Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway • East Wenatchee, Washington 98802-4497 • 509/884-7191 • FAX 509/884-0553 • www.douglaspud.org

Via Electronic Filing May 31, 2017

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 1st Street N.E.
Washington, D.C. 20426

Subject: Wells Hydroelectric Project – FERC Project No. 2149
Consolidated 2016 Aquatic Settlement Agreement Annual Report

Dear Secretary Bose:

Public Utility District No. 1 of Douglas County, Washington (Douglas PUD), licensee for the Wells Hydroelectric Project No. 2149 (Wells Project) respectfully submits the attached Annual Report of activities conducted during calendar year 2016 in compliance with Article 406 of the FERC license for the Wells Project, sections 6.4, 6.6 and 7(b) of the Clean Water Act section 401 Water Quality Certification (401 Certification), and section 11.7 of the Aquatic Settlement Agreement (ASA).

Article 406 of the license requires Douglas PUD to file with the FERC an Annual Report documenting the results of studies and measures completed during the previous calendar year pursuant to the Aquatic Settlement Agreement’s White Sturgeon Management Plan (WSMP), Bull Trout Management Plan (BTMP), Pacific Lamprey Management Plan (PLMP), Resident Fish Management Plan (RFMP), Aquatic Nuisance Species Management Plan (ANSMP), and Water Quality Management Plan (WQMP) as required in whole or in part by Ordering Paragraph F and Appendix C, Ordering Paragraph G and Appendix D, and Ordering Paragraph H and Appendix E. The final ASA Annual Report and the final ASA Management Plan Reports for 2016, including water temperature and aquatic nuisance species reports, are attached to this letter as Exhibit A.

License Article 401(b) and Section 6.7(3)(b) of Douglas PUD’s 401 Water Quality Certification requires that the District respectively file with the FERC and Washington Department of Ecology an annual Water Temperature report by April 30th of each year. At the request of the parties to the ASA and following a request filed on behalf of the parties by Douglas PUD’s, the FERC approved Douglas PUD’s request to modify the water temperature reporting deadline from April 30th to May 31st each year in order to be consistent with other annual reporting deadlines (FERC Order issued February 24, 2017). In the same FERC issued Order, the Aquatic Nuisance Species Management Plan annual reporting deadline was moved from April 1st of each
year to May 31st. As such, Douglas PUD’s 2016 Annual Water Temperature Report and 2016 Aquatic Nuisance Species Management Plan Report have also been included into Exhibit A.

Article 406 of the license also requires Douglas PUD to provide documentation of consultation with resource agencies and tribes including the parties to the ASA. Towards meeting these requirements, these agencies and tribes were provided an opportunity to review, provide comment, and approve the annual report and all six of the management plan reports. The pre-filing consultation record documenting the review and May 10, 2017 approval of the ASA Annual Report and including all six Annual Management Plan Reports can be found in Exhibit B to this letter.

In addition to meeting the requirements of Article 406 of the FERC license, the enclosed ASA Annual Report and Management Plan Reports were developed to meet the requirements of section 6.4, 6.6 and 7(b) of the 401 Certification, section 11.7 of the ASA and section 4.0 within each of the aquatic resource management plans contained within the ASA.

If you have any questions or require further information related to the attached documents, please feel free to contact me at (509) 881-2208 or sbickford@dcpub.org.

Sincerely,

Shane Bickford
Natural Resources Supervisor

Enclosures:

(1) Exhibit A – Annual Report Calendar Year 2016 Activities under the Aquatic Settlement Agreement for the Wells Hydroelectric Project, pages 3 – 831
(2) Exhibit B – Pre-filing Consultation Record supporting the approval of the 2016 Aquatic Settlement Agreement Annual Report, 2016 Aquatic Settlement Agreement Management Plan Reports, and 2016 Water Temperature Report, pages 832 – 850

CC: Aquatic Settlement Work Group
Mr. Andrew Gingerich – Douglas PUD
Mr. Chas Kyger – Douglas PUD
EXHIBIT A

ANNUAL REPORT CALENDAR YEAR 2016 ACTIVITIES UNDER THE AQUATIC SETTLEMENT AGREEMENT FOR THE WELLS HYDROELECTRIC PROJECT
ANNUAL REPORT
CALENDAR YEAR 2016
ACTIVITIES UNDER THE AQUATIC SETTLEMENT AGREEMENT
WELLS HYDROELECTRIC PROJECT
FERC LICENSE NO. 2149

Prepared for
Public Utility District No. 1
of Douglas County, Washington
1151 Valley Mall Parkway
East Wenatchee, Washington  98802-4497

Prepared by
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720 Olive Way, Suite 1900
Seattle, Washington  98101

May 2017
# TABLE OF CONTENTS

1 INTRODUCTION

1.1 Aquatic Settlement Agreement

1.2 Wells Project Federal Energy Regulatory Commission License

1.3 Aquatic Resource Management Plans

2 PROGRESS TOWARD IMPLEMENTING THE AGREEMENT AND WELLS PROJECT LICENSE ORDER

2.1 2016 Aquatic Settlement Agreement Decisions, Agreements, and Milestones

2.1.1 White Sturgeon

2.1.1.1 Wild Larval Program and Direct Gamete Program (2013 to 2016)

2.1.1.2 Wild Larval Program (2018 to 2022)

2.1.1.3 Collection and Stocking

2.1.1.4 Phase One White Sturgeon Management Plan Monitoring and Evaluation Study Plan

2.1.1.5 Fish Health

2.1.1.6 Guidelines for Hatchery Rearing Juvenile Sturgeon

2.1.1.7 Outreach

2.1.1.8 Planned Monitoring, Studies, and Activities in 2017

2.1.2 Bull Trout

2.1.2.1 Bull Trout Monitoring

2.1.2.2 Wells Reservoir Drawdown and Bull Trout Survey

2.1.2.3 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study

2.1.2.4 Participation in Bull Trout Recovery Planning and Regional Coordination

2.1.2.5 Planned Monitoring, Studies, and Activities in 2017

2.1.3 Water Quality

2.1.3.1 Total Dissolved Gas Monitoring

2.1.3.2 Gas Bubble Trauma Monitoring

2.1.3.3 Water Temperature Report

2.1.3.4 Total Dissolved Gas Reduction Alternative Analysis

2.1.3.5 Wells Project Water Forecast Tracking

2.1.3.6 2016 Wells Project Water Quality Updates
2.1.3.7 Planned Monitoring, Studies, and Activities in 2017

2.1.4 Pacific Lamprey

2.1.4.1 Pacific Lamprey Studies

2.1.4.2 Pacific Lamprey Study Modifications

2.1.4.3 Juvenile Pacific Lamprey Habitat Evaluation Study

2.1.4.4 Regional Coordination

2.1.4.5 Planned Monitoring, Studies, and Activities in 2017

2.1.5 Aquatic Nuisance Species

2.1.5.1 Crayfish

2.1.5.2 Zebra/Quagga Mussels and Macrophytes

2.1.5.3 Eurasian Milfoil

2.1.5.4 Planned Monitoring, Studies, and Activities in 2017

2.1.6 Resident Fish

2.1.6.1 Northern Pikeminnow Removal

2.1.6.2 Planned Monitoring, Studies, and Activities in 2017

3 AGREEMENT ADMINISTRATION

3.1 Habitat Conservation Plan Coordination

3.1.1 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan

3.1.2 2016 Adult Pacific Lamprey Passage and Enumeration Study

3.2 Wells Dam Site Visits

3.3 Agreement Rules and Regulations Refresher

3.4 Aquatic Settlement Work Group Members

3.5 Agreement-related Publications in Calendar Year 2016

4 REFERENCES

List of Tables

Table 1 2016 Summary of Decisions, Agreements, and Milestones – Aquatic SWG

List of Appendices

Appendix A Aquatic Settlement Work Group 2016 Meeting Minutes and Conference Call Minutes
<table>
<thead>
<tr>
<th>Appendix B</th>
<th>Aquatic Settlement Work Group Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix C</td>
<td>Final Request for Consolidation of Aquatic Settlement and Water Quality Certification Reporting Deadlines</td>
</tr>
<tr>
<td>Appendix E</td>
<td>2016 Aquatic Settlement Agreement and Workgroup Action Plan</td>
</tr>
<tr>
<td>Appendix F</td>
<td>Evaluations of White Sturgeon Supplementation and Management in the Wells Reservoir, 2015</td>
</tr>
<tr>
<td>Appendix G</td>
<td>Low Pool Elevation Bull Trout Survey – License Article 402</td>
</tr>
<tr>
<td>Appendix H</td>
<td>Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Final Study Plan</td>
</tr>
<tr>
<td>Appendix I</td>
<td>Total Dissolved Gas Abatement Plan 2015 Annual Report</td>
</tr>
<tr>
<td>Appendix J</td>
<td>2016 Total Dissolved Gas Abatement Plan and Final 2016 Juvenile Fish Bypass Operating Plan</td>
</tr>
<tr>
<td>Appendix K</td>
<td>Total Dissolved Gas Reduction Alternatives Analysis</td>
</tr>
<tr>
<td>Appendix L</td>
<td>Adult Lamprey Approach, Passage, And Enumeration Study Plan, Wells Dam – 2016</td>
</tr>
<tr>
<td>Appendix M</td>
<td>Juvenile Pacific Lamprey Habitat Evaluation Study Plan Report</td>
</tr>
<tr>
<td>Appendix N</td>
<td>Final Regional Pacific Lamprey Workshop Minutes</td>
</tr>
</tbody>
</table>
1 INTRODUCTION

1.1 Aquatic Settlement Agreement

The Wells Hydroelectric Project (Wells Project) is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD). The Aquatic Settlement Agreement (Agreement) for the relicensing of the Wells Project (Federal Energy Regulatory Commission [FERC] License No. 2149) was signed by Douglas PUD’s commissioners on January 19, 2009, following the receipt of signatures from the Confederated Tribes of the Colville Reservation (CCT; November 10, 2008), Washington State Department of Ecology (Ecology; November 18, 2008), and Washington Department of Fish and Wildlife (WDFW; November 20, 2008). The Yakama Nation (YN) signed the Agreement on February 24, 2009, the U.S. Fish and Wildlife Service (USFWS) signed the Agreement on July 23, 2009, and the Bureau of Land Management signed the Agreement on November 13, 2009. These signatory entities are collectively referred to as the Parties. The Agreement is intended to resolve all aquatic resource issues related to compliance with all federal and state laws applicable to the Wells Project FERC License that are not already addressed by the Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Wells Project (Douglas PUD 2002), or other related agreements. The Agreement is the culmination of 3 years of collaborative discussions with stakeholders, which began in March 2006.

Preparation of this report was funded by Douglas PUD as a requirement of the Agreement and License Article 406 in the Well Hydroelectric Project License, and it is the eighth annual report to be developed for activities accomplished under the Agreement, covering the period from January 1 to December 31, 2016. This report is due annually to FERC by May 31 of each year (see License Article 406 Project No. 2149). Accordingly, on May 11, 2016, the Aquatic Settlement Work Group (Aquatic SWG) approved the 2015 Aquatic Settlement Agreement Annual Report, and Douglas PUD filed the report with FERC on May 26, 2016 (available at: http://dcpud.org/wells-project/aquatic-settlement-agreement). This 2016 Aquatic Settlement Agreement Annual Report will be reviewed and approved by the Aquatic SWG, and subsequently filed with FERC on or prior to the May 31, 2017, deadline, as required.
1.2 **Wells Project Federal Energy Regulatory Commission License**

On November 9, 2012, FERC issued Douglas PUD their current License Order for the Wells Project (available at: http://dcpud.org/wells-project/wells-project-license). The term of the license is 40 years, retroactive to November 1, 2012. FERC adopted the Wells Project Clean Water Act (CWA) 401 Certification along with the required measures in the aquatic resource management plans (see below). Since license issuance, Douglas PUD has worked collaboratively with the signatories to the Agreement to implement said actions.

1.3 **Aquatic Resource Management Plans**

As of the effective date of the Agreement, pursuant to Section 5 of the Agreement, the Parties agreed that the measures set forth in the six aquatic resource management plans (*White Sturgeon Management Plan*, *Bull Trout Management Plan*, *Water Quality Management Plan*, *Pacific Lamprey Management Plan*, *Aquatic Nuisance Species Management Plan*, and *Resident Fish Management Plan*) contained in Attachments B through G, respectively, of the Agreement, are adequate to identify and address Wells Project impacts to aquatic resources not addressed by the HCP and are expected to achieve the goals and objectives set forth in each of the six aquatic resource management plans.

In 2016, as required by Article 406 of the Wells Project License, annual reports were developed for each aquatic resource management plan documenting progress made toward the implementation of each respective plan, with focus on the previous year’s progress under each specific management plan objective. Last year, five of six aquatic resource management plan annual reports were due to FERC by May 31, and the *2015 Aquatic Nuisance Species Management Plan Annual Report* was due by April 1. Accordingly, on March 17, 2016, the Aquatic SWG approved the *2015 Aquatic Nuisance Species Management Plan Annual Report*, and Douglas PUD filed the report with FERC on March 29, 2016. On May 11, 2016, the Aquatic SWG approved the remaining five 2015 aquatic resource management plan annual reports, which were subsequently filed with FERC on May 26, 2016. All six final 2015 aquatic resource management plan annual reports are available at: http://dcpud.org/wells-project/aquatic-settlement-agreement. The 2016 aquatic resource management plan annual reports will be updated in 2017 in consultation with the Aquatic
SWG, and subsequently filed with FERC on or prior to the April 1 and May 31 deadlines, per FERC license requirements.

In 2015, the Aquatic SWG began discussing how to streamline the review process for the numerous annual reports required under the Agreement. As described above, some reports have similar, but separate, deadlines. Further, some reports with different deadlines are similar in content. For the sake of simplicity and comprehensiveness, the Aquatic SWG agreed that Douglas PUD should inquire with FERC regarding the feasibility of combining all aquatic resource management plan annual reports required by the Agreement into one submittal to FERC. In 2016, Douglas PUD and the Aquatic SWG continued reviewing and discussing this action. Per a request from the Aquatic SWG, Douglas PUD proposed requesting from FERC and Ecology approval to move the deadlines for the *Aquatic Nuisance Species Management Plan Annual Report* (typically filed April 1) and the *Water Temperature Annual Report* (typically filed April 30), to May 31, which would combine these two submittals with the submittal of the Aquatic Settlement Agreement Annual Report and other aquatic resource management plan annual reports. In December 2016, Douglas PUD provided a draft letter addressed to FERC requesting the report deadline changes to the Aquatic SWG for review, which was approved by the Aquatic SWG in early 2017. (Note: Douglas PUD filed the approved consolidation request letter [Appendix C] with FERC on February 13, 2017, and FERC subsequently approved consolidation of reporting deadlines by Order Amending Reporting Deadlines on February 24, 2017.)

2 PROGRESS TOWARD IMPLEMENTING THE AGREEMENT AND WELLS PROJECT LICENSE ORDER

Section 11.7 of the Agreement requires preparation of an annual report that includes all relevant materials associated with Agreement activities during the year. The following subsections describe activities that were implemented during 2016 in accordance with the Agreement and aquatic resource management plans, which are also found as requirements in the Wells Project License Order.

2.1 2016 Aquatic Settlement Agreement Decisions, Agreements, and Milestones

In 2016, Douglas PUD completed actions required by their *White Sturgeon, Bull Trout, Water Quality, Pacific Lamprey, Aquatic Nuisance Species, and Resident Fish Management Plans*, as outlined in the *2016 Aquatic Settlement Agreement and Workgroup Action Plan* (Appendix E), which was approved by the Aquatic SWG on February 10, 2016.

Decisions, agreements, and milestones reached by the Aquatic SWG during 2016 that are related to the Agreement are shown in Table 1 and are documented in the Aquatic SWG meeting minutes (Appendix A).

Table 1
2016 Summary of Decisions, Agreements, and Milestones – Aquatic SWG

<table>
<thead>
<tr>
<th>Aquatic SWG Decisions, Agreements, and Milestones</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecology provided a letter to Douglas PUD approving Douglas PUD’s TDG Reasonable and Feasible Analysis, which was approved by the other Aquatic SWG Technical Representatives on December 10, 2014, contingent on approval by Ecology.</td>
<td>January 22, 2016</td>
</tr>
<tr>
<td>Approved the 2016 Pacific Lamprey Approach, Passage, and Enumeration Study Plan, as revised. (Note: Steve Lewis provided USFWS approval of the plan via email on February 9, 2016, contingent on incorporation of USFWS edits and comments.)</td>
<td>February 10, 2016</td>
</tr>
<tr>
<td>Aquatic SWG Decisions, Agreements, and Milestones</td>
<td>Date</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan, contingent on incorporating comments received from USFWS, which were reviewed and discussed during the meeting on February 10, 2016. <em>(Note: Steve Lewis provided USFWS approval of the plan via email on February 9, 2016, contingent on incorporation of USFWS edits and comments. Lewis also provided an email accepting the revisions in the final study plan on February 23, 2016.)</em></td>
<td>February 10, 2016</td>
</tr>
<tr>
<td>Approved the 2016 ASA Action Plan, as revised.</td>
<td>February 10, 2016</td>
</tr>
<tr>
<td>Agreed to a March 1, 2016, deadline to transfer surplus white sturgeon off site that are in excess of the Douglas PUD 5,000-fish White Sturgeon Program, in order to grow program fish to the target size at release.</td>
<td>February 10, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Total Dissolved Gas Abatement Plan Annual Report, contingent on approval by Ecology. <em>(Note: Charlie McKinney provided Ecology's approval of the report via email on February 18, 2016, as distributed to the Aquatic SWG by Kristi Geris on February 29, 2016.)</em></td>
<td>February 18, 2016</td>
</tr>
<tr>
<td>Approved the 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan, contingent on approval by Ecology. <em>(Note: Charlie McKinney provided Ecology's approval of the plan via email on February 18, 2016, as distributed to the Aquatic SWG by Kristi Geris on February 29, 2016.)</em></td>
<td>February 18, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Aquatic Nuisance Species Management Plan Annual Report, as revised, via email as follows: Douglas PUD approved on March 9; the CCT approved on March 10; USFWS approved on March 11; the YN approved on March 17; WDFW conditionally approved on March 17, pending incorporation of suggested edits; and Ecology abstained (did not vote). <em>(Note: Douglas PUD indicated WDFW's suggested edits would be incorporated into the final report, as distributed on March 18, 2016.)</em></td>
<td>March 17, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Water Temperature Annual Report, with the YN abstaining.</td>
<td>April 13, 2016</td>
</tr>
<tr>
<td><strong>Aquatic SWG Decisions, Agreements, and Milestones</strong></td>
<td><strong>Date</strong></td>
</tr>
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</tr>
<tr>
<td>Approved the 2015 Bull Trout Management Plan and Incidental Take Statement Annual Report. <em>(Note: the CCT approved the report via email prior to the meeting on May 11; Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Resident Fish Management Plan Annual Report. <em>(Note: the CCT approved the report via email prior to the meeting on May 11, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Approved the 2015 White Sturgeon Management Plan Annual Report. <em>(Note: the CCT approved the report via email prior to the meeting on May 11, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Water Quality Management Plan Annual Report. <em>(Note: the CCT approved the report via email prior to the meeting on May 11, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Approved the 2015 Pacific Lamprey Management Plan Annual Report. <em>(Note: Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Approved the 2015 ASA Annual Report. <em>(Note: Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, Ecology approved the report via email on May 14, and the YN abstained via email on May 20, 2016.)</em></td>
<td>May 11, 2016</td>
</tr>
<tr>
<td>Agreed to open attendance for all interested parties at the Regional Pacific Lamprey Workshop.</td>
<td>May 11, 2016</td>
</tr>
</tbody>
</table>
2.1.1 White Sturgeon

In 2016, Douglas PUD continued efforts to supplement the white sturgeon (Acipenser transmontanus) population in the Wells Reservoir, as outlined in the White Sturgeon Management Plan, and as required by FERC License Order 2149-52.

FERC License Order 2149-52, issued in 2012, requires Douglas PUD to release up to 5,000 white sturgeon yearlings into the Wells Reservoir annually for 4 consecutive years (up to 20,000 total), beginning in the first year following issuance of the operating license. This required collection of white sturgeon broodstock or larvae beginning in 2013, and stocking of juvenile white sturgeon in the years 2014 through 2017. In 2016, Douglas PUD, in coordination with the Aquatic SWG, stocked the third consecutive year of a 5,000-fish release (brood year 2015) toward the 20,000-fish release group, and collected brood year 2016 fish for the fourth and final consecutive year of release in 2017 to meet the goal of releasing up to 20,000 white sturgeon yearlings. In the 3 years ending 2016, more than 15,000 white sturgeon yearlings have been released into the Wells Project.

FERC License Order 2149-52 also requires additional years and numbers of white sturgeon yearlings to be stocked during Phase I, as determined by the Aquatic SWG, and not to exceed an additional 15,000 white sturgeon yearlings stocked (a total of 35,000 white sturgeon yearlings released during Phase I). Therefore, in 2016, Douglas PUD and the Aquatic SWG began discussing an updated broodstock collection and breeding plan for releasing 15,000 fish in Years 5 to 10 of the FERC license.
2.1.1.1  Wild Larval Program and Direct Gamete Program (2013 to 2016)

Prior to the issuance of FERC License Order 2149-52 and since 2010, Douglas PUD and the Aquatic SWG had been working toward addressing implementation of the artificial propagation program identified in Phase I of the *White Sturgeon Management Plan*. Following several months of intensive discussions in an attempt to reach consensus on a single white sturgeon broodstock collection plan, in spring 2012, Douglas PUD introduced a Statement of Agreement (SOA) indicating that Douglas PUD would implement a dual strategy for the collection of white sturgeon offspring starting in the spring of 2013, including implementation of wild larval and adult broodstock collection. The proposed SOA met the goals and objectives of the *White Sturgeon Management Plan*, and addressed the concerns and uncertainties that were debated while discussing early implementation of the program. In April 2012, after several modifications and revisions, the Aquatic SWG approved a *Wells White Sturgeon Offspring Collection Plan Statement of Agreement* (as appended to the 2012 Aquatic Settlement Agreement Annual Report) for implementation in 2013 through 2016. The Aquatic SWG agreed to use this two-program approach for 4 years as a means of identifying the best strategy for the long-term supplementation of white sturgeon in the Wells Project.

2.1.1.2  Wild Larval Program (2018 to 2022)

In 2016, the Aquatic SWG began discussing a fish source for the 15,000-fish release group in Years 5 to 10 of the FERC license. Based on the success of the larval-origin program in Years 1 to 4 of Phase I, the general consensus was there is no technical justification to move away from prioritizing larval-origin fish in Years 5 to 10 of Phase I. In December 2016, a draft SOA memorializing this agreement was distributed to the Aquatic SWG for a decision in early 2017.

2.1.1.3  Collection and Stocking

**Brood Year 2013**

In March 2013, the Aquatic SWG approved a *White Sturgeon Collection Plan SOA* (as appended to the 2013 Aquatic Settlement Agreement Annual Report) for implementation of the first year (2013) of Douglas PUD’s white sturgeon collection efforts, which included the following efforts: 1) larval collection in the Mid-Columbia River from the Vernita Bridge
upstream to the Rock Island Dam tailrace, and in Lake Roosevelt, with collection from Mid-Columbia locations as the highest priority; and 2) broodstock collection in the pools of the Columbia River between Bonneville Dam upstream to Rock Island Dam. The Aquatic SWG also agreed that the proportion of fish from each program (larvae and brood-collected offspring) released into the Wells Project would be agreed on prior to planting in spring 2014 following the completion of the larvae and brood-collection season and following the results from initial incubation and rearing efforts.

In March 2014, following several months of discussions regarding genetics, fish health, and the merits of stocking larval-origin versus direct gamete-origin fish, the Aquatic SWG approved the following plan for stocking Wells white sturgeon in 2014: 1) all stocked fish will be asymptomatic of disease (i.e., no clinical signs of disease); 2) all larvae-source fish available at the Wells Fish Hatchery (approximately 2,200) will be stocked at a target size of at least 146 to 272 grams (280 to 352 millimeters [mm]); and 3) the balance of the 5,000-fish target will be stocked using direct gamete-source fish from 12 families (half-sibling) and be stocked at a target mean size of 111 to 146 grams (256 to 280 mm).

In April 2014, approximately 2,900 brood year 2013 direct gamete-origin fish were released into Wells Reservoir. Larval-origin fish were held an additional 2 months for additional growth; in June 2014, more than 2,100 brood year 2013 larval-origin fish were released into the Wells Reservoir.

**Brood Years 2014 to 2016**

From 2014 to 2016, larval-origin collection efforts were focused in Lake Roosevelt and not below Rock Island Dam, based on the 2013 collection efforts where few larvae were collected below Rock Island Dam, suggesting low production in this area. In order to obtain direct gamete-origin white sturgeon, from 2014 to 2016, broodstock collection efforts continued in the same manner as in 2013, including brood collection by the YN below John Day and McNary dams, and in coordination with Grant and Chelan PUDs regarding brood collection at their respective facilities for sturgeon supplementation efforts. Captured broodstock were spawned at Marion Drain Fish Facility. In 2015 and 2016, direct gamete-origin fish were initially reared at Marion Drain Fish Facility before being
transferred to the Wells Fish Hatchery. In 2014, direct gamete-origin fish were transferred to Wells Fish Hatchery on the same day as spawning, immediately following fertilization.

In February 2015, the Aquatic SWG approved the White Sturgeon Collection and Stocking SOA: Brood Years 2014 to 2016, as revised, with the YN abstaining (as appended to the 2015 Aquatic Settlement Agreement Annual Report). This followed months of revisions and discussions about fish source, collection capabilities, cultural boundaries, fish health, stocking goals, and genetics, including consultation with geneticists Drs. Paul Anders (Cramer Fish Sciences/University of Idaho) and Andrea Drauch-Schreier (University of California, Davis). The final SOA captured the following common objectives expressed by Aquatic SWG members: 1) moving genes from the lower river upstream; 2) achieving a genetically based split through parental representation; and 3) meeting the stocking target of 5,000 fish per year in the first 4 years of implementation following issuance of the operating license. The SOA also stipulated that wild larval-origin fish collected between Bonneville and McNary dams be prioritized over wild larval-origin fish collected upstream of McNary Dam; however, flexibility for including at least some wild larvae from other Columbia River population segments above McNary Dam was incorporated in the SOA.

In June 2015, a total of 5,007 brood year 2014 larval-origin white sturgeon were released into the Wells Project, per the February 2015 SOA guidelines. In June 2016, a total of 5,288 brood year 2015 larval-origin white sturgeon were released into the Wells Project, per the February 2015 SOA guidelines. In 2017, brood year 2016 larval-origin white sturgeon will be released into the Wells Project, per the February 2015 SOA guidelines.

Brood Years 2017 to 2021

In 2016, the Aquatic SWG began discussing collection and stocking for the up to 15,000-fish release group in Years 5 to 10 of the FERC license. The Aquatic SWG agreed to convene a white sturgeon subgroup to further discuss the technical merits of different collection and stocking strategies. In August 2016, the subgroup convened to discuss how to approach stocking rates in the Wells Project, including how to attain a diverse age and size structure that could be supported with the available habitat. The subgroup developed an adult abundance target and inputs for a productivity simulation model that were then used to estimate the number of yearlings needed to be stocked to achieve the abundance target.
Inputs to the simulation model that were discussed and agreed to included the size of the starting population, the current level of natural recruitment, a 50-year model simulation period, expected survival, and exploitation rates. Based on model results, a general agreement was reached around targeting a population within the Wells Reservoir of approximately 1,000 to 1,100 adult white sturgeon. The target was based on adult fish upstream of the Bonneville Dam reservoir and scaling the surface area of the Bonneville Dam reservoir to the surface area of the Wells Reservoir. In September 2016, the subgroup presented the results from the white sturgeon population modeling for the Wells Project to the Aquatic SWG. The model analyzed release data from 2014 to 2016 and applied a logistic equation for a survival estimate where weight at release was the key variable. After discussing this model with the Aquatic SWG, in October 2016, the white sturgeon subgroup convened again to review the white sturgeon population model and model inputs. Findings from these discussions suggested that stocking approximately 325 fish at a weight of 200 grams each would be needed to reach the abundance target. The subgroup also generally agreed these releases will comprise larval-origin fish sourced from the Columbia River between Bonneville Dam and the United States/Canadian border (see Section 2.1.1.3). The subgroup presented these findings to the Aquatic SWG, and the Aquatic SWG agreed raising fish to the size of 300 grams each may also be possible. In early December 2016, a draft SOA was distributed for review. The Aquatic SWG discussed minor revisions, including adding a range for the stocking number. In late December 2016, a revised draft SOA was distributed to the Aquatic SWG for decision in early 2017.

2.1.1.4  Phase One White Sturgeon Management Plan Monitoring and Evaluation Study Plan

In January 2014, the Aquatic SWG approved the Phase One White Sturgeon Management Plan Monitoring and Evaluation Study Plan (as appended to the 2013 Aquatic Settlement Agreement Annual Report). In 2015, consistent with the White Sturgeon Management Plan, the first year of white sturgeon monitoring and evaluation (M&E) was conducted in the Wells Reservoir. This effort was described at length in the 2015 Aquatic Settlement Agreement Annual Report, as well as in a summary report titled Evaluations of White Sturgeon Supplementation and Management in the Wells Reservoir, 2015 (Appendix F), which was approved by the Aquatic SWG on September 14, 2016.
In 2016, the second year of white sturgeon M&E was conducted in the Wells Reservoir. In May 2016, a total of 5,288 brood year 2015 larval-origin white sturgeon were passive integrated transponder (PIT) tagged, and 50 of those fish were also acoustically-tagged. In June 2016, brood year 2015 white sturgeon were released into the Wells Project (see Section 2.1.1.3).

In July 2016, the first 25-day mark and recapture effort was conducted, and in September 2016, the second 25-day effort took place. In summary, there were a total of 723 white sturgeon captures, including 240 captures during the first effort and 483 captures during the second effort. There were 120 fish that appeared to have been recaptured more than once (i.e., two to four times during the 50-day effort). Among the total captures, approximately 88% were brood year 2013 (3-year-olds), 10% were brood year 2014 (2-year-olds), and 2% were brood year 2015 (1-year-olds). The higher catch of 3-year-olds may suggest brood year 2013 fish have higher survival than other brood years, or that 3-year-olds recruit to the capture gear better. Three wild fish were captured during the first effort, and nine wild fish were captured during the second effort, none of which were recaptures.

Also in 2016, between the two indexing efforts, a 13-day effort was conducted targeting adult wild white sturgeon. No sampling of this nature has taken place since mid-2000 relicensing studies. In summary, there were a total of 15 wild white sturgeon captures. One wild fish was a recapture from 2015 indexing, and two wild fish were recaptures from 2016 indexing (July effort). Among the wild fish captures, six were classified as adults (greater than 170 centimeters [cm] fork length), and nine fish were classified as subadults (the smallest was 70 cm, and the largest was 105 cm). Fin ray samples were obtained from all wild subadult fish for aging, as discussed and recommended in 2015. Genetic samples (DNA tissue samples) were also obtained for all wild fish, as recommended. These data will be used as baseline data to compare to in future years.

Similar to the 2015 white sturgeon M&E effort, all wild-origin fish captured during the 2016 M&E effort were given 2L (i.e., second left) scute marks to identify as wild fish in the event that the inserted PIT tag fails during the fish’s lifetime.

A summary report on the 2016 white sturgeon M&E sampling effort is expected in May 2017.
2.1.1.5   Fish Health

White Sturgeon Iridovirus

In 2013, White Sturgeon Iridovirus (WSIV) was detected in brood year 2013 larval-origin fish collected from Lake Roosevelt. WDFW, in coordination with the YN and the CCT, developed a standardized White Sturgeon Fish Health Protocol for implementation starting with brood year 2014 white sturgeon broodstock and larval collections. This protocol, which was reviewed by the Aquatic SWG, Chelan and Grant PUDs, the Spokane Tribe of Indians, and the Columbia River Inter-Tribal Fish Commission, was intended to be a document open for discussion and modification as new information becomes available. Similar to 2015, in 2016, fin tissue samples were collected from brood year 2015 larval-origin white sturgeon prior to release, and all samples came back negative for WSIV.

Brood Year 2015

In general, the overall condition of brood year 2015 white sturgeon while on station at Wells Fish Hatchery was optimal. In late December 2015 and early January 2016, there was a brief high loss localized to one tank; however, mortalities decreased shortly thereafter. Fish growth was similar to past years and was maintained to meet size targets at release throughout grow out. On February 10, 2016, the Aquatic SWG agreed to a March 1, 2016, deadline to transfer surplus brood year 2015 white sturgeon off site that were in excess of the 5,000 fish needed for the Douglas PUD White Sturgeon Program. Surplus fish were transferred to a Canadian White Sturgeon Program in Arrow Reservoir and coordinated between WDFW and Canadian Resource Professionals via the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit. The transfer deadline was needed to grow program fish to the target size at release. Overall mortalities were as expected and, in total, relatively negligible.

Brood Year 2016

Similar to 2015, in 2016, the overall condition of brood year 2016 white sturgeon while on station at Wells Fish Hatchery was optimal. However, in late September 2016, there was high loss localized to two tanks due to what appeared to be a fungus. Fish responded well to treatment, and subsequent growth was maintained on track to meet size targets at release in
Aside from the isolated high loss in September 2016, overall mortalities were as expected and, in total, relatively negligible.

2.1.1.6 Guidelines for Hatchery Rearing Juvenile Sturgeon

In early 2015, following the transfer of surplus fish off station as agreed to by the Aquatic SWG, the Aquatic SWG began discussing the selection process for Wells white sturgeon being transferred into other aquaculture programs. There was concern that selecting only the smallest fish may not be the most beneficial for Douglas PUD’s program or the receiving program. The Aquatic SWG was not aware of any specific protocols addressing this; however, it was suggested that, in the future, the Aquatic SWG should provide guidance regarding how to select fish being transferred from the Wells white sturgeon program to other programs, including making the selection as random as possible. In August 2015, the CCT provided draft guidelines for hatchery rearing of juvenile sturgeon. The guidelines proposed using an unbiased selection procedure for culling, and then holding fish and using minimum target release sizes along with staggered releases through spring and summer so that all fish are of similar size at release. The Aquatic SWG was in general agreement with the proposed guidelines; however, concern was expressed regarding capacity issues if fish were held on station for longer periods of time. The Aquatic SWG also noted that the proposal needed to be communicated with, and supported by, affected hatchery staff. In 2016, the Aquatic SWG continued discussing possibly convening to discuss guidelines for hatchery rearing of juvenile sturgeon; however, the Aquatic SWG also acknowledged that the only real way to assess the various practices is to conduct research. Considering that Douglas PUD’s program has been successful in meeting requirements, the Aquatic SWG agreed conducting research would not be warranted at this time, and suggested convening a meeting only if needed.

2.1.1.7 Outreach

Similar to 2014 and 2015, in 2016, Douglas PUD continued public outreach as a part of the White Sturgeon Management Plan and Douglas PUD White Sturgeon Outreach Plan (as appended to the 2014 Aquatic Settlement Agreement Annual Report). In early June 2016, students from Bridgeport High School participated in the release of approximately 40 yearling white sturgeon into the Wells Reservoir. Students interrogated the fish for
presence of PIT tags, recorded lengths and weights, and had an opportunity to learn about white sturgeon life history.

2.1.1.8 Planned Monitoring, Studies, and Activities in 2017

In 2017, implementation of the White Sturgeon Management Plan and white sturgeon measures outlined in FERC License Order 2149-52 will continue. The 2016 White Sturgeon Management Plan Annual Report will be submitted to FERC and the Aquatic SWG in spring 2017, which will summarize the activities and results from 2016 (appended to this 2016 Aquatic Settlement Agreement Annual Report; Appendix D). Douglas PUD will continue discussing an updated broodstock and breeding plan for a 15,000-fish release group in Years 5 to 10 of the FERC license.

2.1.2 Bull Trout

In 2016, Douglas PUD continued to identify, monitor, and address impacts, if any, on bull trout (Salvelinus confluentus) in the Wells Reservoir, as outlined in the Bull Trout Management Plan, and as required by FERC License Order 2149-52. Measures outlined in the Bull Trout Management Plan and FERC License Order 2149-52 are consistent with USFWS Terms and Conditions and Fishway Prescriptions and Ecology’s CWA Section 401 Water Quality Certification for the Wells Project.

2.1.2.1 Bull Trout Monitoring

In 2015, monitoring efforts included coordinating with regional groups, participating in bull trout recovery efforts, monitoring passage times and counts at Wells Dam fish count stations, and monitoring incidental take of bull trout at Wells Dam and off-site locations in Methow River tributaries (a coordinated effort with WDFW). Douglas PUD contractors handled more than 300 bull trout in the Methow River and Columbia River basins. The majority of these fish were adults captured in the Twisp River during a mark recapture effort for HCP actions, during screw trapping operations at the Twisp and Carlton river traps, and associated with the 2016/2017 Bull Trout Passage and Survival Radio Telemetry Study at Wells Dam and the Twisp Weir. All bull trout encountered were scanned for a PIT tag. In 2016, contractors were advised to only PIT-tag captured fish that were not carrying a PIT tag, per USFWS recommendations.
Bull trout take limits for Wells Dam and the Douglas PUD hatchery and Aquatic Settlement Agreement mitigation and monitoring programs were not exceeded in 2016, and encounters were well below average encounter levels observed in recent years. This reduction in encounters is directly attributed to the District implementing actions at the dam and Twisp Weir to reduce bull trout encounters. In addition, 252 of the bull trout encountered during the steelhead mark recapture study in the Twisp River Basin were not assigned to Douglas PUD’s bull trout take because these encounters fell under WDFW’s resource actions and associated environmental permitting.

2.1.2.2  Wells Reservoir Drawdown and Bull Trout Survey

In May 2016, the Wells Reservoir elevation was drawn down to help flush the Methow River delta to remove sediment and prevent flooding in the town of Pateros, Washington. The Bull Trout Management Plan stipulates periodic monitoring for bull trout entrapment or stranding during low Wells Reservoir elevations (i.e., below 773 feet mean sea level [MSL]). On May 3, 2016, the reservoir reached 773 feet MSL and, on May 4, 2016, Douglas PUD implemented the Bull Trout Stranding, Entrapment and Take Study Plan (as appended to the 2013 Aquatic Settlement Agreement Annual Report). Six locations known to develop stranding pools were prioritized, based on likeliness to find bull trout, and surveyed. No stranded or entrapped bull trout were observed during the survey of the six locations. On May 20, 2016, a Bull Trout Stranding and Entrapment Survey Technical Memorandum (Low Pool Elevation Bull Trout Survey – License Article 402; Appendix G) summarizing the bull trout survey was finalized and will be included in the 2016 Bull Trout Management Plan and Incidental Take Annual Report, which Douglas PUD will submit to FERC in May 2017.

2.1.2.3  2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study

In 2013, Douglas PUD was planning to implement a Passage Evaluation Study at the Twisp Weir in Year 1 of FERC License Order 2149-52; however, following consultation with USFWS and the Aquatic SWG, Douglas PUD and agency staff decided to postpone the study for 4 years to combine the study with a Bull Trout Passage Evaluation Study scheduled to take place at Wells Dam during Year 5 of the license term. Combining the two studies
results in a more comprehensive study and reduces the potential number of fish needed to conduct studies, while still addressing the objectives of both studies. FERC approved deferring the study as requested, and required that the comprehensive study be conducted by November 2017.

In 2015, Douglas PUD and USFWS, in consultation with the Aquatic SWG, began discussing study methods and the draft study plan, including conducting the study in spring 2016, monitoring for 1 full year, and then developing a report and filing it with FERC by the November 2017 deadline. This meets the requirements outlined in the *Bull Trout Management Plan*, FERC License Order 2149-52, Biological Opinion, USFWS Terms and Conditions and Fishway Prescriptions, and the Ecology CWA Section 401 Water Quality Certification for the Wells Project.

On February 10, 2016, the Aquatic SWG approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan (Appendix H). This study uses radio-telemetry to monitor bull trout and determine whether survival and passage-success rates for adult, marked bull trout are greater than 95 percent at Wells Dam and greater than or equal to 90 percent at the Twisp Weir. In July 2016, 60 adult bull trout were captured at Wells Dam (14 fish) and the Twisp Weir (46 fish). Fish were tagged with radio and PIT tags, and released at a location upstream of the Twisp Weir at the Buttermilk Creek confluence with the Twisp River. Fish were tracked via mobile tracking and by monitoring fixed-station detections. Data from fixed stations were downloaded every other week. Results of the mobile tracking and data downloads from receiver stations were reported to the Aquatic SWG during monthly meetings as the information becomes available. Monitoring of the radio tags will continue through the 2017 migration, and a final report is expected in November 2017.

2.1.2.4 *Participation in Bull Trout Recovery Planning and Regional Coordination*

In 2016, Douglas PUD participated in a number of regional meetings designed to develop recovery documents and actions for listed bull trout, with a specific emphasis on study planning for the *2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and*
Progress Toward Implementing the Agreement and Wells Project License Order

Twisp River Weir Study. These meetings were led by USFWS and took place in Wenatchee and Leavenworth, Washington. Recovery planning is expected to continue with regional stakeholders in 2017.

2.1.2.5 Planned Monitoring, Studies, and Activities in 2017

In 2017, implementation of the Bull Trout Management Plan and bull trout measures outlined in FERC License Order 2149-52 will continue. The 2016 Bull Trout Management Plan and Incidental Take Annual Report will be submitted to FERC and the Aquatic SWG in spring 2017, and will summarize the results of activities conducted in 2016 (appended to this 2016 Aquatic Settlement Agreement Annual Report; Appendix D). Douglas PUD will continue monitoring for bull trout in the Wells Reservoir and implementing the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study.

2.1.3 Water Quality

In 2016, Douglas PUD continued efforts to protect the quality of the surface waters in Wells Reservoir, as outlined in the Water Quality Management Plan, and as required by Douglas PUD’s CWA Section 401 Water Quality Certification for the Wells Project and FERC License Order 2149-52.

2.1.3.1 Total Dissolved Gas Monitoring

2015 Total Dissolved Gas Abatement Plan Annual Report

On February 18, 2016, the Aquatic SWG approved the 2015 Total Dissolved Gas Abatement Plan Annual Report (Appendix I) that summarized the 2015 fish- and non-fish spill season at Wells Dam. This report was filed with FERC on February 26, 2016.

2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan

On February 18, 2016, Ecology approved the 2016 Total Dissolved Gas Abatement Plan and Final 2016 Juvenile Fish Bypass Operating Plan (Appendix J). A 30-day review period was also provided to the Aquatic SWG and Wells HCP Coordinating Committee, and no comments were received. Spill operations for the 2016 spill season are outlined in the 2016 Spill Playbook (which is included as an appendix to the 2016 Gas Abatement Plan and Bypass
Operating Plan). This plan was filed with FERC on February 26, 2016 and was approved by the FERC on April 12, 2016.

2.1.3.2 Gas Bubble Trauma Monitoring

As part of the 2016 Gas Abatement Plan and Bypass Operating Plan, Douglas PUD is required to accompany the Gas Abatement Plan with a biological monitoring plan and, as such, is required to examine migrating salmonids for gas bubble trauma if total dissolved gas in the Wells tailrace exceeds 125% at any point during the fish spill season. In 2016, there were no 125% exceedances; therefore, no gas bubble trauma monitoring occurred.

2.1.3.3 Water Temperature Report

In 2016, as required by Douglas PUD’s CWA Section 401 Water Quality Certification and FERC License Order 2149-52, Douglas PUD drafted the 2015 Water Temperature Annual Report, which summarizes water temperature activities implemented at the Wells Project in 2015. The annual report was approved by the Aquatic SWG on April 13, 2016, and was submitted to FERC on April 29, 2016.

Water temperature monitoring activities at the Wells Project in 2016 were consistent with Douglas PUD’s CWA Section 401 Water Quality Certification to provide real-time data at www.dcpud.org at various locations, including project boundaries, within fish ladders, and above and below Wells Dam. The 2016 Water Temperature Annual Report summarizing water temperature activities implemented at the Wells Project in 2016 will be drafted and reviewed and approved by the Aquatic SWG in early 2017 (appended to the 2016 Water Quality Management Plan Annual Report; Appendix D).

2.1.3.4 Total Dissolved Gas Reduction Alternative Analysis

In 2014, as required by Douglas PUD’s CWA Section 401 Water Quality Certification and FERC License Order 2149-52, Douglas PUD drafted a Total Dissolved Gas Reduction Alternative Analysis, which considers and discusses alternative structural and operational modifications at the Wells Project that might be made in order to obtain compliance with water quality standards, specifically total dissolved gas standards. In December 2014, Ecology requested additional time to review the document, and the Aquatic SWG approved
the document, contingent on approval from Ecology. On January 22, 2016, Ecology provided a letter to Douglas PUD approving Douglas PUD’s *Total Dissolved Gas Reduction Alternatives Analysis* (Appendix K), and the final analysis was filed with FERC on March 15, 2016.

### 2.1.3.5 Wells Project Water Forecast Tracking

In 2016, Douglas PUD continued providing the Aquatic SWG with routine updates on the 2016 water forecast for the Wells Project. Douglas PUD began providing these updates following the below-average snowpack and subsequent drought conditions experienced west of the Cascade Mountains in 2015. Most of the water in the Wells Reservoir originates from snowpack in British Columbia, Canada; therefore, water conditions for the Wells Reservoir are somewhat different than those experienced west of the Cascade Mountains. Nevertheless, Douglas PUD and the Aquatic SWG remained interested in closely tracking water forecasts in terms of potential impacts to water quality and other aquatic resources in the Wells Reservoir. The 2016 water year was characterized by a warm spring and above-average flows observed at Wells Dam in April, with a reduced and below-average freshet in the months of May through July.

### 2.1.3.6 2016 Wells Project Water Quality Updates

In August 2016, Douglas PUD provided an update on Wells Project total dissolved gas levels in 2016, observed to date, as requested by WDFW. In December 2016, Douglas PUD also provided a review of Wells Project water quality for the 2016 water season. The updates included a review of Washington State standards for total dissolved gas, a summary of Wells Project flow data compared to the 10-year average, daily average total dissolved gas values, and total dissolved gas compliance to date.

### 2.1.3.7 Planned Monitoring, Studies, and Activities in 2017

In 2017, implementation of the *Water Quality Management Plan* and water quality measures outlined in Douglas PUD’s CWA Section 401 Water Quality Certification for the Wells Project and FERC License Order 2149-52 will continue. The *2016 Water Quality Management Plan Annual Report* will be submitted to FERC and the Aquatic SWG in spring
2.1.4 Pacific Lamprey

In 2016, Douglas PUD continued efforts to monitor and address impacts, if any, to Pacific lamprey (*Entosphenus tridentatus*) in the Wells Reservoir, as outlined in the Pacific Lamprey Management Plan, and as required by FERC License Order 2149-52.

2.1.4.1 Pacific Lamprey Studies

2013 Adult Pacific Lamprey Passage and Enumeration Study

In October 2012, the Aquatic SWG approved the *Adult Lamprey Passage and Enumeration Study Plan* (as appended to the *2012 Aquatic Settlement Agreement Annual Report*) for implementation in 2013. The study plan, developed by Douglas PUD and Longview Associates, employed active tagging of translocated adult Pacific lamprey to assess Pacific lamprey passage (Protection, Mitigation, and Enhancement [PME] measure 4.1.6 in the Pacific Lamprey Management Plan), and enumeration (PME measure 4.1.3 in the Pacific Lamprey Management Plan) at Wells Dam. Study fish were obtained from Priest Rapids Dam and Bonneville Dam to boost sample size and allow preliminary analysis of fish source. Pacific lamprey were released 1.5 miles below Wells Dam, and a subset of each release group was also placed directly into the fish ladder to increase the chances of fish interaction with the count window, which had 18-inch-wide aluminum ramps installed on the upstream and downstream face of the fish-count louvers to test improved enumeration. Alternating head differentials over weirs were also employed in the Wells Dam collection gallery as treatments in the study. Fixed-station radio telemetry receivers and associated arrays for monitoring tagged fish were deployed at a number of locations within the Wells Project fishways and also located at the mouths of the Okanogan and Methow rivers.

In September 2014, following several stages of review and revisions, the *2013 Adult Lamprey Passage and Enumeration Study Report* (as appended to the *2014 Aquatic Settlement Agreement Annual Report*) was approved by the Aquatic SWG. Overall, conclusions were limited because of small sample sizes; however, the key findings were: 1) the reduction of head differential from 1.5 feet to 1 foot did not significantly improve Pacific lamprey
entrance efficiency, based on the limited evidence available; 2) low passage efficiency within
the ladder appears to be problematic; and 3) the ramps installed on the upstream and
downstream face of the fish count louvers did not seem to significantly improve
Pacific lamprey enumeration. The following recommendations were made for the 2015
study: 1) increase the number of study fish and hence sample size; 2) reduce holding and
handling times of study fish; 3) ensure collection of fish that meet or exceed minimum size
criteria for established tag-burden thresholds; 4) establish downstream radio telemetry
detection gateways to determine when tagged Pacific lamprey leave the study area; and
5) install additional antennas in collection galleries, lower fishways, and the auxiliary water
supply system to increase data resolution in those areas.

2015 Adult Pacific Lamprey Passage and Enumeration Study

In November 2014, the Aquatic SWG approved the Adult Lamprey Passage and Enumeration
Study Plan (as appended to the 2014 Aquatic Settlement Agreement Annual Report) for
implementation in 2015. Key components of the 2015 study plan included: 1) reopening the
low-level fishway entrances on the sides of the Wells Dam collection galleries and installing
a box structure (lamprey entrance box) to provide a lower velocity entrance route for Pacific
lamprey passage, while also excluding salmonid species from accessing that entrance;
2) increasing sample size and statistical power to identify whether there is a passage issue in
the lower ladder; and 3) investigating additional antenna locations throughout the auxiliary
water supply system.

Design and fabrication of the lamprey entrance boxes began in September 2014; however,
due to a series of unavoidable delays, assembling the boxes took longer than anticipated and
installation of the lamprey entrance boxes would have required an unacceptable extension of
the 2014/2015 winter maintenance outage of the fishways at Wells Dam. Based on the early
timing of the 2015 spring Chinook salmon run and the expectation that steelhead
(Oncorhynchus mykiss) overwintering in the mainstem Columbia River may start migrating
early due to warmer water temperatures, in April 2015 the Wells HCP Coordinating
Committee elected not to approve such an extension. As such, installation of the lamprey
entrance boxes was deferred until the 2015/2016 maintenance period, and the 2015 Adult
Pacific Lamprey Passage and Enumeration Study was also deferred to 2016.
2016 Adult Pacific Lamprey Approach, Passage, and Enumeration Study

On February 10, 2016, the 2016 Adult Lamprey Approach, Passage, and Enumeration Study Plan (Appendix L) was approved by the Aquatic SWG for implementation in 2016. The 2016 study shifts from using active radio telemetry, as with earlier studies to evaluate passage at Wells Dam, to a broader Pacific lamprey approach study using acoustic and PIT tags. Douglas PUD had been operating under the assumption that fish will approach and pass Wells Dam; however, this may not be a valid assumption. The goal of the 2016 Pacific Lamprey Approach, Passage, and Enumeration Study was to use acoustic and PIT-tag methodologies to assess this assumption and determine how to appropriately evaluate passage at Wells Dam in the future. In August 2016, 51 Pacific lamprey collected at Priest Rapids Dam were acoustically and PIT tagged by Douglas PUD, and released 0.8-mile upstream of Rocky Reach Dam on the Chelan County side of the reservoir. Between Grant, Chelan, and Douglas PUDs, just fewer than 500 PIT-tagged fish and 151 acoustic and PIT-tagged fish (including 51 from Douglas PUD and 100 from Grant PUD) were released in the Mid-Columbia River in 2016. Results from this year’s study will be summarized in a report, expected to be available in 2017.

2.1.4.2 Pacific Lamprey Study Modifications

Wells Dam Low-level Side Entrance Modifications

In September 2014, the Aquatic SWG began discussing reopening the low-level side entrances of the Wells Dam collection galleries (referred to as the C-channel) to provide a lower velocity route for Pacific lamprey passage, as part of the 2015 Adult Pacific Lamprey Passage and Enumeration Study. The C-channel is located near the entrance to Weir 1 at Wells Dam and runs across the face of the dam and provides a low-level entrance to the collection gallery. Historically, the C-channel and side entrance were open for salmon passage, with the assumption that fish would be attracted to the turbine outlets, and these passage routes would provide a channel through the collection gallery. However, fish ultimately utilized one entrance, and then cycled through the collection gallery and exited via the other entrance; therefore, both entrances were closed, and have been closed for years.

Douglas PUD engineers coordinated with the National Marine Fisheries Service (NMFS) in investigating reopening the C-channel and determining what kind of velocities would be
present if the entrances were to be opened. They also investigated how those velocities would affect Pacific lamprey swimming performance and potentially affect salmonid passage. The Wells HCP Coordinating Committee also discussed potential impacts to salmonid passage.

In addition to reopening the C-channel, Douglas PUD proposed installing a fiberglass box (“lamprey entrance box”) to help make the entrance more conducive to Pacific lamprey passage. Douglas PUD discussed the design of this box with the Wells HCP Coordinating Committee, and specifically with NMFS engineering staff, regarding salmonid passage. In November 2014, after months of discussions and design revisions to the lamprey entrance box, the Aquatic SWG and Wells HCP Coordinating Committee approved the proposed modifications to improve Pacific lamprey passage in the collection gallery at Wells Dam.

In early 2015, the low-level side entrances of the Wells Dam collection galleries were reopened, as approved by the Aquatic SWG and Wells HCP Coordinating Committee. However, due to a series of unavoidable delays, installation of the lamprey entrance boxes would have required an unacceptable extension of the 2014/2015 winter maintenance outage at Wells Dam, and therefore, was deferred until the 2015/2016 maintenance period. Subsequently, the low-level side entrances were closed and the 2015 Adult Pacific Lamprey Passage and Enumeration Study was deferred to 2016.

Wells Dam Count Window Modification
The 2015 Adult Pacific Lamprey Passage and Enumeration Study included installing lamprey enumeration structures at the count windows at Wells Dam to provide a darker area with lower velocities to assist Pacific lamprey passage, while still facilitating enumeration. Despite the new strategy proposed for a Pacific lamprey study in 2016, Douglas PUD still planned to install the structures during the 2015/2016 maintenance period at Wells Dam. In August 2015, the Wells HCP Coordinating Committee reviewed the engineering design drawings of the lamprey enumeration structures, and determined that salmon passage would not be impacted by the proposed lamprey modifications. Therefore, the Wells HCP Coordinating Committee approved installation of the proposed structures.
Completed Modifications
During the 2015/2016 adult fishway maintenance period at Wells Dam, the approved temporary modifications to the fishways at Wells Dam were completed, including reopening the low-level side entrances, and installation of the lamprey entrance boxes and PIT-tag detectors on the lamprey entrance boxes. Nylon brush-strips were also installed to close gaps used by Pacific lamprey to bypass the count windows, and the radio telemetry antennas were inspected throughout the fishways. Installation of lamprey enumeration structures was planned for both fishways during the 2015/2016 winter fishway maintenance at Wells Dam; however, due to issues associated with obtaining construction materials and fabricating the structures, only one structure was installed in the west fishway.

In 2016, it was discovered that the lamprey enumeration structure installed in the west fishway was mistakenly constructed with a larger count tunnel and exit than was specified in the design (see Section 3.1.1.2). In August 2016, the tunnel and exit components of the enumeration structure were removed, modified, and reinstalled. An enumeration structure with correct entrance and exit dimensions was constructed for installation in the east fish ladder; however, it has not yet been installed. During the 2016/2017 fishway maintenance period, the modified lamprey enumeration structure was removed due to problems associated with the collection of debris and risk of trapping small fish. Douglas PUD is working on a solution to these issues.

2.1.4.3 Juvenile Pacific Lamprey Habitat Evaluation Study
In April 2015, Douglas PUD provided a Draft 2015 Juvenile Lamprey Habitat Evaluation Study Plan Report for review. The study plan aimed to identify and quantify potential juvenile Pacific lamprey habitat in the Wells Project, including documenting presence or absence of Pacific lamprey in specific areas of the Wells Project. The proposed timing of the study also partially aligned with the drawdown of the Wells Reservoir planned for September 2015, so that Douglas PUD could take advantage of the lower reservoir conditions and access areas typically not available to the survey. Following in-depth discussions regarding the statistical design of the study, including sample locations, elevations, and duration, in June 2015, the Aquatic SWG approved the 2015 Juvenile Lamprey Habitat Evaluation Study Plan Report.
From July to November 2015, multiple sites were surveyed four times each, including one survey that was conducted while the Wells Reservoir elevation was drawn down. Suitable juvenile Pacific lamprey habitat was limited in the littoral zone of the Wells Reservoir. Where suitable habitat was present, it was frequently interspersed among unsuitable habitat. During juvenile Pacific lamprey presence/absence sampling, no juvenile Pacific lamprey were observed. These results and other details from this effort are further described in the 2015 Juvenile Pacific Lamprey Habitat Evaluation Study Plan Report (Appendix M), which was approved by the Aquatic SWG on February 10, 2016.

2.1.4.4 Regional Coordination

In 2016, Douglas PUD continued participation in regional efforts to coordinate Pacific lamprey investigations. These discussions are expected to continue in 2017.

Translocation

In 2015, the Aquatic SWG and Douglas, Chelan, and Grant PUDs began discussing potential regional adult Pacific lamprey translocation opportunities in the Wells Reservoir. Douglas PUD indicated support of this idea assuming the Aquatic SWG also supported the proposed activities and, after having a thorough discussion, had reached consensus regarding associated risks and possible genetic issues. The proposed activities would also need to be consistent with Pacific lamprey requirements outlined in the Agreement and other applicable permitting and licensing documents.

In 2016, discussions about a translocation program in the Wells Reservoir continued. The Aquatic SWG discussed YN Pacific lamprey translocation efforts in the Upper Columbia Basin conducted to date, as well as future translocation plans, as outlined in the Draft YN Pacific Lamprey Supplementation and Monitoring Frameworks. The 2016 Regional Pacific Lamprey Workshop (see expanded discussion of the workshop below), held on June 8, 2016, included a translocation component that briefly touched on genetics, program feasibility, and fish source topics. The Aquatic SWG began discussing possibly requesting a presentation on respective Pacific lamprey translocation efforts from the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe. Other translocation topics discussed in 2016 included testing of juvenile and adult pheromones as migration cues for adult Pacific lamprey.
and gaining a better understanding of factors limiting the overall productivity of the species. In December 2016, planning was underway for a Pacific Lamprey Workshop to take place in early 2017, which will include review of YN and CCT translocation policies and activities.

Passage Metrics

In May 2016, USFWS noted that other regional fish forums have begun discussing how to determine the best passage metrics to compare projects, and suggested the Aquatic SWG also begin these discussions. The Aquatic SWG agreed this topic is worthwhile, and Douglas PUD indicated openness to such a discussion, using the Pacific Lamprey Management Plan to guide the process. USFWS and Douglas PUD also agreed the topic will be challenging and acknowledged a passage standard may not be reached due to the unique life history of Pacific lamprey.

2016 Regional Pacific Lamprey Workshop

On June 8, 2016, a Regional Pacific Lamprey Workshop was held to address scientific uncertainties regarding the causes of poor adult Pacific lamprey passage over Wells Dam and to facilitate regional collaboration in addressing Pacific Lamprey in the Mid-Columbia River Basin (Appendix N). The workshop convened members of the Aquatic SWG, Rocky Reach Fish Forum, and Priest Rapids Fish Forum, as well as regional expert guest presenters. Discussions began with a review of Wells and Rocky Reach dams’ respective FERC license requirements and results of prior research and passage-improvement actions. The workshop focused mostly on identifying and discussing critical uncertainties, including approach behavior, limitations, propagation or translocation, presence and premature mortality, fish size (energetics), spawn timing, fish collection, survival models, tag types, and threedimensional detection. This workshop was the first of several discussions aimed at improving the Pacific lamprey resource within the respective jurisdictions of Grant, Chelan, and Douglas PUDs.

2.1.4.5 Planned Monitoring, Studies, and Activities in 2017

In 2017, implementation of the Pacific Lamprey Management Plan and Pacific lamprey measures outlined in FERC License Order 2149-52 will continue. The 2016 Pacific Lamprey Management Plan Annual Report will be submitted to FERC and the Aquatic SWG in
spring 2017, and will summarize the activities and results of 2016 (appended to this 2016 Aquatic Settlement Agreement Annual Report; Appendix D). Results from the 2016 Pacific Lamprey Study are expected to be available to inform another Pacific Lamprey Workshop that will be convened in early 2017.

2.1.5 Aquatic Nuisance Species

In 2016, Douglas PUD continued aquatic nuisance species monitoring, as outlined in the Aquatic Nuisance Species Management Plan, and as required by Douglas PUD’s CWA Section 401 Water Quality Certification for the Wells Project and FERC License Order 2149-52.

2.1.5.1 Crayfish

In 2016, two non-native northern crayfish (Astacoidea) were captured at two of five locations throughout the Wells Reservoir during annual crayfish monitoring on October 11. This monitoring effort utilized backpack electrofishing as the sampling method.

2.1.5.2 Zebra/Quagga Mussels and Macrophytes.

In 2016, Douglas PUD coordinated zebra mussel (Dreissena polymorpha) and quagga mussel (D. bugensis) monitoring with WDFW. On three separate occasions, monitoring consisted of plankton net tows for mussel veligers at three locations and the inspection of artificial substrates at three locations in the Wells Reservoir. In addition, shoreline surveys for zebra and quagga mussels were initiated during the October sampling at each of the three monitoring locations; the surveys will continue in 2017. Samples collected during zebra and quagga mussel monitoring were sent to Cameron Lange Environmental Services, in Wheatfield, New York for analysis. Results from sample analysis determined that neither species was detected at any of the sites monitored in the Wells Project in 2016, and these results were provided to WDFW.

In November 2016, WDFW provided a presentation to the Aquatic SWG about the benefits of shoreline surveys for zebra and quagga mussels for early detection monitoring. In 2016, Douglas PUD continued conducting these shoreline surveys, as done in previous years.
2.1.5.3 **Eurasian Milfoil**

On July 18, 2016, aquatic herbicide was applied at swimming areas at Pateros Park, Columbia Cove Park (Brewster), and Marina Park (Bridgeport) to control aquatic macrophytes. The aquatic herbicide used was Tribune™ (the active ingredient is diquat bromide). The control efforts were successful, and no re-application of herbicide was required for the remainder of 2016. This was the third year the herbicide was used successfully in these areas. Based on spot surveys of the species composition of macrophyte communities in these areas, the concentration of Eurasian watermilfoil has not changed.

2.1.5.4 **Planned Monitoring, Studies, and Activities in 2017**

In 2017, implementation of the *Aquatic Nuisance Species Management Plan* and aquatic nuisance species measures, outlined in Douglas PUD’s CWA Section 401 Water Quality Certification for the Wells Project and FERC License Order 2149-52, will continue. The *2016 Aquatic Nuisance Species Management Plan Annual Report* will be submitted to FERC and the Aquatic SWG in spring 2017 and will summarize the activities and results of 2016 (appended to this *2016 Aquatic Settlement Agreement Annual Report; Appendix D*).

2.1.6 **Resident Fish**

In 2016, Douglas PUD continued efforts to protect and enhance native resident fish populations and habitat in the Wells Reservoir, as outlined in the *Resident Fish Management Plan*, and as required by FERC License Order 2149-52.

2.1.6.1 **Northern Pikeminnow Removal**

In 2016, Douglas PUD continued to implement northern pikeminnow (*Ptychocheilus oregonensis*) removal efforts in the Wells Reservoir and tailrace. These efforts resulted in the removal of 13,362 northern pikeminnow from April to November 2016. Incidental captures of other resident fish species were also monitored and recorded during these efforts.

2.1.6.2 **Planned Monitoring, Studies, and Activities in 2017**

In 2017, implementation of the *Resident Fish Management Plan* and resident fish measures outlined in FERC License Order 2149-52 will continue. The *2016 Resident Fish*
Management Plan Annual Report will be submitted to FERC and the Aquatic SWG in spring 2017, which will summarize the activities and results of 2016 (appended to this 2016 Aquatic Settlement Agreement Annual Report, Appendix D). Douglas PUD will also continue northern pikeminnow control activities.
3 AGREEMENT ADMINISTRATION

This section lists events of note that occurred in 2016 related to the administration of the Agreement, and lists reports published in 2016 that relate to the Aquatic SWG.

3.1 Habitat Conservation Plan Coordination

In 2016, the Aquatic SWG continued coordination with the Wells HCP Coordinating Committee, as needed, and as required by FERC License Order 2149-52 and Douglas PUD’s CWA Section 401 Water Quality Certification for the Wells Project.

3.1.1 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan

The 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan was developed collaboratively by the Aquatic SWG and Wells HCP Coordinating Committee (see Section 2.1.3.1). Both work groups approved the document prior to filing with FERC.

3.1.2 2016 Adult Pacific Lamprey Passage and Enumeration Study

In 2016, fish counters at Wells Dam observed sockeye salmon (Oncorhynchus nerka) entering the lamprey enumeration structure, which was installed in the west fishway for the 2016 Adult Pacific Lamprey Passage and Enumeration Study. Wells Dam staff removed the upper portion of the enumeration structure, modified it, and replaced it in August 2016, between the sockeye salmon and steelhead runs (see Section 2.1.4.2). An enumeration structure with correct entrance and exit dimensions is also ready to be installed in the east fish ladder.

3.2 Wells Dam Site Visits

Each year, Douglas PUD extends an invitation to the Aquatic SWG, and other interested parties, to tour the Wells Dam fishway while a ladder is dewatered for annual winter maintenance. This provides an opportunity to view components of the fishway frequently discussed throughout the year while implementing the Agreement and aquatic resources management plans, including any modifications that may be under discussion. This tour is also typically coupled with an in-person Aquatic SWG monthly meeting. Douglas PUD also
consistently offers and accommodates site visits and tours of locations within the Wells Project, as the opportunities arise or are requested.

In 2016, Douglas PUD hosted a tour of the Wells Dam east fishway on February 10, 2016, coupled with an in-person meeting. Douglas PUD and members of the Aquatic SWG toured the dewatered east fish ladder, including the lamprey enumeration system at the count window and the low-level entrance where the lamprey entrance boxes were going to be installed later during the maintenance outage). The tour also included a visit to the Wells Fish Hatchery to see the white sturgeon facility and the size of the broodstock that would be released later in 2016.

3.3 Agreement Rules and Regulations Refresher

In 2016, the Aquatic SWG reviewed the Agreement rules and regulations on three occasions as a refresher on the document approval process. This refresher was intended to help facilitate implementation of stipulations outlined in FERC License No. 2149, including development of a clearer consultation record. Rules and regulations reviewed included guidelines about review periods and submitting comments, and expected absences and abstentions with regard to voting.

3.4 Aquatic Settlement Work Group Members

A designated technical representative and a separate designated policy representative for each of the parties make up the Aquatic SWG, as established under the Agreement. The Aquatic SWG meets collectively to expedite the process for overseeing and guiding the implementation of the Agreement. The policy representatives will meet at least once a year during the term of FERC License Order 2149-52 to review progress and implementation of the Agreement. Minutes from the monthly meetings are compiled in Appendix A of this report. Appendix B lists current members of the Aquatic SWG.
3.5 Agreement-related Publications in Calendar Year 2016

The following documents were finalized by the Aquatic SWG in 2016:

4 REFERENCES


APPENDIX A
AQUATIC SETTLEMENT WORK GROUP
2016 MEETING MINUTES AND
CONFERENCE CALL MINUTES
The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, January 13, 2016, from 10:00 a.m. to 11:15 a.m. Attendees are listed in Attachment A of these meeting minutes.

I. Summary of Action Items

<table>
<thead>
<tr>
<th>Documents for Approval on February 10, 2016</th>
<th>Review Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report</td>
<td>1/19/2016</td>
</tr>
<tr>
<td>Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan</td>
<td>1/19/2016</td>
</tr>
<tr>
<td>Draft 2016 Wells Dam Gas Abatement Plan and Bypass Operating Plan</td>
<td>2/8/2016</td>
</tr>
<tr>
<td>Draft 2016 Aquatic Settlement Agreement Action Plan</td>
<td>2/10/2016</td>
</tr>
</tbody>
</table>

Note:
See Section IV for more details.

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCTs’) proposed criteria for culling juvenile white sturgeon and report back to the Aquatic SWG (Item VI-1).
2. Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS; Item VI-1).
3. Andrew Gingerich will coordinate with Kristi Geris to distribute details regarding the next Aquatic SWG meeting on February 10, 2016, to be held in-person at Wells Dam in
4. Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-10).

5. The Aquatic SWG meeting on February 10, 2016, will be held **in-person at Wells Dam** in Wenatchee, Washington (Item VII-1).

II. **Summary of Decisions**

1. The Washington State Department of Ecology (Ecology) provided a letter to Douglas PUD on January 22, 2016, approving Douglas PUD’s Total Dissolved Gas (TDG) Reasonable and Feasible Analysis (Attachment B), which was approved by the other Aquatic SWG Technical Representatives on December 10, 2014, contingent on approval by Ecology.

III. **Agreements**

1. There were no agreements discussed during today’s conference call.

IV. **Review Items**

1. Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying them that the Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report is available for a 45-day review period, with edits and comments due to Chas Kyger by Tuesday, January 19, 2016 (Item VI-9).

2. Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying them that the Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan is available for a 45-day review period, with edits and comments due to Chas Kyger by Tuesday, January 19, 2016 (Item VI-8). *(Note: Following a coordination call with members of the Aquatic SWG on February 1, 2016, Kyger provided a second Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan on February 5, 2016, which Geris distributed to the Aquatic SWG that same day.)*

3. Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying them that the Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan is available for a 30-day review period, with edits and comments due to Andrew Gingerich by Monday, February 8, 2016 (Item VI-7).

4. Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying them that the Draft 2015 Wells Dam Gas Abatement Plan (GAP) and TDG Report and Draft 2016 Wells Dam GAP and Bypass Operating Plan (BOP) were available for a 30-day review period, with edits and comments due to Andrew Gingerich by Monday, February 8, 2016 (Item VI-4).

5. Kristi Geris sent an email to the Aquatic SWG on January 12, 2016, notifying them that the Draft 2016 Aquatic Settlement Agreement (ASA) Action Plan is available for a 30-day review period, with edits and comments due to Andrew Gingerich by Monday, February 8, 2016 (Item VI-6).
period, with edits and comments due to Andrew Gingerich by Wednesday, February 10, 2016 (Item VI-2).

6. Kristi Geris sent an email to the Aquatic SWG on February 8, 2016, notifying them that the Draft 2015 Aquatic Nuisance Species Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Tuesday, March 8, 2016.

V. Documents Finalized

1. The Douglas PUD TDG Reasonable and Feasible Analysis was finalized following receipt of Ecology’s approval letter, and was redistributed to the Aquatic SWG by Kristi Geris on January 25, 2016 (originally distributed November 10, 2014).

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

   (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. Ferguson reviewed the agenda and asked for additions or other changes to the agenda. No additions or changes were requested.

   The revised draft December 9, 2015, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. She said she also added the Draft 2015 Wells Dam GAP and TDG Report, Draft 2016 Wells Dam GAP and BOP, and Draft 2016 ASA Action Plan under the review items. Aquatic SWG members present approved the December 9, 2015, conference call minutes, as revised.

   Ferguson reviewed action items from the last Aquatic SWG conference call on December 9, 2015, and follow-up discussions were as follows (note: italicized item numbers below correspond to agenda items from the December 9, 2015, meeting):

   - **Bob Rose will provide the Draft YN Pacific Lamprey Supplementation and Monitoring Frameworks to Kristi Geris for distribution to the Aquatic SWG (Item VI 1).** This will be discussed during today’s conference call.
   
   - **Bob Rose will discuss internally the CCT’s proposed criteria for culling juvenile white sturgeon and report back to the Aquatic SWG during the conference call on January 13, 2016 (Item VI-1).**

     Rose said he sent a message to Donella Miller (YN); however, he has not yet been able to discuss the proposed criteria with her. This action item will be carried forward.

   - **Bob Rose will provide details on the recent YN lamprey translocation releases in the Methow Basin, including details regarding monitoring and evaluation (M&E) planning, during the Aquatic SWG conference call on January 13, 2016 (Item VI-1).**
This will be discussed during today’s conference call.

- Douglas PUD will provide the Draft 2015 Wells Dam GAP and TDG Report and Draft 2016 Wells Dam GAP and BOP to Kristi Geris by January 8, 2016, for distribution to the Aquatic SWG, for a 30-day review, with approval of the documents scheduled for the Aquatic SWG meeting on February 10, 2016 (Item VI-2).

  Andrew Gingerich provided the draft 2015 report and draft 2016 study plan to Geris on January 5, 2016, which Geris distributed to the Aquatic SWG that same day.

- Douglas PUD will provide the Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan to Kristi Geris by January 8, 2016, for distribution to the Aquatic SWG, for a 30-day review, with approval of the plan scheduled for the Aquatic SWG meeting on February 10, 2016 (Item VI-3).

  Andrew Gingerich provided the draft study plan to Geris on January 5, 2016, which Geris distributed to the Aquatic SWG that same day.

- Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to a Section 7 consultation with the USFWS (Item VI-4).

  This action item will be carried forward.

- Discussion on potential lamprey translocation and tagging opportunities will continue during the Aquatic SWG conference call on January 13, 2016 (Item VI-4).

  This will be discussed during today’s conference call.

- The Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan will be discussed during the Aquatic SWG conference call on January 13, 2016 (Item VI-4).

  This will be discussed during today’s conference call.

2. Draft 2016 ASA Action Plan (Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 12, 2016, notifying them that the Draft 2016 ASA Action Plan is available for a 30-day review period, with edits and comments due to Gingerich by Wednesday, February 10, 2016. Gingerich said the action plan is not required under the Federal Energy Regulatory Commission (FERC) license for the Wells Project; rather, Douglas PUD develops the plan each year as a courtesy to the Aquatic SWG so members know what to expect in the year to come and can review and comment on the timeline and content of scheduled activities. He said the action plan also lays out a schedule of activities, which helps Douglas PUD anticipate contracting and other preparations.

  Gingerich said the plan is organized in six sections that correspond to each ASA Management Plan, which is consistent with past years. Gingerich highlighted a few items as follows:

  **ASA White Sturgeon Management Plan**

  **B9. Develop a draft broodstock and breeding plan for Years 5 to 10 – August 2016**
Gingerich said 2016 is the final year of the Phase I juvenile white sturgeon collection effort, and this year, the Aquatic SWG needs to begin discussing how to stock the remaining 15,000 fish in Years 5 to 10. John Ferguson asked if a step needs to be added for Aquatic SWG approval of the broodstock and breeding plan prior to FERC submittal. Gingerich agreed and said he would incorporate that step.

ASA Bull Trout Management Plan
Gingerich noted that the Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan is currently out for review.

ASA Water Quality Management Plan
D5. 2016 GAP and BOP Draft for review – January 2016
Gingerich noted that the Draft 2015 Wells Dam GAP and TDG Report and Draft 2016 Wells Dam GAP and BOP are currently out for review.

ASA Pacific Lamprey Management Plan
E4. 2016 Pacific Lamprey Approach, Passage, and Enumeration Study Plan – Aquatic SWG approval in February 2016
Gingerich noted that the Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report and Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan are currently out for review.

ASA Resident Fish Management Plan
Ferguson asked if a step needs to be added for Aquatic SWG approval of the 2015 Pikeminnow Report prior to FERC submittal. Chas Kyger explained that formal approval of pikeminnow materials is the purview of the Wells Habitat Conservation Plan (HCP) Coordinating Committee; therefore, Aquatic SWG approval is not needed.

3. **Wells Dam Fishway Maintenance and Site Visit** (Andrew Gingerich): Andrew Gingerich said the annual winter maintenance at Wells Dam is on schedule to rewater the west fishway by the end of this week and dewater the east fishway by early February 2016. Gingerich said this presents an opportunity for a tour of the Wells Dam fishway coupled with an in-person meeting for the Aquatic SWG meeting on February 10, 2016. He said he needs to obtain an official maintenance schedule from Wells Dam staff; however, he believes a tour can be accommodated.
John Ferguson, said last year, he had the opportunity to tour the dewatered fish ladder and view the low-level entrance where the lamprey entrance boxes will be installed and also the lamprey enumeration system at the count window. He said it was very helpful to see. He asked about maintenance schedule dates, and Chas Kyger said dewatering and a fish salvage is scheduled the first week in February 2016; then the ladder will be dewatered until after the Aquatic SWG meeting on February 10, 2016. Gingerich said Wells Dam staff will likely accommodate a tour request; however, the sooner the request, the better. He suggested convening the meeting at Wells Dam from 10:30 a.m. to 12:00 p.m., take lunch from 12:00 to 12:30 or 1:00 p.m., and then participate in the tour from 1:00 to 2:00 p.m., approximately. He said a caravan can leave from Douglas PUD Headquarters in East Wenatchee, Washington, or Aquatic SWG members can meet at Wells Dam. He also noted that a Wells Dam site visit and in-person meeting can always wait until it works best for Aquatic SWG members’ schedules.

Patrick Verhey agreed an in-person meeting is long overdue; however, he is not yet certain February 2016 is the best time for his schedule. He added that an in-person meeting may be more convenient in a couple of months. Bob Rose and Ferguson said an in-person meeting in February 2016 works for their schedules. Gingerich said he will coordinate with Kristi Geris to distribute details regarding the next Aquatic SWG meeting on February 10, 2016, to be held in-person at Wells Dam in Wenatchee, Washington. (Note: Gingerich provided these details to Geris on January 29, 2016, which Geris distributed to the Aquatic SWG that same day.)

4. Draft 2015 Wells Dam GAP and TDG Report and Draft 2016 Wells Dam GAP and BOP

(Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying them that the Draft 2015 Wells Dam GAP and TDG Report and Draft 2016 Wells Dam GAP and BOP were available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 8, 2016. Gingerich recalled that the 2015 report summarizes water quality compliance throughout the past year, and the 2016 plan provides a path forward in terms of operation, safety, and spill implemented at the Wells Project in the coming year. He said both documents are due to FERC at the end of February 2016, and Douglas PUD is requesting approval of both documents during the Aquatic SWG meeting on February 10, 2016, in order to develop the consultation record to FERC by the submittal deadline. He said the 2016 plan is similar to last year, and because river flow was so low in 2015, the 2015 report is straightforward with nothing out of the ordinary to note.

Bob Rose asked if Douglas PUD has received feedback from Ecology regarding review of this report. Patrick Verhey noted that during the last Rocky Reach Fish Forum (RRFF) meeting, Charlie McKinney notified the RRFF that Anna Harris accepted a different position and will no longer be the Ecology Technical Representative on the various fish forums. Verhey said Ecology is once again beginning the process of searching for a new Ecology Clean Water Act Section
401/Hydroprojects Manager. Gingerich said Douglas PUD will be working directly with McKinney regarding Ecology approval of both the 2015 Wells Dam GAP and TDG Report and 2016 Wells Dam GAP and BOP. Gingerich noted that Ecology’s review and approval of the 2016 plan is required in order to adjust the TDG standard for the fish bypass season.

5. **2016 Water Year** (Andrew Gingerich): Andrew Gingerich said he provided an email containing water data (Attachment C) to Kristi Geris on January 7, 2016, which Geris distributed to the Aquatic SWG that same day. Gingerich explained that the first figure in the email depicts observed (2015) and average (since 1969) monthly river flow at Wells Dam, which, he noted, is also discussed in the 2015 Wells Dam GAP and TDG Report. He said that the freshet historically occurs from about May to July 2015; however, in 2015 flow was well below average for those months. He also noted the fairly wet spring relative to historical norms. He said the second part of that email includes a 3-month prediction released by the National Oceanic and Atmospheric Administration, which predicts a warmer, dryer Pacific Northwest and a wetter California from January to March 2016 (based on a 30-year average). He said this prediction was somewhat surprising considering the above-average precipitation the region has received in December 2015 and January 2016 to date.

6. **Wells White Sturgeon Rearing Update** (Andrew Gingerich): Andrew Gingerich said, as of January 1, 2016, there were about 7,700 larval-origin white sturgeon on station at Wells Dam for the 5,000-fish program. He said, during the first week of December 2015, there was a surprising 900-fish loss. He said more than half the loss came from two tanks holding the smallest fish. He said once fish reach about 25 to 30 grams in weight, they become more resilient and rearing mortality precipitously declines. He said, during the last 2 weeks of December 2015, there were essentially zero mortalities. He said Donella Miller distributed to the RRFF and Priest Rapids Fish Forum fish size data for fish on station at Marion Drain. He said, on average, fish on station at Marion Drain weigh about 58 grams each. He said, comparatively, fish on station at Wells Dam weigh about 41 grams each, which is 30% smaller than fish at Marion Drain. He said this is not surprising, because when larval-origin white sturgeon are brought on station at Wells Dam, they are kept on fairly cold water for 3 months to help improve survival and feed training. He said Douglas PUD is confident in this approach, and noted that a larval-origin program has far less flexibility to incur losses compared to a direct gamete-origin program (more fish available in the latter). He said he expects the fish to do fairly well during the next 4 to 5 months, and anticipates having surplus fish. He said Douglas PUD will begin discussing the fate of these surplus fish with the Washington Department of Fish and Wildlife (WDFW).

Jason McLellan questioned why Douglas PUD chooses to retain fish on cold water for 3 months when this is resulting in fish mortalities several months into the rearing cycle. He said, generally, feed training can be achieved within the first couple of weeks, or 1 month at the maximum. He questioned why water temperatures are not increased earlier to grow fish to larger sizes. He
said Douglas PUD’s current approach seems contradictory if the goal is to increase survival, but then fish are kept small longer, resulting in losses later in the program. Gingerich said Douglas PUD is open to improving hatchery rearing; however, he also noted that the program has been fairly successful, with about 40% survival, which no other larvae rearing hatchery has accomplished to date. He said one thing hatchery staff have noticed is fish are not graded until about 3 months into the rearing cycle, and losses decrease once fish are graded. He speculated there may be some cannibalism between the bigger fish and smaller fish, despite being fed as much feed as they can take. He said there are several moving parts, but Douglas PUD feels pretty good about the condition and number of fish currently on station. John Ferguson asked McLeLLan if the CCT would like to discuss this further offline with Douglas PUD and WDFW. McLeLLan said further discussion is not needed.

Gingerich recalled discussing in 2015, a possible in-person meeting with Douglas PUD, the CCT, and Ferguson to discuss developing guidelines for hatchery rearing of juvenile white sturgeon. Gingerich suggested also including WDFW in this meeting, and possible modifications to the Douglas PUD White Sturgeon Program could be discussed. McLellan said he would be interested in participating in such a meeting; however, he also acknowledged that several entities have experience with white sturgeon rearing, and not everyone has the same methods. He said for many people, including himself, methods are partially based on personal experiences. He said he believes the only real way to address some of these personal preferences is to conduct research. He said that although methods can be discussed, he does not believe agencies will want to spend time and money researching these questions when programs are fairly successful in meeting requirements. He said unless people really want to start getting into these questions (i.e., conduct studies), he is unsure how valuable a meeting, such as the one proposed, would be for the purpose of this program. Ferguson agreed and suggested convening a meeting only if needed.

7. **Draft 2016/2017 Adult Bull Trout Passage at Wells Dam and Twisp Weir Study Plan**

(Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying them that the Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan is available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 8, 2016. Gingerich briefly reviewed the following items in the draft plan:

*Figure 1. Annual Percentage of Bull Trout that Passed Wells Dam during the Month of May and June in a Given Year.*

Gingerich said Figures 1 through 3 provide historical information to consider in terms of sample size. He said Figure 1 shows that historically, peak upstream passage of adult bull trout through the fish ladders at Wells Dam has typically occurred in May and June (mean = 89%); therefore, as reflected in the plan, it makes sense to propose collecting fish during this time.
Figure 2. Total Annual Bull Trout Counts at Wells Dam Count Windows from 2000 to 2015 and the 16-Year Average.
Gingerich said this figure shows that historically, there is a cyclical nature in counts, and counts have been in a downward trend since 2014. He said, on average (since 2000), only about 73 adult bull trout have been counted in the ladders per year.

Figure 3. Bull Trout Annual Ladder Preference as a Percent of Fish that Used a Given Ladder at Wells Dam.
Gingerich said this figure shows that historically, adult bull trout preference to pass Wells Dam via the east or west fish ladders is about equal. He said the plan proposes to trap at one of two fish ladders at Wells Dam.

Section 1.4. Douglas Aquatic Settlement Agreement and Bull Trout Management Plan and Study Objectives
Gingerich said this section includes the goals of the study, which were copied directly from the regulatory documents.

Figure 5. Number of New and Previously Passive Integrated Transponder (PIT)-Tagged Adult Bull Trout Encountered at the Twisp River Weir from 2010 to 2015.
Gingerich said this figure shows, historically, the number of bull trout encountered at the Twisp Weir. He said trapping will likely be more successful at the Twisp Weir compared to Wells Dam because more fish pass the weir than the dam each year.

Figure 6. Arrival of Previously PIT-Tagged Bull Trout at the Twisp Weir in 2014 and 2015.
Gingerich said this figure shows, historically, when bull trout arrive at the Twisp Weir. He said this is important to consider when determining when to conduct the trapping effort. He said, in 2014, bull trout began arriving at the weir more toward the end of June and the beginning of July. He said, in 2015, bull trout began arriving 2 weeks earlier than in 2014, which may have been related to river-flow and water-temperature conditions in 2015.

Table 1. Number of Bull Trout Expected to be Captured at Wells Dam in 2016.
Gingerich said this table estimates the number of bull trout that may be captured and tagged at Wells Dam in 2016. He said this table notes the challenges of capturing 30 fish at Wells Dam. He said Douglas PUD wants to be realistic and transparent with goals and what might be accomplished.

Table 2. Estimated Tag Burden Using 16.0 Gram MCFT2-3BM Radio Tags and 0.1 g PIT-Tag.
Gingerich said this table summarizes tag burden.
Table 3. Fixed Station Receiver Locations at Wells Dam and in the Twisp River.
Gingerich said this table summarizes the locations of antennas.

Figure 7. Distribution of PIT-tag arrays in the Upper Mid-Columbia.
Gingerich said this figure shows the locations of PIT-tag arrays.

Section 3.5. Statistical Analyses and Reporting
Gingerich said the plan ends with a discussion of statistics and how to analyze passage and survival success.

Table 7. Estimated Timeline for Study Development, Implementation and Reporting.
Gingerich said this table summarizes the schedule for the study.

Gingerich encouraged the Aquatic SWG to review the entire plan. He said Douglas PUD would like to obtain Aquatic SWG approval of the draft plan during the Aquatic SWG meeting on February 10, 2016. He said Douglas PUD will also request Wells HCP Coordinating Committee approval of the draft plan. He said obtaining approval of the plan in February 2016 allows time to complete a number of steps with contracting, ordering supplies, and obtaining Commissioner approval, which all need to happen before May 2016. He requested that if Aquatic SWG members need additional time for review, that they please send that feedback as soon as possible. He also indicated that an email approval may be arranged, as needed.

8. Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan (Chas Kyger):
Chas Kyger said Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying them that the Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan is available for a 45-day review period, with edits and comments due to Kyger by Tuesday, January 19, 2016. Kyger asked the Aquatic SWG if anyone had questions on the plan at this point in time.

Patrick Verhey asked why the tag type was changed. Kyger explained that an acoustic tag seemed to be the better choice to address the approach question. He said radio telemetry is a good choice for small-scale detection within the fish ladder; however, it is not a good way to detect the approach. Andrew Gingerich added that acoustic tags function better in bigger water, while radio tags function better in air. He further explained that in shallower waters, where air is entrained, radio tags function better, compared to acoustic tags that function better in a reservoir setting where the signal can be sent and heard farther away on a receiver. Kyger recalled that recent data emerged, which identified possible approach issues; therefore, the Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan revisits the approach being used to determine how translocated lamprey approach and pass Wells Dam.
John Ferguson asked if the study plan has changed since the Aquatic SWG meeting last month, and Kyger replied that it has not.

Bob Rose said Figure 3 (a map of acoustic telemetry receiver locations in the Wells Dam Tailrace) shows one receiver on each fishway and another receiver directly downstream of Wells Dam. He asked if the placement of the third receiver was to form a 3-D arrangement for detecting fish moving into the fishways. Kyger said Douglas PUD discussed using a 3-D arrangement, or triangulation, with Vemco; however, it was determined that it would be too difficult to achieve in that type of turbulent environment. He said, for now, the focus is only on detecting Pacific lamprey approaching the dam downstream of the fish ladders. Rose said this is okay for this year; however, Douglas PUD needs to address entrance efficiency at some point in time, and sooner than later. He added that he does not want to prolong obtaining this information year after year. He said if the 2016 water year projection is close to correct, there may be less turbulence this year than during a normal year. He said he believes Douglas PUD needs the 3-D data, and there may be noise to deal with, but those data can still be useful.

Rose also questioned the proposed number of study fish. He said he is not supportive of the minimalist approach. Kyger explained that the 50-fish sample size will be in addition to Grant PUD’s study, which includes analyzing data from 100 study fish released at Priest Rapids Dam. He said Douglas PUD is anticipating 75 to 100 tagged fish upstream of Rocky Reach Dam to observe and collect data.

Rose suggested installing receivers in front of the Methow and Okanogan rivers in case study fish move near those locations. Kyger said Douglas PUD has an array of acoustic receivers throughout the Wells Reservoir and upstream of Wells Dam. Rose said he appreciates that, and will call Douglas PUD to discuss the plan in more detail. (Note: Following a coordination call with members of the Aquatic SWG on February 1, 2016, Kyger provided a second Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan on February 5, 2016, which Geris distributed to the Aquatic SWG that same day.)

9. **Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report** (Chas Kyger): Chas Kyger said Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying them that the Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report is available for a 45-day review period, with edits and comments due to Kyger by Tuesday, January 19, 2016. Kyger asked the Aquatic SWG if anyone had questions on the report at this point in time. Aquatic SWG members had no questions or comments at this time.

10. **Recent YN Lamprey Translocation Releases in the Methow Basin and Draft YN Pacific Lamprey Supplementation and Monitoring Frameworks** (Bob Rose): Bob Rose said, with regard to the YN Pacific lamprey translocation releases in the Methow Basin that took place last fall 2015,
admittedly, YN coordination with certain entities and fish forums was not conducted the way the YN prefers to do business; however, it just happened that way. He said it was not intentional. He suggested he contact Douglas PUD to discuss questions, if any, and bring a recap of the discussion back to the Aquatic SWG, if necessary. Andrew Gingerich agreed to this suggestion. Rose said the YN is interested in conducting a similar release in 2016, and he anticipates being able to provide information to relevant parties in an expedient manner. He said roughly 250 fish were translocated last year at three release sites. He said a report summarizing the effort will be available within the next couple of months.

Rose said, with regard to the YN Pacific Lamprey Supplementation and Monitoring Frameworks, the YN plans to submit the frameworks to the Bonneville Power Administration within the next 2 months. He said there were several unanticipated issues with the frameworks, and drafting them took longer than planned. He said the frameworks are a part of an experimental design focused in the Yakima Basin. He said the choice to focus in the Yakima Basin, as opposed to the Mid-Columbia Basin, was based on convenience and funding requirements, but the YN is still interested in translocation efforts in the Mid-Columbia Basin.

Rose agreed to provide a report detailing the 2015 YN Pacific lamprey translocation releases in the Methow Basin and YN Pacific Lamprey Supplementation and Monitoring Framework, once available, to Kristi Geris for distribution to the Aquatic SWG.

VII. Next Meetings

1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on February 10, 2016, will be held in-person at Wells Dam in Azwell, Washington. As noted in Agenda Item VI-3, Andrew Gingerich will coordinate with Kristi Geris to distribute details regarding meeting logistics for the in-person meeting.

Upcoming meetings are as follows: February 10, 2016 (in-person); March 9, 2016 (TBD); and April 13, 2016 (TBD).

List of Attachments

Attachment A – List of Attendees
Attachment B – Letter from Ecology approving Douglas PUD’s TDG Reasonable and Feasible Analysis
Attachment C – Water Data Email
# Attachment A
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Bob Rose</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
</tr>
<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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</table>
January 22, 2016

Andrew Gingerich  
Senior Aquatic Resource Biologist  
Public Utility No. 1 of Douglas County  
1151 Valley Mall Parkway  
East Wenatchee, WA 98802

RE: Wells Hydroelectric Project, FERC Project No. 2149  
Total Dissolved Gas Reduction Alternatives Analysis: Reasonable and Feasible Improvements

Dear Mr. Gingerich:

The Washington Department of Ecology (Ecology) hereby approves the Total Dissolved Gas Reduction Alternatives Analysis submitted by Public Utility District (PUD) No. 1 of Douglas County for the Wells Hydroelectric Project; FERC Project No. 2149. This analysis is required under Section 6.7(2)(e) of the 401 Certification /Order No. 8981 issued by Ecology February 27, 2012. It was submitted by the PUD to Ecology within the required time frame of within one year of approval by FERC of the Water Quality Attainment Plan.

Thank you for your continued cooperation and compliance with the 401 requirements. Please let me know if you have any questions, I can be reached at 509/457-7107.

Sincerely,

Charles McKinney  
Section Manager  
Water Quality Program

cc: Shane Bickford, Douglas Co. PUD

NOTED  
JAN 22 2016  
MEM
Hi Aquatic SWG: please see the email below from Andrew regarding Agenda Item VI. 2016 Water Year, to be discussed during next week’s Aquatic SWG 1/13 conference call. Thanks! –kristi

Kristi Geris
ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

From: Andrew Gingerich [mailto:andrewg@dcpud.org]
Sent: Thursday, January 07, 2016 8:45 AM
To: Kristi Geris <kgeris@anchorqea.com>
Subject: Agenda Item VI- Jan 13th Aquatic SWG call

Kristi,

Here is some info for agenda item VI next week. Please share it with the Aquatic SWG. I will refer to it on Wednesday next week. I think it was Steve Lewis asked about it this info last month. Since then NOAA has produced a 3-month outlook and I thought it made sense to provide a better update during the January call.

NOAA has recently released a three month temperature and precipitation model outlook (Jan-March). The prediction for our area of the Pacific Northwest is for a warmer and dryer than average January to March (below figures). It’s hard to believe given how wet December and early January have been so far. Nevertheless, NOAA used 30 years of data (1981-2010) to generate the final two predictive figures below.

If the prediction holds up we might expect similar observations at Wells compared to 2015, which included a wet spring associated with an early melt and Grand Coulee draft, followed by a tempered freshet relative to historic norms during the months of May-July. We also have to assume the Grand Coulee will
be operated similarly to 2015. Since Wells is a run-of-the-river project, flows at Wells are associated with Grand Coulee operation and snowpack/temperatures north of the Canadian Border. Of course keep in mind these are educated guesses in the face of an above average snowfall during the month of Dec.

-93.33% chance that WA state is at or above normal for temperature Jan-March 2016.
63.33%-83.33% chance that our region of WA state will be **at or below** normal precipitation from Jan-March 2016.

Note. California expected to be above normal for precip over the same period.

The Aquatic Settlement Work Group (SWG) met in-person at Wells Dam in Azwell, Washington, on Wednesday, February 10, 2016, from 10:15 a.m. to 12:00 p.m. Attendees are listed in Attachment A of these meeting minutes.

I. Summary of Action Items
   1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG (Item VI-1).
   2. Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS; Item VI-1).
   3. Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-1).
   4. John Ferguson will follow up with Bob Rose regarding YN approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3). (Note: Ferguson contacted Rose on February 11, 2016, and Rose indicated he would contact the Aquatic SWG by later that evening with any concerns regarding the Aquatic SWG-approved study plan.)
   5. The Aquatic SWG meeting on March 9, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions
   1. The Aquatic SWG members present approved the 2015 Juvenile Lamprey Habitat Evaluation Study Report (Item VI-2).
   2. The Aquatic SWG members present approved the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3). (Note: Steve Lewis provided USFWS approval of
3. The Aquatic SWG members present approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan, contingent on incorporating comments received from USFWS, which were reviewed and discussed during the meeting on February 10, 2016 (Item VI-4). (Note: Steve Lewis provided USFWS approval of the plan via email on February 9, 2016, contingent on incorporation of USFWS edits and comments. Lewis also provided an email accepting the revisions in the final study plan on February 23, 2016.)

4. The Aquatic SWG members present approved the 2015 Wells Dam Gas Abatement Plan (GAP) and Total Dissolved Gas (TDG) Report, contingent on approval by the Washington State Department of Ecology (Ecology; Item VI-5). (Note: Charlie McKinney provided Ecology’s approval of the report via email on February 18, 2016, as distributed to the Aquatic SWG by Kristi Geris on February 29, 2016.)

5. The Aquatic SWG members present approved the 2016 Wells Dam GAP and Bypass Operating Plan (BOP), contingent on approval by Ecology (Item VI-6). (Note: Charlie McKinney provided Ecology’s approval of the plan via email on February 18, 2016, as distributed to the Aquatic SWG by Kristi Geris on February 29, 2016.)

6. The Aquatic SWG members present approved the 2016 Aquatic Settlement Agreement (ASA) Action Plan, as revised (Item VI-7).

III. Agreements
1. The Aquatic SWG members present agreed to a March 1, 2016, deadline to transfer surplus white sturgeon off site that are in excess of the Douglas PUD 5,000-fish White Sturgeon Program, in order to grow program fish to the target size at release (Item VI-9).

IV. Review Items
1. Kristi Geris sent an email to the Aquatic SWG on February 8, 2016, notifying members that the Draft 2015 Aquatic Nuisance Species Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Tuesday, March 8, 2016.

2. Kristi Geris sent an email to the Aquatic SWG on March 1, 2016, notifying members that the Draft 2015 Douglas PUD Water Temperature Annual Report is available for review, with edits and comments due to Andrew Gingerich by close of business (COB) Wednesday, April 6, 2016.

V. Documents Finalized
1. The Final 2015 Juvenile Lamprey Habitat Evaluation Study Report that was approved by the Aquatic SWG on February 10, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 11, 2016 (Item VI-2).
2. The Federal Energy Regulatory Commission (FERC) filing of the Douglas PUD TDG Reasonable and Feasible Analysis, which was finalized following receipt of Ecology’s approval letter on January 25, 2016 (Aquatic SWG approved December 10, 2014), was distributed to the Aquatic SWG by Kristi Geris on March 15, 2016.

3. The Final 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan that was approved by the Aquatic SWG on February 10, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 19, 2016 (Item VI-4).

4. The FERC filing of the Final 2015 Wells Dam GAP and TDG Report that was approved by the Aquatic SWG on February 10, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 29, 2016 (Item VI-5).

5. The FERC filing of the Final 2016 Wells Dam GAP and BOP that was approved by the Aquatic SWG on February 10, 2016, and by the Wells Habitat Conservation Plan (HCP) Coordinating Committee on January 26, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 29, 2016 (Item VI-6).

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

   (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. Ferguson reviewed the agenda and asked for additions or other changes to the agenda. No additions or changes were requested by Aquatic SWG members present; however, Ferguson added refreshers on ASA rules and regulations concerning review periods and Decision Items.

The revised draft January 13, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes. She said she also added under the Decision Items, Ecology’s approval of the Douglas PUD TDG Reasonable and Feasible Analysis. Geris explained that the analysis was approved by the other Aquatic SWG Technical Representatives on December 10, 2014, contingent on approval by Ecology, and Ecology provided Douglas PUD with a letter of approval on January 22, 2016, as distributed to the Aquatic SWG on January 25, 2016. Geris said the Douglas PUD TDG Reasonable and Feasible Analysis was also added to the Documents Finalized section, and will be included as an attachment to the final January 13, 2016, conference call minutes. Lastly, she said distribution of the second Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan on February 5, 2016, and notification of the Draft 2015 Aquatic Nuisance Species Management Plan Annual Report review period were also added to the Review Items section of the revised draft January 13, 2016, conference call minutes. Aquatic SWG members present approved the January 13, 2016, conference call minutes, as revised.
Ferguson reviewed action items from the last Aquatic SWG conference call on January 13, 2016, and follow-up discussions were as follows (note: the following italicized item numbers correspond to agenda items from the January 13, 2016, meeting):

- **Bob Rose** will discuss internally the CCTs’ proposed criteria for culling juvenile white sturgeon and report back to the Aquatic SWG (Item VI-1).
  This action item will be carried forward.
- **Steve Lewis** will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with USFWS (Item VI-1).
  This action item will be carried forward.
- **Andrew Gingerich** will coordinate with Kristi Geris to distribute details regarding the next Aquatic SWG meeting on February 10, 2016, to be held in-person at Wells Dam in Wenatchee, Washington (Item VI-3).
  Gingerich provided these details to Geris on January 29, 2016, which Geris distributed to the Aquatic SWG that same day.
- **Bob Rose** will provide a report detailing the 2015 YN Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-10).
  This action item will be carried forward.

2. **DECISION: Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report** (Chas Kyger): Chas Kyger said Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying members that the Draft 2015 Juvenile Lamprey Habitat Evaluation Study Report was available for a 45-day review period, with edits and comments due to Kyger by Tuesday, January 19, 2016. Kyger said no comments were received from Aquatic SWG members on the draft report.

The Aquatic SWG members present approved the 2015 Juvenile Lamprey Habitat Evaluation Study Report, and the final report was distributed to the Aquatic SWG by Geris on February 11, 2016.

3. **DECISION: Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan** (Chas Kyger): Chas Kyger said Kristi Geris sent an email to the Aquatic SWG on December 4, 2015, notifying members that the Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan was available for a 45-day review period, with edits and comments due to Kyger by Tuesday, January 19, 2016. Following a coordination call with members of the Aquatic SWG on February 1, 2016, Kyger provided a second Revised Draft 2016 Lamprey Approach, Passage, and Enumeration Study Plan on February 5, 2016, which Geris distributed to the Aquatic SWG that same day.
The Aquatic SWG members present approved the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised. (Note: Steve Lewis provided USFWS approval of the plan via email on February 9, 2016, contingent on incorporation of USFWS edits and comments.)

John Ferguson recalled the email from the YN to the Aquatic SWG sent on January 13, 2016, indicating that the YN would not accept the study plan in its current form. Ferguson said the purpose of the coordination call on February 1, 2016, was to discuss and address the YN’s comments on the draft study plan; however, even with the coordination call and distribution of the revised study plan, the YN has not yet provided a response. Ferguson said he will follow up with Bob Rose regarding YN approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised. (Note: Ferguson contacted Rose on February 11, 2016, and discussed the coordination call and changes to the study plan, and emailed Rose the latest documents so he could easily locate them. Rose indicated he would review the documents that evening and contact the Aquatic SWG right away with any concerns regarding the Aquatic SWG-approved study plan. Rose provided no comments on the Aquatic SWG-approved study plan. Based in his discussion with Rose, Ferguson took this to mean Rose had approved the revised study plan for 2016.)

4. DECISION: Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan (Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying members that the Draft 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan was available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 8, 2016.

Gingerich said USFWS provided comments on the draft study plan the afternoon of February 9, 2016. He said USFWS comments consisted of about 90% requests for clarifications; however, the other 10% may require further discussion regarding the proposed analyses. John Ferguson asked if obtaining approval of this study plan is constrained by contracting or other factors. Gingerich replied that yes, Douglas PUD is using the same contractor for steelhead, Pacific lamprey, and bull trout activities, and Douglas PUD would ideally prefer to include all activities under one contract as opposed to using separate contracts.

The Aquatic SWG requested to review the USFWS comments that may require further discussion. These comments were discussed, as follows:

Section 3.5 Statistical Analyses and Reporting, fourth bullet (pages 19 to 20)
Steve Lewis’ comment indicated that USFWS does not fully agree with removing a fish from passage statistics analyses when that fish genetically assigns to a local population or sub-basin
located downstream of the Project. The comment further indicated USFWS believes passage should apply to all fish.

Gingerich said there is enough genetic information available to assign fish to a natal stream. He said if a fish genetically typed to the Entiat River enters the Wells Dam tailrace and swims into the ladder, but then turns around and migrates back downstream, this cannot be considered failed passage. Rather, he said the fish may just be homing to its natal stream and using the Project area for foraging. Jason McLellan suggested that because the real reason for not passing is unknown, both types of fish should be included in the analyses (i.e., those genetically assigning to a downstream location and those not). Gingerich agreed.

Section 3.5 Statistical Analyses and Reporting, sixth bullet (page 20)
Lewis’ comment asked about the thought process behind removing from analyses some cases of fall downstream passage at Wells Dam since bull trout are not required to overwinter below Wells Dam and may simply overwinter in the Wells Dam forebay or pool.

Gingerich said it is known that fish overwinter in the Wells Reservoir. He said if a fish migrates upstream to spawn, then migrates back down to the Wells Dam forebay but not to the tailrace, the fish may just be overwintering in the forebay, and this does not necessarily indicate that downstream passage was unsuccessful. McLellan asked if there are available data about behavior indicative of passage (e.g., movements). Gingerich said during the spring and summer, behavior is more predictable based on spawning migration. He said historical passive integrated transponder (PIT)-tag detection data indicate that bull trout that move downstream of Wells Dam one year usually do it in following years, but this is not consistent every year so assuming what a fish’s behavior will be is impossible. He added that when a fish passes Wells Dam, both survival and passage success rates will be evaluated. He said methods to objectively evaluate this are explained in the study plan assumptions. Ferguson suggested collecting and reporting all data and explaining how those data are categorized, which will ultimately be available in a final draft report for Aquatic SWG review and approval.

The Aquatic SWG members present approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan, contingent on incorporating comments received from USFWS, which were reviewed and discussed during the meeting on February 10, 2016. (Note: Steve Lewis provided USFWS approval of the plan via email on February 9, 2016, contingent on incorporation of USFWS edits and comments.)

The Final 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan was distributed to the Aquatic SWG by Kristi Geris on February 19, 2016. (Note: USFWS submitted a second set of comments on February 10, 2016, in addition to the set provided on February 9, 2016. Douglas PUD incorporated both sets of USFWS comments into the
revised draft, and Lewis provided an email accepting the revisions in the final study plan on February 23, 2016.)

5. **DECISION: Draft 2015 Wells Dam Gas Abatement Plan and Total Dissolved Gas Report**

(Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying members that the Draft 2015 Wells Dam GAP and TDG Report was available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 8, 2016. Gingerich said no comments were received on the draft report from Aquatic SWG members. He said Douglas PUD previously met with Charlie McKinney and Mark Peterschmidt (Ecology) to discuss the report, and Gingerich recently sent a follow-up email to McKinney and Peterschmidt regarding obtaining Ecology’s approval of the report. Gingerich said Douglas PUD would like to request Aquatic SWG approval of the report contingent on Ecology’s approval, in order to move closer to filing the report with FERC at the end of February 2016.

The Aquatic SWG members present approved the 2015 Wells Dam GAP and TDG Report, contingent on approval by Ecology. *(Note: McKinney provided Ecology’s approval of the report via email on February 18, 2016, as distributed to the Aquatic SWG by Geris on February 29, 2016.)*

The FERC filing of the Final 2015 Wells Dam GAP and TDG Report was distributed to the Aquatic SWG by Geris on February 29, 2016.

6. **DECISION: Draft 2016 Wells Dam Gas Abatement Plan and Bypass Operating Plan**

(Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 5, 2016, notifying members that the Draft 2016 Wells Dam GAP and BOP were available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 8, 2016. Gingerich recalled that Ecology’s review and approval of the 2016 plan is required in order to adjust the TDG standard for the fish bypass season. He said he noted in the follow-up email he recently sent to Charlie McKinney and Mark Peterschmidt that this plan was also out for review. John Ferguson said this plan was also discussed with the Wells HCP Coordinating Committee and approved on January 26, 2016.

The Aquatic SWG members present approved the 2016 Wells Dam GAP and BOP, contingent on approval by Ecology. *(Note: McKinney provided Ecology’s approval of the plan via email on February 18, 2016, as distributed to the Aquatic SWG by Geris on February 29, 2016.)*

The FERC filing of the Final 2016 Wells Dam GAP and BOP, which was also approved by the Wells HCP Coordinating Committee on January 26, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 29, 2016.

Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on January 12, 2016, notifying members that the Draft 2016 ASA Action Plan was available for a 30-day review period, with edits and comments due to Gingerich by Wednesday, February 10, 2016. Gingerich recalled that the action plan is not required by FERC; rather, it is drafted each year to help show what is expected in the year to come. He said no comments were received on the draft plan outside of those discussed during the last Aquatic SWG meeting on January 13, 2016. He recalled John Ferguson’s request to add to the white sturgeon section Aquatic SWG approval of the broodstock and breeding plan, which Gingerich said was added, as requested.

The Aquatic SWG members present approved the 2016 ASA Action Plan, as revised.

8. **2016 Snow Telemetry Water Forecast Update** (Andrew Gingerich): Andrew Gingerich projected the U.S. Department of Agriculture Natural Resources Conservation Service Snow Telemetry (SNOTEL) webmap (available at http://www.wcc.nrcs.usda.gov/snow/). He said most of the water that Wells Dam receives is from the Upper Columbia Basin in Canada. He noted that SNOTEL does not include data for Canada, and unfortunately, he was unable to locate an online resource that summarizes those data as well as SNOTEL. He said, with regard to Washington, the percent of official median is high in the eastern Cascade Mountains, which will all drain into the Columbia River. He noted that it gets dryer moving east into the Columbia Basin. Jason McLellan said the CCT somewhat track snow pack in Canada and, currently, it is at least average.

Gingerich projected the National Oceanic and Atmospheric Administration Northwest River Forecast Center webmap (available at http://www.nwrfc.noaa.gov/rfc/). He said, looking at the 120-day forecast (percent of average) again, the eastern Cascade Mountains look fairly wet. John Ferguson asked about potential TDG issues, and Chas Kyger said it depends on when Grand Coulee Dam releases water and how much.

Gingerich said, in summary, December 2015 and January 2016 were wetter than in previous years. He said, however, these values can decrease depending on what happens in the spring. He recalled that last year, there was a lot of water in the spring and, essentially, no freshet in June and July when normal peak flows arrive.

9. **Wells White Sturgeon Rearing Update** (Andrew Gingerich): Andrew Gingerich projected a Wells White Sturgeon Summary (Attachment B), which was distributed to the Aquatic SWG by Kristi Geris following the meeting on February 10, 2016. Gingerich said the summary details fish on station at Wells Hatchery as of the end of January 2016. He said there are more than 7,400 fish on station, which are all larval-origin. He recalled that brood year (BY) 2013 larval-origin fish size at release was on average about 199 grams each, and BY 2014 fish were
only about 130 grams each. He said this year, Douglas PUD would like to grow BY 2015 fish closer to 199 grams each, similar to BY 2013 fish. He said fish currently on station are on average about 56 grams each. Jason McLellan asked about the water temperature in the tanks, and Gingerich said the temperature is probably about 56°F (or 13.3°C). Gingerich added that, typically, fish growth increases when surplus fish are moved off station. McLellan recommended, if possible, increasing the water temperature to 62.6°F (or 17°C). Gingerich said hatchery staff will likely be more receptive to increasing the water temperature when about 2,500 fish are moved off station. He recalled discussing during the Aquatic SWG meeting on November 12, 2015, possibly transferring surplus BY 2015 fish to Canadian partners in the Upper Columbia White Sturgeon Recovery Initiative Program (UCWSRIP). McLellan said all required permitting is in place except the USFWS Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit. He added that all permit application materials have been submitted, and now UCWSRIP is just waiting to receive the permit.

Gingerich said, ideally, Douglas PUD would like to move surplus fish off station by March 1, 2016, to provide adequate time to grow fish to the target size at release. He asked what the alternative plan is if the CITES permit is not approved by March 1, 2016. McLellan said this was a topic of discussion during a Lake Roosevelt co-manager meeting, and it was decided to scute mark and release the surplus fish into Lake Roosevelt if permits are not obtained in time. Chad Jackson agreed that, from the Washington Department of Fish and Wildlife (WDFW) standpoint, the alternative plan should be whatever the co-managers decide. Gingerich noted that if this CITES permit is not obtained, this may not be the only opportunity to move fish to Canada. McLellan agreed and said there are different ways to obtain a CITES permit. He explained that if fish are moved frequently, master files are established. He said individual permits still need to be obtained; however, establishing a master file expedites the CITES permit process. He said, at one point, WDFW had a master file; however, it was not maintained. He said he believes a request has been submitted to reinitiate that master file, so transferring fish to Canada may be more feasible in the future. John Ferguson asked what permits are needed to release surplus fish into Lake Roosevelt, and Jackson said it depends on who transports the fish. McLellan speculated that WDFW would transport the fish. Jackson asked if the surplus fish are PIT tagged, and McLellan said they are not. McLellan added that it is not ideal to PIT tag fish fewer than 30 grams in size. He said he has PIT-tagged fish weighing 20 to 25 grams under special circumstances; however, those 14-gram fish (smallest in Attachment B) cannot take a PIT tag. Ferguson asked when the surplus fish will be PIT tagged, and McLellan said surplus fish will be PIT tagged and scute marked just prior to release. McLellan said, generally, it is ideal to PIT tag 1 to 3 months prior to release to assess metrics like mortality and in-hatchery tag retention. He added that survival rates may vary considering naïve fish will be released into a unique environment as opposed to going back into a hatchery tank where feed is provided.
Ferguson asked about the protocol to reduce the Wells White Sturgeon Program size from 7,418 to 5,000 fish. Gingerich said Wells Hatchery staff prefer to move the smallest fish off station. He added that this is not surprising, considering staff are being told program fish need to be larger (199 grams at release). McLellan said the average size at release for white sturgeon is incredibly variable. He said average size at release of direct gamete-origin Marion Drain white sturgeon is 200 grams. He said, throughout the past 15 years in the Columbia River in Washington, the average size at release has been roughly 180 to 185 grams, versus 75 grams in the Columbia River in Canada, where they must heat the water, which is expensive. He said the survival relationship is about 50% survival for fish weighing 100 grams at release, 86% survival for fish weighing 200 grams at release, and survival is in the high 90th percentile for fish weighing 300 grams at release. He said, based on these statistics, it would be ideal to grow fish to 300 grams at release. Gingerich said Douglas PUD is willing to further discuss how to select which fish get transferred off station. McLellan suggested staggered release groups, and Gingerich said at Wells Hatchery there is a capacity issue. Gingerich recalled that last year, Douglas PUD had to ask Marion Drain to hold the BY 2015 fertilized eggs longer because there was no room for them on station at Wells Hatchery. McLellan said the CCT understands the constraints and advocates that the selection is as unbiased as possible.

Gingerich said fish health is good for BY 2015 fish on station at Wells Hatchery, noting that most tanks have zero mortalities (see Attachment B). He also noted, however, the 68 mortalities in Tank 7, which are the smallest fish on station. He recalled that in previous months, there had been 300 mortalities per month, so now fish health is much better. McLellan recalled, that in the past couple of years, one or two tanks have consistently had issues, and he asked if Tank 7 was one of those tanks. He asked, if it is, can the tank be investigated to determine the cause of the issue. Gingerich said fish health has been tested and results came back negative. McLellan suggested the issue might be some dynamic about that particular tank. Chas Kyger suggested it may have something to do with only rearing the smallest fish in that particular tank. Gingerich said Douglas PUD can ask hatchery staff about this. McLellan acknowledged that the Wells White Sturgeon Program has historically been a success, as previously discussed within the Aquatic SWG; however, he said he still thinks Douglas PUD needs to strive for the highest possible in-hatchery survival rates to reduce domestic selection.

Jackson suggested, in case the CITES permit is not obtained in time, making preparations for a BY 2015 transfer to Lake Roosevelt this year and a BY 2016 transfer to Canada next year. McLellan said he thinks UCWSRIP will request that Douglas PUD hold the surplus BY 2015 fish as long as possible; however, if the Aquatic SWG indicates the fish need to be transferred off station, UCWSRIP will adjust, as necessary.
The Aquatic SWG members present agreed to a March 1, 2016, deadline to transfer surplus white sturgeon off site that are in excess of the Douglas PUD 5,000-fish White Sturgeon Program, in order to grow program fish to the target size at release.

10. **Aquatic Settlement Agreement Rules and Regulations Refresher** (John Ferguson):
    John Ferguson suggested distributing a refresher on ASA rules and regulations concerning review periods and Decision Items. He said the refresher should include ASA language describing protocols for review deadlines and Aquatic SWG approval of Decision Items. He said, for example, Decision Items need to be approved by the Aquatic SWG Technical Representative (opposed to technical support staff). He said also, if an agency needs more time to make a decision, that agency must provide notice to the Aquatic SWG in advance of the decision date requesting additional time. He said a refresher will be distributed to the Aquatic SWG following the meeting.  *(Note: Kristi Geris distributed a refresher email to the Aquatic SWG Technical Representatives, as discussed, on February 18, 2016.)*

**VII. Next Meetings**

1. **Upcoming meetings** (John Ferguson): The Aquatic SWG meeting on March 9, 2016, will be held by conference call.

   Upcoming meetings are as follows: March 9, 2016 (conference call); April 13, 2016 (TBD); and May 11, 2016 (TBD).

**List of Attachments**

Attachment A – List of Attendees
Attachment B – Wells White Sturgeon Summary, January 2016
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
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<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
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<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
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<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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<tr>
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**NOTES:**
1/5-1/6: Fish sacrificed from each tank for Virology testing (entered on this sheet in "Cull" column).

**Totals By Stock:**
- Marion
- Roosevelt 7,418
The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, March 9, 2016, from 10:00 a.m. to 11:00 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Anchor QEA, LLC, will incorporate edits, as discussed, to the Aquatic SWG Revised Draft February 10, 2016, Meeting Minutes, and will redistribute the minutes for final review, with approval via email due within 1 week of distribution (Item VI-1). *(Note: Kristi Geris revised the minutes, as discussed, and distributed the draft for approval on Friday, March 11, 2016.)*

2. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).

3. Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, including the 2016 release, monitoring and evaluation plans, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-1).

4. Aquatic SWG members will submit their approval, disapproval, or abstention on the Draft Aquatic Nuisance Species Management Plan (ANSMP) Annual Report via email to Chas Kyger (with a copy to Kristi Geris) by Wednesday, March 16, 2016. The draft report for review was distributed to the Aquatic SWG by Geris on March 9, 2016, prior to the meeting (Item VI-6). *(Note: Votes were submitted and the report was approved; see Summary of Decisions.)*

5. Douglas PUD will consider requesting permission from the Federal Energy Regulatory Commission (FERC) to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal, and will report back to the Aquatic SWG (Item VI-7).

6. The Aquatic SWG meeting on April 13, 2016, will be held by conference call (Item VII-1).
II. Summary of Decisions

1. Aquatic SWG members approved the 2015 ANSMP Annual Report, as revised, via email as follows: Douglas PUD approved on March 9, 2016; the CCT approved on March 10, 2016; the U.S. Fish and Wildlife Service (USFWS) approved on March 11, 2016; the YN approved on March 17, 2016; the Washington Department of Fish and Wildlife (WDFW) conditionally approved on March 17, 2016, pending incorporation of suggested edits; and the Washington State Department of Ecology (Ecology) abstained (did not vote; Item VI-6). *(Note: Douglas PUD indicated WDFW’s suggested edits would be incorporated into the final report, as distributed on March 18, 2016.)*

III. Agreements

1. The Aquatic SWG members present agreed to submit their approval, disapproval, or abstention on the Draft ANSMP Annual Report via email to Chas Kyger (with a copy to Kristi Geris) by Wednesday, March 16, 2016 (Item VI-6).

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on March 1, 2016, notifying members that the Draft 2015 Douglas PUD Water Temperature Annual Report is available for review, with edits and comments due to Andrew Gingerich by close of business (COB) Wednesday, April 6, 2016 (Item VI-2).
2. Kristi Geris sent an email to the Aquatic SWG on March 18, 2016, notifying members that the Draft 2015 Aquatic Settlement Agreement Annual Report is available for a 45-day review period, with edits and comments due to Geris by Wednesday, May 4, 2016 (Item VI-7).
3. Kristi Geris sent an email to the Aquatic SWG on March 31, 2016, notifying members that the Draft 2015 Bull Trout Management Plan and Incidental Take Annual Report is available for review, with edits and comments due to Andrew Gingerich by COB Friday, May 6, 2016 (Item VI-3).
4. Kristi Geris sent an email to the Aquatic SWG on April 4, 2016, notifying members that the Draft 2015 Pacific Lamprey Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Wednesday, May 4, 2016.
5. Kristi Geris sent an email to the Aquatic SWG on April 4, 2016, notifying members that the Draft 2015 Resident Fish Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Wednesday, May 4, 2016.
6. Kristi Geris sent an email to the Aquatic SWG on April 4, 2016, notifying members that the Draft 2015 Water Quality Management Plan Annual Report is available for review, with edits and comments due to Andrew Gingerich by Monday, May 9, 2016.
7. Kristi Geris sent an email to the Aquatic SWG on April 6, 2016, notifying members that the Draft 2015 White Sturgeon Management Plan Annual Report is available for review, with edits and comments due to Andrew Gingerich by Monday, May 9, 2016.
V.  Documents Finalized

1. The Final 2015 ANSMP Annual Report was distributed to the Aquatic SWG by Kristi Geris on March 29, 2016 (Item VI-6).

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

(John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. Ferguson reviewed the agenda and asked for additions or other changes to the agenda. Chas Kyger added a Decision Item on the Draft 2015 ANSMP Annual Report.

The revised draft February 10, 2016, meeting minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there were no outstanding edits or questions to discuss. Steve Lewis asked if Bob Rose submitted an official approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan. Ferguson said he contacted Rose on February 11, 2016, and discussed the coordination call held on February 1, 2016, and changes to the study plan. He also emailed Rose the latest documents so Rose could easily locate them. Ferguson said Rose indicated he would review the documents that evening and contact the Aquatic SWG right away with any concerns regarding the Aquatic SWG-approved study plan. Ferguson said Rose provided no comments on the study plan, and based on his discussion with Rose, Ferguson took this to mean Rose had approved the revised study plan for 2016. Andrew Gingerich suggested incorporating Ferguson’s and Rose’s discussion into the revised draft February 10, 2016, meeting minutes, and redistributing for review and approval. Patrick Verhey asked what changes were made to the plan (note: Verhey was on annual leave during these discussions). Gingerich said there were several, which were thoroughly discussed during the coordination call on February 1, 2016, and documented in notes distributed to the Aquatic SWG by Geris on February 2, 2016. Verhey said he will review the notes and contact Gingerich if he has further questions. Anchor QEA will incorporate edits, as discussed, to the Aquatic SWG Revised Draft February 10, 2016, Meeting Minutes, and will redistribute the minutes for final review, with approval, via email, due within 1 week of distribution. (Note: Geris revised the minutes, as discussed, and distributed the draft for approval on Friday, March 11, 2016.)

Aquatic SWG members approved the February 10, 2016, meeting minutes, as revised, via email as follows: Douglas PUD, WDFW, and the CCT approved on March 14, 2016; USFWS approved on March 15, 2016; and Ecology and the YN abstained (did not vote).
Ferguson reviewed action items from the last Aquatic SWG meeting on February 10, 2016, and follow-up discussions were as follows (note: the following italicized item numbers correspond to agenda items from the February 10, 2016, meeting):

- **Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG** (Item VI-1). This action item will be carried forward.

- **Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS; Item VI-1).**
  
  Lewis suggested closing this action item for now. Andrew Gingerich agreed, considering the Aquatic SWG is not proposing a formal translocation plan at this time. Gingerich suggested revisiting this item in the future, if needed. Patrick Verhey agreed, but noted that there is still benefit for everyone to continue to be transparent about translocation plans.

- **Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG** (Item VI-1).
  
  Steve Lewis suggested broadening this item to include 2016 release, monitoring, and evaluation plans. Patrick Verhey asked how translocating lamprey in the Methow Basin is relevant to the Wells Project and the Aquatic SWG. Lewis suggested that translocation in the Methow Basin could have effects on the Wells Project and should continue to be discussed. Verhey asked about the nature of these effects. For example, he discussed if Lewis believes the Aquatic SWG would have authority to influence release numbers in the Methow Basin or if translocation in the Methow Basin might provide opportunities for other studies under the ASA Pacific Lamprey Management Plan. Lewis said he believes both are possibilities. This action item will be carried forward and will include 2016 release, monitoring, and evaluation plans.

- **John Ferguson will follow up with Bob Rose regarding YN approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised** (Item VI-3).
  
  Ferguson contacted Rose on February 11, 2016, and Rose indicated he would contact the Aquatic SWG by later that evening with any concerns regarding the Aquatic SWG-approved study plan.

2. **Draft 2015 Water Temperature Annual Report** (Andrew Gingerich):

   Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on March 1, 2016, notifying members that the Draft 2015 Douglas PUD Water Temperature Annual Report is available for review, with edits and comments due to Gingerich by COB Wednesday, April 6, 2016. Gingerich said Douglas PUD will request approval of this report during the Aquatic SWG meeting on April 13, 2016.
Patrick Verhey asked whom Douglas PUD has been coordinating with at Ecology. Gingerich replied, Charlie McKinney; however, McKinney is retiring soon, so now Douglas PUD is communicating with Mark Peterschmidt (Ecology). Gingerich said McKinney approved the 2015 Wells Total Dissolved Gas Annual Report and the 2016 Gas Abatement Plan and Bypass Operations Plan; however, now Ecology is in the process of hiring new staff.


(Andrew Gingerich): Andrew Gingerich said the Bull Trout Management Plan and Incidental Take Annual Report is submitted to USFWS as part of Douglas PUD’s requirement for incidental take reporting. Gingerich said the report is due to USFWS by April 15, 2016, so the Aquatic SWG will receive the draft report for review very soon. John Ferguson asked if the report will be available for a 30-day review with approval in April 2016, and Gingerich said that is correct because the report is due to FERC by May 31, 2016.

Kristi Geris sent an email to the Aquatic SWG on March 31, 2016, notifying members that the Draft 2015 Bull Trout Management Plan and Incidental Take Annual Report is available for review, with edits and comments due to Gingerich by COB Friday, May 6, 2016.

4. **2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study**

(Andrew Gingerich): Andrew Gingerich said everything is moving forward in preparation for this study, including securing a contractor, obtaining radio-telemetry receivers from Grant PUD, and ordering supplies (e.g., tags). Gingerich asked that Aquatic SWG members contact him with questions.

5. **Wells White Sturgeon Inventory Update**

(Andrew Gingerich):

Andrew Gingerich recalled that last month, the Aquatic SWG agreed that if the USFWS Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit was not secured by March 1, 2016, the CCT would transfer surplus white sturgeon off site for release in Lake Roosevelt. Gingerich said the CITES and other various permits were all processed, and on March 4, 2016, a B.C. Hydro representative picked up approximately 2,200 surplus larval-origin fish from Wells Hatchery to transfer to Canada. Gingerich said fish transferred included 180 fish per tank (fish are graded by size per tank, so there is a good representation of fish sizes), and average fish size was 100 to 120 grams. He said there are now approximately 5,200 fish on station at Wells Hatchery. He said, with reduced density, hatchery staff plan to grow the fish out to about two fish per pound during the next 3 months.


(Chas Kyger): Chas Kyger said Kristi Geris sent an email to the Aquatic SWG on February 8, 2016, notifying members that the Draft 2015 ANSMP Annual Report is available for a 30-day review period, with edits and comments due to Kyger by Tuesday, March 8, 2016. Kyger said
Jason McLellan provided CCT comments on the draft report on February 29, 2016, which Geris distributed to the Aquatic SWG that same day. Kyger said the CCT requested adding additional information clarifying future activities and plans, specifically regarding Northern pike discovered in Lake Roosevelt and Rufus Woods reservoirs. Kyger said he added this information, as requested, including plans to perform scoping this year and next year to verify Northern pike are not present in the Wells Reservoir. He said a revised draft report was distributed to the Aquatic SWG by Geris today, March 9, 2016, prior to the meeting. Kyger apologized for not including this item on the agenda as a Decision Item, and said if Aquatic SWG members are not yet ready to approve, Douglas PUD will request approval via email sometime prior to the April 1, 2016, deadline to FERC.

Patrick Verhey asked about the observations of Northern pike in the Rufus Woods Reservoir. Kyger said Northern pike were discovered there last year, and the CCT received funding for monitoring and removal. Kyger said he is uncertain about population levels or exact locations, but efforts are aimed to be proactive, specifically in the Okanogan River.

(Note: Kyger later clarified via email, which was distributed to the Aquatic SWG by Geris on March 11, 2016, that Northern pike observations in the Rufus Woods Reservoir was an error; observations have only been in Lake Roosevelt.)

Steve Lewis requested 1 additional week to review the revised draft report. He also asked if, during biological monitoring for total dissolved gas (TDG) at the Rocky Reach bypass sampler, there has been an increase in aquatic nuisance species. Kyger said Douglas PUD only actively monitors that location when there is a TDG exceedance. He said most encounters are incidental while performing other activities. He said to this end, the CCT also suggested adopting new techniques to actively monitor for species of concern that may not be encountered incidentally, which is why the revised draft report includes the recommendation for additional monitoring.

The Aquatic SWG members present agreed to submit their approval, disapproval, or abstention on the Draft ANSMP Annual Report via email to Kyger (with a copy to Geris) by Wednesday, March 16, 2016. Aquatic SWG members approved the 2015 ANSMP Annual Report, as revised, via email as follows: Douglas PUD approved on March 9, 2016; the CCT approved on March 10, 2016; USFWS approved on March 11, 2016; the YN approved on March 17, 2016; WDFW conditionally approved on March 17, 2016, pending incorporation of suggested edits; and Ecology abstained (did not vote). (Note: Douglas PUD indicated WDFW’s suggested edits would be incorporated into the final report, as distributed on March 18, 2016.)

The Final 2015 ANSMP Annual Report was distributed to the Aquatic SWG by Geris on March 29, 2016.
7. **Draft 2015 ASA Annual Report and ASA Management Plan Annual Reports** (Chas Kyger):

Chas Kyger said the other Draft 2015 ASA Management Plan Annual Reports will be available for review soon. The Draft 2015 ASA Annual Report will be distributed to the Aquatic SWG for a 45-day review on Friday, March 18, 2016. Kyger said all management plan annual reports are due to FERC by May 31, 2016.

Patrick Verhey noted that WDFW, and likely Aquatic SWG members from other agencies, have several reports and documents to review between December and February, and suggested changing the review deadline for Aquatic SWG reports to later than April 15, if possible. Kyger said he is uncertain about the flexibility of FERC deadlines; however, he said Douglas PUD could try drafting documents quicker, within reason, to provide longer review period. He also suggested combining deadlines, as previously discussed. Verhey said he believes it is worth asking FERC, noting that adjusting the deadlines would facilitate a more quality review.

John Ferguson suggested, in the spirit of consolidation and efficiency, revisiting the request to combine annual reporting and deadlines. Verhey said the May 31 deadline seems reasonable to him, and he would be supportive of combining annual reporting. Kyger said Douglas PUD could pursue this request again. Ferguson suggested combining the management plan annual reports into the ASA Annual Report, as appendices.

Douglas PUD will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal, and will report back to the Aquatic SWG.

**VII. Next Meetings**

1. **Upcoming meetings** (John Ferguson): The Aquatic SWG meeting on April 13, 2016, will be held by conference call.

   Upcoming meetings are as follows: April 13, 2016 (conference call); May 11, 2016 (TBD); and June 8, 2016 (TBD).

**List of Attachments**

Attachment A – List of Attendees
## Attachment A
### List of Attendees

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<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, April 13, 2016, from 10:00 to 11:30 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

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1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).
2. Douglas PUD will consider requesting permission from the Federal Energy Regulatory Commission (FERC) to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).
3. Bob Rose and John Ferguson (and other Aquatic SWG members, if interested) will compile topics to discuss during a potential Regional Pacific Lamprey Workshop, for discussion during the Aquatic SWG meeting on May 11, 2016 (Item VI-5).

4. The Aquatic SWG meeting on May 11, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. Aquatic SWG members present approved the 2015 Water Temperature Annual Report, with the Yakama Nation (YN) abstaining (Item VI-2).

III. Agreements

1. There were no agreements discussed during today’s conference call.

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on March 18, 2016, notifying members that the Draft 2015 ASA Annual Report is available for a 45-day review period, with edits and comments due to Geris by Wednesday, May 4, 2016 (Item VI-3).

2. Kristi Geris sent an email to the Aquatic SWG on March 31, 2016, notifying members that the Draft 2015 Bull Trout Management Plan and Incidental Take Annual Report is available for review, with edits and comments due to Andrew Gingerich by close of business (COB) Friday, May 6, 2016 (Item VI-3).

3. Kristi Geris sent an email to the Aquatic SWG on April 4, 2016, notifying members that the Draft 2015 Pacific Lamprey Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Wednesday, May 4, 2016 (Item VI-3).

4. Kristi Geris sent an email to the Aquatic SWG on April 4, 2016, notifying members that the Draft 2015 Resident Fish Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Wednesday, May 4, 2016 (Item VI-3).

5. Kristi Geris sent an email to the Aquatic SWG on April 6, 2016, notifying members that the Draft 2015 Water Quality Management Plan Annual Report is available for review, with edits and comments due to Andrew Gingerich by Monday, May 9, 2016 (Item VI-3).

6. Kristi Geris sent an email to the Aquatic SWG on April 6, 2016, notifying members that the Draft 2015 White Sturgeon Management Plan Annual Report is available for review, with edits and comments due to Andrew Gingerich by Monday, May 9, 2016 (Item VI-3).

V. Documents Finalized

1. The Final 2015 Water Temperature Annual Report was distributed to the Aquatic SWG by Kristi Geris on April 14, 2016, and the FERC submittal of the report was distributed on May 2, 2016 (Item VI-2).
VI. **Summary of Discussion**

1. **Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items**
   
   (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. Ferguson reviewed the agenda and asked for additions or other changes to the agenda. The following revisions were requested:
   
   - Bob Rose added discussions on: 1) Pacific lamprey, including the Douglas PUD 2016 Lamprey Approach, Passage, and Enumeration Study, a potential Regional Pacific Lamprey Workshop, and translocation in the Wells Reservoir; and 2) recent YN Pacific lamprey translocation efforts.

   Ferguson noted that a change in U.S. Fish and Wildlife Service (USFWS) Aquatic SWG Policy representation was distributed to the Aquatic SWG by Kristi Geris on March 31, 2016. Ferguson explained that Steve Lewis will replace Jessie Gonzales as the USFWS Aquatic SWG Policy Representative. Ferguson said Lewis will also remain the USFWS Aquatic SWG Technical Representative.

   Ferguson also noted that the 2015 Aquatic Nuisance Species Management Plan Annual Report was filed with the Federal Energy Regulatory Commission (FERC) on March 29, 2016, and distributed to the Aquatic SWG by Geris on March 30, 2016.

   The revised draft March 9, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes. She said she also added the Draft 2015 ASA Annual Report, Draft 2015 Water Quality Management Plan Annual Report, and Draft 2015 White Sturgeon Management Plan Annual Report under the review items. Aquatic SWG members present approved the March 9, 2016, conference call minutes, as revised.

   Ferguson reviewed action items from the last Aquatic SWG meeting on March 9, 2016, and follow-up discussions were as follows (note: the following italicized item numbers correspond to agenda items from the March 9, 2016, meeting):
   
   - Anchor QEA, LLC, will incorporate edits, as discussed, to the Aquatic SWG Revised Draft February 10, 2016, Meeting Minutes, and will redistribute the minutes for final review, with approval via email due within 1 week of distribution (Item VI-1).
     Kristi Geris revised the minutes, as discussed, and distributed the draft for approval on Friday, March 11, 2016.
   - Bob Rose will discuss internally the CCT’s proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).
     This action item will be carried forward.
- Bob Rose will provide a report detailing the 2015 YN Lamprey Translocation Releases in the Methow Basin, including the 2016 release, monitoring and evaluation plans, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-1). This will be discussed during today’s conference call.

- Aquatic SWG members will submit their approval, disapproval, or abstention on the Draft Aquatic Nuisance Species Management Plan Annual Report via email to Chas Kyger (with a copy to Kristi Geris) by Wednesday, March 16, 2016. The draft report for review was distributed to the Aquatic SWG by Geris on March 9, 2016, prior to the meeting (Item VI-6). Votes were submitted, and the report was approved on March 17, 2016.

- Douglas PUD will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal, and will report back to the Aquatic SWG (Item VI-7). Andrew Gingerich recalled that a request letter was drafted last year; however, the Aquatic SWG agreed to postpone submitting the request until after 2015 ASA annual reporting is completed on May 31, 2016. This action item will be carried forward.

2. DECISION: Draft 2015 Water Temperature Annual Report (Andrew Gingerich): Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on March 1, 2016, notifying members that the Draft 2015 Douglas PUD Water Temperature Annual Report was available for review, with edits and comments due to Gingerich by COB Wednesday, April 6, 2016. Gingerich said Douglas PUD provided a slightly longer review period to provide Aquatic SWG members adequate time to review the draft report during this busy time of year (typically only 30 days). He said the Washington State Department of Ecology has typically provided the most substantive comments on this report; however, no comments from any members of the Aquatic SWG were received. He said this report is due to FERC at the end of April each year.

Aquatic SWG members present approved the 2015 Water Temperature Annual Report, with the YN abstaining. The Final 2015 Water Temperature Annual Report was distributed to the Aquatic SWG by Geris on April 14, 2016, and the FERC submittal of the report was distributed on May 2, 2016.

3. Draft Aquatic SWG Reports for Review (Andrew Gingerich): Andrew Gingerich said a series of annual reports are available for Aquatic SWG review, per Douglas PUD’s FERC License requirements. Gingerich recalled that the 2015 Aquatic Nuisance Species Management Plan Annual Report has already been approved by the Aquatic SWG, finalized, and submitted to FERC. He said a table outlining reports currently available for review was distributed to the Aquatic SWG by Kristi Geris on April 6, 2016. Gingerich said he appreciates everyone’s time and effort to review these documents. John Ferguson noted that Douglas PUD will request approval of the remaining draft reports during the Aquatic SWG meeting on May 11, 2016.
Draft 2015 Bull Trout Management Plan and Incidental Take Annual Report
Gingerich said the Bull Trout Management Plan and Incidental Take Annual Report is filed with USFWS on April 15 each year, per Douglas PUD’s incidental take reporting requirements. He said the report is then due to FERC on May 31. He said the Aquatic SWG has the option to submit comments by April 15, 2016, for USFWS review, or the official review period ends May 6, 2016.

Draft 2015 Pacific Lamprey, Resident Fish, Water Quality, and White Sturgeon Management Plan Annual Reports
Gingerich said the remaining draft management plan annual reports are also available for review. He said the reports use the respective management plans as templates, and a summary is provided under each objective outlining what was accomplished toward the objective that year. He recommended focusing review on the summary portions that discuss accomplishments in 2015.

Bob Rose expressed concern about a statement in the Draft 2015 Pacific Lamprey Management Plan Annual Report, which indicates that, ‘Douglas PUD will continue to monitor impacts, if any.’ He said this statement seems odd because some would say Wells Dam is one of the worst passage locations on the Columbia River for Pacific lamprey. He said it is more than apparent there is a problem. He said, for example, consider the drastic decrease in Pacific lamprey counts at Rocky Reach Dam compared to Wells Dam. He asked why Douglas PUD does not state the obvious—most fish are not detected at Wells Dam that are detected at Rocky Reach Dam. He said based on this fact, known since 2006, it is more than apparent there is a problem and something needs to be done about it. He said the 2015 Pacific Lamprey Management Plan Annual Report should be more direct instead of carrying forward old statements. He said he gets frustrated with the PUDs when they use careful language to hide the problem. He said it is the responsibility of the Douglas PUD and the Aquatic SWG to address these problems at Wells Dam, and he suggested calling it like it is. Ferguson asked if Rose plans to provide these comments to Douglas PUD, and Rose said he is not. Rose added that he believes Douglas PUD will do the right thing. He added that he is also frustrated that the Douglas PUD 2016 Lamprey Approach, Passage, and Enumeration Study Plan is not about addressing passage, but rather about whether to conduct a study, and suggested stopping sidestepping the problem. He said he is not requesting changes to the Draft 2015 Pacific Lamprey Management Plan Annual Report, but hopes to continue these discussions.

Patrick Verhey agreed with Rose, but indicated that the Washington Department of Fish and Wildlife (WDFW) will submit comments on the draft report. Verhey suggested, for example, balancing out Section 2.4 on page 7 when discussing distance from the ocean and bio-
expenditures. In this section, Douglas PUD explains why passage may be so poor, which may be true, but the statement should also state there may be a passage issue at the dam.

Ferguson noted that historical data during the past three years (2013 to 2015) indicate that approximately 7,000 Pacific lamprey were counted at Rocky Reach Dam, and only 28 were counted at Wells Dam. Rose said that is the situation, and asked why this is not stated up front.

Gingerich said he encourages Aquatic SWG members to provide comments. He said Douglas PUD has no objections to stating facts, as far as counts, and agreed it is good to have balance. He also suggested, however, remaining clear about the ability to enumerate at Wells Dam, which he said is not intended to mask low counts during the last few years, and being clear that the mechanism behind apparent low “conversion rates” is poorly understood. Therefore, low counts at Wells may not be as simple as “Project Effects.” He said recent data can be incorporated; however, he also suggested keeping language consistent with the Pacific Lamprey Management Plan.

Verhey said when WDFW submits comments, the intention is not to put a black mark against Douglas PUD by FERC; rather, it is meant to benefit Douglas PUD in that they are receiving and addressing consultation. Gingerich agreed, noting that comments received are included in the consultation record, along with follow-up correspondence describing how those comments were addressed. He said, historically, Douglas PUD has been contacted by FERC when the consultation record is not clear.

Chas Kyger recognized that using the management plans as templates for annual reports where the process is essentially the same every year (e.g., aquatic nuisance species and water quality) may work better than for annual reports where the activities can change drastically (e.g., Pacific lamprey and white sturgeon). He said, if FERC approves combining all the annual reports, this may be a good opportunity to revamp the template and language. He said some of these comments are just symptoms of using the management plans as templates.

Rose said he appreciates the consideration, and added that it seems these revisions would also benefit Douglas PUD. He said if the reports reflect the real issues, it shows Douglas PUD has much more work to do.

Rose said, regarding the Draft 2015 White Sturgeon Management Plan Annual Report, the report seems to be quite text heavy, and he suggested inserting a summary table to supplement the narrative that shows what actions have been taken. Gingerich asked where Rose would like this table inserted, and Rose suggested wherever Douglas PUD feels appropriate. Ferguson asked if a similar table should be inserted in the other management plan annual reports. Gingerich suggested inserting a similar table only in the white sturgeon, bull trout, and Pacific
lamprey reports, because they are heavier on actions and would benefit most with a summary table.

**Draft 2015 ASA Annual Report**

Gingerich said the 2015 ASA Annual Report is the larger, more comprehensive report that Anchor QEA drafts. He said the report packages meeting minutes and summaries for each resource area. He said this report is due to FERC by May 31, 2016.

4. **Wells White Sturgeon Tagging and Rearing Update** (Andrew Gingerich): Andrew Gingerich said surplus fish on station at Wells Hatchery were transported to Canadian fish managers, which greatly improved fish growth for those remaining on station during the last few weeks. He said from March 7 to 28, 2016, average weight gain was 27%, and average fish size on station is currently about 85 to 86 grams per fish. He said this includes two tanks of small fish. He added that the tanks with small fish have had the best growth, increasing in mass by about 50 to 54%. He said those fish are now about 10 to 18 grams per fish. He said reducing density really helped and suggested next year, transporting surplus fish earlier, if needed. He said there are currently about 5,200 fish on station, and Douglas PUD plans to stock 5,000 fish on June 1 and 2, 2016. He said passive integrated transponder (PIT) tagging will occur at the end of May, and weights and lengths will be obtained just prior to release.

Chad Jackson reminded the Aquatic SWG that one more round of disease sampling is required prior to release, which is typically done around the same time as tagging. He said a 2- to 4-week window is typically needed to send and receive results back from the lab. Gingerich said this is a good point, and noted that the tagging dates may need adjusting to accommodate fish health testing. Jackson also noted that the WDFW Eastern Washington Pathologist is leaving the agency, so fish health testing will need to be completed by a WDFW Western Washington Pathologist. He said Wells Hatchery staff will also likely need to conduct the tissue sampling. Gingerich said this should be no problem.

Bob Rose requested clarification about the implementation schedule for white sturgeon in the Wells Reservoir. Gingerich explained that Year 1 was the requirement to develop a plan; Year 2 was the first year of collection; and Year 3 was the first year of plants. He further explained that the last year of the first 4 years of stocking will be next year’s plants (2017 or brood year 2016). He said this spring/summer 2016, will be the last year of the 4-year plan to collect fish. He said, in August 2016, the Aquatic SWG will need to update the Broodstock and Breeding Plan and discuss how to move forward in Years 5 to 10, in terms of collection and stocking. Rose noted that there has been updates to the population growth model spreadsheet used to develop the next 5 years of stocking in the Rocky Reach and Priest Rapids project areas, and suggested those models may be useful to include in future discussions regarding the future of the Wells Reservoir. Jackson agreed. John Ferguson noted that Douglas PUD’s FERC license requires
releasing 15,000 fish during the next 5 years, and asked if Douglas PUD should start evaluating this (i.e., the growth model) now. Jackson said there is plenty of time still to consider this and suggested waiting until next year’s fish are in the hatchery.

Ferguson asked, regarding transportation next year, if the USFWS Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit needs to be obtained annually, or does this year’s CITES permit cover next year. Gingerich said he thinks he recalls a goal to establish a master file, which would expedite the process in the future. Jackson said he would need to double check, but he recalls that a CITES permit covers only one year. He added that he is not 100% certain that Canada would want additional surplus, if it exists. He said future surplus fish may go to the CCT. He said, regardless, if this situation occurs again next year, the burden would be on WDFW, not Douglas PUD.

Ferguson asked about the target fish size at release. Gingerich said the goal is the same as the first year’s wild larval release, which was about 2 fish per pound (about 230 grams per fish). He recalled experiencing trouble last year achieving that target size, and noted that it was not about husbandry; rather, too many fish were kept on station for too long, while the Aquatic SWG discussed details for planting. He said this year, however, he believes fish growth is on pace to meet the target release size.

5. **Pacific Lamprey** (Bob Rose):

Bob Rose said this study plan does not propose to tag many sample fish, and suggested obtaining more. He said he understands Douglas PUD is concerned about taking too many fish out of the Priest Rapids Reservoir, but Rose suggested taking even more fish. He said, in his opinion, this would be better than taking less than 1,000 fish. He suggested taking as many fish as possible to increase the sample size of the study. He said there are some aspects of the study plan the YN can accept; however, he wants to see more study fish. He also suggested coordinating an approach with Chelan PUD. He said more receivers are needed to increase detection of the sample fish. He said he believes Chelan PUD is already doing this, per their FERC License. He said there is a critical uncertainty about what is occurring in the Priest Rapids and Rocky Reach reservoirs, which also needs to be addressed in the Wells Reservoir. He said preliminary data indicate there may be good movement throughout the Wells Reservoir; however, more study fish are needed to test this. He said he believes this information can be pieced together, and he would like to work toward that in 2016 and future years.

Chas Kyger agreed that sample size is an issue, and said Douglas PUD wants to increase the sample size used in the study as much as possible. However, he said the concern based on what was experienced in the past. He recalled, in 2013, there were issues obtaining study fish because a lot of agencies wanted fish, including fish in the lower river and at Priest Rapids Dam.
He added that Douglas PUD is trying to coordinate with Grant and Chelan PUDs to incorporate their study fish into Douglas PUD’s analysis. He said Douglas PUD is not trying to minimize sample size. He said Douglas PUD is considering the feasibility of obtaining fish without experiencing the same issues as in the past. He agreed regional coordination is a good idea.

Rose said he believes this year tribal allocation will increase, and the YN are more than happy to commit to giving Douglas PUD another 100 fish. He said those fish can be PIT-tagged and evaluated alongside Priest Rapids fish to detect behavioral differences between lower and upper river fish and also increase sample size.

**Translocation in the Wells Reservoir**

Rose said downstream, there are ongoing discussions about a long-term translocation program, and considering the low passage rates at Wells Dam, Rose suggested Douglas PUD participate in this program as well. Patrick Verhey agreed with Rose’s suggestion, and Kyger said Douglas PUD is interested in participating in these discussions.

**Regional Pacific Lamprey Workshop**

Rose said he, John Ferguson, and Tracy Hillman (Rocky Reach Fish Forum and Priest Rapids Fish Forum Facilitator) discussed convening a workshop with Douglas, Grant, and Chelan PUDs to discuss a path forward. Rose suggested the goal of the workshop would be to address what can be interpreted at this time regarding passage, and identify obvious data gaps and plan how to approach the subject in 2016 and beyond. Verhey agreed a workshop is a good idea. Ferguson asked about agenda details, noting that other topics could include discussing biology of the species, technology, population status, demographics, and other supplemental information beyond passage topics. He also asked if discussions should only include adults or if discussions regarding juveniles should be added. Rose suggested discussing only adults, and said he and Ferguson will compile topics to discuss during a potential Regional Pacific Lamprey Workshop, for discussion during the Aquatic SWG meeting on May 11, 2016. Rose also suggested that other Aquatic SWG members participate in this discussion, if interested.

**6. Recent YN Pacific Lamprey Translocation Efforts** (Bob Rose): Bob Rose said the Draft YN Pacific Lamprey Supplementation and Monitoring Frameworks are almost ready for Aquatic SWG review. He explained that the YN would like to increase the number of juveniles in rivers; however, the Bonneville Power Administration is first requiring the YN to complete the Independent Scientific Review Panel and National Environmental Protection Act processes.

John Ferguson asked if the YN have translocation plans for 2016. Rose said, to date, the YN have translocated 240 fish into the Wenatchee River, upstream and downstream of Tumwater Dam. He said this was all that was planned for the Upper Columbia Basin in 2016. He added that the idea was to have the YN address the Upper Columbia Basin and the PUDs address the
Mid-Columbia Basin. Ferguson asked if the releases near Tumwater Dam were intended to evaluate the passage issues at the dam and if they were associated with a specific study design. Rose said they were not, and added that the releases were just for seeding.

7. **Draft 2015 White Sturgeon M&E Report** (Andrew Gingerich): Andrew Gingerich said a Draft 2015 White Sturgeon M&E Report summarizing M&E efforts from 2015 is ready for review and has been for a few months. He said, however, he has not yet distributed it because this report has no hard deadlines, and there are several documents out for review which have deadlines. He suggested distributing the draft report for review sometime in May 2016. John Ferguson and the Aquatic SWG agreed postponing review of the draft report made sense.

VII. **Next Meetings**

1. **Upcoming meetings** (John Ferguson): The Aquatic SWG meeting on May 11, 2016, will be held by conference call.

   Upcoming meetings are as follows: May 11, 2016 (conference call); June 8, 2016 (in-person); and July 13, 2016 (TBD).

**List of Attachments**
Attachment A – List of Attendees
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
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<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
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<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Bob Rose</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
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The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, May 11, 2016, from 10:00 to 11:00 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG (Item VI-1).

2. Douglas PUD will consider requesting permission from the Federal Energy Regulatory Commission (FERC) to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal, and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).

3. Kristi Geris will distribute to the Aquatic SWG a request for email approval of the six Draft 2015 ASA Annual Reports, with approval due by Friday, May 13, 2016 (Item VI-2). (Note: Geris distributed this request following the meeting on May 11, 2016.)

4. Douglas PUD will provide the U.S. Fish and Wildlife Service (USFWS) a memorandum summarizing a recent bull trout survey conducted in the Wells Reservoir when the reservoir was drawn down to a lower elevation (Item VI-4). (Note: Andrew Gingerich provided this memorandum to Kristi Geris on May 20, 2016, which Geris distributed to the Aquatic SWG that same day.)

5. Kristi Geris will distribute to the Aquatic SWG a request for agenda items for the Aquatic SWG meeting on June 8, 2016, to gauge whether a June 2016 meeting will be necessary (Item VII-1). (Note: Geris distributed this request following the meeting on May 11, 2016, and the Aquatic SWG agreed via email to cancel the meeting on June 8, 2016, due to lack of agenda items.)

6. The Aquatic SWG meeting on June 8, 2016, is tentatively scheduled to be held in-person at Douglas PUD Headquarters in East Wenatchee, Washington (Item VII-1). (Note: the Aquatic SWG agreed via email to cancel the meeting on June 8, 2016, due to lack of agenda items.)
II. Summary of Decisions

1. Aquatic SWG members present approved the 2015 Bull Trout Management Plan and Incidental Take Statement Annual Report (Item VI-2). *(Note: the CCT approved the report via email prior to the meeting on May 11, 2016, Patrick Verhey confirmed the Washington Department of Fish and Wildlife’s [WDFW’s] approval of the report by Chad Jackson via email on May 12, 2016, the Washington State Department of Ecology [Ecology] approved the report via email on May 14, 2016, and the Yakama Nation [YN] abstained via email on May 20, 2016.)*

2. Aquatic SWG members present approved the 2015 Resident Fish Management Plan Annual Report (Item VI-2). *(Note: the CCT approved the report via email prior to the meeting on May 11, 2016, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, 2016, Ecology approved the report via email on May 14, 2016, and the YN abstained via email on May 20, 2016.)*

3. Aquatic SWG members present approved the 2015 Evaluations of White Sturgeon Supplementation and Management in the Wells Reservoir Report (Item VI-2). *(Note: the CCT approved the report via email prior to the meeting on May 11, 2016, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, 2016, Ecology approved the report via email on May 14, 2016, and the YN abstained via email on May 20, 2016.)*

4. Aquatic SWG members present approved the 2015 Water Quality Management Plan Annual Report (Item VI-2). *(Note: the CCT approved the report via email prior to the meeting on May 11, 2016, Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, 2016, Ecology approved the report via email on May 14, 2016, and the YN abstained via email on May 20, 2016.)*

5. Aquatic SWG members present approved the 2015 Pacific Lamprey Management Plan Annual Report (Item VI-2). *(Note: Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, 2016, Ecology approved the report via email on May 14, 2016, and the YN abstained via email on May 20, 2016.)*

6. Aquatic SWG members present approved the 2015 ASA Annual Report (Item VI-2). *(Note: Patrick Verhey confirmed WDFW’s approval of the report by Chad Jackson via email on May 12, 2016, Ecology approved the report via email on May 14, 2016, and the YN abstained via email on May 20, 2016.)*

III. Agreements

1. Aquatic SWG members present agreed to open attendance for the Regional Pacific Lamprey Workshop (Item VI-6).

2. Aquatic SWG members present agreed to hold the Aquatic SWG meeting on June 8, 2016, in-person, at Douglas PUD Headquarters in East Wenatchee, Washington, from 8:30 to 9:30 a.m., if needed, prior to the Regional Pacific Lamprey Workshop (Item VII-1). *(Note: the Aquatic SWG agreed via email to cancel the meeting on June 8, 2016, due to lack of agenda items.)*

3. The Aquatic SWG agreed via email to cancel the Aquatic SWG meeting on June 8, 2016, due to lack of agenda items, as follows: USFWS agreed to cancel on May 11, 2016; Douglas PUD,
Aquatic Settlement Work Group  Page 3 of 9
May 11, 2016 Conference Call

Ecology, and the CCT agreed to cancel on May 20, 2016; and WDFW and the Yakama Nation agreed to cancel on May 24, 2016 (Item VII-1).

