are a native species, currently found in relict populations in western North America. Pygmy whitefish are not found within the Project boundary. Therefore, they are not considered further in this RFMP. The only known population near the Project exists in Lake Chelan (Hallock and Mongillo, 1998). This species inhabits lakes, typically staying deeper than 18 feet. They also reside in streams, preferring habitats with moderate to swift current.

2.2.2 Burbot

Burbot (*Lota lota*) are listed as a species of concern by the WDFW. Burbot are the only fresh-water member of the cod family and are found in the Columbia River system and in deep lakes (Wydoski and Whitney, 1979). Although burbot have been documented rarely in the Project area, they are present in the upper Columbia River system and have been reported in Lake Roosevelt, Lake Rufus Woods, and Banks Lake. They are also present in Lake Chelan.

2.3 Northern Pikeminnow

Northern pikeminnow (*Ptychocheilus oregonensis*) (formerly northern squawfish) are a native species to the Columbia River. They are slow-growing, long-lived predators. In summer, adult northern pikeminnow prefer shallow, low-velocity water in cool lakes or rivers. During the winter, they use deeper water and pools (Scott and Crossman, 1973). Spawning occurs during the summer, in shallow water areas with gravel substrate.

Northern pikeminnow are the most abundant predator species in the Columbia River system, and they account for over 75 percent of the total catch of predator fish in the mid-Columbia River (Loch, et al., 1994). They tend to concentrate in tailrace areas downstream of mainstem dams during the juvenile salmonid migration period, holding in relatively slow-moving water areas (less than about 3 feet per second) near passage routes. They also spend time in the slowing-moving portions of tributary streams.

Northern pikeminnow are considered a nuisance species because of their tendency to prey upon desirable native and sport fish species. Therefore, efforts have been made to remove numbers of northern pikeminnow from the Project area. Between 1994 and 2001, the predator abatement programs resulted in the removal of 33,110 northern pikeminnow at Rock Island Dam, 44,882 at Rocky Reach Dam, and 32,250 at Wells Dam (Chelan PUD, 1999; Douglas PUD, 1999; Bickford, 2002 personal communication). In 2004, a total of 39,088 northern pikeminnow were caught in the Rocky Reach and Rock Island project reservoirs during implementation of the predator control program, with 25,529 coming from the Rocky Reach Reservoir. In addition, over 7,700 northern pikeminnow were removed during fishing derbies conducted between the Rock Island and Chief Joseph dams from 1998 through 2001 (West, 2002). During the 2004 derby, 114 anglers participated in the one-day event, catching 2,943 northern pikeminnow; prizes totaling $20,000 were distributed.

2.4 Other Species

Several other species are native to the Reservoir, including peamouth chub (*Mylocheilus caurinus*), redside shiner (*Richardsonius balteatus*), largescale sucker (*Catostomus macrocheilus*), bridgelip sucker (*C. columbianus*), longnose sucker (*C. catostomus*), longnose dace (*Rhinichthys cataractea*) and speckled dace (*Rhinichthys osculus*). No management actions or active fisheries for these species occur currently.

An initial "explosion" of non-game fish after the construction of the Rocky Reach Dam was followed by a reduction and, over the last decade, and eventual leveling off of non-game species. Mullan, et al., (1986) theorized that the mid-Columbia reservoirs are dominated by trophic generalists, such as cyprinids, in part because of minimal predation. The reservoirs lack a substantive population of highly piscivorous keystone predators, such as walleye (Burley and Poe, 1994).

2.5 Recreational Fisheries for Resident Fish

According to Washington State fishing regulations for 2002, recreational fishing within the Reservoir is open year-round for game fish such as smallmouth bass and walleye. In addition to these game fish species, over 20 other species, such as northern pikeminnow, mountain whitefish and occasionally pumpkinseed may be taken by anglers while fishing in the Reservoir. Fishing for white sturgeon is limited to catch and release only, but is allowed year-round.

Fishing for trout in the Reservoir is currently closed at all times. Fishing for spring-run Chinook salmon and bull trout is closed due to their listing under the ESA. Fishing may occur for steelhead on a year-to-year basis, based on the run strength and wild-origin composition of the run. No fishing is allowed at any time in areas directly surrounding dams. These no-fishing zones range from the upstream line of each dam to boundary markers located 400 feet downstream of the fish ladders at Rocky Reach and Rock Island hydroelectric projects, and 400 feet downstream of the spawning channel discharge (on the Chelan County side) and the fish ladder (on the Douglas County side) at Wells Hydroelectric Project.

2.5.1 Smallmouth Bass

Smallmouth bass (*Micropterus dolomieui*) are a non-native game fish that have inhabited the mid-Columbia River reach since at least the 1940s. They are listed as a priority species in Washington State because of their vulnerability to habitat loss or degradation and their recreational importance (WDFW, 2002). Preferred habitat for this species includes rocky shoals, banks, or gravel bars. Adult smallmouth bass in the mid-Columbia River are most abundant around the deltas of warmer tributary rivers, but they do not occur in tributary streams. The optimal temperature range for this species is from 21^0 to 27^0C (Wydoski and Whitney, 1979), which is higher than the typical temperatures in the mid-Columbia River reservoirs.

Ideal spawning temperatures for this species range from 15.5° to 18.5°C. Such temperatures do not occur consistently in the mid-Columbia River reservoirs until late summer. Smallmouth bass build and defend nests in sloughs and littoral areas with sand and gravel substrates. Such areas are generally lacking in the mid-Columbia River system. It is believed that primary natural reproduction of smallmouth bass in the mid-Columbia River occurs only in the Hanford Reach, below Priest Rapids Hydroelectric Project, and in the Okanogan River.

Smallmouth bass were the second most abundant predator species captured in the mid-Columbia River region during predator assessment sampling conducted in 1993. They were most frequently captured from forebay sampling sites (Burley and Poe, 1994). They are a significant fish predator species in the Columbia River, preying on juvenile salmonids. Similar relative abundance estimates of smallmouth bass were observed in recent sampling programs in the mid-Columbia River reservoirs (Beak and Rensel Associates, 1999; Parametrix and University of Idaho, 2000; DES, 2001). In the 1993 predator assessment, fish composed 87 percent of the smallmouth bass diet, with salmonids consisting of 11 percent of the fish consumed.

2.5.2 Walleye

Walleye (*Stizostedion vitreum*) are a cool-water, piscivorous game fish that are believed to have moved downstream into the mid-Columbia River reach from a population that was originally established for recreational fishing in Lake Roosevelt in the late 1950s (Zook, 1983). However, they were the least abundant predator species captured in the mid-Columbia River in 1993 (Burley and Poe, 1994). They are listed as a priority species in Washington State because of their vulnerability to habitat loss or degradation and their recreational importance (WDFW, 2002).

Walleye occur throughout the mainstem reservoirs, but are not typically found in the tributaries. Although suitable spawning habitat appears to be plentiful in the mid-Columbia River, evidence of successful reproduction has not been observed (Zook, 1983). Recruitment of walleye into the mid-Columbia River reservoirs is suspected to result from the entrainment of young fish through Grand Coulee Hydroelectric Project during spring runoff (Zook, 1983).

2.5.3 Largemouth Bass

Largemouth bass (*Micropterus salmoides*) were widely introduced in Washington State in the late 1800s (Wydoski and Whitney, 1979). They are listed as a priority species in Washington State because of their vulnerability to habitat loss or degradation and their recreational importance (WDFW, 2002). They prefer clear water habitat with mud and sand substrates, which is best suited for aquatic vegetation production (Wydoski and Whitney, 1979). Largemouth bass are captured infrequently in the Reservoir, and little is known about their populations in this area (Beak and Rensel, 1999; DES, 2001; Parametrix and University of Idaho, 2000; Burley and Poe, 1994).

2.5.4 Channel Catfish

Channel catfish (*Ictalurus punctatus*) is a non-native species that is found most often in clear lakes, reservoirs, and streams. In streams, this species is usually found in moderate to swift currents over sand, gravel, and rubble substrate. However, little is known about their habitat preferences in lakes and reservoirs (Wydoski and Whitney, 1979). Channel catfish are listed as a priority species in Washington State because of their vulnerability to habitat loss or degradation, and their recreational importance (WDFW, 2002). Channel catfish are infrequently captured in the Reservoir, and little is known about their populations in this area (DES, 2001; Parametrix and University of Idaho, 2000; Burley and Poe, 1994).

2.5.5 Rainbow Trout

Rainbow trout (*Oncorhynchus mykiss*) are an inland (remains in freshwater) form of steelhead. However, some rainbow trout remain in fresh water for a significant portion of their lives, then undergo a physiological change to a smolt and migrate to the ocean late in life. In contrast to the potential for rainbow trout to become anadromous, the progeny of steelhead are believed to have the potential to become resident rainbow (Peven, 1990). Inland rainbow and juvenile steelhead are not distinguishable from each other until steelhead undergo smoltification. The mid-Columbia River tributaries contain a mixture of resident rainbow and ocean-migrating steelhead. The ability of the species to alternate life-history strategies is an adaptive mechanism to variable environmental conditions within their home (natal) streams.

Under a 1963 agreement between the Washington Department of Game (WDG) (the predecessor to WDFW) and Chelan PUD, in conjunction with the original license for the Project. Chelan PUD implemented a rainbow trout hatchery program to address the loss of a potential recreational whitefish fishing opportunity in the mainstem Columbia River, near the mouth of the Entiat River. A new hatchery produced 90,000 catchable-sized rainbow trout annually, originally intended for placement in tributaries. However, due to concerns about interactions between rainbow trout and native fish in the tributaries, and the fact that juvenile pre-smolt steelhead were being harvested along with the hatchery fish, the fishery management agencies decided in 1989 to, instead, stock the hatchery rainbow trout in local area lakes.

2.5.6 Mountain Whitefish

Mountain whitefish (*Prosopium williamsoni*) are a native species and are assumed to occur in all small-order tributaries to the Wenatchee, Entiat, Methow, and Okanogan rivers, and in connecting larger lake systems. They are also believed to occur in the mainstem Columbia River reservoirs, although their behavior patterns are not known. They mostly inhabit riffles in summer and large pools in winter (Wydoski and Whitney, 1979). Spawning typically occurs from October through December, generally in riffles but also on gravel shoals of lake shores. Mountain whitefish feed primarily on instar forms of benthic aquatic insects, although they also occasionally eat crayfish, freshwater shrimp, leeches, fish eggs, and small fish. In lakes, they feed extensively on zooplankton, particularly cladocerans.

The potential for a recreational fishery for whitefish existed in the mainstem Columbia River, near the mouth of the Entiat River, prior to construction of the Project. Under the original Project license, Chelan PUD funded a rainbow trout hatchery program as mitigation for that potential lost recreational fishing opportunity.

SECTION 3: STUDIES AND EVALUATION OF PROJECT EFFECTS

Relicensing baseline studies to determine the current status of fishery resources in the Reservoir were initiated in 1999 (Figure 6-1). Studies relevant to resident fish issues included: 1) a creel study to investigate sport catch; 2) a fish presence and habitat use survey; 3) an analysis of benthic organisms; 4) a pool fluctuation report; 5) a study of the role of large woody debris; 6) aquatic habitat mapping; and 7) re-identification of sport fishing access points on the Wenatchee River.

3.1 Relicensing Studies

3.1.1 Creel Survey

Creel sampling was conducted on average two days per week, including weekdays and weekends, from August through early October, 1999, and from April through July, 2000 (DES 2000). A total of 134 anglers were surveyed. Ninety of the anglers interviewed were observed on the Reservoir, with the largest percentage fishing from the mouth of the Chelan River downstream to the mouth of the Entiat River. The number of anglers per weekend day was 71 percent higher than on weekdays. Walleye were the primary targeted species, followed by northern pikeminnow and smallmouth bass. Northern pikeminnow were the most abundant, with 125 captured during the surveys. Walleye were the second most abundant with 39 captured. A total of four smallmouth bass and three largemouth bass were captured. No burbot, yellow perch, catfish, or sturgeon were observed. Very little fishing was observed on the Reservoir. The value of the study was limited by the fact that the fishing season for salmon, trout, and char was closed during the survey periods.

3.1.2 Aquatic Habitat Mapping

In preparation for a study of fish presence and habitat use, Chelan PUD contracted with Duke Engineering Services, Inc. (2001) to conduct an aquatic habitat survey to measure and map the baseline aquatic habitat conditions of the Reservoir (depth, velocity, substrate type, cover types, and fish structures) and update information on the distribution of aquatic plant growth throughout the Reservoir, with an emphasis on assessing the extent of non-native, invasive Eurasian watermilfoil.

Results of the aquatic habitat mapping effort were used to help identify sampling areas for the fish presence and habitat use survey. The aquatic habitat model developed from this study may have its highest utility, however, as a predictive tool to analyze current conditions, predict utilization of habitat types by fish, and to address potential enhancement areas.

3.1.3 Fish Presence and Habitat Use

The specific goals and objectives of the fish presence and habitat use survey were to: 1) determine the presence of various habitat types found within the Reservoir, and describe how these areas are utilized by various species over time; 2) to determine habitat use by species; and, 3) in combination with the aquatic habitat mapping data, to predict habitat use and production of fish in other areas of the Reservoir.

The fish presence and habitat use survey determined that non-game fish such as suckers, chubs, northern pikeminnow, stickleback, and shiners make up the majority of the Reservoir resident fish population (DES, 2001). The introduced species (walleye, centrarchids, catfish and carp) are common, but not abundant. Walleye, smallmouth bass, and carp recruitment is probably limited by the low temperatures in the Reservoir in spring and early summer (Bennett, 1991; Mullan, et. al., 1986).

3.1.4 Benthic Analysis

Benthic organisms provide an important source of nutrients to resident fish. Therefore, a benthic analysis was conducted in 1999 to: 1) obtain baseline macroinvertebrate data; 2) provide information on benthic invertebrate communities; and 3) examine the status and composition of mollusk populations in the Reservoir. The study, conducted by Duke Engineering & Services, Inc. and RL&L Environmental Services Ltd., showed that the more diverse the habitat (e.g., local differences in substrate, depth, velocity, etc.), the higher the density and variety of macroinvertebrates. In terms of density, midges, caddisflies, sow bugs, clams and mussels, and scuds accounted for most of the benthic invertebrates. The mollusk species found were dominated by an introduced Asian clam (Corbicula fluminea).

None of the species found were candidates for listing as priority species by Washington State, probably because the habitat types preferred by state-listed species are not found in the Reservoir. Similarly, no ESA-listed species were found.

3.1.5 Reservoir Fluctuation

In 2000, BioAnalysts, Inc. produced an investigation into the potential effects of Reservoir fluctuations on fisheries resources. The investigation included an assessment of effects on ESA-listed anadromous fish populations, as well as the riparian habitat bordering the pool. It considered the possibility that fluctuations in both surface water elevation and water velocity in the Reservoir may affect migration, spawning, rearing, and stranding of fish within the reservoir, as well as riparian zone structure and reservoir habitat.

The study found no incidents of resident fish stranding since May, 1988. The Project operational characteristics help to avoid fish stranding. The Project forebay level is very stable (within 705-707 feet) and the forebay level changes slowly because the forebay surface area is large in comparison to the hydraulic capacity of the powerhouse.

3.1.6 Role of Large Woody Debris

BioAnalysts (2000) investigated the source, function, and fate of large woody debris in the Reservoir, emphasizing the function of large woody debris in the reservoir. Because there is virtually no information on large woody debris in the Reservoir, information from other systems was drawn upon, mostly studies of large woody debris in lakes. No studies were found that described the function of large woody debris in reservoirs of run-of-river hydroelectric projects.

It appears that most wood enters the Reservoir from upstream locations, such as the Entiat River, or wood that passes through Wells Dam. Riparian areas along the Reservoir probably contribute little large woody debris. Wood that enters the Reservoir can submerge in littoral areas or at the bottom of the Reservoir, float at or near the water surface, strand on the floodplain, or pass through Rocky Reach Dam. Wood that becomes anchored on the floodplain can trap sediments and aid in establishing riparian vegetation. Wood recruited to the Reservoir from riparian areas along the shoreline may stay in the Reservoir for extended periods of time if the wood remains partially attached to the shore. Both submerged and floating large woody debris increase habitat structure and provide habitat for fish and macroinvertebrates. Several species of fish use submerged and floating wood for cover. Prey fish species use wood to make themselves less conspicuous to predators, while lurking predators use wood to conceal themselves from potential prey. The removal of large woody debris at hydroelectric projects has reduced the recruitment of debris to downstream locations and to the estuary.

Chelan PUD currently removes trash, aquatic macrophytes, and large woody debris from the forebay of Rocky Reach Dam that washes up to the face of the Dam as part of routine operations. Large woody debris is transported to below the Dam, where it is chipped. Chelan PUD will consider collecting and hauling large pieces of large woody debris suitable for tributary habitat enhancement efforts, as described in Section 4.4.2.

3.1.7 Sport Fishing Access

Per a 1963 agreement with WDFW, Chelan PUD purchased easements within the vicinity of the Project to mitigate for wildlife impacts resulting from the initial development of the Project. These included easements providing public stream bank access and fishing areas along the Wenatchee and Entiat rivers. These easement areas were created as off-site mitigation for loss of sports-fishing access areas that were inundated by creation of the Reservoir, and were deeded to WDFW. The 28 Wenatchee River easements are located from the Wenatchee River mouth (located approximately five miles downstream of the Dam) upstream to approximately one mile below Leavenworth. The Entiat River easements are located downstream from the Forest Service boundary at river mile 26.

A 2000 report by BioAnalysts described public access along the Wenatchee River commonly used by people using rafts, kayaks, canoes, and drift boats, the location of public access, and documented its uses. The report documented opinions from local fishing and rafting groups on how to improve access on the Wenatchee River, such as providing a takeout near the mouth of the Wenatchee River, improving sites at Monitor and Cashmere so that launch sites are suitable for trailers, providing a public takeout suitable for trailers near Plain and/or Tumwater Campground in Reach 4 to improve use of the upper Wenatchee River to drift boats, and improving access to lower Icicle Creek, which would allow bank anglers to access the spring Chinook salmon fishery in the lower river.

3.2 Benefits of the Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for Resident Fish

The primary benefit to resident fish species of implementing the Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plan (HCP Agreement) is construction, operation, and maintenance of the downstream bypass. The downstream bypass provides a non-turbine passage route for anadromous fish, primarily juvenile salmon and steelhead, past Rocky Reach Dam to increase their downstream migration survival. The downstream bypass provides resident fish species with the same passage protection.

The downstream bypass provides two passage routes for fish from the forebay to the tailrace: the juvenile collection facilities and adult bypass pipe. It contains adult separator bars that divert fish smaller than 12 to 15 inches through the juvenile collection facilities during sub-sampling operations, which occurs a small percentage of the time, and larger fish around the facilities directly to the tailrace of the Project.

Resident fish species smaller than 12 to 15 inches observed regularly in the downstream bypass during routine sub-sampling operations for juvenile salmonids are threespine stickleback, peamouth, chiselmouth, juvenile suckers, mountain whitefish, redside shiner, bluegill, crappie, smallmouth and largemouth bass, rainbow trout, pikeminnow, and, rarely, Westslope cutthroat trout. Adult (larger than 12 to 15 inches) resident fish species observed include suckers, walleye, and mountain whitefish.

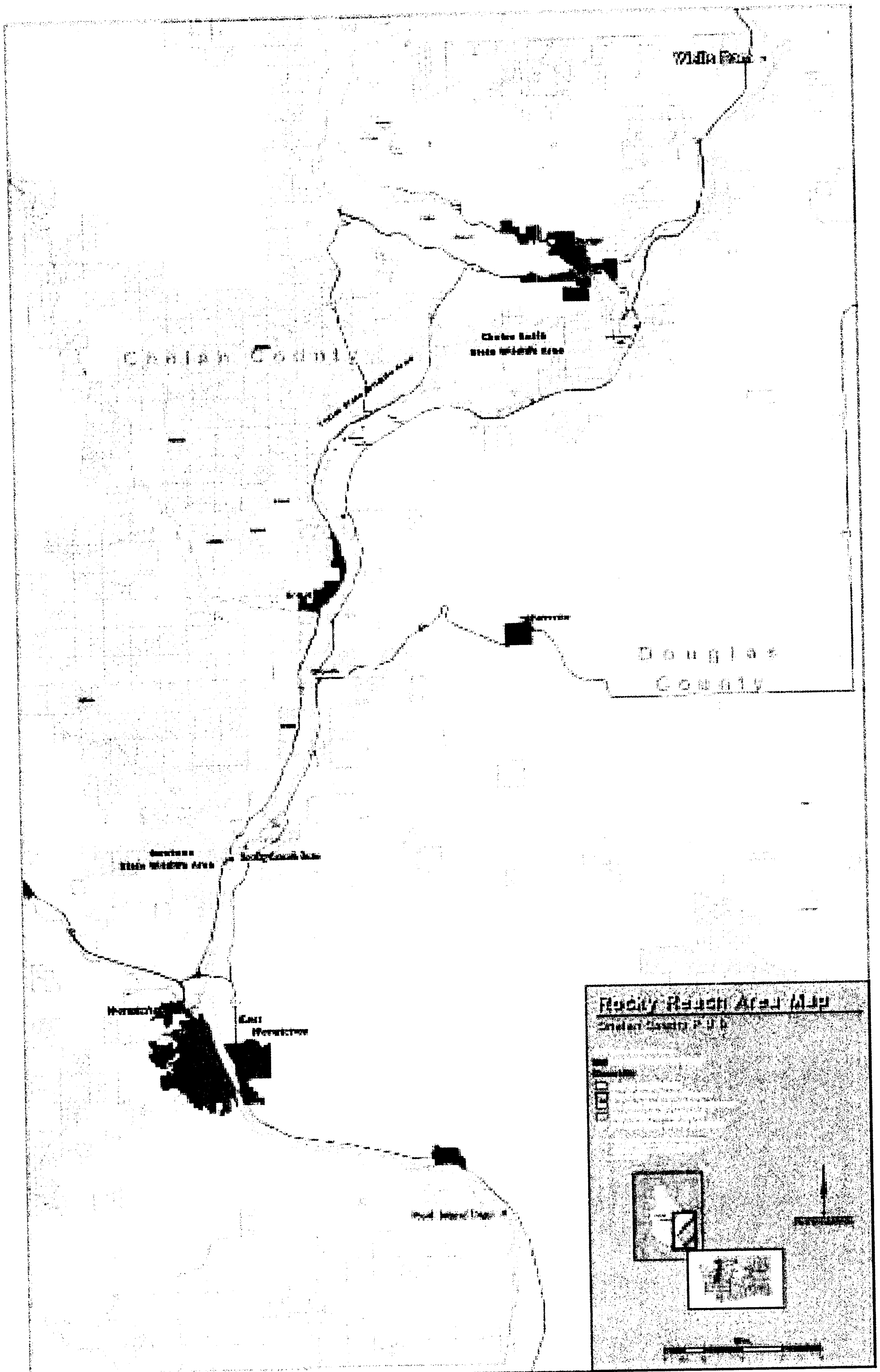

Figure 6-1: Rocky Reach Hydroelectric Project Area Map

SECTION 4: PROTECTION, MITIGATION, AND ENHANCEMENT MEASURES

The goal of the RFMP is to protect and enhance resident fish and their habitat within the Project boundary, and to enhance recreational fishing opportunities. Chelan PUD has agreed to implement several resident fish PME measures, including continued funding for measures provided in the existing license for resident fish and to enhance recreational fishing opportunities. Chelan PUD has also agreed to implement fish rearing and operation and maintenance of the Twentyfive Mile Creek spawning channel. Taken together, these PME measures are intended to meet the following objectives:

Objective 1: Continue to enhance recreational fishing opportunities; and

Objective 2: Conduct resident fish monitoring to measure relative abundance and species composition in the Reservoir.

