Klamath Hydroelectric Settlement Agreement

Implementation Report

Klamath Hydroelectric Project

FERC Project No. 2082

PACIFICORP

August 2018

Executive Summary

The Klamath Hydroelectric Settlement Agreement (KHSA) was signed on February 18, 2010 and the amendments signed on April 6, 2016 and November 30, 2016. This report focuses on events that occurred June 1, 2014 through June 30, 2018.

Federal Legislation

While Senators Wyden, Merkley, Feinstein, and Boxer continued to support the implementation of the KHSA, Klamath Basin Restoration Agreement (KBRA), and the Upper Basin Comprehensive Agreement, the proposed legislation never moved beyond the Senate Committee on Energy and Natural Resources prior to December 31, 2015, at which point the KBRA expired.

Amended KHSA

In early 2016 the parties to the KHSA and KBRA met to chart a new path forward to implement the KHSA that did not rely on congressional approval. The result was an amended KHSA that specified a pathway by which PacifiCorp would apply to the Federal Energy Regulatory Commission (FERC) to transfer ownership of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate to a specially created Dam Removal Entity (DRE). That DRE would then apply to FERC to surrender the license for these facilities and decommission them. The amended KSHA was signed in April 2016. The Klamath River Restoration Corporation (KRRC) was incorporated in May 2017 and will serve as the DRE.

Dam Removal Funding

The California and Oregon public utility commissions have authorized customer surcharges designed to provide the full $200 million capped amount that PacifiCorp customers will contribute toward dam removal under the KHSA. PacifiCorp has collected dam removal surcharges from Oregon customers since March 2010 and from California customers in January 2012.

The Oregon customer surcharge, with accrued interest, is designed to provide approximately $184 million for dam removal. The California surcharge, with accrued interest, is designed to provide approximately $16 million in funding for dam removal. As of June 30, 2018, the dam removal trust accounts overseen by the Oregon Public Utility Commission (OPUC) had a balance of $124.5 million and the dam removal trust accounts overseen by the California Public Utilities Commission (CPUC) had a balance of $10.1 million, for a combined balance of $134.7 million. The KRRC has entered into funding agreements with both the OPUC and CPUC and is now able to access funds to implement dam removal activities. The OPUC has allocated just over $27.5 million from the Oregon trust accounts to the KRRC through the end of June 2018. No disbursements to the KRRC were made from the California dam removal surcharge funds through the end of June 2018.

Interim Measures

PacifiCorp continues to implement the interim measures in the KHSA in the period prior to dam removal. The company is funding basin-wide water quality monitoring and studies intended to reduce nutrient levels in the Klamath River and improve water quality in the Project reservoirs. PacifiCorp has made operational adjustments to the Project and is implementing and funding of fish habitat improvements within the Project and in the Klamath Basin downstream of Iron Gate Dam. PacifiCorp is also now funding the ongoing operations of Iron Gate Hatchery and the implementation of a Hatchery and Genetics Management Plan to aid in the conservation and recovery of Coho salmon.

PacifiCorp is pleased with the progress made in implementing the KHSA and the various interim measures that continue to create improvements to water quality, fish habitat, and other environmental conditions. PacifiCorp notes the significant contributions of KHSA parties, tribes, and involved state and federal agencies in these efforts and looks forward to working with our stakeholders as these efforts continue to move forward.

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1.0 Introduction

On February 18, 2010, PacifiCorp, along with representatives of more than 40 organizations, including federal agencies, the states of California and Oregon, Native American tribes, counties, irrigators, and conservation and fishing groups signed the historic Klamath Hydroelectric Settlement Agreement (KHSA). The 2010 KHSA laid out the process for additional studies, environmental review, and, following the passage of federal legislation, a decision by the Secretary of the Interior regarding whether removal of four Klamath River dams owned by PacifiCorp should proceed. The four Klamath River dams proposed to be removed are J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate. The KHSA included provisions for the interim operation of the dams until their anticipated removal in 2020 and spelled out the process to transfer, decommission, and remove the dams. Federal legislation to enact the provisions of the KHSA was not passed by Congress and the agreement was amended in April 2016 to provide for an administrative pathway to potential dam removal consistent with the provisions of the Federal Power Act, as administered by the Federal Energy Regulatory Commission (FERC).

The KHSA also contained a set of interim measures that PacifiCorp is to implement during the period prior to potential dam removal to improve water quality and fish habitat, support and improve hatchery operations, and benefit environmental resources in the Klamath basin. A copy of the KHSA can be found on PacifiCorp's website at:

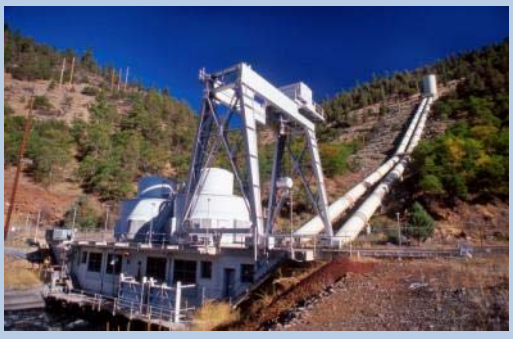
http://www.pacificorp.com/es/hydro/hl/kr.html

Since the execution of the KHSA, PacifiCorp has been working diligently in cooperation with parties to the KHSA and other affected stakeholders and regulatory agencies to implement its obligations under the KHSA and advance the settlement process. The purpose of this report is to document the progress made in implementing the KHSA.

Iron Gate Dam and Powerhouse

Copco No. 2 Dam

Copco No. 1 Dam and Powerhouse



J.C. Boyle Powerhouse

1.1 Background

PacifiCorp owns and operates the Klamath Hydroelectric Project (Project), located on the upper Klamath River in Klamath County (south-central Oregon) and Siskiyou County (north-central California). The Project consists of eight developments (Figure 1). Seven of the developments are located on the Klamath River between river mile (RM) 190.1 and 254.3, including (in order moving upstream) Iron Gate (RM 190.1 to 196.9), Copco No. 2 (RM 198.3 to 198.6), Copco No. 1 (RM 198.6 to 203.1), J.C. Boyle (RM 220.4 to 228.3), Keno (RM 233 to 253.1), and East Side and West Side (both in Link River at RM 253.1 to 254.3). The eighth development is on Fall Creek, a tributary to the Klamath River (in Iron Gate Reservoir) at RM 196.3.

The Project is licensed by FERC as Project No. 2082 (P-2082). With the exception of Fall Creek, the Project is largely dependent on water releases from Upper Klamath Lake at the U.S. Bureau of Reclamation's (Reclamation) Link River Dam (RM 254.3).

On February 25, 2004, PacifiCorp filed an application with FERC for a new 50-year license for the Project. PacifiCorp proposed in this application to operate five of the developments in a manner similar to historic operations with a set of environmental measures, the purposes of which included (but were not limited to) water quality and habitat enhancement, instream flow and ramp rate[1] management, facilitation of fish passage, and improved management of Iron Gate Hatchery fish stocks.

Following the submittal of its application for a new license, PacifiCorp began settlement discussions with a diverse group of stakeholders to resolve issues related to relicensing of the Project. PacifiCorp worked collaboratively with this group of stakeholders to develop and enter into the KHSA. A precursor to the KHSA, the Klamath Agreement in Principle (AIP) laid out a framework for the KHSA and was signed on November 13, 2008.

After 5 years of negotiations, the original KHSA was signed by the involved parties on February 18, 2010 and identified a process and path forward that provided for the potential decommissioning and removal of Iron Gate, Copco No. 2, Copco No. 1, and J.C. Boyle dams as early as 2020.

PacifiCorp agreed to a potential dam removal path for the Project and executed the KHSA based upon an assessment that the KHSA provided superior cost and risk protections for PacifiCorp and its customers as compared to continuing on a path of relicensing the Project. Under the KHSA, PacifiCorp's customers in California and Oregon will be assessed surcharges to provide up to $200 million in funding towards dam removal costs. The state of California will provide up to $250 million in funding for dam removal costs in excess of the $200 million Customer Contribution.

There were however, several contingencies in the KHSA, including provisions for funding the dam removal effort and the passage of federal legislation.

Congress had to pass legislation authorizing the Secretary of the Interior to make a determination on the KHSA and its companion agreement the Klamath Basin Restoration Agreement (KBRA). Starting in 2010 and continuing through 2015 the Senators from Oregon and California introduced Senate bills that would have provided this authority. While hearings in the Senate Committee on Energy and Natural Resources occurred, the bill never moved out of committee for consideration on the Senate Floor.

[1] Hydroelectric facilities typically have the capability of increasing and decreasing flow levels downstream of the facilities. In general, the rate at which these flow changes occur is called the "ramp rate" or "ramping."

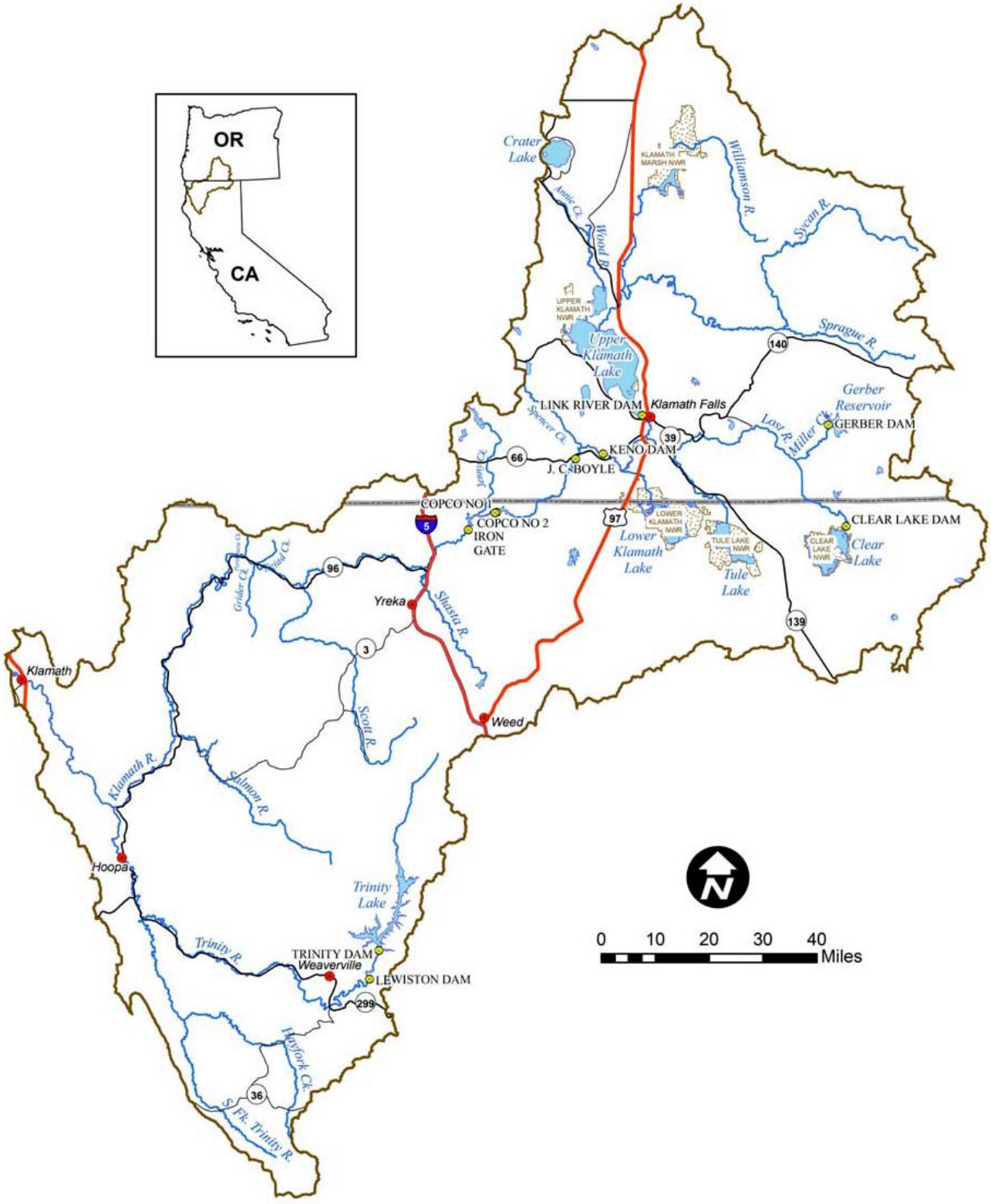


Figure 1. Klamath Basin

While the KHSA does not have an expiration date, the KBRA was designed to expire on December 31, 2015 if Congressional approval was not obtained. There was some renewed traction in early December 2015 to conduct Senate hearings on the proposed legislation, but the hearings never occurred and the required legislation was never passed. As a result, the KBRA expired at the end of 2015.

While PacifiCorp was not a party to the KBRA, the KBRA was important to the overall implementation of the KHSA because it provided funding for post-dam removal habitat restoration in areas that would be newly accessible to fish, addressed water rights disputes in the upper basin, and provided means to improve water supply reliability for Klamath Basin irrigators.

In early 2016, the Parties to the KHSA met in an attempt to determine if there was a way to amend the KHSA to provide an administrative pathway to potential dam removal consistent with the provisions of the Federal Power Act, as administered by FERC. The amended KHSA provides that PacifiCorp will apply to FERC to transfer ownership of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments to a Dam Removal Entity (DRE). The DRE would then accept the license for these developments and petition FERC to surrender the license and remove the facilities. The amended KHSA was signed on April 6, 2016.

Following the execution of the amended KHSA, the Klamath River Renewal Corporation[2] (KRRC) was incorporated as a nonprofit corporation in California on May 24, 2016. The KRRC is the DRE as envisioned in the amended KHSA.

The mission of the KRRC is to accept ownership of the four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) collectively known as the Lower Klamath Project (P-14803) from PacifiCorp and obtain approval from FERC to surrender the license and eventually remove these facilities. To accomplish this objective, the KRRC must obtain all necessary state, federal, and local permits for removal; create the necessary planning documents; select a contractor to conduct the removal process; and successfully implement the removal of the four lower dams on the Klamath River. Ownership of Keno Dam, currently a PacifiCorp facility will to be transferred to Reclamation as described in the KHSA because it will continue to serve irrigation purposes.

On September 23, 2016, PacifiCorp and the KRRC filed an application to transfer ownership of the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments to the KRRC. Simultaneously with the filing of the transfer application, the KRRC filed a surrender application with FERC for these same developments. On March 1, 2017, the KRRC filed additional information with FERC in support of the September 23, 2016 filing. On April 24, 2017, FERC requested additional information from PacifiCorp and the KRRC. The responses to this request were submitted to FERC on June 24, 2017. Subsequent requests for additional information have been received from FERC on July 14, 2017 and October 5, 2017, and responses to several of these requests were provided to FERC on June 29, 2018.

On March 15, 2018, FERC issued an order that splits the Klamath Hydroelectric Project (P-2082) into two separate projects. The Klamath Hydroelectric Project (P-2082) contains Keno Dam, the Eastside and Westside development, and the Fall Creek development. The Lower Klamath Hydroelectric Project (P-14803) contains the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments. However, acting on a petition submitted by PacifiCorp to FERC on April 16, 2018, FERC issued an order on June 21, 2018 that stayed the implementation of this order until such time that FERC acts on

[2] Information about the KRRC can be found here: http://www.klamathrenewal.org/

the application to transfer ownership of the Lower Klamath Project to the KRRC.

On June 29, 2018, the KRRC filed answers to questions posed by FERC in the March 15, 2018 Order along with the Definite Plan for dam removal. The Definite Plan provides the details on how removal of J.C. Boyle, Copco No. 1, Copco No. 2, Iron Gate developments would occur[3].

The current FERC license for the Project expired on March 1, 2006, and the Project is now operating under annual licenses from FERC. It is anticipated that the Project will continue operating under annual licenses until the dams are removed pursuant to the KHSA or a new license is issued. The KHSA provides that Project operations will continue over the interim period until the dams are removed or, should dam removal not proceed, until a new license is issued. Should FERC determine that dam removal should not proceed, or the KHSA terminates for other reasons, the FERC relicensing process for the Project would resume. The KHSA also provides that a new FERC license will not be issued and the licensing process will be held in abeyance pending the outcome of the KHSA dam removal process.

[3] The Definite Plan can be found on the KRRC's website: http://www.klamathrenewal.org/definite-plan/

2.0 Parties to the Klamath Hydroelectric Settlement Agreement

The parties to the KHSA, as amended, are listed below.