IV. Review Items

1. There are no items that are currently available for review.

V. Documents Finalized

1. The Final 2015 ASA Annual Report was distributed to the Aquatic SWG by Kristi Geris on May 16, 2016 (Item VI-2).
2. Kristi Geris sent an email to the Aquatic SWG on June 1, 2016, notifying them that the Final 2015 ASA Annual Report, which was filed with FERC on May 26, 2016, and full consultation record are available for download from the Douglas PUD website (Item VI-2).

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

(John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. No additions or changes to the agenda were requested.

The revised draft April 13, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes. She said she also corrected the meeting date in the first sentence of the minutes. Aquatic SWG members present approved the April 13, 2016, conference call minutes, as revised.

Action items from the last Aquatic SWG meeting on April 13, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the April 13, 2016, meeting):

• **Bob Rose will discuss internally the CCT’s proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).**
  This action item will be carried forward.

• **Douglas PUD will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).**
  This action item will be carried forward.

• **Bob Rose and John Ferguson (and other Aquatic SWG members, if interested) will compile topics to discuss during a potential Regional Pacific Lamprey Workshop, for discussion during the Aquatic SWG meeting on May 11, 2016 (Item VI-5).**
This will be further discussed during today’s conference call.

2. **DECISION: 2015 ASA Management Plan Annual Reports** (Andrew Gingerich): Andrew Gingerich said, despite the low attendance, Douglas PUD would still like to request formal approval of the six ASA Management Plan Annual Reports from the Aquatic SWG members present. Gingerich noted that all reports have been available for at least a 30 day-review period, and notice and reminders of Douglas PUD’s intention to request formal approval of the documents during today’s conference call have been distributed several times.


The Final 2015 ASA Annual Report was distributed to the Aquatic SWG by Kristi Geris on May 16, 2016. Geris sent an email to the Aquatic SWG on June 1, 2016, notifying them that the Final 2015 ASA Annual Report, which was filed with FERC on May 26, 2016, and full consultation record are available for download from the Douglas PUD website.

3. **Wells White Sturgeon Tagging and Rearing Update** (Andrew Gingerich): Andrew Gingerich said, briefly, the fish on station are doing well, and growth has improved with increased water temperature and feed.

4. **Wells Project Water Forecast Update** (Andrew Gingerich): Andrew Gingerich said river flow through the Wells Reservoir has been high for this time of year. He also noted that the reservoir was recently drawn down to a lower elevation to facilitate work in the Methow River. He said, per the ASA Bull Trout Management Plan, during the period of low reservoir elevation, Douglas PUD conducted an investigation for entrapped or stranded bull trout. Gingerich said Douglas PUD will provide USFWS a memorandum summarizing the recent bull trout survey conducted in the Wells Reservoir when the reservoir was drawn down to a lower elevation. *(Note: Gingerich provided this memorandum to Kristi Geris on May 20, 2016, which Geris distributed to the Aquatic SWG that same day.)*
5. 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Update (Andrew Gingerich): Andrew Gingerich said preparations for the bull trout study are moving forward. He also noted that two bull trout have already been detected in the Wells Reservoir. He said, on May 5, 2016, one adult bull trout was trapped in the west fish ladder during spring Chinook salmon broodstock collection. He said the fish had an existing passive integrated transponder (PIT) tag indicating the fish was tagged in 2013 at Wells Hatchery at a fork length of 580 millimeters (mm). He said the fish was recaptured at a fork length of 720 mm. He also said the fish was detected last fall in Lost River (headwaters of the Methow River), which would be consistent with post-spawn migration. He said the other fish was also an adult, detected in early April 2016 at the Twisp Weir by WDFW staff. Gingerich said the fish was not captured but was detected on the PIT-tag detector.

Steve Lewis asked if Douglas PUD plans to modify the start date for the bull trout study, considering bull trout are already being detected in the Wells Reservoir. Gingerich said the study start date was derived from a comprehensive review of arrival date distribution data for bull trout throughout the last 10 years, queried from the Data Access in Real Time database. He added that Douglas PUD does have the capacity to start radio tagging tomorrow. He also said WDFW is already trapping 3 days per week at both fish ladders for spring Chinook salmon broodstock collection, and Douglas PUD requested that WDFW retain incidentally captured bull trout for tagging. Gingerich said, however, the study will not technically start until May 23, 2016.

Lewis asked where the retained bull trout will be held prior to radio tagging. Gingerich explained that fish captured at the east fish ladder will be tagged within 1 hour. He said at the west fish ladder, there is a water-to-water handling facility within Wells Hatchery. He said, per the spring Chinook salmon protocol, a monitoring and evaluation (M&E) crew arrives the following morning to work up spring Chinook salmon broodstock captured the previous day. He said Douglas PUD proposes that the retained bull trout will be worked up the next day with the M&E crew. He said, if bull trout are worked up at a different time, this could lead to harassment of spring Chinook salmon, which is not wanted. He added that fish tags include how fish were handled.

John Ferguson asked about the tag type, and Gingerich said the tags are surgically implanted. Gingerich added that bull trout can spawn multiple times, which is why a gastric tag is not used. He further explained two incisions are made, the radio tag is laid in the cavity, and a catheter is used to allow the antennae to exit the body cavity near the tail.

Chad Jackson asked about the schedule for releasing the juveniles. Gingerich said the goal is to PIT tag the fish from May 23 to 25, 2016, and then release the fish the following week on June 1 and 2, 2016. He said this schedule might be modified pending receipt of fish health
screening results. He said fish health samples were taken about 1 or 2 weeks ago, and Jason Wahls (WDFW) has not yet heard back from the laboratory. Jackson said Douglas PUD will likely receive the fish health results within a week or so.

6. Pacific Lamprey Update

Regional Pacific Lamprey Workshop (John Ferguson):

John Ferguson recalled recently discussing within the Aquatic SWG convening a regional workshop to discuss Pacific lamprey. He said, based on these discussions, he, Bob Rose, and Tracy Hillman (Rocky Reach Fish Forum [RRFF] and Priest Rapids Fish Forum Facilitator) crafted a draft workshop agenda, which was distributed to the Aquatic SWG for review by Kristi Geris on May 9, 2016. Ferguson said the workshop currently starts at 9:00 a.m.; however, the start time may change to 9:30 a.m., if the Aquatic SWG determines convening a brief monthly meeting is needed prior to the start of the workshop. Ferguson said he will begin the workshop with reviewing workshop goals. He said goals will focus on continuing discussions about Pacific lamprey, identifying how those discussions fit in the broader Mid-Columbia River Basin context, and determining what is known and what is not known. He said the workshop is intended to facilitate dialogue and share positions on Pacific lamprey. He said discussions may also include potential revisions to the Douglas PUD 2016 Lamprey Approach, Passage, and Enumeration Study Plan, if feasible, including future plans for Pacific lamprey in the Wells Reservoir. He said the PUDs will outline their views, constraints, and agreements. He said the group will also discuss and identify critical uncertainties, plans for 2016, and the future. He added that this workshop may be followed by additional workshops.

Ferguson asked about limiting attendance. He said Andrew Gingerich indicated room capacity should not be an issue. Ferguson said pros to opening attendance to anyone include lots of discussion and perspectives; however, cons include lacking focus strictly to Aquatic SWG members. He added that sometimes the ideal environment to educate a specific group is to create a comfortable place to voice opinions without extremist opinions present. Steve Lewis asked what Ferguson meant by extremist opinions. Ferguson said, for example, he does not know some of the requested attendees or their views, and there is also sometimes the desire to avoid having consultants or vendors present so that the technical discussions are not potentially influenced by participants with vested interests. Lewis said he does not believe there should be any concern with the requested attendees to date. He said many of these people are specialists in Pacific lamprey and can bring a lot of insight to the discussions. Gingerich agreed with Lewis and briefly introduced requested attendees to date, as follows: 1) Bao Le (HDR Engineering, Inc.) was formerly employed by Douglas PUD and conducted a lot of pre-licensing Pacific lamprey studies for Douglas PUD and also participates in Pacific lamprey efforts in the lower Columbia River; 2) Rod O’Connor (Blue Leaf Environmental) conducted early acoustics work on Pacific lamprey for Grant PUD; 3) Mike Clement (Grant PUD) is the technical lead for Pacific lamprey for Grant PUD; and 4) Pat McGuire (Ecology) is Ecology’s technical
representative for Grant PUD’s forum. Gingerich suggested, in the spirit of regional coordination, not to restrict attendance. He added that the Aquatic SWG can convene a more focused group at a later date, if needed. Aquatic SWG members present agreed to open attendance for the Regional Pacific Lamprey Workshop.

Lewis said, during the last RRFF meeting, this Regional Pacific Lamprey Workshop was discussed, and he perceived a bit of hesitation from Chelan PUD to participate. He recalled Chelan PUD asking why they should have to participate, and the RRFF explaining the goal of regional coordination. Lewis said he believes Chelan PUD understands; however, he suggested facilitating the workshop carefully. He requested that Chelan PUD be an active participant, and not just a presenter of their data. Gingerich said he appreciates the desire to encourage Chelan PUD participation; however, within the Aquatic SWG, there is no control over what Chelan PUD does. Gingerich said he spoke with Steve Hemstrom (Chelan PUD RRFF Representative), and Hemstrom indicated Chelan PUD plans to participate. Gingerich noted that there is a lot of uncertainty about the approach of Pacific lamprey to Wells Dam; however, if fingers are pointed, the discussion will not be productive. Lewis agreed and suggested Ferguson and Hillman carefully set the tone for this discussion. Ferguson agreed.

**Passage Metrics (Steve Lewis):**

Lewis said, during the last RRFF meeting, the RRFF discussed how to determine the best passage metrics to compare projects. He said metrics increase and decrease depending on the project, and the RRFF was not sure how to glean an average to compare projects. He said he wants to continue this discussion within the Aquatic SWG. He asked how to determine when Douglas PUD has obtained the best passage metric. Ferguson said this is a complex topic. He said his recollection of the ASA Pacific Lamprey Management Plan is fairly generic in that regard (i.e., Douglas PUD will address passage problems). He said the topic is a good one, and will require a lot of discussion within the Aquatic SWG. He added that the upcoming workshop may be a good venue to start these discussions. Andrew Gingerich agreed this is a good question. He said there is language in the ASA Pacific Lamprey Management Plan about addressing project effects, and also achieving passage success rates no less than other projects. He said these are questions Douglas PUD has been asking for years. He added that Pacific lamprey do not necessarily need to return to a natal stream, so it is difficult to evaluate lamprey the same way salmon are evaluated. He said Douglas PUD hopes to approach this topic incrementally. He said other projects have installed infrastructure to improve passage, and maybe the same will eventually be installed at Wells Dam. He recalled one year when fish accessed the auxiliary water supply system, and last year, when fish did not seem to want to approach Wells Dam. He said Douglas PUD needs to have long-term goals, but also needs to confirm study assumptions, which is how the 2016 Lamprey Approach, Passage, and Enumeration Study is crafted. Gingerich said Douglas PUD needs to incrementally go through this process. He said Douglas PUD is also open to discuss how to move forward using the ASA Pacific Lamprey
Management Plan to guide the process. He said this will be challenging, and he is not sure a passage standard will ever be reached due to the unique life history of the Pacific lamprey. Lewis agreed with Gingerich’s sentiments and explained that some of this discussion stems from the last paragraph in the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, indicating if passage at Wells Dam is the same at other projects, then Pacific lamprey efforts have been accomplished. Gingerich said it has never been the policy of Douglas PUD to just check a box and ignore the resource. He said there should be no concern regarding Douglas PUD discontinuing efforts concerning Pacific lamprey.

VII. Next Meetings
1. Upcoming meetings (John Ferguson): Aquatic SWG members present agreed to hold the Aquatic SWG meeting on June 8, 2016, in-person at Douglas PUD Headquarters in East Wenatchee, Washington, from 8:30 to 9:30 a.m., if needed, prior to the Regional Pacific Lamprey Workshop. Kristi Geris will distribute to the Aquatic SWG a request for agenda items for the Aquatic SWG meeting on June 8, 2016, to gauge whether a June 2016 meeting will be necessary. *(Note: Geris distributed this request following the meeting on May 11, 2016, and the Aquatic SWG agreed via email to cancel the meeting on June 8, 2016, due to lack of agenda items.)*

   The Aquatic SWG meeting on June 8, 2016, is tentatively scheduled to be held in-person at Douglas PUD Headquarters in East Wenatchee, Washington. *(Note: the Aquatic SWG agreed via email to cancel the meeting on June 8, 2016, due to lack of agenda items.)*

   Upcoming meetings are as follows: June 8, 2016 (canceled); July 13, 2016 (TBD); and August 10, 2016 (TBD).

List of Attachments
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<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, July 13, 2016, from 10:00 to 11:00 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. **Summary of Action Items**

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).
2. Douglas PUD will consider requesting permission from the Federal Energy Regulatory Commission (FERC) to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).
3. Steve Lewis will provide edits on the Regional Pacific Lamprey Workshop minutes to Kristi Geris, and Geris will verify the edits with respective parties and redistribute the revised minutes once finalized (Item VI-2). *(Note: Lewis provided edits to the minutes on July 14, 2016, and the revised final minutes were distributed to the Aquatic SWG by Geris on July 18, 2016.)*
4. Douglas PUD will provide an update on Wells Project total dissolved gas (TDG) levels observed to date in 2016, and the forecast for the remainder of the year, during the Aquatic SWG meeting on August 10, 2016 (Item VI-3).
5. The Aquatic SWG will further discuss the future of the Douglas PUD White Sturgeon Program during the Aquatic SWG meeting on August 10, 2016 (Item VI-6).
6. Douglas PUD will provide a Draft ASA Document Approval Process Statement of Agreement (SOA) for discussion during the Aquatic SWG meeting on August 10, 2016 (Item VI-7).
7. The Aquatic SWG meeting on August 10, 2016, will be held by conference call (Item VII-1).

II. **Summary of Decisions**

1. There were no decisions approved during today’s conference call.
III. Agreements
   1. There were no agreements discussed during today’s conference call.

IV. Review Items
   1. Kristi Geris sent an email to the Aquatic SWG on June 29, 2016, notifying them that the Revised Draft 2015 White Sturgeon Monitoring and Evaluation (M&E) Report was available for review, with comments due to Andrew Gingerich by August 3, 2016. Douglas PUD plans to request approval of the draft report during the Aquatic SWG meeting on August 10, 2016 (Item VI-6).

V. Documents Finalized
   1. There are no documents that have been recently finalized.

VI. Summary of Discussion
   1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items
      (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. The following revisions were requested:
      - Steve Lewis added the Regional Pacific Lamprey Workshop minutes.
      - Patrick Verhey added an update on Wells Project TDG levels observed to date in 2016 and the forecast for the remainder of the year.

      The revised draft May 11, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes. Aquatic SWG members present approved the May 11, 2016, conference call minutes, as revised.

      Action items from the last Aquatic SWG conference call on May 11, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the May 11, 2016, conference call):
      - Bob Rose will discuss internally the CCT’s proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG (Item VI-1). This action item will be carried forward.
      - Douglas PUD will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal, and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1). This action item will be carried forward.
• **Kristi Geris will distribute to the Aquatic SWG a request for email approval of the six Draft 2015 ASA Annual Reports, with approval due by Friday, May 13, 2016 (Item VI-2).**
  Geris distributed this request following the meeting on May 11, 2016.

• **Douglas PUD will provide the U.S. Fish and Wildlife Service (USFWS) a memorandum summarizing a recent bull trout survey conducted in the Wells Reservoir when the reservoir was drawn down to a lower elevation (Item VI-4).**
  Andrew Gingerich provided this memorandum to Kristi Geris on May 20, 2016, which Geris distributed to the Aquatic SWG that same day. This will be further discussed during today’s meeting.

• **Kristi Geris will distribute to the Aquatic SWG a request for agenda items for the Aquatic SWG meeting on June 8, 2016, to gauge whether a June 2016 meeting will be necessary (Item VII-1).**
  Geris distributed this request following the meeting on May 11, 2016, and the Aquatic SWG agreed, via email, to cancel the meeting on June 8, 2016, due to lack of agenda items.

2. **Regional Pacific Lamprey Workshop Minutes** (Steve Lewis): The final minutes from the Regional Pacific Lamprey Workshop that was held in-person on Wednesday, June 8, 2016, from 9:00 a.m. to 3:00 p.m., at Douglas PUD Headquarters in East Wenatchee, Washington, were distributed to the Aquatic SWG and workshop attendees by Kristi Geris on July 12, 2016.
  Steve Lewis said he believes there is a typo in the minutes with regard to who conducted the Pacific lamprey passage study at Tumwater Dam in March 2016. He said he will provide edits to Geris, and Geris will verify the edits with respective parties and redistribute the revised minutes once finalized. *(Note: Lewis provided edits to the minutes on July 14, 2016, and the revised final minutes were distributed to the Aquatic SWG by Geris on July 18, 2016.)*

3. **Wells Project TDG Forecast** (Andrew Gingerich): Andrew Gingerich said, this year, flows and gas levels above Wells Dam have been very moderate, with no exceedances to date. He said he will provide a more detailed update on Wells Project TDG levels observed to date in 2016, and the forecast for the remainder of the year, during the Aquatic SWG meeting on August 10, 2016.

4. **2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Update** (Andrew Gingerich): Andrew Gingerich said trapping was completed last week for the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study. He said the goal was to trap 30 bull trout at Wells Dam and 30 bull trout at the Twisp Weir; however, only 14 bull trout were obtained from Wells Dam, and the balance was collected at the Twisp Weir consistent with the study plan language. He said one other modification to the study plan included changing the release location of tagged fish. He explained, that before releasing tagged fish, Douglas PUD contacted the U.S. Fish and Wildlife Service (USFWS) to request moving the release location from the confluence of the Twisp and Methow rivers to
upstream of the weir. He said river flow at the original release location was higher than preferred and, considering trapping at the weir, there was concern that tagged bull trout might be recaptured. He said the new release location was upstream of the weir between two radio telemetry sites at the Buttermilk Creek confluence with the Twisp River. He said releasing the fish between these radio telemetry sites will ensure the fish are tracked, whether they move upstream or downstream. He said everything else went as planned, and now fish are being tracked via mobile tracking and monitoring of fixed station detections. He said data from fixed stations are downloaded every other week.

Steve Lewis said USFWS appreciated Douglas PUD’s foresight and coordination. He said these studies sometimes require flexibility.

John Ferguson asked about the tag life, and Gingerich replied that although this study is a 1-year study, Douglas PUD agreed to use a 3-year tag, per USFWS’s request that was noted during study plan development. Gingerich agreed this made sense because: 1) if passage and survival metrics are not achieved, the longer battery life allows a second year to obtain those data, which is consistent with the Bull Trout Management Plan; and 2) that USFWS suggested, as long as those fish are already being handled, the longer tag life would allow other agencies interested in tracking those fish during the life of the tag do so.

Lewis asked if trapped fish at the Twisp Weir were crowded. Gingerich said no; the most fish trapped was 13 fish in 1 night, and the trap box/holding area had sufficient flow and volume to hold those fish. He said there were no concerns with numbers or holding, and no fish were held longer than 16 hours. He said fish were typically trapped during crepuscular or nighttime hours, and then tagged the next morning. Lewis asked if there were any unique size distributions, and Gingerich said he could not recall much quantitatively about size; however, details will be included in the final report. Gingerich said two fish were rejected because they were a bit too small. He said all study fish lengths were larger than 400 millimeters.

5. **Bull Trout Survey Memorandum** (Andrew Gingerich): Andrew Gingerich said the Bull Trout Survey Memorandum to USFWS summarizing a recent bull trout entrapment and stranding survey conducted in the Wells Reservoir, per Article 402 of Douglas PUD’s FERC License Order 2149, was distributed to the Aquatic SWG by Kristi Geris on May 20, 2016. Gingerich said, on May 3, 2016, the Wells Reservoir reached an elevation of 773 feet mean sea level. He said this low elevation was implemented to help flush the Methow River delta to remove sediment and prevent flooding in the town of Pateros, Washington. He said Article 402 requires that Douglas PUD conduct a survey within 24 hours of reaching the lowered elevation, which Douglas PUD complied with. He said, consistent with past surveys, this memorandum provides documentation that the survey took place. He said no bull trout were observed; however,
juvenile summer Chinook salmon were found in a couple of pools and were recovered and returned to the mainstem river.

6. Wells White Sturgeon

Brood Year (BY) 2015 Release (Andrew Gingerich):

Andrew Gingerich said a white sturgeon release update was provided to Kristi Geris on June 3, 2016, which Geris distributed to the Aquatic SWG that same day. He said, as described in the update, about 5,200 fish were released into the Wells Project during a 2-day period. To date, more than 15,000 fish have been raised and released during the last 3 years. He said all fish released in 2016 were Lake Roosevelt larval-origin fish. He said 50 fish were acoustically tagged prior to release. In addition, he noted that about 40 of these fish were released at Marina Park in Bridgeport, Washington, with assistance from a local high school’s biology students. He said the students interrogated the fish, recorded lengths and weights, and had an opportunity to learn about sturgeon life history. He said the other tagged fish were released at Washburn Island, consistent with past years. He said the fish were approximately 11 months old. He said size distribution will be provided in the final report, and noted that fish were a little bit larger than last year. He said, however, the fish were slightly smaller than the target weight of 200 grams, which is the product of not culling fish earlier in the growth season.

BY 2016 Collection (Jason McLellan and Andrew Gingerich):

Larval-origin fish

Jason McLellan said crews went out in June 2016, noting that everything occurred earlier this year due to low flows and higher temperatures. He said spawning was detected within a 3-day period with the new sampling setup and a total of 22,000 larvae fish were captured during 3 nights of sampling. He said a little more than 22,000 larvae were delivered to Wells Hatchery, which is well beyond the collection goal. John Ferguson asked how this compares to last year. McLellan said last year, a total of 17,000 fish were captured throughout 5 nights of sampling, and that, in general, the CCT have developed their technique to a point where target sample sizes can easily be captured during a few nights of sampling.

Direct gamete-origin fish

Andrew Gingerich said, in addition to a successful larval year, Douglas PUD also obtained 15,000 direct gamete-origin fish that had been fertilized and hatched out at Marion Drain. He said fish were picked up 2 weeks post-fertilization. He said fish were collected via a 6x6 cross, predominantly from adult sturgeon caught downstream of McNary Dam.

Future of Douglas PUD White Sturgeon Program (Andrew Gingerich):

Gingerich said 2016 is the last year in the 4-year SOA, where Douglas PUD funds collection of adult broodstock for the conventional brood program. He said BY 2016 fish will be released in early June 2017, and now the Aquatic SWG needs to start discussing how to move forward with
Aquatic Settlement Work Group  Page 6 of 8
July 13, 2016 Conference Call

the program, per FERC license requirements. He clarified that the license requires up to
20,000 fish be released in the first 4 years, followed by up to 15,000 fish released in the next
5 years. John Ferguson suggested adding this as an agenda item for next month. McLellan
agreed this is a good idea, noting that he hopes not to put this off too long, so there is enough
time to assemble field crews and complete the contracting necessary for larvae collection in
future years. Gingerich also agreed, and suggested that Chad Jackson (Washington Department
of Fish and Wildlife) participate in these discussions. The Aquatic SWG will further discuss the
future of the Douglas PUD White Sturgeon Program during the Aquatic SWG meeting on
August 10, 2016.

Revised Draft 2015 White Sturgeon M&E Report (Andrew Gingerich):
Gingerich said Geris sent an email to the Aquatic SWG on June 29, 2016, notifying them the
Revised Draft 2015 White Sturgeon M&E Report was available for review, with edits and
comments due to Gingerich by August 3, 2016. The email also indicated that Douglas PUD plans
to request approval of the draft report during the Aquatic SWG meeting on August 10, 2016.
Gingerich recalled, when the draft report was originally distributed on April 6, 2016, Douglas
PUD decided to delay requesting review and approval of the report because so many other ASA
reports were already out for review. He said he believes this report has bearing on how to move
forward with this program, and suggested reviewing the document prior to discussing this topic
on August 10, 2016. He also noted that the report includes a first attempt at estimating survival,
which both LGL Unlimited, LLC, and Gingerich believes is conservative because other programs
are showing that fish begin to recruit to gear several years after release and as they age.

M&E Update (Andrew Gingerich):
Gingerich said white sturgeon M&E activities in 2016 (the second year of M&E) are consistent
with last year. He said M&E is divided into two sampling sessions: 1) a 25-day sample session
that is taking place now; and 2) a second 25-day sample session that will take place in fall 2016.
He said this second year of M&E will hopefully improve upon the estimate of survival; however,
he noted that a survival estimate can be calculated only for the first release group. He said
Douglas PUD will keep the Aquatic SWG updated on the M&E efforts as the season progresses.

7. ASA Document Approval Process (Andrew Gingerich): Andrew Gingerich said the ASA document
approval process begins with Douglas PUD distributing draft documents for review, providing at
least 30 days for comment, and then Aquatic SWG members providing edits and comments on
the documents, which are then voted upon. He said this year was a bit disorganized,
recognizing that there were a lot of documents for review in the first quarter of the year (most
due May 31, and some earlier). He said Douglas PUD is hoping to establish an SOA, which
includes language that clarifies the review and approval process, because the language in the
ASA is not clear. He said, the general thought is, if Aquatic SWG members do not have time to
review and approve every single document, an abstention will be noted instead of being ‘chased
down’ or ‘chasing down’ approvals. He said the SOA will be consistent with the ASA, provide
Douglas PUD with the flexibility to move forward with their implementation of FERC license stipulations, and facilitate development of a clearer consultation record. He said the purpose of the SOA is to make the approval process easier for everyone. John Ferguson added that the SOA will help reestablish voting protocols, including outlining the review period and approval process. Douglas PUD will provide a Draft ASA Document Approval Process SOA for discussion during the Aquatic SWG meeting on August 10, 2016.

VII. Next Meetings
1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on August 10, 2016, will be held by conference call.

Upcoming meetings are as follows: August 10, 2016 (conference call); September 14, 2016 (TBD); and October 12, 2016 (TBD).

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Notes:
† Joined for white sturgeon agenda items
The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, August 10, 2016, from 10:00 to 11:20 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).

2. Douglas PUD will consider requesting permission from the Federal Energy Regulatory Commission (FERC) to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).

3. There will be a formal introduction of the new Washington State Department of Ecology (Ecology) Aquatic SWG Technical Representative, Breean Zimmerman, at the next Aquatic SWG meeting on September 14, 2016 (Item VI-2).

4. Douglas PUD will distribute a Doodle Poll to convene a technical subgroup to discuss the future of the Douglas PUD White Sturgeon Program (Item VI-4). (Note: Andrew Gingerich distributed a poll following the meeting on August 10, 2016.)

5. Updates on discussions about the future of the Douglas PUD White Sturgeon Program will be provided during each Aquatic SWG monthly meeting, with the goal to make a decision by the Aquatic SWG meeting on January 11, 2017 (Item VI-4).

6. Douglas PUD will distribute a Revised Draft 2015 White Sturgeon Monitoring and Evaluation (M&E) Report for a 10-day review, with plans to request approval of the draft report during the Aquatic SWG meeting on September 14, 2016 (Item VI-4). (Note: Andrew Gingerich provided the revised draft report, as well as a comment and response document, to Kristi Geris on August 15, 2016, which Geris distributed to the Aquatic SWG that same day.)

7. Douglas PUD will provide a Draft ASA Document Approval Process Statement of Agreement (SOA) for discussion during the Aquatic SWG meeting on September 14, 2016 (Item VI-5).

8. The Aquatic SWG meeting on September 14, 2016, will be held by conference call (Item VII-1).
II. Summary of Decisions
   1. There were no decisions approved during today’s conference call.

III. Agreements
   1. There were no agreements discussed during today’s conference call.

IV. Review Items
   1. Kristi Geris sent an email to the Aquatic SWG on August 15, 2016, notifying them the Revised Draft 2015 White Sturgeon M&E Report is available for a 10-day review period, with comments due to Andrew Gingerich by Thursday, August 25, 2016 (Item VI-4).

V. Documents Finalized
   1. There are no documents that have been recently finalized.

VI. Summary of Discussion
   1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items
      (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and asked for any additions or other changes to the agenda. The following revisions were requested:
         • Steve Lewis requested an update on bull trout and Pacific lamprey activities.

      The revised draft July 13, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes. Aquatic SWG members present approved the July 13, 2016, conference call minutes, as revised.

      Action items from the last Aquatic SWG conference call on July 13, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the July 13, 2016, conference call):
         • Bob Rose will discuss internally the CCT’s proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1). This action item will be carried forward.
• **Douglas PUD** will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1). This action item will be carried forward.

• **Steve Lewis** will provide edits on the Regional Pacific Lamprey Workshop minutes to Kristi Geris, and Geris will verify the edits with respective parties and redistribute the revised minutes once finalized (Item VI-2).

  Lewis provided edits to the minutes on July 14, 2016, and the revised final minutes were distributed to the Aquatic SWG by Geris on July 18, 2016.

• **Douglas PUD** will provide an update on Wells Project total dissolved gas (TDG) levels observed to date in 2016, and the forecast for the remainder of the year, during the Aquatic SWG meeting on August 10, 2016 (Item VI-3).

  This will be discussed during today’s meeting.

• **The Aquatic SWG** will further discuss the future of the Douglas PUD White Sturgeon Program during the Aquatic SWG meeting on August 10, 2016 (Item VI-6).

  This will be discussed during today’s meeting.

• **Douglas PUD will provide a Draft ASA Document Approval Process SOA for discussion during the Aquatic SWG meeting on August 10, 2016** (Item VI-7).

  This will be discussed during today’s meeting.

2. **Washington State Department of Ecology Aquatic SWG Technical Representative – Breean Zimmerman** (John Ferguson): John Ferguson said because Breean Zimmerman is not present, there will be a formal introduction of the new Ecology Aquatic SWG Technical Representative at the next Aquatic SWG meeting on September 14, 2016.

3. **Wells Project TDG Update/Forecast** (Andrew Gingerich): Andrew Gingerich recalled a request by Patrick Verhey during the last Aquatic SWG meeting on July 13, 2016, for an update on Wells Project TDG levels observed to date in 2016 and the forecast for the remainder of the year. Gingerich said, as requested, he compiled a Wells Dam 2016 Mid-Season TDG Compliance presentation (Attachment B), which was distributed to the Aquatic SWG by Kristi Geris prior to the meeting on August 10, 2016.

  Gingerich said this year was an odd flow year compared to the 10-year average, with the freshet occurring in April when it typically occurs in June and July. He noted a forebay sensor failure during the July 4th holiday weekend, which resulted in a loss of 1 week of data. He said the sensor has since been fixed. He also noted a power failure occurred in late July of 2016, resulting in a loss of 3 days of data from the tailrace sensor. He said, however, these data losses are insignificant in terms of compliance, and the Wells Project was well below water quality standards before the sensors failed and after the sensors were restored. He said, to date, 100% TDG compliance has been achieved in the Wells Dam tailrace. He added that there were 3 days in April 2016 where the Rocky Reach Dam forebay was out of compliance, which was associated
with the high flow experienced in April 2016, as well as unit maintenance and outages at Wells Dam during this time.

Gingerich reviewed the State standards for TDG, as reported in slide 3 of Attachment B. He noted that a fish passage TDG adjustment for the 2016 spill season was obtained, which allows for higher TDG values associated with increased spill or bypass volumes and to increase juvenile survival through the project. He reviewed Slide 4 of Attachment B, which depicts daily average river flow observed at Wells Dam this year compared to the 10-year average. He said Douglas PUD scheduled bi-annual unit and transformer maintenance during the month of April, because historically, this has been a safe time to do so since the freshet is typically in June and July, and April flows are moderate. He noted, however, the highest river flow occurred during the last 2 weeks of April this year. He said he believes this was due to maintenance activities at Grand Coulee Dam.

Gingerich reviewed Slide 5 of Attachment B, which depicts 15-minute interval data points of the Wells Dam forebay TDG. He said, because there is no anadromous fish passage at Chief Joseph Dam, the project does not have a fish passage TDG adjustment from Ecology, and therefore, water arriving at Wells Dam should be 110% or less. He also noted the data gap due to the lost sensor during the July 4th holiday weekend. He said Slide 6 of Attachment B is the same as Slide 4, and he reminded Aquatic SWG members that the water quality standards state that an operator of a dam is not held to the TDG standards when the river flow exceeds the 7-day, 10-year-frequency (7Q10) flood, which at Wells Dam is 246,000 cubic feet per second.

Gingerich reviewed Slide 7 of Attachment B, which shows the Wells Dam tailrace being in compliance with the 110% non-bypass standard from December 2015 to April 2016. He said, although values looked high in early April 2016, there were no 120% 12-C High or 125% hourly exceedances in the Wells Dam tailrace. He also noted the black arrow, which indicates when a sensor was lost due to power failure.

Gingerich reviewed Slide 8 of Attachment B, which depicts daily average TDG values in the Rocky Reach Dam forebay. He said the goal is to remain below the 115% 12C-high TDG standard; however, TDG in the Rocky Reach Dam forebay exceeded this standard on April 18, 19, and 23, 2016. He noted that these exceedances occurred during the highest river flow of this year. He said Wells Dam did not have the powerhouse capacity for high river flow because of biannual maintenance, so when the unexpected high flow occurred, operators had no choice but to spill the water.

Steve Lewis asked if Douglas PUD conducted biological monitoring associated with the three observed non-compliance events in the Rocky Reach Dam forebay. Gingerich said no, the Gas Abatement Plan only requires biological monitoring when TDG exceeds 125% for an
extended period of time. He added, in his experience, when Wells Dam has experienced high TDG values associated with high freshet flow and biological monitoring was conducted, it has not been until about 125% TDG when gas bubble trauma (GBT) is observed in smolts. He said further, high TDG values need to be sustained. He said if high TDG values are experienced only for a few hours, no GBT has been observed.

John Ferguson asked if there is preseason coordination between Grand Coulee Dam and Grant, Chelan, and Douglas PUDs to coordinate outflow and maintenance schedules. Gingerich said yes, the PUDs and Grand Coulee Dam operators convene an annual preseason meeting, and Grand Coulee Dam also distributes weekly river forecasts (although, these forecasts are modified throughout the week). He said he believes TDG violations correlate with power sales and hydrosystem operations; however, he feels he still needs to gain a better understanding of how power generation, sales, and flow forecasts throughout the Columbia River impact TDG compliance. He said there is a lot of communication, but this is not to say that coordination cannot be improved.

Lewis asked who is at fault when TDG exceedances occur and asked if these exceedances might warrant additional measures in the spill playbook. Gingerich said the fault is on the operator (i.e., an exceedance at Wells Dam is owned by Douglas PUD). He said Douglas PUD submits a water quality report to Ecology and FERC showing how Douglas PUD plans to comply with the water quality standards. He said, currently, there are no fines per se associated to TDG since Douglas PUD is currently on a 10-year compliance schedule. He noted, occasionally, gas abatement plans are not developed at U.S. Army Corp of Engineer (USACE) projects, and it is difficult to follow State standards when USACE projects may not have the same standards. He said, with regard to exceedances in 2016, if Wells Dam was at least a nine-unit plant (instead of seven), and with accurate daily forecasts of river flow and below the 7Q10 threshold, there should have been no issues with meeting TDG standards. He said, once river flow exceeds the 7Q10 threshold, TDG standards are waived due to flood conditions. He said if Douglas PUD knew there would be high river flow in April 2016, the maintenance would not have been scheduled during that time. He said, typically, April is ideal for maintenance. He said, when factors change last minute, it complicates things.

4. **Wells White Sturgeon** (Andrew Gingerich):
   **Future of the Douglas PUD White Sturgeon Program**

John Ferguson recalled discussing during the last Aquatic SWG meeting on July 13, 2016, that 2016 was the last year of collection under the current Douglas PUD white sturgeon program SOA, and 2017 will be the last year of release. Ferguson said the Aquatic SWG needs to discuss how to move forward with the program, per Douglas PUD’s FERC license.
Andrew Gingerich recalled Douglas PUD’s FERC license requirement to plant no more than 15,000 fish in years 5 to 10 of the license, which is in addition to the 20,000 fish planted in the first 5 years of the license, totaling 35,000 fish. He said 15,000 fish divided by 5 years equals 3,000 fish per year, which is less than the stocking targets for the first 4 years of stocking. He said this target may be further reduced based on M&E data and consideration of carrying capacity. He said survival estimates in past reports will increase as fish grow and recruit better to the gear. He said he and Chad Jackson plan to run calculations based on findings from Grant and Chelan PUDs. Gingerich suggested convening a subgroup to discuss these details sooner rather than later, as Jason McLellan has also previously suggested, in order to reach an agreement in time, secure contracts, and develop and approve documents prior to collection next June 2017. Gingerich said he reviewed Grant PUD’s recent white sturgeon SOA, noting that he believes some components may also be a part of Douglas PUD’s discussions. He said, however, Grant PUD’s and Douglas PUD’s respective White Sturgeon Management Plans are not consistent. He said, for example, the stocking numbers may be slightly different, and the term, ‘harvest,’ is included differently in the Grant PUD management plan. Gingerich recommended the Aquatic SWG review the Aquatic SWG-approved Douglas PUD White Sturgeon Management Plan to help keep requirements and goals straight.

Steve Lewis asked if Douglas PUD has a sense of the scope of downstream migration of released individuals based on preliminary data to date. Gingerich said, based on acoustic data to date, emigration is estimated to be 2 to 5%. He added that McLellan commented in the Draft 2015 White Sturgeon M&E Report that these emigration values should be considered conservative estimates. Gingerich said some fish migrated into the Okanogan River, but it is uncertain whether those fish only temporarily left the Wells Reservoir. He said a couple fish were detected at Rocky Reach Dam, and only one Wells Project white sturgeon was captured during the entire Chelan PUD M&E effort.

Lewis asked if it would be useful for Douglas PUD to use a Grant PUD or Chelan PUD SOA as a template to start drafting the Douglas PUD SOA. Gingerich said Douglas PUD is not against this idea; however, he would want to be sure the entire Aquatic SWG also agrees this is the best approach. He said he is not sure using fish per river kilometer (RKM) is the best approach to establishing carrying capacity, because the reservoirs are different in terms of productivity and area. He added that he is open to considering it; however, he cautioned about applying certain metrics universally. He said the Wells Reservoir length is roughly 35 RKM. McLellan said the CCT approved the Grant PUD and Chelan PUD SOAs for the sake of consensus and moving forward; however, they and the Yakama Nation (YN) provided letters outlining their concerns with the SOAs. He suggested reviewing and considering these letters prior to and during drafting of an SOA for Douglas PUD. *(Note: The CCT and YN letters, which were attachments to the Grant and Chelan PUDs SOAs, were distributed to the Aquatic SWG by Kristi Geris following the meeting on August 10, 2016 [Attachments C and D].)*
McLellan said, at this point, he believes the Aquatic SWG needs to discuss larger next steps and not necessarily small details. He said he does not mean to downplay discussions on densities; rather, he is not sure the Aquatic SWG is ready for those discussions today. Gingerich said he was only trying to make best use of these meetings and not lose forward momentum on the topic. Lewis agreed with McLellan regarding the benefit of first reviewing comments from the CCT and the YN regarding the Grant PUD and Chelan PUD SOAs. Lewis also agreed it will be beneficial to run calculations and further discuss conservation versus harvest requirements. He said USFWS prefers to err on the side of caution. Gingerich suggested that McLellan summarize the CCT’s comments on the Grant PUD and Chelan PUD SOAs. McLellan said in summary, comments included: 1) presence of a lot of extraneous information, including inaccuracies and it did not reflect the process by which the CCT used to reach its decision to approve the documents; 2) issues with density calculations; 3) lack of description of adult white sturgeon, which density calculations were derived; and 4) unclear model assumptions that were not necessarily agreed upon were included in the SOAs. He said these comments are applicable to both SOAs, and the CCT requests that these issues are considered while drafting and approving future SOAs.

Jackson said the Grant and Chelan PUDs processes were long and arduous, and the technical and policy representatives struggled to reach agreement. He said the resulting SOAs were the best compromise the groups could agree to. He said, for Douglas PUD’s process, the policy realm is not even on the table. He agreed with Gingerich’s suggestion to convene a small workgroup to address outstanding technical details, and hopefully agreement can be reached within the Aquatic SWG without involving the policy level. McLellan also agreed with Gingerich and Jackson, noting that a lot was learned through the Grant and Chelan PUDs processes, which is why McLellan suggested the Aquatic SWG review the CCT and YN letters and consider these issues up front.

Ferguson asked about a deadline for reaching agreement in order to avoid delaying collection of brood year 2017 fish. Gingerich suggested reaching agreement by the end of December 2016 or beginning of January 2017, considering the first quarter of each year is always busy with annual reporting. McLellan agreed with the proposed deadline, and said agreement may not be needed on numbers by that date; however, agreement on source is needed.

Douglas PUD will distribute a Doodle Poll to convene a technical subgroup to discuss the future of the Douglas PUD White Sturgeon Program. Updates on discussions about the future of the Douglas PUD White Sturgeon Program will be provided during each Aquatic SWG monthly meeting, with a goal to make a decision by the Aquatic SWG meeting on January 11, 2017. (Note: Gingerich distributed a poll following the meeting on August 10, 2016.)
Draft 2015 White Sturgeon M&E Report
Andrew Gingerich said Kristi Geris sent an email to the Aquatic SWG on June 29, 2016, notifying them that the Revised Draft 2015 White Sturgeon M&E Report was available for review, with comments due to Gingerich by August 3, 2016. He added that Douglas PUD planned to request approval of the draft report during the Aquatic SWG meeting on August 10, 2016. Gingerich said comments on the draft report were received from the CCT on August 3, 2016, which were distributed to the Aquatic SWG by Geris that same day. Gingerich said about 75% of the comments have been addressed by Douglas PUD, and the remaining comments are pending review by LGL Unlimited. Douglas PUD will distribute a Revised Draft 2015 White Sturgeon M&E Report for a 10-day review, with plans to request approval of the draft report during the Aquatic SWG meeting on September 14, 2016. (Note: Gingerich provided the revised draft report, as well as a comment and response document, to Geris on August 15, 2016, which Geris distributed to the Aquatic SWG that same day.)

5. Draft ASA Document Approval Process SOA (Andrew Gingerich): Andrew Gingerich said this SOA is still being drafted and vetted internally. Douglas PUD will provide a Draft ASA Document Approval Process SOA for discussion during the Aquatic SWG meeting on September 14, 2016.

   Bull Trout
   Andrew Gingerich said monitoring of bull trout is ongoing. He said staff are also closely monitoring the voltage in the detection arrays as days are getting shorter (the arrays are solar powered). He said he is coordinating with Greg Mackey (Douglas PUD Habitat Conservation Plan Hatchery Committee Representative) on removing the trap boxes at the Twisp Weir, as brood collection is complete. Gingerich said the trap boxes will be removed prior to the post-spawn downstream migration.

   Pacific Lamprey
   Andrew Gingerich said Douglas PUD is moving forward with the 2016 Pacific lamprey study. He said fish collection and tagging will begin next week.

VII. Next Meetings
1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on September 14, 2016, will be held by conference call.

   Upcoming meetings are as follows: September 14, 2016 (conference call); October 12, 2016 (TBD); and November 9, 2016 (TBD).
List of Attachments
Attachment A – List of Attendees
Attachment B – Wells Dam 2016 Mid-Season TDG Compliance Presentation
Attachment C – Final Priest Rapids White Sturgeon Stocking SOA, with letters
Attachment D – Final Rocky Reach White Sturgeon Stocking SOA, with letters
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<th>Name</th>
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<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
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<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
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<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
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<td>Chas Kyger</td>
<td>Technical Support</td>
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<td>Steve Lewis</td>
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<td>U.S. Fish and Wildlife Service</td>
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<td>Patrick Verhey</td>
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<td>Jason McLellan</td>
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Wells Dam Mid-Season TDG Compliance 2016

Douglas County PUD
August 10 2016
Summary

• Data Collection:
  – Odd flow (April freshet)- Historically in June and July.
  – Forebay sensor failure over 4th of July. Lost a week of data.
  – Tailrace power failure in late July. Lost 3 days of data.
  – Data losses are insignificant in terms of compliance (well below WQ standards at these periods of time).

• 2016 Compliance to Date:
  – 100% TDG compliant in Wells Tailrace.
  – 3 days in April where Rocky Reach Forebay non-compliance observed.
    • Associated with high flow in April and Unit maintenance/outages at Wells Dam during this time.
Recall State Standards for TDG

• <110% September-March.

• April-August (Bypass/Spill Season) - TDG waiver obtained.
  - <120% 12C-High in Wells Tailrace (rolling 12 hour average).
  - <125% in Wells Tailrace as measured as an hourly average.
  - <115% 12C-High in Rocky Reach Forebay (rolling 12 hour average).

• Douglas PUD scheduled bi-annual unit and transformer maintenance during the month of April - historically safe to do so since freshet is in June and July.
• Bi-annual maintenance reduces powerhouse capacity. 7 Unit plant in late April.
Forebay TDG sensor failed July 1, 2016 after 9 years of functioning. Backup sensor was swapped in on the 7th.

No TDG Waiver at Chief Joseph therefore TDG is <110% year-round
Douglas PUD scheduled bi-annual unit and transformer maintenance during the month of April - historically safe to do so since freshet is in June and July.

- Bi-annual maintenance reduces powerhouse capacity. 7 Unit plant in late April.
Wells Tailrace: Zero Days of Non-Compliance in 2016

Dashed vertical (black) line denotes April fish passage season.

Orange dashed circle:
Early April values above 120% did not violate 12C-High standard.

7/22 to 7/24 tailrace sensor power failure (arrow).
Rocky Reach Forebay non-compliance observed on 4/18, 4/19 and 4/23 (red circles). 115% 12C-High standard.

This has been an ongoing concern for Columbia River Hydro-Operators. 12C-High formula can make it seem like more days are in violation than actual based on the running average method.
Statement of Agreement: Priest Rapids Project White Sturgeon Stocking Program for Population Rebuilding, Mitigation, and Enhancement

Background
In accordance with the Priest Rapids Project White Sturgeon Management Plan, beginning in year three (2011) of the new FERC license, Grant Public Utility District (GPUD) released between zero to 6,500 yearling hatchery White Sturgeon into the Priest Rapids Project Area (PRPA) annually in years three to seven (2011-2015). Subsequent years stocking (2016 and beyond) will be determined by the Priest Rapids Fish Forum (PRFF). In 2015, GPUD fulfilled its annual White Sturgeon stocking requirements for years three through seven.

To determine future releases of yearling hatchery White Sturgeon into the PRPA, the PRFF and PRFF Policy Committee (PRFF-PC) identified a target population size to rebuild towards and used a population growth model to develop a stocking strategy for Priest Rapids and Wanapum reservoirs. Described below is the approach used to identify a target population size and model inputs used to develop a stocking strategy.

Approach
The PRFF-PC identified adult abundance as the population metric upon which to develop a stocking strategy from. The PRFF-PC selected the 2012 White Sturgeon adult density (adults per river kilometer) estimate from Bonneville Reservoir to identify rebuilding targets for Priest Rapids and Wanapum reservoirs. Bonneville Reservoir was selected because the White Sturgeon population there is abundant, stable-aged, appears to exhibit some level of density dependence, and allows for a non-treaty and treaty harvest fishery. The 2012 adult density estimate for Bonneville Reservoir is 40 adults per river kilometer and the highest density estimate observed. Using this estimator, adult abundance targets for Priest Rapids and Wanapum reservoirs are 1,200 and 2,440, respectively.

With an adult abundance target identified and agreed to by the PRFF-PC, the PRFF used a population growth model to develop a stocking strategy. The population growth model uses age and growth, age-specific survival rates, existing wild population abundance, and past hatchery release data to evaluate the effects of different stocking and harvest rates on rebuilding White Sturgeon populations in Priest Rapids and Wanapum reservoirs. For age-specific survival, stocking, and harvest rates, a variety of inputs were used in the model. Inputs used in the model are as follows:
1. **Survival Rates**: Upper estimate (86% year 1, 98% year 2, and 98% year 3+) based on data from sturgeon populations above Grand Coulee Dam, Lower estimate (70%, 80%, and 95%) based on data from sturgeon populations below McNary Dam, and a Median value (78%, 89%, and 96.5%) between the upper and lower estimates.

2. **Harvest Rates**: 10%, 20%, and 30% exploitation rates; Bonneville Reservoir-based slot length limit of 38-54 inches and “liberal” slot length limit of 31-54 inches

3. **Stocking Rates**: 500 to 5,000 fish per year (500 fish intervals) for Wanapum and 500, 1,000, 1,500, 3,000, and 4,500 for Priest Rapids reservoirs.

Using the model to develop a stocking strategy that perfectly builds the White Sturgeon population towards and sustains it at the Bonneville Reservoir-based adult abundance targets is nearly impossible. Past hatchery releases are projected to exceed those adult abundance targets for short period of time. Future releases are intended, in most instances, to slow the effects of natural mortality so the population eases and hopefully sustains itself around the adult abundance target. Interpreting the various model runs graphically can be difficult. To more easily identify an appropriate stocking strategy, a different approach was employed.

Each model run calculates the number of adults in the White Sturgeon population per year. To determine whether a specific stocking and harvest rate model run is achieving rebuilding objectives (i.e., meeting adult abundance targets), adult abundance averages from years 2035 to 2065 were calculated for each model run. This time period is when hatchery releases affect adult abundances. Year 2035 is when the first stocked fish (release year 2011) reaches maturity; whereas year 2065 is when the last stocked fish (release year 2040) reaches maturity. The assumption is stocking and harvest rate model runs that result in long-term average adult abundances “falling around” the Bonneville Reservoir-based adult abundance target are considered to be achieving White Sturgeon population rebuilding objectives. Specifically, long-term average adult abundances within ±20% of the Bonneville Reservoir-based adult abundance target are considered an acceptable stocking and harvest rate scenario. Long-term average adult abundances within ±30% are considered cautionary, and greater than 30% are considered inappropriate stocking and harvest rate scenarios. Further, long-term average adult abundances considered acceptable, cautionary, or inappropriate are also color coded as green, orange, and red, respectively. Over 400 model runs were completed, evaluated, summarized in matrices, and color coded to indicate appropriate stocking and harvest rate scenarios.
**Recommendation**

The PRFF-PC recommends the following:

1. The most appropriate stocking rate is based off a model run using the median survival rates, a 20% exploitation rate, and the Bonneville Reservoir slot length limit.

2. Based off this model run, maximum stocking rates that best achieve the Bonneville Reservoir-based adult abundance targets for Priest Rapids and Wanapum reservoirs is 1,250 and 2,000 yearling hatchery White Sturgeon, respectively.

3. Recommended stocking rates will be in effect for release years 2016 through 2020.

4. White sturgeon brood stock (and/or wild larvae) collection, spawning, and release guidelines affecting release years 2016 through 2020 include:
   a. If white sturgeon larvae are available for stocking, they will be used first towards the yearling release target to the extent possible. Brood stock origin yearlings would then be used to make up the program balance if necessary and in accordance with guidelines (b.) through (f.) listed below.
   b. A minimum of 18 unique (one male and one female) crosses, produced from a partial or full factorial breeding strategy, must be achieved during spawning in order to release the maximum number yearlings.
   c. If >18 unique crosses are produced the number of yearling white sturgeon released will not exceed 1,250 for Priest Rapids and 2,000 for Wanapum reservoirs, respectively.
   d. If only brood stock origin fish are available and <18 unique crosses are produced then a reduced and pro-rated release strategy will be employed as described below: Example: 3,250 (Priest Rapids + Wanapum) fish/18 unique crosses = 180 fish/cross, thus if 10 unique crosses are produced the stocking rate would be 10 X 180 = 1,800 yearlings release between Priest Rapids and Wanapum reservoirs.
   e. Regardless of how many unique crosses are produced, family (cross) equalization will be reflected in the release to the greatest extent possible.
   f. All entities involved in brood stock collection on behalf of GPUD agree to fish the entire contracted length of time and collect as many potential brood stock as possible as opposed to ceasing collections once six males and six females have been collected.
5. GPUD will continue to implement the monitoring and evaluation activities as defined in the White Sturgeon Management Plan and 401 Certification, as modified via the annual white sturgeon report and study plan per the review and approval by the PRFF, and additional activities agreed to by the PRFF-PC (November 6, 2015).

6. A healthy sturgeon population commensurate with the available habitat includes a population sustaining a reasonable level of harvest of hatchery White Sturgeon released into Priest Rapids and Wanapum reservoirs is acknowledged by all PRFF-PC members as a beneficial outcome of this hatchery supplementation program.

7. Following termination of this SOA the PRFF and PRFF-PC will re-evaluate the model runs using empirical data collected from Priest Rapids and Wanapum reservoirs, in particular site specific survival estimates, to determine if changes in stocking should be made.

Terms and Conditions:

1. Effective dates of this SOA begin the month and day in 2016 of unanimous approval by the PRFF through December 31st, 2020

2. This SOA reflects an entirely voluntary commitment between members of the PRFF. However, all parties agree to work in good faith to adhere to the guidelines listed above.

3. Post 2020 stocking may be increased or decreased depending on then-current information including relevant survival estimates, ecological impacts, and potential harvest capabilities.

4. There will be a three year check in during the life of the SOA in order that Parties to this agreement may introduce significantly new information that may alter the reasoning or intent of the SOA. If the parties agree, the SOA may then be amended or replaced.

Submitted to Priest Rapids Fish Forum – Policy Representatives on: March 9, 2016

Approved by the Priest Rapids Fish Forum – Policy Representatives on: March 11, 2016
March 17, 2016

Dr. Tracy Hillman, Chair
Priest Rapids Fish Forum

Re: Letter for the record regarding the PRFF sturgeon SOA

Dear Tracy,

Thank you for your skillful facilitation of the process leading to a successful conclusion of the Statement of Agreement regarding sturgeon stocking levels in the Priest Rapids Project Area for 2016-2020. The willingness of parties to collaborate in developing a consensus model is a long step in moving to a rational decision-making process that considers the interests of all parties, especially those of the resource we are charged to preserve.

These comments are not an attempt to reinterpret or alter any terms of the SOA. I am writing only to clarify my understanding of certain terms of the SOA and what they imply for its implementation. This seems advisable to avoid potential future disagreements over what was meant or understood by Forum members when a decision was taken. Documented understandings serve as a record of the assumptions under which a party agreed to a proposed action, and they may also illuminate a need to further reconcile what other parties took to be implicit in a decision.

My understandings pertain to the Recommendations and are **bolded** below:

1. **The location of larval collection is not specified.** Part 4.a. indicates that larval collection will be used first towards meeting release targets to the extent possible. It is not specified where suitable larvae can be collected. It is my understanding that some Forum members are reluctant to release fish from Lake Roosevelt into the PRPA. This should be clarified in follow-up discussions. As an aside, the members assume that larval collections incorporate a broad diversity of families, but this is not regularly verified to my knowledge – another topic for discussion.

2. **Grant will continue to fund brood stock collection at an adequate level to ensure more than 18 unique crosses are produced.** Part 4.d. describes how juvenile releases may be reduced pro-rata if fewer than 18 unique crosses are produced by brood stock collection. Given the greatly diminished stocking levels agreed to in the SOA and the
harvest interests of the fishery co-managers, collecting an adequate number of brood stock to support full stocking is a priority. The SOA does not describe whether and how brood stock collection will be implemented to back up larval collection. Part 4.f. indicates that Grant’s agents will fish the “entire contracted length of time”, but there is no commitment to what that time period is. It is assumed that brood stock collection will be adequate to reliably provide enough juveniles to fill any deficit in the larval collection up to the full juvenile stocking level.

3. **Grant ensures that M&E will produce the information needed to determine population status and condition in 2020.** Removal of the qualifier, “annually”, from the statement in Part 5 creates ambiguity in Grant’s commitment to produce all data that may be needed to address the technical questions raised in the deliberation of this SOA. As much of the difficulty in reaching agreement was based on the absence of empirical data, it is assumed that Grant commits to an M&E program that is sufficient to produce the empirical data needed by Forum members to determine new stocking levels in 2020.

4. **The check-in at year 3 is advisory only and does not alter the terms of the SOA unless agreed to by all members.** The term of the SOA is five years and continues for that duration unless new information obtained at year 3, or any other time, warrants a change in terms that is agreed to by all Forum members.

Thanks for the opportunity to offer these thoughts and clarifications. I welcome any responses to the record if it is thought I have misunderstood or mischaracterized the terms of the sturgeon SOA.

Sincerely,

Steven S. Parker, Policy Committee representative
Yakama Nation Fisheries
March 21, 2016

Tracy Hillman, Ph.D.
Priest Rapids Fish Forum Chair
4725 N. Cloverdale Rd; Ste 102
Boise, ID 83714

RE: LETTER FOR THE RECORD Regarding The 11 March 2016 Approved White Sturgeon SOA.

On March 11, 2016 the Priest Rapids Fish Forum Policy Committee (Committee) members unanimously approved the “Statement of Agreement: White Sturgeon Stocking Program for Population Rebuilding, Mitigation, and Enhancement” (SOA) drafted by the Washington Department of Fish and Wildlife (WDFW). We consider our vote in support of the SOA a compromise intended to promote consensus building. Our vote represents our acceptance of the release numbers and the stipulations associated with Recommendation section items 4a-f. However, we have outlined the following concerns with regard to the remainder of the SOA:

- The Background, Approach, and Terms and Conditions sections, as well as items 5, 6, and 7 of the Recommendations section, are not necessary to describe the terms of the agreement.
- The Recommendations section of the SOA is misnamed, as it consists of the agreement terms and not recommendations.
- The SOA suggests that the Committee used the model to develop the stocking strategy. For clarification, members of the Priest Rapids Fish Forum (PRFF) utilized the population model to generate adult abundance and harvest estimates for consideration by the Committee during their dialogues regarding the stocking strategy (see next bullet).
- The Approach section is not representative of the process employed to make our determination, nor does it reflect our rationale for agreeing to the SOA.
- The SOA language stating, [t]he PRFF-PC selected the 2012 White Sturgeon adult density (adults per river kilometer) estimate from Bonneville Reservoir to identify rebuilding targets for Priest Rapids and Wanapum reservoirs [period deleted] implies the Committee explicitly selected the method by which the target density was calculated. While the Committee did agree to use the Bonneville Reservoir adult\textsuperscript{1} White Sturgeon densities to calculate target abundances for the project reservoirs during the modeling exercises\textsuperscript{2}, it did not provide guidance as to the

\textsuperscript{1} The Committee meeting notes do not explicitly state that the target referred to adults although it is implied throughout.

\textsuperscript{2} Final November 6, 2015 Committee Meeting Notes (page 8) state: \textit{The Forums will use densities of sturgeon in Bonneville Reservoir as an initial estimate for carrying capacity within the project areas.}
method by which the density was to be calculated. Moreover, the density calculation method was not considered within the PRFF.

- Reservoir area should have been used instead of reservoir length to calculate the target density of adult White Sturgeon. Fish habitat is a function of the amount of area within the reservoir and not the reservoir’s length, thus the most common method for calculating reservoir fish densities is to divide the abundance by the surface area of the reservoir (e.g., fish/ha). White Sturgeon densities have been generated for the lower Columbia River reservoirs (John Day, The Dalles, and Bonneville) using this method (Beamesderfer et al. 1995). The CCT raised this issue with WDFW during a February 24, 2016 phone conversation regarding the draft SOA.

- The SOA lacks a description of the defining characteristics of an adult White Sturgeon in reference to the target density. According to Beamesderfer et al. (1995), the mean FL of a mature female White Sturgeon in the Bonneville Reservoir was 168 cm FL. If White Sturgeon >166 cm FL were considered adults, the resulting target density would have been 26 fish/km – a roughly 34% reduction relative to the SOA target density. When applied to Priest Rapids (29 km) and Wanapum (58 km) reservoirs, the abundance targets would have been 754 and 1,508 adults, respectively.

- Further examination of the 2012 Bonneville Reservoir White Sturgeon abundance values in Cox and Schade (2014) suggest that the SOA adult abundance targets were derived with White Sturgeon 138 cm FL and larger. The abundance estimates provided in Cox and Schade (2014) are length group specific and do not specify life stage (i.e., juveniles, sub-adults, adults) or age. As demonstrated in the previous bullet, the more liberal length characterization of an adult resulted in a higher target density value and ultimately greater release numbers. There is no record of discussion within either the PRFF or Committee regarding the appropriate consideration of what constitutes an adult within the context of deriving target densities despite these large implications. Future modeling efforts should clearly define what constitutes an adult White Sturgeon.

- For clarification, the SOA and the Hildebrand Memo incorrectly indicate that the low survival rate values that the PRFF agreed to use in the model were based on data from sturgeon populations below McNary Dam. The low year one survival rate value used in the modeling was the mid-point between the broodyear (BY) 2012 (75%) and BY2013 (65%) year one survival estimates for hatchery sturgeon released in Rocky Reach Reservoir. The low year two survival rate value was the approximate BY2012 (82%) year two survival estimate for hatchery sturgeon released in Rocky Reach Reservoir.

- The use of mean adult abundance between 2035 and 2065 under the model assumptions of consistent annual stocking for 25 years following program inception and no natural recruitment results in inflated annual release numbers. Since the range of adult abundance values used to

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3 Within the context of the modeling, adult sturgeon are age 25 and older. Using the model Life Table age 25 White Sturgeon are 192.5 cm FL.

4 Maximum length group in Cox and Schade (2014) abundance estimates and corresponds with mean size at maturity in Beamesderfer et al. (1995).

5 Table A-6 in Cox and Schade (2014).

6 Hildebrand Memo to Hillman titled Updated white sturgeon adult abundance projections in the Wanapum, Priest rapids, and Rocky Reach reservoirs and dated February 4, 2016.

7 See Table 1 in Beamesderfer and Anders Technical Memorandum to Yakama Nation Fisheries dated January 8, 2016.
generate the mean extends beyond the period after which fish are recruiting to the population, the cumulative abundance declines\(^8\). Their inclusion in the calculation drives the mean lower providing for higher release numbers.

- The yearly cumulative adult abundance values are not normally distributed and no statistical justification is provided for the use of arithmetic mean adult abundance.
- The SOA assumption that the proposed stocking will result in ...*long-term average adult abundances* “falling around” the Bonneville Reservoir-based adult abundance target... will only happen if stocking is discontinued within 25 years of the program’s start and natural recruitment is not restored. In addition, the decline to the target abundance occurs only after the abundance has peaked at levels substantially greater than the target.
- The SOA states that ... *long-term average adult abundances within \(\pm 20\%\) of the Bonneville Reservoir-based adult abundance target are considered an acceptable stocking and harvest rate scenario*. The appropriateness of this range was not agreed upon by the PRFF or Committee.
- The abundance of hatchery White Sturgeon originating from the Columbia River Inter-Tribal Fish Commission releases conducted in 2003 in the Rock Island Reservoir that are currently residing in the Wanapum and Priest Rapids reservoirs were not accounted for in model runs. Had they been included, the projected abundance values would have been reached with lower release numbers. They were excluded from the modeling because WDFW intends to remove substantial numbers of them within the near future. There is considerable uncertainty associated with the implementation and effectiveness of this program.
- The size of the fish at release and release timing (i.e., late spring) should be specified along with the release number in Item 2 of the Recommendations. The high survival rate value modeled was associated with a 200 g size at release.

This letter summarizes our primary concerns associated with the SOA. Despite all parties’ best intentions, the SOA was crafted without a thorough discussion of some important factors that influenced the stocking rates. Our expectation is that future agreements related to the release numbers of hatchery White Sturgeon associated with the Priest Rapids project will address our concerns.

Respectfully,

\[\text{(Signature)}\]

William T. Towey
PRFF Policy Representative

\(^{8}\) See Figures 3-5 in Hildebrand Memo.


**Literature Cited**


Statement of Agreement: Rocky Reach Project White Sturgeon Stocking Program for Population Rebuilding, Mitigation, and Enhancement

Background
In accordance with the Rocky Reach White Sturgeon Management Plan, beginning in year two (2011) of the new FERC license, Chelan Public Utility District (CPUD) released between zero to 6,500 yearling hatchery White Sturgeon into the Rocky Reach Project Area (RRPA) annually in years two to four (2011-2013). Disease issues prevented attainment of the desired front loaded stocking abundance by year four, and CPUD fulfilled its annual White Sturgeon stocking requirements in 2014. In 2015, CPUD stocked 6,492 white sturgeon in the RRPA under a one year Statement of Agreement. Subsequent years stocking (2016 and beyond) have been and will be determined by the Rocky Reach Fish Forum (RRFF).

To determine future releases of yearling hatchery White Sturgeon into the RRPA, the RRFF and RRFF Policy Committee (RRFF-PC) identified a target population size to rebuild towards and used a population growth model to develop a stocking strategy for Rocky Reach Reservoir. Described below is the approach used to identify a target population size and model inputs used to develop a stocking strategy.

Approach
The RRFF-PC identified adult abundance as the population metric upon which to develop a stocking strategy from. The RRFF-PC selected the 2012 White Sturgeon adult density (adults per river kilometer) estimate from Bonneville Reservoir to identify rebuilding targets for Rocky Reach Reservoir. Bonneville Reservoir was selected because the White Sturgeon population there is abundant, stable-aged, appears to exhibit some level of density dependence, and allows for a non-treaty and treaty harvest fishery. The 2012 adult density estimate for Bonneville Reservoir is 40 adults per river kilometer and the highest density estimate observed. Using this estimator, the adult abundance target for Rocky Reach Reservoir is 2,760 sturgeon.

With an adult abundance target identified and agreed to by the RRFF-PC, the RRFF used a population growth model to develop a stocking strategy. The population growth model uses age and growth, age-specific survival rates, existing wild population abundance, and past hatchery release data to evaluate the effects of different stocking and harvest rates on rebuilding White Sturgeon populations in Rocky Reach Reservoir. For age-specific survival,
stocking, and harvest rates, a variety of inputs were used in the model. Inputs used in the model are as follows:

1. **Survival Rates**: Upper estimate (86% year 1, 98% year 2, and 98% year 3+) based on data from sturgeon populations above Grand Coulee Dam, Lower estimate (70%, 80%, and 95%) based on data from sturgeon populations below McNary Dam, and a Median value (78%, 89%, and 96.5%) between the upper and lower estimates.

2. **Harvest Rates**: 10%, 20%, and 30% exploitation rates; Bonneville Reservoir-based slot length limit of 38-54 inches and “liberal” slot length limit of 31-54 inches

3. **Stocking Rates**: 500 to 6,500 fish per year (500 fish intervals) for Rocky Reach Reservoir

Using the model to develop a stocking strategy that perfectly builds the White Sturgeon population towards and sustains it at the Bonneville Reservoir-based adult abundance targets is nearly impossible. Past hatchery releases are projected to exceed those adult abundance targets for short period of time. Future releases are intended, in most instances, to slow the effects of natural mortality so the population eases and hopefully sustains itself around the adult abundance target. Interpreting the various model runs graphically can be difficult. To more easily identify an appropriate stocking strategy, a different approach was employed.

Each model run calculates the number of adults in the White Sturgeon population per year. To determine whether a specific stocking and harvest rate model run is achieving rebuilding objectives (i.e., meeting adult abundance targets), adult abundance averages from years 2035 to 2065 were calculated for each model run. This time period is when hatchery releases affect adult abundances. Year 2035 is when the first stocked fish (release year 2011) reaches maturity; whereas year 2065 is when the last stocked fish (release year 2040) reaches maturity. The assumption is stocking and harvest rate model runs that result in long-term average adult abundances “falling around” the Bonneville Reservoir-based adult abundance target are considered to be achieving White Sturgeon population rebuilding objectives. Specifically, long-term average adult abundances within ±20% of the Bonneville Reservoir-based adult abundance target are considered an acceptable stocking and harvest rate scenario. Long-term average adult abundances within ±30% are considered cautionary, and greater than 30% are considered inappropriate stocking and harvest rate scenarios. Further, long-term average adult abundances considered acceptable, cautionary, or inappropriate are also color coded as green, orange, and red, respectively. Over 400 model runs were completed, evaluated, summarized in matrices, and color coded to indicate appropriate stocking and harvest rate scenarios.
**Recommendation**

The RRFF-PC recommends the following:

1. The most appropriate stocking rate is based off a model run using the median survival rates, a 20% exploitation rate, and the Bonneville Reservoir slot length limit.

2. Based off this model run, maximum stocking rates that best achieve the Bonneville Reservoir-based adult abundance targets for Rocky Reach Reservoir (2,760) is 2,250 yearling hatchery White Sturgeon.

3. Recommended stocking rates will be in effect for release years 2016 through 2020.

4. White sturgeon brood stock (and/or wild larvae) collection, spawning, and release guidelines affecting release years 2016 through 2020 include:
   
   a. If white sturgeon larvae are available for stocking, they will be used first towards the yearling release target to the extent possible. Brood stock origin yearlings would then be used to make up the program balance if necessary and in accordance with guidelines (b.) through (f.) listed below.
   
   b. A minimum of 18 unique (one male and one female) crosses, produced from a partial or full factorial breeding strategy, must be achieved during spawning in order to release the maximum number yearlings.
   
   c. If >18 unique crosses are produced, the number of yearling white sturgeon released will not exceed 2,250 for Rocky Reach Reservoir.
   
   d. If only brood stock origin fish are available and <18 unique crosses are produced then a reduced and pro-rated release strategy will be employed as described below: Example: 2,250 fish/18 unique crosses = 125 fish/cross, thus if 10 unique crosses are produced the stocking rate would be 10 X 125 = 1,250 yearlings in the Rocky Reach Reservoir.
   
   e. Regardless of how many unique crosses are produced, family (cross) equalization will be reflected in the release to the greatest extent possible.
   
   f. All entities involved in brood stock collection on behalf of CPUD agree to fish the entire contracted length of time and collect as many potential brood stock as possible as opposed to ceasing collections once six males and six females have been collected.

5. CPUD will monitor and evaluate White Sturgeon age structure, survival rates, abundance, density, diet, condition, growth rates, emigration and immigration, distribution, and habitat use annually from 2016 through 2020.
6. A healthy sturgeon population commensurate with the available habitat includes a population sustaining a reasonable level of harvest of hatchery White Sturgeon released into Rocky Reach Reservoir and is acknowledged by all RRFF-PC members as a beneficial outcome of this hatchery supplementation program.

7. Following expiration of this SOA, the RRFF and RRFF-PC will re-evaluate the model runs using empirical data collected from Rocky Reach Reservoir, in particular site specific survival estimates, to determine if changes in stocking should be made.

Terms and Conditions:

1. Effective dates of this SOA begin the month and day in 2016 of unanimous approval by the RRFF through December 31st, 2020.

2. This SOA reflects an entirely voluntary commitment between members of the RRFF. However, all parties agree to work in good faith to adhere to the guidelines listed above.

3. Post 2020 stocking may be increased or decreased depending on then-current information including relevant survival estimates, ecological impacts, and potential harvest capabilities.

Submitted to Rocky Reach Fish Forum – Policy Representatives on: March 7, 2016

Approved by the Rocky Reach Fish Forum – Policy Representatives on: March 11, 2016
March 21, 2016

Tracy Hillman, Ph.D.
Rocky Reach Fish Forum Chair
4725 N. Cloverdale Rd; Ste 102
Boise, ID 83714

RE: LETTER FOR THE RECORD Regarding The 11 March 2016 Approved White Sturgeon SOA.

On March 11, 2016 the Rocky Reach Fish Forum Policy Committee (Committee) members unanimously approved the “Statement of Agreement: White Sturgeon Stocking Program for Population Rebuilding, Mitigation, and Enhancement” (SOA) drafted by the Washington Department of Fish and Wildlife (WDFW). We consider our vote in support of the SOA a compromise intended to promote consensus building. Our vote represents our acceptance of the release numbers and the stipulations associated with Recommendation section items 4a-f. However, we have outlined the following concerns with regard to the remainder of the SOA:

- The Background, Approach, and Terms and Conditions sections, as well as items 5, 6, and 7 of the Recommendations section, are not necessary to describe the terms of the agreement.
- The Recommendations section of the SOA is misnamed, as it consists of the agreement terms and not recommendations.
- The SOA suggests that the Committee used the model to develop the stocking strategy. For clarification, members of the Rocky Reach Fish Forum (RRFF) utilized the population model to generate adult abundance and harvest estimates for consideration by the Committee during their dialogs regarding the stocking strategy (see next bullet).
- The Approach section is not representative of the process employed to make our determination, nor does it reflect our rationale for agreeing to the SOA.
- The SOA language stating, [t]he RRFF-PC selected the 2012 White Sturgeon adult density (adults per river kilometer) estimate from Bonneville Reservoir to identify rebuilding targets for Rocky Reach reservoir [period deleted] implies the Committee explicitly selected the method by which the target density was calculated. While the Committee did agree to use the Bonneville Reservoir adult\(^1\) White Sturgeon densities to calculate target abundances for the project reservoir during the modeling exercises\(^2\), it did not provide guidance as to the method.

\(^1\) The Committee meeting notes do not explicitly state that the target referred to adults although it is implied throughout.

\(^2\) Final November 6, 2015 Committee Meeting Notes (page 8) state: The Forums will use densities of sturgeon in Bonneville Reservoir as an initial estimate for carrying capacity within the project areas.
by which the density was to be calculated. Moreover, the density calculation method was not considered within the RRFF.

- Reservoir area should have been used instead of reservoir length to calculate the target density of adult White Sturgeon. Fish habitat is a function of the amount of area within the reservoir and not the reservoir’s length, thus the most common method for calculating reservoir fish densities is to divide the abundance by the surface area of the reservoir (e.g., fish/ha). White Sturgeon densities have been generated for the lower Columbia River reservoirs (John Day, The Dalles, and Bonneville) using this method (Beamesderfer et al. 1995). The surface area (7,632 ha) based density of adult White Sturgeon in Bonneville Reservoir was 0.39 fish/ha. Using the target density of 0.39 fish/ha, the adult White Sturgeon abundance target in Rocky Reach Reservoir (3,334 ha) should have been 1,301 fish – 1,459 fewer fish than the target derived by reservoir length. The CCT raised this issue with WDFW during a February 24, 2016 phone conversation regarding the draft SOA.

- The SOA lacks a description of the defining characteristics of an adult White Sturgeon in reference to the target density. According to Beamesderfer et al. (1995), the mean FL of a mature female White Sturgeon in the Bonneville Reservoir was 168 cm FL. If White Sturgeon >166 cm FL were considered adults, the resulting target density would have been 26 fish/km – a roughly 34% reduction relative to the SOA target density. When applied to Rocky Reach Reservoir (68 km), the abundance target would have been 1,768 adults. If the area-based density of White Sturgeon >166 cm FL in Bonneville Reservoir (0.26 fish/ha) had been applied, the abundance target would have been 867 adults.

- Further examination of the 2012 Bonneville Reservoir White Sturgeon abundance values in Cox and Schade (2014), suggest that the SOA adult abundance target was derived with White Sturgeon 138 cm FL and larger. The abundance estimates provided in Cox and Schade (2014) are length group specific and do not specify life stage (i.e., juveniles, sub-adults, adults) or age. As demonstrated in the previous bullet, the more liberal length characterization of an adult resulted in a higher target density value and ultimately a greater release number. There is no record of discussion within either the RRFF or Committee regarding the appropriate consideration of what constitutes an adult within the context of deriving target densities despite these large implications. Future modeling efforts should clearly define what constitutes an adult White Sturgeon.

- For clarification, the SOA and the Hildebrand Memo incorrectly indicate that the low survival rate values that the RRFF agreed to use in the model were based on data from sturgeon populations below McNary Dam. The low year one survival rate value used in the modeling was the mid-point between the broodyear (BY) 2012 (75%) and BY2013 (65%) year one survival estimates for hatchery sturgeon released in Rocky Reach Reservoir. The low year two

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3 Based on the SOA density of 40 fish/km and a reservoir length of 75 km.
4 Within the context of the modeling, adult sturgeon are age 25 and older. Using the model Life Table age 25 White Sturgeon are 192.5 cm FL.
5 Maximum length group in Cox and Schade (2014) abundance estimates and corresponds with mean size at maturity in Beamesderfer et al. (1995).
6 Table A-6 in Cox and Schade (2014).
7 Hildebrand Memo to Hillman titled Updated white sturgeon adult abundance projections in the Wanapum, Priest Rapids, and Rocky Reach reservoirs and dated February 4, 2016.
8 See Table 1 in Beamesderfer and Anders Technical Memorandum to Yakama Nation Fisheries dated January 8, 2016.
survival rate value was the approximate BY2012 (82%) year 2 survival estimate for hatchery sturgeon released in Rocky Reach Reservoir.

- The use of mean adult abundance between 2035 and 2065 under the model assumptions of consistent annual stocking for 25 years following program inception and no natural recruitment results in inflated annual release numbers. Since the range of adult abundance values used to generate the mean extends beyond the period after which fish are recruiting to the population, the cumulative abundance declines\textsuperscript{9}. Their inclusion in the calculation drives the mean lower providing for higher release numbers.

- The yearly cumulative adult abundance values are not normally distributed and no statistical justification is provided for the use of arithmetic mean adult abundance.

- The SOA assumption that the proposed stocking will result in \textit{...long-term average adult abundances “falling around” the Bonneville Reservoir-based adult abundance target...} will only happen if stocking is discontinued within 25 years of the program’s start and natural recruitment is not restored. In addition, the decline to the target abundance occurs only after the abundance has peaked at levels substantially greater than the target.

- The SOA states that \textit{... long-term average adult abundances within ±20% of the Bonneville Reservoir-based adult abundance target are considered an acceptable stocking and harvest rate scenario}. The appropriateness of this range was not agreed upon by the RRFF or Committee.

- The size of the fish at release and release timing (i.e., late spring) should be specified along with the release number in Item 2 of the Recommendations. The high survival rate value modeled was associated with a 200 g size at release.

This letter summarizes our primary concerns associated with the SOA. Despite all parties’ best intentions, the SOA was crafted without a thorough discussion of some important factors that influenced the stocking rates. Our expectation is that future agreements related to the release numbers of hatchery White Sturgeon associated with the Rocky Reach project will address our concerns.

Respectfully,

\underline{William T. Towey}

RRFF Policy Representative

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\textsuperscript{9} See Figures 3-5 in Hildebrand Memo.
Literature Cited


The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, September 14, 2016, from 10:00 a.m. to 12:00 p.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Douglas PUD will: 1) provide a draft letter to the Federal Energy Regulatory Commission (FERC) to the Aquatic SWG for review, requesting permission from FERC to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal; and 2) determine where and from whom the respective agency support letters should be sent (Item VI-1).

2. Douglas PUD will distribute a Doodle Poll to convene a second technical subgroup meeting to further discuss the future of the Douglas PUD White Sturgeon Program (Item VI-3). *(Note: Andrew Gingerich distributed a poll following the meeting on September 14, 2016.)*

3. Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-4).

4. Douglas PUD will investigate the one bull trout acoustic tag located in the Columbia River near the Wenatchee River that has been sending a mortality signal after not moving for 2 days and will provide a summary of data once available (Item VI-5). *(Note: Andrew Gingerich provided this update on September 15, 2016, which Kristi Geris distributed to the Aquatic SWG that same day.)*

5. **The Aquatic SWG meeting on October 12, 2016, will be held by conference call** (Item VII-1).

II. Summary of Decisions

1. Aquatic SWG members present approved the 2015 White Sturgeon M&E Report, as revised, with Washington State Department of Ecology (Ecology) abstaining (Item VI-3).
III. **Agreements**

1. There were no agreements discussed during today’s conference call.

IV. **Review Items**

1. There are no items that are currently available for review.

V. **Documents Finalized**

1. There are no documents that have been recently finalized.

VI. **Summary of Discussion**

1. **Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items**

   (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and asked for any additions or other changes to the agenda. No additions or changes were requested.

   The revised draft August 10, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. Aquatic SWG members present approved the August 10, 2016, conference call minutes, as revised. Ecology abstained because an Ecology representative was not present during the August 10, 2016, conference call.

   Action items from the last Aquatic SWG conference call on August 10, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the August 10, 2016, conference call):

   - **Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon and will report back to the Aquatic SWG (Item VI-1).** Rose said he has no updates at this time. He said he or Donella Miller (Yakama Nation [YN]) will raise questions or concerns if and when they arise.
   - **Douglas PUD will consider requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal and will report back to the Aquatic SWG following completion of the 2015 ASA reporting season (May 31; Item VI-1).** Andrew Gingerich said he spoke with Shane Bickford, and Bickford indicated that Douglas PUD does not have objections to this proposal. Bickford also suggested that individual Aquatic SWG members provide agency support letters to submit to FERC to illustrate that all agencies are supportive of consolidating these reports. Gingerich said, once Bickford reviews and approves Douglas PUD’s draft letter to FERC, Gingerich can
Aquatic Settlement Work Group  Page 3 of 12  
September 14, 2016 Conference Call

distribute the letter for Aquatic SWG members to use as a template for their respective agency letters. John Ferguson asked if agency letters should be addressed to Douglas PUD or to FERC, and Gingerich said he is unsure. Patrick Verhey suggested providing an email to Douglas PUD indicating support of consolidation that can then be appended to Douglas PUD’s request to FERC. Gingerich said he will pass that suggestion along to Bickford. Gingerich added that he believes FERC is willing to allow the Aquatic SWG to decide how to meet compliance, so long as there is unanimous agreement among the group. Steve Lewis said, typically, if the U.S. Fish and Wildlife Service (USFWS) were to file agency letters, they would be appended to the official request. Lewis suggested contacting the Wells Project contact at FERC to determine what FERC will require to process this request. Gingerich agreed, and said he will also pass this information along to Bickford. Gingerich said Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) determine where and from whom the respective agency support letters should be sent.

- **There will be a formal introduction of the new Ecology Aquatic SWG Technical Representative, Breean Zimmerman, at the next Aquatic SWG meeting on September 14, 2016 (Item VI-2).** This will be discussed during today’s conference call.

- **Douglas PUD will distribute a Doodle Poll to convene a technical subgroup to discuss the future of the Douglas PUD White Sturgeon Program (Item VI-4).** Andrew Gingerich distributed a poll following the meeting on August 10, 2016. This will be further discussed during today’s conference call.

- **Updates on discussions about the future of the Douglas PUD White Sturgeon Program will be provided during each Aquatic SWG monthly meeting, with the goal to make a decision by the Aquatic SWG meeting on January 11, 2017 (Item VI-4).** This will be discussed during today’s conference call.

- **Douglas PUD will distribute a Revised Draft 2015 White Sturgeon M&E Report for a 10-day review, with plans to request approval of the draft report during the Aquatic SWG meeting on September 14, 2016 (Item VI-4).** Andrew Gingerich provided the revised draft report, as well as a comment and response document, to Kristi Geris on August 15, 2016, which Geris distributed to the Aquatic SWG that same day. This will be further discussed during today’s conference call.

- **Douglas PUD will provide a Draft ASA Document Approval Process Statement of Agreement (SOA) for discussion during the Aquatic SWG meeting on September 14, 2016 (Item VI-5).** This will be discussed during today’s conference call.

2. **Ecology Aquatic SWG Technical Representative – Breean Zimmerman** (John Ferguson): John Ferguson asked Breean Zimmerman, the new Ecology Aquatic SWG Technical
Representative, to introduce herself to the Aquatic SWG. Zimmerman said she was hired with the Ecology Water Quality Program as the Hydropower Projects Manager in mid-June 2016. She said she has a background in water rights and has worked with the water resource program for a number of years. She said she also worked with Aspect Consulting for several years. She said she is new to aspects of this type of work and appreciates everyone’s patience as she gets settled in. She said these workgroups and forums are interesting and she is excited to be a part of it. She said she is looking forward to meeting in person at some point in time. Ferguson provided Zimmerman with a brief overview of what to expect in the Aquatic SWG, including notice about the several documents to review in the first quarter of the year. Ferguson suggested Zimmerman review the Aquatic SWG meeting minutes from August 2016, regarding the total dissolved gas (TDG) update. Ferguson also reviewed current ongoing white sturgeon, lamprey, and bull trout topics, which will be further discussed during today’s conference call.

3. **White Sturgeon (Andrew Gingerich):**

   **DECISION: 2015 White Sturgeon M&E Report**

   Andrew Gingerich said the Draft 2015 White Sturgeon M&E Report was available for a 30-day review period. He said, after the CCT provided comments, a Revised Draft 2015 White Sturgeon M&E Report and a comment and response document were distributed to the Aquatic SWG by Kristi Geris on August 15, 2016, for an additional review period. Gingerich said Jason McLellan indicated the revised draft adequately addressed the CCT’s comments. Gingerich noted that the 2015 report is a good start to several more years of M&E. Aquatic SWG members present approved the 2015 White Sturgeon M&E Report, as revised, with Ecology abstaining.

   **Brood Year 2016 Wells Hatchery Update**

   Gingerich said there are just more than 13,000 larval-origin fish remaining on station at Wells Hatchery, from the initial 22,000 larval-origin fish collected from Lake Roosevelt. He said there are approximately 3,500 direct gamete-origin fish on station from Marion Drain. He said Marion Drain fish will eventually be surplused to Chelan Falls to support Chelan PUD’s program. He said Washington Department of Fish and Wildlife (WDFW) and Chelan PUD are in direct discussions about when to move those fish. He said, in terms of larval-origin fish on station, mortality is down in all five tanks, with zero to five mortalities per tank per day. However, he said mortalities increased in two of the tanks last week, with 20 to 40 mortalities per day occurring in those two tanks. He said fish health samples were obtained from those tanks on September 12, 2016, and hatchery staff are awaiting the results of those samples being processed. He said the remaining fish in the two tanks are being treated with a standard salt bath. He said he is cautiously optimistic that survival will improve.

   **2016 White Sturgeon M&E Update**

   Gingerich said he recently provided a white sturgeon M&E summary sheet (Attachment B) to Geris, which Geris distributed to the Aquatic SWG prior to the call on September 14, 2016. Gingerich said the Attachment B summarizes Douglas PUD’s 2016 white sturgeon M&E efforts to
date. He said 2015 data are not included in the summary, partly because he wanted to convey that Douglas PUD is employing similar indexing methodologies as Chelan and Grant PUDs and are not directly comparable to 2015 data given the small modifications in methods.

Gingerich reviewed Attachment B, noting the two indexing sessions in July and September. He said Douglas PUD is only about 30% through the second indexing session for 2016. He said six wild and more than 400 hatchery fish have been captured to date. He said, among those fish, 88% were brood year (BY) 2013 (or 3-year-olds), 10% were BY 2014 (or 2-year-olds), and 2% were BY 2015 (or 1-year-olds). He noted there is no difference in capture probability between BYs from July through September. He said it is interesting that the current indexing is catching a lot of 3-year-olds and not a lot of 2- and 1-year-olds. He suggested this may mean that: 1) 2013 fish have higher survival than other BYs; or 2) the capture probability for 3- and 4-year-olds is higher (due to their recruiting to the capture gear better). He said he feels the latter is more likely, which implies the M&E technique is biased. He also noted, that in July, crews caught an average 9 fish per day, while in September, they caught 28 fish per day. He said, on average, fish size in September is slightly larger as well. Bob Rose asked about bait used in July versus September, and Gingerich said there has been no change in bait. Gingerich said crews are using Gilmore squid, which is another standardization among regional M&E programs. He said he thought water temperature might be a factor; however, water temperatures are fairly similar between the two sampling periods (within 1 or 2 °C). Rose asked if similar results have been observed in Lake Roosevelt. McLellan said yes, there have been lower numbers caught in the spring versus late summer and fall sampling periods. He said the highest rates of movement are during fall months. He said fish are fairly small at release, and at the rate they grow, size may have an impact on recruitment to the sampling gear. Gingerich also noted that Douglas PUD is only 6 days into the September sampling session, and catch rates may decrease. He said the data in Attachment B are comparing 27 days (July) to 6 days (September) of sampling.

Gingerich said, between the indexing sampling efforts, Douglas PUD took the opportunity to target sampling of wild and larger fish, because no sampling of that nature has taken place since mid-2000 relicensing studies. He said a crew sampled for a 13-day period, using eight lines per day and 40 hooks per line, with an equal distribution of hook sizes. He said catch rates decreased significantly compared to juvenile/hatchery fish indexing in July and September. He believes this is largely because hatchery fish did not recruit to the larger gear. He said 86 fish were captured in total, including 15 wild. He said hatchery fish were predominantly 3-year-olds. He said, among the wild fish, six were classified as adults (greater than 170 centimeters [cm] fork length), and nine fish were classified as subadults, which were all similar in size (about 100 cm). He said the smallest subadult was 70 cm, which was an outlier. He said most were 85 cm and larger, and the largest was 105 cm. He said fin ray samples were obtained from all wild subadult fish for aging, as discussed and recommended in 2015. He said fin ray sampling techniques are improving, and genetic samples (DNA) are also being obtained, for all wild fish as
He said one fish was a recapture from 2015 indexing, and two fish were recaptures from 2016 indexing conducted in July. He said, interestingly, no medium-sized fish (between 105 and 170 cm) were captured. He said these data will be used as baseline data to compare to in future years.

Years 5 through 10 Subgroup Meeting Summary

Gingerich said a subgroup convened on August 30, 2016. He said all Aquatic SWG members participated, except USFWS, who could not attend. He said some members participated in-person and some joined by phone, and he believes the subgroup had a good first discussion about how to proceed in future years. The meeting notes from the subgroup meeting (Attachment C) were distributed to the Aquatic SWG by Geris on September 6, 2016.

Gingerich said the subgroup discussed how many fish to stock, and he believes the subgroup generally reached consensus on using number of adults in the Bonneville Pool as a model—however, not by river mile, but scaled on surface area. He said a target of about 1,000 adults (166 cm fork length) was reached. He said the subgroup also agreed to attempt model runs similar to what Grant and Chelan PUDs have done. He said the group needs to determine expected survival rates for hatchery-origin fish, noting that they discussed possibly using Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) survival estimates. He said he sent data to McLellan and Chad Jackson (WDFW) to formulate expected survival rates for model inputs. Gingerich said the group also needs to determine how to include exploitation rates.

McLellan said he just distributed an email to the Aquatic SWG during today’s meeting, which contains a white sturgeon population model for the Wells Project (Attachment D) and estimated Wells Project releases survival information using the logistic regression developed by the UCWSRI (Attachment E). McLellan said he revised the survival estimates based on the release data Gingerich provided. McLellan explained that he ran simple descriptive statistics with all data combined and applied the Upper Columbia River logistic equation for a survival estimate where weight at release is the key variable. He said data analyzed included release data from 2014 to 2016. He noted that 2014 was the release group with the greatest weight at release and had the highest predicted survival, whereas the release group with the smallest weight at release had the lowest predicted survival. He said the means and medians were close and the data was fairly normally distributed. He also noted the histograms located in the lower portion of the Attachment D.

McLellan said part of the discussions focused on determining what survival values to use. He said the idea was to evaluate the available data by applying the Upper Columbia River survival rates to establish numbers to begin considering. He said the group needs to decide whether to use a particular survival rate from the release data to date and produce fish of that size, or agree on releasing fish of a certain size (e.g., 200 grams) and using model predicted survival for that size for model runs. Rose said it may take 4 to 5 years to obtain a good dataset, and asked if...
catch rates would then be compared. McLellan said this is correct, that everything would be dependent on M&E. He noted, that if fish are released at 300 grams, where survival is estimated at 98%, the vast majority of those fish will survive and there is lower uncertainty. He said, however, there is less certainty with smaller fish because of their lower estimated survival. He suggested conducting a program based on this survival-size assumption, continue M&E, reevaluate, and adjust as needed.

Gingerich said McLellan’s suggestions make sense; however, he noted that raising fish to 300 grams in size may be limited by hatchery capacity/growth constraints. He also questioned if there is a scientific justification to having the local environment provide differential survival. He said 98% survival limits natural selection. McLellan agreed these are valid discussions. He suggested, regarding Gingerich’s first point, reviewing Attachment D where McLellan took the Beamesderfer model with Chelan and Grant PUDs data and input Wells Project data into the model. He suggested Aquatic SWG members modify the inputs to the model to see how they affect model outputs. He also suggested convening another in-person meeting, sooner rather than later, to discuss these numbers and to evaluate different strategies. He said, based on his review of Attachment D, he found that the stocking numbers needed to maintain 1,000 adult fish are relatively small and well below the 3,000 and 5,000 fish per year currently being stocked. He said, based on these calculations, he believes it is logistically possible to produce 300-gram fish. He said his calculations even included 20% exploitation. He also suggested perhaps including 100 fish harvested per year, but also asked how members want to address harvest and allotment rates.

John Ferguson questioned if hatchery facility modifications will be required to grow fish to 300 grams, or if the number of fish needed is low enough that capacity may not be an issue. He also asked if this target size of adults applies only to hatchery fish or also to wild fish. McLellan said the model is setup to assume no natural production (leaves natural recruitment at 0). He added that the model does take into account the current population, based on the Jerald (2007) estimate of 34 fish (Attachment F). McLellan also noted that there is an input for wild abundance in the model, which tapers off over time. Steve Lewis asked if there is a way to incorporate natural production for future years, and McLellan said there is.

Rose said he believes Gingerich’s comments are relevant; however, he also suggested setting aside the genetic piece for now because it is difficult to address and hypothetical. He said regarding the logistics piece, he agrees with growing fish to a larger size and appreciates that these conversations are occurring. He suggested McLellan and Gingerich determine and share with the Aquatic SWG what needs to be done to be able to accommodate these fish. Rose said, if Wells Hatchery cannot accommodate the fish, he suggests thinking about what other resources are available to achieve this fish size.
McLellan reiterated his suggestion for Aquatic SWG members to review Attachment D to make sure the tool is working correctly. He said he believes it is; however, he wants the SWG members to verify that they agree with the model.

Ferguson asked about next steps, and suggested that Gingerich distribute another Doodle Poll to convene a second in-person subgroup meeting, to which Gingerich agreed. He also noted that the last subgroup meeting focused on this model and how to obtain a target number of fish. He said the other part of this discussion is fish source. He said, once the Aquatic SWG agrees on a target stocking number, discussions need to focus on where the fish come from. He said he believes there were good results from the larval program, and Douglas PUD will likely support staying with larval-origin fish; however, these discussion still need to take place. He said the subgroup is still targeting reaching resolution on both issues by the end of the year. Ferguson asked if the source discussion will be handled within the subgroup or the entire Aquatic SWG. Gingerich said he has no preference, and noted that almost all Aquatic SWG members are also participating in the subgroup. He said the source discussion naturally feeds into ongoing discussions within the subgroup, so it makes sense to begin the source discussion there. He said, ultimately, unanimous approval is needed, and suggested the subgroup bring a recommendation back to the Aquatic SWG.

Douglas PUD will distribute a Doodle Poll to convene a second technical subgroup meeting to further discuss the future of the Douglas PUD White Sturgeon Program. Gingerich noted that he will also setup a WebEx for those who cannot make the meeting in-person. (Note: Gingerich distributed a poll following the meeting on September 14, 2016.)

**4. 2016 Pacific Lamprey Study Update** (Chas Kyger): Chas Kyger said the Douglas PUD 2016 Pacific Lamprey Study is underway. He said 51 Pacific lamprey collected at Priest Rapids Dam were acoustically and PIT-tagged, and released 0.8-mile upstream of Rocky Reach Dam on the Chelan County side of the reservoir. He said those tags are now being tracked in the PIT-Tag Information System (PITAGIS). He said there has been one detection on an array in the Entiat River, which was detected within 8 hours of release. He said between Grant, Chelan, and Douglas PUDs, just fewer than 500 PIT-tagged fish and 151 acoustically tagged fish (including 51 from Douglas PUD and 100 from Grant PUD) have been released in the mid-Columbia River, which may contribute to the ongoing Pacific lamprey studies. Kyger said no downloads have been obtained from the acoustic receivers yet; however, data will be downloaded from seven receivers at Wells Dam beginning tomorrow, September 15, 2016. He said Chelan PUD also operates a number of acoustic receivers throughout the Rocky Reach Reservoir; however, he is not sure when Chelan PUD plans to download data. He said Douglas PUD will coordinate with Chelan PUD to share those data when they become available and will provide an update to the Aquatic SWG at that time.
Andrew Gingerich noted that LGL Unlimited (LGL) manages Douglas and Chelan PUDs' acoustic receivers; therefore, data analysis will be conducted in a consistent manner among the relevant datasets. John Ferguson asked about the turnaround time to receive an update after the download. He asked if LGL first processes those data and then Douglas PUD provides a summary. Kyger said he cannot speak to the turnaround time for data analysis from LGL; however, he said Douglas PUD can at least provide a basic summary of data as soon as the downloads are obtained. He added that this should be available within the next couple of weeks.

Steve Lewis asked about a fish released downstream of Wells Dam and detected upstream of Wells Dam. Patrick Verhey said WDFW and Douglas PUD are discussing this further offline. Kyger said the fish was not counted or detected, which means there are still issues at the count window or there are still gaps. He said he is suspicious of the grating installed near the count window, which may be too wide and fish are slipping through.

Lewis asked about lamprey translocation opportunities and support from Douglas PUD. Gingerich said, per the ASA and Douglas PUD’s FERC license, unanimous approval is needed to move forward with translocation. Bob Rose said, in his opinion, there is flexibility within the regional participation and adaptive management portions of the ASA for Douglas PUD to support translocation efforts. Rose called for being creative in how to advance actions. Gingerich said he realizes the lack of Pacific lamprey upstream of Wells Dam may be a pheromone issue; however, he does not want this discussion to interfere with carrying out the current Pacific lamprey study. Ferguson agreed, and acknowledged the need to continue discussing translocation; however, at a later time. Rose said he believes the Aquatic SWG is agreeing there is flexibility in the interpretation of governing documents. He said he would like these discussions to move forward early next year and suggested putting this on the agenda beginning in January 2017. Lewis agreed there may be ways to interweave translocation, to some extent, into future efforts and studies. Ferguson suggested, for now, carrying forward monthly updates on the current Pacific lamprey study. Rose read Objective 1 in the Pacific Lamprey Management Plan, which states, “Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey.” He said he believes addressing the passage problem falls under this objective. He said Objective 3, which states, “Participate in the development of regional Pacific lamprey conservation activities,” has room for interpretation.

5. 2016 Bull Trout Study Update (Andrew Gingerich): Andrew Gingerich said, currently, there is not a lot of movement of fish tagged for the bull trout study because most bull trout are on the spawning grounds or staging. He said Douglas PUD conducted an aerial mobile tracking survey in the mainstem Columbia River, designed to determine if fish were remaining in the mainstem Columbia River. He said, during the survey, 2 of 60 tagged fish were found. He said one tagged fish was not sending a mortality signal (detected near Beebe Springs). He said the second
tagged fish was detected near the confluence of the Wenatchee and Columbia rivers, and was sending a mortality signal. He said a PITAGIS query indicated this fish was last detected at a PIT-tag array at the Rocky Reach Bypass facility. Gingerich noted that he is not associating the death of the bull trout to the Rocky Reach Bypass facility; however, the fish was last detected at the Rocky Reach Bypass facility and was the only PTAGIS hit. He said, after not moving for 2 days, a code sent a mortality signal. He said, during the next survey, a crew will verify whether the tag is still sending a mortality code, and if so, will try to recover the tag to determine if it was expelled or is a dead fish. Steve Lewis asked how large the fish was, and Gingerich said the data is not currently available; however, Douglas PUD will investigate the possible mortality and will provide a summary of data once available. (Note: Gingerich provided this update on September 15, 2016, which Kristi Geris distributed to the Aquatic SWG that same day.)

6. Draft ASA Document Approval Process SOA (Andrew Gingerich): Andrew Gingerich said, he and Shane Bickford reviewed the language in the ASA and decided the language is strong enough to not need an SOA for the document-approval process. He said Douglas PUD will continue providing 30-day reviews for documents and ensure the agenda is distributed in advance of decision items. He said Douglas PUD is taking the position that if Aquatic SWG members are unavailable and do not request to postpone voting, this will be considered an abstention. He said there is no requirement in the ASA or Douglas PUD FERC license that states Aquatic SWG members must vote or attend meetings. He said review and approval on certain documents is stipulated (e.g., Ecology approval of the Gas Abatement Plan); however, this is not the case for every document. He suggested that Aquatic SWG members review Section 11 in the preamble of the ASA as a refresher on the approval process.

Steve Lewis asked if providing no comments conveys agreement. Ferguson said this conveys an abstention. Gingerich said the language in the ASA stipulates that if an item is on the agenda and a review period is provided, if a party does not request to defer voting within 5 days of the decision, the item can be approved by members present. Lewis asked if an agency discovers a major red flag in a study, but does not meet the comment deadline, can the agency still submit the comment. Gingerich said Douglas PUD will still accept the comment. Ferguson asked for clarification. Gingerich further explained that if the Aquatic SWG reviews and approves a plan, Douglas PUD may proceed with planning. He said if an agency submits requests after approval, Douglas PUD will attempt to accommodate the request to the extent possible; however, they may still move forward as planned. He said he does not recall Douglas PUD ever refusing to accept comments. He added that Douglas PUD tries hard to work with Aquatic SWG members on deadlines, but if the document is approved and late request cannot be accommodated to meet a subsequent deadline (FERC deadline or contract development as an example) Douglas PUD could refuse to accommodate.
VII. Next Meetings

1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on October 12, 2016, will be held by conference call.

Upcoming meetings are as follows: October 12, 2016 (conference call); November 9, 2016 (TBD); and December 14, 2016 (TBD).

List of Attachments

Attachment A – List of Attendees
Attachment B – White Sturgeon M&E Summary Sheet Email
Attachment C – Aquatic SWG White Sturgeon Subgroup August 30, 2016, Meeting Notes
Attachment D – White Sturgeon Population Model for the Wells Project
Attachment E – Wells Project Releases Survival Information
Attachment F – White Sturgeon (Acipenser Transmontanus) Population Assessment In Wells Reservoir (Jerald 2007)
## Attachment A
### List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Steve Lewis</td>
<td>Aquatic SWG Technical Representative</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Breean Zimmerman</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Bob Rose</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
</tr>
<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
</tr>
</tbody>
</table>
Hi ASWG Reps: please see the email below from Andrew regarding the white sturgeon discussion on today’s call. Talk soon! –kristi 😊

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

Indexing totals (2/0 & 4/0 hook size; 12 lines a day)

- 6 wild fish to date. And > n= 400 fish captured (only ~30% of the way through second session sampling).
- Capture rates for Brood years:
  - 88% BY 2013 fish captured (3 year olds); Released in 2014 and therefore at large for two years.
  - 10% BY 2014 fish captured (2 year olds); Released in 2015 and therefore at large for 1 year.
  - 2% BY 2015 fish captured (1 year olds); Released in 2016 and therefore at large for 1-3 months.
- No difference in capture probability between age classes and the first and second index session in 2016.

July Indexing
- 9 fish/day (27 day effort)
- Mean fish size 607 FL; 1671 g

September indexing
- 28 fish/day in first 6 days of sampling (3X greater than July session using identical gear and effort)
- Mean fish size 620 FL; 1700 g
**Adult and subadult sampling (August 22-Sept 4, 2016; 8 lines a day; 40 hooks per line; 14/0; 16/0; 18/0; 20/0 hooks)**

- 6.6 fish/day
- 86 fish captured of which 15 were wild origin (17%)
- Wild fish
  - N = 6 adults (>170cm)
  - N = 9 subadults
    - One was a recap from 2015 index sampling
    - One was a recap from 2016 index sampling
Technical representatives in the Aquatic Settlement Work Group (Aquatic SWG) met to discuss how to approach stocking rates in the Wells Project for the years 2018-2022. Andrew Gingerich began the discussion with a summary of White Sturgeon Management Plan stocking targets in the first 10 years of license implementation and stocking success to date. The Aquatic SWG discussed how to attain a diverse age and size structure that could be supported within the available habitat. The following adult target and model input considerations were developed:

**Draft Adult Abundance Target**

- Wells Project area: 3942 Ha. or 28 River Miles (excluding Methow and Okanogan tributaries within Project).
- What is an adult? 138 cm? 168 cm (Mean length of mature Bonneville Pool female (Beamesderfer et al. 1995).
- 40 adults/river mile 2012 estimate highest on record for Bonneville Pool (used in Grant County PUD and Chelan PUD forums for model development). Previous work used river mile not area or volume.
- Using river surface area instead: Bonneville reservoir is ~75 km or 7634 ha. 0.26 adults/ha (greater than 166 cm FL [Cox and Schade 2014]).
- Using 2012 estimate of adult abundance in Bonneville and Wells Project area = 1,019 adults would be the target.

**Model Input Considerations**

- Need to include Wells stocking information to date and assumed for 2017 plants.
- Need to include Wells wild/existing population of sturgeon.
- Need to include survival rates from M&E or other estimate.
  - Use M&E data?
  - Use UCWSRI data?
- What about harvest?
  - Model could be 10% and 20% exploitation rate?
- Growth rates? Lower Columbia growth rates used in other models.
  - Need to consider growth rates in Wells Project?
  - Acceptable to use Wanapum and Priest Rapids data and is it sufficient to use for modeling. Revisit in five years when we have additional growth and other M&E data.
- How do we select an output? Some years the number of fish is too high and decline is large.
- How do we model the fact that we see some recruitment within Wells?
The meeting ended with a short discussion on the prioritization of larvae and where the fish source would come from to meet stocking goals once target stocking numbers are understood. Jason McLellan agreed to track down logistic regression curve formula from BC Hydro and Golder Associates and Andrew Gingerich agreed to look up detailed fish size in the stocking data. The Aquatic SWG will use these data in the model runs and make a plan for future work on model development during the September 14, 2016 Aquatic SWG conference call.

Attendees: Bob Rose (Yakama Nation), Chad Jackson (Washington Department of Fish and Wildlife), Patrick Verhey (Washington Department of Fish and Wildlife), Andrew Gingerich (Douglas County PUD), Breean Zimmerman (Washington Department of Ecology), and Jason McLellan (Colville Tribes).
**Number of Juvenile Hatchery White Sturgeon Released**

<table>
<thead>
<tr>
<th>Release Year</th>
<th>Priest Rapids</th>
<th>Wanapum</th>
<th>Rocky Reach</th>
<th>Wells</th>
</tr>
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<tbody>
<tr>
<td>2011</td>
<td>2,101</td>
<td>8,086</td>
<td>6,376</td>
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<tr>
<td>2012</td>
<td>0</td>
<td>0</td>
<td>137</td>
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<tr>
<td>2013</td>
<td>1,717</td>
<td>2,264</td>
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<tr>
<td>2014</td>
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<td>5,094</td>
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<tr>
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<td></td>
<td></td>
<td>5,289</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
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</tr>
</tbody>
</table>

TOTAL: 6,614 19,351 25,942 15,342  
AVERAGE: 1,363 3,870 5,188 5,114

In 2012, no hatchery releases due to fish health (WSIV) concerns
In 2013, Wanapum releases were “prorated” commensurate with available genetic diversity in hatchery
In 2014, per FF agreement, Rocky Reach releases were prorated commensurate with available genetic diversity in hatchery

**White Sturgeon Population Estimates**

<table>
<thead>
<tr>
<th>Origin</th>
<th>Priest Rapids</th>
<th>95% CI</th>
<th>Wanapum</th>
<th>95% CI</th>
<th>Rocky Reach</th>
<th>95% CI</th>
<th>Wells</th>
<th>95% CI</th>
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<tr>
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<td>28-2,680</td>
<td>550</td>
<td>314-1,460</td>
<td>75</td>
<td>58-151</td>
<td>34</td>
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<tr>
<td>CRITFC</td>
<td>1730</td>
<td>889-3,181</td>
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<td>2,340-5,830</td>
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<td>NA</td>
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</table>

CRITFC juvenile hatchery White Sturgeon released into Rock Island Reservoir and have migrated downstream into the PRPA.
None of these fish are present in Rocky Reach or Wells reservoirs.

Useful instructions/explanations

From Larry Hildebrand (highlighted text are notes and/or additions from CEA):

The reason you do not see the difference in the peak adult numbers is because that first peak of the graph at 25 years from 2011 or at 30 years is totally driven by the cumulative numbers of fish stocked in the first five years (aka front loading phase). That is the number that all become adults in 25 years. The much lower stocking rates of 300 fish per year after 2016 are not enough to offset the mortality from the existing adult population and the total adult (black) line trends downward (as in your example). If you increase the stocking rate to 500 fish, however, the trend line continues to increase after the first 25 years as shown below, and then declines after 50 years since after 25 years at 500 fish/year, stocking rates are reduced to 300 fish per year.

Future hatchery stocking (aka post front loading, considered to occur in 2016) can either increase adult abundance, keep it stable, or reduce it because stocking numbers are not enough to offset adult natural mortality. Sturgeon stocked beginning in 2016 first become adults in 2041

Peak adult abundance in model runs occurs between the 25 and 50 year mark (2036 to 2061).

After 2051, the model ends hatchery stocking (default setting) and the modeler must either let the population naturally decline between 2061 and 2091 (the 51 and 100 year marks) or arbitrarily select a natural recruit value to either slow the decline, stabilize, or increase the adult abundance as represented in the graph. It is “recommended” to find the natural recruits value that essentially stabilizes the adult abundance.

If you stock 500 fish per year for 50 years, the population stabilizes as per the output below.

Keep in mind the output is adults that are set at a 25 year maturity cycle so the first set of inputs in the model used here are for the first 25 years and the next set is for the subsequent 25 years. The stocking rates and the durations can be changed in either of these input sets but the adult numbers are determined by how many fish survive to age 25.
INPUTS

<table>
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<th>Defaults (Based on Wanapum)</th>
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</tr>
<tr>
<td>pop est</td>
<td>pop est</td>
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<td>current wild juveniles/yr</td>
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<tr>
<td>future wild juveniles/yr</td>
<td>future wild juveniles/yr</td>
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WHITE STURGEON (Acipenser transmontanus) POPULATION ASSESSMENT
IN WELLS RESERVOIR

A Thesis
Presented To
The Graduate Faculty
Central Washington University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

by
Tyson Jerald
January 24, 2007
ABSTRACT

WHITE STURGEON (Acipenser transmontanus) POPULATION ASSESSMENT AND PREFERRED HABITATS IN WELLS DAM RESERVOIR

By

Tyson Jerald

January 2007

This project focused on acquiring information regarding white sturgeon population structure, movement patterns, and preferred habitats within Wells Reservoir. Prior to this study, no research had been conducted on white sturgeon populations in Wells Reservoir and therefore the status of these fish has been poorly understood.

Set lines were deployed throughout the entire Wells Reservoir during 2001 and 2002. A total of 13 individual white sturgeon were captured on the set line gear. Additionally, 5 recaptures were recorded bringing the total number of captures events to 18. All white sturgeon were captured near the confluence of the Okanogan and Columbia Rivers.

Two of the captured fish were classified as juveniles (i.e. less than 90 centimeters fork length) and the remaining 11 fish were classified as adult. White sturgeon ranged in length from 65 centimeters to 202 centimeters. Using pectoral fin analysis, ages ranged from 5 to 30 years, representing the 1972 to 1997 year classes.

A variable capture probability Schnabel abundance estimate from the mark-recapture data was computed at N=31.35. The 95% confidence interval for sturgeon was large due to a small number of recaptured fish CI (13.15 < N < 217.50) =0.95.

A total of 6 white sturgeon were outfitted with radio transmitters. All telemetry observations during boat surveys were recorded near the confluence of the Okanogan and Columbia rivers. One fixed telemetry receiver located within the Okanogan River (10 kilometers upstream from the mouth) recorded two white sturgeon during the spring of 2002 and one white sturgeon during the spring of 2003.
White sturgeon were only observed via set line capture and telemetry in the Okanogan Columbia River confluence area and upstream in the Okanogan River. These areas were defined as preferred holding locations within the study area. However, white sturgeon were not recorded during telemetry surveys or set line surveys in these locations during probable spring spawning periods. White sturgeon may migrate from the confluence area to spawn in the upper portions of the reservoir during the spring. The upper portion of Wells Reservoir is heavily influenced by discharges from Chief Joseph Dam. High flows through Chief Joseph project in June coincide with preferred white sturgeon egg incubation temperatures in the tailrace area. This provides evidence that white sturgeon may utilize the upper reservoir for spawning purposes.

Data collected during this study should provide a strong foundation for future white sturgeon monitoring and management programs in the Wells Reservoir. Future population level monitoring of these fish, as well as the identification of preferred habitats, will be necessary to promote an expansion of the small population that was identified during this study. Future research regarding white sturgeon in Wells reservoir should include an analysis of supplementation options and evaluation of the carrying capacity of white sturgeon in Wells Reservoir. This information will ultimately provide regional biologists with the ability to implement strategies that promote white sturgeon abundance within Wells Reservoir.
ACKNOWLEDGEMENTS

Special thanks to Dr. Paul James for his guidance on this project. Dr. James’ in-depth understanding of ichthyology provided a strong background for this Thesis. Dr. Darda and Dr. Bryan are also thanked for their input and support.

I would also like to thank Shane Bickford and Public Utility District No. 1 of Douglas County. Mr. Bickford arranged for funding of this project through Douglas PUD. Mr. Bickford also helped coordinate the field research and provided valuable technical and field collaboration.

Ken LePla at Idaho power is graciously thanked for his instruction regarding telemetry tag application onto white sturgeon. Mr. Lepla provided valuable direction in regards to data analysis, white sturgeon ecology. He also provided valuable length frequency data from sturgeon populations within the Snake River Basin.

Brad James with Washington Department of Fish and Wildlife supplied valuable length frequency data for lower Columbia River fish stocks. Mr. James also provided valuable input on the project and supplied recent life history data white sturgeon on the lower Columbia River.

John Skalski and Richard Townsend are appreciated for their help in developing an accurate white sturgeon population estimate for the project.
TABLE OF CONTENTS

INTRODUCTION .......................................................................................................................................... 8
MATERIALS AND METHODS ..................................................................................................................13
Study Area: Wells Reservoir ..................................................................................................................13
Field Methods ...........................................................................................................................................15
Laboratory Methods ..................................................................................................................................18
Population Estimate ..............................................................................................................................18
Physical Data .........................................................................................................................................19
Radio Telemetry .......................................................................................................................................21
RESULTS ..................................................................................................................................................23
Field Sampling Results ..........................................................................................................................23
Laboratory Results ....................................................................................................................................24
Population Estimate ..............................................................................................................................24
Physical Data .........................................................................................................................................25
Radio Telemetry .......................................................................................................................................27
DISCUSSION ...........................................................................................................................................27
Field Sampling ........................................................................................................................................27
Population Estimate ..............................................................................................................................35
Physical Data .........................................................................................................................................37
Regional Comparisons ..........................................................................................................................40
Radio Telemetry .......................................................................................................................................48
Management Implications ......................................................................................................................55
CITED REFERENCES ..............................................................................................................................57
LIST OF FIGURES

Figure 1  Mid-Columbia Hydroelectric Operations on the Columbia River in Washington State. 14
Figure 2  Sampling Zones within Wells Reservoir, Washington State. 16
Figure 3  Radio tag placement on white sturgeon borrowed from Ken LePla Idaho Power Council. 21
Figure 4  Year class composition of white sturgeon in Wells Reservoir 1970 to 2002 26
Figure 5  Length frequency distribution for white sturgeon captured by set lines in Wells Reservoir Washington State, during 2001 and 2002. 27
Figure 6  Telemetry observations for radio tag 13-3, Wells Reservoir, Washington 29
Figure 7  Telemetry observations for radio tag 13-6, Wells Reservoir, Washington 30
Figure 8  Telemetry observations for radio tag 13-5, Wells Reservoir, Washington 31
Figure 9  Telemetry observations for radio tag 13-7, Wells Reservoir, Washington 32
Figure 10 Telemetry observations for radio tag 13-4, Wells Reservoir, Washington 33
Figure 11 Telemetry observations for radio tag 13-4, Wells Reservoir, Washington 34
Figure 12 Length frequency histogram comparison for white sturgeon captured in Wanapum Reservoir and white sturgeon captured in Wells Reservoir. 43
Figure 13 Length frequency histogram comparison for white sturgeon captured in Bonneville Reservoir and white sturgeon captured in Wells Reservoir. 45
Figure 14 Length frequency histogram comparison for white sturgeon captured in Wells Reservoir and white sturgeon captured in Lower Granite Reservoir, Snake River Idaho. 47
Figure 15 Daily mean discharge (cubic feet per second) from May 1, 2002 to July 30, 2002 within Okanogan River taken at Malott Bridge USGS gauging station approximately 8 kilometers upstream from the Columbia River confluence. 50
Figure 16 Daily mean discharge (cubic feet per second) from May 1, 2003 to July 30, 2003 within Okanogan River taken at Malott Bridge USGS gauging station approximately 8 kilometers upstream from the Columbia River confluence. 51
Figure 17 Daily average water temperature (C) and daily average discharge (cfs) in Chief Joseph Dam tailrace from May 1 to July 30, 2002. Spawning window represents optimal white sturgeon egg incubation temperature (13 C to 17 C) and high flow velocities. 53
Figure 18 Daily average water temperature (C) and daily average discharge (cfs) in Chief Joseph Dam tailrace from May 1 to July 30, 2003. Spawning window represents optimal white sturgeon egg incubation temperature (13 C to 17 C) and high flow velocities. 54
LIST OF TABLES

Table 1  Fork length, PIT-tag number, radio tag codes, capture location, number of capture events and estimated age for 13 white sturgeon sampled in Wells Reservoir, Washington State. 23

Table 2  Modified Schnabel variable capture probability model used to estimate white sturgeon abundance in Wells Reservoir, Washington State. 25

Table 3  Telemetry Information on 6 radio tagged white sturgeon released in Wells Reservoir, Washington State. 28
INTRODUCTION

A total of 24 sturgeon species are recognized worldwide. These fish are all restricted to the Northern Hemisphere and spawn in freshwater environments (Helfman et al. 1999). Anadromy (spawning in freshwater and spending a portion of life in saltwater) is exhibited by some (but not all) sturgeon species. White Sturgeon (Acipenser transmontanus) have changed little since their appearance in the fossil record. Documentation of these prehistoric fishes has been dated back to the Upper Cretaceous, with these fish evolving approximately 400 million years ago (Hanson 1992).

Historically, white sturgeon populations existed throughout the west coast of North America from the Aleutian Islands to central California. Currently, spawning populations have been identified in three large river systems of their native range (the Sacramento-San Joaquin in California, the Columbia River in Washington State, and the Fraser River in Canada). Tag recovery has shown that some sturgeon may utilize more than one river on the West Coast during different life stages (Kohlhorst et al. 1991). Analysis of mitochondrial deoxyribonucleic acid (mtDNA) has implied that the Columbia River and Fraser River populations are genetically similar (Brown et al. 1990). After the last ice age, the Columbia River population probably provided the founders for the Fraser River population. Small numbers of clonal lines within the mtDNA suggest a recent genetic bottleneck and imply that a small number of females founded the present populations in the Columbia and Fraser river systems (Brown et al. 1990).

White sturgeon are the largest of all North American freshwater fishes. These fish possess an armor like skin that covers a cartilaginous skeleton. Distinct bony plates called scutes run along the body. This anadromous species may complete their life cycle in fresh water or spend a portion of their life in brackish or marine environments. The largest authentic record of a white sturgeon was recorded as a 630 kg specimen taken from the Fraser River in 1897 (Scott and Crossman 1973). White sturgeon are long lived fishes, with fin ray analysis documentation of fish over 100 years in age (Beamesderfer et al. 1995; Rien and Beamesderfer 1994).

Commercial and sport fishing have impacted Columbia River sturgeon. A commercial fishery was initiated in the 1880’s. During the peak, in 1892, approximately 80,000 fish were harvested weighing 2.5 million kg (Rieman and Beamesderfer 1990). By 1900 the extensive white sturgeon population had
collapsed from overexploitation. Over the last 100 years sport angling for white sturgeon has grown dramatically while commercial fishing has been reduced. Most of the fishing activity has been focused on the lower 100 mile stretch of Columbia River, downstream of Bonneville Dam (Devore et al. 1995).

Regional federal, state, and county agencies have expressed growing concern over the status of white sturgeon within the Columbia River. The once free flowing Columbia River has been segmented by a series of hydroelectric projects that have altered habitats within the aquatic ecosystem. White sturgeon historically migrated throughout the entire river system. The construction of Rock Island Dam in 1934 cut off the sturgeon populations in the mid-Columbia from accessing the ocean. Currently Priest Rapids Dam is thought to be the upstream migration terminus for adult white sturgeon in the Lower Columbia River. Upstream of Priest Rapids, resident populations of sturgeon remain between each of the Mid-Columbia River hydroelectric projects. It is estimated that there are as many as 18 landlocked sub populations of white sturgeon within the Columbia and Snake River impoundments (Hanson et al, 1992). Resource managers typically consider sturgeon confined between hydroelectric projects as discrete populations, even if fish passage facilities are available, as white sturgeon do not readily use fish ladders (Kreitman and LaVoy 1989).

Male white sturgeon reach sexually maturity at around 18 to 25 years of age at approximately 120 CM fork length. Females do not reach sexual maturity until 16 to 35 years of age (Devore et al. 1995) at approximately 150 cm fork length. This old age of maturity results in large generation times. Sexually mature female white sturgeon may only spawn every two to five years (Smith, 1985). Female white sturgeon spawn only when environmental conditions are favorable, reabsorbing their eggs during years in which environmental conditions are unfavorable. This ultimately restricts the fish’s ability to respond to factors such as altered habitat. During successful spawning events, mature female white sturgeon release from .1 million to 7 million eggs, depending on fish size and age (Hanson et al. 1992). It has been documented that white sturgeon preferred spawning habitats consist of high water velocities over 0.8 m/s and focus spawning activities downstream of hydroelectric projects (Parsley and Kappenman 2000, Parsley et al. 1993). Presently, spawning habitat is restricted to dam tailrace areas and tributary streams. It is in the dam tailrace locations that high water velocities can be found within the impounded Columbia River ecosystem. Moderate to high flow velocities can also be found within tributary streams of the Columbia
River. Confluence areas of tributary streams within the Columbia River have been documented as preferred sturgeon habitats. Haynes et al. (1978) documented white sturgeon movements to the mouths of the Snake and Walla Walla rivers, where the fish remained until transmitter failure. White sturgeon may conduct spawning migrations into tributary rivers or tributary confluences with suitable spawning habitats. Within Wells Reservoir, the Okanogan River and Methow River tributaries have moderate to high flow velocities. Therefore, suitable spawning habitats within the study area are located downstream of Chief Joseph Dam and within the Okanogan and Methow rivers.

It has been observed that white sturgeon spawn at water temperatures from 10 degrees C to 18 degrees C (Parsley et al 1993). The Columbia River reaches these temperatures in the spring of each year and triggers white sturgeon spawning events. Therefore, any observed movements of white sturgeon during this time period may provide evidence of spawning migrations within the study area.

A white sturgeon population assessment was conducted in Rocky Reach Reservoir in 2001. This reservoir is located immediately downstream from Wells Reservoir. The mark recapture population estimate for the Rocky Reach Reservoir was determined to be 29 adult sturgeon with a 95% confidence interval ranging from 11 to 108 fish. From 2000 to 2002, an extensive study was conducted within Wanapum Reservoir and Priest Rapids Reservoir located approximately 110 km downstream from Wells Reservoir. The project involved an extensive mark-recapture evaluation and in-depth analysis of fish movements within both reservoirs. The population estimates derived for the Wanapum and Priest Rapids reservoirs were also relatively low with 134 adult fish (95% CI 48-2,680) estimated for the Wanapum Reservoir and 551 adult fish (95% CI 143-4,746) estimated in the Priest Rapids Reservoir (Golder 2003). These population estimates were relatively small when compared to population estimates for the lower Columbia River.

The Public Utility District No. 1 of Douglas County (PUD) owns and operates the Wells Hydroelectric Project (Wells Project), located at river km 829.8 on the Columbia River (Figure 1). The Wells Project boundary encompasses 47.5 km of the mainstem Columbia River upstream to Bridgeport Bridge which is 0.5 km downstream of the Chief Joseph Hydroelectric Project (Rkm 877.3). The Wells Reservoir has riverine characteristics in the upper 15-km section downstream from the Chief Joseph Dam tailrace. The middle section is more characteristic of a lacustrine environment. The lowermost section of
the reservoir slows and deepens as it nears the forebay of Wells Dam (Beak, 1999). The drainage area of the Columbia River Basin upstream of the Wells Project is approximately 220,900 square kilometers.

Within the Mid-Columbia River, white sturgeon populations have been studied in the Priest Rapids, Wanapum and Rocky Reach reservoirs (Golder 2002, Golder 2003). These studies were conducted as part of the relicensing of those respective hydroelectric projects. The license for the Wells Project expires in May of 2012. Biological data was collected regarding white sturgeon research as part of this relicensing process. The purpose for this study is to analyze the white sturgeon population structure within Wells Reservoir. Because little historical data exists on white sturgeon in the reservoir, it has been difficult for regional biologists to accurately assess hydroelectric impacts on these fish. Prior to this study there was little documentation that a resident population of white sturgeon existed in the reservoir. However, it was assumed that a population of sturgeon was present, as viable populations of these fish were documented within Columbia River reservoirs both immediately upstream and downstream from the study area (Golder 2002, Ward et al. 2003). Additionally, recreational fishing took place for white sturgeon in the Wells Pool up through the 1980’s as indicated from punch card returns from Washington Department of Fish and Wildlife (WDFW). These catch cards recorded the presence of white sturgeon in the study area during that time period.

Analysis of the white sturgeon population within the Wells Reservoir was composed of two primary objectives. The first objective was to capture an adequate number of individual white sturgeon to provide a basic analysis of the population abundance, age structure, size, growth, and ecology within the study area. Age structure and population estimates were derived using mark-recapture techniques. The age of each individual fish was determined through the collection and analysis of fin rays. It was of particular interest to determine whether juvenile and sub-adult sturgeon were present within the reservoir. The presence of fish younger than the project, completed in 1967, would indicate that recruitment, either through spawning or entrainment (downstream migration of white sturgeon), is occurring within the population. Lengths of captured fish were recorded to construct a length frequency histogram. The length frequency histogram was then analyzed to determine the age structure of the white sturgeon population in Wells Reservoir.
The second objective of this study was to analyze the movement of radio tagged white sturgeon within the reservoir. This objective was accomplished through the application of external radio transmitter tags onto adult and juvenile white sturgeon. Fixed and mobile telemetry stations were then utilized to track radio tagged fish. Tracked movements were then investigated in regards to possible spawning migrations, feeding activity, and habitat use.

Taking into account the importance of developing a baseline data collection project, this Masters of Science Thesis has been designed to develop an initial assessment of ecological and biological characteristics of white sturgeon populations within Wells Reservoir. A crucial goal for this project is to ensure information contained within is scientifically valuable to regional biologists involved in white sturgeon research and management activities. Information from this study will ultimately promote the development of effective white sturgeon enhancement and research activities within Wells Reservoir.
MATERIALS AND METHODS

Study Area: Wells Reservoir

The Columbia River originates at Columbia Lake in British Columbia and flows approximately 2,000 km to the Pacific Ocean. The Columbia River drains a majority of the inland Pacific Northwest and is fed from over 175 streams and rivers. The Columbia drains more than 650,000 square kilometers and averages a drop of one meter-per-five km drop. The river has been divided into three regions known as the Lower, Mid, and Upper Columbia. The Upper Columbia is described as that portion of the river from the international boundary between United States and Canada upstream to the headwaters of Columbia Lake. The Mid Columbia River is known as that portion of the river from the international boundary downstream to the Snake River Confluence (Figure 1). The Lower Columbia is described as that portion of the river downstream from the Snake River Confluence. The Lower Columbia River forms a deep gorge through the Cascade Mountains on its way to the Pacific Ocean designating the border between Oregon and Washington.

The Mid-Columbia River traverses 589 kilometers from the international boundary to the Snake River and once dropped 315 meters in elevation in a series of 50 rapids and one major waterfall at Kettle Falls. Historically, the Mid-Columbia River was a free flowing system, and it is suspected that white sturgeon migrated throughout the system from the Pacific Ocean and Columbia River estuary as far upstream as Kettle Falls. Upstream migrations of adult white sturgeon have been impeded by the hydroelectric projects following the construction of the Columbia River hydroelectric projects. Dams containing navigation locks and fish ladders presently provide limited upstream passage for adult sturgeon and it is generally accepted that Priest Rapids Dam is the upstream terminus of white sturgeon migrations within the lower Columbia River.

The climate of the Mid-Columbia Region is primarily influenced by the Pacific Ocean and winds from the Arctic. Moisture containing rains from the coast are dispersed on the west slope of the Cascade Mountains, leaving the eastern slopes sunny and dry. The rain shadow effect results in a semi arid inland shrub steppe community with an average of 46 millimeters of rain per year. The Mid-Columbia Region is
a dry land farming area with little water resources other than the Columbia River and Snake River drainages. Over the last century irrigation requirements have played a major role in construction of Hydroelectric projects on the Columbia River.

Wells Reservoir study area is located within the mainstem Columbia River from Wells Dam (river km 829.8) to the tailrace of Chief Joseph Dam (river km 877.9)(Figure 1). Wells Reservoir has two major tributaries, the Okanogan River and Methow River. The Okanogan River flows 185 km beginning at the headwaters of Lake Okanogan near Penticton, British Columbia. The river flows in a southerly direction passing through Osoyoos Lake near the international border. From there the river is a relatively free flowing system to the Confluence with the Columbia River.

The Methow River enters the Columbia River approximately 20 kilometers miles downstream of the Okanogan River and flows 129 km through an irrigated agricultural valley. The river rises from the Cascade mountain range north of Lake Chelan (Cohen 2000).

Figure 1  Mid-Columbia Hydroelectric Operations on the Columbia River in Washington State.
Field Methods

Methodology for the first phase of this study involved the deployment of set lines to capture white sturgeon within Wells Reservoir. Set lines have been used extensively for white sturgeon capture and research activities within the lower Columbia River (Elliott and Beamesderfer, 1990, Nigro et al. 1988, North et al. 1993, Rien et al. 1994). Set lines have also been utilized in recent white sturgeon research activities in the Mid-Columbia (Golder 2002, Golder 2003). A successful application of setline methodology was crucial to the success of this project.

Fish captured on set lines were measured, marked with PIT-tags and secondarily marked by scoot removal. Some of the fish were also radio-tagged and had pectoral fin rays removed for age analysis. The collection of fish information was essential to developing a population estimate, understanding recruitment and population demographics and was used to understand general movement patterns for juvenile and adult white sturgeon. Wells Reservoir was sampled with setline gear over a 2 year period (2001 and 2002). Sampling activities during 2001 were initiated on June 18 and conducted through August 28. Sampling in 2002 was initiated on June 26 and conducted through September 19.

The study area was divided into four sampling locations (Figure 2). Zone 1 included the Columbia River from Wells Dam to the town Pateros, including the Methow River. Zone 2 included waters from Pateros to Brewster Bridge. Zone 3 was designated from Brewster Bridge to Park Island and included the Okanogan Columbia River confluence area. Zone 4 was designated from Park Island to the tailrace of Chief Joseph Dam. These four sampling locations were further sub-divided into 4 locations providing a total of 16 sample locations to ensure all areas and habitat types would be sampled throughout the reservoir.
Figure 2  Sampling Zones within Wells Reservoir, Washington State.

A three person field crew conducted a majority of the collection and research. The crew was equipped with all necessary equipment to complete the project. A majority of the equipment (vehicle, vessel, and gear) was provided by Public Utility District No. 1 of Douglas County. Crews typically operated for 3 days during a designated sampling week. The first day consisted of setting the setline gear. Day 2 consisted of checking, re-baiting, and re-setting the lines. On day 3 the set lines were typically pulled from the water.

Set line configurations were similar to those used by Oregon Department of Fish and Wildlife (ODFW) and WDFW for white sturgeon capture in the lower Columbia River (Elliott and Beamesderfer 1990, North et al. 1996). This capture method has been a successful sampling technique for white sturgeon in the mid Columbia over the last two decades. The system provides high catch rates for adult white sturgeon, and is less size selective than other methods, and has resulted in low levels of non-target catch (Elliot and Beamesderfer, 1990). Even though set lines were less size selective than other techniques, this sampling technique is by no means unbiased. The set lines provide a sampling technique that is successful in capturing white sturgeon over 50 cm in Fork Length (Elliott and Beamesderfer 1990, Nigro 1988).
Smaller white sturgeon are not susceptible to the larger hooks and baits used on the set line gear. As such, set lines do not provide accurate sampling of fish under 50 cm.

Set lines for this study measured 133 meters in length. This is 66 meters less than the standard gear used by WDFW and ODFW for white sturgeon capture. The shorter gear allowed deployment in smaller areas of the Mid-Columbia River and was more manageable when fishing in high velocity sections of the river. The shorter lines were also less likely to tangle when oversized sturgeon were hooked. The mainline or ground line consisted of 1600 lb multi-strand nylon rope. Each circle hook was attached to the mainline with a 2-foot long section of 300 lb. nylon fishing line and a Berkley-McMahon bright snap. The gabions were attached to the mainline by a stainless steel trolling snap. Set lines were typically placed parallel to the river flow. The upstream anchor consisted of an 80 lb rocking chair anchor and the downstream setline was typically held on the bottom with a 20 lb. pyramid anchor. Each anchor attached to a surface line terminating at a single buoy. Lower pyramid anchors were attached to 68 pound LD series buoys. The larger upstream anchors were attached to multiple buoys to ensure that the gear would be located.

Size 11/0, 13/0 and 15/0 VMC Circlematic 2000 carbon-steel hooks were baited primarily with commercially available pickled squid (Loligo spp). This has been determined to be the best bait for sturgeon capture on similar setline research programs conducted by WDFW (North et al. 1993). Herring (Misc. clupidae), salmon fillets, (Oncorhynchus spp.) and fresh water clams (Corbicula manilensis) were also used to a lesser extent. This hook configuration provided a diverse range of sturgeon lengths in lower Columbia River research activities with sizes of white sturgeon ranging from 34 to 274 cm in fork length (Beamesderfer et al. 1989). Each line was baited with 25 to 35 hooks.

Sturgeon captured on the set lines were tethered to the boat using cotton web rope long enough for the entire body of the fish to remain submerged. Crew members then continued to pull the setline and remove any additional fish from the gear prior to working up the captured fish. Smaller sturgeon were placed in an on-board live well, while larger fish were tethered and brought to shore for processing. Hoods were placed on sturgeon during processing and wet towels were set around the skin to prevent moisture loss. Fresh river water was poured over the gills to further promote respiration. After data collection was complete, technicians applied necessary respiration measures to ensure the healthy release of the fish.
Field data were recorded on standardized sheets and transferred to a computer database. Each setline locations and depth was recorded. Depths were recorded using a Lowrance X135 depth sounder at the beginning of the setline and the end of the setline to provide an overview of the entire water column in which the lines were placed. Total hooks, hook size, and bait types for each setline were recorded. Field data for each white sturgeon capture event consisted of capture location, capture depth, hook size, and bait (if discernable). Size data from each captured white sturgeon consisted of fork length and total length measured to the nearest 1.0 cm.

A small portion of the pectoral fin ray was removed for age sampling. It has been determined that calcified structures of white sturgeon pectoral fins, opercles, clavicles, cleithra, medialnuchals and dorsal scutes do not result in significantly different age estimates (Brennen and Cailliet 1991). Pectoral fins age analysis provided the highest level of accuracy and did not require lethal sampling of the fish. Two perpendicular cuts were made in the rays with a hacksaw. The first cut was made 5 to 10 mm outside of the pectoral fin knuckle. The second cut was made approximately 5 mm outside of the first cut resulting in the removal of approximately 5 mm of pectoral fin. The samples were then placed in sample envelopes and frozen for future lab analysis. Removal of the pectoral fin ray for aging purpose provides a noticeable mark for several years (Rien et al 1994) enabling technicians to identify recaptured fish during future encounters.

Each fish was injected with a Passive Integrated Transponder tag (PIT tag) to identify individual fish. ISO 134 kHz PIT tags were injected under the armor of the head near the dorsal midline. A series of scutes (bony armor-like plates located on sturgeon head and back areas) were also removed to indicate a tag was administered. During the 2001 sample period right scutes 2 and 3 were removed. In 2002 left scutes 2 and 3 were removed. Scutes were removed from different areas in subsequent years to provide a year-specific external mark.

**Laboratory Methods**

**Population Estimate**

An adult white sturgeon abundance estimate was developed for the Wells Reservoir population using the University of Washington’s RECAP.GLM program. The program RECAP.GLM allowed for the
examination of several mark-recapture models and provided for the comparison of these models using likelihood ratio tests.

The program was used to examine two specific Schnabel methods; the Schnabel constant capture probability (Mo) and the Schnable variable capture probability (Mt). The Schnabel constant capture probability model assumes that all fish within the population have an equal chance of capture throughout the sampling periods. The Schnable variable capture probability assumes variable probability of capture throughout the sampling period. Population estimates were determined using capture data from five sampling periods. (i.e. July 2001, early August 2001, late August 2001, early September 2002, and late September 2002).

Standard assumptions were applied to the Schnabel population estimate. A primary assumption was that a closed population of white sturgeon existed within the study area. For the purpose of this study it was assumed that Chief Joseph hydroelectric project provided a barrier for downstream migrants into the study area. No fish ladder exists at Chief Joseph Dam so upstream migrations do not take place. The downstream terminus of migration into or out of the study area was defined as Well Dam. It was assumed that within a sampling period, each fish had an equal probability of being captured. For the purpose of this study it was assumed that prior capture histories did not affect present or future capture histories.

The RECAP.GLM program provided for examination of the residuals associated with the lack-of-fit to individual capture histories. Examination of these residuals provided information as to whether certain individual white sturgeon exhibited gear selectivity towards the set-lines (Certain individual fish within a sampled population may frequent capture gear, therefore being more prone to capture events than other individuals). Juvenile white sturgeon were expected to be less susceptible to being hooked but more susceptible to capture once hooked. This is the opposite case for very large or oversize adult sturgeon. These fish were susceptible to being hooked but were much less susceptible to direct capture due to their ability to break the gabions, hooks and setline snaps.

Physical Data

Length of each captured white sturgeon was entered into a database to construct a length-frequency histogram. Length frequency histograms were used to determine age class strength, and strong age classes may indicate periods of high recruitment. The histogram was constructed using slot increments
of 15 centimeters. These data were then compared to length frequency histograms constructed for other white sturgeon sub-populations within the Columbia River.

Flow velocity patterns and water temperatures have been linked to white sturgeon spawning intensity in the lower Columbia River (Anders and Beckman 1993, Parsley at al. 1993,). Research has indicated that white sturgeon prefer fast flowing water velocities for spawning activities. Parsley et al. (1993) recorded a fast mean water column velocity of 1.46 m/s at white sturgeon spawning sites within lower Columbia River reservoirs. These high water velocities typically occur within the tailrace section of hydroelectric projects. Parsley et al. also recorded water temperatures during spawning activities from 10C to 18C, with most spawning events occurring at near 14C. Additionally, 13C to 17 C has been identified as the optimal temperature for white sturgeon egg development (Wang et al. 1985). Wang et al. recorded elevated mortality of white sturgeon embryos incubated at 18C and complete mortality of embryos incubated at 20C.

Surface water temperatures were collected for this study during set line sampling activities. Temperatures were also collected from fixed field sites within the tailrace of Chief Joseph Dam, Wells Dam Forebay and the Okanogan River. These data were collected to correlate any existing relationships that may exist between fluctuating water temperatures and white sturgeon movements within the study area (e.g. migrations within the reservoir or use of tributary streams for spawning or feeding activities).

Physical data collected from sampled white sturgeon consisted of pectoral rays. Pectoral fins were air dried for several days and standard methodology for counting growth rings was applied (Cuerrier 1951, Beamesderfer et al. 1989). It was first necessary to section the samples into approximately 0.5 millimeter sections. To accomplish this, the samples were glued with a standard model epoxy onto a wooden dowel. This allowed for the handling of the fins during the sectioning process. A 2 millimeter balsa wood saw was then used to section the fins. The sections were then hand sanded to approximately 0.2mm and mounted on microscope slides using clear epoxy. A dissecting microscope was then used to count the translucent pectoral fin annuli. One year of age was assigned to fish captured in the spring and early summer as these individuals were captured prior to annulus formation for that year.

Discharge and temperature information was obtained from Army Corps of Engineers at Chief Joseph Dam. These data were graphed to form a temperature discharge window. The window represents
the suspected spawning period in Chief Joseph Tailrace or Upper Wells Reservoir based on preferred flow velocities and optimal egg incubation temperatures.

**Radio Telemetry**

White sturgeon were outfitted with 7 volt Lotek Micro Coded Fish Transmitters. The radio tags had a minimum 18 month life expectancy allowing researchers the ability to acquire telemetry information on the tagged fish for two summer field sessions.

Radio tags were attached externally to the posterior portion of the dorsal fin using 1mm wire cable (Figure 3). This tag application procedure has been used with a high degree of success during white sturgeon telemetry studies conducted throughout the upper Snake River (K. Lepla, personal communication 2000). The process involved running a pair of small tubes through the base of the dorsal fin. A stainless steel wire was then fed through the radio tag and then ran through the tubes. With the wire through the dorsal, the tubes were then backed out and the wire free ends were fed through a 1” PVC and then secured with a crimp.

![Figure 3 Radio tag placement on white sturgeon (borrowed from Ken LePla, Idaho Power Company).](attachment:F)

Movements of radio tagged white sturgeon within the study area were recorded using Lotek Wireless SRX-400 telemetry receivers. Aerial surveys, boat surveys, and fixed land surveys were all attempted to identify activated transmitters. After the capture and outfitting of the first radio tagged fish, bi-monthly aerial surveys were conducted over Wells Reservoir for activated radio tags. These surveys were conducted between July of 2001 and July of 2002. Sweeps of the reservoir study area were
performed approximately 50 feet from each bank. The aerial surveys were conducted in conjunction with
the Douglas PUD bull trout survey which typically only reads activated tags within the first 15 meters of
the water column. Boat surveys were conducted intermittently throughout the study. The SRX-400
receivers were mounted on the research vessel and transects along the west and east shore of the reservoir
were conducted in an attempt to locate tagged fish. Three fixed site receivers were located within the study
area. The receivers were functional throughout the study and were downloaded onto a laptop computer
every two weeks. One receiver was located approximately 10 kilometers upstream of the Okanogan River
near Crazy Rapids Pump Station. Two receivers were located near the mouth of the Methow River. One of
these receivers was located approximately 400 meters upstream from the confluence area and one receiver
was located approximately two kilometers downstream from the mouth of the Methow River.
RESULTS

Field Sampling Results

A total of 13 individual white sturgeon were captured on the set line gear during the two year mark-recapture study. Additionally, five recaptures were recorded bringing the total number of captures events to 18. Of the 18 events, 13 were recorded in 2001 and five were recorded in 2002. Two of the captured fish were classified as juveniles (i.e. less than 90 centimeters fork length)) and the remaining 11 fish were classified as adult. White sturgeon ranged in length from 65 centimeters to 202 centimeters. Twelve of the fish were injected with PIT tags. One fish was not PIT-tagged because it escaped after being measured but before being PIT-tagged. All 18 of the white sturgeon capture events took place within zone 3 near the Okanogan Columbia rivers confluence. Data collected on the 13 individual fish are summarized in Table 1.

<table>
<thead>
<tr>
<th>Fish #</th>
<th>Fork Length (cm)</th>
<th>Pit Tag #</th>
<th>Radio Tag #</th>
<th>Capture Location</th>
<th>Capture Events</th>
<th>Estimated Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>124</td>
<td>3D9.1BF0E220404</td>
<td>3</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>96</td>
<td>3D9.1BF1092483</td>
<td>3</td>
<td>1</td>
<td>7</td>
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<td>133</td>
<td>3D9.1BF0FD31EF</td>
<td>3</td>
<td>1</td>
<td>13</td>
<td></td>
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<td>118</td>
<td>3D9.1BF109F2B9</td>
<td>3</td>
<td>1</td>
<td>11</td>
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<td>5</td>
<td>105</td>
<td>3D9.1BF10916A2</td>
<td>3</td>
<td>1</td>
<td>N/A**</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>65</td>
<td>3D9.1BF10920B9</td>
<td>204-209</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>183</td>
<td>3D9.1BF0E473EF</td>
<td>13-6</td>
<td>3</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>197</td>
<td>3D9.1BF0DCA36A</td>
<td>13-5</td>
<td>3</td>
<td>23</td>
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<td>9</td>
<td>183</td>
<td>3D9.1BF0DD71A</td>
<td>13-7</td>
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<td>26</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>184</td>
<td>3D9.1BF188EAFB</td>
<td>13-4</td>
<td>3</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>202</td>
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<td>204-211</td>
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<td>30</td>
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<td>12</td>
<td>73</td>
<td>3D9.1BF1890404</td>
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<td>2</td>
<td>6</td>
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<tr>
<td>13</td>
<td>90</td>
<td>N/A*</td>
<td>3</td>
<td>N/A*</td>
<td>N/A*</td>
<td></td>
</tr>
</tbody>
</table>

*Fish lost at water surface
**Technicians failed to remove sample

Set lines were placed within the study area at surface water temperatures from 9 C to 25 C and placed in depths from 6 to 45 meters. 129 set lines were fished throughout the study. A total of 83 set lines
were fished in 2001 (June 18 to August 28), and 45 set lines fished in 2002 (June 26 to September 27). 3,060 hooks were placed on the 129 set lines resulting in 72,006 hook hours of effort. Hook CPUE was .025 fish per 100 hook hours (18 capture events / 72,006 hook hours).

A total of 15 set-lines were placed in zone 1, 16 set-lines were placed in zone 2, 68 set-lines were placed in zone 3, and 21 set-lines were placed in zone 4. A minimum of 1 set-line was placed in each of the 16 sub zones. A majority of effort was placed in zone 3 as it was necessary to obtain an adequate sample size for the population assessment and telemetry portion of this study.

Laboratory Results

Population Estimate

The utilization of Program RECAP.GLM provided for the examination and comparison of several versions of the Schnabel population estimate. Due to unequal trapping effort over time, it was determined that the variable capture probability Schnabel Model (Mt) most adequately fit the data compared to the constant-capture Schnabel Model (Mo).

The program provided the ability to examine the residuals associated with the various capture histories (i.e. to determine if certain individual fish were more likely to be encountered due to gear selectivity). Examination of the various capture histories found fish #6 to have significant lack of fit, an indication that the fish was highly susceptible to capture on the set-line gear. White sturgeon #6 was a small juvenile fish that was recaptured three times. Because this fish exhibited capture prone behavior, the recapture information from this fish was excluded from the calculation of the Wells Reservoir population estimate.

With fish #6 not included in the data set, abundance was estimated at N=31.35 and a standard error of 17.51 (Table 2). Factoring in unequal trapping effort over time, the abundance estimate of N=31.35 is suggested to be the most appropriate. The 95% confidence interval for sturgeon abundance was calculated to be CI(13.15 ≤ N ≤ 217.50) =0.95.
Table 2  Modified Schnabel variable capture probability model used to estimate white sturgeon abundance in Wells Reservoir

<table>
<thead>
<tr>
<th>Session</th>
<th>Number Fish Caught (Ct)</th>
<th>Number of Recaptures (Rt)</th>
<th>Number of Fish Newly Marked</th>
<th>Marked Fish At Large (Mt)</th>
<th>CtMt</th>
</tr>
</thead>
<tbody>
<tr>
<td>July of 2001</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Early August 2001</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Late August 2001</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Early September 2002</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Late September 2002</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Totals</td>
<td>14</td>
<td>2</td>
<td>12</td>
<td>32</td>
<td>66</td>
</tr>
</tbody>
</table>

\[ N = \text{Sum (Ct x Mt)} = 66 \]

\[ \text{Population Estimate} = \frac{\text{Sum (Rt)}}{\text{2-Mt Correction factor}} \]

\[ N = 31.35 \]

Physical Data

Ages were estimated for 11 white sturgeon captured during the study. These fish were estimated from 5 years to 30 years, representing the 1972 to 1997 year classes. Three groupings within the age class data are apparent. The first grouping was concentrated between the 1972 to 1978 year classes (Figure 4) and was comprised of five individual fish. The second grouping of three fish took place within the 1988 to 1990 age classes. The third grouping took place from 1995 to 1997 (3 fish).
Two white sturgeon were captured and subsequently recovered to provide growth rate information. One juvenile fish was measured at 65 cm in fork length on July 11, 2001. The fish was again captured on September 26, 2002 and measured 87 cm in fork length. This represented a growth rate of 22 cm in 14 months. One adult fish was captured on August 9, 2001 measuring 197 cm in fork length. The fish was subsequently captured on September 6, 2002 and measured 199 cm in fork length representing a 2 cm growth rate over approximately 13 months. This fish was found deceased in October of 2006 along the west bank of the Columbia River above the town of Brewster. At that time biologists measured the fish at 228.5 cm representing a 29.5 cm increase in length over an approximate four year period, or an average of 7.4 cm of growth per year.

A length frequency histogram was constructed from the white sturgeon length data (Figure 5). Two fish were captured within each of the length slots from 60 to 75 centimeters, 90 to 105 centimeters, 105 to 120 centimeters, and 195 to 210 centimeters. Three fish were captured within the length slot from 165 to 180 centimeters. Catch on the set line gear was dominated by white sturgeon from 60 to 135...
centimeters in fork length, and from 180 to 210 centimeters in fork length. These two age class
distributions accounted for all captures. The histogram showed a relatively low distribution of juvenile
white sturgeon, with 15% of the total catch composed of juvenile fish (i.e. less than 90 cm).

Figure 5  Length frequency distribution for white sturgeon captured by set lines in Wells Reservoir

Radio Telemetry

A total of six white sturgeon were outfitted with radio transmitters (Figure 3). Five of the fish
were mature adults (Fork Length 183cm, 183cm, 184cm, 197cm, and 202cm). One juvenile fish was
tagged measuring 65cm in fork length. Transmitters were not available for this study until August 8, 2001.
At that time the transmitters were administered to the first six captured white sturgeon to ensure a
maximum amount of telemetry data could be obtained from the tagged fish.
Table 3  Telemetry information on six radio tagged white sturgeon released in Wells Reservoir, Washington State.

<table>
<thead>
<tr>
<th>Date</th>
<th>Tag Code</th>
<th>Length (cm)</th>
<th>Zone</th>
<th>Encounters</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/12/01</td>
<td>13-3</td>
<td>65</td>
<td>3</td>
<td>5</td>
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<tr>
<td>8/8/2001</td>
<td>13-6</td>
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<td>8/9/2001</td>
<td>13-7</td>
<td>183</td>
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</tr>
<tr>
<td>9/5/2002</td>
<td>13-4</td>
<td>184</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>11/27/2002</td>
<td>204-211</td>
<td>201</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Encounters were recorded as the initial capture of the fish, recapture of the fish, and telemetry observations. Telemetry observations consisted of vessel recordings and fixed telemetry receiver recordings. Four reservoir surveys were conducted by boat. Three of the surveys were conducted in late summer of 2001 (August 27, 2001, August 28, 2001). One survey was conducted in late summer of 2002 (September 6) and one survey was conducted in late winter of 2002 (November 27). The number of boat telemetry surveys was limited by personnel and budget constraints at Douglas PUD as they owned and operated the vessel. During all 4 telemetry surveys, all white sturgeon were recorded within zone 3. The winter survey conducted in November of 2002 identified all outstanding tagged fish within zone 3 and within 100 meters of one another. No white sturgeon were recorded during the aerial surveys. It was suspected that the aerial antennas would not pick up any of the activated tags as the aerial surveys typically only pick up transmissions from water depths less than 15 meters.

A total of 17 encounters were recorded at the fixed telemetry receiver located approximately 10 kilometers upstream from the mouth of the Okanogan River. These 17 encounters were from three individual mature fish. The first two encounter were recorded from May 19 to June 19 of 2002. Two white sturgeon frequented the area passing upstream and downstream of the fixed receiver. The third encounter was recorded from May 10 to May 24 of 2003. No white sturgeon were recorded near the fixed telemetry receiver at the mouth of the Methow River or the fixed telemetry receiver 2 kilometers downstream from the mouth of the Methow River. Capture histories of the six radio tagged white sturgeon are outlined below:
White Sturgeon 13-3

White Sturgeon 13-3 was a juvenile fish approximately 65 cm in length. The fish was first captured on July 12, 2001 approximately 1 kilometer east of the confluence of the Okanogan and Columbia River (Figure 6). The fish was subsequently captured on the set line gear in the same vicinity on August 8, 2001, August 28, 2001, and September 26, 2002. The fish was tracked by boat telemetry to the west bank of the Columbia River approximately 1 kilometer below the Okanogan River confluence on November 27, 2002. It is possible that the boat telemetry observation may have identified a shed tag as the telemetry signal was coming from a vicinity of the shoreline area.

Figure 6  Telemetry observations for radio tag 13-3, Wells Reservoir, Washington
White Sturgeon 13-6

White sturgeon 13-6 was captured on August 8, 2001 and encountered on 10 separate occasions (Figure 7). This fish was 183 cm long and was initially captured and released approximately 1 kilometer south of the Okanogan-Columbia River confluence area. The fish was then recorded during vessel telemetry transects on August 27, 2001. A majority of encounters were recorded at the fixed telemetry station within the Okanogan River. Telemetry observations of the fish moving through the Okanogan River were recorded on May 19, 2002, June 2, 2002, June 8, 2002, June 9, 2002, June 12, 2002, June 18, 2002 and June 19, 2002. The fish was once again recorded during a vessel telemetry survey conducted within Wells Reservoir on November 27, 2002.