More specifically, the RFMP calls for Chelan PUD to implement the following PME measures:

4.1 Objective 1: Continue to Enhance Recreational Fishing Opportunities

4.1.1 Fish Rearing

Chelan PUD shall continue to make funding available for a fish rearing program conducted by WDFW to produce approximately 30,000 pounds of rainbow trout, or other fish species reared at a comparable production cost for annual planting in local area waterbodies in Chelan and Douglas counties. Other fish species will be determined by WDFW, following consultation with the RRFF. The estimated cost of this measure is $100,000 per year during the term of the New License and any subsequent annual licenses. It is intended that WDFW will exercise a least-cost method of obtaining high quality fish with this funding, which may include raising or purchasing such fish. Use of existing hatchery facilities to produce these fish is included in the Habitat Conservation Plan (HCP) *Hatchery Facilities Evaluation- Suggested Guidelines for Anadromous Fish Hatchery Programs* (Chelan PUD, 2004).

4.1.2 Resident Fish Enhancement Measures

The most cost-effective resident fish recreation opportunities are outside the Project boundary. Construction of the Twentyfive Mile Creek spawning channel provided off-site mitigation under the current Rocky Reach Project license. Funding for off-site measures will continue, as outlined below, for the term of the New License.

Chelan PUD shall, in consultation with the RRFF, be responsible for implementing resident fish enhancement measures described below for an amount not to exceed a total of $50,000 during years one through ten of the New License. Chelan PUD shall, in consultation with the RRFF, be responsible for implementing the resident fish enhancement measures described below for an amount not to exceed a total of $62,000 during years 11 through the term of the New License and any subsequent annual licenses.

The first priority will be to use funds in the Lake Chelan Basin. However, through recommendation by the RRFF, funding may be used within the Project boundary or in tributaries to the Reservoir. The rationale for prioritizing the Lake Chelan Basin is two-fold: 1) maintain the existing license benefits to recreational fisheries; and 2) recreational fishing enhancements are more cost-effective in the Lake Chelan Basin than the Rocky Reach Reservoir.

The Resident Fish Technical Group (RFTG) supports continuation of the current rationale for enhancing recreational fishing. Resident fish enhancement measures may include the following:

1) Habitat enhancement on Twentyfive Mile Creek;

2) Culvert modification on Twentyfive Mile Creek to improve upstream fish passage;

3) Installation of remote-site egg incubators on Lake Chelan tributaries;

4) Blocking off entrance to the existing Twentyfive Mile Creek spawning channel to preclude fish access to the degraded channel, and re-visiting Twentyfive Mile Creek spawning channel reconfiguration some time in the future;

5) Lake Chelan tributary habitat enhancement;

6) Fishing pier acquisition/construction/enhancement in Lake Chelan (located in the lower (Wapato) Basin with suitable public access); and

7) Other projects as recommended by the RRFF and the Lake Chelan Fishery Forum (LCFF), pending the results of a food web model study to be performed on Lake Chelan[1]

Recommendations for future implementation of resident fish PME measures under this section of the RFMP will be made jointly by the LCFF and RRFF.

During preliminary discussions regarding the development of PME measures to include in this RFMP, Chelan PUD proposed continued funding for existing license measures for resident fish, including fish rearing and operation and maintenance of the Twentyfive Mile Creek spawning channel. However, on July 19, 2004, a high intensity, short duration storm dropped at least 0.75 inches of rain on the recently burned South Fork Twentyfive Mile Creek drainage, resulting in a mud/debris torrent that totally inundated the spawning channel with an estimated 200 cubic yards of silt. The RFTG made the determination that providing funding for spawning channel rehabilitation at the present time would not be the best use of these funds because continued siltation of the channel is expected to occur over the next four to five years. Instead, the RFTG developed the preceding list of potential PME projects that could be implemented with the same amount of funding proposed for the spawning channel rehabilitation.

[1] Dr. Dave Beauchamp's food-web model per the Lake Chelan Comprehensive Settlement Agreement [Chelan PUD, 2003]

4.1.3 Recreational Fishing Evaluation

Within one year of the effective date of the New License, Chelan PUD shall, in consultation with the RRFF, evaluate the creation of an additional recreational fishing opportunity in the Reservoir that is compatible with existing fish resources. This evaluation will be conducted for an amount not to exceed $60,000.

4.2 *Objective 2: Resident Fish Monitoring to Measure Relative Abundance and Species Composition in the Reservoir*

Within one year following the effective date of the New License, Chelan PUD shall initiate implementation of a one-year comprehensive evaluation of resident fish in the Reservoir focusing on predatory fish species. The comprehensive evaluation shall be developed in consultation with the RRFF.

If, based on the comprehensive evaluation results, Chelan PUD determines, in consultation with the RRFF, that the predatory fish population adversely affects the achievement of HCP Plan Species survival standards in the Reservoir, Chelan PUD shall, in consultation with the HCP Coordinating Committee, develop and implement predator control measures as necessary to achieve such standards. Following implementation of any such predator control measures in the Reservoir, Chelan PUD shall conduct: 1) an additional one-year follow-up comprehensive evaluation to determine the efficacy of predator control measures undertaken in the Reservoir. The methodology used for the follow-up evaluation shall be the same as for the initial evaluation unless modified by recommendation of the RRFF; and 2) an additional one-year monitoring survey to assess any changes in abundance or species composition of the resident fish populations in the Reservoir. The timing and methodologies for the monitoring survey shall be developed by Chelan PUD in consultation with the RRFF.

If, based on the initial comprehensive evaluation results, Chelan PUD determines, in consultation with the RRFF, that a predator fish predation problem does not exist in the Reservoir, Chelan PUD shall conduct three, one-year monitoring surveys to monitor any changes in abundance or species composition in the resident fish populations in the Reservoir. The timing and methodologies for the monitoring surveys shall be developed by Chelan PUD in consultation with the RRFF.

The total cost of the resident fish comprehensive evaluations and monitoring surveys under this subsection shall not exceed $300,000.

Biological objectives for supporting designated uses for resident fish are shown in Table 6-1. A summary of criteria for achievement of objectives for resident fish are shown in Table 6-2.

Table 6-1: Biological Objectives for Supporting Designated Uses for Resident Fish

Designated Use	Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Plan Action
Native, Non-Stocked Resident Fish Species	No negative impact caused by ongoing Project operations.	Years 1-4, with subsequent surveys determined by the RRFF	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.2

Table 6-2: Summary of Criteria for Achievement of Objectives for Resident Fish

Use/Action	Biological Objective	Management Action (PME)	Schedule	Actions if Objective Achieved	Actions if Objective Not Achieved	Plan Action
Recreational Fishing	Increase number of resident game fish for fishing	Fund rearing of 30,000 lbs. of rainbow trout, or other fish recommended by the RRFF	Annual	Fish produced and stocked	Rear different species of comparable production costs; adjust stocking location	Section 4.1.1
Recreational Fishing	Increase available habitat for resident game fish	Fund habitat projects not to exceed $50,000 over funding timeframe	Available from years 1-10	Enhancement projects implemented	Continue to implement measures until $50,000 is expended	Section 4.1.2
Recreational Fishing	Increase available habitat for resident game fish	Fund habitat projects not to exceed $62,000 over funding timeframe	Available from years 11-50	Enhancement projects implemented	Continue to implement measures until $62,000 is expended	Section 4.1.2
Recreational Fishing	Recreational fishing evaluation	Provide funding not to exceed $60,000 to implement measure	One- time	Funding provided and used for evaluation	None	Section 4.1.3
Native, non-stocked resident fish species	No negative impact caused by ongoing Project operations	Monitor Project-related impacts for a cost not to exceed $300,000 over New License and any subsequent annual licenses	Years 1-4, with subsequent surveys determined by the RRFF	Funding provided and used for monitoring and evaluation	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s)	Section 4.2

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CHAPTER 7: ROCKY REACH WILDLIFE MANAGEMENT PLAN

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EXECUTIVE SUMMARY

Under the direction of the Natural Resources Working Group (NRWG), numerous studies were conducted during the Rocky Reach Project (Project) relicensing process, including mapping of rare, threatened, and endangered wildlife and cover-type, a survey of botanical resources, surveys of Canada goose nesting, surveys of bald eagle overwintering abundance, and a study of overwinter mule deer mortality. The Wildlife Technical Group (WTG) representatives developed the measures included in this Rocky Reach Wildlife Management Plan (WMP) to provide benefit to local wildlife and botanical resources.

The goal of the WMP is to protect and enhance wildlife populations and habitat in the vicinity of Rocky Reach Project. Chelan PUD has agreed to implement several Protection, Mitigation, and Enhancement (PME) measures for wildlife as part of the Agreement. The objectives of these PME measures are to: 1) restore, maintain, or improve Chelan Wildlife Area lands; 2) restore, maintain, improve, or increase habitat for key indicator wildlife species; and 3) implement the "Ute Ladies Tresses (*Spiranthes diluvialis*) Along Rocky Reach Reservoir Management Plan."

The specific PME measures to be implemented by Chelan PUD during the term of the New License and any subsequent annual licenses to meet these goals and objectives are described in Section 4 of this Chapter. They include the following:

1) Funding to restore, maintain, and improve the Chelan Wildlife Area;
2) Funding for habitat restoration on Washington Department of Fish and Wildlife (WDFW) lands;
3) Funding for habitat restoration on US Bureau of Land Management (BLM) lands;
4) Funding for habitat restoration on USDA Forest Service lands;
5) Providing a riparian conservation easement on Chelan PUD Sun Cove property;
6) Funding for an integrated noxious weed control program;
7) Conducting wildlife surveys;
8) Funding for noxious weed control, specifically to protect rare, threatened and endangered botanical species;
9) Funding for rare, threatened and endangered botanical species monitoring; and
10) Funding for a conservation easement for rare, threatened and endangered botanical species protection.

SECTION 1: INTRODUCTION

The relicensing process for the Rocky Reach Hydroelectric Project (Project) brought fisheries, wildlife, and botanical resource agencies, tribes, and interested parties together in a Natural Resources Working Group (NRWG) that provided an opportunity for comprehensive review of current and future management priorities for fish, wildlife, and botanical resources potentially impacted by ongoing Project operations. The NRWG was established to identify issues, develop study plans, review study reports, and develop long-term management plans for fish and wildlife species. The NRWG consisted of representatives from the USDA Forest Service, US Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration Fisheries (NOAA), Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), the US Bureau of Land Management (BLM), the Colville Confederated Tribes (CCT), the Yakama Nation (YN), Columbia River Inter-Tribal Fish Commission (CRITFC), and other interested parties.

Technical groups were formed for each comprehensive plan e.g., white sturgeon, bull trout, Pacific lamprey, resident fish, and wildlife due to the complexity of issues surrounding each species and so that agency experts could focus on meetings pertaining to their specific expertise. A subgroup of the NRWG, the Wildlife Technical Group (WTG), comprised of the USDA Forest Service, USFWS, Ecology, WDFW, and Chelan PUD, completed this Wildlife Management Plan (WMP). Following the effective date of the New License, and any subsequent annual licenses, the Rocky Reach Wildlife Forum (RRWF) will assume responsibility for meeting to share information, coordinate efforts, and make recommendations and decisions regarding the implementation of this WMP.

State lands included in the Chelan Wildlife Area (the Swakane, Entiat, and Chelan Butte Units) are those of the WDFW, and the Washington Department of Natural Resources (DNR). Federal lands in the Rocky Reach Wildlife Area[1] include those of the USDA Forest Service, BLM, and USFWS lands adjacent to their hatchery (Figure 7-1). The primary areas of concern include: 1) the Rocky Reach Wildlife Area; 2) the Chelan Wildlife Area; and 3) Chelan PUD lands.

The WTG representatives developed the measures included in this WMP to provide benefit to local wildlife and botanical resources. This WMP contains sections highlighting the background of wildlife species (Section 2); relicensing and other studies conducted to determine ongoing Project impacts, if any, on wildlife, and potential wildlife enhancement measures (Section 3); goals and objectives of the management plan (Section 4); and PME measures for wildlife that Chelan PUD is to implement through the term of the New License, and any subsequent annual licenses (Section 4).

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[1] For purposes of this Chapter of the Comprehensive Plan, the Rocky Reach Wildlife Area is defined as the public lands in Chelan County and Douglas County contained within an approximately 6-mile wide corridor of the Rocky Reach Reservoir (Reservoir).

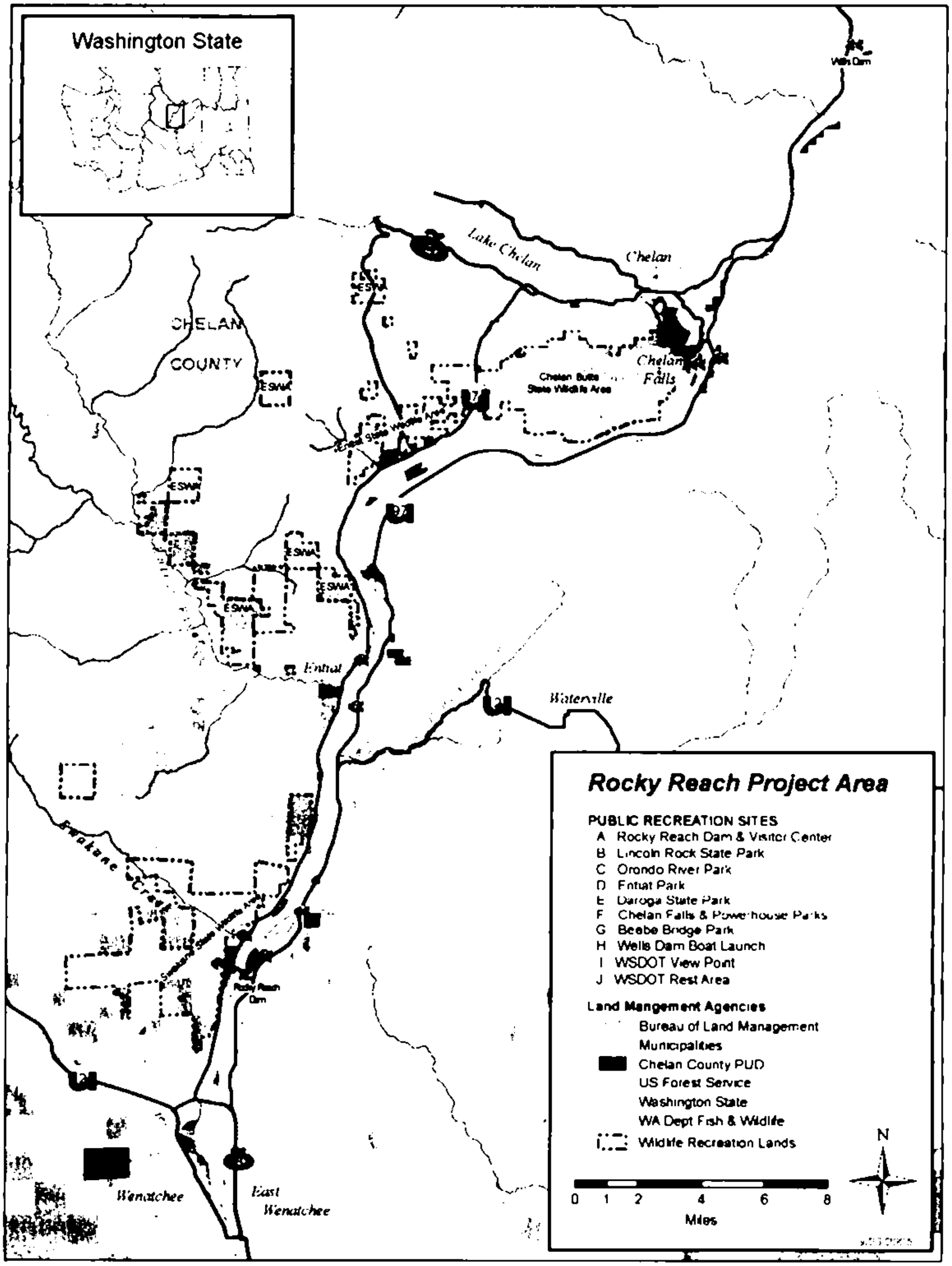

Figure 7-1: Rocky Reach Project Area

SECTION 2: BACKGROUND

Before European settlement, the vegetation of the area surrounding the Project was largely shrub-steppe, which was maintained by frequent wildfires. A number of factors have altered the historic vegetation in the vicinity of the Project. Before the Project was constructed in 1961, the area had already been altered to some extent by grazing, fires and fire suppression, farming, residential development and exotic weed invasion. These factors continue to affect current conditions

Existing botanical resources closely resemble the historical botanical resources in the vicinity of the Project, consisting mainly of shrub-steppe communities. Subsequent to inundation of the Reservoir, new riparian and aquatic plant communities have developed on the present day shoreline. There are also some areas of riparian vegetation along streams or rivers and some wetland communities within the Project boundary. In addition, there are some habitats with distinct vegetation communities, these include areas with gravelly or sandy soils, shallow and/or stony sites; and sand dunes near the Columbia River (Franklin and Dyrness, 1973).

Much of the area surrounding the Project has been cultivated with a variety of crops or is grazed by livestock. Irrigated cropland and orchards dominate the river corridor lands around the Project and Reservoir.

In the mid-1960s, as part of the originals license, Chelan PUD provided funds to the Washington Department of Game (now the WDFW) for the purchase of 20,397 acres of land along the Columbia River between Swakane Canyon and Chelan Butte, collectively referred to as Chelan Wildlife Area lands. These lands were purchased to mitigate the loss of the wildlife habitat that was inundated by original Project construction. These lands are important mule deer winter range within Chelan County. In addition to WDFW lands, the Chelan Wildlife Area is intermingled with lands administered by the BLM, USDA Forest Service, and DNR, along with some private land in-holdings. These lands provide additional benefit to wildlife resources.

Mule deer (*Odocoileus virginianus*) bighorn sheep (*Ovis canadensis*), cougar (*Felis concolor*), bobcat (*Lynx rufus*) and coyotes (*Canis latrans*) inhabit range in the mid-Columbia region. These species are present near the Reservoir, and have been recorded occasionally within the Project boundary. Upland game birds that use the Reservoir shorelines and Rocky Reach Wildlife Area lands include ring-necked pheasants (*Phasianus colchicus*), California quail (*Lagopus californicus*), chukars (*Alectoris chukar*) and mourning doves (*Zenaidura macroura*).

An important component of the WMP is to convert the existing 1,300-1,400 acres of agricultural lands on Chelan Wildlife Area lands into self-maintaining shrub steppe-habitat vegetated by bunchgrasses and shrubs such as snowy eriogonum, lupine, balsamroot, big sage, bitterbrush, serviceberry, elderberry. Additional portions of that objective would be to maintain strips of forage crops within the larger expanses of restored shrub steppe. These strips would provide annual, high quality forage and would serve as firebreaks. Noxious weed control would also be an important part of management of these lands.

SECTION 3: STUDIES AND EVALUATION OF PROJECT EFFECTS

Under the direction of the NRWG, numerous studies were conducted during the Rocky Reach relicensing process, including the Rare Plant Survey of the Rocky Reach Reservoir (Calypso Consulting, 2000), Rare, Threatened, and Endangered Wildlife and Cover-Type Mapping Study (DES, 2000), historic and ongoing Chelan PUD monitoring studies, and Mule Deer Mortality Study (Myers, 2003).

3.1 Relicensing Studies

3.1.1 RTE Wildlife and Cover-type Mapping

The Rare, Threatened, and Endangered Wildlife and Cover Type Mapping report assessed 13 cover types in the vicinity of the Project (DES, 2000). The study determined that approximately 57 percent of lands near the Project are comprised of disturbed, developed, or modified cover-types. Of all cover-types within the study area, orchards occupy the largest area (25.2 percent), shrub-steppe is the second largest (22.3 percent), and residential/industrial is the third largest area (15.6 percent). The residential/industrial cover-type increased more than any cover-type from 1991 to 1999 (approximately 230 acres), followed by the recreational cover-type (increase of approximately 59 acres). Residential and industrial development results in the conversion and permanent loss of native wildlife habitats. Collectively riparian and shoreline wetland habitats constitute a small portion of all habitats in the area (9.2 percent).

The primary conclusion of the report was that "suitability of wildlife habitats within the Rocky Reach study area are influenced by current human activities, past land-use practices, and physical landform characteristics." One significant habitat feature identified by this study and the Rare Plant Survey (Calypso Consulting, 2000) was the dramatic increase in riparian vegetation within the Project boundary, and the associated increase in wildlife species diversity.

3.1.2 Botanical Resources Survey

During a rare plant survey in 1999–2000 (Calypso Consulting, 2000), botanists located 14 populations of six rare plant species within the Project boundary, including four currently state-listed species: porcupine sedge (*Carex hystericina*), giant helleborine (*Epipactis gigantea*), adder's-tongue (*Ophioglossum pusillum*) and Ute ladies'-tresses (*Spiranthes diluvialis*). One of these, the Ute ladies'-tresses, is also federally listed as a threatened species. Due to their rarity in the state, two other species that were located during the course of surveys can be expected to be added to the Washington National Heritage Program list and tracked in the future. These species are little bluestem (*Schizachyrium scoparium*) and blue-eyed grass (*Sisyrinchium montanum*).

Noxious weeds such as purple loosestrife (*Lythrum salicaria*), diffuse knapweed (*Centaurea diffusa*), Russian knapweed (*Acroptilon repens*), perennial pepperweed (*Lepidium latifolium*), Dalmatian toadflax (*Linaria dalmatica*), Yellow Starthistle (*Centaurea solstitialis*), Common Mullein (*Verbascum thapsus*), Camelthorn (*Alhagi maurorum*), Canada thistle (*Cirsium arvense*), common St. John's-wort (*Hypericum perforatum*), and hoarycress (whitetop) (*Cardaria draba*) pose a particular risk to native and rare plant populations in the vicinity of the

Project. Other weeds such as Japanese knotweed (*Polygonum cuspidatum*), yellow flag (*Iris pseudacorus*) and reed canary-grass (*Phalaris arundinacea*) may also be problematic.

Besides direct destruction of habitat, increases in weedy plant species probably poses the highest threat to rare plant populations and native plant communities (Calypso Consulting, 2000). The higher the level of disturbance within a habitat, the greater the probability that non-native weedy plant species will become established and potentially out-compete native and rare plant species.

Similar to noxious weed invasion, populations of giant helleborine (*Epipactus gigantea*) and porcupine sedge (*Carex hystericina*) have increased dramatically since 1990 (Calypso Consulting, 1990, 2000). The increase in populations of these species indicates that current Project operations result in maintaining riparian vegetation through providing a stable reservoir elevation and by reducing flood scour.