United States

The United States Department of Commerce, National Marine Fisheries Service

The United States Department of the Interior, including:

- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- Fish and Wildlife Service

State of California

California Department of Fish and Wildlife
California Natural Resources Agency

State of Oregon

Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Water Resources Department

PacifiCorp

Klamath River Renewal Corporation

Tribes

Karuk Tribe
Yurok Tribe

Counties

Humboldt County, California

Non-Governmental Organizations

American Rivers
California Trout
Institute for Fisheries Resources
Northern California/Nevada Council Federation of Fly Fishers
Pacific Coast Federation of Fishermen's Associations
Sustainable Northwest
Trout Unlimited

3.0 Funding

The KHSA sets out a cost cap for facilities removal of $450 million. Of this amount, up to $200 million is to come from surcharges on PacifiCorp's customers in California and Oregon. In addition, the state of California will fund up to $250 million in dam removal costs in excess of the customer cost cap. In November 2014, California voters approved the *Water Quality, Supply, and Infrastructure Improvement Act* (Proposition 1). This bond measure included funding for implementation of California's responsibilities under the KHSA.

3.1 Customer Contributions

3.1.1 Oregon Public Utility Commission Proceedings

On March 18, 2010, in accordance with KHSA Sections 4.1.1 and 7.3.9, PacifiCorp filed its analyses of the rate-related costs, benefits, and risks to customers from the KHSA as compared to relicensing the Klamath River dams with the Oregon Public Utility Commission (OPUC). This filing, with supporting testimony, was an application to implement provisions of Oregon Senate Bill 76 passed in the 2009 Oregon legislative session. PacifiCorp concurrently filed an advice letter establishing two surcharges, effective upon filing, to collect the customer contribution towards dam removal costs. In its application, PacifiCorp also requested that the depreciation schedule for Project facilities be adjusted in contemplation of their anticipated removal in 2020 and sought authorization to transfer Project facilities to the DRE. On September 16, 2010, the OPUC issued a final order affirming the dam removal surcharges for Oregon customers and a depreciation schedule for the facilities that provides for removal in 2020.[4] The OPUC order requires PacifiCorp to seek authorization to transfer Project facilities to the DRE at a later date. Since the surcharges commenced in March 2010, PacifiCorp has been remitting collected surcharges to trust accounts established by the OPUC with an independent financial institution. As of June 30, 2018, the balance of the Oregon customer dam removal trust accounts was as follows:

J.C. Boyle Trust Account	$30,899,508.60
Copco 1, Copco 2, and Iron Gate Trust Account	$93,628,768.12
Total	**$124,528,276.72**

The Oregon customer surcharges, with accrued interest, are designed to provide approximately $184 million in funding for dam removal.

3.1.2 California Public Utilities Commission Proceedings

On March 18, 2010, in accordance with KHSA Sections 4.1.1 and 7.3.9, PacifiCorp filed an application with the California Public Utilities Commission (CPUC) requesting authorization to begin collecting dam removal surcharges from its California customers and seeking authorization to transfer Project facilities to the DRE. This application included supporting testimony regarding the rate-related costs, benefits and risks to customers of the KHSA as compared to relicensing. In its application, PacifiCorp also requested that the depreciation schedule for Project facilities be adjusted in contemplation of their anticipated removal in 2020. On May 6, 2011, the CPUC issued a final decision approving 1) the request for a surcharge of $13.76 million collected over 9 years; 2) institution of two trust accounts for the deposit of the surcharge; and 3) depreciation of the rate base of the Klamath River Project assets, and amortization of the relicensing and settlement costs associated with the Klamath River Project, on an accelerated basis. On June 6, 2011, PacifiCorp filed an advice letter requesting approval of revised tariffs adding the Klamath Surcharge. The trust

[4] The OPUC Order is available at: http://apps.puc.state.or.us/orders/2010ords/10-364.pdf

accounts were established with an independent financial institution by the CPUC in January 2012 and PacifiCorp began assessing the surcharge on January 10, 2012.

Because of a delay between the issuance of the decision and the establishment of the trust accounts, approximately 8 months of surcharge collections were lost. On January 13, 2012, PacifiCorp filed a request to increase the Klamath surcharge rate in order to collect the full amount of the surcharge within the original collection timeframe. The CPUC approved PacifiCorp's request on October 25, 2012[5] and new rates became effective October 29, 2012.

As of June 30, 2018, the balance of the California customer dam removal trust accounts was as follows:

J.C. Boyle Trust Account	$2,524,376.96
Copco 1, Copco 2, and Iron Gate Trust Account	$7,599,409.76
Total	**$10,123,786.72**

The California customer surcharges, with accrued interest, are designed to provide approximately $16 million in funding for dam removal.

3.1.3 Total Trust Account Balances

The total balance of the California and Oregon dam removal trust accounts maintained by independent financial institutions under the direction of the California and Oregon public utility commissions was $134,652,063.44 as of June 30, 2018.

3.1.4 Management of the Trust Accounts

Pursuant to KHSA Section 4.2.4, the public utility commissions in California and Oregon have entered into trust management agreements with independent financial institutions to manage the trust accounts established to hold the dam removal surcharges that constitute the Customer Contribution towards dam removal costs.

Disbursement of funds to the KRRC for permitting and facilities removal expenditures has and will continue to occur at the direction of authorized representatives of the public utility commissions. As of December 2017, the KRRC has obtained approval from the OPUC to access the Oregon surcharge funds and from the CPUC to access the California surcharge funds. As of the end of June 2018, $27,465,281.00 had been disbursed to the KRRC from the trust accounts managed by the OPUC.

3.2 State of California Funding

If the cost of facilities removal exceeds the $200 million Customer Contribution, then the state of California is to provide funding of up to $250 million to cover the additional costs.

The *Water Quality, Supply, and Infrastructure Improvement Act* (Assembly Bill No. 1471) was submitted to the California voters on November 4, 2014 as Proposition 1. Voters approved the bond and it was signed into law by Governor Brown. Per KHSA Section 4.1.2, this bond provides for funding up to $250 million to cover the difference between funds available under the Customer Surcharge and the actual costs for full facilities removal.

[5] Final CPUC decision is available at: http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/134812.htm

4.0 Federal Legislation

On May 21, 2014, Senators Wyden, Merkley, Boxer and Feinstein introduced Senate Bill S. 2379 which would endorse the KHSA, the KBRA, and the Upper Basin Comprehensive Agreement (Comprehensive Agreement). The Comprehensive Agreement was finalized in March 2014 and provides the framework for a settlement of water rights claims between the Klamath Tribes, the Bureau of Indian Affairs, and Off-Project irrigators in the Upper Klamath Basin. The Comprehensive Agreement was envisioned by the KBRA and, with its execution in early 2014, the Klamath Settlements in their entirety could be considered by Congress and enacted through S. 2379.

On June 3, 2014, the Senate Energy and Natural Resources Committee held a hearing to receive testimony on the proposed legislation and the recently executed Comprehensive Agreement. In a subsequent meeting of the Senate Energy and Natural Resources Committee on November 13, 2014, a rollcall vote approved recommendation of passage of S. 2379. The bill was subsequently placed on the Senate Legislative calendar on December 10, 2014, but was never acted upon before the end of that Congressional session.

Because bills that were not acted on expire at the end of a Congressional session, on January 8, 2015, Senators Wyden, Merkley, Boxer, and Feinstein introduced Senate Bill S. 133 into the 114th Congress (S. 133 was the same as S. 2379). This bill was read twice and referred to the Senate Energy and Natural Resources Committee. The Senate Energy and Natural Resources Committee held hearings on the bill on July 28-30, 2015. It was never acted upon by the Committee before the KBRA expired at the end of 2015.

The amended KHSA, executed on April 6, 2016, provides for potential dam removal to occur through a license surrender process before FERC. Federal legislation is no longer required to implement the amended KHSA.

5.0 Studies and Environmental Review

As described in Section 3 of the KHSA executed in February 2010, the Secretary of the Interior, in cooperation with the Secretary of Commerce and other federal agencies, conducted studies and environmental review to determine whether to proceed with facilities removal. The Secretary of the Interior was supposed to determine whether facilities removal 1) would advance restoration of the salmonid fisheries of the Klamath Basin; and 2) was in the public interest, which includes but was not limited to consideration of potential impacts on affected local communities and tribes.

On April 4, 2013, the Department of the Interior (Interior) released a Record of Decision and Final Klamath Facilities Removal Environmental Impact Statement (Final EIS) prepared consistent with the requirements of the National Environmental Policy Act (NEPA). The Final EIS identifies effects of the proposed action (dam removal and implementation of the KBRA) as well as other alternatives analyzed. The Final EIS identified full removal of all four mainstem PacifiCorp hydroelectric facilities (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) as the preferred alternative to achieve a free flowing river and realize other goals and objectives expressed in the KHSA and KBRA. Once the Final EIS was complete congressional action was necessary to authorize the Secretary of the Interior to make a determination whether the removal of the four facilities should proceed. As was discussed previously (Section 4.0), this authorization was never provided and the KBRA expired at the end of December 2015.

Information on the NEPA process, the Final EIS, and the related environmental studies can be found at the website http://klamathrestoration.gov. Because the KBRA has expired and it was part of the proposed action analyzed in this Final EIS, the usefulness of the 2013 Final EIS in supporting implementation of the 2016 amended KHSA is unclear. However, it is anticipated that FERC will conduct supplemental NEPA analysis of the KRRC's Definite Plan for dam removal.

6.0 Interim Operations

6.1 Lease of State-Owned Beds and Banks

Pursuant to KHSA Section 2.4, PacifiCorp and the state of Oregon executed leases for J.C. Boyle and Keno dams in June 2011 and PacifiCorp is complying with the terms of those leases and remitting lease payments to the state of Oregon.

6.2 Keno Transfer

Pursuant to KHSA Section 7.5.2, PacifiCorp and Reclamation executed an Agreement in Principle in August 2012 regarding the potential transfer of the Keno development to Reclamation. The Agreement in Principle memorializes broad principles designed to function as a framework for the development of a final agreement for PacifiCorp to transfer the Keno Facility to Reclamation. PacifiCorp and Reclamation continue good-faith negotiations to reach a final Transfer Agreement consistent with the principles outlined in the Agreement in Principle.

Keno Dam

The final Transfer Agreement will outline exactly how necessary lands and improvements will be transferred to Reclamation as specified in the KHSA. It will also include details related to ongoing access to affected lands and provisions for the transfer of control of the facility from PacifiCorp to Reclamation.

6.3 Local Community Power

Pursuant to KHSA Section 5.3, representatives of Interior, PacifiCorp, the Klamath Water and Power Agency (KWAPA), Klamath Water Users Association (KWUA), Bonneville Power Administration, and the Western Area Power Administration have held numerous meetings regarding the development and implementation of a federal power program that would provide federal power to eligible Klamath Basin irrigation loads.

PacifiCorp transferred customer load information to KWAPA for customers that have indicated an interest in the program and who signed releases authorizing the release of their customer information to KWAPA. This customer load data informed KWAPA and Interior's planning for the delivery of federal power to serve eligible loads and estimated costs associated with the program.

PacifiCorp assisted KWAPA and its consultants to develop an analysis of the potential cost savings associated with implementation of the federal power program. PacifiCorp continues to work cooperatively with the involved parties to address power cost issues for Klamath Basin irrigators who are now paying higher power rates under tariffs approved by the public utility commissions.

6.4 Section 401 Water Quality Certification Process

Section 6.5 of the KHSA commits the KHSA parties to request abeyance of the California and Oregon Clean Water Act Section 401 water quality certification process for PacifiCorp's relicensing application, pending completion of the FERC transfer process to the KRRC and during the interim period prior to potential dam removal. Given the anticipated removal of the hydroelectric project facilities in 2020, abeyance of the Section 401 water quality certification process is intended to relieve the states, PacifiCorp, and other interested parties of the burden of processing relicensing related

certification applications during the interim period prior to dam removal pursuant to the KHSA. At the same time, full authority of the states to condition the Project through the Section 401 certification process is preserved should dam removal under the KHSA not occur and the relicensing process resume.

On March 19, 2010, PacifiCorp requested, on behalf of the Parties except the Oregon Department of Environmental Quality (ODEQ), that the California State Water Resources Control Board (SWRCB) and ODEQ hold in abeyance permitting and environmental review for PacifiCorp's relicensing during the interim period. This request was subsequently granted by ODEQ on March 29, 2010 and the SWRCB passed a resolution granting the abeyance, with conditions, on May 18, 2010.

The SWRCB's abeyance resolution expired in June 2013. Because of this, PacifiCorp modified and re-submitted its California-specific Section 401 application, in consultation with SWRCB staff, to incorporate relevant technical information and the results of ongoing water quality studies into its certification application.

As required by the KHSA, PacifiCorp annually withdrew and resubmitted its application for Section 401 certification from California and Oregon to preserve the authority of the states to issue Section 401 water quality certifications should there be a return to the relicensing process. This practice ensured that there was no waiver of certification as a result of the focus of the KHSA parties on successful implementation of the KHSA. PacifiCorp most recently withdrew and resubmitted its requests for Section 401 certification from California and Oregon on November 24, 2014 and November 10, 2015, respectively.

On November 30, 2015, the SWRCB decided to proceed with environmental review associated with PacifiCorp's application for a Section 401 water quality certification. As required by the California Environmental Quality Act (CEQA), the SWRCB held four scoping meetings in January 2016, prepared a scoping report, and began preparation of setting sections of an environmental impact report.

With the execution of the amended KHSA in April 2016, PacifiCorp subsequently petitioned FERC for a formal abeyance of all work related to relicensing. The SWRCB supported PacifiCorp's request on May 23, 2016 and FERC granted this abeyance on June 16, 2016. Following this action by FERC, PacifiCorp withdrew its Section 401 applications from both the SWRCB and ODEQ on June 23, 2016.

In September 2016, concurrent with filling the transfer and surrender applications to FERC, the KRRC submitted Section 401 certification applications for facilities removal to the SWRCB and ODEQ. The SWRCB is currently preparing an environmental impact report on the KRRC's proposed project as part of their standard processing of the KRRC's application. On June 7, 2018, the SWRCB[6] released a draft Section 401 water quality certification for the KRRC's proposed removal of the California dams. On May 23, 2018, ODEQ[7] issued a draft Oregon Section 401 water quality certification for KRRC's proposed dam removal of J.C. Boyle, and held a public hearing on June 12, 2018 in Klamath Falls, Oregon to receive public testimony on the proposed Section 401 certification.

6.5 Total Maximum Daily Loads

Pursuant to KHSA Section 6.3, PacifiCorp filed a *Plan for Implementing Management Strategies*

[6] The SWRCB has posted all California Section 401 information here: https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/lower_klamath_ferc14803.shtml

[7] The ODEQ has posted all Oregon Section 401 information here: https://www.oregon.gov/deq/wq/wqpermits/Pages/Section-401-Hydropower.aspx

and Water Quality-Related Measures with the ODEQ and the North Coast Regional Water Quality Control Board (NCRWQCB) on February 22, 2011. PacifiCorp's submittal of this plan was triggered under the KHSA by the NCRWQCB's approval of the *Klamath River Total Maximum Daily Load* (TMDL) on September 7, 2010 and by ODEQ's issuance of the *Upper Klamath and Lost River Subbasins Total Maximum Daily Load* on December 21, 2010. These plans specify the interim water quality measures that PacifiCorp will implement prior to potential transfer of the Project to the KRRC.

7.0 Interim Measures Implementation

7.1 Interim Measures Implementation Committee Meeting Dates and Members

7.1.1 Purpose and Goals of the Interim Measures Implementation Committee

The purpose of the Interim Measures Implementation Committee (IMIC) is to collaborate with PacifiCorp on ecological and other issues related to the implementation of the Interim Measures set forth in Appendix D of the KHSA. The primary goals of the IMIC are: (1) to achieve consensus where possible; and (2) timely implementation of the matters within the scope of the IMIC's responsibilities under the KHSA.

The IMIC meets quarterly and members can attend in person or via a webcast and conference line. These meetings typically consist of a technical review of study plans, updates on Interim Measure study progress, and review of technical reports. The IMIC has held most of its quarterly meetings in Yreka, California, which is a central location for most members.

Between June 2014 and May 2018, 16 meetings were held; two in the second half of 2014, four each in 2015, 2016, 2017, and two in the first half of 2018. Meetings are typically held during the third week of January, April, July, and October with specific dates selected for the next year at the October meeting. Representatives to the IMIC come from 18 different organizations (Table 1). Over the last few years, several members have left the IMIC and been replaced by others who represent the same organization. These changes are noted in the table below.