Figure 7  Telemetry observations for radio tag 13-6, Wells Reservoir, Washington
White Sturgeon 13-5

White sturgeon 13-5 was 197 cm in length and was captured and outfitted with a radio transmitter on August 9, 2001. The fish was encountered on seven separate occasions (Figure 8). In the spring of 2002 white sturgeon 13-5 was recorded at the Okanogan River fixed telemetry station on four different dates (May 16, May 29, May 31, and June 3). The fish was again recorded during a vessel telemetry survey conducted on August 1, 2002 approximately 200 meters downstream from the mouth of the Okanogan River. White sturgeon 13-5 was recaptured on September 6, 2002 at which time the radio transmitter was removed. It was assumed the remaining battery life of the transmitter was short and removing the tag would promote the fish’s health. During October of 2006 biologists at Douglas PUD received reports of a white sturgeon washed ashore near the east bank of the Columbia River across from the confluence of the Okanogan River. Upon investigation and PIT tag confirmation, it was determined that fish was white sturgeon 13-5. White sturgeon 13-5 was the second largest fish sampled during this study at 197 cm (very close in length to the largest fish sampled at 202 cm). The cause of death was undetermined. There were no signs of hemorrhaging or heavy parasite loads on the fish.

![Figure 8 Telemetry observations for radio tag 13-5, Wells Reservoir, Washington](Attachment F)
White Sturgeon 13-7

White sturgeon 13-7 was captured and outfitted with a radio transmitter on August 9, 2001. The fish was 183 cm long and was subsequently identified during three vessel telemetry surveys in 2002 (August 8, September 9, and November 27)(Figure 9). During the spring of 2003 white sturgeon 13-7 was recorded at the Okanogan River fixed telemetry site six times within a two week period (May 10, May 14, May 16, May 22, May 23, and May 24).

Figure 9 Telemetry observations for radio tag 13-7, Wells Reservoir, Washington
White Sturgeon 13-4

White sturgeon 13-4 was captured and outfitted with a radio transmitter on September 5, 2002. This fish was 184 cm long. The following day a vessel telemetry survey identified the fish near the mouth of the Okanogan River (Figure 10). The fish was once again identified during the final telemetry survey conducted on November 27, 2002.

![Telemetry observations for radio tag 13-4, Wells Reservoir, Washington](image)
White Sturgeon 204-211

White Sturgeon 204-211 was captured and outfitted with a radio transmitter on September 9, 2002. This fish was 201 cm long. The fish was only recorded one additional time during the final vessel telemetry survey conducted on November 27, 2002 (Figure 11). At that time the fish was recorded within 100 meters of three other tagged fish in the mid-channel of the Columbia River across from the confluence of the Okanogan River.

Figure 11 Telemetry observations for radio tag 13-4, Wells Reservoir, Washington
DISCUSSION

Field Sampling

For the purposes of this study, it was necessary to apply effort in the field to accomplish several objectives. The first objective was to sample an adequate number of individual fish that would provide basic information on population abundance, age class structure, growth, and ecology. An additional objective was the capture and outfitting of an adequate number of white sturgeon with radio tags to provide information on movement patterns and possible spawning migrations or feeding patterns within Wells Reservoir.

Success of this project was contingent upon capturing enough individuals within the population to obtain the primary objectives. Application of the set-line system proved to be a successful capture method for this project. However, set-line placement and retrieval was a time consuming and labor intensive process. A crew of three individuals was necessary to operate the vessel and successfully work the gear. Only four to five lines were set and checked during an average eight hour day. A typical sample week consisted of setting the gear on Monday, checking and resetting on Tuesday and Wednesday and retrieving the gear on Thursday. Therefore, only 12 to 15 set-lines were worked each sample week.

Prior to initiating set-line sampling in June of 2001, the white sturgeon distribution within Wells Reservoir was unknown. In an effort to sample the entire study area and ensure that all locations within Wells Reservoir were surveyed, the reservoir was divided into four zones and further into four sub zones. This provided 16 sampling areas within study area. It was surmised that spreading the gear throughout the reservoir it would increase the chances of capturing white sturgeon, as it was unknown which zone, if any, would be the most productive sampling location.

The goal of the sampling effort was to place set-lines within each of the four main zones. It was believed that white sturgeon densities could be highest within zone 4 as it has been documented that white sturgeon frequent high flow velocities in the tailrace areas of hydroelectric projects (Parsley and Beckman 1994). Zone 4 was heavily influenced by Chief Joseph Dam, and of the 4 sub-zones contained the highest flow velocities. Zones 2 and 3 both contained large tributary rivers with moderate flow velocities that white sturgeon may utilize for feeding or spawning migrations. For the first 2 weeks of sampling activities, no white sturgeon were captured. On July 10, three white sturgeon were captured in zone 3. Subsequently,
two fish were captured on July 11 and one fish was captured on July 12. These fish were also captured in zone 3.

For the remainder of the study all white sturgeon were captured in zone 3. An adequate amount of effort was focused there for the remainder of the study to accomplish the objective of capturing white sturgeon for lab analysis and radio tag application. A smaller but consistent amount of effort was continuously applied to the other zones for the remainder of the project in an attempt to capture fish outside of zone 3.

It may have been possible to more intensively sample zones 1, 2, and 4 during this study. However, an increase in effort within these zones would have resulted in a decrease of effort in zone 3 and ultimately compromised the objective of obtaining adequate sample size. It was also unclear as to whether applying additional effort into the other zones would result in the capture of any white sturgeon within these areas. Within zone 3 a total of 68 sets were placed resulting in the capture of 18 white sturgeon translating into one sturgeon capture per 3.77 sets. A total of 15 sets were placed in zone 1, a total of 16 sets were placed in zone 2, and 21 sets were placed in zone 4. These sets were randomly distributed within each sub-zone. At an average of one sturgeon capture per 3.77 sets as recorded in zone 3, the 15 set-lines placed in zone 1 would have resulted in approximately four white sturgeon captures.

Set-lines have been the primary sampling gear utilized for white sturgeon capture in the Columbia River. However, it should be addressed that the set-line sampling efficiency on sturgeon under 50 cm is greatly reduced (Beamesderfer et al. 1989. Beamesderfer and Rien, 1993). Smaller white sturgeon are not generally susceptible to the larger hook sizes used on the gear. Attempts to decrease hook size during this study resulted in broken hooks. During July of 2001, smaller hooks were placed on the gear and when pulled the next day these hooks were straightened or broken at the shank by larger white sturgeon. Similar results have been encountered on other white sturgeon sampling projects (K. LePla, personal communication). It is therefore assumed that sampling bias of the set-line gear resulted in a misrepresentation of younger year class recruitment. This bias was evident in this study and could be observed by the absence of any white sturgeon captured under 50 cm in fork length.

The gear used in this study was also limited in its ability to capture fish in the larger size categories (e.g. greater than 215 cm). This was evident during the study from the relatively high number of
straightened hooks (11), broken snaps (7) and broken gabions (3). It is difficult to estimate the number of
fish that were lost as it was not possible to determine whether hooks were snagged on the bottom or broken
off by larger white sturgeon. During sampling activities in 2002, smaller hooks on the set line gear were
removed to promote the capture of larger hooked fish. This likely resulted in additional bias towards
hooking large fish in 2002 and overall skewed the data towards intermediate sized fish. Small fish were not
as apt to get hooked due to hook and bait size and very large fish were hooked but not landed due to their
ability to break the set line gear.

The set line CPUE for this study (CPUE = 0.025 fish per 100 hook hours) was similar to that of
other reported CPUE rates for white sturgeon captures in the Mid Columbia (Golder, 2003). Golder
reported 523,204 hook hours of set line sample effort to capture 115 white sturgeon in Wanapum and Priest
Rapids Reservoirs resulting in a CPUE of 0.022 fish/100 hook hours. It appears that set line gear efficiency
observed during this study was similar to that of other white sturgeon monitoring programs within the
Columbia River Region.

The population estimate for the Wells Reservoir (n = 31) was similar to that developed for other
Mid-Columbia River white sturgeon populations (Golder 2003, Golder 2002). In 2001 and 2002, a white
sturgeon survey was conducted within Rocky Reach Reservoir located immediately downstream from
Wells Reservoir (Golder, 2002). During the Rocky Reach study, a total of 24 individual white sturgeon
were captured and four fish were recaptured during two years of sampling activities.

**Population Estimate**

Initially it was hypothesized that white sturgeon would be captured throughout the study area, as
Wells Reservoir has a variety of diverse habitats including two tributary streams and a large section of free-
flowing water for 10 kilometers below Chief Joseph Dam. The study area was divided into zones in an
attempt to ensure that all habitat types were sampled within the study area. White sturgeon were only marked and recaptured in zone 3 making it difficult to determine whether the population estimate pertains only to zone 3 or the entire study area. The absence of any white sturgeon encounters within zones 1, 2, and 4 prohibited statistical analysis between the zones. There are currently no statistical models that enable the analysis of fish populations between locations when no fish are captured within one of the locations (R. Townsend, personal communication).

Absence of fish within the sampled zones indicates one of three possibilities. Either there are no fish in the zones or the location was not sampled enough to capture a very small population of fish within the zone. It is also plausible that white sturgeon may utilize zones 1, 2, and 4 on a limited basis. There are no physical barriers between zones and it is possible that at some time white sturgeon travel out of zone 3. The most probable explanation of movements out of zone 3 would be the seasonal movements of fish into zone 4 for feeding or spawning migrations within the Chief Joseph Tailrace. Dam tailrace areas have been documented as preferred locations for white sturgeon spawning activities, and it is possible that flow velocities within Chief Joseph tailrace attract white sturgeon to spawn during the spring months. The limited telemetry data collected during this study does not support movements into zone 4. However, these movements may not have been documented during this study as vessel telemetry sweeps within zone 4 were limited due to personnel and budget constraints.

Additional evidence that white sturgeon may not utilize zones 1, 2 and 4 (or only utilize them occasionally) is present in the telemetry data. A total of four boat telemetry surveys were conducted (limited by personnel and budget). Three of the surveys were conducted in late summer or fall of 2001 and 2002 and one survey was conducted in the winter of 2002. During the telemetry surveys, no white sturgeon were recorded outside zone 3. The telemetry data shows that white sturgeon probably stay within zone 3 during the winter months as the winter survey conducted in late November verified all outstanding tagged fish were in zone 3 and within 100 meters of one another. It has been documented in similar studies that white sturgeon congregate together during the winter months within the deep water pools (Golder, 2003, North et al. 1993). Additionally, no white sturgeon were recorded passing through zone 2 at the fixed receiver sites near the mouth of the Methow River. This provides evidence that white sturgeon do not utilize or rarely utilize habitats in the lower Wells Reservoir.
When analyzing the white sturgeon telemetry data, it is important to take into consideration that white sturgeon do not spawn on an annual basis. Typically, gravid female white sturgeon spawn every two to five years (Smith 1985). It is possible that during the two year time frame of this study, radio tagged white sturgeon were not recorded moving out of zone 3. Spawning movements of the radio tagged fish may have been limited or these fish simply did not conduct spawning migrations during the study.

A primary assumption for the abundance estimate was that a closed population of white sturgeon existed within the study area. Data collected during the set-line sampling and telemetry tracking surveys supports the assumption of no immigration out of the study area. Throughout the study two fixed receivers were present in zone 2. These receivers should have recorded any radio tag transmissions from radio tagged fish that were tagged in zone 3 and were passing through zone 2 and out of the study area. In regards to upstream migrations out of the study area, white sturgeon cannot pass through Chief Joseph Dam as there is no fish ladder at that project.

Sturgeon migrations into the study area may occur. Migrations of white sturgeon have been documented, and the incidences of white sturgeon passing through hydroelectric projects is highly variable (Hanson et al. 1992, Ward et al. 2003). Wells Dam contains two fish ladders. It is possible that white sturgeon could travel upstream from Rocky Reach Reservoir as a white sturgeon population has been documented in that reservoir (Golder 2002). However, there have been few documented observations of white sturgeon moving upstream through Wells Dam fish ladders by fish counting personnel since dam construction in 1967. The most probable route of immigration into the study area is the passage of juvenile or sub-adult individuals from the upstream Chief Joseph Reservoir. Downstream migrations may be a factor in recruitment within Columbia River white sturgeon populations as these fish historically migrated downstream to the Pacific Ocean. Ward et al. (2003) analyzed movements of white sturgeon between lower Columbia River reservoirs from 1987 to 2002. During this time period, 4,294 white sturgeon were recaptured. A total of six white sturgeon were recaptured in reservoirs above the release site (.13%) and 147 fish were captured below the release area (3.3%). These data indicate that migrations between reservoirs in the Columbia River system are limited. Upstream migrations are rare and downstream migrations may occur at a limited rate. Therefore, movements of white sturgeon from upstream or downstream reservoirs into Wells Reservoir may take place but are probably limited events.
The assumption that each white sturgeon within the study area had an equal chance of capture was violated by fish #6 (a juvenile white sturgeon). The RECAP.GLM program provided analysis of the data and examination of the residuals associated with the lack-of-fit to individual capture histories (Skalski et al. 2005). Examination of these residuals provided information as to whether certain individual white sturgeon exhibited gear selectivity towards the set-lines. The program identified fish #6 as an individual exhibiting gear selectivity towards the set line gear, and therefore the fish was removed from the data set. Fortunately, enough fish were recaptured that a population estimate was possible without using the data from this “capture prone” fish.

Physical Data

Large variances in growth rates were recorded for fish sampled in Wells Reservoir. Related literature has shown similar trends of relatively high growth rates in juvenile white sturgeon compared to adult white sturgeon (Hanson 1992). For this study, one juvenile and one adult white sturgeon were recovered to providing growth data. The small juvenile fish exhibited a high growth rate of 22 cm during 14 months. The adult fish was recorded as only growing 2 cm from August 2001 to September 2002. However, the same fish was found deceased and washed ashore nearly four years later and had grown an average of 7.4 cm per year over the 4 year period. The average growth rate of 7.4 cm per year for this individual fish is consistent with a growth rate of 6.8 cm per year reported in Wanapum Reservoir (Golder, 2003). White sturgeon may exhibit yearly growth fluctuations due to varying environmental variables such as water temperature and food abundance (K. LePla, personal communication).

Presently, fin ray analysis is the most precise method for aging white sturgeon. However, Rien and Beamesderfer (1994) concluded that fin ray analysis to age white sturgeon is not a precise method and determining age for younger individuals is more precise than older individuals. In regards to older aged individuals, assigned ages may underestimate their true age due to crowded annuli. Additionally, some annuli are very small due to environmental variance (e.g. short supplies of prey items during certain years) and may be overlooked by technicians. These factors ultimately lead to discrepancies in age frequencies and year class strengths. For the purpose of this report, sturgeon ages were presented in the form of an exact year class. It should be addressed that ages should be viewed as approximated rather than exact. Fish
aged within one to five years of one another may be from the same age class, with the variance growing larger in older aged individuals.

This effect could be displayed in the data from the population of white sturgeon that are designated within the 1972 to 1978 age classes. Within this time period, five adult white sturgeon were age estimated (one fish from each of years 1972, 1975, and 1978, and two fish from year 1974). It is possible that these fish originated from one or two productive year classes during this time period. Additional studies in the Mid-Columbia have shown strong age classes for these years (Golder 2002, Golder 2003). Within Wanapum and Priest Rapids Reservoirs, Golder (2003) reported that the 1976 age class made up the second largest number of sampled white sturgeon.

In the Golder (2003) study, the highest number of individuals sampled within Wanapum and Priest Rapids Reservoirs were documented to be juvenile white sturgeon from the 1997 age class. Water flows during that spring were the highest on record since the construction of the project in 1961. Golder (2003) suggests that high flow years increase the survival and recruitment of juvenile white sturgeon. Several other studies have documented a positive relationship between white sturgeon year class strength and high flows (Kohlhorst et al. 1991, Miller and Beckman 1995). Three juvenile white sturgeon were sampled during our collection activities in Wells Reservoir and estimated to come from the 1995, 1996, and 1997 year classes. Given the margin for error during fin ray analysis, it is possible that these 3 fish may be from the 1997 age class. Flows through Wells Reservoir were some of the highest on record in 1997 (S. Bickford, personal communication).

All female white sturgeon within a population will not spawn during ideal environmental conditions. However, a certain number of highly gravid white sturgeon will conduct spawning activities during year with such conditions. A combination of high fecundity and inconsistent spawning periods would ultimately result in large year classes. High flows may have produced strong year class recruitment for white sturgeon throughout the mid-Columbia region in 1997. These groups of similarly aged fish present evidence that strong age classes of white sturgeon may have hatched in the mid-Columbia during specific time periods. If these small groups of similarly aged fish represent a few year classes, it is possible that recruitment of white sturgeon within Wells Reservoir is limited by environmental factors such as water temperature, velocity and/or turbidity.
Regional Comparisons

This study was intended to provide an initial assessment of white sturgeon abundance, population structure, and movement patterns within Wells Reservoir. It is difficult to compare the current population to historic populations as no previous data exists on the status of white sturgeon in the study area. However, it is possible to draw inferences when comparing data collected from this project with other regional data. The Wells Reservoir length frequency histogram was compared with data obtained from three regional agencies studying white sturgeon within the Columbia River Region. One histogram was constructed for data assimilated within the Mid-Columbia Region, one histogram was constructed for the Lower-Columbia Region, and one histogram was constructed for a population of white sturgeon studied in the upper Snake River Basin.

The histogram constructed for the Wells Reservoir population of white sturgeon contains a low proportion of juvenile white sturgeon under 90 CM. This is partially a result of the size bias of the long-line gear and the removal of smaller hooks half way through the study. Even though the incidence of juvenile fish was low during the study, the fact that any were captured at all shows that there is recruitment within the Wells Reservoir population either through natural reproduction or immigration from upstream populations.

The Mid-Columbia histogram taken from the Wanapum Pool represents a population of white sturgeon with an age class structure that most resembles the Wells Reservoir population (Figure 12). Two distinct peaks can be identified within both populations. These peaks indicate strong recruitment for white sturgeon from 60 to 105 centimeters and 165 to 195 centimeters, suggesting strong recruitment classes of white sturgeon within the Mid-Columbia in the mid 1970’s, the late 1980’s, and the mid 1990’s. Lepla and Chandler (2001) documented decreased recruitment of white sturgeon upstream of Hells Canyon from 1987 to 1994 that was observed to correspond with a drought that lasted eight consecutive years. Effects of this drought may have impacted white sturgeon populations throughout the Columbia and Snake River basins.

If strong year classes were present throughout the mid-Columbia, white sturgeon in Wells Reservoir may grow faster than those in the Wanapum reservoir. This is demonstrated in the Wells Reservoir length frequency histogram as both peaks are shifted slightly to the right. If the two peaks shown
within each population were from the same age classes then the Wells Reservoir population exhibits a higher growth rate.

Figure 12 Length frequency histogram comparison for white sturgeon captured in Wanapum Reservoir and white sturgeon captured in Wells Reservoir.

The white sturgeon population in Bonneville Reservoir represents a Lower Columbia River population that has been heavily influenced by sport and tribal set line fisheries (Figure 13). There are currently harvest fisheries for white sturgeon within all lower Columbia River reservoirs. Within Bonneville Reservoir, sport anglers are allowed to retain white sturgeon from 107 centimeters to 152 centimeters. The tribal commercial fishery allows for the harvest of white sturgeon from 114 centimeters to 152 centimeters. These management slot regulation are designed to provide for the take of sub-adult sturgeon. The adult segment of the population then provides recruitment within the population. This management strategy results in a steep decline in the number of adult white sturgeon over 100 cm and can be clearly seen in the Bonneville Reservoir length frequency histogram.
Compared to the Bonneville Reservoir population, the Wells Reservoir population contains a higher portion of adult fish and a smaller portion of juvenile fish. Recruitment within the Wells Reservoir population may be occurring at a lower rate. Only two white sturgeon were captured during this study in the juvenile age bracket from under 90 centimeters. The remaining fish were all over 90 cm in length and classified as sub-adults or adults. The Wanapum Reservoir Length Frequency Histogram (Figure 12) also exhibits a high proportion of adult to juvenile ratios. This is further evidence that low recruitment levels are occurring in the impounded mid-Columbia white sturgeon populations.

The Bonneville reservoir data indicate low numbers of adult spawning white sturgeon can provide high levels of recruitment. White sturgeon are extremely gravid, with large females able to disperse from as many as 7 million eggs (Hanson et al. 1992). It may not take a large number of adults to provide adequate levels of recruitment within white sturgeon populations if favorable spawning conditions and environmental conditions exist on a consistent basis, which may be the case in Bonneville Reservoir. It has been well documented that white sturgeon do not spawn each year and oocyte development may take from two to five years (Smith 1985). If environmental factors are not ideal when female white sturgeon have completed oocyte development, these fish may reabsorb the gametes or spawn in unfavorable environmental conditions. This reproductive strategy may benefit the species, as ideal spawning conditions may not occur each year.
Figure 13  Length frequency histogram comparison for white sturgeon captured in Bonneville reservoir and white sturgeon captured in Wells Reservoir.
The Lower Granite – Hells Canyon sturgeon population exhibits a healthy population structure, based on a current stock structure that is dominated by juveniles and contains a wide range of size classes and stages of maturity from immature juveniles to reproductive adults (Figure 14). A steady down slope curve occurs at slot lengths for older fish, evidence of strong stock structure and a wide range of individuals throughout the population. The last sport fishery that was conducted on the population took place in 1970. From 1970 to present a small tribal fishery has occurred on the reservoir, however the impacts of that fishery are not clear at the present time (Everett et al. 2003).

A high incidence of younger aged individuals within the Snake River population can be observed when compared to the Wells Reservoir population. High levels of recruitment exist within the Snake River population, likely a result of ideal rearing conditions and relatively high rates of productivity in that river compared to the Mid-Columbia River. Additionally, Idaho Power has sporadically stocked white sturgeon within the reservoir. Higher water velocity, temperatures and turbidity in Hells Canyon may promote high levels of recruitment within the Snake River sturgeon population.
Length Frequency for White Sturgeon captured by set lines in Snake River, Lower Granite Reach, 1997 to 2002.

Length frequency distributions for white sturgeon captured by set lines in Lake Pateros 2001 to 2002

Figure 14 Length frequency histogram comparison for white sturgeon captured in Wells Reservoir and white sturgeon captured in Lower Granite Reservoir, Snake River Idaho.
Analysis of the length frequency data should be interpreted with caution. The identification of year classes based on fish lengths is highly variable (Rien et al. 1994). Once white sturgeon are over one year old, lengths may not be a good predictor of age. As juveniles age, growth variability and age inaccuracy make it increasingly difficult to correlate environmental conditions with specific year classes, particularly when based on lengths of older fish.

Additional caution should be taken when analyzing the Wells Reservoir white sturgeon population as the length frequency graphs assumed age structure are composed of a very small sample size (n=13). This small sample size may result in inaccuracies or gaps in the presented stock structure. If the sample size were increased, more distinct trends in the population could be observed.

Radio Telemetry

The 7 volt Lotek Micro Coded Fish Transmitters can transmit signals up to 20 meters (M. Vandentillart, personal communication). This range of transmittal may be limited by conductivity of the water and the efficiency of the receivers and antenna. Aerial surveys typically locate radio transmitters within 5 to 10 meters of the water surface. All white sturgeon during this project were captured and recorded during boat telemetry surveys at depths greater than 15 meters. Therefore, it is probable that the transmitted signals from the 7 volt tags were not recorded during the aerial surveys due to poor signal strength transmitted from tags at depths greater than 15 meters.

Boat telemetry surveys were the most productive method for locating activated tags. However, only four boat surveys were conducted (this telemetry gathering procedure was limited by funding and availability of the research vessel). White sturgeon were detected during each survey, often within close vicinity of each other and all within zone 3. Several of these fish were located within depths of over 20 meters, an indication that the receiver and antenna setup on the telemetry vessel was functioning with a high degree of accuracy. The final telemetry survey on November 27, 2003 identified four tagged fish within 100 meters of one another near the mid-Channel of the Columbia River across from the confluence of the Okanogan and Columbia rivers. It is presumed that these four tags were the only active tags (of the six applied tags, one radio tag had been removed from a fish three months prior and one tag was presumed to have been shed). The November 27 survey was the only mobile tracking survey that was conducted during the winter months. There is evidence that white sturgeon congregate in specific areas of the Mid-
Columbia River reservoirs during the winter (Golder Associates, 2003). White sturgeon were located in similar “pods” within Wanapum Reservoir during the winter of 2000 and 2001. Movement information collected on white sturgeon within Priest Rapids Reservoir in the Mid-Columbia indicated white sturgeon were relatively inactive from October to early April, and usually remained in one of four overwintering areas. It is probable that the deep channel of the Columbia River near the Okanogan River confluence is a preferred overwintering location for white sturgeon within Wells Reservoir.

The fixed station telemetry data presented in this report indicates white sturgeon were at the Okanogan River telemetry site during May and June of 2002 and May of 2003. In an attempt to correlate white sturgeon movements with environmental factors, discharge flows and water temperatures were collected near the fixed telemetry receiver in the Okanogan River during the spring of 2002 and 2003. Discharge data were collected from the Okanogan River at the USGS gauging station located near Malott Bridge approximately 8 kilometers upstream from the fixed telemetry site. Water temperature data were not available on a consistent basis for the Okanogan River due to temperature probe malfunction in 2002 and 2003. Intermittent temperature readings for the Okanogan River were obtained from the Colville tribe and Department of Ecology.

Yearly hydrographs for the Okanogan River consist of low flows from September to April, typically under 4000 cubic feet per second (cfs). Peak spring run-off usually occurs in June when flows may range from 16,000 to 20,000 cfs. From mid-May to mid-July of 2002 peak discharges occurred in the Okanogan River. Two radio tagged white sturgeon were present at the site during this peak flow period from May 19 to June 19 (Figure 15). Water temperatures ranged from approximately 11 C to 12.5 C during this time period. In 2003 peak discharges occurred during the first two weeks of June One radio tagged white sturgeon was present at the fixed telemetry site prior to the peak flow period from May 10 to May 24 (Figure 16). Water temperatures ranged from approximately 10 C to 11.5 C during this time period.
Figure 15  Daily mean discharge (cubic feet per second) from May 1, 2002 to July 30, 2002 within Okanogan River taken at Malott Bridge USGS gauging station approximately 8 kilometers upstream from the Columbia River confluence.
White sturgeon movements are often related to spawning and/or feeding activities (Hynes 1978). The presence of white sturgeon within the relatively shallow depths of the Okanogan River (less than 15 meters) provides evidence of these movements. White sturgeon left the vicinity of the site when water temperatures neared 11 to 12°C. Therefore, it is unlikely that white sturgeon frequented the Okanogan River relative to spawning activities. White sturgeon did exit the Okanogan River just prior to the lower egg incubation temperature of 13°C. Radio tagging studies in the Fraser River document gravid fish moving upstream from 11.3 to 16.1 km per day (Hanson et al. 1992). It is possible that white sturgeon may have been leaving the Okanogan River to conduct spawning activities elsewhere in the study area.

White sturgeon may be utilizing the Okanogan River for foraging purposes in the spring. During the high spring flows, large amounts of decayed material and juvenile salmonids are washed out of the Okanogan River, which may include steelhead carcasses and juvenile sockeye (S. Bickford, personal...
White sturgeon may be scavenging on steelhead carcasses, juvenile sockeye or other food sources that are washed downstream during the yearly spring run-off.

Research throughout the Columbia River system has indicated that white sturgeon prefer dam tailrace areas for spawning attempts as these areas contain fast flowing water velocities and suitable spawning habitat (Brannon and Setter 1992, Haynes et al. 1978, Lepla and Chandler 2001, Parsley et al. 1993, Parsley and Beckman 1994). Additionally, changes in hydroelectric facility operations have been documented to effect sturgeon movements in tailrace areas (Auer 1996, Votinov NP and Kas'yanov 1978). Parsley and Kappenman (2000) documented 17 white sturgeon spawning locations on the Snake River. All 17 locations contained high water velocities and were located within five kilometers downstream of hydroelectric projects. It is possible that white sturgeon are migrating out of zone 3 to spawn in or near the tailrace of Chief Joseph Dam. Golder and Associates (2003) observed distinct movements of white sturgeon from over wintering areas upstream to the base of Rock Island Dam within Wanapum Reservoir. These movements occurred during the spawning period in early June, and most fish remained below Rock Island Dam until July.

Chief Joseph Dam heavily influences water velocity and pool levels within Wells Reservoir. All of zone 4 and the upper part of zone 3 within the study area are subject to high water discharges from the project, especially during spring run-off periods. Waters below the tailrace of Chief Joseph Dam are much more heavily influenced by hydroelectric operations than most other dams on the Columbia River due to a narrow river channel that exists there. Water velocities remain high for approximately 15 kilometers below the project and water does not begin to pool within the reservoir until far downstream of the project. This scenario ultimately results in a large section of river that contains high flow velocities and may be suitable white sturgeon spawning habitat.

During this study it was not possible to conclude whether spawning events took place, however it was possible to create a temperature discharge graph and define time periods when white sturgeon spawning events may have occurred within the upper reservoir. A temperature discharge curve was constructed for the upper Wells Reservoir for spring periods in 2002 and 2003. Water temperature and discharge information were obtained from the United States Corps of Engineers for the immediate Chief Joseph Dam Tailrace. Water temperatures from 13 to 18 C that coincide with high spring flows create a
spawning window indicating the most probable time white sturgeon spawning events would occur. Given high water velocities throughout the upper study area, the spawning window is suggested to be appropriate for all areas of the upper reservoir that are influenced by Chief Joseph Dam. This would include the entire section of zone 4 and the upper section of zone 3 near the confluence of the Columbia and Okanogan rivers.

During 2002, the spawning window within the upper reservoir should have taken place from approximately June 25 to July 10 (Figure 17). During this time, period peak discharge occurred from Chief Joseph Dam nearing 20,000 cfs and water temperatures ranged from 13 C to 15 C. The estimated spawning window in 2003 also occurred near the end of June from approximately June 17 To July 8 (Figure 18). Flow velocities were high and water temperatures ranged from 13 C to 15 C.

![Figure 17 Daily average water temperature (C) and daily average discharge (cfs) in Chief Joseph Dam tailrace from May 1 to July 30, 2002. Spawning window represents optimal white sturgeon egg incubation temperature (13 C to 17 C) and high flow velocities.](attachment:F)
White sturgeon were not captured on the set line gear during the spring of 2001 or the spring of 2002 within zone 3. A number of set lines were placed throughout zone 3 from mid to late June of 2001 with no incidence of white sturgeon captures. White sturgeon were only encountered on the set line gear within zone 3 during the summer and fall sampling periods. Golder and Associates (2003) noted low catch rates during the spring and early summer months in mid-Columbia sampling efforts. In Priest Rapids reservoir, no white sturgeon were encountered during sampling efforts during the spring of 2000. However, a total of nine fish were captured during fall sampling of that same year. Lack of captures during the spring periods may indicate white sturgeon are more susceptible to the set line gear during the summer and fall months. Because fish metabolism is related to water temperature, low water temperatures in spring may have inhibited the fish’s feeding response to baits placed on the set line gear.

Low incidences of white sturgeon captures in the spring may also indicate that white sturgeon are utilizing habitats within the reservoir that were not sampled or could not be sampled. During high flow, velocities it was not feasible to place set line gear in the immediate Chief Joseph Tailrace due to dangerous
and turbulent water conditions. It is possible that white sturgeon were present within the Chief Joseph tailrace area and not sampled. The absence of fish captures within zone 3 during high flow events and the presence of high flow velocities in the upper reservoir indicate the possibility that white sturgeon may have traveled out of zone 3 to conduct spawning efforts in or below the Chief Joseph tailrace area.

**Management Implications**

The Schnabel mark-recapture estimate (n=31.35) indicates that the white sturgeon population within Wells Reservoir is composed of a low number of individual fish. This project has verified the presence of a white sturgeon population within Wells Reservoir and future strategies will need to be implemented that will enhance and expand the existing population. Future management objectives should include promoting white sturgeon enhancement and monitoring the effects of these restoration efforts. A larger population of white sturgeon within Wells Reservoir would better withstand variable environmental conditions as a sufficient number of adult spawning individuals would be available to reproduce during productive environmental conditions. Ultimately, strong spawning events during productive environmental conditions should provide recruitment levels that allow the population to exist even during periods of unfavorable environmental conditions (i.e. extended droughts from low snow packs).

Promoting white sturgeon growth within Wells Reservoir will require the collection of brood stock and the culture of juvenile sturgeon. Studies have successfully identified white sturgeon spawning locations throughout the Columbia and Snake Rivers (Anders and Beckman 1993, Parsley and Kappenman 2000, Parsley at al. 1993, Parsley and Beckman 1994). These spawning locations have been discovered through the tagging of mature white sturgeon with radio and sonic tags and the tracking of the fish to spawning sites. Positive verification of spawning sites within Columbia River reservoirs has entailed the use of egg mats (Parsley and Kappenman 2000, Parsley at al. 1993). These mats are deployed downstream of suspected spawning areas to capture eggs or larvae that are dispersed during spawning events.

It is not presently possible to determine whether brood stock could be obtained from the existing Wells Reservoir population. Because the population of fish within Wells Reservoir is relatively low, it may not be feasible to obtain spawners from the existing population. Assuming a population of 31 fish (of which 50% are mature) and a sex ratio of 50% females, there could be up to eight mature females in the
population. However, as white sturgeon females may only spawn every two to five years, it is possible that only one to three females may spawn within Wells Reservoir within a given year. The capture of these ripe females during a limited spring spawning period is highly questionable.

Seven evolutionary significant units (ESUs) for white sturgeon have been defined for white sturgeon on the Pacific Coast of North America. The Columbia River white sturgeon population consists of two ESUs. These two ESUs consist of the Upper Columbia River Population in Canada and the United States and the lower/middle Columbia River in the United States. Because the lower and mid Columbia regions are considered the same ESU, additional options may be available regarding acquisition of brood stock and/or juvenile white sturgeon for stocking purposes. It may not be possible to acquire brood stock from nearby reservoirs within the Mid-Columbia as these populations also contain low numbers of individual fish and similar problems regarding brood stock capture would probably be experienced.

It may be possible to collect white sturgeon within the lower Columbia River for brood stock or transplant purposes. Brood stock could be collected from the lower Columbia River to provide managers with the ability to begin a hatchery supplementation program. Additionally juvenile or adult sturgeon could be trapped within the lower Columbia River and transported for direct release into Wells Reservoir.

Regardless of which future management options is implemented, continued monitoring programs will be vital to evaluate the success of restoration efforts within the study area.
CITED REFERENCES

Anders PJ, and Beckman LG. 1993. Location and timing of white sturgeon spawning in three Columbia River impoundments. Report B. Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam. Final report to Bonneville Power Administration, Portland, Oregon. Pages 47-60.


Cuerrier JP. 1951. The use of fin rays to determine the age of sturgeon and other species of fish. Canadian Fish Culturist 11:10-18.


The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, October 12, 2016, from 10:00 to 11:00 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Douglas PUD will: 1) provide a draft letter to the Federal Energy Regulatory Commission (FERC) to the Aquatic SWG for review, requesting permission from FERC to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal; and 2) determine where and from whom the respective agency support letters should be sent (Item VI-1).

2. Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-1).

3. The Aquatic SWG White Sturgeon Subgroup will: 1) discuss drafting a White Sturgeon Statement of Agreement (SOA) in November 2016; 2) address outstanding action items discussed during the last subgroup meeting on October 4, 2016, including discussing proposed release numbers and fish size at release, with their respective policy representatives; and 3) provide an update on White Sturgeon Subgroup discussions to date during the Aquatic SWG meeting on November 9, 2016 (Item VI-2).

4. The Aquatic SWG meeting on November 9, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. There were no decisions approved during today’s conference call.

III. Agreements

1. There were no agreements discussed during today’s conference call.
IV. Review Items

1. There are no items that are currently available for review.

V. Documents Finalized

1. The Final Douglas PUD 2015 White Sturgeon M&E Report, which was approved by the Aquatic SWG on September 14, 2016, was distributed to the Aquatic SWG by Kristi Geris on October 12, 2016.

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

(John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and asked for any additions or other changes to the agenda. No additions or changes were requested.

The revised draft September 14, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. Aquatic SWG members present approved the September 14, 2016, conference call minutes, as revised.

Action items from the last Aquatic SWG conference call on September 14, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the September 14, 2016, conference call):

- Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) determine where and from whom the respective agency support letters should be sent (Item VI-1).

Andrew Gingerich said Shane Bickford agreed with Steve Lewis’s suggestion to have each Aquatic SWG member agency provide a letter to append to the letter from Douglas PUD supporting the proposal to combine all ASA Annual Reports and deadlines into one submittal. Gingerich said the letter from Douglas PUD is drafted and will be reviewed by Bickford this week. Gingerich added that Douglas PUD may also contact FERC to confirm what is needed to process this request. This action item will be carried forward.

- Douglas PUD will distribute a Doodle Poll to convene a second technical subgroup meeting to further discuss the future of the Douglas PUD White Sturgeon Program (Item VI-3).

Andrew Gingerich distributed a poll following the meeting on September 14, 2016. This will be further discussed during today’s conference call.
• **Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-4).** Chas Kyger provided a summary to Kristi Geris on October 4, 2016, which Geris distributed to the Aquatic SWG that same day. This will be further discussed during today’s conference call, and will also be carried forward.

• **Douglas PUD will investigate the one bull trout acoustic tag located in the Columbia River near the Wenatchee River that has been sending a mortality signal after not moving for 2 days and will provide a summary of data once available (Item VI-5).** Andrew Gingerich provided this update on September 15, 2016, which Kristi Geris distributed to the Aquatic SWG that same day. This will be further discussed during today’s conference call.

2. **White Sturgeon (Andrew Gingerich):**

   **2016 White Sturgeon M&E Update**

   Andrew Gingerich said the 2016 white sturgeon M&E effort was completed on October 2, 2016. He said this recent effort was the second of two 25-day sampling efforts targeting juvenile indexing. He said, during the 50 days of sampling, crews captured more than 720 fish, including 120 fish that appeared to have been recaptured more than once (i.e., some fish were captured twice, three times, and a couple four times, during those 50 days). He said, during the first 25-day session, 240 fish were captured; during the second session, 483 fish were captured. He noted the increase in capture during the second session compared to the first session, and suggested this may be due to having switched to barbed hooks at the advice of the collective PUDs and standardizing capture methodologies. He also noted this may not be the only factor, and additional causes may manifest through the statistical analyses.

   Gingerich said, in addition to the 720 fish, crews also handled more than 12 wild fish. He recalled that, between the two indexing efforts, crews conducted an effort targeting adult wild white sturgeon, as described in the Aquatic SWG September 14, 2016, meeting minutes. Gingerich said the next step is to coordinate with LGL Limited to develop a collaborative report and provide a draft for review to the Aquatic SWG, similar to last year.

   **Brood Year 2016 Wells Hatchery Rearing Update**

   Andrew Gingerich said there are still nearly 12,000 larval-origin fish and more than 3,000 direct gamete-origin fish on station at Wells Hatchery. He said the direct gamete-origin fish will eventually be transported to Chelan Falls. He said Washington Department of Fish and Wildlife (WDFW) is working directly with Chelan PUD on this effort.

   Gingerich said, as of the end of September 2016, there was still high loss in two tanks (i.e., 30 to 60 mortalities per day per tank). He said results from fish health sampling are still pending. He noted the high loss is localized to only those two tanks. He said larval loss in the other three tanks is very low (about 0 to 5 fish per day). He said he expects mortalities to decline further.
through rearing. He said, with nearly 12,000 fish on station and only about 5,000 fish needed to plant, at some point, there may be extra fish beyond program needs.

Jason McLellan recalled that each year, it seems one or two tanks experienced problems with high mortality, and he asked if these are consistently the same tanks. Gingerich said he does not believe so, but would need to confirm. He said, last year, Tank 7 had the high mortality, but this year there are no issues with that tank. He said this year, Tank 8 and Tank 11 have the high mortality rates. He said, in the past, there have never been issues with Tank 11, and he will need to check with regard to Tank 8. He said hatchery staff suggested that the fish brought on station first (earliest arrivals) experience the most issues; however, he is uncertain there are data to support this. McLellan acknowledged there have been surplus fish each year; however, he noted that high mortality in select tanks does have somewhat of a selective effect. He said he is not advocating a large-scale study; rather, he is noting it would be beneficial to determine what the issue is. Gingerich agreed and noted that Douglas PUD is always advocating minimizing loss at every stage of in-hatchery rearing. He said he is not sure what the solution is but is open to ongoing discussions regarding how to decrease losses. He also agreed mortality rates have not created an issue with respect to meeting stocking goals, with surplus fishing being available in each of the last two years.

John Ferguson asked about the fish health results. Gingerich said, typically, results are received in about 1 month. He said it has been that long, and he is surprised he has not yet heard anything. He said, when results are received, he is typically notified immediately. McLellan asked if hatchery staff have increased water temperature yet. Gingerich said yes, the water temperature is currently at 57 degrees Fahrenheit. He said the water temperature was increased early this year due to the ongoing Wells Hatchery Modernization. He said certain wells have been turned on and off as crews work on different sources of water and upgrading the facility. He added that, this year, a different well water source is being used and has warmer ambient water than well water used in the past. McLellan said he believes once fish are on feed, the sooner the temperature is increased, the better. He also acknowledged fish growth is constricted by density, and suggested moving surplus fish off station as early as possible. Gingerich agreed and noted there will be more flexibility in future years as stocking numbers decrease.

Years 5 through 10 Subgroup Meeting Summary
Andrew Gingerich said a subgroup convened on October 4, 2016. He said almost all of the Aquatic SWG representatives participated in-person at Douglas PUD Headquarters in East Wenatchee, Washington, and a few participated on the phone. He said the meeting notes from the subgroup meeting (Attachment B) and an updated white sturgeon population model for the Wells Project (Attachment C) were distributed to the Aquatic SWG by Kristi Geris following the meeting on October 4, 2016. Gingerich said the notes describe what was discussed, but most of the time was spent reviewing Attachment C. He said Jason McLellan and
Chad Jackson (WDFW) reviewed the model and described the different inputs. Gingerich said the blue cells in Attachment C were updated as the subgroup could justify. He said there was a good discussion on every input and, once the subgroup was satisfied with the inputs, the model was run. He said the modeling indicates that hatchery releases beginning in year 2018 (from fish collected in 2017) should target approximately 350 fish being released at 200 grams per fish. He said the subgroup then agreed to review this general agreement with their respective policy representatives, and sometime in November 2016 the Aquatic SWG would develop an SOA for the next 5 years (second half of Phase 1) that is written in a way to allow modifications if there are updates to the available technical information (for example updated M&E results).

Steve Lewis said there was also discussion during the subgroup meeting about the possibility of raising fish size to 300 grams per fish, and he asked if any feedback about this has been received from hatchery staff. Gingerich recalled that Jackson volunteered to have that conversation with hatchery staff. Gingerich added that he agrees with McLellan that 300 grams per fish in-hatchery is probably possible. He noted that these fish would be about 14 inches in length, which may mean higher survival rates and stocking less than 350 fish. John Ferguson asked if fish raised at this growth rate can be released in the wild and sustain or support that same growth rate. McLellan said absolutely, and he provided three examples of fish raised to the 300-gram range surviving at high rates, including: 1) in 2006, Columbia Basin Hatchery releases into Lake Roosevelt released on average at more than 300 grams were physically handled 10 years later, including about 40% of individuals handled on more than one occasion; 2) ten fish held over for public outreach were released at more than 300 grams and eight were later handled (i.e., at least 80% survival); and 3) fish in a radio telemetry study were released on average at more than 240 grams had over 80% survival.

Ferguson asked about discussions on fish origin (direct gamete versus larval). Gingerich said there was some discussion on this topic; however, nothing substantive. He said the subgroup reviewed some of the work of Andrea Drauch-Schreier (University of California, Davis), potential locations, and the recent SOA prioritizing larval-origin fish. He said a more comprehensive discussion on fish origin may be the next step. He said, from a technical perspective and based on what is known about the lack of distinct populations in the hydro system, Douglas PUD believes fish from Bonneville Dam to the Transboundary Reach of the Columbia River are acceptable fish. He said the literature speculates the hydro-system is not old enough to provide differentiation, but fish are more related when reservoirs sampled are geographically closer. He said there is also a gradient of genes and gene flow moving downstream. He said the subgroup also discussed allelic diversity, and that there may be an advantage of fish from the lower Columbia River in this respect. He said, however, not much resolution has been reached on this topic within the subgroup at this point.
McLellan said he has a slightly different perspective on this discussion. He said the subgroup identified larval-origin fish as the priority in the current Wells, Rocky Reach, and Priest Rapids SOAs, and he believed the general consensus was there is no technical justification to move away from that in a new SOA. He said the most uncertainty was regarding the source of those fish and how to proportionally allocate the fish depending on source. Gingerich said he does not disagree with McLellan’s perspective on the discussion. Lewis also agreed with McLellan’s recollection.

Ferguson asked if this discussion is ready for the entire Aquatic SWG, or if it should remain in the subgroup. Bob Rose proposed that Douglas PUD draft a document outlining fish origin options for discussion during the next Aquatic SWG meeting on November 9, 2016. Rose suggested this would clarify the conversation. Gingerich said Douglas PUD can do this; however, he questioned the value of this, suggesting it may create more problems than it solves. He said he believes convening in-person meetings has been very productive, and may be a better option opposed to him writing out options. Rose said he is supportive of whatever is preferred.

McLellan said he believes these discussions are a bit premature, and suggested first reviewing the Rocky Reach and Priest Rapids SOAs. He said those SOAs include lists of viable source populations, as well as support information. He said discussion about proportions is a little premature because the group has not yet been able to source wild larval-origin fish from other areas within the acceptable stretch of the Columbia River Basin other than from Lake Roosevelt. He said he is not advocating against discussing proportional allocation; however, he is not sure how to build that into an SOA when the location is unknown. Rose agreed. McLellan said he thinks the Aquatic SWG will have to operate under the understanding that everyone is okay with any one of the viable locations, and the group will negotiate in good faith where the fish come from. He noted this is from the technical standpoint and added there may also be a policy aspect. He said he requested policy input internally; however, has not yet received feedback. He said, from a technical standpoint, he believes Drauch-Schreier’s work is valid.

Based on these discussions, the Aquatic SWG White Sturgeon Subgroup will: 1) discuss drafting a White Sturgeon SOA in November 2016; 2) address outstanding action items discussed during the last subgroup meeting on October 4, 2016, including discussing proposed release numbers and fish size at release with their respective policy representatives; and 3) provide an update on White Sturgeon Subgroup discussions to date during the Aquatic SWG meeting on November 9, 2016.

3. **2016 Pacific Lamprey Study Update** (Chas Kyger):

Chas Kyger said a summary of Pacific lamprey M&E acoustic- and passive integrated transponder (PIT)-tag data collected to date (Attachment D) was distributed to the Aquatic SWG by Kristi Geris on October 4, 2016. Kyger reviewed Attachment D, noting two lamprey detections in
the Wells Dam tailrace 2 kilometers downstream on river right, two detections in front of the Wells Dam west fishway collection gallery, and one detection in front of the Wells Dam east fishway collection gallery. He also said the most recent query of the PIT Tag Information System (PTAGIS) showed one study fish entered the Entiat River 8 hours after release and was last detected at the upper Entiat River PIT-tag array at river kilometer 37.5. Kyger said Douglas PUD is also in contact with Chelan PUD and, once Chelan PUD data are available, they will be shared with Douglas PUD.

4. **2016 Bull Trout Study Update** (Andrew Gingerich):

   Andrew Gingerich said, similar to last month, crews continue to download data from fixed station arrays. He said September 2016 was a busy month in terms of detections, because fish were leaving the spawning grounds and migrating downstream. He said Douglas PUD is closely monitoring the fixed station arrays and is being careful not to fill up the data banks in the receivers. He said a couple radio tags have been identified that are sending a mortality code. He said Douglas PUD has been updating the U.S. Fish and Wildlife Service (USFWS) when this occurs.

   Steve Lewis asked if those tags sending a mortality signal are retrieved at some point. Gingerich said tags in the tributaries will likely be retrieved; however, locating the tags is not an easy task. He said if the tag is in the deep waters of the Columbia River, they are much more difficult to locate and retrieve. He also questioned how the recovered tag helps support a question in the study plan. He said there is interest in recovering the tag; however, he suspects this will not be possible in every case.

   Lewis asked if WDFW notified USFWS about the recent discovery of a stranding pool in the Wells Reservoir. Gingerich explained he recently emailed Lewis notifying him that WDFW is conducting M&E work in the Twisp River and encountered a stranding pool that often develops seasonally this time of year around the Poplar Flat Campground. Gingerich explained that sometimes river flow is low enough that water in the area goes subsurface and fish become stranded in shallow water pools. He said, this year, there was a number of bull trout discovered in the stranding pool, including some live fish and some dead. He said the dead fish were inspected to determine if they spawned, and the one tagged fish was spawned out (less that ten eggs remained). He said he is uncertain if WDFW notified USFWS. Gingerich reiterated development of this particular stranding pool is fairly common. Lewis asked about a contact person for WDFW, and Gingerich said Charlie Snow (WDFW) is the field manager for that area. Gingerich added that Mark Nelson (USFWS) also has good data on dry reaches in that area as well.
VII. Next Meetings

1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on November 9, 2016, will be held by conference call.

Upcoming meetings are as follows: November 9, 2016 (conference call); December 14, 2016 (TBD); and January 11, 2016 (TBD).

List of Attachments

Attachment A – List of Attendees
Attachment B – Aquatic SWG White Sturgeon Subgroup October 4, 2016, Meeting Notes
Attachment C – Updated White Sturgeon Population Model for the Wells Project
Attachment D – Pacific Lamprey M&E Acoustic and PIT-tag Data
# List of Attendees

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<tr>
<th>Name</th>
<th>Role</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
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<tr>
<td>Kristi Geris</td>
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<td>Chas Kyger</td>
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<td>Dave Robichaud</td>
<td>Observer</td>
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<td>Steve Lewis</td>
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<td>Breean Zimmerman</td>
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<td>Washington State Department of Ecology</td>
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<td>Bob Rose</td>
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<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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Aquatic SWG White Sturgeon Subgroup Model Runs: Refining Stocking Rates in Years 5-10 of White Sturgeon Management Implementation

October 4, 2016
Douglas County PUD, East Wenatchee, WA 98802

Summary:
Members of the Aquatic Settlement Work Group (Aquatic SWG) met to review white sturgeon population model and model inputs at Douglas PUD in East Wenatchee, WA on Oct 4th 2016. The meeting took place from 9:30 am to 12:00 pm. Jason McLellan reviewed model inputs and the setup of the excel model. The model and draft inputs were generally agreed to by all participants with the understanding that our recommendation should be reviewed with policy leads. Our recommendation is attached below as Attachment A.

Attendees:
Attendees included Andrew Gingerich (Douglas PUD), Stephen Lewis (United States Fish and Wildlife), Breean Zimmerman (Washington Department of Ecology), and Jason McLellan (Colville Confederated Tribes). Those participating by WebEx and phone included Donella Miller (Yakama Nations) and Chad Jackson (Washington Department of Fish and Wildlife [WDFW]).

Specifics:
- Jason McLellan reviewed the model and inputs.
- Agreed that starting population using the Jerald estimate had little impact on meeting a target of 1000-1100 adults. As such, starting population kept at 34 fish.
- Agreed that not enough information was available for natural recruitment and if it was occurring it is probably less than an average of 10-20 fish/year. As such, agreed to leave at 0 for this Statement Of Agreement (SOA) development.
- Agreed to assume 5,000 fish would be released in 2017 as a final step to stocking 20,000 in the first of a four year upfront goal. Changed “Hatchery Release Years Beginning” from year 7 to year 8 to reflect 2017 release assumption of 5,000 fish.
- Agreed to model for releasing fish each year for 50 years (notably slightly longer than license term, however recognized that management actions and M&E data will revise schedule so 50 year term was not very important for the purpose of this exercise).
- Agreed to target survival rate of 86% for released fish in their first year at large and therefore target 200 gram fish (estimate of survival is based on Upper Columbia White Sturgeon Recovery Initiative M&E data specific to weight based survival). Agreed that survival after 1 year at large is probably 98% for all subsequent years. A discussion on the value of stocking fish at a higher and lower average weight took place in addition to the logistical considerations when growing larger
and smaller fish. Ideas including different stocking periods to provide a more equal size at release were discussed.

- Agreed on a slot assumption based on Bonneville pool slot (widest slot on Columbia River; 38-54 inches). Agreed on an exploitation rate of this slot of 25% beginning 10 years from start. Noted that the first few years of a fishery using this slot limit would have many more fish in the slot compared to years after 2028, since upfront stocking in years 1-4 are much greater than recommended stocking rates 2018 and beyond. Discussed tribal interest in harvest allotment/rate vs. exploitation rate.

- No changes were made to the “Age and Growth” and “Reproduction”. Discussed challenges between size and age at maturity and the disconnect between average mature fish at ~166 cm compared to 193 cm included in the model. Acknowledged disconnect/assumptions here but did not change.

- Ran Model:
  - Based on modelling, agreed that hatchery releases beginning in year 2018 (collected in 2017) should approximate 350 fish at 200 grams/fish. This would provide 1,163 adults at year 50 and 212 fish a year for total harvest (recreational and tribal) within the slot discussed.
  - Acknowledged that the target of 1,000-1,100 adults would be exceeded after 50 years even with the slot limit and exploitation rates.

- All members acknowledged that many assumptions were being made and that this model would feed into a 5 year SOA. Additional M&E data and improved estimates of survival would feed into improved iterations in subsequent years.

- Finally, a short discussion of fish source, availability, and methods took place. Members agreed to discuss the recommendation included in Attachment A with policy leads as needed and introduce recommended path in subsequent Aquatic SWG calls (October and November). A draft SOA will be prepared as early as November 2016.

**Action Items:**
1. Discuss recommendation with policy leads if appropriate (All members)
2. Discuss logistics of rearing 350 fish to 200 grams with WDFW Fish Husbandry leads (Wells Hatchery; Chad Jackson)
3. Develop memo and distribute updated model to Aquatic SWG (Douglas PUD)
4. Introduce meeting summary (All members)
**Attachment A**

Model inputs and results

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**INPUTS**

**DEFAULTS (Based off Wanapum)**

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**Hatchery releases**

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**survival**

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</table>

<table>
<thead>
<tr>
<th>hatch 1st year survival</th>
<th>hatch 2nd year survival</th>
<th>hatch 2+ survival (same as natural)</th>
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<tr>
<td>0.860</td>
<td>0.980</td>
<td></td>
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<tr>
<td>0.700</td>
<td>0.800</td>
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**Fishing**

<table>
<thead>
<tr>
<th>Annual exploitation rate (of slot)</th>
<th>beginning x years (from start)</th>
<th>min size (fork length)</th>
<th>max size (fork length)</th>
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</thead>
<tbody>
<tr>
<td>0.250</td>
<td>10</td>
<td>97</td>
<td>137</td>
</tr>
<tr>
<td>0.100</td>
<td>5</td>
<td>97</td>
<td>137</td>
</tr>
<tr>
<td>0.200</td>
<td></td>
<td>38 in</td>
<td>54 in</td>
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</table>
### Age & Growth

<table>
<thead>
<tr>
<th>Age 1-5</th>
<th>L inf</th>
<th>k</th>
<th>to</th>
<th>actual age / est age</th>
</tr>
</thead>
<tbody>
<tr>
<td>age 1-5</td>
<td>253.538</td>
<td>0.054</td>
<td>-1.385</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age &gt;5</th>
<th>L inf</th>
<th>k</th>
<th>to</th>
<th>actual age / est age</th>
</tr>
</thead>
<tbody>
<tr>
<td>age &gt;5</td>
<td>253.538</td>
<td>0.054</td>
<td>-1.385</td>
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</table>

<table>
<thead>
<tr>
<th>LCR Values</th>
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<th>Wanapum</th>
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<tbody>
<tr>
<td>2.25E-06</td>
<td>2.25E-06</td>
<td>kg</td>
</tr>
<tr>
<td>3.26</td>
<td>3.26</td>
<td>wt-leng</td>
</tr>
<tr>
<td>4.24</td>
<td>4.24</td>
<td>fl-tl intercept</td>
</tr>
<tr>
<td>1.09</td>
<td>1.09</td>
<td>fl-tl slope</td>
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</table>

### Reproduction

<table>
<thead>
<tr>
<th>p female</th>
<th>female spawning periodicity (yrs)</th>
<th>fem maturity avg size</th>
<th>fem maturity var</th>
<th>age of scenescence</th>
<th>fecundity a</th>
<th>fecundity b</th>
<th>egg-age surv</th>
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</thead>
<tbody>
<tr>
<td>0.500</td>
<td>5</td>
<td>193.0</td>
<td>17.5</td>
<td>100</td>
<td>0.000339</td>
<td>4.050000</td>
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<td>0.000339</td>
<td>0.500</td>
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<td>17.5</td>
<td>100</td>
<td>3.39E-04</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results

<table>
<thead>
<tr>
<th>Year</th>
<th># hatchery juveniles</th>
<th># hatchery subadults</th>
<th># hatchery adults</th>
<th># current cohort</th>
<th># new natural</th>
<th># ♀ spawning/yr (all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>yr 1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>yr 25</td>
<td>2,675</td>
<td>1,481</td>
<td>0</td>
<td>2,675</td>
<td>660</td>
<td>0</td>
</tr>
<tr>
<td>yr 50</td>
<td>2,675</td>
<td>0</td>
<td>1,163</td>
<td>2,675</td>
<td>660</td>
<td>0</td>
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</tbody>
</table>

Harvest / year

<table>
<thead>
<tr>
<th>Year</th>
<th>Harvest</th>
<th>ELER</th>
</tr>
</thead>
<tbody>
<tr>
<td>yr 1</td>
<td>0</td>
<td>82%</td>
</tr>
<tr>
<td>yr 25</td>
<td>212</td>
<td>50%</td>
</tr>
<tr>
<td>yr 50</td>
<td>212</td>
<td>50%</td>
</tr>
</tbody>
</table>

Sturgeon biomass (kg)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Juveniles</th>
<th>Subadults</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>yr 2011</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>yr 2021</td>
<td>50</td>
<td>47</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2031</td>
<td>100</td>
<td>97</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2041</td>
<td>150</td>
<td>137</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2051</td>
<td>200</td>
<td>188</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2061</td>
<td>250</td>
<td>212</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2071</td>
<td>300</td>
<td>267</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2081</td>
<td>350</td>
<td>312</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>yr 2091</td>
<td>400</td>
<td>367</td>
<td>3</td>
<td>0</td>
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<tr>
<td>yr 2101</td>
<td>450</td>
<td>422</td>
<td>3</td>
<td>0</td>
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</table>

Female spawning / yr

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Current Cohort</th>
<th>Hatchery</th>
<th>Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>yr 2011</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>yr 2021</td>
<td>20</td>
<td>18</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>yr 2031</td>
<td>40</td>
<td>36</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>yr 2041</td>
<td>60</td>
<td>56</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>yr 2051</td>
<td>80</td>
<td>76</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>yr 2061</td>
<td>100</td>
<td>96</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>yr 2071</td>
<td>120</td>
<td>116</td>
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<tr>
<td>yr 2081</td>
<td>140</td>
<td>136</td>
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<td>yr 2091</td>
<td>160</td>
<td>156</td>
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<tr>
<td>yr 2101</td>
<td>180</td>
<td>176</td>
<td>4</td>
<td>0</td>
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</tbody>
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Harvest

<table>
<thead>
<tr>
<th>Year</th>
<th>Harvest (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>yr 2011</td>
<td>0</td>
</tr>
<tr>
<td>yr 2021</td>
<td>212</td>
</tr>
<tr>
<td>yr 2031</td>
<td>212</td>
</tr>
<tr>
<td>yr 2041</td>
<td>212</td>
</tr>
<tr>
<td>yr 2051</td>
<td>212</td>
</tr>
<tr>
<td>yr 2061</td>
<td>212</td>
</tr>
<tr>
<td>yr 2071</td>
<td>212</td>
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<td>yr 2081</td>
<td>212</td>
</tr>
<tr>
<td>yr 2091</td>
<td>212</td>
</tr>
<tr>
<td>yr 2101</td>
<td>212</td>
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ELER 82%
## More Inputs

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td><strong>year</strong></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>hatchery releases</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5,044</td>
<td>5,009</td>
<td>5,289</td>
<td>5,000</td>
<td>2,906</td>
<td>20,342</td>
<td></td>
</tr>
<tr>
<td>Priest Rapids</td>
<td>2,101</td>
<td>0</td>
<td>1,717</td>
<td>1,501</td>
<td>1,495</td>
<td></td>
<td>1,363</td>
<td>6,814</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanapum</td>
<td>6,986</td>
<td>0</td>
<td>2,264</td>
<td>5,094</td>
<td>5,007</td>
<td></td>
<td>3,870</td>
<td>19,351</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocky Reach</td>
<td>6,376</td>
<td>137</td>
<td>7,975</td>
<td>4,962</td>
<td>6,492</td>
<td></td>
<td>5,188</td>
<td>25,942</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wells</td>
<td>5,044</td>
<td>5,009</td>
<td>5,289</td>
<td>5,000</td>
<td>5,086</td>
<td></td>
<td>5,086</td>
<td>20,342</td>
<td></td>
<td></td>
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</tbody>
</table>

**Attachment B**
**Number of Juvenile Hatchery White Sturgeon Released**

<table>
<thead>
<tr>
<th>Release Year</th>
<th>Priest Rapids</th>
<th>Wanapum</th>
<th>Rocky Reach</th>
<th>Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2,101</td>
<td>6,376</td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>0</td>
<td>137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1,717</td>
<td>2,264</td>
<td>7,975</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>1,501</td>
<td>6,376</td>
<td>5,044</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>1,495</td>
<td>6,492</td>
<td>5,009</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td>5,289</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>6,814</td>
<td>19,351</td>
<td>25,942</td>
<td>15,342</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>1,363</td>
<td>3,870</td>
<td>5,188</td>
<td>5,114</td>
</tr>
</tbody>
</table>

In 2012, no hatchery releases due to fish health (WSIV) concerns
In 2013, Wanapum releases were “prorated” commensurate with available genetic diversity in hatchery
In 2014, per FF agreement, Rocky Reach releases were prorote commensurate with available genetic diversity in hatchery

**White Sturgeon Population Estimates**

<table>
<thead>
<tr>
<th>Origin</th>
<th>Priest Rapids</th>
<th>95% CI</th>
<th>Wanapum</th>
<th>95% CI</th>
<th>Rocky Reach</th>
<th>95% CI</th>
<th>Wells</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRITFC</td>
<td>1,495</td>
<td>5,009</td>
<td>6,492</td>
<td>5,009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>1,363</td>
<td>3,870</td>
<td>5,188</td>
<td>5,114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CRITFC juvenile hatchery White Sturgeon released into Rock Island Reservoir and have migrated downstream into the PRPA.
None of these fish are present in Rocky Reach or Wells reservoirs.

**Useful instructions/explanations**

From Larry Hildebrand (highlighted text are notes and/or additions from C2):

- The reason you do not see the difference in the peak adult numbers is because that final peak (of the group at 25 years from 2015 or at 2060) is totally driven by the cumulative numbers of fish stocked in the past five years (aka post front leading phase fish) that all become adults in 25 years. The much lower stocking rates of 300 fish per year after 2016 are not enough to offset the mortality from the existing adult population and the total adult (black) line trends downward (as in your example). If you increase the stocking rate to 500 fish, however, the trend line continues to increase after the first 25 years as shown below, and then declines after 50 years since after 25 years at 500 fish/year, stocking rates are reduced to 300 fish per year.

- Future hatchery stocking (aka post front leading; considered to occur in 2016) can either increase adult abundance, keep it stable, or reduce it because stocking numbers are not enough to offset adult natural mortality. Sturgeon stocked beginning in 2016 first become adults in 2041.

- Peak adult abundance in model runs occurs between the 25 and 50 year mark (2035 to 2061).

- After 2061, the model ends hatchery stocking (default setting) and the modeler must either let the population naturally decline between 2061 and 2101 (the 51 and 100 year marks) or arbitrarily select a natural recruits value to either slow the decline, stabilize, or increase the adult abundance as represented in the graph. It’s “recommended” to find the natural recruits value that essentially stabilizes the adult abundance.

If you stock 500 fish per year for 50 years, the population stabilizes as per the output below.

Keep in mind the output is adults that are set at a 25 year maturity cycle so the first set of inputs in the model used here are for the first 25 years and the next set is for the subsequent 25 years. The stocking rates and the durations can be changed in either of these input sets but the adult numbers are determined by how many fish survive to age 25.
### Inputs

<table>
<thead>
<tr>
<th>Model Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Starting Pop</td>
<td>34</td>
</tr>
<tr>
<td>Pop Est</td>
<td>current wild juveniles/yr</td>
</tr>
<tr>
<td>Year Supplementation Commences</td>
<td>x years</td>
</tr>
<tr>
<td>Natural Recruitment</td>
<td>current wild juveniles/yr</td>
</tr>
<tr>
<td>Hatchery Releases</td>
<td>hatchery juveniles/yr</td>
</tr>
<tr>
<td>Life Stages</td>
<td>subadult age</td>
</tr>
<tr>
<td>Survival</td>
<td>adult age</td>
</tr>
<tr>
<td>Fishing</td>
<td>Annual exploitation rate (of slot)</td>
</tr>
<tr>
<td>Age &amp; Growth</td>
<td>age 1-5</td>
</tr>
<tr>
<td></td>
<td>age 6+</td>
</tr>
<tr>
<td>Reproduction</td>
<td>p female</td>
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</table>

### Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Current Cohort</th>
<th>New Natural</th>
<th>Spawning/Yr (All)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hatchery Juveniles</td>
<td>0</td>
<td>1,481</td>
</tr>
<tr>
<td></td>
<td>Hatchery Subadults</td>
<td>0</td>
<td>660</td>
</tr>
<tr>
<td></td>
<td>Hatchery Adults</td>
<td>0</td>
<td>1,163</td>
</tr>
</tbody>
</table>

### Harvest

<table>
<thead>
<tr>
<th>Year</th>
<th>Current Cohort</th>
<th>New Natural</th>
<th>Spawning/Yr (All)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>212</td>
<td>212</td>
</tr>
</tbody>
</table>

### Other Parameters

- **Note:** This is a snapshot of the model for the purpose of inclusion in this annual report. This model was used as a tool to estimate Wells Project releases survival information, and model outputs vary depending on inputs.
Hi Aquatic SWG: please see the email below from Chas regarding a Douglas PUD 2016 Pacific Lamprey Study update. Thanks! –kristi 😊

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

Hi Kristi,

Please distribute the brief update below on the 2016 Lamprey Approach, Passage, and Enumeration Study to the Aquatic SWG.

2016 Lamprey Approach, Passage, and Enumeration Study Update (Acoustic Receiver Download 9/26/16, PTAGIS 10/4/16)

So far 5 of the 51 acoustic tagged lamprey released above Rocky Reach Dam on 8/20/16 have been detected on DCPUD deployed acoustic receivers in the Wells Dam Tailrace. The most recent download of the acoustic receivers occurred on 9/26/15.

Most Recent Detections:

Wells Tailrace 2km Downstream River Right - 2 lamprey
Front of West Fishway Collection Gallery – 2 lamprey
Front of East Fishway Collection Gallery – 1 lamprey

Also, recall that all acoustic tagged lamprey were also PIT tagged. The most recent query of PTAGIS (10/4/16) showed that one of the study lamprey entered the Entiat River 8 hours after release on 8/21/16 and was last detected 8/28/16 at the upper Entiat River PIT Array at rkm 37.5. No other study fish have been detected on mainstem dam or instream PIT arrays to date.
If you have any questions let me know. I’m also happy to discuss this update in more detail during the call next week.

I’ll be sure to provide another update as additional data comes in.

Chas

Chas Kyger
Aquatic Resource Biologist
Douglas County PUD
(509) 881-2388
Final Conference Call Minutes

Aquatic Settlement Work Group

To: Aquatic SWG Parties

From: John Ferguson, Chair (Anchor QEA, LLC)

Date: December 14, 2016

Re: Final Minutes of the November 9, 2016 Aquatic SWG Conference Call

The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, November 9, 2016, from 10:00 a.m. to 12:15 p.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-1).

2. Anchor QEA and Douglas PUD will discuss Aquatic Settlement Agreement (ASA) Annual Report deadlines, including the feasibility of providing a draft report (with the Draft Water Temperature Report and draft ASA resource management plan annual reports appended, including aquatic nuisance species, bull trout, Pacific lamprey, resident fish, water quality, and white sturgeon), for Aquatic SWG review by March 15 (Item VI-3). (Note: Anchor QEA and Douglas PUD discussed and agreed on an annual report production schedule, which includes providing the annual report, plus the discussed management plan reports, to the Aquatic SWG for a 45-day review on March 21. This schedule also accommodates all necessary internal drafting and review periods, discussion during the Aquatic SWG meeting on April 12, approval during the meeting on May 10, and submittal to the Federal Energy Regulatory Commission [FERC] by May 31, 2017.)

3. Once ASA Annual Report deadlines are verified, Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) coordinate obtaining agency support letters, as necessary (Item VI-3).

4. Douglas PUD will provide a Draft White Sturgeon Stocking Statement of Agreement (SOA) to Kristi Geris for distribution to the Aquatic SWG prior to the Aquatic SWG meeting on December 14, 2016 (Item VI-4). (Note: Andrew Gingerich provided a draft SOA on December 2, 2016, which Geris distributed to the Aquatic SWG Technical Representatives that same day.)

5. Douglas PUD will arrange for an Aquatic SWG in-person meeting on January 11, 2017, including coordinating a fishway tour at Wells Dam (Item VI-5).
6. Bob Rose will provide the Draft Pacific Lamprey Supplementation Plan to Kristi Geris for distribution to the Aquatic SWG (Item VI-5). *(Note: the draft plan was provided to Geris on November 11, 2016, which Geris distributed to the Aquatic SWG on November 14, 2016.)*

7. Bob Rose will inquire internally and with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Nez Perce regarding possibly presenting on current Pacific lamprey translocation efforts during the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-5).

8. Douglas PUD will provide a revised bull trout mortality summary to U.S. Fish and Wildlife Service (USFWS), and copy Kristi Geris for distribution to the Aquatic SWG (Item VI-6). *(Note: Andrew Gingerich provided the revised summary to Geris following the meeting on November 9, 2016, which Geris distributed to the Aquatic SWG that same day.)*

9. The Aquatic SWG meeting on December 14, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. There were no decisions approved during today’s conference call.

III. Agreements

1. There were no agreements discussed during today’s conference call.

IV. Review Items

1. There are no items that are currently available for review.

V. Documents Finalized

1. There are no documents that have been recently finalized.

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items
(John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and asked for any additions or other changes to the agenda. Bob Rose added an update on Pacific lamprey regional coordination.

The revised draft October 12, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. Aquatic SWG members present approved the October 12, 2016, conference call minutes, as revised.
Action items from the last Aquatic SWG conference call on October 12, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the October 12, 2016, conference call):

- **Douglas PUD will**: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) determine where and from whom the respective agency support letters should be sent (Item VI-1).
  
  This will be discussed during today’s conference call.

- **Douglas PUD will provide a summary of Pacific lamprey M&E acoustic data collected to date as soon as those data are downloaded** (Item VI-1).
  
  This will be discussed during today’s conference call and will be carried forward.

- **The Aquatic SWG White Sturgeon Subgroup will**: 1) discuss drafting a White Sturgeon SOA in November 2016; 2) address outstanding action items discussed during the last subgroup meeting on October 4, 2016, including discussing proposed release numbers and fish size at release, with their respective policy representatives; and 3) provide an update on White Sturgeon Subgroup discussions to date during the Aquatic SWG meeting on November 9, 2016 (Item VI-2).
  
  This will be discussed during today’s conference call.

2. **PRESENTATION: Zebra and Quagga Mussel Shoreline Surveys** (Richard Visser): Richard Visser (Washington Department of Fish and Wildlife [WDFW]) shared a presentation titled, “Adding Shoreline Surveys for Zebra/Quagga Mussel Early Detection Monitoring,” (Attachment B), which was distributed to the Aquatic SWG by Kristi Geris following the meeting on November 9, 2016.

Visser provided an overview of early detection zebra and quagga mussel monitoring, which is conducted from May to October. Monitoring sites include areas with high potential for introduction of zebra and quagga mussels, such as aquatic recreational areas. Regions with abundant calcium are also monitored because these areas promote shell growth in zebra and quagga mussels. Mussel monitoring typically involves deploying plankton tows and artificial substrate (the latter monitored only during high-frequency boating events), and collecting water quality samples. These monitoring activities are a coordinated effort among tribal, state, and federal agencies, including Douglas, Chelan, and Grant PUDs. Mussel monitoring sites are more prevalent in Eastern Washington due to the availability of staff dedicated to the project in this area. Visser said WDFW is now encouraging agencies to conduct shoreline surveys, which are proven to be effective and cost effective. In 2016, Douglas PUD conducted two shoreline surveys at three sites, which contributed to the monitoring effort and only required an additional 60 minutes to normal survey time.

John Ferguson asked if WDFW is asking Douglas PUD for additional support or thanking them for their contributions. Visser said WDFW definitely thanks Douglas PUD, but is also asking to implement additional shoreline surveys into their current monitoring efforts. Chas Kyger noted that Douglas PUD did conduct an additional survey in early-October 2016 and will gladly
continue conducting additional surveys. He agreed the effort is minimal and simple to accomplish. Visser said WDFW appreciates it.

Ferguson asked if data collected in Washington State indicate zebra and quagga mussel populations are expanding. Visser said zebra and quagga mussels have not been detected in Washington State, but WDFW is working to build a database that includes reports of several aquatic invasive species. Patrick Verhey asked, in general, if zebra and quagga mussels are spreading and if there is an elevated level of concern compared to past years. He also asked what climatic changes encourage spreading of zebra and quagga mussels. Visser said increased calcium into water systems may be one factor that encourages spreading. Ferguson said he thought zebra mussels were sampled on recreational boats coming into Washington from Idaho. Visser said zebra and quagga mussels have been detected nearby Washington State. He said at WDFW check stations, about 14 of 3,000 boats inspected were carrying aquatic invasive species of some sort, including plants. He said the amount coming in is not large, but the potential is still there.

3. ASA Report Consolidation Discussion and Update (Andrew Gingerich): Andrew Gingerich said he spoke with Shane Bickford, who suggested packaging the resource management plan reports together with the ASA Annual Report, including the Water Temperature Report (typically filed April 30) and the Aquatic Nuisance Species Management Plan Report (typically filed April 1). Gingerich said this would entail requesting from FERC and the Washington State Department of Ecology (Ecology) to move the deadlines for two reports, and submitting the entire package on May 31. He said this will require fewer review deadlines for the Aquatic SWG and hopefully streamline the process.

John Ferguson asked if the management plan reports would be appended to the ASA Annual Report. Gingerich said that is correct, and this is consistent with how the reports are filed with FERC, as well. He said the Aquatic SWG will then have a comprehensive package and can choose where to focus their review. Bob Rose noted the difficulty in reviewing every document, and suggested developing a summary document highlighting the controversial issues. Gingerich said most controversial issues will have already been discussed throughout the year, as documented in the meeting minutes, and the annual reports are more a summary of discussions. He said he could provide a narrative highlighting what to find and where. Rose said anything to help speed up the review but still cover ground would be helpful. Steve Lewis also noted that the introduction summaries in reports typically highlight hot topics.

Ferguson asked about the feasibility for Douglas PUD and Anchor QEA to complete all report writing in time to meet a May 31 deadline. Patrick Verhey also recalled one reason behind combining the reports was to reduce redundancy in reviewing different reports. He said it is also important to ensure adequate time for review and discussion within the workgroup before the final reports are due. Gingerich suggested providing a comprehensive draft for review by
March 15. Ferguson said this would allow discussion during the April meeting, approval during the May meeting, and submittal by May 31. Anchor QEA and Douglas PUD will discuss ASA Annual Report deadlines, including the feasibility of providing a draft report (with the Draft Water Temperature Report and draft ASA resource management plan annual reports appended, including aquatic nuisance species, bull trout, Pacific lamprey, resident fish, water quality, and white sturgeon), for Aquatic SWG review by March 15. (Note: Anchor QEA and Douglas PUD discussed and agreed on an annual report production schedule, which includes providing the annual report, plus the discussed management plan reports, to the Aquatic SWG for a 45-day review on March 21. This schedule also accommodates all necessary internal drafting and review periods, discussion during the Aquatic SWG meeting on April 12, approval during the meeting on May 10, and submittal to FERC by May 31, 2017.)

Breean Zimmerman asked if Douglas PUD is suggesting including the Total Dissolved Gas Abatement Plan Annual Report and Water Temperature Report in the ASA Annual Report. Gingerich clarified only the Water Temperature Report would be included with the ASA Annual Report, and the Total Dissolved Gas Abatement Plan Annual Report will be submitted separately (by February 28). Zimmerman said she does not foresee any issues with this.

Once ASA Annual Report deadlines are verified, Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) coordinate obtaining agency support letters, as necessary.

4. **White Sturgeon (Andrew Gingerich):**
   **Brood Year 2016 Wells Hatchery Update**

Andrew Gingerich said Wells White Sturgeon Fish Health Reports 217 and 218 (Attachments C and D) were distributed to the Aquatic SWG by Kristi Geris on November 8, 2016. Gingerich said fish were negative for White Sturgeon Iridovirus (WSIV). He said, although fish tested negative for WSIV, they must have had a fungus or another ailment. He recalled that fish health in two tanks was not good; however, following transfers, grading, and treatment, fish are responding well. He said there are still more than 8,000 fish available to meet the 5,000 fish required to be released this year. He said WDFW hired a new pathologist, and there are plans to sample more fish.

**White Sturgeon SOA Development (Stocking Next 5 Years)**

Gingerich recalled the white sturgeon subgroup having good discussions about a month and a half ago, and the action item for the subgroup members was to review these discussions with their respective policy representatives, if necessary, before drafting an SOA. Gingerich said he had a good conversation internally, and Douglas PUD believes these discussions are moving in a good direction. He said he is interested in hearing other feedback.
Jason McLellan said the Colville Confederated Tribes (CCT) are supportive of the numbers from the modeling side, and fish being sourced through a WDFW effort in the Lower Columbia River (Zone 6), as well as other collection efforts in Lake Roosevelt and other Mid-Columbia pools, as needed. Patrick Verhey said he has not yet discussed this with Chad Jackson (WDFW). Verhey said he believes Jackson is also discussing this with Jeff Korth (WDFW North Central Regional Fish Program Manager). Breean Zimmerman said Ecology has no comments.

Bob Rose asked if there is an SOA to consider at this point. Gingerich said there is no SOA yet; however, there is an outline of what might go into an SOA, based on modeling. He recalled the general agreement around targeting an adult population within the Wells Reservoir, based on healthy adult fish upstream of the Bonneville Pool, scaled according to surface area, which equals about 1,100 adults. He said this translates into about 325 fish to be stocked at a weight of 200 grams each. He said assumptions for harvest were discussed, and general support for larval-origin fish was expressed. He said the action was to discuss these points with policy representatives to obtain feedback. Rose said the Yakama Nation (YN) has no comments at this point and looks forward to reviewing an SOA.

Steve Lewis asked if the Aquatic SWG plans to use the Rocky Reach Fish Forum or Priest Rapids Fish Forum white sturgeon SOA templates. McLellan suggested the Aquatic SWG create their own SOA. John Ferguson agreed, noting he saw no reason to use another forum’s template. Ferguson also recalled discussing leaving the source topic vague and flexible, with everything adjustable depending on M&E data throughout the next couple years. Gingerich agreed with Ferguson and also agreed with McLellan about the Aquatic SWG creating their own SOA. Gingerich said he reviewed the Grant and Chelan PUD white sturgeon SOAs and believed they were fairly lengthy. Gingerich said he would like to keep the Douglas PUD SOA short, concise, and less complicated. McLellan agreed and suggested only including stipulations of the agreement and leaving out unnecessary background information. Lewis agreed simple is better in this case. Douglas PUD will provide a Draft White Sturgeon Stocking SOA to Kristi Geris for distribution to the Aquatic SWG prior to the Aquatic SWG meeting on December 14, 2016.

(Nota: Gingerich provided a draft SOA on December 2, 2016, which Geris distributed to the Aquatic SWG Technical Representatives that same day.)

5. Pacific Lamprey

2016 Pacific Lamprey Study Update (Chas Kyger): Chas Kyger said no downloads have been obtained from acoustic receivers since late-September 2016; however, there are plans to obtain another download from the Wells Dam tailrace during the next few weeks. Kyger said he spoke with Grant PUD and Blue Leaf, who indicated that since the last update, one acoustically tagged study fish tagged and released at Priest Rapids Dam had been detected in the Wells Dam tailrace. Kyger said four study fish were also detected on receivers 2 miles downstream of Wells Dam; however, these fish were not detected on Wells Dam tailrace receivers. He said passive integrated transponder (PIT)-tag data indicate no detections other than the one fish
detected entering the Entiat River the day of release. He said, to date, only one PIT-tagged lamprey has passed Wells Dam, which was tagged by Chelan PUD in August 2016. Andrew Gingerich summarized the available data from 2016 by saying, to date, five acoustically tagged study fish had been detected in the Wells Dam tailrace or the area just downstream from the tailrace.

Bob Rose asked if any acoustically tagged study fish have passed Wells Dam, and Kyger said none have passed the dam. Steve Lewis asked about the behavior of the fish in the tailrace (e.g., moving in and out or holding). Kyger said it appeared some fish had been detected outside of the fishway entrances but had fallen back and were last detected on receivers farther downstream. Lewis asked if this could be related to the reduced head differential in the adult fish ladders (lamprey operations), and Kyger said operations were in a normal configuration this year. He recalled that 2 years ago, after the passage efficiency studies, Douglas PUD determined there was not enough evidence to suggest continuing the reduced head differential (from 1.5 feet [high] to 1 foot [moderate]). He said, additionally, the study objectives shifted from evaluating how fish pass the fishway to how (and whether) fish approach the dam. He said Douglas PUD may revisit how lamprey are behaving within and passing the fishways and count stations once sample sizes are adequate for such studies (i.e., when more fish are approaching the dam). John Ferguson noted that change to the head differential will also need to be approved by the Wells Habitat Conservation Plan Coordinating Committee and Kyger agreed. Kyger said, this year, Douglas PUD was focused on approach numbers and behavior and did not incorporate fishway and dam passage variables into the study design. He said the focus was on evaluating the assumption that fish are attempting to pass, which so far, only a small proportion have come close to Wells Dam. He also pointed out that, in past Grant PUD studies, some fish were detected in late spring of the following year, which could be expected this spring.

Ferguson asked about detections at the low-level entrance. Kyger recalled installing a lamprey entrance box at the low-level entrance to provide a low-velocity entrance to the fishway for lamprey and said there have been no PIT-tag detections there so far. He also recalled installing an acoustic receiver in the collection gallery; however, he was skeptical how well the receiver would perform at that location due to noise. He said tag testing indicated good detection efficiency with test tags, but there have not been any detections of study fish there yet.

Pacific Lamprey Regional Coordination Update (Bob Rose):

Part I: Lamprey Passage Studies

Rose said his comments are not intended to be a criticism; however, he believes the current approach to studying lamprey passage at Wells Dam is too incremental and suggested changing to something more comprehensive. He recalled holding a joint Chelan and Douglas PUDs discussion a couple of years ago and suggested doing this again. He said there are critical uncertainties, which fall under adaptive management under Chelan and Douglas PUDs’ licenses.
He said this approach cannot continue happening, and the YN is going to start advocating that more actions be implemented.

Gingerich suggested keeping in mind constraints and noted that the best time for fishway maintenance is during the annual winter outage in December and January, which is now. He said, having said that, he does not know how to conduct a study of passage at Wells Dam similar to 2013, while at the same time violating the assumption that some number of fish are actually wanting to migrate upstream past Wells Dam. He said the small sample size of fish wanting to pass the dam will make testing dam passage, or the effectiveness of a fishway modification, difficult, if not impossible. He said he thinks it would be valuable to revisit the translocation concept that Rose and Patrick Verhey have mentioned. Gingerich questioned whether the passage issue is actually an attraction issue. He said there may not be enough fish in the Methow Basin to have measurable counts like those that occurred in the past. He suggested producing data from this year, including the most recent download and Chelan PUD receivers, to report what happened to Douglas PUD’s study fish. Ferguson asked about timing for a report. Kyger said Douglas PUD plans to download data in the next couple of weeks. He said, however, Blue Leaf indicated the tags were programmed to go into sleep mode during the winter months, so no downloading of receivers would occur again until spring 2017. Kyger said Douglas PUD can still monitor the immediate tailrace. He also suggested keeping in mind potential springtime movement as observed in the past, and discussing a strategy in the meantime.

Ferguson asked if Rose is suggesting holding another workshop like the one held on June 8, 2016. He asked about the purpose of such a workshop and asked if it is to inform next year’s study plans. He asked when it should be held, and if it should follow an in-person meeting. Gingerich suggested holding an in-person meeting at Wells Dam in December 2016 or January 2017. He said Douglas PUD could provide a refresher on modifications and present data to date following the final 2016 download from acoustic receivers, perhaps including Blue Leaf and Chelan PUD data. Lewis said an in-person meeting is a great idea and said he is willing to help with salvage activities to see if lamprey are overwintering in the fishways. Ferguson asked about timing of the ladder outage. Gingerich said, typically, one ladder is offline for a 2-week period in December, then the other ladder is offline for a longer outage, and this schedule rotates each year. He said there is a good chance one ladder will be offline in early-January; however, dates shift year-to-year. He said a more definitive schedule will be available in the next week or so.

Ferguson summarized the next steps, based on these discussions, include obtaining available data and bringing different perspectives to the discussion. He said, in terms of modifying the fish ladder, Douglas PUD needs to evaluate enumeration efficacy at the lamprey passage structure at the count windows. He asked, beyond that, where the lamprey evaluation topic is headed. He suggested pheromone research and translocation have been raised as possible
hypotheses to test and actions to take to increase the number of lamprey wanting to pass the dam. He said part of next year’s study could be looking in greater detail at what is going on in the reservoir downstream of Wells Dam. He said this could entail multiple study components and suggested that meeting in-person, in addition to the monthly Aquatic SWG meetings, may be worthwhile. Rose agreed and re-emphasized he believes the effort needs to be more aggressive. He said the early Dual-Frequency Identification Sonar (DIDSON) lamprey passage studies conducted by Douglas PUD suggest accessing the fishways is possibly an issue, as is remaining in the fishway. He said he is glad to hear there may be an opportunity to cut through the fishway noise issue with acoustics. He suggested a hydraulic modeling exercise may be needed to determine what the fishway entrances look like in the eyes of lamprey and determine if the entrances may need to be modified. He encouraged the workgroup to think about every potential hypothesis and suggested maximizing information gained from one tagged fish instead of an approach where one type of tag is used to try to answer a single question. Gingerich said fishway modifications, in general, are definitely on the table, provided they are a data-driven finding. He said Douglas PUD is committed to addressing project effects. He also added that the DIDSON data was not too convincing, based on sample size, and Rose agreed.

Ferguson asked if Chelan PUD should be invited to the in-person meeting in January 2017. Rose suggested keeping this discussion within the Aquatic SWG for now, and if there is impetus to involve Chelan PUD, arrangements can be decided at that time. The Aquatic SWG expressed general agreement to this suggestion. Douglas PUD will arrange for an Aquatic SWG in-person meeting on January 11, 2017, including coordinating a fishway tour at Wells Dam.

Part II: Translocation

Rose said he believes translocation has a scientific benefit. He said surveys indicate a decline in the lamprey population in the Methow Basin, and Wells Dam may be involved with this. He said he believes translocation needs to be considered and advocated for further discussion in January 2017 to determine how to implement this and how to coordinate with downstream dams. Ferguson asked about the YN Pacific Lamprey Supplementation Plan, which included translocation, that was discussed earlier in 2016. He suggested it may be useful for the Aquatic SWG to review and understand what plans the YN and/or the CCT have for upper basin. Rose said the draft plan was submitted to the Bonneville Power Administration several months ago, and he intended to also distribute the plan to the Aquatic SWG. He apologized, explaining this was a complete oversight. He said comments were received on the draft plan and the YN is responding to those comments to submit to the Independent Scientific Review Panel. He said, in general, the YN is focusing primarily on the Yakima Basin for the artificial propagation program. He said the program will be fairly expensive (to release fish and find them again). He said the optimal methodology for finding these fish is still uncertain and added that it takes a few years for fish to grow large enough to net them. He said details about the artificial propagation program are still under discussion. He said he believes the CCT might be able to
bring the program up into the Upper Columbia Basin; however, the YN is not focusing on that right now. He said, regarding the translocation component of the supplementation plan, there is a proposed design outlining where these fish could and should go. He said the bulk of the fish would go to the mainstem in the Methow Basin and 20 to 30% would go to the tributaries. He said the plan proposes translocating about 400 to 500 fish to each subbasin, not including the Okanogan Basin, which the YN will need to coordinate with the CCT about. He said there is also interest in the Entiat and Wenatchee basins. He said all fish will be PIT-tagged, and the extra fish will be used for studies. He suggested reviewing the plan for specific numbers, and said he will provide the Draft Pacific Lamprey Supplementation Plan to Kristi Geris for distribution to the Aquatic SWG. *(Note: the draft plan was provided to Geris on November 11, 2016, which Geris distributed to the Aquatic SWG on November 14, 2016.)*

Gingerich noted Aaron Jackson’s (CTUIR) and Ralph Lampman’s (YN) translocation M&E efforts and suggested requesting one of them to present or have Rose present their efforts. Rose agreed and said he will inquire internally and with the CTUIR and the Nez Perce regarding possibly presenting on current Pacific lamprey translocation efforts during the Aquatic SWG in-person meeting on January 11, 2017.

6. **2016 Bull Trout Study Update** (Andrew Gingerich): Andrew Gingerich said October 2016 was a busy month. He said Douglas PUD continued downloading fixed station arrays and also conducted mobile tracking by flight, boot, and truck. He said there were downstream detections at Wells Dam and the Twisp Weir; however, those data were not available to present at this time. He said, as of November 1, 2016, no fish have been detected in those locations or in the tailrace, nor have mortality signals been received. He said Douglas PUD will continue tracking fish through the winter months. He noted that tracking the fate of fish and detecting where mortalities occur are important to understanding the life history and what to expect in terms of sample size. He recalled that Douglas PUD tagged 14 fish at Wells Dam in May and June 2016, and 46 at the Twisp Weir in June and July 2016. He said, as of November 1, 2016, mortality codes have been sent by 17 fish (or 28% of study fish), and six tags have been recovered. He said tags have been recovered in the upper reaches of the Twisp River, a region notorious for flow going subsurface during the fall. He said another tag was recovered in the Wells Reservoir between the cities of Pateros and Brewster, and another in the first 5 miles of the Methow River, close to fishing access sites. He cautioned not to speculate about causes of mortality because, without hard evidence, it is difficult to ascertain. He reminded the workgroup that the purpose of this study is to evaluate successful passage at Wells Dam and the Twisp Weir.

Steve Lewis and Judy Neibauer (USFWS) asked for clarification about details included in a bull trout mortality summary Douglas PUD provided to USFWS. Gingerich clarified, that after submitting the summary to USFWS, additional mobile tracking was conducted, which resulted in updated the numbers in the first draft summary. He said Douglas PUD will provide a revised bull
trout mortality summary to USFWS and copy Kristi Geris for distribution to the Aquatic SWG. (Note: Gingerich provided the revised summary [Attachment E] to Geris following the meeting on November 9, 2016, which Geris distributed to the Aquatic SWG that same day.)

Neibauer said she was also interested in discussing other details about the summary, including the potential for bull trout entrapment at an irrigation bypass, how temperature affects survivability in study fish, genetics, and possibly incorporating PIT-tagged fish into the study. Gingerich agreed that discussing these details could be beneficial and told Neibauer he could discuss these topics with USFWS offline, outside of the Aquatic SWG meeting. Lewis asked what Douglas PUD thought about increasing the incidental take in the Biological Opinion. Gingerich said he agrees with USFWS that increasing take is not needed at this point, but that could change in the future. He said Douglas PUD has modified how the Twisp Weir is operated to reduce bull trout take and is optimistic those measures will reduce the amount of fish handled there. Lewis agreed and said he appreciates the feedback.

VII. Next Meetings

1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on December 14, 2016, will be held by conference call.

   Upcoming meetings are as follows: December 14, 2016 (conference call); January 11, 2017 (in-person); and February 8, 2017 (TBD).

List of Attachments
Attachment A – List of Attendees
Attachment B – Adding Shoreline Surveys for Zebra/Quagga Mussel Early Detection Monitoring Presentation
Attachment C – Wells White Sturgeon Fish Health Report 217
Attachment D – Wells White Sturgeon Fish Health Report 218
Attachment E – Revised Bull Trout Mortality Summary to USFWS
# Attachment A
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
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<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
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<tr>
<td>Dave Robichaud</td>
<td>Observer</td>
<td>LGL Limited</td>
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<tr>
<td>Steve Lewis</td>
<td>Aquatic SWG Technical Representative</td>
<td>U.S. Fish and Wildlife Service</td>
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<tr>
<td>Judy Neibauer†</td>
<td>Technical Support</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Breean Zimmerman</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Richard Visser††</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Bob Rose</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
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<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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Notes:
- † Joined for the 2016 Bull Trout Study Update
- †† Joined for the Zebra and Quagga Mussel Shoreline Surveys Presentation
Adding Shoreline Surveys for Zebra/Quagga Mussel Early Detection Monitoring

Washington Department of Fish and Wildlife
Aquatic Invasive Species Unit
Richard Visser
November 9, 2016
Early Detection Zebra/Quagga Mussel Monitoring
(conducted May – October)

- Artificial substrates
- Vertical and horizontal plankton tows
- Shoreline
- Water quality
Early Detection Zebra/Quagga Mussel Monitoring Criteria

• Water bodies are determined by the potential for introduction of zebra/quagga mussels through human activities such as boating, recreational fishing, tournament fishing, infrastructure, high calcium, etc.…

• Sites within the water body are determined by where the most usage occurs (launches and marinas) and veliger drifting patterns.
Artificial Substrate

- In water year around
- For post-settled juveniles and adults
- 1 per site
Plankton Tow

- Water temperatures greater than 12 C (spawning)
  - For juveniles/veligers
- Horizontal and vertical tows for 1 composite sample
  - 1 sample per site
Water Quality

- Visibility
- Calcium
- Salinity
- pH
- Temperature
- Dissolved Oxygen
2015 Mussel Monitoring Sites

Legend
- All Sampling
- Plankton Tow Only
- Artificial Substrate Only

- 1 - 5 Samples
- 6 - 15 Samples
- 16 - 22 Samples

[Map of 2015 Mussel Monitoring Sites in Washington State]
2016 Artificial Substrates
(329 Total)
2016 Plankton Tows
(326 Total)

Chelan County PUD: 12
City of Everett: 3
Douglas County PUD: 6
Grant County PUD: 14
National Park Service: 20
Sauk-Suiattle Indian Tribe: 6
Spokane Tribe: 30
WDFW: 235
2016 Shoreline
(247 Total)
2016 Calcium

144 Total - WDFW
Why Add More Work with Shoreline Surveys?

• Proven to be effective first detection method covering large area.

• No cost for equipment or analysis

• Only 10 minutes extra at each site

• Standardize sampling methodology throughout the Region as part of the Columbia River Basin Team comprised of WA, OR, MT, ID, WY, and British Columbia.
Zebra/Quagga Mussel Artificial Substrate & Shoreline Survey

Date (M/D/Y): ______________ Site #: ___________ Sampler (s): ____________________

Water Body: __________________________ Reservoir: ___________________________

Site Location: __________________________ Substrate Attached To: _______________

GPS (WGS 84, Decimal Degrees 00.000): N __________ W __________

Substrate Depth (m): __________ Total Water Depth (m): __________ Secchi Depth (m): __________

Salinity: ___________________________ pH: ___________________________ Temperature @: ______________ D.O.: __________

Artificial Substrate

1) Present ☐ Absent ☐ 2) Intact ☐ Damaged ☐ Out of the water ☐ 3) Redeployed: Yes ☐ No ☐
4) Zebra/Quagga Mussels: Present ☐ Absent ☐ If present, contact WDFW IMMEDIATELY
5) Other Organisms Present: Algae ☐ Algae Blue Green ☐ Algae Brown ☐ Algae Green ☐ Algae Red ☐
Bryozoans ☐ Chironomids ☐ Limpets ☐ Periphyton ☐ Snails Physid ☐ Snails Unknown ☐ Sponges ☐
Other: ___________________________

Shoreline

(Conduct 10 minute visual survey of existing structure)

1) Surveyed: Dock ☐ Boat Ramp ☐ Shoreline ☐ Concrete Structures ☐ LWD ☐ Dock/Mooring Lines ☐
Other: ___________________________

2) Zebra/Quagga Mussels: Present ☐ Absent ☐ If present, contact WDFW IMMEDIATELY
3) Other AIS Present: Asian Clams ☐ Chiness Mystery Snail ☐ New Zealand Mudsnails ☐ Grayfish Nonnative ☐
Other: ___________________________

Comments: ___________________________
## 2016 Douglas County PUD Sites and Dates

- Brewster City Park
- Bridgeport Marina
- Pateros City Park
- July 28
- August 29

<table>
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<th># of Sites Sampled per Year</th>
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<td>3</td>
<td>2</td>
<td>30</td>
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Thanks

WDFW AIS Unit
Richard Visser (360) 480-9071
Richard.Visser@dfw.wa.gov
United States Department of the Interior  
U.S. FISH & WILDLIFE SERVICE  
Idaho Fish Health Center  
276 Dworshak Complex Drive  
Orofino, ID 83544-  
Phone: 208-476-9500  
Fax: 208-476-9741

<table>
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| Species Information: white sturgeon |

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**United States Department of the Interior**  
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### Case Information

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### Facility Information

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</tr>
<tr>
<td>Contact</td>
<td>MEGHAN BAKER</td>
</tr>
<tr>
<td>Phone</td>
<td>509-923-2728</td>
</tr>
<tr>
<td>Fax</td>
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### Comments

**Background**  
Roosevelt White Sturgeon from WDFW Wells Hatchery. Pectoral fins collected 9-12-16 for WSIV testing by histology.

**Remarks**

**Species Information: white sturgeon**

### Sample Information

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<tr>
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<tbody>
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<td>Live</td>
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### Species Comments

**Remarks**  
Fins were received in individual vials, 60 fins total with 12 from each of 5 tanks.

**Internal Obs.**

**External Obs.**

**Recommendations**  
No WSIV detected.

### Assay Results

<table>
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<tr>
<th># Tested</th>
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<th>Tissue Tested</th>
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<td>WSIV not detected by histology.</td>
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2016 Bull Trout Passage and Take Study Plan Mortality Report

Prepared by Douglas PUD and LGL

11/9/2016

Background:

Douglas PUD and LGL tagged \( n = 14 \) fish at Wells Dam in May and June 2016 and \( n = 46 \) fish at the Twisp Weir in June and July 2016 using radio tags as part of a passage and take study associated with Douglas PUD’s license to operate Wells Dam.

Mobile tracking by flight, boot, and truck coupled with fixed station PIT and radio-telemetry arrays have been used to estimated \( n = 17 \) dead of 60 (28%) by November 1, 2016. However, only 6 of these tags have been recovered so far. One tag was found inside a dead bull trout by WDFW in a stranding pool near Poplar Flats by WDFW M&E staff. The other tags have been recovered without fish carcass or material present near the tags. Three tags appear to have bite marks or damaged antennae consistent with small mammal bite marks.

Suspected modes of mortality include post- or pre-spawning mortality near or on spawning grounds, stranding near spawning grounds due to subsurface or low fall Twisp River flows, predation, and delayed mortality (days) after tagging in the mainstem Columbia River. To date no mortality has occurred immediately after upstream or downstream passage past the Twisp Weir or Wells Dam.
Currently (11/2/2016) Suspected Mortalities:

**Tag 30**: Tagged at Twisp Weir by Dave Robichaud. New PIT 3DD.003BB8F348
- Released above Weir 6/23/16
- Passed Buttermilk 6/27/16
- Suspected dead a mile or two upstream of Mystery Campground and near Reynolds creek 11/2/16
- See Appendix 2. Estimate: 48°24'40.23"N, 120°29'4.71"W

**Tag 53**: Tagged at Twisp Weir by Andrew Gingerich. New PIT 3DD.003BB8F309
- Released above Weir 6/22/16
- Passed Buttermilk 7/1/16
- Suspected dead near Poplar Flat Campground 11/2/16
- See Appendix 2. Estimate: 48°25'19.10"N, 120°29'50.38"W

**Tag 42**: Tagged at Twisp Weir by Katie Menke. Existing PIT 3D9.1C2D92D9BF
- Released above Weir 6/18/16
- Passed Buttermilk 6/20/16
- Suspected dead three tenths of a mile above Poplar Flat Campground 11/2/16
- See Appendix 2. Estimate: 48°25'20.31"N, 120°30'16.49"W

**Tag 41**: Tagged at Twisp Weir by Katie Menke. New PIT 3DD.003BB8F382
- Released above Weir 6/18/16
- Suspected dead near mouth of Scatter or South Creek in Twisp 11/2/16
- See Appendix 2. Estimate: 48°25'50.90"N, 120°31'13.96"W

**Tag 39**: Tagged at Twisp Weir by Katie Menke. New PIT 3DD.003BB8F32F
- Released above Weir 6/17/16
- Suspected dead near mouth of Scatter or South Creek in Twisp 11/2/16
- See Appendix 2. Estimate: 48°25'50.90"N, 120°31'13.96"W

**Tag 36**: Tagged at Twisp Weir by Katie Menke. New PIT 3DD.003BB8F33B
- Released above Weir 6/16/16
- Suspected dead near mouth of North Creek in Twisp (Gilbert) 11/2/16
- See Appendix 2. Estimate: 48°27'13.31"N, 120°33'45.35"W

**Tag 4**: Tagged at Wells Dam by Bryan Nass. New PIT 3DD.003BB8F330
- Released below Wells 5/25/16
- Left Wells Dam tailrace 6/03/16
- Suspected dead downstream of Entiat via flight track 09/28/16 @ [47.530692, -120.29905].
- Not detected via flight track 10/27/16.

**Tag 5**: Tagged at Wells Dam by Katie Menke. New PIT 3DD.003BB8F335
- Released below Wells Dam 5/25/16
- Left Wells Dam tailrace 5/31/16
- Detected in Rocky Reach Juvenile Bypass 6/1/16 1:23 PM
- Suspected dead downstream of Entiat via flight track 06/01/16 and 09/28/16
- Detected downstream of Entiat, but in LIVE mode via flight track 10/27/16 @ [47.453906, -120.32883].

**Commented [AG1]**: Tag 44 was very close to signal 142 on 11/1/16 but was in live mode.

**Commented [AG2]**: We heard additional tags here that we could not code out.

**Commented [AG3]**: Comment A. Gingerich: I do not believe the fish is alive. Mobilization in fall flows probably mobilized the tag turning it back to live mode. I suspect it will return to mortality shortly.
Tag 13: Tagged at Twisp Weir. Existing PIT 3D9.1C2E0BC0D1. FL = 67.
- Released above the Weir in good condition on 3 July.
- Detected at Buttermilk the next day, 4 July
- Seen back at Buttermilk ~ 2.5 months later on 9/25/16
- Seen at Twisp Weir at 9/27/16 at 2 AM
- Seen at Twisp Ponds at 9/27/16 at 9 PM
- Mobile detection in Methow between Twisp and Libby creeks via flight track 9/28/16.
- Suspected dead in Methow near Mouth via flight track 10/27/16 @ [48.074102, -119.959299].
- Mobile track via truck and foot on 11/1/2016 confirmed mobile signal in deep pool 48.073684, -119.957666. Currently, tag is too deep to recover.

Tag 14: Tagged at Wells Dam by Bryan Nass. New PIT 3DD.003BB8F308
- Released below Wells Dam 6/03/16
- Left Wells Dam Tailrace 6/05/16
- Suspected dead downstream of Entiat via flight track 09/28/16 and 10/27/16 @ [47.626589, -120.23189].

Tag 26: Tagged at Twisp Weir. Existing PIT 3D9.1C2D687F91. FL = 74.
- Released above the Weir in good condition on 24 June.
- Detected at Buttermilk the next day, 25 June.
- Seen back at Buttermilk ~ two months later on 9/27/16
- Seen at Twisp Weir at 10/2/16 at 2 AM
- Seen at Twisp Ponds at 10/2/16 at 10 PM
- Passed receiver at Methow mouth from 10/8/16 – 10/9/16.
- Suspected dead in Columbia River between Brewster and Pateros via flight track 10/27/16 @ [48.078547, -119.839571].
- Did not attempt on 11/1/16 mobile track but will in the future

RECOVERED TAGS

Tag 6: Tagged at Wells Dam by Katie Menke. Existing PIT 3D9.1BF2427F29
- Released below Wells Dam 5/25/16
- Left Wells Dam Tailrace 5/28/16
- Entered Wells Dam Tailrace 5/28/16
- Ascended Wells Dam West Fish Ladder 5/29/16
- Entered Methow River 5/31/16
- Entered Twisp River 6/20/16
- Passed Twisp Weir 6/23/16
- Passed Buttermilk/Twisp confluence 6/26/16
- Suspected dead above the confluence of Buttermilk/Twisp via flight track 9/28/16 and 10/27/16 @ [48.361355, -120.33857].
- Recovered tag river right of Twisp above the confluence of Buttermilk and Twisp River. See Appendix 1. Estimate 48°21'39.72"N, 120°20'26.14"W
Tag 22: Tagged at Twisp Weir June 26, 2016. New PIT 3DD.003BB8F322. FL = 58 cm
- Tagger Dave Robichaud
- Released above the Weir in good condition same day
- Detected at Buttermilk four days later on 6/30/16
- Seen back at Buttermilk ~two months later on 9/13/16
- Seen at upstream and across antenna near Twisp Weir at 9/16/16 - 9/23/16
- Mortality signal on upstream antenna near Twisp Weir 9/23/16
- Recovered tag in irrigation beaver pond 10/19/16

Tag 29: Tagged at Twisp Weir June 23, 2016. Existing PIT 3D9.1C2E0BD127. FL = 70 cm
- Tagger Dave Robichaud
- Released above the Weir in good condition same day
- Detected at Buttermilk sixteen days later on 7/9/16
- Seen back at Buttermilk ~two months later on 9/11/16
- Seen at upstream and across antenna near Twisp Weir at 9/11/16 - 9/14/16 (stranded in beaver pond?)
- Mortality signal on across antenna near Twisp Weir 9/18/16
- Recovered tag in irrigation beaver pond 10/11/16

Tag 46: Tagged at Twisp Weir by Andrew Gingerich
- Released above Twisp Weir 6/21/16
- Passed Buttermilk/Twisp confluence 6/23/16
- Recovered tag by WDFW in stranding pool near Poplar Flats Campground 10/1/16

Tag 47: Tagged at Twisp Weir June 21, 2016. Existing PIT 384.36F2B4DC73. FL = 69.5 cm
- Tagger Andrew Gingerich
- Released above the Weir in good condition same day
- Detected at Buttermilk one day later on 6/21/16
- Seen back at Buttermilk three months later on 9/22/16
- Seen at upstream and across antenna near Twisp Weir at 9/23/16 - 9/29/16
- Mortality signal at across antenna near Twisp Weir 9/29/16
- Recovered tag in irrigation return/acclimation channel 10/11/16

Tag 58: Tagged at Twisp Weir June 22, 2016. New PIT 3DD.003BB8F315. FL = 53 cm
- Tagger Andrew Gingerich
- Released above the Weir in good condition same day
- Detected at Buttermilk six days later on 6/28/16
- Seen back at Buttermilk ~three months later on 9/17/16
- Seen at upstream and across antenna near Twisp Weir at 9/18/16 - 9/21/16
- Mortality signal at across antenna near Twisp Weir 9/21/16
- Recovered tag in irrigation return/acclimation channel 10/11/16

On 10/19/2016 we successfully recovered tag 22 above the Twisp Weir in the beaver pond immediately adjacent to the irrigation ditch at the site. Recall, last week (10/12/2016) we recovered tags 29, 58, and 47.
as well (email correspondence between S. Lewis and A. Gingerich). I assume the fish are dead, however we did not find any fish remains with any of the tags and none of their PIT tags have been detected since mortality codes have been picked up by the fixed RT array.

I found it interesting that none of the tags were found along the Twisp River channel itself. Rather, all four tags were found away from the main Twisp River channel. This makes me suspicious that in all four cases predation with or without the help of off channel areas may have been the source of mortality. Further supporting this suspicion is attached in the image where physical damage to two antennas is seen in tags 58 and 29 (Figure 1). The antennas are coated with a plastic that has been in some cases removed down to the wire. The wires were also bent in some cases. During recovery tag 58 had been bundled, or almost tied. Mink predation was an important source of mortality among tagged trout during Lindstrom and Hubert (2004), specifically mink killed at least 8% of tagged cutthroat trout and 28% of tagged brook trout. Additionally, graduate work by Jakober (1995) and Simpkins (1997) suggest that mink may have a substantial effect on natural mortality rates of fluvial salmonids.

![Figure 1. Antennas from tags recovered in beaver pond and irrigation channel upstream of the weir appear to have bite marks that could indicate predation.](image)

The easiest way into the beaver pond where Tag 22 and 29 were found appears to be from the irrigation intake/ditch weir (Figure 2). The red lines in the image show the approximate location of the irrigation ditch and return/acclimation volunteer channel (Figure 2).
It is impossible to know if the fish were killed by a predator once they entered the irrigation ditch, or if they died and the predator moved/ate them after they died. However, the location of the recovery makes me suspicious of the former. Also, the RT fixed arrays power history suggest that the bulk of the detections were on the upstream antenna location before and after the tags switched to mortality mode and, therefore, point to mortality occurring near the upstream antenna. If the fish entered the irrigation area and/or beaver pond they would have been susceptible to predation since these are shallower water areas, with very little stream width, and would not provide easy escape routes. Figure 3 shows flows in the Twisp was 50 cfs or less at the approximate time morality occurred for all four fish. The beaver pond and irrigation ditch is easy to wade at twice this volume (~100 cfs). All tags were found in arm length to just a few inches of water.

We thoroughly inspected the area and it would be very easy for a BT moving downstream to enter the irrigation ditch, provided the fish were traveling down the Twisp River on river left. I would suggest a site visit for anyone with additional interest (bring waders). Also, keep in mind that these fish just completed spawning. All four of these fish were detected moving upstream of Buttermilk in June/July and only a few days after tagging and they were all subsequently detected moving downstream of Buttermilk confluence in September and October. These movements and timing are consistent with a spawning migration. Finally, if the fish spawned they would be depleted of energy and in some cases moribund (energetically compromised) since there is a lot of somatic energy invested in gonadal development and physical spawning. From a physiological perspective this would make them susceptible to further predation. A final note is the mortality function of these tags turn on after 48 hours of being stationary. They turn back on to live mode if the tag moves when stationary (postmortem movement associated with
river flows or animal foraging on carcass). Interpretation is made more difficult by the fact that a carcass floating down the river would appear to be alive before it found a resting spot for 48 hours. It is therefore possible for a dead fish to show up on the upstream antenna at the weir as alive when it is in fact dead.

**Figure 3.** Fall 2016 Twisp River flow and approximate dates when tags 58, 29, 22, and 47 switched to mortality function (red stars).

**Notable observations**
After flight 10/27/2016 by LGL (See figure 5 below) Douglas PUD conducted a mobile track via foot and truck, that focused on the Twisp River above Mystery Bridge to Roads End campgrounds. The Chelan River area was also mobile tracked after Chelan PUD biologist notified Douglas PUD that contractors observed five bull trout, of which, two radio-tagged bull trout in the Chelan River (Steve Hemstrom pers comm 10/31/2016). Douglas PUD staff coded out tags 19 and 57 on 11/01/2016 (Figure 4). These fish were also determined to be in the general area on the 10/27/2016 flight (Figure 5).
Figure 4. 11/01/2016 truck mobile track determined that 57 and 19 were alive and in the Chelan River.
Figure 5. Flight path and bull trout hits from radio tags 10/27/2016
References:

Jakober, M.J. 1995. Autumn and winter movement and habitat use of resident bull trout and westslope cutthroat trout in Montana. Master’s thesis, Montana State University, Bozeman


Appendix 1

The next 5 photos show recovery of tag 6 on 11/1/16. The tag antenna was damaged (indicative of predation). Directly next to the tag was a small mammal access slide along the riparian area. Recovery location was less than a mile above the confluence of Buttermilk Creek and the Twisp River and along river right (Twisp River). Approximate recovery locations was 48°21'39.72"N, 120°20'26.14"W. The white arrow indicates small mammal/animal access along the bank.
Appendix 2

Images showing new mort tags as determined by 11/1/16 mobile track.
The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, December 14, 2016, from 10:00 to 11:45 a.m. Attendees are listed in Attachment A of these conference call minutes.

I. Summary of Action Items

1. Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-1).

2. Douglas PUD will: 1) provide a draft letter to the Federal Energy Regulatory Commission (FERC) to the Aquatic SWG for review, requesting permission from FERC to combine all Aquatic Settlement Agreement (ASA) Annual Reports and deadlines into one submittal; and 2) coordinate obtaining agency support letters, as necessary (Item VI-1). (Note: Andrew Gingerich provided a draft letter to Kristi Geris on December 16, 2016, which Geris distributed to the Aquatic SWG on December 19, 2016.)

3. Chad Jackson (Washington Department of Fish and Wildlife [WDFW]) will inquire with WDFW Wells Hatchery Staff about the flexibility (±5 or 10%) associated with the proposed white sturgeon release number stipulated in the Draft White Sturgeon Stocking Statement of Agreement (SOA; Item VI-2).

4. Aquatic SWG members will submit edits and comments on the Draft White Sturgeon Stocking SOA to Andrew Gingerich by Friday, December 23, 2016. Gingerich will distribute a revised draft SOA for approval at least 10 days prior to the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-2).

5. Andrew Gingerich and Kristi Geris will coordinate to distribute meeting logistic details for the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-6). (Note: Gingerich and Geris coordinated, as discussed, and details were distributed to the Aquatic SWG by Geris on December 19, 2016.)

6. The Aquatic SWG meeting on January 11, 2017, will be held by in-person at Wells Dam (Item VII-1).
II. Summary of Decisions

1. There were no decisions approved during today’s conference call.

III. Agreements

1. There were no agreements discussed during today’s conference call.

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on December 2, 2016, notifying them the Draft White Sturgeon Stocking SOA is available for review. Edits and comments on the draft SOA are due to Andrew Gingerich by Friday, December 23, 2016. Douglas PUD will request approval of the SOA during the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-2).

2. Kristi Geris sent an email to the Aquatic SWG on December 19, 2016, notifying them the draft letter to FERC requesting consolidation of ASA and Water Quality Certification reporting deadlines is available for review. Douglas PUD will request approval of the letter during the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-1).

3. Kristi Geris sent an email to the Aquatic SWG on January 5, 2017, notifying them the Draft 2015 Total Dissolved Gas Abatement Plan Annual Report and Draft 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan are available for a 30-day review period, with edits and comments due to Andrew Gingerich by Monday, February 6, 2017. Douglas PUD will request approval of both documents during the Aquatic SWG meeting on February 8, 2017.

V. Documents Finalized

1. There are no documents that have been recently finalized.

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items

   (John Ferguson): John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and asked for any additions or other changes to the agenda. No additions or changes were requested.

   The revised draft November 9, 2016, conference call minutes were reviewed. Kristi Geris said all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. Aquatic SWG members present approved the November 9, 2016, conference call minutes, as revised.
Action items from the last Aquatic SWG conference call on November 9, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the November 9, 2016, conference call):

- **Douglas PUD will provide a summary of Pacific lamprey M&E acoustic data collected to date as soon as those data are downloaded (Item VI-1).**
  This will be discussed during today’s conference call and also carried forward.
- **Anchor QEA and Douglas PUD will discuss ASA Annual Report deadlines, including the feasibility of providing a draft report (with the Draft Water Temperature Report and draft ASA resource management plan annual reports appended, including aquatic nuisance species, bull trout, Pacific lamprey, resident fish, water quality, and white sturgeon), for Aquatic SWG review by March 15 (Item VI-3).**
  Anchor QEA and Douglas PUD discussed and agreed on an annual report production schedule, which includes providing the annual report, plus the discussed management plan reports, to the Aquatic SWG for a 45-day review on March 21. This schedule also accommodates all necessary internal drafting and review periods—discussion during the Aquatic SWG meeting on April 12, approval during the meeting on May 10, and submittal to FERC by May 31, 2017.
- **Once ASA Annual Report deadlines are verified, Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine all ASA Annual Reports and deadlines into one submittal; and 2) coordinate obtaining agency support letters, as necessary (Item VI-3).**
  This action item will be carried forward. *(Note: Andrew Gingerich provided a draft letter to Kristi Geris on December 16, 2016, which Geris distributed to the Aquatic SWG on December 19, 2016.)*
- **Douglas PUD will provide a Draft White Sturgeon Stocking SOA to Kristi Geris for distribution to the Aquatic SWG prior to the Aquatic SWG meeting on December 14, 2016 (Item VI-4).**
  Andrew Gingerich provided a draft SOA on December 2, 2016, which Geris distributed to the Aquatic SWG Technical Representatives that same day.
- **Douglas PUD will arrange for an Aquatic SWG in-person meeting on January 11, 2017, including coordinating a fishway tour at Wells Dam (Item VI-5).**
  This will be discussed during today’s conference call.
- **Bob Rose will provide the Draft Pacific Lamprey Supplementation Plan to Kristi Geris for distribution to the Aquatic SWG (Item VI-5).**
  The draft plan was provided to Geris on November 11, 2016, which Geris distributed to the Aquatic SWG on November 14, 2016.
- **Bob Rose will inquire internally and with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Nez Perce regarding possibly presenting on current Pacific lamprey translocation efforts during the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-5).**
Due to logistics and time constraints discussed during today’s conference call, these presentations will likely be postponed.

- Douglas PUD will provide a revised bull trout mortality summary to U.S. Fish and Wildlife Service (USFWS), and copy Kristi Geris for distribution to the Aquatic SWG (Item VI-6). Andrew Gingerich provided the revised summary to Geris following the meeting on November 9, 2016, which Geris distributed to the Aquatic SWG that same day.

2. White Sturgeon (Andrew Gingerich):

Draft White Sturgeon SOA

Andrew Gingerich said a Draft White Sturgeon Stocking SOA was distributed to the Aquatic SWG by Kristi Geris on December 2, 2016. Gingerich said he feels the draft SOA is consistent with details discussed during the past few months with regard to the number of fish to stock in the next 5 years (final years in Phase I of the ASA White Sturgeon Management Plan). He said Douglas PUD hopes to request approval of the draft SOA during the Aquatic SWG meeting on January 11, 2017.

Jason McLellan said, overall, this is a good first draft. He said the Colville Confederated Tribes (CCT) have a few suggested edits for clarification. McLellan reviewed and distributed these edits to the Aquatic SWG during the meeting on December 14, 2016 (Attachment B). He said he does not believe the edits change the meaning of the SOA, but they simplify it.

Chad Jackson agreed with the CCT’s edits, and said he essentially had the same comments. Patrick Verhey also suggested clarifying the date, i.e., specifying 5 years of consecutive stocking. He added that WDFW supports any edits making the SOA more clear and concise.

John Ferguson said he also has comments clarifying the background language of the SOA, which he distributed to the Aquatic SWG following the meeting on December 14, 2016 (Attachment C).

Gingerich said, based on a first review of the CCT’s edits, Douglas PUD does not have any issues with the suggested clarifications. He said the reason behind including a range for the stocking number was to provide flexibility to hatchery staff. He added that Douglas PUD has no objections to picking one number. He said, for example, in certain cases, WDFW establishes program goals of ±10% for stocking, and suggested including the word, “approximately,” if necessary. Jackson agreed a single number can be stated, and then parenthetically include ±10%. He said he does not have a preference either way. Ferguson asked if 10% is correct, or if the range needs to be tighter. McLellan suggested that 5% will suffice; however, the CCT would also be supportive of 10%. He said, when discussing numbers this small, it will not be much of an issue. He also noted that 315 to 325, as currently included in the SOA, is less than 5%. Jackson said he will inquire with WDFW Wells Hatchery Staff about the flexibility (±5 or 10%) associated with the proposed white sturgeon release number stipulated in the Draft White Sturgeon Stocking SOA.
Gingerich requested a 10-day review period starting today, for the draft SOA. Aquatic SWG members will submit edits and comments on the Draft White Sturgeon Stocking SOA to Gingerich by Friday, December 23, 2016, and then Gingerich will distribute a revised draft SOA for approval at least 10 days prior to the Aquatic SWG in-person meeting on January 11, 2017.

**BY 2016 Wells Hatchery White Sturgeon Rearing Update**
Gingerich said it seems fish health has improved during the past couple of weeks for fish remaining on station. He recalled two tanks of larval-origin fish developing what appeared to be a fungus, so Douglas PUD had fish health samples sent to the USFWS Fish Health Lab at the Dworshak National Fish Hatchery, which came back negative for white sturgeon iridovirus. Gingerich said, since then, those fish have responded well to treatment. He said the other remaining larval-origin tanks became symptomatic and have also responded well to treatment. He said the direct gamete-origin fish seem to be developing the same thing, despite efforts to reduce horizontal transmission and application of best husbandry practices. He said approximately 8,000 larval-origin fish and 2,500 direct gamete-origin fish remain on station. He recalled that this year, less direct gamete-origin fish were brought on station because, in the past, more have been brought on station than were needed to meet program goals. He said direct gamete-origin fish not needed for Douglas PUD’s program will be surplused to Chelan Falls to supplement the Chelan PUD program. Gingerich said the water temperature in the tanks is about 56 to 57 degrees Fahrenheit (ambient well water), and will soon be increased a degree or two to grow fish closer to size for stocking next June 2017.

3. **2016 Water Quality/TDG Review** (Andrew Gingerich): Andrew Gingerich said Douglas PUD prepares a presentation each year for the U.S. Army Corp of Engineers (USACE) Seasonal Total Dissolved Gas (TDG) Review. He said the review focuses on TDG monitoring data quality and quantity at a number of area hydroelectric projects. He said Douglas, Chelan, and Grant PUDs participate each year. He added that TDG monitoring is required by Douglas PUD’s Clean Water Act Section 401 Water Quality Certification; however, it is also addressed under the ASA Water Quality Management Plan.

Gingerich reviewed a presentation titled, Wells Hydroelectric Project TDG 2016 Annual Report (Attachment D), which was distributed to the Aquatic SWG by Kristi Geris on December 3, 2016. Gingerich said slide 2 of Attachment D provides background information about the Wells Project. He said slide 3 of Attachment D is a picture of the hydrocombine style of dam where the spillway (which is also the juvenile fish bypass system) is located on top of the turbines. Slide 3 shows what a juvenile fish would be viewing as it approaches the system. He said the gray bars at the bottom are the trash racks. He explained, for size scale, a 5-gallon bucket can fit through the trash racks, and the wide spacing is intended to exclude large logs. He said the trash racks meet the turbine intake flow starting at about 75 feet below the surface of the water. He said, before peak smolt migration from watersheds upstream of Wells Dam in
the spring, Douglas PUD installs spill barriers, which include one panel with open square grating, through which water and juvenile fish pass through (orange panels with square grating in slide 3 of Attachment D). He said fish then pass through a leaf gate located behind the spill barriers (the red gate behind the orange grating in slide 3 of Attachment D). He said the reason Wells Dam is so efficient for smolt passage is that smolts are often at the surface and follow the modest spill flow, opposed to the larger volume of water flowing deep into the turbine intakes.

John Ferguson noted that a passive integrated transponder (PIT)-tag detection system was recently installed in Bypass Bay 2 at Wells Dam. Gingerich said Tom Kahler (Douglas PUD Habitat Conservation Plan [HCP] Coordinating Committees Representative) coordinated with Biomark to install the system; however, Gingerich could not say with certainty how well it performs, noting that water moves quickly through this area. He added, formerly, there was no smolt detection system at Wells Dam. Steve Rainey (USFWS) asked if the accuracy and performance of the system is still being gauged. Ferguson explained, based on discussions within the HCP Coordinating Committees, in general, the detector was installed during the 2015/2016 winter maintenance period at Wells Dam; however, it was not operational in time to capture the entire smolt run. He said the system also does not cover the entire bypass bay opening. He said the system this year was somewhat of a prototype, but key findings are that it worked, and Douglas PUD was able to obtain detections of PIT-tagged fish passing through the bypass. He said Douglas PUD is now considering expanding coverage in Bypass Bay 2 from top to bottom. Gingerich added that acoustic data indicate that distribution is not the same across all bypass bays; however, some data indicate most fish pass through Bypass Bay 2. Ferguson said he mentioned this is to alert Aquatic SWG members that detection capability is here, in case PIT-tagged Pacific lamprey or bull trout pass through the area.

Gingerich briefly reviewed slide 5 of Attachment D (TDG standards), slide 6 (TDG monitoring locations), and slide 7 (TDG field comparisons). He said slide 8 of Attachment D describes outages and issues in 2016. He said these data can be further reviewed via the Douglas PUD webpage or USACE link, both of which are provided on slide 8. He said slide 9 compares river flow in 2016 to the 10-year average. He noted that the blue line shows the freshet typically occurs around June, and the red line represents the 2016 observed flow. He said, in 2016, the highest flows occurred in mid-April, which is earlier than usual. He also noted the large swings on a daily basis, and explained that Wells Dam is a run-of-the-river project. He said this means river flow is largely dictated by the federal power system upstream of Wells Dam.

Gingerich reviewed slide 10 of Attachment D, which shows TDG in the Wells Dam forebay. He noted the sensor failure that occurred during the July 4th holiday weekend, which resulted in a data gap during that period. He said the good news is, the river flows during this period were such that TDG production and exceeding the standards were not an issue, and so losing those data was not detrimental. He said slide 11 of Attachment D reviews TDG in the Wells Dam
tailrace. He said the black hashed lines separate the fish passage season from the non-passage season, and the red horizontal lines show the water quality standard. He noted the data points above the red line during the bypass season, but explained there were no 120% 12-C High or 125% hourly exceedances in the Wells Dam tailrace. He said slide 12 of Attachment D shows TDG in the Rocky Reach Dam forebay, which includes the only compliance issues for the Wells Project in 2016. He said there were 3 days of high river flow and short durations where Wells Dam was forced to spill in excess of the standard, all occurring during the month of April.

Patrick Verhey asked if there have been any regional efforts to work with the Federal Columbia River Power System (FCRPS) to coordinate releases for optimal power generation and reduced TDG. Gingerich said his personal interactions with FCRPS river and power operators are limited; however, there are Douglas PUD and other agency staff who regularly coordinate with power operation and water quality personnel. He said there is a lot of complexity to the system, including Canadian river storage. He said he has started participating in a project operators meeting each spring, where entities convene to discuss these topics. He said TDG is very much on managers’ radars. He added that USACE has a plan each year that outlines spill caps and how to change spill operations to try to minimize TDG while also addressing high flows. He said an additional complexity is that USACE is a federal agency, and Douglas PUD is focused on meeting state standards, explicitly. Verhey said he appreciates the subject is not being overlooked, and it is nice to be assured there is an ongoing effort to make conditions better.

Rainey noted the peak of the hydrograph occurring in April this year, versus the previous 40 to 60 years, when the peak has occurred in June. He questioned how heavily managers should be anticipating this global warming phenomenon, with less snowpack and greater runoff earlier in the year, and those effects on the hydrosystem. Gingerich said, again, he personally does not spend a lot of time meeting with folks about climate change; however, he knows this is on everybody’s radar. He also noted that 2016 is just one year, noting that in 2011, there was a more “true” freshet in terms of peak river timing, and flows were very high during June and July. He added, this is not to say larger trends over time should not be monitored.

4. **2016 Bull Trout Study Update** (Andrew Gingerich): Andrew Gingerich said crews are working hard to maintain the fixed station arrays this winter. He said several of the fixed station arrays are maintained by solar panels, which require weekly maintenance to clear snow off the panels or check the battery to keep stations running during inversions and other cold weather conditions. He said he expects this level of effort to continue throughout the next several weeks. He said, in November 2016, there were a lot of detections, including: 12 fish at Buttermilk Creek above the Twisp Weir; 6 fish at the Twisp Weir; 8 fish at the Twisp Ponds; 17 fish in the Methow River; 1 fish in the Okanogan River; 2 fish in the Wells Dam forebay; 6 fish at the gateway location; and 3 fish downstream of the Entiat River (same three that have been there in previous reports). He said crews have also recovered five tags to date. He said an aerial
flight survey was not conducted during the end of November due to inclement weather. He said, traditionally, fish are not migrating during December. He said he expects to provide similar updates in January through March 2017, and expects fish to start moving again in April or May 2017.

Steve Rainey asked about the study fish. Gingerich recalled that 60 study fish were tagged from May to July 2016, with 3-year radio-telemetry tags. He said most were tagged at the Twisp Weir, and about 14 were tagged at Wells Dam. He said all study fish were adults. He said reproductive maturity was not assessed; however, crews targeted fish with fork lengths of 450 millimeters and above. Rainey asked if most activity has been downstream movement, and Gingerich responded, among the detections in November 2016, it certainly was.

5. 2016 Pacific Lamprey Study Update (Chas Kyger): Chas Kyger said Dave Robichaud is working on a more comprehensive update with movement and detection updates in the Wells Dam tailrace. Kyger said he plans to present this update during the Aquatic SWG meeting on January 11, 2017. He said Douglas PUD has not downloaded receivers since the last update; therefore, the same data are in-hand as was presented last month.

6. Aquatic SWG Meeting and Wells Dam Fish Ladder Tour on January 11, 2017 (John Ferguson and Andrew Gingerich): John Ferguson said an all-day meeting is scheduled for January 11, 2017. He said there is a lot to cover, including a Pacific lamprey workshop and fish ladder tour. He said logistics and schedule are still under discussion; however, draft details discussed to date, include: either carpooling from Douglas PUD at 8:00 a.m., or meeting at Wells Dam at 9:00 a.m.; Pacific lamprey workshop from 9:30 a.m. to 12:30 p.m.; Douglas PUD to provide lunch; fish ladder tour from 1:00 to 3:00 p.m., including in-ladder passage routes and PIT detection, Pacific lamprey passage structures, count station, and low-level entrance PIT detectors; and then depart by 3:00 p.m. Andrew Gingerich agreed, but added that he would also like a few minutes to discuss the White Sturgeon SOA. He said it will also help to receive RSVPs for security and lunch purposes. He said it will also help to know whether folks plan to carpool or meet at Wells Dam, so no one is left behind. He noted the possibility of cold weather and dirty work areas, and suggested warm clothing and work boots. He said Douglas PUD can supply hard hats, if needed.

Ferguson asked about external speakers (i.e., CTUIR and Nez Perce), noting that time may be constrained. He said, currently, the draft agenda includes: a) introductions; b) review of past Pacific lamprey studies; c) review of language in ASA and management plans; d) review of the Yakama Nation translocation efforts and the Bonneville Power Administration report (at a high level); e) review of any CCT translocation policies and activities; and f) an open discussion of potential hypotheses for the approach and dam passage behaviors observed recently, including pheromones and hydraulic conditions at fishway entrances, priorities, and what falls within the
purview of the ASA, among other topics. Ferguson suggested, considering this full agenda, postponing the CTUIR and Nez Perce presentations. He added that he is still unclear about WebEx connectivity at the dam, and said if the CTUIR and Nez Perce presented, it may need to be at a different location.

Steve Rainey said, years ago, he was asked to evaluate Pacific lamprey passage at Tumwater Dam, under the Rocky Reach Fish Forum. He said in doing so, he met with Aaron Jackson (CTUIR) at Three Mile Falls Dam on the Umatilla River, and learned that the CTUIR had a Pacific lamprey restoration program ongoing for a number of years. Rainey said the program started slowly, but is now seeing increased Pacific lamprey returns during the last several years. He said the program tested many of the same issues discussed here in the Aquatic SWG, including translocation and pheromones. He said he believes the program is well-funded, and can serve as a model for other tributaries; however, maybe not necessarily for the mainstem river. He said there may still be value in learning about the program, and then picking and choosing elements from that program.

Patrick Verhey said WDFW supports considering a translocation program. He recognized the CTUIR’s success; however, he said he would like to verify the same success of Pacific lamprey translocated upstream of Wells Dam, or progeny of those, and he does not believe the CTUIR has that information. He said, since the initiation of the CTUIR program, there has been an increase in returns; therefore, it has been assumed the program is successful. He said, however, he would like to see a more scientific explanation. He said, at the moment, translocation seems to be the best path forward in order to gain a better understanding of the limiting factors. He said, obviously, Wells Dam is more than 600 miles from the ocean, which may have something to do with the passage issue. He said, however, historically, there have been larger numbers passing Wells Dam. He added he would like to verify everything has been addressed in the fishways to improve Pacific lamprey passage. He questioned whether enumeration issues have been fully addressed. He asked when is the right time to begin discussing a Pacific lamprey passage system.

Rainey said he was involved in discussions about the modified head differentials at the Wells Dam fishway entrances (from 1.5 feet to 1 foot during nighttime hours). He said, admittedly, significant numbers of Pacific lamprey were not approaching the entrances; however, he believed it was clear those approaching passed more readily during nighttime hours at the 1-foot differential. He said he understands this concept was discontinued due to low passage numbers; however, he suggested those Pacific lamprey operations may be beneficial. Chas Kyger clarified that those operations are not off the table. He explained that there were contradictory data in 2013, when more fish passed under the standard differential established to pass salmonids (1.5 feet). He said Douglas PUD would like to reevaluate those operations once there are more fish approaching. He said Pacific lamprey operations were
discontinued this year because the study was focused on the assumption of approach behavior. Verhey recalled back during relicensing discussing hydraulic conditions at the fishway entrances, and noted that this may be affecting approach and should be discussed. He asked why fish are not passing Wells Dam, questioning if it might be a bioenergetics issue, and said this should be discussed. He questioned whether the overall population is not robust enough to encourage Pacific lamprey to explore spawning in various locations. He said all of these topics need to be discussed.

Rainey asked about a study plan for 2017, and Ferguson said this is still under discussion. He explained, that in 2016, the study focused on evaluating approach behavior. He said out of 151 acoustically tagged fish, only a few have been detected close to the dam. He said Douglas PUD and the Aquatic SWG are now trying to evaluate this issue, and one hypothesis is pheromones. Rainey suggested one reason might be due to the unique hydraulic conditions of the hydrocombine style of dam. Kyger explained that only eight fish have been detected within about 3 miles of Wells Dam, and only four have been detected within the first mile downstream of the dam. He said this is likely outside the effects of hydraulic conditions from the hydrocombine.

Gingerich said he and Kristi Geris will coordinate to distribute meeting logistic details for the Aquatic SWG in-person meeting on January 11, 2017. (Note: Gingerich and Geris coordinated, as discussed, and details were distributed to the Aquatic SWG by Geris on December 19, 2016.)

VII. Next Meetings

1. Upcoming meetings (John Ferguson): The Aquatic SWG meeting on January 11, 2017, will be held in-person at Wells Dam.

Upcoming meetings are as follows: January 11, 2017 (in-person); February 8, 2017 (TBD); and March 8, 2017 (TBD).

List of Attachments

Attachment A – List of Attendees
Attachment B – Draft White Sturgeon Stocking SOA – CCT edits
Attachment C – Draft White Sturgeon Stocking SOA – Anchor QEA edits
Attachment D – Wells Hydroelectric Project Total Dissolved Gas 2016 Annual Report Presentation
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Dave Robichaud</td>
<td>Observer</td>
<td>LGL Limited; consultant to Douglas PUD</td>
</tr>
<tr>
<td>Sierra Franks</td>
<td>Technical Support</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Steve Rainey</td>
<td>Technical Support</td>
<td>GEI; consultant to the U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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Statement of Agreement

Wells Reservoir White Sturgeon Supplementation 2017-2021

Date: December 2016

Douglas PUD will release **315-325** white sturgeon **≥ 200 grams/fish** into the Wells Reservoir annually between 2017 and 2021 to complete the supplementation **goals remaining requirement** in Phase I of the White Sturgeon Management Plan. Douglas PUD will rear fish to a target of **≥ 200 grams/fish**. Fish used during this period of supplementation will be captured as wild larval fish (born in river). These releases will be comprised of juveniles originating as wild caught larvae from larvae sourced from the Columbia River between Bonneville Dam and the US/Canada border. Lake Roosevelt will be used to meet this program unless wild caught larvae from additional areas of the Columbia River are available. The Aquatic SWG will determine the proportional composition of each stocking of fish from additional areas of the Columbia River in release in years when they are available. If fish were captured at more than one location (reservoir) and successfully raised at the hatchery, the Aquatic SWG will discuss **revising increasing the** stocking numbers target in the subsequent year.
**Background**
From 2014-2016 Douglas PUD released >15,000 yearling white sturgeon into the Wells Project. In 2017, an additional 5,000 yearling white sturgeon are expected to be released into the Wells Project. Following the initial four years of stocking (up to 20,000 white sturgeon) the White Sturgeon Management Plan (WSMP) limits additional stocking in license years 5-10 to no more than an additional 15,000 fish.

During the summer and fall of 2016 the Aquatic Settlement Work Group (Aquatic SWG) considered several factors when determining how many white sturgeon to stock during the remainder of the WSMP’s Phase I and to meet the ‘up to 15,000’ fish guideline. Example considerations included, but were not limited to, recent monitoring and evaluation data, adult density data from the Bonneville Reservoir, the Wells Reservoir surface area, expected survival at given release sizes and years at large, harvest and slot exploitation (harvest) rates, slot limits, estimated size of existing population, recruitment limitations, and size and age at maturity.

As a result of the former considerations, the Aquatic SWG agreed to the following principles:

- Estimated carrying capacity of approximately 1,000-1,100 adult white sturgeon for the Wells Reservoir, by considering applying the number density of adults (fish/ha) in the Bonneville Reservoir relative to the Wells Reservoir surface area.
- Estimated that the first year post-release survival for 200 gram fish would be approximately 86% and based on data presented in the *Upper Columbia White Sturgeon Recovery Initiative* monitoring results.
- Estimated 2+ year old annual survival rates of fish age 2 and older would approximate be 98% each year thereafter.
- Combined (tribal and recreational) harvest rates were expected to be higher in earlier years but equalize to around 210 fish each year.
- The exploitation rate was assumed to be 25% within a 40 cm harvest slot; thus the projected combined (tribal and recreational) harvest rate would equalize at approximately 210 fish each year following higher rates in the first 4 years due to the larger numbers of fish initially released.
- A preference of for using wild caught larvae white sturgeon larvae to meet stocking goals.

Considering the assumptions listed above, and as well as all other input variables (i.e., growth functions), resulting the modeling determined indicated that releasing approximately 315-325 white sturgeon at 200 grams each on an annual basis would meet adult population goals during and after the term of the license. Moreover, the Aquatic SWG agreed to reconsider stocking rates as monitoring and evaluation data improved.
Recent research suggests that white sturgeon populations are not differentiated genetically from the Bonneville Pool to the transboundary reach of the Columbia River (Canadian border Hugh Keenleyside Dam, British Columbia) and that fish are more related based on reservoir proximity with gene flow historically occurring downstream. Therefore, larvae—the Aquatic SWG agreed that larval fish—white sturgeon captured from all any of the Columbia River reservoirs between the Bonneville Reservoir Dam and the US/Canadian—Canada border are suitable acceptable for supplementing for the Wells Reservoir.
Statement of Agreement

Wells Reservoir White Sturgeon Supplementation 2017-2021

Date: December 2016

Douglas PUD will release 315-325 white sturgeon into the Wells Reservoir annually between 2017 and 2021 to complete the supplementation goals remaining in Phase I of the White Sturgeon Management Plan. Douglas PUD will rear fish to a target of ≥ 200 grams/fish. Fish used during this period of supplementation will be captured as wild larval fish (born in river). Wild caught larvae from Lake Roosevelt will be used to meet this program unless wild caught larvae from additional areas of the Columbia River are available. The Aquatic SWG will determine the proportional stocking of fish from additional areas of the Columbia River in years when they are available. If stocking numbers cannot be met in a given year the Aquatic SWG will discuss revising stocking numbers in the subsequent year.
Background

From 2014-2016 Douglas PUD released >15,000 yearling white sturgeon into the Wells Project. In 2017, an additional 5,000 yearling white sturgeon are expected to be released into the Wells Project. Following the initial four years of stocking (up to 20,000 white sturgeon), the White Sturgeon Management Plan (WSMP) limits additional stocking in license years 5-10 to no more than a total of an additional 15,000 additional fish.

During the summer and fall of 2016, the Aquatic Settlement Work Group (Aquatic SWG) considered several factors when determining how many white sturgeon to stock during the reminder of the WSMP’s Phase I and to meet the ‘up to 15,000’ fish guideline. These factors included, but were not limited to, recent monitoring and evaluation data, adult density data from the Bonneville Reservoir, the Wells Reservoir surface area, expected survival at given release sizes and years at large, harvest and slot exploitation rates, estimated size of existing population, recruitment limitations, and size and age at maturity.

After reviewing these factors and information, a result of the former considerations, the Aquatic SWG agreed to the following principles:

- Estimated carrying capacity of the Wells Reservoir for adult white sturgeon is approximately 1000-1100 fish adult (>165 cm fork length) white sturgeon for the Wells Reservoir, based on estimates of the number of adult white sturgeon in the Bonneville Reservoir relative to the Wells Reservoir surface area.

- Estimated that the first year survival for 200 gram fish in the first year after release is estimated to be approximately 86%, and based on monitoring data developed as part of the presented in the Upper Columbia White Sturgeon Recovery Initiative monitoring results.

- Annual survival rates for Estimated 2+ year-old fish are estimated to be survival rates would approximate 98% each year thereafter.

- Combined harvest rates for (tribal and recreational fisheries are) harvest rates were expected to be higher in earlier years but equalize to around 210 fish each year.

- The exploitation rate was assumed to be 25% within a 40 cm harvest slot.

- A preference of using wild caught larvae fish to meet stocking goals.

Considering the above and all other input variables, a white sturgeon production model developed for the Middle Columbia River was run. Model results indicated that resulting modeling determined that releasing from approximately 315 to 325 white sturgeon at 200 grams each on an annual basis would meet the Wells Reservoir adult population goals during and after the term of the license. Moreover, The Aquatic SWG agreed to start with these production rates initially.
in license years 5-10 and reconsider stocking rates as monitoring and evaluation data becomes available/improved.

Recent research suggests that white sturgeon populations are not differentiated genetically within the reach of the Columbia River from the Bonneville Reservoir Pool to the transboundary reach of the Columbia River (Canadian border), and that fish are more closely related based on reservoir proximity, and that gene flow historically has occurred in a downstream direction. Based on this information, therefore, the ASWG concluded that larvae fish from all reservoirs between the Bonneville Reservoir and the Canadian border are suitable for rearing and stocking in the Wells Reservoir.
Wells Hydroelectric Project
Total Dissolved Gas
2016 Annual Report

Andrew Gingerich
andrewg@dcpud.org

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802

USACE Seasonal TDG Review
Portland, OR
Dec. 1, 2016

andrewg@dcpud.org
509-881-2323
Wells Dam

- Nameplate rating of ~ 774 MW and a peaking capacity of approximately 840 MW.
- Generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine.

- **4 TDG Monitoring (MS5):**
  - Washburn Island
  - Forebay
  - Tailrace x 2

- Report data to USACE year-round

- Data available at douglaspud.org

- Bypass season: April - August

- PH capacity is roughly 200 kcfs
  - 7Q10: 246 kcfs
The bypass consists of flow barriers placed in five of eleven spillbays (2, 4, 6, 8, and 10).

- 92% of the spring migration and 96% of the summer migration bypassed.
- Survival studies: >96%.

**Several features that allow for high guidance and survival of juveniles:**
- 10 turbine intakes are very deep.
- Situated immediately above the turbine intake are the 11 spillways.
- Fish hesitate to follow the water flowing into the deep turbine intakes.
- Instead follow modest spill flow.
- Vertical opening 16 ft. wide and 70 ft. deep.
- The five bypass gates operate in conjunction to the operation of paired turbines immediately below.
- i.e., 6 turbines operating, those 3 gates located above are opened.
Year Round TDG Criteria

Ecology requirements once Fish Passage Waiver is obtained (110% otherwise):

1. **No hourly value above 125% in tailrace***

2. **12-C high (rolling 12 hour average) during any hour of the day in the Wells tailrace of 120%***

3. **12-C high (rolling 12 hour average) during any hour of the day in the Rocky Reach forebay of 115%***

*If 7Q-10 flows are occurring exempt from standards (246 KCFS @ Wells Dam)

Typically, no problem with 110% WQS outside of fish passage season
• Basically always in this range: 95-102%
Wells 2016 Total Dissolved Gas Field Comparisons

Deviation = TDG_{post-calibration} – TDG_{pre-calibration}

Very good.

Not % TDG but mmHg difference from standard.
Wells 2016 Outages and Issues

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<td>DPUD</td>
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<td>7/1-7/7/16</td>
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<td>WELW2</td>
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<td>WEL</td>
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<td>No explanation</td>
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Reporting to TMT page at USACE site has been unreliable lately @ [http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/](http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/)
- Send hourly data packages
- Working on resolving

Preferred data location
• Douglas PUD scheduled bi-annual unit and transformer maintenance during the month of April - historically safe to do so since freshet is in June and July.
• Bi-annual maintenance reduces powerhouse capacity. 7 Unit plant in late April.
Forebay TDG sensor failed July 1, 2016 after 9 years of functioning. Backup sensor was swapped in on July 7th.
Wells Tailrace 100% Compliant in 2016

Wells Tailrace TDG

Dashed vertical line denotes April fish passage season.

Orange dashed circle: Early April values above 120% did not violate 12C- High standard.

7/22 to 7/24 tailrace sensor power failure.

8 hrs of 16.3 kfc
3 hrs of 12.2 kfc

Attachment D
Rocky Reach Forebay non-compliance observed on 4/18, 4/19 and 4/23 (red circles). 115% 12-C High standard.

This has been an ongoing concern for Columbia River Hydro-Operators. 12-C High formula can make it seem like more days are in violation than actual based on the running average method.
• 100% TDG compliant in Wells Tailrace.

• 3 days in April where Rocky Reach Forebay non-compliance observed.
Wells Dam - Unique WQ Challenges

- Limited storage (maybe not very unique).
  - GCL has 58 X storage capacity than Wells.

- **Hydrocombine:**
  - Highest downstream survival of smolts >96%.
  - Over 4 years of survival studies (93% juvenile survival standard and 97% adult).
  - However, JBS operates through spill and even small volumes of spill can add 1-3% TDG.
  - When incoming TDG is out of compliance and Douglas PUD adds even 0.1% Ecology determines DCPUD is in violation - even though JBS needs to run (required by HCP and NMFS).
  - Fighting regulatory standards, which conflict in this case.
Comments?

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4331

Andrew Gingerich
andrewg@dcpud.org
509-881-2323
APPENDIX B
AQUATIC SETTLEMENT WORK GROUP MEMBERS
### Aquatic Settlement Work Group Members

**2016**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Policy Representative</th>
<th>Technical Representative</th>
</tr>
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<tbody>
<tr>
<td>Anchor QEA, LLC</td>
<td>John Ferguson (Chairman)</td>
<td>John Ferguson (Chairman)</td>
</tr>
<tr>
<td>Douglas PUD</td>
<td>Shane Bickford</td>
<td>Andrew Gingerich</td>
</tr>
<tr>
<td>Colville Confederated Tribes</td>
<td>Bill Towey</td>
<td>Jason McLellan</td>
</tr>
<tr>
<td>Yakama Nation</td>
<td>Paul Ward</td>
<td>Bob Rose</td>
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<tr>
<td>U.S. Bureau of Land Management</td>
<td>Chris Sheridan</td>
<td>Chris Sheridan</td>
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<tr>
<td>U.S. Fish and Wildlife Service</td>
<td>Stephen Lewis</td>
<td>Stephen Lewis</td>
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<tr>
<td>Washington Department of Fish and Wildlife</td>
<td>Jim Brown</td>
<td>Patrick Verhey</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>Charlie McKinney</td>
<td>Charlie McKinney (Jan-May)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breean Zimmerman (Jun-Dec)</td>
</tr>
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APPENDIX C
FINAL REQUEST FOR CONSOLIDATION
OF AQUATIC SETTLEMENT AND WATER
QUALITY CERTIFICATION REPORTING
DEADLINES
Honorable Kimberly D. Bose  
Secretary  
Federal Energy Regulatory Commission  
888 1st Street N.E.  
Washington, D.C. 20426

Subject: **Wells Hydroelectric Project – FERC Project No. 2149**  
**Consolidation of Aquatic Settlement and Water Quality Certification Reporting Deadlines**

Dear Secretary Bose:

Public Utility District No. 1 of Douglas County, Washington (Douglas PUD), licensee for the Wells Hydroelectric Project No. 2149 (Wells Project), and the signatories to the Aquatic Settlement Agreement (ASA), respectfully requests that the FERC consolidate four reporting deadlines associated with the ASA, Clean Water Act section 401 Water Quality Certification (401 Certification) and the FERC license requirements to operate the Wells Project.

Article 406 of the license requires Douglas PUD to file with the FERC an annual report documenting the results of studies and measures completed during the previous calendar year pursuant to the Aquatic Settlement Agreement’s White Sturgeon Management Plan (WSMP), Bull Trout Management Plan (BTMP), Pacific Lamprey Management Plan (PLMP), Resident Fish Management Plan (RFMP), Aquatic Nuisance Species Management Plan (ANSMP), and Water Quality Management Plan (WQMP) as required in whole or in part by Ordering Paragraph F and Appendix C, Ordering Paragraph G and Appendix D, and Ordering Paragraph H and Appendix E.

In addition to meeting the requirements of Article 406 of the FERC license, annual Management Plan reports are required under section 6.4, 6.6 and 7(b) of the 401 Certification, section 11.7 of the ASA and section 4.0 within each of the aquatic resource management plans contained within the ASA.

License Article 405 required Douglas PUD to revise the ANSMP found within the ASA. Once updated and filed with the FERC, FERC approved the revised ANSMP in an order issued May 30, 2013.\(^1\) This Order requires Douglas PUD to submit a ANSMP annual report on April 1st of

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\(^1\) See Order Approving and Modifying Aquatic Nuisance Species Management Plan Pursuant to License Article 405 Regarding Public Utility District No. 1 of Douglas County, Washington under P-2149.
each year, which is different than the ASA management plan annual reporting deadline of May 31st. Douglas PUD respectfully request that the FERC move the ANSMP annual report filing deadline to May 31st of each year to be consistent with the ASA management plan reporting deadline. This change will eliminate the need to file the ANSMP twice with the FERC and the Washington State Department of Ecology within the same calendar year.

Similarly, License Article 401(b) and the 401 Certification requires Douglas PUD to file with the FERC an annual Water Temperature Report by April 30th of each year. Douglas PUD respectfully request that the FERC approve moving this report filing deadline to May 31st to be consistent with the ASA management plan reporting deadline.

Together Douglas PUD and the ASA signatory parties (See Attachment A), respectfully request that the FERC approve the consolidation of the ASA annual report (currently May 31st), ASA management plan reports (currently May 31st), ANSMP management plan report (currently April 1st) and Water Temperature Report (currently April 30th) to May 31st of each year.

If you have any questions or require further information related to the report consolidation request, please feel free to contact me at (509) 881-2208 or sbickford@dcpud.org.

Sincerely,

Shane Bickford
Natural Resources Supervisor

Enclosures:

Attachment A: Wells Aquatic Settlement Agreement Meeting Minutes from the January 11, 2017 meeting noting the signatory party’s request and approval of the Report Consolidation Letter.

Cc: Mr. Stephen Lewis – United States Fish and Wildlife Service
    Mr. Bob Rose – Yakama Nations
    Mr. Jason McLellan – Colville Confederated Tribes
    Ms. Breean Zimmerman – Washington Department of Ecology
    Mr. Patrick Verhey – Washington Department of Fish and Wildlife
    Mr. Chris Sheridan – Bureau of Land Management
    Mr. Andrew Gingerich – Douglas PUD
    Mr. Chas Kyger – Douglas PUD
Attachment A:
Wells Aquatic Settlement Agreement Meeting Minutes from the January 11, 2017 meeting
noting the signatory party’s request and approval of the Report Consolidation Letter
The Aquatic Settlement Work Group (SWG) met in-person at Wells Dam in Azwell, Washington, on Wednesday, January 11, 2017, from 9:45 a.m. to 12:45 p.m. Attendees are listed in Attachment A of these meeting minutes.

I. Summary of Action Items

1. John Ferguson will contact Tracy Hillman (Rocky Reach Fish Forum [RRFF] Facilitator) to notify Hillman the Aquatic SWG began discussing how to improve coordination between the Aquatic SWG and the RRFF with regard to Pacific lamprey behavior and survival in the Rocky Reach Reservoir (Item VI-4). (Note: Ferguson notified Hillman, as discussed, on January 16, 2017.)

2. Douglas PUD, in coordination with Dave Robichaud (LGL Limited), will synthesize Douglas PUD and Grant PUD 2016 Pacific Lamprey Study data collected to date (to demonstrate the behavior of each tagged individual) for discussion during the Aquatic SWG meeting on February 8, 2017 (Item VI-4). (Note: Chas Kyger provided these data to Kristi Geris on January 13, 2017, which Geris distributed to the Aquatic SWG that same day.)

3. The Aquatic SWG will further discuss Pacific lamprey passage hypotheses and study plans for 2017 during the Aquatic SWG meeting on February 8, 2017 (Item VI-4).

4. Aquatic SWG members will contact Andrew Gingerich if there is interest in touring the west fish ladder at Wells Dam while the ladder is dewatered. The ladder will be dewatered for 2 to 3 weeks starting on January 19, 2017 (Item VI-4).

5. The Aquatic SWG meeting on February 8, 2017, will be held by conference call (Item VII-1).
II. Summary of Decisions

1. Aquatic SWG members present approved the White Sturgeon Stocking Statement of Agreement (SOA), Wells Reservoir White Sturgeon Supplementation 2018-2022, as revised, with the Yakama Nation (YN) abstaining (Item VI-2).