3.1.3 Mule Deer Overwinter Mortality Study

This study, conducted by WDFW, was designed to provide baseline information concerning the most effective and efficient use of funds to enhance mule deer habitats (Myers 2003). Chelan PUD provided partial funding for this project, with an objective to determine the habitat quality on the existing wildlife lands in the Swakane, Entiat, and Chelan Butte units.

Bitterbrush (*Purshia tridentata*), the preferred winter forage species by mule deer when present, was reduced dramatically during the 1988 and 1994 fires. The loss of this important winter forage species very likely had severe impacts to deer numbers, since the quality of digestible winter forage affects survival. The logical step for enhancing mule deer winter ranges in Chelan County would start with restoring bitterbrush stands to a level that could help the mule deer population recover from a combination of severe winters and wildfires. Determining areas with consistent mule deer use will focus restoration of bitterbrush stands to areas important for mule deer. Given these considerations, the goal of this study was to provide deer managers in Chelan County with information on winter habitat use by mule deer so that those areas can be enhanced.

As determined by this study, the primary causal agent to mule deer population decline is loss of winter habitat due to fire. The information gathered regarding habitat quality on existing wildlife areas will be valuable in determining where habitat enhancement efforts will likely be the most successful in terms of benefiting mule deer, and other wildlife species associated with mule deer habitat.

3.2 Ongoing Studies

3.2.1 Canada Goose Nesting Surveys

Canada goose surveys have been conducted by Chelan PUD on the Reservoir since 1983 (Fielder 2003). These surveys have been used by WDFW to assess Canada goose abundance and set harvest regulations. The Reservoir provides limited habitat for breeding waterfowl. Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*) and common mergansers (*Mergus merganser*) are probably the most common breeding waterfowl, although wood ducks (*Aix sponsa*) occasionally use the nesting boxes dotted along the Reservoir. Backwater areas probably also support a few nesting pairs of pied-billed grebes (*Podilymbus podiceps*) and coots (*Fulica atra*).

Since 1983, 30 to 80 pairs of geese have nested annually along the Reservoir. Currently, Chelan PUD maintains 31 artificial nest structures for geese along the Reservoir. Each year about two-thirds of the nests are successful in producing approximately 200 goslings.

3.2.2 Bald Eagle Overwinter Abundance Surveys

Bald eagle overwinter abundance surveys have been conducted by Chelan PUD on the Reservoir since 1982. Several adult bald eagles (*Haliaeetus leucocephalus*) were observed in the vicinity of the Project during the wildlife survey in 2002 (DES, 2000). Eagles were seen during the summer season, but no evidence of nesting was documented. In addition, Chelan PUD estimates that between 20 and 56 bald eagles overwinter along the Reservoir, feeding on the abundant overwintering waterfowl and deer carrion (Fielder, 1982). Bald eagles are not known to breed within the Project boundary.

Chelan PUD and the wildlife management agencies (WDFW, USDA Forest Service, BLM, and USFWS) that participated in development of this Chapter anticipate that habitat and wildlife enhancement activities and projects could include some of the general management recommendations provided in this section. Several of these items were addressed through the Lake Chelan Project relicensing proceeding, while others may be funded by Chelan PUD, USDA Forest Service, BLM, and WDFW. The WTG has developed the following potential activities and projects for lands in the Chelan and Rocky Reach Wildlife areas:

3.3 Potential Activities and Projects on Wildlife Lands

3.3.1 Habitat

- Identify the needs and habitat types that address the biology of each of the indicator or key species.
- Use existing habitat inventories, to the extent possible, to guide habitat management on public lands in Chelan and Douglas counties adjacent to the Reservoir.
- Re-establish shrub steppe habitat and/or herbaceous cover in present agricultural fields and other suitable sites.
- Monitor and control noxious weeds, and re-establish competitive permanent, native vegetative cover.
- Plant shrubs in steppe habitat.
- Develop additional deer winter range using native and fire resistant browse species.
- Apply fertilizer, prune, and/or use controlled burns to maximize forage production and palatability.

3.3.2 Agronomy

- Establish annual and perennial irrigated wildlife plantings where appropriate in Swakane Canyon.
- Establish dry-land wildlife/cover plots in suitable areas.

3.3.3 Tree and Shrub Plantings

- Plant shrub and trees to develop riparian strips, wetland areas, shorelines, and lands in irrigated and sub-irrigated areas.
- Establish corridors of evergreen trees to provide large mammal travel lanes and thermal cover.

3.3.4 Erosion Control

- Construct a series of erosion control structures in selected canyons.
- Plant herbaceous and woody vegetation in sediment basins and sub-irrigated areas associated with these structures.

3.3.5 Water Developments

- Optimize availability of water from springs and streams, improve developed springs, and develop new springs.
- Install water guzzlers where needed.
- Replace livestock tanks with wildlife watering basins.
- Maximize pond construction and water storage throughout the area to create wetlands, riparian habitat, and provide water for wildlife use, fire fighting, irrigation, and noxious weed control at strategic locations.
- Provide water for butterfly populations.

3.3.6 Irrigation

- Improve efficiencies and optimize water used by improving existing irrigation system.
- Develop irrigation systems at other locations where appropriate.

3.3.7 Nesting and Raptor Perching Structures

- Provide artificial nesting structures throughout the area, as needed, as an interim project until planted trees grow to functional size.
- Provide brush piles to offer dense escape cover as an interim project until planted riparian habitat grows to functional habitat.
- Preserve crucial perching habitats for bald eagles that migrate through the Rocky Reach Wildlife Area.

3.3.8 Wildlife Re-establishment

- Re-introduce native wildlife that no longer exist in area vicinity or exist in low numbers (e.g., sharp-tailed grouse, bighorn sheep).
- Transplant wildlife within an area as determined desirable.

3.3.9 Habitat Connectivity

- Restore, enhance, maintain, or improve habitat or key species corridors that provide landscape linkages, especially migration corridors.
- Consider consolidation of land units.

3.3.10 Ecosystem Processes

- Provide for various ecological processes (fire, riparian large woody debris jams, cavities, etc.) that provide various "renewal" age classes, site condition changes, or development of natural features beneficial to wildlife.

3.3.11 Habitat Protection

- Enforcement to protect investment of wildlife enhancement areas.
- Education.
- Maintenance.

3.3.12 Public Use Management

- Ensure that public use does not impact resource or habitat.
- Construct interpretive facilities and wildlife viewing sites.
- Coordinate efforts with recreation planning.
- Ensure overlap and coordination with habitat protection efforts.
- Include elements of education, interpretation, control, and enforcement.

3.3.13 Comprehensive Property Management

- Manage the Rock Reach Wildlife Area and intermixed properties to maximize resource protection and land stewardship.
- Optimize compatible recreation use of public lands within the Rocky Reach Wildlife Area.
- Monitor and evaluate effectiveness of improvements

SECTION 4: PROTECTION, MITIGATION, AND ENHANCMENT MEASURES

The WTG representatives developed the measures included in this WMP to provide benefit to local wildlife and botanical resources. The goal of the WMP is to protect and enhance wildlife populations and habitat in the Rocky Reach Wildlife Area. Chelan PUD has agreed to implement the following wildlife and botanical PME measures as part of the Agreement to meet the following objectives:

Objective 1: Restore, maintain, or improve Chelan Wildlife Area lands;

Objective 2: Restore, maintain, improve, or increase habitat for key indicator wildlife species; and

Objective 3: Implement the "Ute Ladies Tresses (*Spiranthes diluvialis*) Along Rocky Reach Reservoir Management Plan".

Wildlife key indicator species for purposes of the WMP include mule deer and bighorn sheep; rare, threatened, endangered, and sensitive species; species of concern; or priority species.

To ensure better comprehensive assessment of short and long-term wildlife habitat activities and needs, the RRWF will meet at least annually to coordinate efforts, and to make recommendations regarding the expenditure of funds and other resources. It is anticipated that in some years agencies could pool resources for mutually beneficial projects. All funding identified in Section 4 is available to be used for application for matching funds. Adaptive Management is a key component of implementing the WMP successfully during the term of the New License and any subsequent annual licenses for the Project. Therefore, Chelan PUD and the RRWF shall prepare an annual progress report documenting actions taken and funded during the year, accomplishments, monitoring and evaluation results of such actions, and recommendations for future actions.

An analysis of potential projects and costs to restore, maintain, or improve Chelan Wildlife Area lands, focusing primarily on WDFW lands, was conducted by wildlife biologists Marc Hallet (WDFW) and Paul Fielder (Chelan PUD) (Hallet and Fielder, 2004). The analysis identified habitat restoration projects and areas within the Chelan Wildlife Area. A similar analysis within the Rocky Reach Wildlife Area was conducted for BLM lands by John Musser (BLM), Neil Hedges (BLM), and David St. George (BLM) (Musser et al., 2004). Both analyses, Chelan PUD relicensing baseline studies, and Chelan PUD's commitment to continue several existing license measures into the New License, were used by the WTG as guidance for some of the recommended actions that follow in this section. It is not intended that future projects be limited to those mentioned in the analyses above.

A component of restoring, maintaining, and improving wildlife habitat is to implement measures that provide for compatible public use of Rocky Reach Wildlife Area lands. The Rocky Reach

Recreation Resources Management Plan (RRMP) proposes to conduct a Recreation Use Assessment during the New License term. A component of the study is to include analysis of wildlife impacts resulting from recreation use of the Reservoir. This analysis shall be done in coordination with the Rocky Reach Wildlife Forum (RRWF) established pursuant to the Settlement Agreement. The WTG intends to have the same level of coordination between the RRWF and the Rocky Reach Recreation Forum (RRRF) when habitat restoration, maintenance, and improvement projects are implemented in order to provide for such compatible public use.

The WTG recommends that Chelan PUD implement the following PME measures:

4.1 Objective 1: Restore, Maintain, or Improve Chelan Wildlife Area Lands

Chelan PUD shall make available to WDFW $74,000 annually, for the term of the New License and any subsequent annual licenses, to restore, maintain, or improve Chelan Wildlife Area lands.

4.2 Objective 2: Restore, Maintain, Improve, or Increase Habitat for Key Indicator Wildlife Species

4.2.1 Habitat Restoration on WDFW lands

Chelan PUD shall make available funding to WDFW, for the term of the New License and any subsequent annual licenses, to restore 1300-1400 acres in the Chelan Wildlife Area previously under cultivation or in need of restoration, as identified in the WMP, to self maintaining shrub-steppe habitat vegetated by bunchgrasses and shrubs such as snowy eriogonum, lupine, balsamroot, big sage, bitterbrush, serviceberry, elderberry. An additional objective is to maintain strips of forage crops within the larger expanses of restored shrub-steppe. These strips would provide annual, high quality forage and would serve as firebreaks.

Chelan PUD shall provide funding as follows:

a. Within 180 days of the effective date of the New License, Chelan PUD shall make available to the WDFW an amount not to exceed $286,000 to restore 1300-1400 acres in the Chelan Wildlife Area previously under cultivation or in need of restoration;

b. Within 180 days of the effective date of the New License, and by January 31st of subsequent years two through six of the New License, Chelan PUD shall make available $67,000 to WDFW for the habitat restoration of agricultural lands in the Chelan Wildlife Area; and

c. Between year 10 and the final year of the New License, Chelan PUD shall make available to WDFW an amount not to exceed a total of $457,000 to restore, maintain, or improve the Chelan Wildlife Area.

It is the understanding of the RRWF participants that other WDFW resources may be used anywhere within the Rocky Reach Wildlife Area, per the recommendation of the RRWF.

4.2.2 Habitat Restoration on BLM Lands

Chelan PUD shall make available annually to the BLM $20,000, and an additional amount of up to $20,000 on a 50/50 matching basis, for the term of the New License and any subsequent annual licenses, to restore, maintain, or improve intermixed BLM lands within the Rocky Reach Wildlife Area. Funding in this section may be used for native shrub-steppe habitat rehabilitation, noxious weed control, native forbe replanting, water development projects, etc., on BLM lands within the Rocky Reach Wildlife Area.

4.2.3 Habitat Restoration on USDA Forest Service Lands

Chelan PUD shall make available annually to the USDA Forest Service $5,000, and an additional amount of up to $5,000 on a 50/50 matching basis, for the term of the New License and any subsequent annual licenses, to restore, maintain, or improve USDA Forest Service administered lands within the Rocky Reach Wildlife Area. Funding in this section may be used for native shrub-steppe habitat rehabilitation, noxious weed control, native forb replanting, and prescribed fire ecosystem processes, etc., on USDA Forest Service administered lands within the Rocky Reach Wildlife Area.

4.2.4 Sun Cove Property Riparian Conservation Easement

Chelan PUD shall enter into a contract with the Chelan-Douglas Land Trust, or other appropriate entity, to acquire a conservation easement and limited access to the Reservoir on Chelan PUD-owned property near Sun Cove for protection of the shoreline riparian area. The easement will also allow the remaining portions of the properties to be managed or sold by Chelan PUD at its discretion.

The riparian easement will run the length of the riverward portion of the property (approximately 3500 feet along the shoreline) and extend inland 50 feet from the ordinary high water line. The easement shall further provide for two 100-foot-long access corridors along the riverward portion of the Chelan PUD property, at locations to be approved by WDFW, to provide community access to the river for the benefit of future land owners, including boat launching and moorage facilities.

4.2.5 Integrated Noxious Weed Control Program

Chelan PUD shall, in consultation with the RRWF, make available $10,000 per year, for the term of the New License and any subsequent annual licenses, for implementation of an integrated noxious weed control program in the Rocky Reach Wildlife Area. Implementation of the program described in this subsection will be conducted by Chelan PUD personnel or other qualified personnel selected by the RRWF. Noxious weeds species will be defined by the Washington Natural Heritage Program, Washington State Weed Board, or other entity recommended by the RRWF.

Assumptions used for this subsection are:

- The noxious weed control program does not include aquatic weeds; and
- There will be ample opportunities for efficiencies through inter-agency cooperation and coordination. The proposal is to develop area-wide noxious weed control strategy.

4.2.6 Wildlife Surveys

Chelan PUD shall, in coordination with the RRWF, continue to conduct wildlife surveys similar to those conducted during the original FERC license for the Project and/or habitat improvement projects for a cost not to exceed $10,500 or equivalent staff-days per year during the term of the

New License and any subsequent annual licenses. The intent of this funding is to survey and monitor threatened, endangered, and sensitive species on a periodic schedule as directed by the RRWF. Survey techniques and schedule will be developed in coordination with the RRWF. Surveys should be conducted on an annual basis and address priority species. Chelan PUD shall provide an annual report of survey results to the RRWF.

4.3 *Objective 3: Implement the "Ute Ladies Tresses (Spiranthes diluvialis) Along Rocky Reach Reservoir Management Plan"*

4.3.1 Noxious Weed Control to Protect Spiranthes

Chelan PUD, in coordination with the RRWF, shall make available $5,000 per year, for the term of the New License and any subsequent annual licenses, for implementation of a noxious weed control program to protect *Spiranthes*, other species of concern as determined by WDFW and USFWS, or future listed species where *Spiranthes* needs are satisfied in the Rocky Reach Wildlife Area. Implementation of the program described in this subsection will be conducted by Chelan PUD personnel or other qualified personnel selected by the RRWF.

4.3.2 Spiranthes Monitoring

Chelan PUD shall make available $3,000 per year to qualified personnel selected by the RRWF, for the term of the New License and any subsequent annual licenses, for implementation of an annual *Spiranthes* (or other species should *Spiranthes* "requirements" be met) monitoring program and report. Funds may accumulate, if surveys are not conducted in any given year, to a maximum of $15,000. The "Ute Ladies' Tresses *Spiranthes diluvialis* Along Rocky Reach Reservoir Management Plan" will be used as a guideline for implementing the *Spiranthes* monitoring program (Chelan PUD, 2005). The results of the *Spiranthes* monitoring conducted under this section shall be included in the annual progress report prepared by Chelan PUD and the RRWF.

4.3.3 Conservation Easement

Chelan PUD shall enter into a contract with the Chelan-Douglas Land Trust, or other appropriate entity, to pursue acquisition of a conservation easement on a parcel of private land to protect an identified *Spiranthes* site. The total cost to Chelan PUD of acquiring a conservation easement under this subsection is not to exceed $160,000.

SECTION 5: LITERATURE CITED

Calypso Consulting. 1990. A botanical inventory and rare and sensitive plant survey of the Rocky Reach reservoir. Calypso Consulting, 2405 West Shore Drive, Lummi Island, Washington.

Calypso Consulting. 2000. A rare plant survey of the Rocky Reach reservoir -final, Rocky Reach Hydroelectric Project No. 2145. Prepared by Calypso Consulting, Bellingham, Washington, for Chelan PUD. December 15, 2000. 49 pp.

DES. 2000. RTE wildlife and cover-type mapping - final, Rocky Reach Hydroelectric Project No. 2145. Prepared by DES, Bellingham, Washington, for Chelan PUD. December 15, 2000. 138 pp.

Fielder, P. C. 1982. Food habits of bald eagles along the mid-Columbia River, Washington. Murrelet 63:46-50.

Fielder, P. C. 2003. Canada goose nesting 2003, Rock Island and Rocky Reach reservoirs. An annual report summarizing data from 1982 - 2003. Chelan PUD, Wenatchee, Washington.

Franklin, J. F., and C. T. Dyrness. 1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW 8. USFS, Portland.

Hallet, M. and P. C. Fielder. 2004. Memo regarding summary of meeting discussion by Paul Fielder and Marc Hallet to discuss Rocky Reach Dam mitigation funding needs to realistically achieve most basic WDF&W land management objectives for the Chelan wildlife lands.

Musser, J., N. Hedges, and D. St. George. 2004. Habitat enhancement considerations related to Rocky Reach re-license. Technical memo.

Myers, W. L. 2003. Observations of mule deer habitat use, movements, and survival in Chelan County, Washington. Prepared by WDFW for Chelan PUD. W. L. Myers, ed. June 6, 2003. 77 pp.

CHAPTER 8: ROCKY REACH HISTORIC PROPERTIES AND CULTURAL RESOURCES MANAGEMENT PLAN

In order to protect sensitive cultural information, Chelan PUD is requesting the Federal Energy Regulatory Commission place Chapter 8: Rocky Reach Historic Properties and Cultural Resources Management Plan in its non-public file. Chelan PUD is submitting one copy of Chapter 8 of Attachment B: Comprehensive Plan of the Rocky Reach Comprehensive Settlement Agreement under separate mailing to the Federal Energy Regulatory Commission.

This plan is available only with specific permission. Members of the public interested in requesting this plan may contact Chelan PUD's public information officer at the following address.

Public Information Officer
327 North Wenatchee Avenue
Wenatchee, WA 98801
(509) 663-8121

CHAPTER 9: ROCKY REACH RECREATION RESOURCES MANAGEMENT PLAN

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EXECUTIVE SUMMARY

The Recreation Resources Management Plan (RRMP) contained in this Chapter updates the existing Recreation Plan (Exhibit R to the existing License) submitted by Chelan PUD in 1976 in conjunction with the addition of four generating units to the Rocky Reach Hydroelectric Project (Project) dam powerhouse in 1968. It describes Chelan PUD's plans for the utilization, design, and development of Project recreation facilities and public access within the Project boundary, as required by 18 CFR 4.51 (f) (5). The RRMP was prepared in consultation with the Social Sciences Working Group (SSWG), comprised of appropriate local, state and federal recreation agencies and planning commissions, the National Park Service, the United States Department of Agriculture Forest Service, and other federal and state agencies with land management responsibilities within the Project boundary.

The SSWG identified Project impacts and developed proposed Protection, Mitigation, and Enhancement measures (PMEs) based on five primary considerations:

1) Ongoing Project-related impacts
2) Consistency with relicensing and other relevant recreation study results
3) Effectiveness of proposed measure
4) Cost (including cost-sharing opportunities)
5) The presence or absence of federal reservation lands giving rise to mandatory conditioning authority under section 4(e) of the Federal Power Act.

Chelan PUD shall implement the following PMEs, as specified in Section 4 of this Chapter:

1) Continued operation and maintenance of Rocky Reach Visitor Center and Park, Entiat Park, Chelan Falls/Powerhouse Park, Beebe Bridge Park, Daroga State Park and Lincoln Rock State Park.
2) Renovations and enhancements at Lincoln Rock State Park and Daroga State Park.
3) Completion of a paved one mile trail from Lincoln Rock State Park to a fish by-pass viewing station approximately 300 feet downstream of Rocky Reach Dam.
4) Design and implementation of an irrigation system throughout Orondo Park.
5) Revitalization of Entiat Park, including:
    5.1 Design and implement the Entiat Park upgrades.
    5.2 Wastewater treatment plant upgrade to accommodate usage of Park facilities.
    5.3 Design and construction of Entiatqua Trail.
    5.4 Lease/purchase of 9.32 shoreline acres currently owned by Chelan PUD to city of Entiat.
    5.5 Convene annual meetings with the community of Entiat.
6) Completion of an update of the Recreation Needs Forecast and Analysis in year 23 of the New License.
7) Development and implementation of Recreation Resources Monitoring and Evaluation Program.

SECTION 1: INTRODUCTION

1.1 Purpose

The Recreation Resources Management Plan (RRMP) contained in this chapter updates the existing Recreation Plan (Exhibit R to the existing License) submitted by Chelan PUD in 1976 in conjunction with the addition of four generating units to the Rocky Reach Hydroelectric Project (Project) dam powerhouse in 1968. It describes Chelan PUD's plans for the utilization, design, and development of Project recreation facilities and public access to the Project lands and waters, as required by 18 CFR 4.51(f)(5). The plan was prepared in consultation with appropriate local, state and federal recreation agencies and planning commissions, the National Park Service (NPS) and the United States Department of Agriculture Forest Service (USDA Forest Service) and other federal and state agencies with land management responsibilities within the Project boundary.

1.2 Exhibit R Summary

The 1976 Exhibit R identified seven sites within the Project boundary for recreational development. Three were completed by the Chelan PUD and opened to the public in the late 1970s, one in the 1980s and three in the 1990s. These recreation sites represent Chelan PUD's commitment to providing recreational facilities and access to the Rocky Reach Hydroelectric Project Reservoir (Reservoir). Over one million people visit these parks each year. As-built drawings of these sites are contained in Appendix A.

The seven sites are described below. The locations of these recreation sites, as well as other public recreation sites on the Reservoir, are shown on Figure 9-1.

Rocky Reach Visitor Center and Park

Located on the west side of the Dam, this Park provides several educational and interpretative opportunities for visitors. It consists of a four-story public information and tour center, landscaped grounds, fish viewing rooms and an innovative fish by-pass system, interpretive history gallery and turbine exhibit, picnic shelters, restrooms and playground equipment. The Park is owned and operated by Chelan PUD.

Orondo Park

Located 15 miles north of Rocky Reach Dam on the east side of the Reservoir, this Park was originally developed in the early 1970s. Under Exhibit R, additional lands were acquired, and the Park was expanded over several years to include irrigated lawns, a gazebo, swimming area, boat launch, day moorage, day-use area, restrooms, 14 RV camping sites and tent camping in a grassy area within the Park. This Park is owned in part by Chelan PUD and owned in part and operated by the Port of Douglas County.