Table 1. Interim Measures Implementation Committee Members and Affiliations

IMIC Member	Organization
Steve Rothert	American Rivers
Chelsea Aquino	Bureau of Land Management
Rick Carlson	Bureau of Reclamation
Donna Cobb	California Department of Fish and Wildlife
Gary Curtis (to Dec 2015)	California Department of Fish and Wildlife
Jane Vorpagel	California Department of Fish and Wildlife
Erin Ragazzi	California State Water Resources Control Board
Parker Thaler	California State Water Resources Control Board
Curtis Knight	California Trout
Mark Rockwell	Federation of Fly Fishers, N. CA Council
Glen H. Spain	Institute for Fisheries Resources
Susan Fricke	Karuk Tribe
S. Craig Tucker	Karuk Tribe

IMIC Member	Organization
Mark Hampton	National Marine Fisheries Service
Jim Simondet	National Marine Fisheries Service
Clayton Creager	North Coast Regional Water Quality Control Board
Chris Stine	Oregon Department of Environmental Quality
Mike Hiatt	Oregon Department of Environmental Quality
Robert M. Hooton	Oregon Department of Fish and Wildlife
Bill Tinniswood	Oregon Department of Fish and Wildlife
Ted Wise	Oregon Department of Fish and Wildlife
Kyle Gorman	Oregon Water Resources Department
Mary Grainey	Oregon Water Resources Department
Tim Hemstreet	PacifiCorp
Linda Prendergast (to Apr 2015)	PacifiCorp
Demian Ebert (after July 2015)	PacifiCorp
Larry K. Dunsmoor (to July 2016)	The Klamath Tribes
Megan Skinner (July 2016 to July 2017)	The Klamath Tribes
Stan Swerdloff (after July 2017)	The Klamath Tribes
John Hamilton (to April 2017)	U.S. Fish and Wildlife Service
Ryan Fogerty (after July 2017)	U.S. Fish and Wildlife Service
Gina Glenne (after April 2017)	U.S. Fish and Wildlife Service
Nick Hetrick	U.S. Fish and Wildlife Service
Mike Edwards (after April 2017)	U.S. Fish and Wildlife Service
Mike Belchik (to Oct 2015)	Yurok Tribe
Micah Gibson (to April 2016)	Yurok Tribe
Louisa McCovey (after April 2016)	Yurok Tribe
Matthew Hanington (after July 2016)	Yurok Tribe

7.2 Interim Conservation Plan Interim Measures and Endangered Species Act Regulatory Process

Section 6.2.1 of the KHSA provides as follows:

PacifiCorp shall apply to the Services pursuant to ESA Section 10 and applicable implementing regulations to incorporate the Interim Conservation Plan measures, including both Appendix C (ICP Interim Measures) and the Interim Conservation Plan measures for protection of listed

sucker species not included in Appendix C, into an incidental take permit.

Since 2009, PacifiCorp has worked closely with the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) to develop applications for Endangered Species Act (ESA) Section 10 permits consistent with agency regulations.

Coho Salmon Habitat Conservation Plan

In February, 2011, PacifiCorp filed an application for an ESA Section 10 permit with NMFS. The permit application developed with NMFS included a Habitat Conservation Plan (referred to as the Coho HCP) that identifies a process to implement measures that will avoid, minimize, and mitigate the effects of Project operations on Coho salmon and attain the biological goals and objectives described in the Coho HCP's conservation strategy. Such measures include:

1. Implementing habitat enhancement activities through a Coho Enhancement Fund
2. Implementing flow releases and turbine venting at Iron Gate Dam to improve habitat conditions for Coho salmon in the Klamath River
3. Funding research focused on fish disease in the Klamath River
4. Retrieval and passage of large wood trapped at PacifiCorp's facilities
5. Monitoring to assess the benefits of these measures

On February 24, 2012, NMFS issued a final Incidental Take Permit under Section 10 of the ESA that authorizes potential incidental take of Coho salmon that could occur as a result of PacifiCorp's interim operation of the Project consistent with the terms of the Coho HCP. Annually PacifiCorp files a report with NMFS documenting Coho HCP implementation actions taken the previous year.

Activities conducted under the Coho HCP to date include operational adjustments to improve dissolved oxygen in flow releases from Iron Gate powerhouse, the implementation of habitat enhancement projects to benefit Coho salmon downstream of Iron Gate Dam as funded through PacifiCorp's Coho Enhancement Fund, fish disease research, development of a Hatchery and Genetics Management Plan, delivery of flows from Iron Gate Dam in support of Reclamation's regulatory requirements, and monitoring and adaptive management.

Coho Salmon

PacifiCorp developed a Gravel Augmentation Plan[1] as required by the Coho HCP, which was submitted to NMFS for review and approved by NMFS on March 6, 2013. Gravel augmentation immediately below Iron Gate Dam has taken place in 2014, 2016, and 2017. The material placed in 2014 and 2016 was moved downstream by subsequent high flows. As of July 2017, about 3,500 cubic-yards of spawning gravel has been placed downstream of Iron Gate Dam meeting the target volume in the Coho HCP. In addition, approximately 1,100 cubic-yards of spawning gravel was placed below the Iron Gate Dam spillway in December 2017 to provide access for spillway maintenance work. This gravel was left in place following construction activities. It has since been washed downstream by high flows and

further enhances spawning habitat downstream of Iron Gate Dam.

Gravel Augmentation Downstream of Iron Gate

The Coho HCP also requires water quality data collection and analysis. PacifiCorp submitted a final Water Quality Monitoring Plan[2] to NMFS on February 24, 2013. This plan included procedures to monitor water temperature and dissolved oxygen at designated locations downstream of Iron Gate Dam. Since 2008, continuous monitoring of water temperature and dissolved oxygen has occurred in the Klamath River downstream of Iron Gate Dam. In May 2013, PacifiCorp completed arrangements with the U.S. Geological Survey (USGS) to install and collect continuous water temperature data in the Klamath River at Orleans. As required in the Incidental Take Permit, this location is used as a down-river reference location that is outside the area where water temperatures are influenced by releases from Iron Gate Dam. Data is collected and used to evaluate consistency with the water quality objectives contained in the Coho HCP and is included in the annual Coho HCP Reports submitted to NMFS.

Sucker Habitat Conservation Plan

In August 2011, PacifiCorp filed an application for an ESA Section 10 Incidental Take Permit with USFWS, including a draft HCP (referred to as the Sucker HCP), to address potential incidental take of Lost River and Shortnose suckers that could occur during period before Project removal (the interim period). PacifiCorp submitted a revised Sucker HCP to USFWS in late 2012 and public comments on PacifiCorp's application were solicited in March 2013. On February 20, 2014 USFWS issued a final Incidental Take Permit that authorizes potential incidental take of listed suckers that could occur as a result of PacifiCorp's interim operation of the Project consistent with the terms of the Sucker HCP[3].

The Sucker HCP identifies a conservation strategy consisting of substantial shutdown of the East Side and West Side hydroelectric developments, continued support for an important restoration project on the Williamson River Delta, and a protocol for implementing a Sucker Conservation Fund that will avoid, minimize, and mitigate take of listed suckers.

Since 2014, PacifiCorp has not operated the East Side and West Side developments except for tests lasting less than 24 hours and coordinated with the USFWS to avoid take of suckers. Through the Sucker Conservation Fund, PacifiCorp funded a fish screening and irrigation efficiency improvement project on the Sprague River in 2016. This project replaced an unscreened diversion with an agency-approved fish screen. The project also included a variable drive pump that allowed more efficient use of water and overall has reduced diversions. This project resulted in improvements to instream conditions for suckers by both preventing fish entrainment and allowing more water to remain in the river.

Wayne Fish Screen on the Sprague River

7.3 Interim Measure 2: California Klamath Restoration Fund / Coho Enhancement Fund

PacifiCorp shall establish a fund to be administered in consultation with the California Department of Fish and Wildlife (after providing notice and opportunity for comment to the State Water Resources Control Board and North Coast Regional Water Quality Control Board) and NMFS to fund actions within the Klamath Basin designed to enhance the survival and recovery of Coho salmon, including, but not limited to, habitat restoration and acquisition. PacifiCorp has provided $510,000 to this fund in 2009 and shall continue to provide this amount of funding annually by January 31 of each subsequent year in which this funding obligation remains in effect. Subject to Section 6.1.1, this funding obligation shall remain in effect until the time of decommissioning of all of the Facilities in California.

As of January 2018, PacifiCorp has provided funding of over $4,900,000 into the Coho Enhancement Fund (CEF). Starting in 2009 and running through the 2017 grant cycle, 42 grants have been selected to receive funding for projects that benefit Coho salmon downstream of Iron Gate Dam (Figure 2). These projects have a combined grant value of about $4.3 million. Selections of projects to fund are made by PacifiCorp with the assistance of a technical advisory team comprised of staff from NMFS and CDFW.

PacifiCorp has developed a partnership with the National Fish and Wildlife Foundation (NFWF) to administer the fund. This partnership allows CEF grant recipients to be eligible for additional funding through other grant programs, further enhancing the conservation benefit of the fund. Using this process, grantees have leveraged an additional $7.7 million in matching funds for Coho restoration projects as of 2017.

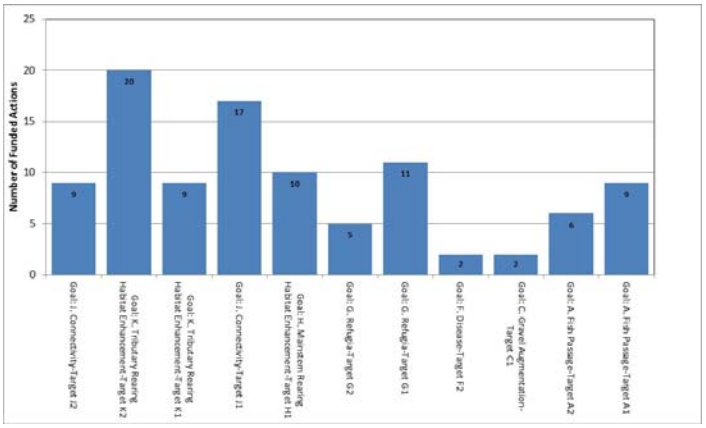


Figure 2. Number of Funded Activities Through 2017 as They Relate to Coho HCP Goals and Objectives

Funded projects have resulted in a substantial benefit to Coho salmon downstream of Iron Gate Dam. When the projects are considered collectively, the CEF has resulted in:

- Over 2,300 linear feet of channel restoration
- Creation of over 163,000 square feet of off-channel ponds
- Installation of three fish screens
- Removal of 73 passage barriers
- Improved access to over 71 miles of Coho habitat
- Installation of over 7 miles of riparian fencing
- Implementation of 29 separate water leases providing improved flows in almost 36 miles of stream
- Implementation of 71,000 square feet of other types of habitat enhancement projects

The recipients of Coho Enhancement Fund grants and the corresponding projects thus far include:

- **Karuk Tribe**: Seiad Creek Channel Restoration, Phase I, II, and III created engineering designs, permitting, stakeholder identification, and construction to realign Seiad Creek to a natural course to enable Coho salmon potential year round habitat access.

Completed Seiad Creek Channel Restoration Project

- **Mid Klamath Watershed Council:** Seiad Creek Off-Channel Pond Habitat Construction.
- **Siskiyou County Resource Conservation District:** Fish Passage Improvement in the Scott River.
- **Siskiyou County Resource Conservation District:** Denny Ditch Fish Screen Improvements.
- **Emmerson Investments:** Shasta River Coho Habitat Project to conserve and enhance more than 6 miles of Shasta River habitat with fencing as well as providing livestock stock water lanes.
- **Grenada Irrigation District:** Huseman Ditch point of diversion fish passage improvements allowing for 4.7 miles of instream cold water retention.
- **Scott River Water Trust:** Scott River Water Acquisition Program enabling critical Coho streams to remain connected to the Scott River. This project has gone through three award cycles.
- **Mid Klamath Watershed Council:** Coho Rearing Habitat Enhancement to create and restore more than 10 tributary cold water refugia areas at their confluences with the middle Klamath.
- **Mid Klamath Watershed Council:** Middle Klamath Restoration Prioritization Project to identify Coho restoration projects that will provide the greatest species benefit.
- **Mid Klamath Watershed Council:** Tributary Fish Passage Improvement Project to create fish passage at the mouths and in the lower reaches of 72 Mid Klamath Subbasin tributaries.
- **Yurok Tribe:** Lower Klamath Coho Habitat Enhancement and Monitoring for construction of an off-channel habitat feature in McGarvey Creek to increase juvenile Coho salmon rearing capacity.
- **Mid Klamath Watershed Council:** Seiad/West Grider Coho Winter Rearing Habitat Project to create two off-channel ponds to improve winter habitat.
- **Mid Klamath Watershed Council:** Mid Klamath Coho Rearing Habitat Enhancement Project to enhance habitat complexity.
- **Caltrans District 2:** Replace existing culvert on Fort Goff Creek with a single-span bridge to restore the stream channel and provide passage for Coho along with enhanced habitat.
- **Mid Klamath Watershed Council:** Stanshaw Creek Water Rights Evaluation, Phase 1 and 2.
- **Mid Klamath Watershed Council:** Tributary Coho Rearing Habitat Improvement. This project will create and/or enhance off-channel rearing and thermal refugia for Coho salmon.
- **Montague Water Conservation District:** Shasta River Flow Augmentation Project.
- **Yurok Tribe:** Restoring Off-Estuary Habitat. This project will enhance habitat in the Lower Hoopaw Creek to benefit Coho salmon.
- **Mid Klamath Watershed Council:** Mid Klamath Off-Channel Coho Rearing Habitat. This project will create approximately 22,000 square feet of critical off-channel winter and summer Coho rearing habitat at four different locations.
- **Scott River Watershed Council:** Juvenile Coho Habitat Improvement using Beaver Dams. Beaver and beaver dam analogues

are being used to improve the quantity and quality of Coho rearing habitat in the Scott River and its tributaries.

- **Scott River Water Trust:** Emergency Stream Augmentation Project. This project added additional water to the Scott River to support rearing Coho during critical drought.
- **Salmon River Restoration Council:** Salmon River Coho Rearing Habitat Enhancement Project increased function and value of Coho rearing habitat.
- **Klamath Basin Rangeland Trust:** Cold Creek Coho Passage and Screening Design is developing a design for a fish-friendly irrigation diversion to replace a push-up dam on Cold Creek a tributary to Bogus Creek.
- **Yurok Tribe:** Lower Klamath Coho Rearing Habitat Case Studies. The Yurok Tribe are conducting a detailed review of eight constructed habitats in the lower river tributaries and evaluating their effectiveness to ensure lessons are learned and shared.
- **Scott River Water Trust:** French Creek Coho Enhancement through Flow Augmentation 2015 and 2016. This project was able to double the flow in some reaches and substantially support summer rearing Coho in French Creek.
- **Siskiyou Resource Conservation District:** Sugar Creek Off-channel Enhancement for Coho Salmon. By improving a connection from an existing groundwater-fed pond to Sugar Creek, Coho were provided access to cold water refugia.
- **Shasta Valley Resource Conservation District:** Novy/Rice Fish Passage Project Design. This project involves design of a replacement system for the last flashboard dam on the mainstem Shasta River and will allow access to 14 miles of habitat when complete.
- **Mid Klamath Watershed Council:** Coho Habitat Enhancement and Monitoring Project. Work on this project will create a new 19,000 square-foot off-channel rearing pond and conduct detailed monitoring and maintenance on 13 other off-channel rearing sites.
- **GS Black, Inc.:** Shasta River Coho Protection through Diversion Enhancement. This project installed a self-cleaning cone screen and electric pump to replace a failed non-cleaning passive fish screen and diesel pump on the Shasta River.
- **Scott River Watershed Council:** Watershed-scale Floodplain Restoration to Enhance and Increase Juvenile Coho Salmon Off-Channel Summer Rearing and Overwintering Habitat in the Scott River Watershed—Phase 1, Planning and Design. Phase 1 of this project inventories quality habitat and creates a plan to restore high-priority sites in the Scott River.
- **Salmon River Restoration Council:** Salmon River Coho Rearing Habitat Enhancement Project. This project will improve critical Coho salmon rearing habitat by increasing cover, pool depth, and habitat complexity with manual modifications and the addition of small and large wood and brush bundles.
- **Mid Klamath Watershed Council:** Klamath River Coho Habitat Enhancement, Monitoring and Design Project. This project will create about 20,000 square-feet of off-channel rearing habitat, monitor and maintain 19 existing sites, develop designs

Sugar Creek Off-Channel Pond after Improvement

for four new sites, and enhance about 4,000 linear-feet of stream channel.

- **Scott River Watershed Council:** Juvenile Coho Habitat Improvement Using Beaver Dams II. This project will construct three beaver dam analogues and monitor for habitat change and fish response.
- **Mid Klamath Watershed Council:** Middle Creek Channel Rehabilitation Project. This project will create a comprehensive restoration design for about 3,300 feet of stream channel that will tie into adjacent restoration projects.
- **Yurok Tribe:** Lower Bear Creek Stream and Floodplain Habitat Enhancement Project: Phase 1. This project will install wood jams in Bear Creek to create rearing habitat for natal and non-natal Coho and conduct detailed fish-use data evaluation of the work.
- **California Trout, Inc.:** Upper Shasta Coho Habitat Restoration. This project will improve Coho spawning and rearing habitat and access to cold-water refugia in the upper Shasta River.
- **Scott River Water Trust:** Water Dedication Development in the Scott River Basin. This project supports continued development of permanent instream water dedication.

Juvenile Coho Salmon

A Technical Review Team was formed in 2012 and meets annually (if necessary) to review existing projects funded under the CEF and to recommend possible adaptive management changes, if warranted, based, in part, on the results of monitoring data developed from funded projects. To date, no changes have been recommended in the CEF process. The first Technical Review Team meeting was held in June 2012 and subsequent meetings were held in November 2013, October 2014, and January 2017. By consensus of the group a meeting was not held in 2015.