2. Aquatic SWG members present reviewed and approved the Aquatic SWG request to consolidate annual reporting, and pursuant to the letter, be filed with the Federal Energy Regulatory Commission (FERC); Consolidation of Aquatic Settlement and Water Quality Certification Reporting Deadlines (Item VI-3).

III. Agreements

1. There were no agreements discussed during today’s meeting.

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on January 5, 2017, notifying them the Draft 2016 Total Dissolved Gas Abatement Plan Annual Report and Draft 2017 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan are available for a 30-day review period, with edits and comments due to Andrew Gingerich by Monday, February 6, 2017. Douglas PUD will request approval of both documents during the Aquatic SWG meeting on February 8, 2017 (Item VI-5).

V. Documents Finalized

1. The Final White Sturgeon Stocking SOA, Wells Reservoir White Sturgeon Supplementation 2018-2022, was distributed to the Aquatic SWG by Kristi Geris on January 12, 2017 (Item VI-2).

VI. Summary of Discussion

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items (John Ferguson):
   John Ferguson welcomed the Aquatic SWG members (attendees are listed in Attachment A) and reviewed the agenda. Ferguson asked for any additions or other changes to the agenda. Andrew Gingerich added a reminder about the current documents available for review.

   The revised draft December 14, 2016, conference call minutes were reviewed. Kristi Geris said she added three items under the Review Items section of the minutes, including: 1) the draft letter to FERC requesting consolidation of Aquatic Settlement Agreement (ASA) and Water Quality Certification reporting deadlines, which will be discussed during today’s meeting; and
2) the Draft 2015 Total Dissolved Gas Abatement Plan Annual Report and Draft 2016 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan, which are available for a 30-day review with comments due to Gingerich by February 6, 2017. Geris said all other comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and there are no outstanding edits or questions to discuss. Aquatic SWG members present approved the December 14, 2016, conference call minutes, as revised. The YN and Washington State Department of Ecology (Ecology) abstained, because YN and Ecology representatives were not present during the December 14, 2016, conference call.

Action items from the last Aquatic SWG conference call on December 14, 2016, are as follows (note: the following italicized item numbers correspond to agenda items from the December 14, 2016, conference call):

- **Douglas PUD will provide a summary of Pacific lamprey monitoring and evaluation (M&E) acoustic data collected to date as soon as those data are downloaded (Item VI-1).**
  This will be discussed during today’s meeting.

- **Douglas PUD will: 1) provide a draft letter to FERC to the Aquatic SWG for review, requesting permission from FERC to combine ASA Annual Reports and deadlines into one submittal; and 2) coordinate obtaining agency support letters, as necessary (Item VI-1).**
  Andrew Gingerich provided a draft letter to Kristi Geris on December 16, 2016, which Geris distributed to the Aquatic SWG on December 19, 2016. This will be further discussed during today’s meeting.

- **Chad Jackson (Washington Department of Fish and Wildlife [WDFW]) will inquire with WDFW Wells Hatchery Staff about the flexibility (±5 or 10%) associated with the proposed white sturgeon release number stipulated in the Draft White Sturgeon Stocking SOA (Item VI-2).**
  This will be discussed during today’s meeting.

- **Aquatic SWG members will submit edits and comments on the draft White Sturgeon Stocking SOA to Andrew Gingerich by Friday, December 23, 2016. Gingerich will distribute a revised draft SOA for approval at least 10 days prior to the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-2).**
  Gingerich provided a revised draft SOA to Kristi Geris on December 30, 2016, which Geris distributed to the Aquatic SWG that same day. This will be discussed during today’s meeting.

- **Andrew Gingerich and Kristi Geris will coordinate to distribute meeting logistic details for the Aquatic SWG in-person meeting on January 11, 2017 (Item VI-6).**
Aquatic Settlement Work Group

Gingerich and Geris coordinated, as discussed, and details were distributed to the Aquatic SWG by Geris on December 19, 2016.

2. **DECISION: White Sturgeon SOA on Supplementation Beginning in 2018**
   **(Andrew Gingerich):**

   Andrew Gingerich said a revised draft White Sturgeon Stocking SOA was distributed to the Aquatic SWG by Kristi Geris on December 30, 2016. Gingerich recalled that comments received and addressed in the revised draft SOA were discussed during the Aquatic SWG meeting on December 14, 2016. He said comments were also received after distribution of the revised draft SOA from U.S. Fish and Wildlife Service (USFWS), and Douglas PUD provided responses to those comments, as distributed to the Aquatic SWG by Geris on January 6, 2017. Gingerich said Douglas PUD suggested no additional revisions and USFWS agreed after receiving Douglas PUD’s explanations.

   Gingerich said Douglas PUD also located two errors in the revised draft SOA. He said first, supplementation will be from 2018 to 2022, and collection will be from 2017 to 2021; therefore, the dates in the revised draft SOA will be revised to reflect supplementation (i.e., 2018 to 2022). He said, secondly, in the second-to-last sentence in the Agreement statement, the word ‘were’ will be revised to ‘are.’ He said Douglas PUD is requesting approval of the revised draft SOA, including the modifications just discussed.

   John Ferguson asked Chad Jackson about the flexibility (±5 or 10%) associated with the proposed white sturgeon release number stipulated in the revised draft SOA. Chad Jackson said he discussed this with WDFW Wells Hatchery Staff and they indicated support for either one.

   The Aquatic SWG members present approved the White Sturgeon Stocking SOA, *Wells Reservoir White Sturgeon Supplementation 2018-2022*, as revised, with the YN abstaining.

   Bob Rose said he appreciates the effort put forth; however, wants to note for the record that the YN acknowledge the stocking rate stipulated in the White Sturgeon Stocking SOA, but it does not set precedent for what the YN intend to do in other reservoirs. He added that the numbers in this SOA are much different than numbers in downstream reservoirs. He said it will be interesting to observe how this lower density of stocking pans out, and it may be useful for adaptive management scenarios at different densities.

   The Final White Sturgeon Stocking SOA, *Wells Reservoir White Sturgeon Supplementation 2018-2022*, was distributed to the Aquatic SWG by Geris on January 12, 2017 (Attachment B).
3. **DECISION: Douglas PUD’s Consolidation of ASA and Water Quality Certification Reporting Deadlines Letter to FERC (Andrew Gingerich):**

Andrew Gingerich said a draft letter to FERC requesting permission from FERC to combine ASA and Water Quality Certification reporting deadlines into one submittal was distributed to the Aquatic SWG by Kristi Geris on December 19, 2016. Gingerich recalled that the Aquatic SWG has been discussing this topic for several months, and the impetus was because review and approval of the numerous required annual reports has become somewhat complex during the first two quarters or each year. He said when FERC License No. 2149 was issued in 2012, this initiated new requirements to submit several reports around the same time of year, which made review of all FERC-, ASA-, and Ecology-required reports challenging for reviewers. He said to remedy this, the Aquatic SWG requested that Douglas PUD investigate modifying report scheduling.

Gingerich said the draft letter to FERC describes the history of documents and deadlines, and points out that two documents seem to be most out of line with the other reporting schedules. He said Douglas PUD is requesting to move the deadlines for these two documents, the Aquatic Nuisance Species Management Plan Annual Report (typically filed April 1) and Water Temperature Annual Report (typically filed April 30), to May 31, similar to the other resource management plan annual reports.

Per this Aquatic SWG discussion and request, Gingerich said Douglas PUD is requesting Aquatic SWG approval of this letter. If approved by FERC, this will enable Douglas PUD to provide a more comprehensive annual report package to the Aquatic SWG for review (as opposed to individual reports with several different deadlines for comment submittals). Gingerich noted that some annual document deadlines will remain the same, e.g., the Total Dissolved Gas Abatement Plan Annual Report and Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan, and therefore will have different deadlines than May 31. He said those document deadlines cannot be changed due to environmental timing such as bypass season. He added that approving this letter now will hopefully allow time for FERC to process the request before the April 2017 deadlines.

Aquatic SWG members present approved the Aquatic SWG request and letter to FERC; Consolidation of Aquatic Settlement and Water Quality Certification Reporting Deadlines.

4. **2017 Pacific Lamprey Passage Workshop:**

John Ferguson said today’s workshop is a follow-up to the 2016 Pacific Lamprey Passage Workshop held on June 8, 2016. He said today’s agenda continues discussions about Pacific lamprey, including review of results of research conducted to date, notably the...
ongoing 2016 Pacific Lamprey Study data, review of governing documents, and discussing next steps, including plans for Pacific lamprey studies in 2017 and beyond. He said another goal of today’s workshop is to identify working hypotheses to focus on within the Aquatic SWG. Ferguson added that today’s discussions will likely continue throughout the year.

2016 Pacific Lamprey Passage Workshop – Recap (John Ferguson):
Ferguson said the workshop held on June 8, 2016, began with review of Douglas PUD FERC license and ASA requirements, as a refresher about what governing processes require for Pacific lamprey in terms of Douglas PUD and Aquatic SWG responsibilities. Ferguson recalled that this discussion was fundamental to discussing planning for the Douglas PUD 2016 Pacific Lamprey Study. He said the workshop also focused on critical uncertainties about Pacific lamprey passage, and there was also a summary on Chelan PUD and Grant PUD Pacific lamprey topics.

Douglas PUD 2016 Pacific Lamprey Study – Results to Date (Chas Kyger):
Chas Kyger said a Douglas PUD 2016 Pacific Lamprey Study Update (Attachment D) was distributed to the Aquatic SWG by Kristi Geris on January 10, 2017. Kyger recalled that study rationale from previous years was based on the assumption that translocated Pacific lamprey would approach and actively pass Wells Dam, and past studies also relied on translocated fish in an attempt to increase sample size. He said the 2016 Pacific Lamprey Study shifted to a more approach-based focus to determine what fish are doing between Rocky Reach and Wells dams. He said Douglas PUD believes that a critical first step in determining how fish pass Wells Dam is understanding whether the assumption is met that study fish want to pass Wells Dam. He said Douglas PUD acoustically tagged 51 Pacific lamprey collected at Priest Rapids Dam, and released the fish 1 mile upstream of Rocky Reach Dam. He said Grant PUD also acoustically tagged 100 Pacific lamprey collected at Priest Rapids Dam and released the fish at various locations between Priest Rapids and Wanapum dams. He said all these fish are available for analysis.

Kyger said Attachment D includes data for Douglas PUD acoustically tagged fish (51 fish) and Grant PUD acoustically tagged fish that have passed Rocky Reach Dam (33 fish), totaling 84 study fish. He noted very few fish have been detected in the tailrace of Wells Dam; there are four to ten fish, depending on the boundary of the tailrace. He recalled the null hypothesis assumed that 50% of the tagged fish will approach the dam and enter the tailrace, based on the option for a tagged fish to move either upstream or downstream after release. He said, at this point, it seems that approach is something to focus on because not
enough fish are approaching Wells Dam to draw conclusions on possible issues with passage at the dam.

Bob Rose asked about detections at other upstream or downstream receivers, and Kyger said those data have not yet been analyzed. Kyger said analyses to date have only focused on the Wells Dam tailrace, and he added that other data will be analyzed eventually. Rose expressed interest in the fate of those fish, noting that this should be available in the receiver data. He asked about detection efficiency in the receivers, particularly at Gateway (see Attachment D). Kyger said Douglas PUD is confident detection efficiency is at or near 100% for Douglas PUD receivers, based on tag testing. He said Gateway is a Chelan PUD receiver and, for white sturgeon, Chelan PUD indicated detection efficiency was 100%. Andrew Gingerich noted that Table 2 in Attachment D shows 100% detection efficiency when Gateway and GW-TR transition were combined. He said all fish subsequently detected at upstream locations were detected at either Gateway or GW-TR transition. Jason McLellan said he is not disputing detection efficiency is probably high; however, it may not be 100%. He said for example, fish may pass Gateway but not get detected. He also noted Tag 44867 in Table 2 of Attachment D was not detected at Gateway, but was detected at GW-TR transition. He said there could also be code collision issues, or detection differences between the types of tags used between the two PUDs or other equipment differences. Gingerich agreed, and noted he was referring only to fish detected at Gateway and GW-TR transition and subsequently detected at an upstream location.

Ferguson asked about the disposition of study fish not included in Table 2 of Attachment D. He asked how long the tags are operable, what is the frequency of Chelan PUD downloads, and what is the spatial resolution. Kyger said Grant PUD tags are programmed differently than Douglas PUD tags. He said Grant PUD tags are programmed to switch to sleep mode this time of year, and Douglas PUD tags are operable year-round. He acknowledged that operating the tags year-round limits the tag life; however, he said Douglas PUD adjusted the ping rate to help the tags last longer (at least through spring 2017). He said the receivers are installed at about 10- to 15-mile intervals throughout the Rocky Reach Reservoir. He said this provides information on the last detection location; however, it does not provide the type of resolution needed to inform disposition, mortality, holding, or spawning in the mainstem. Ferguson asked about mobile tracking, and Kyger said the study plan does not include specifics on mobile tracking; however, if fish are observed holding in a particular zone, mobile tracking could be a tool to obtain more data. Kyger said there is one such area, Sun Cove (previously referred to as Duck Tail Rock), located about 18 to 20 miles downstream of Wells Dam. He said last year, fish seemed to be holding in that area, which seems to be the pattern this year, too. He said there is no known tributary in that area, but
there is a deep trench with a rocky floor, which might serve as good cover from predators. He said it is unknown why fish seem to hold there. Gingerich noted that the deep trench may also be the location of expelled tags from Pacific lamprey that were predated upon by white sturgeon. McLellan suggested setting up four VR2W (Vemco) receivers around the hole for 1 to 2 hours and running a Vemco Positioning System to confirm whether fish are aggregating in a hole. He said this is a way to evaluate this question, if there are available funds.

Rose agreed with McLellan, and further supported conducting mobile tracking, as needed, to provide insight. He said the whole point of this workshop is to better understand what is happening. He suggested more tags and more cooperation, in less time than in the past. He said about 100% detection efficiency is needed, otherwise there will only be speculation. Ferguson noted that the 2016 Pacific Lamprey Passage Workshop focused more on regional coordination; however, this workshop is more focused on the Wells Project. Gingerich said, from Douglas PUD’s perspective, the 2016 Pacific Lamprey Study is already stepping out of the purview of FERC License No. 2149 and the ASA since tracking in the Rocky Reach Reservoir is outside the Wells Project boundary. He said Douglas PUD wants to conduct studies to address Wells Project effects if and where they exist; however, this is based on the assumption that fish want to interact with Wells Dam. He said the 2016 Pacific Lamprey Study is in the Rocky Reach Reservoir, which is not in the Wells Project. He said he hopes the Aquatic SWG can acknowledge this. Rose said, as he and others have stated for years, some of these questions are common for all PUDs, but then each PUD retreats to its own confines and time goes by. He said the PUD boundary model is no longer useful, and he hopes the PUDs can embrace this. He said if this is not obvious to all PUDs, agencies need to start writing letters. Gingerich said he appreciates the frustration; however, he argued that Douglas PUD has not retreated, and the 2016 Pacific Lamprey Study is an example of this. He said Douglas PUD released tagged study fish in the Rocky Reach Dam forebay, outside of the Douglas PUD boundary, and he believes that FERC would support the notion that tracking fish outside of project boundary falls outside of the Pacific Lamprey Management Plan and ASA actions, or protection, mitigation, and enhancement measures. He added that some criticism is appropriate, but not all. Rose said he appreciates the comments, and assured the Aquatic SWG that Chelan PUD will be a part of this, as well.

Ferguson asked the Aquatic SWG for suggestions on how to start discussions with the RRFF. Rose suggested drafting SOAs that show interest in a regional effort. He said, for example, he believes there is reasonable likelihood that translocating adult Pacific lamprey upstream of Wells Dam will encourage a certain percent of other Pacific lamprey to pass Wells Dam. He said this may require a lot of fish (juveniles and adults), and all PUDs need to embrace this
and help fund it. He said a systematic, cohesive, larger-scale study is needed, which includes getting adults and juveniles in upstream habitats. He said the Aquatic SWG can keep discussing these data to date; however, he interprets the data as confirming the effort is just tip-toeing along, and the resource is suffering all the while. Ferguson noted that these data do suggest the Rocky Reach Reservoir is likely an area of focus, which is why he asked about coordination between forums.

Ferguson asked about timing for the next data download with regard to what data will be available for discussing the 2017 study design. Kyger said Douglas PUD will have downloads from at least the Douglas PUD receivers in the Wells Dam tailrace by early spring. He said he cannot speak with certainty as to when Chelan and Grant PUDs will download their receivers; however, he believes they plan to download their receivers shortly after the tags wake up in the spring. He said Douglas PUD will distribute a report summarizing the results as soon as possible, and then the study hypotheses will be reviewed to determine the next logical step. He noted that Douglas PUD is not debating if fish want to pass upstream of Wells Dam; rather, the current focus is evaluating this assumption for passage at Wells Dam. He said, at this point in time, it seems that adequate data are not available to at this time to inform discussions of modifications at Wells Dam. He said the objectives of the 2016 Pacific Lamprey Study are not Douglas PUD’s only goals; however, Douglas PUD’s FERC license stipulates figuring out passage issues at the concrete. He said Douglas PUD is also interested in this regional, larger-scale study.

ASA Adaptive Management (Andrew Gingerich):
Gingerich presented slides on adaptive management (Attachment E), which Geris distributed to the Aquatic SWG following the meeting on January 11, 2017. Gingerich read slide 1 of Attachment E, which he said is adaptive management language copied directly from the ASA. He reviewed slide 2 of Attachment E, which demonstrates how Douglas PUD has executed adaptive management steps A and B, as outlined in the ASA, through implementation of the 2016 Pacific Lamprey Study.

YN Translocation Policies (Draft Bonneville Power Administration Report) and Anticipated Implementation Actions (Bob Rose):
Rose said the YN does not have translocation policies, per se; rather, YN translocation efforts are all very technical. He said the YN are still internally discussing the best approach to these efforts. He said ongoing discussions are often about numbers, what is available, where to capture, and where to distribute. He said all of this is starting to take shape; however, nothing is final. He said, with regard to the Wells Project, whether or not 200 or 400 fish are translocated upstream of Wells Dam is still quite subjective. He welcomed this discussion.
with the Aquatic SWG, including what the forum can do to bring the Methow and Okanogan rivers into the fold and have the necessary resources to conduct M&E. He said the YN are very interested in getting fish upstream of Wells Dam, noting he believes this is a very germane thing. He said Ralph Lampman (YN) wonders if there are enough pheromones upstream of Wells Dam. He suggested that perhaps a lot more adult pheromone is needed upstream of Wells Dam, along with pheromones produced by juvenile lamprey. Rose said he believes this is a reasonable hypothesis. He said the YN are only able to extract x-number of fish from the lower Columbia River, which is defined by the Columbia River Inter-Tribal Fish Commission. He said this number ends up being about 1,000 fish per year, split among tribes. He said more fish are needed, and care needs to be taken not to mix those fish with fish predestined to the Snake River. He said useful information on the success of translocating Pacific lamprey has been obtained by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Nez Perce, and the YN are also starting to obtain useful information. He suggested something similar is needed in the Upper Columbia River. He said, when the PUDs begin working together and have a strong collection effort, the YN believe there will be more pheromones from juveniles and adults, and better Pacific lamprey numbers overall in the Methow and Okanogan rivers. He said the YN do not believe this is a Bonneville Power Administration (BPA)-funded Columbia Basin Fish Accords projects; rather, he suggested this is a PUD project. He added that, over time, it has become more evident this needs to happen in a more coordinated way.

Steve Lewis asked, with regard to adaptive management, has the threshold been passed to explore translocation for the Wells Reservoir and should the Aquatic SWG begin defining what this will look like. Rose said he believes so. He said translocation is not included in the adaptive management language; however, he believes the Aquatic SWG should do what makes sense, and translocation seems to make sense. He said he does not believe the current studies are very accurate, noting that if there is no solid trail for adults to follow from pheromones, then it seems the overall lifecycle is incomplete. Lewis asked if the Aquatic SWG were to pursue pheromones, how this would take shape. He recalled, for example, discussing the possibility of conducting tests directly in the fishway to ground truth this hypothesis before translocating fish. The Aquatic SWG agreed to postpone this discussion until after hypotheses and prioritization are further discussed.

Ferguson asked why the Wenatchee River is not included in the Draft BPA Report and Draft YN Pacific Lamprey Supplementation and Monitoring Frameworks. Rose said this is one topic the YN are still debating. He said he believes if fish are translocated into the Wenatchee River basin and are reared at the Dryden Acclimation Facility, for example, this will solve the pheromone issue. He also noted, however, the YN is discussing adopting the
approach where Pacific lamprey are allowed to pass Tumwater Dam and distribute and colonize habitats naturally. He said there is disagreement within the YN, and this is still under discussion.

CCT Translocation Policies and Implementation Plans (Jason McLellan):
McLellan said these discussions are still under development.

Hypotheses for Poor Approach Behavior or Passage at Wells Dam (All):
Ferguson reviewed hypotheses discussed to date as to why approach behavior or passage at Wells Dam is poor, including lack of pheromones; poor hydraulic conditions at fishway entrances; upper-dam bioenergetics; and project operations having changed tailrace hydraulic patterns. Ferguson said this is an open discussion about these and other possible hypotheses, with the goal of prioritizing a select few for study in 2017.

Poor Hydraulic Conditions at Fishway Entrances
Rose asked what the fishway entrances look like under water, and suggested this as a good place for white sturgeon to hold and prey on Pacific lamprey. He asked if Pacific lamprey would also be exposed to reasonably higher velocities at the fishway entrances. Gingerich shared a figure of a cross section of the fishway entrance at Wells Dam (Attachment F), which Geris distributed to the Aquatic SWG following the meeting on January 11, 2017. McLellan said this may be a good location for white sturgeon to hold; however, Pacific lamprey ascended several dams downstream of Wells Dam with the same presence of white sturgeon. He added that it seems Pacific lamprey numbers at the Wells Dam fishway entrance were in the 100s until about 2006, and then dropped to the 20s; and this steep decline does not align with white sturgeon supplementation. He said he is not ruling out that white sturgeon may affect Pacific lamprey behavior to some degree; however, he is not sure it is the cause of the wholesale decline. Gingerich noted that Douglas PUD has a couple of VR2W receivers installed in the Wells Dam collection gallery and can review these data for detections of Chelan PUD-tagged white sturgeon at the fishway entrance. Lewis asked if white sturgeon have ever been recovered during dewatering of the Wells Dam fishways. Kyger said a few years ago, one small juvenile white sturgeon was recovered in the collection gallery.

Rose said, with regard to velocities at the fishway entrances, it seems, based on past studies (notably the Dual Frequency Identification Sonar [DIDSON] camera studies), those fish were having a hard time entering and staying in the fishway. He said these studies suggest the fishway is not conducive for Pacific lamprey passage. Gingerich noted that those same hydraulic conditions were present when there were 30 to 40% conversion rates, indicating a number of fish were able to pass during those conditions years ago. Kyger added that
studying hydraulic conditions at the fishway entrances may be an even lesser priority because not even 5% of study fish are reaching the fishway entrances. Ferguson asked Rose if he is suggesting, while evaluating reservoir issues, that the Aquatic SWG not lose sight of entrance conditions as well, and Rose said that is correct. He suggested considering not only biological, but physical constraints.

**Rocky Reach Reservoir Mortality, Fate within the Rocky Reach Reservoir, and Mainstem Spawning**

Rose suggested, in response to McLellan’s comment about white sturgeon presence at the fishway entrances, that there may be some imbalance of Pacific lamprey pheromone coupled with white sturgeon presence that deters Pacific lamprey. He suggested conversely, if there was more Pacific lamprey pheromone, it may surpass the deterring effects of white sturgeon presence. McLellan agreed there is likely an ideal balance, and white sturgeon have some impact on that balance. He said, however, he would not make this judgment based on the information available. He added that he could probably make a stronger argument for stocking white sturgeon in the Rocky Reach Reservoir in 2003. He said those fish are probably quite large now, and could be the cause of declining Pacific lamprey numbers. He said he is not suggesting this, but just mentioned it for the sake of argument. Lewis also agreed that historically, there was balance between white sturgeon and Pacific lamprey in the reservoirs, and over time this balance has been disrupted.

Gingerich asked what proportion of acoustically tagged white sturgeon have been detected in the Wells Dam tailrace versus the Wells Reservoir. Dave Robichaud said random indexing shows there are two pockets of concentrations, and tracking data show white sturgeon prefer the upper reservoir. He said two lines of evidence indicate there are a lot of white sturgeon in the Wells Dam tailrace; however, this may not be the case. He said the issue with random indexing is it is one snapshot. Gingerich said he is interested in acoustic data during the months of June through September, because Pacific lamprey were released in the Rocky Reach Dam forebay; if white sturgeon were stacked in the Wells Dam tailrace, this could explain why Pacific lamprey did not want to approach Wells Dam.

Ferguson said while discussing this topic of Pacific lamprey with Mary Moser (National Marine Fisheries Service), she asked about the disposition of the fish and suggested that mortality in the Rocky Reach Reservoir may be a factor. Ferguson said Moser also indicated that researchers in the Great Lakes are investigating using predator scent to deter sea lamprey from entering streams, and suggested this may have merit with Pacific lamprey, as well. Lewis asked if Moser had literature on this, and Ferguson said she did not. Moser indicated that a graduate student at Central Washington University conducted laboratory
Aquatic Settlement Work Group

studies of the effects of white sturgeon scent on Pacific lamprey behavior. Ferguson also suggested considering the effects of white sturgeon hatchery rearing at Wells Fish Hatchery on Pacific lamprey. He said the effluent from the hatcheries may affect Pacific lamprey migration. He said he spoke with Tracy Hillman, who indicated a white sturgeon was detected in a fish ladder at a Grant PUD facility and Pacific lamprey vacated the area. Ferguson said Hillman agreed Pacific lamprey could be sensitive to olfactory cues. Lewis also agreed there is a link.

Gingerich asked about other evolutionary driving factors, such as mainstem spawning. He said considering Pacific lamprey use their own muscle reserves for energy, he questioned what the tradeoffs are for fish migrating farther, but at a potential cost of reproduction or gonadal development, especially for a panmictic fish that does not need to return to a natal spawning stream, like salmonids. He asked, if there is available habitat downstream of Wells Dam, would Pacific lamprey spawn lower downstream opposed to migrating farther and using energy for migration and not reproduction. Rose said it seems fish will go as far and wide as possible.

McLellan said it seems numbers coming over Rocky Reach Dam are relatively consistent and high. He said it is unknown how many fish are actually reaching Wells Dam; however, telemetry data suggest not many. He said there have been no major operational or structural changes to Wells Dam. He said, based on these factors, it seems that evaluating Rocky Reach Reservoir mortality or fate within the Rocky Reach Reservoir should be a priority. Rose asked if McLellan is indicating he believes it is reasonable that white sturgeon are accumulating and predating upon Pacific lamprey in the upper Rocky Reach Reservoir, particularly later in the summer and early fall when Pacific lamprey are present. McLellan said he believes there is the opportunity for white sturgeon to prey on Pacific lamprey between Rocky Reach and Wells dams. Rose added that it seems the river constricts in that area, providing less places to hide.

Ferguson asked about the influence of stocking white sturgeon in the Rocky Reach Reservoir, and McLellan suggested this falls under reservoir mortality. He added that he believes Chelan PUD plans to analyze stomach contents of white sturgeon this year, and Chad Jackson said he believes this was started last year.

Lack of Juvenile and Adult Pheromones
Rose said he agrees reservoir mortality is a high priority, and suggested another high priority is the lack of juvenile and adult pheromone cues to drive fish upriver. Gingerich agreed the Aquatic SWG has discussed lack of pheromones, and there is interest in a translocation effort, to some degree. He said this is part of the reason behind having Aaron Jackson (CTUIR) and
Lampman participate in these discussions. Gingerich said, with regard to testing this hypothesis, it seems a number of fish will be needed at a certain location before there is a response. He added that he is unsure there will be a response after only 1 year, and suggested first translocating juvenile pheromones and then retesting. Rose agreed, and suggested 5 to 7 years may be needed to obtain sufficient numbers of fish upstream of Wells Dam to produce a sufficient signal without inserting artificial pheromones. Ferguson asked about the pheromone concentrations present in the Methow River, with regard to ensuring the signal upstream of Wells Dam is significant. Rose suggested researching the Entiat River where it seems juvenile Pacific lamprey and habitat already exist. Gingerich noted, however, data indicate very few Pacific lamprey entered the Entiat River in 2016. Ferguson also cautioned investing a lot of effort in pheromones, noting that most available pheromone research has only been on sea lamprey where there has been a suite of bioassays to show cause and effect. He said he is uncertain significant research has been conducted with Pacific lamprey, which ultimately comes back to concentration, cause and effect, and what pheromones to measure. He said, in the end, it may be unknown whether pheromones made a difference at all.

Upper-Dam Bioenergetics
Ferguson recalled Patrick Verhey mentioning this hypothesis during a past meeting. Ferguson said it seems bioenergetics could be on the list of hypotheses to follow up on, because there are data to analyze it. Lewis asked if data are available on girth of tagged individuals when passage at Wells Dam was higher, and what other data might be available. Kyger said he is not sure datasets exist from when there were greater numbers of Pacific lamprey passing Wells Dam versus present day. He said there is strong evidence Pacific lamprey are getting smaller as they migrate upstream. Gingerich said there are data, which suggest larger fish are more successful in passing dams and migrating farther upstream. He said data from past Douglas PUD studies do not suggest fish size was a factor, but he is uncertain what the 2016 data indicate. Ferguson recalled Moser suggesting bioenergetics would be lowest priority factor to study on the list from her perspective, based on laboratory work on Pacific lamprey that were held for 2 years and then successfully spawned. Ferguson said Moser believes these fish have evolved and adapted to long-term starvation periods while still preserving the ability to successfully reproduce. Ferguson said the graduate student work previously referenced also suggests a similar notion. Robichaud said fish size data are available from the 2016 Pacific Lamprey Study, but the analyses have not yet been run. Gingerich said mean size at each detection point can easily be reviewed.
Changes at Wells Dam
Ryan Fortier (WDFW) asked about any changes at Wells Dam. Gingerich said there has been some operational variability year to year, but very few structural changes in the recent past. He recalled concern about salmonids holding in the collection gallery, which prompted adding a baffle to increase velocity from the collection gallery into Weir 1, to encourage salmon to move through the area quicker. He said this is the only structural change and it does not align with the decline in Pacific lamprey numbers.

Changes to the Spill Playbook
Lewis asked if changes to the Spill Playbook might affect Pacific lamprey approaching Wells Dam. Gingerich said this might be worth looking into; however, the majority of these changes occurred after the large drop in fish counts. He also noted Pacific lamprey usually migrate through the area during the time of year when there is not a lot of spill. He suggested, based on these factors, this hypothesis be moved farther down the list to consider.

Prioritized Hypotheses and Next Steps (All):
Ferguson summarized (in no particular order) the following three hypotheses identified as priorities for study in 2017: 1) lack of juvenile and adult pheromones; 2) poor hydraulic conditions at fishway entrances; and 3) reservoir mortality, fate in reservoir, and mainstem spawning. The following next steps were also identified as described below.

Fish Forum Coordination
Ferguson asked how to initiate coordination between the Aquatic SWG and RRFF. Rose suggested developing an SOA, either issued from the YN or jointly, recognizing Pacific lamprey passage at Wells Dam is an issue which transcends one PUD and there are specific management questions that need to be addressed in a more holistic manner rather than an individual approach. He suggested pushing such an SOA forward and getting the PUDs to respond. He also noted an SOA might help define roles of coordination, and suggested that Ferguson notify Hillman this effort is underway. Ferguson said he will contact Hillman to notify Hillman the Aquatic SWG began discussing how to improve coordination between the Aquatic SWG and the RRFF with regard to Pacific lamprey behavior and survival in the Rocky Reach Reservoir. (Note: Ferguson notified Hillman, as discussed, on January 16, 2017.)

Study Fish Fate in the Rocky Reach Reservoir
McLellan suggested gaining a better understanding about study fish fate in the reservoir (are fish still alive or not). He said it is not clear where these fish are moving or end up. He
suggested summarizing detections of fish, and once there is a clearer idea about fate, causes of that fate can be assessed. Douglas PUD, in coordination with Robichaud, will synthesize Douglas PUD and Grant PUD 2016 Pacific lamprey Study data collected to date to demonstrate the behavior of each tagged individual, for discussion during the Aquatic SWG meeting on February 8, 2017. McLellan requested that sample size and total detections by tag code are included. *(Note: Kyler provided these data to Geris on January 13, 2017, which Geris distributed to the Aquatic SWG that same day.)*

*Initial Discussion of 2017 Study Plan Development*

Rose said he would like to begin discussing what might be possible in terms of a study in 2017. He said he has already been discussing this and a tour of the dewatered fishway at Wells Dam with Gingerich. Rose acknowledged the time constraints already present for a study this year; however, he indicated he would like to begin translocation efforts, if possible. He suggested further discussing these hypotheses soon. The Aquatic SWG will further discuss Pacific lamprey passage hypotheses and study plans for 2017 during the Aquatic SWG meeting on February 8, 2017.

Gingerich agreed discussing hypotheses soon is good, and extended the invitation to tour the dewatered fishway at Wells Dam to all Aquatic SWG members. Aquatic SWG members will contact Gingerich if there is interest in touring the west fish ladder at Wells Dam while the ladder is dewatered; the ladder will be dewatered for 2 to 3 weeks starting on January 19, 2017. *(Note: Rose, Fortier, Gingerich, and Kyler toured the entire dewatered west fishway on January 23, 2016.)*

5. **Draft 2016 Total Dissolved Gas Abatement Plan Annual Report and Draft 2017 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan (Andrew Gingerich):**

Andrew Gingerich reminded the Aquatic SWG that Kristi Geris sent an email on January 5, 2017, notifying the Aquatic SWG that the Draft 2016 Total Dissolved Gas Abatement Plan Annual Report and Draft 2017 Total Dissolved Gas Abatement Plan and Juvenile Fish Bypass Operating Plan are available for a 30-day review period, with edits and comments due to Gingerich by Monday, February 6, 2017. Gingerich said Douglas PUD will request approval of both documents during the Aquatic SWG meeting on February 8, 2017.

**VII. Next Meetings**

1. **Upcoming meetings (John Ferguson):**

   The Aquatic SWG meeting on February 8, 2017, will be held by conference call.
Upcoming meetings are as follows: February 8, 2017 (conference call); March 8, 2017 (TBD); and April 12, 2017 (TBD).

VIII. Wells Dam Fish Ladder Tour

1. Wells Dam Fish Ladder Tour (All):
Originally, the west fish ladder at Wells Dam was scheduled to be dewatered for annual winter maintenance, and a tour of the ladder in the dry was planned for interested Aquatic SWG members and Pacific Lamprey Passage Workshop attendees. Due to unexpected bad weather, the west fish ladder was not yet dewatered; however, Douglas PUD still provided a short tour of the upper end of the west fish ladder in the wet. Aquatic SWG members present also toured the Wells White Sturgeon Fish Hatchery. Douglas PUD is still offering tours of the west fish ladder, once dewatered, to those interested. (Note: Bob Rose, Ryan Fortier, Andrew Gingerich, and Chas Kyger toured the entire dewatered west fishway on January 23, 2016.)

List of Attachments

Attachment A  List of Attendees
Attachment B  Final White Sturgeon Stocking SOA, Wells Reservoir White Sturgeon Supplementation 2018-2022
Attachment C  Final Douglas PUD letter to FERC, Consolidation of Aquatic Settlement and Water Quality Certification Reporting Deadlines
Attachment D  Douglas PUD 2016 Pacific Lamprey Study Update
Attachment E  Adaptive Management Slides
Attachment F  Cross Section of the Fishway Entrance at Wells Dam
### Attachment A – Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
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<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Kristi Geris†</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
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<tr>
<td>Dave Robichaud†</td>
<td>Observer</td>
<td>LGL Limited</td>
</tr>
<tr>
<td>Bao Le†</td>
<td>Observer</td>
<td>HDR, Inc.</td>
</tr>
<tr>
<td>Steve Lewis†</td>
<td>Aquatic SWG Technical Representative</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Breean Zimmerman†</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Ryan Fortier</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Bob Rose†</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
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<tr>
<td>Jason McLellan†</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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**Notes:**
† Joined by phone
APPENDIX D
2016 WHITE STURGEON MANAGEMENT PLAN ANNUAL REPORT, 2016 BULL TROUT MANAGEMENT PLAN ANNUAL REPORT, 2016 WATER QUALITY MANAGEMENT PLAN ANNUAL REPORT, 2016 PACIFIC LAMPREY MANAGEMENT PLAN ANNUAL REPORT, 2016 AQUATIC NUISIBLE SPECIES MANAGEMENT PLAN ANNUAL REPORT, AND 2016 RESIDENT FISH MANAGEMENT PLAN ANNUAL REPORT
2016 BULL TROUT MANAGEMENT PLAN AND INCIDENTAL TAKE ANNUAL REPORT

WELLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 2149

April 15, 2017

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington
EXECUTIVE SUMMARY

The Bull Trout Management Plan (BTMP) and Incidental Take Annual Report includes information on existing bull trout measures required by the Wells Hydroelectric Project (Wells Project or Project) Federal Energy Regulatory Commission (FERC) operating license including the U.S. Department of Interior’s Federal Power Act section 18 Fishway Prescriptions; the Clean Water Act section 401 Water Quality Certification; and Endangered Species Act (ESA) section 7 bull trout consultation for the relicensing of the Wells Project. The 2012 Biological Opinion (BO) for the Wells Project (resulting from ESA consultation) requires Public Utility District No. 1 of Douglas County (Douglas PUD) to monitor incidental take during Wells Project license implementation activities and submit a bull trout annual take report to the Central Washington Field Office of the U.S. Fish and Wildlife Service (USFWS) on or before April 15th each year. Article 406 of the license requires Douglas PUD to submit an annual report of management plan activities by May 31st of each year.

Since measures required by the BO are largely consistent with the measures found in the BTMP and because the reporting requirements for the BTMP, BO, Clean Water Act section 401 Water Quality Certification, and the FERC license are largely consistent, this 2016 Bull Trout Management Plan and Incidental Take Annual Report will be used to demonstrate compliance with all of Douglas PUD’s bull trout obligations for the Wells Project.

The goal of the BTMP is to identify, monitor, and address impacts on bull trout (Salvelinus confluentus) resulting from the Wells Project in a manner consistent with the USFWS Bull Trout Recovery Plan and the terms of the Section 7 Incidental Take Statement (ITS). The BTMP is intended to continue the implementation of management activities to protect bull trout during the new license term in a manner consistent with the original Wells Bull Trout Monitoring and Management Plan (Douglas 2004). The Protection, Mitigation and Enhancements presented within the BTMP are designed to meet the following objectives:

Objective 1: Operate the upstream fishways and downstream bypass systems in a manner consistent with the Wells Project Habitat Conservation Plan (HCP). In 2016, Douglas PUD maintained safe, efficient and timely passage through the downstream juvenile fish bypass system and upstream adult fishway passage structures for bull trout and conducted video monitoring of the Wells Dam fishway viewing windows during the fish passage season. Douglas PUD continued to operate the juvenile fish bypass system at Wells Dam in accordance with criteria outlined in the HCP.

Objective 2: Identify any adverse Project-related impacts on adult and sub-adult bull trout passage. In 2016, Douglas PUD conducted a study designed to examine bull trout passage and survival at the Twisp River Weir and Wells Dam. Preliminary results are reported in this annual report, however the study will continue in the spring and summer of 2017.

During 2016, fewer than 10 sub-adult bull trout have been observed at Wells Dam. Adult counts remained below twice the 5-year average. As such, no new bull trout related monitoring activities were proposed or implemented.
Objective 3: Implement reasonable and appropriate options to modify upstream fishway, downstream bypass, or operations if adverse impacts on bull trout are identified and evaluate the effectiveness of these measures. No adverse impacts to bull trout were identified in 2016.

Objective 4: Periodically monitor for bull trout entrapment or stranding during low Wells Reservoir elevations (i.e., below 773’ mean sea level [msl]). On May 3, 2016 the Project forebay reached 773’ msl. This low elevation was a result of Wells Dam hydroelectric Project operations that were designed to flush the Methow River delta using newly refurbished rock groins. This flushing was necessary to facilitate the removal of deposited fine material that builds up in the lower mile of the Methow River as the river meets the Columbia. Moving this fine material provides a safeguard against flooding areas of the town of Pateros, Washington.

Consistent with license requirements, on May 4, 2016 Douglas PUD biologists conducted a Wells Project stranding, entrapment and take survey consistent with regulatory requirements. No bull trout were observed in stranding pool. Results from this survey are provided in this annual report.

Objective 5: Participate in the development and implementation of the USFWS Bull Trout Recovery Plan including information exchange and genetic analysis. Should bull trout be delisted, the Aquatic Settlement Work Group will re-evaluate the needs and objectives of the BTMP. In 2016, Douglas PUD continued to participate in regional and technical meetings specific to bull trout recovery including the development of the Recovery Unit Implementation Plan for bull trout. Genetic samples were collected in 2016 during the bull trout passage and survival study.

Objective 6: Identify any adverse impacts of Project-related hatchery operations on adult and sub-adult bull trout. In 2016 bull trout were encountered in the Twisp and Methow Rivers and Wells Dam fish traps. In addition, bull trout were encountered during the Twisp River Population study. All encounters fell below take limits listed in the USFWS Biological Opinion for Douglas PUD.
1.0 INTRODUCTION

The Bull Trout Management Plan (BTMP) is one of six resource management plans developed by Public Utility District No. 1 of Douglas County (Douglas PUD). The BTMP directs the implementation of measures to mitigate Wells Hydroelectric Project (Wells Project or Project) impacts, if any, on bull trout (Salvelinus confluentus) and to monitor incidental take of bull trout at the Wells Project. The BTMP directs the long-term management of bull trout in the Wells Project. Additionally, the BTMP is intended to continue implementation activities aimed at protecting bull trout in a manner consistent with measures specified in the original Wells Bull Trout Monitoring and Management Plan (WBTMMP) (Douglas 2004).

To ensure active stakeholder participation and support, Douglas PUD developed all of the resource management plans found in the Aquatic Settlement Agreement in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). Entities invited to participate in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), and Douglas PUD.

In addition to the requirements found within the BTMP, the Endangered Species Act (ESA) section 7 Consultation and the Biological Opinion (BO) for the relicensing of the Wells Project, the Clean Water Act section 401 Water Quality Certification, and the Federal Energy Regulatory Commission (FERC) license including the Federal Power Act section 18 Fishway Prescription identify several additional bull trout related requirements associated with the continued operation of the Wells Project.

Since measures required by the BO are largely consistent with the measures found in the BTMP and because the reporting requirements for the BTMP, BO, Clean Water Act section 401 Water Quality Certification, and the FERC license are largely consistent, this 2016 Bull Trout Management Plan and Incidental Take Annual Report will be used to demonstrate compliance with all of Douglas PUD’s bull trout obligations for the Wells Project.

2.0 GOALS AND OBJECTIVES

The goal of this report is to present summary information related to BTMP activities conducted in 2016 and after Wells Dam Operating license was issued in November 2012. The goal of the BTMP is to identify, monitor and address impacts, if any, on bull trout resulting from the Project in a manner consistent with the USFWS Bull Trout Recovery Plan and the terms of the Section 7 Incidental Take Statement (ITS) (See Section 4.7). The Protection, Mitigation and Enhancement measures (PMEs) presented within the BTMP are designed to meet the following objectives:

Objective 1: Operate the upstream fishways and downstream bypass systems in a manner consistent with the Hatchery Conservation Plan (HCP);
Objective 2: Identify any adverse Project-related impacts on adult and sub-adult bull trout passage;

Objective 3: Implement reasonable and appropriate options to modify upstream fishway, downstream bypass, or operations if adverse impacts on bull trout are identified and evaluate effectiveness of these measures;

Objective 4: Periodically monitor for bull trout entrapment or stranding during low Wells Reservoir elevations (similar to the WBTMMP);

Objective 5: Participate in the development and implementation of the USFWS Bull Trout Recovery Plan, including information exchange and genetic analysis. Should bull trout be delisted, the Aquatic SWG will re-evaluate the needs and objectives of the BTMP;

Objective 6: Identify any adverse impacts of Project-related hatchery operations on adult and sub-adult bull trout.

In addition to the reporting BTMP activities, this report also addresses additional terms and conditions for bull trout as identified in the USFWS 2012 Biological Opinion for the Operation of the Wells Project and related facilities. As such, listed below are these terms and conditions that are largely consistent with BTMP measures.

To implement Reasonable and Prudent Measures (RPM) 1: FERC shall require Douglas PUD, in coordination with the Service, to provide adequate year-round passage conditions for bull trout at all Project facilities.

1. Upstream and Downstream Passage for Adult and Sub-Adult Bull Trout (BTMP Section 4.1.1): FERC shall require Douglas PUD, in coordination with the Service, to provide upstream passage for bull trout through the existing upstream fishways and downstream passage for bull trout through the existing downstream bypass system consistent with the HCP and Aquatic Settlement Agreement. Both upstream fishway facilities (located on the west and east shores) shall be operational year round with maintenance occurring on each fish way at different times during the winter to ensure that one upstream fishway is always operational. Operation of the downstream passage facilities for bull trout shall be consistent with bypass operations for Plan Species identified in the Wells HCP.

2. Bull Trout Passage Performance Standard (BTMP Section 4.3): FERC shall require Douglas PUD, in coordination with the Service, to implement the upstream and downstream measures contained in the Wells Hydroelectric Project BTMP to provide safe, timely, and effective upstream and downstream passage for adult and sub-adult bull trout at the Wells Hydroelectric Project. "Safe, timely and effective" passage shall be achieved when Douglas PUD has demonstrated that the survival and passage success rates for adult marked fish are greater than 95% and greater than or equal to 90%, respectively, and when passage studies demonstrate that the fishway facilities at Wells Dam do not impede the passage of bull trout. To ensure that safe, timely and effective passage at Wells Dam is maintained during the term of the new license, Douglas PUD
shall implement the bull trout upstream and downstream measures consistent with the BTMP.

3. **Upstream Fishway Operations Criteria (BTMP Section 4.1.3):** FERC shall require Douglas PUD, in coordination with the Service, to operate the upstream fishway at Wells Dam in accordance with criteria outlined in the Wells HCP.

4. **Bypass Operations Criteria (BTMP Section 4.1.4):** FERC shall require Douglas PUD, in coordination with the Service, to operate the bypass system at Wells Dam in accordance with criteria outlined in the Wells HCP.

5. **Implement Reasonable and Appropriate Measures to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull Trout are Identified (BTMP Section 4.3):** FERC shall require Douglas PUD, in coordination with the Service, to identify, design, implement, and evaluate reasonable and feasible measures to modify the upstream fishway, downstream bypass, or operations to reduce the identified incidental take of bull trout if monitoring (Term and Condition #10) identifies upstream or downstream passage problems for bull trout, in consultation with the Service, WCC and the Aquatic SWG. Study protocols and radio-telemetry assessment methodologies prescribed above in Term and Condition #10 and #11, shall be used to evaluate the effectiveness of any additional measures implemented to reduce the incidental take of bull trout. Upon completion of the evaluation, the Service and the NMFS, in consultation with the Aquatic SWG, and the WCC, will determine whether the proposed measure should be made permanent, removed, or modified.

To implement RPM 2: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of hydrographic variation to all life stages of bull trout at all Project facilities.

6. **Investigate Entrapment or Stranding of Bull Trout during Periods of Low Reservoir Elevation (BTMP Section 4.4):** FERC shall require Douglas PUD, in coordination with the Service, to continue to investigate potential entrapment or stranding areas for bull trout through periodic monitoring when periods of low reservoir elevation expose identified sites. During the first five years of the new license, Douglas will implement up to five bull trout entrapment/stranding assessments during periods of low reservoir elevation (below 773' msl). If no incidences of bull trout stranding are observed during the first five years of study, additional assessment will take place every fifth year during the remainder of the license term, unless waived by the Aquatic SWG. If bull trout entrapment and stranding result in take in exceedance of the authorized incidental take level, then reasonable and appropriate measures will be implemented by Douglas, in consultation with the Aquatic SWG, to address the impact.

To implement RPM 3: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of the Hatchery Supplementation Program to all life stages of bull trout.

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1 Refer to the USFWS 2012 reference in the literature cited page for reference.
7. **Bull Trout Monitoring During Hatchery Activities (BTMP 4.6.1):** FERC shall require Douglas PUD, in coordination with the Service, to monitor hatchery actions (e.g., salmon trapping, sturgeon capture activities) that may encounter adult and sub-adult bull trout resulting from incidental capture and take. Actions to be monitored shall be associated with the Wells Hatchery, the Methow Hatchery, and any future facilities directly funded by Douglas PUD. If the incidental take of bull trout is exceeded due to Douglas PUD’s hatchery actions then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

To implement RPM 4: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of implementing the Aquatic Resource Management Plans (white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality) and the Predator Control Program to all life stages of bull trout.

8. **Monitoring Other Aquatic Resource Management Plan Activities and Predator Control Program for Incidental Capture and Take of Bull Trout (BTMP Section 4.5.1):** FERC shall require Douglas PUD, in coordination with the Service, to monitor activities associated with the implementation of other Aquatic Resource Management Plans for white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality and Predator Control Program that may result in the incidental capture and take of bull trout. If the incidental take of bull trout is exceeded due to the implementation of other Aquatic Resource Management Plan activities, then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take. If the incidental take of bull trout is exceeded due to the implementation of the Predator Control Program, then Douglas PUD will develop a plan, in consultation with the HCP Coordinating Committee and the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

To implement RPM 5: FERC shall require Douglas PUD, in coordination with the Service, to design and implement a bull trout monitoring program that will adequately detect and quantify Wells Hydroelectric Project impacts, including those associated with the Wells Dam, Twisp Weir trapping facilities, and hatchery facilities. This information will allow the Service to determine whether authorized take levels are exceeded.

9. **Upstream Fishway Counts (BTMP Section 4.1.2):** FERC shall require Douglas PUD, in coordination with the Service, to conduct video monitoring in the Wells Dam fishways from May 1st through November 15th to count and provide information on the population size of upstream moving bull trout.

10. **Adult Bull Trout Upstream and Downstream Passage Evaluation (BTMP Section 4.2.1):** FERC shall require Douglas PUD, in coordination with the Service, to periodically monitor incidental take of bull trout through Wells Dam and in the Wells Reservoir through the implementation of a radio-telemetry study. Specifically, in years 5 and 10 of
the new license, and continuing every ten years thereafter during the new license term, Douglas PUD shall conduct a 1 year monitoring study to verify continued compliance with the bull trout passage performance standard (Term and Condition #2). These monitoring studies shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the monitoring results demonstrate continued compliance with the bull trout passage performance standard (Term and Condition #2), then no additional actions are needed. If the monitoring results demonstrate that Douglas PUD is no longer in compliance with the bull trout passage performance standard (Term and Condition #2), then the monitoring study will be replicated to confirm the results. If the results after two years of monitoring demonstrate that Douglas PUD is no longer in compliance with the bull trout passage performance standard (Term and Condition #2), then Douglas PUD shall, pursuant to Term and Condition #5, develop and implement additional measures to improve bull trout passage until compliance with the bull trout passage performance standard (Term and Condition #2) is achieved. If the bull trout counts at Wells Dam increase more than twice the existing 5-year average or if there is a significant change in the operation of the fish ladders, bypass, or hydrocombine, then Douglas PUD shall, in consultation with the Service, the Aquatic SWG, and the Wells HCP Coordinating Committee, shall conduct a 1 year, follow-up monitoring study to verify continued compliance with the bull trout performance standard (Term and Condition #2). Although the BTMP specifies Douglas PUD to utilize radio-telemetry as the recommended monitoring method, the Service concludes that future monitoring technologies may be utilized in the implementation of this term and condition.

11. Adult Bull Trout Passage Evaluation at Off-Project Collection Facilities (BTMP Section 4.2.2): FERC shall require Douglas PUD, in coordination with the Service, beginning in year one of the new license, to conduct a one-year radio-telemetry evaluation to assess incidental take of adult bull trout at the adult salmon and steelhead broodstock collection facilities associated with the Wells HCP, including but not limited to, the Twisp Weir adult collection facility. Douglas PUD shall capture and tag up to 10 adult, migratory bull trout (>400 mm) per assessment per year and use fixed receiver stations upstream and downstream of the collection facilities. Assessments shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the evaluation demonstrates that Douglas PUD is not in compliance with the bull trout passage performance standard (Term and Condition #2), then the evaluation will be replicated to confirm the results. If the results after two years of evaluation demonstrate that Douglas PUD is not in compliance with the bull trout passage performance standard (Term and Condition #2), then Douglas PUD shall develop, implement, and evaluate additional measures, in consultation with the Service, Wells HCP Coordinating Committee and the Aquatic SWG, until the Service determines that the bull trout passage performance standard has been achieved. At such time as the Service determines the bull trout passage performance standard has been achieved, the implementation of this measure shall be integrated into the 1 year telemetry monitoring program that is to be conducted every ten years (beginning in year 10 of the new license) at Wells Dam as identified in Term and Condition #10 above. Although the BTMP specifies Douglas PUD to utilize radio-telemetry as the recommended monitoring
method, the Service concludes that future monitoring technologies may be utilized in the implementation of this term and condition.

12. **Sub-Adult Bull Trout Monitoring (BTMP Section 4.2.3):** FERC shall require Douglas PUD, if at any time during the new license term, sub-adult bull trout are observed passing Wells Dam in significant numbers (>10 per calendar year), in consultation with the Service, and the Aquatic SWG, implement reasonable and appropriate methods for monitoring sub-adult bull trout. Although the BTMP states that >10 sub-adults per calendar year as the threshold, new information leads the Service to conclude that 31 sub-adults per calendar year is a more appropriate threshold. Specifically, Douglas PUD may modify counting activities, and shall 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. This activity shall occur the following year of first observation of sub-adult bull trout (>10 per calendar year), in consultation with the Service and the Aquatic SWG.

13. **Funding Collection of Tissue Samples and Genetic Analysis (BTMP Section 4.5.2):** FERC shall require Douglas PUD, in coordination with the Service, to collect up to 10 adult bull trout tissue samples in the Wells Dam fish way facilities over a period of one year and fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the bull trout radio-telemetry monitoring study. Any sub-adult bull trout collected during these activities will also be incorporated into the bull trout genetic analysis. Beginning in year 1 of the new license, Douglas will collect up to 10 adult bull trout tissue samples from the Twisp River broodstock collection facility over a period of one year and will fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the off-Project bull trout radio-telemetry monitoring study. This term and condition is consistent with other section 10(a)(1)(a) permits that involve handling of bull trout. The analysis will provide valuable information on the conservation status and genetic relationships between bull trout populations in the Columbia basin. This information will be used to determine the local populations impacted by Project operations, and when used in conjunction with other data such as movement data and redd counts, the resiliency of local populations impacted by the proposed action may be determined. Samples will be submitted to the Service (Central Washington Field Office in Wenatchee, Washington).

**Reporting Requirements**

In order to monitor the impacts of incidental take, Douglas PUD shall prepare an annual report describing the progress of implementation and its impact on the bull trout. The report, which shall be submitted to the Service (Central Washington Field Office) annually on or before April 15th, shall list and describe the work that was completed and the number of bull trout, if any, observed and/or incidentally taken (i.e., injured or killed) during the course of implementation.

Upon locating a dead, injured, or sick endangered or threatened species specimen, initial notification must be immediately made to the nearest Service Law Enforcement Office (Redmond, Washington; telephone 425-883-8122) and reported to the Service's Central
Washington Field Office (509-665-3508). Care should be taken in handling sick or injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species and preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Service Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. The RPMs, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take described above is exceeded, such additional take represents new information requiring reinitiating consultation (assuming the Commission retains discretion or control over the action) and review of the RPMs provided. Douglas PUD must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

3.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

Consistent with the BTMP and USFWS Biological Opinion Terms and Conditions, Douglas PUD, in consultation with the Aquatic SWG, has initiated the implementation of the following measures.

3.1 Operate the Upstream Fishways and Downstream Bypass Systems in a Manner Consistent with the HCP (Objective 1)

3.1.1 Provide Upstream and Downstream Passage for Adult and Sub-adult Bull Trout

Douglas PUD will continue to provide upstream passage for adult bull trout through the existing upstream fishways and downstream passage of adult and sub-adult bull trout through the existing downstream bypass system. Both upstream fishway facilities (located on the west and east shores) are operational year around with maintenance occurring on each fishway at different times during the winter to ensure that one upstream fishway is always operational. Maintenance activities on Wells fishways occur during the winter when bull trout have not been observed passing Wells Dam. Operation of the downstream passage facilities for bull trout will be consistent with bypass operations for Plan Species identified in the Wells HCP. Currently, the bypass system is operated from April 12 through August 26 of each year. This operating period is consistent with the period of high bull trout and anadromous fish presence at the Project.

3.1.1.1 Progress Towards Meeting Objective 1 in 2016 - Provide Upstream and Downstream Passage for Adult and Sub-adult Bull Trout

Consistent with the requirements of the FERC license for the Wells Project and the Wells HCP, Douglas PUD maintained safe, efficient and timely passage through the downstream juvenile fish bypass system and upstream adult fishway passage structures for bull trout. Winter maintenance occurred in the adult fishway structures in January 2016 and December 2016. At least one of the adult fishways was in operation at all times during the winter maintenance period.
(December – February) and both adult fishways were in operation for the remainder of the year (March – November).

Juvenile fish bypass operations were implemented consistent with the 2016 Bypass Operations Plan. Dates of operation included initiation on April 9 at midnight with the bypass system operated continuously through August 19. The 2016 dates of operation for the juvenile fish bypass system are the result of species run-timing estimates developed by the University of Washington and Columbia Basin Research. Operational dates were reviewed, approved and adopted by the Wells HCP Coordinating Committee and implemented by Douglas PUD prior to the beginning of the 2016 bypass season.

3.1.2 Upstream Fishway Counts

Douglas PUD shall continue to conduct video monitoring in the Wells Dam fishways from May 1st through November 15th to count and provide information on the population size of upstream moving bull trout.

3.1.2.1 Progress Towards Meeting Objective 1 in 2016 - Upstream Fishway Counts

Total upstream counts at Wells Dam fish ladder viewing windows was 51 bull trout in 2016. Counts in 2016 were below the five-year average from 2011-2015 by 39 fish. Ninety six percent of the passage occurred during the months of May and June, which is consistent with historic adult bull trout peak passage timing at Wells Dam normally May-July. This passage is often associated with upstream movement towards natal streams in the Methow River basin where spawning occurs in the fall.

3.1.3 Upstream Fishway Operations Criteria

Douglas PUD shall continue to operate the upstream fishway at Wells Dam in accordance with criteria outlined in the Wells HCP.

3.1.3.1 Progress Towards Meeting Objective 1 in 2016 - Upstream Fishway Operations Criteria

Consistent with the license and the Wells HCP, Douglas PUD continued to operate the two upstream fishways at Wells Dam in accordance with upstream fishway criteria found in the Wells HCP and as approved by the Wells HCP Coordinating Committee.

3.1.4 Bypass Operations Criteria

Douglas PUD shall continue to operate the bypass system at Wells Dam in accordance with criteria outlined in the Wells HCP.
3.1.4.1 Progress Towards Meeting Objective 1 in 2016 - Bypass Operations Criteria

Consistent with the license and the Wells HCP, Douglas PUD continued to operate the juvenile fish bypass system at Wells Dam in accordance with criteria outlined in the Wells HCP and as approved by the HCP Coordinating Committee.

3.2 Identify Any Adverse Project-related Impacts on Adult and Sub-adult Bull Trout Passage (Objective 2)

3.2.1 Adult Bull Trout Upstream and Downstream Passage Evaluation

Douglas PUD shall continue to monitor upstream and downstream passage and incidental take of adult bull trout through Wells Dam and in the Wells Reservoir through the implementation of a radio-telemetry study. Specifically, in years 5 and 10 of the new license, and continuing every ten years thereafter during the new license term, Douglas PUD will conduct a one-year monitoring program to determine whether Douglas PUD remains in compliance with the ITS. The same study protocols used during past radio-telemetry assessments at Wells Dam (LGL and Douglas PUD 2007) will be employed for these monitoring studies.

If the adult bull trout counts at Wells Dam increases more than two times the existing 5-year average or if there is a significant change in the operation of the fish ladders or hydrocombine, then the Aquatic SWG will determine whether additional years of take monitoring are needed beyond those identified in this section of the BTMP. If the authorized incidental take level is exceeded during any one-year period, Douglas PUD will conduct another monitoring study in the succeeding year. If the authorized incidental take level is exceeded in this second year, Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to exceedance of the allowable level of incidental take.

3.2.1.1 Progress Towards Meeting Objective 2 in 2016 - Adult Bull Trout Upstream and Downstream Passage Evaluation

Douglas PUD implemented a Passage Evaluation Study in 2016. Beginning in May 2016 and ending in early July 2016 Douglas PUD radio and PIT tagged 60 adult sized bull trout at Wells Dam (n = 14) and the Twisp Weir (n= 46).

Mobile tracking by flight, boot, and truck coupled with fixed station PIT and radio-telemetry arrays have been used to estimated n = 17 dead of 60 (28%) by November 1, 2016. However, only 6 of these tags were recovered at the time of this report. One tag was found inside a dead bull trout by WDFW in a stranding pool near Poplar Flats by WDFW M&E staff. The remaining tags have been recovered without fish carcass or material present near the tags. Three tags appear to have bite marks or damaged antennae consistent with small mammal bite marks.

Suspected modes of mortality include post- or pre-spawning mortality near or on spawning grounds, stranding near spawning grounds due to subsurface or low fall Twisp River flows, predation, and delayed mortality (days) after tagging in the mainstem Columbia River. To date
no mortality has occurred immediately after upstream or downstream passage past the Twisp Weir or Wells Dam. This study will continue in 2017 and data summarized in study report.

At the time that the Aquatic Settlement Agreement was signed the five year average count of bull trout at Wells Dam in 2005 was 60 fish. In 2016 the five-year average increased to 90 fish per year, representing a 50 percent increase. Total bull trout counts since 2000 are provided in Figure 1, including the 17 year average of 72.

No significant changes in the operation of the fish ladders or hydrocombine have been implemented or are proposed that would trigger the early implementation of a bull trout passage evaluation.

![Total Bull Trout Observed Annually at Wells Dam Count Windows](image)

**Figure 1. Total Bull Trout Observed Annually at Wells Dam Count Windows**

3.2.2 **Adult Bull Trout Passage Evaluation at Off-Project Collection Facilities**

Douglas PUD shall assess upstream and downstream passage and incidental take of adult, migratory bull trout at off-Project (outside of the Project boundary) adult salmon and steelhead broodstock collection facilities associated with the Wells HCP. Specifically, beginning in year one of the new license, Douglas PUD will conduct a one-year radio-telemetry study to assess passage and incidental take at off-Project adult collection facilities (i.e., Twisp Weir). Douglas PUD will capture and tag up to 10 adult, migratory bull trout (>400 mm) at adult collection facilities and use fixed receiver stations upstream and downstream of collection facilities to examine upstream and downstream passage characteristics and incidental take. Study protocols
that have been used during past radio-telemetry assessments at Wells Dam (LGL and Douglas PUD 2008) will be employed for this assessment.

If negative impacts to passage associated with off-Project collection facilities are observed or the authorized incidental take level is exceeded during any one-year period, Douglas PUD will conduct another monitoring study in the succeeding year. If negative impacts to passage continue to be observed or the authorized incidental take level is exceeded in this second year, Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to passage impacts or the exceedance of the allowable level of incidental take.

After year one of the new license, the implementation of this sub-objective will be integrated into the one-year telemetry monitoring program that is to be conducted every ten years (beginning in year 10 of the new license) at Wells Dam as identified in Section 4.2.1. In year 10 of the new license and every 10 years thereafter, bull trout will be captured and tagged only at Wells Dam (Section 4.2.1) since data show that bull trout passing Wells Dam are migrating back into the Methow River watershed (LGL and Douglas PUD 2008). Through the continued deployment of fixed station monitoring at off-Project adult salmon and steelhead broodstock collection facilities, these tagged bull trout will continue to provide passage and take information in support of this sub-objective throughout the term of the new license.

3.2.2.1 Progress Towards Meeting Objective 2 in 2016 - Adult Bull Trout Passage Evaluation at Off-Project Collection Facilities

During 2012, Douglas PUD, in consultation with the Aquatic SWG developed a study plan to assess incidental take of bull trout at the Twisp River Weir broodstock collection facility. All parties including the USFWS, agreed that Douglas PUD should postpone the Off-Project Passage Evaluation until year five of the new license when the Bull Trout Passage and Enumeration Study is scheduled to take place at Wells Dam. Combining the studies would provide a more comprehensive study and potentially require less study fish than two independent studies, thereby limiting the overall impact or take of bull trout.

During 2013, Douglas PUD, in consultation with the Aquatic SWG filed a letter with the FERC proposing to postpone the Off-Project Passage Evaluation until year five of the new license when the Bull Trout Passage and Enumeration Study is scheduled to take place at Wells Dam. FERC approved the deferral on October 15, 2013. Planning of the compressive study began in 2015 with the development of a draft study plan and in coordination with the USFWS and the Aquatic SWG. Preliminary results from the 2016 study are provided in 3.2.1.1 above. This study will continue in 2017 and data summarized in study report.

In 2016, there were 71 encounters of adult bull trout at the Twisp River Weir that were handled by Douglas PUD staff and its contractors. Forty six of these fish were radio tagged and the remaining 24 released untagged. Of the 24 untagged, 15 had existing PIT tags. New PIT tags that were given to study fish (also radio-tagged) and exiting PIT tagged fish were uploaded to PITAGIS in respective tagging and recapture databases. PIT tag histories will be provided in the 2017 Study Report.
Twisp Weir encounters in 2016 were well below the take limits of 118 as identified in Table 14 of the Bull Trout BO for Wells Dam (USFWS 2012) and are summarized in Table 1. The Twisp Weir is normally operated for steelhead and spring Chinook collection March through August.

3.2.3 Sub-adult Bull Trout Monitoring

While an objective of the BTMP is to identify potential Project impacts on upstream and downstream passage of sub-adult bull trout, Aquatic SWG members (including the USFWS) agree that it is not feasible to assess sub-adult passage because sub-adult bull trout have not been observed at Wells Dam. During the previous six years of bull trout data collection at Wells Dam (BioAnalyst Inc. 2004; LGL and Douglas PUD 2008), sub-adult bull trout have not been documented passing Wells Dam (based upon fishway video counts and bull trout trapping for radio-telemetry). However, it is expected that through the increased monitoring associated with the implementation of the BTMP that there may be additional encounters with sub-adult bull trout. If at any time during the new license term sub-adult bull trout are observed passing Wells Dam in significant numbers (i.e., >10 per calendar year), the Aquatic SWG will recommend reasonable and appropriate methods for monitoring sub-adult bull trout. Specifically, Douglas PUD may modify counting activities, 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. This activity would occur the following year after significant numbers of sub-adult bull trout (>10 per calendar year) were observed.

3.2.3.1 Progress Towards Meeting Objective 2 in 2016 - Sub-adult Bull Trout Monitoring

Of the 51 bull trout counted at Wells Dam in 2016, 5 were estimated to be less than 450 mm fork length. Of these five, all were estimated to be over 400 mm fork length, suggesting that very few, if any bull trout observed in the Wells Dam count windows in 2016 were subadults.

3.3 Implement Reasonable and Appropriate Measures to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull Trout are Identified (Objective 3)

Douglas PUD shall continue to operate the upstream fishway and downstream bypass at Wells Dam in accordance with the Wells HCP. However, if upstream or downstream passage problems for bull trout are identified (as agreed to by the USFWS and Douglas PUD), Douglas PUD will identify and implement, in consultation with the Aquatic SWG and Wells HCP Coordinating Committee, reasonable and appropriate options to modify the upstream fishway, downstream bypass, or operations to reduce the identified impacts to bull trout passage.

3.3.1 Progress Towards Meeting Objective 3 in 2016 - Implement Reasonable and Appropriate Measures to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull trout are Identified
No new adverse impacts to bull trout were identified in 2016. As a result, Douglas PUD is not proposing to implement any new upstream fishway or downstream bypass measures.

3.4 Investigate Entrapment or Stranding of Bull Trout during Periods of Low Reservoir Elevation (Objective 4)

During the implementation of the WBTMMP from 2004-2008, Douglas PUD, through the use of high resolution bathymetric information, hydraulic and elevation data, and backwater curves, identified potential bull trout entrapment and stranding areas in the Wells Reservoir. Although no stranded bull trout were observed in these areas during the implementation of the WBTMMP, Douglas PUD will continue to investigate potential entrapment or stranding areas for bull trout through periodic monitoring when periods of low reservoir elevation expose identified sites. During the first five years of the new license, Douglas PUD will implement up to five bull trout entrapment/stranding assessments during periods of low reservoir elevation (below 773’ msl). If no incidences of bull trout stranding are observed during the first five years of study, additional assessment will take place every fifth year during the remainder of the license term, unless waived by the Aquatic SWG. If bull trout entrapment and stranding result in take in exceedance of the authorized incidental take level, then reasonable and appropriate measures will be implemented by Douglas PUD, in consultation with the Aquatic SWG, to address the impact.

3.4.1 Progress Towards Meeting Objective 4 in 2016 - Investigate Entrapment or Stranding of Bull Trout during Periods of Low Reservoir Elevation

Pursuant to Article 402 of the Wells Project license, Douglas PUD developed a Bull Trout Stranding, Entrapment, And Take Study Plan (Plan). This document was developed collaboratively with the USFWS and the Aquatic SWG. The Plan was filed with the FERC on September 24, 2013 and approved on October 29, 2013.

The Plan requires Douglas PUD to conduct 5 reservoir surveys when Wells Dam (Project) operations reduce the forebay elevation to 773 feet above sea level (msl) within the first five years of the new operating license for the Project. These surveys are to be conducted opportunistically when reservoir elevations may be at or below 773’ msl for an extended period of time. This sampling regime is also consistent with the USFWS 2013 Section 10 Biological Opinion, Section 18 Fishway Prescriptions for the Wells Project license, and Douglas PUD’s BTMP.

Since issuance of the new Operating License three standing surveys have taken place. The first stranding survey occurred on February 24, 2013. During this survey no bull trout were observed in stranding pools. Results from this effort were summarized in a technical memorandum dated March 10, 2013 and submitted to the USFWS and the Aquatic Settlement Work Group. These results were also filed with the FERC as part of 2013 Annual Bull Trout Management Plan report.

On September 2, 2015 the Wells Reservoir was lowered to 772’ msl to facilitate a construction project at the mouth of the Methow River. On September 3, 2015 Douglas PUD biologists conducted a bull trout stranding survey consistent with the Plan. Although all identified stranding
locations were examined no bull trout were observed. The results from the second bull trout stranding survey since license issuance in 2013 were again summarized in a technical memorandum and delivered to the USFWS.

On May 3, 2016 the Project forebay reached 773’ msl. This low elevation was a result of Wells Dam hydroelectric Project operations that were designed to flush the Methow River delta using newly refurbished rock groins. This flushing was necessary to facilitate the removal of deposited fine material that builds up in the lower mile of the Methow River as the river meets the Columbia. Moving this fine material provides a safeguard against flooding areas of the town of Pateros, Washington. Consistent with license requirements, on May 4, 2016 Douglas PUD biologists conducted a Wells Project stranding, entrapment and take survey consistent with regulatory requirements. During this survey no bull trout were observed. Similarly to the first and second stranding survey, results of the 2016 survey were summarized and provided to the USFWS (See Appendix 1).

3.5 Participate in the Development and Implementation of the USFWS Bull Trout Recovery Plan (Objective 5)

3.5.1 Monitoring Other Aquatic Resource Management Plan Activities and Predator Control Program for Incidental Capture and Take of Bull Trout

Douglas PUD will monitor activities associated with the implementation of other Aquatic Resource Management Plans (white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality) and the Predator Control Program that may result in the incidental capture and take of bull trout. If the incidental take of bull trout is exceeded due to the implementation of other Aquatic Resource Management Plan activities, then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take. If the incidental take of bull trout is exceeded due to the implementation of the Predator Control Program, then Douglas PUD will develop a plan, in consultation with the Wells HCP Coordinating Committee and the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

3.5.1.1 Progress Towards Meeting Objective 5 in 2016 - Monitoring Other Aquatic Resource Management Plan Activities and Predator Control Program for Incidental Capture and Take of Bull Trout

Two activities conducted under other Aquatic Resource Management Plan actions had the potential to encounter bull trout in 2016:

1. Pikeminnow removal associated with the Predator Control Program
   - The Wells HCP required Predator Control Program, principally Douglas PUD’s pikeminnow control program, did not encounter any bull trout in 2016. The pikeminnow control program used setlines to capture pikeminnow in deep water areas of the Wells Project. Over the program’s existence (more than fifteen years) no bull trout have been encountered.
2. The 2016 Wells Project White Sturgeon Monitoring and Evaluation Program
   • Over the spring and summer of 2016 Douglas PUD and its contractors conducted a White Sturgeon Monitoring and Evaluation Program consistent with license requirements found within the White Sturgeon Management Plan. To accomplish this task set lines were used to estimate survival, growth, habitat use and condition of white sturgeon within the Project. No bull trout were encountered during these sampling efforts.

3.5.2 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, Douglas PUD will, if recommended by the Aquatic SWG, collect up to 10 adult bull trout tissue samples in the Wells Dam fishway facilities over a period of one year and fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the bull trout radio-telemetry monitoring study. Samples will be submitted to the USFWS Central Washington Field Office in Wenatchee, Washington. Any sub-adult bull trout collected during these activities will also be incorporated into the bull trout genetic analysis.

Beginning in year one of the new license, Douglas PUD will collect up to 10 adult bull trout tissue samples from the Twisp River broodstock collection facility over a period of one year and will fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the off-Project bull trout radio-telemetry monitoring study.

3.5.2.1 Progress Towards Meeting Objective 5 in 2016 - Funding Collection of Tissue Samples and Genetic Analysis

During the Wells Dam and Twisp Weir Passage and Survival Study sixty genetic samples were taken. In early 2017 samples will be analyzed by the Washington Department of Fish and Wildlife Genetics Lab and study bull trout will therefore be assigned back to natal locations. In addition, in early 2017 previously taken genetic samples will be analyzed as required under pre-licensing agreement(s) and associated with radio-telemetry studies that took place in the mid-2000 at Wells Dam.

3.5.3 Information Exchange and Regional Monitoring Efforts

Douglas PUD will continue to participate in information exchanges with other entities conducting bull trout research and regional efforts to explore availability of new monitoring methods and coordination of radio-tag frequencies for bull trout monitoring studies in the Project.

Douglas PUD will make available an informational and educational display at the Wells Dam Overlook to promote the conservation and recovery of bull trout in the Upper Columbia River and associated tributary streams.

3.5.3.1 Progress Towards Meeting Objective 5 in 2016 - Information Exchange and Regional Monitoring Efforts
In 2016, Douglas PUD participated in a number of regional meetings designed to develop recovery documents and actions for listed bull trout, with specific emphasis on study planning for the 2016/2017 Wells Dam and Twisp Weir study. These meetings were led by USFWS and took place in Wenatchee and Leavenworth, Washington. Recovery planning is expected to continue with regional stakeholders in 2017 and Douglas PUD will continue to participate in these regional information exchanges.

3.6 Identify Any Adverse Impacts of Project-related Hatchery Operations on Adult and Sub-adult Bull Trout (Objective 6)

3.6.1 Bull Trout Monitoring During Hatchery Activities

During the term of the new license, Douglas PUD shall monitor hatchery actions (e.g., salmon trapping, sturgeon brood stocking and capture activities) that may encounter adult and sub-adult bull trout for incidental capture and take. Actions to be monitored shall be associated with the Wells Hatchery, the Methow Hatchery, and any future facilities directly funded by Douglas PUD.

If the incidental take of bull trout is exceeded due to Douglas PUD’s hatchery actions then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

3.6.1.1 Progress Towards Meeting Objective 6 in 2016 - Bull Trout Monitoring During Hatchery Activities

Hatchery actions in 2016 were similar to other years where broodstock was collected at Wells Dam and the Twisp Weir in 2016. Screw traps used during HCP related smolt monitoring and evaluation activities in the Methow River basin often encounter juvenile bull trout. Other M&E and hatchery activities that have the potential to encounter bull trout is adult handling at Methow Hatchery, Wells Dam Volunteer Channel. All of these trapping and hatchery activities are conducted by WDFW, Douglas PUD’s lead hatchery contractor.

Twisp Weir operations encountered 71 bull trout and LGL and Douglas PUD tagged 46 of these. Well Dam hatchery actions associated with Spring Chinook broodstock collection encountered 2 bull trout (Table 1). Additionally, 14 adult bull trout were collected at Wells Dam for the Twisp and Wells Dam radio telemetry study. Finally, 20 subadult bull trout were captured at the Twisp and Carlton screw trap in 2016 (Table 1).

In addition to hatchery actions, during September 2016, Douglas PUD in concert with WDFW piloted a third year of a Steelhead Mark Recapture Study in the Twisp River in order to estimate the carrying capacity of steelhead in the basin. To accomplish this task, 100 meter stream sections were randomly selected as mark and recapture locations. A team of 5-6 biologists sampled the Twisp, Chewuch and Methow Rivers using backpack electrofishing and encountered 2067 steelhead, 846 spring Chinook, and incidentally encountered 278 bull trout. All of these salmonids were PIT tagged unless captured fish were <55 mm. Encountered bull trout fall under WDFW Section 10 sampling and are therefore not considered in the report towards Douglas
PUD take estimates. PIT tag ID’s from all tagged salmonids during this study have been uploaded to PTAGIS. PIT tag data can be use in the future to examine immigration timing, life history patterns, and population size.

2016 Douglas PUD Project Actions collectively were well below take estimates (limits) as described in the March 2012 issued Section 7 Biological Opinion from the USFWS. A summary of all bull trout encounters in 2016 and respective take limits are provided in Table 1.

Table 1. Summary of 2016 Bull Trout Incidental Encounters Under Douglas PUD License Actions and Related Project Encounter Limits Under the 2012 Issued Section 7 Biological Opinion.

<table>
<thead>
<tr>
<th>Project Element</th>
<th>2012 ISSUED BIOLOGICAL OPINION (Table 14)</th>
<th>2016 Incidental Take Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lethal Take</td>
<td>Non-lethal Take</td>
</tr>
<tr>
<td></td>
<td>Adult</td>
<td>Sub-adult</td>
</tr>
<tr>
<td>Turbine Operation (A-1)</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Spillway Operation (A-2)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Reservoir Operation (A-3)</td>
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<td>2</td>
</tr>
<tr>
<td>Wells Dam Juvenile Passage Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Fish Bypass Operation (A-1)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>-Juvenile Survival Study (A-2)</td>
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<td>2</td>
</tr>
<tr>
<td>Wells Dam Adult Passage Plan</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Tributary Conservation Plan and Committee</td>
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<td>-</td>
</tr>
<tr>
<td>Hatchery Management Plans</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>-Hatchery Management (A-1)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>-Operation of the Twisp Weir (A-2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>-HGMP Implementation (A-3)</td>
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<tr>
<td>-Juvenile Salmonid Release (A-4)</td>
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<td>-</td>
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<td>Water Quality Management Plan</td>
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<td>2</td>
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<td>Bull Trout Management Plan</td>
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<td>Pacific Lamprey Management Plan</td>
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<td>Line Avian Protection Plan</td>
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<tr>
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<td>Historic Properties Management Plan</td>
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<tr>
<td>Land Use Policy</td>
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3.7 USFWS Section 7 Consultation

The PMEs contained within the BTMP were specifically developed, in consultation with the USFWS, to address potential RPMs for the Project relicensing and associated Section 7 consultation. All of the USFWS’s potential RPMs for the Wells Project can be found in Section 2.0 above. Each of these RPMs has been cross referenced with the specific supporting objective and PME (Sections 4.1 - 4.6) found within the BTMP. The purpose of these RPMs are to
provide consistency with Douglas PUD’s Aquatic Settlement Agreement and the USFWS’ subsequent Section 7 consultation on the relicensing of the Wells Project.

3.7.1.1 Progress Towards Meeting Objective 5 in 2016 - USFWS Section 7 Consultation

On March 16, 2012, the USFWS issued a Bull Trout BO related for the relicensing of the Wells Project. The BO contained various RPMs and the terms and conditions (T&Cs). These RPMs and T&Cs can be found within Appendix E of the FERC license for the Wells Project and they are consistent with the measures identified in the BTMP and within this report. Since license issuance Douglas PUD has implemented the PME’s from the BTMP and RPM’s from the Biological Opinion consistent with requirements.

No formal Section 7 consultation was required in 2016.

3.8 Reporting

Douglas PUD will provide a draft annual report to the Aquatic SWG summarizing the previous year’s activities undertaken in accordance with the BTMP. The report will document all bull trout activities conducted for the Wells Project and describe activities proposed for the following year. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this BTMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas PUD will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

3.8.1.1 Progress Towards Meeting Annual Reporting Requirements

This 2016 report fulfills the reporting requirements identified in the BTMP and Article 406 of the Wells Project FERC operating license. In addition, this report fulfills requirements of the Bull Trout BO to submit an annual take report to the Central Washington Field Office of the USFWS on or before April 15 each year.

Because the measures required by the BO are entirely consistent with the measures found in the Aquatic Settlement Agreement’s BTMP and because the reporting requirements for the BTMP, bull trout BO and Article 406 are consistent, the 2016 BTMP Annual Report will be used to satisfy all three of the bull trout annual reporting requirements.
4.0 REFERENCES


Subject: Low Pool Elevation Bull Trout Survey – License Article 402
Wells Hydroelectric Project No. 2149

Steve:

Pursuant to Article 402 of the license for the Wells Hydroelectric Project (Wells Project), the Public Utility District No. 1 of Douglas County (Douglas PUD) developed a Bull Trout Stranding, Entrapment, And Take Study Plan (Plan). This document was developed collaboratively with the United States Fish and Wildlife Service (Service) and the Aquatic Settlement Work Group (Aquatic SWG). The Plan was filed with the Federal Energy Regulatory Commission (FERC) on September 24, 2013 and approved by the FERC on October 29, 2013.

The Plan requires Douglas PUD to conduct 5 reservoir surveys when Wells Dam (Project) operations reduce the forebay elevation to 773 feet above sea level (msl) within the first five years of the new operating license for the Project. These surveys are to be conducted opportunistically when reservoir elevations may be at or below 773’ msl for an extended period of time. This sampling regime is also consistent with the Service’s 2013 Section 10 Biological Opinion, Section 18 Fishway Prescriptions for the Project, and Douglas PUD’s Bull Trout Management Plan.

On Tuesday May 3, 2016 the Project forebay reached 773’ msl. This low elevation was a result of Wells Dam hydroelectric Project operations that were designed to flush the Methow River delta using newly refurbished rock groins. This flushing is necessary to facilitate the removal of deposited fine material that builds up in the lower mile of the Methow River as the river meets the Columbia. Moving this fine material provides a safeguard against flooding areas of the town of Pateros, Washington.

Consistent with license requirements, on May 4, 2016 Douglas PUD biologists conducted a Wells Project stranding, entrapment and take survey consistent with regulatory requirements. Results of the survey are as follows:

- Methow River mouth - one pool with no fish observed.
- Okanogan River mouth - no pools or fish found.
• Kirk Islands - three pools found (e.g. Figure 1), with one containing approximately 300 redside shiner (*Richardsonius balteatus*) juveniles.

• El Rio Road bed (across from Okanogan River mouth) - visual inspection showed no fish in shallow part of a single pool. The pool was estimated to be over 9 feet deep and seining ineffective.

• Schluneger Flats - no pools or fish found.

• Bridgeport Bar Islands - 7 pools (e.g. Figure 2), 3 of which contained stickleback (*Gasterosteidae* sp.) and juvenile pikeminnow (*Ptychocheilus oregonensis*). Two of the three pools each contained approximately 200 subyearling Chinook salmon (*Oncorhynchus tshawytscha*) fry (measuring approximately 35 mm fork length; Figure 3). Finally, two non-native Northern crayfish (*Orconectes virilis*) were removed from one pool at this location. The crayfish were not returned to the Columbia River (Figure 4).

Figure 1. One of the pools at Kirk Islands containing no fish.
Figure 2. One of the pools at Bridgeport Bar Islands that contained stickleback and subyearling Chinook fry.

Figure 3. Stickleback and subyearling Chinook fry that were salvaged by beach seine at the Bridgeport Bar Islands.
Figure 4. Two non-native Northern crayfish were removed by beach seine at the Bridgeport Bar Islands.

No bull trout were observed during this effort. For all other non-target taxa, fish were beach seined from smaller shallow pools and returned to the main river channel. In the event of future low reservoir events where forebay elevations drop to or below 773’ msl, Douglas PUD will implement the Bull Trout Stranding, Entrapment, and Take Study Plan accordingly. This memo completes the third of five stranding surveys that are to be conducted opportunistically in the first five years of the Wells Hydroelectric Project License.

If you have any questions or require further information regarding the above sampling, please feel free to contact Andrew Gingerich at (509) 881-2323, andrewg@dcpud.org.

Sincerely,

Andrew Gingerich
Sr. Aquatic Resource Biologist

Cc: Wells Aquatic Settlement Work Group
    Mr. Shane Bickford – Douglas PUD
    Mr. Chas Kyger – Douglas PUD
EXECUTIVE SUMMARY

The annual White Sturgeon Management Plan (WSMP) Report includes a summary of the progress made towards meeting measures required by the Federal Energy Regulatory Commission (FERC) operating license for Wells Dam and the requirements found within Appendix A (Clean Water Act section 401 Water Quality Certification). The 2012 FERC Order requires Public Utility District No. 1 of Douglas County (Douglas PUD) to submit an annual WSMP report to the FERC on or before May 31st during each year of the license.

The goal of the WSMP is to increase the white sturgeon (Acipenser transmontanus) population in the Wells Reservoir to a level that can be supported by the available habitat and characterized by a diverse age structure consisting of multiple cohorts (juvenile and adult). In addition, the WSMP is intended to support spawning, rearing and migration as identified by the aquatic life designated use under WAC 173-201A in the Washington state water quality standards. Based upon the information available as of December 2006, the Aquatic Settlement Work Group (Aquatic SWG) determined that an assessment of the Wells Hydroelectric Project (Project or Wells Project) effects on white sturgeon was not practical given sturgeon life history characteristics and the limited number of fish estimated to exist in the Project. Therefore, the Aquatic SWG concluded that resource measures related to white sturgeon should focus on population protection and enhancement by means of supplementation as an initial step in order to increase the number of fish within the Wells Reservoir. In addition to the initial supplementation activities, implementation of a monitoring and evaluation program shall be conducted to accurately assess natural recruitment, juvenile habitat use, emigration rates, carrying capacity, and the potential for natural reproduction so as to inform the scope of a future, longer-term supplementation strategy. All objectives were developed in order to meet the WSMP goal. The Protection, Mitigation and Enhancement measures presented within the WSMP are designed to meet the following objectives:

Objective 1: Supplement the white sturgeon population in order to address Project effects, including impediments to migration and associated bottlenecks in spawning and recruitment. Douglas PUD, in consultation with the Aquatic SWG has developed a larval collection and direct gamete take program to implement in years 1-4 of the Wells Operating License. During May through July of 2016, both larvae and fertilized eggs were collected and transported to Wells Hatchery where juveniles were reared for up to one year. These fish will be released in the Wells Project in 2017 towards meeting this objective, and will be the fourth white sturgeon release, conducted as part of Douglas PUD’s Phase I WSMP.

Objective 2: Determine the effectiveness of the supplementation activities through a monitoring and evaluation program. Monitoring of naturally produced and hatchery produced juvenile and adult sturgeon was initiated in 2015 and continued in 2016 (draft from two years of study will be appended to the 2017 WSMP Annual Report. The final version of the two year M&E report expected to be approved before July 1 2017).

Objective 3: Determine the potential for natural reproduction in the Wells Reservoir in order to appropriately inform the scope of future supplementation activities. Natural reproduction evaluations may be coupled with the active tagging studies being implemented under Objective 2
Index Monitoring Program. This objective is covered in the 2014 approved White Sturgeon Monitoring and Evaluation Study Plan.

Objective 4: Adaptively manage the supplementation program as warranted by the monitoring results. Phase II goals will be addressed following the completion of Phase I in 2022.

Objective 5: Evaluate whether there is biological merit to providing safe and efficient adult upstream passage. Phase II goals, including longer term indexing and evaluating the feasibility and biological merit of adult passage measures will be addressed one year after the completion of Phase I (2023).

Objective 6: Identify white sturgeon educational opportunities that coincide with WSMP activities. In 2014, as a part of the WSMP, Douglas PUD began white sturgeon public outreach. In spring of 2014 - 2016, Douglas PUD hosted two tours for high school students at Wells Hatchery as part of a pre-college credit program. During tours, held in June 2014 -2016, students participated in releasing 30-40 direct gamete-origin fish into the Wells Reservoir. Instructional videos including community outreach activities as they relate to white sturgeon actions continue to be available at Douglas PUD’s public webpage at www.douglaspud.org.

This WSMP is intended to be compatible with other white sturgeon management plans in the Columbia River mainstem. Furthermore, this management plan is intended to be not inconsistent with other management strategies and recovery goals of federal, state and tribal natural resource management agencies. The WSMP is not intended to be a harvest management plan and does not create or supersedes jurisdiction over fisheries management decisions made by the responsible fishery agencies and tribes. However, the WSMP activities are expected to ultimately support appropriate and reasonable harvest opportunities consistent with the goals of the responsible fishery agencies and tribes and designated use for harvest under WAC 173-201A identified in the Washington state water quality standards. Should the responsible fishery agencies and tribes determine that there is an ongoing harvestable surplus of sturgeon in the Wells Reservoir, then this indicates significant progress toward achievement of the goals and objectives of this plan.
1.0 INTRODUCTION

The White Sturgeon Management Plan (WSMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license (Issued November 9, 2012).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas PUD) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of the WSMP, the Aquatic SWG focused on developing management priorities for resources potentially impacted by the Wells Hydroelectric Project (Project or Wells Project) operations. Entities invited to participate in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), and Douglas PUD.

The WSMP directs the implementation of measures to protect against and mitigate for potential Project impacts on white sturgeon (*Acipenser transmontanus*).

The Aquatic SWG agrees on the need to develop a plan for the long-term management of white sturgeon in the Project. This management plan report summarizes the relevant resource issues and background (Section 2), identifies the goal and objectives of the plan (Section 3), and describes the relevant PMEs (Section 4) for white sturgeon during the term of the new license. In addition, the progress toward meeting each of these sections is provided.

In addition to the requirements found within the WSMP, the new Federal Energy Regulatory Commission (FERC) license added several additional sturgeon related requirements associated with the continued operation of the Wells Project. Implementation of all of the WSMP related measures will be reported to the various agencies and tribes within this report.

2.0 BACKGROUND

2.1 White Sturgeon Biology

White sturgeon are the largest of all North American freshwater fish. They are found in marine waters and freshwaters of rivers along the Pacific coast from Monterey, California to Cook Inlet in northwestern Alaska (Wydoski and Whitney 2003). Significant populations of the Pacific coast appear to be restricted to three locations: the Sacramento, Fraser, and Columbia rivers (Lane 1991). White sturgeon are distributed throughout the U.S. portion of the Columbia River and in many of its larger tributaries. Historically, white sturgeon migrated 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).
White sturgeon are long-lived fish, with fin ray analysis documenting fish over 100 years in age (Beamesderfer et al. 1995). This anadromous species has been reported to reach a length of 20 feet and a weight of 1,800 pounds (Wydoski and Whitney 2003). In the Columbia River, white sturgeon spawn in the spring between April and July. Only a small percentage of adult white sturgeon in the Columbia River spawn in a given year. Intervals between spawning have been estimated to be between 3 and 11 years. White sturgeon deposit eggs through broadcast spawning at water temperatures between 10 and 18°C. Mature white sturgeon commonly produce between 100,000 and 300,000 eggs, but larger fish may produce up to 3 million eggs (Wydoski and Whitney 2003). Spawning and egg incubation in the Columbia River occur in the swiftest water available (2.6-9.2 feet per second) at depths between 13.1 and 65.6 feet over cobble, boulder, and bedrock substrates (Wydoski and Whitney 2003). In mainstem Columbia River reservoirs, spawning occurred within 5 miles downstream of the mainstem dams. Eggs hatch in approximately 7 days at 15°C.

Columbia River white sturgeon have declined in number due to numerous factors, including obstruction of migration by mainstem hydroelectric dams, altered stream flows, altered hydrologic regimes, altered temperature regimes, reduced spawning habitat, and over harvest (van der Leeuw et al. 2006; Wydoski and Whitney 2003). Variations in population characteristics also have been attributed to differences in exploitation rates and recruitment success, access to marine food resources, and suitability of hydrologic conditions and available habitats (Devore et al. 1995). During the 1800s, prior to construction of mainstem hydroelectric dams on the Columbia River, white sturgeon were in great demand for their caviar and smoked flesh. In 1892, during the peak of commercial harvest activities, approximately 2.5 million kilograms of white sturgeon were harvested (Wydoski and Whitney 2003). Regulations of the white sturgeon fishery began with a 4-foot minimum size limit established in 1899. Several regulations were established from 1899 to 2000 to manage the fishery in the lower Columbia River, although, effective recovery efforts did not begin until spawners were protected in the 1950s (Wydoski and Whitney 2003).

Beginning in the 1930s, with the 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 River Basin, such as Priest Rapids, Wanapum, Rock Island, Rocky Reach, and Wells also affected the 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 isolated populations in the mid-Columbia River reservoirs such as the Rocky Reach and Wells reservoirs are not well understood.

### 2.2 White Sturgeon Management and Recovery Efforts

Management programs to protect and restore white sturgeon in the Kootenai River and the upper Columbia River are on-going and have provided a relevant framework for the development of a white sturgeon management plan in the Wells Reservoir. The Kootenai and upper Columbia
sturgeon recovery efforts have also provided a good technical framework for implementing a sturgeon management plan. The strategies and activities outlined in these aforementioned management programs have provided important information, which has been used to develop an effective WSMP.

2.2.1 Kootenai River White Sturgeon Recovery

In the early 1990s following concerns that white sturgeon populations were decreasing due to near total recruitment failure, a detailed monitoring program was instituted by the Idaho Department of Fish and Game (IDFG) to provide more information on white sturgeon species status in the Kootenai River system. In 1994, the USFWS listed the Kootenai stock of white sturgeon as an endangered species, 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 hatchery supplementation efforts. A final Kootenai White Sturgeon Recovery Plan was signed by the USFWS in 1999.

Kootenai white sturgeon recovery efforts consist of a multi-faceted approach aimed at improving survival at various life history stages. Coordinated flow releases during spring are a major habitat restoration focus designed to increase natural recruitment, although currently it is difficult to assess the relationship between flows and recruitment success (USFWS 1999). Directed stocking programs, which address genetic concerns, stocking rates, and fish size at release, have also been implemented to boost juvenile sturgeon in the Kootenai system. The Kootenai Tribe of Idaho in collaboration with the Kootenay Trout Hatchery (KTH) in Canada are primarily responsible for producing high-quality juvenile white sturgeon for the directed stocking program. Information collected from annual monitoring activities, which assess survival, growth rates, and natural spawning success, allow for an adaptive management approach with regards to the stocking program.

2.2.2 Upper Columbia River White Sturgeon Recovery

In 2002, a bi-national Recovery Team, termed the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) finalized the Upper Columbia White Sturgeon Recovery Plan in response to concerns that the transboundary white sturgeon population residing between Hugh L. Keenleyside Dam and Grand Coulee Dam consists of an aging and declining population with extremely limited recruitment. The 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.

Due to near total recruitment failure over the past 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 (UCWSRI 2002). The breeding plan (Kincaid 1993) developed for the Kootenai sturgeon program was used as a model for the upper Columbia sturgeon, although this was modified in 2007 to a factorial breeding design using wild adult broodstock (Hildebrand and Parsley 2013). The UCWSRI program shifted to the use of wild caught eggs and first-feeding larvae for the conservation aquaculture program in Washington in 2011 and British Columbia in 2014. Rearing of fish for the stocking program currently occurs at WDFW Sherman Creek and Colville Tribal Resident Fish hatcheries in Washington and the
Similar to the Kootenai recovery program, a coordinated monitoring program is employed in Washington and British Columbia to assess growth, survival, health, distribution, and relative abundance of released juveniles, which provides information essential to managing the upper Columbia sturgeon population and evaluating the success of the aquaculture program.

### 2.2.3 Rocky Reach White Sturgeon Management Plan

The relicensing process for the Rocky Reach Hydroelectric Project brought fisheries agencies, tribes, and interested parties together in a Natural Resources Working Group (Rocky Reach Fish Forum or RRFF) that provided an opportunity for comprehensive review of current and future management priorities for fish resources potentially impacted by ongoing Project operations (Chelan PUD 2005). In 2004 and 2005, RRFF members collaborated on the development of goals and objectives to manage the white sturgeon population within the Rocky Reach Project boundary under the new license. Based upon the information collected from white sturgeon field studies implemented by Chelan PUD in 2001 and 2002, a white sturgeon management plan was developed to promote population growth of sturgeon to a level commensurate with the available habitat. The Rocky Reach management plan measures include the implementation of a white sturgeon supplementation program, a monitoring program to determine population characteristics, and tracking surveys to determine movements and to assess potential spawning locations.

Following the issuance of Rocky Reach Dam’s operating license from the FERC Chelan PUD implemented the first year of broodstock collection in 2010. Few viable adults were obtained despite many adults being captured. Offspring from 1x2 cross and captive brood fish were released into the Rocky Reach Reservoir, for an approximate 2011 release of 6,500 fish. In 2011, viable broodstock capture increased, however offspring produced showed signs of White Sturgeon Iridovirus which prevented the release of very many fish in 2012. Approximately 130 fish were released into the Rocky Reach Project in 2012. In 2012, broodstock collection resulted in two spawning groups that contained multiple males. From 2013 to 2016 Chelan PUD had successful releases of direct gamete origin fish into the Rocky Reach Reservoir.

### 2.2.4 Priest Rapids Project White Sturgeon Management Plan

As part of the Priest Rapids Project relicensing, white sturgeon populations were investigated in the Priest Rapids and Wanapum reservoirs from 1999 to 2003. Results of the study have assisted in identifying a framework for the future development and implementation of a Priest Rapids Project White Sturgeon Management Plan. Biological objectives associated with this management plan consist of increasing white sturgeon populations to a level commensurate with available habitat through a supplementation program and the implementation of a monitoring program to determine population characteristics such as natural recruitment, spawning, rearing, growth, survival, and rates of emigration.

Following the issuance of the Priest Rapids Dam license Order and the issuance of a Clean Water Act Section 401 Water Quality Certification (401 Certification) via Ecology, Grant PUD has begun implementing white sturgeon stocking objectives. Similar to Chelan PUD, Grant PUD has participated in three years of juvenile sturgeon releases above Priest Rapids and Wanapum
Dams. Release numbers and broodstock collection for this effort is coordinated through the Priest Rapids Fish Forum (PRFF), but have targeted approximately 6,500 fish per year.

2.3 Project White Sturgeon Study

Since little information existed on the status of white sturgeon populations in the mid-Columbia, Chelan, Grant, and Douglas PUDs each initiated studies of white sturgeon to support their current or upcoming relicensing processes. The information gathered from these studies was intended to provide basic white sturgeon life history information, distribution, and current population sizes in the mid-Columbia River Basin. Additionally, study results provided the foundation for the development of appropriate management goals and objectives.

From 2001-2003, Douglas PUD implemented a study to examine the white sturgeon population within the Project. Prior to the implementation of this study, little information on white sturgeon was available for the Wells Reservoir. WDFW catch record card returns for 1993 and 1994 indicate that legal size white sturgeon were present in the Wells Reservoir (Brad James, WDFW, pers. comm.). Additionally, information from previous studies in reservoirs upstream and downstream supported the existence of a population. The primary objectives of the study were to provide basic information on the population abundance, age structure, size, and growth of Project white sturgeon; analyze movements of white sturgeon within the Reservoir; and compare the data collected during this study with data collected during assessments at other projects (Jerald 2007).

During the summers of 2001 and 2002, setlines were deployed in the Wells Reservoir. Sturgeon captured on setlines were measured, marked with passive integrated transponder (PIT) tags and with scute markings. Additionally, a select number of captured fish were fitted with radio-transmitters to track movements and had pectoral fin rays removed for age analysis using standard methodologies (Beamesderfer et al. 1989).

Setline sampling took place over a two-year timeframe with a total of 129 setlines deployed and retrieved from throughout the reservoir. In total, 13 white sturgeon were captured during the 2-year study with the majority of the fish being captured in the Columbia River within five miles of the mouth of the Okanogan River. Twelve of the captured fish were PIT tagged. Subsequently, five recapture events were recorded for a total of 18 capture events during the mark-recapture period (one fish was recaptured twice). Population abundance was estimated to be 31.35±17.51. The 95% confidence interval for sturgeon abundance was calculated to be CI (13<N<218). The results of the mark-recapture portion of the study indicated that the sturgeon population in the Wells Reservoir is small with a point estimate of 31 fish over 50 cm in length (Skalski and Townsend 2005).

The length of the 13 fish captured during the study ranged from 60-202 cm. Two of the fish were classified as juveniles (65 and 73 cm) while 11 were classified as sub-adults or adults (>90 cm; range 90-202 cm). It is important to note that the capture methodology was not designed to provide accurate sampling of fish under 50 cm. Captured sturgeon ranged in age from 6 to 30 years old (based on 11 fish) demonstrating that all of these fish recruited to the Wells Reservoir after Wells Dam was completed in 1967 with strong year class recruitment between the years
1972 and 1978 and again between 1988 and 1996. The presence of fish within these age classes suggests that successful recruitment within or to the Wells Reservoir is occurring either through (1) spawning within the Wells Reservoir and/or (2) immigration into the Wells Reservoir from populations upstream. Two white sturgeon were captured in 2001 and subsequently recaptured in 2002 to provide limited growth rate information. One juvenile fish was measured at 65 cm (fork length) on July 11, 2001. The fish was again captured on September 26, 2002 and measured 87 cm. This represented a growth rate of 22 cm in 14 months, or 18.9 cm/year. One adult fish was captured on August 9, 2001 measuring 197 cm (fork length). The fish was subsequently captured on September 6, 2002 and measured 199 cm representing a 2 cm growth rate over approximately 13 months, or 1.85 cm/year (Jerald 2007). In October 2006, this fish was found dead along the shoreline of the Columbia River adjacent to the mouth of the Okanogan River. At that time, biologists measured the fish at 228.5 cm representing a 29.5 cm increase in length over a four year period or an average of 7.4 cm of growth per year.

A total of six white sturgeon were fitted with radio-tags and monitored throughout the study period using mobile and fixed telemetry. Telemetry data along with setline capture data verify that white sturgeon congregate in the Columbia River near the Okanogan River confluence during the summer, fall, and winter months with none of the six fish being detected downstream from Brewster river mile (RM 530) or upstream of Park Island (RM 538). Very little movement of tagged sturgeon was observed during winter months. In the spring of 2002, one of the five mature fish radio-tagged made an upstream migration into the Okanogan River and two different radio-tagged mature sized sturgeon made movements into the Okanogan River during 2003.

In general, the results of the white sturgeon study in the Wells Reservoir were similar to the results of a study conducted in the neighboring Rocky Reach Reservoir in 2001-2002 (Chelan PUD 2005). Results indicate that the Wells Reservoir adult sturgeon population is estimated from 13-217 fish. These results are similar to the Rocky Reach assessment which estimated numbers of sturgeon from 50-115 fish. Both studies captured similar numbers of sturgeon using similar amounts of effort and similar capture techniques (Rocky Reach=18 sturgeon, Wells=13 sturgeon). Radio-telemetry data from both studies suggest that very little activity occurs during the overwintering period. Wells Reservoir sturgeon ranged in age from 6 to 30 years old while Rocky Reach sturgeon ranged in age from 7 to 50 years old. Both studies suggest that some recruitment into each population is occurring given the presence of juvenile fish in their respective reservoirs (Chelan PUD 2005; Jerald 2007).

### 3.0 GOAL AND OBJECTIVES

The goal of the WSMP is to increase the white sturgeon population in the Wells Reservoir to a level that can be supported by the available habitat and characterized by a diverse age structure consisting of multiple cohorts (juvenile and adult). In addition, the WSMP is intended to support spawning, rearing and migration as identified by the aquatic life designated use under WAC 173-201A in the Washington state water quality standards. Based upon the available information, the Aquatic SWG agreed that a rigorous and reliable assessment of ongoing Project effects on white sturgeon was not practical given sturgeon life history characteristics and the limited number of fish estimated to exist in the Wells Reservoir. Therefore, the Aquatic SWG concluded that efforts should focus, initially, on supplementation efforts to increase the population within the
Wells Reservoir in order to address Project effects. Once the population numbers have been increased to a level that can be studied, as determined by the Aquatic SWG, Douglas PUD shall implement a monitoring and evaluation program to accurately assess natural recruitment, juvenile habitat use, emigration rates, carrying capacity, and the potential for natural reproduction so as to inform the scope of a future, long-term supplementation strategy. The PMEs of the WSMP are designed to meet the following objectives:

Objective 1: Supplement the white sturgeon population in order to address Project effects, including impediments to migration and associated bottlenecks in spawning and recruitment;

Objective 2: Determine the effectiveness of the supplementation activities through a monitoring and evaluation program;

Objective 3: Determine the potential for natural reproduction in the Wells Reservoir in order to appropriately inform the scope of future supplementation activities;

Objective 4: Adaptively manage the supplementation program as warranted by the monitoring results and in consultation with the Aquatic SWG;

Objective 5: Evaluate whether there is biological merit to providing safe and efficient adult upstream passage;

Objective 6: Identify white sturgeon educational opportunities that coincide with WSMP activities.

This WSMP is intended to be compatible with other white sturgeon management plans in the Columbia River mainstem. Furthermore, this management plan is intended to be not inconsistent with other management strategies and recovery goals of federal, state and tribal natural resource management agencies. The WSMP is not intended to be a harvest management plan and does not create or supersede jurisdiction over fisheries management decisions made by the responsible fishery agencies and tribes. However, the WSMP activities are expected to ultimately support appropriate and reasonable harvest opportunities consistent with the goals of the responsible fishery agencies and tribes and designated use for harvest under WAC 173-201A identified in the Washington state water quality standards. Should the responsible fishery agencies and tribes determine that there is an ongoing harvestable surplus of sturgeon in the Wells Reservoir, then this indicates significant progress toward achievement of the goals and objectives of this plan.

The schedule for implementation of specific measures within the WSMP is based on the best information available at the time the Plan was developed. As new information becomes available, implementation of each activity may be adjusted through consultation with the Aquatic SWG.
4.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

In order to fulfill the goal and objectives described in Section 3.0 of the WSMP, Douglas PUD, in consultation with the Aquatic SWG, has initiated the implementation of the following measures. The program shall be implemented in two phases. Phase I of the PMEs shall be implemented during the first ten years of the new license and consist of supplementation, monitoring and evaluation activities. Results of Phase I PMEs will be used to inform the scope of continued PMEs during Phase II, which shall be implemented for the remainder of the new license.

Douglas PUD, in consultation with the Aquatic SWG, shall initiate implementation of the following PMEs during the 50-year license term:

Phase I (Years 1-10)

- Development of a Broodstock Collection and Breeding Plan (Year 1 and updated as determined by the Aquatic SWG, See Section 4.1.1);
- Broodstock Collection (Years 1-4 and other years TBD by the Aquatic SWG, see Section 4.1.1);
- Juvenile Stocking (Years 2-5 and other years TBD by the Aquatic SWG, see Section 4.1.2);
- Index Monitoring Program (Years 3-5 and 2 more years prior to Year 10 TBD by the Aquatic SWG, see Section 4.2.1);
- Marked Fish Tracking (Years 3-5 and 2 more years prior to Year 10 TBD by the Aquatic SWG, see Section 4.2.2);
- Natural Reproduction Assessments (5 annual assessments over the license term, see Section 4.2.3)*;

* Natural reproduction assessments can be implemented over the term of the license (Phase I and Phase II) as determined by the Aquatic SWG.

Phase II (Years 11-50)

- Long-term juvenile stocking (stocking rate and frequency TBD by Aquatic SWG in Years 11-50, see Section 4.4.1);
- Supplementation Program Review (Years 11-50 TBD by the Aquatic SWG, see Section 4.4.2);
- Long-term Index Monitoring Program (Year 12 and once every 3-5 years thereafter TBD by the Aquatic SWG, see Section 4.4.3);
- Adult Passage Evaluation (Year 11 and once every 10 years thereafter, see Section 4.4)

As determined by the Aquatic SWG, appropriate educational opportunities coinciding with implementation of WSMP activities (Section 4.5) will be made available during the entire license term.
The following sections describe, in detail, the components, timing of implementation, and decision-making process of the PMEs to be conducted during Phase I and II of the white sturgeon management program.

4.1 Phase I Supplementation Program (Objective 1)

4.1.1 Broodstock Collection and Breeding Plan

Due to the low numbers of sturgeon indicated by the 2001-2003 white sturgeon study and the need to increase genetic variation, there is a low probability that broodstock from only the Wells Reservoir can be utilized as the basis for supplementation activities. Consequently, other sources of fish must be considered in addition to capturing fish from Wells Reservoir to increase the white sturgeon population. Within one year of issuance of the new license Douglas PUD shall prepare and implement a Broodstock Collection and Breeding Plan, in consultation with the Aquatic SWG, which considers such factors as genetics and questions of imprinting, and are consistent with the goal and objectives of the WSMP and includes the level of detail provided in other existing white sturgeon breeding plans.

Following is a prioritized list\(^1\) of juvenile fish source options that shall be incorporated into a Broodstock Collection and Breeding Plan:

- Broodstock collected from the Wells Reservoir;
- Broodstock collected from nearby reservoirs (Priest Rapids, Wanapum, Rocky Reach, Rock Island);
- Broodstock collected from McNary Reservoir;
- Juvenile production from the Lake Roosevelt white sturgeon recovery effort;
- Broodstock collected from below Bonneville Dam in the lower Columbia River;
- Juveniles purchased from a commercial facility.

A white sturgeon supplementation program may include, but may not be limited to, the following implementation options (Not listed in a priority order):

- Build new or retrofit existing Douglas PUD funded hatchery facilities to accommodate white sturgeon broodstock, egg incubation, and juvenile rearing;
- Development of a mid-Columbia hatchery facility funded by the three PUDs (Douglas, Chelan, and Grant) to accommodate various phases of white sturgeon supplementation; broodstock, egg incubation, and juvenile rearing;
- Direct release into the Wells Reservoir of juveniles produced via appropriate Breeding Plan criteria and reared at a commercial facility;

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\(^1\) Although the original WSMP included a prioritized list, since the development of the WSMP the Aquatic SWG has approved the White Sturgeon Broodstock Collection and Breeding Plan (filed with the FERC on February 14, 2012) and a sturgeon collection location Statement of Agreement developed and approved in the Aquatic SWG on March 20, 2012. Collectively, these two documents approve all capture locations found in the WSMP and remove the prioritization found in the WSMP.
• Direct release into the Wells Reservoir juveniles or adults trapped and hauled from the lower Columbia River.

The initial source of broodstock shall be determined within the first year of issuance of the new license. Collection of broodstock shall occur consistent with the broodstock collection plan in years 1-4 of the new license. Any additional years during the Phase I program (first ten years of the new license) in which broodstock collection shall occur in order to facilitate additional juvenile stocking into the Wells Reservoir (Section 4.1.2) will be determined by the Aquatic SWG. The intent of broodstock collection is to use their progeny, if feasible, for future white sturgeon stocking activities in the Wells Reservoir. The broodstock collection plan shall be updated annually, or as otherwise recommended by Douglas PUD in consultation with the Aquatic SWG, to incorporate new and appropriate information.

4.1.1 Progress Towards Objective 1 in 2016 – Broodstock Collection and Breeding Plan

Since the approval of the 2011 Broodstock and Breeding Plan a number of statements of agreements (SOAs) have been reviewed and approved within the Aquatic SWG. In 2012, the Parties approved two white sturgeon collection techniques consistent with the Broodstock and Breeding Plan. In 2016, at the approval of the Aquatic SWG, Douglas PUD planted only wild origin caught larvae into the Wells Project. Douglas PUD is expected to stock wild origin larvae in June 2017 and complete the first four years of stocking requirements.

4.1.2 Juvenile White Sturgeon Stocking

Within two years following issuance of the new license, Douglas PUD shall release up to 5,000 yearling white sturgeon into the Wells Reservoir annually for four consecutive years (20,000 fish total). Additional years and numbers of juvenile sturgeon to be stocked during Phase I will be determined by the Aquatic SWG and will not exceed 15,000 juvenile sturgeon (total of 35,000 juvenile sturgeon during Phase I). In consultation with the Aquatic SWG, yearling fish for release shall be acquired through one or more of the sources listed in priority order in Section 4.1.1 above, or through other measures identified by the Aquatic SWG. If juvenile sturgeon stocking deadlines cannot be achieved, the Aquatic SWG will determine alternative implementation measures that will be undertaken by Douglas PUD (see Table 4.7-1, footnote 2).

Douglas PUD shall ensure that all hatchery-reared juvenile white sturgeon released into the Wells Reservoir are marked with PIT tags 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, Douglas PUD shall ensure that up to one percent (or a maximum of 50) of the juvenile white sturgeon released into the Wells Reservoir are large enough to allow implantation of an active tag prior to release. In addition, following the third year of supplementation (unless the Aquatic SWG determines more analysis is required), the Aquatic SWG may elect to release juveniles at an earlier or later life stage for the fourth year in order to compare success of fish released at varying life stages. For example, the Aquatic SWG 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.
4.1.2.1 Progress Towards Objective 1 in 2016 – Juvenile White Sturgeon Stocking

Brood Year 2013
In March 2013, the Aquatic SWG approved a White Sturgeon Collection Plan SOA for implementation in the first year (2013) of Douglas PUD’s white sturgeon collection efforts, which included the following efforts: 1) larval collection in the mid-Columbia River from the Vernita Bridge upstream to the Rock Island Dam tailrace, and in Lake Roosevelt, with collection from mid-Columbia locations as the highest priority; and 2) broodstock collection in the pools of the Columbia River between Bonneville Dam upstream to Rock Island Dam. The Aquatic SWG also agreed that the proportion of fish from each program (larvae and brood-collected offspring) released into the Wells Project would be agreed on prior to planting in spring 2014 following the completion of the larvae and brood-collection season and following the results from initial incubation and rearing efforts.

In March 2014, following several months of discussions regarding genetics, fish health, and the merits of stocking larval-origin versus direct gamete-origin fish, the Aquatic SWG approved the following plan for stocking Wells white sturgeon for implementation in 2014: 1) all stocked fish will be asymptomatic of disease (i.e., no clinical signs of disease); 2) all larvae-source fish available at the Wells Fish Hatchery (approximately 2,200) will be stocked at a target size of at least 146 to 272 grams (280 to 352 millimeters [mm]); and 3) the balance of the 5,000-fish target will be stocked using direct gamete-source fish from 12 families (half sibling) and be stocked at a target mean size of 111 to 146 grams (256 to 280 mm).

In April 2014, approximately 2,900 direct gamete-origin fish were released into Wells Reservoir. Larval-origin fish were held an additional 2 months for additional growth; in June 2014, more than 2,100 larval-origin fish were released into the Wells Reservoir.

Brood Years 2014 to 2016
In 2014, based on 2013 collection efforts, the Aquatic SWG agreed to focus larval-collection efforts in Lake Roosevelt, and to not collect below Rock Island Dam in subsequent years because few larvae were collected in 2013, which suggested low production in the area. The Aquatic SWG also agreed that 2014 brood-collection efforts would continue in the same manner as in 2013, including brood collection in the Dalles and Bonneville pools, and coordination with Grant PUD and Chelan PUD for brood collection at their respective facilities.

In May 2014, Douglas PUD distributed a draft Wells White Sturgeon Collection and Stocking SOA for brood years 2014 to 2016. During the next several months, the Aquatic SWG discussed fish source, collection capabilities, cultural boundaries, fish health, genetics, and stocking goals. Several revisions and iterations of the draft SOA were provided by Douglas PUD, the CCT, the YN, and WDFW. The following common objectives were expressed by Aquatic SWG members: 1) moving genes from the lower river upstream; 2) achieving a genetically based split through parental representation; and 3) meeting the stocking target of 5,000 fish.

In early 2015 the Aquatic SWG approved the prioritization of stocking larvae origin fish when available through 2017 stocking (brood year 2016). In 2015 and 2016 just over 5,000 wild origin larvae captured from Lake Roosevelt and reared at Wells Hatchery for almost one year...
were released into the Wells Project. No direct gamete fish were released into the Project in 2015 or 2016. Detailed information of fish size and releases is provided in (Robichaud and Gingerich, 2016), however releases into the Wells Project under license implementation is summarized in Table 1 and Figure 1 below.

Table 1. Douglas PUD’s releases of PIT-tagged sturgeon in 2014-2016, by date, location (Washburn Island vs. Bridgeport), and rearing type (wild-caught larval fish vs. standard hatchery crosses).

<table>
<thead>
<tr>
<th>Date</th>
<th>Washburn Island</th>
<th>Near Bridgeport, WA</th>
<th>TOTAL</th>
<th>GRAND TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wild-caught</td>
<td>Broodstock</td>
<td>Wild-caught</td>
<td>Broodstock</td>
</tr>
<tr>
<td></td>
<td>Larvae</td>
<td>Crosses</td>
<td>Larvae</td>
<td>Crosses</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Jan</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10 Apr</td>
<td>0</td>
<td>2,881</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>12 Jun</td>
<td>2,116</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2014 TOTAL</td>
<td>2,132</td>
<td>2,882</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 Jun</td>
<td>4,985</td>
<td>0</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>2015 TOTAL</td>
<td>4,985</td>
<td>0</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Jun</td>
<td>5,247</td>
<td>0</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>2016 TOTAL</td>
<td>5,247</td>
<td>0</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>12,364</td>
<td>2,882</td>
<td>66</td>
<td>30</td>
</tr>
</tbody>
</table>
Figure 1. Fork length frequency distributions for fish released in 2014 (Brood Year 2013, left panels), 2015 (Brood Year 2014, middle panels), and 2016 (Brood Year 2015, right panels). Top row: fork lengths at release (orange: fish that were recaptured in 2015; green: recaptures in 2016, yellow: recaptures in both years; blue: all others). Middle row: fork lengths upon recapture in 2015. Bottom row: fork lengths upon recapture in 2016.
4.2 Phase I Monitoring and Evaluation Program (Objective 2)

Douglas PUD shall conduct a monitoring and evaluation program within the Wells Reservoir for the purpose of assessing the effectiveness of the supplementation activities described in Section 4.1 and outlined in Table 4.7-1. Monitoring shall include both an Index Monitoring Program (Section 4.2.1) and a Marked Fish Tracking Program (Section 4.2.2). Both of these studies will be used to collect life history and population dynamics information including rates of fish movements into and out of the Wells Reservoir and habitat use. Douglas PUD shall also obtain updated information, when available, on other white sturgeon recovery programs (e.g., Upper Columbia River, Kootenai River, mid-Columbia PUDs), in order to improve the monitoring and evaluation program and refine its implementation. The results of this information will also inform supplementation, monitoring and evaluation activities during implementation of Phase II of the WSMP.

4.2.1 Index Monitoring Program

Within three years following issuance of the New License, Douglas PUD shall initiate a three-year index monitoring program (Years 3-5) for juvenile and adult sturgeon in the Wells 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 shall include using gillnets, set lines or other appropriate recapture methods for juveniles and adults.

As a component of the Phase I indexing program, Douglas PUD shall capture and implant active tags in a portion of the juvenile and sexually mature adult sturgeon population found in the Wells Reservoir. This tagging effort shall be used to augment broodstock collection (Section 4.1.1), population level information and juvenile habitat use (Section 4.2.2) and natural reproduction potential (Section 4.2.3).

After the initial three-year indexing period (Years 3-5), Douglas PUD shall conduct an additional two years of index monitoring in Phase I as determined by the Aquatic SWG. After year 9, an additional year of index monitoring would take place in year 12 and then every three to five years over the term of the new license (Phase II) to assess age-class structure, survival rates, abundance, condition factor, growth rates; identify distribution and habitat selection of juvenile sturgeon; and to inform the supplementation program strategy (see Table 4.7-1).

Frequency (every 3, 4 or 5 years) of implementation of a long-term index monitoring activities (after year 12) will be determined by the Aquatic SWG. Phase II index monitoring activities will not consist of implantation of active tags in captured individuals.

4.2.1.1 Progress Towards Objective 2 in 2016 – Index Monitoring Program

On January 8, 2014, the Aquatic SWG approved the Phase One White Sturgeon Management Plan Monitoring and Evaluation Study Plan (See Anchor QEA., 2015). (Note: Ecology and USFWS approved the study plan via email on December 20, 2013.)
In 2015, Douglas PUD began implementing the WSMP. Phase I components of the WSMP include supplementation releases, an Index Monitoring Program, an Acoustic-Tracking Program, and research towards Determining Natural Reproduction Potential.

To date, supplementation has comprised a total of 15,342 hatchery-produced PIT-tagged juvenile sturgeon that were released into the Wells Reservoir. One percent, or 149 hatchery fish have been acoustic tagged, with approximately 50 fish of each hatchery release group being acoustic tagged. A tagging summary is provided in Table 2.

Table 2. Douglas PUD’s releases of acoustic-tagged sturgeon in 2015 and 2016, by tag type.

<table>
<thead>
<tr>
<th>Brood Year</th>
<th>Year of Hatchery Release</th>
<th>Number Tagged in 2015</th>
<th>Number Tagged in 2016</th>
<th>Tag’s Estimated Battery Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild-Origin</td>
<td>na</td>
<td>7</td>
<td>1</td>
<td>487&lt;sup&gt;a&lt;/sup&gt; 904&lt;sup&gt;b&lt;/sup&gt; 1070&lt;sup&gt;c&lt;/sup&gt; 3650&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>2012</td>
<td>2013</td>
<td>1</td>
<td>1&lt;sup&gt;†&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>2014</td>
<td>50</td>
<td>25&lt;sup&gt;†&lt;/sup&gt; 24&lt;sup&gt;†&lt;/sup&gt; 1&lt;sup&gt;†&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>2015</td>
<td>49</td>
<td>49&lt;sup&gt;‡&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>2016</td>
<td>50&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>50&lt;sup&gt;‡&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>107</td>
<td>51</td>
<td>99 25 25 9</td>
</tr>
</tbody>
</table>

* tagged at the hatchery prior to release
† tagged in situ upon recapture during indexing setline efforts
<sup>a</sup> Vemco Model V9-2H-069k-1 (length 29 mm, diameter 9 mm, weight in air 4.7 g); pings every 150-210 s.
<sup>b</sup> Vemco Model V13-1H-069k-1 (length 36 mm, diameter 13 mm, weight in air 11 g); pings every 150-210 s.
<sup>c</sup> Vemco Model V13-1H-069k-1 (length 36 mm, diameter 13 mm, weight in air 11 g); pings every 150-300 s.
<sup>d</sup> Vemco Model V16-4L-069k-1 (length 36 mm, diameter 16 mm, weight in air 25 g); pings every 150-210 s.

For Index Monitoring, strictly-implemented stratified-random setline sampling was conducted in the summer (July/August) and fall (September/October) of 2015 and 2016. For each set, the total number of sturgeon (by brood-year-class) was recorded. All captured sturgeon were scanned for PIT tags, measured (fork length, weight), and any fish without a PIT tag or scute mark had one applied.

2015 Collectively, there were 441 capture events (acoustic tags were applied to fifty BY2013 fish when they were recaptured). Apparent survival rates were estimated for BY2013 fish using the PIT-tag mark and recapture data. Survival from release (January to June 2014) to recapture (July to August 2015) was estimated at 17.3% (SE = 2.4%), and was probably biased low. Survival of wild-origin fish (those raised from wild-caught larvae) was 2% higher than that for hatchery-origin fish (those raised from broodstock eggs), but the difference was not statistically significant. The apparent survival rates did not account for tag loss or emigration. Modelling a 2% emigration rate and 5% tag-loss rate resulted in ~1.2% increase in survival. Growth rates appeared to be higher than those observed in other similar studies. A comprehensive monitoring and evaluation report will be provided in draft to the Aquatic SWG in early 2016 and references as follows (Robichaud and Gingerich, 2016).
2016
In 2016, the second year of white sturgeon M&E was conducted in the Wells Reservoir. In May 2016, a total of 5,288 brood year 2015 larval-origin white sturgeon were passive integrated transponder (PIT) tagged, and 50 of those fish were also acoustically-tagged. In June 2016, brood year 2015 white sturgeon were released into the Wells Project.

In July 2016, the first 25-day mark and recapture effort was conducted, and in September 2016, the second 25-day effort took place. In summary, there were a total of 723 white sturgeon captures, including 240 captures during the first effort and 483 captures during the second effort. There were 120 fish that appeared to have been recaptured more than once (i.e., two to four times during the 50-day effort). Among the total captures, approximately 88% were brood year 2013 (3-year-olds), 10% were brood year 2014 (2-year-olds), and 2% were brood year 2015 (1-year-olds). The higher catch of 3-year-olds may suggest brood year 2013 fish have higher survival than other brood years, or that 3-year-olds recruit to the capture gear better. [Insert] Three wild fish were captured during the first effort and [insert] nine wild fish were captured during the second effort, none of which were recaptures.

Also in 2016, between the two indexing efforts, a 13-day effort was conducted targeting adult wild white sturgeon. No sampling of this nature has taken place since mid-2000 relicensing studies. In summary, there were a total of 15 wild white sturgeon captures. One wild fish was a recapture from 2015 indexing, and two wild fish were recaptures from 2016 indexing (July effort). Among the wild fish captures, six were classified as adults (greater than 170 centimeters [cm] fork length), and nine fish were classified as subadults (the smallest was 70 cm, and the largest was 105 cm). Fin ray samples were obtained from all wild subadult fish for aging, as discussed and recommended in 2015. Genetic samples (DNA tissue samples) were also obtained for all wild fish, as recommended. These data will be used as baseline data to compare to in future years.

Similar to the 2015 white sturgeon M&E effort, all wild-origin fish captured during the 2016 M&E effort were given 2L or second left scute marks to identify as wild fish in the event that the inserted PIT tag fails over the fish’s life time.

4.2.2 Marked Fish Tracking Program

Beginning in year three of the new license and continuing for three years (Years 3-5), Douglas PUD shall conduct tracking surveys of the juvenile white sturgeon that were released with active tags as part of supplementation activities. This will require one percent of each of the annual classes of juvenile sturgeon (up to a maximum of 50 fish each year) released in years 2, 3, 4, and 5 to be reared large enough to implant an active tag for tracking purposes (See Table 4.7-1). The purpose of tracking active-tagged fish is to determine juvenile white sturgeon emigration rates out of the Wells Reservoir and habitat use within the Wells Reservoir.

Douglas PUD shall repeat the tracking survey for two additional years during Phase I (see Table 4.7-1). The additional two years of surveys shall track: 1) active tags implanted in a percentage of juvenile fish from previous years of supplementation activities (dependent upon tag life) and 2) any juvenile and adult fish implanted with active tags during the last indexing period
preceding the survey. Subsequent Phase I surveys are likely to coincide with the additional Phase I index monitoring and juvenile stocking activities.

4.2.2.1 Progress Towards Objective 2 in 2016 – Monitoring and Evaluation Program

On January 8, 2014, the Aquatic SWG approved the Phase I White Sturgeon Management Plan Monitoring and Evaluation Study Plan (See Anchor QEA., 2015). (Note: Ecology and USFWS approved the study plan via email on December 20, 2013.) Consistent with the WSMP, Monitoring and Evaluation with specific emphasis on applying active tags and monitoring white sturgeon movement within the Wells Project began in 2015 and continued in 2016.

Acoustic-tracking was done using an array of 23 receivers deployed throughout the study area from the Chief Joseph Dam tailrace to the Wells Dam tailrace. PIT-tag detection arrays were deployed in the Methow and Okanogan rivers, and at Wells Dam fish ladders. All telemetry data were processed using LGL’s custom software, Telemetry Manager. The acoustic-tagged fish appeared to have initially spread out from the release site. Following initial movements, subsequent movements of sturgeon was not marked. Sturgeon were detected in all of the reservoir sampling zones, although some areas had significantly more sturgeon than others. The distribution of sturgeon did not vary markedly between the summer and fall sampling sessions.

4.2.3 Determining Natural Reproduction Potential (Objective 3)

In years where environmental conditions are appropriate, Douglas PUD shall track sexually mature adult sturgeon that were captured and implanted with active tags under Section 4.2.1 for the purpose of identifying potential spawning locations and determining natural reproduction potential. Appropriate environmental conditions may be determined by examining the following factors: water quality and quantity (i.e., flow, temperature, and turbidity), the presence of reproductively viable adults during index monitoring activities, and the status of maturity for supplemented fish. In years in which sexually mature adult sturgeon are tagged under Section 4.2.1, Douglas PUD may also utilize egg collection mats in combination with tracking in areas of the Wells Reservoir for the purpose of identifying potential spawning locations and activity. Five surveys of natural reproduction using adult tracking and/or egg mat placement shall occur over the term of the new license. Several of these surveys are intended to be implemented during the latter part of the license in order to examine the natural reproductive potential of supplemented fish recruiting to sexually maturity. These activities will support the aquatic life designated use for spawning under WAC 173-201A in the Washington state water quality standards.

4.2.3.1 Progress Towards Objective 3 in 2016 – Determining Natural Reproduction Potential

On January 8, 2014, the Aquatic SWG approved the Phase I White Sturgeon Management Plan Monitoring and Evaluation Study Plan (See Anchor QEA., 2015). (Note: Ecology and USFWS approved the study plan via email on December 20, 2013.) Consistent with the WSMP, Monitoring and Evaluation with specific emphasis on determining white sturgeon natural reproduction potential within the Wells Project is scheduled to occur during the first 10 years of
monitoring and evaluation and in years when environmental conditions are appropriate (as determined by the Aquatic SWG).

In 2016, no work was done towards the goal of determining natural reproduction potential, but will be examined in subsequent monitoring years during Phase I of the WSMP.

### 4.3 Phase II Supplementation and Monitoring Program (Objectives 2 and 4)

The information collected through activities described in Section 4.1-4.3 will provide insight into the population dynamics, habitat availability, and limiting factors that affect the natural population structure of white sturgeon within the Wells Reservoir. This information will inform supplementation, monitoring and evaluation activities during implementation of Phase II supplementation and monitoring activities in the WSMP for the duration of the new license term after year 10.

#### 4.3.1 Long-Term Juvenile White Sturgeon Stocking

The number and frequency of yearlings released in Phase II of the white sturgeon supplementation program will range from 0 to 5,000 fish. Stocking rates shall be based on the results of the Phase I Monitoring and Evaluation Program (Section 4.2) and determination of carrying capacity (Section 4.3) and shall be consistent with the goal and objectives of the WSMP. The Phase II stocking rates can also be adjusted as determined by the Aquatic SWG (also see Table 4.7-1, footnotes 2 and 3).

#### 4.3.1.1 Progress Towards Objectives 2 and 4 - Phase II Supplementation and Monitoring Program

Phase II goals will be addressed following the completion of Phase I in 2022.

#### 4.3.2 Supplementation Program Review

Douglas PUD shall compile information on other white sturgeon supplementation programs in the Columbia River Basin in order to assess whether the white sturgeon supplementation program being implemented at the Project is: (i) consistent and comparable with the technology and methods being implemented by other supplementation programs in the region; (ii) reasonable in cost and effective to implement at the Project; and (iii) consistent with the supplementation program goals and objectives. The supplementation program review will be conducted annually in coordination with the development of the annual report (Section 4.6).

#### 4.3.2.1 Progress Towards Objectives 2 and 4 - Phase II Supplementation and Monitoring Program

Phase II goals will be addressed following the completion of Phase I in 2022.

#### 4.3.3 Long-term Index Monitoring Program
Beginning in Year Twelve of the new license and every 3 to 5 years thereafter for the duration of the new license, Douglas PUD shall continue to conduct a Phase II Index Monitoring Study for juvenile and adult sturgeon in the Wells Reservoir. This program will be used to monitor age-class structure, survival rates, abundance, condition factor, growth rates, identify distribution and habitat selection of juvenile sturgeon, and may continue to support broodstock collection activities. The indexing methods will include using gillnets or other appropriate recapture methods for juveniles and set lines for adults and will not consist of actively tracking fish. Frequency (every 3, 4, or 5 years) of implementation of long-term index monitoring activities (after year 12) will be determined by the Aquatic SWG.

4.3.3.1 **Progress Towards Objectives 2 and 4 - Phase II Supplementation and Monitoring Program**

Phase II goals will be addressed following the completion of Phase I in 2022.

4.4 **Evaluation and Implementation of Adult Passage Measures (Objective 5)**

In Year Eleven of the new license and every 10 years thereafter for the duration of the new license unless otherwise determined by the Aquatic SWG, the Aquatic SWG shall evaluate the biological merit to providing upstream passage for adult white sturgeon. The assessment of biological merit shall be determined by: (i) evaluating information gathered from monitoring and evaluation activities and determining whether there is significant biological benefit and need for upstream passage; (ii) the availability of reasonable and appropriate means to provide upstream passage; and (iii) consensus from all other operators of the mid-Columbia projects to implement adult upstream passage measures\(^2\). If all three criteria above are met, Douglas PUD, in consultation with the Aquatic SWG shall develop adult passage measures that are consistent with measures being implemented by other mid-Columbia project operators.

4.4.1 **Progress Towards Objective 5 - Phase II Evaluation and Implementation of Adult Passage Measures**

Phase II goals, including longer term indexing and evaluating the feasibility and biological merit of adult passage measures will be addressed one year after the completion of Phase I (2023).

4.5 **Educational Opportunities Coinciding with WSMP Activities (Objective 6)**

Douglas PUD, in consultation with the Aquatic SWG, shall identify appropriate WSMP activities as opportunities for education to local public entities such as schools, cities, fishing and recreation groups, and other interested local groups. WSMP activities that may be appropriate for public participation are hatchery tours, release of hatchery juveniles, and tagging of juveniles prior to release.

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\(^2\) The intent is to provide connectivity to the Hanford Reach white sturgeon population.
4.5.1 Progress Towards Objective 6 in 2016 – Educational Opportunities Coinciding with WSMP Activities

On May 14, 2014, the Aquatic SWG approved the Douglas PUD White Sturgeon Outreach Plan, which identifies selected WSMP activities as opportunities for education to public entities such as schools, cities, fishing and recreation groups, and other interested local groups. Instructional videos including community outreach activities as they relate to white sturgeon actions were created in 2014 and are available at Douglas PUD’s public webpage at www.douglaspub.org. In addition, during the development of the new visitor center at Wells Dam, white sturgeon educational material will be provided consistent with requirements of the WSMP. Consistent with the 2014 approved White Sturgeon Outreach Plan, in June 2015 and 2016 Douglas PUD staff met with Bridgeport, WA elementary and high school children to release 30-40 white sturgeon juveniles into the Wells Project. During this activity students were given information about the supplementation program, white sturgeon life history and biology, and monitoring and evaluation efforts that will continue in the Project area. Similar outreach activities are planned and are expected to continue in 2017.

4.6 Reporting

Douglas PUD will provide a draft annual report to the Aquatic SWG summarizing the previous year’s activities undertaken in accordance with the WSMP. The report will document all white sturgeon activities conducted within the Project. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this WSMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas PUD will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

4.6.1 Progress Towards Meeting Annual Reporting Requirements

Consistent with the reporting requirements in Article 406 of the FERC License for the Wells Project, the 401 Certification, and the Aquatic Settlement Agreement WSMP, the WSMP Annual Report will be updated annually in consultation with the Aquatic SWG. Each year the WSMP Annual Report (this report) will be provided to the Aquatic SWG for review and then filed with the FERC on or prior to May 31st. The report will include a summary of the annual progress made towards the implantation of the WSMP and focus on the previous year’s developments.
4.7 Implementation Schedule

Table 4.7-1 outlines the estimated long-term schedule of the activities described in Sections 4.1-4.4 of the WSMP.

Table 4.7-1 Project White Sturgeon Implementation Schedule

<table>
<thead>
<tr>
<th>New License Year</th>
<th>Broodstock Plan and Collection</th>
<th>Release Fish into Wells Reservoir</th>
<th>Index Monitoring</th>
<th>Tracking Marked Fish</th>
<th>Natural Production Assessment</th>
<th>Adult Passage Evaluation</th>
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<td>13-50</td>
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<td>TBD</td>
<td>TBD</td>
<td>Every ten years after Year 11</td>
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</tbody>
</table>

3 Douglas PUD broodstock plan shall be completed within one year following this issuance of the new license. Broodstock collection activities will occur at a minimum in years 1-4 during the new license term. Additional years, during Phase I, will be determined by the Aquatic SWG. In Year 11 (Phase II), level and frequency of activity will be determined by the Aquatic SWG and will be based upon the level of long-term supplementation identified from monitoring results.

4 No more than a total of 35,000 fish will be stocked in Phase I (Years 1-10). The Phase II supplementation program will be determined by the Aquatic SWG and consistent with the goal of the WSMP.

5 Results of the index monitoring activities will be used to determine the scope of future supplementation activities. Index monitoring activities from year 12 through the remainder of the new license term will occur at a frequency of 3-5 years as determined by the Aquatic SWG.

6 Active-tagged juvenile and adult sturgeon will be tracked to assess emigration, habitat use, and potential spawning locations. This activity will occur in years 3, 4, and 5. Two additional years will be determined by the Aquatic SWG but will likely be consistent with years in which index monitoring activities are implemented.

7 Tracking of reproductively viable adult sturgeon in combination with deployment of egg collection mats to identify natural production in the Wells Reservoir during 5 separate years over the term of the new license based on flow conditions or other data as determined by the Aquatic SWG.

8 Phase II activities will consist only of broodstock plan and collection, stocking activities, index monitoring, and potentially natural reproduction assessments for the remainder of the new license.

9 Adult Passage Evaluations will occur in Year 11 and every 10 years thereafter for the term of the new license.
5.0 REFERENCES


2016 ANNUAL REPORT
WATER QUALITY MANAGEMENT PLAN
WELLS HYDROELECTRIC PROJECT
FERC PROJECT NO. 2149

April 2017

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington
EXECUTIVE SUMMARY

The annual Water Quality Management Plan (WQMP) Report includes a summary of water quality measures carried out by Public Utility District No. 1 of Douglas County (Douglas PUD) in 2016. Actions taken were consistent with the Federal Energy Regulatory Commission’s (FERC) license order for the Wells Hydroelectric Project (Project), and the requirements found within Appendix A (Clean Water Act section 401 Water Quality Certification [401 Certification]). The 2012 Federal energy Regulatory Commission (FERC) Order requires Douglas PUD to submit an annual WQMP report to the FERC on or before May 31st during each year of the license.

The goal of the WQMP is to protect the quality of the surface waters affected by the Wells Project with regard to the numeric criteria. Studies conducted during the relicensing process have found water quality within the Wells Project to be within compliance. Douglas PUD, in collaboration with the Aquatic Settlement Work Group (Aquatic SWG), has agreed to implement measures in support of the WQMP. Reasonable and feasible measures will be implemented in order to maintain compliance with the numeric criteria of the Washington State Water Quality Standards (WQS), Chapter 173-201A WAC. The measures presented within the WQMP (Section 4.0) are designed to meet the following objectives:

Objective 1: Maintain compliance with state WQS for Total Dissolved Gas (TDG). If non-compliance is observed, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD. In early 2016 Washington Department of Ecology (Ecology) approved Douglas PUD’s Gas Abatement Plan (GAP) and issued a fish passage TDG adjustment waiver for the 2016 spill season. The final 2016 GAP required Douglas PUD to monitor TDG in the forebay and tailrace of Wells Dam throughout the entire fish passage season (April 9 – August 19). Hourly forebay and tailrace TDG values were reported on Douglas PUD’s public webpage (www.douglaspud.org) and the U.S. Army Corps of Engineers Water Management Division webpage and the Columbia River Data Access Real Time webpage, consistent with regional fish management agencies. The GAP also included a biological monitoring plan, which involved the collection of adult salmonids at Wells Dam and juvenile salmonids at Rocky Reach Dam when TDG at Wells Dam exceeded 125% in the tailrace during any hour. In 2016, no values of 125% were observed in the Wells Dam Tailrace.

Objective 2: Maintain compliance with state WQS for water temperature. If information becomes available that suggests non-compliance is occurring or likely to occur, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD. Water temperature monitoring in 2016 was consistent with the requirements listed in the WQMP and 401 Certification.

Objective 3: Maintain compliance with state WQS for other numeric criteria. If information becomes available that suggests non-compliance is occurring or likely to occur, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD. In 2016, no WQS outside of TDG and temperatures were observed to be outside of compliance and as such no new measures occurred.
Objective 4: Operate the Project in a manner that will avoid, or where not feasible to avoid, minimize, spill of hazardous materials and implement effective countermeasures in the event of a hazardous materials spill; and

Objective 5: Participate in regional forums tasked with improving water quality conditions and protecting designated uses in the Columbia River basin. Consistent with the WQMP, 401 Certification, and Operating License, during calendar year 2016, Douglas PUD participated in regional forums lead by Ecology, the Sovereign Technical Team, and U. S. Army Corps of Engineers and other managers. In addition, the Wells Project was operated in a manner to minimize spill and TDG production consistent with the developed Spill Playbook and GAP.

The WQMP is intended to be compatible with other water quality management plans in the Columbia River mainstem, including Total Maximum Daily Loads (TMDL). Furthermore, the WQMP is intended to be supportive of the Habitat Conservation Plan (HCP), Bull Trout Management Plan, Pacific Lamprey Management Plan, Resident Fish Management Plan, White Sturgeon Management Plan, and Aquatic Nuisance Species Management Plan through the protection of designated uses (WAC 173-201A-600) in Project waters. The WQMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies.

This 2016 annual report on the implementation of the WQMP includes all of the water quality compliance related activities implemented during the calendar year.
1.0 INTRODUCTION

The Water Quality Management Plan (WQMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license (issued November 9, 2012).

During the development of the WQMP plan, the Aquatic Settlement Work Group (Aquatic SWG) focused on management priorities for resources potentially impacted by Wells Hydroelectric Project (Project) operations. Entities that participated in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), and Public Utility District No. 1 of Douglas County (Douglas PUD).

The Washington State Water Quality Standards (WQS) found at WAC 173-201A include designated uses (recreation, agriculture, domestic and industrial use, and habitat for aquatic life) and supporting numeric criteria. The WQMP is intended to address only the numeric criteria of the WQS. Aquatic life uses of the Project identified by the WQS are addressed by the five other Aquatic Resource Management Plans within the Agreement and by the measures implemented in the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP).

This management plan report summarizes the relevant resource issues and background (Section 2), identifies goals and objectives of the plan (Section 3), and describes the relevant measures (Section 4) to maintain compliance with the numeric criteria of state WQS during the term of the new license.

2.0 BACKGROUND

Section 401 of the Clean Water Act (CWA, 33 USC Chapter 26 § 1341 et seq.) requires that applicants for a hydroelectric project license from the Federal Energy Regulatory Commission (FERC) provide the FERC with a 401 Water Quality Certification (401 Certification) that provides reasonable assurance that the Project will comply with applicable WQS and any other appropriate requirements of state law. In Washington State, Ecology is responsible for issuing 401 Certifications. The 401 Certification for the Wells Project was issued on February 27, 2012.

2.1 Water Quality Standards

Congress passed the CWA in 1972, and designated the U.S. Environmental Protection Agency (EPA) as the administering federal agency. This federal law requires that a state’s water quality standards protect the surface waters of the U.S. for beneficial or designated uses, such as recreation, agriculture, domestic and industrial use, and habitat for aquatic life. Any state WQS, or amendments to these standards, do not become effective under the CWA until they have been approved by EPA.
Ecology is responsible for the protection and restoration of Washington State’s waters. Ecology establishes WQS that set limits on pollution in lakes, rivers, and marine waters in order to protect water quality and specified designated uses of such water bodies. These standards are found in WAC 173-201A.

2.1.1 Water Quality Standards for the Project

The Project includes the mainstem Columbia River above Wells Dam, one mile of the mainstem Columbia River below Wells Dam, the Methow River (up to river mile [RM] 1.5) and the Okanogan River (up to RM 15.5).

Under the 2006 WQS, the Project includes designated uses for spawning/rearing (aquatic life), primary contact recreation, and all types of water supply and miscellaneous uses. Numeric criteria to support the protection of these designated uses consist of various physical, chemical, and biological parameters including total dissolved gas (TDG), temperature, dissolved oxygen (DO), pH, turbidity, and toxins.

Unless stated otherwise in the subsections below, WQS criteria discussed in subsections 2.1.1.1 to 2.1.1.6 apply to all waters within the Project.

2.1.1.1 Total Dissolved Gas

TDG is measured as a percent saturation. Based upon criteria developed by Ecology, TDG measurements shall not exceed 110% at any point of measurement in any state water body. The WQS state that an operator of a dam is not held to the TDG standards when the river flow exceeds the seven-day, 10-year-frequency (7Q10) flood. The 7Q10 flow is the highest value of a running seven consecutive day average using the daily average flows that may be seen in a 10-year period. The 7Q10 total river flow for the Project was computed by Ecology (Pickett et al 2004) using the hydrologic record from 1974 through 1998 and a statistical analysis to develop the number from 1930 through 1998. The U.S. Geological Survey Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” was followed. The resulting 7Q10 flow at Wells Dam is 246,000 cubic feet per second (cfs).

In addition to allowances for TDG standard exceedances during natural flood flows in excess of 7Q10, the TDG criteria may be adjusted to accommodate spill to facilitate fish passage over hydroelectric dams when consistent with an Ecology-approved Gas Abatement Plan (GAP). Ecology has approved on a per application basis, an interim exemption to the TDG standard (110%) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). Dams in the Columbia and Snake rivers may be granted such an exemption. The GAP must be accompanied by fisheries management, physical, and biological monitoring plans (173-201A-200(1)(f)(ii)).

Columbia and Snake River TDG Exemption

On the Columbia and Snake rivers, three conditions apply to the TDG exemption. First, in the tailrace of a dam, TDG shall not exceed 125% as measured in any one-hour period during spillage for fish passage. Second, TDG shall not exceed 120% in the tailrace of a dam, as an
average of the 12 highest consecutive hourly readings in any one day (24-hour period), relative to atmospheric pressure. Third, TDG shall not exceed 115% in the forebay of the next dam downstream, also based on an average of the 12 highest consecutive hourly readings in any one day (24-hour period), relative to atmospheric pressure.

The increased levels of spill resulting in elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine passage. The TDG exemption provided by Ecology is based on a risk analysis study conducted by the National Marine Fisheries Service (NMFS; NMFS 2000).

2.1.1.2 Temperature

Temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax). The 7-DADMax for any individual day is calculated by averaging that day’s daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date (WAC 173-201A-020).

Under the WQS, the 7-DADMax temperature within the Columbia, Methow, and Okanogan river portions of the Project shall not exceed 17.5°C (63.5°F) (WAC 173-201A-602 and 173-201A-200(1)(c)). Additionally, the WQS contains additional supplemental temperature requirements for the Project portion of the Methow River (see Methow River Supplemental Requirements section below). When a water body's temperature is warmer than 17.5°C (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).

When the background condition of the water is cooler than 17.5°C, the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:

(A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed $28/(T+7)$ as measured at the edge of a mixing zone boundary (where "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).

(B) Incremental temperature increases resulting from the combined effect of all non-point source activities in the water body must not, at any time, exceed 2.8°C (5.04°F). Temperatures are not to exceed the criteria at a probability frequency of more than once every ten years on average.

Temperature measurements should be taken to represent the dominant aquatic habitat of the monitoring site. This typically means samples should:

(A) Be taken from well mixed portions of rivers and streams.

(B) Not be taken from shallow stagnant backwater areas, within isolated thermal refuges, at the surface, or at the water's edge.
The following guidelines on preventing acute lethality and barriers to migration of salmonids are also used in determinations of compliance with the narrative requirements for use protection established in WAC 173-201A (e.g., WAC 173-201A-310(1), 173-201A-400(4), and 173-201A-410 (1)(c)). The following site-level considerations do not, however, override the temperature criteria established for waters in WAC 173-201A-200(1)(c) or WAC 173-201A-602:

(A) Moderately acclimated (16-20°C, or 60.8-68.0°F) adult and juvenile salmonids will generally be protected from acute lethality by discrete human actions maintaining the 7-DADMax temperature at or below 22°C (71.6°F) and the 1-day maximum (1-DMax) temperature at or below 23°C (73.4°F).

(B) Lethality to developing fish embryos can be expected to occur at a 1-DMax temperature greater than 17.5°C (63.5°F).

(C) To protect aquatic organisms, discharge plume temperatures must be maintained such that fish could not be entrained (based on plume time of travel) for more than two seconds at temperatures above 33°C (91.4°F) to avoid creating areas that will cause near instantaneous lethality.

(D) Barriers to adult salmonid migration are assumed to exist any time the 1-DMax temperature is greater than 22°C (71.6°F) and the adjacent downstream water temperatures are 3°C (5.4°F) or cooler.

**Methow River Supplemental Requirements**

Ecology has identified water bodies, or portions thereof, which require special protection for spawning and incubation in accordance with Ecology publication 06-10-038. This publication indicates where and when the following criteria are to be applied to protect the reproduction of native char, salmon, and trout. Water temperatures are not to exceed 13°C from October 1 to June 15 in the lower Methow River including the portion within the Project boundary (up to RM 1.5).

2.1.1.3 Dissolved Oxygen

DO criteria are measured in milligrams per liter (mg/L). Under the WQS, DO measurements shall not be under the 1-day minimum of 8.0 mg/L. 1-day minimum is defined as the lowest DO reached on any given day. When a waterbody's DO is lower than the 8.0 mg/L criteria (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L. Concentrations of DO are not to fall below 8.0 mg/L at a probability frequency of more than once every ten years on average.

DO measurements should be taken to represent the dominant aquatic habitat of the monitoring site. This typically means samples should:

(A) Be taken from well mixed portions of rivers and streams.
(B) Not be taken from shallow stagnant backwater areas, within isolated thermal refuges, at the surface, or at the water's edge.

2.1.1.4 pH

pH is defined as the negative logarithm of the hydrogen ion concentration. Under the WQS, pH measurements shall be in the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.5 units.

2.1.1.5 Turbidity

Turbidity is measured in nephelometric turbidity units (NTUs). Turbidity shall not exceed 5 NTU over background when the background is 50 NTU or less; or a 10% increase in turbidity when the background turbidity is more than 50 NTU.

2.1.1.6 Toxins

Toxic substances shall not be introduced above natural background levels in waters of the state which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by Ecology.

Ecology shall employ or require chemical testing, acute and chronic toxicity testing, and biological assessments, as appropriate, to evaluate compliance with WAC 173-201-240 and to ensure that aquatic communities and the existing and characteristic beneficial uses of waters are being fully protected.

Within the Project Area, specifically within the Project portion of the Okanogan River, two toxic substances are of concern: Dichloro-Diphenyl-Trichloroethane (DDT) and Polychlorinated Biphenyls (PCBs). DDT is a synthetic organochlorine insecticide that was frequently used in agriculture prior to being banned in 1972. PCBs are an organic compound that were used as coolants and insulating fluids for transformers, and capacitors. PCBs are classified as persistent organic pollutants and production was banned in the 1970s due to its high level of toxicity.

Toxic substances criteria identified in the WQS for these two substances are as follow:

(A) In freshwater, DDT (and metabolites) shall not exceed 1.1 μg/L as an instantaneous concentration at any time. Exceedance of the criteria is defined as an acute condition. DDT (and metabolites) shall not exceed 0.001 μg/L as a 24-hour average. Exceedance of the criteria is defined as a chronic condition.

(B) In freshwater, PCBs shall not exceed 2.0 μg/L as a 24-hour average. Exceedance of the criteria is defined as an acute condition. PCBs shall not exceed 0.01 μg/L as a 24-hour average. Exceedance of the criteria is defined as a chronic condition.
2.1.2  305(b) Report, 303(d) List and Total Maximum Daily Loads

Every two years, the EPA, as specified in section 305(b) of the CWA, requires Ecology to compile an assessment of the state’s water bodies. Data collected from the water quality assessment are used to develop a 305(b) report. The report evaluates and assigns each water body into five categories based upon the Ecology’s evaluation of the water quality parameters collected from within each water body.

Category 1 states that a water body is in compliance with the State WQS for the parameter of interest.
Category 2 states a water body of concern.
Category 3 signifies that insufficient data are available to make an assessment.
Categories 4a-4c indicates an impaired water body that does not require a Total Maximum Daily Load (TMDL) for one of three reasons:
- Category 4a indicates a water body with a finalized TMDL.
- Category 4b indicates a water body with a Pollution Control Program.
- Category 4c indicates a water body impaired by a non-pollutant (e.g., low water flow, stream channelization, and dams).

Category 5 represents all water bodies within the state that are considered impaired and require a Water Quality Implementation Plan (WQIP) (formerly TMDL). The 303(d) list consists of only water bodies with Category 5 listings.

Information presented below in subsections 2.1.2.1 to 2.1.2.6 are based upon the Draft 2008 Water Quality Assessment and candidate 303(d) list that has been finalized by Ecology and submitted to the EPA for approval.

2.1.2.1  Total Dissolved Gas

The reach of the Columbia River within the Project is on the state’s 1998 303(d) list for TDG impairment (Category 5 listing). In 2004, Ecology developed a TDG TMDL (which was approved by EPA) for the mid-Columbia River and as such, this reach of the Columbia River, which includes the Project, is no longer on the 303(d) list for TDG (Category 4a).

Neither the reach of the Methow River within the Project (RM 1.5) nor the reach of the Okanogan River within the Project (RM 15.5) are listed on the 2008 303(d) list for TDG.

2.1.2.2  Temperature

The reach of the Columbia River within the Project is on the state’s 2004 303(d) list for temperature impairment. The EPA has developed a draft temperature TMDL for the mainstem Columbia River, including that portion of the Columbia River contained within the Project. It is anticipated that the EPA will issue the final temperature TMDL for the Columbia River at some future date. The TMDL will address the water temperature effects of dams and other human actions, including model analyses and load allocations for mainstem hydroelectric projects including Wells Dam.
The reach of the Methow River within the Project (RM 1.5) is not on the 2008 303(d) list for temperature.