Entiat Park

Entiat Park is located 15 miles north of Rocky Reach Dam on the west side of the Reservoir. Built in the 1970s, this Park was a result of the joining of two existing community parks, Silico Saska and Will Risk Memorial Park. This Park provides 4,000 feet of shoreline and includes a day-use picnic area, restrooms, boat launch and boat handling facilities. In addition, overnight tent camping, RV sites with partial hook-ups, and day moorage facilities are available. This Park is owned by Chelan PUD. It is operated by the City of Entiat.

Lincoln Rock State Park

This Park is located just north of the east side of the Dam. Beginning as a 17-acre site (called Eastbank in the 1976 Exhibit R), this Park was later expanded to 60 acres and re-named Lincoln Rock State Park. The Park offers 94 campsites with full and partial hookups, three picnic shelters, five restrooms, outdoor activity courts, swim area, boat launch and docking facilities and a multi-use play area. This Park is owned by Chelan PUD and operated by Washington Department of Parks and Recreation Commission (Washington State Parks).

Daroga State Park

Daroga Park is located 25 miles north of the Dam on the east side of the Reservoir. This Park's 140 acres offers facilities consisting of a camp loop with 28 camping units, 17 hike-in or boat-in camp units, and one large group camp area with a current capacity of 50 people. Partial hookups are provided for recreational vehicles. Other Park facilities include three picnic shelters, five restrooms, outdoor activity courts, multi-use sports field, shoreline trails, large landscaped day-use areas, wind surfing beach area, swim area, playground area, boat launching and docking facilities. This Park is owned by Chelan PUD and operated by Washington State Parks.

Chelan Falls/Powerhouse Park

This Park is located 34 miles north of the Dam on the west side of the Reservoir. The development of these sites provides a boat ramp, a boat dock, trails, an extensive day-use picnic area, restrooms, irrigated landscaping, two swim beaches and expansive playfields. This Park is owned and operated by Chelan PUD.

Beebe Bridge Park

This Park is located 34 miles north of the Dam on the east side of the Reservoir. Beebe Bridge Park provides two loops of overnight camping (46 units), full hook-ups for recreational vehicles, restrooms, guest parking, day-use and picnic facilities, swim beach, boat ramp, boat docks and irrigated landscaping. This Park is owned and operated by Chelan PUD.

1.3 Planning Process

The Federal Energy Regulatory Commission (FERC) alternative licensing process for the Project required extensive planning, including environmental studies, consultation with relevant agencies and organizations, and public involvement. This RRMP is the result of a five-year planning process undertaken by a Social Sciences Working Group (SSWG) consisting of the USDA Forest Service, NPS, Washington Department of Ecology (WDOE) Washington Department of Fish and Wildlife (WDFW), Interagency Committee for Outdoor Recreation (IAC), Washington State Parks, Bureau of Land Management (BLM), Entiat Focus Group, Entiat School District, Boat Club of Wenatchee, Columbia Breaks Fire Interpretative Center, Entiat Valley Chamber of Commerce, Trout Unlimited, City of Entiat, landowners along the Project boundary, Chelan PUD and other interested stakeholders.

The SSWG identified relicensing-related recreation issues, including the need for recreation use monitoring, a recreation needs analysis, and the development of recreation enhancement options. Agency and public involvement has been an integral part in the identification of recreation issues.

Early in the relicensing process, agencies, the public, and Chelan PUD developed an overall plan to gather information for the ultimate development of the RRMP. The SSWG developed individual study plans and scopes of work for the studies. Meetings, discussions, and reviews continued as the studies proceeded, allowing the SSWG to obtain further information and participate in the preparation of final study results and reports. The studies conducted as part of the relicensing process to assess and record recreational use at Reservoir recreation facilities and other related public recreational sites included the following:

- *1999/2000 Recreation Use Assessment Study Report*, March 2, 2001. This report provides the results of data collection efforts and surveys regarding existing recreational use. It was conducted during the summer and fall of 1999 and spring of 2000.

- *Recreation Needs Forecast and Analysis*, September 21, 2001. This report provides an analysis of the current and future recreation use, demand, and needs at public recreation sites along the Reservoir. The study was conducted in late 1999 and early 2000.

- *Socioeconomic Study*, December 1, 2000. This study documents historical and forecasted socioeconomic impacts associated with the Project's operation.

- *Project Lands Management Study Report*, May 30, 2003. This report summarizes applicable federal, state and local land management plans, identify conflicts or gaps critical to shoreline or land management practices and review the effectiveness of land management plans and shoreline master programs.

In addition, the following studies were also referenced and provided important information during development of the RRMP.

- *Recreation Resources Inventory Summary Report*, September 21, 2001
- *Sportsmans Access on the Wenatchee River*, December 15, 2000
- *Washington State Comprehensive Outdoor Recreation Planning Document* (SCORP) 2002-2005, October 2002

This RRMP is based on the results of these studies, as well as the extensive consultation effort undertaken through the SSWG. It is also consistent with the relevant recreation management planning documents prepared by federal, state, and other local recreation management agencies.

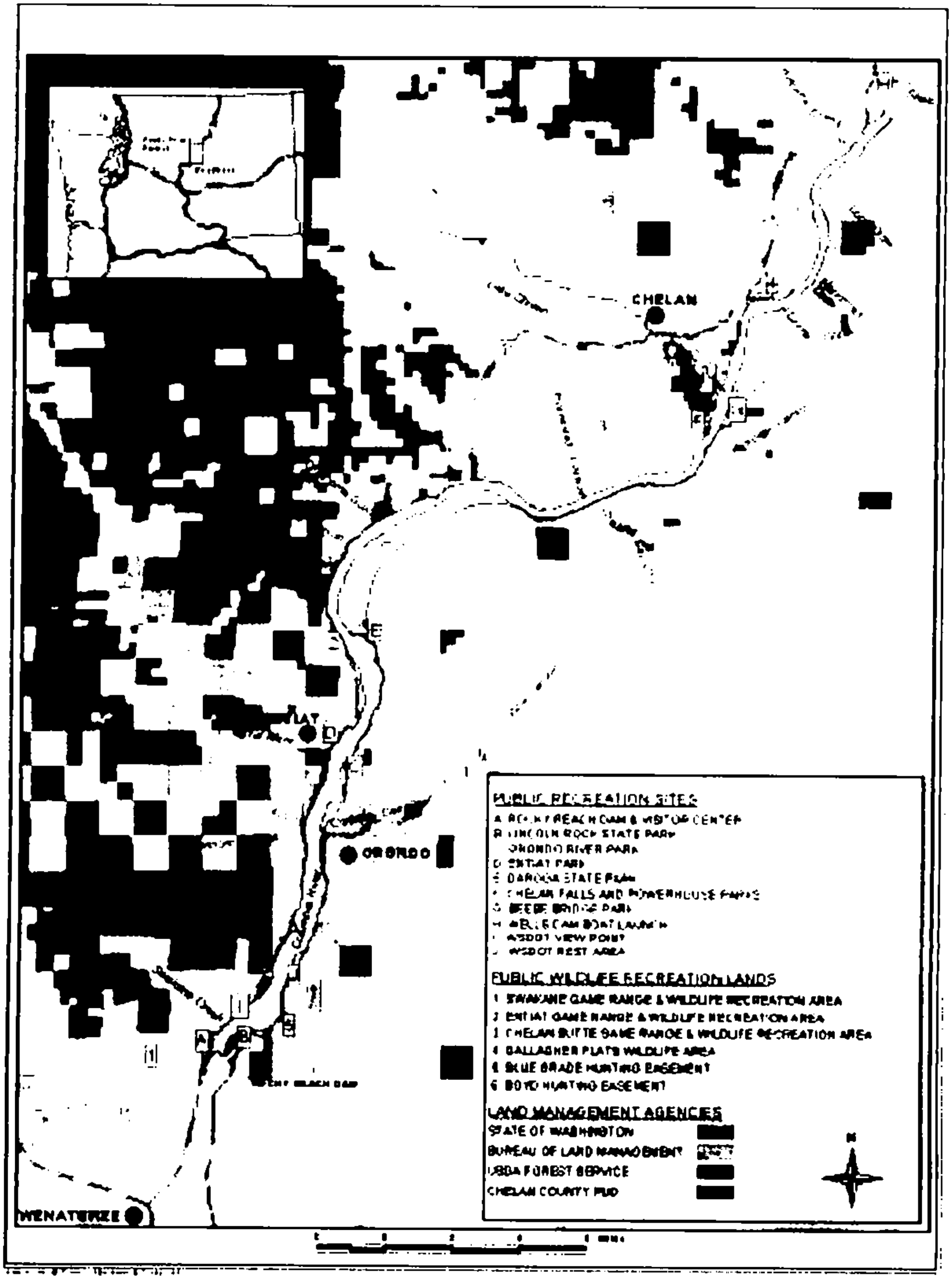


Figure 9-1: Public Recreation Sites and Designated Wildlife Recreation Lands

SECTION 2: BACKGROUND AND EXISTING CONDITIONS

2.1 Existing Recreation Development

2.1.1 Public Recreation Facilities

For each of the existing public recreation facilities shown on Figure 9-1, the facilities provided and site acreage is shown in Table 9-1.

Chelan PUD constructed seven public recreation sites that provide access to the Rocky Reach Hydroelectric Project Reservoir (Reservoir). All seven sites are adjacent to the Reservoir. All seven of these sites have irrigated lawns, hardened surfaces, paved trails, and flush toilets, and can accommodate a high level of use. In addition, some sites offer undeveloped and riparian areas.

Upstream of the Project is Douglas County PUD's Wells Dam. Douglas County PUD operates and maintains a boat launch at the tailrace of Wells Dam. This boat launch also provides access to the Reservoir.

2.1.2 Private Recreation Facilities

Few private recreation sites are available on the Reservoir, and none of the private facilities are open to the general public.

Wenatchee Boat Club

The Wenatchee Boat Club is located on the west bank of the Reservoir, upstream of the Rocky Reach Dam and Visitor Center and across the river from Turtle Rock Island. The marina is open to club members only. The marina has 24 boat moorage slips and four day-use boat slips. The marina site also has a boat launch and a small campground with 18 campsites.

Residential Subdivisions

Sun Cove, a residential development located on the east side of the Reservoir on US 97 between Daroga State Park and Beebe Bridge Park, has a park, boat launch, and boat moorage for use by property owners in the subdivision. The McDonald residential subdivision, north of Entiat, has a dock for use by subdivision property owners. Many private homes along the Reservoir have their own private docks.

2.1.3 Public Recreation Sites

Washington State Department of Transportation (WSDOT) has a viewpoint, located on the west side of the Reservoir just north of Rocky Reach Dam, on US 97A

2.1.4 Public Recreation Use Areas

The Washington State Department of Fish and Wildlife (WDFW), Bureau of Land Management (BLM), and USDA Forest Service own lands in the vicinity of the Reservoir that are managed for hunting, fishing access and other dispersed recreation. A description of these wildlife areas appears in Section 2.1.5 below. In addition, Section 2.1.6 summarizes dispersed recreation on non-park Chelan PUD-owned lands. No developed recreation facilities are located on these lands. For further information on designated wildlife recreation areas and dispersed recreation activities on the Reservoir, see the *Recreation Resources Inventory Summary Report* (September 21, 2001, Chelan PUD 2001b).

2.1.5 Wildlife Areas

The Swakane, Entiat and Chelan Butte Units (collectively the Chelan Wildlife Area) are located in Chelan County just west and northwest of the Reservoir. Under a 1963 agreement (1963 Agreement) with the Washington Department of Game (now WDFW) to mitigate for the effects of dam construction on wildlife, Chelan PUD provided $700,000 for mitigation, including the purchase of 20,397 acres of wildlife habitat. Per the 1963 Agreement, these lands are owned and managed by WDFW. In addition, WDFW has agreements with the US Bureau of Land Management (BLM) and State of Washington Department of Natural Resources (DNR) to coordinate management of approximately 10,000 acres of BLM and DNR lands intermingled with WDFW lands in the Chelan Wildlife Area. The lands are popular areas for hunting upland birds, deer and big horn sheep. Wildlife viewing is also popular.

The Swakane and Entiat Units together cover approximately 14,200 acres. The Swakane Unit is five miles north of Wenatchee, just west of Rocky Reach Dam and extends to the Entiat River. This area has approximately 25 miles of dirt roads, primitive, undeveloped campsites, and parking areas. Because this area is easily accessible, it is a very popular hunting area. The 1988 Dinkleman fire burned nearly all of the Swakane Unit, changing the habitat primarily to grass.

The Entiat Unit is located between the Navarre Coulee Road and Entiat River on US 97A. This area has approximately 35 miles of dirt roads, primitive, undeveloped campsites, and parking areas. Both areas are important winter range for mule deer and offer year-round habitat for upland game birds. Non-game species including birds and small mammals also inhabit the areas.

The Chelan Butte Unit is located between 25 Mile Creek Road on US 97A and Chelan Falls and extends to just outside of the town of Chelan on the south-facing slopes of Chelan Butte. The Chelan Butte Unit covers approximately 8,200 acres. This area has over 20 miles of dirt roads, primitive, undeveloped campsites, and parking areas. Chelan Butte Unit is also a popular hunting area. This area contains upland game habitat favorable for game birds including chukar, quail, grouse, and mourning doves. The area was burned in the 1994 Tyee fire.

A 173-acre parcel called Gallagher Flats was purchased by Chelan PUD, as part of the 1963 Agreement to mitigate Project impacts. Gallagher Flats is located upstream of Beebe Bridge, along the west bank of the Reservoir. These lands were subsequently exchanged by WDFW with WSDOT for other lands now contained in the Chelan Butte Unit.

Also as part of the 1963 Agreement, Chelan PUD acquired hunting easements on two privately owned areas for which WDFW has management responsibilities. These two sites are not located adjacent to the Reservoir but are mentioned here because they were included as part of the 1963 agreement to mitigate impacts resulting from construction of the Project. The Blue Grade hunting easement is located in Douglas County just east of Lincoln Rock State Park. The Boyd hunting easement is located in Chelan County, west of the Project and north of Lake Chelan.

Both of these areas are designated on WDFW maps as hunting easements, but are otherwise undeveloped.

Chelan PUD also purchased 22 fishing access easements on private lands along the Wenatchee River as part of the 1963 Agreement. These lands provide public stream bank accesses and fishing areas along the Wenatchee River as off-site mitigation for sports fishing access areas inundated by Project construction. These easements were deeded to WDFW and are located from the Wenatchee River mouth (located approximately five miles downstream of Rocky Reach Dam) upstream to approximately one mile below the City of Leavenworth. Some of these easements include parking, and others include only public access across private lands from the road to the shoreline and lands along the shoreline.

2.1.6 Other Chelan PUD Owned Lands Used for Dispersed Recreation

Chelan PUD-owned Turtle Rock Island is a 160-acre island located approximately two miles upstream from the Rocky Reach Dam. A small (less than one acre) sandy beach attracts boat-in visitors to the island. While no recreational facilities are located on the island, boat-in visitors use the beach for swimming and relaxing. Given the small size of the beach area, use is limited by the number of boats (approximately four to five) the beach can accommodate at one time. The island currently provides wildlife habitat, and is the site of a fish hatchery owned by Chelan PUD and operated by WDFW.

The Entiat River, at its confluence with the Columbia River, is used for dispersed recreation activities. Most of this area is owned by Chelan PUD. Several established trails leading to the Entiat River provide recreational access. Many people use these trails, visit the beach, and swim along the Reservoir shoreline adjacent to the mouth of the Entiat River.

2.1.7 Availability of Public Boat Launches on the Reservoir

The boat launches that provide public access to the Project are listed below, along with their current seasonal availability:

- Lincoln Rock State Park Boat Launch (March to October)
- Orondo River Park Boat Launch (May to September)
- Entiat Park Boat Launch (Mid-April to Mid-October)
- Daroga State Park Boat Launch (March to October)
- Chelan Falls Boat Launch (Open year-round)
- Beebe Bridge Park Boat Launch (Early April to November)
- Douglas Co. PUD Boat Launch (Open year-round)

2.1.8 Trails Near the Reservoir

Developed designated trails are located within public recreation sites developed by Chelan PUD:

- Rocky Reach Dam Site, 0.45 mile
- Lincoln Rock State Park, 1.3 miles
- Daroga State Park, 2.5 miles

- Chelan Falls and Powerhouse Parks, 0.2 mile
- Beebe Bridge Park, 0.6 mile

Numerous additional trails also exist in the vicinity of the Project, including:

- The Columbia Breaks Fire Interpretive Center Foundation has developed a 1/2 mile interpretive trial, "Trail of Fire and Forest," located on the west side of Highway 97A, at the north end of the town of Entiat. The interpretive trail was designed to explain various elements of fire history, fire suppression and fire ecology. The graveled self-guided loop interpretive trail currently passes two historic lookouts and has twelve numbered stations highlighting interpretive messages that are described in the trail brochure. The trail goes through the 18-acre future site of the proposed Columbia Breaks Fire Interpretive Center and amphitheater.

- The Apple Capital Recreation Loop Trail located in Wenatchee and East Wenatchee, just south of the Project, traverses more than 10 miles of Columbia River shorelines. The trail has three bridges - two over the Columbia River and one spanning the Wenatchee River. Wenatchee Confluence State Park is located near the northwest end of the Apple Capital Recreation Loop Trail.

- Entiat River Valley, located west of the Reservoir, has many multiple use trails that can be accessed from the Entiat Valley Road off of Highway 97A.

- Badger Mountain, located several miles east of the Reservoir, also has many hiking and mountain biking trails.

2.1.9 Existing Recreation Use Sites near the Reservoir

During development of the *Recreation Resource Inventory Summary Report*, the Social Sciences Working Group (SSWG) decided that the inventory should include descriptions of public recreation facilities at the lower end of Wells Hydroelectric Project, upstream of the Reservoir, and at the upper end of Rock Island Hydroelectric Project, downstream of the Reservoir. In addition, the USDA Forest Service requested that it include descriptions of USDA Forest Service recreation sites in the Entiat River Valley, west of the Reservoir. These recreation use sites are described in the *Recreation Resource Inventory Summary Report*.

2.2 Existing Recreational Use

Recreation sites along the Reservoir provide facilities for a variety of recreation activities, such as camping, fishing, picnicking, boating, walking, swimming, field sports, tennis, basketball, horseshoes, and playground activities.

The *1999/2000 Recreational Use Assessment Study Report* (March 2, 2001, Chelan PUD 2001c) estimated average daily use by activity at the seven Chelan PUD-developed recreation sites on the Project Table 9-2 summarizes the estimated average daily use by activity for the peak, fall, and spring seasons. Field data was collected in the peak-season, from Memorial Day weekend through Labor Day weekend of 1999 and 2000. Off-season data collection was conducted in the fall months of mid-September through October 1999 and in the spring months of April and May

2000. Data was collected by Chelan PUD, Washington State Parks, Port of Douglas County, the City of Entiat and other recreation facility managers within the study area. Additional methods used for assessing daily use included observation, license plate monitoring, boat counts, on-site interviews and written surveys.

During the peak-season monitoring (most peak-season use is during July and August), camping had the greatest use followed by picnicking, walking and boating. During the fall-season monitoring, camping showed the greatest use followed by visits to the dam and the visitor center. Picnicking had the highest visitor use followed by camping during spring-season monitoring. As can be seen from Table 9-2, significantly more daily visitor use occurred during peak-season monitoring (1999) than during the fall- and spring-season monitoring. More visitor use occurred during fall-season monitoring (1999) than during spring-season monitoring (2000).

2.3 Existing Recreation Facilities and Physical Capacity

Collectively, existing facilities on the Reservoir include 397 acres of developed recreational land, 213 RV sites, 100 tent sites, 4 RV dump sites, 13 picnic shelters, 11 boat launch lanes, 19 boat docks, 250 boat trailer parking spaces, 408 picnic tables, 170 toilets, 1,975 linear feet of swimming beaches, and 4.69 miles of trails/walkways. The facilities all have restrooms with showers, and a variety of amenities such as picnic shelters with power, amphitheatres, landscaping and lawns, RV and tent camp sites, RV dump stations and concession buildings. Table 9-1 summarizes the existing facilities at the recreation sites in the Project study area. With the exception of Orondo Park, Entiat Park, and Lincoln Rock State Park, these facilities were mostly developed during the early 1990s. The following reviews existing camping, boating, and non-boating day-use facilities in the project study area and the physical capacities of these facilities. Further comparisons of visitor use and facility capacity are provided in the *Recreation Needs Forecast and Analysis* (September 21, 2001, Chelan PUD 2001a).

2.3.1 Camping

Existing Facilities

Five out of the seven recreation sites in the study area have camping facilities. These include Lincoln Rock State Park, Orondo River Park, Entiat Park, Daroga State Park, and Beebe Bridge Park. These sites have a total of 292 campsites and 2 group sites (Table 9-1).

As explained in the *1999/2000 Recreation Use Assessment Study Report*, during the 1999 monitoring, the City of Entiat allowed a maximum of 50 tent sites in the day-use area; this number is included in the 292 campsite total. Due to limited capacity of the Entiat sewer treatment facility, Entiat Park reduced the number of tent sites allowed in the day-use area to 25 in 2001.

Physical Capacity

Use estimates of the number of people camping at recreation sites were based on the number of campsites occupied multiplied by a factor of five people per campsite. The number of occupied group camping areas at Daroga State Park was multiplied by 50 people per group sites, since they each have a capacity of 50 people per site. In this way a direct comparison can be made regarding campsite occupancy whether or not numbers of campsites or numbers of people are used. Using the above multipliers, the capacity of campgrounds at Rocky Reach Project campgrounds was 1,560 people per day/night in 1999, when peak-season monitoring was conducted. Since the allowed number of tent sites at Entiat Park has been reduced from 50 to 25 tent sites, the current (2001) There are currently 248 tent/RV sites and 17 group camping sites. Reservoir campground capacity is 2,090 people per night.

2.3.2 Boating

Existing Facilities

Six out of the seven parks on the Reservoir have boating facilities. Rocky Reach Dam and Visitor Center is the only recreation site that does not have boating facilities. There are a total of 11 launch lanes, 19 boat tie-up docks, and 250 boat trailer parking spaces at the six recreation sites. Orondo Park has a marina with marine gas available Table 9-1). Douglas County PUD operates and maintains a boat launch at the tailrace of Wells Dam. This boat launch provides access to the Rocky Reach Reservoir but is located within the Wells Project boundary; therefore it is not evaluated in detail or included in the *Recreation Resources Inventory Summary Report*. The site consists of a one-lane boat launch and about six boat trailer parking spaces. There is additional parking along the dirt access road. Portable restrooms are placed at the site in the summer. Unlike the other boat launches on the Reservoir, the Wells Dam boat launch is used mainly by locals and by walleye and steelhead anglers. Due to the swift currents near the site, relatively few other recreation boaters use this launch, although some water skiers have used the launch but need to motor down river. Parking in the designated parking area fills up on some weekends and evenings, but there is generally always additional boat trailer parking space along the dirt access road (pers. comm. G. Brett, Douglas County PUD, March 2001).

Physical Capacity

Reservoir recreation sites have the capacity to accommodate 440 boats or 1,320 people per day, using Bureau of Reclamation (BOR) general design standards for boat launches of 40 boats per launch lane per day and three persons per boat. Currently there are 250 boat trailer parking spaces at recreation sites in the project study area.