7.4 Interim Measure 3: Iron Gate Turbine Venting

PacifiCorp shall implement turbine venting on an ongoing basis beginning in 2009 to improve dissolved oxygen concentrations downstream of Iron Gate Dam. PacifiCorp shall monitor dissolved oxygen levels downstream of Iron Gate Dam in 2009 and develop a standard operating procedure in consultation with NMFS for turbine venting operations and monitoring following turbine venting operations in 2009.

Passive venting of the Iron Gate turbine was successfully tested at the Iron Gate powerhouse in the fall of 2008 and PacifiCorp installed a blower system at the Iron Gate powerhouse in January 2010 to enhance the effectiveness of turbine venting. The combined system was tested in 2010 and demonstrated an ability to increase dissolved oxygen levels in the river downstream of Iron Gate Dam. PacifiCorp has been implementing turbine venting on an ongoing basis and developed a turbine venting Standard Operation Procedure (SOP) in early 2013 consistent with the terms of PacifiCorp's incidental take permit for Coho salmon.

7.5 Interim Measure 4: Hatchery and Genetics Management Plan

Beginning in 2009, PacifiCorp shall fund the development and implementation of a Hatchery and Genetics Management Plan (HGMP) for the Iron Gate Hatchery. PacifiCorp, in consultation with the National Marine Fisheries Service and the California Department of Fish and Wildlife, will develop an HGMP for approval by

NMFS in accordance with the applicable criteria and requirements of 50 C.F.R. § 223.203(b)(5). To implement the HGMP, PacifiCorp, in consultation with NMFS and CDFW, will develop and agree to fund an adequate budget. When completed, CDFW shall implement the terms of the HGMP at Iron Gate Hatchery in consultation with PacifiCorp and NMFS. Funding of this measure is in addition to the 100 percent funding described in Non-ICP Interim Measure 18.

PacifiCorp worked collaboratively with NMFS and CDFW to develop the Hatchery and Genetic Management Plan (HGMP) for the Iron Gate Hatchery Coho Salmon Program. The HGMP was submitted by PacifiCorp and CDFW to NMFS on September 16, 2010.

The NMFS publically noticed the HGMP, Section 10 permit application, and environmental review documents in the January 8, 2013 Federal Register (78 FR 1200). This notice solicited public review and comment to NMFS's evaluation of the HGMP. The California Hatchery Scientific Review Group recommended that the Iron Gate HGMP be approved in its April 2012 report. PacifiCorp and CDFW submitted a final HGMP[4] to NMFS in September 2014. In late October 2014, NMFS formally approved the HGMP, issued the final Environmental Assessment and Finding of No Significant Impact, Biological Opinion, and Incidental Take Permit (79 FR 69428).

The HGMP program operates in support of the Klamath River Basin's Coho salmon recovery efforts by conserving a full range of the existing genetic, phenotypic, behavioral and ecological diversity of the Coho salmon run. The program's conservation measures, include genetic analysis, broodstock management, and rearing and release techniques that maximize fitness and reduce straying of hatchery fish to natural spawning areas.

In 2010, in cooperation with CDFW and NMFS, PacifiCorp began funding an active broodstock management program at Iron Gate Hatchery; a program that continues annually. The program is based on real-time genetic analysis of Coho spawning broodstock that provides information necessary to reduce the rate of inbreeding in the hatchery Coho population. Changes were also made to increase the proportion of natural-origin fish in the total hatchery Coho spawning population. These measures are anticipated to increase population diversity and fitness.

Hatchery culture practices under the HGMP program are also being improved to increase egg-to-smolt survival rates by increasing survival during egg incubation and covering raceways with netting to reduce bird predation.

On-going water quality challenges at the Iron Gate hatchery led PacifiCorp and CDFW to pool resources and install a filtration and ultraviolet (UV) light water treatment system capable of handling the entire flow to the hatchery egg-rearing building. This system was installed in fall 2015. The system has been successful at improving water quality to the incubator stacks and has resulted in an improved survival rate in all eggs that receive this cleaner water. Survival from green egg to eyed egg has been over 90 percent while the survival rate from green egg to fry has also increased. In 2016 and 2017 survival from green egg to fry averaged 72 percent. In 2017 survival from green eggs to fry was 80 percent, a substantial improvement over conditions before the filtration system was installed. There continue to be challenges with late-arriving adult Coho. In 2016 egg fertilization was poor in some lots late in the

Water Filtration System at Iron Gate Hatchery

spawning season. In 2017 the adult Coho that arrived in January (about a month later than normal) had very poor success and those that hatched showed high levels of deformities.

Pursuant to the HGMP, in 2016 PacifiCorp began monitoring Klamath River tributaries for the presence of Coho adults and redds during the spawning season in the geographic area of the Upper Klamath Population Unit (Bogus Creek downstream to Portuguese Creek). Spawning surveys have been conducted in 2015-16, 2016-17, and 2017-18 spawning seasons. While this work has documented spawning in several tributaries between Iron Gate and Portuguese Creek, most spawning Coho have been observed in Seiad Creek, Horse Creek, and Bogus Creek. The total population estimate from the spawning surveys has varied from year to year, but averages about 268 fish (Figure 3). The total population estimate for the Upper Klamath population unit averages about 329 fish.

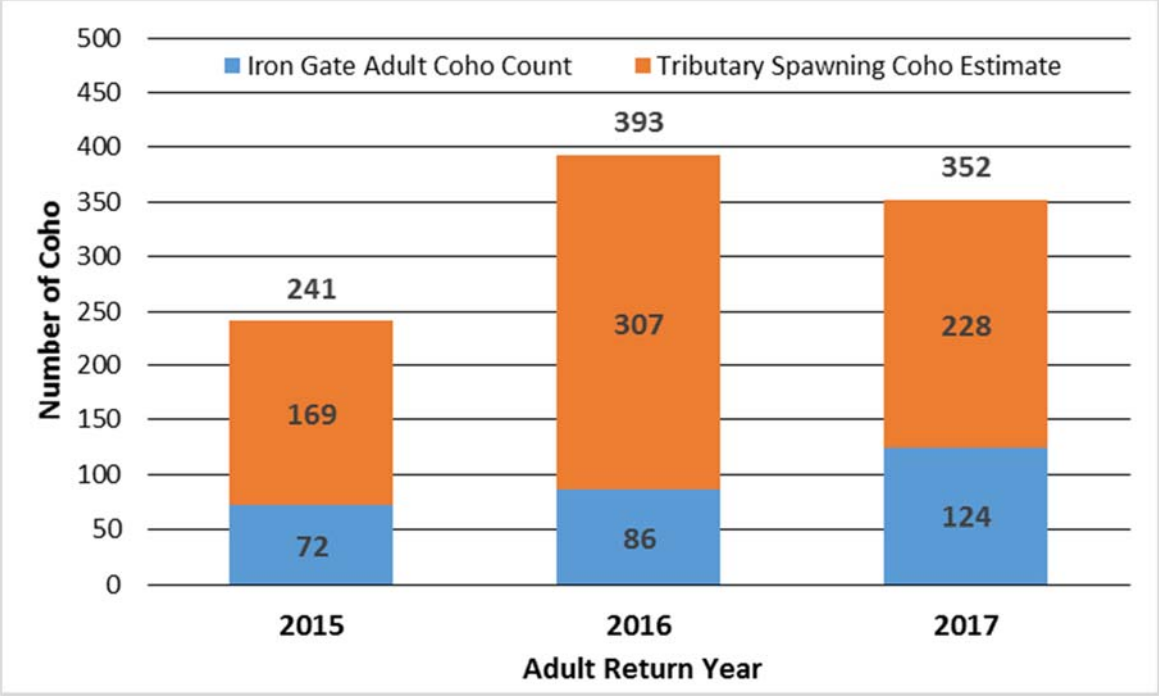


Figure 3. Adult Coho Captured at Iron Gate Dam and Coho Population Estimate Based on Spawning Surveys of Tributaries from Bogus Creek to Portuguese Creek (Does not include the Scott or Shasta rivers)

7.6 Interim Measure 5: Iron Gate Flow Variability

In coordination with NMFS, USFWS, States, and Tribes, PacifiCorp and Reclamation shall annually evaluate the feasibility of enhancing fall and early winter flow variability to benefit salmonids downstream of Iron Gate Dam, subject to both PacifiCorp's and Reclamation's legal and contractual obligations. In the event that fall and early winter flow variability can feasibly be accomplished, PacifiCorp, in coordination with NMFS, USFWS, and Reclamation will, upon a final Incidental Take Permit issued to PacifiCorp by NMFS becoming effective, annually develop fall and early winter flow variability plans and implement those plans. Any such plans shall have no adverse effect on the volume of water that would otherwise be available for the Klamath Reclamation Project or wildlife refuges.

The joint biological opinion on Reclamation's Klamath Project for 2013-2023 includes provisions for more variable flow releases from Iron Gate Dam to provide benefits to listed species. To achieve more "natural" flow variability in releases from Iron Gate Dam, Reclamation schedules variable flows based on the profile of the week-prior hydrograph of the Williamson River. In addition, accretions within PacifiCorp's Project area (downstream of Keno Dam to Iron Gate Dam) are accounted for and generally reflected in flow releases downstream from Iron Gate Dam. PacifiCorp has been working closely with Reclamation to coordinate river operations and dam releases in a manner that achieves Reclamation's flow requirements below Iron Gate Dam while also meeting operational and other regulatory objectives of Reclamation and PacifiCorp.

In summer 2015, in response to a request from NMFS to further evaluate the opportunity to create additional variability in flow releases, PacifiCorp developed and tested a program to automatically adjust releases from the Iron Gate Powerhouse to provide a diurnally variable flow pattern. The goal was to create a program that could automatically follow a daily pattern similar to that seen in an unregulated stream. The flow program increases flows starting in the early morning, reaching a peak at 6 percent above the targeted daily release around mid-day. Flows then gradually ramp down to a minimum value of 3 percent less than the targeted daily release in the early evening. This pattern repeats on a daily cycle without any intervention from PacifiCorp operators. The entire flow pattern is water neutral in the sense that the daily delivered flow volume is consistent with the targeted daily flow which would otherwise remain constant. The NMFS approved implementation of the diurnal flow pattern and PacifiCorp made modifications to its control system to allow the flow controls program to run unassisted beginning in September 2015. Even with a total fluctuation of less than 100 cfs, the effect could be seen as far downstream as the Klamath River near Klamath, CA gage (USGS No. 11530500) about 185 miles downstream of Iron Gate Dam (Figure 5). The diurnal fluctuation program was again implemented in 2016 from about mid-June through mid-December. Because the summer and fall of 2017 were relatively dry with little change in flows, PacifiCorp turned the diurnal program on again in June 2017 and it operated for about a month before variability in target flows provided by Reclamation made the diurnal program unnecessary.

Because of the ongoing drought, flows downstream of Iron Gate Dam in 2015 were near the minimums for most of the year. There were a couple of exceptions in early 2015 when spill at Iron Gate Dam resulted in short-lived pulse flows (Figure 5).

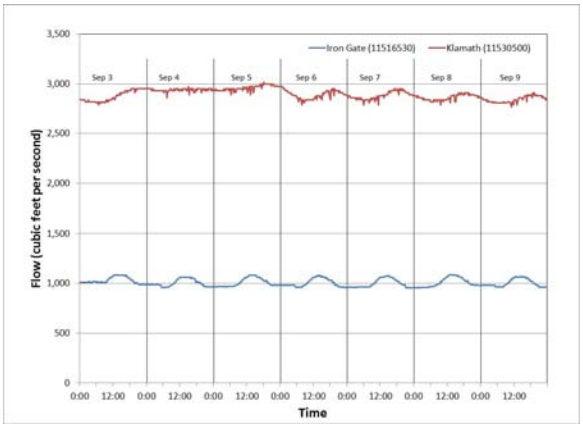


Figure 4. Illustration of Downstream Flow Fluctuation Downstream of Iron Gate Dam and at Klamath Resulting from Implementation of the Diurnal Flow Program (Preliminary 15-minute data USGS Station Nos. 11516530 and 11530500 from September 3-9, 2015)

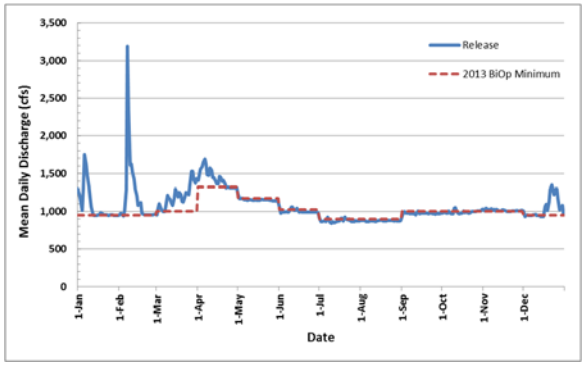


Figure 5. Mean Daily Discharge in 2015 in the Klamath River Downstream of Iron Gate Dam at USGS Station No. 11516530

Drought conditions persisted through 2016. However, there was a somewhat more abundant snow-pack in the Upper Klamath Basin entering the spring months than in previous years. This melted off very rapidly in mid-March and as a result, Upper Klamath Lake surface elevations exceeded the flood control targets which required a large release of water from the lake to prevent local flooding. This generated a peak flow downstream of Iron Gate Dam just over 9,600 cfs on March 16 (Figure 6).

Also of interest in 2016 was a brief pulse event that reached almost 2,000 cfs in mid-August to support Karuk Tribe boat dance ceremonies downstream.

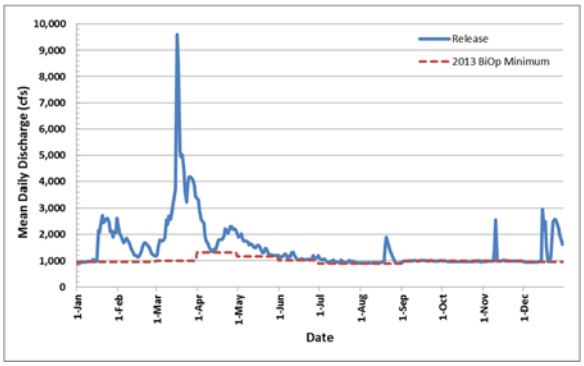


Figure 6. Mean Daily Discharge in 2016 in the Klamath River Downstream of Iron Gate Dam at USGS Station No. 11516530

In late October and early November 2016, concerns were expressed during the Flow Account Scheduling Technical Advisory (FASTA) team calls that Chinook salmon carcasses downstream of Iron Gate Dam could be contributing to the load of *Ceratonova shasta* (a myxozoan parasite that can cause mortality in Chinook and Coho salmon) spores in the river. It was decided to make a short duration, high flow release from Iron Gate Dam in an attempt to move Chinook carcasses either out of the river or wash them further downstream. Following approval of the release plan from NMFS, flows at Iron Gate Dam were rapidly increased on the afternoon of November 9, 2016 from the baseflow of 1,000 cfs to over 3,000 cfs where they remained for about 12 hours before ramping down. Follow-up survey work by the USFWS during Chinook carcass surveys downstream of Iron Gate Dam indicated that while some carcasses moved, almost half of the marked carcasses were within 0.1 kilometer of where they had been marked before the event.

The multi-year drought broke in the fall of 2016 with abundant rain and snowfall in the early winter and into the spring of 2017. Upper Klamath Lake reached Reclamation's wet-year flood control curve in late February 2017. At this point, releases from Upper Klamath Lake were made to maintain the lake elevation on this flood control curve. Because there is minimal storage in J.C. Boyle, Copco, and Iron Gate reservoirs downstream, the entire hydroelectric project operated in spill mode for

most of the spring. Simply put, this meant that water released from Upper Klamath Lake or entering as accretion from points downstream of the lake, simply passed through the hydroelectric reach and spilled into the river downstream of Iron Gate Dam. This is apparent in the flow data from Iron Gate Dam in 2017 (Figure 7).

In response to litigation surrounding Reclamation's Biological Opinion, Reclamation received a court order[8] in February 2017 ordering it to release two types of pulse flow events in the winter and early spring. These pulse releases were intended to provide flows adequate to move gravel in the river downstream of Iron Gate Dam, thereby reducing the abundance of polychaetes which host *Ceratonova shasta*. The first flow target was 11,250 cfs for 24 hours and the second was 6,030 cfs for 72 hours; for both types of events flows were measured at the USGS gage downstream of Iron Gate Dam. In mid-February 2017 Reclamation attempted to reach the 11,250 cfs target because rainfall, snowmelt, and forecasted accretions indicated this release may be feasible. Because of flooding concerns downstream of Iron Gate Dam, this release was cut short and mean daily flows downstream of Iron Gate Dam peaked at 8,280 cfs on February 11 (Figure 7). A second large pulse event was initiated on February 22, 2017 and again peaked short of the 11,250 cfs target with a mean daily flow of 8,600 cfs. Near the end of March 2017, Upper Klamath Lake was operating above Reclamation's specified flood control curve and there was substantial rainfall, and snowmelt. This event resulted in mean daily flows 10,100 cfs at Iron Gate Dam on March 24, 2017, but flows still did not achieve the 11,250 cfs target (Figure 7).