The reach of the Okanogan River within the Project (RM 15.5) is not on the 2008 303(d) list for temperature. However, reaches of the Okanogan River upstream of the Wells Project boundary are listed on the 2008 303(d) list for temperature.

2.1.2.3 DO

No part of the Project area is on the 2008 303(d) list for DO.

2.1.2.4 pH

No part of the Project area is on the 2008 303(d) list for pH.

2.1.2.5 Turbidity

No part of the Project area is on the 2008 303(d) list for turbidity.

2.1.2.6 Toxins

Neither the reach of the Columbia River within the Project nor the reach of the Methow River within the Project (RM 1.5) is on the 2008 303(d) list for toxins.

The reach of the Okanogan River within the Project (RM 15.5) is not listed on the 2008 303(d) list for toxins. In 1998, Ecology put the portion of the Okanogan River within Project boundary on the 303(d) list for 4, 4'-DDE, 4,4'-DDD, PCB-1254, and PCB 1260 concentrations above standards in edible carp tissue (Ecology 1998). In 2004, Ecology completed the Lower Okanogan River DDT and PCB TMDL (which was approved by EPA).

2.2 Project Water Quality Monitoring Results

2.2.1 Total Dissolved Gas

TDG supersaturation is a condition that occurs in water when atmospheric gasses are forced into solution at pressures that exceed the pressure of the overlying atmosphere. Water containing more than 100% TDG is in a supersaturated condition. Water may become supersaturated through natural or dam-related processes that increase the amount of air dissolved in water. Supersaturated water in the Columbia River may result from the spilling of water at Columbia River dams. The occurrence of TDG supersaturation in the Columbia River system is well documented and has been linked to mortalities and migration delays of salmon and steelhead (Beiningen and Ebel 1970; Ebel et al. 1975).

At Wells Dam, Douglas PUD has monitored TDG for compliance with state and federal water quality regulations since 1998 and more recently in support of its GAP and TDG exemption issued by Ecology for juvenile fish passage (Le 2008). Douglas PUD is required to monitor TDG in the Wells Dam forebay and tailrace area (on the Columbia River, near RM 515.6).
Douglas PUD uses Rocky Reach forebay TDG data collected by Chelan County PUD for downstream forebay monitoring compliance data.

A TDG study conducted in 2006 indicated that the current location of the TDG compliance monitoring stations are appropriate in providing representative TDG production information both longitudinally and laterally downstream of Wells Dam (EES Consulting et al. 2007). Detailed information regarding the study is provided in Section 2.3.1.2.

Since 2003, Douglas PUD has operated the Project during the juvenile fish passage season (April – August) in accordance with an Ecology-approved GAP and associated TDG exemption. TDG monitoring at Wells Dam is facilitated through the deployment of Hydrolab Minisonde probes in the center of the Wells forebay and approximately 3 miles downstream of Wells Dam. TDG data are logged every fifteen minutes, averaged (4 in an hour) and transmitted on the hour. Probes are serviced and checked monthly for accuracy and calibrated if necessary.

Levels of TDG at Wells Dam and the Rocky Reach Dam forebay that result in exceedances of the numeric criteria are most likely to occur during April through August as a result of high flows caused by either rapid snow melt or federal flow augmentation intended to aid downstream juvenile salmonid passage. Douglas PUD monitors for TDG at Wells Dam year round. Chelan County PUD monitors for TDG at Rocky Reach Dam between April 1 and August 31. High TDG values at both Wells Dam and Rocky Reach Dam resulting in exceedances are often associated with various factors including high spring flows, unit outages, and upstream Federal Columbia River Power System operations, including federal flow augmentation, resulting in water entering the Project with relatively high TDG levels. During these time periods, river conditions in the mid-Columbia River system are conducive to exceedances of the TDG criteria.

2.2.2 Temperature

Beginning in 2001, an extensive water temperature monitoring effort was initiated by Douglas PUD in order to better understand the temperature dynamics throughout the Wells Reservoir. Temperature data was collected by Douglas PUD at four locations in the Columbia River (RM 544.5, RM 535.3, RM 530.0, and RM 515.6) and at one site each on the Okanogan (RM 10.5) and Methow (RM 1.4) rivers. Data collected by Douglas PUD were collected hourly using Onset tidbit temperature loggers. Monitoring start and end dates varied from year to year but generally began in the early spring and ended in late fall. Quality assurance and control measures were implemented prior to deploying and upon retrieving temperature loggers to ensure that data collected were accurate. Due to sensor loss or sensor malfunction in some years, the availability of data at some of these monitoring locations is sporadic.

In general, 7-DAD Max temperature data indicate that the portion of the Columbia River upstream of and within the Project generally warms to above 17.5°C (WQS numeric criteria) in mid-July and drops below the numeric criteria by early October (Figure 2.2-1). Water temperatures in the Methow River upstream of the Project warm to above 17.5°C in mid-July and drop below the numeric criteria by September (Figure 2.2-2), while trends in the Okanogan River (upstream of the Project) indicate warming above 17.5°C from early June with cooling by late September (Figure 2.2-3). Maximum water temperatures typically occur in late summer (August) with temperatures below Chief Joseph Dam, the Methow River (RM 1.4), and the
Okanogan River (RM 10.5) reaching 20.0°C, 22.5°C, and 27.0°C, respectively. It is important to note that these data are representative of water temperatures as they flow into the Project. In 2006, Douglas PUD expanded the Project temperature monitoring season to cover the entire year and implemented a more frequent downloading schedule. Douglas PUD also added additional monitoring stations at the mouths of the Okanogan (RM 0.5) and Methow (RM 0.1) rivers. These have been used to model temperature and allocate the effects of Project operations on water temperatures at Wells Dam and within the Wells Reservoir as they relate to compliance with the WQS numeric criteria for temperature.¹

Figure 2.2-1  7-DAD Max water temperature collected in the tailrace of Chief Joseph Dam (RM 544) using Onset temperature loggers for years 2001-2007.

¹ As part of new 401 Certification requirements in 2013 Douglas PUD installed remote real time temperature loggers at boundary locations on the Wells Project, and in various other locations as required by these license requirements.
Figure 2.2-2  7-DADMax water temperature collected in the Methow River upstream from the influence of Wells Dam (RM 1.4) using Onset temperature loggers for years 2001-2007. Data were unavailable in 2002 and 2003.

Figure 2.2-3  7-DADMax water temperature collected in the Okanogan River (RM 10.5) using Onset temperature loggers for years 2001-2007.
2.2.2.1 Wells Dam Fish Ladder Temperature Monitoring

Wells Dam has two fish ladders, one at each end of the dam. The two fish ladders are conventional staircase type fish ladders with 73 pools. The water source for the upper pools is the Wells Dam forebay. The flow through the upper 17 pools varies from 44 cfs at full reservoir to approximately 31 cfs at maximum reservoir drawdown. The lower 56 pools discharge a constant 48 cfs of water. To maintain the flow at 48 cfs in the lower ladder pools, supplementary water (auxiliary water supply) is introduced into Pool No. 56 through a pipeline from the reservoir. Pools are numbered in order from the bottom (near the collection gallery and entrance) to the top (exit to the Wells Dam forebay). The ladders are enclosed.

According to the HCP Biological Opinion (BO) issued by NMFS, all entities that use the fish trapping facilities at Wells Dam are required to discontinue trapping operations when fish ladder water temperatures exceed 69.8º F (21°C). In 2001 and 2003, Douglas PUD added supplemental temperature recording equipment at Pool 39 near the broodstock collection facilities in the east fishway at Wells Dam to ensure compliance with requirements in the NMFS BO. In 2001, hourly data indicated that water temperatures at this location in the east fish ladder did not exceed 69.8ºF (21°C) at any time during the monitoring period (Figure 2.2-4), which ran from late July to early December. In 2003, data were recorded every two hours (Figure 2.2-5).

Figure 2.2-4 Hourly water temperatures collected at the Wells Dam east fish ladder trap during 2001.
2.2.3  DO, pH, and Turbidity

2.2.3.1  DO and pH

In 2005, Douglas PUD added sensors to its existing forebay TDG monitoring equipment (Hydrolab Minisonde) in order to collect preliminary information on pH and DO within the Project to monitor these parameters during the late summer when probabilities of exceedance are highest. In 2006, Douglas PUD expanded the monitoring period to include the entire late summer period. In 2007, Douglas PUD further expanded the monitoring period to begin in July and end in early December (Figure 2.2-6 and 2.2-7). The monitoring data indicate that values for these parameters are generally in compliance with the WQS numeric criteria at this site. pH values are consistently within the range of 6.5 to 8.5 as specified by the numeric criteria. During August and September periods of this study, there were periodic excursions of DO below the numeric criteria of 8.0 mg/L. Probable causes are likely due to the physiological processes of aquatic plants; however, these exceedances do not appear to be the dominant trend.
Figure 2.2-6  pH measurements collected at the Wells Forebay TDG monitoring station (Hydrolab MiniSonde), 2005-2007.

Figure 2.2-7  DO measurements collected at the Wells Forebay TDG monitoring station (Hydrolab MiniSonde), 2005-2007.
2.2.3.2 Turbidity

At Wells Dam, Secchi disk readings are taken daily during the adult fish passage assessment period of May 1 to November 15 to examine turbidity. A standard Secchi disk is lowered into the forebay on the west side of Wells Dam near the exit to the west fishway. Measurements are recorded in meters of visibility and records have been made since the early 1970s; however, continuous, reliable information adhering to a standard protocol has been collected since 1998. General trends of Secchi disk data suggest relatively lower periods of visibility (0.6 meters to 1.2 meters) during the spring and early summer. These relatively low periods of visibility are highly correlated with high flows during the spring runoff period. As the high flow period subsides, Secchi disk values increase to between 3.4 and 4.6 meters for the remainder of the monitoring period. In 2008, Douglas PUD installed a fixed turbidity sensor near the east fishway exit in the Wells forebay and collected turbidity data in the Wells Dam forebay.

2.3 Project Water Quality Studies

2.3.1 Total Dissolved Gas

Each year from 2003-2008, Douglas PUD implemented spill testing activities to examine the relationship between water spilled over the dam and the production of TDG. These results were subsequently used by IIHR-Hydroscience and Engineering of University of Iowa to develop and calibrate an unsteady state three-dimensional (3D), two-phase flow computational fluid dynamics (CFD) tool to predict the hydrodynamics of gas saturation and TDG distribution within the Wells tailrace. These tools were then used to reliably predict TDG production at Wells Dam and establish how preferred operating conditions and spillway configurations can be used as methods to manage TDG within WQS numeric criteria (Politano et al. 2009b).

2.3.1.1 Project TDG Assessments 2003-2005

In 2003 and 2004, Douglas PUD hired Columbia Basin Environmental (CBE) to determine the effectiveness of the tailwater sensor relative to the tailwater cross section profile for TDG and better define the relationship between spillway releases and TDG production (CBE 2003, 2004). CBE deployed TDG sensors along two transects. Based on the results of these studies, the tailwater station provided an accurate record of daily average TDG values in the Wells Dam tailrace. The studies also showed that at times, gas levels from some turbine flows were being affected by spill.

In spring 2005, Douglas PUD contracted with CBE to implement a TDG study at Wells Dam designed to measure TDG pressures resulting from various spill patterns at the dam (CBE 2006). An array of water quality data loggers was installed in the Wells Dam tailwater for a period of two weeks between May 23, 2005 and June 6, 2005. The Wells Dam powerhouse and spillway were operated through a predetermined range of operational scenarios that varied both total flow and shape of the spillway discharge. A total of eight configurations were tested including flat spill patterns (near equal distribution of spill across the entire spillway), crowned spill patterns (spill is concentrated towards the center of the spillway) and spill over loaded and unloaded units (Table 2.3-1).
Table 2.3-1  Test matrix for 2005 Wells Dam TDG Production Dynamics Study.

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Spill over load, east spill/east generation</td>
</tr>
<tr>
<td>1B</td>
<td>Spill over unloaded units, east spill/west generation</td>
</tr>
<tr>
<td>1C</td>
<td>Spill over unloaded units, west spill/east generation</td>
</tr>
<tr>
<td>1D</td>
<td>Spill over load, west spill/west generation</td>
</tr>
<tr>
<td>2A</td>
<td>Crowned spill, modest flow</td>
</tr>
<tr>
<td>2B</td>
<td>Dentated spill, modest flow</td>
</tr>
<tr>
<td>2C</td>
<td>Crowned spill, high flow</td>
</tr>
<tr>
<td>2D</td>
<td>Flat spill, high flow</td>
</tr>
</tbody>
</table>

Results from the study indicated that spill from the west side of the spillway resulted in consistently higher TDG saturations than similar spill from the east side. All dentated spill patterns and flat spill patterns at high river flow yielded higher TDG saturations than crowned spill for similar total discharges. The results of this study also indicated that TDG levels of powerhouse flows may have been influenced by spill.

2.3.1.2  EES Consulting 2006 Project TDG Production Dynamics Study

In 2006, Douglas PUD continued TDG assessments at the Project by examining the best spillway configurations and project operations to minimize the production of TDG. Douglas PUD hired a team of hydraulic and TDG experts from the Pacific Northwest to help design a monitoring program for a study that would examine various operational scenarios and their respective TDG production dynamics.

Thirteen sensors were placed along three transects at 1,000, 2,500, and 15,000 feet below Wells Dam. There were also three sensors placed across the forebay, one being the fixed monitoring station midway across the face of the dam and two more a distance of 300 feet from the dam. The sensors were programmed to collect data in 15-minute intervals for both TDG and water temperature. Each test required the operations of the dam to maintain static flows through the powerhouse and spillway for at least a three-hour period. While there were 30 scheduled spill events, there were an additional 50 events where the powerhouse and spillway conditions were held constant for a minimum three-hour period. These “incidental” events provided an opportunity to collect additional TDG data on a variety of Project operations that met study criteria and are included in the results of the 2006 TDG Abatement Study. Spill amounts ranged from 5.2 to 52% of project flow; the volume of spill ranged from 2.2 to 124.7 kcf and the total discharge ranged from 16.4 to 254.0 kcf. There were six tests that were done at flows that exceeded the Wells Dam 7Q10 flows of 246 kcf.

Results of the study indicated that two operational scenarios, spread spill and concentrated spill, produced the lowest levels of TDG. The EES Consulting team recommended continued testing of operational measures to ameliorate TDG production at Wells Dam (EES Consulting et al. 2007). The 2006 study confirmed that the current locations of the forebay and tailwater TDG compliance monitoring station are appropriate in providing representative TDG production information both longitudinally and laterally downstream of Wells Dam.
2.3.1.3 IIHR-Hydroscience and Engineering TDG Modeling

A study was initiated with the University of Iowa IIHR-Hydroscience and Engineering in 2007 to develop a numerical model capable of predicting the hydrodynamics and TDG concentrations in the tailrace of the Wells Project. The purpose of the model was to assist in the understanding of the underlying dynamics of TDG production allowing an accurate evaluation of the effectiveness of various spill configurations and plant operations in reducing TDG at Wells Dam. The modeling efforts were divided into three phases. Phase I was a developmental stage for calibration and validation. The results from Phase I were successful and the model was proven to provide a reliable predictor of tailrace TDG and therefore a useful tool to identify Project operations that can minimize TDG concentrations downstream of Wells Dam (Politano et al. 2008). Phase II was a series of model runs using varying spill configurations based on typical 7Q10 events observed over the past decade. The final model run, referred to as Scenario-9, showed that preferred operating conditions and spillway configurations are able to reduce tailrace TDG to levels within Washington State WQS (< 120%) during a 7Q10 flow (Politano et al. 2009a).

Phase III included a final series of model runs aimed at gaining further reductions in tailrace TDG by reconfiguring the spillway operations used to achieve the tailrace standard in Phase II (Scenario-9). In addition to gaining additional reductions in TDG, IIHR-Hydroscience and Engineering ran a “Standard Compliance Comparison” scenario. The Standard Compliance Comparison scenario included a forebay TDG of 115%, along with 9 of 10 units operating at full capacity (i.e., 90% of total powerhouse capacity), to provide results comparable to downstream hydroelectric project TDG evaluations. The Phase III report also demonstrated compliance with two other requirements of the state WQS: (1) the ability to meet 115% in the forebay of Rocky Reach Dam during fish spill; and (2) the ability to maintain 110% in the tailrace during non-fish spill periods (Politano et al. 2009b).

2.3.1.4 Project TDG Playbooks

Since 2007, spill playbooks have been developed annually for operators at Wells Dam. The original spill playbook in 2007 focused on a range of operations to evaluate TDG production along with potential operational constraints. The subsequent playbooks evolved to the current 2012 format that simply focuses on strategies that have been identified to effectively manage TDG production in the tailrace of Wells Dam.

Since the Wells Project is a “run-of-the river” project with a relatively small storage capacity, river flows in excess of the ten-turbine hydraulic capacity must be passed over the spillways. Outside of system coordination and gas abatement spill (Douglas PUD has adopted a policy of not accepting the latter), minimization of involuntary spill has primarily focused on minimizing TDG production dynamics of water spilled based upon a reconfiguration of spillway operations. The 2009 Wells Project GAP (Lê and Murauskas, 2009) introduced the latest numerical model developed by the University of Iowa’s IIHR-Hydroscience and Engineering Hydraulic Research Laboratories. The two-phase flow computational fluid dynamics tool was used to predict hydrodynamics of TDG distribution within the Wells Dam tailrace and further identify operational configurations that would minimize TDG production at the Project. In an April 2009 report, the model demonstrated that Wells Dam can be operated to meet the TDG adjustment
criteria during the passage season with flows up to 7Q-10 levels provided the forebay TDG levels are below 115%. Compliance was achieved through the use of a concentrated spill pattern through Spillbay No. 7 and surplus flow volume through adjacent odd numbered spillbays in a defined pattern and volume. These preferred operating conditions create surface-oriented flows by engaging submerged spillway lips below the ogee, thus increasing degasification at the tailrace surface, decreasing supersaturation at depth, and preventing high-TDG waters from bank attachment. These principles were the basis of the 2009 Wells Project Spill Playbook and were fully implemented for the first time during the 2009 fish passage (spill) season with success. Overall, no exceedances were observed in either the Wells Dam tailrace or the Rocky Reach forebay in 2009.

In 2010, the concepts from the 2009 Spill Playbook were integrated into the 2010 Wells Project Spill Playbook given their effectiveness in maintaining levels below TDG criteria during the previous year. High Columbia River flows in June, which exceeded the preceding 15-year average flow, resulted in several exceedances of the hourly (125% maximum) and 12C-High (120%) TDG limits in the Wells Dam tailrace, and Rocky Reach forebay (115%). In response, Douglas PUD implemented an in-season analysis of the 2010 Spill Playbook and determined that full implementation of the recommendations from IIHR Engineering Laboratory would require the removal of the juvenile fish bypass system flow barriers in one even numbered spillbay. Following the in-season analysis and consultation with the HCP Coordinating Committee, changes were made to the 2010 Spill Playbook that allowed for the removal of the juvenile fish bypass system barriers in spillbay 6. Specifically, the Spill Playbook was modified to state that when spill levels approach the 53 kcfs threshold, the JBS barriers in spillbay 6 would be removed in order to remain in compliance with the TDG criteria in the Wells Dam tailrace and Rocky Reach Dam forebay. When spill exceeded 53 kcfs, excess spill would be directed through spillbays 6 and 7 rather than through spillbays 5 and 7. This operational configuration resulted in a more compact spill pattern that reduced the air-water interface surface area between spillway flows and the subsequent potential for lateral mixing and air entrainment.

In February 2011, Douglas PUD conducted an additional technical analysis of the 2010 Spill Playbook (after in-season changes) and confirmed that continued implementation would be appropriate for 2011 with additional minor modifications. Following approval of the 2011 GAP by Ecology, the 2011 Spill Playbook was implemented. Only minor changes were made to the 2012 spill playbook as a result of high compliance during the 2011 spill season.

In December of 2012 the final GAP report was completed for the 2012 spill season. After analysis it was determined that the 2012 spill season had the third highest average monthly flows since 1969 (April- August). In addition incoming flows were reliably above 115%. Despite these conditions Wells Dam demonstrated high compliance with all standards aside from the Rocky Reach 115% 12C-high forebay standard since incoming flows to Wells were above 115% greater than 50% of the spill season days. Given these unique conditions, and high compliance performance in 2011 no changes were suggested for the 2012 spill playbook.

In summary, the resulting 2012 spill strategies are based on four basic principles:

- Spill operations concentrated through a single spillbay (as opposed to spread through several spillbays) reduce TDG production and increase degasification at the tailwater surface.
- Discharge from spillbays (denoted S hereafter) located near the middle of the dam (e.g., S7) prevent water with high TDG from attaching to the shoreline.
- Forced spill exceeding Juvenile Bypass System (JBS) flows of 2.2 kcfs must be increased to ≥ 15 kcfs to ensure that the submerged spillway lip below the ogee is engaged. The resulting force creates flows that are surface oriented, ultimately promoting degasification at the tailwater surface.
- Operations of spillbays should change with expected incoming flows, which include the removal and reinstallation of bypass barriers. Active management of the spillbays and bypass barriers should improve TDG performance.

The above principles are used as a guideline for Project operators to spill at a range of outflows to ensure the future compliance with the Washington State WQS for TDG and have been the basis for spill/bypass operations over the years of 2012-2016.

2.3.2 EES Consulting 2006 Project Limnology

In 2005, Douglas PUD implemented a study to collect baseline limnological information for waters within the Project (EES Consulting 2006). The objectives of this study were to further document existing water quality conditions within the Project and to collect information to fill water quality data gaps identified by Douglas PUD to support the water quality certification process administered by Ecology. A total of nine sampling sites, consisting of 5 mainstem sites, 2 tributaries and 2 littoral habitats, were selected to represent the spatial variability within the Project (Table 2.3-2). The year-long study began in May 2005 and investigated various water quality parameters at each of the nine sampling sites. Sampling included physical, chemical and biological water quality characteristics. A total of 22 water quality characteristics were sampled. All procedures used for the purpose of collecting, preserving and analyzing samples followed established EPA 40 CFR 136 protocol.

<table>
<thead>
<tr>
<th>Site</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Downstream of Chief Joseph Dam (at Hwy 17 bridge)</td>
</tr>
<tr>
<td>2</td>
<td>Columbia River just downstream of the Brewster Bridge</td>
</tr>
<tr>
<td>3</td>
<td>Bridgeport Bar littoral site</td>
</tr>
<tr>
<td>4</td>
<td>Columbia River downstream of Pateros where the thalweg approaches maximum depth in the lower Wells Reservoir</td>
</tr>
<tr>
<td>5</td>
<td>Okanogan River upstream of confluence with Columbia River</td>
</tr>
<tr>
<td>6</td>
<td>Methow River upstream of confluence with Columbia River</td>
</tr>
<tr>
<td>7</td>
<td>Lower Wells Reservoir/Starr Boat Launch littoral site</td>
</tr>
<tr>
<td>8</td>
<td>Wells Forebay</td>
</tr>
<tr>
<td>9</td>
<td>Wells Tailrace</td>
</tr>
</tbody>
</table>

Results from the limnological investigation showed that the Project is characterized by low to moderately low levels for nutrients, slightly basic pH (range 7.5–8.5), well-oxygenated water and low turbidity with moderately low algae growth. Average Secchi depth for the Wells Reservoir varied minimally during May through August with only a slight increase as the season.
progressed (study average per site range 4.1 meters to 4.5 meters). Secchi depth (transparency) increased to a seasonal peak in September of 6.25 meters before slightly decreasing in October to a mean depth of 5.3 meters. Transparency increased downstream at the Brewster Bridge and Wells Forebay relative to the head of the reservoir at the Chief Joseph Dam tailrace for all months.

Turbidity in the Columbia River showed little seasonal variation with an annual average of 0.98 NTU and a variation of 0.38 NTU in September, 2005 (Wells Forebay site) to 3.81 NTU in February, 2006 (Brewster Bridge site). Longitudinal variation in turbidity was also minimal; sampling did not occur within the mixing zone plume of the Okanogan River. Turbidity in the Okanogan River was consistently higher than the Columbia River. Turbidity in the Methow River was higher than in the Columbia River in May (due to sediment load) and in August due to phytoplankton growth. The only turbidity reading over 5.0 NTU was in the Methow River during May where turbidity was 5.6 NTU.

Under the EES Consulting limnology study, water temperature in the Wells Reservoir is primarily governed by the temperature of inflowing water at Chief Joseph Dam with little warming occurring as water traverses the Wells Reservoir’s length. Similar to the Wells hourly temperature monitoring data (Section 2.2.2), results of the study indicate that the Project waters remained unstratified throughout the entire study period and was vertically homogeneous for DO. Figure 2.3-1 shows a vertical water profile of the Project. Low respiration rates at depth, a lack of vertical stratification and short water retention times resulted in homogeneous DO levels at all depths within the Project.

![Figure 2.3-1 Vertical water quality profile of the Project forebay from sampling date August 17, 2005.](image-url)
DO levels at one meter depth increased from upriver to downriver; the average difference (May through October) was 1.07 mg/L. The difference was more pronounced during May through August. The difference in September and October was 0.3 mg/L, which is at the limit of instrument reliability. Upstream to downstream differences in surface DO were negligible for the February 2006 sampling event. Littoral DO was similar or slightly higher than pelagic DO for surface waters. DO saturation levels were equal to or greater than 100% for all sites and all depths in all months except October when DO percent saturation for surface waters ranged from 110% to 91% saturation. The lower saturation levels in October may be due to reduced primary productivity while water temperatures were still relatively warm. All DO readings were above 8.0 mg/L and in compliance with the WQS numeric criteria.

Nitrogen and phosphorus are the two primary macronutrients needed for plant growth. Silica is important for diatomaceous phytoplankton. Ammonia (Nitrogen) levels were near or below detection levels for pelagic and littoral Columbia River Project waters as well as the Okanogan River for May through August and in February. Ammonia levels were only slightly higher in September and October. Ammonia peaked in the Methow River in August. Nitrates/Nitrites (Nitrogen) for Columbia River Project waters were higher in May before leveling off during the summer and fall. Nitrates/Nitrites were significantly higher at all sites for the February sample than any other month. Nitrates within littoral waters were lower than pelagic waters except in February when levels were similar. Nitrates/Nitrites in both the Okanogan and Methow rivers showed an increasing trend during the growing season. Total nitrogen levels for Columbia River pelagic and littoral waters were similar and relatively constant with the exception of significantly higher levels at most sites during February.

Orthophosphorus peaked for all stations in July. Orthophosphorus levels for pelagic and littoral waters were similar in all months except July when littoral orthophosphorus concentrations were significantly higher than observed for pelagic areas. Orthophosphorus levels in the Methow and Okanogan rivers were higher than in the Columbia River. Orthophosphorus was partially depleted in the Okanogan River but not in the Methow River at the time of the August sampling. Total phosphorus was slightly higher in littoral waters than in pelagic areas. Wave disturbance to bottom sediments may be a factor for this difference. Total phosphorus levels in pelagic surface waters ranged from below detection limits to 30.8 ug/L. Total phosphorus was higher for the Okanogan River than elsewhere, which is likely due to the higher sediment load. Total phosphorus for all stations peaked in July before gradually declining throughout the rest of the growing season.

The range in Nitrogen to Phosphorus (N:P) ratios for the Project waters was 2.5 to 30.8. The average Total Nitrogen to Total Phosphorus (TN:TP) ratio in the Project waters was 13.7 for the photic zone and averaged 14.8 for samples from all depths. These values are within the suggested literature ranges for phosphorus limitation. The N:P ratios peaked in July with pelagic and littoral waters showing similar trends. A decreasing N:P ratio through the major part of the algae growing season is typical of moderate to low nutrient waters as algae assimilate available nutrients. The N:P ratios were higher in the tributary rivers relative to the Columbia River. The N:P ratios are an indicator but not an absolute confirmation of factors limiting productivity. Moderate to low chlorophyll a concentrations (range 0.5 ug/L to 5.8 ug/L) occurred throughout the sample period with peaks in July and October for the Project waters. Concentrations were
lowest in August and also had the least variability among sites for the August sampling event. Pelagic and littoral waters were similar for chlorophyll \( a \) concentrations in most months except October when littoral waters reported twice as high chlorophyll \( a \) levels.

Phytoplankton were dominated by diatoms for all months at all sites sampled with Chrypophyta (small unicellular flagellates) being second dominant based on biovolume. Diatoms and Chrypophyta are both considered a good food source for the rest of the aquatic food web. Diatoms comprised 75% to 84% of the total phytoplankton biomass for the Project sites. Chlorophytes (green algae) were sub-dominant in the tailrace but only a minor component elsewhere. Total phytoplankton biomass was relatively low for all Project sample sites; total biomass was generally less than 200,000 um\(^3\)/ml. Biomass peaked in July and August for pelagic areas of the Project waters and minor peaks occurred in October for littoral sites. The timing of peaks varied among all stations. Cyanophyta (blue-green algae) were only recorded in the Project sites for the July sample at Brewster Bridge where they comprised 16% of the total biomass; however, the biomass of Cyanophytes were comprised of relatively few but very large multicellular units. Cyanophytes also were recorded in the Wells Tailrace (4.7% biomass) in July. Diatoms dominated phytoplankton in the Methow River where peak biomass occurred in August (1,455,158 um\(^3\)/ml). This peak is much higher than biomass observed anywhere else in the Project. Biomass levels in the Okanogan River were only slightly higher than in the Columbia River for most months with minor peaks occurring in May and October. Cyanophytes were a small proportion of the August biomass sample for the Okanogan River.

Diatoms also dominated periphyton. Seasonal lows occurred in July for all sites except Bridgeport shallows where the trend was decreasing periphyton biovolume as the season progressed.

Zooplankton density for pelagic waters was greatest in July (6,080/m\(^3\)) and lowest (1,289/m\(^3\)) in August. Copepods dominated the zooplankton population. Zooplankton densities in the tributary river mouths peaked in May. Although rotifers were present in all months, their density dropped to very low levels after May. Cladocera were the third most prevalent group with a minor peak occurring in July for this group.

Trophic Status Index (TSI) developed by Carlson (1977, 1996) and modified for nitrogen by Kratzer and Brezonik (1981) is an indication of the productivity of a lake based on Secchi depth, TP, TN and chlorophyll \( a \) concentrations for summer months (June through September). Project waters are classified as oligo-mesotrophic based on a mean TSI score of 36.5 with 40 to 50 being the range for mesotrophic classification (EES 2006).

### 2.3.3 Okanogan River Sediment Loading Analysis

In 2006, Douglas PUD, at Ecology’s request, conducted an analysis to assess sediment accumulation within the Project portion of the Okanogan River (lower 15.5 miles). The request was based upon concerns that Project operations might be contributing to the accumulation of DDT and PCB-laden sediment that could impact aquatic life designated use. Douglas PUD contracted with Erlandsen and Associates to collect bathymetric information at nine transects (RM 0.8, 1.3, 2.7, 4.9, 8.2, 10.5, 14.4, 16.6, and 19.0) within and above the Project portion of the Okanogan River. Bathymetric data of these same nine transects were collected previously by the
Bechtel Corporation in 1997. A comparison of the bathymetric data for all nine transects between 1997 and 2006 indicated that sediment is not accumulating in the Project portion of the Okanogan River. It was concluded that with regard to sediment loading, the Okanogan River is exhibiting natural riverine processes and is not affected by Project operations. Douglas PUD presented the results of the information to Ecology and the issue has been resolved.

### 2.3.4 Temperature, Dissolved Oxygen, pH, and Turbidity

#### 2.3.4.1 Water Temperature Modeling

To assess compliance with the State temperature standards, two 2D laterally-averaged temperature models (using CE-QUAL-W2) were developed that represent existing (or “with Project”) conditions and “without Project” conditions of the Wells Project including the Columbia River from the Chief Joseph Dam tailrace to Wells Dam, the lowest 15.5 miles of the Okanogan River, and the lowest 1.5 miles of the Methow River. The results were processed to develop daily values of the 7-DADMax, and then compared for the two conditions (West Consultants, Inc. 2008).

The model analyses demonstrated that “with Project” temperatures in the Columbia, Okanogan and Methow rivers do not increase more than 0.3°C compared to ambient (“without Project”) conditions anywhere in the reservoir, and that the Project complies with state water quality standards for temperature. The analyses also show that backwater from the Wells Project can reduce the very high summer temperatures observed in the lower Okanogan and Methow rivers. The intrusion of Columbia River water into the lowest 1-2 miles of the Okanogan River and lowest 1.5 miles of the Methow River can significantly decrease the temperature of warm summer inflows from upstream, and can also moderate the cold winter temperatures by 1-3°C, reducing the extent and length of freezing.

#### 2.3.4.2 Dissolved Oxygen, pH, and Turbidity

A study to collect additional DO, pH, and turbidity data from within the Wells Project was proposed by the Aquatic Resource Work Group in 2007. The goal of this study was to obtain required DO, pH, and turbidity information for the Wells Dam forebay and lower Okanogan River, both above and within the Wells Project boundary. The information gathered from these monitoring efforts demonstrated that the Project, as proposed to be operated under the new license, will meet the numeric criteria for WQS (Parametrix, Inc. 2009).

DO measurements demonstrated that the Okanogan River and the forebay of Wells Dam were in compliance with WQS. Project effects on DO concentrations in the Okanogan River were not evident as incoming water quality closely resembled that of the inundated portions of the Okanogan River. Changes in background minimum DO levels at Malott (above Project boundary) have a strong and significant linear relationship (P < 0.0001) with minimum values recorded within Project boundaries at both Monse and the Highway 97 Bridge. These results indicate that there is no statistically significant difference between minimum DO measurements collected above the Project and within the Project. DO concentrations in the forebay of Wells Dam remained well above the minimum numeric water quality criterion, excluding an instrument-related malfunction observed in early October (Parametrix, Inc. 2009).
Only on one occasion did pH within the Project exceed background measurements, but only by 0.06 units, well within the water quality allowance for human caused conditions. These results indicate that pH measurements within the Project boundary are well within the numeric criteria for WQS (Parametrix, Inc. 2009).

It is not clear what effect, if any, the Wells Project may have had on turbidity. Elevated turbidity values appeared to coincide with snowmelt and precipitation causing increased river flow. Turbidity levels in the Okanogan River above the Project (at Malott) were inconsistent with readings collected at both Monse (5 of 122 comparable days, or 4%) and Highway 97 (8 of 165 comparable days, or 5%), suggesting that such events are not widespread or persistent within the Wells Project (Parametrix, Inc. 2009). In 2009, Douglas PUD contracted Columbia Basin Environmental to continue monitoring turbidity for an additional year. Results from the 2009 field season indicate that turbidity decreases from the background monitoring location (Malott, RM 17.0), to both Monse (RM 5.0) and the Highway 97 Bridge (RM 1.3). No exceedances were observed and the data showed that the Wells Project is in compliance with the Washington State water quality standards for turbidity (DCPUD and CBE 2009).

2.3.5 Summary of Compliance with WQS

Based on the Initial and Updated Study Reports the Aquatic SWG was able to determine that waters within the Wells Project currently meet state numeric criteria of WQS as defined in Chapter 173-201A WAC. The following table presents supporting studies, by standard:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Studies</th>
<th>Result(s)</th>
<th>Continued Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDG</td>
<td>Politano et al. 2008, 2009a, 2009b.</td>
<td>Compliance met under preferred operating conditions and standard compliance scenario.</td>
<td>Yes</td>
</tr>
<tr>
<td>Temperature</td>
<td>West Consultants, Inc. 2008</td>
<td>Compliance met, zero exceedances. Potential future TMDL.</td>
<td>Yes</td>
</tr>
<tr>
<td>DO</td>
<td>Parametrix, Inc. 2009</td>
<td>Compliance met, zero exceedances</td>
<td>No</td>
</tr>
<tr>
<td>Turbidity</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
3.0 GOAL AND OBJECTIVES

The goal of the WQMP is to protect the quality of the surface waters affected by the Project with regard to the numeric criteria. Studies conducted during the relicensing process have found water quality within the Wells Project to be within compliance. Douglas PUD, in collaboration with the Aquatic SWG, has agreed to implement measures in support of the WQMP. Reasonable and feasible measures are being implemented in order to maintain compliance with the numeric criteria of the Washington State WQS, Chapter 173-201A WAC. The measures presented within the WQMP (Section 4.0) are designed to meet the following objectives:

Objective 1: Maintain compliance with state WQS for TDG. If non-compliance is observed, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD;

Objective 2: Maintain compliance with state WQS for water temperature. If information becomes available that suggests non-compliance is occurring or likely to occur, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD;

Objective 3: Maintain compliance with state WQS for other numeric criteria. If information becomes available that suggests non-compliance is occurring or likely to occur, the Aquatic SWG will identify reasonable and feasible measures, which will be implemented by Douglas PUD;

Objective 4: Operate the Project in a manner that will avoid, or where not feasible to avoid, minimize, spill of hazardous materials and implement effective countermeasures in the event of a hazardous materials spill; and

Objective 5: Participate in regional forums tasked with improving water quality conditions and protecting designated uses in the Columbia River basin.

The WQMP is intended to be compatible with other water quality management plans in the Columbia River mainstem, including TMDLs. Furthermore, the WQMP is intended to be supportive of the HCP, Bull Trout Management Plan, Pacific Lamprey Management Plan, Resident Fish Management Plan, White Sturgeon Management Plan, and Aquatic Nuisance Species Management Plan through the protection of designated uses (WAC 173-201A-600) in Project waters. The WQMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies.

The schedule for implementation of specific measures within the WQMP is based on the best information available at the time the plan was developed. As new information becomes available, the measures proposed in the WQMP may be adjusted through consultation with the Aquatic SWG.
4.0 WATER QUALITY MEASURES

In order to fulfill the goals and objectives described in Section 3.0 of the WQMP, Douglas PUD, in consultation with the Aquatic SWG, has initiated the implementation of the following measures.

4.1 TDG Compliance (Objective 1)

4.1.1 Monitoring

Douglas PUD shall continue to maintain fixed monitoring stations in the forebay and tailrace area of Wells Dam to monitor TDG and barometric pressure. TDG will be monitored hourly during the fish spill season each year. Data from the Wells forebay and tailrace stations will be transmitted on a daily basis to the applicable web-accessible database used by Ecology and regional fish management agencies. Douglas PUD shall maintain this monitoring program consistent with activities described in the then-current Wells GAP (Section 4.1.3).

Douglas PUD shall provide an annual report of all spill (and predicted TDG levels in the tailrace) occurring outside the fish passage season (currently October 1 to March 15).

4.1.1.1 Progress Towards Meeting Objective 1 in 2016 - Monitoring

In February 2012 Ecology issued a 401 Certification for Wells Dam, consistent with Federal Power Act Requirement for licensing non-federal hydro-projects. Requirements in the 401 Certification are consistent with the WQMP. In November 2012 the FERC issued a new license for the Wells Project. Requirements in the license are consistent with the 401 Certification and the WQMP.

In early 2016 Ecology approved Douglas PUD’s GAP and issued a fish passage TDG adjustment waiver for the 2016 spill season. On February 26, 2016 Douglas PUD submitted the 2016 GAP to the FERC. FERC subsequently approved the submitted GAP in April 2016. The final 2016 GAP required Douglas PUD to monitor TDG in the forebay and tailrace of Wells Dam throughout the entire fish passage season (April 19th to – August 19th). Hourly forebay and tailrace TDG values were reported on the U.S. Army Corps of Engineers Water Management Division webpage and the Columbia River Data Access Real Time webpage, consistent with regional fish management agencies. In addition, data was made available in realtime at www.douglaspud.org in accordance with 401 Certification requirements. Douglas PUD provided Ecology and the Aquatic SWG in-season reports on water quality. Following the completion of the calendar year, and consistent with 401 Certification requirements, Douglas PUD prepared a 2016 GAP/TDG report. The GAP report was approved by Ecology and the ASWG and filed with the FERC in February 2017, consistent with FERC license requirements.

4.1.2 Spill Operations

Within one year of issuance of the new license, Douglas PUD shall coordinate the annual HCP Project Fish Bypass/Spill Operations Plan with the Aquatic SWG and the GAP, using best available information to minimize the production of TDG during periods of spill. All operations
identified within the plan shall require the approval of the Wells HCP Coordinating Committee and the Aquatic SWG in order to ensure that spill operations are aimed at protecting designated uses and complying with the WQS numeric criteria for TDG in the Columbia River at the Project. In consultation with the Wells HCP Coordinating Committee and Aquatic SWG, the spill operations plan will be reviewed and updated, as necessary.

4.1.2.1  Progress Towards Meeting Objective 1 in 2016 - Spill Operations

In early 2016 Douglas PUD developed a 2016 GAP concomitantly with the 2016 Spill and Bypass Operations Plan and coordinated the review of these two documents with the HCP Coordinating Committee. Both plans were filed with the FERC after being approved by Ecology, the NMFS and the USFWS. In April 2016 the FERC approved the Juvenile Fish Bypass Plan and the Gas Abatement Plan and Spillway Play Book for 2016.

4.1.3  Project Gas Abatement Plan and TDG Exemption

Pending Ecology’s approval of each subsequent GAP (which provides for the TDG exemption), Douglas PUD shall continue to implement the activities identified within the previously-approved plan. Douglas PUD shall submit the GAP to Ecology by February 28th of each year, or on a less frequent basis, as documented by Ecology in writing. Douglas PUD shall submit the GAPs through the term of the new license or until no longer required by Ecology.

The GAP will include the Spill Operations Plan (Section 4.1.2) and will be accompanied by a fisheries management plan and physical and biological monitoring plans. The GAP shall include information on any new or improved technologies to aid in the reduction in TDG.

It is anticipated that: (1) the TDG monitoring activities described in Section 4.1.1 will be adequate for the physical monitoring plan requirement; and (2) the Wells HCP and Aquatic Resource Management Plans in the Aquatic Settlement Agreement with respect to fish passage will be adequate for fish management plans, for the purposes of the GAP. Additional biological monitoring studies for purposes of Gas Bubble Trauma Monitoring may be required.

Douglas PUD shall provide an annual TDG report as required by the Ecology-approved GAP.

4.1.3.1  Progress Towards Meeting Objective 1 in 2016 - Project Gas Abatement Plan and TDG Exemption

In 2016, Douglas PUD implemented the Aquatic SWG and Ecology approved 2016 GAP. The GAP was submitted to, and approved by, Ecology prior and the FERC. The 2016 GAP included Douglas PUD’s Spill Playbook for 2016 (Playbook), which serves as the Spill Operations Plan identified above. The Playbook is consistent with methods used at Wells to minimize the production of TDG during differing flow regimes up to 246.0 kcf/s of river flow. Additional details of spill and TDG performance were provided in the 2016 GAP Report filed with Ecology and the FERC in February 2017.

The GAP also included a biological monitoring plan, which involved the collection of adult salmonids at Wells Dam and juvenile salmonids at Rocky Reach Dam when TDG at Wells Dam
exceeded 125% in the tailrace during any hour. In 2016, the hourly tailrace TDG levels never exceeded the 125% standard.

4.1.4 Measures to Address Non-Compliance

Douglas PUD shall report all occurrences of non-compliance with TDG numeric criteria immediately to Ecology for regulatory discretion and to the Aquatic SWG for consideration.

If the Project is found to be consistently out of compliance with TDG at any time during the new license term, Douglas PUD shall, in coordination with the Aquatic SWG, take the following steps:

(A) Evaluate any new reasonable and feasible technologies that have been developed; and

(B) After the evaluation, if no new reasonable and feasible improvements have been identified, propose an alternative to achieve compliance with the standards, such as site-specific criteria, a use attainability analysis, or a water quality offset.

4.1.4.1 Progress Towards Meeting Objective 1 in 2016 - Measures to Address Non-Compliance

During the 2016 water year, Ecology was updated regularly when flows were exceptionally high and when TDG standards exceeded those required by the fish passage TDG exemption. In addition, Douglas PUD provided Ecology regular TDG and water reports.

In consultation with Ecology and the Aquatic SWG, Douglas PUD addressed both (A) and (B) above through the development of a Quality Assurance Project Plan (Douglas PUD., 2013a) for TDG and water temperature and a Water Quality Attainment Plan (Douglas PUD., 2013b). Both Plans were developed in 2013 as a requirement of the Wells Project 401 Certification and article 401(a) in the FERC license order for Wells Dam. The plans are specifically designed to determine if the Wells Project is in compliance for TDG and what measures will be used to improve or address compliance concerns. Both plans were completed prior to October 31st 2013.

4.2 Water Temperature Compliance (Objective 2)

4.2.1 Monitoring

Douglas PUD shall continue to monitor temperature at the Wells Dam forebay and tailrace in conjunction with its TDG monitoring program (currently April 1-September 15). Temperature data from the TDG monitoring program will be recorded hourly and reported daily to regional databases. Water temperatures shall also be monitored at all boundary conditions of the Project (Methow River RM 1.5, Okanogan River RM 10.5, and Columbia River RM 544.5) and in the Well Dam forebay and tailrace as required by the Aquatic SWG.

Douglas PUD shall continue to collect hourly fish ladder temperatures 24 hours a day during the fish passage season (May 1 to November 15) at Pool No. 39 on the east ladder. Water temperatures shall also be monitored hourly in the auxiliary water supply system and near the
east shore of the Wells Dam forebay (bottom, middle, and surface depths) during this same time period.

4.2.1.1 Progress Towards Meeting Objective 2 in 2016 - Monitoring

Water temperature monitoring in 2016 was consistent with new requirements found in the Wells Project 401 Certification. Consistent with 401 Certification requirements Douglas PUD collected real time water temperature data in boundary locations and at Wells Dam. Data was made available at dcpud.org in real time. Additional information on monitoring is contained within the Quality Assurance Project Plan (QAPP) filed and approved by the FERC in 2013. Monitoring is consistent with the WQMP, the Wells Project 401 Certification and the Wells Dam Operating License issued by the FERC. In April of 2016 Douglas PUD submitted an annual Water Temperature Report to Ecology and the FERC describing the monitoring that occurred during the calendar year 2015. The 2016 water temperature report is attached to this WQMP at Exhibit A.

4.2.2 Temperature TMDL Development and Implementation

Douglas PUD shall participate in EPA Region 10’s water temperature TMDL development for the U.S. portion of the Columbia River, in coordination with the Parties of the Aquatic SWG. Temperature data from the monitoring program at Wells Dam (Section 4.2.1) and software and results of the CE-QUAL-W2 model will be made available to EPA and other entities to assist in the development of the Columbia River temperature TMDL.

Where the measures identified in the TMDL are more protective than other measures in this plan, provisions of the temperature TMDL and implementation plans relevant to the Project and its operations, including specified time frames for implementing improvement measures, shall be implemented at the Project.

If a TMDL is not timely approved by EPA, Ecology may establish an allocation. In this case, Ecology will work with the Aquatic SWG and other interested parties to identify reasonable and feasible measures.

This plan does not exclude the option of the Aquatic SWG to consider modifying the water quality standard through a use attainability analysis or other process.

4.2.2.1 Progress Towards Meeting Objective 2 in 2016 - Temperature TMDL Development and Implementation

No TMDL planning took place in 2016. When the EPA’s TMDL development occurs, Douglas PUD will participate.

4.2.3 Measures to Address Non-Compliance

Douglas PUD shall report information indicative of non-compliance with water temperature immediately to Ecology for regulatory discretion and to the Aquatic SWG for consideration.
Such information may include changes in Project operations likely to increase water temperature or observations inconsistent with related environmental parameters.

If the Project is found to be consistently out of compliance with water temperature at any time during the new license term, Douglas PUD shall, in coordination with the Aquatic SWG, take the following steps:

(A) Evaluate alternative Project operations or any new reasonable and feasible technologies that have been developed; and

(B) After the evaluation, if no new reasonable and feasible improvements have been identified, propose an alternative to achieve compliance with the standards, such as site-specific criteria, a use attainability analysis, or a water quality offset.

4.2.3.1 Progress Towards Meeting Objective 2 in 2016 - Measures to Address Non-Compliance

No issues of non-compliance with the state’s water temperature standards were observed during 2016. As a result, no new measures are proposed to address non-compliance of the water temperature standards.

4.3 Compliance with Other Numeric Criteria (Objective 3)

Douglas PUD shall report information indicative of non-compliance with other numeric criteria immediately to Ecology for regulatory discretion and to the Aquatic SWG for consideration. This includes existing or developed criteria for toxic substances in water or sediments within Project Boundaries. The Aquatic SWG shall evaluate the information, and, if needed, require Douglas PUD to develop a plan to identify and address Project-related impacts, if any.

After the evaluation, if no reasonable and feasible improvements have been identified, Douglas PUD may propose an alternative to achieve compliance with the standards, such as site-specific criteria, a use attainability analysis, or a water quality offset.

4.3.1.1 Progress Towards Meeting Objective 3 in 2016 - Compliance with Other Numeric Criteria

In 2016 no other numeric criteria concerns were observed in the Project Area.

4.4 Spill Prevention and Control (Objective 4)

4.4.1 Spill Prevention and Control Requirements

Douglas PUD shall operate the Project in a manner that will minimize spill of hazardous materials and implement effective countermeasures in the event of a hazardous materials spill. The Project Spill Prevention Control and Countermeasures Plan (SPCC) will be updated
pursuant to FERC requirements and recommendations as provided by Ecology. Douglas PUD shall comply with the updated version(s) of the SPCC.

4.4.1.1 Progress Towards Meeting Objective 4 in 2016 - Spill Prevention and Control Requirements

The Wells Project is operated in strict compliance with the Spill Prevention and Control requirements of the WQMP, 401 Certification and the FERC license. No spill events occurred during 2016.

4.4.2 Participation in the Columbia and Snake River Spill Response Initiative

Douglas PUD shall continue participation in the Columbia and Snake River Spill Response Initiative (CSR-SRI). The CSR-SRI is a collaborative effort made up of local, state, and federal oil spill response community as well as members of industry and was developed to address the immediate need for oil spill preparedness and response in the area along the Columbia and Snake rivers. In addition to participation in the CSR-SRI, Douglas PUD shall continue to operate the Project in accordance with its SPCC (Jacobs 2007).

4.4.2.1 Progress Towards Meeting Objective 4 in 2016 - Participation in the Columbia and Snake River Spill Response Initiative

Douglas PUD has been an active participant in the Snake-Columbia Spill Response Initiative toward the minimization of TDG throughout the Columbia and Snake rivers. The project continues to be operated in a manner that is consistent with the SPCC (2007).

4.4.3 Inspections

For the term or the new license, Douglas PUD shall, upon reasonable notice, allow Ecology staff or representatives access to inspect the Project, including inside the dam, for the purpose of assessing Spill Prevention and Control measures and compliance with Section 4.4.1. Following inspection, Douglas PUD shall address oil and hazardous material prevention and control issues identified by Ecology.

4.4.3.1 Progress Towards Meeting Objective 4 in 2016 - Inspections

Douglas PUD allows access to the Project as required and as requested by Ecology. No Ecology inspection occurred in 2016.

4.5 Regional Forums (Objective 5)

4.5.1 Participation in Regional Water Quality Forums

Douglas PUD shall continue its participation in both the Water Quality Team and Adaptive Management Team meetings to address regional water quality issues, including sharing the results from monitoring, measuring, and evaluating water quality in the Wells Project. However,
Douglas PUD will not advocate for any water quality measures in regional forums without consulting with the Aquatic SWG.

4.5.1.1 Progress Towards Meeting Objective 5 in 2016 - Participation in Regional Water Quality Forums


4.5.2 Project Operations

Douglas PUD may, following notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with other mid-Columbia hydroelectric operations to the extent practicable. Coordinated operations are intended to reduce spill, increase generating efficiencies and thereby reduce the potential for exceedances of the TDG numeric criteria. These coordinated operations should be beneficial to TDG compliance and Aquatic Resources.

4.5.2.1 Progress Towards Meeting Objective 5 in 2016 - Project Operations

Douglas PUD continued implementation of the Hourly Coordination Agreement in 2016, consistent with the WQMP, 401 Certification, and FERC Operating License.

4.6 Reporting

Douglas PUD shall provide a draft annual report to the Aquatic SWG summarizing the previous year’s water quality activities and activities proposed for the coming year, in accordance with the WQMP and as determined by the Aquatic SWG. The report will include any decisions, statements of agreement, evaluations, or changes made pursuant to this WQMP. If significant activity was not conducted in a given year, Douglas PUD may prepare a memorandum providing an explanation of the circumstances in lieu of the annual report. A summary of monitoring results, any analyses and compliance with the WQS numeric criteria will be included in an appendix to the annual report.

4.6.1 Progress Towards Meeting Annual Reporting Requirements

In addition to the reporting requirements found within the Aquatic Settlement Agreement requiring the submission of annual reports for all six of the management plans including the WQMP, Article 406 of the FERC license for the Wells Project also requires Douglas PUD to submit annual reports detailing the implementation of each of the six Aquatic Settlement Agreement management plans. This report is intended to satisfy those reporting requirements associated with the new license for the Wells Project.
4.6.2 Study Plans

Douglas PUD shall prepare study plan(s) that include QAPP(s) for each parameter to be monitored. The QAPPs shall follow the Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (July 2004 Ecology Publication Number 04-03-030) or its successor. The QAPPs shall contain, at a minimum, a list of parameter(s) to be monitored, a map of sampling locations, and descriptions of the purpose of the monitoring, sampling frequency, sampling procedures and equipment, analytical methods, quality control procedures, data handling and data assessment procedures and reporting protocols.

Douglas PUD shall review and update the QAPPs annually based on a yearly review of data and data quality. Ecology may also require future revisions to the QAPP based on monitoring results, regulatory changes, changes in Project operations, and/or the requirements of TMDLs.

The initial QAPPs and any changes shall be submitted to the Aquatic SWG for review and are subject to approval by Ecology. Implementation of the monitoring program shall begin upon Ecology’s written approval of the QAPP, unless otherwise provided by Ecology.

4.6.2.1 Progress Towards Meeting Objective 5 in 2016 - Study Plans

No new QAPP were developed in 2016, since no new monitoring was conducted. The QAPP developed and approved in 2013 for water temperature and TDG monitoring was used in 2016 as a guiding document to implement water quality monitoring in and around the Wells Project area in 2016.
5.0 REFERENCES


EXHIBIT A

2016 WATER TEMPERATURE ANNUAL REPORT

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

February 21, 2017

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, WA

Prepared for:
Washington Department of Ecology
Yakima, WA
For copies of this plan, contact:

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>INTRODUCTION ..................................................................................</td>
<td>1</td>
</tr>
<tr>
<td>2.0</td>
<td>BACKGROUND ..................................................................................</td>
<td>1</td>
</tr>
<tr>
<td>2.1</td>
<td>Project Description ......................................................................</td>
<td>1</td>
</tr>
<tr>
<td>2.2</td>
<td>Regulatory Framework ....................................................................</td>
<td>4</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Temperature Water Quality Standard ..........................................</td>
<td>4</td>
</tr>
<tr>
<td>2.2.2</td>
<td>305(b) Report, 303(d) List and Total Maximum Daily Loads ..............</td>
<td>4</td>
</tr>
<tr>
<td>2.3</td>
<td>Wells Project Water Temperature Activities ..................................</td>
<td>5</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Wells Reservoir and Tributaries ...............................................</td>
<td>5</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Wells Dam Fish Ladders ..................................................................</td>
<td>6</td>
</tr>
<tr>
<td>2.4</td>
<td>401 Certification Temperature Requirements ..................................</td>
<td>7</td>
</tr>
<tr>
<td>3.0</td>
<td>IMPLEMENTATION RESULTS ..................................................................</td>
<td>7</td>
</tr>
<tr>
<td>3.1</td>
<td>Quality Assurance Project Plan ....................................................</td>
<td>7</td>
</tr>
<tr>
<td>3.2</td>
<td>Temperature Monitoring Equipment ...............................................</td>
<td>8</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Equipment Acquisition ...................................................................</td>
<td>8</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Equipment Installation ...................................................................</td>
<td>10</td>
</tr>
<tr>
<td>3.3</td>
<td>Temperature Data Results ................................................................</td>
<td>15</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Chief Joseph Dam Tailrace ............................................................</td>
<td>16</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Okanogan River Boundary ................................................................</td>
<td>17</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Methow River Boundary ...................................................................</td>
<td>17</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Wells Dam Forebay .........................................................................</td>
<td>18</td>
</tr>
<tr>
<td>3.3.5</td>
<td>Wells Dam Tailrace ........................................................................</td>
<td>19</td>
</tr>
<tr>
<td>3.3.6</td>
<td>Wells Dam Forebay Multiple Depth Requirement ................................</td>
<td>20</td>
</tr>
<tr>
<td>3.3.7</td>
<td>Wells Dam Auxiliary Water Supply ...............................................</td>
<td>21</td>
</tr>
<tr>
<td>3.3.8</td>
<td>Wells Dam East Fishway Pool No. 39 .............................................</td>
<td>22</td>
</tr>
<tr>
<td>4.0</td>
<td>CONCLUSIONS ..................................................................................</td>
<td>24</td>
</tr>
<tr>
<td>5.0</td>
<td>REFERENCES ....................................................................................</td>
<td>25</td>
</tr>
</tbody>
</table>


**LIST OF TABLES**

Table 1. 7-DADMax by location as determined by remote real time temperature sensor. 24

**LIST OF FIGURES**

Figure 1. Location Map of the Wells Project .......................................................... 3
Figure 2. Remote water temperature station that sends data in real time using GOES satellite link .......................................................... 9
Figure 3. Temperature monitoring at and around Wells Dam (graduated green circles are intended to show surface middle and deep depths). ........................................ 11
Figure 4. Methow River temperature monitoring location (RM 1.5). The location of the sensor is approximated by the green circle. ........................................ 12
Figure 5. Okanogan River temperature monitoring location (RM 10.5). The location of the sensor is approximated by the green circle. ........................................ 13
Figure 6. Chief Joseph Tailrace (Columbia River RM 544.5) temperature monitoring. The location of the sensor is approximated by the green circle. .................. 14
Figure 7. Water temperature data collected in the Chief Joseph Tailrace ................. 16
Figure 8. Water temperature data collected in the Okanogan River at RM 10.5 ........ 17
Figure 9. Water temperature data from the Methow River at RM 1.5. Criterion of 13°C applies only from October 1- June 15 each year (bottom horizontal line). ........ 18
Figure 10. Water temperature data collected in the Wells Dam Forebay at pier nose 6 .... 19
Figure 11. Water temperature data collected in the Wells Dam Tailrace. .................. 20
Figure 12. Water temperature data collected in the Wells Dam Forebay at three depths. Temperature profiles show the lack of stratification in this location during the time period. ......................................................... 21
Figure 13. Water temperature data collected in the auxiliary water supply system at Wells Dam .......................................................... 22
Figure 14. Water temperature data collected in Pool 39 of the east fish ladder at Wells Dam. The horizontal line at 21°C (top line) denotes the threshold whereby adult broodstock trapping at Wells Dam discontinues and the horizontal line at 17.5 (bottom line) denote the 17.5°C 7-DADMax .................................................. 23
6.0 INTRODUCTION


Pursuant to the Wells Project License Order and the 401 Certification, Douglas PUD is required to maintain compliance with the state Water Quality Standard (WQS) for water temperature through continued implementation of a monitoring program and to prepare an annual report of the monitoring results and analyses for submittal by April 30 of the following year (Ecology 2012).

This annual report summarizes water temperature activities implemented at the Wells Project in 2016. Background activities including the Project description, regulatory framework, past Wells Project temperature activities, and 401 Certification temperature requirements are presented in Section 2.0. Implementation results for 2016 are presented in Section 3.0 and include the implementation of an Ecology-approved Quality Assurance Project Plan (QAPP) for water temperature, and the results of water temperature monitoring activities within the Wells Project.

7.0 BACKGROUND

7.1 Project Description

The Wells Project is located at river mile (RM) 515.6 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Dam, owned and operated by the U.S. Army Corps of Engineers (USACE), and 42 miles upstream from the Rocky Reach Dam, owned and operated by Public Utility District No. 1 of Chelan County. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 774.3 MW and a peaking capacity of approximately 840 MW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of Well Dam, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height. The juvenile fish bypass system (JBS) was developed by Douglas PUD and uses a barrier system to modify the intake velocities on all even numbered spillways (2, 4, 6, 8 and 10).
The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at elevation of 781 feet above mean sea level (msl). The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1).
Figure 1. Location Map of the Wells Project.
7.2 Regulatory Framework

7.2.1 Temperature Water Quality Standard

Temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax). The 7-DADMax for any individual day is calculated by averaging that day’s daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date (WAC 173-201A-020).

Under the Washington State WQS, the 7-DADMax temperature within the Columbia, Methow, and Okanogan river portions of the Wells Project shall not exceed 17.5°C (63.5°F) (WAC 173-201A-602 and 173-201A-200(1)(c)). When a water body's temperature is warmer than 17.5°C (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).

In addition to the numeric criteria above, the WQS contains additional supplemental temperature requirements for the Project portion of the Methow River (i.e., Methow River Supplemental Requirements). Ecology has identified water bodies, or portions thereof, which require special protection for spawning and incubation in accordance with Ecology publication 06-10-038. This publication indicates where and when the following criteria are to be applied to protect the reproduction of native char, salmon, and trout. Water temperatures are not to exceed 13°C from October 1 to June 15 in the lower Methow River including the portion within the Project boundary (up to RM 1.5).

7.2.2 305(b) Report, 303(d) List and Total Maximum Daily Loads

Every two years, the Environmental Protection Agency (EPA), as specified in section 305(b) of the CWA, requires Ecology to compile an assessment of the State’s water bodies. Data collected from the water quality assessment are used to develop a 305(b) report. The report evaluates and assigns each water body into five categories based upon the Ecology’s evaluation of the water quality parameters collected from within each water body.

1. Category 1 states that a water body is in compliance with the State WQS for the parameter of interest.
2. Category 2 states a water body of concern.
3. Category 3 signifies that insufficient data are available to make an assessment.
4. Categories 4a-4c indicates an impaired water body that does not require a Total Maximum Daily Load (TMDL) for one of three reasons:
   - Category 4a indicates a water body with a finalized TMDL.
   - Category 4b indicates a water body with a Pollution Control Program.
   - Category 4c indicates a water body impaired by a non-pollutant (e.g., low water flow, stream channelization, and dams).
(5) Category 5 represents all water bodies within the State that are considered impaired and require a Water Quality Implementation Plan (WQIP) (formerly TMDL). The 303(d) list consists of only water bodies with Category 5 listings.

For temperature, the reach of the Columbia River within the Project is on the State’s 2015 303(d) list for temperature impairment. The EPA has developed a draft temperature TMDL for the mainstem Columbia River, including that portion of the Columbia River contained within the Project. It is anticipated that the EPA will issue the final temperature TMDL for the Columbia River at some future date. The TMDL will address the water temperature effects of dams and other human actions, including model analyses and load allocations for mainstem hydroelectric projects including Wells Dam.

The EPA approved Ecology’s September 2015 submittal of the latest Water Quality Assessment 305(b) report and 303(d) list on July 22, 2016. The 2015 submittal and assessment fulfills Washington State’s obligation under the federal Clean Water Act (CWA) §303(d) and §305(b) to identify polluted waters (known as the 303(d) list) as well as report on the status of water quality statewide where data is available.

The reach of the Methow River within the Project (RM 1.5) is not on the 2015 303(d) list for temperature. Slightly upstream of project boundary however, the Methow River is listed as a category 5 and 303(d) listed since samples taken between 7/7/2010 and 9/30/2010, showed that the 7-day mean of daily maximum values (7DADmax) exceeded the criterion for this waterbody (17.5°C) on 41 of 86 days (48%).

The reach of the Okanogan River within the Project (RM 15.5) is listed as a 305(b) and category 2 for temperature. The listing is a result of one sample in 2002 that showed excursions of the criteria 17.5°C for this waterbody. However, annual reporting conducted by Douglas PUD and the U.S. Geological Survey shows that incoming temperatures at the Project boundary in the Okanogan River routinely exceed the 17.5°C standard in the summer months and therefore is a result of loading that occurs in water prior to entry in the Project area.

### 7.3 Wells Project Water Temperature Activities

#### 7.3.1 Wells Reservoir and Tributaries

Beginning in 2001, an extensive water temperature monitoring effort was initiated by Douglas PUD in order to better understand the temperature dynamics throughout the Wells Reservoir. Temperature data was collected by Douglas PUD at four locations in the Columbia River (RM 544.5, RM 535.3, RM 530.0, and RM 515.6) and at one site each on the Okanogan (RM 10.5) and Methow (RM 1.4) rivers. Data collected by Douglas PUD were collected hourly using Onset© Tidbit temperature loggers. Monitoring start and end dates varied from year to year but generally began in the early spring and ended in late fall. Quality assurance and control measures were implemented prior to deploying and upon retrieving temperature loggers to ensure that data collected were accurate.

The 7-DADMax temperature data recorded since 2001 indicate that the portion of the Columbia River upstream of and within the Project generally warms to above 17.5°C (WQS numeric
criteria) in mid-July and drops below the numeric criterion by early October. Temperatures in the Methow River upstream of the Project warm to above 17.5°C in mid-July and drop below the numeric criterion by September, while trends in the Okanogan River upstream of the Project indicate warming above 17.5°C starting in early June with cooling below the criteria by late September.

To assess compliance with the state WQS for temperature (during the Wells Project FERC relicensing process), two 2-dimensional laterally-averaged temperature models (using CE-QUAL-W2) were developed that represented existing (or “with Project”) conditions and “without Project” conditions of the Wells Project, including the Columbia River from the Chief Joseph Dam tailrace to Wells Dam, the lowest 15.5 miles of the Okanogan River, and the lowest 1.5 miles of the Methow River. The results were processed to develop daily values of the 7-DADMax, and then compared for the two conditions.

The model analyses demonstrated that “with Project” temperatures in the Columbia, Okanogan and Methow rivers do not increase more than 0.3°C compared to ambient (“without Project”) conditions anywhere in the reservoir, and that the Project complies with the state WQS for temperature (West Consultants Inc. 2008). However, as identified in the Wells Project 401 Certification, a full evaluation of potential temperature impacts of hydroelectric power generation on the Columbia River will most likely require analysis of hydraulic and temperature conditions on a system-wide basis. Hydraulic and temperature influences from upstream storage dams complicate the evaluation of Project-related impacts. The only way to properly understand these impacts is to examine the river water temperatures more comprehensively through a system-wide TMDL study such as that which is under consideration for development by EPA and the USACE.

Importantly, the Wells Project is a “run-of-river” Project with limited storage capacity. For example, the Grand Coulee Project has more than 50 times the storage when compared to the Wells Project. Wells Reservoir has an operating range of 771-781 feet above sea level, but it is operated within the 779-781 range more than 95% of normal operation. As such, inflows on a given day approximate outflow volumes. Water particle transport time from Chief Joseph Dam to Wells Dam is 39.4-37.0 hours under moderate 111 kcfs flows (GeoEngineers Technical Memo 2009), and therefore water has very limited time to take up thermal load. Taking storage, operations, and particle transport time together, the Wells Project temperature profile mimics the profile of combined inflow temperatures when accounting for input volume (Methow, Okanogan and Columbia River conditions).

7.3.2 Wells Dam Fish Ladders

According to the terms and conditions found in the Biological Opinion (BO) supporting the implementation of the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP) all entities that use the fish ladder trapping facilities at Wells Dam are required to monitor the water temperatures within the ladders every two hours from May 1 to November 15 and to discontinue trapping operations when fish ladder water temperatures exceed 69.8°F (21.0°C). In 2001, Douglas PUD added supplemental temperature recording equipment at Pool 39 near the broodstock collection facilities in the east fishway at Wells Dam to ensure compliance with requirements in the National Marine Fisheries Service (NMFS) HCP BO. In 2001 and 2002,
hourly data indicated that water temperatures at this location in the east fish ladder did not exceed 69.8°F (21.0°C) at any time during the monitoring period, which ran from late July to early December.

7.4 401 Certification Temperature Requirements

The Wells Project 401 Certification requires that Douglas PUD maintain compliance with the state WQS for water temperature (via citation of the Wells Project Water Quality Management Plan [Douglas PUD 2008]) by monitoring water temperature at various Wells Project locations at certain times of the year and transmitting these data on a daily basis to a web-accessible database. Specific 401 Certification requirements include:

1. Prepare a QAPP for each water quality parameter to be monitored. QAPPs shall follow the Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (July 2004 Ecology Publication Number 04-03-030).

2. Monitor water temperatures at three boundary locations of the Wells Project (Methow River RM 1.5, Okanogan River RM 10.5, and Columbia River RM 544.5) and in the Well Dam Forebay and Tailrace on an hourly basis, from April 1st to October 31st.

3. Continue to collect hourly fish ladder temperatures 24 hours a day during the upstream fish passage season (currently May 1 to November 15) at the Wells Dam East Fishway Pool No. 39².

4. Monitor water temperatures hourly in the auxiliary water supply system and near the east shore of the Wells Dam Forebay (bottom, middle, and surface depths) during the upstream fish passage season (May 1 to November 15).

5. Transmit hourly temperature data on a daily basis to a web-accessible database maintained by Douglas PUD and available to Ecology, regional fish management agencies, and the public.

6. Develop an annual report of the monitoring results and analyses, in a format approved by Ecology, and submit it by April 30 of the following year.

8.0 IMPLEMENTATION RESULTS

8.1 Quality Assurance Project Plan

As required by the 401 Certification section 6.7(7)(a)(i), Douglas PUD developed a Wells Project QAPP for water temperature and total dissolved gas (TDG) (Douglas PUD 2013). The QAPP describes a systematic approach for collecting high quality and reliable data that may be used to determine compliance of these parameters with the State of Washington’s WQS for the Wells Project. With regard to temperature, the QAPP contains a map of sampling locations,

² Both the WDFW staff and Douglas PUD monitor water temperatures in the Wells Dam fishways during trapping periods in order to remain in compliance with hatchery permitting.
descriptions of the purpose of the monitoring, sampling frequency, sampling procedures and equipment, analytical methods, quality control procedures, data handling and data assessment procedures and reporting protocols (Douglas PUD 2013). The QAPP was provided to Ecology for review on March 4, 2013 and subsequently approved. Douglas PUD submitted the QAPP to the FERC on June 21, 2013, which issued an order approving the QAPP on August 8, 2013.

8.2 Temperature Monitoring Equipment

8.2.1 Equipment Acquisition

Prior to the issuance of a new Wells Project FERC License, Douglas PUD collected temperature data using Onset© Tidbit temperature loggers (see Section 2.3.1 above), which were programmed to collect hourly data year-round and required retrieval in order to download and report data. Douglas PUD retrieved and downloaded loggers two to four times a year depending upon river conditions and access.

Per the Wells Project 401 Certification section 6.7(3)(a)(iii), hourly temperature data was required to be transmitted to a web-accessible database maintained by Douglas PUD and available to Ecology, regional fish management agencies, and the public. To meet the daily data transmission requirement, Douglas PUD applied for and received permits, before acquiring and subsequently installing new temperature monitoring equipment. At each temperature monitoring location, equipment consists of a Design Analysis H-377 temperature sensor, Sutron GOES radio/logger, GOES satellite antenna and cable, 20 watt solar panel, and voltage regulator. On shore housing includes a National Electrical Manufacturers Association enclosure, 12 volt sealed lead-acid battery, galvanized pipe, flex conduit, fittings, and other hardware (Figure 2). The system consists of a sensor connected to a communications box with wireless modem access. Data is collected hourly and sent wirelessly and uploaded to Douglas PUD’s publically available webpage in real time. The system is powered by battery and charged using a solar panel (Douglas PUD 2013).
Figure 2. Remote water temperature station that sends data in real time using GOES satellite link.
8.2.2 Equipment Installation

Consistent with 401 Certification section 6.7(3)(a)(i-iii), remote water temperature sensors were installed at eight locations in the Wells Project during 2013 and have been collecting seasonal data since then. Locations and required durations of monitoring include:

April 1st to October 31st:

1. Methow River, RM 1.5 - Project Boundary
2. Columbia River, RM 544.5 - Chief Joseph Dam Tailrace
3. Okanogan River, RM 10.5 - Project Boundary
4. Wells Dam Forebay (data from TDG sensor)
5. Wells Dam Tailrace (data from TDG sensor)

May 1st to November 15th:

6. Wells Dam East Fishway, Pool No. 39
7. Wells Dam Auxiliary Water Supply
8. Wells Dam Forebay (three depths)

Temperature monitoring locations are illustrated in Figures 3 through 6.
Figure 3. Temperature monitoring at and around Wells Dam (graduated green circles are intended to show surface middle and deep depths).
Figure 4. Methow River temperature monitoring location (RM 1.5). The location of the sensor is approximated by the green circle.
Figure 5. Okanogan River temperature monitoring location (RM 10.5). The location of the sensor is approximated by the green circle.
Figure 6. Chief Joseph Tailrace (Columbia River RM 544.5) temperature monitoring. The location of the sensor is approximated by the green circle.
In May of 2013, Douglas PUD entered into a Joint Funding Agreement with the United States Geological Survey (USGS) to install and maintain remote water temperature equipment at four of the eight monitoring locations including the Wells Dam Forebay (three depths), the Methow River, the Okanogan River, and the Chief Joseph Dam Tailrace. The Wells Dam Forebay and Tailrace sensors are maintained by Columbia Basin Environmental (these sensors collect both temperature and TDG data year round) but data is managed by Douglas PUD. The remaining two locations (Wells Dam East Fishway and Wells Dam Auxiliary Water Supply) were installed and are maintained by Douglas PUD.

Following approval of the QAPP, securing required permits, and equipment acquisition, the USGS began installation of temperature sensors at four locations. The Chief Joseph Dam Tailrace and Okanogan River sensors were installed in July 2013 and the Methow River and Wells Forebay locations were completed in October 2013. The Wells Dam Forebay and Tailrace sensors began collecting data on April 1st 2013 after being calibrated and installed by Columbia Basin Environmental. Douglas PUD installed sensors at two locations; the Wells Dam East Fishway and Auxiliary Water Supply, these stations were upgraded and installed respectively during the month of October 2013.

In October 2013 Douglas PUD launched a new website where hourly temperature data is transmitted daily and is publically accessible. This webpage provides a link to all real-time temperature data at [http://www.dcpud.org/wells-project/total-dissolved-gas-and-temperature-monitoring](http://www.dcpud.org/wells-project/total-dissolved-gas-and-temperature-monitoring). In addition, historic water temperature data and 2016 data featured in this report is available from this website.

### 8.3 Temperature Data Results

Temperature data from new equipment was available towards the end of the compliance year 2013. As such, water temperature monitoring using Tidbit sensors from Onset© was discontinued by the end of 2013. The 2016 annual report consists exclusively of data from the new wireless transmitting temperature equipment. In general, observed 2016 water temperatures in tributaries that feed into the Wells Project were higher on average earlier in the year compared to historic observations, which was attributed to a warmer than average spring and early runoff. Generally, peak summer water temperatures were slightly lower than those observed in 2015; however, warmer temperatures persisted longer in 2016 relative to an earlier late summer cool down observed in 2015.

In all subsequent figures, horizontal lines at 17.5 or 13°C illustrate 7-DADMax thresholds, aside from Figure 14 where the 21°C trapping threshold is denoted (see section 3.4.8).
8.3.1 Chief Joseph Dam Tailrace

The Chief Joseph Dam Tailrace temperature sensor location is at RM 544.5 on the left bank (looking downstream) of the Columbia River near the town of Bridgeport, WA. Water temperature data is collected from April 1 to October 31 and is indicative of incoming water temperature conditions to the Wells Project at this location.

Water temperature ranged from 6.1 to 19.2°C during the monitoring period. 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from July 25 - October 11, 2016 (Figure 7; Table 1).

Figure 7. Water temperature data collected in the Chief Joseph Tailrace.
8.3.2 Okanogan River Boundary

The Okanogan River Boundary monitoring location is at RM 10.5. This station is located upstream of the influence of the Wells Project and as such is representative of natural temperature conditions for the Okanogan River. Per requirements, water temperature is gathered at this location from April 1 to October 31 of each year and is generally indicative of incoming water temperature conditions to the Wells Project at this location. The USGS maintains operations of this sensor. 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from June 2, 2016 to June 14, 2016 and again from June 18, 2016 to September 19, 2016 (Figure 8).

![Water temperature data collected in the Okanogan River at RM 10.5.](image)

8.3.3 Methow River Boundary

The Methow River Boundary monitoring location is at RM 1.5 on the left bank near Pateros, WA. This station is located upstream of the influence for the Wells Project and as such is representative of natural temperature conditions for the Methow River. Water temperature data is required to be collected from April 1 to October 31 and is indicative of incoming water temperature conditions to the Wells Project at this location. In addition to the WQS numeric criteria of 17.5°C, Ecology has identified this portion of the Methow River as requiring special protection for spawning and incubation in accordance with Ecology publication 06-10-038. This publication indicates where and when the following criteria are to be applied to protect the reproduction of native char, salmon, and trout. In the lower Methow River water temperatures...
are not to exceed 13°C from October 1 to June 15. During 2016, the natural flowing Methow River had daily average water temperatures that were at or above 13°C from May 31, 2016 to June 14, 2016, October 1, 2016 to October 2, 2016, and October 7, 2016. 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from June 26, 2016 to July 4, 2016, July 6, 2016, July 9, 2016 to September 3, 2016, and September 7, 2016 to September 13, 2016 (Figure 9).

![Figure 9. Water temperature data from the Methow River at RM 1.5. Criterion of 13°C applies only from October 1- June 15 each year (bottom horizontal line).](image)

8.3.4 Wells Dam Forebay

The Wells Dam Forebay location, where temperatures are required to be collected hourly from April 1 to October 31 of each year, is located on the face of pier nose 6 at Wells Dam. Columbia Basin Environmental maintains operations of this sensor (collects both temperature and TDG) and Douglas PUD manages the data. 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from July 20, 2016 to October 8, 2016 (Figure 10; Table 1), which is generally consistent with historic Wells Project temperature monitoring data (see section 2.3.1).
8.3.5 Wells Dam Tailrace

The Wells Dam Tailrace location, where temperatures are required to be collected hourly from April 1 to October 31 of each year, is located approximately 2 miles downstream of Wells Dam on the left bank of the river. Columbia Basin Environmental maintains operations of this sensor (collects both temperature and TDG) and Douglas PUD manages the data. 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from July 23, 2016 to October 8, 2016 (Figure 11; Table 1), which is generally consistent with historic Wells Project temperature monitoring data (see section 2.3.1).
8.3.6 Wells Dam Forebay Multiple Depth Requirement

The Wells Dam Forebay temperature monitoring location is at RM 515.8. Monitoring at this location is required between May 1 and November 15. Temperature data is collected at three depths to provide temperature profiles throughout the water column at this location. Sensors are located near the surface (<2m depth), mid-water column (approximately 10m), and near bottom (>30m). 7-DADMax temperature values at this location were above the WQS numeric criteria (17.5°C) from July 29, 2016 to October 4, 2016 for the surface reading (Figure 12; Table 1). Comparison of data at the three depths indicates that thermal stratification does not occur at this location (Figure 12) despite small differences in 7-DADMax observations (Table 1). Measurements between three depths were similar throughout the season. The lack of thermo-stratification in the Wells Forebay was confirmed during relicensing efforts conducted by Douglas PUD and West Consultants (West Consultants Inc., 2008). Given the run-of-river nature of the Well Project, retention time is insufficient for thermo-stratification to occur.
8.3.7 Wells Dam Auxiliary Water Supply

The Wells Dam Auxiliary Water Supply location is within the lower west fishway adjacent to the collection gallery. Water from this location originates from the tailrace and is used to provide additional water for the lower 22 pools of the fishway including the fish collection gallery (Douglas PUD 2001). Monitoring at this location is required between May 1 and November 15. Results indicate that temperatures were above the 7-DADMax (17.5°C) from July 22, 2016 to October 8, 2016 (Figure 13; Table 1).
According to the HCP hatchery permits, all entities that use the fish trapping facilities at Wells Dam are required to monitor the ladders every two hours May 1 to November 15 and discontinue trapping operations when fish ladder water temperatures exceed 69.8°F (21.0°C). The Wells Project 401 Certification also adopted this requirement with the addition of hourly monitoring. Wells Fish ladders did not reach this threshold in 2016 with the highest water temperature being recorded as 19.8°C on August 20, 2016. In addition, results indicate that temperatures were above the 7-DADMax (17.5°C) from July 22, 2016 to October 08, 2016 (Figure 14; Table 1).
Figure 14. Water temperature data collected in Pool 39 of the east fish ladder at Wells Dam. The horizontal line at 21°C (top line) denotes the threshold whereby adult broodstock trapping at Wells Dam discontinues and the horizontal line at 17.5°C (bottom line) denote the 17.5°C 7-DADMax.

Water temperature data from the 2016 monitoring season for all locations and sources are summarized in Table 1 and indicate that during the summer water temperatures (i.e., 7-DADMax values) at multiple locations within the Wells Project were above the state WQS of 17.5°C. However, as discussed in more detail in the conclusions, the thermal regime observed was consistent with the temperatures recorded at Chief Joseph Dam, and Methow and Okanogan rivers. The temperatures observed during 2016 were also consistent with historical temperature data collected and evaluated using the CE-QUAL-W2 model which found that the Wells Project remains in compliance with the state WQS.
Table 1.  7-DADMax by location as determined by remote real time temperature sensor.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Required Monitoring Days</th>
<th>Actual Number of Days Monitoring</th>
<th>Number of days exceeding 7-DADMax</th>
<th>Days exceeding 7-DADMax (17.5°C)</th>
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<td>Chief Joseph Tailrace</td>
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<td>79</td>
<td>7/25 – 10/11</td>
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<td>Okanogan RM 10.5</td>
<td>4/1 – 10/31 (n = 214)</td>
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<td>107</td>
<td>6/2-6/14 &amp; 6/18 – 9/19</td>
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<tr>
<td>Methow RM 1.5</td>
<td>4/1 – 10/31 (n = 214)</td>
<td>214</td>
<td>74</td>
<td>6/26-7/4 &amp; 7/6 &amp; 7/9 – 9/3 &amp; 9/7 - 9/13</td>
</tr>
<tr>
<td>Wells Forebay Pier Nose 6</td>
<td>4/1 – 10/31 (n = 214)</td>
<td>214</td>
<td>81</td>
<td>7/20 – 10/8</td>
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<tr>
<td>Wells Tailrace</td>
<td>4/1 – 10/31 (n = 214)</td>
<td>214</td>
<td>78</td>
<td>7/23 – 10/8</td>
</tr>
<tr>
<td>Wells Forebay Surface</td>
<td>5/1 – 11/15 (n = 199)</td>
<td>199</td>
<td>68</td>
<td>7/29 – 10/04</td>
</tr>
<tr>
<td>Wells Forebay Mid</td>
<td>5/1 – 11/15 (n = 199)</td>
<td>199</td>
<td>68</td>
<td>7/29 – 10/04</td>
</tr>
<tr>
<td>Wells Forebay Deep</td>
<td>5/1 – 11/15 (n = 199)</td>
<td>199</td>
<td>71</td>
<td>7/28 – 10/06</td>
</tr>
<tr>
<td>Auxiliary Water Supply</td>
<td>5/1 – 11/15 (n = 199)</td>
<td>199</td>
<td>83</td>
<td>7/20 – 10/10</td>
</tr>
<tr>
<td>Pool 39 East Fish Ladder</td>
<td>5/1 – 11/15 (n = 199)</td>
<td>199</td>
<td>79</td>
<td>7/22 – 10/08</td>
</tr>
</tbody>
</table>

9.0 CONCLUSIONS

During the 2016 monitoring period, all stations recorded data in accordance with Douglas PUD’s Wells Project 401 Certification requirements. Data was made available in real time at [www.dcpud.org](http://www.dcpud.org). Data collection in 2016 was the most complete since installing real-time data collection in 2013.

In general, data indicates that the thermal regime observed during the Wells Project relicensing process is still reflective of current observations. In 2016 temperatures warmed to above the WQS criteria of 17.5°C slightly earlier than normal but then moderated sooner than normal and were not as extreme as typical mid-summer temperatures. In addition, exceedances of the WQS appear to be associated with water entering the Wells Project out of compliance due to the operation of large storage projects upstream of Wells Dam and inflows from the Okanogan and Methow Basin observed in 2016. There were 79 days when water entering the Wells Project via Chief Joseph Dam discharges were above the 7-DAD Max and 68 days and 78 days above the same criteria in the Wells Forebay and Wells Tailrace, respectively. Data collected in 2016 confirms that spring temperatures and local basin snowpack drive the rate at which water temperatures increase at Project boundary locations similarly to late summer rain and flow...
regimes above Wells Dam. Monitoring will continue, consistent with 401 Certification requirements during the 2017 monitoring period.

10.0 REFERENCES


PACIFIC LAMPREY MANAGEMENT PLAN

2016 ANNUAL REPORT

WELLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 2149

March 2017

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington
EXECUTIVE SUMMARY

The annual Pacific Lamprey Management Plan (PLMP) Report includes a summary of all of the existing Pacific lamprey measures required by the Federal Energy Regulatory Commission (FERC) including Article 406 of the license for the Wells Hydroelectric Project (Wells Project), the requirements found within Appendix A of the Clean Water Act Section 401 Water Quality Certification (401 Certification). Article 406 of the license requires Public Utility District No. 1 of Douglas County (Douglas) to submit an annual report of management plan activities by May 31st of each year.

The measures required by the FERC license are largely consistent with the measures found in the Aquatic Settlement Agreement’s PLMP and the reporting requirements for the PLMP and 401 Certification. The 2016 PLMP annual report (this report) will be used to demonstrate compliance with all three of Douglas’s Wells Project Pacific lamprey related reporting obligations.

Douglas developed all six of the aquatic resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Members of the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas.

The National Marine Fisheries Service (NMFS) was invited to participate in the development of Aquatic Resource Management Plans, but declined because its interests are currently satisfied by the measures within the Anadromous Fish Agreement and Habitat Conservation Plan (HCP).

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey (Lampetra tridentata) resulting from the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several Pacific lamprey Protection, Mitigation and Enhancements (PMEs) in support of the PLMP. The PMEs presented within the PLMP are designed to meet the following objectives:

Objective 1: Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey;

Objective 2: Identify and address any Project-related impacts on downstream passage and survival and rearing of juvenile Pacific lamprey;

Objective 3: Participate in the development of regional Pacific lamprey conservation activities.
The PLMP is intended to be compatible with other Pacific lamprey management plans in the Columbia River mainstem. Furthermore, the PLMP is intended to be supportive of the HCP, the critical research needs identified by the Columbia River Basin Technical Work Group, the Resident Fish Management Plan, Bull Trout Management Plan, and White Sturgeon Management Plan by continuing to monitor and address ongoing impacts, if any, on Pacific lamprey resulting from Project operations. The PLMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under Washington state water quality standards found at WAC 173-201A.
1.0 INTRODUCTION

The Pacific Lamprey Management Plan (PLMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement (PME) measures during the term of the new license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP), will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification (401 Certification) for the Wells Hydroelectric Project (Wells Project or Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Entities invited to participate in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas.

The PLMP will direct implementation of measures to protect against and mitigate for potential Project impacts on Pacific lamprey (Lampetra tridentata). To ensure active stakeholder involvement and support, Douglas developed this plan, along with the other aquatic management plans, in close coordination with the members of the Aquatic SWG.

The Aquatic SWG agrees on the need to develop a plan for the long-term management of Pacific lamprey in the Project. This management plan summarizes the relevant resource issues and background (Section 2), identifies the goal and objectives of the plan (Section 3), and describes the relevant PMEs (Section 4) for Pacific lamprey during the term of the new license.

2.0 BACKGROUND

2.1 Pacific Lamprey Biology

Pacific lamprey are present in most tributaries of the Columbia River and in the mainstem Columbia River during their migration stages. They have cultural, utilitarian and ecological significance in the basin, because Native Americans have historically harvested them for subsistence, ceremonial and medicinal purposes (Close et al. 2002). As an anadromous species, they also play an important role in the food web by contributing marine-derived nutrients to the basin and may act as a predatory buffer for juvenile salmon and steelhead. Little specific information is available on the life history or status of lamprey in the mid-Columbia River watersheds. They are known to occur in the Methow, Wenatchee and Entiat rivers (NMFS 2002) and recently have been captured during juvenile salmon and steelhead trapping operations in the Okanogan River.
In general, adults are parasitic on fish in the Pacific Ocean while ammocoetes (larvae) are filter feeders that inhabit the fine silt deposits in backwaters and quiet eddies of streams (Wydoski and Whitney 2003). Adults generally spawn in low-gradient stream reaches in the tail areas of pools and in riffles, over gravel substrates (Jackson et al. 1997). Adults die after spawning. After hatching, the ammocoetes burrow into soft substrate for an extended larval period filtering particulate matter from the water column (Meeuwig et al. 2002). The ammocoetes undergo a metamorphosis into macrophthalmia (outmigrating juvenile lamprey) between 3 and 7 years after hatching, and then migrate from their parent streams to the ocean (Close et al. 2002). Adults typically spend 1-4 years in the ocean before returning to freshwater tributaries to spawn.

Pacific lamprey populations of the Columbia River have generally declined in abundance over the last 40 years according to counts at dams on the lower Columbia and Snake rivers (Close et al. 2002). Starke and Dalen (1995) reported that adult lamprey counts at Bonneville Dam regularly exceeded 100,000 fish in the 1960s and more recently have ranged between 20,000 and 120,000 for the period 2000-2013 with a 10-year average of 34,068 from 2003 to 2012 (DART - www.cqs.washington.edu/dart/adult.html).

In the mid-Columbia River Basin, adult lamprey count data at hydroelectric projects varies by site but is generally available for all projects since 1998 (with the exception of Wanapum Dam where data is only available for 2007). As is expected, the general trend for mid-Columbia River counts is relatively consistent with observations at Bonneville Dam from year to year (i.e., relatively high count years at Bonneville result in relatively high count years in the mid-Columbia River). It is important to note that the daily and seasonal time periods as well as the counting protocols may differ at each project. These differences may affect data reliability and need to be considered when examining and comparing these data. Table 2.1-1 provides a summary of adult lamprey passage data for mid-Columbia River hydroelectric facilities.

Table 2.1-1. Total lamprey counts for the 2013 calendar year and ten-year (2003-2012) average counts for adult Pacific lamprey at mid-Columbia River hydroelectric projects.

<table>
<thead>
<tr>
<th></th>
<th>Priest Rapids</th>
<th>Wanapum*</th>
<th>Rock Island</th>
<th>Rocky Reach</th>
<th>Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>5,968</td>
<td>4,277</td>
<td>2,157</td>
<td>1,626</td>
<td>21†</td>
</tr>
<tr>
<td>Average</td>
<td>3,740</td>
<td>2,435</td>
<td>1,576</td>
<td>737</td>
<td>210</td>
</tr>
</tbody>
</table>

* Wanapum Dam counts are only available beginning in 2006.
† Count includes fish translocated and released in the Wells Dam tailrace and fishways.

Close et al. (1995, 2002) identified several factors that may account for the decline in lamprey counts in the Columbia River Basin. This includes reduction in suitable spawning and rearing habitat from flow regulation and channelization and pollution, reductions of prey in the ocean, and juvenile and adult passage problems at dams. Mesa et al. (2003) found that adult Pacific lamprey had a mean critical swimming speed of approximately 85 cm/s which suggests that they may have difficulty negotiating fishways with high current velocities that were designed for salmon and steelhead passage.
The study of adult Pacific lamprey migration patterns past dams and through reservoirs in the lower Columbia River has provided the first data sets on lamprey passage timing, travel times, and passage success at hydroelectric projects (Vella et al. 2001; Ocker et al. 2001; Moser et al. 2002a; Moser et al. 2002b). These studies have shown that approximately 90% of the radio-tagged lamprey released downstream of Bonneville Dam migrated back to the tailrace below Bonneville Dam; however, less than 50% of the lamprey which encountered a fishway entrance actually passed through the ladder exit at the dam (Nass et al. 2005).

Similar collection and passage efficiency results were observed at Rocky Reach, Wanapum, and Priest Rapids dams during tagging studies conducted at those projects (Nass et al. 2003; Stevenson et al. 2005).

Of the 125 radio-tagged lampreys released approximately 7 kilometers downstream of Rocky Reach Dam, 93.6% were detected at the project, and of those fish, 94.0% entered the fishway. Of the fish that entered the Rocky Reach fishway, 55.5% exited the ladder (Stevenson et al. 2005).

During studies at Wanapum and Priest Rapids dams, a total of 51 and 74 lamprey were radio-tagged and released downstream of Priest Rapid Dam in 2001 and 2002, respectively. Over the two years of study, the proportion of fish that approached the fishway that exited the ladders was 30% and 70% at Priest Rapids and 100% and 51% at Wanapum Dam in 2001 and 2002, respectively (Nass et al. 2003).

Two recent reviews of Pacific lamprey (Hillman and Miller 2000; Golder Associates Ltd. 2003) in the mid-Columbia River have indicated that little specific information is available regarding their population status (Stevenson et al. 2005).

2.2 Status of Pacific Lamprey

In January 2003, the USFWS received a petition from 11 environmental groups seeking the listing of four lamprey species (Pacific lamprey, river lamprey, western brook lamprey, and Kern brook lamprey). The petition cited population declines and said lampreys are threatened by artificial barriers to upstream and downstream migration, de-watering and habitat degradation among other threats. In response to the petition, the USFWS conducted an initial review to determine whether an emergency listing was warranted and decided in March 2003 that such a situation did not exist.

In an agreement stemming from a lawsuit filed by the petitioners in response to the initial finding, the USFWS committed to the issuance of a 90-day finding on the petition by December 20, 2004. Again, the USFWS announced that the petition seeking a listing of the four lamprey species did not contain enough information to warrant further review and the agency was not going to place the lamprey species on the Endangered Species list. For Pacific lamprey, the petitioners provided information showing a drop in range and numbers, but did not provide information describing how the regional portion of the species’ petitioned range, or any smaller portion, is appropriate for listing under the Endangered Species Act (ESA). The agency did however decide it will continue to work with others on efforts to gather information related to the conservation of lamprey and their habitats.
2.3 Monitoring and Studies of Outmigrating Juvenile Lamprey (Macrophthalmia)

Little information in the mid-Columbia River basin exists with regard to the outmigration timing and abundance of juvenile Pacific lamprey. Upstream of the Project, recent juvenile salmonid trapping operations by WDFW and the Colville Tribe have provided preliminary information on the presence of juvenile lamprey outmigrants in both the Methow and Okanogan rivers. This information represents incidental captures of juvenile lamprey, and may not be reflective of actual abundance or population trends. In the Okanogan River, information is available for 2006 and 2007 where 220 and 24 juvenile lamprey were observed, respectively, during spring trapping operations. In the Methow River watershed, information is available for two sites; the Twisp and Methow rivers. At the Twisp River site, no juvenile lamprey have been observed since data has been collected (2005). At the Methow River site, for the years 2004-2007, 89, 84, 831, and 37 juvenile lamprey were observed, respectively, in trapping operations that typically last from April to November with peaks generally occurring in the spring. Data collection from these activities is likely to continue and provide information on juvenile Pacific lamprey as they begin their outmigration through the Columbia River hydrosystem towards the Pacific Ocean.

Although there is a growing body of information on adult Pacific lamprey and their interactions at hydroelectric projects, relatively little information exists describing the effects of hydroelectric plant operations on outmigrating juvenile lamprey (macrophthalmia). Recent juvenile lamprey studies at hydroelectric projects have addressed testing for lamprey macrophthalmia survival through juvenile bypass facilities (Bleich and Moursund 2006), impingement at intake diversion screens (Moursund et al. 2000 and 2003), validation of existing screening criteria (Ostrand 2005), and responses of juvenile Pacific lamprey to simulated turbine passage environments (Moursund et al. 2001; INL 2006). Results of other studies targeting predaceous birds and fish suggest that juvenile lamprey may compose a significant proportion of the diets of these predators (Poe et al. 1991; Merrell 1959).

A review of the recent body of work addressing juvenile lamprey at hydroelectric facilities concludes that there is a current lack of methods and tools to effectively quantify the level of survival for juvenile lamprey migrating through hydroelectric facilities. Furthermore, no studies exist that assign a level of survival attributed to a project’s operations. This is due to the lack of miniaturized active tag technologies to overcome two study limitations. Macrophthalmia (juvenile outmigrating lamprey) are relatively small in size and unique in body shape and they tend to migrate low in the water column resulting in the rapid attenuation of active tag signal strength. In an effort to develop a tagging protocol, the Bonneville Power Administration (BPA) funded Oregon State University (OSU) to identify and develop tag technologies for lamprey macrophthalmia. Recent reports on this developmental effort have concluded that the smallest currently available radio-tag was still too large for implantation in the body cavity of a juvenile lamprey (Schreck et al. 2000). Additionally, external application was not effective as animals removed tags within the first week and fish performance was affected. This report also concluded that internal implantation of Passive Integrated Transponder (PIT) tags was the most viable option for tagging juvenile lamprey although this method included severe limitations such as the limited range of detection systems and the ability to tag only the largest outmigrating juvenile lamprey (Schreck et al. 2000).
2.4  Project Adult Pacific Lamprey Counts and Passage Timing

Returning adult Pacific lamprey have been counted at Wells Dam since 1998. Between the years of 2003 and 2012, the number of lamprey passing Wells Dam annually has averaged 210 fish and ranged from 1 fish in 2011 to 1,417 fish in 2003. In addition to the overriding condition that Pacific lamprey numbers are declining in the Columbia River system, the relatively small number of adult lamprey observed at Wells Dam may be attributed to fact that the Project is the last of nine passable dams on the mainstem Columbia River and the fact that the Project is over 500 miles upstream from the Pacific Ocean and the bioenergetic expenditure for a relatively poor swimming species such as Pacific lamprey is likely great.

Adult lamprey pass Wells Dam from early July until late November with peak passage times between mid-August and late October (Figure 2.4-1). In all years since counting was initiated, Pacific lamprey counts at the east fish ladder were greater than at the west fish ladder except for 2007. It is important to note that historically, counting protocols were designed to assess adult salmonids and did not necessarily conform to lamprey migration behavior (Moser and Close 2003). Traditional counting times for salmon did not coincide with lamprey passage activity which occurs primarily at night; the erratic swimming behavior of adult lamprey also makes them inherently difficult to count (Moser and Close 2003). Beamish (1980) also noted that lamprey overwinter in freshwater for one year prior to spawning. Consequently, lamprey counted in one year may actually have entered the system in the previous year (Moser and Close 2003) which confounds annual returns back into the Columbia River Basin. In addition to salmonid-specific counting protocols, adult fishway facilities have been constructed specifically for passage of salmonids. Recent research has identified areas such as picketed lead structures downstream of fish count windows that adult lamprey may access to bypass count stations and avoid being enumerated (LGL 2008). It is unknown to what degree lamprey behavior and methodological and structural concerns are reflected in Columbia River lamprey passage data. However, it is important to consider such caveats when examining historic lamprey count data at Columbia River dams including Wells Dam.
Figure 2.4-1 Daily counts of adult Pacific lamprey at Wells Dam during the fish counting season, 2003-2007.

2.5 Project Pacific Lamprey Studies

Until recently, relatively little information was available on Pacific lamprey in the mid-Columbia River Basin. However, with increased interest in the species coupled with a petition for listing under the ESA (Section 2.2), Douglas has initiated studies to address Pacific lamprey passage and migratory behavior in the Project consistent with currently available technology.

2.5.1 2001-2003 Project Pacific Lamprey Study

In 2004, Douglas contracted with LGL Limited to conduct a lamprey radio-telemetry study at Wells Dam in coordination with Chelan PUD, which was conducting a similar study at Rocky Reach Dam. A total of 150 lamprey were radio-tagged and released at or below Rocky Reach Dam. The radio-tags used in this study had an expected operational life of 45 days (Nass et al. 2005). It is important to note that as a result of the lamprey release site being located over 50 miles downstream of Wells Dam, the value of the study results for the Project was limited by the relatively small numbers of tagged fish detected upstream at Wells (n=18) and the fact that many of the radio-tags detected at Wells Dam were within days of exceeding their expected battery life.

The 2004 study at Wells Dam was implemented through a combination of fixed-station monitoring at the dam and fixed-stations at tributary mouths. Collectively, these monitoring sites were used to determine migration and passage characteristics of lamprey entering the Project Area. Of the 150 adult lamprey released at or below Rocky Reach in 2004, 18 (12% of
150) were detected in the Wells Dam tailrace, and ten (56% of 18) of these were observed at an entrance to the fishways at Wells Dam. A total of 3 radio-tagged lamprey passed Wells Dam prior to expiration of the tags, resulting in a Fishway Efficiency estimate of 30% (3 of 10) for the study period. A single lamprey was detected upstream of Wells Dam at the mouth of the Methow River (Nass et al. 2005).

For lamprey that passed the dam, the majority (92%) of Project passage time was spent in the tailrace. Median time required to pass through the fishway was 0.3 d and accounted for 8% of the Project Passage time (Nass et al. 2005).

Although the 2004 study at Wells Dam provided preliminary passage and behavioral information for migrating adult lamprey, the limited observations due to the small sample size (n=18) were insufficient in addressing the objectives of the 2004 study.

2.5.2 2007-2008 Project Pacific Lamprey Study

In 2007, Douglas contracted with LGL Limited to conduct a second lamprey radio-telemetry study at Wells Dam. The study was scheduled to occur from early August through November and utilized tags that had 87 days of battery life. A total of 21 adult lamprey were tagged and released for the purpose of this study. However, due to very low adult lamprey returns to Wells Dam in 2007 (n=35) and low trapping efficiency, only 6 adult Pacific lamprey were captured at Wells Dam during trapping activities (August 14 to October 3). Therefore, 15 additional adult lamprey were collected at Rocky Reach Dam, transported to Wells Dam, tagged and released. The project was continued in 2008 to obtain additional information.

A comprehensive report was produced in February of 2009 containing the results from the two-year radio-telemetry behavior studies (Robichaud et al. 2009). Results indicated that the “greatest impediment to successful passage of adult lamprey at Wells Dam appears to be the conditions at the fishway entrance, probably related to water velocities that limit swimming and attachment capabilities.” An equally significant impediment to successful passage of adult lamprey at Wells Dam in 2008 was the installation of perforated plates on the floor of the weir orifices in an effort to increase trapping efficiency. Robichaud et al. further recommended the following:

- Implement a reduction in fishway head differential to reduce entrance velocities to levels within the swimming capabilities of Pacific lamprey (0.8 to 2.1 m/s). These proposed flow reductions should be restricted to hours of peak lamprey activity (i.e., nighttime) and within their primary migratory period at Wells Dam (August-September).
- Remove perforated plates from orifice floors at the current trapping locations and discontinue trapping efforts at Wells Dam.
- Consider using monitoring tools that are less intrusive, do not require the collection of fish from the ladders at Wells Dam, and minimize the surgical implantation of tags in fish that are nearing their physiological limits.
2.5.3 2009 Pacific Lamprey Ladder Modification Study

In response to Robichaud et al. (2009), Douglas, in consultation with the Aquatic SWG, prepared a plan to implement and evaluate measures to enhance passage of adult Pacific lamprey at Wells Dam (Murauskas and Johnson, 2009). These measures, originally scheduled for year two after license issuance (2013), were designed to determine whether temporary velocity reductions at the fishway entrances would enhance the attraction and relative entrance success of adult lamprey at Wells Dam. Three alternative entrance flow velocities (i.e., existing high, moderate, and low) will be assessed using Dual-frequency Identification Sonar (DIDSON) in a randomized block design during the fall of 2009. The goal is to identify optimal hydraulic conditions conducive to entry of adult lampreys into the fishways at Wells Dam.

3.0 GOALS AND OBJECTIVES

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey resulting from the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several Pacific lamprey PMEs in support of the PLMP. The PMEs presented within the PLMP are designed to meet the following objectives:

Objective 1: Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey;

Objective 2: Identify and address any Project-related impacts on downstream passage and survival, and rearing of juvenile Pacific lamprey;

Objective 3: Participate in the development of regional Pacific lamprey conservation activities. The PLMP is intended to be compatible with other Pacific lamprey management plans in the Columbia River mainstem. Furthermore, the PLMP is intended to be supportive of the HCP, the critical research needs identified by the Columbia River Basin Technical Work Group, the Resident Fish Management Plan, Bull Trout Management Plan, and White Sturgeon Management Plan by continuing to monitor and address ongoing impacts, if any, on Pacific lamprey resulting from Project operations. The PLMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under Washington state water quality standards found at WAC 173-201A.

The schedule for implementation of specific measures within the PLMP is based on the best information available at the time the Plan was developed. As new information becomes available, implementation of each activity may be adjusted through consultation with the Aquatic SWG.
4.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

Douglas, in consultation with the Aquatic SWG, will implement PMEs for Pacific lamprey in the Project consistent with the goals and objectives identified in Section 3.0. The measures proposed in this section are intended to serve as PMEs for Pacific lamprey throughout the new license term.

4.1 Adult Pacific Lamprey Passage (Objective 1)

4.1.1 Upstream Fishway Operations Criteria

Douglas shall operate the upstream fishways at Wells Dam in accordance with criteria outlined in the HCP. Based upon information collected from activities conducted in Sections 4.1.3 - 4.1.7, Douglas, in consultation with the Aquatic SWG and the HCP Coordinating Committee, may evaluate various operational and structural modifications to the upstream fishways (e.g., reduction in fishway flows at night) for the benefit of Pacific lamprey passing upstream through Wells Dam during the new license term. If requested, the Aquatic SWG shall develop an Operations Study Plan (OS Plan) that specifically identifies all operational modifications to be evaluated, the proposed monitoring strategy, implementation timeline and criteria for success. The plan shall include a component to evaluate the effects of lamprey modifications on salmon. Upon completion of the evaluation, the Aquatic SWG, in consultation with the HCP Coordinating Committee, will determine whether the proposed modifications should be made permanent, removed, or modified.

4.1.1.1 Progress Towards Objective 1 in 2016

In 2016, the Wells Dam fishways were operated in accordance with the criteria outlined in the HCP. No modifications to fishway operating criteria were implemented therefore, no evaluation of effects on lamprey passage were warranted.

4.1.2 Salvage Activities During Ladder Maintenance Dewatering

Douglas shall continue to implement the Adult Fish Passage Plan and associated Adult Ladder Dewatering Plan as required by the HCP. These plans include practices and procedures utilized during fishway dewatering operations to minimize fish presence in the fish ladders and then once dewatered directs Douglas staff to remove stranded fish and safely place them back into the Columbia River. All fish species, including Pacific lamprey that are encountered during dewatering operations are salvaged consistent with the protocol identified in the HCP. Any adult lamprey that are captured during salvage activities will be released upstream of Wells Dam, unless otherwise determined by the Aquatic SWG. Douglas will coordinate salvage activities with the Aquatic SWG and allow for member participation. Douglas will provide a summary of salvage activities in the annual report.
4.1.2.1 Progress Toward Objective 1 in 2016

During the fish ladder maintenance period in 2016, Douglas implemented the practices and procedures in the Adult Ladder Dewatering Plan to minimize the presence of lamprey and other fish and to safely place any stranded fish back into the Columbia River. During salvage activities in both fishways no adult lamprey were encountered.

4.1.3 Upstream Fishway Counts and Alternative Passage Routes

Douglas shall continue to conduct annual adult fish passage monitoring in the Wells Dam fishways using the most current technology available, to count and provide information on upstream migrating adult Pacific lamprey 24-hours per day during the adult fishway monitoring season (May 1- November 15). Based upon information collected from activities conducted in Sections 4.1.6 - 4.1.7, Douglas, in consultation with the Aquatic SWG, may choose to address the use of alternative upstream passage routes around Wells Dam fishway counting stations by adult Pacific lamprey. Potential measures to improve counting accuracy, following consultation and approval of the Aquatic SWG, may include, but may not be limited to, the development of a correction factor based upon data collected during passage evaluations (Sections 4.1.6 and 4.1.7) or utilization of an alternative passage route as a counting facility for adult Pacific lamprey.

4.1.3.1 Progress Towards Objective 1 in 2016

During 2016, Douglas monitored adult fish passage, including Pacific lamprey, 24 hours a day during the fishway monitoring season.

4.1.4 Upstream Passage Improvement Literature Review

If additional passage improvement measures are deemed necessary by the Aquatic SWG, then within six months after this determination, Douglas, in consultation with the Aquatic SWG, shall complete a literature review on the effectiveness of upstream passage measures (i.e., lamprey passage systems, plating over diffuser grating, modifications to orifices, rounding sharp edges, fishway operational changes, etc.) implemented at other Columbia and Snake river hydroelectric facilities. The literature review will be conducted in support of activities identified in Section 4.1.5 to help in the selection of reasonable measures that may be implemented to improve adult lamprey passage at Wells Dam.

4.1.4.1 Progress Towards Objective 1 in 2016

The Aquatic SWG did not deem additional passage improvements measures necessary in 2016, therefore no upstream passage improvement literature review was conducted.

4.1.5 Fishway Modifications to Improve Upstream Passage

If additional passage improvement measures are deemed necessary by the Aquatic SWG, based upon the results of studies conducted at Wells Dam, then within one year or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify, design and
implement any reasonable upstream passage modifications (structural and/or operational). Passage measures will be designed to improve passage performance by providing safe, effective, and volitional passage for Pacific lamprey through the Wells Dam fishways without negatively impacting the passage performance of adult anadromous salmonids. The following components shall be included in these passage measures:

- **Fishway Inspection**: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall conduct a fishway inspection with the Aquatic SWG and regional lamprey passage experts to identify and prioritize measures to improve adult lamprey passage and enumeration at Wells Dam. Additional ladder inspections will be conducted at the request of the Aquatic SWG, consistent with winter ladder dewatering operations.

- **Entrance Efficiency**: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall develop a Lamprey Entrance Efficiency Plan (LEE Plan) for evaluating operational and physical ladder entrance modifications intended to create an environment at the fishway entrances that are conducive to adult lamprey passage without significantly impacting the passage of adult salmonids. These improvements shall be evaluated until compliance, as described below, is attained.

- **Diffuser Gratings**: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, diffuser gratings within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.

- **Transition Zones**: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, transition zones within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.

- **Ladder Traps and Exit Pools**: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, lamprey ladder traps and exit pools within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.

Douglas shall exhibit steady progress, as agreed to by the Aquatic SWG, towards improving adult lamprey passage until performance at Wells Dam is determined to be similar to other mid-Columbia River hydroelectric dams, or until scientifically rigorous standards and evaluation techniques are established by the Lamprey Technical Workgroup, or its successor, and adopted regionally. The Aquatic SWG will then evaluate, and if applicable and appropriate, adopt these standards for use at Wells Dam. If compliance is achieved, Douglas shall only be required to implement activities pursuant to Section 4.1.7 (Periodic Monitoring) for adult Pacific lamprey passage.

### 4.1.5.1 Progress Towards Objective 1 in 2016.

*Installation of lamprey low-level entrances was completed in 2016. In addition lamprey enumeration structures were installed in the fishway count windows. Objectives of the 2016 Lamprey Approach, Passage, and Enumeration Study were to evaluate these modifications.*
Results of the study showed that few acoustic and tagged lamprey approached the Wells Dam tailrace and none interacted with the low-level entrances or count window enumeration structures. Lamprey enumeration structures caused problems with anadromous salmonid passage in the count windows and were removed from the count windows in December 2016.

4.1.6 Adult Pacific Lamprey Upstream Passage Evaluation

Should upstream passage measures be implemented under Section 4.1.5, then within one year following the implementation of such measures, Douglas, in consultation with the Aquatic SWG, shall conduct a one-year study to monitor the effectiveness of such measures on upstream passage performance of adult Pacific lamprey through Wells Dam. If monitoring results indicate that passage rates at Wells Dam are not similar to passage rates at other mid-Columbia River dams or within standards as described in Section 4.1.5, Douglas, in consultation with the Aquatic SWG, shall develop and implement additional measures to improve upstream Pacific lamprey passage. Measures described in Sections 4.1.5 and 4.1.6 may be repeated, as necessary, until adult passage through Wells Dam is similar to passage rates at other mid-Columbia River hydroelectric dams or within standards as described in Section 4.1.5.

4.1.6.1 Progress Towards Objective 1 in 2016

In 2016, the Lamprey Approach, Passage, and Enumeration Study was conducted. Preliminary results of the study showed that 12% of 151 acoustic and PIT tagged lamprey released upstream of Priest Rapids Dam and Rocky Reach Dam were detected by acoustic receivers within 5 miles of Wells Dam and 7% were detected near the Wells Dam fishways. A final study report will be available in 2017 after additional data has been collected and analyzed.

4.1.7 Periodic Monitoring

Once adult Pacific lamprey upstream passage rates at Wells Dam are similar to rates at other mid-Columbia River dams or within standards as described in Section 4.1.5, Douglas, in consultation with the Aquatic SWG, shall periodically monitor adult Pacific lamprey passage performance through Wells Dam fishways to verify the effectiveness of passage improvement measures. Specifically, every ten years after compliance has been achieved, or as determined by the Aquatic SWG, Douglas shall implement a one-year study to verify the effectiveness of the adult fish ladders with respect to adult lamprey passage. If results of the monitoring program confirm the effectiveness of adult lamprey passage measures and the results indicate that passage rates are still in compliance, then no additional measures are needed. If the results indicate that adult upstream passage rates are out of compliance, then the upstream passage study will be replicated to confirm the results. If the results after two years of study both indicate that passage rates have not been maintained, Douglas, in consultation with the Aquatic SWG, shall develop and implement measures to improve upstream Pacific lamprey passage, if any (see Section 4.1.5).

4.1.7.1 Progress Towards Objective 1 in 2016

Periodic monitoring will take place following the implementation of passage improvements.
4.2 Juvenile Pacific Lamprey Downstream Passage and Survival and Rearing (Objective 2)

4.2.1 Downstream Bypass Operations Criteria

Douglas is required to operate the downstream bypass system at Wells Dam in accordance with criteria outlined in the HCP.

4.2.1.1 Progress Towards Objective 2 in 2016

In 2016, Douglas operated the downstream bypass system at Wells Dam in accordance with the criteria outlined in the HCP.

4.2.2 Salvage Activities During Ladder Maintenance Dewatering

Douglas shall continue to conduct salvage activities as required by the HCP’s Adult Fish Passage Plan during fishway dewatering operations. All fish species, including Pacific lamprey that are encountered during dewatering operations shall be salvaged consistent with the protocol identified in the HCP. Any juvenile Pacific lamprey that are captured during salvage activities will be released downstream of Wells Dam. Douglas will coordinate salvage activities with the Aquatic SWG and allow for member participation. Douglas will provide a summary of salvage activities in the annual report.

4.2.2.1 Progress Towards Objective 2 in 2016

Douglas conducted salvage activities during dewatering of the Wells Dam west fishway in December 2016. During salvage operations no juvenile lamprey were captured in the fishway collection galleries during dewatering.

4.2.3 Juvenile Pacific Lamprey Passage and Survival Literature Review

Beginning in year five and every five years thereafter during the new license, Douglas, in consultation with the Aquatic SWG, shall conduct a literature review to summarize available technical information related to juvenile lamprey passage and survival through Columbia and Snake rivers’ hydroelectric facilities. This information will be used to assess the feasibility of conducting activities identified in Section 4.2.4.

4.2.3.1 Progress Towards Objective 2 in 2016

A literature review of technical information related to juvenile lamprey passage and survival through Columbia and Snake rivers’ hydroelectric facilities is scheduled for year 5 of the new license.
4.2.4 Juvenile Pacific Lamprey Downstream Passage and Survival Evaluation

Based upon the current state of the science regarding tag technology and methodologies for Pacific lamprey macrophthalmia (Section 2.3), coupled with the challenges of obtaining macrophthalmia in sufficient numbers within the Project to meet sample size requirements for a statistically rigorous study, a juvenile downstream passage and survival evaluation is not feasible at this time.

During the term of the new license, if tag technology and methodologies are developed and field tested and a sufficient source of macrophthalmia in or upstream of the Project are identified to ensure that a field study will yield statistically rigorous and unbiased results, Douglas, in consultation with the Aquatic SWG, shall implement a one-year juvenile Pacific lamprey downstream passage and survival study.

If statistically valid study results indicate that Project operations have a significant negative impact on the Pacific lamprey population above the Wells Dam, Douglas, in consultation with the Aquatic SWG, shall identify and implement scientifically rigorous and regionally accepted measures (e.g., translocation, artificial production or habitat enhancement), if any, or additional studies to address such impacts. If operational changes are needed to improve passage survival of juvenile lamprey migrants, then those changes need to be coordinate with the HCP Coordinating Committee.

4.2.4.1 Progress Towards Objective 2 in 2016

Currently no tag technologies and methodologies exist for use in studying downstream passage and survival of juvenile Pacific lamprey.

4.2.5 Juvenile Pacific Lamprey Habitat Evaluation

Within three years of the effective date of the new license, Douglas shall implement a one-year study to examine presence and relative abundance of juvenile Pacific lamprey in habitat areas within the Project that may be affected by Project operations. As part of this measure, Douglas shall identify areas of potential juvenile Pacific lamprey habitat for future evaluation. Sampling of these areas will assess presence/absence and relative abundance. Any sampling methodologies used in support of this activity will require coordination with the HCP Coordinating Committee and regulatory approval of the federal and state agencies.

4.2.5.1 Progress Towards Objective 2 in 2016

The Juvenile Lamprey Habitat Evaluation Study was conducted in 2015. The results of the report can be found in the 2015 Aquatic Settlement Work Group Annual Report (Anchor QEA 2016).
4.3 Participate in Regional Pacific Lamprey Conservation Activities (Objective 3)

4.3.1 Regional Lamprey Working Groups

Douglas shall participate in Pacific lamprey work groups in order to support regional conservation efforts (e.g., the Pacific Lamprey Technical Work Group and the USFWS Lamprey Conservation Initiative). Activities may include but are not limited to information exchanges with other entities, meeting attendance, and coordination of Douglas’ Pacific lamprey activities with other entities conducting lamprey research in the mid-Columbia River. Activities may also include conducting PLMP research within the Project, and sharing that information with other entities.

4.3.1.1 Progress Towards Objective 3 in 2016

In 2016, Douglas representatives attended and participated in regional coordination and information exchanges related to Pacific lamprey including: the Pacific Lamprey Technical Work Group, and the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program Review. In addition, Douglas hosted a regional pacific lamprey workshop in June 2016.

4.3.2 Reporting

Douglas will provide an annual report to the Aquatic SWG summarizing the previous year’s activities and proposed activities for the following year undertaken in accordance with the PLMP. The report will document all Pacific lamprey activities conducted within the Project and describe activities proposed for the following year. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this PLMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

4.3.3 Progress Towards Objective 3 in 2016

Consistent with the FERC License Order for Wells Dam, the Wells 401 Certification, and the PLMP, this report will be updated annually with the assistance of the Aquatic SWG. Each year the report will be filed on or prior to May 31st. The report will include a summary of the progress made towards the implementation of the PLMP and focus on the previous year’s developments.
5.0 REFERENCES


1.0 INTRODUCTION

The Aquatic Nuisance Species Management Plan (ANSMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP) will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification for the Wells Hydroelectric Project (Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Members of the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas.

The National Marine Fisheries Service (NMFS) was invited to participate in the development of Aquatic Resource Management Plans, but declined because its interests are currently satisfied by the measures within the HCP.

The goal of the ANSMP is to prevent the introduction and/or spread of aquatic nuisance species in Project waters. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several PMEs in support of the ANSMP. The PMEs presented within the ANSMP are designed to meet the following objectives:

The ANSMP is intended to be compatible with other aquatic nuisance species management plans in the Columbia River mainstem. Furthermore, this management plan is intended to be supportive of the HCP, Bull Trout Management Plan, Pacific Lamprey Management Plan, Resident Fish Management Plan, White Sturgeon Management Plan, and Water Quality Management Plan by continuing to prevent the introduction and/or spread of aquatic nuisance species in Project waters. The ANSMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies.

This document outlines the goals and objectives of the ANSMP and the actions undertaken in support of each in 2016. Within Section 2.0, under each goal or objective, a section entitled “Progress Towards Objective X in 2016” outlines actions taken in 2016 and other related information. To help differentiate between existing management plan language and actions taken in 2016, new information for 2016 is presented in italicized font in each section.

Additional background information on aquatic nuisance species issues in the Wells Project can be found in the most recent ANSMP, filed with the Federal Energy Regulatory Commission (FERC) in 2015.
2.0 GOAL AND OBJECTIVES

The goal of the ANSMP is to prevent the introduction and/or spread of aquatic nuisance species in Project waters. An up-to-date list of species considered aquatic invasives in Washington State can be found at [http://wdfw.wa.gov/ais/wac.html](http://wdfw.wa.gov/ais/wac.html). Douglas, in collaboration with the Aquatic SWG, has agreed to implement several PMEs in support of the ANSMP. The PMEs presented within the ANSMP are designed to meet the following objectives:

Objective 1: Implement best management practices to prevent Eurasian watermilfoil *Myriophyllum spicatum* proliferation during in-water (i.e., construction, maintenance and recreation improvements) improvement activities in the Project.

Objective 2: Continue participation in regional and state efforts to prevent the introduction and spread of aquatic nuisance species. Activities include continued monitoring for the presence of ANS, monitoring bycatch data collected during other aquatic management plan activities and conducting education outreach within the Project.

Objective 3: In response to proposed changes in the Project requiring FERC approval, the Aquatic SWG will assess the potential effects, if any, with respect to the introduction or proliferation of aquatic nuisance species in the Project to inform management decisions to support success of the ANSMP and will implement reasonable and appropriate measures to address any potential effects.

The ANSMP is intended to be compatible with other aquatic nuisance species management plans in the Columbia River mainstem. Furthermore, this management plan is intended to be supportive of the HCP, Bull Trout Management Plan, Pacific Lamprey Management Plan, Resident Fish Management Plan, White Sturgeon Management Plan, and Water Quality Management Plan by continuing to prevent the introduction and/or spread of aquatic nuisance species in Project waters. The ANSMP is intended to be not inconsistent with other management strategies of federal, state, and tribal natural resource management agencies.

The schedule for implementation of specific measures within the ANSMP is based on the best information available at the time the Plan was developed. As new information becomes available, implementation of each activity may be adjusted through consultation with the Aquatic SWG.

3.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

In order to fulfill the goals and objectives described in Section 3.0, Douglas, in consultation with the Aquatic SWG, has agreed to implement the following PMEs.
3.1 Implement Best Management Practices During Recreational Improvement Activities (Objective 1)

If at any time during the new license term, Douglas is required to construct, improve or maintain recreation access at boat launches and swim areas and the removal or disturbance of aquatic macrophyte beds that contain Eurasian watermilfoil may potentially occur, Douglas will implement containment efforts utilizing best management practices agreed to by the Aquatic SWG during such activities.

Douglas will implement the following best management practices (BMPs) to prevent the spread of ANS during contracted construction or maintenance of recreation enhancement measures:

For any contracted construction and maintenance activities requiring in-water work, Douglas will require, as part of construction bids, the inclusion of BMPs to address potential ANS threats. Prior to contract award, Douglas contract management staff will review and approve the sufficiency of proposed ANS BMPs with contractors and if necessary, require modifications in proposed ANS BMP implementation scope. Contractors will be instructed to share information with all sub-contractors prior to the start of work.

All equipment will undergo thorough inspection prior to entry into the Project to prevent the introduction of ANS. Inspections will be carried out on construction equipment and watercraft at a staging area dedicated to equipment and watercraft cleaning. This site will be located away from the ordinary high water line and away from any storm drains that run into Project waters. Douglas will provide adequate training and information on ANS inspection and cleaning procedures to personnel responsible for inspections at field sites. An inspection process for vehicles and equipment that arrive onsite from other areas will be provided. Equipment from rental agencies, outside contractors, and managing partners will also be subject to inspection and cleaning. Precleaning inspections will be used to identify problem areas and determine whether hand removal of large accumulations of soil and debris is necessary before washing of equipment. Douglas will provide equipment necessary for conducting proper inspections.

Douglas will provide adequate training and information on ANS cleaning procedures to personnel responsible for cleaning watercraft and equipment. Specific information on cleaning of in-water equipment and watercraft will be provided. Special cleaning and decontamination protocols and methods will be required for equipment and watercraft that has been previously used in areas where zebra mussels *Dreissena polymorpha* and other Dreissenid species are present. Douglas will require that records of inspections and cleanings be provided for all watercraft and construction equipment used in or near Project waters prior to, and after completion of construction projects. Inspection and cleaning records will include the location and date the watercraft or equipment was last used, date of inspection, findings of inspections, and the date and method used during the last cleaning. Inspection and cleaning records will be used to ensure that all watercraft and equipment has undergone proper inspection and cleaning before use in Project waters.
3.1.1.1 Progress Towards Objective One in 2016

In 2013 modifications were made to section 4.1 of the ANSMP. Article 405 of the new FERC operating license for the Wells Project issued in November 2012 required that within 6 months of license issuance, Douglas PUD would modify sections 4.1 of the existing ANSMP. The modifications required were:

(a) Section 4.1 of the plan must include specific best management practices that will be implemented to prevent the spread of aquatic nuisance species during construction of recreation enhancement measures.

In consultation with the Aquatic SWG, these modifications were made to the ANSMP and the updated plan was filed with FERC on April 30, 2013. The FERC approved the updated ANSMP on May 30, 2013. The approval of the plan also included a change in the reporting date for the ANSMP annual report from May 31 to April 1 for the preceding year’s activities.

3.1.1.2 Aquatic Macrophyte Control

On July 18, 2016 aquatic herbicide was applied to control aquatic macrophytes at swimming areas at Pateros Park, Columbia Cove Park (Brewster), and Marina Park (Bridgeport). The aquatic herbicide used was Tribune™ (active ingredient- diquat bromide). The control efforts were successful and no re-application of herbicide was required for the remainder of 2016. This is the third year that this herbicide has been used in these areas successfully and based upon spot surveys the species composition of the macrophyte communities in these areas has not changed to a higher or lower concentration of Eurasian watermilfoil.

3.2 Participation in Regional and State ANS Efforts (Objective 2)

3.2.1 Coordination with Regional and State Entities

Douglas shall continue to coordinate with regional and state entities to implement activities in Project waters to monitor for the presence of ANS, specifically zebra and quagga mussels 
Dreissena rostriformis bugensis. Activities covered by this objective will consist of monitoring for the presence of zebra and quagga mussels as is identified in Section 2.2.3. If ANS are detected during monitoring activities, Douglas will immediately notify the appropriate regional and state agencies and assist in the implementation of reasonable and appropriate measures to address the ANS presence as is consistent with ANS management protocols.

In the event of positive identification of new ANS within the Project area, Douglas will conduct the following response activities:

• Douglas will immediately notify Ecology and WDFW of positive or suspected ANS species identified during monitoring and/or boat inspections. Photographs will be taken and sent to Ecology or WDFW for assistance in identification. If necessary, samples may also be collected for positive identification.
• Once the presence of ANS has been positively determined, Douglas will within 30 days of the positive identification (requiring confirmation by relevant agencies), begin monitoring at multiple sites throughout the Project to determine the extent and distribution of the new ANS within the Project. Monitoring methods will vary depending on species and will be developed in consultation with the Aquatic SWG.

• If zebra mussels or other Dreissenid species are discovered in Project waters, Douglas will also notify upstream and downstream operators (Corps and Chelan PUD) and the Columbia River Basin Team. Douglas will help coordinate subsequent Columbia River Basin Team rapid response actions as applicable to the Project, such as implementing mandatory boat inspections, boat launch closures, quarantines, treatments, etc., in consultation with the Aquatic SWG.

• Douglas will work collaboratively with Ecology and WDFW, and in consultation with the Aquatic SWG, to develop an appropriate control response. Douglas will cooperate with the Columbia River Basin Team in implementing rapid response actions. It is anticipated that the Columbia River Basin Team will use up to the date technical information to guide decisions. The Columbia River Basin Team is also expected to follow the protocols contained within the 100th Meridian Initiative as it applies to the containment of zebra and other Dreissenid species.

• Appropriate information will also be provided to the public about any new ANS observations. Up-to-date outreach will be provided to the public with information about the presence and distribution of the ANS in Project waters, and on the appropriate measures being implemented to prevent the proliferation of the species.

• After initial response efforts are conducted, Douglas will assist the Columbia River Basin Team in implementing control and/or eradication actions as appropriate based on the location, extent, and type of ANS identified. The Aquatic SWG will be consulted when selecting control and eradication methods.

Douglas shall participate in information exchanges and regional efforts to coordinate monitoring activities.

3.2.1.1 Progress Towards Objective Two in 2016

_Similar to previous years, Douglas coordinated zebra and quagga mussel monitoring with WDFW during 2016. Monitoring consisted of plankton net tows for mussel veligers at three locations and the inspection of artificial substrates at three locations in the Wells Reservoir on three occasions. In addition, shoreline surveys for zebra and quagga mussels were initiated during the October sampling at each of the three monitoring location and will continue in 2017. Plankton tow samples collected were sent for analysis and results were provided to WDFW. Results from sample analysis determined no presence of either species at any of the sites monitored in the Wells Project (Table 1). Douglas will continue to monitor for these species in 2017, in consultation with the Aquatic SWG._

_In 2016, representatives from Douglas PUD participated in regional information exchanges by attending the 100th Meridian Initiative Columbia River Basin Team meeting in Portland, OR December 6-7, 2016._
Northern Pike (esox luscious) have been detected upstream of the Wells Project in Lake Roosevelt. The introduction and establishment of northern pike in the Wells Reservoir could potentially threaten native salmonid populations, therefore monitoring efforts are planned for 2017 to determine if northern pike are now present. Monitoring efforts will consist of gillnetting in the spring in areas of the Wells Reservoir with suitable northern pike spawning habitat. Monitoring and prevention efforts, and control efforts, if necessary, will be carried out in coordination with other stakeholders in the region.

Figure 1. Location of sites monitored for zebra and quagga mussels in 2016 in the Wells Reservoir.
### Table 1. Summary of zebra and quagga mussel monitoring efforts in 2016.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Sample Type</th>
<th>Zebra/Quagga Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-Jul</td>
<td>Pateros winter boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>28-Jul</td>
<td>Brewster boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>28-Jul</td>
<td>Bridgeport boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>28-Jul</td>
<td>100 m downstream of Methow River mouth</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>28-Jul</td>
<td>100 m downstream of Brewster Swimming Area</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>28-Jul</td>
<td>100 m downstream of Bridgeport boat launch</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>Pateros winter boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>Brewster boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>Bridgeport boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>100 m downstream of Methow River mouth</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>100 m downstream of Brewster Swimming Area</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>29-Aug</td>
<td>100 m downstream of Bridgeport boat launch</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Pateros winter boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Brewster boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Bridgeport boat launch dock</td>
<td>Artificial Substrate</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>100 m downstream of Methow River mouth</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>100 m downstream of Brewster Swimming Area</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>100 m downstream of Methow River mouth</td>
<td>Veliger Tow</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Pateros winter boat launch</td>
<td>Shoreline Survey</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Brewster boat launch</td>
<td>Shoreline Survey</td>
<td>No</td>
</tr>
<tr>
<td>11-Oct</td>
<td>Bridgeport boat launch</td>
<td>Shoreline Survey</td>
<td>No</td>
</tr>
</tbody>
</table>

#### 3.2.2 Monitor Bycatch from other Project Aquatic Resource Management Activities

Douglas shall monitor bycatch data collected from ongoing Project aquatic resource management activities for aquatic nuisance species presence to support regional and state efforts and the ANSMP. Such ongoing activities may consist of broodstock collection activities at Wells Dam and in associated Project tributaries, the northern pikeminnow removal program, water quality monitoring and any other aquatic resource activities related to implementation of Aquatic Resource Management Plans for bull trout, Pacific lamprey, white sturgeon, and resident fish.

#### 3.2.2.1 Progress Towards Objective Two in 2016

*Douglas monitored bycatch for aquatic nuisance species during aquatic resource management activities in 2016. Specific activities in which monitoring of bycatch occurred included: northern pikeminnow removal program and white sturgeon monitoring. In 2016, two non-native northern crayfish were captured at two of five locations throughout the Wells Reservoir during annual crayfish monitoring on October 11 (Table 2). This monitoring effort utilized backpack electrofishing as a sampling method. White sturgeon monitoring and northern pikeminnow...*
removal occurred in 2016 and both efforts utilized baited setlines; however, no non-native species were captured incidentally during either activity.

Table 2. Northern crayfish encounters in 2016.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
<th>Location</th>
<th>Number Captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crayfish Monitoring</td>
<td>10/11/2016</td>
<td>Starr</td>
<td>0</td>
</tr>
<tr>
<td>Crayfish Monitoring</td>
<td>10/11/2016</td>
<td>Washburn Island</td>
<td>0</td>
</tr>
<tr>
<td>Crayfish Monitoring</td>
<td>10/11/2016</td>
<td>Approximately 5 km downstream of Colville trout hatchery</td>
<td>1</td>
</tr>
<tr>
<td>Crayfish Monitoring</td>
<td>10/11/2016</td>
<td>Okanogan river mouth</td>
<td>0</td>
</tr>
<tr>
<td>Crayfish Monitoring</td>
<td>10/11/2016</td>
<td>Mouth of Chief Joseph State Park Canal</td>
<td>1</td>
</tr>
</tbody>
</table>

3.2.3 ANS Information and Education

Douglas shall make information regarding the effects of ANS introductions and the importance of prevention available to the public. Such outreach activities may consist of posting signage at Project recreation areas and boat launches.

Douglas shall also provide literature produced by appropriate state entities (Ecology and WDFW) for distribution at the visitor centers of local communities of the Project (Pateros, Brewster, Bridgeport) including Wells Dam.

3.2.3.1 Progress Towards Objective Two in 2016

In 2016, Douglas maintained ANS signage at all public boat launch facilities in the Wells Project. Signs included information about preventing the spread of ANS. Douglas also provided educational literature in the form of brochures and fact sheets on ANS prevention measures and the risks of ANS introductions, which were placed at boat launches around the Project area and the Wells Dam Overlook. This information has been available to the public since May 2013. Douglas will continue to make this information available in 2017.

3.3 Monitor and Address ANS Effects to Aquatic Communities During Changes in Project Operations (Objective 3)

If at any time during the new license term, future changes in Project operations requiring FERC approval are proposed and the Aquatic SWG concludes that such proposed operations may encourage the introduction or proliferation of aquatic nuisance species within the Project, the Aquatic SWG will assess the potential effects, if any, in order to make informed management decisions.

If the assessment identifies adverse effects to Aquatic Resources due to aquatic nuisance species attributable to changes in Project operations, Douglas shall consult with the Aquatic SWG to
select and implement reasonable and appropriate PMEs to address the identified adverse effect(s).

3.3.1.1 Progress Towards Objective Three in 2016

No significant changes in Project operations occurred in 2016.

3.4 Reporting

Douglas will provide a draft annual report to the Aquatic SWG summarizing the previous year’s activities undertaken in accordance with the ANSMP. The report will document all ANS activities conducted within the Project. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this ANSMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

Consistent with the FERC License Order for Wells Dam, the Wells Dam Water Quality 401 Certification and ANSMP, this report will be updated annually with the assistance of the Aquatic SWG. Each year of the new FERC license the ANS Annual Report has been filed with the FERC prior to April 1st. Douglas will continue to file this report on this schedule for the duration of the license. The report will continue to include a summary of the progress made towards the implementation of the ANSMP and focus on the previous year’s developments. In 2016, the Aquatic SWG requested that FERC move the filing deadline of the ANSMP Annual Report to May 31st each year to align with filing deadlines of the other five management plans that make up the Aquatic Settlement Agreement.
EXECUTIVE SUMMARY

The annual Resident Fish Management Plan (RFMP) Report includes a summary of all of the existing resident fish measures required by the Federal Energy Regulatory Commission (FERC) including Article 406 of the license for the Wells Project and the requirements found within the Clean Water Act section 401 Water Quality Certification. Article 406 of the license requires Public Utility District No. 1 of Douglas County (Douglas) to submit an annual report of management plan activities by May 31st of each year.

The measures required by the FERC license are largely consistent with the measures found in the Aquatic Settlement Agreement’s RFMP and the reporting requirements for the RFMP and the Clean Water Act section 401 Water Quality Certification. The 2016 RFMP annual report (this report) will be used to demonstrate compliance with all three of Douglas’s Wells Project resident fish related reporting obligations.

Douglas developed all six of the aquatic resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Members of the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas.

The National Marine Fisheries Service (NMFS) was invited to participate in the development of Aquatic Resource Management Plans, but declined because its interests are currently satisfied by the measures within the Anadromous Fish Agreement and Habitat Conservation Plan (HCP).

The goal of the RFMP is to protect and enhance native resident fish populations and habitat in the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several resident fish Protection, Mitigation and Enhancement (PMEs) measures in support of the RFMP. The PMEs presented within the RFMP are designed to meet the following objectives:

Objective 1: Continue to provide additional benefits to resident fishery resources in the Project as a result of continued implementation of the HCP, Predator Control Programs and Douglas’s Land Use Policy.

Objective 2: In year 2 and every 10 years thereafter during the new license term, Douglas will conduct a resident fish study to determine the relative abundance of the various resident fish species found within the Project. The study objectives will focus on (1) identifying whether there have been major shifts in the resident fish populations resulting from the implementation of the White Sturgeon, Bull Trout, Pacific Lamprey, and Aquatic Nuisance Species (ANS) Management Plans, and (2) collecting information on resident predator fish populations found within the Wells Reservoir. The results of this study may be used to inform the implementation
activities of the other Wells aquatic resource management (ANS, bull trout, Pacific lamprey, and white sturgeon) plans and HCP predator control activities.

Objective 3: If any statistically significant negative changes to native resident fish populations of social, economic, and cultural importance are identified, and are not caused by and cannot be addressed through implementation of other aquatic resource management plans or activities (white sturgeon, Pacific lamprey, bull trout, ANS, HCP, predator control), reasonable and appropriate implementation measures to address negative changes, if any, will be undertaken by Douglas.

Objective 4: In response to proposed major changes in Wells Dam operations requiring FERC approval, Douglas will assess the potential effects, if any, on Project habitat functionally related to spawning, rearing, and migration of native resident fish, in order to make informed management decisions towards the success of the RFMP. Douglas will implement reasonable and appropriate measures to address any effects on social, economic, and culturally important native species.

This RFMP is intended to be compatible with other resident fish management plans in the Columbia River mainstem. Furthermore, the RFMP is intended to be supportive of the HCP, Bull Trout Management Plan, Pacific Lamprey Management Plan and White Sturgeon Management Plan by continuing to monitor changes, if necessary, in the resident fish assemblage within the Project. The RFMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under WAC 173-201A, the Washington state water quality standards.
1.0 INTRODUCTION

The Resident Fish Management Plan (RFMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP) will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification for the Wells Hydroelectric Project (Wells Project or Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Entities invited to participate in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas.

The RFMP will direct implementation of measures to protect and enhance native resident fish populations in the Wells Reservoir. To ensure active stakeholder involvement and support, Douglas developed this plan, along with the other aquatic management plans, in close coordination with the members of the Aquatic SWG.

The Aquatic SWG agrees on the need to develop a plan for the long-term management of native resident fish populations in the Project. This management plan summarizes the relevant resource issues and background (Section 2), identifies goals and objectives of the plan (Section 3), and describes the relevant PMEs (Section 4) for native resident fish during the term of the new license.

2.0 BACKGROUND

2.1 Resident Fish Species

The resident fish assemblage present in the Wells Reservoir is composed of a diverse community of native and introduced, warm and coldwater, and recreational and non-recreational fish species. Since the construction of Wells Dam several studies have either directly (McGee 1979; Beak 1999) or indirectly (Dell et al. 1975; Burley and Poe 1994) addressed the resident fish assemblage in the Wells Reservoir.
2.1.1 Project Resident Fish Assessments

In assessing the occurrence of gas bubble disease in fish in the mid-Columbia River reservoirs, Dell et al. (1975) observed that the most abundant resident fish species in the Wells Reservoir were Northern Pikeminnow (*Ptychocheilus oregonensis*), stickleback (*Gasterosteus* spp.), and suckers (*Catostomus* spp.). They also determined that mountain whitefish (*Prosopium williamsoni*) and pumpkinseed (*Lepomis gibbosus*) were the most abundant resident game fish, although these two species accounted for less than two percent of the total 32,289 fish sampled. Overall, 27 species of resident and migratory fish were identified in the study area (Table 2.1-1).

In 1993, a one-year study was conducted to determine the relative predation by northern pikeminnow on outmigrating juvenile salmonids and to develop relative predation indices for each of the five mid-Columbia River reservoirs. During the study, incidental catch (species captured other than northern pikeminnow) was high with over 25 fish species recorded and catch dominated by Catostomidae (suckers) (Burley and Poe 1994).

Table 2.1-1 Native and non-native resident fish species that have been documented in the Wells Reservoir from past resident fish assessments, monitoring efforts, and miscellaneous studies (Dell et al. 1975; McGee 1979; Burley and Poe 1994; Beak 1999; NMFS 2002; BioAnalyst, Inc. 2004).

<table>
<thead>
<tr>
<th>Native Species</th>
<th>Non-Native Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Sturgeon <em>Acipenser transmontanus</em></td>
<td>Carp <em>Cyprinus carpio</em></td>
</tr>
<tr>
<td>Chiselmouth <em>Acrocheilus alutaceus</em></td>
<td>Black bullhead <em>Ictalurus melas</em></td>
</tr>
<tr>
<td>Longnose sucker <em>Catostomus catostomus</em></td>
<td>Brown bullhead <em>Ictalurus nebulosus</em></td>
</tr>
<tr>
<td>Bridgelip sucker <em>Catostomus columbianus</em></td>
<td>Pumpkinseed <em>Lepomis gibbosus</em></td>
</tr>
<tr>
<td>Largescale sucker <em>Catostomus macrocheilus</em></td>
<td>Bluegill <em>Lepomis macrochirus</em></td>
</tr>
<tr>
<td>Prickly sculpin <em>Cottus asper</em></td>
<td>Smallmouth bass <em>Micropterus dolomieu</em></td>
</tr>
<tr>
<td>Threespine stickleback <em>Gasterosteus aculeatus</em></td>
<td>Largemouth bass <em>Micropterus salmoides</em></td>
</tr>
<tr>
<td>Burbot <em>Lota lota</em></td>
<td>Yellow Perch <em>Perca flavescens</em></td>
</tr>
<tr>
<td>Peamouth <em>Mylocheilus caurinus</em></td>
<td>Black crappie <em>Pomoxis nigromaculatus</em></td>
</tr>
<tr>
<td>Rainbow trout <em>Oncorhynchus mykiss</em></td>
<td>Walleye <em>Sander vitreus</em></td>
</tr>
<tr>
<td>Mountain whitefish <em>Prosopium williamsoni</em></td>
<td>Tench <em>Tinca tinca</em></td>
</tr>
<tr>
<td>Northern pikeminnow <em>Ptychocheilus oregonensis</em></td>
<td>Lake whitefish <em>Coregonus clupeaformis</em></td>
</tr>
<tr>
<td>Redside shiner <em>Richardsonius balteatus</em></td>
<td></td>
</tr>
<tr>
<td>Dace <em>Rhinichthys</em> spp.</td>
<td></td>
</tr>
<tr>
<td>Bull Trout <em>Salvelinus confluentus</em></td>
<td></td>
</tr>
</tbody>
</table>

* Individual management plans for both sturgeon and bull trout have been developed and as such, they are not addressed in this Resident Fish Management Plan.

McGee (1979) noted that chiselmouth (*Acrocheilus alutaceus*), redside shiners (*Richardsonius balteatus*), and largescale suckers (*Catostomus macrocheilus*) were the most abundant non-game fish captured during Wells Reservoir surveys while pumpkinseed were the most abundant game fish caught. Similar sampling design and methodology to the 1974 study (Dell et al. 1975) were employed in order to ensure that results of the study were comparable with past observations. In total, 2,480 fish were collected during the study using live traps, beach seines and angling.
Twenty of the 27 known species previously trapped in other mid-Columbia reservoirs (Dell et al. 1975) were captured in the Wells Reservoir during the study.

In 1998, Douglas conducted an updated Wells Reservoir resident fish assessment (Beak 1999). Again, an effort was made to implement a sampling design similar to the two previous studies (1974 and 1979) so as to be consistent and allow comparisons with past results. In total, 22 species of fish were identified with 5,657 fish captured using beach seines and 716 fish observed via diving transects. Beak (1999) reported suckers (*Catostomus* spp.) as the most abundant resident fish captured in beach seining sampling in the Wells study area. These species represented 41 percent of the beach seining catch and 46 percent of the underwater dive survey count. Other abundant species in the beach seine catch were bluegill (*Lepomis macrochirus*) (32 percent), northern pikeminnow (10 percent), peamouth (*Mylocheilus caurinus*) (6 percent), and carp (*Cyprinus carpio*) (5 percent). Fifteen other species represented the remaining 7 percent of the total catch of 3,783 fish.

### 2.1.2 Recreational Fish Species

**Kokanee**

Landlocked sockeye (*Oncorhynchus nerka*), known as kokanee are a native fish which occur in several lakes in the mid and upper Columbia basins including Lake Wenatchee, Lake Chelan, Lake Osoyoos, and Lake Roosevelt. Although previous resident fish assessments have not detected the presence of this fish species in the Project, anecdotal information exists indicating that low numbers of kokanee may be present in the Project. These fish likely originate from Lake Roosevelt, above Grand Coulee Dam, and during periods of high spring flow are displaced downstream through Grand Coulee and Chief Joseph dams and into the Wells Reservoir.

**Largemouth Bass**

Largemouth bass (*Micropterus salmoides*) were widely introduced in Washington in the late 1800s (Wydoski and Whitney 2003). 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 2003). Little is known about the populations in the Wells Reservoir as they are infrequently captured (Beak 1999; Duke 2001; Burley and Poe 1994).

**Mountain Whitefish**

Mountain whitefish are assumed to occur in all small-order tributaries to the Methow, Okanogan, Wenatchee and Entiat rivers, and in connecting larger lake systems. They are also believed to occur in the mainstem reservoirs, although their behavior patterns are not known. They mostly inhabit riffles in summer and large pools in winter (Wydoski and Whitney 2003). 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. There is evidence that
mountain whitefish still spawn in the lower reaches of some tributaries (NMFS 2002). Mountain whitefish appear to use the Wells Reservoir principally as a migration route between spawning areas in the Methow River and the Wells Dam tailrace (Zook 1983).

Northern Pikeminnow

Northern pikeminnow are a slow-growing, long-lived predator native to the Columbia River basin. In summer, adult northern pikeminnow prefer shallow, low velocity areas 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. 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 (NMFS 2002). Due to their large numbers and distribution throughout the Columbia River basin, northern pikeminnow are considered to pose the greatest predation threat to migrating juvenile anadromous salmonids (NMFS 2002).

Resident Rainbow Trout

Rainbow trout (Oncorhynchus mykiss) are an inland (remains in freshwater) form of steelhead. However, some rainbow trout remain in freshwater for most of their life but undergo a physiological change to a smolt and migrate to the ocean late in life. In addition 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 the steelhead undergo smoltification. The mid-Columbia River tributaries contain a mixture of resident rainbow and ocean-migrating steelhead. Resident rainbow trout are likely present in low numbers in the Wells Reservoir. During the 1998 resident fish assessment, rainbow trout consisted of 0.05 percent of the relative catch (Beak 1999).

Smallmouth Bass

Smallmouth bass (Micropterus dolomieu) 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. In the Wells Reservoir, smallmouth bass are typically found in the lower Okanogan River and the confluence of the Okanogan and Columbia rivers (Beak 1999). They are also abundant in areas upstream of the mid-Columbia River.

Smallmouth bass were the second most abundant predator species captured in the mid-Columbia River during predator assessment sampling conducted in 1994. They were most frequently captured from forebay sampling sites (Burley and Poe 1994). Similar relative abundance estimates of smallmouth bass were observed in recent sampling programs in other mid-Columbia River reservoirs (Beak 1999; Duke 2001). They are a significant fish predator species in the Columbia River, and prey on juvenile salmonids. In the 1994 predator assessment, fish
composed 87 percent of the smallmouth bass diet, with salmonids consisting of 11 percent of the prey fish.

**Walleye**

Walleye (*Sander vitreus*) are a cool-water, piscivorous game fish believed to have moved downstream into the mid-Columbia River reach from a population established for recreational fishing in Lake Roosevelt in the late 1950s (Zook 1983). They were the least abundant predator species captured in the mid-Columbia River in 1994 (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). In 2014, size and bag limit restrictions were removed for walleye and other non-native fish in the Columbia River below Chief Joseph Dam and in the Okanogan River.

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, peak summer temperatures in this section of river are suboptimal and appear to restrict the recruitment of subyearling walleye to the yearling age class (Zook 1983). Recruitment of walleye into the mid-Columbia River reservoirs is suspected to result from the entrainment of young fish through Grand Coulee Dam during spring run-off (Zook 1983).

**2.1.3 Other Resident Species**

Resident, non-recreational species make up the bulk of the standing crop of fish in the Wells Reservoir. Many of these species are native to the Wells Reservoir, including burbot (*Lota lota*), chiselmouth, peamouth chub, redside shiner, largescale sucker, bridgelip sucker (*C. columbiae*), longnose sucker (*C. catostomus*), lake whitefish (*Coregonus clupeaformis*), Prickly sculpin (*Cottus asper*), threespine stickleback (*Gasterosteus aculeatus*), and dace species (*Rhinichthys spp.*) (See Table 2.1-1). Currently, no management actions or active fisheries for these species occur.

**2.2 Resident Fish Habitat**

**2.2.1 Spawning habitat**

Objectives of past resident fish studies (McGee 1979; Zook 1983; Beak 1999) did not specifically address spawning habitat but rather focused on species diversity, relative abundance and spatial distribution. Therefore, little information exists about the location and availability of spawning habitat for resident fish species in Project waters. It is likely that some resident fish species (cyprinids, catostomids, cottids) that spend their entire lives in Project waters utilize areas of the Wells Reservoir, tailrace, and lower tributaries (Methow and Okanogan rivers) to reproduce while other resident species, although present in the Wells Reservoir, utilize areas outside of the Project Boundary. Zook (1983) in his review of resident fish in the Wells Reservoir, hypothesized that some resident species such as mountain whitefish, rainbow trout, and walleye, although present, may not be successfully reproducing. Zook’s review (1983) suggests that resident rainbow trout are primarily a product of residualism of hatchery-produced steelhead and that mountain whitefish appear to use the Wells Reservoir principally as a
migration route between spawning areas in the Methow River and the Wells Tailrace. The report also suggests that walleye populations in the Wells Reservoir are recruited from the Lake Roosevelt population that was introduced in the late 1950s. The report also states that although spawning habitat appears to be available, evidence of successful reproduction has not been observed (Zook 1983).

Northern pikeminnow control efforts have been implemented at the Wells Reservoir starting in 1995. Part of these efforts included the identification of known spawning locations through the use of radio-telemetry. Based upon results of this study, northern pikeminnow spawning habitat is located in the Wells Reservoir near Park Island, near river mile (RM) 1.5 on the Methow River and in the Wells tailrace immediately downstream of the east bank fish ladder (Bickford and Skillingstad 2000).

2.2.2 Rearing habitat

Past resident fish surveys (McGee 1979; Beak 1999) observed significant spatial trends in species distribution within the Wells Reservoir. Both McGee (1979) and Beak (1999) noted that in general, spiny ray species (centrarchids) were most abundant between RM 530 and RM 540 and in the lower Okanogan River portion of the Project. This unique area of the Wells Reservoir is shallow and broad with slower water velocities, finer substrate, warmer water temperatures, and higher turbidity (Beak 1999) and is conducive to rearing spiny ray fish species while excluding more streamlined fish that prefer fast flowing water. Both surveys also found that the more streamlined resident fish species, such as chiselmouth and redside shiner (cyprinids), were most abundant downstream of RM 530 where water velocities increased, turbidity decreased, and the amount of shallow littoral habitat decreased. Other resident fish such as various sucker species and white sturgeon are most likely distributed throughout the Wells Reservoir but reside and feed at depths near the river bottom. Migratory, cold water species such as bull trout and whitefish spawn outside of the Wells Reservoir and it is likely that the majority of juvenile fish of these species rear in tributary habitats. Sub-adult bull trout, however, have been observed passing over other mid-Columbia River dams and recent studies suggest that bull trout forage for resident species present in the Wells Reservoir (BioAnalysts Inc. 2004).

2.3 Management Activities Affecting Resident Fish

2.3.1 Habitat Conservation Plan’s Predator Control Program

Section 4.3.3 of the Wells HCP includes the requirement that Douglas implement a northern pikeminnow and piscivorous bird harassment and control program to reduce the level of predation upon anadromous salmonids in the mid-Columbia Basin. The northern pikeminnow removal program includes a northern pikeminnow control program, participation in fishing derbies and tournaments and the use of long-line fishing equipment. These efforts are designed to provide an immediate and substantial reduction in the predator populations present within the waters of the Project.

Since efforts were first initiated in 1995, Douglas’s northern pikeminnow removal program has captured over 290,000 northern pikeminnow (1995-2016). The continual harvest of northern
pikeminnow from these waters will provide additional decreases in predator abundance. Yearly removal efforts will also keep the northern pikeminnow population in a manageable state.

The other component of the predator control program is the implementation of control measures for piscivorous birds. The focus of Douglas’s piscivorous bird control program is not removal but hazing and access deterrents. Hazing includes propane cannons, pyrotechnics and the physical presence of hazing staff. Access deterrents include steel wires across the hatchery ponds and tailrace, fencing and covers for hatchery ponds, and electric fencing. When hazing and access deterrents fail, options for removal are also implemented by the US Department of Agriculture (DOA) Animal Control staff hired to conduct the hazing programs.

Although the intent of the predator control program is for the protection of anadromous salmonids, reductions in aquatic and terrestrial predator abundance within the Reservoir may benefit many native resident fish species.

2.3.2 Project Shoreline Management and Land Use Policy

Douglas owns approximately 89 miles of shoreline in fee title and addresses shoreline management issues through the implementation of a strict Land Use Policy that requires formal approval of all land use activities that take place within the Project Boundary. Applications to permit activities such as construction of boat docks, piers, and landscaping are reviewed and considered for approval by Douglas after all required regulatory permits are acquired by the applicant. Additionally, when making land use or related permit decisions on Douglas owned lands that affect habitat within the Project Boundary, Douglas is required by Section 5 of the HCP to notify and consider comments from the HCP signatory parties (Douglas 2002). Shoreline management activities directly related to Project land use benefit resident fish, juvenile anadromous fish, and aquatic invertebrates and plants by minimizing impact in littoral areas within the Project Boundary.