Using a turnover rate of two, it can be estimated that approximately 500 vehicles per day can park at publicly owned boat launch facilities. Using an average of three people per car, it can be estimated that public boat launch parking can accommodate approximately 1,500 people per day.

2.3.3 Non-Boating Day-Use Activities

All seven public recreation sites in the study area have day-use facilities (Table 9-1). The following summarizes day-use parking, picnic, beach, trails and other day-use facilities provided on the Reservoir and discusses the physical capacity of day-use facilities.

Parking Facilities

Currently, there are 918 day-use parking spaces on the Reservoir recreation sites. Currently there is day-use parking available on the Reservoir to accommodate approximately 5,500 people per day. This estimate is based on the number of day-use parking spaces, multiplied by an average of three people per vehicle and a turnover rate of two per day.

Picnic Facilities
Currently there are approximately 438 picnic tables at Reservoir recreation sites. The existing picnic tables have capacity for approximately 3,504 people per day using general design standards of four people per table and a turnover rate of two per day.

Swimming/Sunbathing (Beach) Facilities
A total of 1,975 linear feet of swimming beaches is provided at Reservoir recreation sites. Assuming an average beach width of 50 feet, it is estimated that approximately 2.4 acres of swimming beaches are available at Reservoir recreation sites. The current swimming beaches on the Reservoir have capacity for approximately 1,056 people per day using general design standards of 220 people per acre and a turnover rate of two per day for swimming beaches.

Trails
Reservoir recreation sites currently have a total of over five miles of developed trails/walkways. The existing trails/walkways at Reservoir recreation sites are assumed to have the capacity for 450 people per day using National Recreation and Park Administration (NRPA) general standards for trails of 90 people per day per mile.

Other Day-Use Facilities
Six of the seven Reservoir recreation sites provide playground equipment. Additional facilities, such as horseshoe pits, baseball fields, volleyball courts, tennis courts, basketball courts, and open court areas are provided at all sites, although available facilities vary from site to site (Table 9-1). The Rocky Reach Dam Site has a visitor center and museum, and provides concessions, tours of the dam and fish bypass system, and fish viewing opportunities.

2.3.4 Park Acreage

The majority of park visitors are not from the local Chelan/Douglas County region, but it would not be appropriate to plan for parks at Rocky Reach Project recreational facilities based on the population of the Seattle Metropolitan area. Currently, there are not standards available that provide recommendations related to the number of park acres per number of park visitors.

City and County park planners generally use standards for planning city and regional parks. For instance, National Recreation and Park Administration standards for regional parks include 5-10 acres per 1,000 population. However, this is based on the population of the region that is accommodated by the park.

2.4 Social Capacity

Recreation site capacity is based on the physical capacity of existing facilities and design standards as described above, as well as social capacity. Social capacity refers to visitors' perceptions of crowding and conflict, as well as visitor attitudes towards recreation sites and their recreation experience. On-site surveys conducted at Reservoir recreation sites in 1999 included questions intended to determine the social capacity of Project recreation sites. Visitors were generally satisfied with the recreation sites along the Reservoir and in the activities that they participated in during their visit. Less than 2 percent of those responding indicated that "fewer people" would have made their experience better. Results of the visitor survey are provided in the *1999/2000 Recreational Use Assessment Study Report*. Further evaluation of survey responses in regards to social capacity is presented in the *Recreation Needs Forecast and Analysis*.

2.5 Accessible Facilities

Facilities with barrier-free access exist at all Reservoir recreation sites. Projects are currently underway to improve accessibility at Orondo River Park. Additional accessible facilities will also be provided at all Reservoir recreation sites as existing facilities are improved or replaced.

2.6 Socioeconomics

The community of Entiat is located on the west side of the Project reservoir in Chelan County. The downtown core of Entiat had to be relocated to accommodate the initial development and inundation of the Rocky Reach Hydroelectric Project. When the Project began operations, Chelan PUD compensated land owners that were affected by dam construction and subsequent reservoir inundation. In addition, Chelan PUD provided infrastructure in upland areas of the town site. Chelan PUD paid a total of approximately $3.1 million during 1956-1961 in compensation to property owners in the area adjacent to the Columbia River. Chelan PUD also provided planning assistance to the city of Entiat during this period. In addition, Chelan PUD made payments for legal assistance and infrastructure development totaling approximately $426,000.

Relocation of the downtown core of Entiat changed the character and the economic welfare of the community during subsequent decades. A detailed analysis of the impact of the Project on the city of Entiat and Entiat School District No. 127 is provided in the appendix of the Socioeconomic Study Report (McHugh, 2000).

Table 9-1: Existing Facilities at Public Recreation Sites in Project Study Area

Site	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming Beach	Trails/ Walk-ways	Interpretation Facilities	ADA Facilities*
Rocky Reach Dam and Visitor Center	38	No	20 picnic tables, 2 shelters formal gardens, visitor center, museum, playground equipment 2 horseshoe pits 3 restrooms 217 parking spaces	No	No	0.45 mi.	Yes	Yes
Lincoln Rock State Park	65	94 RV/tent spaces RV dump	166 picnic tables, 3 shelters, amphitheater, playground equipment, 1 baseball field 2 volleyball courts 2 tennis courts 2 basketball courts 3 horseshoe pits 1 open court area concession building 6 restrooms 44 toilets/ 12 showers 148 day-use parking spaces	3 launch lanes 6 tie up docks 102 boat trailer parking spaces	175 linear feet	.94 mi.	No	Yes
Orondo River Park	5	14 RV tent sites Grassy area: 10-15 tents	14 picnic tables, 1 shelter 1 volleyball court 1 horseshoe pit 1 restroom 4 toilets 4 showers 22 day-use parking spaces	1 launch lane 3 tie up docks marina overnight moorage 14 boat trailer parking spaces	225 linear feet	No	No	ADA improvements are in process

Table 9-1: Existing Facilities at Public Recreation Sites in Project Study Area

Site	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming Beach	Trails/ Walk-ways	Interpretation Facilities	ADA Facilities*
Entiat Park	40	31 RV sites 50 tent sites allowed (1991) in day-use area (25 tents allowed in 2001)	108 picnic tables, 1 shelter playground equipment 1 volleyball court 2 horseshoe pits 3 restrooms/12 toilets/4 showers 43 day-use parking spaces	1 launch lane 2 tie up docks 17 boat trailer parking spaces	250 linear feet	No	Museum	Yes
Daroga State Park	140	28 RV/tent campsites - 17 boat/walk-in tent sites 2 group camping areas (capacity 100 people) RV dump station	75 picnic tables, 3 shelters playground equipment 1 baseball field 1 soccer field tennis courts 2 basketball courts 1 open court area 4 restrooms/38 toilets/12 showers 114 day-use parking spaces	2 launch lanes 3 tie up docks 76 boat trailer parking spaces	475 linear feet	2.5 miles	No	Yes
Chelan Falls and Powerhouse Parks	53	No	11 picnic tables + 16 in 2 shelters playground equipment 2 softball fields 1 soccer field 2 volleyball courts 1 tennis court 1 basketball court 2 horseshoe pits 2 open court areas 3 restrooms 24 toilets/4 showers 178 parking spaces	2 launch lanes 2 tie up docks 25 boat trailer parking spaces	375 linear feet	0.2 mile	No	Yes

Table 9-1: Existing Facilities at Public Recreation Sites in Project Study Area

Site	Acres	Camping	Picnic & Day-Use Facilities	Boating Facilities	Swimming Beach	Trails/ Walk-ways	Interpretation Facilities	ADA Facilities*
Beebe Bridge Park	56	46 RV/tent sites	14 picnic tables + 14 in 1 shelter playground equipment 1 baseball field 1 soccer field 1 volleyball court 2 tennis courts 1 open court area 3 restrooms/24 toilets 6 showers 196 day-use parking spaces	2 launch lanes 3 tie up docks 16 boat trailer parking spaces	475 linear feet	0.6 mile	No	Yes

* Additional ADA facilities information is available through Chelan PUD Parks Department and Washington State Parks.

Table 9-2: Estimated Average Daily Use by Activity at Public Recreation Sites

Activity	Peak-Season '99/00 May 30 – Sept 9 (Avg. # People/Day)	Fall-Season'99 Sept 10 – Oct 31 (Avg. # People/Day)	Spring-Season '00 April 1 – May 26 (Avg. # People/Day)
Camping	863	371	186
Boating	298	34	14
Visiting Dam/Visitor Center	245	231	180
Shore Fishing	2	0	3
Visiting Beach/Sunbathing	117	0	23
Swimming/Wading	99	0	10
Nature Study Photo	3	0	14
Gathering/Collecting	0	0	0
Hang gliding	8	0	8
Walking	336	227	117
Hiking	0	0	0
Backpacking	0	0	0
Skating	5	0	14
Jogging	50	0	0
Picnicking	598	183	261
Off-road vehicle riding	0	11	0
Bicycling on-road	8	5	29
Bicycling off-road	98	40	0
Sightseeing	185	30	13
Using playgrounds	210	13	50
Group Activity	213	0	84
Other Activity	159	356	129
Total:	3497	1501	1135

SECTION 3: STUDIES AND RECREATION DEMAND, FACILITY NEEDS AND RESOURCE CAPACITY

This section provides information regarding existing and projected future recreation use and demands based on field monitoring, population projections, and existing recreation-related studies and planning documents. Demand for recreation facilities on the Rocky Reach Hydroelectric Project Reservoir (Reservoir) is assessed by projecting recreation visitation based on existing conditions and future growth rates. Recreation planning documents and surveys conducted on the Reservoir also provide information regarding recreation-related activity demands and trends.

3.1 Existing Recreation Use at Public Recreation Sites

As discussed in the *1999/2000 Recreation Use Assessment Study Report*, estimated visitor use for Project recreation sites was calculated using several types of data. The following represents visitor use data based on 1999 and 2000 data collection and monitoring efforts. Refer to the above report or the *Recreation Needs Forecast and Analysis* for further information.

Visitor Use at Recreation Sites

Table 9-3 shows the estimated visitor use at Reservoir recreation sites based on 1999/2000 monitoring efforts. Estimated visitor use at each recreation sites is broken out into camping, boating and non-boating activities.

Seven developed public recreation sites were monitored during the summer and fall of 1999 and the spring of 2000. Based on field monitoring and data collection efforts an average of almost 3,500 people per day visited developed recreation sites on the Reservoir during the peak-season. An estimated average of 1,500 people per day visited developed recreation sites on the Project during the fall-season, and an estimated average of 1,135 people per day visited developed public recreation sites on the Reservoir during the spring-season.

Visitor Use by Activity

Table 9-4 provides a summary of the estimated average number of people per day that participate in different activity categories at the seven developed public recreation sites on the Project.

As shown in Table 9-4, during the peak-season (July and August had the highest use), camping facilities received the most visitor use followed by picnicking. Boating was the third most popular activity on weekends, whereas, on weekdays walking was third and boating had the fourth highest use.

During the fall-season, camping had the highest average use followed by other activities then visiting the dam/visitor center. On fall weekdays, other activities had the highest use followed by camping, whereas on weekends camping had the highest use followed by other activities.

During spring-season monitoring, picnicking had the highest average visitor use followed by camping, then visiting the dam/visitor center. On spring weekdays other activities had the highest use followed by visiting the dam/visitor center and then picnicking, whereas on weekends picnicking had the highest use followed by camping then visiting the dam/visitor center.

3.2 Existing Watercraft Activity and Dispersed Use

Watercraft activity and shoreline activity or dispersed use is described in Section 5.2.1 of the *1999/2000 Recreation Use Assessment Study Report.*

Watercraft Activity

Table 9-5, summarizes the average number of watercraft observed during boat-run surveys on the Reservoir. This information was gathered from Memorial Day, 1999 through Labor Day, 2000. As can be expected, most of the watercraft use occurs during peak season weekends and the majority of watercraft observed during all seasons were motorized.

Based on peak-season observations, an average of 42.5 watercraft were observed per day during weekday boat runs and an average of 101.5 watercraft were observed per day during weekend boat runs. Most watercraft activity was spread out between the north end of Turtle Rock Island and Beebe Bridge. Motorized boats made up nearly 70 percent of the peak-season watercraft use on the Reservoir. Personal watercraft (jet skis) made up 29 percent, non-motorboats made up one percent, and airplanes and windsurfers made up less than one percent of the watercraft use.

No watercraft were observed during fall-season weekday boat runs and only five watercraft were observed during the weekend boat run. Watercraft observed on the weekend boat run were between Orondo Park and Beebe Bridge. All watercraft observed were motorboats.

During the spring-season weekday boat run, only two watercraft were observed, one between the north end of Turtle Rock Island and Orondo River Park and the other between Daroga State Park and Beebe Bridge. During the spring-season weekend boat run, a total of 12 watercraft were observed. These included three motorized watercraft between Rocky Reach Dam and Turtle Rock Island, eight motorized watercraft, between Orondo River Park and Beebe Bridge, and one non-motorized watercraft between Rocky Reach Dam and the north end of Turtle Rock island. Two out of the 11 motorized watercraft observed were jet skis.

Dispersed Shoreline Use

Table 9-6 summarizes the average number of people observed on undeveloped shorelines of the Reservoir. Almost all dispersed shoreline activity occurred during the peak season with most activity on weekends.

During peak-season boat runs, an average of 34 people were observed on weekdays and an average of 64.5 people were observed on weekends at undeveloped shorelines along the Reservoir. Activities observed during peak-season boat runs were mostly swimming/visiting the beach, and some shore angling and other shore activity. Most dispersed shoreline use was observed at a beach on Chelan PUD owned Turtle Rock Island and on mostly private and some state, Chelan PUD and the Bureau of Land Management (BLM) owned undeveloped shorelines between Daroga State Park and Beebe Bridge. A few people were observed on the Entiat River Sandbar, located at the mouth of the Entiat River, and along undeveloped shorelines.

Undeveloped shorelines include those privately owned and owned by Chelan PUD and managed by the Washington State Department of Fish and Wildlife (WDFW) between Beebe Bridge and Wells Dam.

No people were observed along undeveloped shorelines during 1999 fall-season weekend and weekday boat runs.

During the spring-season, only one person was observed shore angling along undeveloped shorelines between Rocky Reach Dam and the north end of Turtle Rock Island. No people were observed along undeveloped shorelines during spring-season weekend boat runs.

3.3 Estimated Growth

National and state studies indicate that as populations grow, demand for recreation opportunities will also grow. Estimated growth in recreation in the vicinity of the Project, based on this premise, can be determined from population forecasts and growth rates for the location of visitors to Reservoir recreation sites. The location of visitors was determined based on the 1999 and 2000 surveys and documentation of vehicle license plate numbers. During surveys at recreation sites, people were asked where they were from. During car runs, observers documented license plate numbers of vehicles at recreation sites and Washington State Department of Licensing provided county of origin for each vehicle license plate number. The percentages of peak-, fall- and spring- season visitors who came from different areas are shown, respectively, Table 9-7, Table 9-8 and Table 9-9. The annual population growth rates for each area, weighted average based on the percentage of people and the growth rate for each area are also shown. Currently significant growth is occurring along the Reservoir.

The following sections provide demand projections for recreation sites and activity based on population growth. In actuality, a number of other factors can influence recreation demand such as demographics and age of populations, economics, technology, etc. For instance, over the last ten years the Hispanic population around the Project has more than doubled with an increase from 1990 to 1999 of almost 118 percent and 107 percent for Chelan and Douglas counties, respectively. In comparison, Washington State's Hispanic population has increased by 66 percent over the same period of time. These increases in the vicinity of the Project can affect different use patterns. For example, according to a study done by USDA Forest Service research staff member Dr. Deborah Chavez, Hispanics recreate with their immediate and extended families, which require additional group facilities. In addition, Spanish-speaking staff and Spanish signs allow Hispanic visitors to feel more welcome and may contribute to increasing use of facilities. Aging baby boomers can result in needs for different facilities, such as Americans with Disabilities Act facilities. Trends toward larger motor homes and boats can have an impact on facility needs. Increases in fuel prices can also impact different types of recreation activity demands. Results of these other factors are not always easy to predict especially for many years out into the future.

3.4 Growth Projections for Recreation Sites and Activity in Project Area

During the twenty-year period from 2000 to 2020, the following types of growth have been projected for recreation sites and activities in the Reservoir:

- Total average number of people per day during the peak-season is estimated to grow by almost 1,325 additional visits (see Table 9-10 for a breakdown by site and Table 9-11 for a breakdown by activity);
- Total average number of people per day during the fall-season is estimated to grow by almost 545 additional visits (see Table 9-12 for a breakdown by site and Table 9-13 for a breakdown by activity);
- Total average number of people per day during the spring-season is estimated to grow by almost 420 additional visits (see Table 9-14 for a breakdown by site and Table 9-15 for a breakdown by activity);
- Estimated physical capacities of recreation sites, based on the number of campsites and parking spaces, are also shown on Table 9-10, Table 9-12 and Table 9-14 for comparison with estimated current and future use.
- The average number of peak-season watercraft is estimated to grow by an average of 15 additional watercraft on weekdays and 35 additional watercraft on weekends (See Table 9-16);
- The average number of fall-season watercraft is estimated to grow by an average of almost two additional watercraft on weekends (See Table 9-17);
- The average number of spring-season watercraft is estimated to grow by an average of less than 1 additional watercraft on weekdays and almost 4.5 additional watercraft on weekends (See Table 9-18);
- The average number of peak season dispersed activity along Reservoir shorelines is estimated to grow by an average of 12 additional people on weekdays and just over 23 additional people on weekends (See Table 9-19);
- The average number of spring-season dispersed activity along Reservoir shorelines is estimated to grow by an average of less than one person (See Table 9-20).

Growth projections were calculated using annual weighted averages of the population growth rates for the various locations from which visitors come during each season. (See Table 9-7, Table 9-8, and Table 9-9). The projections were also based on the premise that as populations grow, demands for recreation opportunities grow correspondingly, assuming demand can be met, but that emphasis may change by activity. For example, according to Interagency Committee for Outdoor Recreation (IAC), there is a current decrease in camping, fishing and hunting and an increase in walking activities.

Existing planning documents and studies have identified potential recreation development opportunities that can accommodate additional facilities to satisfy the projected increases in demand. Comments were also received during development of the *Recreation Needs Forecast and Analysis* related to potential recreation development opportunities in the Project Area. Potential recreation development and expansion opportunities identified in the Project Area include the following: campground expansion opportunities, Entiat Park revitalization, trail expansions and/or additions and educational and interpretive sign development.

Table 9-3: Estimated Average Daily Use Rocky Reach Recreation Sites[1]

SITE	Peak-Season (1999) May 30 – Sept 9 Average # People/Day			Fall (1999) Sept 10 – Oct 31 Average # People/Day			Spring (2000) April 1 – May 26 Average # People/Day		
	Avg. Peak	Week-day	Week-end[2]	Avg. Fall	Week-day	Week-end[2]	Avg. Spring	Week-day	Week-end[2]
Rocky Reach Dam Recreation Facilities and Visitor Center (Day-Use):	568	530	660	331	305	390	359	335	425
Lincoln Rock State Park:									
Camping/Overnight:	337	285	455	215	185	285	124	100	170
Boating:	89	72	132	15	0	54	7	0	24
Non-Boating Day-Use:	552	458	773	256	255	256	172	165	196
Orondo River Park									
Camping/Overnight:	63	50	90	8	5	15	14	10	20
Boating:	20	19	25	2	0	12	0	0	0
Non-Boating Day-Use:	131	101	205	23	10	53	17	15	30
Entiat Park:									
Camping/Overnight[3]:	RV 59 Tent 56	RV 43 Tent 42	RV 92 Tent 88	All 40	All 25	All 80	All 2	All 0	All 5
Boating:	55	42	90	4	0	12	3	0	12
Non-Boating Day-Use:	244	183	390	107	80	163	50	10	153
Daroga State Park:									
Camping/Overnight (Group):	69	55	97	12	0	38	0	0	0
Camping/Overnight (Other):	120	97	175	58	40	95	34	25	49
Boating:	60	54	78	8	6	15	2	0	6
Non-Boating Day-Use:	285	256	352	83	69	110	101	85	149
Chelan Falls Powerhouse Parks:									
Boating:	6	5	8	0	0	0	1	0	2
Non-Boating Day-Use:	281	250	352	115	100	145	122	115	148
Beebe Bridge Park:									
Camping/Overnight:	159	135	210	38	25	75	12	8	20
Boating:	68	60	90	5	0	21	1	0	2
Non-Boating Day-Use:	275	220	405	181	180	179	114	110	128
TOTAL	3497	2957	4767	1501	1285	1998	1135	978	1539

1 Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
2 Weekend refers to Friday and Saturday nights for camping/overnight and Saturday and Sunday for day-use.
3 Differentiation between RV and tent camping at Entiat Park during peak-season based on on-site surveys. No data available to separate fall- and spring-season RV and tent camping.

Table 9-4: Rocky Reach Project Recreation Sites - Estimated Average Daily Use By Activity

Activity	Peak-Season (1999) May 30 – Sept 9 Average # People/Day			Fall (1999) Sept 10 – Oct 31 Average # People/Day			Spring (2000) April 1 – May 26 Average # People/Day		
	All Days*	Weekday	Weekend	All Days*	Week-day	Week-end	All Days*	Week-day	Week-end
Camping	863	707	1207	371	280	588	186	143	264
Boating	298	252	423	34	6	114	14	0	46
Visiting Dam/Visitor Center	245	220	302	231	214	273	180	161	234
Shore Fishing	2	3	1	0	0	0	3	2	6
Visiting Beach/Sunbathing	117	90	176	0	0	0	23	10	50
Swimming/Wading	99	67	174	0	0	0	10	4	20
Nature Study/Photography	3	4	0	0	0	0	14	24	0
Hang Gliding	8	4	14	0	0	0	8	0	16
Walking	336	338	330	227	259	162	117	97	159
Skating	5	2	10	0	0	0	14	17	10
Jogging	50	58	34	0	0	0	0	0	0
Picnicking	598	450	945	183	131	260	261	160	498
Off-road vehicle riding	0	0	0	11	15	6	0	0	0
Bicycling on-road	8	8	7	5	2	8	29	17	40
Bicycling off-road	98	94	108	40	34	56	0	0	0
Sightseeing	185	180	200	30	8	76	13	6	20
Using Playgrounds	210	225	175	13	0	44	50	82	30
Group Activity	213	127	415	0	0	0	84	84	83
Other activity	159	128	246	356	336	411	129	171	63
Total:	3497	2957	4767	1501	1285	1998	1135	978	1539

*Based on 1999/2000 data collection and field monitoring. *Refer to Recreation Use Assessment Study Report* (Chelan PUD, 2001c)

Table 9-5: Average # Watercraft Observed

Type of Watercraft	Peak-Season (2000) May 30 – Sept 9 Average # Watercraft Observed per Day		Fall (1999) Sept 10 – Oct 31 # Watercraft Observed per Day		Spring (2000) April 1 – May 26 # Watercraft Observed per Day	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Motorboat angling	1.5	6	0	2	0	0
Motorboat skiing/tubing	11.5	34	0	2	0	6
Motorboat other/unidentified	15	32	0	1	2	3
Jetskis	13.5	28	0	0	0	2
Airplanes	0.5	0	0	0	0	0
Non-motorboat angling	0	0	0	0	0	0
Non-motorboat other	0.5	1	0	0	0	1
Windsurfers	0	0.5	0	0	0	0
Total:	42.5	101.5	0	5	2	12
Based on 1999/2000 instantaneous counts by boat. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)						

Table 9-6: Average Dispersed Shoreline Activity Observed

Activity	Peak-Season (2000) May 30 – Sept 9 Average # People Observed per Day		Fall (1999) Sept 10 – Oct 31 # People Observed per Day		Spring (2000) April 1 – May 26 # People Observed per Day	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Angling	0	4.5	0	0	1	0
Swimming/Visiting Beach	34	59.5	0	0	0	0
Other Shore Activity	0	0.5	0	0	0	0
Total:	34	64.5	0	0	1	0
Based on 1999/2000 instantaneous counts by boat. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)						

Table 9-7: Population Weighting Factors for Estimating Recreation-Use Projections (Peak-Season)

Area	% of People from each area (column a)	Annual Growth Rate of Population[1] (column b)*	Weighted Annual Average (a) x (b)
Chelan/Douglas Counties	21%	1.62	0.34%
Seattle Metro Area[2]	61%	1.49	0.91%
Other Washington Counties	17%	1.64	0.27%
Other U.S. States	1%	0.89	0.01%
British Columbia, Canada	0%	1.09	0.00%
Weighted Average			1.54%

[1] Based on 1999-2020 projections provided by Washington OFM
[2] Includes King, Snohomish, Kitsap, Pierce, and Thurston counties
* Annual population growth rates for each area are based on a weighted average: percentage of people vs the growth rate for each area show.