The second type of pulse event required 6,030 cfs for 72 hours. As a result of hydrologic conditions, this target was met on four separate occasions through the spring of 2017. In March 2017, flows downstream of Iron Gate Dam averaged 8,658 cfs for 18 consecutive days (Figure 7).

Because of the abundant rain, snowpack, and rapid filling of Upper Klamath Lake, releases downstream of Iron Gate Dam remained above 2,000 cfs through mid-June 2017.

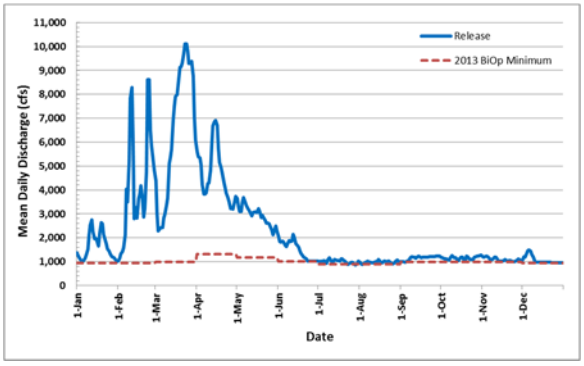


Figure 7. Mean Daily Discharge in 2017 in the Klamath River Downstream of Iron Gate Dam at USGS Station No. 11516530

Early winter of 2018 continued the dry pattern established late in 2017. Flows downstream of Iron Gate Dam remained at or near minimum flows through mid-March 2018 (Figure 8). In March a series of small storms increased inflow to Upper Klamath Lake and resulted in small increases is flows downstream of Iron Gate Dam. On April 6, 2018 Reclamation, after coordinating with Klamath River stakeholders, instructed PacifiCorp to initiate a court-ordered surface flushing flow (6,030 cfs for 72 hours). This event was planned to coincide with an incoming storm system. Flows downstream of Iron Gate Dam ramped up to more than 6,030 cfs and remained there for over 72 hours before ramping back down (Figure 8).

The third type of flow event included in the February 2017 court order is a disease dilution

[8] *Yurok Tribe v. Bureau of Reclamation*, No. 16-cv-6863 and *Hoopa Valley Tribe v Bureau of Reclamation.* No. 16-cv-4294

flow. This event is triggered by either the prevalence of *Ceratonova shasta* infection in salmon of more than 30 percent or detection of more than five *Ceratonova shasta* spores per liter of water in samples collected at any of a variety of locations downstream of Iron Gate Dam. If triggered, flows downstream of Iron Gate Dam are to be increased to 3,000 cfs and maintained there for at least a week. Subsequent increases to 4,000 cfs are possible based on further disease monitoring. The total volume of water required to be available for disease dilution flows under the court order is 50,000 acre-feet. In early May 2018, infection rates in Chinook salmon exceeded the 30 percent trigger and Reclamation requested PacifiCorp increase flows downstream of Iron Gate Dam to 3,000 cfs. This event was initiated on May 8, 2018 and flows generally remained at this level before ramping back down to target flows starting on May 21, 2018 (Figure 8).

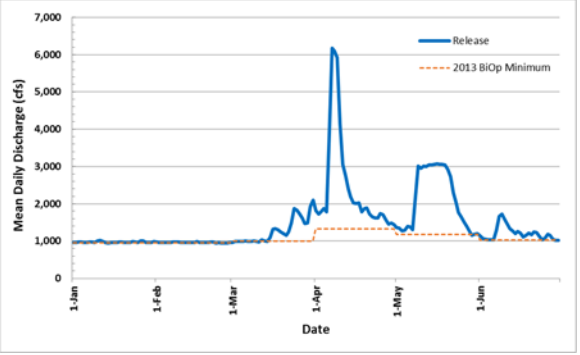


Figure 8. Mean Daily Discharge in from January 1-June 30, 2018 in the Klamath River Downstream of Iron Gate Dam at USGS Station No. 11516530 (Preliminary data after April 11, 2018)

7.7 Interim Measure 6: Fish Disease Relationship and Control Studies

PacifiCorp has established a fund in the amount of $500,000 in total funding to study fish disease relationships downstream of Iron Gate Dam. Research proposals will be solicited and agreed upon by PacifiCorp and NMFS for the purpose of determining that the projects are consistent with the criteria and requirements developed by PacifiCorp and NMFS in the ESA review process applicable under Settlement Section 6.2. PacifiCorp will consult with the Klamath River Fish Health Workgroup regarding selection, prioritization, and implementation of such studies, and such studies shall be consistent with the standards and guidelines contained in the Klamath River Fish Disease Research Plan and any applicable recovery plans.

Humboldt State University, USGS, Oregon State University, the Karuk Tribe, and the Yurok Tribe collaborated on a research proposal to examine how management actions could be focused to reduce the incidence of ceratomyxosis. Specific studies as part of the proposal include:

- Determine combinations of water hydraulics and sediment compositions that produce mortality in polychaetes
- Measure the response of selected polychaete populations in the Klamath River to any experimental control actions over appropriate temporal and spatial scales
- Determine the relative contribution of species-specific genotypes of *Ceratonova shasta* from tributary and mainstem sources and determine seasonal myxospore abundance

Polychaete Tubes on a Bolder in the Klamath River

- Develop mathematical models to improve the understanding of *Ceratonova shasta*

dynamics and provide opportunities for management (e.g., flow manipulations)

PacifiCorp and NMFS have agreed to appropriate money from the Fish Disease Fund to implement these studies. Results from these studies include several technical reports and a published journal article. Fish-disease related work in 2016, 2017, and early 2018 has continued to focus on refinements to the predictive model for polychaete distribution (including testing with data from 2017), polychaete collection and testing for *Ceratonova shast*a, and development of a model for predicting salmon mortality resulting from *Ceratonova shasta*.

7.8 Interim Measure 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement

Beginning on the Effective Date and continuing through decommissioning of the J.C. Boyle Facility, PacifiCorp shall provide funding of $150,000 per year, subject to adjustment for inflation as set forth in Section 6.1.5 of the Settlement, for the planning, permitting, and implementation of gravel placement or habitat enhancement projects, including related monitoring, in the Klamath River above Copco Reservoir.

Within 90 days of the Effective Date, PacifiCorp, in consultation with the IMIC, shall establish and initiate a process for identifying such projects to the Committee, and, upon approval of a project by the Committee, issuing a contract or providing funding to a third party approved by the Committee for implementation of the project.

The objective of this Interim Measure is to place suitable gravels in the J.C. Boyle bypass and peaking reach using a passive approach before high flow periods, or to provide for other habitat enhancement providing equivalent fishery benefits in the Klamath River above Copco Reservoir.

The IMIC and PacifiCorp collaborated on the development of a gravel enhancement and monitoring plan, which serves as the basis for ongoing implementation actions under this interim measure.

Because access to the river to implement this measure occurs on BLM roads, the BLM conducted a NEPA analysis to assess potential impacts from implementation of this interim measure. The BLM issued a Finding of No Significant Impact on October 3, 2011. Since 2011 the NEPA work has been revisited as new sites have been identified.

As of October 2017, about 3,500 cubic yards of gravel has been added to nine sites in the Klamath River below J.C. Boyle Dam (Figure 9).

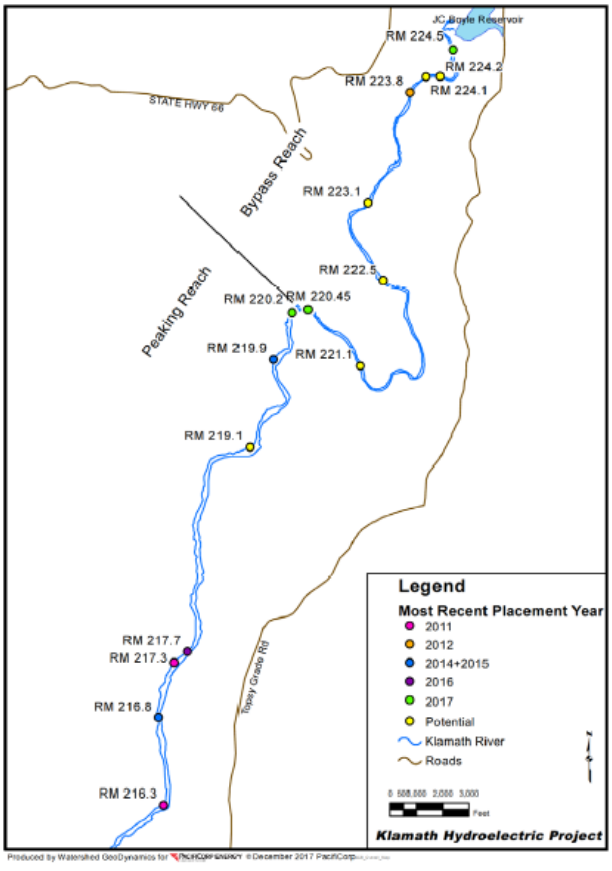


Figure 9. Gravel Placement Locations Downstream of J.C. Boyle Dam from 2011-2017

At some locations in the peaking reach, flows are adequate to move gravel every year following placement. In the bypass reach, this is

not the case. Monitoring in October 2016 indicated that winter flows in 2015/2016 were sufficient to finally move gravel that had been placed in the bypass reach in 2011 (Figure 10).

Figure 10. Gravel Extent at River Mile 216.3 in 2011 (top) and October 2016 (bottom) Illustrating Movement of Material

7.9 Interim Measure 8: J.C. Boyle Bypass Barrier Removal

Within 90 days of the Effective Date, PacifiCorp, in consultation with the Committee, shall commence scoping and planning for the removal of the sidecast rock barrier located approximately 3 miles upstream of the J.C. Boyle Powerhouse in the J.C. Boyle bypass reach. In accordance with a schedule approved by the Committee, PacifiCorp shall obtain any permits required for the project under Applicable Law and implement removal of the barrier. If blasting will be used, PacifiCorp shall coordinate with ODFW to ensure the work occurs during the appropriate in-water work period. The objective of this Interim Measure is to provide for the safe, timely, and effective upstream passage of Chinook and Coho salmon, steelhead trout, Pacific lamprey, and redband trout.

As was reported previously[5], PacifiCorp completed removal of this barrier in 2012 following coordination with the IMIC and BLM. Unimpeded fish passage through the area was created by this effort. The USFWS, NMFS, BLM, and ODFW reviewed the post-project information and agreed that the fish passage concern was resolved.

7.10 Interim Measure 9: J.C. Boyle Powerhouse Gage

Upon the Effective Date, PacifiCorp shall provide the U.S. Geological Survey (USGS) with continued funding for the operation of the existing gage below the J.C. Boyle Powerhouse (USGS Gage No. 11510700). Funding will provide for continued real-time reporting capability for half-hour interval readings of flow and gage height, accessible via the USGS website. PacifiCorp shall continue to provide funding for this gage until the time of decommissioning of the J.C. Boyle Facility.

PacifiCorp is continuing to provide USGS with funding for the operation of the gage downstream of the J.C. Boyle powerhouse (USGS Gage No. 11510700). This gage data is available at: http://waterdata.usgs.gov/usa/nwis/uv?site_no=11510700.

7.11 Interim Measure 10: Water Quality Conference

PacifiCorp shall provide one-time funding of $100,000 to convene a basin-wide technical conference on water quality within one year from the Effective Date of this Settlement. The conference will inform

participants on water quality conditions in the Klamath River basin and will inform decision-making for Interim Measure No. 11, with a focus on nutrient reduction in the basin including constructed wetlands and other treatment technologies and water quality accounting. PacifiCorp, the North Coast Regional Water Quality Control Board, and the Oregon Department of Environmental Quality, will convene a steering committee to develop the agenda and panels.

PacifiCorp, NCRWQCB, and ODEQ formed a steering committee to organize the workshop, which was conducted from September 11-13, 2012 in Sacramento, California. The goal of the workshop was to inform participants on water quality conditions in the Klamath River Basin and engage invited experts and managers to evaluate large-scale nutrient and organic matter reduction technologies for application in the Klamath River Basin. NCRWQCB took the lead on the steering committee and the California Coastal Conservancy matched PacifiCorp's funding to assist with workshop planning and pre- and post-workshop reporting. Over 100 invited participants attended the workshop. A report on the outcomes from the workshop activities is available online at: http://www.stillwatersci.com/case_studies.php?cid=68.

7.12 Interim Measure 11: Interim Water Quality Improvements

The purpose of this measure is to improve water quality in the Klamath River during the Interim Period leading up to dam removal. The emphasis of this measure shall be nutrient reduction projects in the watershed to provide water quality improvements in the mainstem Klamath River, while also addressing water quality, algal and public health issues in Project reservoirs and dissolved oxygen in J.C. Boyle Reservoir. Upon the Effective Date of the Settlement until the date of the DRE's acceptance of the FERC surrender order, PacifiCorp shall spend up to $250,000 per year to be used for studies or pilot projects developed in consultation with the Implementation Committee regarding the following:

- ***Development of a Water Quality Accounting Framework***
- ***Constructed Treatment Wetlands Pilot Evaluation***
- ***Assessment of In-Reservoir Water Quality Control Techniques***
- ***Improvement of J.C. Boyle Reservoir Dissolved Oxygen***

Within 60 days of the DRE's acceptance of the FERC surrender order, PacifiCorp shall develop a priority list of projects in consultation with the Implementation Committee. The priority list will be informed by, among other things, the information gained from the specific studies conducted before the DRE's acceptance of the FERC surrender order and the information generated at the water quality conference specified in Interim Measure 10. Following the DRE's acceptance of the FERC surrender order, PacifiCorp shall provide funding of up to $5.4 million for implementation of projects approved by the Oregon Department of Environmental Quality (ODEQ) and the State and Regional Water Boards, and up to $560,000 per year to cover project operation and maintenance expenses related to those projects, these amounts subject to adjustment for inflation as set forth in Section 6.1.5 of this Settlement. Recognizing the emphasis on nutrient reduction projects in the watershed while also seeking to improve water quality conditions in and downstream of the Project during the Interim Period, the Parties agree that up to 25 percent of the funding in this measure for pre-surrender-order-acceptance studies and post-surrender-order-acceptance studies may be directed towards in-reservoir water quality improvement measures, including but not limited to J.C. Boyle.

Consistent with the intent of this interim measure, studies are being conducted that focus on nutrient reduction in the Klamath River while also addressing water quality issues in Project reservoirs. Annual study plans and draft technical reports generated by the ongoing work are prepared for IMIC review. After review and responding to comments from the IMIC, work plans for water quality studies and technical reports are finalized. The Interim Measure 11 studies that were in progress in mid-2014 and those that have been pursued from 2015 through early 2018 are described below. Citations for each of these follows this section and the reader is referred to the PacifiCorp Klamath Hydroelectric Project webpage for complete reports on these and previously completed work (http://www.pacificorp.com/es/hydro/hl/kr.html#).

7.12.1 Conceptual Feasibility Study of Aeration/Oxygenation Systems at Keno Reservoir[6]

Keno Reservoir extends 20 miles from the headwaters of Lake Ewauna (RM 253.4) to Keno Dam (RM 233.3). The impoundment is generally a broad, shallow body of water. Keno Reservoir experiences severe seasonal water quality impairment. These impairments include summer and fall anoxia in the reservoir and seasonally warm water temperatures. The anoxia is caused primarily by the substantial oxygen demand from the high levels of organic matter loading from Upper Klamath Lake as well as that contributed more locally by agricultural and industrial return flows. Water temperatures contribute to the anoxic conditions and are driven by climatic conditions, long retention times, and the broad, shallow nature of Keno Reservoir. At times, very high concentrations of algae can be found in the reservoir.

One way to address this issue would be to supplement the oxygen levels through the length of Keno Reservoir. To evaluate the feasibility of this approach, PacifiCorp used an existing water quality model for Keno Reservoir and added the ability to 'inject' oxygen at different locations and rates.

The modeling indicated that commercially available systems could deliver oxygen to Keno Reservoir at rates that could substantially enhance dissolved oxygen conditions (Figure 11). The amount of change generated by supplementation depended on the number of locations and amount of oxygen injected. The goals of supplementation (e.g., seasonal fish passage only or dissolved oxygen levels at higher levels or for longer periods of time) also drive the amount of oxygen required to be added to the reservoir. Modeling indicated that a side-stream injection system would likely be necessary to meet water quality objectives in Keno Reservoir although sparging systems may be feasible in the deeper areas of Keno Reservoir.