3.0 GOALS AND OBJECTIVES

The goal of the RFMP is to protect and enhance native resident fish populations and habitat in the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several resident fish PMEs in support of the RFMP. The PMEs presented within the RFMP are designed to meet the following objectives:

Objective 1: Continue to provide additional benefits to resident fishery resources in the Project as a result of continued implementation of the HCP, Predator Control Programs and Douglas PUD’s Land Use Policy.

Objective 2: In year 2 and every 10 years thereafter during the new license term, Douglas will conduct a resident fish study to determine the relative abundance of the various resident fish species found within the Project. The study objectives will focus on (1) identifying whether there have been major shifts in the resident fish populations resulting from the implementation of the White Sturgeon, Bull Trout, Pacific Lamprey, and Aquatic Nuisance Species (ANS) Management Plans, and (2) collecting information on resident predator fish populations found within the Wells Reservoir. The results of this study may be used to inform the implementation
activities of the other Wells aquatic resource management (ANS, bull trout, Pacific lamprey, and white sturgeon) plans and HCP predator control activities.

Objective 3: If any statistically significant negative changes to native resident fish populations of social, economic, and cultural importance are identified, and are not caused by and cannot be addressed through implementation of other aquatic resource management plans or activities (white sturgeon, Pacific lamprey, bull trout, ANS, HCP, predator control), reasonable and appropriate implementation measures to address negative changes, if any, will be undertaken by Douglas.

Objective 4: In response to proposed major changes at Wells Dam requiring FERC approval, the Aquatic SWG will assess the potential effects, if any, on Project habitat functionally related to spawning, rearing, and migration of native resident fish, in order to make informed management decisions towards the success of the RFMP. Douglas will implement reasonable and appropriate measures to address any effects on social, economic, and culturally important native species.

This RFMP is intended to be compatible with other resident fish management plans in the Columbia River mainstem. Furthermore, the RFMP is intended to be supportive of the HCP, Bull Trout Management Plan, Pacific Lamprey Management Plan, and White Sturgeon Management Plan by continuing to monitor changes, if necessary, in the resident fish assemblage within the Project. This management plan is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under WAC 173-201A, the Washington state water quality standards.

The schedule for implementation of specific measures within the RFMP is based on the best information available at the time the Plan was developed. As new information becomes available, implementation of each activity may be adjusted through consultation with the Aquatic SWG.

4.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

In order to fulfill the goal and objectives described in Section 3.0, Douglas, in consultation with the Aquatic SWG, shall develop and implement a resident fish management program that includes the following PMEs.

4.1 Implementation Of Programs that Benefit Resident Fish (Objective 1)

4.1.1 HCP Predator Control Programs

Douglas shall continue to conduct annual predator control activities for northern pikeminnow and avian predators as outlined in the HCP (Douglas 2002). Although implementation of this program is targeted at reducing predation on anadromous species covered by the HCP, it is also anticipated to have direct benefits for resident fish species.
4.1.1.1 Progress Towards Objective 1 in 2016

*Douglas implemented predator control activities for northern pikeminnow in 2016. The pikeminnow control program resulted in the removal of 12,798 pikeminnow from the Wells Project.*

4.1.2 Project Shoreline Management and Land Use Policy

Douglas shall continue to implement the Douglas Land Use Policy which requires approval of all land use activities that take place within the Project Boundary. All permit activities such as construction of boat docks, piers, and landscaping within Project Boundary will be subject to review and approval by Douglas only after the applicant has received all other required regulatory permits, in addition to consideration by the HCP signatory parties and permit review by state and federal action agencies. The intent of the review and approval process captured in the Land Use Policy is to protect aquatic habitats and aquatic species that may be affected by proposed land use activities within the Project.

4.1.2.1 Progress Towards Objective 1 in 2016

*Douglas continued to implement its land use policy in 2016.*

4.2 Monitoring the Resident Fish Assemblage within the Wells Reservoir (Objective 2)

Douglas shall conduct a resident fish study to determine the relative abundance of the various resident fish species found within the Wells Reservoir. This assessment shall occur in year 2 and every 10 years thereafter during the term of the new license. The study objectives will focus on (1) identifying whether there have been major shifts in the resident fish populations resulting from the implementation of the White Sturgeon, Bull Trout, Pacific Lamprey, and ANS Management Plans, and (2) collecting information on resident predator fish populations found within the Wells Reservoir.

In order to maintain comparative assemblage information over time to inform Project resident fish status and trends, methodology for monitoring activities shall remain consistent with the methods described in Beak (1999). Information collected from these monitoring activities may be used to inform the implementation activities of the other Wells aquatic resource management plans and the HCP predator control activities.

4.2.1 Progress Towards Objective 2 in 2016

*A Resident Fish Assemblage Study was conducted in 2014. The final study report can be found in the 2014 Aquatic Settlement Work Group Annual Report (Anchor QEA 2015).*
4.3 **Actions to Address Major Shifts in Native Resident Fish Assemblage (Objective 3)**

Based upon information collected during the resident fish status and trends monitoring (Section 4.2), if any statistically significant negative changes to native resident fish populations of social, economic, and cultural importance are identified, and are not caused by and cannot be addressed through the implementation of other Aquatic Resource Management Plans or activities (white sturgeon, Pacific lamprey, bull trout, ANS, HCP, predator control), reasonable and appropriate implementation measures to address negative changes, if any, will be undertaken by Douglas.

4.3.1 **Progress Towards Objective 3 in 2016**

*No major shifts in native resident fish populations were identified by the 2014 Resident Fish Assemblage Study.*

4.4 **Monitoring in Response to Proposed Changes in Project Operations (Objective 4)**

If at any time during the new license term, future changes in Wells Dam operations are proposed that require FERC approval and the Aquatic SWG concludes that either reservoir or tailrace habitat within Project Boundary may be affected with regards to spawning, rearing, and migration (aquatic life designated uses) of native resident fish, an assessment will be implemented to identify potential effects, if any, in order to make informed license decisions. If the results of the assessment identify adverse effects to native resident fish species of social, economic and cultural importance, attributable to such changes in Project operations, then Douglas will consult with the Aquatic SWG to select and implement reasonable and appropriate measures to address such effects.

4.4.1 **Progress Towards Objective 4 in 2016**

*No significant changes in Project operations occurred in 2016.*

4.5 **Reporting**

Douglas will provide a draft annual report to the Aquatic SWG summarizing the previous year’s activities undertaken in accordance with the RFMP. The report will document all native resident fish activities conducted within the Project. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this RFMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

4.5.1 **Progress Towards Annual Reporting Requirements**

*Consistent with the FERC License Order for Wells Dam, the Wells Dam Water Quality 401 Certification, and the RFMP will be updated annually with the assistance of the Aquatic SWG. Each year the annual report will be filed on or prior to May 31st. The report will include a summary of the progress made towards the implementation of the RFMP and focus on the previous year’s developments.*
5.0 REFERENCES


APPENDIX E
2016 AQUATIC SETTLEMENT AGREEMENT AND WORKGROUP ACTION PLAN
2016 AQUATIC SETTLEMENT AGREEMENT AND WORKGROUP ACTION PLAN

A) Annual Report and Webpage
1. Distribute Aquatic Settlement Agreement Annual Report to Aquatic SWG, BIA and NMFS March 30, 2016
2. Final Annual Report approved by Aquatic SWG and NMFS April 30, 2016
5. Maintain/Update public website Throughout 2016

B) White Sturgeon MP
1. Continue rearing juvenile sturgeon Throughout 2016
2. Juvenile sturgeon tagging/marking February-March 2016
5. Release juvenile sturgeon with public participation June 2016
7. Rearing of juvenile sturgeon for 2017 release June-December 2016
8. Year 2 of Monitoring and Evaluation Program June-September 2016
9. Develop a draft Broodstock and Breeding Plan for years 5-10 August 2016
10. Aquatic SWG Approval of Broodstock and Breeding Plan for years 5-10 October 2016
11. Submit the approved broodstock and breeding plan to FERC for approval December 2016
13. Incorporate White Sturgeon MP activities into Aquatic SA Annual Report to FERC March 2016

C) Bull Trout MP
1. Wells Dam and Twisp Weir RT Study Plan for review January 2016
2. Wells Dam and Twisp Weir RT Study Plan approval February 2016
3. HCP CC trapping approval, tag order, contract development Feb-March 2016
4. Wells Dam and Twisp Weir RT Study Throughout 2016
5. Stranding surveys as necessary (only implemented at reservoir elevations below 773’ MSL; Up to five) Throughout 2016
6. Enumerate bull trout in Wells Dam count windows Throughout 2016
7. Monitor (via counts) for sub-adults at Wells Dam (>10/year triggers additional measures) Throughout 2016
8. ESA bull trout incidental take report to the FWS for review and approval April 2016
9. ESA bull trout incidental take report to the FERC May 2016
12. Incorporate 2015 Bull Trout MP activities and incidental take monitoring into Aquatic SA annual Report to FERC March 2016

D) Water Quality MP

1. 2015 Gas Abatement Plan (GAP) Report to ASWG and NMFS for review January 2016
2. 2015 Gas Abatement Plan Report approval February 2016
4. Update the QAPP at the request of the Aquatic SWG Throughout 2016
5. 2016 Gas Abatement Plan and Bypass Operating Plan Draft for review January 2016
6. 2016 Gas Abatement Plan approval February 2016
7. 2016 Gas Abatement Plan filed with FERC for approval February 2016
8. Year-round TDG monitoring at three locations (hourly with web-accessibility) Throughout 2016
10. 2015 Water Temperature Report to Aquatic SWG and HCP CC for comments March 2016
12. 2015 Water Temperature Report to FERC for approval April 2016
15. Water Quality Protection Plan, as needed (60 d before action), for Future Construction Activities Throughout 2016
16. Participate in WQ forums (e.g., TMDL, Columbia River Treaty, STT-WQ, CSR-SRI, etc.) Throughout 2016
17. Incorporate Water Quality MP Activities into Aquatic SA Annual Report to FERC March 2016

E) Pacific Lamprey MP

1. Install lamprey entrance/passage structures (Lower collection gallery side entrance and count window) January/February 2016
2. Fill gaps in and around count window January/February 2016
4. 2016 Pacific Lamprey Approach, Passage, and Enumeration Study Plan – Aquatic SWG approval February 2016
6. Ladder salvage during winter maintenance December 2016
7. Fishway inspection, if requested December 2016
8. Regional participation in forums and technical information sharing Throughout 2016
9. Incorporate Pacific Lamprey MP activities into Aquatic SA Annual Report to FERC March 2016
F) Aquatic Nuisance Species MP
1. ANS pamphlets at Wells Project boat launches and visitor overlook Throughout 2016
2. Zebra mussel monitoring with substrate mats and plankton tows April-October 2016
3. Crayfish incidental captures database management Throughout 2016
4. Crayfish monitoring August-September 2016
5. Milfoil monitoring adjacent to recreation sites Summer 2016
6. Regional coordination Throughout 2016
7. Incorporate ANS MP activities into Aquatic SA annual Report to FERC March 2016

G) Resident Fish MP
1. 2015 Pikeminnow Report to Aquatic SWG and HCP CC for review March 2016
2. 2015 Pikeminnow Report incorporated into Aquatic SA Annual Report to FERC March 2016
4. Regional coordination Throughout 2016
5. Incorporate Resident Fish MP activities into Aquatic SA Annual Report to FERC March 2016
APPENDIX F
EVALUATIONS OF WHITE STURGEON SUPPLEMENTATION AND MANAGEMENT IN THE WELLS RESERVOIR, 2015
Evaluations of White Sturgeon Supplementation and Management in the Wells Reservoir, 2015

David Robichaud\textsuperscript{1} and Andrew Gingerich\textsuperscript{2}

\textsuperscript{1} LGL Limited, Sidney, BC, Canada
\textsuperscript{2} Public Utility District No. 1 of Douglas County, East Wenatchee, WA, USA

Prepared for:

Public Utility District No. 1 of Douglas County,
East Wenatchee, WA

August 10\textsuperscript{th}, 2016
EXECUTIVE SUMMARY

In 2015, Public Utility District No. 1 of Douglas County (Douglas PUD) began implementing the White Sturgeon Management Plan (WSMP). Phase I components of the WSMP include supplementation releases, an Index Monitoring Program, an Acoustic-Tracking Program, and research towards Determining Natural Reproduction Potential.

To date, supplementation has comprised a total of 10,053 hatchery-produced PIT-tagged juvenile sturgeon that were released into the Wells Reservoir. These included 5,044 ‘brood year 2013’ fish (BY2013), released in 2014; and 5,009 ‘brood year 2014’ fish (BY2014), released in 2015. Forty-nine (1%) of the BY2014 fish also bore an acoustic tag when released.

For Index Monitoring, strictly-implemented stratified-random setline sampling was conducted in the summer (July/August) and fall (September/October) of 2015. For each set, the total number of sturgeon (by brood-year-class) was recorded. All captured sturgeon were scanned for PIT tags, measured (fork length, weight), and any fish without a PIT tag or scute mark had one applied. Collectively, there were 441 capture events (acoustic tags were applied to fifty BY2013 fish when they were recaptured).

Apparent survival rates were estimated for BY2013 fish using the PIT-tag mark and recapture data. Survival from release (January to June 2014) to recapture (July to August 2015) was estimated at 17.3% (SE = 2.4%), and was probably biased low. Survival of wild-origin fish (those raised from wild-caught larvae) was 2% higher than that for those raised from broodstock eggs (direct gametes), but the difference was not statistically significant. The apparent survival rates did not account for tag loss or emigration. Modelling a 2% emigration rate and 5% tag-loss rate resulted in ~1.2% increase in survival. Growth rates appeared to be higher than those observed in other similar studies.

Acoustic-tracking was done using an array of 23 receivers deployed throughout the study area from the Chief Joseph Dam tailrace to the Wells Dam tailrace. PIT-tag detection arrays were deployed in the Methow and Okanogan rivers, and at Wells Dam fish ladders. All telemetry data were processed using LGL’s custom software, Telemetry Manager. The acoustic-tagged fish appeared to have initially spread out from the release site. Following initial movements, subsequent movements of sturgeon was not marked. Sturgeon were detected in all of the reservoir sampling zones, although some areas had significantly more sturgeon than others. The distribution of sturgeon did not vary markedly between the summer and fall sampling sessions.

In 2015, no work was done towards the goal of determining natural reproduction potential, but will be examined in subsequent monitoring years during Phase I of the WSMP.
On the cover:
An 11-month old (BY 2013) white sturgeon is released into the Wells Project in spring 2014.

Suggested Reference:
# TABLE OF CONTENTS

EXECUTIVE SUMMARY ........................................................................................................I
LIST OF TABLES ..................................................................................................................IV
LIST OF FIGURES ................................................................................................................IV

## 1 INTRODUCTION
1.1 White Sturgeon Management Plan .......................................................... 1
1.2 Previous Research ................................................................................. 2
1.3 Broodstock and Breeding Plan ............................................................... 3
1.4 Monitoring and Evaluation ................................................................. 3

## 2 METHODS
2.1 Study Site ...................................................................................... 3
2.2 PIT-tag Releases ................................................................................ 4
2.3 Acoustic Tracking ........................................................................... 6
   2.3.1 Acoustic-tag Applications ......................................................... 6
   2.3.2 Acoustic Tracking Infrastructure ............................................. 8
   2.3.3 Telemetry Data Processing ................................................. 8
2.4 Emigration Rate ........................................................................... 10
2.5 Gross-Level Habitat Use ................................................................. 10
2.6 Index Monitoring ........................................................................... 10
   2.6.1 Standardized Fishing Effort ...................................................... 10
   2.6.2 Survival and Abundance Estimation ....................................... 11
   2.6.3 Seasonal Distribution ............................................................. 12
   2.6.4 Condition, Size and Growth .................................................. 12
   2.6.5 Sex and Maturity .................................................................. 12
2.7 Determining Natural Reproduction Potential ................................... 12

## 3 RESULTS
3.1 Acoustic-Tracking Results ............................................................... 13
   3.1.1 Emigration ........................................................................... 13
   3.1.2 Movements and Habitat Use .................................................. 13
PIT-tag Tracking Results ......................................................................................... 15
3.2 Index Monitoring Results ................................................................ 15
   3.2.1 Captures ............................................................................... 15
   3.2.2 Survival Estimation .............................................................. 15
   3.2.3 Distribution .......................................................................... 16
   3.2.4 Condition, Size and Growth .................................................. 18

## 4 DISCUSSION ................................................................................... 25
4.1 Acoustic-tracking ........................................................................... 25
   4.1.1 Sturgeon Movements ............................................................. 25
   4.1.2 Emigration ........................................................................... 25
4.2 Index Monitoring ........................................................................... 26
   4.2.1 Capture Success .................................................................. 26
   4.2.2 Survival Estimation .............................................................. 27
   4.2.3 Growth ................................................................................. 28
4.3 Determine Best Stocking Approaches ............................................. 29

## 5 ACKNOWLEDGEMENTS ........................................................................ 29

## 6 REFERENCES .................................................................................. 29
LIST OF TABLES

Table 1. Douglas PUD’s releases of PIT-tagged sturgeon in 2015, by date, location (Washburn Island vs. Bridgeport), and rearing type (wild-caught larval fish vs. standard hatchery crosses) in 2014 and 2015................................................................. 6

Table 2. Douglas PUD’s releases of acoustic-tagged sturgeon in 2015, by tag type. Tags with longer battery life are larger, and more powerful. ................................................................. 7

Table 3. Douglas PUD’s spring releases of PIT-tagged juvenile sturgeon by year, semiannual recapture events (indexing), and the specific survival estimates that can be generated. Note that two surveys are required to estimate any single survival value. .................. 12

Table 4. Estimates of apparent (Φ) or true (S) survival, and detection probability (p) derived from CJS models, by release cohort, and parental origin. Apparent survival was estimated when no emigration data were considered. When a 2% emigration rate was applied, estimates of True Survival were generated. .................................................. 16

LIST OF FIGURES

Figure 1. Location map of the Well Project................................................................. 4

Figure 2. Locations and boundaries of the Sampling Zones, into which the Wells Reservoir study area was partitioned................................................................. 5

Figure 3. Biologists prepare to close incision after inserting a V13 acoustic tag into a BY 2013 white sturgeon................................................................. 7

Figure 4. Locations of receivers in Wells study area, 2015........................................... 9

Figure 5. Second left lateral scute is removed from a wild origin fish captured in 2015. The fish was given a V16 acoustic tag, and was PIT-tagged and scute marked before being released at the point of capture. .................................................. 11

Figure 6. Proportions of the 2014 brood year acoustic-tagged White Sturgeon that were in each of the Sampling Zones, by date in 2015. Proportions calculated when n ≥ 5. Black line (plotted on right axis) shows the total number of tagged 2014 brood year fish........ 14

Figure 7. Proportions of the 2013 brood year acoustic-tagged White Sturgeon that were in each of the Sampling Zones, by date in 2015. Proportions calculated when n ≥ 10. Black line (plotted on right axis) shows the total number of tagged 2013 brood year fish........ 14

Figure 8. Catch of White Sturgeon in setlines deployed in six Sampling Zones during two seasons in 2015. Black dots show the observed catch (sturgeon per setline), jittered along the horizontal dimension (and very slightly in the vertical) to minimize the hiding of points underneath others. Red letters indicate the statistical differences among Sampling Zones (zones that share a letter are not significantly different from each other). Box plots extend from the 25th to 75th percentiles, and include a horizontal line at the median, and whiskers extend to 1.5 times the interquartile
range. Mean values are indicated by blue diamonds. * two large catches are left off the upper (Summer 2015) plot: in the Upper Reservoir, abnormally successful sets on July 29th and August 4th caught 28 and 22 fish, respectively.

Figure 9. Fork length frequency distributions for fish released in 2014 (Brood Year 2013, left panels) and 2015 (Brood Year 2014, right panels). Top row: fork lengths at release (orange: fish that were recaptured in 2015; blue: all others). Orange bars are small and hard to see in the top right panel, values ranged 212-312. Bottom row: fork lengths upon recapture in 2015.

Figure 10. Growth (change in fork length) for fish released in 2014 (Brood Year 2013, upper panels) and 2015 (Brood Year 2014, lower panels). Left column: change in length between release and recapture. Right column: change in length, shown as a ‘per year’ rate.

Figure 11. Frequency distributions of weights of fish released in 2014 (Brood Year 2013, right panels) and 2015 (Brood Year 2014, left panels). Top row: weights at release (orange: fish that were recaptured in 2015; blue: all others). The orange bars are small and hard to see in the top right panel, values ranged from 71-210. Bottom row: weights upon recapture in 2015.

Figure 12. Growth (change in weight) for fish released in 2014 (Brood Year 2013, upper panels) and 2015 (Brood Year 2014, lower panels). Left column: change in weight between release and recapture. Right column: change in weight, shown as a ‘per year’ rate.

Figure 13. Relative weight at release (first row) and at recapture (second row) for fish released in 2014 (left column) and 2015 (right column). Also, change in relative weight (RW) is shown ‘as measured’ (third row), and scaled to show the rate of change per year (bottom row).

Figure 14. Lengths and weights of seven wild-caught sturgeon, captured in the Wells Reservoir in 2015. The length-weight relationship (red line) is based on data from six fish (blue dots) that were both measured and weighed. One of the seven fish was not weighed (black triangle), hence its Y position has been plotted along the trend line.
1 INTRODUCTION

1.1 White Sturgeon Management Plan

The goal of the White Sturgeon Management Plan (WSMP) is to increase the White Sturgeon (*Acipenser transmontanus*) population in the Wells Reservoir to a level that can be supported by the available habitat and characterized by a diverse age structure consisting of multiple cohorts (juvenile and adult). In addition, the WSMP is intended to support spawning, rearing and migration as identified by the aquatic life designated use under WAC 173-201A in the Washington state water quality standards.

The WSMP is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the Wells Project license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP), will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification for the Wells Hydroelectric Project (Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas PUD) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (i.e., the Aquatic SWG). Members of the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Nation (Yakama), and Douglas PUD. During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations.

Based upon the information available as of December 2006, the Aquatic SWG determined that an assessment of Project effects on White Sturgeon was not practical given sturgeon life history characteristics and the limited number of fish estimated to exist in the Project. Therefore, the Aquatic SWG concluded that resource measures related to White Sturgeon should focus on population protection and enhancement by means of supplementation as an initial step in order to increase the number of fish within the Wells Reservoir. In addition to the initial supplementation activities, implementation of a monitoring and evaluation program was prescribed to accurately assess natural recruitment, juvenile habitat use, emigration rates, carrying capacity, and the potential for natural reproduction, so as to inform the scope of a future, longer-term supplementation strategy. All objectives were developed in order to meet the WSMP goal. The PMEs presented within the WSMP are designed to meet the following objectives:

- **Objective 1**: Supplement the White Sturgeon population in order to address Project effects, including impediments to migration and associated bottlenecks in spawning and recruitment;
- **Objective 2**: Determine the effectiveness of the supplementation activities through a monitoring and evaluation program;
- **Objective 3**: Determine the potential for natural reproduction in the Wells Reservoir in order to appropriately inform the scope of future supplementation activities;
- **Objective 4**: Adaptively manage the supplementation program as warranted by the monitoring results;
- **Objective 5**: Evaluate whether there is biological merit to providing safe and efficient adult upstream passage; and
- **Objective 6**: Identify White Sturgeon educational opportunities that coincide with WSMP activities.

### 1.2 Previous Research

From 2001-2003, Douglas implemented a study to examine the White Sturgeon population within the Project. Prior to the implementation of this study, little information on White Sturgeon was available for the Wells Reservoir\(^1\). The primary objectives of the study were to provide basic information on the population abundance, age structure, size, and growth of Project White Sturgeon; analyze movements of White Sturgeon within the Reservoir; and compare the data collected during this study with data collected during assessments at other projects (Jerald 2007). During the summers of 2001 and 2002, setlines were deployed in the Wells Reservoir. Sturgeon captured on setlines were measured, marked with passive integrated transponder (PIT) tags and with scute markings. Additionally, a select number of captured fish were fitted with radio-transmitters to track movements, and had pectoral fin rays removed for age analysis using standard methodologies (Rien and Beamesderfer 1994). Setline sampling took place over a two-year timeframe with a total of 129 setlines deployed and retrieved from throughout the Reservoir. In total, 13 White Sturgeon were captured during the 2-year study with the majority of the fish being captured in the Columbia River within five miles of the mouth of the Okanogan River. Twelve of the captured fish were PIT tagged. Subsequently, five recapture events were recorded for a total of 18 capture events during the mark-recapture period (one fish was recaptured twice). Population abundance was estimated to be 31.35±17.51. The 95% confidence interval for sturgeon abundance was calculated to be CI (13<N<218). The results of the mark-recapture portion of the study indicated that the sturgeon population in the Wells Reservoir is small with a point estimate of 31 fish over 50 cm in length (Skalski and Townsend 2005).

The length of the 13 fish captured during the study ranged from 60-202 cm. Two of the fish were classified as juveniles (<90 cm fork length) while 11 were classified as sub-adults or adults. It is important to note that the capture methodology was not designed to provide accurate sampling of fish under 50 cm. Captured sturgeon ranged in age from 6 to 30 years old (based on 11 fish), demonstrating that all of these fish recruited to the Wells Reservoir after Wells Dam was completed in 1967, with strong year class recruitment between the years 1972 and 1978, and again between 1988 and 1996. The presence of fish within these age classes suggests that successful recruitment within or to the Wells Reservoir is occurring either through (1) spawning within the Wells Reservoir, and/or (2) immigration into the Wells Reservoir from populations upstream.

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\(^1\) WDFW catch record card returns for 1993 and 1994 indicated that legal size White Sturgeon were present in the Wells Reservoir (Brad James, WDFW, pers. comm.). Additionally, information from previous studies in upstream and downstream reservoirs supported the existence of a population.
1.3 Broodstock and Breeding Plan

Following the November 2012 FERC license issuance, and consistent with requirements found in Section 4.1.1 of the WSMP, Douglas PUD and Aquatic SWG partners developed a Broodstock and Breeding Plan (BSBP) for the purposes of determining how Douglas PUD will meet stocking goals for White Sturgeon. Once approved by the Aquatic SWG, Douglas PUD filed the BSBP and the associated consultation record with the Federal Energy Regulatory Commission (FERC) on February 13th, 2013. The FERC subsequently approved the BSBP on May 28th, 2013. The BSBP has been used since 2013 to meet supplementation goals outlined in section 4.1.2 of the WSMP.

As identified in the WSMP, stocking targets are outlined as follows: within two years following issuance of the new license, Douglas PUD was required to release up to 5,000 yearling White Sturgeon into the Wells Reservoir annually for four consecutive years (20,000 fish total; years 2014-2017). Additional years and numbers of juvenile sturgeon to be stocked during Phase I (years 2018-2023) will be determined by the Aquatic SWG and will not exceed 15,000 juvenile sturgeon (total of 35,000 juvenile sturgeon during Phase I).

Beginning in June of 2013, broodstock (direct gamete) and larvae (wild caught larvae) sturgeon were captured to meet stocking targets designed for the first release in 2014. Under these actions, juvenile sturgeon obtained by implementing the BSBP were reared at the Wells Fish Hatchery for approximately 11 months prior to release into the Wells Reservoir. In both 2014 and in 2015 stocking targets were met.

1.4 Monitoring and Evaluation

As part of Douglas PUD’s implementation of the WSMP contained within the Agreement, Douglas PUD began implementing White Sturgeon monitoring in 2015. The ‘Phase I: White Sturgeon Management Plan Monitoring and Evaluation Study’ Plan was approved by the Aquatic SWG in December 2013 and January 2014.

Components of White Sturgeon monitoring and evaluation include:

- an Index Monitoring Program (section 4.2.1 of the WSMP),
- an Acoustic-Tracking Program (section 4.2.2 of the WSMP), and
- research towards Determining Natural Reproduction Potential (section 4.2.3 of the WSMP).

A study plan (Douglas PUD 2014), developed to meet the above areas of monitoring and evaluation, was approved by the Aquatic SWG, and field work began in the spring of 2015. This report details the progress made and results generated up to December, 2015 (i.e., Year One of a three-year M&E task).

2 METHODS

2.1 Study Site

The core study area extends from the tailrace of Chief Joseph Dam to the tailrace of Wells Dam. Wells Dam is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers; and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan
Figure 1. Location map of the Well Project.

County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at the normal maximum water surface elevation of 781 feet (Figure 1). The reservoir was divided into six Sampling Zones (Figure 2).

2.2 PIT-tag Releases
The WSMP calls for ~5000 PIT-tagged hatchery-reared juvenile sturgeon to be released into the Wells Reservoir annually from 2014-2017. In 2014, a total of 5,044 juvenile sturgeon were released (17 fish
were released on January 15th; 2,911 on April 10th; and 2,116 on June 12th). Of these, there were 2,132 sturgeon that were raised from wild-caught larval fish; and 2,912 that were raised using standard hatchery crosses (eggs and milt stripped from adult broodstock, using a variety of family crosses). In 2015, all 5,009 of the juvenile sturgeon were released between June 1st-2nd, and all were raised from wild-caught larval fish (Table 1).

In both years, >99% of the fish were released at Washburn Island (48° 5' 17.76" N, 119° 40' 34.51" W). However, a small number of fish were released in 2014 and 2015 near the town of Bridgeport, WA (48° 0' 53.21" N, 119° 40' 40.66" W) as a community outreach event where local high school and grade school students participated (Table 1). In 2015, 1% of the hatchery sturgeon were acoustic-tagged prior to release (see Section 2.3.1).

Figure 2. Locations and boundaries of the Sampling Zones, into which the Wells Reservoir study area was partitioned.
2.3 Acoustic Tracking

2.3.1 Acoustic-tag Applications

In 2015, 49 (1%) of the hatchery-produced juvenile sturgeon were acoustic-tagged (in addition to being PIT-tagged) prior to their release. Active tags were also implanted into 50 Brood Year 2013 fish (fish released in 2014) that were recaptured during the Indexing Monitoring Program. Of these 50 Brood Year 2013 fish, 30 were originally produced at Marion Drain Hatchery (produced directly from broodstock or direct gametes), and 20 were ‘wild-caught’ during their larval phase from the Lake Roosevelt section of the Columbia River. Additionally, one Brood Year 2012 fish (a Chelan PUD Chelan Falls Release), and 7 wild-origin fish were recaptured and acoustic-tagged in 2015. These latter, larger fish are able to carry larger, more powerful tags with longer battery life (Table 2), as compared to the fish that are tagged in the hatchery prior to release. All tags were uniquely coded transmitters, manufactured by Vemco (models V9, V13 and V16 tags; Table 2), and programmed to ping once every 210-300 s (see model-specific ping rates in Table 2).

For the hatchery-produced fish released in 2015, surgical implantation of acoustic transmitters took place on May 29th, 2015 at the Wells Fish Hatchery (Azwell, WA). The fish were allowed to recover for 33 days and were released on 1 June at Washburn Island. Surgeries on all other acoustic-tagged fish took place in situ: upon capture in set line gear, fish designated for acoustic tagging were held in coolers on the boat until a full setline was pulled, then transported to a Douglas PUD tagging boat. On the tagging boat, fish were held (prior to and following tagging) in a 100 L livewell that constantly provided fresh river water via electric pump (temperature and DO was continually monitored using a YSI temp/DO meter). After being tagged, the fish were held for at least 10 minutes to ensure adequate post-surgery recovery, and were released from the livewell at the original capture location.

In general, the surgical process followed the most up-to-date basin-wide standards (described by Liedtke et al. 2012). Sturgeon were placed in an anesthetic bath (MS-222; 60-80 mg/L) until a loss of equilibrium was attained, at which time they were examined for markings/abnormalities and had biometrics (length, weight, scute-mark pattern) recorded. The fish were then transferred to a surgical table and administered a

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</tbody>
</table>
maintenance dose of anesthesia (MS-222; 19 mg/L). For fish tagged in the hatchery, acoustic transmitters were implanted through an incision centered approximately between both the pectoral and pelvic fins and the lateral and ventral scute lines. Fish tagged in the field (Figure 3) were larger and therefore the incision was made ventrally between the lineae alba and the left ventral scutes, and approximately four scutes anterior of the pelvic fin (McLellan Jason, Colville Confederated Tribes, pers. comm.). The incision was then closed with two to three sutures and the fish was transferred to a recovery bucket/livewell with fresh water and aeration and monitored until equilibrium was recovered. For in-field surgeries, wetted shop towels were placed over fish, except in the area where the tag was implanted. The towels kept the fish moist and shielded them from sun exposure. In addition, the wetted towels aided in holding the tube that delivered the maintenance dose of anesthetic in the fish’s mouth (Figure 3).

Table 2. Douglas PUD’s releases of acoustic-tagged sturgeon in 2015, by tag type. Tags with longer battery life are larger, and more powerful.

<table>
<thead>
<tr>
<th>Brood Year</th>
<th>Year of Hatchery Release</th>
<th>Number Tagged in 2015</th>
<th>Tag’s Estimated Battery Life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild Origin</td>
<td>na</td>
<td>7</td>
<td>487&lt;sup&gt;a&lt;/sup&gt; 904&lt;sup&gt;b&lt;/sup&gt; 1070&lt;sup&gt;c&lt;/sup&gt; 3650&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>2012</td>
<td>2013</td>
<td>1</td>
<td>1†</td>
</tr>
<tr>
<td>2013</td>
<td>2014</td>
<td>50</td>
<td>25† 24† 1†</td>
</tr>
<tr>
<td>2014</td>
<td>2015</td>
<td>49</td>
<td>49&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>107</td>
<td>49 25 25 8</td>
</tr>
</tbody>
</table>

* tagged at the hatchery prior to release  † tagged in situ upon recapture during indexing settling efforts  
<sup>a</sup> Vemco Model V9-2H-069k-1 (length 29 mm, diameter 9 mm, weight in air 4.7 g); pings every 150-210 s.  
<sup>b</sup> Vemco Model V13-1H-069k-1 (length 36 mm, diameter 13 mm, weight in air 11 g); pings every 150-210 s.  
<sup>c</sup> Vemco Model V13-1H-069k-1 (length 36 mm, diameter 13 mm, weight in air 11 g); pings every 150-300 s.  
<sup>d</sup> Vemco Model V16-4L-069k-1 (length 36 mm, diameter 16 mm, weight in air 25 g); pings every 150-210 s.

Figure 3. Biologists prepare to close incision after inserting a V13 acoustic tag into a BY 2013 white sturgeon.
2.3.2 Acoustic Tracking Infrastructure
An array of 23 acoustic receivers (Vemco Model VR2W) was deployed to monitor White Sturgeon movement in and around the Wells Project (Figure 4). Specifically, receivers were positioned in order to assess emigration of released juvenile sturgeon, assess tributary use, and to focus on areas where sturgeon were thought to concentrate in the Wells Reservoir given previous research. Receivers were fixed to docks, piers, or deployed in recoverable bottom frames. Detection ranges were tested for each receiver in April 2015, and most were found to detect fish clear across the channel, with dead zones in the areas immediately adjacent to the receivers themselves. As a result, most deployments involved a pair of receivers, one located on each river bank. In addition to the receivers owned and operated by Chelan PUD, three additional receivers were deployed downstream of Wells Dam, to maximize the probability of tag detection in the noisy environment. On July 23rd, 2015, one receiver was removed from the Wells tailrace and redeployed (on October 15th) in the Foster Creek Delta near the Chief Joseph tailrace.

All receivers were pulled to the surface, inspected, and downloaded regularly during the study period. The most recent data included in this report was downloaded on December 4th. See Appendix A for details of the data that were included in this report.

2.3.3 Telemetry Data Processing
All receiver data were downloaded to a field laptop running Vemco VUE software and then subsequently transferred to LGL’s custom processing software, Telemetry Manager. Telemetry Manager facilitates data organization, record validation and analysis through the systematic application of user-defined criteria. Temporal or spatial resolution and noise filtering criteria can be changed by the user at any time without altering the raw data (English et al. 2012). False records (e.g., non-study tags; detections before release; detections that resulted from electronic noise; single hits; and those that occurred in a sequence which was not possible) were flagged for exclusion, and the remaining records were compressed into a manageable database of sequential detections for each fish. Each record included the tag number, detection location, and the first and last date and time of any sequential detections in that location. The compressed database was used for all subsequent analyses.

For this report, acoustic telemetry detections were binned into the Sampling Zones (Figure 2) in order to simplify the picture of sturgeon distributions and movements in the Reservoir. On every date during the study period, we determined the number of sturgeon in each of the Sampling Zones, and plotted the proportions over time. During periods when fish were not detected, they were presumed to be in the vicinity of their most recent detection, and to be residing there until they were detected at another receiver.
Figure 4. Locations of receivers in Wells study area, 2015.
2.4 Emigration Rate

Emigration was defined as movement out of the Reservoir, including downstream movements through Wells Dam, and unidirectional movements into tributary areas. Two tag types provide insight into emigration rates. First, information on the emigration of acoustic tagged fish was derived from the VR2W acoustic-receiver array. Second, information on the emigration of PIT-tagged fish could be derived from fixed PIT-receiver antennas and from setline recapture events in Rocky Reach Reservoir. Acoustic-tagged fish had much higher detection probability, but there were fewer tagged fish. Conversely, nearly all fish in the Reservoir were expected to bear PIT tags, but detection probability was markedly lower. Emigration rates were estimated as a proportion of total abundance.

2.5 Gross-Level Habitat Use

Telemetry detections and physical recaptures were used to describe seasonal and overall patterns of distribution, and to describe gross-scale habitat use (i.e., the relative use of each of the Sampling Zones). Generalized Linear Models (GLM) were used to test for CPUE (Catch per unit effort) differences among Sampling Zones. Models were initially run with a Poisson-distributed error structure, but if residual deviances were large relative to the degrees of freedom (suggesting over dispersion), then alternative (quasipoisson) models were used. Catch rates were plotted (along with a boxplot showing the first and third quartiles, and with vertical bars extending to the highest value that was within 1.5 times the distance between the first and third quartiles) to reveal patterns.

In addition, tributary-use was documented by querying the acoustic tracking data and the within-tributary fixed PIT arrays.

2.6 Index Monitoring

Index monitoring was designed to determine size structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon.

2.6.1 Standardized Fishing Effort

In the summer (July/August) and again in autumn (September/October) of 2015, strictly-implemented stratified-random setline sampling was conducted. The reservoir was divided into six Sampling Zones (Figure 2), and random fishing locations were generated within each zone, with elevated effort allocated to zones in which sturgeon catches were expected to be more productive (34% of sets were in Erlandsen; 20% in the Lower Reservoir; ~15% in each of Bathtub, Upper Reservoir and Chief Joseph Tailrace; and 1% in Okanogan). The length of the lines (91.4 m, or 300 ft), the number (80) and size (VMC 2/0 & 4/0 sure set circle) of hooks per line, and the bait (mix of worms, crickets and squid in the summer; squid only in the fall) were constant across all sets. In the summer session, 207 setlines were deployed over 26 days between July 6th and August 4th. In the autumn session, 212 setlines were deployed over 27 days between September 8th and October 8th.

For each set, the location, depth, temperature and soak time were recorded, along with the total number of sturgeon (by size-class) caught. All captured sturgeon were scanned for PIT tags, measured (fork length, weight), and checked for scute marks; and any fish without a PIT tag or scute mark had one applied. The scute marks applied in situ were different (‘second left’ for wild origin fish; Figure 5) from those used for the hatchery-produced fish (‘first three scutes anterior to dorsal on right’ for fish raised from wild-caught

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2 Bait was changed to only use squid on advice from the Aquatic SWG in August 2015.
larvae; and ‘first three scutes anterior to dorsal on left side’ for fish of direct gamete origin). During these setline sessions, some of the captured large-size sturgeon (either of wild origin, or from release years prior to 2015) were acoustic-tagged prior to release (see the ‘Acoustic-tag Applications’ section, above).

![Second left lateral scute is removed from a wild origin fish captured in 2015. The fish was given a V16 acoustic tag, and was PIT-tagged and scute marked before being released at the point of capture.](image)

Figure 5. Second left lateral scute is removed from a wild origin fish captured in 2015. The fish was given a V16 acoustic tag, and was PIT-tagged and scute marked before being released at the point of capture.

### 2.6.2 Survival and Abundance Estimation

PIT-tag mark and recapture data were used to estimate survival rates of each of the hatchery-reared juvenile sturgeon cohorts. Survival was assessed using a Cormack-Jolly-Seber (CJS) model (Lebreton et al. 1992). The CJS method allows the simultaneous estimation of the probability of detection during survey events (p) and the apparent survival between events (Φ), but requires at least one additional sampling event to occur after the period of interest, and requires that some individual fish be captured in more than one sampling session. Based on the schedule of annual releases and twice-annual surveys (Table 3), it will be possible to get several independent estimates survival over the three year study. Currently, two survival estimates are possible at this stage:

- survival (Φ_{rls-1\frac{1}{4}y}) of the 2014 release group from release in spring 2014 until the first survey in summer 2015 (1.25 years at large); and
- survival (Φ_{rls-\frac{1}{4}y}) of the 2015 release group from release in spring 2015 until the first survey in summer 2015 (0.25 years at large).

Note that the survival models described above do not explicitly allow for emigration or tag loss. Emigration rates were estimated using PIT and acoustic telemetry data (see ‘Emigration Rate’ section, above). PIT tag loss/failure rates were calculated using the proportions of scute-marked fish that were caught without PIT tags. Once tag loss and emigration are accounted for (by ‘reducing’ the total number of fish being modelled), ‘True’ survival rates (S) were calculated using modelling methods described above.
Table 3. Douglas PUD’s spring releases of PIT-tagged juvenile sturgeon by year, semiannual recapture events (indexing), and the specific survival estimates that can be generated. Note that two surveys are required to estimate any single survival value.

<table>
<thead>
<tr>
<th>PIT Tag Release Year</th>
<th>n</th>
<th>Recapture Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Summer 2015</td>
</tr>
<tr>
<td>2014</td>
<td>5,044</td>
<td>Φ rlø - 1½ y</td>
</tr>
<tr>
<td>2015</td>
<td>5,009</td>
<td>Φ rlø - ¾ y</td>
</tr>
<tr>
<td>2016</td>
<td>~5,000</td>
<td>-</td>
</tr>
<tr>
<td>2017</td>
<td>~5,000</td>
<td>No survival estimates are possible</td>
</tr>
</tbody>
</table>

All survival models were fit using the R (R Core Team 2014) package called ‘RMark’ (Laake 2013), which allows models to be constructed and fed to the program ‘MARK’ (White and Burnham 1999) for analysis.

2.6.3 Seasonal Distribution
CPUE was calculated from the randomized indexing sessions for each Sampling Zone, and compared among zones and between seasons using GLMs. A significant interaction term (Zone x Season) would be evidence for a change in distribution between seasons.

In addition, tributary-use was documented by querying the acoustic tracking data and the within-tributary fixed PIT arrays.

2.6.4 Condition, Size and Growth
Condition of the recaptured sturgeon was assessed using the relative weight index (Beamesderfer 1993). Growth rates of recaptured sturgeon were computed in mm/yr and g/yr for each of the hatchery-reared juvenile sturgeon cohorts. The size structures of the recaptured fish were plotted using length frequency distributions.

2.6.5 Sex and Maturity
No fish were sexed in 2015.

2.7 Determining Natural Reproduction Potential
No work was done towards the goal of determining natural reproduction potential in 2015. This work is planned to begin once more of the survival and distribution results have been collected.
3 RESULTS

3.1 Acoustic-Tracking Results

3.1.1 Emigration
To date, we have record of two acoustic-tagged fish that emigrated from the study area. One fish (tag A69-1601-34139), measuring 271 mm (123 g), was part of the 2014 hatchery brood year (it was given an acoustic tag prior to release from the hatchery), and was released on June 1st 2015. After release, it moved downstream as follows: it was detected in the Erlandsen Zone (opposite Pelican Point) from June 17th to July 6th, in the Bathtub (Brewster) on July 6th, and in the Lower Reservoir (on Pateros, Starr and Wells forebay arrays) on July 7th. It was first detected in the Wells Dam tailrace on July 13th, where it has been detected periodically right up until the most recent downloads (December 4th).

The second fish (tag A69-1601-57125) was part of the 2013 hatchery brood year. It was recaptured on September 14th 2015 in the Lower Reservoir, where it was measured (577 mm) and weighed (1.37 kg), given an acoustic tag, and released. It was detected in the Wells Forebay from September 14th to 23rd. After that, it was detected in the Wells Tailrace, past Gallagher Flats, and near Beebe Bridge on September 23rd, and has not been detected since that date (most recent Rocky Reach downloads from areas beyond the Wells tailrace were on November 4th).

From these data, we can make a preliminary estimation that the minimum emigration rate of the 2014 hatchery brood year is 1/49 (2%), and that of the 2013 hatchery brood year is 1/50 (2%).

3.1.2 Movements and Habitat Use
Binning the acoustic telemetry detections into the Sampling Zones allowed a more simplified picture of sturgeon distributions and movements to emerge (Figures 6 to 7).

For the 2014 brood year, 49 tagged fish were released in the Upper Reservoir (i.e., at Washburn Island) on June 1st 2015. By mid-June, less than half of these fish remained in this Zone (Figure 6). Initial movements (i.e., the first observed movements, made within 1 month of release) were largely (83%) in the upstream direction. Yet by July 1st, approximately one third of the fish were in each of three upper zones (Chief Joseph Tailrace, Upper Reservoir, and Erlandsen), and a few fish had moved into the Bathtub or the Lower Reservoir (Figure 6). In fact, 40% of all observed movements occurred in the first month of tracking. By August 1st, a few fish had repositioned themselves, as 22 fish (45%) were in the Chief Joseph Tailrace, 13 fish (27%) were in the Upper Reservoir, 9 fish (18%) were in Erlandsen, and the remainder were in the Bathtub (n=3, 6%), the Lower Reservoir (n=1, 2%) or in the Wells Tailrace (n=1, 2%). After August, few fish movements were detected, and the distribution pattern (Figure 6) appeared to be stable until the end of the data available for this update report (early December 2015). As of the end of data collection (early December 2015) it appeared that 90% of fish (n=44) were in the three highest zones (Erlandsen or above) and 96% (n=47) were in the four highest zones (Bathtub or above), with only 4% in the Lower Reservoir (n=1) or in the Wells Tailrace (n=1).

The 2013 brood year fish were tagged over the course of the summer (Figure 7) and released at various locations throughout the Reservoir. Initial movements (i.e., the first observed movements, made within 1 month of release) were largely (91%) in the upstream direction. Since tagging was not evenly distributed across zones, interpreting proportion of fish per zone is a little misleading. However, over time, a portion
Figure 6. Proportions of the 2014 brood year acoustic-tagged White Sturgeon that were in each of the Sampling Zones, by date in 2015. Proportions calculated when n ≥ 5. Black line (plotted on right axis) shows the total number of tagged 2014 brood year fish.

Figure 7. Proportions of the 2013 brood year acoustic-tagged White Sturgeon that were in each of the Sampling Zones, by date in 2015. Proportions calculated when n ≥ 10. Black line (plotted on right axis) shows the total number of tagged 2013 brood year fish.
of the fish moved away from the Chief Joseph Tailrace and from Erlandsen, and into the Bathtub and the Lower Reservoir (Figure 7). The number of fish in the Lower Reservoir peaked at the end of September and declined thereafter (one fish passed into the Wells Tailrace in mid-September), generally moving back upstream. The apparent mid-November movement of fish out of Erlandsen (Figure 7) may have been an artifact of download dates (the Erlandsen receiver opposite Pelican Point was downloaded on November 13th, whereas other local receivers were downloaded in early December).

**PIT-tag Tracking Results**

Emigration rates, estimated from PIT tag data were considerably lower than those from acoustic tracking data. Since release, 6 PIT tags from BY2013 (0.1% of the group), and 1 PIT tag from BY2014 (0.02% of the group) have been detected at the PIT detector in the Rocky Reach Bypass Surface Collector. The low emigration rate derived from these results are not surprising, given the suspected difference in detection efficiency between acoustic and PIT tags.

Several of the PIT tagged sturgeon were detected in tributaries. One BY2013 fish was detected in Foster Creek in mid-April 2014, about a week after release. Also, 75 BY2013 fish were detected in the lower Okanogan River: 72 were detected in 2014 (in all months from June to December), 2 fish in 2015 (one in May, and one in October), and one fish was detected in both years (September 2014 and July 2015). Five of the fish that were detected in the Okanogan River in 2014 were caught in mainstem setlines in 2015 (1 in the Bathtub, 3 in Erlandsen, and 1 in the Upper Reservoir), including two that were then acoustic tagged.

Four BY2014 fish were detected on the Lower Okanogan PIT detection array (one each in June, July, September).

### 3.2 Index Monitoring Results

**3.2.1 Captures**

In 2015, there were 441 White Sturgeon capture events (including some individuals that were caught multiple times) within the Wells Project area. Of these, 242 captures were made during 26 days of sampling in July through August; and 199 captures were made over 27 days of sampling from September through October. These capture events involved 384 unique individuals, including one fish released in 2013 (by Chelan PUD near Beebe Bridge), 317 fish released in 2014, 42 fish released in 2015, and seven fish of wild origin. In addition, 17 fish were of hatchery origin, but their PIT tag was not functional, hence the brood year was unknown. In cases where hatchery reared fish (identified by scute pattern) were observed to not have a functioning PIT tag, one was applied. The new PIT-tag ID codes were recorded and all data and metadata were uploaded to PTAGIS.

**3.2.2 Survival Estimation**

Of the fish released in 2014, 317 unique individuals were recaptured in 2015. In the Summer Session 195 unique individuals were recaptured, and in the Fall Session 157 unique individuals were recaptured (35 unique individuals were caught in both sessions). Based on these recapture histories, apparent survival from release (January to June 2014) to recapture (July to August 2015) was estimated to be 17.3% (SE = 2.4%; Table 4).
Since many fish of both wild larval origin and direct gamete fish were captured, it was possible to estimate survival specific to origin. For wild larval origin fish released in 2014, 111 unique individuals were recaptured in the Summer Session, and 80 in the Fall Session (22 in both sessions). Based on these recapture histories, apparent survival from release to recapture was estimated to be 18.9% (SE = 3.2%). For direct gamete origin fish released in 2014 (those raised from broodstock eggs), 83 unique individuals were recaptured in the Summer Session, and 77 in the Fall Session (13 in both sessions). Apparent survival from release to recapture was estimated to be 16.9% (SE = 6.9%; Table 4). Although it was possible to estimate survival specific to fish origin, the differences between the wild larval origin and direct gamete origin were not statistically significant.

Table 4. Estimates of apparent (Φ) or true (S) survival, and detection probability (p) derived from CJS models, by release cohort, and parental origin. Apparent survival was estimated when no emigration data were considered. When a 2% emigration rate was applied, estimates of True Survival were generated.

<table>
<thead>
<tr>
<th>Test</th>
<th>Emigration ignored</th>
<th></th>
<th>Emigration 2%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>All 2014</td>
<td>17.3%</td>
<td>2.4%</td>
<td>22.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Wild Larvae 2014</td>
<td>18.9%</td>
<td>3.2%</td>
<td>27.5%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Direct Gamete 2014</td>
<td>16.9%</td>
<td>6.9%</td>
<td>11.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>All 2015</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Of the fish released in 2015, 42 unique individuals were recaptured in 2015. In the Summer Session, 25 unique individuals were recaptured, and in the Fall Session 17 fish were recaptured. None of the fish were caught in both sessions, thus the model could not resolve the difference between detection and survival, and hence no estimates could be generated (Table 4).

The survival models described above do not explicitly allow for emigration or tag loss. Minimum emigration rates were estimated using acoustic telemetry data at 2% (see above). PIT tag loss/failure rates were estimated at 5.0%, since 17 scute-marked fish were caught without PIT tags (of 434 scute-marked fish examined). We accounted for tag loss and emigration by ‘reducing’ the total number of fish being modelled. ‘True’ survival rates (S) were about 1.2 points higher than apparent rates (Table 4).

3.2.3 Distribution

There were clear differences in the catch rates among the Sampling Zones. General linearized models showed that the among-zone differences in CPUE were statistically significant in both Summer (Dev = 230.4; df = 5, F = 11.3, P < 0.0001) and Fall (Dev = 66.9; df = 4, F = 4.7, P = 0.0012). Despite considerable variability within the data, post hoc tests revealed a few statistically significant pairwise differences for Summer 2015: CPUE estimates from Erlandsen and Upper Reservoir were significantly higher than those recorded in the Lower Reservoir (Figure 8).

There was no obvious seasonal effect on sturgeon distribution in 2015 (Figure 8). Using the relative CPUE among Sampling Zones as a measure of distribution, we found that the Sampling Zones followed the identical rank-order in Summer as in Fall. Specifically, CPUE was highest in Erlandsen, Upper
Figure 8. Catch of White Sturgeon in setlines deployed in six Sampling Zones during two seasons in 2015. Black dots show the observed catch (sturgeon per setline), jittered along the horizontal dimension (and very slightly in the vertical) to minimize the hiding of points underneath others. Red letters indicate the statistical differences among Sampling Zones (zones that share a letter are not significantly different from each other). Box plots extend from the 25th to 75th percentiles, and include a horizontal line at the median, and whiskers extend to 1.5 times the interquartile range. Mean values are indicated by blue diamonds. * two large catches are left off the upper (Summer 2015) plot: in the Upper Reservoir, abnormally successful sets on July 29th and August 4th caught 28 and 22 fish, respectively.
Reservoir was second, Bathtub was third, Lower Reservoir was fourth, and Chief Joseph Tailrace was fifth (very few samples were collected from the Okanogan Zone). Moreover, two-way GLM showed no significant interaction between Sampling Zone and Season, indicating that the among-zone distribution pattern (i.e., the CPUE pattern) did not vary significantly between seasons (Dev = 19.7; df = 4, F = 1.3, \( P = 0.27 \)).

The acoustic-tracking data confirmed that there was not a large difference in sturgeon distribution between the summer (July/August) and fall (September/October) periods in 2015 (Figures 6 to 7). Finer-scale examinations of the acoustic tracking data suggest that some upstream redistribution may have begun at the end of November (Figure 7). Further collection and processing of the sturgeon telemetry data will reveal if this trend continues into the winter. As data collection continues into 2016, we will get our first insights into springtime movements and continued tracking into 2017 may reveal whether any repeated seasonal behaviors can be detected.

### 3.2.4 Condition, Size and Growth

#### 3.2.4.1 Brood Year 2013

At the time of release in 2014, the BY2013 fish ranged in length from 98 to 413 mm (mean 281.9 mm), with 95% of the lengths falling between 207 and 355 mm (Figure 9). In 2015, 391 to 547 days after release, we recorded 373 recaptures of these fish, of which 370 were measured. Upon recapture in 2015, the BY2013 fish measured between 357 and 739 mm (Figure 9), having grown between 38 and 446 mm (mean = 197.0 mm; 95% of length increases were between 62 and 345 mm; Figure 10), which scaled to 34-314 mm per year (mean = 152.3 mm; 95% of growth rates were between 56 and 253 mm per year; Figure 10).

At the time of release in 2014, the BY2013 fish universally weighed less than 500 g (mean 166.5 g; 95% of the weights falling between 67 and 306 g; Figure 11). After 391 to 547 days, recaptured fish weighed 787 g on average (95% of the weights falling between 311 g and 1.5 kg; Figure 11), having grown 592 g on average (95% of weight increases were between 87 g and 1.3 kg; Figure 12). These weight increases scaled to an average of 454.3 g per year (95% of growth rates were 75-957 g per year; Figure 12).

The recaptured BY2013 fish had relative weights averaging 1.18 at the time of their release in 2014 (Figure 13); and relative weights averaged 0.92 at the time of recapture in 2015 (391 to 547 days later). The average change in relative weight was -0.27 (95% of the relative weight changes were between -0.69 and +0.02), which scaled to an annual change of -0.21 per year (95% of annual changes were between -0.52 and +0.01; Figure 13).

#### 3.2.4.2 Brood Year 2014

At the time of release in 2015, the BY2014 fish ranged in length from 97 to 373 mm (mean 234.2 mm), with 95% of the lengths falling between 165 and 294 mm (Figure 9). In 2015, 38 to 130 days after release, we recorded 43 recaptures of these fish. Upon recapture in 2015, the BY2014 fish measured between 290 and 429 mm (Figure 9), having grown between 45 and 162 mm (mean = 82.6 mm; Figure 10), which scaled to 222-644 mm per year (mean = 389.8 mm; Figure 10).

At the time of release in 2014, the BY2014 fish universally weighed less than 300 g (mean 97.6 g; 95% of the weights falling between 34.7 and 182.6 g (Figure 11). After 38 to 130 days, recaptured fish weighed
Figure 9. Fork length frequency distributions for fish released in 2014 (Brood Year 2013, left panels) and 2015 (Brood Year 2014, right panels). Top row: fork lengths at release (orange: fish that were recaptured in 2015; blue: all others). Orange bars are small and hard to see in the top right panel, values ranged 212-312. Bottom row: fork lengths upon recapture in 2015.
Figure 10. Growth (change in fork length) for fish released in 2014 (Brood Year 2013, upper panels) and 2015 (Brood Year 2014, lower panels). Left column: change in length between release and recapture. Right column: change in length, shown as a ‘per year’ rate.
Figure 11. Frequency distributions of weights of fish released in 2014 (Brood Year 2013, right panels) and 2015 (Brood Year 2014, left panels). Top row: weights at release (orange: fish that were recaptured in 2015; blue: all others). The orange bars are small and hard to see in the top right panel, values ranged from 71-210. Bottom row: weights upon recapture in 2015.
Figure 12. Growth (change in weight) for fish released in 2014 (Brood Year 2013, upper panels) and 2015 (Brood Year 2014, lower panels). Left column: change in weight between release and recapture. Right column: change in weight, shown as a ‘per year’ rate.
Figure 13.  Relative weight at release (first row) and at recapture (second row) for fish released in 2014 (left column) and 2015 (right column). Also, change in relative weight (RW) is shown ‘as measured’ (third row), and scaled to show the rate of change per year (bottom row).
Figure 14. Lengths and weights of seven wild-caught sturgeon, captured in the Wells Reservoir in 2015. The length-weight relationship (red line) is based on data from six fish (blue dots) that were both measured and weighed. One of the seven fish was not weighed (black triangle), hence its Y position has been plotted along the trend line.

236 g on average (95% of the weights falling between 101 and 541 g; Figure 11), having grown 101 g on average (95% of weight increases were between 26 and 400 g; Figure 12). These weight increases scaled to an average of 452.0 g per year (95% of growth rates were between 149 g and 1.2 kg per year; Figure 12).

The recaptured BY2014 fish had relative weights averaging 1.25 at the time of their release in 2015 (Figure 13); and relative weights averaged 0.90 at the time of recapture in 2015 (38 to 130 days later). The average change in relative weight was -0.35, which scaled to an annual change of -1.76 per year (Figure 13).

In 2015, seven wild origin fish were caught. These measured between 696 and 905 mm, and weighed between 2.4 and ~6 kg. The weights of the wild-caught sturgeon fit tightly ($r^2 = 0.995$) to a third-power function of length (Figure 14; $F = 748.4$, $P < 0.0001$). Ages of the wild-caught sturgeon are not known.
4 DISCUSSION

4.1 Acoustic-tracking

4.1.1 Sturgeon Movements

Only a few months of acoustic telemetry were available when this report was prepared. To date, it appears that the tagged fish have initially spread themselves throughout the study area, although fewer fish appear to occupy the lower half of the Reservoir. Subsequent movement of animals among the Reservoir zones was not marked, and there was little difference in the overall distribution of fish during summer versus autumn. This pattern of movements is consistent with that seen in other juvenile sturgeon studies – an initial period of rapid redistribution, followed by settling behavior (e.g., Howell and McLellan 2007, Golder 2010, Golder 2014, Wright and Robichaud 2015). And the preferential distribution of fish in the upper reaches of the Reservoir is a pattern that has also been observed in the Rocky Reach Reservoir (Wright and Robichaud 2015).

The observed juvenile sturgeon distribution in Wells Reservoir was markedly different from that of adult-sized fish, as documented in 2002-3003 using radio-telemetry. Specifically, Jerald (2007) fitted six large-sized sturgeon with radio tags, and found them to congregate near the Okanogan River confluence, with none detected upstream of Park Island (RM 538) or downstream of Brewster (RM 530). By contrast, our acoustic-tagged juveniles were found throughout the Reservoir, whereas the Okanogan Confluence (part of the Bathtub Sampling Zone) was an area of relatively little use. However, direct comparisons between adult radio tagged fish and <3 year old fish carrying acoustic tags are difficult, since differences between movements may be associated with variables that include but are not limited to life stage, point of capture and tracking methodology. For example, radio tracking detection probabilities are reduced when fish occupy deeper habitats, like those found in the upper and lower reservoir.

Jerald (2007) observed three individuals (one fish in 2002 and two fish in 2003) – all mature-sized fish – moving upstream into the Okanogan River. To date, we have detected no acoustic tagged fish, and a small proportion of the PIT-tagged fish (79 of the ~10,000 fish at large) in the Okanogan River, suggesting that use of this tributary may increase as the sturgeon grow or mature, or environmental conditions in the Okanogan were unfavorable for sturgeon compared to historical norms (e.g., flows and turbidity were below average and water temperatures were above average in 2015). Evidence for the latter is supported by far fewer PIT-tag detections of sturgeon in the Okanogan in 2015 compared to 2014 (see section 3.2). A direct comparison between 2002/2003 radio tagged adult fish and PIT tagged hatchery fish is admittedly difficult because methodologies of detection are dissimilar. For example, the PIT-detection array is located approximately 20 river km up the Okanogan, thus PIT-tagged fish could be using the lower Okanogan River without detection. In addition, detection efficiency of the PIT-detection array has not been empirically evaluated and would be expected to change with river flows, thus fish could pass the array undetected.

4.1.2 Emigration

There appears to have been a small (2%) amount of emigration from Wells Reservoir. Since acoustic tracking began, there have been two emigration events. Both events occurred within a few weeks of acoustic tagging, and may have been the result of handling stresses. To confirm that emigration is a natural process, it would be preferable to detect emigration events after the initial post-tagging period.
Our emigration rate is low relative to that estimated for the Rocky Reach Reservoir (4.7%; Wright and Robichaud 2015), and may be biased as a result of the short duration over which we have been tracking. Yet Wright and Robichaud (2015) reported that many of their departures were recorded in the autumn (with very little movement recorded over the winter), thus our observation period (June to December – which included the autumn months) may have been adequate to capture the majority of the emigration events. Additional years of monitoring should improve our estimate of emigration.

Besides moving downstream of Wells Reservoir, it is also possible for fish to move out of our core study area into the Methow or Okanogan rivers. We have acoustic arrays deployed in both these systems, as well as PIT-tag detection equipment. To date, no acoustic-tagged fish has been detected in either tributary. However, PIT-tag scanners in the Okanogan River have detected 75 BY2014 or BY2015 sturgeon (0.75%). If these sturgeon eventually move back into the Wells Reservoir, they cannot be considered to have emigrated. Yet, temporary departures from the core area could bias our survival estimates (see Fujiwara and Caswell 2002). When more detection data are available (within both the reservoir and the tributaries), it may be possible to estimate survival using multi-state models that take into account temporary periods of emigration (e.g., Schaub et al. 2004).

At this stage, our preliminary estimates of emigration have not been seriously implemented into our survival models – we have simply made an adjustment to the ‘available population’ in order to coarsely estimate ‘true’ (rather than ‘apparent’) survival. Once more data are available, finer-scale analyses of emigration rate will occur, accounting for the differing sample sizes and battery life spans of the various tag models deployed. Once emigration and tag-loss rates are parametrized, they can be woven into the structure of the survival models in order to better reconstruct the age-structured population within Wells Reservoir.

The emigration to the Okanogan, or temporary use of this habitat, is an interesting observation since we are unaware of other studies that have tracked sturgeon into Columbia River tributaries. Specific to the Wells Project, no sturgeon were detected using the Methow River in either 2014 or 2015, suggesting that the Okanogan may provide preferred habitat at certain times of the year compared to the Methow River.

### 4.2 Index Monitoring

#### 4.2.1 Capture Success

In 2015, we captured 441 White Sturgeon in the summer and fall sessions, combined. In all, 373 fish (83%) were from BY2013, and 43 (10%) were from BY2014. Approximately equal numbers of fish were released from each brood year. It follows that, having been exposed to dangers in the Reservoir for one year longer, there should have been fewer BY2013 fish at large than BY2014 fish. Thus, it is interesting that we captured 8.6× more BY2013 fish than BY2014 fish in 2015. Two explanations can account for this pattern. First, it is possible that the survival of BY2014 was, for some reason, very poor compared to that of BY2013. Because so few BY2014 fish were captured, it was not possible to estimate their post-release survival for this report. Perhaps after collecting more data in 2016-2017, we will be able to estimate survival and address this possibility. Nevertheless, it should be noted that other studies have observed marked variability in survival rates among brood years (e.g., Justice et al. 2009, Wright and Robichaud 2015). The second possibility is that gear selectivity negatively affected our ability to catch the one-year-old (BY2014) fish, as compared to the larger two-year-old (BY2013) fish. It would be surprising that the range of hook sizes used (2/0 - 4/0) would preclude the capture of the one-year old fish,
given these hooks are successfully used in nearby reservoirs (e.g., Wright and Robichaud 2015). Although similar capture gear has been used in other sturgeon studies, there are nevertheless reports of vastly different capture probabilities among cohorts (e.g., in 2013, Wright and Robichaud (2015) reported capture probabilities of 7% for BY2012 and 28% for BY2010, where the fish from different brood years differ noticeably in size, as expected). A combination of the two possibilities for differences in capture rates among brood years is also possible. However we suspect that capture efficiency was the leading cause of differences in catch rates, as it has been demonstrated in the Upper Columbia White Sturgeon Initiative Monitoring Program (Jason McLellan, pers. comm.). We expect to tease these factors apart when subsequent years of monitoring occur.

4.2.2 Survival Estimation
The apparent survival rates estimated in this report, 17-19% depending on the group in question, are likely underestimated. To calculate survival ‘from release to the Summer 2015 survey’, we needed to tease apart the effects of survival and detection probability. The number of fish caught in the Summer 2015 survey was the product of three parameters: the number of fish released × the survival rate × the capture probability during the Summer 2015 survey. The value of the first parameter (number of fish released) is known. But to calculate the value of the second parameter (survival), requires that we know (or have an estimate of) the third parameter (capture probability during the Summer 2015 survey). The Fall 2015 survey provided the data needed to independently estimate the capture probability of the Summer 2015 survey3. And, with two known (or estimated) parameter values, we can calculate the third parameter: survival. Here, we note that only a single pair of surveys has been conducted to date, and this study will continue for two more years, including four more surveys. Moving forward, every additional fish that is captured will downwardly-adjust the Summer 2015 capture probability and produce a concomitant increase in our initial post-release survival estimates. And there is room for improvement: post-release survival in other studies is considerably higher than that reported here. A recent survival estimate from the Rocky Reach Reservoir was 35.7% (Wright and Robichaud 2015). In the Upper Columbia River, the published survival rates, ranging from 27% to 29% (Golder Associates 2009), were likely underestimated. Recent data from the Upper Columbia White Sturgeon Recovery Initiative M&E Program have shown that after 16 years of stocking, the growing/ageing fish are becoming more effective at recruiting to the sampling gear. Specifically, BC Hydro and Golder Associates have revised the annual survival estimates (i.e., survival adjusted to a 1-year period), which were heavily influenced by release weight, from 0.476 (95% CI of 0.382-0.574) at 100 g, to 0.863 (95% CI of 0.744-0.933) at 200 g, and 0.981 (95% CI of 0.938-0.994) at 300 g (Golder Associates in prep.). For comparison, in 2014 we released larval origin fish at a mean size of 227 g, and estimated 18.9% survival in their first year. If fish recruit to gear better as they grow it is possible that our survival estimates will improve through time as observed in the Upper Columbia White Sturgeon Recovery Initiative program.

It is possible that the Wells Reservoir survival could be improved by releasing sturgeon of a larger size. Justice et al. (2009) found evidence of size-dependent mortality for supplementation releases of juvenile sturgeon into the Kootenai River. Examination of their survival-at-length curves shows that fish the size of Douglas’ 2013 Brood Year (average 281.9 mm) would have had lower-than-average survival rates. In

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3 Any fish caught in the Fall survey was, logically, known to be alive during the Summer survey. Thus, we have a set of fish that are known to have been alive during the Summer survey, and we know the portion of them that were actually caught during the Summer survey, thus we have an estimate of the capture probability of the Summer survey.
the Upper Columbia White Sturgeon Recovery Initiative, the 20th, 50th, 75th, and 90th percentiles of all release weights (2002-2014) were 35, 55, 93, and 181 g, respectively, which corresponded to annual survival estimates of 0.238, 0.293, 0.444, and 0.811 (Golder Associates in prep.).

Our initial results indicated a 2% survival difference between 2013 brood year fish reared from larvae versus those produced from direct gametes. The difference was not large, and not statistically significant, but was in the ‘preferred’ direction (i.e., larval fish survived better), given that Aquatic SWG members had already decided (starting with the 2014 brood year, released in 2015) to release only larval-reared fish moving forward. It makes sense that wild-caught fish might be better adapted for in-river survival than hatchery produced individuals (Tringali and Bert 1998, Leberg 1990, Hughes and Sawby 2004). Moreover, wild animals may be so well adapted, that their advantages may be detected in the survival estimates of the next generation: progeny of wild-caught adults survived better than progeny of captive broodstock in the Rocky Reach Reservoir (Wright and Robichaud 2015).

4.2.3 Growth
Growth rates for BY2014 sturgeon in the Wells Reservoir were notably greater than some other published growth rates. In their first 1-4 months in the Reservoir, BY2014 fish grew between 45 and 162 mm, and averaged 389.8 mm/year (rates extrapolated to 365 days). This rate is quite high when compared to the growth rates reported for one-year old sturgeon in other similar studies. For example, average annual growth of age-one sturgeon averaged 153 to 176 mm/year in the Rocky Reach Reservoir (Wright and Robichaud 2015), 280 mm/year in the Keenleyside and Roosevelt reaches (Golder Associates 2009) and 120 mm/year in the Kootenai River (Neufeld and Spence 2002). It is not surprising, however, that our growth rate is biased, given that it was based on measurements that were extrapolated from relatively short at-large periods.

When measured over longer at-large periods, the Wells Reservoir sturgeon appeared to grow at rates that were similar to other recent studies. Averaged over 1-1.5 years in the Wells Reservoir, the BY2013 fish grew on average 152.3 mm/year; and age 2 sturgeon in the Keenleyside and Roosevelt reaches grew on average 160 mm/year (Golder Associates 2009). By contrast, lower growth rates were observed in the Rocky Reach Reservoir, where age 2 sturgeon averaged growth rates between 62 and 93 mm/year (Wright and Robichaud 2015). The only other sturgeon growth rates data from the Wells Reservoir comes from two fish tagged in 2001: one 65 cm fish grew 22 cm in 14 months (189 mm/year; Jerald 2007); and a 197 cm adult grew 31.5 cm in about 5 years (61.1 cm/year; unpublished data).

In terms of weight gain, both BY2013 and BY2014 fish averaged ~450 g/year in the Wells Reservoir. This is similar to the growth rate of Rocky Reach BY2010 when recaptured in 2015 (457 g/year ; Wright and Robichaud 2015), but exceeds the rates observed for this brood year in 2012 or 2013 (96 or 272 g/year, respectively), or those of any other Rocky Reach brood year (BY2012 recaptured in 2013 or 2014 gained 143 and 157 g/year, respectively; BY2013 recaptured after ~0.5 years gained 141 g/year).

Moreover, Golder Associates reported growth of 389 g/year for age 2 hatchery-released sturgeon in the Keenleyside and Roosevelt reaches (Golder Associates 2009), and only 37 g/year in Canada’s middle-Columbia River (Golder Associates 2010). Slower growth rates observed in these more northern sections of the Columbia River might, however, be attributed to colder water temperatures and relatively low productivity. Low conspecific competition, warmer water temperatures, and higher productivity may all contribute to the observed higher growth rates in the Wells Reservoir for hatchery released fish.
4.3 Determine Best Stocking Approaches
LGL analysts and Douglas PUD biologists will work with the Aquatic SWG to determine preferred stocking techniques. Throughout the 3-year study period, Douglas PUD will experiment with size of the sturgeon at release, holding periods, and release locations, and we will use these independent variables when examining relative survival rates.

5 ACKNOWLEDGEMENTS
Douglas PUD’s White Sturgeon Management Plan implementation program has benefited from many individual and agency supporters. The Washington Department of Fish and Wildlife’s Scott Moore, Jayson Wahls, and Chad Jackson participated in rearing, release and various program review topics. The Colville Confederated Tribes and Bands of the Yakama Nation fish biologists provided valuable program oversight and fish delivery. Jason McLellan, Matt Howell, and Donella Miller and their respective staffs were instrumental in helping support this program. Columbia Research Specialists, Tyson Jerald and staff are thanked for countless long rain-or-shine hours making indexing possible. Many Douglas PUD staff participated in various components of the program including but not limited to Chas Kyger, Karl Shulke, Barb Wolfe, and Mary Mayo. We thank Lucia Ferreira (LGL Limited) for surgical tagging and instruction. LGL administrative staff kept various technical, financial and logistical aspects of the project running smoothly. Chelan and Grant PUD, Blue Leaf Environmental, Golder Associates, and members of the Upper Columbia White Sturgeon Recovery team have provided valuable regional coordination and data sharing. Agencies that contributed to PIT tag and receiver maintenance are also thanked, including Colville OBMEP staff, specifically Jenny Miller. Private residents around the Wells Reservoir, including but not limited to Roger Erlandsen, are thanked for providing receiver mounting locations and access. The Colville Tribes and the U.S Army Corps of Engineers provided receiver and Project access near Chief Joseph Dam.

6 REFERENCES


Appendix A. Dates for which fixed-station data were included in this report, by receiver. Receiver numbers with decimal points have been deployed in multiple locations, where the digit after the decimal indicates the deployment sequence.

<table>
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<th>Last Included Data</th>
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Subject: Low Pool Elevation Bull Trout Survey – License Article 402 Wells Hydroelectric Project No. 2149

Steve:

Pursuant to Article 402 of the license for the Wells Hydroelectric Project (Wells Project), the Public Utility District No. 1 of Douglas County (Douglas PUD) developed a Bull Trout Stranding, Entrapment, And Take Study Plan (Plan). This document was developed collaboratively with the United States Fish and Wildlife Service (Service) and the Aquatic Settlement Work Group (Aquatic SWG). The Plan was filed with the Federal Energy Regulatory Commission (FERC) on September 24, 2013 and approved by the FERC on October 29, 2013.

The Plan requires Douglas PUD to conduct 5 reservoir surveys when Wells Dam (Project) operations reduce the forebay elevation to 773 feet above sea level (msl) within the first five years of the new operating license for the Project. These surveys are to be conducted opportunistically when reservoir elevations may be at or below 773’ msl for an extended period of time. This sampling regime is also consistent with the Service’s 2013 Section 10 Biological Opinion, Section 18 Fishway Prescriptions for the Project, and Douglas PUD’s Bull Trout Management Plan.

On Tuesday May 3, 2016 the Project forebay reached 773’ msl. This low elevation was a result of Wells Dam hydroelectric Project operations that were designed to flush the Methow River delta using newly refurbished rock groins. This flushing is necessary to facilitate the removal of deposited fine material that builds up in the lower mile of the Methow River as the river meets the Columbia. Moving this fine material provides a safeguard against flooding areas of the town of Pateros, Washington.

Consistent with license requirements, on May 4, 2016 Douglas PUD biologists conducted a Wells Project stranding, entrapment and take survey consistent with regulatory requirements. Results of the survey are as follows:

- Methow River mouth - one pool with no fish observed.
- Okanogon River mouth - no pools or fish found.
• Kirk Islands - three pools found (e.g. Figure 1), with one containing approximately 300 redside shiner (*Richardsonius balteatus*) juveniles.

• El Rio Road bed (across from Okanogan River mouth) - visual inspection showed no fish in shallow part of a single pool. The pool was estimated to be over 9 feet deep and seining ineffective.

• Schluneger Flats - no pools or fish found.

• Bridgeport Bar Islands - 7 pools (e.g. Figure 2), 3 of which contained stickleback (*Gasterosteidae* sp.) and juvenile pikeminnow (*Ptychocheilus oregonensis*). Two of the three pools each contained approximately 200 subyearling Chinook salmon (*Oncorhynchus tshawytscha*) fry (measuring approximately 35 mm fork length; Figure 3). Finally, two non-native Northern crayfish (*Orconectes virilis*) were removed from one pool at this location. The crayfish were not returned to the Columbia River (Figure 4).

![Figure 1. One of the pools at Kirk Islands containing no fish.](image-url)
Figure 2. One of the pools at Bridgeport Bar Islands that contained stickleback and subyearling Chinook fry.

Figure 3. Stickleback and subyearling Chinook fry that were salvaged by beach seine at the Bridgeport Bar Islands.
Figure 4.  Two non-native Northern crayfish were removed by beach seine at the Bridgeport Bar Islands.

No bull trout were observed during this effort. For all other non-target taxa, fish were beach seined from smaller shallow pools and returned to the main river channel. In the event of future low reservoir events where forebay elevations drop to or below 773’ msl, Douglas PUD will implement the Bull Trout Stranding, Entrapment, and Take Study Plan accordingly. This memo completes the third of five stranding surveys that are to be conducted opportunistically in the first five years of the Wells Hydroelectric Project License.

If you have any questions or require further information regarding the above sampling, please feel free to contact Andrew Gingerich at (509) 881-2323, andrewg@dcpud.org.

Sincerely,

Andrew Gingerich
Sr. Aquatic Resource Biologist

Cc: Wells Aquatic Settlement Work Group
    Mr. Shane Bickford – Douglas PUD
    Mr. Chas Kyger – Douglas PUD
APPENDIX H
BULL TROUT PASSAGE AND TAKE MONITORING AT WELLS DAM AND TWISP RIVER WEIR FINAL STUDY PLAN
For copies or question related to this Study Plan, contact:

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1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509) 884-2323
E-Mail: andrewg@dcpud.org
# Table of Contents

ABSTRACT ....................................................................................................................................1

1.0 INTRODUCTION ..................................................................................................................2

1.1 Bull Trout Biology and Status .................................................................................................2
1.2 General Description of the Wells Hydroelectric Project Area ..................................................3
1.3 Previous Bull Trout Studies at Wells Dam ..................................................................................3
1.4 Douglas Aquatic Settlement Agreement and Bull Trout Management Plan and Study Objectives ....................................................................................................................................6
1.5 Twisp Weir Study Deferral and Consolidation of Studies ......................................................8
1.5.1 Twisp River Weir ................................................................................................................8
1.6 Bull Trout Encounters at the Twisp Weir ...........................................................................10

2.0 GOALS, ASSUMPTIONS AND HYPOTHESES ....................................................................13

2.1 Goals ....................................................................................................................................13
2.2 Sample Size ............................................................................................................................13
2.3 Hypotheses .............................................................................................................................14
2.4 Assumptions and Treatment .................................................................................................14

3.0 METHODOLOGY ....................................................................................................................14

3.1 Capture and Release Details ....................................................................................................14
3.2 Tagging Procedures .................................................................................................................16
3.3 Genetics .................................................................................................................................17
3.4 Monitoring .............................................................................................................................17
3.5 Statistical Analyses and Reporting ..........................................................................................20
3.5.1 Wells Dam Example Statistical Analyses .............................................................................21
3.5.2 Effect of Small Virtual Release Sample Size .....................................................................22
3.5.3 Standards Not Achieved .....................................................................................................22

4.0 REPORTING ............................................................................................................................23

5.0 REFERENCES .........................................................................................................................26
List of Figures

Figure 1. Annual Percentage (y-axis) of Bull Trout that Passed Wells Dam During the Month of May and June in a Given Year. -------------------------------------- 5
Figure 2. Total Annual Bull Trout Counts (y-axis) at Wells Dam Count Windows from 2000-2015 and the 16-Year Average (blue bar). ----------------------------- 6
Figure 3. Bull Trout Annual Ladder Preference as a Percent of Fish that Used a Given Ladder at Wells Dam.----------------------------------------------- 6
Figure 4. Twisp River Weir A) during September removal, illustrating the hydraulic pickets and B) during a high flow event (not operating). ----------- 9
Figure 5. Number of new and previously PIT tagged adult bull trout encountered at the Twisp River Weir from 2010-2015. ----------------------------------- 11
Figure 6. Arrival of previously PIT tagged bull trout at the Twisp Weir in A) 2014 and B) 2015. Bins are 5 days long with numbers above the bars representing bin count, and percent of annual run that bin represents. ------ 12
Figure 7. Distribution of PIT tag arrays in the Upper Mid-Columbia. -------------------- 20
List of Tables

Table 1. Number of Bull Trout Expect to be Captured at Wells Dam in 2016. --------13
Table 2. Estimated Tag Burden Using 16.0 Gram MCFT2-3BM Radio Tags and
0.1 g PIT Tag. ..........................................................16
Table 3. Fixed Station Receiver Locations at Wells Dam and in the Twisp River. ----18
Table 4. Example Tagging and Passage Results at Wells Dam.------------------------21
Table 5. Example Summation and Calculated Survival/Passage Statistics Using
Example Data from Table 3. --------------------------------------------21
Table 6. Relationship Between Sample Size and Mortality Towards Meeting
Survival Standards.--------------------------------------------------------22
Table 7. Estimated Timeline for Study Development, Implementation and
Reporting.---------------------------------------------------------------24
ABSTRACT

Bull Trout (*Salvelinus confluentus*) originating from the Methow, Entiat and Wenatchee rivers are known to interact with Wells Hydroelectric Project and the Twisp River. During relicensing studies at Wells Dam bull trout moved upstream and downstream past Wells Dam freely with no observed mortality or passage delay. The new 40-year Federal Energy Regulatory Commission (FERC) Operating License for the Wells Project, owned and operated by the Public Utility District No. 1 of Douglas County (Douglas PUD), requires Douglas PUD to determine the survival and passage success rates for bull trout at Wells Dam and the Twisp Weir.

This study plan outlines the methods that will be employed to examine if survival and passage success rates for adult marked bull trout are greater than 95% and greater than or equal to 90%, respectively, at Wells Dam and the Twisp Weir as part of the implementation of the Bull Trout Management Plan and the United States Fish and Wildlife Service’s Section 18 Fishway Prescription for the Wells Hydroelectric Project.

Although the study is narrowly focused on meeting requirements in the BTMP and Section 18 Fishway Prescriptions, the study is designed such that new behavioral data may be obtained that could aid in understanding bull trout ecology in the mid-Columbia. Specific tools such as genetics, radio telemetry, and PIT tags will help provide this information.
1.0 INTRODUCTION

Bull Trout (*Salvelinus confluentus*) background and the species interaction with the Wells Hydroelectric Project (Wells or Wells Project) are reviewed in this section.

1.1 Bull Trout Biology and Status

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 Mackenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997). 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 clean, cold, connected, and complex instream habitat (USFWS et al. 2000), 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 exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. Of all salmonids, bull trout are excellent indicators of water quality.

Because of historical declines of bull trout, in November 1999, the U.S. Fish and Wildlife Service (Service) listed all populations of bull trout within the coterminous United States as a threatened species pursuant to the Endangered Species Act of 1973, as amended (Act) (64 FR 58910; November 1, 1999). This 1999 listing rule applied to one distinct population segment (DPS) of bull trout within the coterminous United States by including bull trout in the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) and Saint Mary-Belly River populations (east of the Continental divide in Montana) with previous listings of three separate distinct population segments of bull trout in the Columbia River, Klamath River, and Jarbidge River basins (63 FR 31647, June 10, 1998; 64 FR 17110, April 8, 1999)

In April 2008, the USFWS completed the 5-year status review for Columbia River bull trout with two recommendations: maintain “threatened” status for the species and evaluate whether distinct populations segments exist and merit the ESA’s protection. A second status review completed by the USFWS in 2015 reconfirmed that the bull trout should remain listed. New critical habitat was proposed throughout the range of bull trout in January 14, 2010 (75 FR 2270), including all of the Wells Project waters except the Okanogan River since the Project is a migratory corridor and provided foraging and overwintering habitat. In 2015, the USFWS issued a new Final Bull Trout Recovery Plan in the coterminous of the United States that finalized new recovery units of which the Mid-Columbia Recovery Unit encompasses the Well Project Area. The plan generally focuses on managing bull trout threats in order to facilitate bull trout recovery. Recovery criteria include managing threats across core areas and local population and providing connected forage, migration, and overwintering (FMO) habitat. The associated Mid-Columbia Recovery Unit Implementation Plan (RUIP)
Bull Trout Passage at Wells Dam and Twisp Weir

Page 3  Wells Project No. 2149

outlines recovery criteria, threats, a recovery actions narrative, and a recovery implementation table specific to bull trout in the Wells Project area. Many threats have been identified as factors effecting bull trout in the Middle Columbia including but not limited to climate change, logging, road networks, invasive species, fragmentation, water use practices, water quality, and dams and diversions. The RUIP describes actions for connectivity and passage and prioritize connecting Forage, Migration, and Overwintering habitat to spawning and rearing habitat. An example action (#1.2.5) for the Methow Core Area is to minimize ongoing impacts from Hydropower dams and the Twisp Weir through adaptive management of Wells Dam FERC relicensing and actions # 1.2.2 and 1.2.3 for the Okanogan FMO area is to develop/maintain passage between FMO habitats outside of core areas to spawning and rearing areas.

1.2 General Description of the Wells Hydroelectric Project Area

The Wells Project is located at river mile (RM) 515.6 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam. The Wells Project is the chief generating resource for the Public Utility District No. 1 of Douglas County (Douglas PUD). It includes 10 generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet mean sea level (msl) in height. The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at elevation of 781 feet msl. The normal maximum water surface elevation of the reservoir is 781 feet msl.

1.3 Previous Douglas PUD Bull Trout Studies at Wells Dam

During relicensing investigations Douglas PUD attempted to identify potential project-related impacts on upstream and downstream passage of adult bull trout (fish ≥ 400 mm in length) through Wells Dam and the reservoir. During these investigations radio telemetry was used to monitor upstream and downstream passage.

Between 2005 and 2008, 26 adult bull trout were trapped at Wells Dam and radio-tagged. Concurrent with the implementation of the Bull Trout Plan, the USFWS and Chelan PUD radio-tagged and released 136 adult bull trout at other mid-Columbia River basin locations including the Methow River, and Rock Island and Rocky Reach dams (50 USFWS tags 2006-2008, 86 Chelan PUD tags 2005-2007). From 2005 to 2008, 25 downstream passage events and 52 upstream passage events by 40 individual bull trout were recorded at Wells Dam. Of these, 17
downstream and 41 upstream passage events occurred within one year of tagging and release. Of all tags released from 2001 to 2004, there were 2 downstream passage events and 41 upstream passage events. Of these, 2 downstream and 38 upstream passage events occurred within one year of release.

The take estimates for the Wells Project were based upon the number of unique upstream and downstream passage events that took place within one year of each bull trout being tagged and released. During the six year study and eight years of monitoring, 19 downstream and 79 upstream passage events took place at Wells Dam by radio-tagged bull trout within one year of release. Taking into account all observed passage events, a total of 27 downstream and 93 upstream passage events took place at Wells Dam. All 27 of the radio-tagged bull trout that passed downstream through the dam passed using either the turbines or spillways. Out of the 19 downstream passage events that occurred within one year of tagging, zero bull trout injury or mortality was observed at the Wells Project. Out of the 79 upstream passage events that occurred within one year of tagging, zero bull trout injury or mortality was observed at the Wells Project.

Upstream passage of adult bull trout through the fish ladders at Wells Dam has historically occurred between early May and late October, with peak passage typically occurring in May and June (mean = 89%; Figure 1). During the 2005 and 2008 study, 214 adult bull (24% of which were radio tagged; n = 52) trout were counted passing upstream through Wells Dam. Annual counts of bull trout at Wells Dam have ranged between 43 and 109 during the years of 2000 to 2015 (Figure 2). At Wells Dam east and west side ladders operate year round with bull trout showing some amount of favoritism each year to specific ladders (Figure 3), but no multi-year preference or trend.
Figure 1. Annual Percentage (y-axis) of Bull Trout that Passed Wells Dam During the Month of May and June in a Given Year.
1.4 Douglas Aquatic Settlement Agreement and Bull Trout Management Plan and Study Objectives

Following the completion of bull trout radio-telemetry studies the Bull Trout Management Plan (BTMP) was developed. The BTMP is one of six Aquatic Resource Management Plans within the Aquatic Settlement Agreement (Agreement). The Agreement was developed as part of the Integrated License Process for the Wells Project. The BTMP is largely consistent with Fishway Prescriptions and a Biological Opinion (BIOP) issued by the USFWS in 2012 as part of the relicensing of Wells Dam. The BTMP is incorporated into the BIOPs incidental take statement and referenced in the terms and conditions section. This study is being proposed in order to satisfy two sections of requirements found in the BTMP and the USFWS Incidental Take Statement for the Wells Project (emphasis added):

“... BTMP 4.1 Bull Trout Passage Performance Standard (BIOP RPM#1; Terms and Condition #2): The Licensee shall implement the upstream and downstream measures contained in the Wells Hydroelectric Project BTMP to provide safe, timely, and effective upstream and downstream passage for adult and sub-adult bull trout at the Wells Hydroelectric Project. ‘Safe, timely and effective’ passage shall be achieved when the Licensee has demonstrated that the survival and passage success rates for adult marked fish are greater than 95% and greater than or equal to 90%, respectively, and when passage studies demonstrate that the fishway facilities at Wells
Dam do not impede the passage of bull trout. To ensure that safe, timely and effective passage at Wells Dam is maintained during the term of the new license, the Licensee shall implement the following bull trout upstream and downstream measures consistent with the BTMP.

... 

4.6 Bull Trout Upstream and Downstream Passage Evaluation (BTMP Section 4.2.1; BIO RPM #5 Terms and Conditions #10): The Licensee shall periodically monitor upstream and downstream passage of bull trout through Wells Dam and in the Wells Reservoir through the implementation of a radio-telemetry study. Specifically, in years 5 and 10 of the new license, and continuing every 10 years thereafter during the new license term, the Licensee shall conduct a 1-year monitoring study to verify continued compliance with the bull trout passage performance standard (Section 4.1 of this Prescription). These monitoring studies shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the monitoring results demonstrate continued compliance with the bull trout passage performance standard (Section 4.1 of this Prescription), then no additional actions are needed. If the monitoring results demonstrate that the Licensee is no longer in compliance with the bull trout passage performance standard (Section 4.1 of this Prescription), then the monitoring study will be replicated to confirm the results. If the results after 2 years of monitoring demonstrate that the Licensee is no longer in compliance with the bull trout passage performance standard (Section 4.1 of this Prescription), then the Licensee shall, pursuant to Section 4.8 of this Prescription, develop and implement additional measures to improve bull trout passage until compliance with the bull trout passage performance standard (Section 4.1 of this Prescription) is achieved. If the bull trout counts at Wells Dam increase more than two times the existing 5-year average or if there is a significant change in the operation of the fish ladders, bypass, or hydrocombine, then the Licensee shall, in consultation with the FWS, the Aquatic SWG, and the Wells HCP Coordinating Committee (WCC), shall conduct a 1-year, follow-up monitoring study to verify continued compliance with the bull trout passage standard (Section 4.1 of this Prescription).

4.7 Adult Bull Trout Passage Evaluation at Brood Stock Collection Facilities (BTMP Section 4.2.2; RPM #5; Terms and Conditions #11): The Licensee shall, beginning in year 1 of the new license, conduct a 1-year radio-telemetry evaluation to assess upstream and downstream passage of adult bull trout at the adult salmon and steelhead brood stock collection facilities associated with the Wells AFA/HCP, including but not limited to, the Twisp weir adult collection facility. The Licensee shall capture and tag up to 10 adult, migratory bull trout (>400mm) per assessment per year and use fixed receiver stations upstream and downstream of the collection facilities. Assessments shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the evaluation demonstrates that the Licensee is not in compliance with the bull trout passage performance standard (Section 4.1 of this Prescription), then the evaluation will be replicated to confirm the results. If the results after 2 years of evaluation demonstrate that the Licensee is not in compliance with the bull trout passage performance standard (Section 4.1 of this Prescription), then the Licensee shall develop, implement, and evaluate additional measures, in
consultation with the FWS, WCC and the Aquatic SWG, until the FWS determines that the bull trout passage performance standard has been achieved. At such time as the FWS determines the bull trout passage performance standard has been achieved, the implementation of this Condition shall be integrated into the 1-year telemetry monitoring program that is to be conducted every 10 years (beginning in year 10 of the new license) at Wells Dam as identified in Section 4.6 above.”

1.5 Twisp Weir Study Deferral and Consolidation of Studies

On September 6, 2013, Douglas PUD, licensee for the Wells Hydroelectric Project, FERC No. 2149, filed an extension of time request, which was related to conducting an adult bull trout passage study at the Twisp River Weir (Twisp Weir). Specifically Douglas PUD, on behalf of the USFWS, requested that the deadline for conducting the study be postponed until year five of the license term, or, November 2017. As recommended by the USFWS, postponement would allow Douglas PUD to combine the Twisp Weir study with a bull trout passage study that is scheduled to take place at Wells Dam during year five of the license term. Consolidating both studies would provide a more comprehensive analysis of project impacts to bull trout in the upper Columbia River region, and would also require the use of fewer study fish compared to two independent studies, thereby reducing handling impacts on federally-protected bull trout.

Included in Douglas PUD’s request to the Federal Energy Regulatory Commission (FERC) was a consultation record with the USFWS and the Aquatic Settlement Work Group (Aquatic SWG) recommending the study deferral. Meeting minutes from the Aquatic SWG meeting dated July 10, 2013 indicate that all members of the work group approved the deferral. Additionally, the USFWS requested that the study be deferred by letter dated June 27, 2013 and filed with the FERC on July 22, 2013. In the same letter, the USFWS reiterated the Aquatic SWG’s concurrence with the request. This letter was also included as part of Douglas PUD’s deferral filing. FERC approved Douglas PUD’s, the Aquatic SWG’s and the USFWS’s request deferring the Twisp Weir Study to year five of the license in an Order Granting Extension of Time issued on October 15, 2015.

In addition, the USFWS and Douglas PUD coordinated with other agencies to anticipate study fish efficiencies that might be realized with the other agencies conducting bull trout projects in 2016 or 2017. WDFW, USFWS and Chelan PUD are agencies with an interest or ongoing efforts specific to bull trout monitoring. Coordination among these groups was expected to allow some minimization of impact to numbers of bull trout handled or harmed and may allow for additional cost share and a larger pool of data to assist with Douglas PUD analysis.

1.5.1 Twisp River Weir

The Twisp River Weir (Weir) is comprised of a series of hydraulically-controlled panels and two trap boxes (Figure 4A). The panels of the Twisp Weir are permanently installed and kept in the fully lowered position throughout the fall and winter. In the spring the trap boxes are installed and the pickets are raised enough to encourage upstream migrating fish to swim along the sill and through the passage notches. Once fish enter into one of the two passage notches, the fish volitionally enters a trap box.
Each year Douglas PUD installs the trap boxes around March 15th. During the spring (March 15th to mid-July) the trap is operated by Washington Department of Fish and Wildlife (WDFW) Science Division staff as part of Douglas PUD’s steelhead broodstock and spring Chinook collection activities. Operations are supervised by WDFW Methow Hatchery staff that collect spring Chinook salmon broodstock and Twisp WDFW staff that collect steelhead in the early spring. The trap boxes are usually removed in August or early September and the slide gates (trap exit doors) on the traps are removed during the interim between the end of the Chinook trapping season and the removal of the traps.

During operation/trapping fish are sampled a minimum of once daily. The Twisp Weir, however, is monitored throughout the day and adjusted, as needed, to ensure that upstream migration fish are directed to pass the weir through one of the two notched gates. They also adjust the weir in order to compensate for changing flow levels, and to allow debris passage, as needed. During trapping, the panels are raised only enough to discourage fish from swimming over the Twisp Weir and instead try to pass the weir via the trap boxes. Depending on water levels, the panels are off the river bottom but still at a negative angle in relation to the river bed. This negative angle allows fish and debris moving downstream to pass safely over the Twisp Weir. The Twisp Weir is monitored throughout the day and raised and lowered for short periods of time to pass debris at the operator’s discretion (debris loads can change quickly during spring freshets). The upstream exits of the trap boxes are protected by a temporary debris boom. The debris boom is installed and removed annually during the same days that the trap boxes are installed and removed. The Twisp Weir is considered to be operating whenever the trap boxes are in and the trap box doors are closed. No trapping or fish sampling is conducted during high flow events because conditions are not safe for personnel to enter the traps to remove captured fish (see the below photo; Figure 4B). The Twisp Weir is operated under guidelines specified in the annual Broodstock Collection Plan and the annual Monitoring and Evaluation Work Plan developed and approved by the Wells HCP Hatchery Committee (USFWS, National Marine Fisheries Service, Tribal agencies, and Douglas PUD) and the Twisp Weir Operations Plan that was developed in early 2015 (Appendix A).

Figure 4. Twisp River Weir A) during September removal, illustrating the hydraulic pickets and B) during a high flow event (not operating).
1.6 Bull Trout Encounters at the Twisp Weir

The Twisp River is an important spawning and rearing area for bull trout in the Methow Core Area. Some proportion of bull trout in the Twisp River local population use the Columbia River, the Methow River, and the lower Twisp River as forage, migration, and overwintering (FMO) areas. The upper Twisp River is considered mostly spawning and rearing (S&R) habitat. PIT tag histories suggest that adult bull trout are often repeat spawners in the Twisp but spawn frequency is poorly understood. Adults can be present in the FMO habitat both within and outside of their Core Area. Migratory bull trout are encountered at the Twisp Weir on a seasonal basis. Bull trout appear to primarily make upstream spawning migrations past the Twisp Weir during the months of June and July and numbers seem to be increasing (Figure 5). The total number of new (untagged) bull trout that were observed by WDFW staff at the Twisp Weir over the last 5 years is summarized in Figure 5.
Note: Captures are not standardized by trapping efficiency or effort precluding detailed annual comparisons. No bull trout were tagged at the Twisp Weir in 2015. Of the fish encountered in 2015 48% were tagged in 2014, 29% were tagged in 2013, 10% were tagged in 2012, 3% were tagged in 2011 and 3% were tagged in 2010.

**Figure 5.** Number of new and previously PIT tagged adult bull trout encountered at the Twisp River Weir from 2010-2015.

Bull trout observations were low in 2011 compared to recent years and is likely partly related to above average freshet flows that prevent the trap from being safely operated. Previously Passive Integrated Transponder (PIT) tagged bull trout arrive at the Twisp Weir in the months of June and July (Figure 6). Bull trout arrived at the Twisp Weir earlier in 2015 (Figure 6B) compared to 2014 (Figure 6A), which is likely due to lower flows in 2015 and warmer water temperatures. Earlier run-timing was also observed at Wells Dam in 2015 (data not shown), whereby 52% of the run arrived in the month of May and the 16-year average is 36%.
Figure 6. Arrival of previously PIT tagged bull trout at the Twisp Weir in A) 2014 and B) 2015. Bins are 5 days long with numbers above the bars representing bin count, and percent of annual run that bin represents.
2.0 GOALS, ASSUMPTIONS AND HYPOTHESES

2.1 Goals

The primary goal of the 2015 Bull Trout Study is outlined in measure 4.2.1 and 4.2.2 of the BTMP (See section 1.4 of this study plan):

Specifically, Douglas PUD aims to determine if survival and passage success rates for adult marked bull trout are greater than 95% and greater than or equal to 90%, respectively, at Wells Dam and the Twisp Weir.

2.2 Sample Size

Although section 4.2.1 and 4.2.2 of the BTMP call for N = 10 fish at the Wells Dam and the Twisp Weir, Douglas PUD, the USFWS, and the Aquatic SWG recognize the value in conducting a survival and passage study using a sufficient sample size. As such, Douglas PUD and its contractor(s) aim to tag thirty fish (N = 30) at Wells Dam and thirty fish (N = 30) at Twisp Weir. In both cases fish will be ≥450 mm. Previous studies of radio tagged bull trout above Wells Dam indicate that some fish around 450 mm might not spawn (Nelson 2015) and therefore fish over 500 mm might be targeted if available. In previous Douglas PUD bull trout studies only ten fish (N = 10) were tagged at Wells Dam in a given year and therefore it is unknown if tagging thirty (N = 30) bull trout is feasible at both sites. However, an estimate of expected sample size at Wells Dam can be developed using the following assumptions:

- Trapping will occur 5 of 7 days¹
- Trapping will occur for up to 29 days during the peak of bull trout migration
- Trapping will occur for up to 10 hours a day during peak bull trout usage
- Only one of two ladder traps will be employed at Wells Dam
- N = 73 bull trout will pass Wells Dam in 2016 (16-year average)

Using these assumptions the following table and sample size estimate can be derived (Table 1).

<table>
<thead>
<tr>
<th></th>
<th>2016 Ladder Count Estimate (N = 73; 16-yr mean +/- N= 25 stdev)</th>
<th>Ladder Favoritism (East Ladder Trapping 16-yr mean)</th>
<th>Trapping Time (Peak Passage 8-6 PM; 2015 data)</th>
<th>Trapping Days (May 20- June 30)</th>
<th>5 days a week of a 7 Day week</th>
<th># RT tagged (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Case</td>
<td>98</td>
<td>0.6</td>
<td>0.85</td>
<td>0.81</td>
<td>0.71</td>
<td>29</td>
</tr>
<tr>
<td>Worst Case</td>
<td>48</td>
<td>0.4</td>
<td>0.85</td>
<td>0.76</td>
<td>0.71</td>
<td>9</td>
</tr>
<tr>
<td>Actual est.</td>
<td>73</td>
<td>0.53</td>
<td>0.85</td>
<td>0.8</td>
<td>0.71</td>
<td>19</td>
</tr>
</tbody>
</table>

¹ HCP Coordinating Committee and NMFS approval will need to be obtained to increase or approve trapping schedule in order to meet ESA listed salmonid trapping conditions and permit requirements.
PIT tag histories of fish tagged at the Twisp Weir show that ~7% of these fish interact with Wells Dam (Douglas PUD unpublished data) and therefore tagging more fish at the Twisp Weir may allow for a better sample size at Wells Dam. Therefore, if tags go unused at Wells Dam the balance may be added to the Twisp Weir tagging effort. Given the number of adult bull trout that have been encountered at the Twisp Weir in recent years (Figure 5), it is expected that N > 30 will be met during the study.

Although not part of the scope of this study the USFWS has indicated a desire to PIT tag subadult bull trout that are encountered during trapping at Wells Dam. A small number (<10/year) of subadult bull trout have been documented using Wells Dam fish ladders each year. Given the efficiencies, Douglas PUD will work with the USFWS to determine the number of subadult fish that will be PIT tag during study fish capture in addition to any new tagged adults.

2.3 Hypotheses

Null and alternative hypotheses are as follows:

Ho: survival and passage success rates for adult marked fish are greater than 95% and greater than or equal to 90%, respectively.

Ha: survival and passage success rates for adult marked fish are less than 95% and less than 90%, respectively.

2.4 Assumptions and Treatment

We assume that handling (e.g. electro-anesthesia, surgery, netting, etc.) and moving captured bull trout downstream may have some effect on the migration behavior of radio and PIT tagged bull trout (e.g. Kelly Ringel et al. 2014). After a multi-day recovery period, tagged bull trout are assumed to be representative of the untagged population. As such, fish tagged at the Twisp Weir and Wells Dam that are transported below these facilities after tagging will only be assessed for downstream survival and passage through the Project (Wells Dam or Twisp Weir) starting after September 15, 2016 and running through September 2017 (2017; See section 3.5 below). This sampling and treatment procedure will allow for a long recovery period prior to survival and passage verification and is aimed at eliminating, to the extent practical, the impacts of handling and tagging on bull trout survival and passage success rates.

3.0 METHODOLOGY

3.1 Capture and Release Details

Fish will be captured at the Twisp Weir and Wells Dam in the months of May June and July. Tagging and fish availability will be coordinated between the contractor, Douglas PUD’s contract manager and the WDFW (weir operators), USFWS Wenatchee ES, and Mid-Columbia FRO. Historical information on fish availability will be provided to the contractor to assist in predicting tagging periods in June and July (e.g. see Figure 1 & 6). Water temperatures and total dissolved gas during trapping will be recorded daily.
After tagging, fish will be recovered and transported to a designated area downstream of the Twisp Weir and Wells Dam. The Carpenter Island Boat Launch and slightly upstream of the TWR PIT array will serve as the release locations for Wells Dam and Twisp Weir tagged fish, respectively. These sites are easily accessed. At a minimum, all receiver stations will be operating to detect and monitor fish passage from May 15, 2016 to August 30, 2017.

In June and July of 2016 the weir trap will be closed during night time hours to facilitate bull trout capture. Once target sample size is met (N = 30+) and tagging is complete, the trap will not operate during night time hours which is consistent with the normal trapping operations at the Twisp Weir and consistent with the 2015 Twisp Weir Operating Plan (See Appendix A). In the spring and summer of 2017 the Twisp Weir Operating Plan guidelines will be employed to mimic conditions that migrating bull trout would normally experience absent bull trout collection for tagging:

“...June 1 through August Operations:

a. The weir will be fished selectively during this time period to trap spring Chinook broodstock. Normally the weir will be fished daily from 6:00 AM until 9:00 PM, but overnight trapping may be used if greater trapping effort is needed to collect spring Chinook broodstock\(^2\). The weir will be attended by WDFW personnel at all times while the weir is fishing, as mandated under ESA Section 10 Permit 1196. When the weir is not fishing, the weir panels will be lowered and/or the traps will be opened to allow passage.

b. Trapping effort will be based on meeting the spring Chinook broodstock collection target of approximately 20 adult spring Chinook of natural origin with equal sex ratio (~10 males and ~10 females). In-season information derived from sampling and counts at Wells Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available.

c. Trapping will not necessarily occur every day or for 24 consecutive hours per day, dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.

d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.

e. Trapping will be suspended when the broodstock target is met. When the weir is not fishing the traps will be opened to allow passage and the weir panels will be lowered. The traps will be removed from the river in mid- to late August.

f. High flows typically occur during the spring Chinook trapping season. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered and the traps are opened for

\(^2\) PIT tag data at TWR suggest bull trout move upstream in the Twisp River during the night. During tagging in 2016 the Twisp Weir will be fished during these night time hours until sample size is reached. Once tagging is complete the Twisp Weir will be operated according to the protocols described above.
passage. During high flow episodes that prevent trapping the weir is fully passable to all species…(For Additional Detail see Appendix A)”

3.2 Tagging Procedures

Tagging procedures will follow methods described in previous bull trout radio telemetry studies conducted at Wells Dam (LGL and Douglas PUD, 2007; 2008) and will consider recent advances in knowledge and understanding of fish health and condition (e.g., Cooke et al. 2011a; b; Harnish et al. 2011; Oldenburg et al. 2011; Wagner et al. 2011). Effort will be made to minimize impacts to fish’s biological and physiological condition. Specific attention will be made to minimize incision length, possibility of infection, handling time, water temperature stressors, and air exposure. Tagging logistics will follow handling and holding procedures approved by the USFWS. Staff with experience implanting active tags will perform all surgeries. DC electro-anesthesia will be used while tagging fish.

During tagging a scale sample and small fin clip (genetic sample; see section 3.3 below) will be taken by the contractor and preserved in ethanol and furnished to Douglas PUD. Other biological observations will be made and include but limited to sex (if determination can be made), fork length, total length, and fish weight.

Tags will be purchased by Douglas PUD from Lotek Wireless (New Market, Ontario). Tags (MCFT2-3A) will have an expected tag life of 1376 days\(^3\) and a pulse rate interval (PRI) of 5 seconds. Tag burden estimates are provided in Table 2 and are considered reasonable based on other tag studies (Brown et al., 2006). In addition, each fish will be given a 12 mm RFID PIT tag. Radio tags will be outfitted with a motion or mortality sensor whereby receivers will be able to determine if the study fish is still active and/or alive.

<table>
<thead>
<tr>
<th>Fish TL (mm)</th>
<th>Fish Mass (g)*</th>
<th>Combined Pit Tag + RT Tag Mass (g)</th>
<th>Tag burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>846.1</td>
<td>16.1</td>
<td>1.9%</td>
</tr>
<tr>
<td>500</td>
<td>1159.4</td>
<td>16.1</td>
<td>1.4%</td>
</tr>
<tr>
<td>550</td>
<td>1541.7</td>
<td>16.1</td>
<td>1.0%</td>
</tr>
<tr>
<td>600</td>
<td>1999.8</td>
<td>16.1</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

* As determined from wild Walla Walla River bull trout length weight curves; where mass (g) = \(9.87 \times 10^{-6} \times (TL)^{2.99}\) (Budy et al. 2007).

\(^3\) A longer tag life will allow for a subsequent study to be conducted if standards are not achieved and allow for other researchers in the basin to make use of the study fish if they so choose in years 2-3. PIT tag will be followed indefinitely by Douglas PUD staff.
3.3 Genetics

Study Fish
Douglas PUD will provide genetic samples to the USFWS Abernathy, WA office for genotyping. All N = 60 samples will be analyzed using similar methods as described in DeHaan et al. (2014) and will be similarly analyzed and compared against baseline local population genotypes determined in DeHaan and Neibauer (2012). Fish will be assigned back to sub-basin and local population and confidence in assignment will be reported on a probability scale of 0-1. Genetic samples should allow Douglas PUD to determine if fish intended to pass upstream of the Project location, especially if fish are over 500 mm (Nelson 2015).

Previous Samples
Douglas PUD will work together with the USFWS to identify obligations for funding the analysis of previous bull trout genetic samples (E.g. N=30 taken from bull trout sampled and tagged at Wells Dam during previous radio telemetry studies in the Mid-2000s). Previous samples and current samples will be analyzed by a qualified laboratory (e.g. the WDFW Genetic Lab, the USFWS Abernathy Genetics Lab, or other qualified laboratory).

3.4 Monitoring

Monitoring will involve fixed station radio telemetry receivers (herein referred to as “stations”) and existing basin wide PIT tag arrays. Stations will be similar to previous radio telemetry studies at Wells Dam, but will focus on the forebay and entrance locations at Wells Dam, since these receivers will serve as virtual release locations. Table 3 provides a summary of receiver locations and green cells indicate those that will be used when counting study fish (virtual release fish).

Radio-Tag Tracking
Private small aircraft tracking activities will occur in weekly, bimonthly or monthly depending on movements observed in August, September, October and November, or when needed to identify the fate of tags or tagged fish. Mobile tracking will be conducted as field verification and when necessary and will focus on locating “lost fish”, which as necessary will include boat tracking above and below Wells Dam and in tributary tracking. Tracking will occur by foot and boat as needed.

PIT Tag Monitoring:
In addition, Douglas PUD will summarize PIT tag behaviors of bull trout tagged during the study using existing basin wide PIT arrays, including but not limited to those featured in Figure 7. Douglas PUD will also examine tag histories of existing PIT tagged fish at Wells Dam and other interrogation locations and compared study fish to PIT histories of fish tagged prior to 2016.
Table 3. Fixed Station Receiver Locations at Wells Dam and in the Twisp River.

<table>
<thead>
<tr>
<th>SRX (Receiver) #</th>
<th>Antenna #</th>
<th>Location Description</th>
<th>Antenna Type</th>
<th>Virtual Release Fish?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>Gateway Below Wells (3 Mi Downstream)</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>Wells Hatchery Outfall</td>
<td>Coax</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wells Lower Fishway - Left</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>WLF Left Entrance Inside</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>WLF Left Weir 1</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>WLF Left Weir 7</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wells Upper Fishway - Left</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>WUF Left Above Trap</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>WUF Left Above Count</td>
<td>Coax</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>C</td>
<td>WUF Left Exit</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td>Wells Left Tailrace</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wells Lower Fishway - Right</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>A</td>
<td>WLF Right Entrance Inside</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>WLF Right Weir 1</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>WLF Right Weir 7</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wells Upper Fishway - Right</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>A</td>
<td>WUF Right Above Trap</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>B</td>
<td>WUF Right Above Count</td>
<td>Coax</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>C</td>
<td>WUF Right Exit</td>
<td>Fixed Dipole</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>A</td>
<td>Wells Right Tailrace</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td>9</td>
<td>A</td>
<td>Wells Forebay (Various along deck)</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>B</td>
<td>U 1&amp;2</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>C</td>
<td>U 3&amp;4</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>D</td>
<td>U 5&amp;6</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>E</td>
<td>U 7&amp;8</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>U9&amp;10</td>
<td>Aerial</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>A</td>
<td>Methow Aerial (Columbia confluence)</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>A</td>
<td>Okanogan Aerial (Columbia confluence)</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>A</td>
<td>Twisp Aerial (Methow Confluence- below release)</td>
<td>Aerial</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Twisp Weir</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>A</td>
<td>Below</td>
<td>Aerial Directional</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>B</td>
<td>At</td>
<td>Aerial Directional</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>C</td>
<td>Above Weir</td>
<td>Aerial Directional</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>A</td>
<td>Twisp Above Weir (~5 miles)</td>
<td>Aerial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Tagging/Release/Mobile</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>Wells</td>
<td>Hand</td>
<td>NA</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>Twisp Weir</td>
<td>Hand</td>
<td>NA</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>Flights</td>
<td>Hand</td>
<td>NA</td>
</tr>
</tbody>
</table>
Although tagging will take place in year one only, fixed station radio telemetry will be conducted over two seasons (15 month target). Stations will be maintained and operable immediately following the release of the first tagged fish (no later than May 15, 2015). The months of June through October, in both years will be considered the key monitoring period since bull trout pass the Twisp Weir primarily during these months. Study fish carrying PIT tags will be tracked for the remainder of the life on an annual basis with these results being provided in the annual BTMP report and Incidental Take Report filed in May and April of each year respectively.
3.5 Statistical Analyses and Reporting

The emphasis of the analyses will be made on passage criteria as outlined in the goals and hypotheses of this study plan. In order to determine passage and survival statistics virtual releases will be used, whereby only fish detected on stations immediately above and below the Twisp Weir or Wells Dam will be used as sample fish that contribute to denominators (see equations below). Fish may pass the upstream of facility locations more than once in a given monitoring period and as such may be used as two data points (i.e. passage, fallback and passage).

Passage_{Weir} = \frac{\text{Number of unique fish observed at the weir [fall 2016 to summer 2017] – Number of unique fish that failed to pass the weir [fall 2016 to summer 2017]}}{\text{Total number of unique fish observed at the weir [fall 2016 to summer 2017]}}.

Passage_{Wells} = \frac{\text{Number of unique fish observed at the fish ladder entrance at Wells Dam [fall 2016 to summer 2017] – Number of unique fish that failed to pass the dam after being observed inside ladder entrance [fall 2016 to summer 2017]}}{\text{Number of unique fish observed at the fish ladder entrance at Wells Dam [fall 2016 to summer 2017]}}.

Survival_{Weir} = \frac{\text{Number of unique fish alive at the weir [fall 2016 to summer 2017] – Number of unique fish dead at the weir [fall 2016 to summer 2017]}}{\text{Number of unique fish alive at the weir [fall 2016 to summer 2017]}}.

Survival_{Wells} = \frac{\text{Number of unique fish alive at Wells Dam [fall 2016 to summer 2017] – Number of unique fish dead at Wells Dam [fall 2016 to summer 2017]}}{\text{Number of unique fish alive at Wells Dam [fall 2016 to summer 2017]}}.

Whereby passage and survival statistics will be calculated as follows:

- A fish that is detected inside the fishway entrance at Wells Dam or is detected immediately below the weir in the summer of 2017 but is subsequently detected alive downstream of each structure will be considered a passage failure in the applicable passage equation above. The same assumption will be made for downstream movements in the fall of 2016 using immediately upstream arrays.
- A fish that is observed dead or whose tags is detected as being a dead tag 48 hours after passage and in the immediately vicinity of the Project following an up- or downstream passage event, at either facility, will be considered a mortality and be subtracted from the numerator or total number of unique fish observed at the applicable structure.
- In the fall of 2017 total post September 15, 2016 (or fall cutoff) total approaches will be summed, and total post September 15, 2016 failures will be summed to determine the passage statistic for both structures.
- Fish that are genetically assigned to a local population or sub-basin that is located downstream of the Project will be removed from passage statistics analyses if the fish does not safely pass a Project facility (e.g., a fish is tagged at Wells Dam and is assigned
to the Mad River in the Entiat Basin). The fish that is genetically typed as a non-Methow origin fish that enters the Wells Dam fish ladders but never passes the Dam and instead moves downstream will not be counted as a failed passage event). Fish that are typed downstream of the Project area but fail to pass will be reported independently.

- If a fish is clearly missed as a “virtual release” fish, Douglas PUD will include these missed fish in analyses (e.g., fish was last detected at the mouth of the Methow River and is subsequently detected in the Wells Tailrace; missed on the forebay array).
- Fall downstream passage at Wells Dam in some cases may be removed from analyses since bull trout are not required to overwinter below Wells Dam and may simply overwinter in the Wells Dam forebay/pool. However, overwintering locations and all behavior will be reported in the final report for committee review.

3.5.1 Wells Dam Example Statistical Analyses

Table 4 is provided to consider an example scenario of tagging at Wells Dam in 2016. The yellow cells indicate a tagging and handling effects period where fish are considered to be recovering from the handling procedure. Light green cells indicate the first treatment group where Douglas PUD and contractors are monitoring downstream movement and approach as the Wells Dam. Dark green cells are aimed at summarizing upstream movements in tagged fish during the year subsequent to tagging. Table 5 shows the summation from Table 4 and the resulting passage and survival statistics.

Table 4. Example Tagging and Passage Results at Wells Dam.

<table>
<thead>
<tr>
<th>Tagging and Handling Effects</th>
<th>Downstream Treatment 2016/2017 (Fall/Winter/Spring)</th>
<th>Upstream Treatment 2017 (Spring/Summer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tagged @ Wells</td>
<td>Released Below Wells</td>
<td>Arrive Back at Wells (10 d later)</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Tagged @ Twisp Weir</td>
<td>Released Below Twisp</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Example Summation and Calculated Survival/Passage Statistics Using Example Data from Table 3.

<table>
<thead>
<tr>
<th>Totals</th>
<th>Sum</th>
<th>Total</th>
<th>Statistic</th>
<th>Goal</th>
<th>Standards Achieved?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Release (Arrival)</td>
<td>20+16</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If standards are achieved by September 2017 Douglas PUD will discontinue dedicated telemetry tracking and instead will focus on tracking PIT tags of study fish. In addition, vehicle and ground mobile tracking will continue for the life of the radio tags. Tag frequencies will also be provided to regional fish managers and researchers.

3.5.2 Effect of Small Virtual Release Sample Size

Given the small sample size expected in the study only one fish can be killed at a Project facility provided virtual release totals are at or above N=20. If virtual release sample size is <20 no fish may be killed in order to meet standards. The following sample size and standards tolerance table illustrates this survival and sample size relationship (Table 6). Red cells in Table 6 would indicate standard not achieved and green cells indicate standards achieved.

### Table 6. Relationship Between Sample Size and Mortality Towards Meeting Survival Standards.

<table>
<thead>
<tr>
<th>Survival Tolerance</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Survival Tolerance Continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>N</td>
<td>Survival</td>
<td>Mortality</td>
<td>N</td>
<td>Survival</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>90.00%</td>
<td>2</td>
<td>27</td>
<td>92.59%</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>90.91%</td>
<td>2</td>
<td>28</td>
<td>92.86%</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>91.67%</td>
<td>2</td>
<td>29</td>
<td>93.10%</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>92.31%</td>
<td>2</td>
<td>30</td>
<td>93.33%</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td>92.86%</td>
<td>2</td>
<td>31</td>
<td>93.55%</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>93.33%</td>
<td>2</td>
<td>32</td>
<td>93.75%</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>93.75%</td>
<td>2</td>
<td>33</td>
<td>93.94%</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>94.12%</td>
<td>2</td>
<td>34</td>
<td>94.12%</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>94.44%</td>
<td>2</td>
<td>35</td>
<td>94.29%</td>
</tr>
<tr>
<td>1</td>
<td>19</td>
<td>94.74%</td>
<td>2</td>
<td>36</td>
<td>94.44%</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>95.00%</td>
<td>2</td>
<td>37</td>
<td>94.59%</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
<td>95.24%</td>
<td>2</td>
<td>38</td>
<td>94.74%</td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>95.45%</td>
<td>2</td>
<td>39</td>
<td>94.87%</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>95.65%</td>
<td>2</td>
<td>40</td>
<td>95.00%</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>95.83%</td>
<td>2</td>
<td>41</td>
<td>95.12%</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>96.00%</td>
<td>2</td>
<td>42</td>
<td>95.24%</td>
</tr>
<tr>
<td>1</td>
<td>26</td>
<td>96.15%</td>
<td>2</td>
<td>43</td>
<td>95.35%</td>
</tr>
</tbody>
</table>

3.5.3 Standards Not Achieved

If standards are not achieved the study may continue into 2017/2018 as permitted by section 4.2.1 and section 4.2.1:
“If negative impacts to passage associated with Off-Project collection facilities are observed or the authorized incidental take level is exceeded during any one-year period, Douglas will conduct another monitoring study in the succeeding year. If negative impacts to passage continue to be observed or the authorized incidental take level is exceeded in this second year, Douglas will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to passage impacts or the exceedance of the allowable level of incidental take.”

4.0 REPORTING

Reporting will be a collaborative effort between the contractor and the Douglas PUD contract manager. The contractor will provide a draft report including an introduction, methods, results/statistical analyses, and discussion or conclusion sections by Sept 30, 2017. The draft report will be made available to the Douglas PUD’s contract manager and will be furnished to the Aquatic SWG for comment before finalizing the document. The report will be appended to the 2017 Bull Trout Incidental Take Report due to the USFWS April 15 2018 (per BIOP requirements) and will also be filed and appended to the 2017 Bull Trout Management Plan Annual Report filed with the FERC on or before May 31, 2018.

If passage and survival metrics are not met, Douglas PUD will work with the Aquatic SWG to repeat and conduct a second year of the study with any recommended adaptive modifications to the study. If following a second year of study metrics are not met Douglas PUD will refer to the Fishway Prescriptions and BTMP to identify improvements to address effects to bull trout.

See Table 7 for a more comprehensive timeline.
Table 7. Estimated Timeline for Study Development, Implementation and Reporting.

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Study Plan development</td>
<td>December 2015/January 2016</td>
</tr>
<tr>
<td>2</td>
<td>Study Plan review by ASWG</td>
<td>Second week of January 2016</td>
</tr>
<tr>
<td>3</td>
<td>Study Plan finalized</td>
<td>February 10th, 2016</td>
</tr>
<tr>
<td>4</td>
<td>Contractors/Scope of Work and budget request</td>
<td>Late February 2016</td>
</tr>
<tr>
<td>5</td>
<td>HCP CC trapping consultation</td>
<td>Late February 2016</td>
</tr>
<tr>
<td>6</td>
<td>Order tags</td>
<td>March 1st, 2016</td>
</tr>
<tr>
<td>7</td>
<td>Scope or Work and budget deadline</td>
<td>March 15th 2016</td>
</tr>
<tr>
<td>8</td>
<td>Internal review and recommendation</td>
<td>Late March 2016</td>
</tr>
<tr>
<td>9</td>
<td>Professional Services Agreement development</td>
<td>Late March/Early April 2016</td>
</tr>
<tr>
<td>10</td>
<td>Professional Services Agreement signed by contractor</td>
<td>Middle/late April 2016</td>
</tr>
<tr>
<td>11</td>
<td>Notice to Proceed delivered to contractor</td>
<td>Late April 2016</td>
</tr>
<tr>
<td>12</td>
<td>Receiver install and tagging</td>
<td>May/June/July 2016</td>
</tr>
<tr>
<td>13</td>
<td>Monitoring</td>
<td>June 2016-August 31 2017</td>
</tr>
<tr>
<td>14</td>
<td>Draft Interim due to District</td>
<td>January 1st, 2017</td>
</tr>
<tr>
<td>15</td>
<td>Draft report due to Aquatic SWG</td>
<td>September 2017</td>
</tr>
<tr>
<td>16</td>
<td>Aquatic SWG approval of Report and standards met(^4)</td>
<td>October 2017</td>
</tr>
<tr>
<td>17</td>
<td>File Final Report with Incidental Take Report</td>
<td>April 15, 2018</td>
</tr>
</tbody>
</table>

\(^4\) If standards are not met in the study Douglas PUD will work with the Aquatic SWG to revise (if necessary) the study and implement a second year of study towards meeting achievements. If standards are not met following the second study Douglas PUD will implement Section 18 Fishway Prescriptions and the BTMP to identify items to address effect to bull trout passage and survival.
REFERENCES


Twisp Weir Trapping Operations Plan

Douglas PUD

May 2015

Prepared by:

Douglas County Public Utility District

and the Washington Department of Fish and Wildlife
Background:

On November 9, 2012 the Federal Energy Regulatory Commission (FERC) issued a new Operating License (license) for the Wells Hydroelectric Project. This 40-year license is retroactive to Nov 1, 2012 and contains a host of fisheries and aquatic resource requirements that Douglas County Public Utility District (Douglas PUD) must meet during the course of the license including being subject to:

(E) the conditions submitted by the Secretary of the U.S. Department of Commerce under section 18 of the Federal Power Act (FPA).
(F) the conditions submitted by the Secretary of the U.S. Department of the Interior under section 18 of the FPA.
(G) the incidental take terms and conditions of the biological opinion submitted by the National Marine Fisheries Service on March 7, 2012, under section 7 of the Endangered Species Act.
(H) the incidental take terms and conditions of the biological opinion submitted by the U.S. Fish and Wildlife Service on March 19, 2012, under section 7 of the Endangered Species Act.

These various biological opinions and terms and conditions found in the above regulatory guidelines redundantly require the implementation of the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP). Within the HCP is a requirement to achieve no net impact (NNI) for spring Chinook, summer/fall Chinook, sockeye, Coho and summer steelhead (Plan Species) through habitat and hatchery actions to address unavoidable loss of said Plan Species through the operation of Wells. These Hatchery actions require collection of adult broodstock for steelhead and spring Chinook from various locations, including the Twisp Weir; Monitoring and Evaluation of the hatchery programs including evaluation of returning adult salmon and steelhead; removal of hatchery origin fish (i.e., “adult management”) to control the proportion of hatchery spawners in the wild relative to wild spawners. The HCP Hatchery Committee, comprising signatories to the HCP, includes the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Reservation, Yakima Nation, and Douglas PUD.

The Twisp Weir is located in the Twisp River, a tributary of the Methow River. The panels of the weir are operated hydraulically to allow the weir to be set so downstream-moving fish can descend over the weir while upstream-moving fish are diverted into either of two traps, one located on the river-left bank and the other approximately ten feet to the center of the channel from the left bank. The current weir has been operated since March of 2008.

WDFW is currently contracted by Douglas PUD, under the HCP hatchery operations and monitoring and evaluation program, to operate the weir and has done so since the weir went into operation in 2008.

Potential bull trout encounter

Bull Trout were listed as threatened in 1998. The history of their Federal listing can be found in Appendix 1.
Following the issuance of the United States Fish and Wildlife Service’s 2012 Biological Opinion for bull trout found within the Wells Project Area, Douglas PUD was issued a not to exceed, non-lethal, and annual take of $N = 118$ adult bull trout at the Twisp River Weir. From 2010 – 2012, less than 100 adult bull trout were captured in each year. However, bull trout encounters have increased since 2011 and in the 2014 trapping season $N = 135$ unmarked adult bull trout were incidentally captured. In the same year, an additional $N = 80$ previously PIT tagged adult bull trout were incidentally encountered. Collectively in 2014, $N = 215$ adult bull trout were captured at the Twisp Weir (Figure 1). All incidentally encountered bull trout have been PIT tagged as described in Douglas PUD’s Bull Trout Stranding Entrapment and Take Study Plan. 2014 was the first year that the $N = 118$ take non-lethal threshold was exceeded. Bull trout encounters at the Twisp River Weir have generally tracked closely to the number of bull trout annually counted passing over Wells Dam. Large counts of bull trout at Wells Dam generally resulting in large counts at the Twisp Weir. The number of bull trout encountered at the Weir has increased year over year from 2010, with a low of $N = 26$ in 2011 and a peak of $N = 215$ in 2014 (Figure 1). The observed increasing trend may signify an increase in the number of bull trout in the Twisp River and be the result of strong adult spawning and juvenile escapement from 2009-2010 year classes (Figure 1). However, trap efficiency and effort, and the relatively short time period of the observation are sources of uncertainty in interpreting the data (Table 1). For example, high flows in 2011 prevented weir trap operation during the peak of the adult bull trout spawning migration and, as such, encountering $N = 26$ adult bull trout that year is probably more indicative of reduced trapping effort as opposed to true abundance. PIT tag detections beginning in 2010 suggest that most bull trout that are handled, tagged, and released at the Weir leave the Twisp River in late September and October during a post-spawn migration as bull trout seek post-spawn forage and overwintering habitat. These detections suggest that bull trout handled at the Weir not only survived the handling process but completed spawning events following release from the Weir. In addition, PIT tag data suggest that the majority of fish return in subsequent years to spawn again, often within a week of the previous year. Bull trout encounters with the Twisp River peak between June 9 and July 23 historically (Figure 2). Specifically, over 97% of incidental encounters at the Weir occur during this period, and no bull trout have been encountered before June 5 or after August 13 (Figure 2). The peak period for Spring Chinook migration into the Twisp River and trapping to collect broodstock at the Weir also occur during the of the peak bull trout migration. However, incidental captures of bull trout provide an opportunity to collect vital information on bull trout population status, survival, repeat spawning propensity, life history and growth information: all areas where little to no information exists for the species in the Methow Basin.

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5 Historically, the Twisp Weir is not operated in August since both Spring Chinook and Steelhead trapping are completed by then.
Figure 1. Number of adult bull trout PIT tagged and recaptured at the Twisp Weir (left axis) over the last five years over the last ten years.

Figure 2. Proportion of adult bull trout captured at the Twisp Weir during the spawning migration in the Twisp River. The shaded area illustrates that over 97% of the adult bull trout that have been encountered at the Twisp Weir since 2010 were captured between June 9 and July 23.
Purpose

The purpose of this plan is to describe a new operations plan for the Twisp Weir that will simultaneously meet the HCP Plan Species spring Chinook and summer steelhead program requirements, including broodstock collection, monitoring and evaluation activities, and adult management activities, while minimizing the exposure of bull trout to incidental capture and handling and maintaining incidental take of bull trout within previously authorized take limits.

Twisp River Weir

For 2015, WDFW and the District propose the following plan:

2) General Weir Operating Parameters:
   a. Weir fished from ice out in late February/early March through mid-August.
   b. Steelhead trapping occurs from late February/early March through June 1.
   c. Spring Chinook Trapping occurs from June 1 until brood stock and adult management targets are achieved (usually mid-August).
   d. The height of the weir panels is hydraulically controlled and panels are set at the water surface level when the weir is fishing to allow downstream migrating steelhead, spring Chinook and bull trout to safely and effectively pass the weir.
   e. Weir is tended by WDFW personnel whenever the trap is operated. WDFW is contracted by Douglas PUD under the HCP Monitoring and Evaluation Plan and HCP hatchery operations and maintenance to monitor the trap.
   f. Operation of the weir under ESA is currently authorized by Section 10 Permits 1196 and 1395 (permits extended by NMFS on September 20, 2013).
   g. Real-time monitoring and trap operations: Throughout all trapping activities described in this plan, PIT tag interrogation locations WEL and WEA (Wells Dam), LMR (Lower Methow River) and TWR (Twisp River) will be monitored by WDFW and DCPUD staff for detections of previously PIT tagged steelhead, spring Chinook, and bull trout. Detections at Wells Dam are nearly 100% efficient. However, detections at LMR and TWR during the higher flows, particularly when spring Chinook and bull trout are migrating, may be less than 20% efficient (comparing fall downstream movements to upstream movements). Data will be examined on a yearly basis to determine if there are peak periods when bull trout are most likely to pass the weir.
   h. When the weir is not fishing, the weir panels will be lowered to the stream bottom, or the traps will be opened to passage, or both. If only the weir panels are lowered the entrances to the traps will be closed.
   i. Limitation in staffing or other unforeseen problems: If WDFW staff are not available to staff the trapping facility (according to this plan) for any reason, or the trap will not be checked within 24 hours, then full passage will be allowed by lowering the weir panels or opening the traps or both, dependent on flow conditions until staff are able to return.
   j. Unforeseen scenarios and in-season observations: If during the trapping period, observations from field staff warrant reconsideration of any part of the plan as described above, WDFW and the District will alert the National Marine Fisheries.
Service, HCP Hatchery Committee, and/or the USFWS, as appropriate, and work cooperatively with these parties to minimize incidental take or otherwise ensure that take is maintained at the manner and extent previously approved by the USFWS.

k. Trapping effort monitoring: Trapping effort in the form of daily trap operation time will be recorded by WDFW operators. Trapping effort will be used in subsequent years to refine this plan.

l. Nocturnal vs diurnal use: Species composition during trapping hours will be recorded to document times of day when various species are trapped.

m. Trapping will be suspended prior to exceeding the take limits specified by USFWS for bull trout and by NMFS for summer steelhead and spring Chinook.

n. Broodstock collection target numbers are established annually prior to trapping based on predicted age composition, fecundity, and survival of broodstock and rearing in-hatchery.

o. This Plan does not limit other ESA Permit (1395 and 1196, Wells Bull Trout Biological Opinion) conditions that also apply under this plan.

3) Late February/Early March through June 1 Operations:

a. Weir begins fishing in late February or early March as environmental conditions allow.

b. The weir will be fished constantly during this time to trap steelhead, as conditions allow. The weir will be tended by WDFW personnel at least once daily, but twice daily or more when fish are present. An attempt will be made to capture all adult steelhead during this time period:

i. Steelhead are trapped during this period for Twisp River broodstock collection for the Douglas PUD Twisp Steelhead Conservation Program (N=26).

ii. Steelhead are trapped for population census data collection and for a relative reproductive success study of hatchery and wild steelhead required of Douglas PUD under the Wells HCP.

iii. Steelhead are trapped to control the relative abundance of hatchery and wild steelhead adults upstream of Twisp Weir. Currently the wild to hatchery ratio is 1:1 under the relative reproductive success study. Steelhead removed via adult management may be used as broodstock for other Douglas PUD and WNFH programs.

c. Bull trout have not been observed or trapped at the Twisp Weir prior to June 5th.

d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.

e. High flows that may occur during the steelhead trapping season can significantly limit the efficiency of the weir or prevent fishing the weir. In these cases, the weir panels are lowered or over-topped by the water and the traps are opened for passage. During such flow episodes that prevent trapping, the weir and trap boxes are fully passable to all species.
4) **June 1 through August Operations:**
   a. The weir will be fished selectively during this time period to trap spring Chinook broodstock. Normally the weir will be fished daily from 6:00 AM until 9:00 PM, but overnight trapping may be used if greater trapping effort is needed to collect spring Chinook broodstock. The weir will be attended by WDFW personnel at all times while the weir is fishing, as mandated under ESA Section 10 Permit 1196. When the weir is not fishing, the weir panels will be lowered and/or the traps will be opened to allow passage.
   b. Trapping effort will be based on meeting the spring Chinook broodstock collection target of approximately 20 adult spring Chinook of natural origin with equal sex ratio (~10 males and ~10 females). In-season information derived from sampling and counts at Wells Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available.
   c. Trapping will not necessarily occur every day or for 24 consecutive hours per day, dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.
   d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.
   e. Trapping will be suspended when the broodstock target is met. When the weir is not fishing the traps will be opened to allow passage and the weir panels will be lowered. The traps will be removed from the river in mid- to late August.
   f. High flows typically occur during the spring Chinook trapping season. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered and the traps are opened for passage. During high flow episodes that prevent trapping the weir is fully passable to all species.

**Expected Performance:**

1) **Late February/Early March through June 1 Operations:**
   a. Wild steelhead broodstock collected for the Twisp Steelhead Conservation Program.
   b. No more than 33% of the wild steelhead run collected for broodstock.
   c. Census sampling of all steelhead for the steelhead relative reproductive success study.
   d. Steelhead spawning escapement upstream of weir managed for pHOS ~ 0.5.
   e. Surplus hatchery steelhead removed for broodstock or adult management.
   f. No bull trout are expected to be encountered.
   g. Trap operated continuously as environmental conditions allow.
   h. Trapping operations will be halted prior to exceeding ESA take levels for any ESA listed species. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) trapped and handled in the entire annual Twisp Weir trapping season (late February – mid-August). No lethal take is expected.
2) **June 1 through August Operations**: 

   a. Wild spring Chinook collected for broodstock for the Twisp Spring Chinook Conservation program (N≈20).
   
   b. No more than 33% of the wild spring Chinook run collected for broodstock.
   
   c. Expected escapement of spring Chinook with no handling is 35% via fish moving past the weir during non-fishing periods.
   
   d. Expected escapement of bull trout with no handling at least 40% via fish moving past the weir during non-fishing periods.
   
   e. All fish removed from the traps within 1 hour.
   
   f. Trapping operations will be halted prior to exceeding ESA take levels for any ESA listed species. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) trapped and handled in the entire annual Twisp Weir trapping season (late February – mid-August). No lethal take is expected.

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6 This plan is intended to be consistent with pHOS management requirements. In the future the Twisp Weir may be used to manage the number of hatchery Chinook spawners that access the Twisp in accordance with NMFS permitting requirements and HCP obligations.
Bull Trout Handling Protocol

Bull trout captured will not be PIT tagged unless otherwise approved by the USFWS. Bull trout will be allowed to pass volitionally out of the trap when operators open the top end trap slide gate.

Reporting and Annual Review

Bull Trout reporting will be carried out through the development of an annual Incidental Take Report furnished to the Service by April 15 of every year. In season updates will be provided. Dead bull trout will be reported immediately. When possible the carcass will be recovered and furnished to the United States Fish and Wildlife Service.

Douglas PUD will meet annually with the USFWS to discuss previous year’s operations and the upcoming year.
Appendix 1

**Bull Trout Listing Status**

On June 10, 1998, the USFWS listed bull trout within the Columbia River Basin as threatened under the ESA (FR 63(111)). Later (November 1, 1999), the USFWS listed bull trout within the coterminous United States as threatened under the ESA (FR 64(210)). The USFWS identified habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, and grazing; blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species as major factors affecting the distribution and abundance of bull trout. They noted that dams (and natural barriers) have isolated population segments resulting in a loss of genetic exchange among these segments (FR 63(111)). The USFWS believes many populations are now isolated and disjunct. In October 2002, the USFWS completed the first draft of a bull trout recovery plan intended to provide information and guidance that will lead to recovery of the species, including its habitat (USFWS 2002). Threatened bull trout population segments are widely distributed over a large area and because population segments were subject to listing at different times, the USFWS adopted a two-tiered approach to develop the draft recovery plan for bull trout (USFWS 2002). In November 2002, the USFWS published in the federal register a proposed rule for the designation of critical habitat for the Klamath River and Columbia River distinct population segments of bull trout (67 FR 71235). In October 2004 the USFWS published a final rule in the Federal Register designating critical habitat for the Klamath River and Columbia River populations of bull trout (69 FR 59995).

In April 2008, the USFWS completed the 5-year status review for Columbia River bull trout with two recommendations: maintain “threatened” status for the species, and determine if multiple distinct population segments exist within the Columbia River and merit protection under the ESA. The recommendations intend to facilitate analysis of project effects over more specific and biologically appropriate areas, ultimately allowing a greater focus of regulatory protection and recovery resources (USFWS 2008a). The review also identified specific issues that limit the overall ability to accurately and quantitatively evaluate the current status of bull trout. Seven recommendations were made to improve future evaluation and management decisions, all of which are largely based on improvement and standardization of monitoring and evaluation techniques, better delineation and agreement of core areas and Recovery Units, and multi-agency cooperation and management (USFWS 2008b).

The USFWS published a Revised Draft Recovery Plan for Bull Trout on Sept. 4, 2014. The Revised Draft updated the recovery criteria proposed in the 2002 and 2004 draft recovery plans to focus on effective management of threats to bull trout, and de-emphasizes achieving targeted population numbers in specific areas. The USFWS intends to publish a Final Recovery Plan by Sept. 30, 2015. The Final Bull Trout Recovery Plan will include individual Recovery Unit Implementation Plans (RUIP) for each recovery unit. RUIPs will be developed through collaboration of interested and knowledgeable federal, tribal, state, private, and other parties prior to completion of the final Recovery Plan (USFWS 2014).
Per the Revised Draft Recovery Plan, the Wells Project is situated within the Mid-Columbia River Recovery Unit. Within this recovery unit, the USFWS has identified 25 occupied core areas in four geographic regions. The Wells Project is situated within the Upper Mid-Columbia geographic region and relevant core areas include the Wenatchee, Entiat and Methow rivers. A core area represents the closest approximation of a biologically functioning unit for bull trout. A core area functions as a metapopulation for bull trout. Not all core areas are equal and each has specific functions that are unique. For example, the Entiat River Core Area depends heavily on the mainstem Columbia River to provide overwinter, migration, and forage habitats. The Wenatchee River Core Area has populations using lake and riverine (both the Wenatchee and Columbia rivers) habitat for overwintering, migration, and foraging. Within a core area, many local populations may exist. A local population is assumed to be the smallest group of fish that is known to represent an interacting reproductive unit. Nineteen local populations have been identified in the Wenatchee (7), Entiat (2) and Methow (10) core areas (USFWS 2014).
Appendix 2

Data Analysis

Various sets of data have been examined in order to develop the Weir Operations Plan towards limiting the number of ESA listed fish handled. They are summarized in short sections below.

**Justification for different weir operating criteria for steelhead and spring Chinook**

Steelhead trapping at the Twisp Weir begins in March and ends May 31 each year. Spring Chinook trapping at the Twisp Weir begins June 1 each year. Since 2010 June 5th has been the earliest bull trout arrival date at the Twisp Weir. For example, in 2014, bull trout arrived at the Twisp Weir between June 7 and July 22 (Figure 3). Together, results suggest the bull trout arrived at the Weir exclusively during the Spring Chinook trapping period.

![Bull trout arrival at the TWR PIT-tag-detection array in 2014.](image)

**Justification for opening the trap boxes at night during spring Chinook brood collection efforts**

N = 72 detections occurred at TWR PIT antenna location from March 23 to August 23 2014 (generally upstream spawning movements). Results show that 91% of the movements occurred between 9:00 pm and 6:00 am (Figure 4). Similarly, N = 131 post spawning and downstream detections occurred at TWR PIT antenna location from September 1 to November 15, 2014. Results show that more than 97% of the downstream movements occurred between 6:00 pm and 6:00 am (Figure 5). As such, both upstream and downstream movements near the weir appear to occur almost exclusively at night. Since spring Chinook trapping is proposed to occur predominately during daytime hours and data suggest that bull trout move during nighttime hours, the proportion of bull trout expected to be captured should be under 40% of the run.
Figure 4. Frequency distribution for the hour of the day (x-axis) that upstream detection of bull trout at TWR occurred in the spring and summer of 2014, where the number above each bar is the proportion of total detections.

Figure 5. Frequency distribution for the hour of the day (x-axis) that downstream detections of bull trout occurred at TWR in the fall of 2014, where the numbers above each bar are proportion of total detections (left) and sample size per bin (right).
Justification for daytime Spring Chinook Trapping

Forty-two percent of spring Chinook detections occurring at TWR over the years 2009-2014 occurred during the hours of 6 am - 9 pm (Figure 6; n = 245). The remaining 58% of the run moved upstream in the Twisp during nighttime hours. As such, fishing the weir from 6-9pm should provide adequate opportunity for collecting necessary broodstock while minimizing collection to ≤ 33% of the natural-origin returns to the Twisp River.

Figure 6. Hour of the day frequency distribution of Spring Chinook tagged at Wells Dam and arriving at the TWR PIT tag array in 2014. The number above each bar is the proportion of total detections.
**Justification for Removing Twisp Weir in late August**

PIT tag data suggests that adult bull trout leave the Twisp post spawn predominately in the month of October (72% in 2014; Figure 7) with some downstream detections occurring in late September and early November. No downstream movements have been observed at TWR PIT array in the month of December, January or February. As such, dropping the weir panels to the stream bottom and removing the two trap boxes in August should protect downstream moving bull trout. The weir is designed and operated to allow downstream passage when fishing and not fishing.

![Figure 7. Distribution of downstream detections of bull trout at TWR in 2014, where the left bar represents the month of September (20%), the middle the month of October (72%), and the right the month of November (8%).](image)

**Figure 7.** Distribution of downstream detections of bull trout at TWR in 2014, where the left bar represents the month of September (20%), the middle the month of October (72%), and the right the month of November (8%).
APPENDIX I
TOTAL DISSOLVED GAS ABATEMENT
PLAN 2015 ANNUAL REPORT
Wells Hydroelectric Project
Total Dissolved Gas Abatement Plan

2015 Annual Report

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4331

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TABLE OF CONTENTS

1 INTRODUCTION .............................................................................................................. 7
  1.1 Project Description ........................................................................................................... 7
  1.2 Fixed Monitoring Site Locations .................................................................................... 7
  1.3 Regulatory Framework ................................................................................................... 9
  1.4 2015 Gas Abatement Plan Approach ............................................................................. 9
    1.4.1 *Operational* ............................................................................................................... 9
    1.4.2 *Structural* .................................................................................................................. 10
    1.4.3 *Consultation* ............................................................................................................. 10

2 OPERATIONS .................................................................................................................. 10
  2.1 Description of Fish-Passage Season Flow ...................................................................... 10
  2.2 Fish Spill Program .......................................................................................................... 12
  2.3 Fish Spill Quantities and Duration ................................................................................... 12

3 IMPLEMENTATION RESULTS ..................................................................................... 13
  3.1 Fisheries Management ................................................................................................... 13
    3.1.1 *Fish Passage Efficiencies* .......................................................................................... 13
    3.1.2 *Survival Studies* ......................................................................................................... 13
  3.2 Biological Monitoring ................................................................................................... 13
  3.3 Water Quality Forums ................................................................................................... 13
  3.4 Physical Monitoring ....................................................................................................... 14
    3.4.1 *Overview* .................................................................................................................. 14
    3.4.2 *Data Evaluation and Analyses* ................................................................................... 15
  3.5 TDG Compliance .......................................................................................................... 15
    3.5.1 Non-Fish Passage Season Compliance (Wells Tailrace 110%) .................................... 15
    3.5.2 Fish Passage Season Compliance ............................................................................. 15
    3.5.3 Yearly TDG Compliance Summary ............................................................................. 16

4 DISCUSSION OF GAS ABATEMENT MEASURES ....................................................... 17
  4.1 Water Quality Attainment Plan Activities ....................................................................... 17
  4.2 Operational .................................................................................................................... 18
This page intentionally left blank
LIST OF FIGURES

Figure 1. TDG fixed monitoring stations (yellow pins) above and below the Wells Project ...............8

Figure 2. 2015 monthly flows compared to historic normal and averages. The blue bars in the inset figure represent the percent of average flows observed in 2015 relative to historic norms....................... 11

Figure 3. 12C-High values in the Rocky Reach forebay during the 2015 fish passage season. The 115% standard is represented by the solid red line. Data courtesy of Chelan PUD.........................................................17

LIST OF TABLES

Table 1. Monthly average river discharge (kcfs) from the Wells Project, 1969-2015. .....................11

Table 2. 2015 TDG compliance summary. ......................................................................................16
1 INTRODUCTION

The 2015 Wells Hydroelectric Project (Wells Project) Gas Abatement Plan (GAP) was approved by the Washington State Department of Ecology (Ecology) on February 11, 2015. The GAP and its associated measures represent a long-term strategy to achieve compliance with the Washington State Water Quality Standard (WQS) criteria for total dissolved gas (TDG) in the Columbia River at the Wells Project while continuing to provide safe passage for downstream migrating juvenile salmonids. This annual report concludes the 2015 monitoring season and describes the background, operations, and results of GAP implementation at the Wells Project in 2015. In addition, this report contains TDG performance for the Wells Project following the completion of the 2015 fish passage season, towards measuring TDG performance outside of the fish passage season. Data summarized in this report includes monitoring from January 1, 2015 to December 31, 2015.

1.1 Project Description

The Wells Project is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD) and is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (USACE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream of Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. The hydrocombine is 1,130 feet long, 168 feet wide and has a top of dam elevation of 795 feet above mean sea level (msl). Upstream fish passage facilities are located on both sides of the hydrocombine.

The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends 1.5 miles up the Methow River and 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet msl.

1.2 Fixed Monitoring Site Locations

Fixed monitoring stations (FMS) for TDG are located above and below Wells Dam. The forebay station (WEL) is located midway across the deck of Wells Dam (47° 56’ 50.28” N, 119° 51’ 54.78” W). The tailrace station (WELW) is located on the left bank of the Columbia River 2.6 miles downstream of Wells Dam (47° 54’ 46.86” N, 119° 53’ 45.66” W). In the spring of 2014, Douglas PUD installed a third FMS at Washburn Island (WSBW; 48° 5' 17.15" N, 119°40' 33.82" W), located approximately 7 miles downstream of Chief Joseph Dam. Hach® HYDROLAB MiniSonde instruments equipped with TDG and
temperature probes are deployed approximately 15 feet below normal surface water elevation and are calibrated monthly. Data from the three stations are automatically transmitted by radio to Wells Dam, stored, forwarded to the USACE, and posted to the Douglas PUD public webpage (www.dcpud.org). Weather data are recorded by Global Water, Inc. instrumentation, including an electronic barometer located on the deck of Wells Dam at 810 feet elevation. All three FMS are geographically represented by yellow pins in Figure 1.

Figure 1. TDG fixed monitoring stations (yellow pins) above and below the Wells Project
1.3 Regulatory Framework

Washington Administrative Code (WAC) Chapter 173-201A identifies the WQS for surface waters in Washington State. Per the WQS, TDG measurements shall not exceed 110% saturation at any point of measurement in any state water body. The WQS provide for two exceptions to this rule: (1) for spill over dams to increase survival of downstream migrating juvenile salmon; and (2) during natural flood flows.

Ecology may approve an adjustment to the 110% upper criterion for TDG saturation during the outmigration of juvenile salmon; provided that spill aids in the survival of migratory fish. The TDG adjustment is considered by Ecology on a per-application basis and must be accompanied by an approved Gas Abatement Plan and biological monitoring plan (WAC 173-201A-200(1) (f) (ii)). On the Columbia and Snake rivers, the TDG exception for fish passage has three standards during the fish passage season: (1) TDG shall not exceed 125% saturation in the tailrace of the project as measured in any one-hour period; (2) TDG shall not exceed 120% saturation in the tailrace of the project based on the average of the twelve highest consecutive hourly readings (12C-High); and, (3) TDG shall not exceed 115% saturation in the forebay of the next downstream project based on the average of the twelve highest consecutive hourly readings.

Natural flood flows are identified by periods in which river flow volume exceeds the highest seven consecutive day average observed during a ten-year period, called the 7Q-10 flow. The 7Q-10 flow for the Wells Project is 246,000 cubic feet per second (cfs), based on the hydrologic records from 1930 to 1998 and the USGS Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” (Pickett et al. 2004). When river flow volume exceeds 7Q-10 flows, the WQS established in the WAC do not apply.

1.4 2015 Gas Abatement Plan Approach

1.4.1 Operational

Based on the success of 2009 and 2010 operations associated with implementation of the Wells Project Spill Playbook (Spill Playbook), those operations were implemented again between 2011 and 2015 with minor modification as described below.

In February 2011, Douglas PUD conducted an additional technical analysis of the 2010 Spill Playbook (after in-season changes) and confirmed that continued implementation would be appropriate for 2011 with additional minor modifications. Additional recommendations for 2011-2015 operations, from a TDG management perspective, included:

1. Minimize spill.

2. Forced Spill (≤ 53.0 kcfs). Switch the priority for forced spill less than 53 kcfs from spillbay 7 to spillbay 5. Turbine units 4 and 5 should be operated to support spill from spillbay 5.
3. If spill exceeds 53 kcfs, or is predicted to exceed 40 kcfs for more than 8 hours, remove the Juvenile Bypass System (JBS) barriers in spillbay 6.

4. When spill exceeds 30 kcfs in spillbay 5 and JBS barriers have been removed in spillbay 6, shift at least 15.0 kcfs from spillbay 5 to spillbay 6 (i.e., 27.2 kcfs and 15.0 kcfs through spillbays 5 and 6, respectively). Support spill through spillbays 5 and 6 by operating turbine units 4, 5 and 6.

5. Reinstall the JBS barriers if total spill is predicted to remain below 40 kcfs for more than four days.

Modifications were based on previous adaptive operational results, model predictions, and operational contingencies, including the prolonged rebuild of turbine unit 7 at Wells Dam. In 2015, the GAP recommended moving spill back to the spillbays above turbine unit 7 when forced spill exceeded 53 kcfs, since turbine unit 7 was operable prior to the 2015 bypass season. Using these modifications Wells Dam has demonstrated high TDG compliance with the WAC and WQS.

1.4.2 Structural

No permanent structural modifications were proposed or conducted in the 2015 monitoring season. No bypass barriers were removed in 2015 since flows were moderate and did not require prolonged periods of forced spill at or above 40 kcfs for more than 8 hours. In each year, the removal and reinstallation of the JBS barriers follows the requirements of the Federal Energy Regulatory Commission (FERC) approved Spill Playbook, Bypass Operating Plan and Wells Dam Emergency Action Plan (EAP).

1.4.3 Consultation

Towards the end of 2015 the Washington Department of Ecology designated a new 401 Certification and Hydropower Project Manager for the Wells Project. In previous years Douglas PUD directed all correspondence related to TDG compliance to the Washington Department of Ecology’s Hydropower Projects Manager located in the Central Region Office (Yakima, Washington 98902). However, beginning with the 2015 Annual Report Douglas PUD will direct correspondence related to TDG compliance to the Hydropower Projects Manager in Union Gap, Washington (98903). In addition, Douglas PUD annually consults with the Aquatic SWG and HCP Coordinating Committee for specific TDG and WQS documents per Douglas PUD’s 401 Certification and FERC license requirements.