Table 9-8: Population Weighting Factors for Estimating Recreation-Use Projections (Fall-Season)

Area	% of People from each area (column a)	Annual Growth Rate of Population[1] (column b)*	Weighted Annual Average (a) x (b)
Chelan/Douglas Counties	26%	1.69	0.44%
Seattle Metro Area[2]	45%	1.4	0.63%
Other Washington Counties	21%	1.58	0.33%
Other U.S. States	6%	0.89	0.05%
British Columbia, Canada	2%	1.09	0.02%
Weighted Average			1.48%

[1] Based on 1999-2020 projections provided by Washington OFM
[2] Includes King, Snohomish, Kitsap, Pierce, and Thurston counties
* Annual population growth rates for each area are based on a weighted average: percentage of people vs the growth rate for each area show.

Table 9-9: Population Weighting Factors for Estimating Recreation-Use Projections (Spring-Season)

Area	% of People from each area (column a)	Annual Growth Rate of Population[1] (column b)*	Weighted Annual Average (a) x (b)
Chelan/Douglas Counties	30%	1.73	0.52%
Seattle Metro Area[2]	40%	1.55	0.62%
Other Washington Counties	21%	1.71	0.36%
Other U.S. States	5%	0.89	0.04%
British Columbia, Canada	4%	1.09	0.04%
Weighted Average			1.58%

[1] Based on 1999-2020 projections provided by Washington OFM
[2] Includes King, Snohomish, Kitsap, Pierce, and Thurston counties
* Annual population growth rates for each area are based on a weighted average: percentage of people vs the growth rate for each area show.

Table 9-10: Projected Peak-Season Visitation at Rocky Reach Project Recreation Sites[1]

RECREATION SITES	Est.[2] Daily Capacity	Average 1999 # People/Day			Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
		AD	WD	WE	AD	WD	WE	AD	WD	WE	AD	WD	WE
Rocky Reach Dam Recreation Facilities and Visitor Center (Day-Use):	1,190	568	530	660	577	538	670	672	627	780	782	731	910
Lincoln Rock State Park:													
Camping/Overnight:	470	337	285	455	342	289	462	399	337	538	465	393	627
Boating:	612	89	72	132	90	73	134	105	85	156	123	99	182
Non-Boating Day-Use:	888	552	458	773	561	465	785	653	542	915	761	631	1066
Orondo River Park:													
Camping/Overnight:	130	63	50	90	64	51	91	75	59	106	87	69	124
Boating:	84	20	19	25	20	19	25	24	22	30	28	26	34
Non-Boating Day-Use:	132	131	101	205	133	103	208	155	119	243	181	139	283
Entiat Park:													
Camping/Overnight RV:	155	59	43	92	60	44	94	70	51	109	81	59	127
1999 Tent[3]	250	56	42	88	57	43	89	66	50	104	77	58	121
2001 Tent[3]:	125												
Boating:	102	55	42	90	56	43	91	65	50	106	76	58	124
Non-Boating Day-Use:	258	244	183	390	248	186	396	289	217	461	336	252	538
Daroga State Park:													
Camping/Overnight (Group):	100	69	55	97	70	56	99	82	65	115	95	76	134
Camping/Overnight (Other):	225	120	97	175	122	98	178	142	115	207	165	134	241
Boating:	456	60	54	78	61	55	79	71	64	92	83	74	108
Non-Boating Day-Use:	684	285	256	352	289	260	358	337	303	416	393	353	485
Chelan Falls/Powerhouse Parks:													
Boating:	150	6	5	8	6	5	8	7	6	9	8	7	11
Non-Boating Day-Use:	1,068	281	250	352	285	254	358	332	296	416	387	345	485
Beebe Bridge Park:													
Camping/Overnight:	230	159	135	210	161	137	213	188	160	248	219	186	289
Boating:	96	68	60	90	69	61	91	80	71	106	94	83	124
Non-Boating Day-Use:	1176	275	220	405	279	223	411	325	260	479	379	303	558
TOTAL	8,581	3497	2957	4767	3550	3003	4840	4137	3499	5636	4820	4076	6571

1 Based on 1999 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
2 Estimated capacity is measure of physical capacity based on number of campsites & parking spaces.
3 During 1999 monitoring, 50 tent sites in the day-use area were allowed. The number of tent sites allowed has been reduced to 25 in the day-use area in 2001.
Legend: AD = All-Days; WD – Weekdays; WE = Weekends

Table 9-11: Projected Peak-Season Visitation by Activity at Rocky Reach Project Recreation Sites

ACTIVITY	Average 1999 # People/Day			Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
	AD	WD	WE	AD	WD	WE	AD	WD	WE	AD	WD	WE
Camping	863	707	1207	876	718	1226	1021	836	1428	1190	975	1664
Boating	298	252	423	303	256	430	353	298	500	411	347	583
Visiting Dam/Visitor Center	245	220	302	249	223	307	290	260	357	338	303	416
Shore Fishing	2	3	1	2	3	1	2	4	1	3	4	1
Visiting Beach/Sunbathing	117	90	176	119	91	179	138	106	208	161	124	243
Swimming/Wading	99	67	174	100	68	177	117	79	206	136	92	240
Nature Study/Photography	3	4	0	3	4	0	4	5	0	4	6	0
Hang Gliding	8	4	14	8	4	14	9	5	17	11	6	19
Walking	336	338	330	341	343	335	398	400	390	463	466	455
Skating	5	2	10	5	2	10	6	2	12	7	3	14
Jogging	50	58	34	51	59	34	59	69	40	69	80	47
Picnicking	598	450	945	607	457	959	707	532	1118	824	620	1303
Off-road vehicle riding	0	0	0	0	0	0	0	0	0	0	0	0
Bicycling on-road	8	8	7	8	8	7	9	9	8	11	11	10
Bicycling off-road	98	94	108	100	95	110	116	111	128	135	130	149
Sightseeing	185	180	200	187	183	203	219	213	237	255	248	276
Using Playgrounds	210	225	175	213	228	178	248	266	207	289	310	241
Group Activity	213	127	415	216	129	421	252	150	491	294	175	572
Other activity	159	128	246	161	130	250	188	151	291	219	176	339
Total of All Activities	3497	2957	4767	3549	3001	4841	4136	3496	5639	4820	4076	6572

Based on 1999 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: AD = All-Days; WD = Weekdays; WE = Weekends

Table 9-12: Projected Fall-Season Visitation at Rocky Reach Project Recreation Sites[1]

RECREATION SITES	Est.[2] Daily Capacity	Average 1999 # People/Day			Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
		AD	WD	WE	AD	WD	WE	AD	WD	WE	AD	WD	WE
Rocky Reach Dam Recreation Facilities & Visitor Center (Day-Use):	1,190	331	305	390	336	310	396	389	358	458	451	415	531
Lincoln Rock State Park:													
Camping/Overnight:	470	215	185	285	218	188	289	253	217	335	293	252	388
Boating:	612	15	0	54	15	0	55	18	0	63	20	0	74
Non-Boating Day-Use:	888	256	255	256	260	259	260	301	300	301	349	347	349
Orondo River Park:													
Camping/Overnight:	130	8	5	15	8	5	15	9	6	18	11	7	20
Boating:	84	2	0	12	2	0	12	2	0	14	3	0	16
Non-Boating Day-Use:	132	23	10	53	23	10	54	27	12	62	31	14	72
Entiat Park:													
Camping/Overnight 1999[3]:	405	40	25	80	41	25	81	47	29	94	54	34	109
Camping/Overnight 2001[3]	280												
Boating:	102	4	0	12	4	0	12	5	0	14	5	0	16
Non-Boating Day-Use:	258	107	80	163	109	81	165	126	94	192	146	109	222
Daroga State Park:													
Camping/Overnight (Group):	100	12	0	38	12	0	39	14	0	45	16	0	52
Camping/Overnight (Other):	225	58	40	95	59	41	96	68	47	112	79	54	129
Boating:	456	8	6	15	8	6	15	9	7	18	11	8	20
Non-Boating Day-Use:	684	83	69	110	84	70	112	98	81	129	113	94	150
Chelan Falls/Powerhouse Parks:													
Boating:	150	0	0	0	0	0	0	0	0	0	0	0	0
Non-Boating Day-Use:	1,068	115	100	145	117	101	147	135	118	170	157	136	197
Beebe Bridge Park:													
Camping/Overnight:	230	38	25	75	39	25	76	45	29	88	52	34	102
Boating:	96	5	0	21	5	0	21	6	0	25	7	0	29
Non-Boating Day-Use:	1176	181	180	179	184	183	182	213	212	210	246	245	244
TOTAL	8,736	1501	1285	1998	1524	1304	2027	1765	1510	2348	2044	1749	2720

1 Based on 1999 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
2 Estimated capacity is measure of physical capacity based on number of campsites & parking spaces.
3 During 1999 monitoring, 50 tent sites in the day-use area were allowed. The number of tent sites allowed has been reduced to 25 in the day-use area in 2001.
Legend: AD = All-Days; WD = Weekdays; WE = Weekends

Table 9-13: Projected Fall-Season Visitation by Activity at Rocky Reach Project Recreation Sites

ACTIVITY	Average 1999 # People/Day			Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
	AD	WD	WE	AD	WD	WE	AD	WD	WE	AD	WD	WE
Camping	371	280	588	376	284	597	436	329	690	505	381	801
Boating	34	6	114	35	6	116	40	7	134	46	8	155
Visiting Dam/Visitor Center	231	214	273	234	217	277	272	252	321	314	291	372
Shore Fishing	0	0	0	0	0	0	0	0	0	0	0	0
Visiting Beach/Sunbathing	0	0	0	0	0	0	0	0	0	0	0	0
Swimming/Wading	0	0	0	0	0	0	0	0	0	0	0	0
Nature Study/Photography	0	0	0	0	0	0	0	0	0	0	0	0
Hang Gliding	0	0	0	0	0	0	0	0	0	0	0	0
Walking	227	259	162	230	263	164	267	304	190	309	353	221
Skating	0	0	0	0	0	0	0	0	0	0	0	0
Jogging	0	0	0	0	0	0	0	0	0	0	0	0
Picnicking	183	131	260	186	133	264	215	154	306	249	178	354
Off-road vehicle riding	11	15	6	11	15	6	13	18	7	15	20	8
Bicycling on-road	5	2	8	5	2	8	6	2	9	7	3	11
Bicycling off-road	40	34	56	41	35	57	47	40	66	54	46	76
Sightseeing	30	8	76	30	8	77	35	9	89	41	11	103
Using Playgrounds	13	0	44	13	0	45	15	0	52	18	0	60
Group Activity	0	0	0	0	0	0	0	0	0	0	0	0
Other activity	356	336	411	361	341	417	418	395	483	485	457	560
Total of All Activities	1501	1285	1998	1522	1304	2028	1764	1510	2347	2043	1748	2721

Based on 1999 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: AD = All-Days; WD = Weekdays; WE = Weekends

Table 9-14: Projected Spring-Season Visitation at Rocky Reach Project Recreation Sites

RECREATION SITES	Est.[2] Daily Capacity	Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
		AD	WD	WE	AD	WD	WE	AD	WD	WE
Rocky Reach Dam Recreation Facilities & Visitor Center (Day-Use).	1,190	359	335	425	420	392	497	491	458	582
Lincoln Rock State Park:										
Camping/Overnight:	470	124	100	170	145	117	199	170	137	233
Boating:	612	7	0	24	8	0	28	10	0	33
Non-Boating Day-Use:	888	172	165	196	201	193	229	235	226	268
Orondo River Park:										
Camping/Overnight:	130	14	10	20	16	12	23	19	14	27
Boating:	84	0	0	0	0	0	0	0	0	0
Non-Boating Day-Use:	132	17	15	30	20	18	35	23	21	41
Entiat Park:										
Camping/Overnight 1999[3]:	405	2	0	5	2	0	6	3	0	7
Camping/Overnight 2001[3]	280									
Boating:	102	3	0	12	4	0	14	4	0	16
Non-Boating Day-Use:	258	50	10	153	58	12	179	68	14	209
Daroga State Park:										
Camping/Overnight (Group):	100	0	0	0	0	0	0	0	0	0
Camping/Overnight (Other):	225	34	25	49	40	29	57	47	34	67
Boating:	456	2	0	6	2	0	7	3	0	8
Non-Boating Day-Use:	684	101	85	149	118	99	174	138	116	204
Chelan Falls/Powerhouse Parks:										
Boating:	150	1	0	2	1	0	2	1	0	3
Non-Boating Day-Use:	1,068	122	115	148	143	135	173	167	157	203
Beebe Bridge Park:										
Camping/Overnight:	230	12	8	20	14	9	23	16	11	27
Boating:	96	1	0	2	1	0	2	1	0	3
Non-Boating Day-Use:	1176	114	110	128	133	129	150	156	151	175
TOTAL	8,736	1135	978	1539	1326	1145	1798	1552	1339	2106

1 Based on 2000 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)

2 Estimated capacity is measure of physical capacity based on number of campsites & parking spaces.

3 During 1999 monitoring, 50 tent sites in the day-use area were allowed. The number of tent sites allowed has been reduced to 25 in the day-use area in 2001.

Legend: AD – All-Days; WD = Weekdays; WE – Weekends

Table 9-15: Projected Spring-Season Visitation by Activity Rocky Reach Project Recreation Sites

ACTIVITY	Average 2000 # People/Day			Average 2010 # People/Day			Average 2020 # People/Day		
	AD	WD	WE	AD	WD	WE	AD	WD	WE
Camping	186	143	264	218	167	309	254	196	361
Boating	14	0	46	16	0	54	19	0	63
Visiting Dam/Visitor Center	180	161	234	211	188	274	246	220	320
Shore Fishing	3	2	6	4	2	7	4	3	8
Visiting Beach/Sunbathing	23	10	50	27	12	58	31	14	68
Swimming/Wading	10	4	20	12	5	23	14	5	27
Nature Study/Photography	14	24	0	16	28	0	19	33	0
Hang Gliding	8	0	16	9	0	19	11	0	22
Walking	117	97	159	137	113	186	160	133	218
Skating	14	17	10	16	20	12	19	23	14
Jogging	0	0	0	0	0	0	0	0	0
Picnicking	261	160	498	305	187	583	357	219	681
Off-road vehicle riding	0	0	0	0	0	0	0	0	0
Bicycling on-road	29	17	40	34	20	47	40	23	55
Bicycling off-road	0	0	0	0	0	0	0	0	0
Sightseeing	13	6	20	15	7	23	18	8	27
Using Playgrounds	50	82	30	58	96	35	68	112	41
Group Activity	84	84	83	98	98	97	115	115	114
Other activity	129	171	63	151	200	74	177	234	86
Total of All Activities	1135	978	1539	1327	1143	1801	1552	1338	2105

Based on 2000 Monitoring. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: AD = All-Days; WD = Weekdays; WE = Weekends

Table 9-16: Projected Peak-Season Watercraft Activity

ACTIVITY	Average 2000 # Watercraft/Day		Average 2010 # Watercraft/Day		Average 2020 # Watercraft/Day	
	WD	WE	WD	WE	WD	WE
Motorboat angling	1.5	6	2	7	2	8
Motorboat skiing/tubing	11.5	34	13	40	16	46
Motorboat other/unidentified	15	32	17	37	20	43
Personal water craft (jetskis)	13.5	28	16	33	18	38
Airplanes	0.5	0	0.6	0	0.7	0
Non-motorboat angling	0	0	0	0	0	0
Non-motorboat other	0.5	1	0.6	1	0.7	1
Windsurfers	0	0.5	0	0.6	0	0.7
Total of All Activities	42.5	101.5	49.2	118.6	57.4	136.7
Based on 2000 boat run observations. Refer to *Recreation Use Assessment Study Report* **Legend:** WD = Weekdays; WE = Weekends						

Table 9-17: Projected Fall-Season Watercraft Activity

ACTIVITY	Average 1999 # Watercraft/Day		Average 2000 # Watercraft/Day		Average 2010 # Watercraft/Day		Average 2020 # Watercraft/Day	
	WD	WE	WD	WE	WD	WE	WD	WE
Motorboat angling	0	2	0	2	0	2.4	0	2.7
Motorboat skiing/tubing	0	2	0	2	0	2.4	0	2.7
Motorboat other/unidentified	0	1	0	1	0	1.2	0	1.4
Personal water craft (jetskis)	0	0	0	0	0	0	0	0
Airplanes	0	0	0	0	0	0	0	0
Non-motorboat angling	0	0	0	0	0	0	0	0
Non-motorboat other	0	0	0	0	0	0	0	0
Windsurfers	0	0	0	0	0	0	0	0
Total of All Activities	0	5	0	5	0	6	0	6.8
Based on 1999 boat run observations. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c) **Legend:** WD = Weekdays; WE = Weekends								

Table 9-18: Projected Spring-Season Watercraft Activity

ACTIVITY	2000 Average # Watercraft/Day		2010 Average # Watercraft/Day		2020 Average # Watercraft/Day	
	WD	WE	WD	WE	WD	WE
Motorboat angling	0	0	0	0	0	0
Motorboat skiing/tubing	0	6	0	7	0	8
Motorboat other/unidentified	2	3	2.3	4	2.7	4
Personal water craft (jetskis)	0	2	0	2	0	3
Airplanes	0	0	0	0	0	0
Non-motorboat angling	0	0	0	0	0	0
Non-motorboat other	0	1	0	1.2	0	1.4
Windsurfers	0	0	0	0	0	0
Total of All Activities	2	12	2.3	14.2	2.7	16.4

Based on 2000 boat run observations. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: WD = Weekdays; WE = Weekends

Table 9-19: Projected Peak-Season Dispersed Shoreline Activity

ACTIVITY	Average 2000 # People/Day		Average 2010 # People/Day		Average 2020 # People/Day	
	WD	WE	WD	WE	WD	WE
Angling	0	4.5	0	5	0	6
Swimming/Visiting Beach	34	59.5	40	69	46	81
Other Shore Activity	0	0.5	0	0.6	0	0.7
Total of All Activities	34	64.5	40	74.6	46	87.7

Dispersed shoreline activity includes activities along undeveloped shorelines.
Based on 2000 boat run observations. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: WD = Weekdays; WE = Weekends

Table 9-20: Projected Spring-Season Dispersed Shoreline Activity

ACTIVITY	Average 2000 # People/Day		Average 2010 # People/Day		Average 2020 # People/Day	
	WD	WE	WD	WE	WD	WE
Angling	1	0	1.2	0	1.4	0
Swimming/Visiting Beach	0	0	0	0	0	0
Other Shore Activity	0	0	0	0	0	0
Total of All Activities	1	0	1.2	0	1.4	0

Dispersed shoreline activity includes activities along undeveloped shorelines.
Based on 2000 boat run observations. Refer to *Recreation Use Assessment Study Report* (Chelan PUD, 2001c)
Legend: WD = Weekdays; WE = Weekends

SECTION 4: PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

Based on the efforts of the Social Sciences Working Group (SSWG), this section provides for operation and maintenance of existing recreation facilities on the Reservoir to ensure public access and recreational use of Project lands and waters, as well as additional facilities and access to Project lands. The following describes the proposed Protection, Mitigation and Enhancement measures (PMEs) for recreation and provides costs and a schedule for the implementation of such actions.

The SSWG identified project impacts and recreation enhancement measures based on the studies referred to in Section 1.3 of this Chapter. Proposed PMEs were identified based on five primary considerations:

1. Ongoing Project-related impacts.
2. Consistency with relicensing and other relevant recreation study results.
3. Effectiveness of proposed measure.
4. Cost (including cost-sharing opportunities).
5. The presence or absence of federal reservation lands giving rise to mandatory conditioning authority under section 4(e) of the Federal Power Act.

4.1 Ownership, Operation and Maintenance of Existing Parks

Seven parks currently exist within the Project boundary. Chelan PUD built these parks, or portions of these parks, as part of Exhibit R of the original license. Three parks are fully owned and operated by Chelan PUD (Rocky Reach Visitor Center and Park, Chelan Falls/Powerhouse Park, and Beebe Bridge Park). Two parks, Lincoln Rock State Park and Daroga State Park, were built and are owned by Chelan PUD but are operated and maintained by Washington State Parks through an agreement with the Washington Parks and Recreation Commission. One park, Orondo Park, was built in part and is owned in part by Chelan PUD. Douglas County Port, which owns most of Orondo Park, operates and maintains it. Entiat Park was built and is owned by Chelan PUD. The city of Entiat operates and maintains the Park in partnership with Chelan PUD.

For the term of the New License and any subsequent annual licenses, Chelan PUD shall continue to ensure the operation and maintenance of Rocky Reach Park and Visitor Center, Beebe Bridge Park, Lincoln Rock State Park, Daroga State Park, Entiat Park, and Chelan Falls/Powerhouse Park. Chelan PUD shall continue to ensure the operation and maintenance of the portion of Orondo Park that it owns.

4.2 Renovation and Enhancement of Lincoln Rock State Park and Daroga State Park

Within one year of the effective date of the New License, Chelan PUD shall begin implementation of the renovation and enhancement of Lincoln Rock State Park and Daroga State Park that shall include feasibility, finalization of design, development of a schedule, and determination of costs based on conceptual plans outlined in Appendices B and C. Chelan PUD shall provide for major renovation of, and minor improvements to, existing facilities and enhancements in either or both of these parks, which could include, but are not limited to, group camping (an area of the park set aside for groups to camp together in tents, RVs) and convenience camping (small cabins with windows, a door, sleeping bunks, and electricity, but no water or sewer).