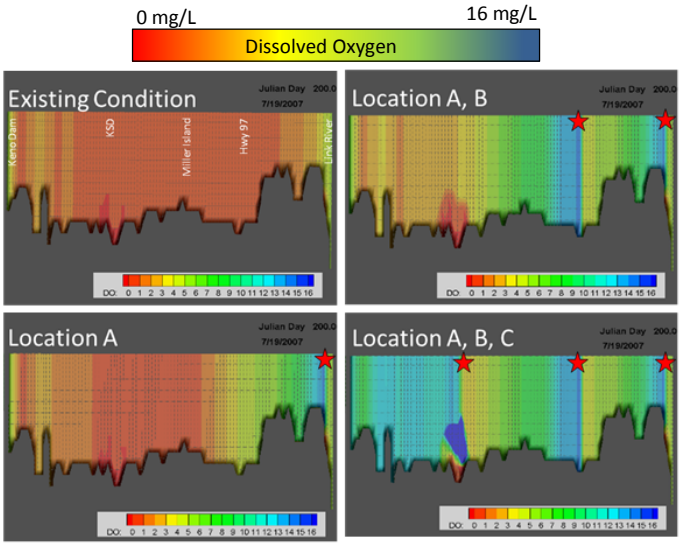


Figure 11. Simulations of Existing Conditions at Midnight on July 19, 2007 (upper left) and Side-stream Oxygenation at Locations A (lower left), A and B (upper right), and A, B, and C (lower right) (Flow is from right to left on all panels).

While supplementation is feasible from an engineering perspective, the study also indicated that it was an expensive undertaking. Side-stream oxygenation could cost $54 to $90 million to install. While operational costs were not specifically developed, similar yet smaller in

scale systems were expected to cost over $3 million per year to operate.

7.12.2 Nutrient Removal Methods[7]

Upper Klamath Lake supplies an abundance of nutrients to the Klamath River. PacifiCorp supported and investigation into potential approaches to reduce this load thereby possibly improving water quality in Upper Klamath Lake, Keno Reservoir, and the Klamath River downstream.

In 2014, a laboratory experiment was conducted to assess potential treatment with chemical agents to reduce phosphorus in selected source waters. Jar tests were conducted to evaluate the effect of coagulation, flocculation, and sediment on nutrients. This work also allowed development of potential dosage levels. Four commercially available products were selected for testing: Lanthanum-modified bentonite clay (Phoslock™), Aluminum-modified zeolite (Aqual P™), Polyaluminum hydroxychloride (PAX-18™), and alum (aluminum sulfate buffered with sodium aluminate). Water samples from Sevenmile Canal (upstream of Agency Lake), Upper Klamath Lake near Link Dam, and Keno Reservoir near Miller Island were collected for use in the tests.

The experiment showed consistent trends of increased phosphorus removal with increasing doses of the four agents. The greatest amount of removal came from PAX-18™ and buffered alum. Water from Upper Klamath Lake had the lowest efficiency of removal, possibly a result of higher algae and particulate matter in this sample. While the PAX-18™ and buffered alum were the most effective, both resulted in dissolved aluminum levels greater than the EPA's recommended water quality criteria which indicated potential toxicity concerns with these products. Use of Phoslock™ in the Sevenmile Canal water sample produced lanthanum levels at levels potentially toxic to rainbow trout eggs.

Overall, chemical methods were shown to reduce nutrient loading in the laboratory, but there would need to be further evaluation to address the toxicity concerns and determine the feasibility before implementing such a method on a larger scale.

7.12.3 Assessment of Potential Algae Harvesting and Removal Techniques at Link River Dam[8]

While chemical control of nutrients may be technically feasible, the toxicity concerns led PacifiCorp and the IMIC to other avenues of investigation that might achieve similar results. One of these methods would be to physically remove algae from the water as it passes by Link River Dam. Systems necessary to accomplish this would typically involve some sort of screen that would separate the water from the algae. The water would be returned to the river while the algae would be pumped to a truck for transport to a disposal facility. For this particular effort, PacifiCorp convened a technical advisory team to review a variety of questions that addressed overall feasibility; drivers of scope, size, and type of system; and process-related steps.

In general, no fatal flaws were found in the initial review of the technology and in discussion with experts. Areas of uncertainty included disposal of harvested material, toxin degradation from harvested biomass, and, depending on the outcome of the toxin question, possible commercial applications. Ultimately the IMIC agreed that it was worth pursuing physical removal of algae with a demonstration project.

7.12.4 Link River Algae Removal Demonstration Project[9]

Because the previous work indicated that it was likely feasible to build an algae removal system, PacifiCorp and the IMIC decided pursue a demonstration project. The overall project was broken down into four phases from conceptual project description and assessment of permitting/regulatory approvals in Phase 1,

design and cost estimates in Phase 2, getting regulatory approvals and constructing the project in Phase 3, and operations of the facility and algae disposal studies in Phase 4. In Phase 1, a conceptual description of the facility along with an operational plan was developed (Figure 12).

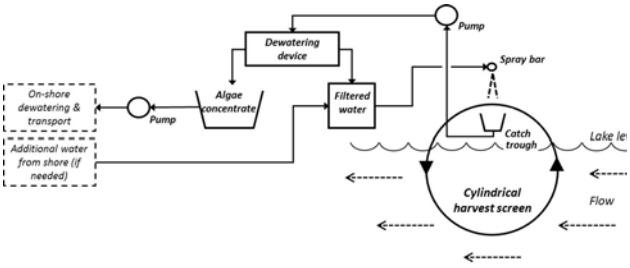


Figure 12. Conceptual Schematic of Proposed Link River Algae Removal Demonstration Project Facilities Set-up

Using this conceptual design, detailed conversations with regulatory agencies occurred to clarify the permitting requirements and approval process. While it was likely that the pilot project would not require permits from some agencies (e.g., Oregon Department of State Lands) there were serious obstacles to overcome to obtain permits from other agencies. The main challenge was the protections required to be provided for federally endangered Lost River and shortnose suckers in Upper Klamath Lake as required by the Endangered Species Act. Because the algae removal project would screen water from the lake and suckers are present in the lake, the pilot project would need to obtain clearance for incidental take of these species under the Endangered Species Act. There were discussions about scaling the project down, changing the operational window, finding a federal lead agency to streamline the consultation process, and a host of other possible modifications designed to ease the Endangered Species Act consultation process and in turn allow the Demonstration Project to continue. The outcome of all of these discussions was that if the Demonstration Project had to be placed in the lake, then the Endangered Species Act-compliance was required and remained a major challenge.

Ultimately, the IMIC determined that committing the time and funding to prepare a Habitat Conservation Plan and obtain a Section 10 incidental take permit for the Demonstration Project did not appear to be a reasonable use of Interim Measure 11 funds. Because of the uncertainty surrounding Endangered Species Act issues, difficulty obtaining necessary approvals, and the overall expense of the Demonstration Project, the IMIC ultimately decided that it was not worth proceeding with the Demonstration Project.

7.12.5 Study of Algal Conditions Management within a Reservoir Cove Using Physical Measure[10]

Cyanobacteria (also commonly known as blue-green algae) are seasonally-dominating components of the phytoplankton community in the Klamath Basin. Cyanobacteria are a potential nuisance because some species produce substances toxic to humans, pets, livestock, and other organisms. While there are an abundance of algae species in Iron Gate and Copco reservoirs, the primary species of concern for this study was *Microcystis aeruginosa* (*Microcystis*). *Microcystis* was the focus because of its potential to produce microcystin. Microcystin is a liver toxin that can have adverse health effects at higher concentrations.

PacifiCorp evaluated the ability of physical mixing to reduce algae growth within Mirror Cove in Iron Gate Reservoir. Physical techniques could mix the water column or accelerate flow exchange and thereby disrupt favorable conditions for cyanobacterial growth. Using a water quality model and site-specific information for Mirror Cove in the Camp Creek arm of Iron Gate Reservoir, a variety of mixing techniques and the presence of a barrier curtain across the cove mouth could be evaluated. The curtain was necessary to increase effectiveness of mixing within the cove and restrict the stabilizing thermal effect of Iron Gate Reservoir on the cove. Ultimately, the most effective combination of methods for mixing this cove was shown by the model to be a barrier curtain,

aeration, and pumping which when combined would result in a mixed cove, reduced residence time, and suppression of the cyanobacterial growth.

7.12.6 Planning and Design for a Demonstration Wetlands Facility Adjacent to the Klamath River[11]

PacifiCorp proposed a demonstration wetlands facility (DWF) adjacent to the upper Klamath River to provide an important opportunity for interested stakeholders and researchers to investigate the site-specific requirements, effectiveness, feasibility, and costs of wetland technologies in the Upper Klamath Basin. This information would be valuable for future planning, design, and ultimate implementation of wetland technologies to improve water quality in the Upper Klamath Basin.

Based on IMIC recommendations, PacifiCorp formed a Technical Advisory Committee (TAC) comprised of local and regional water quality experts from state, federal, tribal, and private organizations to move forward with DWF planning during 2013-2014. The TAC was engaged in the process to discuss DWF aspects and concepts.

Working with the TAC, PacifiCorp developed an experimental design for the DWF that included such elements as different water depths, vegetation patterns, water retention times, hydraulic loading rates, and levels of groundwater interaction. The goal was to have a system that would allow specific experimental manipulation of DWF features to allow accurate evaluation of different design elements on nutrient removal. The result of this effort was the design of a DWF with 10 wetland cells of different sizes, depths, and liners occupying about 8 acres of land. Five sites in the Upper Klamath Basin were evaluated as possible locations where a DWF could be constructed, operated, and monitored. Other elements completed by PacifiCorp in collaboration with the TAC and the IMIC during this effort include development of construction cost estimates for the DWF of $2.275 million, an experimental design, and a sample collection and data analysis plan.

7.12.7 2014 Localized Treatment of Long Gulch Cove in Iron Gate Reservoir using Hydrogen Peroxide Based Algaecide[12]

Investigations into the effectiveness of algaecide in reducing algae concentrations in isolated coves of Copco and Iron Gate reservoirs were conducted in 2012 and 2013. This work led to specific recommendations for further investigations that were in turn conducted in 2014 in Long Gulch Cove in Iron Gate Reservoir. Test applications of GreenClean Liquid were made in the summer and fall of 2014 and a comprehensive water quality monitoring program was put into motion to track the changes in water quality. The study was complicated by what appeared to be an algae bloom between the third and fourth treatments; however, the algaecide likely inhibited growth and reduced the overall magnitude of this bloom and the fourth treatment reduced algae standing crop in the test area. Overall, reductions in algae species and chlorophyll-*a* were consistent with findings from previous years.

Long Gulch Cove Algal Management Study Area

7.12.8 Research on *Microcystis* Genotypes in the Klamath River System[13]

Microcystis is well known for forming major blooms in lakes and reservoirs, but it is not commonly observed in flowing rivers. The 190 mile-long segment of the Klamath River

downstream of Iron Gate Dam is one river system that has experienced high numbers of *Microcystis* cells and elevated microcystin toxin concentrations for a number of years. PacifiCorp provided funding to Oregon State University to use a genetic approach to test whether *Microcystis* in the Klamath River downstream of Iron Gate Dam was derived from upstream reservoirs or local populations endemic to the river. Samples were collected from 15 sites between Upper Klamath Lake and the estuary during the 2012 algae season. The study approach was to track any changes in *Microcystis* genotypes over time and to determine whether there were coincident changes in the *Microcystis* populations at various locations. Corresponding changes would represent linked populations, while independent, endemic populations would not be expected to show the same population composition or switches. The *Microcystis* populations at almost all sites sampled during 2012 showed a predominance of one genetic variant. This is in contrast to 2007, when a succession of at least four different genotypes was observed. A genetic marker[9] was used to assess the connectivity between populations. Because the shifts in this marker were observed coincidentally in Iron Gate Reservoir and sites downstream, the data indicated that the *Microcystis* population types in the Klamath River downstream of Iron Gate Dam in 2012 were mostly similar to those population types observed in the outflow of the reservoir.

Further genetic work was completed using this dataset (see Section 7.12.9). However, the initial analysis indicated that during 2012, *Microcystis* cells were associated with high levels of microcystin toxin, both in the reservoirs and in the Klamath River downstream of Iron Gate Dam. The stability of toxigenic *Microcystis* cells in a flowing river and the delivery of microcystin toxin to remote sites represents a potential public and environmental health risk.

7.12.9 Multi-year Analysis of *Microcystis* Population Structure and Toxigenicity in Copco and Iron Gate Reservoirs[14]

Based on the results of the previous work (Section 7.12.8), PacifiCorp continued to fund genetic analysis of *Microcystis* populations in Copco and Iron Gate reservoirs with a goal of better understanding population dynamics, relative toxin-producing capability, and environmental factors possibly influencing algae growth. Working with Oregon State University, an analysis of the *Microcystis* population structure in Copco and Iron Gate reservoirs over a 9-year period (2007-2015) was conducted. Changes in *Microcystis* population structure were inferred from time-series assessments of specific phycocyanin gene sequences and the grouping of these sequences into distinct operational taxonomic units (OTUs); OTUs can be thought of as strains or subspecies. In Copco and Iron Gate reservoirs, the 9 years of data indicated that one strain of *Microcystis*, a microcystin producer, tended to be the dominant strain during most years. However, there were periods when this strain was replaced by other strains believed to not produce toxins. Genetic sequencing indicated that four or five different allelotypes (clustered into OTUs) comprised the Klamath River *Microcystis* population.

This study included genetic analysis of the *Microcystis* population from samples collected in Upper Klamath Lake. While there are only samples available for three years, the strains of *Microcystis* found in Copco and Iron Gate reservoirs in those years were also found in Upper Klamath Lake. While the previous genetic work (Section 7.12.8) indicated that *Microcystis* in Copco and Iron Gate reservoirs was genetically similar to that found downstream,

[9] This was a non-synonymous single nucleotide polymorphism (SNP)

this effort extended that evaluation upstream and found that the *Microcystis* in Upper Klamath Lake was genetically similar to the strain found in the reservoirs and the Klamath River downstream of Iron Gate Dam.

A combination of analytical methods were applied to the data in an effort to determine if changes in *Microcystis* population structure (i.e., strain composition) coincided with specific environmental conditions. Environmental variables evaluated included flow, dissolved organic carbon, orthophosphate, nitrate, alkalinity, and particulate matter (PM2.5 was used as a surrogate for wildfire smoke). The water quality variables varied from year-to-year, but not in a way that explained changes in the *Microcystis* strains present. There was some indication that a shift in the light intensity towards the red end of the spectrum as a result of wildfire smoke could explain some of the strain turnover events, but the specific mechanism remains unclear.

7.12.10 Evaluation of Intake Barrier Systems for Water Quality Improvement from Iron Gate Powerhouse Releases[15]

One strategy for improving water quality in the Klamath River downstream of Iron Gate Dam involves reducing the amount of cyanobacteria transported to the river from Iron Gate Reservoir. Seasonal cyanobacteria blooms in Iron Gate Reservoir typically occur in near-surface waters of the photic zone where light and nutrients are available. The penstock intake for Iron Gate Powerhouse is open from the surface to the reservoir bottom at about 35 feet. Thus, the intake tower entrains water from the full depth of the water column at the location of the intake. Withdrawal of water from the photic zone can result in releases of cyanobacteria to the Klamath River downstream.

PacifiCorp has been investigating ways to isolate the surface waters of Iron Gate Reservoir since installing the first curtain on the log boom in 2009[16]. This was followed by testing a cover that was installed over the upper portion of the intake structure in 2011[17]. In 2014, a curtain was temporarily installed in the current location for a short period of time as a proof of concept exercise. In 2015 the existing curtain was installed.

The purpose of the curtain is to improve the quality of near-surface waters in the reservoir downstream of the curtain because this is the water that is subsequently released into the Klamath River downstream of Iron Gate Dam. Segregation is accomplished by utilizing the density differences associated with seasonal temperature stratification in the reservoir. These density differences create an opportunity to use an intake barrier curtain to isolate warmer, less dense near-surface waters that contain most of the cyanobacteria, while withdrawing cooler, denser, and deeper waters from the reservoir for release to the Klamath River downstream. Since 2015, studies have shown that the curtain reduces the release of near-surface waters with higher levels of cyanobacteria.

In 2015 the curtain was gradually deployed throughout the summer. Water quality monitoring upstream and downstream of the curtain and in the river downstream of Iron Gate Dam indicated that the presence of the curtain resulted in the withdrawal of deeper waters from Iron Gate Reservoir. Data from Acoustic Doppler Current Profiler (ADCP) velocity measurements upstream of the curtain indicated that shallow, near-surface waters had little or no velocity, while deeper waters near the bottom of the curtain had notable velocities towards the intake. Multiple transects upstream of the curtain indicated largely quiescent shallow waters and a well-defined zone of horizontal flow at the bottom of and below the curtain. Water quality samples, physical measurements, and field observations of conditions in the project area consistently identified that waters of the photic zone, where the majority of cyanobacteria occur, were largely isolated to the upstream side of the curtain. Waters that ultimately passed under the curtain were drawn from deeper, cooler

depths in Iron Gate Reservoir upstream of the curtain (Figure 13). The 2015 study indicated that the curtain was effective at isolating near-surface waters of Iron Gate Reservoir upstream of the curtain.