2 OPERATIONS

2.1 Description of Fish-Passage Season Flow

The 2015 Fish Passage Season started on April 9 (0:00 hrs) and ended at midnight on August 19th at Wells Dam. As required, TDG performance was monitored during this period and transmitted to the USACE, Northwest Division on a real-time basis (www.nwd-wc.usace.army.mil) and made available on Douglas PUD’s public webpage (http://dcpud.org/wells-project/total-dissolved-gas-and-temperature-monitoring). Historical data continues to be available for download at both of these websites.
Data from 1969 to 2015 show that average monthly flows between April and August ranged from 106.2 to 163.7 kcfs at the Wells Project (Table 1; Figure 2). During this time period, flows tend to be greater in June and lowest in August. Flows at the run-of-river Wells Project are determined by upstream storage releases at the Grand Coulee Hydroelectric Project, with typically less than 10% of the total river flow provided by the two rivers that flow into the Columbia River within the Wells Project (Okanogan and Methow Rivers).

#### Table 1. Monthly average river discharge (kcfs) from the Wells Project, 1969-2015.

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>130.2</td>
<td>144.3</td>
<td>134.5</td>
<td>109.6</td>
<td>113.1</td>
<td>106.6</td>
<td>101.5</td>
<td>111.0</td>
<td>71.9</td>
<td>68.5</td>
<td>87.1</td>
<td>86.7</td>
<td>107.1</td>
</tr>
<tr>
<td>Average since 1969</td>
<td>108.8</td>
<td>107.8</td>
<td>106.5</td>
<td>116.7</td>
<td>150.0</td>
<td>163.7</td>
<td>135.2</td>
<td>106.2</td>
<td>75.3</td>
<td>75.7</td>
<td>87.7</td>
<td>101.4</td>
<td>111.1</td>
</tr>
<tr>
<td>Minimum since 1969</td>
<td>67.4</td>
<td>69.9</td>
<td>56.0</td>
<td>51.9</td>
<td>55.2</td>
<td>73.7</td>
<td>53.4</td>
<td>63.9</td>
<td>53.5</td>
<td>56.0</td>
<td>63.8</td>
<td>72.6</td>
<td>63.8</td>
</tr>
<tr>
<td>Maximum since 1969</td>
<td>159.2</td>
<td>180.7</td>
<td>193.9</td>
<td>184.9</td>
<td>262.6</td>
<td>348.7</td>
<td>253.8</td>
<td>181.3</td>
<td>123.0</td>
<td>108.9</td>
<td>110.0</td>
<td>149.0</td>
<td>149.0</td>
</tr>
<tr>
<td>2006-2015 (10 year Mean)</td>
<td>106.3</td>
<td>95.7</td>
<td>99.2</td>
<td>129.6</td>
<td>161.8</td>
<td>182.1</td>
<td>149.4</td>
<td>109.8</td>
<td>65.2</td>
<td>66.5</td>
<td>84.1</td>
<td>97.7</td>
<td>112.4</td>
</tr>
</tbody>
</table>

Average monthly flows during the first three months of 2015 were noticeably higher than historic norms; the months of January through March saw 120-134% of normal flows (Figure 2 inset). A wet spring was followed by a reduction in average flows and the apparent absence of a normal freshet in June 2015 (Figure 2). Columbia River flows at Wells Dam in 2015 were well below averages in all months of the fish passage season except August when compared to historic monthly flows (1969-2015; Figure 2). Flows from August to December were normal and moderate in 2015.

**Figure 2.** 2015 monthly flows compared to historic normal and averages. The blue bars in the inset figure represent the percent of average flows observed in 2015 relative to historic norms.
2.2 Fish Spill Program

Wells Dam is a hydrocombine, where the spillbays are located directly above the turbine water passages. Research at Wells Dam in the mid-1980s demonstrated that a modest amount of spill could be used to effectively guide a high proportion of the downstream migrating juvenile salmon away from the turbines and into a surface oriented bypass system. A JBS was subsequently developed at Wells in the late 1980s. The Wells Dam JBS was engineered based on biological research and hydraulic modeling, and utilizes constricting flow barriers deployed in five of the eleven spillbays to effectively attract and safely guide fish through the project. The Wells Project JBS has since proven to be the most efficient system on the mainstem Columbia River, providing high levels of fish protection and survival that has met approval from various fisheries agencies and tribes (Skalski et al. 1996). The passage and survival performance measures contained within the FERC approved Anadromous Fish Agreement and Habitat Conservation Plan (HCP) have been consistently exceeded, with a three-year survival average of 96.2% for juvenile steelhead and Chinook salmon (Bickford et al. 2001). The results from a fourth year of survival study at Wells Dam in 2010 (Bickford et al. 2011) confirmed past study results by documenting that survival through the entire Wells Project is in excess of 96.4% for juvenile spring migrating anadromous fish (see Section 3.1.2 below).

2.3 Fish Spill Quantities and Duration

The Wells Dam JBS uses up to 2,200 cfs of water for each of the five bypass/spillbay. Under normal conditions, the JBS will use roughly five to eight percent of the total river flow for fish guidance. The increased spill has a small influence on TDG production (~0-2%) while providing a safe and highly effective, non-turbine passage route for over 92% of the spring and 96% of the summer migrating juvenile salmonids. The HCP defined juvenile fish migration period runs from April 1st to August 31st of each year. From 2003 to 2011 the HCP Coordinating Committee (HCP) directed the District to operate the JBS on a fixed schedule between April 12 and August 26 in an effort to provide a non-turbine passage route for at least 95% of the spring and summer migration of juvenile salmonids. The HCP CC retains annual operating oversight that includes the potential to operate the JBS as early as April 1 and as late as August 31 to ensure that 95% of the spring and summer migration of juvenile salmonids are provided a safe, non-turbine passage route over Wells Dam. Any spill that occurs between April 1st and August 31st is deemed to have a beneficial effect on migrating juvenile salmonids.

In 2012, Douglas PUD evaluated past performance of the Wells Dam JBS operating dates relative to observed annual run timing (at the Rocky Reach Bypass) for both spring and summer migrants. With that data, a request was made to and granted by the HCP CC to revise the bypass operating dates in 2012 to start April 9 and end August 19. These dates were therefore used in 2012-2015 to operate the fish bypass system for migrating juvenile salmonids. Juvenile anadromous salmonids that pass Wells Dam before and after the bypass system is shut down for the year benefit from spill at the Project and therefore Douglas PUD annually develops a GAP and conducts biological and physical monitoring in order obtain an Ecology approved TDG adjustment for the entire juvenile salmonid migration period (April 1st to August 31st).
Late winter and spring flows (Jan to March) at Wells Dam were much higher than average historic flows. However, flows in May, June, and July were well below historic norms. Large spill volumes from May through July are characteristic of normal freshet conditions observed at Wells Dam. Flows during these months are associated with winter snowpack melt or “freshet run-off” in the upper-Columbia River including Columbia River drainage located in Canada. However, 2015 flows were atypical and characterized by a wet late winter and early spring and a relatively dry spring and summer period.

3 IMPLEMENTATION RESULTS

3.1 Fisheries Management

3.1.1 Fish Passage Efficiencies

No new fish passage efficiency studies were conducted at the Wells Project in 2015. However, three years of bypass efficiency studies have shown the Wells Dam JBS to be the most efficient juvenile salmonid collection system in the Columbia River with fish passage efficiencies up to 92% for spring migrants and up to 96% for summer migrants (comprised of steelhead, spring Chinook, and sockeye salmon, and summer/fall Chinook salmon, respectively; Skalski et al. 1996).

3.1.2 Survival Studies

No survival studies were conducted at the Wells Project in 2015.

3.2 Biological Monitoring

The 2015 Wells Project GAP includes the National Marine Fisheries Service (NMFS) recommendation to sample for Gas Bubble Trauma (GBT) in juvenile salmon when hourly tailrace TDG levels exceed 125% saturation (NMFS 2000).

In 2015, there were no 125% exceedances and therefore no GBT monitoring occurred.

3.3 Water Quality Forums

Douglas PUD has actively participated in regional water quality forums with Ecology, WDFW, NMFS, Tribal Agencies, the US Fish and Wildlife Service, the USACE, and other Mid-Columbia PUDs (i.e., Grant and Chelan counties). Specific forums include the Trans-boundary Gas Group, Columbia Basin meetings with Ecology, and the Sovereign Technical Team Water Quality Work Group. These meetings allow for regional coordination for monitoring, measuring, and evaluating water quality in the Columbia Basin and support ongoing Upper Columbia Treaty review analyses that will provide a foundation for Treaty negotiations between Canada and the U.S. Douglas PUD will continue its involvement in water quality meetings for further coordination with other regional water quality managers towards meeting TDG standards.
3.4 Physical Monitoring

3.4.1 Overview

TDG monitoring at the Wells Project has occurred since 1984 when forebay stations were first established. TDG monitoring in the tailrace of Wells Dam began in 1997 by actively collecting data at four points across the width of the river. Based on these data, the location for a FMS was established in 1998. Subsequent analysis verified that both monitoring station locations are appropriate and representative of mixed river condition, particularly during high flows (EES et al. 2007; Politano et al. 2009). TDG monitoring at the Wells Project currently occurs year round as required by Douglas PUD’s Wells Project 401 Water Quality Certification (401 Certification). As required by Douglas PUD’s Quality Assurance Project Plan for TDG, FMS sensors are serviced and calibrated at least once per month or sooner if calibration issues are observed on the devices.

In 2014, an additional reservoir monitoring station was installed at Washburn Island (RM 537.5) to collect TDG data representative of water quality entering the Wells Project from Chief Joseph Dam. The current Chief Joseph Dam tailwater station (CHQW) minisonde TDG sensor is deployed along the right bank of the Columbia River, 0.75 miles downstream from the dam. The river right location of the U.S. Army Corps of Engineers TDG sensor precludes it from collecting bulk flow data, and instead the sensor monitors spillbay water disproportionately. Under some conditions, water coming from Chief Joseph Dam spillbays is of lower TDG concentration than the powerhouse. For example, when the Chief Joseph Dam forebay has high concentrations of TDG (e.g. greater than 120 %) as a result of high spill volumes from Grand Coulee Dam and limited degassing through Rufus Woods Reservoir, water sent through the spillbays at Chief Joseph Dam may actually be stripped of gas via the spill deflectors. However, powerhouse TDG concentrations are essentially identical to those in the forebay and can be missed by the CHQW sensor since powerhouse flows orient to river left rather than river right where the TDG sensor resides. As a result of the CHQW location and the orientation of spill and powerhouse flows, bulk flows leaving the federal system and entering into the Wells Project are not accurately monitored. The Washburn Island location installed and operated by Douglas PUD allows water quality managers and the Aquatic Settlement Work Group Parties to:

1) Better understand TDG degassing in the Wells Project and expected TDG saturation in the Wells forebay.

2) Assure data quality at the Wells forebay TDG sensor since Washburn Island TDG values should correlate predictably with Wells forebay TDG values. Based on the comparison of the sensors at these two locations, technicians can ensure reliable data collection by scheduling sensor servicing when data appears to be erroneous.

3) More accurately assess TDG production from the federal power system upstream of Wells Dam, which may support improved management towards minimizing TDG production in the Columbia River.
3.4.2 Data Evaluation and Analyses

Hourly TDG monitoring data were retrieved from the USACE, Northwest Division for three monitoring locations: the forebay of Wells Dam (WEL), tailrace of Wells Dam (WELW), and forebay of Rocky Reach Dam (RRH). The data were partitioned to include only readings obtained during the fish passage season (April 1 to August 31). Data were stratified by monitoring site, ascending date, and ascending time. The Ecology-approved 12C-High method was used to obtain TDG measurements for comparison to numeric criteria and evaluation of compliance.

3.5 TDG Compliance

Outside of the fish passage season the TDG criterion in the Wells tailrace is 110% (September 1 – March 31). Additionally, there were three compliance criteria for the 2015 fish passage adjustment that must be met in association with operation at the Wells Project as described in the 2015 GAP:

1) Average TDG in the tailrace cannot exceed 125% for one hour or

2) 120% for 12 continuous hours (12C-High), and

3) TDG in the downstream Rocky Reach forebay cannot exceed 115% (12C-High).

These compliance criteria are waived when flows exceed the 7Q-10 value for the Wells Project (246 kcf). For more information refer to WAC 173-201A-200.

3.5.1 Non-Fish Passage Season Compliance (Wells Tailrace 110%)

Per the Douglas PUD FERC Operating License and 401 Certification, in August 2013 Douglas PUD started collecting TDG data during the non-fish passage season (January 1 to March 31 and September 1 to December 31). Non-spill flows at Wells Dam (through the turbine units and fishways) generate little to no additional dissolved gas. Spill outside the fish passage adjustment period is uncommon but occurred in 2015. In the preceding months (January to March) leading up the fish passage season the Wells Tailrace sensor recorded n = 6 days where observed values were at or above 110%. These days included 2/14 (4 hours), 2/19 (1 hour), 2/21 (1 hour), 2/27 (3 hours), 3/21 (3 hours), and 3/24 (3 hours). Post event analysis suggests that the exceedances were associated with unscheduled discharges from the upstream federal Columbia River projects and unexpectedly high incoming flows with no actionable option(s) to schedule load and prevent exceeding the 781 msl Project Elevation.

Following the completion of the fish passage season on August 31st there were no hourly values above 110% recorded (September to December).

3.5.2 Fish Passage Season Compliance

Wells Tailrace 125% hourly standard

No exceedances of the 125% hourly tailrace criterion occurred in 2015 (Table 2).
**Wells Tailrace 120% 12C-High standard**
No exceedances of the 120% 12C –High tailrace criterion occurred in 2015 (Table 2).

**Rocky Reach Forebay 115% 12C-High standard**
No exceedances of the 115% 12C –High Rocky Reach Forebay criterion occurred in 2015 (Table 2; Figure 3).

### 3.5.3 Yearly TDG Compliance Summary
The following table summarizes TDG compliance at the Well Project for the entire 2015 season.

#### Table 2. 2015 TDG compliance summary.

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Wells Tailrace 125% hourly standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days out of compliance</td>
<td>0</td>
</tr>
<tr>
<td>Fish passage season</td>
<td>152</td>
</tr>
<tr>
<td>DCPUD compliance</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Wells Tailrace 120% 12C-High standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days out of compliance</td>
<td>0</td>
</tr>
<tr>
<td>Fish passage season</td>
<td>152</td>
</tr>
<tr>
<td>DCPUD compliance</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Rocky Reach Forebay 115% 12C-High standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days out of compliance</td>
<td>0</td>
</tr>
<tr>
<td>Fish passage season</td>
<td>152</td>
</tr>
<tr>
<td>DCPUD compliance</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Wells Tailrace 110% (Non-fish passage season standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days out of compliance</td>
<td>6</td>
</tr>
<tr>
<td>Fish passage season</td>
<td>213</td>
</tr>
<tr>
<td>DCPUD compliance</td>
<td>97.2%</td>
</tr>
</tbody>
</table>
Figure 3. 12C-High values in the Rocky Reach forebay during the 2015 fish passage season. The 115% standard is represented by the solid red line. Data courtesy of Chelan PUD.

4 DISCUSSION OF GAS ABATEMENT MEASURES

4.1 Water Quality Attainment Plan Activities

As required by the Wells Project 401 Certification, Douglas PUD developed a Water Quality Attainment Plan (WQAP). The WQAP was approved by Ecology and the FERC in 2013. The WQAP provides a detailed strategy for achieving compliance with the TDG state WQS within a required ten-year timeframe (i.e., compliance schedule). The compliance schedule outlines a step-wise approach toward meeting compliance with the TDG WQS. In 2015 (Year 2), the WQAP called for continued adaptive management and implementation of the Spill Playbook, biological monitoring (i.e., GBT monitoring in biota, as needed), and the identification of key Project operating parameters towards developing a database that would house fine scale operation data. In future year’s data would be used to identify fine scale operations that might improve TDG compliance.

In the spring of 2015 Douglas PUD reviewed Wells Project Operations data collection with Wells Dam Hydro Operations staff and the Information Systems Department. The objective of this analysis was to conduct a comprehensive evaluation of both operational and structural data collection towards ultimately improving compliance with the TDG WQS criteria. A fine scale spill data collection database is currently under development. Development is expected to continue in 2016, with the first year data collection (pilot) expected to begin in the spring of 2017. Adaptive management and implementation of the Spill Playbook and biological monitoring (i.e., GBT monitoring in biota, as needed) continued in 2015 and is expected to continue in 2016.
4.2 Operational

Flows at Wells Dam were above normal in early 2015 but below normal during the juvenile fish passage season. High spring flows coupled with coordination challenges between BPA and Mid-C Central whereby Chief Joseph Dam daily discharge estimates were exceeded by large amounts without actionable notice to downstream projects. These unexpected high incoming flows led to the need to spill larger volumes of water at Wells Dam to avoid exceeding the FERC license maximum pool elevation of 781 msl. The result of these early spill events was six days were values slightly above 110% were recorded in the Wells tailrace. Historically, Douglas PUD has not had difficulty meeting the 110% standard outside of the fish bypass season.

Wells Dam demonstrated exceptional performance during the fish passage season with nine out of ten turbine units available during this period. All tailrace and downstream standard were met during the fish passage season.

Douglas PUD implemented the Ecology approved GAP during the entire 2015 fish passage season utilizing the lessons learned during previous years of spill study at the Wells Project. The 2015 Spill Playbook was an important element in managing TDG at Wells Dam during the fish passage season.

4.3 Structural

No permanent structural modifications were proposed or conducted during the 2015 monitoring season.

5 CONCLUSIONS

TDG performance at Wells Dam during the 2015 season was very high. Results support the continued implementation of the Spill Playbook to manage TDG production through operational means, and suggest future operational performance should result in even higher rates of TDG standards compliance. Douglas PUD will put an emphasis on testing the Spill Playbook in years where ten units are available 95% of the time (normal reliability). The current turbine rebuild that provides only 9 out of 10 units to operate during the peak hydrograph reduces the amount of water that can be generated by approximately 20 kcfs and therefore makes compliance more challenging, since this water must be spilled. Despite this challenge Douglas PUD has maintained high TDG compliance with WQS. Douglas PUD will work closely with the Washington Department of Ecology towards meeting year round TDG standards in subsequent years.
6 REFERENCES


APPENDIX B – PRE-FILING CONSULTATION RECORD FOR THE 2015 TDG REPORT
NOTICE TO THE AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE
2015 TDG REPORT
Hi Aquatic SWG: please see the email below from Andrew and the attached Draft 2015 Wells Dam Gas Abatement Plan (GAP) and Total Dissolved Gas (TDG) Report and Draft 2016 Wells Dam GAP and Bypass Operating Plan (BOP) for review. The attached draft 2015 report and draft 2016 plan are available for a 30-day review period, with comments due to Andrew by **COB Monday, February 8, 2016**. Douglas PUD will request approval of the draft 2015 report and draft 2016 plan during the Aquatic SWG meeting on February 10, 2016.

The attached draft 2015 report and draft 2016 plan are also available for download from the Aquatic SWG Extranet site under: Documents > All by Mtg Date > 1/13/2016 (instructions below). Thanks! –kristi 😊

**Instructions:**

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: [https://extranet.dcpud.net/sites/nr/aswg/](https://extranet.dcpud.net/sites/nr/aswg/)
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

**If you encounter problems, or need a login username and password to access the site:**
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

**ANCHOR QEA, LLC**
kgeris@anchorqea.com
T  509.491.3151 x104
C  360.220.3988
As I discussed during the December call, every year at this time Douglas PUD provides two documents to the Aquatic SWG for consideration. The first summarizes TDG compliance during the previous year and the second provides the plans that will be in place to provide safe and effective passage of juvenile salmonids, meet TDG criteria, and operate the Project safely. The latter of these documents get reviewed concurrently with the HCP CC per our 401 Certification and FERC license requirements. These two documents are:

1. 2015 Annual TDG (GAP) Report
2. 2016 Gas Abatement Plan and Bypass Operating Plan

The latter document is also required in order to obtain an Ecology’s approved TDG adjustment during the bypass season, which facilitates survival of downstream migrating fish. Both documents are attached for committee review and consideration. Douglas PUD is hoping to have them reviewed and approved by the Feb 10th call, since both are due to the FERC by Feb 28th.

Please let me know if you have questions.

Andrew Gingerich
Senior Aquatic Resource Biologist
Public Utility No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802
Office: (509) 881-2323
APPROVAL OF THE 2015 TDG REPORT FROM THE AQUATIC SETTLEMENT WORK GROUP
Final Meeting

Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties

From: John Ferguson, Chairman (Anchor QEA, LLC)

Re: Final Action Items of the February 10, 2016 Aquatic SWG Meeting

Below is a summary of Action Items from the Aquatic SWG meeting that was held in-person at Wells Dam in Azwell, Washington, on Wednesday, February 10, 2016, from 10:15 a.m. to 12:00 p.m. Attendees are listed in Attachment A. These action items include the following:

I. Summary of Action Items

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG (Item VI-1).

2. Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS; Item VI-1).

3. Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-1).

4. John Ferguson will follow-up with Bob Rose regarding YN approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3).

5. The Aquatic SWG meeting on March 9, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. The Aquatic SWG members present approved the 2015 Juvenile Lamprey Habitat Evaluation Study Report (Item VI-2).
2. The Aquatic SWG members present approved the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3).

3. The Aquatic SWG members present approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan, contingent on incorporating comments received from USFWS, which were reviewed and discussed during the meeting on February 10, 2016 (Item VI-4).

4. The Aquatic SWG members present approved the 2015 Wells Dam Gas Abatement Plan (GAP) and Total Dissolved Gas (TDG) Report, contingent on approval by the Washington State Department of Ecology (Ecology; Item VI-5).

5. The Aquatic SWG members present approved the 2016 Wells Dam GAP and Bypass Operating Plan (BOP), contingent on approval by Ecology (Item VI-6).

6. The Aquatic SWG members present approved the 2016 Aquatic Settlement Agreement (ASA) Action Plan (Item VI-7).

III. Agreements

1. The Aquatic SWG members present agreed to a March 1, 2016, deadline to transfer surplus white sturgeon offsite that are in excess of the Douglas PUD 5,000-fish White Sturgeon Program, in order to grow program fish to the target size at release (Item VI-9).

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on February 8, 2016, notifying them that the Draft 2015 Aquatic Nuisance Species Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Tuesday, March 8, 2016.

V. Documents Finalized

1. The Final 2016 Wells Dam GAP and BOP that was approved by the Aquatic SWG on February 10, 2016, and by the Wells Habitat Conservation Plan (HCP) Coordinating Committee on January 26, 2016, was distributed to the Aquatic SWG by Kristi Geris following the Aquatic SWG meeting on February 10, 2016 (Item VI-6).

2. The Final 2015 Juvenile Lamprey Habitat Evaluation Study Report that was approved by the Aquatic SWG on February 10, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 11, 2016 (Item VI-2).
## Attachment A

**List of Attendees**

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
</tr>
</tbody>
</table>
APPROVAL OF THE 2015 TDG REPORT FROM WASHINGTON
DEPARTMENT OF ECOLOGY
February 18, 2016

To: Andrew Gingerich, Douglas County PUD

From: Charles McKinney, WA Dept. of Ecology, Water Quality Program

The Washington Department of Ecology (Ecology) has reviewed and approves the 2015 GAP and TDG report submitted by Douglas PUD for the Wells Project. Ecology has also reviewed and approves the 2016 Gas Abatement Plan, Spill Play Book and Bypass Operating plan.

Ecology grants PUD District No. 1 of Douglas County an adjustment to the 110% TDG standard for the purposes of 2016 Spill Season, as authorized under WAC 173-201A-200(1)(f)(ii), in order to facilitate the passage of ESA listed salmonids at the Project.

Please let me know if you have any questions.
APPENDIX J
2016 TOTAL DISSOLVED GAS
ABATEMENT PLAN AND FINAL 2016
JUVENILE FISH BYPASS OPERATING
PLAN
APPENDIX A – 2016 TOTAL DISSOLVED GAS ABATEMENT PLAN – WELLS PROJECT
2016 TOTAL DISSOLVED GAS ABATEMENT PLAN

WELLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 2149

Prepared by:

Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

Prepared for:

Hydropower Projects Manager
Washington Department of Ecology
Yakima, Washington 98902-3452

And

Aquatic Settlement Work Group

January 2016
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# TABLE OF CONTENTS

## 1.0 INTRODUCTION AND BACKGROUND

1.1 Project Description ................................................................. 2
1.2 Regulatory Framework .......................................................... 4
1.2.1 Federal Columbia River Power System Above Wells Dam ....... 5
1.2.2 7Q-10 Flood Flows .............................................................. 5
1.2.3 Fish Passage Season and Spill ............................................. 5
1.2.4 Incoming TDG Levels ......................................................... 6
1.2.5 Additional 401 Certification Requirements ......................... 6
1.2.6 Additional Requirements of the FERC Operating License .... 9
1.3 History of Operations and Compliance .................................... 9
1.3.1 Historical Flows ................................................................. 9
1.3.2 Spill Operations ................................................................. 10
1.3.2.1 General Operation .......................................................... 10
1.3.2.2 Spill for Fish ................................................................. 11
1.3.2.3 Flows in Excess of Hydraulic Capacity ......................... 11
1.3.2.4 Flow in Excess of Power Demand ................................. 12
1.3.2.5 Gas Abatement Spill ..................................................... 12
1.3.2.6 Other Spill ..................................................................... 12
1.3.3 Compliance Activities in Previous Year ......................... 13
1.3.3.1 Operational ................................................................. 13
1.3.3.2 Structural ................................................................. 14
1.3.3.3 Biological Monitoring .................................................. 14
1.3.4 Compliance Success in 2015 ........................................... 14

## 2.0 PROPOSED OPERATIONS AND ACTIVITIES

2.1 Operational Spill ................................................................. 15
2.2 Implementation ................................................................. 15
2.2.1 Fisheries Management Plans ........................................... 15
2.2.2 Biological Monitoring ................................................... 17
2.2.3 Water Quality Forums .................................................... 18
2.3 Water Quality Attainment Plan and Quality Assurance Project Plans ................................................................. 18

## 3.0 COMPLIANCE AND PHYSICAL MONITORING

3.1 Monitoring Locations ........................................................... 19
3.2 Quality Assurance .............................................................. 20
3.3 Reporting ............................................................................ 20

## 4.0 CONCLUSIONS

......................................................................................... 21

## 5.0 LITERATURE CITED

......................................................................................... 22
LIST OF TABLES

Table 1. Average monthly flows (kcfs) at Wells Dam ........................................................ 9
Table 2. Wells Hydroelectric Project Juvenile Bypass System Efficiency ....................... 11
Table 3. 1998-2000, 2010 Wells Hydroelectric Project Juvenile Survival Study Results .................................................................................................................. 16
Table 4. Wells Hydroelectric Project Habitat Conservation Plan Species Phase Designations ........................................................................................................ 17

LIST OF FIGURES

Figure 1. Map of the Wells Hydroelectric Project in Central Washington ....................... 3
Figure 2. Historic and Ten Year Flow Average as Observed at Wells Dam ......................... 10

APPENDICES

Appendix 1 Wells Hydroelectric Project Spill Playbook ...................................................... 25
Appendix 2 Wells Bypass Operating Plan ........................................................................... 34
EXECUTIVE SUMMARY

Washington State Water Quality Standards (WQS) are defined in Washington Administrative Code (WAC) Chapter 173-201A, and are administered by the Washington Department of Ecology (Ecology). Compliance with the total dissolved gas (TDG) standard requires that TDG not exceed 110 % at any point of measurement in any state water body. A dam operator is not held to the TDG standards when the river flow exceeds the seven-day, 10-year frequency flood (7Q-10). In addition to allowances for natural flood flows, Ecology has approved a TDG exemption for Columbia and Snake River dams on a per-application basis (WAC 173-201A-200(1)(f)(ii)). The exemption allows for the TDG criteria to be adjusted to allow spill for juvenile fish passage past hydroelectric dams when consistent with an Ecology-approved Gas Abatement Plan.

On the Columbia and Snake rivers there are three separate standards that are applicable to the TDG exemption: 1) TDG shall not exceed 125 % in the tailrace of a dam, as measured in any one-hour period; 2) TDG shall not exceed 120 % in the tailrace of a dam; and 3) shall not exceed 115 % in the forebay of the next dam downstream. Compliance with the latter two standards is determined using an average of the 12 highest consecutive hourly readings in any 24-hour period. The increased levels of spill, resulting in elevated TDG levels, are intended to allow increased fish passage with less harm to anadromous fish populations than what would be caused by turbine fish passage. Ecology’s scientific basis for the TDG exemption is based on a risk analysis conducted by the National Marine Fisheries Service (NMFS; NMFS 2000).

The goal of the 2016 Wells Total Dissolved Gas Abatement Plan (GAP) is to implement a long-term strategy to achieve compliance with the Washington State WQS criteria for TDG in the Columbia River at the Wells Hydroelectric Project (Wells Project) while continuing to provide safe passage for downstream migrating juvenile salmonids. Public Utility District No. 1 of Douglas County (Douglas PUD), which owns and operates the Wells Project, is submitting this GAP to Ecology as required for receipt of a TDG exemption at Wells Dam.
1.0 INTRODUCTION AND BACKGROUND

The Wells Hydroelectric Project (Wells Project or Project) Gas Abatement Plan (GAP) provides details on operational and structural measures to be implemented by Public Utility District No. 1 of Douglas County, Washington (Douglas PUD) at Wells Dam under the Federal Energy Regulatory Commission (FERC) license for Project No. 2149. These measures are intended to result in compliance with the modified Washington State water quality standards (WQS) for total dissolved gas (TDG) allowed under the TDG exemption, provided incoming water to the Project is in compliance and flows are below the seven-day, 10-year frequency flood levels (7Q-10: 246 kcfs).

The goal of the GAP is to implement a long-term strategy to achieve compliance with the Washington State WQS for TDG in the Columbia River at the Wells Project or Project, while continuing to provide safe passage for downstream migrating juvenile salmonids via spill. Douglas PUD is the owner and operator of the Wells Project and is submitting this GAP to the Washington Department of Ecology (Ecology) for approval as required for receipt of a TDG exemption for fish passage.

Since 2003, Ecology has approved GAPs and issued TDG exemptions for the Wells Project on an annual basis. The most recent GAP was approved by Ecology in February 2015. This GAP contains the following information: Section 1.0 summarizes the background information related to regulatory and project-specific TDG information at the Wells Project. Sections 2.0 and 3.0 contain proposed Wells Project operations and activities related to TDG management. Section 4.0 provides a summary of compliance and physical monitoring plans, quality assurance and quality control procedures, and reporting.

1.1 Project Description

The Wells Project is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (USACE); and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The spillway consists of eleven spill gates that are capable of spilling a total of 1,180 thousand cubic feet per second (kcfs). The crest of the spillway is approximately five and a half feet above normal tailwater elevation and two feet below tailwater elevation when plant discharge is 219 kcfs. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine.
Wells Project is considered a “run-of-the-river” project due to its relatively limited storage capacity.

Figure 1. Map of the Wells Hydroelectric Project in Central Washington.
The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet.

1.2 Regulatory Framework

Article 401(a) of the FERC license for the Wells Project requires that the GAP be developed in consultation with the United States Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife, Ecology, Confederated Tribes of the Colville Reservation (Colville Confederated Tribes), Confederated Tribes and Bands of the Yakama Nation, United States Bureau of Land Management, and United States Bureau of Indian Affairs. The GAP must also be developed in consultation with the National Marine Fisheries Service (NMFS) where the Wells Bypass Operating Plan is integrated with the GAP in order to minimize TDG production during periods of JBS operation. The Ecology-approved GAP must then be submitted to the FERC for approval by February 28 of each year as required by the Wells Project license (FERC license article 401[a]). The GAP is also due to Ecology by February 28 each year (401 Certification 6.7[2][a][i]).

Under the WQS [WAC Chapter 173-201A, Section 200(1)(f)], TDG shall not exceed 110 % at any point of measurement in any state water body. However, the standards exempt dam operators from this TDG standard when the river flow exceeds the 7Q-10 flow. The 7Q-10 flow is the highest calculated flow of a running seven consecutive day average, using the daily average flows that may be seen in a 10-year period. The 7Q-10 total river flow for the Wells Project was computed using the hydrologic record from 1974 through 1998, coupled with a statistical analysis to develop the number from 1930 through 1998. These methods follow the United States Geological Survey (USGS) Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” and determined that the 7Q-10 flow at Wells Dam is 246,000 cfs (Ecology et. al. 2004).

In addition to allowances for natural flood flows, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology-approved GAP (as defined in subsection ii of Section 200(1)(f)). This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, an exemption to the TDG standard (110 %) that allows Columbia and Snake River dam operators to spill water at projects that often increase TDG beyond 110% but allow for safe juvenile fish passage through non-turbine passage. The Ecology-approved TDG exemption comprises three separate criteria:

1. TDG shall not exceed 125 % in any one-hour period in the tailrace of a dam;
2. TDG shall not exceed 120 % in the tailrace of a dam; and
3. shall not exceed 115 % in the forebay of the next dam downstream.
Compliance criteria 2 and 3 above are measured as an average of the 12 highest consecutive hourly readings in any 24-hour period (12C-High). Ecology’s scientific basis for the TDG exemption at Columbia and Snake River hydroelectric projects is based on a risk analysis conducted by the NMFS (NMFS 2000).

### 1.2.1 Federal Columbia River Power System Above Wells Dam

A significant portion of the Wells Reservoir occupies lands within the boundaries of the Colville Indian Reservation. Wells Project operations do not affect TDG levels in tribal waters, where the Colville Tribes’ TDG standard is a maximum of 110 %, year-round, at all locations. This TDG standard is also the U.S. Environmental Protection Agency’s (EPA) standard for all tribal waters on the Columbia River, from the Canadian border to the Snake River confluence. TDG levels on the Colville Reservation portion of the mainstem Columbia River within Wells Reservoir result from the operations of upstream federal dams but in particular, the USACE’s Chief Joseph Dam (located immediately upstream of Wells Dam) and the US Bureau of Reclamation’s Grand Coulee Dam (located immediately upstream of Chief Joseph Dam).

In 2004, Ecology, the Spokane Tribes of Indians, and the U.S Environmental Protection Agency (EPA) developed a Total Maximum Daily Load (TMDL) report for TDG in the Mid-Columbia and Lake Roosevelt (Pickett et al. 2004). The document indicates that compliance in the Chief Joseph Dam tailrace is carried out by Ecology, the Colville Confederated Tribes and EPA. Ecology’s standards differ between Phase I and Phase II of implementation of the TMDL with Phase I having identical WA State WQS TDG criteria during fish passage periods (i.e., TDG exemption criteria) and Phase II being 73 mm of Hg (or 110% TDG) in the tailrace of Chief Joseph up to the mouth of the Okanogan River (Pickett et al. 2004). In addition, TDG standards in the tailrace of Chief Joseph Dam are enforced by the Colville Confederated Tribes, whereby standards are 110% as measured at any time of year along the reservation boundary, including the Chief Joseph tailrace, and as an instantaneous measurement (Pickett et al. 2004; Colville Confederated Tribes 2010). In 2016, the TDG standard in the Chief Joseph tailrace is expected to be 110% year round because Phase I of the TMDL is complete and Phase II of the TMDL is officially being implemented. A spill plan filed by the USACE in July 2015, for the purposes of modifying the TDG standards to facilitate fish passage at the federal Columbia River dams, did not include Chief Joseph Dam as it had in previous years. As such, Ecology did not provide a TDG exemption to the statewide TDG standard of 110% and incoming TDG to the Wells Project is expected be <110% year round.

### 1.2.2 7Q-10 Flood Flows

The 7Q-10 flood flow at the Wells Project is 246.0 kcfs. TDG values are not considered in the context of WQS compliance when flows at the Project are at or above the 7Q-10 value.

### 1.2.3 Fish Passage Season and Spill

The juvenile fish passage season as defined in the HCP runs from the first of April through to the end of August. Juvenile fish spill at the Wells Project is a defined action found in the Habitat Conservation Plan (HCP) Coordinating Committee (CC) and any spill at the project between April 1st and August 31st results in an increase in the survival of downstream migrating
juvenile salmonid by passing fish over the spillways instead of through the turbines. The HCP requires that fish spill take place during at least 95% of the juvenile fish passage season and normally fish spill is implemented to cover the middle 99% of the spring and summer juvenile fish migration. Outside the juvenile fish passage season (September 1st to March 31st), Douglas PUD intends to remain in compliance with the 110% TDG standard. During the juvenile fish passage season, Douglas PUD operates within Project constraints toward compliance with the TDG exemption criteria as detailed in Section 1.2 above. Nothing in these special conditions allows an impact to existing and characteristic uses.

1.2.4 Incoming TDG Levels

During the fish spill season, TDG concentrations in the Wells Project forebay are primarily determined by the USACE’s upstream water management activities at Chief Joseph Dam and the Bureau of Reclamation’s activities at Grand Coulee Dam.

Since the completion of spill deflectors at Chief Joseph Dam in 2008, there has been a significant increase in the amount of spill at the Chief Joseph Project resulting from wind integration and transmission congestion issues and operational constraints on the other dams in the Federal Columbia River Power System (FCRPS). Recent increases in the amount of spill at Chief Joseph Dam have resulted in a dramatic rise in the volume of supersaturated water entering the Wells Project. For example, in 2012 Wells Dam received non-compliant water (>110 % [EPA and CCT standard]) on 125 days of the 133 days juvenile fish passage season. This mass influx of supersaturated water has resulted in significantly higher TDG concentrations observed in the forebay of Wells Dam that often exceeds TDG values of 115 % (previous Ecology TDG exemption for Chief Joseph Dam allowed 115 % TDG in the Chief Joseph Dam tailrace up until February 2015).

Prior to 2016, the USACE operated under the assumption that the fish passage TDG exemption, approved by Ecology, applied to all FCRPS dams, rather than the eight dams with fish passage in the lower Snake and Columbia rivers. Chief Joseph and Grand Coulee dams do not currently have upstream or downstream fish passage. Further, Chief Joseph operators have not developed a biological monitoring plan specific to the project, which is an Ecology requirement of a fish passage exemption to the 110 % state standard. Despite these discrepancies, the USACE obtained a fish passage waiver from Ecology in 2012 that provides a TDG exemption consistent with fish spill exemptions that is valid until the end of February 2015 (Ecology 2010). Starting in 2016, the USACE will implement a new TDG Monitoring Plan under Phase II of the TMDL. With the absence of fish passage at Chief Joseph and no TDG adjustment, the Chief Joseph Hydroelectric Project will be required to meet the 110 % standard (see TDG exemption criteria as defined in WAC Chapter 173-201A Section 200(1)(f)(ii)) and therefore incoming TDG levels at Wells Dam should be less than 110%.

1.2.5 Additional 401 Certification Requirements

February 27, 2012, Ecology concluded that the Wells Project, as conditioned by its 401 Certification/Order No. 8981, would comply with all applicable provisions of 33 USC 1311, 1312, 1313, 1316, 1317 and appropriate requirements of Washington State law. The 401 Certification general conditions that are relevant to the GAP and the abatement of TDG under the TDG exemption are as follows:

- Douglas PUD shall consult with Ecology before it undertakes any change to the Project or Project operations that might significantly and adversely affect compliance with any applicable water quality standard (including designated uses) or other appropriate requirement of state law.
- Copies of the Wells Project 401 Certification and associated permits, licenses, approvals and other documents shall be kept on site and made readily available for reference by Douglas PUD, its contractors and consultants, and by Ecology.
- Douglas PUD shall allow Ecology access to inspect the Project and Project records required under the 401 Certification for the purpose of monitoring compliance with conditions of the 401 Certification. Access will occur after reasonable notice, except in emergency circumstances.
- Douglas PUD shall, upon request by Ecology, fully respond to all reasonable requests for materials to assist Ecology in making determinations under the 401 Certification and any resulting rulemaking or other process.
- Douglas PUD shall operate the Wells Project in compliance with a GAP approved by Ecology. By February 28 of each year, Douglas PUD shall submit a GAP to Ecology for approval. Pending Ecology’s approval of each subsequent GAP, Douglas PUD shall continue to implement the activities identified within the previously approved plan.
- The GAP will include the Spill Operations Plan and will be accompanied by a fisheries management plan (section 2.2.1) and physical (section 4.1.1) and biological (section 2.2.2) monitoring plans. The GAP shall include information on any new or improved technologies to aid in the reduction in TDG.
- Commencing one year after issuance of a new FERC license, Douglas PUD shall monitor and report spills and TDG during non-fish spill season to determine TDG compliance with the 110 % standard (see section 4.1.1). The non-fish spill season is defined as the times of the year that are not considered the fish spill season (generally April to end of August).
- If Douglas PUD, at any point, considers modifying any of the measures identified in the Spill Playbook, they will immediately develop proposed alternative(s) that will produce levels of TDG equal to or less than those estimated to be produced by the measures to be replaced. These measures should be implementable in a similar timeframe and must be submitted to Ecology for review and approval prior to implementation.
- The Project shall be deemed in compliance with the TMDL for TDG as long as it remains in compliance with the terms of the 401 Certification. The certification, including the GAPs and the Water Quality Attainment Plan (section 2.2.4), is intended to serve as the Project’s portion of the Detailed Implementation Plan for the TDG TMDL.
Specific 401 Certification conditions that are relevant to the GAP and the abatement of TDG under the TDG exemption are as follows:

- Commencing one year after issuance of the new license, Douglas PUD shall monitor and report spills and TDG during non-fish spill season to determine compliance with the 110% standard *(Note. As of August 2013 Douglas PUD began collecting TDG data toward determining compliance with the 110% standard during the non-fish spill season).*

- Douglas PUD shall maintain a TDG monitoring program at its Fixed Monitoring Locations in the forebay and tailrace of Wells Dam and/or at other locations as determined by Ecology, in order to monitor TDG and barometric pressure. Douglas PUD shall monitor TDG hourly throughout the year. *(Note. Since the early 2000s, Douglas PUD has maintained fixed monitoring stations in the forebay and tailrace of Wells Dam. Since 2013 data has been collected hourly and year round).*

- The TDG monitoring program shall conform to the Ecology Quality Assurance Project Plan (QAPP) requirements per Section 6.7 (f) of the [license] order and the procedures shall be at least as stringent as the quality assurance/quality control calibration and monitoring procedures developed by the USGS for the Columbia River. *(Note. In 2013, Douglas PUD worked with Ecology and filed with the FERC a QAPP for TDG and water temperature monitoring. The FERC issued an Order approving the QAPP on August 8, 2013).*

- Douglas PUD shall provide an annual TDG report to Ecology for review and approval by February 28 of each year.

- Within one year of issuance of the new license, Douglas PUD shall coordinate the annual HCP Project Fish Bypass/Spill Operations Plan with the GAP, using best available information to minimize the production of TDG. This coordination shall be accomplished in consultation with the Wells HCP CC and the Aquatic SWG. *(Note. Since 2013, Douglas PUD works with Ecology and the HCP CC to develop the GAP and Bypass Operation Plan concurrently. Once developed these documents are approved by the Aquatic SWG and HCP CC before being filed and approved by the FERC).*

- Within one year of license issuance, Douglas PUD shall submit a TDG Water Quality Attainment Plan for Ecology to review and approve. The plan shall include a compliance schedule to ensure compliance with the TDG water quality criteria within 10 years of approval of the WQAP. *(Note. In 2013, Douglas PUD, in consultation with Ecology, developed a TDG WQAP and filed it with the FERC. The FERC filing date was October 21st, 2013). See section 2.2.4 below for additional detail on the WQAP.*

- Douglas PUD shall manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 by minimizing voluntary spill through operations, including scheduling maintenance based upon predicted flows, avoiding spill by coordinating operations with upstream dams to the extent that it reduces TDG, maximize power house discharge, especially during periods of high river flows, and manage voluntary spill in real time in an effort to continue to meet TDG numeric criteria consistent with the GAP. *(Note. Wells Dam operations continue to manage spill via an annually updated spill playbook and GAP).*
1.2.6 Additional Requirements of the FERC Operating License

Article 401(a) of the FERC operating license for P-2149 requires that the Gas Abatement Plan be filed with the Commission for approval following the approval of the GAP by NMFS, USFWS and Ecology. Article 401(b) requires the TDG report be submitted to the Commission by February 28 of each year. Article 401(c) requires Commission authorization of an application to amend the license, prior to the implementation of measures to address non-compliance with numeric water quality criteria.

1.3 History of Operations and Compliance

1.3.1 Historical Flows

Flow from the Columbia River originates in the headwaters of the Canadian Rockies and picks up snow melt from tributary streams as it travels over 1,243 miles before emptying into the Pacific Ocean. There are 85,300 square miles of drainage area above Wells Dam. The natural hydrograph had low flows in November through January with high flows in May through July. Storage dams on the Columbia River and its tributaries upstream of the Wells Project in the U.S. and Canada capture high spring and summer flows to hold for release in the fall and winter months (Table 1; Figure 2). The current hydrograph of the Columbia River is controlled by upstream, federally managed storage and release regimes, but typically mimics the average hydrograph since 1969 (Figure 2). Juvenile anadromous salmonid migration occurs within a regime of reduced high flows during the spring migration period.

Table 1. Average monthly flows (kcf) at Wells Dam.

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>130.2</td>
<td>144.3</td>
<td>134.5</td>
<td>109.6</td>
<td>113.1</td>
<td>106.6</td>
<td>101.5</td>
<td>111.0</td>
<td>71.9</td>
<td>68.5</td>
<td>87.1</td>
<td>86.7</td>
<td>107.1</td>
</tr>
<tr>
<td>Average since 1969</td>
<td>108.8</td>
<td>107.8</td>
<td>106.5</td>
<td>116.7</td>
<td>150.0</td>
<td>163.7</td>
<td>135.2</td>
<td>106.2</td>
<td>75.3</td>
<td>75.7</td>
<td>87.7</td>
<td>101.4</td>
<td>111.1</td>
</tr>
<tr>
<td>Minimum since 1969</td>
<td>67.4</td>
<td>69.9</td>
<td>56.0</td>
<td>51.9</td>
<td>55.2</td>
<td>73.7</td>
<td>53.4</td>
<td>63.9</td>
<td>53.5</td>
<td>56.0</td>
<td>63.8</td>
<td>72.6</td>
<td></td>
</tr>
<tr>
<td>Maximum since 1969</td>
<td>159.2</td>
<td>180.7</td>
<td>193.9</td>
<td>184.9</td>
<td>262.6</td>
<td>348.7</td>
<td>253.8</td>
<td>181.3</td>
<td>123.0</td>
<td>108.9</td>
<td>110.0</td>
<td>149.0</td>
<td></td>
</tr>
<tr>
<td>2006-2015 (10 year Mean)</td>
<td>106.3</td>
<td>95.7</td>
<td>99.2</td>
<td>129.6</td>
<td>161.8</td>
<td>182.1</td>
<td>149.4</td>
<td>109.8</td>
<td>65.2</td>
<td>66.5</td>
<td>84.1</td>
<td>97.7</td>
<td>112.4</td>
</tr>
</tbody>
</table>
In general, the hydropower system and reservoir operations in the Columbia River are coordinated through a set of complex agreements and policies that are designed to optimize the benefits and minimize the adverse effects of project operations. The Wells Project operates within the constraints of the Pacific Northwest Coordination Agreement, Canadian Treaty, Canadian Entitlement Agreement, Hourly Coordination Agreement, the Hanford Reach Fall Chinook Protection Program and the FERC regulatory and license requirements.

1.3.2 Spill Operations

1.3.2.1 General Operation

The Hourly Coordination Agreement is intended to efficiently manage the power and non-power operations for the seven dams from Grand Coulee to Priest Rapids. "Coordinated generation" is assigned to meet daily load requirements via Central Control in Ephrata, WA. Automatic control logic is used to maintain pre-set reservoir levels to meet load requirements and minimize involuntary spill. These pre-set reservoir levels are maintained at each project via management of a positive or negative "bias". Positive or negative bias assigns a project more or less generation based on its reservoir elevation at a given time and thus, maximizes system benefits and minimizes involuntary spill.
1.3.2.2 Spill for Fish

Wells Dam is a hydrocombine design where the spillway is situated directly above the generating units. Research at Wells Dam in the mid-1980s showed that a modest amount of spill effectively guided 92.0-96.2% of the spring and summer downstream migrating juvenile salmonids through the JBS (Skalski et al. 1996; Table 2). The operation of the Wells JBS utilizes the five even-numbered spillways. These spillways have been modified with constricting barriers to improve the attraction flow while using modest levels of water. These modified spillways are used to provide a non-turbine passage route for downstream migrating juvenile salmonids from April through August. Normal operation of the JBS uses 10 kcfs. During periods of extreme high flow, one or more of the JBS barriers will be removed to provide adequate spill capacity to respond to an emergency plant load rejection. Spill barriers may also be removed to minimize TDG production during high spill events, or when flood flows are forecast. Bypass gates are opened when adjacent turbines are operating.

Typically, the JBS will use approximately 6% to 8% of the total river flow for fish guidance. Between the years 1997 and 2004, the volume of water dedicated to JBS operations ranged from 1.5 to 3.2 million acre-feet annually. The operation of the JBS adds a small amount of TDG while meeting a very high level of fish guidance and survival. This high level of fish survival at Wells Dam has met the approval of the fisheries agencies and tribes and is vital to meeting the survival performance standards contained within the FERC-approved HCP. The Wells Project JBS is the most efficient bypass system on the mainstem Columbia River.

<table>
<thead>
<tr>
<th>Species</th>
<th>% JBS Passage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearling (spring) Chinook</td>
<td>92.0</td>
</tr>
<tr>
<td>Steelhead</td>
<td>92.0</td>
</tr>
<tr>
<td>Sockeye</td>
<td>95.7</td>
</tr>
<tr>
<td>Subyearling (summer/fall) Chinook</td>
<td>96.2</td>
</tr>
</tbody>
</table>

The JBS is used to protect downstream migrating juvenile salmonids. Fish passage operations at Wells Dam fall into two seasons, Spring Bypass and Summer Bypass. For 21 years, the status of the fish migration for both spring and summer periods was monitored by an array of hydroacoustic sensors placed in the forebay of Wells Dam. That monitoring data was used to establish that the operation period for the juvenile bypass begins in April and ends in August. Annual start and stop dates within that period are set by the HCP Coordinating Committee based on annually updated long-term monitoring, to bracket the run timing of greater than 95% of both the spring and summer migrants. Up to thirteen million juvenile salmonids annually migrate downstream past Wells Dam each year.

1.3.2.3 Flows in Excess of Hydraulic Capacity

The forebay elevation at Wells Dam is maintained between 781.0 and 771.0 msl. The Wells Project has a hydraulic generating capacity of 219 kcfs (ASL 2007) and a spillway capacity of 1,180 kcfs. In recent years however the Wells Project has had less than 200 kcfs generating capacity due to ongoing generator and turbine rebuild and upgrade projects.
The Wells Project is a “run-of-the river” project with a relatively small storage capacity (~98,000 acre ft). By comparison, Grand Coulee Dam, two projects upstream of Wells Dam, has a reservoir with 58 times the storage capacity of the Wells Reservoir. River flows in excess of the ten-turbine hydraulic capacity (219 kcfs) at Wells Dam must be passed over the spillways.

1.3.2.4 Flow in Excess of Power Demand

Spill may occur at flows less than the Wells Project hydraulic capacity when the volume of water is greater than the amount required to meet electric power system loads. This may occur during temperate weather conditions and when power demand is low or when non-power constraints on river control result in water being moved through the Mid-Columbia at a different time of day than when power is required (i.e. off-peak periods). Hourly coordination (Section 3.2) between hydroelectric projects on the river was established to maximize generation and minimize spill. Spill in excess of power demand provides benefit to migration juvenile salmonids because fish passing through the spillway survive at a higher rate relative to passage through a turbine. Turbulence in the tailrace generated by spill in excess of power demand increases tailrace velocity and reduces tailrace egress times. The reductions in tailrace egress time and increases in water turbulence and velocity reduce predation in the Wells tailrace.

1.3.2.5 Gas Abatement Spill

Gas Abatement Spill is used to manage TDG levels throughout the Columbia River Basin. The Technical Management Team (including NMFS, USACE, and Bonneville Power Administration [BPA]) implements and manages this spill. Gas Abatement Spill is requested from dam operators at other projects in the Columbia and Snake Rivers where gas levels are high. A trade of power generation for spill is made between operators, providing power generation in the river with high TDG and trading an equivalent amount of spill from a project where TDG is lower. Historically, the Wells Project has accommodated requests to provide Gas Abatement Spill. However, in an effort to limit TDG generated at the Wells Project, Douglas PUD has adopted a policy of not accepting Gas Abatement Spill at Wells Dam.

1.3.2.6 Other Spill

Other spill includes spill as a result of maintenance or plant load rejection. A load rejection occurs when the generating plant is forced off-line by an electrical fault, which trips breakers and shuts off generation. At a run-of-the-river hydroelectric dam, if water cannot flow through operating turbines, then the river flow that was producing power has to be spilled until turbine operation can be restored. These events are extremely rare, and would account for approximately 10 minutes in every ten years.

Maintenance spill is utilized for any activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include checking gate operation, conducting index and generator load testing and all other maintenance activities that would require spill to pass water. The FERC requires that all spillway gates be operated once per year. To control TDG levels associated with maintenance spill, Douglas PUD limits, to the extent practical, maintenance spill during periods of peak flow and high TDG.
1.3.3 Compliance Activities in Previous Year

1.3.3.1 Operational

Since the Wells Project is a “run-of-the-river” project with a relatively small storage capacity, river flows in excess of the ten-turbine hydraulic capacity must be passed over the spillways. Outside of system coordination and gas abatement spill (Douglas PUD has adopted a policy of not accepting the latter), minimization of involuntary spill has primarily focused on minimizing TDG production dynamics of water spilled based upon a reconfiguration of spillway operations. The 2009 Wells Project GAP (Le and Murauskas, 2009) introduced the latest numerical model developed by the University of Iowa’s IIHR-Hydroscience and Engineering Hydraulic Research Laboratories. The two-phase flow computational fluid dynamics tool was used to predict hydrodynamics of TDG distribution within the Wells Dam tailrace and further identify operational configurations that would minimize TDG production at the Project. In an April 2009 report, the model demonstrated that Wells Dam can be operated to meet the TDG exemption criteria during the passage season at flows up to 7Q-10 levels provided the forebay TDG levels are below 115 %. Compliance was achieved through the use of a concentrated spill pattern through Spillbay No. 7 and surplus flow volume through adjacent odd numbered spillways in a defined pattern and volume. These preferred operating conditions create surface-oriented flows by engaging submerged spillway lips below the ogee, thus increasing degasification at the tailrace surface, decreasing supersaturation at depth, and preventing high-TDG waters from bank attachment. These principles were the basis of the 2009 Wells Project Spill Playbook and were fully implemented for the first time during the 2009 fish passage (spill) season with success. Overall, no exceedances were observed in either the Wells Dam tailrace or the Rocky Reach forebay in 2009.

In 2010, the concepts from the 2009 Spill Playbook were integrated into the 2010 Wells Project Spill Playbook given their effectiveness in maintaining levels below TDG criteria during the previous year. High Columbia River flows in June, which exceeded the preceding 15-year average flow, resulted in several exceedances of the hourly (125 % maximum) and 12C-High (120 %) TDG limits in the Wells Dam tailrace, and Rocky Reach forebay (115 %). In response, Douglas PUD implemented an in-season analysis of the 2010 Spill Playbook and determined that full implementation of the recommendations from IIHR Engineering Laboratory would require the removal of the juvenile fish bypass system flow barriers in one even numbered spillbay. Following the in-season analysis and consultation with the HCP Coordinating Committee, changes were made to the 2010 Spill Playbook that allowed for the removal of the juvenile fish bypass system barriers in spillbay 6. Specifically, the Spill Playbook was modified to state that when spill levels approach the 53 kcfs threshold, the JBS barriers in spillbay 6 would be removed in order to remain in compliance with the TDG criteria in the Wells Dam tailrace and Rocky Reach Dam forebay. When spill exceeded 53 kcfs, excess spill would be directed through spillways 6 and 7 rather than through spillways 5 and 7. This operational configuration resulted in a more compact spill pattern that reduced the air-water interface surface area between spillway flows and the subsequent potential for lateral mixing and air entrainment.

In February 2011, Douglas PUD conducted an additional technical analysis of the 2010 Spill Playbook (after in-season changes) and confirmed that continued implementation would be appropriate for 2011 with additional minor modifications. Following approval of the 2011 GAP
by Ecology, the 2011 Spill Playbook was implemented. Only minor changes were made to the 2012 Spill Playbook as a result of high compliance during the 2011 spill season.

In December of 2012, the final GAP report was completed for the 2012 spill season. After analysis it was determined that the 2012 spill season had the 3rd highest average monthly flows since 1969 (April- August). In addition incoming flows from Chief Joseph Dam were reliably above 115 %. Despite these conditions Wells Dam demonstrated high compliance with all standards aside from the Rocky Reach Forebay 115 % 12C-High standard since incoming flows to Wells Dam were above 115 % greater than 50 % of the spill season days.

A Spill Playbook nearly identical to 2012, was employed in 2013-2014. One minor modification included the use of Spillways 5 and 6 when flows exceeded 40 kcfs instead of Spillway 7 since the prolonged rebuild of unit 7 precluded spilling over a loaded unit. Flows for the 2013 and 2014 fish passage season were lower compared to flows observed in the previous two years, which allowed Douglas PUD to reduce spill volumes and maintain normal bypass operations for great lengths of time compared to 2011 and 2012. In addition this resulted in improved TDG performance. The 2015 Spill Playbook returned to concentrating spill over 40 kcfs through Spillway 7 rather than 5 since unit 7 returned to service. Given the high compliance with the TDG adjusted criteria and considering the incoming TDG conditions, no changes are suggested for the 2016 Spill Playbook.

1.3.3.2 Structural

No structural modifications were implemented (none were scheduled) during the 2015 fish passage season. Unit 10 is schedule for rebuild in June or July of 2016, but is not expected to affect Spill Playbook or GAP implementation. No other structural modifications are expected in 2016.

1.3.3.3 Biological Monitoring

NMFS has shown that Gas Bubble Trauma (GBT) is low if the level of TDG can be managed to below 120 % (NMFS 2000). They recommend that “the biological monitoring components will include smolt monitoring at selected smolt monitoring locations and daily data collection and reporting only when TDG exceeds 125 % for an extended period of time.” Since the early 2000’s, Douglas PUD has monitored smolts at the Rocky Reach Juvenile Bypass Sample Site and Wells Dam adult fish ladders on days following 125 % observed exceedances in the Wells Tailrace.

1.3.4 Compliance Success in 2015

Three standards are monitored closely during the juvenile fish passage season towards determining effectiveness and developing the subsequent year’s GAP. TDG compliance during the juvenile fish passage season was exceptional in 2015.

**Wells Tailrace 125% hourly standard**

No exceedances occurred in 2015.
**PROPOSED OPERATIONS AND ACTIVITIES**

### 2.1 Operational Spill

Based on the Wells Project’s improved TDG performance as a result of 2012-2015 operations associated with implementation of the Wells Project Spill Playbook, similar operating principles will be implemented for the 2016 juvenile fish passage season.

The 2016 Spill Playbook proposes to shift concentrated spill to spillway 7. In 2011-2014 concentrated spill was met using Spillways 5 and 6 since unit 7 was being rebuilt and spill over unit 7 would not be able to make use of generation flows leaving the draft tube of unit 7. Douglas PUD is proposing concentrating spill through unit 7. Spillway 7 was selected because spill through this bay can be more reliably supported by discharge from adjacent turbine units. The turbine discharge from units 6 and 7 are expected to further enhance the surface jet being spilled through Spillway 7. The 2016 Spill Playbook is attached as Appendix 1.

In addition to minimizing involuntary spill through the implementation of the Spill Playbook, Douglas PUD shall manage spill toward meeting water quality criteria for TDG during all flows below 7Q-10 as follows:

- Minimize voluntary spill through operations including to the extent practicable, by scheduling biannual maintenance\(^1\) based on predicted flows;
- Avoid spill by continuing to coordinate operations with upstream dams, to the extent that it reduces TDG;
- Maximize generation and powerhouse discharge, especially during periods of high river flows; and
- During fish passage season, manage voluntary spill levels in real time in an effort to continue to meet TDG numeric criteria.

### 2.2 Implementation

#### 2.2.1 Fisheries Management Plans

Juvenile salmon and steelhead survival studies conducted at the Wells Project in accordance with the HCP have shown that the operation of the Wells Project, of which the JBS is an integral part, provides an effective means for outmigrating salmon and steelhead to pass through the Wells Project with a high rate of survival (Bickford et al. 2001, Bickford et al. 2011) (Table 3). The

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\(^1\) Biannual maintenance is the regular schedule maintenance that units would regularly receive. This maintenance would not include the long term outage of the ten generating unit that are being completely rebuilt one at a time.
Wells JBS is the most efficient juvenile fish bypass system on the mainstem Columbia River (Skalski et al. 1996). The Wells Anadromous Fish Agreement and HCP (Douglas PUD 2002) is the Wells Project’s fisheries management plan for anadromous salmonids, and directs operations of the Wells JBS to achieve the No Net Impact (NNI) standard for HCP Plan Species. The Aquatic Resource Management Plans (for white sturgeon, bull trout, Pacific lamprey, resident fish, water quality, and aquatic nuisance species) in the Wells Project’s Aquatic Settlement Agreement (developed in support of the pending Wells Project operating license) are the fisheries management plans for all other aquatic life designated uses.


<table>
<thead>
<tr>
<th>Species</th>
<th>% Project Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearling Chinook (2010)</td>
<td>96.4</td>
</tr>
<tr>
<td>Yearling Chinook and Steelhead (1998-2000)</td>
<td>96.2</td>
</tr>
</tbody>
</table>

In spring 2010, Douglas PUD conducted a survival verification study with yearling Chinook salmon, a required 10-year follow-up study to confirm whether the Wells Project continues to achieve survival standards of the Wells Anadromous Fish Agreement and HCP. Approximately 80,000 Passive Integrated Transponder (PIT)-tagged yearling summer Chinook were released over a 30 day period in 15 replicates. The study determined that juvenile Chinook survival from the mouth of the Okanogan and Methow rivers averaged 96.4 % over the 15 replicate releases of study fish (Table 4). This result confirms conclusions from the three previous years of study, and documents that juvenile fish survival through the Wells Project continues to exceed the 93 % Juvenile Project Survival Standard required by the HCP (Bickford et al. 2011).

The current phase designations (status of salmon and steelhead species reaching final survival determination) for the HCP Plan Species are summarized in Table 4. Specific details regarding survival study design, implementation, analysis, and reporting are available in annual summary reports prepared and approved by the Wells HCP Coordinating Committee.
Table 4. Wells Hydroelectric Project Habitat Conservation Plan Species Phase Designations.

<table>
<thead>
<tr>
<th>Species</th>
<th>Phase Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearling (spring) Chinook</td>
<td>Phase III(^2) – Standard Achieved (22-Feb-05)</td>
</tr>
<tr>
<td>Steelhead</td>
<td>Phase III – Standard Achieved (22-Feb-05)</td>
</tr>
<tr>
<td>Sockeye</td>
<td>Phase III – Additional Juvenile Studies (22-Feb-05)</td>
</tr>
<tr>
<td>Subyearling (summer/fall) Chinook</td>
<td>Phase III – Additional Juvenile Studies (22-Feb-05)</td>
</tr>
<tr>
<td>Coho</td>
<td>Phase III – Standards Achieved (16-Dec-15)</td>
</tr>
</tbody>
</table>

In 2016, Douglas PUD will continue to operate the Wells Dam adult fishways and the JBS in accordance with HCP operations criteria to protect aquatic life designated uses. Furthermore, all fish collection (hatchery broodstock and/or evaluation activities) or assessment activities that occur at Wells Dam will require approval by Douglas PUD and the HCP CC to ensure that such activities protect aquatic life designated uses.

Douglas PUD shall continue to operate the Wells Project in a coordinated manner that reduces forebay fluctuations and maintaining relatively stable reservoir conditions that are beneficial to multiple designated uses (aquatic life, recreation, and aesthetics). Coordinated operations with upstream projects reduces spill at Wells Dam and thus reduces the potential for exceedances of the TDG numeric criteria and impacts to aquatic life associated with TDG.

2.2.2 Biological Monitoring

As in past years, if hourly TDG levels exceed 125% in the tailrace of Wells Dam, Douglas PUD will conduct adult and juvenile salmonid GBT sampling. Douglas PUD will work with the Washington Department of Fish and Wildlife hatchery programs to monitor the occurrence of GBT on adult salmon collected in the Wells Dam and Wells Hatchery fishways. Upon collection of broodstock, hatchery staff will anesthetize each fish, place a marking identification tag on them and look for any fin markings or unusual injuries. It is expected that adult broodstock sampled for GBT will consist of spring and summer Chinook and sockeye since they are the species migrating through the Wells Project during fish spill periods where high TDG is a concern, however all encountered salmonids including steelhead and bull trout will be examined.

The JBS at Wells Dam does not have facilities to allow for juvenile fish sampling and observation. To address GBT sampling for juvenile anadromous salmonids, if hourly TDG levels exceed 125% in the tailrace of Wells Dam, Douglas PUD will request biological sampling of migrating juveniles for symptoms of GBT at the Rocky Reach juvenile bypass sampling facility on the subsequent business day to the exceedance. Target species for juvenile GBT sampling will consist of coho, sockeye, and yearling and subyearling Chinook and steelhead. If flood flows above 7Q-10 persist for extended timeframes (more than one week), sampling effort will be reduced to 3 days per week.

\(^2\) Phase III (Standards Achieved) = Juvenile Project Survival greater than or equal to 93 percent or combined juvenile and adult survival greater than or equal to 91 percent.
2.2.3 Water Quality Forums

Douglas PUD actively participates in regional water quality forums including those that include other hydroelectric operators on the mainstem Snake and Columbia Rivers. The USACE meets with PUD technical leads to review yearly data collections and completeness. In addition, Douglas PUD observes the Technical Management Team water management process, particularly in spring to understand river operations and actions designed to limit TDG production. Finally, Douglas PUD is involved in Columbia River Treaty actions that are dedicated to water quality considerations.

2.3 Water Quality Attainment Plan and Quality Assurance Project Plans

In November 2012, Douglas PUD received a new FERC operating license for Wells Project. As required by Douglas PUD’s Clean Water Act 401 Certification, a Water Quality Attainment Plan (WQAP) for TDG and a Quality Assurance Project Plan (QAPP) for water temperature and TDG were developed, approved by the Aquatic Settlement Work Group and the HCP CC and filed with the FERC for approval prior to Oct 31st of 2013 (within one year of license issuance). Both the WQAP and the QAPP were approved by the FERC in 2013.

The WQAP includes a compliance schedule to ensure compliance with TDG criteria within 10 years. The WQAP also allows time for the completion of the necessary studies or for the resolution of the issue of elevated incoming TDG from upstream projects through rule-making or other means. The WQAP was developed to meet the requirements of WAC 173-201A-510(5).

If implementing the compliance schedule does not result in compliance with TDG criteria at the time the compliance schedule expires, Douglas PUD may explore other alternative approaches available in the water quality standards, including a second compliance schedule or alternatives provided in WAC 173-201A-510(5)(g).

Specific measures in the WQAP that will be conducted in 2016 include:

1. Testing and modifying an adaptive Spill Playbook in and outside of fish passage season
   a. Douglas PUD will implement the Spill Playbook and track its progress towards improving TDG performance and assessing compliance capability.
2. Monitoring gas bubble presence in biota
   a. At TDG levels above 125 % in the Wells tailrace, Douglas PUD will initiate GBT monitoring. The collection of biological data serves two primary purposes. First, Douglas PUD is required to collect biological data to meet GAP requirements associated with the annual TDG adjustment for fish passage. Secondly, Douglas PUD’s 401 Certification identifies potential alternative approaches (e.g., use attainability analysis and site specific variance) as part of implementing the TDG compliance schedule (WAC 173-201A-510(5)(g).
3. Begin developing a Wells Project Database towards improved Project operations that might limit TDG production.
The development of a higher resolution Project operations database would better inform operations toward the improvement of TDG management. Operations and data parameters may include but are not limited to bypass barrier use and removal, unit flow, unit outages, spill gate flow and pattern, forebay/tailrace water surface elevation, incoming TDG, and water temperature. Douglas PUD will also work with Wells Dam engineers, technicians and plant operators to identify opportunities for operational optimization (e.g., spill gate availability, automation, potential utility of spillways 1 and 11, restrictions to bypass removal, etc.). While this process began in 2015, Douglas PUD will continue to develop the fine-scale operations database in 2016.

3.0 COMPLIANCE AND PHYSICAL MONITORING

3.1 Monitoring Locations

TDG monitoring has been implemented in the Wells Dam Forebay since 1984. Douglas PUD began monitoring TDG levels in the Wells Dam Tailrace in 1997 by collecting data from a boat and drifting through the tailrace at four points across the width of the river. During the transect monitoring, no TDG “hot spots” were detected; the river appeared completely mixed horizontally. A fixed TDG monitoring station was established in 1998. The placement of the fixed monitoring station was determined based upon the 1997 work and was further verified as collecting data representative of river conditions during a 2006 TDG assessment at Wells Dam (EES et. al. 2007). Results of the 2008-2009 TDG numerical modeling activities conducted by University of Iowa/IIHR also confirmed that the tailrace monitoring station is located at a site representative of the mixed river flow, particularly during higher flows. Furthermore, locations of both forebay and tailrace sensors had to be protected to avoid sensor/data loss and damage and for safe accessibility during extreme high flows. The current locations of both the forebay and tailrace monitors took these criteria into consideration.

Prior to November 2012, TDG monitoring at the Wells Project typically commenced on April 1 and continued until September 15, annually. This monitoring period encompasses the juvenile fish migration, the operation of the Wells JBS as well as when river flows are at their highest and when a majority of spill occurs. As of August 2013, Douglas PUD continued to collect TDG following the completion of the bypass period towards monitoring TDG outside of the spill and fish passage season (as required by the Wells Project 401 Certification). Currently, year round data from both forebay and tailrace sensors are transmitted by radio transmitters to a master radio at Wells Dam. This system is checked and calibrated monthly or more frequently, as required. TDG data are sent and logged at the Douglas PUD Headquarters’ building in 15-minute intervals. Information on barometric pressure, water temperature and river gas pressure is sent to the USACE on the hour over the Internet and uploaded in real-time to Douglas PUD’s public website (www.dcpud.org). The four data points (15 minute) within an hour are used in calculating the hourly compliance TDG values, the 24-hour TDG average and the 12C-High readings in a day (24-hour period).

In 2014, Douglas PUD installed and began operating an additional TDG sensor station in the Wells Reservoir located several miles downstream of Chief Joseph Dam and upstream from the Okanogan River (Washburn Island). This new TDG sensor station provides reliable mixed flow
TDG being generated at Chief Joseph Dam (Army Corps of Engineers studies show mixing of power house and spill flows at least 7 miles from Chief Joseph Dam) before being diluted by degassing processing at the surface water interface and diluted via tributary influence in the Okanogan River (Easthouse, 2012; pers. comm. with Mike Schneider, USACE). The current system operated by the USACE below Chief Joseph Dam collects TDG values primarily from the project’s spillways and does not provide a reliable measure of mixed flow (powerhouse and spillway combined) TDG values and therefore does not provide a reliable estimate of TDG headed for the forebay of Wells Dam. In 2016, Douglas PUD will continue to monitor TDG in the tailrace and forebay at Wells Dam but also at Washburn Island.

3.2 Quality Assurance

The broad purpose of a well-designed Quality Assurance Project Plan (QAPP) is to attain data of the type and quality needed to make future decisions surrounding the need, or lack thereof, for changes to project operation and construction related to compliance with TDG and temperature standards.

Douglas PUD developed a QAPP for TDG in 2013 in coordination with Ecology. The QAPP was filed on June 24th, 2013 and approved by the FERC on August 8, 2013. An important part of Douglas PUD’s Quality Assurance/Quality Control (QA/QC) program is the requirement that Douglas PUD’s water quality consultant visit each of the TDG sensor sites monthly for maintenance and calibration of TDG instruments. Calibration follows criteria established by the USACE, with the exception of monthly rather than bi-weekly calibration of sensors. A spare probe is available and field-ready at all times in the event that a probe needs to be removed from the field for repairs.

Douglas PUD started collecting TDG data year round beginning April 1, 2013 but spill season data (April – August) will be reported separately in an annual GAP report submitted to Ecology and the FERC. Real time data is available at dcpud.org consistent with reporting requirements found in Douglas’ 401 Certification.

3.3 Reporting

Upon approval of the Wells GAP and issuance of a Wells Project TDG exemption, Douglas PUD will submit an annual report to Ecology no later than February 28 subsequent to each year that the TDG exemption is approved. The annual report will summarize all GAP activities conducted for the prior year (i.e., annual report filed February 28, 2017 will be for all GAP activities conducted in 2016) as required by Ecology and the FERC. In addition to reporting on spill season compliance, the annual report will include TDG compliance outside the spill season (110%), per the 401 Certification Section 6.7 2) c) iii). Additional analyses for the annual report may include examining TDG production above and below Wells Dam to understand TDG production and abatement through the Wells Project. For example, Douglas PUD may plot TDG profiles at the Grand Coulee forebay, Grand Coulee tailrace, Chief Joe forebay, Chief Joe tailrace, Wells forebay, Wells tailrace and Rocky Reach forebay over multiple time scales. Results will be shared with the Aquatic SWG, Ecology, and within water quality forums (see section 2.2.3).
4.0 CONCLUSIONS

Pending approval by Ecology, implementation of the measures identified within the 2016 GAP are intended to serve as a long-term strategy to maintain compliance with the Washington State WQS for TDG in the Columbia River at the Wells Project while continuing to provide safe passage for downstream migrating juvenile salmonids. In addition, the implementation of this GAP will be used as a tool to implement relevant measures identified in the Ecology-approved Wells Project WQAP.
5.0 LITERATURE CITED


Appendices
Appendix 1  Wells Hydroelectric Project Spill Playbook
I. No Forced Spill

The Wells Dam JBS should be operated continuously throughout the juvenile salmon outmigration (April 9 to August 19 for 2016). The standard Wells HCP operating criteria, as described in Section 4.3.1 of the Wells HCP, will apply to the 2016 operating season. The operating criteria includes requirements that at least one bypass bay be operated during the entire JBS season, requires that no turbine is operated without an adjacent bypass bay being open and requires that all five bypass bays be operated continuously for 24 hours when the Chief Joseph Dam uncoordinated discharge estimate for that day is 140 kcf/s or greater. The Wells JBS is normally operated with 1.7 kcf/s passed through S2 and S10, and 2.2 kcf/s through S4, S6, and S8. Figure 1 (below) assumes that the Chief Joseph Dam uncoordinated discharge estimate is greater than 140 kcf/s or sufficient turbines units are operating that all five bypass bays are open.

![Figure 1](image.png)

Figure 1. Operational configuration under no forced spill (JBS only).
I. Total Spill ≤ 53.0 kcfs, JBS barriers in place

As forced spill increases, Project Operators should allocate all spill through S7 until the maximum capacity is reached through that spillbay (~43.0 kcfs). Note that S7 spill requires support of generation flows from units 6 and 7 to minimize TDG production. This, along with the already established JBS spill (10.0 kcfs) would equal 53.0 kcfs (Figure 2). Over 90% of the spill events over the past decade could have been handled under this configuration.

Figure 2. Operational configuration under spill ≤ 53.0 kcfs (including JBS).
II. JBS Barrier Removal Criteria

When either of the following occurs, remove the JBS barrier in S6:

Spill in S7 reaches 30 kcf and total spill is expected to exceed 40 kcf for more than 8 hours, or total spill is expected to exceed 53 kcf. After the JBS barrier is removed from S6 and when flow through S7 is at least 30 kcf, shift 15 kcf to S6 (Figure 3). It is best to have generating units 6, 7, and 8 operating to support this spill configuration. Once at least 15 kcf is being spilled through S6, spill can be allocated to S7 until 43.0 kcf is reached.

![Figure 3](image-url)  

**Figure 3.** Operational configuration once spill reaches 30 kcf in S7 and is expected to be above 40 kcf for more than 8 hours (JBS removed). Shift sufficient spill from S7 to maintain a minimum of 15 kcf spill at S6. Note that the 15.0 kcf includes the existing 2.2 kcf JBS flow.
III. Short duration decreases in Forced Spill (<53.0 kcfs) and JBS Barriers in S6 Removed

If after removal of JBS barrier in S6, total spill drops below 53 kcfs (between 10-53 kcfs), and is expected to stay in this range for only a short period (4 days or less), direct spill through S6 up to 15 kcfs (total spill < 22.9 kcfs). When total spill exceeds 22.8 kcfs, direct the remainder of spill through S7.

IV. Forced Spill (> 53.0 kcfs) and JBS Barriers in S6 Removed

After S7 reaches 43.0 kcfs, additional spill should be allocated to S6 (S6 is already spilling at least 15.0 kcfs needed to fully engage the submerged spillway lip below the ogee). As flow increases, spill should continually increase through S6 until paired with S7 (e.g., 43.0 kcfs through S7 and 26.0 kcfs through S6) (Figure 4). Eventually, S6 will reach 43.0 kcfs (93.8 kcfs, Figure 5).

![Figure 4. Operational configuration under forced spill > 53.0 kcfs (including JBS flow, with removal of JBS barriers in S6). In this instance spill has reached the 43.0 kcfs maximum in S7 and additional spill is being allocated to S6 (26.0 kcfs).](image-url)
Figure 5. Operational configuration under forced spill > 53.0 kcfs (including JBS). In this instance (93.8 kcfs of spill), S6 has been fully allocated and 43.0 kcfs is now allocated through both S7 and S6.

V. Forced Spill (> 93.8 kcfs) and JBS Barriers in S6 Removed

After both S7 and S6 reach 43.0 kcfs, spill can also be allocated to S5. Since a minimum of 15.0 kcfs is needed to fully engage the submerged spillway lip below the ogee, spill through S6 should be relocated to S5 (Figure 6). As flow increases, spill can be continually increased through S5 until paired with S6 (30.0 kcfs through S6 and S5, while S7 continues at 43.0 kcfs). After this point, both S6 and S5 can be increased until all three spillways have reached 43.0 kcfs (136.8 kcfs of spill, Figure 7).
Figure 6. Operational configuration under forced spill > 96.0 kcfs. In this instance (96.8 kcfs of total spill), spill from S6 is relocated to S5 to maintain concentrated flow with S7. A spill of 16.0 kcfs is maintained in S5 as to engage the submerged spillway lip.
VI. Forced Spill (> 136.8 kcfs)

Forced spill exceeding 136.8 kcfs rarely occurs (less than 0.5%). If these conditions arise and total river flow exceeds 246.0 kcfs, then 7Q-10 conditions are occurring and Wells Dam is exempt from the TDG standards. Under this situation, Project Operators may perform any combination of operations to ensure that flood waters are safely passed. Also, at this point, JBS barriers will likely be removed allowing additional flexibility to spill up to 43 kcfs each through S2, S4, S6, and S8. Project Operators may pass spill through S9 in a similar fashion to operations mentioned above (starting at a minimum of 15.0 kcfs to ensure that spillway lips are engaged).

VII. JBS Re-Installment Criteria

Once spills of less than 40.0 kcfs are predicted for at least four days, JBS barriers should be re-installed in S6.
# II. Spill Lookup Table

<table>
<thead>
<tr>
<th>Operation</th>
<th>Total Spill</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S8</th>
<th>S9</th>
<th>S10</th>
<th>S11</th>
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</thead>
<tbody>
<tr>
<td>I. No Forced Spill</td>
<td>10.0</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
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<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
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<tr>
<td>II. Spill (≤ 53.0 kcfs), min.</td>
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<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>0.0</td>
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<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>II. Spill (≤ 53.0 kcfs), max.</td>
<td>53.0</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
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<td>43.0</td>
<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
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<tr>
<td>III. Spill (&gt; 53.0 kcfs, S6 JBS out), min.</td>
<td>54.0</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>0.0</td>
<td>15.0</td>
<td>31.2</td>
<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>III. Spill (&gt; 53.0 kcfs, S6 JBS out), max.</td>
<td>93.8</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>0.0</td>
<td>43.0</td>
<td>43.0</td>
<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>IV. Spill (&gt; 93.8 kcfs, S6 JBS out), min.</td>
<td>96.8</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>16.0</td>
<td>30.0</td>
<td>43.0</td>
<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>IV. Spill (&gt; 93.8 kcfs, S6 JBS out), max.</td>
<td>136.8</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>43.0</td>
<td>43.0</td>
<td>43.0</td>
<td>2.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
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<tr>
<td>V. Spill (&gt;137.0 kcfs), min.</td>
<td>137.0</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>2.2</td>
<td>28.2</td>
<td>43.0</td>
<td>43.0</td>
<td>2.2</td>
<td>15.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>V. Total Flow (&gt;246 kcfs), max.</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Operators may adjust as needed.

TDG exemption in place when total river flows exceed 246.0 kcfs.

Notes: (1) No spill through S1 and S11 as to minimize interference with fish ladders. (2) Even-numbered spillways are designated as the Juvenile Bypass System (JBS). (3) Primary spillways for forced spill are S7, S6, S5, S9, and S3 (in that order).
APPENDIX B – 2016 BYPASS OPERATING PLAN – WELLS PROJECT
Appendix 2  Wells Bypass Operating Plan
Operation of the Wells Dam juvenile bypass system throughout the 2016 season will follow the criteria contained within the Wells Dam Juvenile Dam Passage Survival Plan found in Section 4.3 of the Wells HCP, which specifies a goal of providing bypass operations for at least 95 percent of both the spring and summer migrations of juvenile Plan Species.

Since 2012, bypass operations at Wells Dam have commenced on April 9 and ended on August 19. Annual analyses of bypass performance indicate that these dates of bypass operations provide bypass passage during 98 to 100 percent of the migrations of all Plan Species. Based upon this high level of compliance with the HCP bypass operating criteria (exceeding the 95% bypass-passage criteria for the migrations of all plan species), Douglas PUD proposes to commence operation of the bypass system in 2016 starting at 00:00 on April 9 and to end operations at 24:00 hours on August 19.

Dam safety emergency action planning, as required by the Federal Energy Regulatory Commission (FERC), calls for Douglas PUD to operate Wells Dam with sufficient automatic-gate-opening capacity in the spillways to pass the flow from a plant load-rejection of up to 200 thousand cubic feet per second (kcfs), in addition to any concurrent initial spillway discharge. Of the 11 spillways at Wells Dam, only spillways 3 through 9 have automated gate hoists. Thus, the seasonal installation of bypass barriers in spillways 2, 4, 6, 8 and 10, substantially reduces the automatic-gate-opening capacity of Wells Dam by reducing the capacity of each bypass spillway to 8.6 kcfs. Consequently, Douglas PUD must remove bypass barriers systematically when discharge-volume estimates exceed certain thresholds, as per Table 1, sufficient to provide the necessary automatic-gate-opening flow capacity as described in Appendix I of the FERC-required Emergency Action Plan for the Wells Project. Douglas PUD will make decisions to remove bypass barriers for dam-safety considerations each Monday (or at other times as necessary) during the bypass period based on weekly forecasts of combined discharge from Chief Joseph Dam and side-flows from the Okanogan and Methow rivers (from the National Weather Service Northwest River Forecast Center [NWRFC]).

Table 1. Schedule for removal of spillway flow-barriers (bypass barriers) to accommodate flood flows and load rejections.

<table>
<thead>
<tr>
<th>Inflow Forecast (kcfs)</th>
<th>Bypass Barriers Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 200</td>
<td>None</td>
</tr>
<tr>
<td>200 – 240</td>
<td>Spillway 6</td>
</tr>
<tr>
<td>240 – 275</td>
<td>Spillways 6, 8</td>
</tr>
<tr>
<td>275 – 310</td>
<td>Spillways 4, 6, 8</td>
</tr>
<tr>
<td>310 – 350</td>
<td>Spillways 4, 6, 8, 10, &amp; preset gates 10, 11 to spill excess of 312 kcfs</td>
</tr>
<tr>
<td>350 – 400</td>
<td>Spillways 4, 6, 8, 10, &amp; preset gates 1, 10, 11 to spill excess of 312 kcfs</td>
</tr>
<tr>
<td>400 – 450</td>
<td>All spillways (2, 4, 6, 8, 10)</td>
</tr>
</tbody>
</table>
Juvenile Fish Bypass Operations and Clean Water Act TDG Compliance

Seasonal bypass operations generally coincide with the spring freshet, an event during which operators of hydroelectric projects must cope with flows that often exceed the hydraulic capacity of their powerhouses. During such events, project operators must pass water via the spillway as “involuntary spill,” which increases the concentration of atmospheric gases in the water below hydroelectric projects, and can result in levels of total dissolved gas (TDG) that may injure fish. To minimize the potential for fish injury, the Washington Department of Ecology (WDOE) imposes TDG standards on operators of hydroelectric projects.

Extensive modeling and study of spill operations at Wells Dam provide the basis for the development of annual “spill playbooks” for dam operations aimed at achieving the WDOE standards for TDG. These spill playbooks prescribe spillgate configurations to implement under various flow scenarios. From modeling and physical-spill studies, Douglas PUD determined that concentrating spill through the middle of the spillway and on top of turbine discharge results in the most effective minimization of TDG. The best TDG performance is achieved when concentrating involuntary spill through Spillway 7, and allocating additional spill, beyond the capacity of Spillway 7, to Spillways 6 and then 5, up to a maximum of 43 kcfs per spillway.

To accomplish this TDG-minimizing pattern of concentrated spill requires the removal of the bypass barriers from at least one spillway during periods of excessive involuntary spill. The removal of the bypass barriers from one spillway takes approximately eight hours and requires the use of a four-man mechanical crew and the powerhouse gantry cranes. To comply with the TDG standards below Wells, the bypass barriers must be removed from at least one spillway whenever involuntary spill exceeds 30 kcfs and one or both of the following conditions applies: 1) prolonged (> 8 hours) involuntary spill in excess of 40 kcfs is predicted (based on forecasted tributary inflows from the NWRFC and estimated discharge from Chief Joseph Dam provided by the US Army Corps of Engineers); or 2) total spill is predicted to exceed 53 kcfs, regardless of duration. Once involuntary spill of less than 40 kcfs, for a period of at least four days is predicted, the respective bypass barriers would be reinstalled. At river flows greater than 240 kcfs, bypass barriers would be removed from additional bypass bays as described above (see Table 1) and reinstalled sequentially as appropriate.

Juvenile Fish Bypass Contingency Plan

Following the failure of a gate-hoist cable in a bypass spillway at Wells Dam in late August 2010, Douglas PUD developed a contingency plan for bypass operations during an accident or unanticipated mechanical failure that would preclude normal bypass operations. High river discharge in 2011 and 2012 led to the incorporation of provisions for the management of TDG into the Bypass Contingency Plans in 2013. The 2016 Bypass Contingency Plan continues those provisions, as described below.

Section 4.3 of the Wells HCP directs Douglas PUD to shut down the turbine units adjacent to a bypass spillway that is not operating due to either low flow or an inability to operate the bypass spillway. Under the 2016 Bypass Contingency Plan, if shutting down the turbines would not threaten compliance with TDG standards, Douglas PUD would shut down the associated turbine units. However, if doing so would threaten compliance with TDG standards, Douglas PUD would not shut down the associated turbines but would instead direct spill through spillways...
adjacent to the affected turbine units in a manner that provides bulk flow for fish passage while minimizing TDG (Figure 1, Option 1). Douglas PUD would consult the Spill Playbook (see above) to select such spill configurations, and would spill at least 10 kcfs through selected spillways to engage the submerged flip-lip as a TDG minimization measure and to provide bulk flow for fish attraction to the surface passage route. In circumstances where turbine shutdown would not jeopardize TDG compliance, Douglas PUD would shut down the associated turbine units to evaluate and repair the malfunction, but may then elect to move the bypass barriers from the inoperative bypass spillway to an adjacent, non-bypass spillway to obtain the use of an additional turbine unit (see Figure 1, options 2 and 3). The gate for that substitute bypass spillway would then be set at the standard 1-foot opening for bypass spillways and the adjacent turbine unit(s) could be operated without constraints. This configuration would meet the intent of HCP Section 4.3 by providing bypass spill immediately adjacent to every operating turbine unit and would comply with the goal of the Total Dissolved Gas Abatement Plan.

During the repair of a bypass malfunction, Douglas PUD would daily reevaluate forecasts of Chief Joseph Dam discharge, tributary inflows, and TDG conditions, as well as repair progress, and determine which bypass option to implement as per Figure 1.

**Figure 1.** Evaluation flow chart for daily decisions regarding bypass, spill, and turbine operations during a bypass malfunction.
APPENDIX C – PRE-FILING CONSULTATION RECORD FOR THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN
NOTICE TO THE HABITAT CONSERVATION PLAN COORDINATING COMMITTEE TO REVIEW THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN
Hi HCP-CC: please see the email below from Tom and the attached Draft 2016 Wells Dam Gas Abatement Plan (GAP) and Bypass Operating Plan (BOP) for review. The attached draft plan is available for a 35-day review period, with comments due to Tom by Wednesday, February 10, 2016.

The attached draft plan is also available for download from the HCP Coordinating Committees Extranet site under: Draft Documents (instructions below). Thanks! –kristi 😊

**Instructions:**
To gain access to the HCP Coordinating Committees Extranet Homepage, please use the following procedure:

* Visit: [https://extranet.dcpud.net/sites/nr/hcpcc/](https://extranet.dcpud.net/sites/nr/hcpcc/)
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the HCP CC homepage.

If you encounter problems, or need a login username and password to access the site: Please feel free to contact me or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

ANCHOR QEA, LLC  
[kgeris@anchorqea.com](mailto:kgeris@anchorqea.com)

T  509.491.3151 x104  
C  360.220.3988

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Hi Kristi,

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From: Tom Kahler [mailto:tomk@dcpud.org]
Sent: Wednesday, January 06, 2016 9:56 AM
To: Kristi Geris <kgeris@anchorqea.com>
Cc: John Ferguson <jferguson@anchorqea.com>; Shane Bickford <ShaneB@dcpud.org>; Andrew Gingerich <andrewg@dcpud.org>
Subject: Draft 2016 GAP/BOP for CC review

Hi Kristi,
I’ve attached the draft 2016 Gas Abatement Plan/Bypass Operating Plan (GAP/BOP) for CC review. We need approval of these combined documents by Feb. 10, and thus we request a 35-day review (besides, 30-day reviews are so 2015). Rather than add the confusion of multiple documents to review, I’m sending a review draft of the combined document that we’ll send to FERC, in which the BOP is Appendix 2. While the annual approval of the BOP has been the purview of the CC for years, the HCP specifies nothing regarding a GAP document. However, recall that in the 2012 FERC license for Wells, FERC, at the request of Ecology, required the coordination of the annual development of the GAP and BOP and that the development of the GAP occur in “consultation” with the CC. The CC review of both documents fulfills the FERC license requirements and our HCP needs.

Thanks,

Tom Kahler
Fisheries Biologist
PUD No. 1 of Douglas County
509-881-2322, work
509-679-1232, cell
NOTICE TO THE AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN
Hi Aquatic SWG: please see the email below from Andrew and the attached Draft 2015 Wells Dam Gas Abatement Plan (GAP) and Total Dissolved Gas (TDG) Report and Draft 2016 Wells Dam GAP and Bypass Operating Plan (BOP) for review. The attached draft 2015 report and draft 2016 plan are available for a 30-day review period, with comments due to Andrew by COB Monday, February 8, 2016. Douglas PUD will request approval of the draft 2015 report and draft 2016 plan during the Aquatic SWG meeting on February 10, 2016.

The attached draft 2015 report and draft 2016 plan are also available for download from the Aquatic SWG Extranet site under: Documents > All by Mtg Date > 1/13/2016 (instructions below). Thanks! –kristi ☺

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using "Forms Authentication" (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site: Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris
ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

From: Andrew Gingerich [mailto:andrewg@dcpud.org]
Sent: Tuesday, January 05, 2016 5:04 PM
To: Kristi Geris <kgeris@anchorqea.com>
Subject: 2015 TDG report and 2016 Gas Abatement Plan/Bypass Operating Plan

Hi Kristi, please distribute to the technical reps within the Aquatic SWG. Please make sure that we include BIA, and BLM.
As I discussed during the December call, every year at this time Douglas PUD provides two documents to the Aquatic SWG for consideration. The first summarizes TDG compliance during the previous year and the second provides the plans that will be in place to provide safe and effective passage of juvenile salmonids, meet TDG criteria, and operate the Project safely. The latter of these documents get reviewed concurrently with the HCP CC per our 401 Certification and FERC license requirements. These two documents are:

1. 2015 Annual TDG (GAP) Report
2. 2016 Gas Abatement Plan and Bypass Operating Plan

The latter document is also required in order to obtain an Ecology’s approved TDG adjustment during the bypass season, which facilitates survival of downstream migrating fish. Both documents are attached for committee review and consideration. Douglas PUD is hoping to have them reviewed and approved by the Feb 10th call, since both are due to the FERC by Feb 28th.

Please let me know if you have questions.

Andrew Gingerich  
Senior Aquatic Resource Biologist  
Public Utility No. 1 of Douglas County  
1151 Valley Mall Parkway  
East Wenatchee, WA 98802  
Office: (509) 881-2323
APPROVAL OF THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN FROM THE HABITAT CONSERVATION PLAN COORDINATING COMMITTEE
This memorandum provides a summary of action items, decisions, and documents out for review as agreed on at the Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans (HCPs) Coordinating Committees meeting that met at the Radisson Gateway Hotel, in SeaTac, Washington, on Tuesday, January 26, 2016, from 9:30 am to 12:00 pm. Attendees are listed in Attachment A. These action items include the following:

**ACTION ITEM SUMMARY**

- Douglas PUD will revise the Sub-yearling Chinook Salmon Life-history Study dates in the draft 2016 Wells HCP Action Plan, as discussed, and will provide the final plan to Kristi Geris for distribution to the Coordinating Committees (Item III-A). *(Note: Tom Kahler revised the plan, as discussed, and provided the final plan to Geris on January 27, 2016, which Geris distributed to the Coordinating Committees that same day.)*

- Douglas PUD will revise the historical flows language in the Draft 2016 Wells Dam Gas Abatement Plan (GAP) and Bypass Operating Plan (BOP), as discussed, and will provide the final plan, when available, to Kristi Geris for distribution to the Coordinating Committees (Item III-B).

- Douglas PUD will provide photographs of the lamprey entrance boxes installed in the low-level entrances at Wells Dam to Kristi Geris for distribution to the Coordinating Committees (Item III-C).

- Chelan PUD will discuss with Dr. John Skalski (Columbia Basin Research) possibly adjusting the Data Access in Real Time (DART) database outputs to better capture the
early portion (prior to June 1) of the annual subyearling Chinook salmon counts at the Rock Island Bypass (Item IV-A).

- Chelan PUD will add expected dates to receive Hatchery and Genetic Management Plan (HGMP) permits from the National Marine Fisheries Service (NMFS) to the Draft 2016 Rocky Reach and Rock Island HCP Action Plans, as discussed, and will provide the revised draft plans to Kristi Geris for distribution to the Coordinating Committees. Chelan PUD will request approval of the revised draft plans during the Coordinating Committees meeting on February 23, 2016 (Item III-B).

- Chelan PUD will develop a trip report regarding progress on the refurbishing of the Rock Island Dam right fish ladder sluice gate, RO4, following a site visit to the contractor's facilities in Massachusetts, and will provide the report to Kristi Geris for distribution to the Coordinating Committees (Item III-C).

- Chelan PUD will summarize potential operations scenarios for the Rock Island Dam right fish ladder operating with a bulkhead installed in place of the sluice gate, RO4, including potential effects on salmonid passage past the dam, and will provide the summary to Kristi Geris for distribution to the Coordinating Committees (Item III-C).

- Chelan PUD will provide weekly reports on the progress of repairing and installing the Rock Island Dam right fish ladder sluice gate, RO4, to Kristi Geris for distribution to the Coordinating Committees (Item III-C).

- Chelan PUD will notify the Coordinating Committees when the last denil structure is removed from the Rock Island Dam fishways (Item III-D).

- John Ferguson will discuss with Denny Rohr (Priest Rapids Coordinating Committee [PRCC] Facilitator) possibly holding both the PRCC and Coordinating Committees June 2016 meetings on June 21, 2016, and holding the 2016 Subyearling Chinook Salmon Workshop the next day on June 22, 2016 (Item V-A). *(Note: Ferguson discussed the topic with Rohr following the Coordinating Committees meeting on January 26, 2016.)*

- John Ferguson will communicate developing details about the 2016 Subyearling Chinook Salmon Workshop to the Coordinating Committees during the monthly Coordinating Committees meetings (Item V-A).

- Kristi Geris will contact Julene McGregor (Douglas PUD Information System Staff) to
request member access to the HCP Hatchery Committees Extranet site for Deanne Pavlik-Kunkel (Grant PUD), as approved by the Coordinating Committees, and will and coordinate with Sarah Montgomery (HCP Hatchery Committees support staff) about adding Pavlik-Kunkel to the requested HCP Hatchery Committees email distribution lists (Item V-A). (Note: Geris contacted McGregor and Montgomery following the Coordinating Committees meeting on January 26, 2016, about getting Pavlik-Kunkel Extranet access and on the distribution lists.)

- The Coordinating Committees meeting on February 23, 2016, will be held in-person at the Radisson Hotel in SeaTac, Washington (Item VI-C).

**DECISION SUMMARY**

- The Wells HCP Coordinating Committee representatives present approved the 2016 Wells HCP Action Plan, as revised (Item III-A).

- **The Wells HCP Coordinating Committee representatives present approved the 2016 Wells Dam GAP and BOP, as revised (Item III-B).**

- The Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the 2015 Rocky Reach and Rock Island Spill Report, as revised (Item IV-A).

**AGREEMENTS**

- The Rock Island HCP Coordinating Committee representatives present agreed to extend the 2015/2016 winter maintenance work period at Rock Island Dam by 15 days to allow more time to complete required work, contingent on Chelan PUD providing weekly reports on the progress of repairs. Rather than the typical March 1 completion date, the Rock Island fish ladder will be fully operational by March 15, 2016 (Item III-C).

- Coordinating Committees representatives present agreed to reschedule the Coordinating Committees meeting on June 28 to June 21, 2016, to accommodate the 2016 Subyearling Chinook Salmon Workshop (Item V-A).
Coordinating Committees representatives present agreed to provide Deanne Pavlik-Kunkel member access to the HCP Hatchery Committees Extranet site, and add Pavlik-Kunkel to the requested HCP Hatchery Committees email distribution lists (Item VI-A).

REVIEW ITEMS

Kristi Geris sent an email to the Coordinating Committees on January 22, 2016, notifying them that the Draft 2016 Rocky Reach and Rock Island HCP Action Plans were available for review. Chelan PUD will request approval of the draft plans during the Coordinating Committees meeting on February 23, 2016 (Item IV-B).

FINALIZED DOCUMENTS

The Final 2016 Wells HCP Action Plan, which was approved by the Wells HCP Coordinating Committee on January 26, 2016, was distributed to the Coordinating Committees by Kristi Geris on January 27, 2016 (Item III-A).
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Tracy Hillman††</td>
<td>BioAnalysts</td>
</tr>
<tr>
<td>Lance Keller*</td>
<td>Chelan PUD</td>
</tr>
<tr>
<td>Alene Underwood†††</td>
<td>Chelan PUD</td>
</tr>
<tr>
<td>Tom Kahler*</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Scott Carlon*</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>Jim Craig*</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Jeff Korth*</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Bob Rose*</td>
<td>Yakama Nation</td>
</tr>
<tr>
<td>Kirk Truscott**†</td>
<td>Colville Confederated Tribes</td>
</tr>
</tbody>
</table>

Notes:
* Denotes Coordinating Committees member or alternate
† Joined by phone
‡‡ Joined by phone for the HCP Tributary and Hatchery Committees Update
††† Joined by phone for the Chelan PUD agenda items
APPROVAL OF THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN FROM THE AQUATIC SETTLEMENT WORK GROUP
Final Meeting

Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties       Date: February 11, 2016

From: John Ferguson, Chairman (Anchor QEA, LLC)

Re: Final Action Items of the February 10, 2016 Aquatic SWG Meeting

Below is a summary of Action Items from the Aquatic SWG meeting that was held in-person at Wells Dam in Azwell, Washington, on Wednesday, February 10, 2016, from 10:15 a.m. to 12:00 p.m. Attendees are listed in Attachment A. These action items include the following:

I. Summary of Action Items

1. Bob Rose will discuss internally the Colville Confederated Tribes’ (CCT’s) proposed criteria for culling juvenile white sturgeon, and will report back to the Aquatic SWG (Item VI-1).
2. Steve Lewis will investigate what actions are required of agencies conducting Pacific lamprey translocation activities in the Mid-Columbia Basin, with regard to Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS; Item VI-1).
3. Bob Rose will provide a report detailing the 2015 Yakama Nation (YN) Lamprey Translocation Releases in the Methow Basin, and the YN Pacific Lamprey Supplementation and Monitoring Frameworks, once available, to Kristi Geris for distribution to the Aquatic SWG (Item VI-1).
4. John Ferguson will follow-up with Bob Rose regarding YN approval of the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3).
5. The Aquatic SWG meeting on March 9, 2016, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. The Aquatic SWG members present approved the 2015 Juvenile Lamprey Habitat Evaluation Study Report (Item VI-2).
2. The Aquatic SWG members present approved the 2016 Lamprey Approach, Passage, and Enumeration Study Plan, as revised (Item VI-3).

3. The Aquatic SWG members present approved the 2016-2017 Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir Study Plan, contingent on incorporating comments received from USFWS, which were reviewed and discussed during the meeting on February 10, 2016 (Item VI-4).

4. The Aquatic SWG members present approved the 2015 Wells Dam Gas Abatement Plan (GAP) and Total Dissolved Gas (TDG) Report, contingent on approval by the Washington State Department of Ecology (Ecology; Item VI-5).

5. The Aquatic SWG members present approved the 2016 Wells Dam GAP and Bypass Operating Plan (BOP), contingent on approval by Ecology (Item VI-6).

6. The Aquatic SWG members present approved the 2016 Aquatic Settlement Agreement (ASA) Action Plan (Item VI-7).

III. Agreements

1. The Aquatic SWG members present agreed to a March 1, 2016, deadline to transfer surplus white sturgeon offsite that are in excess of the Douglas PUD 5,000-fish White Sturgeon Program, in order to grow program fish to the target size at release (Item VI-9).

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on February 8, 2016, notifying them that the Draft 2015 Aquatic Nuisance Species Management Plan Annual Report is available for a 30-day review period, with edits and comments due to Chas Kyger by Tuesday, March 8, 2016.

V. Documents Finalized

1. The Final 2016 Wells Dam GAP and BOP that was approved by the Aquatic SWG on February 10, 2016, and by the Wells Habitat Conservation Plan (HCP) Coordinating Committee on January 26, 2016, was distributed to the Aquatic SWG by Kristi Geris following the Aquatic SWG meeting on February 10, 2016 (Item VI-6).

2. The Final 2015 Juvenile Lamprey Habitat Evaluation Study Report that was approved by the Aquatic SWG on February 10, 2016, was distributed to the Aquatic SWG by Kristi Geris on February 11, 2016 (Item VI-2).
## Attachment A

### List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chad Jackson</td>
<td>Technical Support</td>
<td>Washington Department of Fish and Wildlife</td>
</tr>
<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
</tr>
</tbody>
</table>
APPROVAL OF THE 2016 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN
FROM WASHINGTON DEPARTMENT OF ECOLOGY
February 18, 2016

To: Andrew Gingerich, Douglas County PUD

From: Charles McKinney, WA Dept. of Ecology, Water Quality Program

The Washington Department of Ecology (Ecology) has reviewed and approves the 2015 GAP and TDG report submitted by Douglas PUD for the Wells Project. Ecology has also reviewed and approves the 2016 Gas Abatement Plan, Spill Play Book and Bypass Operating plan.

Ecology grants PUD District No. 1 of Douglas County an adjustment to the 110% TDG standard for the purposes of 2016 Spill Season, as authorized under WAC 173-201A-200(1)(f)(ii), in order to facilitate the passage of ESA listed salmonids at the Project.

Please let me know if you have any questions.
EXHIBIT A

TOTAL DISSOLVED GAS REDUCTION ALTERNATIVES ANALYSIS
Total Dissolved Gas Reduction Alternatives Analysis

WELLS HYDROELECTRIC PROJECT

FERC Project No. 2149

Prepared by:

HDR Engineering, Inc.
Portland, OR

and

Public Utility District No. 1 of Douglas County
East Wenatchee, WA

December 2014
# Table of Contents

1.0 INTRODUCTION .....................................................................................................................5

2.0 BACKGROUND ..........................................................................................................................5
   2.1 Wells Project Overview .......................................................................................................5
   2.2 Wells Dam ..........................................................................................................................8
   2.2.1 Spillway .......................................................................................................................9
   2.2.2 Fish Spill Program – Juvenile Fish Passage Facilities ............................................10
   2.2.3 Adult Fish Ladders .....................................................................................................12
   2.3 Mid-Columbia Hydroelectric System ........................................................................14
   2.3.1 Hourly Coordination Agreement .............................................................................14
   2.3.2 Wells Project Operations .........................................................................................16
   2.4 TDG Criteria and Regulatory Framework ................................................................17
   2.4.1 Designated and Beneficial Uses ..............................................................................18
   2.4.2 TDG in the Mid-Columbia River System ................................................................18
   2.4.2.1 Mid-Columbia River Non-Federal Projects .........................................................18
   2.4.2.2 Mid-Columbia River Federal Projects ................................................................19
   2.4.2.3 Federal Gas Abatement and Spill Priority ............................................................20
   2.5 Wells Project TDG Activities ......................................................................................22
   2.5.1 Relicensing Studies ....................................................................................................22
   2.5.1.1 TDG Production Dynamics Study .......................................................................22
   2.5.1.2 2007 Wells Project TDG Operations Playbook ..................................................23
   2.5.1.3 2008 Wells Project TDG Operations Playbook ..................................................24
   2.5.1.4 2008-2009 Numerical Model Development .........................................................25
   2.5.2 Post-relicensing TDG Compliance Activities ..........................................................27
   2.5.2.1 GAP and TDG Annual Reporting .......................................................................27
   2.5.2.2 Spill Playbook .......................................................................................................27
   2.5.2.3 Participation in Regional Work Groups .................................................................27
   2.5.2.4 TDG Monitoring Locations ................................................................................27
   2.5.3 Wells Project TDG Production ................................................................................28

3.0 METHODS ............................................................................................................................... 29
   3.1 Study Objective ..............................................................................................................29
   3.2 Alternatives Identification .............................................................................................29

4.0 ANALYSIS ............................................................................................................................... 30
   4.1 Operational Alternatives ...............................................................................................30
   4.1.1 Maximize Project Generation ..................................................................................30
   4.1.2 Scheduling Project Maintenance ...........................................................................31
   4.1.3 Modification of Existing Agreements ......................................................................32
   4.1.4 Gas Abatement Spill ...............................................................................................32
   4.2 Structural Alternatives ..................................................................................................33
   4.2.1 Spillway Flow Deflectors .......................................................................................33
   4.2.2 Submerged Outlets Through Elimination of Confinement Zone Downstream of Wells Dam ..........................................................................................................................34
   4.2.3 Baffled Spillway .......................................................................................................34
   4.2.4 Side Channel Spillway .............................................................................................34
   4.2.5 Additional Spillway ..................................................................................................35
List of Tables

Table 1. TDG Concentration of Water Received at Wells Dam during 2012 fish spill season (130 days) and Federal Hydrosystem Compliance above Wells Dam per applicable water quality standards ...................................................................................................................................................... 22

Table 2. Evaluation summary of total dissolved gas reduction alternatives at Wells Dam. .......... 39

List of Figures

Figure 1. Map of the Wells Hydroelectric Project in Central Washington. ........................................ 7

Figure 2. Wells Dam looking to the northwest. .................................................................................. 8

Figure 3. Wells Hydroelectric Project often referred to as a hydrocombine for its unique integration of spill/bypass barriers, turbine silos, and switchyard on the deck of the dam. ................. 9

Figure 4. Artistic drawing of the fish bypass system at Wells Dam, which has 92.0%, 95.3%, and 96.2% guidance efficiency for spring Chinook and steelhead, sockeye, and subyearling Chinook respectively. .......................................................................................................................................................... 11

Figure 5. Conventional staircase-type fish ladder at Wells Dam....................................................... 13

Figure 6. Water supply chamber located immediately adjacent to the collection gallery at the Wells Dam fish ladder. ......................................................................................................................................................... 13

Figure 7. Wells Dam water supply chamber and infrastructure within an individual pool .............. 14

Figure 8. Cross section view of Wells Dam Spillway/Bypass structure. The spillway lip is denoted by a black star, which acts to encourage water towards the surface improving degassing. ... 26
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**List of abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-C High</td>
<td>The highest TDG concentration in a day calculated as a rolling 12-hour average</td>
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<tr>
<td>401 Certification</td>
<td>Douglas PUD's Section 401 Water Quality Certification pursuant to the Clean Water Act</td>
</tr>
<tr>
<td>7Q10</td>
<td>The highest stream flow for seven consecutive days that would be expected to occur once in ten years</td>
</tr>
<tr>
<td>ASWG</td>
<td>Aquatic Settlement Work Group</td>
</tr>
<tr>
<td>BO</td>
<td>Biological Opinion</td>
</tr>
<tr>
<td>BPA</td>
<td>Bonneville Power Administration</td>
</tr>
<tr>
<td>CFD</td>
<td>Computational Fluid Dynamics</td>
</tr>
<tr>
<td>CFS</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CHQW</td>
<td>Chief Joseph Dam Tailrace TDG Sensor</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Assessment</td>
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<tr>
<td>Ecology</td>
<td>Washington Department of Ecology</td>
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<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>ESA</td>
<td>Endangered Species Act</td>
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<tr>
<td>FCRPS</td>
<td>Federal Columbia River Power System</td>
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<tr>
<td>FERC</td>
<td>Federal Energy Regulatory Commission</td>
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<tr>
<td>FPA</td>
<td>Federal Power Act</td>
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<tr>
<td>GAP</td>
<td>Gas Abatement Plan</td>
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<td>GBT</td>
<td>Gas Bubble Trauma</td>
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<tr>
<td>HCA</td>
<td>Hourly Coordination Agreement</td>
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<tr>
<td>HCP</td>
<td>Anadromous Fish Agreement and Habitat Conservation Plan</td>
</tr>
<tr>
<td>Hz</td>
<td>hertz</td>
</tr>
<tr>
<td>IIHR</td>
<td>Hydroscience and Engineering Laboratory of the University of Iowa</td>
</tr>
<tr>
<td>JBS</td>
<td>Juvenile Bypass System</td>
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<tr>
<td>KCFS</td>
<td>thousand cubic feet per second</td>
</tr>
<tr>
<td>KW</td>
<td>kilowatts</td>
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<tr>
<td>MSL</td>
<td>feet above mean sea level</td>
</tr>
<tr>
<td>MW</td>
<td>megawatt</td>
</tr>
<tr>
<td>NMFS</td>
<td>National Marine Fisheries Services</td>
</tr>
<tr>
<td>PCHB</td>
<td>Pollution Control Hearings Board</td>
</tr>
<tr>
<td>PIT</td>
<td>Passive Integrated Transponder</td>
</tr>
<tr>
<td>PUD</td>
<td>Public Utility District</td>
</tr>
<tr>
<td>RM</td>
<td>river mile</td>
</tr>
<tr>
<td>RPA</td>
<td>Reasonable and Prudent Alternatives</td>
</tr>
<tr>
<td>TDG</td>
<td>Total Dissolved Gas</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>USACE</td>
<td>United States Army Corps of Engineers</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>USBOR</td>
<td>United State Bureau of Reclamation</td>
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<tr>
<td>USFWS</td>
<td>United States Fish and Wildlife Service</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>VOF</td>
<td>Volume of Fluid</td>
</tr>
<tr>
<td>WAC</td>
<td>Washington Administrative Code</td>
</tr>
<tr>
<td>WEL</td>
<td>Wells Forebay TDG Sensor</td>
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<tr>
<td>WELW</td>
<td>Wells Tailrace TDG Sensor</td>
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<tr>
<td>WELWASH</td>
<td>Wells Project TDG Sensor at Washburn Island</td>
</tr>
<tr>
<td>WQAP</td>
<td>Water Quality Attainment Plan</td>
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<tr>
<td>WQS</td>
<td>Water Quality Standards</td>
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Executive Summary

Consistent with the Washington Administrative Code ((WAC) 173-201A-510(5)) and the Clean Water Act 401 Water Quality Certification (401 Certification) issued to Public Utility District No. 1 of Douglas County (Douglas PUD) to operate the Wells Hydroelectric Project (Wells Project or Project), Douglas PUD submitted a Water Quality Attainment Plan (WQAP) for Total Dissolved Gas (TDG) in October 2013. The Federal Energy Regulatory Commission approved the WQAP on December 20, 2013. Pursuant to the WQAP and Section 6.7(2)(e)(5) of the 401 Certification, within one year of WQAP approval (December 2014), a report summarizing all reasonable and feasible measures to meet Water Quality Standards (WQS) is required to be submitted to the Washington Department of Ecology (Ecology).

The objective of this TDG Reduction Alternatives Analysis (RAA) is to conduct a comprehensive evaluation of any alternatives, both operational and structural, that may improve Wells Project TDG management toward ultimately improving compliance with the TDG WQS criteria (Douglas PUD 2013b). As part of a literature review that focused on both site-specific and regional TDG abatement activities, a suite of operational and structural alternatives were identified and provided to a multi-disciplinary group (i.e., engineering, operations, regulatory, environmental, and power management staff) for review of potential operational, coordination, financial, regulatory, and environmental implementation concerns and whether additional alternatives should be included.

Each of the identified alternatives were evaluated against a set of criteria that included potential TDG benefits, cost (both capital and operations & maintenance), feasibility of operational implementation and any potential implications for generation, environmental resources and public use. As a result of the assessment, a number of different alternatives were identified that could result in some level of TDG benefit (although magnitude is unknown); however, a number of uncertainties were also identified for each alternative. Any further evaluation of any of the alternatives will require detailed site-specific assessment and in some cases require additional physical, hydraulic and financial evaluation to more accurately scope the TDG benefit relative to the implementation cost.

Per the Wells Project TDG WQAP, if by year 9 (2022), compliance schedule activities that include already approved adaptive operational activities (i.e., Spill Playbook and updated Wells Project operational database) and field evaluations of updated modeling scenarios indicate compliance with the TDG WQS are not yet achieved during specific conditions, Douglas PUD will then be required to implement another alternatives analysis which would include an updated section of this original TDG RAA.
1.0 INTRODUCTION

On November 9, 2012, the Federal Energy Regulatory Commission (FERC) issued a new operating license for the Wells Hydroelectric Project (Wells Project or Project) which is owned and operated by the Public Utility District No. 1 of Douglas County (Douglas PUD). Pursuant to the requirements of the Federal Power Act (FPA), the FERC adopted in its entirety, the conditions identified within the 401 Water Quality Certification (401 Certification) issued on February 27, 2012 by the Washington Department of Ecology (Ecology) pursuant to Section 401 of the Clean Water Act (CWA).

Section 6.7(2)(e) of the 401 Certification requires Douglas PUD to develop a Water Quality Attainment Plan (WQAP) for Total Dissolved Gas (TDG) within one year of the issuance of the new FERC license for the Wells Project. On October 21, 2013, Douglas PUD, pursuant to License Article 401, submitted to the FERC for approval a TDG WQAP (Douglas PUD 2013b). The WQAP was developed in consultation with and approved by Ecology. The FERC approved the WQAP on December 20, 2013.

A central component of the WQAP is the requirement for Douglas PUD to include a 10 year compliance schedule that provides a detailed strategy toward ensuring compliance with the state water quality standard (WQS) for TDG. Within 1 year of approval of the WQAP (i.e., year 1 of the compliance schedule - December 2014), Douglas PUD is required to identify reasonable and feasible alternatives that may be implemented at the Wells Project to meet the TDG WQS. The objective of the TDG Reduction Alternatives Analysis (RAA) is to conduct a comprehensive evaluation of any alternatives, both operational and structural, that may improve Project TDG management toward ultimately improving compliance with the TDG WQS criteria (Douglas PUD 2013b). If by year 9 (2022), compliance schedule activities that include field evaluations of updated modeling scenarios indicate compliance with the TDG WQS are not yet achieved during specific conditions, Douglas PUD will then be required to implement another alternatives analysis which would include an updated section of the original TDG RAA.

This TDG RAA has been developed consistent with the relevant requirements identified in the Wells Project 401 Certification (Section 6.7(2)(e)(v)) Ecology 2012) and Douglas PUD’s TDG WQAP (Douglas PUD 2013b). In Section 2.0, the RAA provides background information on the Wells Project, associated facilities and operations (including fish spill), and applicable TDG standards. Also in this section, TDG management within the Mid-Columbia River system relative to Wells Dam and historic and current Wells Project TDG activities are also described. Section 3.0 details the methods for identifying and evaluating TDG reduction alternatives. Section 4.0 summarizes the analysis of both operational and structural TDG reduction alternatives and Section 5.0 provides summary conclusions and next steps for TDG management at the Wells Project.

2.0 BACKGROUND

2.1 Wells Project Overview

The Wells Project is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph
Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (USACE); and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from Wells Dam.

The Wells Reservoir is 29.5 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project Boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet. The Wells Project is considered a “run-of-the-river” project due to its relatively limited storage capacity. The reservoir has 108 miles of reservoir shoreline, the overwhelming majority of which is undeveloped.

The Wells Project Boundary extends downstream of the Wells Anadromous Fish Agreement and Habitat Conservation Plan’s (HCP) tailrace definition to a point 1.2 miles downstream of the dam. The width of the tailrace at the downstream face of the powerhouse is 1,000 feet. The width of the tailrace at its widest point is approximately 1,900 feet. The tailrace begins at the exit of the draft tubes and consists of natural riverbed. Rock riprap lines the immediate left and right banks of the tailrace to prevent erosion during larger spill events. An excavated rock trap, approximately 13 feet deep and 30 feet wide, runs the length of the dam, immediately downstream of the draft tube exit sill. The trap was excavated into bedrock during construction based on the results of previous hydraulic modeling of tailrace scour. High spill volumes during early operations of the Project filled the rock trap with riverbed materials as predicted by the model studies. The trap was re-excavated in 1967 to remove the deposited materials. Accumulated materials are removed from the trap occasionally as part of normal operations of the Wells Project.

Tailwater elevations and velocities at the Wells Project are influenced by the reservoir formed by the Rocky Reach Dam located 42 miles downstream of Wells Dam. The tailwater elevation at the Wells tailrace is a result of both the flow of water through Wells Dam and the forebay elevation maintained by the Rocky Reach Project.
Figure 1. Map of the Wells Hydroelectric Project in Central Washington.
2.2 **Wells Dam**

The design of Wells Dam is unique compared to other mainstem Columbia River Projects. At Wells Dam the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. The hydrocombine structure is 1,130 feet long, 168 feet wide, with a dam top elevation of 795 feet above mean sea level (msl) (Figure 2).

Earth embankments extend from the hydrocombine to the west and east abutments. The west embankment is 2,300 feet long and 40 feet high, with a top elevation of 797 feet. The west embankment consists of a central impervious core with a filter zone on each side and gravel shells. The core extends to a trench below which provides an impervious cut-off to bedrock. The east embankment is 1,030 feet long with a maximum height of 160 feet above foundation level. The east embankment also has a top elevation of 797 feet. It extends from the hydrocombine to the east abutment. The east embankment consists of a central impervious core extending to the riverbed materials with filters and gravel and rockfill shells placed on each side of the core.

![Wells Dam looking to the northwest.](image)

**Figure 2.** Wells Dam looking to the northwest.
The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units (Figure 3) with an installed nameplate capacity of 774,300 kW and a maximum generating capability of 840,000 kW. The generating units are isolated in individual silo-like concrete structures 95 feet wide and 172 feet long with the spaces between the units serving as spillway and fish bypass bays. Each structure contains a vertical-shaft Kaplan turbine. The turbine passages (draft tubes) are located below the spillway bays. The Wells Project switchyard is located atop the hydrocombine deck at elevation 795 feet. Two parallel 230 kV transmission lines transport the power from Wells Dam to the grid. The average annual net\(^1\) energy production for water years 1989 through 2007 was 4,364,959 megawatt-hours (MWh), yielding a plant factor of 64\% (Douglas PUD 2010).

### 2.2.1 Spillway

Wells Dam contains eleven 46-foot-wide gated spillways capable of passing a total of 940 thousand cubic feet per second (kcfs) at normal full pool elevation of 781 feet msl, and 1,180 kcfs at maximum water surface elevation of 791 feet msl. Given the hydrocombine structure, spillbays are located directly above the powerhouse. Each spillway gate is 66 feet in height and composed of two sections or two leaf segments. The upper leaf is approximately 35 feet in height. The lower leaf is approximately 36 feet in height.

---

\(\text{Figure 3.} \quad \text{Wells Hydroelectric Project often referred to as a hydrocombine for its unique integration of spill/bypass barriers, turbine silos, and switchyard on the deck of the dam.}\)

---

\(^1\) Net energy generation equals gross generation minus station service and transmission losses.
The lower leaf of each spillway gate can be raised to release water from the Wells Reservoir when needed. The lower leaf can be raised to any increment from zero up to a normal maximum of 28 feet 6 inches. The lower leaves of gates 3 through 9 are attached by cable to stationary hoists. Raising the seven lower gate leaves to their normal fully-opened position can accommodate passage of 330 kcfs. The hoists that raise these lower gate leaves can be operated by push button from a control cabinet located next to each gate on the hydrocombine deck or from Wells Dam’s main control room (Figure 3). The lower leaves of gates 1, 2, 10, and 11 are raised by one of the two gantry cranes located on the hydrocombine deck. Raising the lower gate leaves of these four gates to their fully-opened position can accommodate passage of an additional 190 kcfs for a total spill of approximately 520 kcfs using the bottom gate leaves with a reservoir elevation of 781.0 feet. Dogging brackets along the sides of each gate provide support for the gates when raised. The upper gate leaves of spillways 2 and 10 are equipped with an automatic hoist for opening two sluiceways. These sluiceways are used to pass ice and debris.

For the handling of larger flows, the upper and lower leaves of the spillway gates can be raised using the gantry cranes and dogged at their maximum opening of 68.5 feet. Raising the upper gate leaves requires the removal of the stationary hoists and steel railings above the spillway gates by hoists. The 11 lower gate leaves can accommodate all but the most extreme spill events.

### 2.2.2 Fish Spill Program – Juvenile Fish Passage Facilities

Research in the mid-1980s demonstrated that a modest amount of spill would effectively guide a high proportion of the downstream migrating juvenile salmon and steelhead away from the turbines and into a surface oriented bypass system. The Wells Project juvenile bypass system (JBS) uses a barrier system to modify the intake velocities on all even numbered spillways (2, 4, 6, 8 and 10). Each spillway has three sections. The bypass system modified the spillway sections by the installation of fabricated steel barriers. The two outside barriers prevent flow from entering the spillway while the middle slotted barrier allows water to enter at a higher velocity than an unmodified spillway intake. The slotted barrier has an opening that is 16 feet wide and 72 feet deep. During bypass operations, the lower leaf gate on each of spillways 2, 4, 6, 8, and 10 is opened approximately 1 foot when an adjacent generating unit is operating. Spillways 2 and 10 are also configured to allow passage either through top spill at the sluiceways or through bottom spill. Since most juvenile salmon and steelhead migrate near the surface, with the help of the bypass system, they successfully pass Wells Dam and avoid the turbine intakes which are located much deeper in the forebay. The bypass system is in operation annually from mid-April until late-August. Because all 11 spillways may be needed during periods of extreme flows, the bypass barriers are designed to collapse when the spillway gates are opened more than 6 feet (Figure 4).
Figure 4. Artistic drawing of the fish bypass system at Wells Dam, which has 92.0%, 95.3%, and 96.2% guidance efficiency for spring Chinook and steelhead, sockeye, and subyearling Chinook respectively.

The JBS was completed in 1989 and has since proven to be the most efficient system on the mainstem Columbia River, providing high levels of fish protection that has met approval of the fisheries agencies and tribes (Skalski et al. 1996). The survival performance measures contained within the FERC-approved HCP have been consistently exceeded, with a four-year survival average of 96.3% for juvenile steelhead and Chinook salmon (Bickford et al. 2011a and 2011b).

The Wells Dam JBS operates continuously from early April through late August and passes up to 2,200 cubic feet per second (cfs) of water through each of the five JBS configured spillways. Under normal conditions the JBS will use roughly 6-8% of the total river flow for fish guidance. The increased spill passed through the JBS has minor influence on TDG production (~0-2%) while providing a non-turbine passage route for over 90% of the spring and summer migration of juvenile salmonids. Historic hydroacoustic data in combination with fyke netting efforts allowed the HCP Parties to identify dates for bypass operations to bracket 95% of the spring and summer juvenile salmon downstream migration. Since 2003, the JBS has been operated on a fixed schedule between April 12th and August 26th although in 2011, Douglas PUD evaluated past performance of the Wells Dam JBS operating dates relative to observed annual run timing (at the Rocky Reach Bypass) for both spring and summer migrants. With that data, a request was made to and granted by the HCP Coordinating Committee to revise operating dates.
in 2012 to start April 9th and end August 19th. These dates were also used in 2013 and 2014 to operate fish passage spill for migrating juvenile salmonids (A. Gingerich, pers. comm. 2014).

2.2.3 Adult Fish Ladders

Wells Dam has two adult fish ladders, one on each end of the hydrocombine. These ladders facilitate the upstream movement of migrating fish through Wells Dam. The two fish ladders at Wells Dam are conventional staircase-type fish ladders with 73 pools (Figure 5). The flow through the upper 17 ladder pools varies from 44 cfs at full reservoir to about 31 cfs at minimum reservoir level. To increase the flow to the 48 cfs required in the lower ladder pools, supplementary water is introduced into Pool 56 through a pipeline from the reservoir. Pools 67 and 68 of both fish ladders are equipped with adult passive integrated transponder (PIT) tag detection devices. Pool 64 of both fish ladders contains facilities for counting fish. Counts of fish by species and by ladder are made available on a daily basis through coordination with the USACE adult fish counting program and the University of Washington’s DART website. At Pool 40, each of the two fish ladders has provisions for sorting and trapping various species of fish.

At the bottom of each fish ladder, projecting downstream from the hydrocombine is the portion of the endwall structure that incorporates the functions of fish attraction and collection. Two turbine-driven pumps on each ladder deliver fish-attraction flows of 800 to 2,500 cfs (depending upon tailwater elevation) to the water supply chamber located immediately adjacent to the collection gallery (Figure 6). Flow from the supply chamber is discharged into the upper sections of the collection gallery and lower 22 pools where it is used to maintain an attraction velocity of 2 feet per second and is also discharged into the main collection gallery at the foot of the ladder through diffusion gratings (Figures 6 and 7). The total fishway flow from the turbine-driven pump(s) and the 48 cfs coming down the ladder from the forebay is discharged into the tailrace through a gated fish entrance at the downstream face of each collection chamber. The fish attraction system is operated to provide a 1.5-foot differential between the main collection gallery and tailwater by constantly adjusting the output of the fish pumps. Modification to ladder operations can only take place following approval by the Wells HCP Coordinating Committee.
Figure 5. Conventional staircase-type fish ladder at Wells Dam.

Figure 6. Water supply chamber located immediately adjacent to the collection gallery at the Wells Dam fish ladder.
2.3 **Mid-Columbia Hydroelectric System**

As the Columbia River enters the U.S. from Canada, it first flows into the 151-mile-long Lake Roosevelt, formed by Grand Coulee Dam. Starting at Grand Coulee Dam, there are seven hydroelectric facilities within a 200-mile stretch of the Columbia River. From upstream to downstream after Grand Coulee Dam, they are Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids. Together, these seven dams make up the mid-Columbia Hydroelectric System.

The seven dam mid-Columbia system contains a significant amount of active storage which serves to enhance the reliability and flexibility of the Northwest’s entire electric generation system. Over 90% of that usable storage resides at Grand Coulee. Overall, about 90% of the annual flow at the Wells Project is provided by controlled releases from Grand Coulee. The maximum flow capacity of the turbines at Grand Coulee is also significantly greater than that of the downstream hydroelectric projects. If each project were operated without regard for its effects on downstream projects, inefficiencies would occur. The desire for close coordination of the operations of the mid-Columbia River system has resulted in the development of a sophisticated Hourly Coordination Agreement (HCA) to optimize the use of water to achieve all of the following purposes including flood control, fish migration, navigation, agriculture, recreation, municipal and industrial use, cultural resources protection, thermal plant cooling, and power generation and regional electric system support (Douglas PUD 2010).

2.3.1 **Hourly Coordination Agreement**

In 1972, the owners of the seven dams of the mid-Columbia River system and their power purchasers entered into an agreement for a coordinated operation of the seven dams. The HCA was the result of discussions among all the affected parties. In general, the parties agreed to coordinate the operation of the projects to achieve the following objectives:
1. Coordinate the hydraulic operation of the projects for the purpose of optimizing the amount of energy from the available water consistent with the need to: (1) adjust the total actual generation to match the total requested generation, and (2) operate within all power and non-power requirements;

2. Provide flexibility and coordinated scheduling of project generation through centralized scheduling, and the use of composite scheduling and accounting procedures;

3. Minimize unnecessary changes in project generation to avoid frequent unit starts and stops; and

4. Reduce the amount of fluctuation in river flow that could otherwise occur without such coordination.

A total of 17 utilities receive a share of the output from the mid-Columbia system. The HCA requires that the power and non-power constraints of the individual projects be recognized in the coordination process. A goal of the HCA is to reduce the extent and rate of fluctuations in river levels as flow moves downstream from Grand Coulee to Chief Joseph, and from Chief Joseph Dam to Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams.

The HCA was originally signed for a one-year experimental period from July 1, 1972 to June 30, 1973. Twelve parties representing the federal government, the three mid-Columbia PUDs, and all of the power purchasers at that time signed the original agreement. In 1997, a new 20-year renewal agreement was signed extending the term of the agreement through June 30, 2017. Douglas PUD has executed the renewal agreement.

Each day, the non-federal Hourly Coordination participants provide an estimated schedule of desired generation from the lower five projects. The federal project operators provide an estimate of water expected to be discharged from Grand Coulee and Chief Joseph. Central River Control (Central), located in Ephrata, Washington, then determines an estimated operation schedule for the following day based on anticipated flows from the federal projects, reservoir levels, and expected load. Central River Control sends the schedule to each of the five lower projects. Each project then pre-schedules its operation, including hourly generation, for the following day based on Central River Control’s estimated operation schedule.

During real-time operation, each non-federal project sends Central River Control an uncoordinated load request signal every four seconds. Based upon the sum of these load requests, Central River Control’s computer system determines the allocation of generation required to meet both load demand and non-power constraints for the system. Central River Control operators use power generation characteristics and reservoir target elevations to establish desired generation and discharges. For example, during reverse load factoring (RLF) at Priest Rapids Dam for compliance with the Hanford Reach Fall Chinook Protection Program, maximum and minimum power settings are used to limit flow fluctuations downstream of Priest Rapids Dam during the day, and a target elevation is used to lower pool levels and increase Priest Rapids discharge at night.

More recently, Grand Coulee and Chief Joseph collectively have been providing much of the load-following requirements for the entire federal system in the Pacific Northwest. In 2008, the National
Marine Fisheries Service (NMFS) issued its Biological Opinion (BO) for the operation of the Federal Columbia River Power System (FCRPS). Included in this BO were requirements to maintain turbine operations within 1% of best efficiency at all lower Columbia and Snake River dams and a 1-foot reservoir level fluctuation limitation for the federal projects on the lower Snake River. This has limited the load-following capability of much of the federal power system resulting in an apparent shift of load-following to Grand Coulee and Chief Joseph, which tends to increase flow fluctuations and decrease flow predictability at the federal projects upstream of Wells Dam. The uncertainty in upstream federal discharge levels has a negative impact on the ability of the Wells Project to generate all of the water available.

2.3.2 **Wells Project Operations**

As described above, the Wells Project operates for both power and non-power purposes within the context of the mid-Columbia system. The Wells Project is a “run-of-river” facility in that, on average, daily inflow to the Wells Reservoir equals daily outflow. This run-of-river operation reflects not only the Project’s role as part of the mid-Columbia system, but also the very limited usable storage capacity of the Wells Reservoir when compared to the average daily flows being discharged from Chief Joseph and Grand Coulee.

The Wells Project has a water right for 220 kcfs for power production with an impoundment gross storage right of 331,200 ac-ft (97,985 ac-ft is usable storage). The Wells Project is authorized to maintain its reservoir level between elevation 781 and 771 feet for power and non-power purposes. Through the period from 2003 to 2007, the reservoir elevation was maintained at or above 774 feet 99.7% of the time. Reservoir fluctuation is less than 2.5 feet about 90% of the time and less than 4 feet about 98% of the time (Douglas PUD 2010).

The daily operation of the Wells Project is influenced by the following factors: (1) FERC license requirements; (2) natural stream flows; (3) regulation of upstream storage reservoirs in the U.S. and Canada; (4) regulation of water releases from upstream power projects on an hourly basis to meet changing power demands; (5) actions in response to fish, wildlife, and other environmental regulations; and (6) variable power demands within Douglas and Okanogan counties and under the long-term power sales contracts with Puget Sound Energy, Inc. (PSE), Portland General Electric Company (PGE), PacifiCorp, and Avista Corporation (collectively, Power Purchasers). Section 3.1 of the Wells Project Final License Application – Exhibit B (Douglas PUD 2010) describes all agreements affecting current Project operations (e.g., HCP, Aquatic Settlement Agreement, Encroachment on Chief Joseph Dam, Colville Settlement, Hourly Coordination Agreement, Power Sales Contracts, Vernita Bar, Hanford Reach Fall Chinook Protection, etc.).

Wells Project operations in all years are dependent on the amount and timing of flows released from Grand Coulee and Chief Joseph dams, the two federally-owned facilities above Wells. Upstream operations greatly influence flows at the Wells Project. Also evident is the influence the discharge from Chief Joseph can exert on the pool level in the Wells Reservoir. Chief Joseph Dam flows can change dramatically over short time periods. Much of the time these changes are unscheduled. Wells Project
operations must react to these rapid changes in flow, while trying to maintain commitments made under the HCA with Chelan PUD and Grant PUD. Fluctuations in the Wells Reservoir are essential to managing these rapid changes in incoming flows. Even when these rapid changes in flow are anticipated, the Wells Reservoir must absorb the pulses while maintaining control of the Wells Project output.

2.4 TDG Criteria and Regulatory Framework

Chapter 173-201A of the WAC defines the WQS for the surface waters of Washington State. Under the WQS, TDG shall not exceed 110% at any point of measurement in any state water body. However, the standards exempt dam operators from this TDG standard when the river flow exceeds the seven-day, 10-year-frequency flood (7Q10). The 7Q10 flow is the highest calculated flow of a running seven consecutive day average, using the daily average flows that may be seen in a 10-year period. The 7Q10 total river flow for the Wells Project was computed using the hydrologic record from 1974 through 1998, coupled with a statistical analysis to develop the number from 1930 through 1998. These methods follow the United States Geological Survey (USGS) Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” and determined that the 7Q10 flow at Wells Dam is 246,000 cfs (Ecology et. al. 2004).

In addition to allowances for natural flood flows, the TDG numeric criteria (110%) may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology-approved Gas Abatement Plan (GAP) per WAC 173-201A-200(1)(f)(ii)). The increased levels of spill resulting in elevated TDG levels are authorized by Ecology to allow salmonid smolts a non-turbine downstream passage route that is less harmful to fish populations than caused by turbine fish passage. This TDG exemption provided by Ecology is based on a risk analysis study conducted by NMFS (NMFS 2000). The GAP must be accompanied by fisheries management and physical and biological monitoring plans and is approved on a per application basis for juvenile fish passage past dams on the Columbia and Snake rivers. This adjustment comprises three separate standards to be met by dam operators.

1. TDG shall not exceed 125% as a maximum one-hour average in the tailrace of a dam;
2. TDG shall not exceed 120% in the tailrace of a dam as measured as an average of the 12 highest consecutive hourly readings in any 24-hour period (12-C High); and
3. TDG shall not exceed 115% in the forebay of the next dam downstream as measured as the 12-C High.

A significant portion of the Wells Reservoir occupies lands within the boundaries of the Colville Indian Reservation. Wells Project operations do not affect TDG levels in tribal waters, where the Colville Tribe’s TDG standard is a maximum of 110%, year-round, at any point of sample collection (Colville Tribe 2010). This TDG standard is also the Environmental Protection Agency’s (EPA) standard for all tribal waters on the Columbia River, from the Canadian border to the Snake River confluence. TDG levels on the Colville Reservation portion of the mainstem Columbia River within the Wells Reservoir are influenced by the operations of Chief Joseph Dam and other federal and non-federal dams upstream of the project.
Each year, Wells Dam operates under this TDG criteria adjustment during its fish spill season (generally April to August) per an Ecology-approved GAP. Outside of the fish spill season, Wells Dam is required to adhere to the general TDG WQS numeric criteria of 110% at any point of measurement in any state water body (i.e., within the Wells Project Boundary).

2.4.1 Designated and Beneficial Uses

It is important to note that in addition to numeric criteria, WQS standards contain narrative criteria and an anti-degradation policy that requires that beneficial and designated and existing water uses be “maintained and protected” 40 CFR § 131.12(a), WAC 173-201A-070(1), 40 CFR §§ 131.6, .12(a), WAC 173-201A-030. Among those uses that must be protected are fish and wildlife, recreation and industrial (including hydropower) 40 CFR § 131.10(a). The fundamental purpose of numeric criteria is to protect beneficial and designated uses, i.e., “states must adopt those water quality criteria that protect the designated use.” 40 CFR § 131.11(a). Thus, numeric criteria exist to support the beneficial and designated uses, not as ends in themselves, and not as something to be achieved regardless of the consequences for beneficial and designated uses (Chelan PUD 2005).

The Washington State Pollution Control Hearings Board (PCHB) recognized this in a decision upholding Ecology’s 401 certification for the Lake Chelan Hydroelectric Project. In rejecting the notion that numeric criteria should be pursued even when the result would harm beneficial and designated uses, 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).

The example above illustrates the need to assure overall compliance with the intent and substance of the WQS, rather than seeking to achieve mechanical compliance with the numeric criteria, regardless of the consequences for beneficial and designated uses. The concept of achieving this balance serves as the framework for the risk based assessment that will be implemented to evaluate potential TDG reduction alternatives for the Wells Project (see Section 3.0 and 4.0 below). Evaluation of potential reduction alternatives in the context of risk and benefit (i.e., environmental, regulatory, economic) is consistent with the Wells Project TDG WQAP (Douglas PUD 2013b).

2.4.2 TDG in the Mid-Columbia River System

2.4.2.1 Mid-Columbia River Non-Federal Projects

As noted above, the mid-Columbia HCA is an agreement focused on coordinating the power operations of the seven mid-Columbia projects toward meeting daily load requirements through the assignment of "coordinated generation" through Central. Each project in the system has preferred operating criteria depending upon generation requests and environmental conditions and requirements. The preferred forebay elevation at each project is a combination of power demand, discharge from upstream projects and maximum and minimum elevations located within each projects respective FERC licenses. Central River Control is used to maintain preset reservoir levels in order to meet load requirements and prevent involuntary spill, which has the potential to produce TDG. These preset reservoir levels are maintained...
at each project through management of a positive or negative “bias” which assigns a project more or less generation depending on whether the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill and resultant TDG. The agreement allows for intermittent trade-offs of maximum benefits at individual dams to spread benefits throughout the system in a coordinated fashion while meeting environmental, recreational, and power generation requirements (Kiefer 2009).

2.4.2.2 Mid-Columbia River Federal Projects

Chief Joseph Dam is part of the FCRPS, which comprises 29 dams. It is located 30 miles upstream from the Wells Project and 52 miles downstream of Grand Coulee Dam and operates as a run-of-river hydropower project, fluctuating less than six feet in elevation over a normal year in Lake Rufus Woods (the reservoir behind Chief Joseph Dam). Chief Joseph Dam has no upstream fish passage and is considered the furthest upstream point of anadromous fish distribution in the Columbia River basin. Water discharge from Chief Joseph Dam is generally dispatched by the Bonneville Power Administration (BPA) for the production of electricity and by the USACE for flood control purposes (USACE 2000a).

Grand Coulee Dam, also part of the FCRPS, is operated by the U.S. Bureau of Reclamation (USBOR), and is located at Grand Coulee, Washington. Grand Coulee was completed with 18 generating units in 1942, prior to Chief Joseph Dam, and impounded what is now called Lake Roosevelt. The Project is authorized by Congress for uses associated with flood control, power production, and irrigation. The reservoir is managed by the USACE to reducing flooding downstream in the spring and to enhance electric generation in the fall and winter. Complete refill of Grand Coulee is normally targeted for June 30 each year and then dropped near elevation 1280 feet or higher by the end of September (full pool elevation is 1290 feet). Fall draft is limited to elevation 1265 feet by December 31 to ensure an 85% confidence of refill to the flood control rule curve on the planning date of April 10 per the supplemental Biological Opinion (BO) (NMFS 1998) or (BO, NMFS 1998) and to be consistent with previous operations and studies conducted during Endangered Species Act (ESA) consultations (USACE 2000a).

The greatest water quality concern related to Chief Joseph and Grand Coulee dams is TDG levels in both Rufus Woods Reservoir and the Columbia River below the Chief Joseph Dam. Due to the height of the spillway and the configuration of the stilling basin at Grand Coulee Dam, TDG levels can easily exceed 110%. This problem is most acute during the spring and summer when both Grand Coulee and Chief Joseph dams are spilling water due to high runoff or the anticipation of freshet conditions causing drafting at Grand Coulee in anticipation of capturing snowmelt entering the Project, and insufficient power demand does not allow all inflow to pass through generating units (USACE 2000a).

In 2004, Ecology, the Spokane Tribes of Indians, and the U.S Environmental Protection Agency (EPA) developed a Total Maximum Daily Load (TMDL) report for TDG in the Mid-Columbia and Lake Roosevelt (Pickett et al. 2004). The document indicates that compliance in the Chief Joseph Dam tailrace is carried out by Ecology, the Colville Confederated Tribes and EPA. Ecology’s standards differ between Phase I and Phase II of implementation of the TMDL with Phase I having identical WA State WQS TDG criteria during fish passage periods and Phase II being 73 mm of Hg (or 110%) in the tailrace of Chief Joseph up
to the mouth of the Okanogan River (Pickett et al. 2004). In addition, TDG standards in the tailrace of Chief Joseph Dam are enforced by the Colville Confederated Tribes, whereby standards are 110% as measured at any time of year along the reservation boundary, including the Chief Joseph tailrace, and as an instantaneous measurement (Pickett et al. 2004; Colville Tribe 2010). As such, standards in the Chief Joseph tailrace are somewhat convoluted and are either 115% at the face of Wells Dam during the fish passage season per Ecology’s standard or 110% at all times of the year in the Chief Joseph Dam tailrace per the Colville approved standard.

During the course of implementing the Wells Project WQAP, Douglas PUD will seek clarity on the incoming TDG standards (i.e., Wells Dam forebay) because Chief Joseph Dam’s TDG values have a direct impact on the ability of the Wells Project to comply with Ecology’s WQS. In addition, Ecology’s adjustment to the TDG standards for the tailrace of Chief Joseph Dam needs to be accompanied by an Ecology approved GAP that provides a biological monitoring plan that is directly tied to monitoring the fish passing that particular hydroelectric facility. Currently, it is unclear to what degree Chief Joseph Dam is complying with these requirements as identified in the FCRPS fish passage TDG adjustment and as such the 110% standard may be more appropriate for Chief Joseph Dam. Even if the TDG standard is determined to be 115% in the forebay of Wells Dam, during the 2012 spill season, Chief Joseph Dam was out of compliance more than 30% of the time in the Wells Dam forebay (See Section 2.4.2.3 below). To address the issue of spill and resultant TDG production, the USACE and USBOR identified a preferred alternative of installing flow deflectors at Chief Joseph Dam combined with joint operations at Grand Coulee Dam (USACE 2000a). The joint operating policy, aimed at more effective management of TDG supersaturation at Grand Coulee and Chief Joseph dams, can limit TDG producing operations (i.e., spilling out of regulating outlets) and increase generation at Grand Coulee thereby providing additional spill capabilities at Chief Joseph Dam without increasing TDG for a comparable level of flow and spill.

2.4.2.3 Federal Gas Abatement and Spill Priority

In response to Reasonable and Prudent Alternative (RPA) 136 in the NMFS 2000 BO, construction of the spillway flow deflectors was initiated in 2005 at Chief Joseph Dam (BPA et al. 2010). Although Chief Joseph Dam does not have fish passage, during Phase I testing of the TMDL implementation (2004-2010), the project was operated under the higher TDG load allocation criteria normally reserved for projects with beneficial fish passage via spill (i.e., similar to fish passage TDG adjustments issued annually at Wells Dam). The purposes for the Phase I TMDL load allocation tests were: 1) to evaluate whether the joint operations of Grand Coulee and Chief Joseph dams could produce less TDG, and 2) to authorize TDG in excess of the standard during the Phase I spill deflector construction and testing at Chief Joseph Dam. Testing of Chief Joseph Dam spill deflectors was completed in 2009 (BPA et al. 2010).

Since the completion of spill deflectors at Chief Joseph Dam in 2009, there has been a marked shift in federal spill operations resulting in a significant increase in the amount of spill at Grand Coulee and Chief Joseph dams. This increase in spill has resulted in a dramatic increase in the volume of water supersaturated with TDG entering the Wells Project. A primary factor for increased spill has been the significant development of new wind generation in the region resulting from renewable portfolio standards and federal production tax credits, investment tax credits, and Renewable Energy Credits.
Currently, 4,000 megawatts (MW) of wind generation are connected to BPA’s transmission grid in the Columbia River Basin (BPA 2013\(^2\)) and this is expected to grow to above 6,000 MW within 3 years. Wind generation usually occurs at night or in the spring when the generation is not needed. However, the power grid requires that system load and generation be balanced at all times. System imbalances can result in system frequency shifts that damage electronic equipment or cause system protection devices to trip. Federal regulations require system operators to maintain system frequency at 60 Hz at all times. Hydropower is one of the best generation sources for managing system frequency and load/generation imbalance due to wind (e.g., wind integration or dynamic capacity). However, curtailing hydroelectric power generation to facilitate the integration of wind into the electric grid often results in increased spill.

Contrary to the trends observed recently, the joint operations of Chief Joseph and Grand Coulee reservoirs and installation of flow deflectors at Chief Joseph Dam were originally intended to reduce TDG levels within the mid-Columbia River. This is recognized in the 2008 BO for the FCRPS (NMFS 2008), in the Environmental Assessment (EA) and Finding of No Significant Impact for the flow deflectors (USACE 2000b), and in the FCRPS TDG TMDL (Ecology et al. 2004). With spill deflectors operational, Chief Joseph Dam should currently be operated under the TDG TMDL Phase 2 load allocation for the reach from Grand Coulee Dam to the Okanogan River: 73 mm Hg above saturation (i.e., 110%) under all conditions, with the narrow exception of any exceedances necessary to meet salmon augmentation flow requirements associated with the 2008 BO (e.g., 135 kcfs at Priest Rapids Dam April 10–June 30) and during periods above the 7Q10 flow at the two federal projects.

If operations at Chief Joseph Dam continue to exceed numeric TDG criteria (i.e., 115% at the forebay of Wells Dam during the federal fish passage waiver criteria period and 110% in the tailrace of Chief Joseph Dam adjacent to the Colville Confederated Tribes) at greater frequencies, the Wells Project will have a more difficult time meeting state WQS due to TDG exceedances of incoming waters. Despite the lack of fish passage facilities at Chief Joseph Dam, the USACE has obtained TDG waivers for fish passage in recent years. Unlike typical TDG waivers, operators at Chief Joseph Dam have been allowed a year-round exemption from state WQS for TDG (personal communication, R. Turner, USACE). This has allowed increased spill at Chief Joseph Dam and has significantly increased TDG levels entering the Wells Project. High federal TDG levels make it almost impossible for the non-federal mid-Columbia River dams to meet the WQS for TDG while simultaneously meeting fish passage and survival standards. For example, during the 130-day fish bypass season at Wells Dam in 2012, TDG concentration in the Wells forebay exceeded 110% on all but 6 days and exceeded 115% on more than 50% of the bypass operation days (Table 1). During the 2013 spill season, no incoming 12C-High values greater than 115% were observed in the Wells forebay. However, almost 50% of the hourly TDG values in the Wells forebay (1,524 hourly values of a total of 3,192 spill season hours) were above 110%. Incoming TDG produced at Chief Joseph Dam was the source for the elevated levels of TDG in the forebay of Wells Dam. If

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operations at Chief Joseph Dam continue to exceed numeric TDG criteria entering the Wells Project, achieving WQS compliance will be difficult if not impossible.

Therefore based upon the regulations for the federal system, Chief Joseph Dam has discharged high TDG into the Wells Project. This has a material impact on the ability of the Wells Project to meet its tailrace standard. Depending upon the different regulatory standards that may apply to the federal projects, the Chief Joseph Dam exceeded the 115% standard more than 30% of spill season days or exceeded the 110% standard more than 90% of the spill season days as measured in the Wells forebay.

Table 1. TDG Concentration of Water Received at Wells Dam during 2012 fish spill season (130 days) and Federal Hydrosystem Compliance above Wells Dam per applicable water quality standards.

<table>
<thead>
<tr>
<th>Year</th>
<th>Applicable Water Quality Criteria (WQS)</th>
<th>Wells forebay TDG Standard</th>
<th>Number of spill season days</th>
<th>Number of days compliant with WQS</th>
<th>Percent Compliant with WQS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Colville Confederated Tribes/EPA 110%</td>
<td>98*</td>
<td>8</td>
<td>8</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Ecology per TDG exemption 115%</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Colville Confederated Tribes/EPA 110%</td>
<td>133</td>
<td>8</td>
<td>6</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Ecology per TDG exemption 115%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>Colville Confederated Tribes/EPA 110%</td>
<td>118*</td>
<td>21</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ecology per TDG exemption 115%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Total number of fish passage days at Wells Dam in 2012 was 133. However, only 98 days were included in the above analysis since 35 days at Chief Joseph Dam had daily average flows above the 7Q10 flow value of 222 kcfs.
2) *Shorted from 133 due to a 15 day period in April where sensor communication failed.

2.5 Wells Project TDG Activities

Since 1984, Douglas PUD has monitored TDG in the Wells Project. Over the last three decades, TDG management has evolved from basic water quality monitoring to a Project operations and monitoring program focused on real-time, adaptive TDG reduction approaches to achieve compliance with state WQS numeric criteria and maximum protection of fish and aquatic resources. Douglas PUD has improved upon its monitoring capabilities and understanding of TDG production at Wells Dam through the implementation of TDG production studies, modeling, and an evolving Project operational playbook.

2.5.1 Relicensing Studies

During the Wells Project relicensing, Douglas PUD implemented a series of detailed assessments to: 1) evaluate the potential impacts of the Project on TDG; and 2) determine the best Project spillway configuration and operation to minimize TDG production to comply with the state WQS.

2.5.1.1 TDG Production Dynamics Study
In 2006, Douglas PUD hired a team of hydraulic and TDG experts to evaluate various operational scenarios and their respective TDG production dynamics. Thirteen sensors were placed along three transects in the tailrace; at 1,000, 2,500 and 15,000 feet below Wells Dam. In addition, three sensors were placed across the forebay, one being the fixed monitoring station midway across the face of the dam and two more a distance of 300 feet from the dam. Each test required the operations of the dam to maintain static flows through the powerhouse and spillway for at least a three hour period. While there were 30 scheduled spill events, there were an additional 50 events where the powerhouse and spillway conditions were held constant for a minimum three hour period. These “incidental” events provided an opportunity to collect additional TDG data on a variety of Project operations that met study criteria and were included in the results of the 2006 TDG Abatement Study. Spill amounts ranged from 5.2 to 52% of project flow and volume of spill and total flows ranged from 2.2 to 124.7 kcfs for spill and 16.4 to 254.0 kcfs for total discharge. Six tests were done at flows that exceeded the Wells Dam 7Q10 flows of 246 kcfs.

Results of the 2006 spill study indicated that two operational scenarios, spread spill at low volumes (< 45 kcfs) and spill conditions and concentrated spill at high flows and spill conditions (>45 kcfs), produced the lowest levels of TDG and recommended continued testing of operational measures to ameliorate TDG production at Wells Dam (EES et al. 2007). The 2006 study also indicated that the current location of the tailwater TDG compliance monitoring station is appropriate in providing representative TDG production information both longitudinally and laterally downstream of Wells Dam.

2.5.1.2 2007 Wells Project TDG Operations Playbook

In 2007, a Spill Playbook was developed to be used by operators at Wells Dam. The intent of the Spill Playbook was to guide Project operators in the configuration of spill operations (specifically the implementation of spread spill and concentrated spill) in a manner that further evaluated the results of the 2006 TDG study and that examined the Spill Playbook operating scenarios over a broader range of environmental conditions. There were no scheduled spill tests in 2007 and operators were instructed to utilize the playbook only during forced spill events (when river flows exceeded flows needed to meet load). Specific objectives of the 2007 assessment included:

1. Evaluate TDG production for concentrated spills over a range of operational conditions;
2. Evaluate TDG production for spread spills over a range of operational conditions;
3. Evaluate indirect effects, operational, and logistical concerns for concentrated spill that might limit their application for TDG management; and
4. Collect additional TDG data in order to refine the relationships of spill momentum and submergence depth as they affect TDG production.

At the end of May 2007, it was determined that the logistics of operating gates 2 and 10 which require manual adjustments, made implementation of spread spill testing impractical. In addition, true spread spill would require the removal of all five of the JBS barriers (in even numbered spill ways) in order to direct equal flow quantities through all 11 spill gates. This operation is incompatible with the HCP and license requirements designed to improve passage efficiency for, and survival of outmigrating juvenile
salmonids. For these reasons coupled with the fact that the concentrated spill operation provided the best TDG performance during high flow and spill conditions, the remainder of the study emphasized testing the concentrated spill strategy.