Renovation and enhancements to the parks will be undertaken in phases, with a timeline for completion of each phase. Some renovation and enhancement components shall occur based on the level of use of existing facilities. The first phase of renovation and enhancement projects shall be accomplished within five years of the effective date of the New License.

Chelan PUD shall obtain approval from the Washington State Parks and/or other operator(s) of Lincoln Rock State Park and Daroga State Park in the development of the renovation and enhancement plan and prior to any revisions to the plan. Should the management contract with Washington State Parks to operate and maintain Lincoln and/or Daroga State Parks be terminated, Chelan PUD shall make other enhancements to these parks and/or other PUD parks on the Rocky Reach Reservoir based on a renovation and enhancement plan that would be developed by Chelan PUD with recommendations from the Rocky Reach Recreation Forum. Chelan PUD shall also consider recommendations or findings contained in the most recent Washington State SCORP document, and the 1999/2000 *Recreation Use Assessment Study Report* and *Recreation Needs Forecast and Analysis Report.*

Chelan PUD shall complete the projects outlined in Appendices B and C or spend $6 million, whichever comes first.

Final design, implementation schedule and costs shall be submitted to FERC for final approval before implementation.

4.3 Trail Link from Lincoln Rock State Park to a Fish Bypass Viewing Station

Washington State Parks has worked with Chelan PUD on the development of a five mile recreational/educational/interpretive trail that will extend from Odabashian Bridge (three miles south of the Reservoir) to Lincoln Rock State Park.

Within 180 days of the effective date of the New License or upon notification from State Parks that it has obtained all necessary permits, whichever comes later, Chelan PUD shall make available to Washington State Parks $500,000 to construct a paved one mile trail on land owned by Chelan PUD, from Lincoln Rock State Park to a fish by-pass viewing station located approximately 300 feet downstream of Rocky Reach Dam. Trail construction includes interpretive signs, benches, and other trail amenities. If Washington State Parks completes trail construction for less than $500,000, Chelan PUD, in consultation with the RRRF, shall make the remaining money available for the renovation and/or construction of other interpretive trails within the Project boundary.

4.4 Design and Construction of an Upgraded Irrigation System throughout Orondo Park

Within 180 days of the effective date of the New License, Chelan PUD shall begin design and construction of an upgraded irrigation system in Orondo Park for an amount not to exceed

$25,000. Chelan PUD shall not be responsible for the operation and maintenance of the irrigation system. Upon completion, the upgraded irrigation system shall be owned, operated, and maintained by the Port of Douglas County.

4.5 Revitalization of Entiat Park

Chelan PUD met with the City of Entiat along with other stakeholder representatives within the Rocky Reach Relicensing Social Science Working Group (SSWG) from August of 1999 to October 2003. In the spring of 2002, conversations began with the City of Entiat regarding PMEs relating directly to the City of Entiat and its surrounding area. These meetings were held with PUD staff and the City of Entiat steering committee, which included city officials, chamber and school district representatives, and community members. In October 2002, the first of four community meetings was held. The purpose of those meetings was to gather input from the community about their master plan for the City of Entiat, recommendations for park enhancements and for PUD staff to better understand the impacts of the Project on the City of Entiat. Working with the community, Chelan PUD developed a list of those things to be evaluated when developing an Entiat Revitalization Plan. (See Appendix E).

Within one year of the effective date of the New License, Chelan PUD shall begin development of the Entiat Park Revitalization Plan. As part of the development of the plan, Chelan PUD shall gather additional community input and create final design, including an implementation schedule, and submit it to FERC for final approval before implementation begins.

Chelan PUD's responsibilities under the Entiat Park Revitalization Plan shall include contributing $8.5 million toward the following measures, to be initiated within one year of the effective date of the New License. If one or more of the activities in subsections 4.5.1 through 4.5.3 of this section is completed using less than the full amount of funding designated for such activity, the remaining money shall be made available for another activity designated in subsections 4.5.1 through 4.5.3 of this section.

4.5.1 Entiat Park Upgrades

Chelan PUD shall design and implement Entiat Park upgrades based on community input at a cost of $6 million.

4.5.2 Wastewater Treatment Plant Upgrades

Chelan PUD shall make available to the City of Entiat $1.3 million for upgrades to the Entiat wastewater treatment plant to serve the needs of the Park.

4.5.3 Entiatqua Trail Link

Chelan PUD shall design and construct a trail linking the Entiat River Outdoor Learning Center (Entiatqua) at the confluence of the Entiat and Columbia Rivers to Entiat Park at a cost of $1.2 million.

4.5.4 Entiat Lease/Purchase Option Agreement

Chelan PUD shall lease 9.32 acres of shoreline land owned by Chelan PUD to the City of Entiat, with an option to purchase such land in 2012.

4.5.5 Annual Community Meeting

During the term of the New License and any subsequent annual licenses, Chelan PUD shall convene a community meeting annually, in coordination with the City of Entiat and the Entiat School District. The purpose of such meeting is to provide ongoing opportunities for community members to ask questions about Chelan PUD activities, receive updates on the implementation of the RRMP and on the partnership activities outlined in Section 4.5 of this Chapter.

4.6 Update Recreation Use Assessment and Recreation Needs Forecast and Analysis

Beginning in year 20 of the New License, and finishing in year 23, Chelan PUD shall update the Recreation Use Assessment and Recreation Needs Forecast and Analysis, in consultation with the RRRF, and prepare a report assessing recreational use and needs as well as an analysis of impacts on wildlife within the Project boundary, at a cost of $100,000. The scope of work will be similar to the scope contained in the *1999/2000 Recreation Use Assessment and the 2001 Recreation Needs Forecast and Analysis*.

The purpose of the recreation use, forecast and analysis is to update information about the level of existing recreational use within the Project boundary in more detail than is possible to predict 20 years in advance, including the number of visits, recreational activity types, high use locations, and temporal trends and impacts on wildlife.

As part of the recreation use, forecast and analysis, data shall be collected in years 21 and 22 of the New License on recreation use within the Project boundary, and a *Recreation Use, Needs Forecast and AnalysisReport* shall be completed in year 23 of the New License. The study area will include all public recreational resources within the Project boundary. The recreation use, needs forecast and analysis will include, but is not limited to:

- Review of existing recreation resources assessment work
- Summary of current management plans and policies of agencies
- Inventory of existing public and private recreation resources
- Analysis of recreational activities and demand for facilities
- Analysis of recreational resource capacity for recreation development
- Recreation resource mapping
- Analysis of wildlife impacts resulting from recreational use of the reservoir. This analysis shall be done in coordination with the Rocky Reach Wildlife Forum.
- Community meetings that allow time for public comment regarding recreational uses and needs

Chelan PUD and the RRRF will evaluate the results of the Recreation Use, Needs Forecast and Analysis along with the findings contained in the most recent Washington State SCORP document. Chelan PUD and the RRRF will also review the Recreation Resources Management Plan for its adequacy in contributing to meeting the recreation needs within the Project boundary and, if necessary, revise it to accommodate the updated recreation needs and priorities identified by the use, needs, forecast and analysis and the SCORP document. The revised plan will be submitted to FERC for final approval before implementation.

4.7 Recreation Resources Monitoring and Evaluation Program

Every six years throughout the life of the New License and any subsequent annual licenses, Chelan PUD, in consultation with the RRRF, shall review and evaluate information with respect to existing and potential recreational use within the Project boundary including on BLM lands. A report shall be submitted to FERC consistent with FERC Form 80 requirements.

In addition this information will be provided by the RRRF to Chelan PUD's communication department for use in its ongoing comprehensive information and education programs.

Immediately following the submittal of the FERC Form 80 as required by FERC every six years, Chelan PUD and the RRRF, shall review and evaluate the information from the FERC Form 80 document along with the findings contained in the most recent Washington State SCORP document. Chelan PUD and RRRF will also review the Recreation Resources Management Plan for its adequacy in contributing to meeting the recreation needs within the Project boundary and, if necessary, revise it to accommodate the updated recreation needs and priorities identified by these documents. The revised plan will be submitted to FERC for final approval before implementation.

A FERC technical conference/meeting was held October 19, 2005 on the Rocky Reach relicensing draft environmental impact statement, whereby FERC provided advice to the Rocky Reach Settlement Group on the types of measures FERC is likely to accept in a comprehensive settlement agreement. During that meeting, FERC advised the Rocky Reach Settlement Group that the proposed Recreation Enhancement Fund contained terms that FERC may not adopt, such as a pool of money not attributable to specific projects and funding for projects outside the Rocky Reach Project boundary.

As recommended by FERC, the proposal was modified to include a six year monitoring and evaluation program within the Rocky Reach Project boundary whereby projects to address recreation needs would be considered (e.g. a river trail, a railroad corridor trail and/or a permanent landing for hang gliders.) All projects would be subject to approval by Chelan PUD Commissioners and FERC.

SECTION 5: LITERATURE CITED

Chelan PUD, 2000(a). Socioeconomic Study – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145, Chelan PUD, Wenatchee, Washington. December 1, 2000.

Chelan PUD, 2000(b). Sportsmans Access on the Wenatchee River – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145. Chelan PUD, Wenatchee, Washington. December 15, 2000.

Chelan PUD, 2001(a). Recreation Needs Forecast and Analysis – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145. Chelan PUD, Wenatchee, Washington. September 21, 2001.

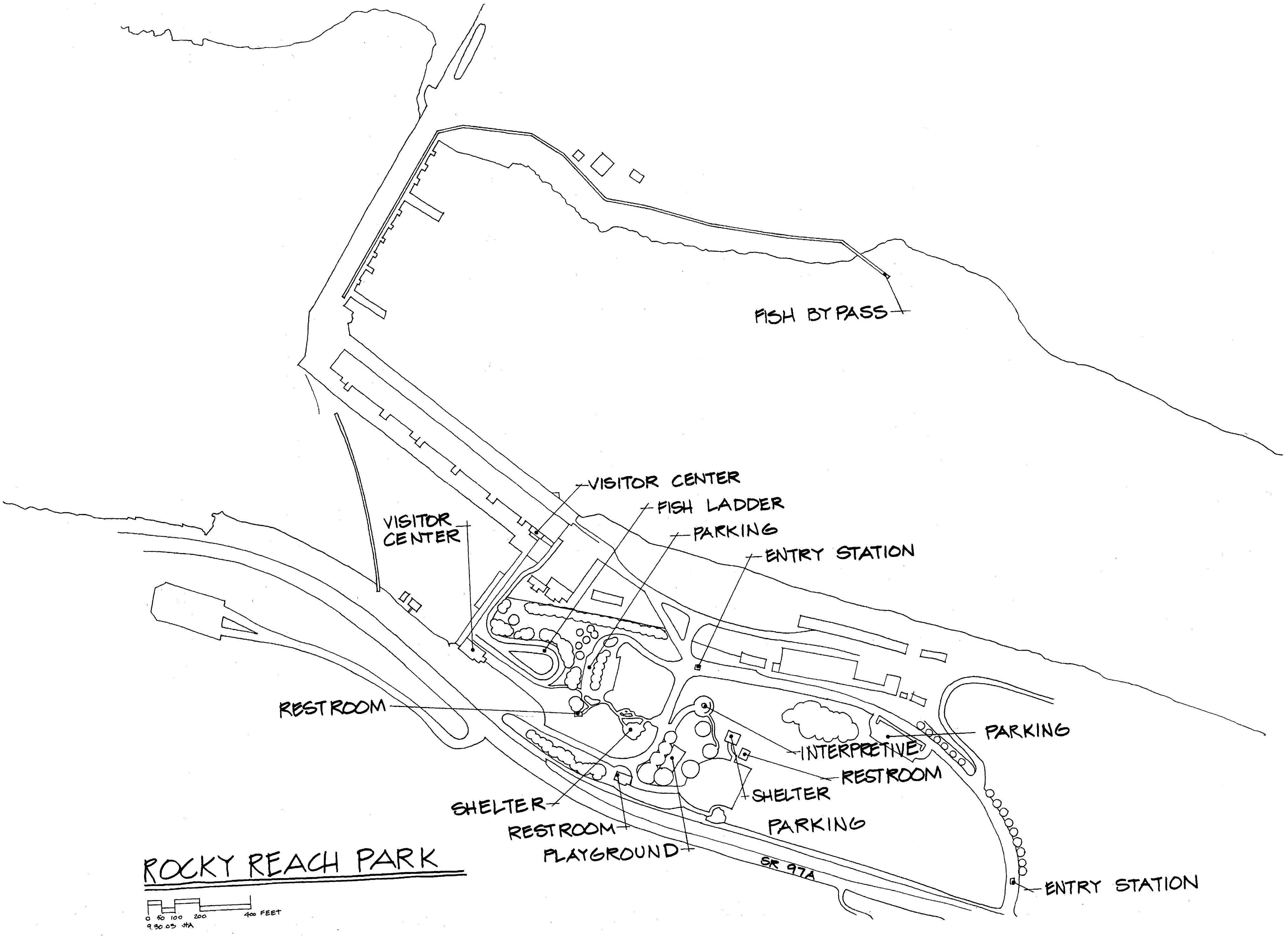
Chelan PUD, 2001(b). Recreation Resources Inventory Summary Report – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145, Chelan PUD, Wenatchee, Washington. September 21, 2001.

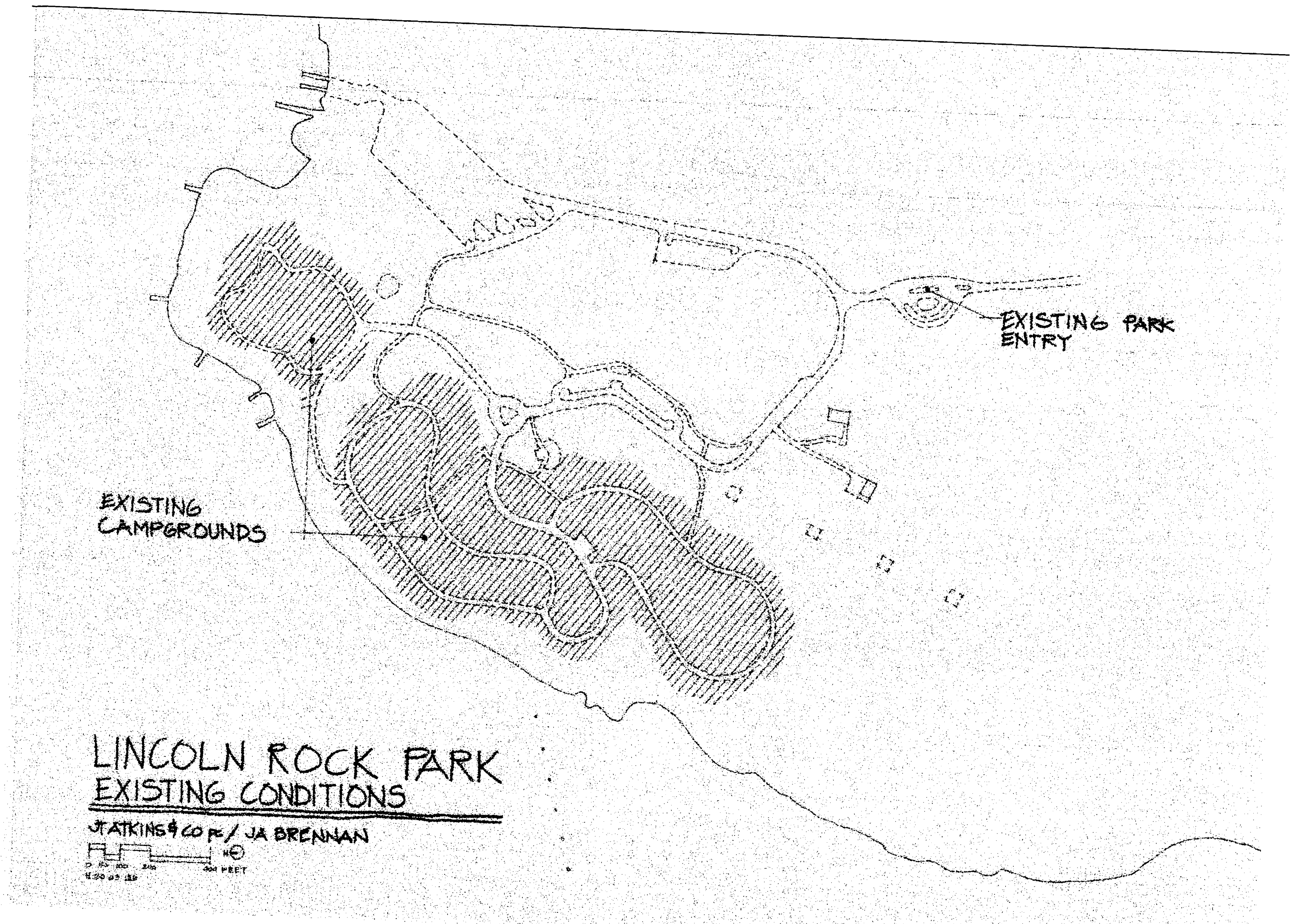
Chelan PUD, 2001(c). 1999/2000 Recreational Use Assessment Study Report – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145. Chelan PUD, Wenatchee, Washington. March 2, 2001.

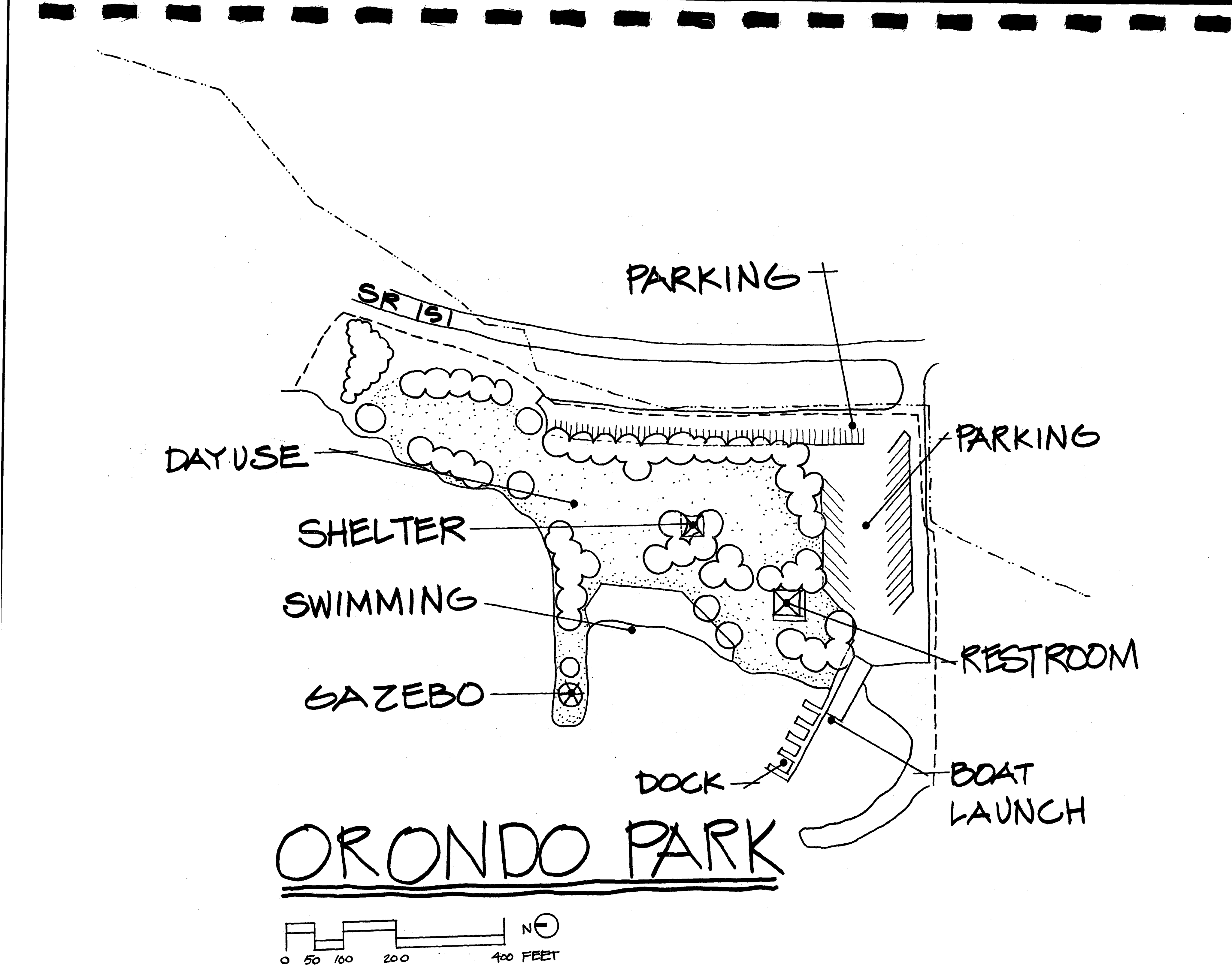
Chelan PUD, 2003. Project Lands Management Study – final, Rocky Reach Hydroelectric Project, FERC Project No. 2145, Chelan PUD, Wenatchee, Washington. May 30, 2003.

Interagency Committee for Outdoor Recreation, 2002. An Assessment of Outdoor Recreation in Washington State, public review draft, Interagency Committee for Outdoor Recreation, Olympia, Washington. March, 2002.