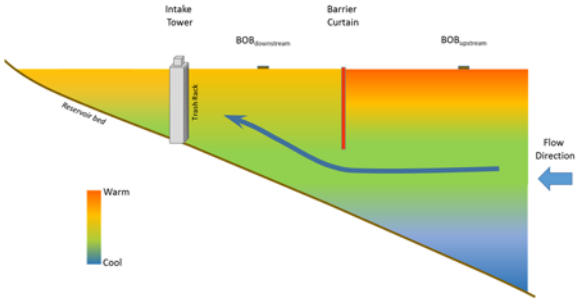


Figure 13. Conceptual Profile View of Thermal Conditions in Iron Gate Reservoir Showing the Location of the Basic Observation Buoys, Curtain, and Intake Tower

The effectiveness of a curtain is dependent on the presence of stratified conditions in the reservoir that allow a curtain to isolate warmer, less dense surface waters. Hence, the 2016 assessment of curtain effectiveness began by characterizing the physical attributes of stratification, mixing, and the localized flow changes caused from deploying a barrier curtain in Iron Gate Reservoir. Wedderburn and Richardson numbers were used to assess the strength of stratification and the effects of wind mixing and increased local velocities associated with curtain placement (e.g., higher velocities under the curtain than would occur without the curtain).

The 2016 field studies were designed and conducted to assess a set of hypotheses regarding the efficacy of the curtain in reducing cyanobacteria downstream. Specifically:

- The curtain isolates warm surface waters upstream of the curtain and minimizes mixing with cooler deeper waters, effectively segregating shallower and deeper waters.
- Shallow and deep water downstream of the curtain are similar to deep-water conditions upstream of the curtain because of withdrawal from beneath the curtain and mixing downstream of the curtain in the relatively shallow region immediately upstream of the intake tower.
- Conditions downstream of Iron Gate Dam are similar to those downstream of the curtain, with the exception of dissolved oxygen, which increases as waters are reaerated through the Iron Gate Powerhouse.

Overall, the 2016 field studies supported these hypothesis and indicated that the curtain was an effective water quality management tool that isolates near-surface waters in Iron Gate Reservoir and reduces the entrainment in the intake and subsequent release downstream into the Klamath River of elevated cyanobacteria concentrations in the near-surface waters of the reservoir. As a secondary benefit, the curtain also functions as a simple selective withdrawal device that isolates warmer surface waters and preferentially draws deeper cooler waters for release to the Klamath River. This selective withdrawal ability can allow for some manipulation of temperatures in released water, which may be beneficial for managing fish disease because disease levels can be exacerbated by higher water temperatures.

Drawing on conclusions from 2015 and 2016 studies, work in 2017 focused on refining curtain deployment depth and timing while using more remote monitoring and less-intensive on-site sampling. *Microcystis* bloomed intensely in Iron Gate Reservoir in 2017. High bloom levels coupled with very calm and warm climatic conditions maximized the stability of the shallow near-surface waters and limited mixing. Under these conditions the curtain was extremely effective at segregating surface waters. However, the limited mixing also resulted in dissolved oxygen levels well above saturation in surface waters and low levels just a few feet deep in the water column on either side of the curtain. Because the curtain resulted in the selective release of water from over 25 feet deep, the water column downstream of the curtain was relatively low in dissolved oxygen.

Iron Gate Reservoir on July 26, 2017 Showing Algae Upstream of Curtain and Clearer Water Downstream

While powerhouse releases were reaerated with turbine venting which improved dissolved oxygen concentrations downstream, PacifiCorp raised the curtain several times after it was initially deployed in an effort to access water with higher levels of dissolved oxygen. Ultimately the curtain was completely rolled up – minimizing the water quality benefits from a cyanobacteria perspective, but maximizing dissolved oxygen concentrations necessary to support aquatic life and comply with water quality standards. Analysis of the data collected in 2017 is underway and 2018 data is being collected.

7.12.11 Klamath Tracking and Accounting Program

Through 2011 PacifiCorp worked in cooperation with NCRWQCB, ODEQ, and United States Environmental Protection Agency (USEPA) Regions 9 and 10 and other interested parties to develop the Klamath Tracking and Accounting Program (KTAP). The KTAP provided a structure through which water quality improvements could be tracked and investments in water quality improvements could be identified to maximize the benefits of those investments. A Protocol Handbook was completed in 2012. PacifiCorp participated in the April 2011 KTAP training and contracted with The Freshwater Trust on a nutrient reduction pilot project in the Klamath River Basin. The Freshwater Trust evaluated the protocols developed by KTAP that account for and track the water quality benefits derived from restoration projects.

The goal of the pilot project was to reduce phosphorus loads through livestock exclusion and use the KTAP protocols and analytical tools to track and account for the resulting phosphorus reductions. The Freshwater Trust installed a half-mile of livestock exclusion fencing and off-channel watering features along the Sprague River at river mile 43.5. The pilot project successfully demonstrated the processes associated with generating, verifying, certifying, and registering a nutrient credit in the Klamath Basin using KTAP. Through implementation of the pilot project, The Freshwater Trust made several recommendations to strengthen the process.

Sprague River Exclusion Fencing

Regardless of the success of the pilot project, there was little long-term support for the relatively complicated process of certifying a project to receive the credits. However, there was also the desire to track water quality projects on a more qualitative scale. This led to the development of a more streamlined and user-friendly version of KTAP. The original protocols remain available and are referred to as the Advanced Project Reporting Protocols.

The streamlined version of KTAP is part of a larger watershed approach designed to track restoration and water quality work going on throughout the basin. A standardized stewardship reporting protocol was developed to solicit information. All the collected

information is available on the KTAP website (http://ktap.willamettepartnership.org/). The project database includes projects as far back as 2011 and as recent as 2016. While KTAP has been designed to accept projects from anywhere in the watershed, the focus to date has been mostly in the Mid and Upper Klamath watersheds. In late 2017, the IMIC decided that the KTAP program was not returning the basin stakeholder input and interest that was necessary to make it a viable and valuable tool to track restoration and water quality improvement projects in the basin. As a result, with the cessation of funding, KTAP was archived until such a time where there was sufficient interest in the basin to support it.

7.12.12 Development, Monitoring, Identification, and Prioritization of Wood River and Sprague River Diffuse Source Treatment Wetland Sites

One way to reduce input of nutrients into Upper Klamath Lake is to treat water in some fashion before it enters the lake. One of the treatment methods being investigated is diffuse source treatment wetlands (DSTWs). These are small wetlands that are constructed in specific locations where they can capture runoff, increase transit time, and where vegetation can take up nutrients from the water before that water enters channels and ultimately Upper Klamath Lake. PacifiCorp is providing funding to support the design, implementation, and detailed evaluation of DSTWs being constructed in the Wood River Basin. To date, site selection has been made, DSTWs have been designed, and pre-implementation monitoring is underway.

7.12.13 Conceptual Design Evaluation for Full-scale Particulate Organic Matter Removal from Klamath River Source Water using Stormwater Treatment Technology[18]

This study was the continuation of investigations and field tests conducted in 2011, 2012, and 2013. Previous work indicated that use of physical separation technology could remove organic matter from the water in Upper Klamath Lake. The data collected from these previous efforts was used to inform the conceptual design for a full-scale organic matter separation system.

Organic Matter Separation Test Unit at A-Canal Fish Screen

Four different conceptual options were developed. All of these were basically the same size, but placed in different locations using either already screened water from downstream of the A-canal fish screen, or water from downstream of a new screen installed in the Eastside Powerhouse intake. A considerable issue for this approach to water treatment is how to deal with the waste water product that is generated from the treatment. Costs for any of the four alternatives vary substantially depending on the volume of water processed and therefore waste water generated; most of the cost differences were driven by fish screens, fish-friendly pumps, water pumps, and electricity costs. Option 2 located in the Eastside forebay without a fish screen was the most cost effective, largely because there was no fish screen included. Even so, it was

predicted that this option would cost between $5,500 and $7,000 per ton of carbon removed. Option 4 (in the Eastside forebay with no pumping) was the second-most cost effective option (ranging from $7,400 to $12,000 per ton of carbon removed) and likely more realistic because fish screening would be required. Removal of phosphorus and nitrogen was substantially more expensive per ton than removal of carbon. Depending on alternative, phosphorus was predicted to cost between $262,500 and $912,100 per ton and nitrogen varied between $26,600 and $92,400 per ton.

The final step in this effort was to connect the different removal rates to an existing water quality model. This work suggested that particulate organic matter removal, while being effective and having a direct impact on downstream water quality conditions, would not completely resolve water quality impairment in Keno Reservoir.

7.12.14 Upper Klamath Basin Watershed Action Plan

Led by the Klamath Tribes, a collaborative group of agencies and land managers in the Upper Klamath Basin began preparation of a comprehensive Upper Klamath Basin Watershed Action Plan (Action Plan). Support for this work is being provided in part by PacifiCorp in 2017 and 2018 and by grant funds from Reclamation. When the draft is completed in late 2018, the Action Plan will provide a suite of site-specific targeted actions that, when implemented, will improve water quality in the Upper Klamath Basin. The Action Plan dovetails very well with the Priority List of Projects (Section 7.12.15). Because of this connection with the Priority List of Projects, in 2017 and 2018, the IMIC suggested that PacifiCorp provide Interim Measure 11 funds to help support this work.

7.12.15 Development of a Priority List of Projects[19]

The previous discussions in Section 7.12 all referred to studies that were focused on water quality improvement and conducted in the interim period between authorization of the KHSA and dam decommissioning; these are studies conducted as discussed in the first part of Interim Measure 11. The second part of Interim Measure 11 refers to development of a Priority List of Projects (PLP) that could be implemented following the KRRC's acceptance of a FERC surrender order.

In the fall of 2016, the SWRCB suggested that the IMIC begin working on developing a PLP and not wait for the KRRC to accept the surrender order or even for FERC to issue the surrender order. This was a reasonable request in part because it allowed a practical and structured approach to developing the PLP. Working with a sub-group of the IMIC, PacifiCorp began this process by reviewing all the various studies and water quality-related investigations conducted under Interim Measures 10 and 11 since the KHSA was signed in 2010. This resulted in a long list of possible projects that could generate water quality improvements if implemented. The IMIC subgroup ranked these projects using specific objectives relating to performance and operability to differentiate between project categories. The outcome of this ranking was a clear division between the top five project categories which were well above all other project categories. These included (in no particular order) DSTWs, Natural Wetlands Restoration, Riparian Fencing and Grazing Management, Irrigation Efficiency and Water Management, and Algae Biomass Removal at Link River Dam. The term 'project categories' was defined to mean a category of project type that if implemented would result in water quality improvement. This term was necessary because specific on-the-ground project locations were beyond the scope of investigation and would be determined in the future. As was discussed previously (Section 7.12.4) the Algae Biomass Removal at Link River Dam project was not carried forward because of Endangered Species Act permitting issues and was therefore removed from the PLP. This list of four project categories completed the first phase of the PLP work.

In the second phase, PacifiCorp continued to work with the IMIC subgroup to refine the list of project categories, allocated funding to the selected list, and develop a conceptual governance structure for implementation of the PLP. To refine the list of project categories, PacifiCorp collected as much detailed information about nutrient removal rates, geographic scope, capital and operations and maintenance costs, and existing and related programs as was readily available. Using this information, the IMIC subgroup decided to simply keep the four project categories previously identified because they could work synergistically in a watershed context to have cumulatively considerable beneficial effects on water quality. PacifiCorp completed documentation of the second phase of the PLP and refined the conceptual governance structure. The KHSA requires approval of the final PLP by SWRCB, NCRWQCB, and ODEQ. These agencies have indicated their support for the project categories but have also said that they cannot approve the final PLP until the governance structure and selection criteria are more well defined. Because of this, work on the third phase of the PLP is underway and should be completed late in 2018 or early 2019.

7.13 Interim Measure 12: J.C. Boyle Bypass Reach and Spencer Creek Gaging

PacifiCorp shall install and operate stream gages at the J.C. Boyle Bypass Reach and at Spencer Creek. The J.C. Boyle Bypass Reach gaging station will be located below the dam and fish ladder and fish bypass outflow, but above the springs in order to record flow releases from J.C. Boyle Dam. The Spencer Creek gage will utilize an existing Oregon Water Resources Department gaging location. It is assumed that the required measurement accuracy will be provided using stage gaging at existing channel cross-sections with no need for constructed weirs. The installed stream gages shall provide for real-time reporting capability for half-hour interval readings of flow and gage height, accessible via an agreed-upon website, until such time as it is accessible on the USGS website. The Spencer Creek gage shall be installed in time to provide flow indication for Iron Gate Flow Variability (ICP Interim Measure 5). Both gages shall be installed and functional prior to September 1, 2010. Installation of the bypass gage, and measurement and maintenance shall conform to USGS standards. The Spencer Creek gage will be maintained according to USGS standards, as applicable.

PacifiCorp completed installation of the J.C. Boyle bypass reach gage in 2011 and the gage is functional and logging data. Gaging data for the J.C. Boyle bypass reach gage is available at:

http://www.pacificorp.com/es/hydro/hl/wr/kr/jbbf.html

Gaging data for the Spencer Creek gage is available at the following website:

http://apps.wrd.state.or.us/apps/sw/hydro_near_real_time/display_hydro_graph.aspx?station_nbr=11510000

7.14 Interim Measure 13: Flow Releases and Ramp Rates

PacifiCorp will maintain current operations including instream flow releases of 100 cubic feet per second (cfs) from J.C. Boyle Dam to the J.C. Boyle bypass reach and a 9-inch per hour ramp rate below the J.C. Boyle powerhouse prior to transfer of the J.C. Boyle facility.

Provided that if anadromous fish have volitional passage to the J.C. Boyle bypass reach after removal or partial removal of the lower dams and before J.C. Boyle is transferred, PacifiCorp will operate J.C. Boyle as a run of river facility with a targeted ramp rate not to exceed 2 inches per hour, and flows will be provided in the J.C. Boyle bypass reach to provide for the appropriate habitat needs of the

anadromous fish species. The operation will also avoid and minimize take of any listed species present. Daily flows through the J.C. Boyle powerhouse will be informed by reservoir inflow gages below Keno Dam and at Spencer Creek. Provided further that if anadromous fish have volitional passage upstream of Iron Gate Dam before the Copco Facilities are transferred, PacifiCorp will operate the remaining Copco Facility that is furthest downstream as a run of the river facility with a targeted ramp rate not to exceed 2 inches per hour and coordinate with NMFS and FWS to determine if any other flow measures are necessary to avoid or minimize take of any listed species present. In either event, flows in the respective bypass reaches will be based on species-specific habitat needs identified by the IMIC.

The Parties agree that if dam removal occurs in a staged manner, J.C. Boyle is intended to be the last dam decommissioned. If, however, the FERC surrender order or Definite Plan directs a different sequence for Decommissioning and Facilities Removal, then the Parties shall Meet and Confer to identify adjustments necessary to implement Facilities Removal in a manner that is consistent with PacifiCorp's Economic Analysis.

PacifiCorp is maintaining flow releases and ramp rates consistent with the existing FERC license and the requirements of applicable biological opinions as contemplated by this interim measure.

7.15 Interim Measure 14: 3,000 cfs Power Generation

Upon approval by OWRD in accordance with Exhibit 1, PacifiCorp may divert a maximum of 3,000 cfs from the Klamath River at J.C. Boyle Dam for purposes of power generation at the J.C. Boyle Facility prior to decommissioning of the facility. Such diversions shall not reduce the minimum flow releases from J.C. Boyle Dam required of PacifiCorp under Interim Measure 13. The implementation of this interim measure shall not: reduce or adversely affect the rights or claims of the Klamath Tribes or the Bureau of Indian Affairs for instream flows; affect the operation of Link River Dam or Keno Dam or any facility of the Klamath Reclamation Project; or otherwise adversely affect lake levels at Upper Klamath Lake, flows in Link River, or Keno Reservoir elevations.

As contemplated by this interim measure and pursuant to the Water Rights Agreement between PacifiCorp and the State of Oregon contained in Exhibit 1 of the KHSA, OWRD issued a limited license to PacifiCorp on April 20, 2010, authorizing diversions to the J.C. Boyle powerhouse of up to 3,000 cfs. This limited license continues to be renewed annually.

7.16 Interim Measure 15: Water Quality Monitoring

PacifiCorp shall fund long-term baseline water quality monitoring to support dam removal, nutrient removal, and permitting studies, and also will fund blue-green algae (BGA) and BGA toxin monitoring as necessary to protect public health. Funding of $500,000 shall be provided per year. The funding shall be made available beginning on April 1, 2010 and annually on April 1 until the time the dams are removed. Annual coordination and planning of the monitoring program with stakeholders will be performed through the Klamath Basin Water Quality Group or an entity or entities agreed upon by the Parties and in coordination with the appropriate water quality agencies. The Regional Board and ODEQ will take responsibility for ensuring that the planning documents will be completed by April 1 of each year. Monitoring will be performed by the Parties within their areas of regulatory compliance or Tribal responsibility or, alternatively, by an entity or entities

agreed upon by the Parties. Monitoring activities will be coordinated with appropriate water quality agencies and shall be conducted in an open and transparent manner, allowing for participation, as desired, among the Parties and water quality agencies.