River flows in spring 2007 were 108.7% of the 20-year average. The peak total river discharge at Wells Dam (based on daily averages) was 238 kcf. The maximum daily spill flow was 127 kcf. There were few spill events in excess of the fish bypass spill after May. Most of the spill events were of short duration, which did not meet the required 3-hour time period that is necessary to establish equilibrium conditions at the Wells tailrace TDG monitoring station (WELW).

Conclusions of the 2007 assessment are as follows:

1. 2007 was an above average water year. During the 2007 fish passage season (April 1-September 15) Wells Dam was able to maintain compliance with the TDG standards 97% of the time;
2. Maintaining a true spread spill pattern (equal flows through all spill gates) at Wells Dam during the fish migration season, required removal of all of the JBS barriers in addition to utilizing manual lifts for spill gates 2 and 10. For these reasons it was not logistically feasible to utilize spread spill for low and moderate ranges of spill during the bypass season (April to August);
3. Spill in 2007 was not of a sufficient duration to adequately test the performance of a concentrated or concentrated spill pattern to minimize TDG below Wells Dam; and
4. The spill data collected at Wells during 2007 were consistent with analytical results for the 2006 TDG Study (EES et al. 2007).

2.5.1.3 2008 Wells Project TDG Operations Playbook

The study objective for the 2008 Wells Project Spill Playbook was continue to evaluate the effectiveness of the concentrated spill configuration at producing lower TDG production. The 2008 study focused attention on total spill volume, tailwater elevation and further tested the logistical constraints identified during the 2007 TDG study. Specific objectives included:

1. Evaluate TDG production for concentrated spills over a range of operational conditions;
2. Evaluate indirect effects, operational, and logistical concerns for concentrated spill that might limit their application for TDG management; and
3. Collect additional TDG data in order to refine the relationships of tailwater elevation, spill momentum and submergence depth as they affect TDG production at low to moderate spill levels.

River flows in spring 2008 were 104.3% of the 20-year average. The peak total river discharge at Wells Dam (based on daily averages) was 270 kcf. The maximum daily spill flow was 145 kcf. Spill events that met the required 3-hour time period occurred from May to July.
Conclusions of the 2008 assessment are as follows:

1. There were 20 spill events that met the required 3-hour time period to establish equilibrium conditions at the WELW;
2. During these 20 events, total outflows at Wells Dam ranged from 22.7 to 260.8 kcfs. Total spill ranged from 6.6 to 98.0 kcfs. Wells forebay station (WEL) TDG ranged from 106% to 116%. WELW TDG ranged from 113% to 127%; and
3. 2008 was an above average water year, with up to 128% of average river flows (June) and high TDG levels resulting from spill at Chief Joseph Dam (Wells forebay exceeded 115% TDG on 23.8% of days monitored).

There were six spill events that exceeded the 246 kcfs 7Q10 flood flow at Wells Dam. These events occurred in May and June which is a month earlier than historic peak flows at Wells Dam.

2.5.1.4 2008-2009 Numerical Model Development

In 2008 Douglas PUD hired IIHR-Hydroscience and Engineering Laboratory of the University of Iowa (IIHR) to develop an unsteady three-dimensional (3D) two-phase flow computational fluid dynamics (CFD) tool to predict the hydrodynamics and TDG distribution within the Wells tailrace. Two models were used in the study; a volume of fluid (VOF) model and a rigid-lid two-phase flow model.

The VOF model predicts the flow regime and the free-surface characteristics, recognizing that a spillway jet may plunge to depth in the tailrace or remain closer to the surface depending upon the geometry of the outlet and the tailwater elevation.

The rigid-lid model included 16,500 feet of the Wells tailrace, from Wells Dam downstream to the TDG compliance monitoring station. This two-phase flow model characterizes the hydrodynamics and three-dimensional distribution of gas volume fraction, bubble size and TDG in the Wells tailrace. The upstream velocity profiles derived from the VOF model were input into the rigid-lid model. The gas volume fraction and bubble diameter at the spillbays are the external parameters of the model.

The model was calibrated and validated using field data collected in 2006 during a TDG production dynamics study (EES et al. 2007). The model was then calibrated using data collected during spill tests conducted on June 4 and June 5, 2006. The spillway flow was spread across spillbays on June 4 and concentrated through a single spillbay on June 5. Agreement was attained between the depth-averaged velocity data collected in the field and those generated by the model. A gas volume fraction of 3% and bubble diameter of 0.5 mm in the spillbays produced TDG values that bracketed the 2006 field observations.

Once calibrated, the predictive ability of the model was validated by running the model for three different operational conditions tested in 2006. The model captured the lateral TDG distribution and the reduction of TDG longitudinally as observed in the field. The numerical results demonstrated that
the model provides a reliable predictor of tailrace TDG and therefore can be used as a tool to identify Project operations that can minimize TDG concentrations downstream of Wells Dam.

In an April 2009 report (Politano et al. 2009), the model demonstrated that Wells Dam can be operated to meet the TDG adjustment criteria during the fish passage season with flows up to 7Q10 levels (246 kcf/s) provided the forebay TDG levels are below 115%, at least nine of ten units are available and units are fully generating. Compliance was achieved through the use of a concentrated spill pattern through spillbay 7 and surplus flow volume through other spillbays in a defined pattern and volume. These preferred operating conditions create surface-oriented flows by engaging submerged spillway lips below the ogee (acting as spillway deflectors; Figure 8), thus increasing degasification at the tailrace surface (surface jet), decreasing supersaturation at depth, and preventing high-TDG waters from bank attachment. These principles were the basis of the 2009 Wells Project Spill Playbook and were fully implemented for the first time during the 2009 spill season with success. Overall, no exceedances were observed in either the Wells Dam tailrace or the Rocky Reach forebay in 2009.

Figure 8. Cross section view of Wells Dam Spillway/Bypass structure. The spillway lip is denoted by a black star, which acts to encourage water towards the surface improving degassing.
2.5.2 Post-relicensing TDG Compliance Activities

Since filing the Wells Project Final License Application on May 27, 2010 (and receipt of a new operating license on November 9, 2012), Douglas PUD has continued to implement activities toward improving TDG management within the Wells Project.

2.5.2.1 GAP and TDG Annual Reporting

Consistent with years prior to the completion of relicensing Douglas PUD continues to submit and operate under an Ecology approved GAP to support downstream fish passage. As required by the new FERC license for the Wells Project, Douglas PUD has begun coordinating the development of the GAP with the HCP Project Fish Bypass/Spill Operations Plan, using best available information to minimize TDG while maximizing the benefits of spill for ESA-listed anadromous salmonids.

2.5.2.2 Spill Playbook

Central to the Douglas PUD’s GAP approach is the continued implementation and adaptation of the Wells Project Spill Playbook. At the end of each spill season, Wells Project TDG performance during the spill season is evaluated to identify opportunities for operational improvements. Any identified improvements are integrated into the Project’s Spill Playbook toward improving TDG management in subsequent years.

2.5.2.3 Participation in Regional Work Groups

Per Douglas PUD’s Water Quality Management Plan, staff continue to participate in both the Water Quality Team and the Adaptive Management Team meetings to address regional water quality issues, including sharing the results from monitoring, measuring, and evaluating water quality in the Wells Project.

2.5.2.4 TDG Monitoring Locations

TDG monitoring has been implemented at Wells Dam since 1984. The forebay station (WEL) is located midway across the deck of Wells Dam (47.94722 -119.86508). The tailrace station (WELW) is located on the left bank of the Columbia River 2.6 miles downstream of Wells Dam (47.91304 -119.89625). Data from both stations are automatically transmitted by radio to Wells Dam. Data is posted to Douglas PUD’s public webpage (www.douglaspud.org), in addition to being forwarded to the USACE via automated electronic mail.

To more effectively meet the requirements identified in the Wells Project 401 Certification, Douglas PUD installed two additional TDG monitoring stations in 2013. A redundant probe was added to the existing WELW station in the Wells Dam tailrace (WELW; 47.94722 -119.86508) to ensure data continuity and quality. Furthermore, an additional reservoir monitoring station was installed at Washburn Island (RM...
537.5) to collect TDG data representative of water quality entering the Wells Project from Chief Joseph Dam operations (WELWASH; 48.088696 -119.675901). The current Chief Joseph Dam tailwater station (CHQW) minisone TDG sensor is deployed along the right bank of the Columbia River, 0.75 miles downstream from the dam (Easthouse 2009). The river right location of the USACE TDG sensor precludes it from collecting bulk flow data, and instead the sensor monitors spillbay water disproportionately under certain operational scenarios. Under these conditions, water coming from Chief Joseph Dam spillbays is of lower TDG concentration than the powerhouse. For example, when the forebay at Chief Joseph Dam has high concentrations of TDG (e.g. greater than 120%) as a result of high spill volumes from Grand Coulee Dam and limited degassing through Rufus Woods Reservoir, water sent through the spillbays at Chief Joseph Dam may actually be stripped of gas via the spill deflectors. However, powerhouse flows are essentially identical to those in the forebay and can be missed by the CHQW sensor since powerhouse flows orient to river left. As a result of the CHQW location and the orientation of spill and powerhouse flows, bulk flows leaving the federal system and entering into the Wells Project are not accurately monitored (pers. comm. with Mike Schneider, USACE). The Washburn Island location is expected to help Douglas PUD:

1. Better understand TDG degassing in the Wells Project and expected TDG saturation in the Wells forebay;
2. Assure data quality at the Wells forebay TDG sensor since Washburn Island TDG values should correlate predictably with Wells forebay TDG values. Based on the comparison of the sensors at these two locations, technicians can ensure reliable data collection by scheduling sensor servicing when data appears to be erroneous; and
3. More accurately assess TDG production from the federal power system upstream of Wells Dam, which may support improved management towards minimizing TDG production in the Columbia River.

In addition, Douglas PUD shall expand the temporal scope of the monitoring program and collect these data throughout the year in order to evaluate both compliance during the fish spill season (TDG adjustment criteria from April through August) and during the non-fish spill season (110% from September through May) as required in Section 6.7(2)(b) of the 401 Certification.

2.5.3 Wells Project TDG Production

Two general principles are applicable to TDG management alternatives; the elimination/reduction of air entrainment and depth minimization of entrained air (Schneider and Wilhelms 2005). When evaluating the risk and benefits of reasonable and feasible TDG reduction alternatives at Wells Dam, the unique hydrocombine structure is a critical factor that must be taken into consideration. At Wells Dam, spillway flows occur on top of generation flows as compared to more traditional hydropower projects where spillway and powerhouse flows are segregated. The 2006 study (EES et al. 2006) first identified that the Wells hydrocombine spillways are equipped with draft tube deck extensions, which tend to act as deflectors for the spill. These structures tend to force the spill flow towards the surface at certain combinations of depth of submergence and flow rate, and this action impacts the gas exchange characteristics of the released water. Relationships were determined between the gas exchange at
Wells Dam and both the depth of submergence of the deflector by tailwater and the spillway bay discharge or discharge per unit width of spillway (kcfs/ft). Additional numerical modeling confirmed the observed relationships by accurately predicting the dynamics of spillway surface jets, the hydrodynamics, and TDG distribution within the Wells tailrace (Politano et al. 2009). According to the model, concentrated spill operations minimize TDG production dynamics during high flows through engagement of the draft tube deck extensions (spillway deflectors) and increased degasification at the free surface. Spilling over generating units was also observed to minimize plunging of spillway flows to depth and thus reduce air entrainment.

3.0 METHODS

3.1 Study Objective

As identified in Douglas PUD’s WQAP, within 1 year of approval of the WQAP (i.e., year 1 of the compliance schedule - December 2014), Douglas PUD is required to identify reasonable and feasible alternatives that may be implemented at the Wells Project to meet the TDG WQS. The objective of the TDG RAA is to conduct a comprehensive evaluation of any alternatives, both operational and structural, that may improve Project TDG management towards meeting TDG WQS criteria (Douglas PUD 2013b). If by year 9 (2022), already identified and approved compliance schedule activities that include field evaluations of updated modeling scenarios indicate compliance with the TDG WQS are not yet achieved during specific conditions, Douglas PUD will then be required to implement another alternatives analysis which would include an updated section of this TDG RAA or develop a new compliance schedule with Ecology.

3.2 Alternatives Identification

Several steps were implemented to achieve the objectives of the evaluation. First, site specific TDG information was acquired and reviewed for relevance. These data, studies, and compliance reports represented over a decade of TDG activities at the Wells Project and were comprised of pre-relicensing TDG compliance monitoring, relicensing field and modeling activities, and post-license issuance compliance activities (Section 2.5). In addition to site-specific information, TDG abatement alternative assessments from facilities in the mid-Columbia River and greater Columbia and Snake River basins (i.e., local and regional) were also evaluated or considered if identified as relevant and applicable to the Wells Project.

Wells Dam is a hydrocombine structure where the powerhouse turbine intakes are situated directly below the spillways (Figure 4 above) and bypass bays separate ten turbine silos from each other. This structural integration is unique and should be considered when evaluating TDG production dynamics at the facility. As such, Wells Dam is dissimilar when compared to more traditional hydroelectric facilities where the powerhouse and spillway are separated along the river channel. Currently, no other hydroelectric projects in the region that are assessing TDG production have a hydrocombine structure. Aside from existing Wells Dam evaluations, the most relevant source of information available was associated with the USACE Phase I and II Dissolved Gas Abatement Studies (DGAS) for the Columbia River Fish Mitigation Program. Many of the alternatives identified as part of these assessments were
As such, alternatives identified as part of the MWH evaluation were indicative of a comprehensive set of potential alternatives being evaluated in the region and served as a basis for this analysis where appropriate and applicable to Wells Dam.

A suite of operational and structural alternatives were identified from the existing information identified above and provided to a multi-disciplinary group of engineering, operations, power management, and environmental staff for review of potential operational, coordination, financial, regulatory, and environmental implementation concerns and whether additional alternatives should be included. Each of the identified alternatives was evaluated against a set of criteria that included:

1. Potential TDG benefits;
2. Capital cost;
3. Operation and maintenance cost;
4. Feasibility of operational implementation;
5. Implications for generation;
6. Implications to environmental resources; and
7. Implications to public use

Section 4.0 below provides a summary of this alternatives analysis.

4.0 ANALYSIS

4.1 Operational Alternatives

Operational alternatives are typically the simplest to implement. They require less capital costs however their annual operating costs can be significant. Operational measures are generally constrained by a number of factors including power-generating requirements, existing coordination agreements, and spill for the downstream passage of juvenile salmonids. Note that as part of its Ecology-approved TDG WQAP (Douglas PUD 2013b), Douglas PUD plans to implement a number of operational measures at the Wells Project as part of the WQAP’s 10-year compliance schedule. These operational alternatives include continued implementation and adaptive management of the Wells Project Spill Playbook, developing an updated Project Operations Database, and re-evaluating TDG model assumptions. More detail on these measures can be found in the Wells Project TDG WQAP (Douglas PUD 2013b) and are not included in this evaluation.

4.1.1 Maximize Project Generation

Water used in generation via the powerhouse has essentially no effect on TDG production and therefore has the same TDG concentration as is observed in the forebay (USACE 2003). Currently water passes through the spillway at Wells Dam and other mainstem Columbia River dams for the following reasons: 1) excess flows at the Project to meet load/demand 2) observed flows above maximum generation of 180-200 kcfs and/or 3) requirement to provide fish bypass flows equal to 5-7% of the river volume for anadromous salmonids. In all three of these scenarios spilled water has the potential to increase TDG
If spill flows can be redirected to the Wells Project powerhouse to maximize generation, then TDG loading can be prevented.

At the Wells Project, the use of this operational alternative is constrained by fish spill requirements. The Wells Project effectively guides a high proportion of the downstream migrating juvenile salmon and steelhead away from the turbines and into a surface oriented JBS using a modest amount of spill. Since most juvenile salmon and steelhead migrate near the surface, with the help of the JBS, they successfully pass Wells Dam and avoid the turbine intakes which are located at 71 ft below the forebay surface. Since its completion, the Wells Dam JBS has since proven to be the most efficient system on the mainstem Columbia River, providing high levels of fish protection that has met approval of the fisheries agencies and tribes (Skalski et al. 1996). The Wells Dam JBS operates continuously from early April through late August and in general, passes up to 2,200 cfs of water through each of the five JBS configured spillways.

Another constraint upon diverting spillway flows to the powerhouse to maximize generation is coordination with upstream operations of federal facilities. FCRPS BO requirements has resulted in limitations to the load-following capability of much of the federal power system resulting in an apparent shift of load-following to Grand Coulee and Chief Joseph, which tends to increase flow fluctuations and decrease flow predictability in the mid-Columbia River existing coordination agreements.

Powerhouse hydraulic capacity also limits the potential benefit of this alternative. The 7Q10 flow at Wells Dam is 246 kcfs and the powerhouse capacity is approximately 220 kcfs (ASL 2007) for short periods of time and with all ten units in service. Even at maximum 10 unit generation, approximately 26 kcfs of spill may be required to meet TDG water quality requirements. Furthermore, time periods when flows are high and compliance with TDG criteria are a concern are often coupled with periods of low electricity demand. This scenario may restrict the potential for maximizing generation at a single project in a coordinated system. In addition, maximizing generation during periods of low energy demand can require Douglas PUD to pay power purchasers to take electricity, often referred to as “paying negative”.

4.1.2 Scheduling Project Maintenance

Scheduling outages for project maintenance may be affected by a number of factors including the type of outage (i.e., major versus minor, unexpected versus annual maintenance) and associated duration, electricity demand and prices; and overall system reserve or shortfall, river flows, and environmental requirements during the maintenance period. Generating unit maintenance is typically scheduled during the “shoulder” months when power demands are lower or when lower river flows are anticipated. Re-evaluating the factors under which project maintenance and associated unit outages are scheduled to consider seasonal peaks in TDG production as a primary consideration may be an option to improving TDG management.

At Wells Dam, recent project maintenance activities that have resulted in unit outages (i.e., reduced generation capacity) consist of bi-annual generating unit and transformer maintenance and generating unit rebuilds. Including TDG performance as a factor for determining the timing of these events may have the ability to further reduce TDG production at the project by ensuring that a maximum number of
units are on-line during peak spill periods. Adopting a policy that prevents annual maintenance during certain months and only allows for emergency outage maintenance during these peak flow periods may provide some benefits to TDG production.

In general, scheduled maintenance events at Wells Dam consider environmental requirements including downstream protection of anadromous salmonids. Furthermore, the duration of major maintenance projects such as unit rebuilds may not be able to avoid a unit outage during typical peak spill periods (i.e., spring). It is likely that any changes in prioritization of factors used to determine maintenance schedules would result in minimal benefits to TDG performance while generating unit reliability and availability could be jeopardized.

### 4.1.3 Modification of Existing Agreements

The Wells Project is operated under a number of agreements (coordinated and uncoordinated) that affect current operations. Section 3.1 of the Wells Project Final License Application – Exhibit B (Douglas PUD 2010) describes all agreements affecting current Project operations (e.g., HCP, Aquatic Settlement Agreement, Encroachment on Chief Joseph Dam, Colville Settlement, Hourly Coordination Agreement, Power Sales Contracts, Vernita Bar, Hanford Reach Fall Chinook Protection, etc.).

Evaluating existing Wells Project agreements to identify potential modifications that would facilitate improved TDG management at the Wells Project could be an option. However, any potential changes to existing agreements would require renegotiations with signatory parties. In the case of the HCA, such discussions would require the participation and approval of a number of federal and mid-Columbia PUD entities, and power purchasers. Furthermore, the HCA requires that the power and non-power constraints of the individual projects be recognized in the coordination process. As such, stable and predictable river flows that would support TDG management are already an objective of this agreement. In general, renegotiating existing agreements would be a complex and timely process with considerable financial implications. Any updated agreement would also need to consider implications for existing resource protection (i.e., ESA) and regulatory compliance (i.e., FERC license) requirements. Given a primary factor of existing agreements aims to maximize generation and minimize spill on a system-wide basis, prioritizing TDG performance at a single project would likely result in a net decrease in overall protection of aquatic life designated uses and at considerable cost (e.g., compensation for replacement spill requests, system-wide effects, ESA and FERC implications, etc.).

### 4.1.4 Gas Abatement Spill

Gas Abatement Spill is used to manage TDG levels throughout the Columbia River Basin. The Technical Management Team (including NMFS, USACE, and BPA) implements and manages this spill. Gas Abatement Spill is requested from dam operators from a reach of the river where TDG levels are high. A trade of power generation for spill is made between operators, providing power generation in the river with high TDG and trading an equivalent amount of spill from a project where TDG was low. Historically, the Wells Project has accommodated requests to provide Gas Abatement Spill. In an effort to limit TDG generated at the Wells Project, Douglas PUD has adopted a policy of not accepting Gas Abatement Spill at Wells Dam. Revisiting the current policy to explore potential Gas Abatement Spill options or other
agreements to trade power generation for spill could result in potential TDG benefits. Costs, operational constraints, and potential impacts to environmental resources cannot be determined at this time since no specific agreement is currently in place.

4.2 Structural Alternatives

At many federal hydroelectric facilities on the Columbia River, substantial effort has been devoted to investigating structural alternatives for TDG reduction (MWH 2003). These are used as the basis for this investigation of structural alternatives. However, the Wells Project is a hydrocombine where the spillway is situated directly above the turbine water passages creating TDG production dynamics that may be different than traditional hydroelectric projects common to the Columbia River where the spillway and powerhouse (and therefore, respective flows) are separated. This is a critical consideration in the evaluation of structural alternatives at the Wells Project. Other factors considered in the evaluation below include TDG benefits, generation impacts, potential resource impacts (e.g., fish and aquatic, recreation, etc.), engineering feasibility, and capital and operations & maintenance (O&M) cost. It is assumed that all structural alternatives would require Douglas PUD to submit a license amendment to FERC for approval (Wells Project License Article 401[c]).

4.2.1 Spillway Flow Deflectors

Spillway flow deflectors are concrete lips built on the lower part of the spillway and have been one of the primary methods for TDG management at dams on the lower Snake and Columbia River dams (USACE 2002). Spillway flow deflectors have been installed at Bonneville, John Day and McNary dams on the lower Columbia River and at Wanapum and Chief Joseph dams on the mid-Columbia River. Spillway flow deflectors have also been installed at Ice Harbor, lower Monumental, Little Goose, and lower Granite dams on the lower Snake River. Flow deflectors direct the spill in a horizontal direction to flow across the surface of the tailrace so that it does not travel deep in the water column allowing entrained air to re-enter the atmosphere at the water surface. Encouraging near-surface flow also prevents entrained air from reaching a depth at which the gas is more readily dissolved resulting in increased TDG levels (MWH 2003). Important factors to consider for spillway flow deflectors include deflector elevation relative to operating tailrace elevation, depth of the stilling basin, and downstream passage requirements for anadromous salmonids.

During the Wells Project FERC relicensing process, TDG modeling activities identified the presence of a submerged spillway lip below the ogee (see figure 8 above) when confirming the geometry of the outlet for input into the VOF model. Modeling results confirmed that the spillway lip functioned as a spillway deflector at certain flows, thus increasing degasification at the tailrace surface (surface jet), decreasing supersaturation at depth, and preventing high-TDG waters from bank attachment. Although further development of spillway deflectors at the Wells Project is likely feasible, capital cost for implementation would be high as compared to additional TDG benefit since infrastructure already exists to encourage near-surface flows during larger spill events where compliance with TDG criteria is of concern. Additional concerns of any spillway or deflector modifications on juvenile fish passage, adult fish passage, and channel erosion must also be considered. The Wells Project currently utilizes spill to pass
downstream migrating anadromous salmonids with the highest level of survival on the Columbia River. Any structural modifications to the existing spillway infrastructure could directly impact the survivability of ESA-listed salmonids migrating downstream. This action would require consultation with the appropriate management agencies (i.e., NMFS and the U.S. Fish and Wildlife Service [USFWS]). Survival verification studies would need to be modelled and tested to examine how fish survival was modified with the manipulation or change in spillway lip.

4.2.2 Submerged Outlets Through Elimination of Confinement Zone Downstream of Wells Dam

This alternative would consist of large conduits under the dam’s spillway that could pass water from the bottom of the upstream reservoir and discharge the water deep in the tailrace. The MWH evaluation of this alternative at Rocky Reach Dam (MWH 2003) proposed six, 12-foot wide by 14.5 foot high conduits in two spillbays (i.e., 3 conduits in each bay). Large gates would be required to regulate outflows and velocities in the conduits would be high.

Although this alternative has the potential to reduce TDG production at the Wells Project, submerged outlets would require either the removal or modification of generating units that are located directly beneath the spillway due to the hydrocombine structure of the Wells Project. Capital costs of this alternative would be high with the potential for reduced capacity and power generation. Additional concerns with this alternative include its potential to injure downstream migrating fish and currently unknown effects to upstream migrating adults (requiring ESA consultation) and dam safety considerations.

4.2.3 Baffled Spillway

A baffled spillway consists of a channel on a slope. The channel would contain baffles that are staggered along the length of the spillway to dissipate energy. Flows passing through a baffled spillway would have little energy left toward the bottom to carry water deep into the tailrace. Baffled spillways have been shown to be effective in preventing an increase in TDG (MWH 2003). Length and width of a baffled spillway depend upon the maximum spill flows and the desired slope of the channel. In general, design unit discharges are less than 200 cfs per foot (MWH 2003).

At Wells Dam, a baffled spillway would need to be located on the east embankment. Although such a structure would likely decrease TDG and may even degas water which passes through it, the costs would be high and the injury to downstream migrating juvenile salmonids would be a concern. Baffled spillway flows would be discharged in the vicinity of the eastside adult fishway and may also disorient and delay adult fish seeking passage upstream. At certain times of the year when flows are high, increased discharge to the east side of the river may also negatively impact recreational fishing in this area.

4.2.4 Side Channel Spillway

A side channel would carry required spill around the dam. At the entrance to the channel, large gates would be required to regulate flows and operation. Downstream of the dam, flows would spill over an
ogee crest into a shallow stilling basin to prevent entrained air from going into solution. To dissipate the energy in the shallow stilling basin, the unit discharge would be limited to about 30 cfs/ft (MWH 2003). Similar to the baffled spillway, this channel would need to be located on the east embankment of Wells Dam. The alternative would be costly and could negatively impact survival of downstream juvenile migrants and upstream adult migrants. During operation, recreational use in the area of the spillway discharge would likely be limited.

4.2.5 Additional Spillway

Additional spillway bays have been investigated at several USACE dams (MWH 2003). Additional spillway bays would primarily allow for existing spill volumes to be spread out further, thus reducing spill per bay and reducing TDG saturation. At Wells Dam, studies have shown that at higher flows during the juvenile fish passage season when compliance with TDG criteria is a concern, true spread spills (i.e., similar flow volumes in all spillway bays across the dam) are difficult to implement due to existing flow constraints of bypass baffles in even numbered spill bay intakes that are in place to facilitate juvenile salmonid downstream passage and survival. Past TDG studies have confirmed that at higher spill flows a result of these constraints result in dentated spill patterns (where odd numbered spillbays spill greater volumes than even numbered bays) that produce high levels of TDG; presumably through lateral mixing of spillway flows. Additional TDG modeling activities concluded that despite the inability to implement true spread spills during high flows, compliance was achieved through the use of a concentrated spill pattern through spillbay 7 and surplus flow volume through other spillbays in a defined pattern and volume (Politano et al. 2009). During the non-fish passage season (i.e., September to March), spread spills can be utilized given bypass baffles are not in place in even numbered spillbays. However, additional spillbays are likely not necessary as current spillways are capable of passing a total of 940 kcfs at normal full pool elevation of 781 feet msl, and 1,180 kcfs at maximum water surface elevation of 791 feet msl; far greater than historic spill flows at Wells Dam. Adding a spillbay to Wells Dam has little benefit and significant cost implications. In addition to cost, adding a spillbay on the east embankment could negatively affect downstream and upstream migration and have impacts to recreation and public use.

4.2.6 Raised Stilling Basin

Raising the still 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 (Schneider and Wilhems 2005). This alternative would add concrete to the bottom of the stilling basin to raise its floor. However, to effectively accommodate the design flood, the stilling basin may need to be lengthened and a hydraulic model would need to be developed to determine specific details of the alternative.

At Wells Dam, the stilling basin is relatively shallow (~30-35 feet) and therefore the incremental TDG benefit may not be large. A number of site specific factors would need to be considered to evaluate the TDG benefit of raising the stilling basin at Wells Dam. These include the range of discharges, range of tailwater elevation, and geometry of the spillway which can affect circulation patterns and air
entrainment. To further consider this alternative, a physical model to assess the hydraulic performance up to the maximum probable flood flow may be required. This alternative has relatively high costs and may also have implications for downstream migration of juvenile salmonids and public use. As noted above, additional modeling would be required to better assess site specific details.

### 4.2.7 Raised Stilling Basin with Deflectors

This alternative is a combination of alternatives described in Sections 4.2.1 and 4.2.6. Evaluation summaries in the above sections are relevant for assessing this alternative.

### 4.2.8 Raise Tailrace Elevations

Several predictive models were developed during the DGAS program (Schneider and Wilhelms 1998a; Schneider and Wilhelms 1998b) to estimate the effects of a raised tailrace channel on TDG exchange at Columbia and Snake River projects. The TDG estimates were based on the application of theoretical and conceptual models of the gas exchange processes, an analysis of historical data, application of an empirical relationship based on near-field measurements, and an analysis of degassing in the tailrace region. Model results suggest that 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 and air bubbles strip dissolved gas from the water column (Schneider and Wilhelms 2005).

Based upon the above principles, an alternative to reduce TDG levels at Wells Dam is to raise the tailrace elevation and reduce the depth of flow associated with aerated flow that exist in the stilling basin by promoting the stripping of TDG gases (Schneider and Wilhelms 2005). Raising the Wells Dam tailrace could reduce TDG production downstream of the stilling basin. However, at specific flows and periods of time where compliance with TDG criteria are a concern, current TDG operations at Wells Dam aim to engage the existing spillway lip (which acts as a spillway deflector) to keep spillway flows on the surface and avoid TDG production as a result of plunging flows to depth. As such, this is likely to be an ineffective measure for TDG management. Further consideration would require additional site-specific hydraulic and physical modeling studies to assess the type, amount and location of the fill; and the potential performance of the alternative. Other factors requiring evaluation include cost (both capital and O&M); whether cofferd amming would be required during construction; impacts to public use (i.e., boating) below the dam as turbulence would likely be carried further downstream; adult upstream migration; erosion; and backwater impacts resulting in reduced head and power revenue impacts.

### 4.2.9 Conversion of Turbine to Sluice

This alternative consists of removing some number of the turbines and replacing them with sluices containing throttling gates. Given the hydrocombine structure of Wells Dam, this alternative would essentially be similar to that of the submerged outlets alternative described in Section 4.2.2. As such, the potential effects and factors requiring consideration are also the same.

### 4.2.10 Additional Generating Units
This alternative would consist of constructing a new powerhouse (some number of additional generating units) to carry additional flows above the present generation capacity of 220 kcfs. A new powerhouse would likely target a flow capacity that brings Wells Project total generation capacity above the 7Q10 flow of 246 kcfs and allow additional capacity in case a turbine is down for maintenance (i.e., 40-50 kcfs). A new powerhouse would be located on the east embankment which has been considered by Douglas PUD as the location for a future unit. It might require both an adult and juvenile fish passage infrastructure. Cost of this alternative would be extremely high but would create offsetting generation revenue. This alternative also assumes that a new powerhouse would require consultation with appropriate fisheries agencies to determine required activities to ensure the continued protection of anadromous salmonids and other fisheries resources. Modification would also require significant consultation and amendment to the Project’s FERC operating license. If this alternative warranted further consideration, additional evaluations would need to be performed to estimate cost (regulatory, capital and O&M), and demand for the additional power and associated revenue; especially during periods when compliance with TDG criteria are a concern (and electricity demand is relatively low).

4.2.11 Pumped Storage Project

The fundamental concept of pumped storage hydroelectricity stores energy in the form of gravitational potential energy of water pumped from a lower elevation reservoir to a high elevation reservoir. At times of low electricity demand, water is pumped using excess generational capacity into a higher reservoir. When there is high demand, water is released back into the lower reservoir through a turbine generating electricity.

The pumped storage project alternative may provide a mechanism to divert river flows, that would otherwise be spilled and produce TDG, into a separate, higher elevation reservoir for use when demand is high. In addition to a mechanism with energy management benefits such as peaking capability, a pumped storage project could help control electrical network frequency and provide reserve generation.

Capital and O&M costs for this alternative are high and additional costs associated with regulatory and environmental processes required to implement this alternative would also be high (i.e., water right acquisition, new FERC license or amendment, state and local permitting, ESA consultation, environmental studies, etc.). Additional effort would be required to assess feasibility of a site with the appropriate characteristics for a pumped storage facility and TDG reduction capabilities. Purchase or lease of the site would also be required. Although implementation costs would be extremely high, once constructed and operating, the facility would generate revenue that could offset initial investment costs. Further consideration would require additional evaluations to estimate cost and the market for additional power and associated revenue; especially during periods when compliance with TDG criteria is a concern.
4.3 Alternatives Evaluation

The various alternatives, both operational and structural are described above with a summary evaluation of their advantages and disadvantages. In the following section, an evaluation matrix is presented in which each alternative is evaluated against a set of criteria.

4.3.1 Evaluation Criteria

Using the MWH (2003) Report as a basis, the following evaluation criteria and scoring metrics were developed for each alternative presented in Section 4.2.

For TDG Reduction (i.e., evaluation criterion 1 below), scoring metrics ranged from 1 to 2. A score of 1 was defined as remaining the same as at present condition and a score of 2 was defined as improvement over present conditions. For all other criterion below (i.e., criterion 2-8), scoring metrics ranged from 1 to 4. A score of 1 was defined as less desirable than present conditions; a score of 2 was defined as same as at present condition; a score of 3 was defined as more desirable than present conditions; and a score of 4 was defined as unknown at this time.

1. TDG Reduction: the potential for the alternative to reduce TDG below current levels;
2. Downstream Fish Passage: the potential for the alternative to impact downstream fish passage past the dam including mortality and injury;
3. Upstream Fish Passage: the potential for the alternative to impact upstream fish passage past the dam including disorientation resulting in passage delays;
4. Maintaining Design Spillway Discharge: how does the project affect the ability of the spillway to pass the spillway design flood?
5. Generation Impacts: the potential for the alternative to impact the ability to generate electricity;
6. Public Use: the potential for the alternative to affect public use of the river;
7. Operations and Maintenance: the potential for the alternative to impact operations and maintenance. This includes both limitation on operational flexibility and O&M cost; and
8. Capital Cost: Four cost categories in 1000’s of dollars were identified and include $0 (no capital cost), <$20,000, $20,000-$60,000, and >$60,000. It includes the cost of construction, engineering, administration, and interest during construction. The accuracy of these estimates is less than that of a feasibility level assessment. The costs were computed by adjusting final costs of alternatives in various studies done at USACE projects (MWH 2003).

A summary of the evaluation table is presented in Table 2.
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<thead>
<tr>
<th>Alternative</th>
<th>TDG Benefit</th>
<th>D/S Passage</th>
<th>U/S Passage</th>
<th>Maintain Spillway Design</th>
<th>Generation Impacts</th>
<th>Public Use</th>
<th>O&amp;M</th>
<th>Capital Cost ($1,000)</th>
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<tbody>
<tr>
<td>Maximize Project Generation</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>$0</td>
<td>Mid-Columbia is under HCA and maximizing generation at single project may be challenging.</td>
</tr>
<tr>
<td>Scheduling Project Maintenance</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>$0</td>
<td>TDG benefit likely minimal with unknown costs and likely increase in O&amp;M.</td>
</tr>
<tr>
<td>Modification of Agreements</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>$0</td>
<td>Given multi-party agreements in place, renegotiation likely complex.</td>
</tr>
<tr>
<td>Gas Abatement Spill</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Spillway Deflectors</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>$20,000-$60,000</td>
<td>Wells Dam spillway lip acts as deflector. D/S passage concerns.</td>
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<tr>
<td>Submerged Outlets</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>$20,000-$60,000</td>
<td>Require removal of generating units.</td>
</tr>
<tr>
<td>Baffled Spillway</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>&gt;$60,000</td>
<td></td>
</tr>
<tr>
<td>Side Channel Spillway</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>&gt;$60,000</td>
<td></td>
</tr>
<tr>
<td>Additional Spillway</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>No cost estimate available.</td>
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<tr>
<td>Raised Stilling Basin</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>$20,000-$60,000</td>
<td>Small incremental TDG benefit for associated cost.</td>
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<tr>
<td>Raised Stilling Basin with Deflectors</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>$20,000-$60,000</td>
<td></td>
</tr>
<tr>
<td>Raised Tailrace Elevation</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>&lt;$20,000</td>
<td>Concerns include resource protection, public use and generation impacts.</td>
</tr>
<tr>
<td>Convert Turbine to Sluice</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>&gt;$60,000</td>
<td>Require removal of generating units.</td>
</tr>
<tr>
<td>Additional Units</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Pumped Storage</td>
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</tr>
</tbody>
</table>
5.0 CONCLUSIONS

The Wells Project TDG WQAP requires that Douglas PUD identify reasonable and feasible alternatives that may be implemented at the Wells Project to meet the TDG WQS. The objective of this TDG RAA is to conduct a comprehensive evaluation of any alternatives, both operational and structural, that may improve Project TDG management toward ultimately improving compliance with the TDG WQS criteria (Douglas PUD 2013b).

This analysis compiled all relevant site-specific and regional information regarding both operational and structural TDG abatement alternatives. Results of the literature review indicated that the most significant source of TDG abatement alternatives information originated from the USACE DGAS program and that these alternatives were compiled in a report by MWH (2003). Many of these alternatives formed the basis for review by a multi-disciplinary group (comprised of engineering, operations, power management, and environmental staff) regarding potential operational, coordination, financial, regulatory, and environmental implementation concerns and whether additional alternatives should be included.

Results of the analysis suggest that many of the alternatives identified would likely produce some level of TDG benefit. However, a number of concerns regarding the uncertainty around impacts to generation, environmental resources, and the feasibility of operational implementation were identified. In addition, many of the structural measures would likely require significant capital costs to implement with reoccurring O&M costs. Any further evaluation of any of the alternatives in the future will require detailed site-specific assessment and in some cases require additional physical, hydraulic and financial evaluations to more accurately scope the TDG benefit relative to the implementation cost.

Per the Wells Project TDG WQAP, if by year 9 (2022), compliance schedule activities that include Ecology-approved adaptive operational activities (i.e., Spill Playbook and updated Wells Project operational database) and field evaluations of updated modeling scenarios indicate compliance with the TDG WQS are not yet achieved during specific conditions, Douglas PUD will then be required to implement another alternatives analysis which would include an updated section of this original TDG RAA.
6.0 REFERENCES


EXHIBIT B

PRE-FILING CONSULTATION RECORD FOR THE TOTAL DISSOLVED GAS REDUCTION ALTERNATIVES ANALYSIS
NOTICE TO THE AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE TOTAL DISSOLVED GAS REDUCTION ALTERNATIVES ANALYSIS
Hi Aquatic SWG: please see the email below from Andrew and the attached draft TDG Reduction Alternatives Analysis Document.

The attached document is also available for download from the Aquatic SWG Extranet site under: Documents > Reports (instructions below). Thanks! –kristi 😊

**Instructions:**

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: [https://extranet.dcpud.net/sites/nr/aswg/](https://extranet.dcpud.net/sites/nr/aswg/)

* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site:
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

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Attached is Douglas PUD’s draft TDG Reduction Alternatives Analysis Document. Douglas PUD is seeking review and comment from the Aquatic Settlement Work Group. The document is required by Douglas PUD’s 401 Certification and is a follow-up to the Water Quality Attainment Plan approved by the FERC almost a year ago.
The document discuss all the structural and operational changes that have been considered by Douglas PUD, which might help meet TDG standards if they can’t be met at Wells Dam within the next ten years. These considerations are discussed in the context of other challenges such as safety, operational limitations, agreements, and fish survival limitations.

The document covers the history of TDG production and analyses at Wells before diving into these structural and operational considerations.

Following a 30 day review Douglas PUD will seek approval of the document during the December ASWG conference call.

Please let me know if you have questions.

Andrew
APPROVAL OF THE TOTAL DISSOLVED GAS REDUCTION ALTERNATIVES ANALYSIS BY THE AQUATIC SETTLEMENT WORK GROUP
The Aquatic Settlement Work Group (SWG) met by conference call on Wednesday, December 10, 2014, from 10:00 a.m. to 11:00 a.m. Attendees are listed in Attachment A of these meeting minutes.

I. Summary of Action Items

1. Douglas PUD will notify the Aquatic SWG when the Washington State Department of Ecology (Ecology) approves the draft Total Dissolved Gas (TDG) Reduction Alternatives Analysis; once approved, Kristi Geris will document approval of the analysis in the meeting minutes (Item VI-2).

2. Aquatic SWG members will submit edits and comments on the revised draft Wells White Sturgeon Stocking Program Statement of Agreement (SOA) to Douglas PUD by Monday, January 5, 2015 (Item VI-3).

3. Douglas PUD will discuss any recommended changes to the Wells White Sturgeon Stocking Program SOA with Aquatic SWG members prior to the next Aquatic SWG meeting (Item VI-3).

4. Douglas PUD will provide an update on 2014 white sturgeon releases in the Wells Project to date to Kristi Geris for distribution to the Aquatic SWG (Item VI-4). *(Note: Andrew Gingerich provided a passive integrated transponder [PIT] tag interrogation file, as discussed, specifically for brood year 2013 fish released in the spring and summer of 2014, to Geris following the conference call on December 10, 2014, which she distributed to the Aquatic SWG that same day [Attachment B].)*

5. Douglas PUD will provide RD Nelle of the U.S. Fish and Wildlife Service (USFWS) with the radio tag frequency information that they will use in the Well Dam 2015 Lamprey Passage and Enumeration Study (Item VI-5).
II. Summary of Decisions


2. The Aquatic SWG members present during the Aquatic SWG conference call on December 8, 2014, approved Dr. John Ferguson (Anchor QEA, LLC) as the new Aquatic SWG Chair (Item VI-8).

III. Agreements

1. There were no agreements reached during today’s conference call.

IV. Review Items

1. Kristi Geris sent an email to the Aquatic SWG on November 13, 2014, notifying them that the revised draft Wells White Sturgeon Stocking Program SOA is available for review. Edits and comments on the revised draft SOA are due to Douglas PUD by Monday, January 5, 2015 (Item VI-2).

V. Documents Finalized

1. There are no documents that have been recently finalized.

VI. Summary of Discussions

1. Welcome, Review Agenda, Meeting Minutes Approval, and Review of Action Items (Mike Schiewe): Mike Schiewe welcomed the Aquatic SWG members (attendees are listed in Attachment A) and opened the meeting. Schiewe reviewed the agenda and asked for additions or other changes to the agenda. Steve Lewis requested addition of the following topics: 1) 2015 Lamprey Passage and Enumeration Study and tributary coordination update; 2) Bull Trout Study update; and 3) lamprey and bull trout passage metrics update.

The revised draft October 22, 2014 conference call minutes were reviewed. Kristi Geris said that all comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and that there were no outstanding edits or questions to address. Aquatic SWG members present approved the October 22, 2014 conference call minutes, as revised.

The revised draft November 12, 2014 conference call minutes were reviewed. Geris said that there was one outstanding comment remaining to be discussed regarding a comment that Chad Jackson made during the draft Wells White Sturgeon Stocking Program SOA discussion about submitting a revised SOA to Douglas PUD. Jason McLellan indicated that he understood that the Washington Department of Fish and Wildlife (WDFW) had not submitted a revised SOA; however, were willing to
consider a revised stocking proportion in the interval between Douglas PUD’s and WDFW’s initial proposals. Andrew Gingerich clarified that WDFW did provide Douglas PUD with a draft SOA; however, Douglas PUD and WDFW mutually agreed not to introduce it at this time. Schiewe suggested revising the language to reflect WDFW’s agreement to consider a revised stocking number, and leave it at that; and McLellan agreed. McLellan also clarified that Andrea Drauch-Schreier’s PhD dissertation that he cited and noted earlier in the same discussion is from 2012, not 2002. In addition, Gingerich noted the language he added to the draft minutes clarifying Douglas PUD’s willingness to fund a pedigree or parent analysis once a stocking formula was agreed to via the Aquatic SWG, and indicated that Douglas PUD would revise their proposed stocking formula if the genetic analysis indicated the number of parents contributing to the larvae changed. Geris said that all other comments and revisions received from members of the Aquatic SWG were incorporated into the revised minutes, and Aquatic SWG members present approved the November 12, 2014 conference call minutes, as revised.

2. **DECISION: Draft TDG Reasonable and Feasible Analysis (Andrew Gingerich):**

Andrew Gingerich said that Kristi Geris sent an email to the Aquatic SWG on November 10, 2014, notifying them that the draft TDG Reduction Alternatives Analysis was available for a 30-day review period. Comments on the draft document were due to Douglas PUD by Tuesday, December 9, 2014. Gingerich said that Pat Irle indicated via email prior to the meeting on December 10, 2014, that Ecology had not yet completed their review of the draft document, and would not be ready to approve it at this time. Gingerich noted the importance of Ecology’s review of water quality documents, and said that because the comment period was based on an Ecology-imposed deadline rather than a Federal Energy Regulatory Commission (FERC) imposed deadline, Douglas PUD did not foresee any issues with granting Ecology additional time for review, as requested. He said, however, that he would still like to obtain Aquatic SWG approval of the document contingent on Ecology’s approval and edits. The Aquatic SWG Technical Representatives present approved Douglas PUD’s TDG Reasonable and Feasible Analysis, contingent on approval from Ecology. Douglas PUD will notify the Aquatic SWG when approval is received from Ecology; Geris will document approval of the analysis in the meeting minutes.

3. **DECISION: Wells White Sturgeon Stocking Program SOA (Andrew Gingerich):**

Andrew Gingerich said that a draft Wells White Sturgeon Stocking Program SOA with a revised stocking formula was distributed to the Aquatic SWG by Kristi Geris on November 13, 2014. Gingerich said that the revised formula applied a coefficient to the direct gamete program that would favor, or acknowledge, increased white sturgeon allelic diversity in the lower river. He said that limited questions and feedback were received on the revised SOA, and that he had hoped to obtain approval of the revised SOA during today’s conference call. However, yesterday he received an email from
WDFW indicating that they were not ready to approve the SOA today, and that they would like additional time to consult other technical experts. Gingerich said that Douglas PUD would still like to document a vote on the SOA as planned.

Jason McLellan said that the proposal incorrectly awards credit to the population in the John Day Pool for diversity in the entire Columbia River sturgeon population downstream of McNary Dam, including the Columbia River estuary. He said, however, that in the spirit of compromise and recognizing the value of including alleles from parents not represented in the larval collection, the Colville Confederated Tribes (CCT) are willing to support the SOA. He added further that the CCT do not think there are data to support anything beyond the original SOA, and they also see merit in the original SOA; however, they understand the desire to include fish from lower portions of the Columbia River. He also noted that this revised SOA is the limit of what the CCT can technically justify.

Steve Lewis agreed with McLellan’s position; however, at this time, he indicated that USFWS will abstain from voting until further discussion with WDFW takes place. Donella Miller said that the Yakama Nation (YN) has no comments on the revised SOA at this time. She added that the YN currently supports WDFW’s original proposal of a 50/50 split between larval-origin and direct gamete-origin fish. Gingerich said that Douglas PUD supports the revised SOA, which he believes meets all Aquatic SWG members’ objectives, including: 1) moving genes from the lower river upstream; 2) achieving a genetically-based split through parental representation; and 3) meeting the stocking target of 5,000 fish. He said that the goal is to balance those interests, while also recognizing that each component will not be perfect for everyone, which he noted, based on today’s discussion, Aquatic SWG members present seemed to agree upon. He said that he thought WDFW planned to consult with Paul Anders (Cramer Fish Sciences/University of Idaho) and Andrea Drauch-Schreier (University of California, Davis). He also said that there are about 30 to 45 days before a final program needs to be in place in order to allow fish adequate hatchery space and time to grow to an appropriate release size. He said that the Wells Hatchery Staff need to know the final program design by the end of December 2014, so the numbers held can be reduced appropriately and thus allow the fish that will be stocked the adequate space for the final 4 months out of growth.

The Aquatic SWG Technical Representatives present voted on Douglas PUD’s revised draft Wells White Sturgeon Stocking Program SOA, as follows: USFWS abstained, and the CCT and Douglas PUD supported the SOA. Voting members from WDFW, the YN and the Bureau of Land Management were not present on the call.

Mike Schiewe asked if, in the interest of reducing the sturgeon population at Wells Hatchery to allow space to grow fish to an adequate release size, there is a need
for actions prior to the next Aquatic SWG meeting on January 14, 2015. Gingerich said that he plans to keep in close contact with WDFW, and added that he is cautiously optimistic that after discussions take place between WDFW and Anders and Drauch-Schreier, progress will be made on an agreeable SOA. Gingerich said that he also plans to contact Anders to obtain his input on this discussion, and he added that a decision is needed no later than January 2015. Schiewe noted that if a decision cannot be reached in January 2015, this discussion may be taken to the Policy level, and if not resolved at the Policy level, the decision falls back to the responsible party, which would be Douglas PUD, and he added that this route is not ideal for anyone. Gingerich also clarified that the dispute resolution process is not consistent between forums (i.e., WDFW will not have the ultimate say in the matter as they may in other forums).

Schiewe suggested that Aquatic SWG members submit edits and comments on the revised draft Wells White Sturgeon Stocking Program SOA to Douglas PUD at least 10 days prior to the next Aquatic SWG conference call (i.e., Monday, January 5, 2015). Douglas PUD will continue to discuss any recommended changes to the Wells White Sturgeon Stocking Program SOA with Aquatic SWG members prior to the next Aquatic SWG meeting.

4. **Wells Hatchery Sturgeon Update** (Andrew Gingerich): Andrew Gingerich said that last month, there were 30,000 to 35,000 direct gamete-origin fish on station. He said that since then, some of the Marion Drain stock was returned to Marion Drain and a small number were culled, leaving about 13,500 Marion Drain direct gamete-origin stock in Tanks 1 through 6 at Wells Hatchery. He said that additional direct gamete-origin fish will soon need to be either returned to Marion Drain or culled in order to reduce the population down to 6,000 direct gamete-origin fish on station.

Gingerich said that yesterday was the first day of handling the larval-origin stock. He recalled reporting last month a little more than 9,000 larval-origin fish on station; however, the actual count turned out to be closer to about 6,900 larval-origin fish on station. He said that the larval-origin stock will be reared for another 30 to 45 days, and then at that stage, Douglas PUD will coordinate with Lake Roosevelt (FDR) stakeholders (i.e., the CCT, WDFW, and the Spokane Tribe of Indians) to determine what to do with any extra fish. Gingerich noted that the preference is to return fish before culling; however, there is not always space available to accomplish it.

Gingerich said that this morning, he queried the PIT-Tag Information System (PTAGIS) to determine how many 2014 white sturgeon releases (BY 2013) have been detected to date. He said that out of just over 5,000 released, the majority detected have been in the Okanogan River, with 73 unique detections. He added that one fish was detected in Foster Creek, and four were detected in the Rocky Reach Juvenile Fish Bypass. He said that most fish were detected in July, August, and September, with 22, 27, and 16 unique
detections, respectively. He said that fewer fish were detected in October, November, and December, with six, zero, and one detected, respectively. He said that nearly all detections were nighttime movements. He also noted that the fewest detections occurred during the colder and lower flow months, and speculated that detections will increase again next spring and summer. He added that he will provide this update on 2014 white sturgeon releases in the Wells Project to date to Kristi Geris for distribution to the Aquatic SWG. *(Note: Gingerich provided a PIT interrogation file, as discussed, specifically for BY 2013 fish released in the spring and summer of 2014, to Geris following the conference call on December 10, 2014, which she distributed to the Aquatic SWG that same day [Attachment B].)*

Mike Schiewe asked if Douglas PUD has heard anything further about the fish health testing. Gingerich said that WDFW recently provided results from the histological screenings of more than 60 fish per population for both Marion Drain direct gamete-origin fish and FDR larval-origin fish, and that they all came back negative for White Sturgeon Iridovirus.

5. **2015 Lamprey Passage and Enumeration Study and Tributary Coordination Update**

(Steve Lewis): Steve Lewis requested that Douglas PUD provide an update on the status of coordination with USFWS on the 2015 Lamprey Passage and Enumeration Study, specifically regarding sharing of radio tag frequencies for monitoring lamprey in tributaries. Andrew Gingerich said that since this was last discussed during the Aquatic SWG conference call on November 12, 2014, he contacted Mark Nelson (USFWS) to inform him about the study and that the Aquatic SWG had encouraged collaboration with Douglas PUD. He said that Nelson recommended contacting RD Nelle, which he agreed to do. Gingerich said that radio tag frequencies have not yet been determined for the study, and he added that Douglas PUD will provide Nelle with the radio tag frequency information that they will use in the Well Dam 2015 Lamprey Passage and Enumeration Study when it is available.

6. **Bull Trout Study Update**

(Steve Lewis): Steve Lewis requested that Douglas PUD provide an update on the developing logistics for the upcoming Bull Trout Study as it relates to Wells Dam and the Twisp Weir. Andrew Gingerich said that discussions have been ongoing between Douglas PUD and USFWS, specifically with Lewis and Judy Neibauer (USFWS). Gingerich said that the question is about what to do when bull trout are encountered. He said that Douglas PUD would like to PIT-tag those fish; however, he understands that USFWS wants to minimize handling those fish. He added that the level of incidental take has also been an ongoing discussion. He recalled that this year, the number of bull trout encountered at the Twisp Weir exceeded the take limit for that facility. He said that Douglas PUD understands that counts at Twisp Weir and at Wells Dam increase and decrease as the population fluctuates naturally, and these fluctuations need to be considered. He said that USFWS suggested developing an
operations plan that identifies ways to minimize bull trout encounters at the Twisp Weir. Gingerich said that at this stage, this might be the preferred option, opposed to reinitiating consultation via FERC and the USFWS. He said that Douglas PUD and USFWS plan to discuss this further at a meeting on December 17, 2014, at 1:30 p.m. Finally, Gingerich noted that the license required 2016/2017 Radio Telemetry Study at Wells Dam and the Twisp Weir was still expected to be carried out as per the requirement.

7. Lamprey and Bull Trout Passage Metrics Update (Steve Lewis): Steve Lewis requested that Douglas PUD provide an update on passage metrics, or fishway prescriptions, regarding when and how Douglas PUD plans to achieve passage standards for both lamprey and bull trout. Lewis asked, with regard to No-Net-Impact (NNI), Section 18 prescriptions, and Pacific Lamprey Management Plan (PLMP) terms and conditions, is Douglas PUD thinking about an approach to compensate for the lack of evaluation capacity, since so few lamprey pass through the project. Gingerich recalled that specific language for "NNI" is not present in the PLMP or the Aquatic Settlement Agreement; however, Douglas PUD is committed to Pacific Lamprey and the implementation of the PLMP. He said that regarding how to study lamprey at Wells Dam when counts suggest there are very few fish passing Wells Dam, Douglas PUD has implemented translocation studies using fish captured fish at Bonneville and Priest Rapids dams as study fish. Gingerich acknowledged that no one was really satisfied with the sample size from the 2013 study. He said that it is hard to say if the issue was associated to Wells Dam, or was from using study fish from another location that may not want to pass Wells Dam. He further speculated that perhaps because the fish are not homing to a natal stream, like salmon, or not enough olfactory cues (e.g., pheromone) to make them want to swim upstream. He said that Douglas PUD continues to consider this, and at this point, he is not certain what the long-term strategy will be. He said that Douglas PUD is conducting the lamprey study in 2015 to evaluate how the fish interact with the project; and if the results are similar to 2013, where only half of the fish are detected, then Douglas PUD and the Aquatic SWG may need to rethink the approach. He added that USFWS and the YN have also discussed other strategies, which will be considered. Lewis suggested expanding the scope of the 2015 Lamprey Passage and Enumeration Study to address these issues, for example, installing an array in the Methow. Gingerich said that he understands USFWS’ interest in monitoring the tributaries; however, Douglas PUD does not plan to consider fish in the tributaries, which is outside the scope of the lamprey study. He reiterated that Douglas PUD is certainly willing to coordinate with others if that is an interest. Lewis explained that when USFWS asks what Douglas PUD is doing to address this Section 18 concern, he would like to give Douglas PUD credit for going above and beyond management plan to compensate for the lack of individuals passing the project. He added that this can be discussed further once RD Nelle is looped into the conversation, including what coordination might look like and what is doable for each party. Gingerich agreed, and said that Douglas PUD can discuss this at any time.
8. **Aquatic SWG Chair Evaluation Recap** (All): Andrew Gingerich said that last Monday, December 8, 2014, the Aquatic SWG met by conference call to conduct interviews for the Aquatic SWG Chair position. Gingerich said that Dr. Pete Bisson (Bisson Aquatic Consulting, LLC) was interviewed first, and Dr. John Ferguson (Anchor QEA, LLC) was interviewed second. Gingerich said that Douglas PUD felt that both interviews went very well, and that both candidates provided good responses. He added that there were pros and cons regarding each candidate, and Douglas PUD felt that either one was qualified to be the next Chair for this forum. Gingerich said that following a relatively short discussion, it was clear that some Aquatic SWG members preferred Ferguson and the remainders were comfortable with either candidate; therefore, the Aquatic SWG members present approved Ferguson as the new Aquatic SWG Chair. Gingerich said that Douglas PUD recorded notes to capture the essence of the conversations for future reference, which will likely be distributed by the end of this week. Steve Lewis and Jason McLellan both agreed with Gingerich’s account of the interviews.

VII. **Next Meetings**

1. **Upcoming meetings** (Mike Schiewe): Upcoming meetings are as follows:

   *January 14, 2015 (conference call); February 11, 2015 (TBD); and March 11, 2015 (TBD).*

**List of Attachments**

Attachment A – List of Attendees
Attachment B – 2014 White Sturgeon Releases in the Wells Project to Date
## List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike Schiewe</td>
<td>Aquatic SWG Chair</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
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<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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<tr>
<td>Donella Miller</td>
<td>Technical Support</td>
<td>Yakama Nation</td>
</tr>
<tr>
<td>Steve Lewis</td>
<td>Aquatic SWG Technical Representative</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
</tbody>
</table>
January 22, 2016

Andrew Gingerich  
Senior Aquatic Resource Biologist  
Public Utility No. 1 of Douglas County  
1151 Valley Mall Parkway  
East Wenatchee, WA 98802

RE: Wells Hydroelectric Project, FERC Project No. 2149  
Total Dissolved Gas Reduction Alternatives Analysis: Reasonable and Feasible Improvements

Dear Mr. Gingerich:

The Washington Department of Ecology (Ecology) hereby approves the Total Dissolved Gas Reduction Alternatives Analysis submitted by Public Utility District (PUD) No. 1 of Douglas County for the Wells Hydroelectric Project; FERC Project No. 2149. This analysis is required under Section 6.7(2)(e) of the 401 Certification /Order No. 8981 issued by Ecology February 27, 2012. It was submitted by the PUD to Ecology within the required time frame of within one year of approval by FERC of the Water Quality Attainment Plan.

Thank you for your continued cooperation and compliance with the 401 requirements. Please let me know if you have any questions, I can be reached at 509/457-7107.

Sincerely,

Charles McKinney  
Section Manager  
Water Quality Program

cc: Shane Bickford, Douglas Co. PUD

NOTED
JAN 22 2016
MEM
APPENDIX L
ADULT LAMPREY APPROACH, PASSAGE, AND ENUMERATION STUDY PLAN, WELLS DAM – 2016
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>1.0 INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>1.1 Aquatic Settlement Agreement and Pacific Lamprey Management Plan</td>
<td>2</td>
</tr>
<tr>
<td>2.0 BACKGROUND</td>
<td>2</td>
</tr>
<tr>
<td>2.1 Wells Project Pacific Lamprey Passage Studies</td>
<td>2</td>
</tr>
<tr>
<td>2.1.1 2001-2003 Pacific Lamprey Radio-telemetry Study</td>
<td>2</td>
</tr>
<tr>
<td>2.1.2 2007-2008 Pacific Lamprey Radio-telemetry Study</td>
<td>3</td>
</tr>
<tr>
<td>2.1.3 2009-2010 Wells Project DIDSON Studies</td>
<td>5</td>
</tr>
<tr>
<td>2.1.4 2011-2012 Lamprey Operations</td>
<td>6</td>
</tr>
<tr>
<td>2.1.5 2013 Adult Lamprey Passage and Enumeration Study</td>
<td>6</td>
</tr>
<tr>
<td>3.0 GOALS, ASSUMPTIONS AND HYPOTHESES</td>
<td>7</td>
</tr>
<tr>
<td>3.1 Goals and Objectives</td>
<td>8</td>
</tr>
<tr>
<td>3.2 Hypotheses</td>
<td>9</td>
</tr>
<tr>
<td>4.0 METHODOLOGY</td>
<td>10</td>
</tr>
<tr>
<td>4.1 Fish Source</td>
<td>10</td>
</tr>
<tr>
<td>4.2 Tagging and Release Procedures</td>
<td>11</td>
</tr>
<tr>
<td>4.3 Acoustic-telemetry</td>
<td>11</td>
</tr>
<tr>
<td>4.4 Acoustic Receiver Range Testing and Data Collection</td>
<td>14</td>
</tr>
<tr>
<td>4.5 PIT Tag Detection</td>
<td>15</td>
</tr>
<tr>
<td>4.6 Count Station Efficiency</td>
<td>15</td>
</tr>
<tr>
<td>4.7 Lamprey Side Entrances</td>
<td>15</td>
</tr>
<tr>
<td>4.8 Lamprey Enumeration Structures</td>
<td>15</td>
</tr>
<tr>
<td>4.9 Statistical Analyses and Reporting</td>
<td>16</td>
</tr>
<tr>
<td>4.9.1 Approach and Passage Attempt</td>
<td>16</td>
</tr>
<tr>
<td>4.9.2 Enumeration Efficiency</td>
<td>17</td>
</tr>
<tr>
<td>4.9.3 Lamprey Side Entrance Evaluation</td>
<td>17</td>
</tr>
<tr>
<td>4.9.4 Lamprey Enumeration Structure Evaluation</td>
<td>17</td>
</tr>
<tr>
<td>4.9.5 Statistical Analyses and Power</td>
<td>17</td>
</tr>
<tr>
<td>4.10 Regional Coordination</td>
<td>18</td>
</tr>
<tr>
<td>4.11 Schedule and Reporting</td>
<td>19</td>
</tr>
<tr>
<td>5.0 REFERENCES</td>
<td>20</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1. Picketed lead immediately downstream of the fishway count window. Behind the picketed lead is the count window bypass area. ---------------------- 4

Figure 2. Map of acoustic telemetry receiver locations in the Wells Tailrace and Rocky Reach Reservoir -------------------------------------------------- 12

Figure 3. Map (detailed view) of acoustic telemetry receiver locations in the Wells Dam Tailrace. ------------------------------------------ 13

Figure 4. Map of acoustic telemetry receivers in the Wells Reservoir. --------------- 14

Figure 5. Conceptual drawing of Lamprey Enumeration Structure LES. Side view. Drawing not to scale.------------------------------------------ 16

Figure 5b. Conceptual drawing of Lamprey Enumeration Structure (LES). Top view. Drawing not to scale.------------------------------------- 16
List of Tables

Table 1. Statistical power (Type II error rate) and sample size needed to detect small (10%) and large (50%) differences, at 90% confidence level between observed and expected proportions under the null hypotheses. ------18

Table 2. Estimated timeline for study development, implementation and reporting. -----------------------------------------------19
ABSTRACT

In an effort to better understand Pacific lamprey (*Entosphenus tridentatus*) behavior at Wells Dam, Public Utility District No. 1 of Douglas County (Douglas PUD), in consultation with the Aquatic Settlement Work Group, is proposing to conduct a multi-faceted adult lamprey passage study at Wells Dam in 2016. This study is intended to collect information necessary to continue implementation of Objective 1 of the Pacific Lamprey Management Plan (PLMP) found in the Aquatic Settlement Agreement (ASA).

The goal of the study is to evaluate the effect of the Wells Hydroelectric Project (Wells Project) and its operations on adult Pacific lamprey upstream passage behavior and enumeration in the Wells Project fishways.

Specific objectives of the study include:

1. **Adult Pacific Lamprey Upstream Passage Evaluation (PLMP section 4.1.6).**
   - Evaluate behavior acoustic-tagged adult Pacific lamprey through Rocky Reach Reservoir and determine the proportion that approach and interact with Wells Dam to help guide future studies of fishway entrance efficiency and passage success.
   - Evaluate adult Pacific lamprey use and entrance efficiency in the re-opened low level fishway entrances and prototype lamprey entrance boxes.

2. **Upstream Fishway Counts and Alternative Passage Routes (PLMP section 4.1.3)**
   - Evaluate the enumeration efficiency, behavior and fish passage efficiency of the fish count station at Wells Dam following sealing of gaps and alternative routes through the fish count stations.
   - Evaluate the use of a lamprey enumeration structure (LES) in the fish count windows.

Implementation of the study is consistent with requirements contained within the Wells Project PLMP. The study results are intended to support the goal of the PLMP, which is to implement measures to monitor and address impacts, if any, on Pacific lamprey resulting from the Wells Project during the term of the new license.
1.0 INTRODUCTION

1.1 Aquatic Settlement Agreement and Pacific Lamprey Management Plan

During the relicensing process for the Wells Hydroelectric Project (Wells Project or Project), Public Utility District No. 1 of Douglas County (Douglas PUD), in collaboration with federal, state and tribal relicensing participants, developed six Aquatic Resource Management Plans in support of a comprehensive Aquatic Settlement Agreement (ASA). The Pacific Lamprey Management Plan (PLMP) is one of the six Aquatic Resource Management Plans contained within the ASA that directs the implementation of Protection, Mitigation, and Enhancement measures (PMEs) for Pacific lamprey (Entosphenus tridentatus) during the term of the new Wells Project operating license.

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey resulting from the Wells Project during the term of the new license. Objective 1 of the PLMP is to identify and address any adverse Project-related impacts on passage of adult Pacific lamprey. Pursuant to this objective, Douglas PUD is proposing to conduct an adult active tag study to: 1) collect additional information on the passage characteristics and behavior of adult lamprey migrating through the Wells Project fishways (section 4.1.6 of the PLMP); and 2) to evaluate enumeration efficiency in the vicinity of the Wells Project fishway count windows (section 4.1.3 of the PLMP) toward identifying alternatives to improve adult lamprey count accuracy.

2.0 BACKGROUND

2.1 Wells Project Pacific Lamprey Passage Studies

As part of the Wells Project relicensing, Douglas PUD conducted several adult lamprey passage studies (2001-2003, 2007, and 2008) to evaluate the effect of the Wells Project and its operations on adult Pacific lamprey upstream migration and behavior as it relates to fishway passage, timing, and downstream passage events through the dam.

2.1.1 2001-2003 Pacific Lamprey Radio-telemetry Study

In 2004, Douglas PUD contracted with LGL Limited to conduct a lamprey radio-telemetry study at Wells Dam in coordination with Chelan PUD, which was conducting a similar study at Rocky Reach Dam. A total of 150 lamprey were radio-tagged and released at or below Rocky Reach Dam. The radio tags used in this study had an expected operational life of 45 days (Nass et al. 2005). Only 18 of these tagged fish were detected upstream at Wells Dam and many of the radio tags detected were within days of exceeding their expected battery life.

The 2004 study at Wells Dam was implemented through a combination of fixed-station monitoring at the dam and fixed-stations at tributary mouths. Collectively, these monitoring sites were used to determine migration and passage characteristics of lamprey entering the Project Area. Of the 150 adult lamprey released at or below Rocky Reach in 2004, 18 (12% of
were detected in the Wells Dam tailrace, and ten (56% of 18) of these were observed at an entrance to the fishways at Wells Dam. A total of 3 radio-tagged lamprey passed Wells Dam prior to expiration of the tags, resulting in a fishway efficiency estimate of 30% (3 of 10) for the study period. A single lamprey was detected upstream of Wells Dam at the mouth of the Methow River (Nass et al. 2005).

For lamprey that passed the dam, the majority (92%) of Project passage time was spent in the tailrace. Median time required to pass through the fishway was 0.3 d and accounted for 8% of the Project passage time (Nass et al. 2005).

Although the 2004 study at Wells Dam provided preliminary passage and behavioral information for migrating adult lamprey, the limited observations due to the small sample size (n=18) were insufficient in addressing the objectives of the 2004 study.

### 2.1.2 2007-2008 Pacific Lamprey Radio-telemetry Study

In 2007, Douglas PUD contracted with LGL Limited to conduct another active tagging study. Twenty-one lamprey were captured, radio-tagged, and released from August to October. Tags used in this study had an expected tag life of 87 days. Of the twenty-one fish, 10 were released into the tailrace and 11 were released directly into the middle fishway section of the Wells fishways. One tailrace-released fish was recaptured and re-released into the fishway, bringing total in-ladder releases to twelve. Ten of the 12 (83%) lamprey released into the middle fishway section successfully ascended, with a median upper fishway passage time of 7.9 hours. Seven of the 10 (70%) lamprey released into the tailrace were detected at the outside of a fishway entrance. Only one of these seven (14%) lamprey entered into the collection gallery and ascended the fishway with a lower fishway passage time of 6.1 hours and upper fishway passage time of 5.9 hours.

During the 2007 study, a total of 11 radio-tagged adult Pacific lamprey passed the fish counting facilities in both fishways. Nine of these fish were detected by an antenna monitoring the count window bypass area (i.e., an area in the fishway accessed through a picketed lead just downstream of the count window which allows lamprey to migrate through the fish counting facilities undetected; Figure 1), although 3 fish were detected for less than 20 seconds and probably did not completely enter the bypass area. Eight of these lamprey were not observed at the count window, and 2 fish had zero detections on the above count window antenna (LGL and Douglas PUD 2008). The results suggested that visual detections at the count windows could be significantly lower (e.g., under estimating by 73% according to these data) than the actual total number of lamprey passing the fish counting facilities.
In 2008, Douglas PUD conducted another adult lamprey passage study where 38 radio-tagged adult Pacific lamprey were released in the tailrace (n= 18) and fishways (n=20) of Wells Dam to continue an evaluation of behavior and passage performance, and to identify potential areas of passage impediment. In 2008, 15 lamprey approached the fishway from the tailrace, five (33%) of which entered the fishway. Movements within the collection gallery indicated that lamprey were able to move relatively unrestricted by flows. At least 11 of 19 (58%) lamprey which volitionally entered or were released in the collection gallery ascended to the lamprey trapping area in the middle fishway section. However, modifications to increase lamprey trapping efficiency effectively obstructed migration and 12 of 14 fish (86%) that encountered the lamprey traps were ultimately blocked. This artifact likely biased lower fishway passage times significantly. Upper fishway passage times of four radio-tagged lamprey that ascended past the trapping area were relatively fast (< 4 hours), except for one fish that ceased upstream movement during daylight hours. No fallbacks of fish that successfully ascended the fishway were observed for the second consecutive year. Overall, results indicate that any potential areas of impediment are restricted entirely to the entrance and lamprey trapping facility, as upper fishway passage efficiency was 100% for the second consecutive year.
During the 2008 study, of the four tagged lamprey that ascended into the upper fishway section, three bypassed the count window via the count window bypass area supporting the 2007 findings that a majority of lamprey that ascend Wells Dam may be uncounted (Robichaud et al. 2009). As concluded in the 2007 study, use of the count window bypass area appears to be an enumeration issue, rather than a passage concern (i.e., tagged fish generally move through this portion of the fishway efficiently and at above average speeds). The study recommended that further consideration should be given regarding effective monitoring of lamprey passage through the count window bypass area depending upon the importance of accurate counts at the Wells Project (LGL and Douglas PUD 2008).

The results of the 2007-2008 studies indicated that: 1) adult lamprey are having difficulty negotiating the fishway entrance; 2) lamprey passage in the fishway can be inhibited by the installation of lamprey traps on the bottom orifices within the middle section of the fishway (traps were removed in 2009); 3) lamprey are passing the middle and upper fishway sections at high rates, in a reasonable amount of time, and with negligible drop back within the ladder; and 4) a large proportion of the adult lamprey are bypassing the adult salmon counting windows (LGL and Douglas PUD 2008).

A comprehensive report was produced in February of 2009 (Robichaud et al. 2009). One of the recommendations by the researchers was to implement a reduction in fishway head differential to reduce entrance velocities to levels within the swimming capabilities of Pacific lamprey (0.8 to 2.1 m/s) during the hours of peak lamprey activity (i.e., nighttime) and within the primary migratory period at Wells Dam (August-September).

**2.1.3 2009-2010 Wells Project DIDSON Studies**

In response to Robichaud et al. (2009), Douglas PUD, in consultation with the Aquatic Settlement Work Group (Aquatic SWG), prepared a plan to implement and evaluate measures to enhance entrance efficiency of adult Pacific lamprey at Wells Dam (Johnson et al. 2011). These measures, originally scheduled for year two after license issuance (2013), were designed to determine whether temporary velocity reductions at the fishway entrances would enhance the attraction and relative entrance success of adult lamprey at Wells Dam.

DIDSON units were deployed at Wells Dam fishway entrances during the peak of historic Pacific lamprey migration in 2009 (20 August to 24 September) and 2010 (7 August to 30 September). DIDSON was used to sample lamprey behavior and upstream passage events along the entire width of the fishway entrances and 1.3 m of vertical coverage above the sills (about 26% of the wetted vertical opening). Lamprey passage was examined relative to variable head differential treatments and entrance velocities. In 2009, three head differential treatments were tested: existing high (0.48 m; or 3.0 m/sec), moderate (0.31 m; or 2.4 m/sec) and low condition (0.15 m; or 1.8 m/sec) (Johnson et al. 2010). In 2010, only two of the 2009 treatments were used: existing high, and the moderate head differential conditions (Johnson et al. 2011). Treatments were grouped in 3-day blocks and lasted four hours each evening in 2009 (21:00 through 00:59). In 2010, the treatments were paired and lasted eight hours each evening (17:00 through 00:59). Data collected during the treatment periods were reviewed and all lamprey observations were described.
Combining both years, a total of seven lamprey observations were recorded where lamprey were observed to encounter the entrance sill heading upstream (N = 5 in 2009; and N = 2 in 2010). Five of these seven observations were in the east fishway and two were in the west fishway. Overall, five of the seven observations showed successful entry into the fishways (71%). During reduced head differential treatments, five observations were recorded with four of the five resulting in successful entry (80% efficiency). Three of three observations with the moderate head differential condition resulted in successful entry (100% entrance efficiency). During high head differential conditions, one of the two lamprey observed entered a fishway (50% entrance efficiency).

Four lamprey exhibited attach and burst behaviors (one during low [25%], two during moderate [50%] and one during high head differential conditions [25%]), all of which resulted in successful entry into the fishways. One of three lampreys that did not exhibit the former behavior successfully entered the fishway, under the moderate treatment condition. The other two lamprey that did not exhibit attach and burst behavior did not successfully enter the fishway.

Extremely low Columbia River basin lamprey runs in 2009 and 2010 resulted in few fish observed at Wells Dam (the ninth and last hydroelectric project on the Columbia River [river mile 516] with fish passage). Low sample sizes precluded statistical evaluation of these results. Nonetheless, operational modifications implemented in these two years of study suggest that lamprey entrance efficiency may be increased with lower head conditions. Pooling observations that occurred during reduced head differential treatments shows 80% (4 of 5) entrance efficiency compared to 50% (1 of 2) under the current operating condition (high condition). Study results suggest that reduced head differentials show promise in providing an environment conducive to upstream passage of lamprey.

2.1.4 2011-2012 Lamprey Operations

As a best management practice in 2011 and 2012 Douglas PUD operated the fishways with a 1.0 foot head differential during the hours 17:00 and 00:59, once five lamprey had been counted at Rocky Reach Dam and continuing through September 30. Beyond those hours, fishway collection-gallery operations should be maintained at the “normal” head differential of 1.5 feet.

2.1.5 2013 Adult Lamprey Passage and Enumeration Study

In 2013, Douglas PUD conducted a study to evaluate physical and operational modifications to the Wells Dam fishways that were designed to improve adult lamprey passage and enumeration efficiency. Physical modifications included the installation of 11/16th inch gap diffuser to exclude lamprey from the count window bypass chamber and the installation of solid aluminum plate ramps leading into and out of the count window area. Operation modifications involved reduction in fishway head differential from 1.5 feet to 1.0 foot.

Adult Pacific lamprey were captured at Bonneville and Priest Rapids dams, and transported to the Wells Fish Hatchery for tagging. Radio and PIT tags were surgically implanted, and the tagged fish were released into the Wells Dam tailrace (n=92) or into the Wells Dam fishways above the adult fish trap (pool 38; n=18). To monitor movements, underwater antenna arrays
were deployed throughout both Wells Dam fishways, and aerial antennas were deployed at the mouths of upstream tributaries (Okanogan and Methow rivers).

Two head differential treatments were compared: a high condition (0.48 m or 1.5 feet) and a moderate condition (0.31 m or 1.0 foot). Treatment conditions occurred in 7-hour blocks (19:00 through 02:00) and alternated daily. Between treatments, the head differential was set at 0.48 m (1.5 feet). From 7 July to 7 October, 80 treatment conditions were tested, including 40 replicate tests of each treatment. The lamprey that were released into the tailrace approached the fishways on 89 occasions (35 during the high differential treatment, 12 moderate). Entrance Efficiency (the proportion of approach events that were followed by an entrance event) was 67% during the moderate treatment and 51% during the high treatment. Differences were not statistically significant, but statistical power was low.

Previous studies had identified an area (‘bypass’ behind the picketed lead) that allowed lamprey to move upstream through picketed leads without passing through the fishway video count window. Concerns about accurate passage count data prompted the installation of modified picketed leads with narrower spacing to help exclude lamprey from the bypass area. Count Station Passage (the proportion of tagged fish detected below the count window that were directed through the count station, rather than the bypass) was 88%, which was a significant improvement from before the new leads were installed (53.3%). Count Station Enumeration Efficiency (the proportion of fish known to have passed the count window that were tallied by the count video technicians) was significantly higher in the west fishway (68%) than in the east (33%), and was 51% overall. Count Station Enumeration Efficiency in 2013 was 11% higher than that estimated prior to installation of the modified picketed leads, but the statistical power of the comparison was limited.

The results of the study showed that radio-tagged lamprey exhibited low passage efficiency in the lower fishways between the collection gallery and adult fish trap. This was evidenced by the large proportion of lamprey that entered the fishways but failed to ascend any higher than weir 7. The results also suggested that lamprey are still capable of bypassing the fish count window and avoid enumeration. Inspection of the fishways in June 2014 revealed gaps and alternative passage routes that lamprey could potentially use to bypass the fish count window.

3.0 GOALS, ASSUMPTIONS AND HYPOTHESES

Many of the previous adult Pacific lamprey passage studies at Wells Dam have relied on fish captured in the Columbia River at downstream locations and translocated and released in the Wells Dam tailrace. A key assumption of previous studies using translocated lamprey is that those fish will exhibit upstream migratory behavior and are motivated to approach and attempt to pass Wells Dam. However, the results of previous studies at Wells Dam showed that approximately half or less of radio-tagged translocated lamprey released in the tailrace interacted with the dam (LGL and Douglas PUD 2008; Robichaud and Kyger 2014). In addition, a pilot acoustic telemetry study by Grant County PUD in 2015 showed that only 1% of lamprey captured and acoustic tagged at Priest Rapids and released at two locations downstream of Rocky Reach Dam were detected within one mile of Wells Dam (Grant PUD 2015, unpublished data). The results from these investigations suggest that the assumption that translocated lamprey, and
Perhaps non-translocated lamprey, actively approach or are motivated to pass Wells dam may be invalid.

In order to identify potential passage issues and to effectively evaluate structural and operational modifications designed to improve lamprey passage, the assumption that lamprey are actively migrating and approaching Wells Dam with the intent to pass must be met. The primary goals of the 2016 study will be to investigate the validity of this assumption using acoustic telemetry while also gleaning information on lamprey passage behavior and the effectiveness of recent structural modifications that are aimed at improving entrance efficiency and enumeration through the use of PIT detections and count window video observations.

3.1 Goals and Objectives

One of the primary goals of the PLMP is to evaluate the effect of the Wells Project and its operations on adult Pacific lamprey upstream passage behavior and enumeration in the Wells Project fishways. In order to conduct studies in support of this goal, the assumption that lamprey translocated from locations downstream and tagged and released below Wells Dam actively migrate upstream, approach, and attempt to pass Wells Dam must be valid. The primary goal of this study is to evaluate this assumption to inform future studies aimed at meeting the goals and objectives of the PLMP.

Specific objectives of the study include:

1. Adult Pacific Lamprey Upstream Passage Evaluation (PLMP section 4.1.6).
   A. Determine the proportion of acoustic-tagged lamprey released in Rocky Reach Reservoir that approach and interact with the Wells Project. Evaluate passage efficiency of PIT-tagged adult Pacific lamprey through Wells Dam fishways.
   B. Determine if PIT-tagged lamprey use the newly installed lamprey side entrances and the entrance efficiency for that route.
   C. Compare passage metrics (i.e., passage efficiency, travel time and behavior) to other mainstem Columbia River projects.

2. Upstream Fishway Counts and Alternative Passage Routes (PLMP section 4.1.3)
   A. Evaluate the passage and enumeration efficiency of adult lamprey at the fish count station at Wells Dam following modifications made to seal gaps and alternative passage routes that bypass the count window.
   B. Evaluate the efficacy of lamprey enumeration structures (LES) as an alternative to the existing fish count window alone.
3.2 Hypotheses

The following null and alternative hypotheses per each objective are as follows:

Objective 1A

H₀: The proportion of acoustic-tagged lamprey released in the Rocky Reach Reservoir that approach and interact with Wells Dam is equal to or greater than the proportion that do not.  
Hₐ: The proportion of acoustic-tagged lamprey released in the Rocky Reach Reservoir that approach and interact with Wells Dam is less than the proportion that do not.

Objective 1B

H₀: There is no difference in the proportions of PIT tagged lamprey that successfully enter the Wells Dam fishways via the side lamprey entrances and the main entrances.  
Hₐ: A greater proportion of PIT tagged lamprey successfully enter the Wells Dam fishways via the lamprey side entrances than the main entrances.

Objective 1C

H₀: There is no difference in passage metrics (i.e., passage efficiency, travel time and behavior) compared to other mainstem Columbia River projects.  
Hₐ: Passage metrics for lamprey differ compared to other mainstem Columbia River projects.

Objective 2A:

H₀: The proportion of tagged lamprey observed passing the count window is similar to previous studies.  
Hₐ: The proportion of tagged lamprey observed passing the count window is dissimilar to previous studies.

H₀: The number of lamprey detected by PIT antenna arrays upstream of the fish count windows is equal to the number of fish observed in the fish count windows.  
Hₐ: The number of lamprey detected by PIT antenna arrays upstream of the fish count windows differs from the number of fish observed in the fish count windows.

Objective 2B:

H₀: The proportion of lamprey observed using the LES to pass through the fish count station is the same as the proportion that pass through the fish count station without using the LES.  
Hₐ: The proportion of lamprey observed using the LES to pass through the fish count station differs from the proportion that pass through the fish count station without using the LES.
4.0 METHODOLOGY

4.1 Fish Source

A total of 50 lamprey will be collected at Priest Rapids Dam for use in the study in 2016. In addition, data will be collected from any acoustic and/or PIT-tagged fish from other concurrent studies being conducted by other entities in the region. In 2016, Grant PUD is planning to release at least 100 acoustic tagged lamprey at or upstream of Priest Rapids Dam, repeating a pilot study conducted in 2015. In the 2015 pilot study, 25 of the 100 acoustic tagged lamprey released passed upstream of Rocky Reach Dam. Given these results, it is expected that similar numbers of acoustic tagged lamprey will pass upstream of Rocky Reach Dam in 2016. With this expectation, a minimum sample size of 75 acoustic tagged lamprey (50 released at Lincoln Rock State Park by Douglas PUD and an additional 25 or more from Grant PUD releases) would be available for this study. Douglas PUD and its contractors will therefore provide and tag 50 pacific lamprey with acoustic tags, but will analyze data from all acoustic tagged lamprey that exit Rocky Reach Dam.

Additional lamprey may be PIT tagged and released below Wells Dam to support the objectives of evaluating the lamprey side entrances and LESs if available. The number of additional lamprey to be PIT tagged and released is uncertain and will depend on the numbers available at Priest Rapids Dam during the 2016 passage season. Douglas PUD will coordinate with other groups conducting lamprey research in the region to obtain additional lamprey to PIT tag and release below Wells Dam, if available. Douglas PUD will provide PIT tags for any additional fish released below Wells Dam.

It is assumed that fish captured at and transported from trapping locations will be exhibiting upstream migratory behavior and will attempt to pass Wells Dam. Since most fish losses from hauling stress are caused by poor water quality and improper handling (Wynne and Wurts 2011), appropriate handling and transport protocols will be developed to ensure study fish in good health are delivered to the Wells Fish Hatchery.

Only adult lamprey in healthy condition (e.g., no signs of injury, disease, etc.) should be collected for transport. All captured fish should be immediately placed in covered hauling tanks via nets. No anesthetics will be used during trapping operations as this can produce a biological response similar to that caused by stress (Wynne and Wurts 2011). An attempt will be made to use larger lamprey (> 450g) for acoustic tagging to minimize tag burden, however during the 2013 Lamprey Passage and Enumeration Study, the majority of the lamprey captured did not meet this size threshold (Robichaud and Kyger 2014).

Covered tank(s) of an appropriate volume will be used to avoid stressors and disease transmission related to overcrowding. Each tank will be filled with river water and water temperature and dissolved oxygen will be measured prior to transport. During transport, both temperature and dissolved oxygen will be checked hourly, levels recorded, and adjustments to equipment will be made to maintain pre-transport water quality conditions. A final evaluation of fish and water quality conditions and total transport time will be noted upon delivery to the Wells Fish Hatchery.
4.2 Tagging and Release Procedures

Tagging procedures will follow methods described in previous lamprey radio-telemetry studies conducted at Wells Dam (LGL and Douglas PUD 2008) and will consider recent advances in knowledge and understanding of fish health and condition (Cooke et al. 2011a; b). An effort will be made to minimize impacts to the biological and physiological condition of the study fish. Specific attention will be made to minimize incision length, possibility of infection, handling time, water temperature stressors, and air exposure.

Lamprey will be tagged with Vemco V9 acoustic tags weighing 2.2g in water. In addition, each fish will be given a full-duplex passive integrated transponder (PIT) tag with tag dimensions of 12mm by 2.12mm and weighing 0.1 g. Total combined weight of both tags is 2.3g and a tag burden of less than 1% of body mass is proposed. Brown et al. (2006) noted that 4% is considered an acceptable burden for tagging studies, however tag burden should be minimized whenever possible.

After surgery, fish will be transferred to a covered tank with flow through river water for recovery (a minimum of one hour). For the purposes of the study, it is assumed that tagged fish are representative of untagged fish.

All tagged fish that have recovered from the tagging process will be transported by truck in a 113 L cooler filled with river water. An air tank and air stones will be used to maintain oxygen levels. Acoustic and PIT-tagged lamprey will be released in the Rocky Reach Reservoir at Lincoln Rock State Park.

4.3 Acoustic-telemetry

A total of 10 acoustic telemetry receivers will be deployed at locations in the Wells tailrace (6 receivers within 3km) and Rocky Reach Reservoir (4 receivers) (Figures 2 and 3). In addition, existing acoustic receivers at 15 locations in the Wells Reservoir will be used to collect data on tagged lamprey that pass upstream of Wells Dam (Figure 4). Mobile tracking of acoustic-tagged lamprey will also take place if data collected by fixed acoustic telemetry receivers suggest that large numbers of fish are congregating in particular river reaches or locations downstream of Wells Dam.
Figure 2. Map of acoustic telemetry receiver locations in the Wells Tailrace and Rocky Reach Reservoir
Figure 3. Map (detailed view) of acoustic telemetry receiver locations in the Wells Dam Tailrace.
4.4 Acoustic Receiver Range Testing and Data Collection

Prior to the release of acoustic tagged lamprey, listening range testing of acoustic telemetry receivers will be conducted using tags identical in size and strength to those to be implanted in study fish. If range testing shows areas where tagged fish may be able to pass undetected, additional receivers will be deployed to ensure complete coverage in those areas. Acoustic telemetry receiver data will be downloaded monthly for receivers maintained by Douglas PUD.
Douglas PUD will coordinate with Chelan PUD to obtain data from receivers in the Rocky Reach Reservoir as soon as available. Raw acoustic data can be shared via a cloud server.

4.5 PIT Tag Detection

All lamprey released during the 2016 will be implanted with full duplex PIT tags. PIT tag antenna arrays are located at pools 19 and 67 in the Wells Dam fishways in addition to antennas on each of the new lamprey side entrances. Multiple instream PIT arrays are located in the Entiat, Methow, and Okanogan Basins (visit www.ptagis.org to view all locations). Detection data will be queried and summarized for all PIT tagged lamprey released as part of the 2016 study in addition to PIT tagged lamprey released by other organizations downstream of Wells Dam. Monthly updates on PIT tag detections will be provided to the Aquatic SWG, but will also be available in real time via www.ptagis.org.

4.6 Count Station Efficiency

During the 2015-2016 Wells Dam ladder maintenance period (typically from December through January), gaps greater than ½ inch identified during fishway inspections in 2014 will be sealed. This study will evaluate the behavior and performance of adult lamprey through the existing fish count stations after the sealing of gaps which provided potential routes for lamprey to bypass the count window. The data collected during this study will be compared to prior years of study at Wells Dam to determine whether lamprey enumeration has been improved without negatively impacting lamprey passage rates and times within the upper fishways.

4.7 Lamprey Side Entrances

The low-level side fishway entrances on both Wells Dam fishways will be re-opened and be equipped with prototype lamprey entrances. The lamprey entrances will consist of a fiberglass box with an opening to the tailrace one inch tall by eight feet wide. The interior of the box will house six rows of pipe bollards that serve to reduce water velocity and head differential. The designed water discharge and velocity of the lamprey entrances are approximately 1 cfs and 2 ft/s. Each lamprey entrance will be equipped with a PIT antenna capable of reading half and full duplex PIT tags. Final design drawings are found in Appendix A.

4.8 Lamprey Enumeration Structures

LES will be installed at the fish count stations of both fishways. The LES will provide lamprey a low velocity passage route through the fish count window. In addition, the LES will provide lamprey a route through the count window that is shielded from the bright lights focused on the count window. Only a small portion of the LES that passes through the count window will be illuminated in order for lamprey to be visible to the count window video camera and be enumerated as they pass. Final LES design drawings are found in Appendix B.
4.9 Statistical Analyses and Reporting

4.9.1 Approach and Passage Attempt

Acoustic-telemetry data will be used to estimate the proportion of translocated lamprey that are tagged and released downstream of Wells Dam that migrate upstream and approach the dam. It will be assumed that an acoustic tagged lamprey detected approaching the dam is attempting to enter and pass the dam. The proportion of lamprey that approach the dam will be calculated as the total number of unique acoustic tagged lamprey that are detected by the acoustic telemetry.
listening station located immediately below the fishways divided by the total number of acoustic tagged lamprey that are released. It should be noted that the effective listening range of acoustic telemetry receivers may exceed 400 m, therefore a detection at the receivers near the fishway entrances may not imply that an acoustic tagged lamprey interacted with the fishway entrance. However, for the purposes of this study, a detection at the receivers near the fishway entrances will be considered an interaction when calculating the proportion of acoustic tagged lamprey that approach Wells Dam. It is not possible to calculate fishway entrance efficiency for acoustic tagged lamprey due to ineffectiveness of acoustic receivers within the fishway because of the high levels of noise and the coarse resolution of acoustic detection data (i.e., long listening range of receivers that may result in false detections of tagged fish outside of the fishway entrances). However, passage information can still be collected based on PIT tag detections of acoustic tagged lamprey in addition to PIT tagged only lamprey at the side lamprey entrances, fishway pools 19 and 67, and on in-stream arrays in the Methow or Okanogan basins.

4.9.2 Enumeration Efficiency

The efficiency of enumerating lamprey using the existing counting station will be evaluated by examining observations of tagged fish via PIT antenna arrays downstream and upstream of the count window (pool 19 below the count windows; pool 67 above count windows) and comparing them to video observations at the count windows. Enumeration efficiency will be reported as a percentage (i.e., tagged fish detected below and above the count windows / the number of fish observed in the count window). Given the low numbers of lamprey that have passed Wells Dam in recent years, confounding observations due to high numbers of passage events of untagged lamprey at this location during the study is not expected. Each fish ladder can be treated separately prior to grouping entrance numbers. Release groups will also be pooled together if statistically justified (either by low sample size or lack of statistical power).

4.9.3 Lamprey Side Entrance Evaluation

The use of lamprey side entrances will be quantified as the number of tagged lamprey that are detected by PIT antennas on the lamprey side entrances. PIT detection capability in the side entrances can also be used to estimate entrance efficiency. However, without other detection methods, subsequent detections at pool 19 or pool 67 arrays will be required to say with certainty that a fish successfully entered and passed the lower fishway using the side entrances.

4.9.4 Lamprey Enumeration Structure Evaluation

Lamprey use of the LES at each count station will be evaluated using video observations. Video counts of all lamprey will be used to make comparisons between the number of lamprey that utilize the LES to pass the count stations and that do not. The count station passage duration and fallback rate will be compared between lamprey that use the LES and those that do not.

4.9.5 Statistical Analyses and Power

A chi square test will be used to test for differences between the observed proportions of acoustic tagged lamprey that approach (are detected on acoustic arrays at the fishway entrances) and the expected proportion that do not under the null hypothesis (the proportions that approach and
proportion that do not are equal). Similar analyses will be carried out to evaluate lamprey enumeration efficiency and use of the LES. Statistical power of these tests is dependent upon sample size and the difference in observed proportions of each group and the expected proportions under the null hypothesis (Table 1). Statistical power and low sample size of available lamprey has been an ongoing challenge at Wells Dam since typically few study fish are available and observed difference between treatment and control groups have been subtle. For example, in Douglas PUD’s 2013 study the Count Station Enumeration Efficiency prior to installation of the new picketed leads was 40% (4 of 10), or 11% lower than the post-installation efficiency. Although the difference was not statistically significant, the test was hampered by a severe lack of power (power analysis showed that ~1500 lamprey would have to have passed for the model to declare this 11% difference as statistically significant). Similar sample size concerns were identified when quantifying the difference between entrance efficiency at Wells Dam under high and moderate head differential conditions (Robichaud and Kgyer 2014). Recognizing these sample size challenges the Aquatic SWG believes that valuable qualitative data can and will be collected during the 2016 study and should help inform subsequent actions in spite of sample size challenges.

Table 1. Statistical power (1-\( \beta \)) and sample size needed to detect small (10%) and large (50%) differences, at 90% confidence level between observed and expected proportions under the null hypotheses.

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<th>Power</th>
<th>Difference in Proportions</th>
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<tr>
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</table>

4.10 Regional Coordination

Douglas PUD will notify other agencies and groups conducting lamprey research in the region of plans to conduct the lamprey passage and enumeration study in 2016. Tag codes and other information on study lamprey that are used in 2016 will be made available upon request, and PIT tag data will be uploaded to PTAGIS. When possible, Douglas PUD will coordinate with other researchers studying lamprey in the area on efforts that are consistent with the objectives of the 2016 study.
4.11 Schedule and Reporting

Reporting will be a collaborative effort between the contractor and the Douglas PUD contract manager for this study. The schedule for study planning and development, implementation, draft reporting, review, and final reporting are presented in Table 2 below.

Table 2. Estimated timeline for study development, implementation and reporting.

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
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<th>ASWG</th>
<th>Contractor</th>
<th>Date</th>
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<td>X</td>
<td></td>
<td>January 2016</td>
</tr>
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<td>3</td>
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</tr>
<tr>
<td>4</td>
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<td></td>
<td>December 2015- January 2016</td>
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<tr>
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<td>6</td>
<td>Preliminary data summary to Aquatic SWG</td>
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<td>X</td>
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<tr>
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<td>Draft Interim Report to PUD</td>
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<td></td>
<td></td>
<td>January 2017</td>
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<tr>
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<td>Draft Report to Aquatic SWG</td>
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<td>X</td>
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<td>May Meeting 2017</td>
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5.0 REFERENCES


JUVENILE PACIFIC LAMPREY HABITAT EVALUATION STUDY PLAN

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December 2015

Public Utility District No. 1 of Douglas County
East Wenatchee, Washington
1.0 INTRODUCTION

1.1 Aquatic Settlement Agreement and Pacific Lamprey Management Plan

During the relicensing process for the Wells Hydroelectric Project (Wells Project or Project), Public Utility District No. 1 of Douglas County (Douglas PUD), in collaboration with federal, state and tribal relicensing participants, developed six Aquatic Resource Management Plans in support of a comprehensive Aquatic Settlement Agreement (ASA). The Pacific Lamprey Management Plan (PLMP) is one of the six Aquatic Resource Management Plans contained within the ASA that directs the implementation of Protection, Mitigation, and Enhancement measures (PMEs) for Pacific lamprey (*Entosphenus tridentatus*) during the term of the new Wells Project operating license.

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey resulting from the Wells Project during the term of the new license. Objective 2 of the PLMP is to identify and address any Project-related impacts on downstream passage and survival, and rearing of juvenile Pacific lamprey. In pursuit of this objective, Douglas PUD conducted a study aimed at identifying potential juvenile lamprey habitat and sampled those areas to assess lamprey presence/absence and relative abundance.

2.0 GOALS AND OBJECTIVES

The goal of the 2015 juvenile Pacific lamprey habitat evaluation was to determine if Project Operations have the potential to impact juvenile Pacific lamprey habitat and rearing in the Wells Project.

Specific objectives of the study included:

1. Juvenile Pacific Lamprey Habitat Evaluation (PLMP section 4.1.6)
   A. Identify areas of potential juvenile lamprey habitat that may be affected by Project operations.
   B. Determine the presence/absence of juvenile Pacific lamprey in areas of potential habitat.
   C. Assess the relative abundance of juvenile Pacific lamprey in areas of potential habitat.
3.0 METHODOLOGY

3.1 Habitat Identification and Evaluation

Potential juvenile lamprey habitat was identified using aerial imagery and bathymetry data for the Wells Project Area. Geographic Information System (GIS) was used to overlay aerial imagery and areas with depths within the normal maximum elevation of 781 ft mean sea level (MSL) and the normal minimum of 771 ft MSL. Where possible, inspection of the aerial imagery was used to determine the likelihood of the presence of juvenile lamprey habitat in the areas within the selected range of depths. This determination involved eliminating areas where characteristics visible in the aerial imagery (large boulders, bedrock, cliff faces, etc.) suggested that it is highly unlikely that suitable juvenile lamprey habitat is present. In areas where the type of habitat present could not be discerned from aerial imagery, surveys by boat were conducted for verification. Information gathered from the review of aerial imagery and cursory habitat surveys was used to create a GIS layer of all of the areas in the Project that warranted further evaluation.

![Map of potential juvenile lamprey habitat survey sites selected using Generalized Random Tessellation Stratified (GRTS) methods. Includes 100% oversample.](image_url)
A total of 20 sample sites were chosen for habitat evaluation from the GIS layer of potential habitat. Samples were selected using generalized random tessellation stratified design (GRTS) to ensure a spatially balanced and unbiased sample. The site selection processes were carried out using Spsurvey package in R (Kincaid and Olsen 2013). Points selected using GRTS served as the midpoint for habitat evaluation surveys. Surveys were conducted along the shoreline 60 m upstream and downstream of the site midpoint for a total site length of 120 m. Visual observations were used to categorize habitat into one of the three classes of lamprey habitat described by Hansen et al. 2003. These habitat classes are:

Type 1 - Preferred habitat for juvenile lamprey consisting of sand, fine organic material, detritus, and/or aquatic vegetation.

Type 2 - Habitat suitable for juvenile lamprey and consisting of shifting sand or gravel with little fine organic material.

Type 3 - Unsuitable juvenile lamprey habitat composed of bedrock or hardpan clay along with larger gravel.

Each 60 m segment of shoreline was divided into two sites 30 m in length. The amount of each type of habitat, estimated in meters of shoreline, was quantified for each site. Other site attributes such as the estimated average distance each habitat type extends from the water’s edge, the estimated slope of the shoreline/bottom, presence and density of aquatic macrophytes, presence of woody debris, and characteristics that may affect the ability to perform lamprey presence/absence sampling were recorded. Sites that could not be safely or effectively sampled for lamprey presence/absence were eliminated. The remaining sites were scored (lamprey likelihood score [LLS]) based on the amount of type 1 and type 2 habitat present and site quality (the distance suitable habitat extends from the water’s edge and a qualitative assessment of the ability to effectively sample for lamprey presence/absence) using the following scoring formula:

\[
LLS = (\text{linear meters of Type 1 habitat} \times 2) + (\text{linear meters of Type 2 habitat}) \times (\text{site quality constant})
\]

Where,

Site quality constant:
- narrow band of habitat < 1 m wide and/or difficult to sample = 0.25;
- band of suitable habitat < 2 m wide near water’s edge and/or moderately difficult to sample = 0.5;
- suitable habitat extends at least 2 m from water’s edge and can easily be sampled = 1.0.

Sites were stratified by score into 1 of 3 groups; Average, Good, and Best with each strata representing the 25\(^{th}\), 50\(^{th}\), and 75\(^{th}\) percentiles of site scores, respectively. Additional sites in other areas of interest may also be included.
3.2 Presence/Absence and Relative Abundance Sampling

A total of ten sites for juvenile lamprey presence/absence and relative abundance sampling were selected from the pool of sites with suitable habitat that were identified in the habitat evaluation phase of the study (Figure 2). Generalized random tessellation stratified (GRTS) design site selection will be used to choose sites in each of the three LLS strata (Average, Good, and Best). The greatest number of sites were selected from the “Best” strata in an effort to concentrate the most sampling effort in areas with the greatest amounts of suitable juvenile lamprey habitat. A site was selected for sampling if a GRTS generated point falls anywhere within its 30 m length. An additional site at the mouth of the Methow River was selected for sampling based on the high amount of suitable juvenile lamprey habitat in that area.

Sites were sampled four times each over the period from July 1 to November 6. The third sampling session took place during a draw-down of the Wells Reservoir for the Methow groins rebuild project from September 4 to September 12. During this time, the reservoir elevation was reduced to 772 ft MSL (1 foot above minimum pool). The other three sampling periods occurred within 2 feet of maximum elevation, which is an elevation that juvenile lamprey would most often experience. For example, from January 1998 to July 2013, the Wells Reservoir has operated within the upper four ft. (777 to 781 ft MSL in elevation) 96.7% of the time (average daily reservoir elevation [Douglas PUD 2013]). During each sampling visit, reservoir elevation, water temperature, and density of macrophyte growth, if present, and any noticeable differences in habitat type or quality from the original habitat evaluation or the previous sampling occasion was recorded.

Backpack electrofishing was used to attempt to capture juvenile lamprey. An ABP-2 backpack electrofisher set to 125 volts DC, 3 pulses per second, 25% duty cycle, and a 3:1 pulse train was used to attempt to extract juvenile lamprey from the substrate to be netted. Sampling was conducted at a slow pace to thoroughly sample 30 meters of shoreline from the water’s edge to a maximum wadeable depth. Total electrofishing time in seconds was recorded for each site.

4.0 RESULTS

4.1 Habitat Evaluation

A total of 40 sites were surveyed for potential juvenile lamprey habitat. Thirteen of the sites surveyed contained no suitable juvenile lamprey habitat (100% Type III habitat). The majority of the remaining 28 sites contained a combination of Type II and Type III juvenile lamprey habitat. Type I juvenile lamprey habitat was only present at three sites, and was the primary habitat type at two of those sites. Each site that contained Type I and/or Type II juvenile lamprey habitat was given an LLS score based on the criteria previously described. Total LLS scores ranged from 2.5 to 50. Sites were categorized by LLS score as “Good”, “Better”, and “Best”, which corresponded roughly to the 25th, 50th, and 75th percentiles of scores, with minimum scores of 2.5, 20, and 27.5, respectively. This resulted in 13, 12, and 3 sites in the “Good”, “Better”, and “Best” categories, respectively (Table 1). One additional site at the mouth of the Methow River was also surveyed based on previous observations of Type I habitat in that area, but it was not scored or categorized.
Table 1. Characteristics of habitat sites surveyed. Percent Type I, II, and III juvenile lamprey habitat, Lamprey Likelihood Score (LLS) habitat, site quality and total score, and categorization for presence/absence sampling.

<table>
<thead>
<tr>
<th>Site</th>
<th>% Type I</th>
<th>% Type II</th>
<th>% Type III</th>
<th>Habitat Score</th>
<th>Site Quality</th>
<th>Total Score</th>
<th>Category</th>
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<td>0.25</td>
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4.2 Presence/Absence and Relative Abundance Sampling

A total of eleven sites were sampled for the presence of juvenile lamprey; 2 sites from the “Good”, 5 sites from the “Better”, and 3 sites from the “Best” habitat categories and one additional site at the mouth of the Methow River (Figure 2). All sites were sampled on four occasions, with the exception of one site (26b) that was not accessible on two occasions.
Figure 2. Map of sites sampled for juvenile lamprey presence/absence with backpack electrofishing.
Sampling sessions occurred: August 4 and 5, September 10 and 14, October 7 and 12, and November 4 and 6. Total electrofishing effort over the entire study was 210 minutes 51 seconds. Median effort per site over all sampling sessions was 5 minutes 2 seconds and ranged from 3 minutes to nearly 8 minutes (Table 2). No juvenile lamprey were observed or captured at any of the sites sampled.

Table 2. Sites sampled for juvenile lamprey using backpack electrofishing with date, time, reservoir elevation, and water temperature for each sampling session.

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Time</th>
<th>Effort</th>
<th>Elevation (ft)</th>
<th>Temp (°C)</th>
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5.0 DISCUSSION

Suitable juvenile lamprey habitat was limited in the littoral zone of the Wells Reservoir. Large scale visual surveys of areas of potential juvenile lamprey habitat revealed that the majority of the area contained substrates unsuitable for juvenile lamprey (bedrock, cobble, large gravel, etc.). Similar results were observed during site specific surveys; one-third of sites surveyed contained no suitable juvenile lamprey habitat. At sites where suitable habitat (Type I or Type II) was present, it was most often Type II habitat and frequently interspersed among unsuitable Type III habitat. Type I habitat was confined to areas near the mouths of the Methow and Okanogan rivers. In contrast to the mainstem Columbia River, the Methow and Okanogan rivers experience larger seasonal fluctuations in discharge and carry higher amounts of sediment that are deposited in low velocity areas, particularly in their lower reaches. This most likely explains the distribution of suitable juvenile lamprey habitat observed.

Juvenile lamprey presence/absence sampling was designed to focus effort in areas with the most appropriate habitat types and to address potentially low juvenile lamprey density and low probability of detection during sampling. Even given these sampling considerations, no juvenile lamprey were detected. With the sampling design employed, if the probability of detecting juvenile lamprey at an individual site was assumed constant at 0.2, the statistical power to detect at least one juvenile lamprey over the entire study area, if present, would be 0.75; at detection probabilities of 0.26 or greater the statistical power would increase to over 0.90 (Figure 3).

![Figure 3. Statistical power to detect juvenile lamprey over the entire study area, if present, over a range of individual site detection probabilities with the sampling design employed; 11 sites sampled on 4 occasions.](image)

Backpack electrofishing with a dual-channel electrofisher is a common and effective method for capturing lamprey in streams. We employed this method to sample sites in the littoral zone to a maximum wadeable depth of approximately 1 m at typical reservoir elevations and also at atypically low reservoir elevation. While no juvenile lamprey were observed while
electrofishing, large numbers of aquatic earthworms were observed exiting the substrate in areas of Type I juvenile lamprey habitat. If lamprey ammocetes were present they would have experienced similar electrical currents, and while their physiological response likely differs from that of aquatic earthworms, it is not unreasonable to assume that lamprey ammocetes should have been observed. It is possible that juvenile lamprey may occupy habitat in areas of greater water depth, however, these areas could not be sampled with the methods employed in this evaluation. Furthermore, deeper habitats, below the minimum reservoir elevation, would be affected negligibly by Project operations.

The results of this evaluation suggest that the operation of the Wells Project has a minimal effect on the rearing of Pacific lamprey due to the limited amount of suitable juvenile habitat and the lack of ammocetes occupying the habitat present in the Wells Reservoir.
6.0 REFERENCES


APPENDIX N
FINAL REGIONAL PACIFIC LAMPREY
WORKSHOP MINUTES
Final Regional Pacific Lamprey Workshop Minutes

To: Aquatic SWG Parties  
From: Kristi Geris (Anchor QEA, LLC)  
Re: Final Minutes of the Regional Pacific Lamprey Workshop  

Date: July 18, 2016

The Regional Pacific Lamprey Workshop was held at Douglas PUD headquarters in East Wenatchee, Washington, on Wednesday, June 8, 2016, from 9:00 a.m. to 2:30 p.m. Attendees are listed in Attachment A of these workshop minutes.

I. Summary of Discussions

1. Welcome, Introductions, and Workshop Goals (John Ferguson): John Ferguson (Aquatic Settlement Work Group [SWG] Chairman) welcomed the attendees (attendees are listed in Attachment A) and opened the meeting. Ferguson said the purpose for this Regional Pacific Lamprey Workshop is to address scientific uncertainties regarding the causes of poor adult Pacific lamprey passage over Wells Dam and to facilitate regional collaboration in addressing Pacific Lamprey in the Mid-Columbia River Basin. Ferguson said the goals of today’s workshop include: 1) identifying critical uncertainties that need resolution; 2) discussing and possibly adjusting 2016 Pacific lamprey study designs for Wells and Rocky Reach reservoirs; 3) establishing the scientific foundation for longer term studies; 4) partitioning out adult Pacific lamprey presence and premature mortality; 5) determining more accurate passage enumeration and efficiencies; 6) aiding the prioritization of available study fish; and 7) beginning development of a more integrated approach to Pacific lamprey passage investigations at Mid-Columbia River dams. Ferguson said today is the first of several discussions aimed at improving the Pacific lamprey resource within the respective jurisdictions of Grant, Chelan, and Douglas PUDs. He indicated the focus of today’s workshop is passage through the Rocky Reach Reservoir and Wells Dam; the Aquatic SWG will focus on fish exiting Wells Dam and migrating through the Wells Reservoir at future meetings.

Tracy Hillman (Priest Rapids Fish Forum [PRFF] and Rocky Reach Fish Forum [RRFF] Facilitator) said, on behalf of the PRFF and RRFF, the forums would like to thank the Aquatic SWG for the invitation to this workshop. Hillman recognized the opportunity for
regional coordination, and said he is confident this will be a productive workshop. Bob Rose (Yakama Nation [YN]) agreed convening a meeting between Grant, Chelan, and Douglas PUDs is an important step for regional coordination. He reminded attendees that about 99% of Pacific lamprey detected at Rocky Reach Dam are unaccounted for (i.e., not detected at Wells Dam), which, he believes, was a key precipitant for today’s discussions. Rose said the topic of Pacific lamprey has several intriguing dimensions with regard to the respective Federal Energy Regulatory Commission (FERC) licenses and requirements; however, he agreed with Ferguson the workshop should focus on the resource.

2. **Review of Wells Dam FERC License Requirements and Results of Prior Research and Passage Improvement Actions** (Andrew Gingerich and Chas Kyger): Andrew Gingerich (Douglas PUD) said Douglas PUD appreciates the opening comments from John Ferguson, Tracy Hillman, and Bob Rose. Gingerich said Douglas PUD has an obligation and interest to meet management plan objectives, and as biologists, Douglas PUD also has questions. He said one issue is applying a salmon-centric view when evaluating Pacific lamprey. He said, for example, fish returning to natal streams and the expectation of conversion rates. He said Douglas PUD has implemented a number of Pacific lamprey studies throughout the years, all of which began with the issue of obtaining study fish and the assumption that the fish wanted to interact with the project, which is an important assumption given it is unknown where a fish should migrate to and spawn. He said the goal is to figure out what is going on, where improvements can be made, and determine if there is the right signal upstream of Wells Dam for fish to cue on. He noted the recent Douglas PUD Pacific lamprey study with radio telemetry gear where fewer than half of the study fish released in the tailrace were detected. He said, when the Aquatic Settlement Agreement (ASA) Pacific Lamprey Management Plan (PLMP) was written, certain assumptions were probably created based on a salmon-centric model, but now it is clear Pacific lamprey are unique.

Gingerich agreed there is a great opportunity for regional coordination and stated Douglas PUD is more than willing to obtain additional data. He also noted that Douglas PUD has unique FERC license requirements. He said, from Douglas PUD’s perspective, care needs to be taken with how the ASA PLMP is interpreted. He said, for example, the notion of No-Net-Impact (NNI) for Pacific lamprey is something to be careful about when interpreting requirements and measures under the ASA. He said this does not mean Douglas PUD is opposed to regional coordination to share data and tags. He said the ASA PLMP targets identification of project effects. He recalled, during the Douglas PUD 2013 Pacific lamprey study, an assumption was made that fish released in the Wells Dam tailrace will want to pass Wells Dam, and it became obvious this may not be a good assumption. He said Douglas PUD discussed these results with Grant PUD, and it was decided there needs to be some level of confidence that fish want to interact with Wells Dam, which is a key question targeted for the Douglas PUD 2016
Pacific lamprey study. He said Grant PUD also plans to perform additional tagging in 2016, which will provide a good opportunity to monitor fish via Douglas PUD’s white sturgeon antennas.

Ferguson asked Douglas PUD to remind workshop attendees of the proposed sample sizes for the Douglas PUD 2016 Pacific lamprey study. Chas Kyger (Douglas PUD) said Douglas PUD is proposing tagging 50 fish at Priest Rapids Dam with acoustic and full-duplex (FDX) passive integrated transponder (PIT) tags. He said, in 2016, Grant PUD is planning to release at least 100 acoustically-tagged Pacific lamprey at or upstream of Priest Rapids Dam, repeating a pilot study conducted in 2015. He recalled, in the 2015 pilot study, 25 of the 100 acoustically-tagged Pacific lamprey released passed upstream of Rocky Reach Dam. He said, given these results, it is expected that similar numbers of acoustically-tagged Pacific lamprey will pass upstream of Rocky Reach Dam in 2016. He said, with this expectation, a minimum sample size of 75 acoustically-tagged Pacific lamprey (50 released at Lincoln Rock State Park by Douglas PUD and an additional 25 or more from Grant PUD releases) would be available for this study. He said Grant and Chelan PUDs will also release up to 225 PIT-tagged fish. Mike Clement (Grant PUD) said fish will be collected, tagged, and released upstream of Rock Island Dam.

Ferguson also recalled that on the last Aquatic SWG conference call, Douglas PUD indicated a willingness to receive additional study fish for the Douglas PUD 2016 Pacific lamprey study and the YN offered to provide additional fish. Rose said he has not yet discussed this internally; however, the YN has authorization for about 1,000 Pacific lamprey from the Columbia River Inter-Tribal Fish Commission (CRITFC). Rose said the YN could likely contribute about 100 fish to the Douglas PUD 2016 Pacific lamprey study. He said he will also want to further discuss sample size, including whether it can be further increased and what levels of certainties are gained with increased sample size. He suggested releasing fish upstream of Rocky Reach Dam and 0.25 mile downstream of Wells Dam. He said, once fish cross the 1,000-foot line downstream of Wells Dam, he suggests those fish should be considered as interacting with Wells Dam. He said he believes steps are being taken too slowly. He said the question should be how many fish are needed in the sample size, rather than how many fish can be afforded. He said these budget constraints affect the progress of these studies. Gingerich said he remembers quite clearly the YN recommending releasing fish lower in the river, and he regrets not doing so. He said Douglas PUD assumed fish released in the tailrace would interact with the project, and acknowledged Rose’s comment as a good criticism. Gingerich said, regarding sample size, he does not recall Douglas PUD ever indicating obtaining sample fish was a budget issue; rather, it has proven difficult to obtain fish at all (no one is willing to give up fish). Ferguson suggested that Douglas PUD and Rose coordinate so the requests for study fish come from the YN.
Ferguson asked if anyone has developed a Pacific lamprey survival model, and Rose said he does not believe anyone has considered one. Ferguson asked if one is needed, and the workshop attendees agreed one is not necessary at this time.

Rose said he appreciates everything Douglas PUD has explained, and he feels these discussions are applicable across all projects. He said what he thinks has not yet been done, is collecting data about where Pacific lamprey have been released and where they are migrating. He suggested releasing fish in several locations within the Rocky Reach and Wells environments and monitoring where they migrate. He said he is also more than willing to represent Grant, Chelan, and Douglas PUDs to obtain fish from Bonneville Dam; however, he suggested the best place to obtain study fish is at Priest Rapids Dam. He recommended that Douglas and Grant PUDs discuss this option.

Kyger said, in the past, Douglas PUD has followed the ASA PLMP, which focuses on project effects with the goal of identifying an issue and evaluating it, which has been difficult. He said Douglas PUD installed modifications at Wells Dam similar to those at other projects, and in order to evaluate the modifications, the focus has been getting as many fish as possible to interact with those modifications. He said, because these efforts have been less successful than anticipated, Douglas PUD decided to shift the scope a bit. He said monitoring Pacific lamprey in the Rocky Reach Reservoir is not within the scope of the ASA PLMP; however, it seems this may be affecting fish at Wells Dam. He said these are important questions to answer. He noted the following items: 1) more than 600 fish are needed to get any statistical power and to say with confidence if fish are approaching the dam; 2) 20 to 30 fish could answer the question of whether a large proportion approach the dam or not; and 3) sample size could decrease if the 80% approach is considered valid. Rose asked if there will be 100% coverage in the Wells Project. Kyger said there will be, and Douglas PUD will install as many receivers as needed to obtain that level of coverage. Gingerich noted there will not be coverage in three-dimensional (3D) space because 3D is too difficult to achieve in a noisy environment. Rose said, regarding the Dual Frequency Identification Sonar (DIDSON) camera studies, his recollection is that it was difficult to monitor fish using this technology because there were very few fish, fish may migrate outside the sight range of the DIDSON cameras, and the cameras could capture only a snapshot of behavior. Gingerich agreed with this recollection. Rose asked if it will be known when a tagged fish enters the Wells Dam fishways, and Gingerich said not via the acoustic tags. Rose said this is the incremental approach he has referred to, and suggested installing additional acoustic receivers in these noisy environments. He said some U.S. Army Corp of Engineers (USACE) staff may suggest this is feasible. Gingerich said the fish will be double-tagged, so once inside the fishways detection efficiency is high because of the PIT tags. Rose said the YN is focused on how to get the most data out of these study fish.
Rose recalled in the early- to mid-2000s, higher numbers of Pacific lamprey were passing Wells Dam and then numbers decreased. He asked what happened during that time, and if anything changed. Kyger said Douglas PUD has investigated this and found no change in operations or structural modifications to the fish ladders around that time that would have caused a change. He said Pacific lamprey passed Wells Dam at good rates until 2007, and then rates decreased. Gingerich recalled one structural modification at Wells Dam where a baffle was added to part of the collection gallery, per the Wells Habitat Conservation Plan (HCP) Coordinating Committee. He said there was concern fish were spending too much time in the collection gallery, so the new baffle restricted flow into the collection gallery entrance at Pool 1 and solved the issue for salmonids. He said Douglas PUD compared this modification to the drop in fish counts and the timing was off by a couple of years. He said one other speculation was made by Beau Patterson (Douglas PUD), who suggested Pacific lamprey once migrated to the Chewuch River to spawn. Gingerich recalled, in the early-2000s, there was the Tripod Complex Fire, and Patterson speculated the fire changed the watershed enough that it no longer produced the pheromone cue fish needed once arriving to Wells Dam.

Patrick Verhey (Washington Department of Fish and Wildlife [WDFW]) said it seems the glaring difference between Grant and Chelan PUDs and Douglas PUD is known pheromone cues above the respective dams. He said it appears Pacific lamprey do not even want to approach Wells Dam. Gingerich said, to be fair, he does not think anyone has quantified pheromones in the Mid-Columbia Basin tributaries.

Kirk Truscott (Colville Confederated Tribes [CCT]) asked if Douglas PUD has looked into any substantive changes in dam operations to change flow dynamics in the tailrace. He said, if approach is an issue, this may be something to consider. Kyger said he spoke with the dam operators and they could not recall any significant changes.

Truscott asked the following questions regarding study fish: 1) whether there is a difference between fish that approach and fish that do not pass; 2) can other causal effects be evaluated; and 3) if this may be an energetics issue. He said fish trapped at Bonneville Dam have greater energy stores than fish trapped at Priest Rapids Dam. He suggested using both types of fish for the study to evaluate energetics. Gingerich agreed evaluating energetics may be a good idea, because there is solid evidence that only the largest fish move upstream. Verhey suggested reviewing the Total Dissolved Gas (TDG) Model that was developed years ago. Hillman said, according to the trapping reports for the hatchery programs in 2014, a total of 409 Pacific lamprey were trapped in the Methow River trap compared to 292 Pacific lamprey in the Wenatchee and Lower Wenatchee rivers’ traps. He acknowledged that trapping efficiencies differ; however, he noted that Pacific lamprey were migrating in both systems, which would suggest there are some pheromones in both systems. He said, given the sizes of these fish, he is
guessing the parents of these fish passed Wells Dam after 2006, which implies some fish are still getting through. He said this may indicate an issue with enumeration.

Ferguson summarized key uncertainties discussed, as follows: 1) sample size; 2) reservoir behavior; 3) fish source; 4) Pacific lamprey survival model; 5) pheromones; and 6) making the most use of study fish available.

3. **Review of Rocky Reach Dam FERC License Requirements and Results of Prior Research and Passage Improvement Actions** (Steve Hemstrom): Steve Hemstrom (Chelan PUD) said Chelan PUD has a different perspective than the YN. He said he disagrees the PUDs are moving forward too slowly. He said Chelan PUD has been studying Pacific lamprey for more than 6 years (since the FERC relicensing), and the amount of information obtained to date is significant. He noted that, in the past, Chelan PUD has used half-duplex (HDX). He said, 2 years ago, the PIT-Tag Information System database (PITAGIS) approved FDX PIT tags for use in marking adult Pacific Lamprey. He said the Rocky Reach FERC License stipulates seven objectives for adult Pacific lamprey, and four objectives for juvenile Pacific lamprey, as follows:

**Adults**

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. *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 upstream fishway modifications to provide Pacific lamprey passage.*
5. *Implement a monitoring program to evaluate fishway modifications.*
6. *Develop a plan to implement measures to address ongoing project effects on downstream adult passage, if any effects are identified through the monitoring program.*
7. *Conduct monitoring every 10 years to confirm the success of any modifications once adult passage success has been achieved.*

**Juveniles**

1. *Monitor juvenile Pacific lamprey impingement and implementing measures to address any ongoing project impacts.*
2. *Measure the type and magnitude of any ongoing project impacts on the downstream passage of juvenile lamprey.*
3. Determine juvenile Pacific lamprey presence/absence and relative abundance in the reservoir.
4. Identify and implement measures to address unavoidable impacts to achieve no net impact.

Hemstrom agreed with Andrew Gingerich that when evaluating Pacific lamprey, managers may do so from a salmon-centric view. He said, for example, conversion rate is a salmon-centric term that may not imply the same thing when related to Pacific lamprey. He also noted, that from 2011 to 2015, the annual Pacific lamprey “conversion rate” from Rock Island Dam to top of Rocky Reach Dam is 80.6%. He agreed it is important to determine where these fish came from and where they are headed.

John Ferguson asked about the location of the downstream-most PIT-tag detector in the Entiat River. Lance Keller (Chelan PUD) said the downstream-most PIT-tag detector is located 1 mile upstream from the confluence of the Columbia River, and Hemstrom indicated the detection efficiency of the array is good. Hemstrom said there are also data from The Dalles and Bonneville dams indicating adult sturgeon may cause Pacific lamprey passage avoidance. He suggested there could also be an avoidance problem at Wells Dam.

Hemstrom said the YN conducted a small study in March 2016, at Tumwater Dam, where Pacific lamprey were released downstream and upstream of the dam and also directly in the fishway. He said there is no known pheromone cues upstream of Tumwater Dam, and no fish have been detected farther upstream to date. Hemstrom said Chelan PUD expected to detect the fish upstream in Lake Jolanda, and Patrick Verhey noted that there are no PIT-tag arrays until Lake Jolanda. Gingerich asked about the source of the fish, and Bob Rose said they were from the lower Columbia River (John Day or Bonneville dams). Ferguson asked if fish have been detected farther downstream, and Keller said some have been detected on the Lower Wenatchee array (net downstream movements).

Ferguson asked about the FDX sample size for the Chelan PUD 2016 Pacific lamprey study. Hemstrom said it was about 225 to 250 fish, released downstream of Rocky Reach Dam along the right and left river banks at Kirby Billingsley Hydro Park. He noted that typically, 90% of fish passage at Rocky Reach Dam occurs on the right bank, so the study is designed to emulate typical fishway passage proportions at Rock Island Dam. He said the acoustic tagged fish will be released below the Entiat River to provide escapement data. Ferguson asked if all fish for the Chelan PUD study are PIT tag only, and Hemstrom said that is correct. Ferguson asked about receivers in the Rock Island Dam forebay for the Grant PUD study, and Keller said 16 receivers designed to detect acoustically tagged sturgeon are deployed in the Rock Island Reservoir.
Rose asked how to sort out if Chelan PUD’s white sturgeon migrate upstream into the Wells Reservoir and predate on Douglas PUD’s Pacific lamprey. He asked how to discern whether an acoustic tag is a live or overwintering Pacific lamprey or one that has been consumed by a white sturgeon. He asked to what degree does this play into project effects. Gingerich agreed this is a valid question. Rose suggested noting this as another uncertainty to sort through. Rod O’Connor (Blue Leaf Environmental) said, from the perspective of someone who builds databases, a sense is developed for what is normal. He said he typically sees acoustically-tagged fish approach, spend some time within the detection zone, and move out and in. He said if a fish is just stationary, that is different. He said it could be that the fish is overwintering or the tag fell out of the fish. He said this does not necessarily answer the uncertainty; however, these types of behaviors are certainly noticed. Hemstrom agreed and said the same goes for radio telemetry.

O’Connor said, last summer, 100 Pacific lamprey were released in the Wanapum Reservoir. He said one of these fish was detected farther upstream, then went undetected until spring 2016, where it was detected at Duck Tail Rock. He said the fish then migrated upstream into the Entiat River. He said one fish is not necessarily significant; however, he wanted to note the interesting behavior. Keller said in 2015, nine Pacific lamprey were detected ascending Rocky Reach Dam, and then went undetected until just recently. He said these fish were also detected in the Entiat River.

Ferguson summarized key uncertainties discussed, as follows: 1) predation by white sturgeon; and 2) disposition of fish when undetected.

4. **Discussion to Identify Critical Uncertainties and Questions** (John Ferguson and Tracy Hillman): John Ferguson reviewed the critical uncertainties included in the agenda. He said most have been discussed during the course of the workshop, and asked what the priority is.

*Approach Behavior*
Andrew Gingerich said the study plan for the Douglas PUD 2016 Pacific lamprey study was drafted to emphasize the need to first address that there is motivation for fish to pass Wells Dam. He said, also included in the study plan is Douglas PUD’s intention to coordinate with the Aquatic SWG to determine and develop next steps. He said, if the assumption in the 2016 study is not met, he is unsure how many study fish will be needed for future studies. He said, ultimately, that last statement was removed from the study plan by request of the Aquatic SWG. He said Douglas PUD believes that statement is still true, as it is the intent of the ASA and ASA PLMP to coordinate with agencies.
**Limitation(s)**

Kirk Truscott suggested not asking about the motivation, but rather what is the limitation. He asked if it is lack of pheromone, or energetics, and recommended re-characterizing the question. He said with the current approach, he can see this study lasting several more years, which is too long.

**Propagation or Translocation**

Steve Hemstrom said Chelan PUD has three artificial propagation contracts for Rocky Reach Dam (i.e., U.S. Fish and Wildlife Service [USFWS], YN, and National Marine Fisheries Service). Hemstrom suggested that Chelan PUD could raise fish for studies, and raise fish that could be released into the Methow River if studies are not possible, because the Methow River is the farthest upstream location Pacific lamprey have been detected. He said the current propagation program includes 1-year-old ammocoetes. He said USFWS is rearing fish at their Northwest Fisheries Science Center and Abernathy Fish Technology Center. RD Nelle (USFWS) cautioned that moving juvenile Pacific lamprey upstream from downstream could present the potential to have western brook lamprey mixed in. He said, if the ammocoetes were reared in the Entiat or Wenatchee rivers, there would not be such a concern. Bob Rose asked when Chelan PUD anticipates releasing these fish, and Hemstrom said it will be on the scale of years. Ferguson asked about the requirements of the Rocky Reach FERC license. Nelle said the plan just requires that Chelan PUD raise the fish for survival studies. Hemstrom said Chelan PUD set aside $700,000 to study project effects under adaptive management. He said there are also no release location requirements.

Rose said the YN is generally in favor of this notion; however, he noted that a cheaper option is an adult translocation program. He said Ralph Lampman (YN) has calculated costs and he was surprised about the resource needs, hatchery space, water, and other needs, to raise fish to a certain size. He said the costs gets exponentially larger year to year as fish age and grow. Rose said, however, raising fish to 2 to 3 months of age and then releasing those fish in numbers will probably result in more fish for less money. He said a key question is how many fish are needed to create a pheromone signal or effect. He also questioned if a propagation program is adopted, what National Environmental Protection Act (NEPA) processes will be required. He said a translocation program does not require actions per NEPA. He suggested determining what these two options entail before adopting one program or the other. He said he believes a translocation program is more immediate, and just as beneficial as a propagation program. Ferguson asked if there are data available regarding pheromone levels. Rose said this has not yet been evaluated. Nelle said it is unknown whether pheromone levels can be measured. He added, regarding juveniles, that shedding only occurs in the substrate. Tracy Hillman noted that there are Pacific lamprey in the Methow River, so there is definitely pheromone there. He said the PRFF and RRFF drafted documents to use as tools to address NNI, and Rose and Hemstrom are referring to Tool 2 (translocation versus
propagation) to introduce pheromone into the river to contribute to adults. Hillman said Nelle is concerned about introducing foreign species up there (in the Methow River). Hillman said, however, it seems like there are decreasing numbers of juveniles and Type 1 habitat in the Methow River, so this may be an excellent opportunity to implement a propagation program there. Gingerich said the Aquatic SWG has not yet discussed at length propagation versus translocation. He agreed it would be the respective forums’ due diligence to discuss the technical and biological merits of one program versus the other. He said, regarding a consultation process, he is uncertain whether Douglas PUD’s current management plans included translocation or propagation. He said the Aquatic SWG technical representatives will need to be unanimously supportive of one program or the other for implementation. He also noted that there is a policy aspect. He said, at this point, Douglas PUD may be more supportive of a translocation program because of the potential of introducing western brook lamprey with a propagation program. Rose said these questions have been discussed within the CRITFC forum, and it was decided if a hatchery program (propagation) was implemented, it would be done with three-by-three crosses. He noted a bottleneck from the larval to juvenile stage where there is an 80% mortality rate. He said after that, survival is 80 to 90%. He said the YN is not concerned with genetic issues, and disease transmission has been resolved, as addressed by work completed by Mary Moser (NOAA Fisheries). Ferguson asked if western brook lamprey could be identified prior to release via eDNA analyses. Nelle said he believes this is true, and it is rather inexpensive to do so.

Presence and Premature Mortality
Rose suggested the primary impetus for these discussions was that although thousands of Pacific lamprey are being detected passing Rocky Reach Dam, only a small percentage of those fish are being detected at Wells Dam. Rose said he wants to know where these fish are, and suggested installing additional detectors at the face of Wells Dam. He said he wants to know if fish are approaching Wells Dam within 1,000 feet, and if they are, what they are doing from there. He questioned whether fish are running out of energy and falling back, or are predated upon, or if there are other factors. He said if fish are not detected in the Entiat River, there is no way to measure whether the fish migrated back downstream past Rocky Reach Dam. Rose said he wants a full accounting of where the fish are so project effects can be more easily evaluated. Gingerich said one issue in terms of accountability is once the acoustic tag battery expires, all data must be derived from PIT-tag detections. He also noted that there is no mechanism to understand loss if fish are not detected.

Rod O’Connor said he does not believe FDX PIT tags fully capture which fish are in the tailrace. He said, formerly, HDX PIT tags were the preference for studying fish ladder passage, and he believes those systems installed in 2009 and 2010 are pushing their lifespan. He said FDX systems are now replacing HDX systems; however, HDX is
cheaper, and when the system works well, it provides data that FDX cannot provide. Lance Keller noted that some readers read both FDX and HDX.

Ferguson asked about the timing of data analysis. Chas Kyger said Douglas PUD will download data from the white sturgeon receivers in October 2016. Keller said Chelan PUD will download data from receivers in the Rocky Reach Reservoir every 2 to 3 months. Ferguson asked about the tag life of the acoustic tags, and Kyger said the tags will expire after 200 days. Gingerich noted that if fish successfully ascend Wells Dam, movement can be monitored through the project. Truscott said the Methow River is also well-wired. Hillman added that the Entiat River also has several PIT-tag antennas. Gingerich said, if Pacific lamprey exit Wells Dam and reach Chief Joseph Dam, Douglas PUD has acoustic receivers installed there too.

Fish Size (Energetics)
Gingerich recalled that in 2013, Douglas PUD attempted to stipulate fish size as a tagging criterion; however, they received criticism about selecting only a certain type of fish (largest). He said the reason Douglas PUD wanted larger fish was so the study fish would be representative of the run at large (i.e., larger overall fish size). Hemstrom added that there is research that indicates larger fish are more successful migraters.

Ferguson asked about the state of energetic research on Pacific lamprey. He asked if this should be tested in future years by obtaining study fish from Bonneville Dam to compare to study fish from Priest Rapids Dam. Mike Clement said, generally, fish from Priest Rapids Dam are one-third the size of fish from Bonneville Dam in terms of length and weight. Tom Dresser (Grant PUD) recalled, in 2001, Grant PUD used tagging criteria from Bonneville Dam for a study using Pacific lamprey from Priest Rapids Dam and had to reject several study fish because they were too small to tag. O’Connor said, however, during a USACE study at Bonneville Dam, he did not notice a difference in size distribution between fish from Bonneville Dam versus Priest Rapids Dam. Ferguson asked about the difference in fish size between Wells and Priest Rapids dams. Clement said fish move through the reservoirs so fast there are no physiological changes. Hemstrom added that Pacific lamprey migrate from Rocky Reach Dam to Rock Island Dam in two days. Kyger said, in 2013, among the study fish that interacted with Wells Dam, there was no significant difference in entrance efficiency or passage success correlated with fish size.

Spawn Timing
Ferguson asked about Pacific lamprey spawn timing and whether this could be a critical uncertainty for a passage study. Bao Le (HDR Engineering, Inc.) said there is a tiny fraction of spawning occurring in the spring; however, he recommended not designing an entire study based on when a small amount of fish re-emerge from overwintering.
Fish Collection
Rose recalled that Grant PUD demonstrated obtaining fish using pots deployed in the fishways and asked if this could be attempted at Wells or Rocky Reach dams. He also asked about the timing for collecting study fish for the Douglas PUD 2016 Pacific lamprey study, noting that he would like the study fish to be representative of the run at large. Clement said Grant PUD intends to trap and tag 125 HDX-only fish for Grant PUD. He said after those fish are released, Grant PUD will continue trapping with a goal of 225 fish for Chelan PUD, and 50 fish for Chelan PUD and Douglas PUD to share. He said trapping will occur 5 days per week, and he expects to trap all fish within a couple of weeks. He said, if requested, Grant PUD can schedule trapping to be more representative throughout a longer period of time. Hemstrom said Chelan PUD would also approve of this.

Clement asked if Douglas PUD has received the tags for the study, and Kyger said the tags are expected to arrive this week. Clement said several Pacific lamprey have already been detected passing Bonneville Dam, so studies may start earlier. He said, if Grant PUD obtains the target 400 fish in the first couple of weeks, Grant PUD may be able to provide Douglas PUD with 100 fish.

Survival Model
Ferguson recalled discussing earlier that it may be slightly premature to develop a Pacific lamprey survival model. He said determining the disposition of tagged fish and conducting post-season analyses are a higher priority at this time. Rose agreed; however, he did not want to dismiss the usefulness of such a model. He said, during the next few years, there will be more data to help develop a survival model.

Le said USFWS established a “Lamprey Technical Workgroup (LTWG),” which includes several subgroups, including a passage subgroup. He said the LTWG and associated subgroups have been discussing Pacific lamprey for several years now and similar issues discussed during this workshop have been identified in the LTWG. He asked, for example, what it means if an arbitrary number is applied to passage. He asked about the significance of numbers if there are no biological data to support them. He said the LTWG is conducting a literature review to determine how to develop standard metrics to be applied universally across all projects. He said this all needs to be considered in order to develop a model.

Tag Types
Ferguson asked about tags that include a predator switch or a mechanism to determine the outcome of predation. Keller asked if such a tag also comes at a size compromise. He added that sometimes tag burden doubles with increased detectability. Hillman said Hydroacoustics Technology, Inc. (HTI) engineered a Predation Detection Acoustic Tag (PDAT), which detects fish when eaten. Hillman reviewed HTI’s PDAT specifications and
also provided the specifications to Kristi Geris (Anchor QEA, LLC) following the workshop on June 8, 2016, which Geris distributed that same day (Attachment B).

Rose asked if there are tagged adult white sturgeon within the Rocky Reach Reservoir, and Keller said there are. Rose asked if white sturgeon have been detected at Wells Dam. Keller said yes, white sturgeon migrate up to Wells Dam the same time that Chinook salmon spawn. He said adults and juveniles then migrate back downstream in September and October to settle in for fall.

3D Detection
Rose asked if there may be value in installing 3D detection at certain locations to determine whether there are interactions between Pacific lamprey and white sturgeon. Keller said he believes there are several difficulties with obtaining 3D detection with VEMCO tags, and there also needs to be an ideal environment. He said 3D analyses also require an increased ping rate, which decreases battery life. Rose asked how else the white sturgeon and Pacific lamprey relationship can be studied. Keller also asked what would be done with those data.

5. Discussion of How (or Whether) to Adjust 2016 Study Plans for Wells and Rocky Reach Dams (John Ferguson and Tracy Hillman): John Ferguson asked, based on today’s discussions, if anything needs to change in the 2016 Pacific lamprey study plans. Chas Kyger said the Douglas PUD 2016 Pacific lamprey study was not designed to address these uncertainties; rather, it is designed to evaluate past study results. He said, therefore, Douglas PUD does not intend to alter the current study plan. He added that this is just one step in a larger evaluation of Pacific lamprey at Wells Dam. Ferguson noted that the ASA PLMP is predominantly focused on passage at Wells Dam, and he applauded Douglas PUD for being broadminded enough to also evaluate other metrics away from the dam.

Kirk Truscott said there is not very much that can be changed this year, because a lot of what was discussed will be post-2016. Andrew Gingerich also noted that installing additional acoustic receivers within the fishway would need to occur during a winter outage. He suggested evaluating this year’s data, as planned, and preparing for future seasons based on those data. Bob Rose said he is not sure he believes the claims stated about acoustic technology not working in noisy environments. He said he thinks there could be value in installing acoustic receivers at the face of Wells Dam, and that value cannot be realized until it is tested. He also suggested installing the receivers in the fall after the spill season ends. Gingerich said the functionality of acoustic receivers installed within the fishways can be tested using a test tag from VEMCO. He said approval would also be required from the Wells HCP Coordinating Committee. He said one concern is, because sound travels through water, a receiver installed in one weir may detect a fish in another weir, so this will require a lot of testing. Ferguson said
acoustic technology may be best-suited for reservoir behavior and radio telemetry may be best for at and within the dam. Kyger said tags are available to do both; however, they are too large for lamprey. Rod O’Connor also agreed with Ferguson that installing acoustic receivers in a confined space does not seem to be the correct tool. Ferguson asked if a PIT-tag detector can be installed at the bottom of the channel in the fishway entrance. Gingerich said Biomark indicated yes; however, detection efficiency would not be strong enough in the open area and velocities.

Ferguson asked about the pots Rose mentioned earlier. Rose clarified the pots are essentially polyvinyl chloride (PVC) pipes that Pacific lamprey can enter, but cannot exit.

Truscott asked about the feasibility of collecting Douglas PUD study fish at Rocky Reach Dam, and asked if additional collection may negatively affect the Chelan PUD 2016 Pacific lamprey study. Steve Hemstrom said this would require additional staffing needs that Chelan PUD is not prepared for. Bao Le added that, historically, trapping Pacific lamprey at Rocky Reach Dam is a fair amount of work, and for the amount of effort, it is not worth it. Hemstrom also added that Chelan PUD is not against it; rather, this year is not a good year for additional collection efforts.

6. Closing Remarks and Future Year Planning for Rocky Reach and Wells Dams (All):
John Ferguson asked for closing remarks. Patrick Verhey said WDFW supports translocating Pacific lamprey upstream of Wells Dam. He suggested increasing pheromones upstream of Wells Dam to create attraction and help determine whether there is a passage issue at Wells Dam. RD Nelle further suggested tagging translocated fish to track directional migration. Chas Kyger said, in 2013, the amount of study fish that passed Wells Dam and migrated into the Methow River were of similar proportion to those that approached the dam (16%).

Ferguson suggested looking further into what changed in 2006. He said the review of the history of communication seems more qualitative, and he suggested conducting a more quantitative review of the timeframe. Gingerich recalled that by August 19, 2006, the bypass was shut off and flows had dropped significantly, so flows were low enough such that when fish were passing, there was very little spill volume. He said Douglas PUD will review spill during that time. Nelle recalled that the last time adults spawned in the Okanogan River also occurred in proximity to that time and suggested perhaps something was occurring in the Okanogan River.

Ferguson suggested reviewing smolt trap data. He said if the chronology is correct, when passage was poor, those trap numbers should also decrease. Gingerich also cautioned to consider how hatchery releases affect those counts. He said he is skeptical of some aspects of data that have too many variables. He said, however, Douglas PUD is
willing to track those data if requested. Tracy Hillman suggested migrating juveniles are a good indicator that adults are still migrating upstream.

Ferguson thanked everyone for participating. He said these discussions will continue once data from 2016 are received and evaluated.

**List of Attachments**
Attachment A – List of Attendees
Attachment B – HTI’s PDAT Specifications
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Kristi Geris</td>
<td>Anchor QEA, LLC</td>
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<tr>
<td>Tracy Hillman</td>
<td>BioAnalysts</td>
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<tr>
<td>Andrew Gingerich*</td>
<td>Douglas PUD</td>
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<tr>
<td>Chas Kyger*</td>
<td>Douglas PUD</td>
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<tr>
<td>Steve Hemstrom</td>
<td>Chelan PUD</td>
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<tr>
<td>Lance Keller</td>
<td>Chelan PUD</td>
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<tr>
<td>Mike Clement</td>
<td>Grant PUD</td>
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<tr>
<td>Tom Dresser</td>
<td>Grant PUD</td>
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<tr>
<td>Mark Peterschmidt*</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>Patrick McGuire</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>Sierra Franks</td>
<td>U.S. Fish and Wildlife Service</td>
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<td>RD Nelle</td>
<td>U.S. Fish and Wildlife Service</td>
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<tr>
<td>Patrick Verhey*</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Bob Rose*</td>
<td>Yakama Nation</td>
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<tr>
<td>Kirk Truscott</td>
<td>Colville Confederated Tribes</td>
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<td>Bao Le</td>
<td>HDR Engineering, Inc.</td>
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<tr>
<td>Rod O’Connor</td>
<td>Blue Leaf Environmental</td>
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</tbody>
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Notes:
*Denotes Aquatic SWG member or alternate
EXHIBIT B

PRE-FILING CONSULTATION RECORD SUPPORTING THE APPROVAL OF THE 2016 AQUATIC SETTLEMENT AGREEMENT ANNUAL REPORT
EMAIL NOTICE TO THE AQUATIC SETTLEMENT WORK GROUP FOR
A 45-DAY REVIEW OF CONSOLIDATED AQUATIC SETTLEMENT
AGREEMENT ANNUAL REPORTS

MARCH 21, 2017
Hi Aquatic SWG: as discussed, the following Aquatic Settlement Agreement documents are now available for a 45-day review period:

DRAFT 2016 Aquatic Settlement Agreement Annual Report.docx (attached and posted 3/21)
DRAFT 2016 Aquatic Settlement Agreement Annual Report_combined appendices.pdf (posted 3/21)

Please submit edits and comments to me and Douglas PUD no later than Friday, May 5, 2017.

Also attached is an updated Aquatic SWG Document Review Checklist.

The documents listed above are posted to the Aquatic SWG Extranet site under: Documents > All by Mtg Date > 5/10/2017 (instructions below). Please let me know if you have Qs! Happy reading! –kristi 😊

Instructions:
To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:
* Visit: https://extranet.dcpud.net/sites/nr/aswg/
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If you encounter problems, or need a login username and password to access the site:
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris
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ANCHOR QEA, LLC
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EMAIL REMINDER NOTICE TO AQUATIC SWG FOR REVIEW OF
CONSOLIDATED ASA ANNUAL REPORTS

APRIL 21, 2017
Hello! Just a friendly reminder that edits and comments on several ASWG documents are due to Andrew and me in one week! See attached and email below. Thanks everyone! -kristi 😊

Kristi Geris

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Hi Andrew,

I have attached the CCT’s comments and suggested edits for the 2016 ANSMP, BTMP, RFMP, and WSMP annual reports. We do not have any comments on the Water Temperature Report.

Thanks,
Jason

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Kristi Geris

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C 360.220.3988

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From: Kristi Geris (mailto:kgeris@anchorqea.com)
Sent: Friday, April 21, 2017 2:11 PM
To: Andrew Gingerich (andrewg@dcpud.org) <andrewg@dcpud.org>; Bob Rose <rosb@yakamafish-nsn.gov>; Chas Kyger <chask@dcpud.org>; Jason McLellan (FNW) <Jason.McLellan@colvilletribes.com>; John Ferguson <jferguson@anchorqea.com>; Kristi Geris <kgeris@anchorqea.com>; Mark Peterschmidt (mape461@ecy.wa.gov) <mape461@ecy.wa.gov>; Patrick Verhey (Patrick.Verhey@dfw.wa.gov) <Patrick.Verhey@dfw.wa.gov>; 'Steve Lewis' <stephen_lewis@fws.gov>; Zimmerman, Breean (ECY) <bzim461@ECY.WA.GOV>
Subject: FW: ASWG docs for review - REMINDER

Hello! Just a friendly reminder that edits and comments on several ASWG documents are due to Andrew and me in one week! See attached and email below. Thanks everyone! -kristi 😊

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NOTICE OF REVISED 2016 MANAGEMENT PLAN ANNUAL REPORTS
FOR APPROVAL

MAY 8, 2017
Hi Aquatic SWG: please see the email below from Andrew.

The draft ASA Annual Reports for approval during our ASWG 5/10 conference call are now available for download from the Aquatic SWG Extranet site under: Documents > All by Mtg Date > 5/10/2017 (instructions below). Thanks! –kristi 😊

<2017_05_08 Douglas - Draft 2016 PLMP Annual Report_for approval.doc>
<2017_05_08 Douglas - Draft 2016 WQMP Annual Report_for approval.doc>
<2017_05_08 Douglas - Draft 2016 WSMP Annual Report_for approval.doc>
<2017_05_08 Douglas - Draft 2016 RFMP Annual Report_for approval.doc>
<2017_05_08 Douglas - Draft 2016 BTMP ITS Annual Report_for approval.doc>
<2017_05_08 Douglas - Draft 2016 ANSMP Annual Report_for approval.doc>
<2017_05_08 Douglas - 03292017 Ecology approval of ASWG documents.msg.pdf>

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Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpwd.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris
ANCHOR QEA, LLC
kgeris@anchorqea.com
T 509.491.3151 x104
C 360.220.3988

-----Original Message-----
Hi Kristi, please find attached revised (where requested) ASA Management Plan Reports for 2016. The documents have been out for 45 days (in some cases longer) Douglas PUD received comments on the BTMP, RFMP, and WSMP annual reports, largely editorial in nature and all changes were made.

Perhaps the biggest change was a request to the intro section of the WSMP where updated info on Chelan PUD and Grant PUD sturgeon stocking programs was requested. We contacted both utilities to get updated info and changed the intro section of the WSMP to reflect current stocking rates in these programs.

Please note, consistent with the new water temperature reporting deadline of May 31st (formally April 1st) we appended the 2016 Water Temperature Report to the 2016 WQMP Report as reviewers would have noted. I just wanted to remind folks of the location.

Finally, WA Dept. of Ecology approved the earlier released reports via email and I attached this email since it wasn't originally distributed.

The documents as revised are attached towards obtaining approval at Wednesday's Aquatic SWG call and in order to meet the May 31st FERC deadline.

Thanks all.
Andrew
Andrew Gingerich
Senior Aquatic Resource Biologist
Public Utility No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802
Office: (509) 881-2323

Your message is ready to be sent with the following file or link attachments:

2017_05_08 Douglas - Draft 2016 ANSMP Annual Report- for approval
2017_05_08 Douglas - Draft 2016 RFMP Annual Report - for approval
2017_05_08 Douglas - Draft 2016 WSMP Annual Report-for approval
2017_05_08 Douglas - Draft 2016 BTMP ITS Annual Report - for approval
2017_05_08 Douglas - Draft 2016 WQMP Annual Report - for approval
2017_05_08 - Draft 2016 PLMP Annual Report- for approval

Note: To protect against computer viruses, e-mail programs may prevent sending or receiving certain types of file attachments. Check your e-mail security settings to determine how attachments are handled.
EMAIL TO AQUATIC SWG REGARDING REVISED 2016 ASA ANNUAL REPORT FOR APPROVAL

MAY 9, 2017
Hi ASWG Reps: attached is the Draft 2016 ASA Annual Report for approval during tomorrow’s ASWG 5/10 call. Only a few edits were received on the draft report, which are still tracked in redline strikeout. The attached is an interim version for voting purposes only, and will not be posted to the Extranet site. Anchor QEA is in the process of finalizing the report for DPUD to submit to FERC, and the final report will be distributed and posted, per usual. Talk to you tomorrow! -kristi ☺

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
8033 West Grandridge Boulevard, Suite A
Kennewick, WA 99336
T 509.491.3151 x104
C 360.220.3988

ANCHOR QEA, LLC
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FINAL ACTION ITEMS FOR THE AQUATIC SWG CONFERENCE CALL SHOWING APPROVAL OF 2016 ASA MANAGEMENT PLANS AND ANNUAL REPORT

MAY 10, 2017
Meeting Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties
From: John Ferguson, Chair (Anchor QEA, LLC)
Re: Final Action Items of the May 10, 2017 Aquatic SWG Conference Call

Date: May 10, 2017

Below is a summary of Action Items from the Aquatic Settlement Work Group (SWG) meeting that was held by conference call on Wednesday, May 10, 2017, from 10:00 a.m. to 12:30 p.m. Attendees are listed in Attachment A. These action items include the following:

I. Summary of Action Items

1. Douglas PUD will provide a summary report documenting Aquatic Nuisance Species Management Plan (ANSMP) northern pike sampling efforts conducted in the Wells Reservoir in 2017, to Kristi Geris for distribution to the Aquatic SWG (Item VI-7).

2. Douglas PUD will coordinate with the Colville Confederated Tribes (CCT) regarding ongoing efforts to remove northern pike from Lake Roosevelt and sampling methods that might support monitoring of northern pike range extension in the Wells reservoir, and will report those discussions back to the Aquatic SWG (Item VI-7).

3. Douglas PUD and Anchor QEA will compile draft Pacific lamprey topics for discussion during the next Aquatic SWG in-person meeting on June 12, 2017, and will provide the draft topics to the Aquatic SWG in advance of the meeting for comments (Item VI-8).

4. The Aquatic SWG meeting on Monday, June 12, 2017, will be held in-person at 9:00 a.m. at Douglas PUD Headquarters in East Wenatchee, Washington (Item VII-1).

II. Summary of Decisions

III. Agreements

1. Aquatic SWG members present agreed to add Donella Miller (Yakama Nation [YN] White Sturgeon Technical Support) and Ralph Lampman (YN Pacific Lamprey Technical Support) to Aquatic SWG Technical Representatives-only emails (Item VI-2).


3. Aquatic SWG members present agreed to reschedule the Aquatic SWG meeting on Wednesday, June 14, 2017, to Monday, June 12, 2017, to accommodate higher in-person attendance (Item VII-1).

IV. Review Items

1. There are no documents currently available for review.

V. Documents Finalized

1. There are no documents that have been recently finalized.
## Attachment A – List of Attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Ferguson</td>
<td>Aquatic SWG Chairman</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Kristi Geris</td>
<td>Administration/Technical Support</td>
<td>Anchor QEA, LLC</td>
</tr>
<tr>
<td>Andrew Gingerich</td>
<td>Aquatic SWG Technical Representative</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>Chas Kyger</td>
<td>Technical Support</td>
<td>Douglas PUD</td>
</tr>
<tr>
<td>RD Nelle</td>
<td>Technical Support</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>Breean Zimmerman</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>Patrick Verhey</td>
<td>Aquatic SWG Technical Representative</td>
<td>Washington Department of Fish and Wildlife</td>
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<tr>
<td>Jason McLellan</td>
<td>Aquatic SWG Technical Representative</td>
<td>Colville Confederated Tribes</td>
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<tr>
<td>Kirk Truscott</td>
<td>Technical Support</td>
<td>Colville Confederated Tribes</td>
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<tr>
<td>Bret Nine</td>
<td>Technical Support</td>
<td>Colville Confederated Tribes</td>
</tr>
<tr>
<td>Bob Rose</td>
<td>Aquatic SWG Technical Representative</td>
<td>Yakama Nation</td>
</tr>
<tr>
<td>Ralph Lampman</td>
<td>Technical Support</td>
<td>Yakama Nation</td>
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