APPENDIX A: AS-BUILT DRAWINGS


ROCKY REACH PARK
0 50 100 200 400 FEET
9.30.05 JHA
FISH BYPASS
VISITOR CENTER
FISH LADDER
PARKING
ENTRY STATION
VISITOR CENTER
RESTROOM
INTERPRETIVE
PARKING
RESTROOM
SHELTER
SHELTER
RESTROOM
PLAYGROUND
PARKING
SR 97A
ENTRY STATION


EXISTING PARK ENTRY
EXISTING CAMPGROUNDS
LINCOLN ROCK PARK
EXISTING CONDITIONS
JT ATKINS & CO PC / JA BRENNAN


PARKING
SR 151
PARKING
DAYUSE
SHELTER
SWIMMING
RESTROOM
GAZEBO
DOCK
BOAT
LAUNCH
ORONDO PARK
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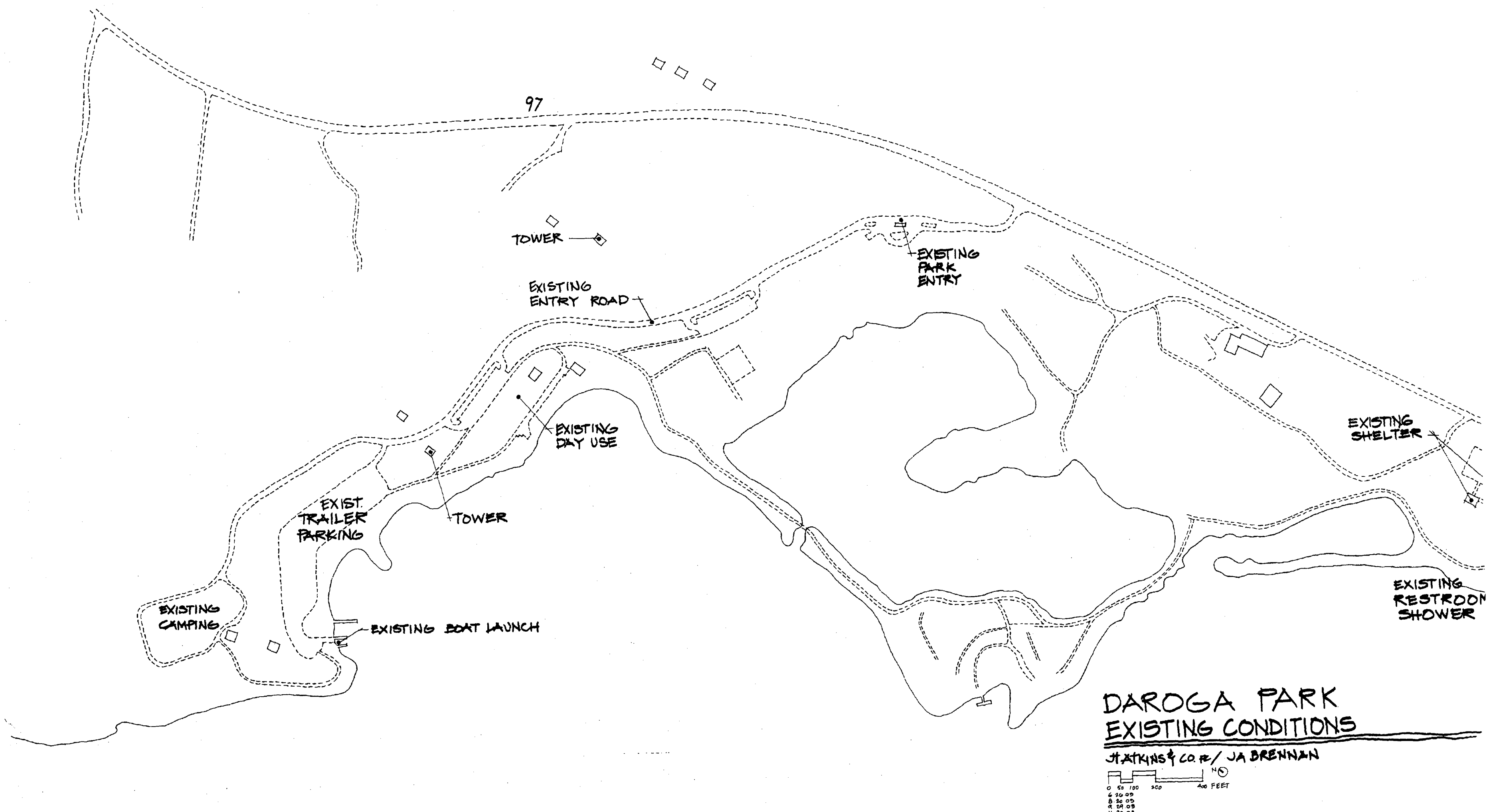
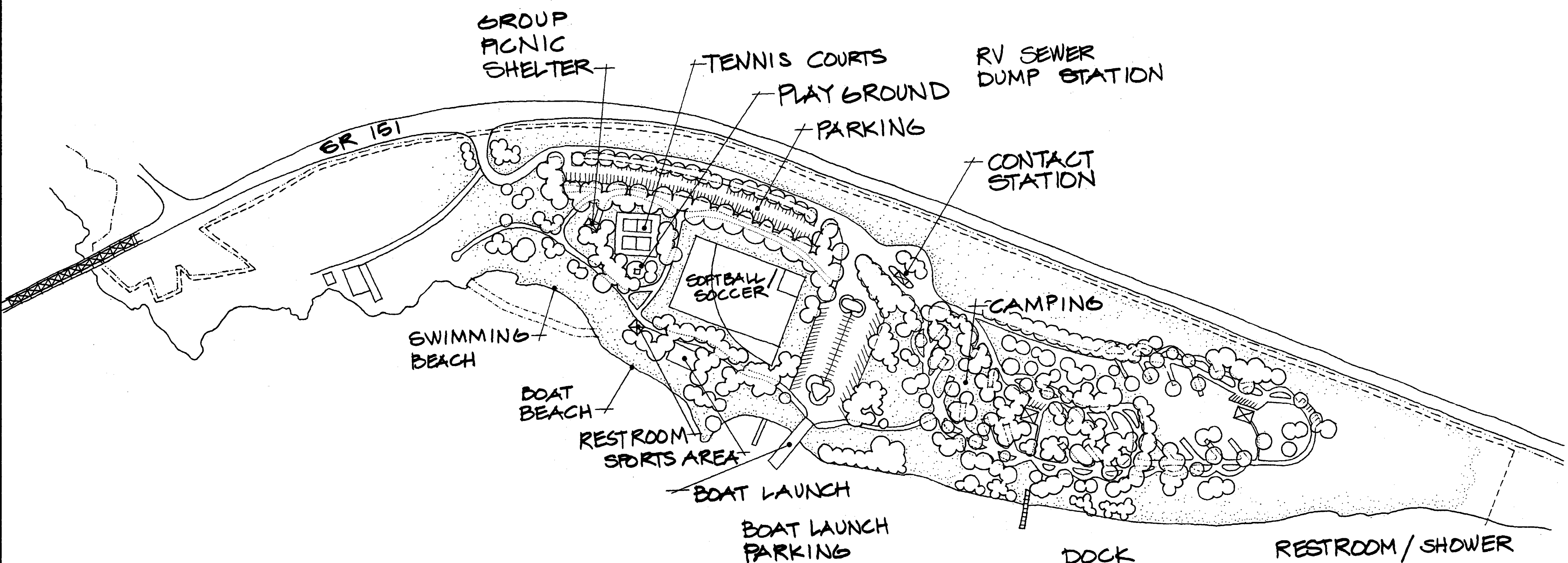

97
TOWER
EXISTING PARK ENTRY
EXISTING ENTRY ROAD
EXISTING DAY USE
EXIST. TRAILER PARKING
TOWER
EXISTING CAMPING
EXISTING BOAT LAUNCH
EXISTING SHELTER
EXISTING RESTROOM SHOWER
DAROGA PARK
EXISTING CONDITIONS
JT ATKINS & CO. PC / JA BRENNAN
FEET



BEEBE BRIDGE PARK

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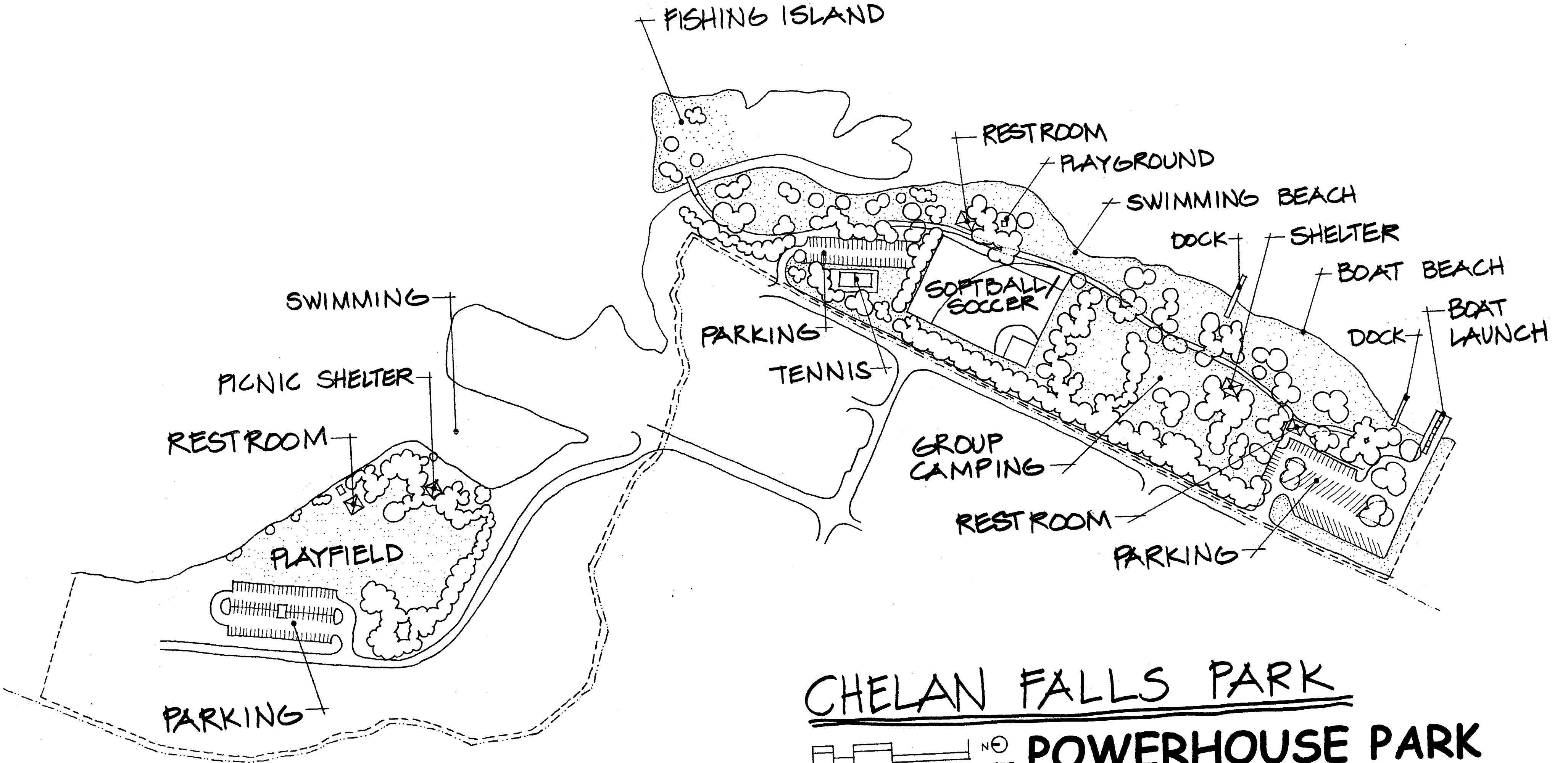
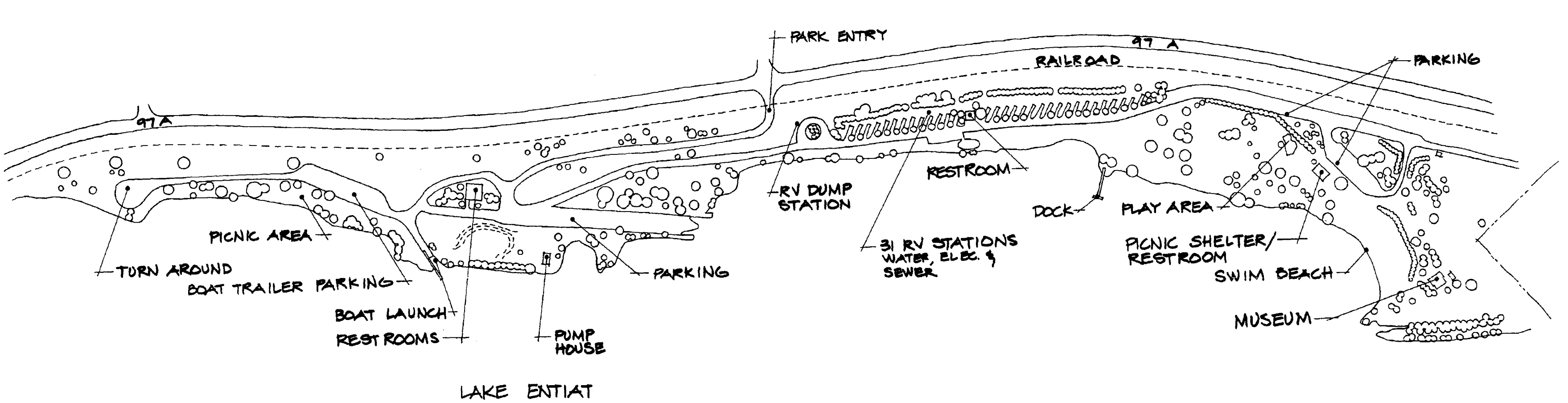


CHELAN FALLS PARK

POWERHOUSE PARK



ENTIAT PARK- EXISTING CONDITIONS

JT ATKINS & CO PC/ JA BRENNAN

0 50 100 200 400 FEET

11.20.03

APPENDIX B: LINCOLN ROCK STATE PARK POTENTIAL RENOVATIONS AND ENHANCEMENTS

Lincoln Rock State Park Description

Introduction

Lincoln Rock State Park is located on the east side of the Reservoir (Lake Entiat), approximately seven miles north of East Wenatchee. The 60-acre Park includes approximately 4,500 linear feet of lake shoreline.

The existing Park serves as a focal point for day-use activities, RV camping and boating opportunities. Many local citizens use the day-use soccer field. Proposed Park improvements include developing a new playground and picnic area and group camping area and improvements to the docks and lawn areas.

Site Status

The Washington State Parks & Recreation Commission (Washington State Parks) operates and maintains Lincoln Rock State Park.

Landscape Character

The Park landscape is composed of turf areas with scattered trees. There is an undeveloped area in the south end of the Park that is composed of native shrubs and grasses. This southern area is dominated by power lines that cross the area. The existing fish hatchery is located on the south boundary of the site.

Project Description

Existing Park development consists of a series of day-use and camping areas.

The following renovations, improvements and additions will be considered in the development by Chelan PUD and Washington State Parks for the Lincoln Rock State Park renovation and enhancement plan:

> **North Day Use Area**
>
> Enhancement of a playground and group picnic area and provide needed landscape improvements.
>
> **Existing Campground Areas**
>
> Development of an irrigation strategy and implementation of an improved system that would conserve water and improve the lawn areas within the existing campgrounds.
>
> **South Group Camping Area**
>
> Development of a new group camping area south of the existing camping and southwest of the administrative area capable of accommodating groups of RV users. A chain link fence will be installed along the margin of this new camping area to extend an existing wildlife corridor and provide habitat for birds and rabbits.

APPENDIX C: DAROGA STATE PARK POTENTIAL RENOVATIONS AND ENHANCEMENTS

Daroga State Park Description

Introduction
Daroga State Park is located on the east side of the Reservoir approximately eight miles upriver from Orondo. Access to the Park is from Highway 97. The 140-acre Park includes approximately 13,000 linear feet of lake shoreline.

The existing Park serves as a focal point for day-use activities, RV and tent camping and boating. Proposed park renovations, improvements and additions include new convenience camping cabins, restrooms/showers and playgrounds. In addition, improvements to the boat launch and docks as well as to the lawn area on the western edge of the Park would be considered.

Site Status
The Washington State Parks & Recreation Commission (Washington State Parks) operates and maintains Daroga State Park.

Landscape Character
The Park site is on the east side of the lake and consists of both shoreline and hillside areas. The existing Park landscape consists of turf areas with stands of trees. Numerous water access points occur along the shoreline. The shoreline and hillside areas provide sweeping vistas of the lake to the south and west and the mountains to the west.

Project Description
The existing Park development consists of a series of day-use and camping areas. The following renovations, improvements and additions will be considered in the development by Chelan PUD and Washington State Parks for the Daroga State Park renovation and enhancement plan:

Cabin Development
The development of convenience camping cabins at various locations throughout the Park. Chelan PUD would be responsible for the development of the infrastructure (e.g., roads, electricity, water, sewer, site preparation, landscaping and restrooms), and Washington State Parks would be responsible for the cabins. The details would be outlined in the renovation and enhancement plan.

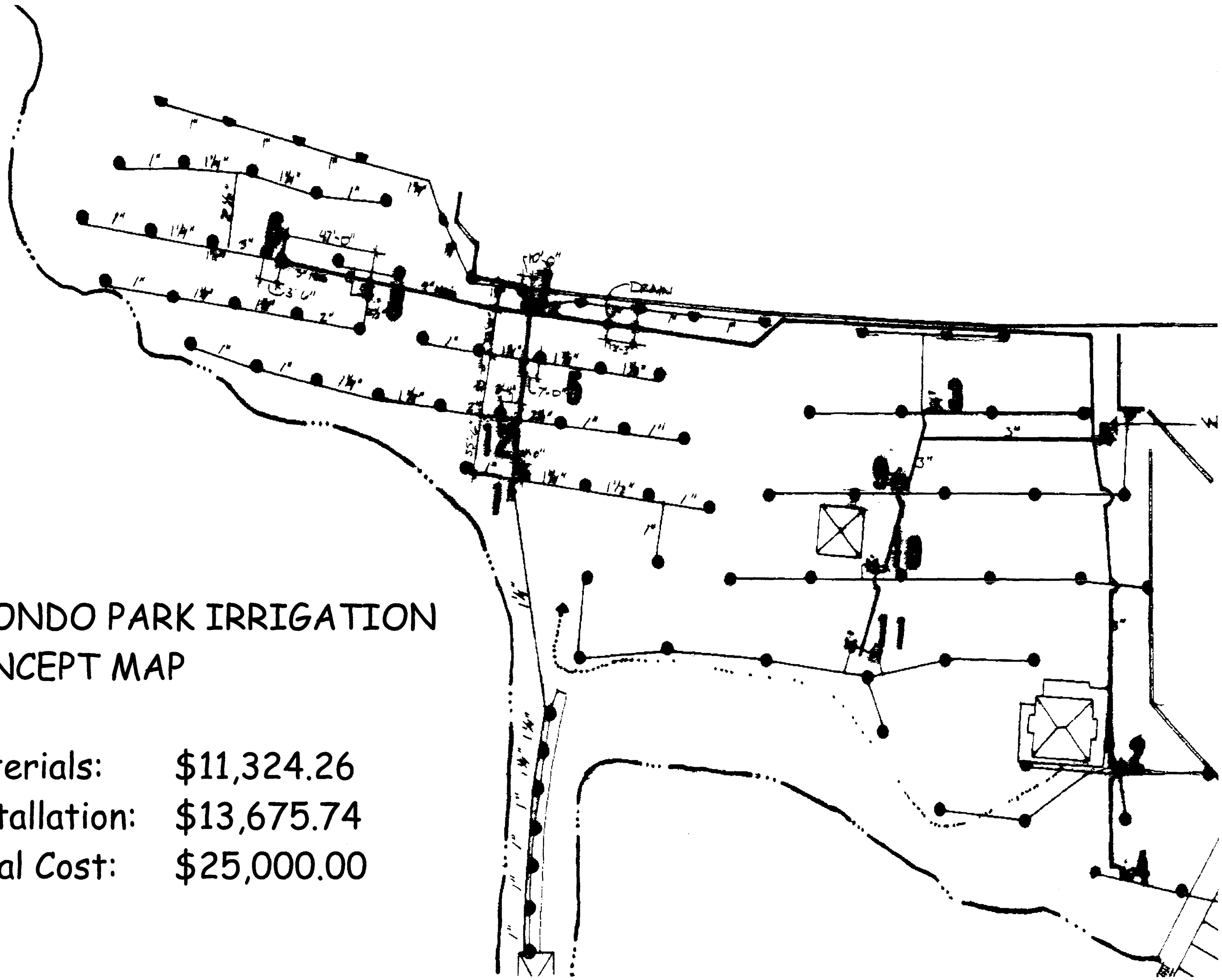
Boat Launch and Shoreline Improvements
Develop and implement a shoreline treatment strategy to retain the sediment that is now being deposited at the end of the boat ramps which could include new flow deflection structures, landscaping, dock improvements, and watercraft launch ramp modifications.

West Park Area Landscapes Improvements
Develop and implement an irrigation strategy for water conservation and the improvement of lawn areas within the Park.

Island Improvements
Improved vault toilets would be considered for this area.


Convenience Camping

APPENDIX D: ORONDO PARK FACILITIES



ORONDO PARK IRRIGATION
CONCEPT MAP

Materials:	$11,324.26
Installation:	$13,675.74
Total Cost:	$25,000.00

APPENDIX E: ENTIAT PARK POTENTIAL PARK ENHANCEMENTS AND RENOVATIONS

Entiat Park Description

Introduction
Entiat Park is located on the west side of the Reservoir (Lake Entiat) within the City of Entiat. The Park is a community resource as well as a regional water access and camping point. The approximately 40-acre Park is located just north of the confluence of the Lake and the Entiat River and includes approximately 4,000 linear feet of Reservoir shoreline to the east and a railroad line to the west. The north portion of the Park is bounded by a residential area and includes an existing community museum.

The existing Park serves as a focal point for day-use activities, RV camping and boating opportunities. Proposed Park improvements focus on addressing existing Park conditions as well as developing new elements that were identified during the community planning process. Native plant species will be used in revegetation efforts wherever possible for wildlife habitat enhancements.

Site Status
The City of Entiat operates and maintains Entiat Park, in partnership with Chelan PUD.

Landscape Character
The Park is composed of a series of camping and day-use areas that are made up of turf areas with scattered trees. There is a range of water access opportunities associated with the park.

Project Description
Park development program consists of a series of day-use and camping areas.

Renovate Existing Camping Areas – Renovate existing camping areas and make improvements to include the following:

- Restroom with showers
- 16 RV / Tent camping sites
- Natural area with interpretive signs

Renovate Existing Day-Use Areas – Renovate existing day-use areas focusing on community activities and connection to the museum at the north end of the park including:

- New restroom
- Picnic shelter
- Interpretive signs presenting town history
- Sports area
- Water-related facilities
- Playground
- Dock and beach improvements
- Maintenance/administration building including fenced service yard

APPENDIX F: ENTIATQUA TRAIL

Entiatqua Trail Description

Introduction

The Entiatqua Trail will provide bike and pedestrian access along the shore of the Reservoir (Lake Entiat) and the Entiat River. Viewpoints located along the trail will provide interpretive opportunities as well as resting and viewing points for the trail users. The future trail is approximately 4,340 feet long and begins at the southern end of Entiat Park and proceeds south along an earth berm that includes the railroad track and highway 97A. The proposed trail will pass under the existing railroad and highway bridges and then proceed west along the north bank of the Entiat River to the site of the future Entiatqua Outdoor Learning Center. Future trail connections could continue up the Entiat River valley.

Site Status

The majority of the site is within Chelan County PUD lands and railroad and highway rights of way.

Landscape Character

The trail site parallels the Reservoir and the Entiat River along the relatively disturbed area associated with the highway and railroad embankments. Striking views of the lake, Number Rock, the Entiat River and riparian habitat and wildlife occur along the trail alignment.

Project Description

This proposed pedestrian and bike trail will connect Entiat Park to the future Entiatqua Outdoor Learning Center to be located on the north shore of the Entiat River to the west of SR97A. The proposed trail will be constructed of gabions set into the side of the railroad and highway fill area. The trail will pass under the existing highway bridge. Two viewpoints with interpretive signs and benches will be located at prominent points along the alignment. Additional benches will be located along the trail. Trailhead access will occur at the south end of Entiat Park and at the future Entiatqua center. When siting the trail, the riparian zone and the minimization of the removal of woody vegetation will be taken into consideration to protect wildlife.

Project Elements

- Trail – 6 foot wide compacted aggregate trail. The trail will be constructed on top of (and adjacent to) gabion retaining walls. The gabions will be tied back into the slope at intervals along the alignment. A guardrail (located on the down slope side of the trail) will be placed in a timber or precast concrete cap at the edge of the trail.
- Viewpoints – Two viewpoints will be located along the trail.
- Pedestrian barrier – A fence will be located on the uphill side of the trail along the railroad and highway alignments.
- Site amenities - Benches and interpretive signs will be located along the trail.
- Restoration planting – native grasses and shrubs will be planted along the trail alignment.