Significant disputes that may arise between the Parties, or with the Regional Board, regarding the monitoring plan content or funding will be resolved by the Implementation Committee, acting on input and advice, as necessary, from the water quality agencies. Notwithstanding the forgoing, the Oregon Department of Environmental Quality and the California State Water Resources Control Board shall make final decisions regarding spending of up to $50,000 dedicated to BGA and BGA toxin monitoring as necessary to protect public health.

PacifiCorp is now in the tenth year (2018) of funding baseline water quality monitoring consistent with this interim measure, which was begun under the AIP in 2009. Annual planning, coordination, and monitoring for Interim Measure 15 is done collaboratively with PacifiCorp, ODEQ, NCRWQCB, USEPA Region 9, Karuk Tribe, Yurok Tribe, and Reclamation. The baseline monitoring program occurs over approximately 254 miles of river and reservoirs waters from Link River dam near Klamath Falls, OR to the Klamath River estuary near Klamath, CA. Parameters measured include basic water quality (temperature, dissolved oxygen, pH, and conductivity) along with a suite of nutrients.

The public health monitoring component is intended to provide timely information that can be used to inform public health agencies if cyanobacteria are present and generating toxins of concern. Public health agencies use this information to determine the need to post warning notices or issue advisories for Upper Klamath Lake, project reservoirs, and river reaches. Public health monitoring is done on a more frequent basis (e.g., biweekly) than the baseline sampling and occurs at public access points along Upper Klamath Lake; Keno, J.C. Boyle, Copco, and Iron Gate reservoirs; and the Klamath River from Iron Gate Dam downstream to the estuary. Results of water sample analysis are immediately forwarded to public health entities. Public health memos that summarize public health data available to date, are routinely provided by each monitoring entity to a wide array of stakeholders and the Klamath Basin Monitoring Program (KBMP) which subsequently posts these memos on their website (www.kbmp.net).

Interim Measure 15 water quality monitoring is coordinated to ensure appropriate quality assurance protocols and standard operating procedures, with transparency being a key element of the program. Study plans, laboratory comparison memoranda, annual summary reports, and data are available on the PacifiCorp (www.pacificorp.com/es/hydro/hl/kr.html) and KBMP websites (www.kbmp.net).

While this program has been functioning relatively efficiently, new challenges have recently emerged. One of the challenges that has become more significant in the last 3 years has been that of increasing costs. Interim Measure 15 sets aside $500,000 for the sampling program of which $50,000 is targeted for public health monitoring. Routine costs for labor, laboratory processing, sample shipping, and almost all other elements of the program have increased since the KHSA was originally signed. Compounding budget challenges was the desire to add public health sampling sites in Upper Klamath Lake and in the Klamath River from Link Dam downstream into J.C. Boyle Reservoir. Further complications came from a reluctance to completely cease sampling at some locations or analyzing some constituents. This came to a head in planning for the 2016 sampling year, and as a result, with the approval of the IMIC, approximately $70,000 was reallocated from the Interim Measure 11 budget to the Interim Measure 15 budget to cover cost increases in the 2016 program. Late in 2016, an aggressive review of the sampling program was undertaken in an effort to reduce

costs for the 2017 program. This was ultimately successful and the budget was met without having to use Interim Measure 11 funds to implement the 2017 program.

Expansion of public health monitoring to Upper Klamath Lake has provided important information to the Oregon Health Authority about the presence of *Microcystis* and microcystin in Upper Klamath Lake. The data collected in samples from Upper Klamath Lake since 2016 have resulted in routine public health advisories issued for Upper Klamath Lake, Keno Reservoir, and once for J.C. Boyle Reservoir.

Because they were intended for almost immediate management decisions, the public health datasets have not historically been reported with the KHSA baseline data. Because of this, the data was not subject to the same quality review process. As interest in the cyanobacteria and public health issues increased, this dataset received more attention. In the summer of 2015, a series of issues ranging from missing samples to incorrectly reported results, were discovered in the public health datasets from 2009 through 2015. Over about 18 months, PacifiCorp conducted a comprehensive quality assurance review of data collected from 2009 through 2016 in both the baseline and public health programs. It is not unusual to have programs change over the years as sampling staff and laboratories shift and study plans change. Maintaining strong quality review processes can be a challenge under these conditions. PacifiCorp has continued to work with our sampling partners to increase focus and strengthen the quality review program for data collected in this program.

The 2009-2016 data from the baseline and public health programs are now considered to be 95 and 100 percent accurate, respectively[20]. Revised datasets have been posted on the PacifiCorp website and uploaded to the California Environmental Data Exchanged Network (www.ceden.org). Once the datasets were acceptable, PacifiCorp prepared revisions to annual reports either in errata or by revising entire reports. This process was completed in early 2018 and all errata and revised reports are on the PacifiCorp website.

7.16.1 Periphyton Study[21]

The lack of information on the periphyton community was identified as a data gap in the understanding of Klamath River water quality. The development of this data could be useful for assessing long-term changes that may occur with planned dam removal. Therefore, a special study by the Karuk and Yurok tribes was begun in 2011 and completed in 2015 that characterized the periphyton algal community in the Klamath River. The study focused on changes in species composition and biomass in response to physical, chemical, biological, or environmental factors (e.g., depth, shade, water velocity, etc.). The study also tested single and composite samples to see if one was just as representative of the other at describing reach-scale conditions.

This work concluded that the periphyton communities were tremendously variable, but show clear temporal and spatial trends. There were numerous micro-habitats within each area sampled, velocity and substrate varied considerably, and other factors (e.g., light, grazing, position, and others) that also contributed to differences in the periphyton community. The velocity preferences of dominant species were consistent for most sites sampled but differences in substrate did not reveal any trends. Nonetheless the temporal and spatial trends provide potentially critical information about how species and biomass respond to water quality, flow, and meteorological factors, as well as instream benthic processes (e.g., grazing, competition, scour, etc.).

7.16.2 2016 Genetics Special Study[22]

The application of molecular diagnostic tools to cyanobacteria monitoring affords several potential benefits over traditional approaches that may ultimately improve Klamath River

water quality monitoring by providing: faster results, lower cost, higher sample throughput, greater accuracy at low cell concentrations, and non-subjective results. The two new tools evaluated in this study were Quantitative Polymerase Chain Reaction (QPCR) analysis and a prototype rapid analysis testing tool. The goal of this study was to demonstrate the effectiveness, accuracy, and reliability of these molecular diagnostic tools for monitoring cyanobacterial toxins in the Klamath River. If effective and accurate, it may be possible to change the existing analysis protocols, reduce the need for laboratory testing to just those samples where toxins are present, and speed the return of data useful to informing public health decision makers. With the participation of our sampling partners, samples routinely collected at public health monitoring sites were split and processed in traditional methods (e.g., microscopy, enzyme-linked immunosorbent assay, etc.) as well as using molecular tools (QPCR and the rapid analysis tool). This allowed comparison of methods and evaluation of accuracy. The false negative rate for the rapid analysis tool was found to be too high. A false positive means that the test predicted no toxin when more conventional laboratory tests found toxin. However, the genetic assays used in QPCR proved accurate with no false negatives when toxin concentrations were over 0.6 micrograms per liter. The study showed that QPCR was also faster and more accurate than cell counts performed using a microscope.

One interesting outcome of this study was the documentation (using QPCR analysis) of anatoxin-a in 41 out of 126 samples collected throughout the watershed. Cyanobacteria capable of producing anatoxin-a were only identified in 6 of the 41 samples that tested positive for the genes that produce anatoxin-a. This lack of correlation between known anatoxin-a producing cyanobacteria and anatoxin-a concentrations suggested the possible production of anatoxin-a by a benthic cyanobacteria which would not be collected readily in water grab samples. As a result, PacifiCorp conducted a follow-up study again using genetic techniques in an effort to identify the producer of this toxin. Using a combination of DNA amplification and sequencing, it was determined that the anatoxin-a producer was likely most closely related to *Phormidium* or *Tychonema*. Differentiation between these two was not feasible because there was not a complete genetic map for the anatoxin-a-producing gene from these species in the Klamath River. Both of these species are benthic mat-forming species known to produce anatoxin-a and both occur in the Klamath River.

7.17 Interim Measure 16: Water Diversions

PacifiCorp shall seek to eliminate three screened diversions (the Lower Shovel Creek Diversion – 7.5 cfs, Claim # S015379; Upper Shovel Creek Diversion – 2.5 cfs, Claim # S015381; and Negro Creek Diversion – 5 cfs, Claim # S015380) from Shovel and Negro creeks and shall seek to modify its water rights as listed above to move the points of diversion from Shovel and Negro creeks to the mainstem Klamath River. Should modification of the water rights be feasible, and then successful, PacifiCorp shall remove the screened diversions from Shovel and Negro creeks associated with PacifiCorp's water rights prior to the time that anadromous fish are likely to be present upstream of Copco Reservoir following the breach of Iron Gate and Copco dams. To continue use of the modified water rights, PacifiCorp will install screened irrigation pump intakes, as necessary, in the Klamath River. The intent of this measure is to provide additional water to Shovel and Negro creeks while not significantly diminishing the water rights or the value of ranch property owned by PacifiCorp. Should costs for elimination of the screened diversions and installation of a pumping system to provide continued use of the water rights exceed $75,000 then the Parties will Meet and Confer to resolve the inconsistency.

Implementation of this measure to relocate irrigation diversions on tributaries above Copco Reservoir is not contemplated to occur until just prior to the reintroduction of anadromous fish as a result of dam removal.

7.18 Interim Measure 17: Fall Creek Flow Releases

Within 90 days of the Effective Date and during the Interim Period for the duration of its ownership while this Settlement is in effect, PacifiCorp shall provide a continuous flow release to the Fall Creek bypass reach targeted at 5 cfs. Flow releases shall be provided by stoplog adjustment at the diversion dam and shall not require new facility construction or the installation of monitoring equipment for automated flow adjustment or flow telemetry.

Additionally, if anadromous fish have passage to the Fall Creek following removal of the California dams, flows will be provided in the Fall Creek bypass reach to provide for the appropriate habitat needs of the anadromous fish species of any kind that are naturally and volitionally present in the Fall Creek bypass reach. Flows will be based on species specific habitat needs identified by the IMIC. The operation will also avoid and minimize take of any listed species present.

State-of-the-Art Marking and Recording Equipment at Iron Gate Hatchery

Pursuant to Interim Measure 17, PacifiCorp adjusted instream flow releases in the Fall Creek bypass reach from 0.5 cfs to 5 cfs on May 18, 2010. The additional instream flow release is being provided through an existing bypass culvert at the Fall Creek Diversion Dam. PacifiCorp's operations staff monitor this flow release during the course of their routine visits to the Fall Creek Diversion Dam to ensure that the instream flow is maintained.

7.19 Interim Measure 18: Hatchery Funding

Beginning in 2010, PacifiCorp shall fund 100 percent of Iron Gate Hatchery operations and maintenance necessary to fulfill annual mitigation objectives developed by the California Department of Fish and Wildlife in consultation with the National Marine Fisheries Service and consistent with existing FERC license requirements. PacifiCorp shall provide funding of up to $1.25 million dollars per year for operations and maintenance costs, subject to adjustment for inflation as set forth in Section 6.1.5 of the Settlement. These operations and maintenance costs shall include a program for 25 percent fractional marking of chinook at the Iron Gate Hatchery facilities as well as the current 100 percent marking program for Coho and steelhead. Labor and materials costs associated with the 25 percent fractional marking program (fish marking, tags, tag recovery, processing, and data entry) shall be included within these operations and maintenance costs. This operations and maintenance funding will continue until the removal of Iron Gate Dam.

PacifiCorp will provide one-time capital funding of $1.35 million for the 25 percent fractional marking program. This funding will include the purchase of necessary equipment (e.g., electrical upgrades, automatic fish marking trailer, tags and a wet lab modular building for processing fish heads). PacifiCorp will ensure the

automatic fish marking trailer is available for use by April 2011. PacifiCorp is not responsible for funding the possible transition to a 100 percent Chinook marking program in the future.

PacifiCorp owns the Iron Gate Hatchery and the current Project license requires PacifiCorp to fund 80 percent of Iron Gate Hatchery operations and maintenance costs, with the remainder being funded by CDFW. However, under Interim Measures 18 PacifiCorp has assumed funding 100 percent of operations and maintenance costs for Iron Gate Hatchery. Consistent with the interim measure, PacifiCorp purchased a fish marking system for Iron Gate Hatchery to provide 25 percent constant fractional marking of Chinook salmon produced at the hatchery. The marking system was first used in the spring of 2011 and has been used every spring since then. The increased marking percentage at Iron Gate Hatchery is providing better data on the contribution of the hatchery-to-basin Chinook salmon harvest and escapement. This information is helping to improve fisheries management in the basin. In 2012, PacifiCorp completed construction of a new wet lab at CDFW's Yreka facility that has been used every season since then to analyze coded wire tags from returning adult Chinook.

Wet Lab for Reading Adult Salmon Tags

7.20 Interim Measure 19: Hatchery Production Continuity

Within 6 months of the Effective Date of the Settlement, PacifiCorp will begin a study to evaluate hatchery production options that do not rely on the current Iron Gate Hatchery water supply. The study will assess groundwater and surface water supply options, water reuse technologies or operational changes that could support hatchery production in the absence of Iron Gate Dam. The study may include examination of local well records and the feasibility of increasing the production potential at existing or new hatchery facilities in the basin.

Based on the study results, and within 6 months following the DRE's acceptance of the FERC surrender order, PacifiCorp will propose a post-Iron Gate Dam Mitigation Hatchery Plan (Plan) to provide continued hatchery production for 8 years after the removal of Iron Gate Dam. PacifiCorp's 8-year funding obligation assumes that dam removal will occur within 1 year of cessation of power generation at Iron Gate Dam. If dam removal occurs after 1 year of cessation of power generation at Iron Gate Dam, then the Parties will Meet and Confer to determine appropriate hatchery funding beyond the 8 years. PacifiCorp's Plan shall propose the most cost effective means of meeting hatchery mitigation objectives for 8 years following removal of Iron Gate Dam. Upon approval of the Plan by the California Department of Fish and Wildlife or Oregon Department of Fish and Wildlife (as appropriate) and the National Marine Fisheries Service, PacifiCorp will begin implementation of the Plan. Plan implementation may include PacifiCorp contracting with the owners or administrators of other identified hatchery facilities and/or funding the planning, design, permitting, and construction of measures identified in the Plan as necessary to continue to meet mitigation production objectives. Five years after the start of Plan implementation, PacifiCorp, the California Department of Fish and Wildlife or Oregon Department of Fish and Wildlife (as appropriate) and the National Marine Fisheries Service, the CDFW or

ODFW (as appropriate) and the NMFS shall meet to review the progress of Plan implementation. The 5 year status review will also provide for consideration of any new information relevant to Plan implementation. Plan implementation shall ultimately result in production capacity sufficient to meet hatchery mitigation goals for the 8-year period being in place and operational upon removal of Iron Gate Dam.

In 2011, PacifiCorp began a study to evaluate hatchery production options that do not rely on the current Iron Gate Hatchery water supply. PacifiCorp engineering and environmental staff researched available water supply options in the area and historic records on hatchery water supply options considered at the time Iron Gate Hatchery was constructed. PacifiCorp, in consultation with CDFW, developed preliminary alternatives for continued hatchery operations. Further progress on the evaluation of these alternatives was delayed because of the uncertain future of the settlement agreements as the end of 2015 approached with little Congressional action. With execution of the revised KHSA in 2016, formation of the KRRC, and filing of the application to transfer ownership to the KRRC, there is renewed interest in determining the future of Iron Gate Hatchery. PacifiCorp continues to work with CDFW, NMFS, KRRC, and other stakeholders to evaluate other locations, changes in fish production goals, and solutions to the water supply challenges that could allow for the production of hatchery fish after the removal of Iron Gate Dam.

7.21 Interim Measure 20: Hatchery Funding After Removal of Iron Gate Dam

After removal of Iron Gate Dam and for a period of 8 years, PacifiCorp shall fund 100 percent of hatchery operations and maintenance costs necessary to fulfill annual mitigation objectives developed by the California Department of Fish and Wildlife in consultation with the National Marine Fisheries Service. The hatchery mitigation goals will focus on Chinook production, with consideration for steelhead and Coho, and may be adjusted downward from current mitigation requirements by the California Department of Fish and Wildlife and National Marine Fisheries Service, in consultation with the other Klamath River fish managers, in response to monitoring trends.

No implementation actions have occurred for this interim measure given that this requirement begins only following removal of Iron Gate Dam.

7.22 Interim Measure 21: BLM Land Management Provisions

Beginning in 2010 and continuing until Decommissioning of the J.C. Boyle facility, PacifiCorp shall fund land management activities by the Bureau of Land Management as specified in this interim measure. BLM will provide PacifiCorp an annual Work Plan for the management measures described below for road maintenance, invasive weed management, cultural resource management, and recreation. The Work Plan will include the status of Work Plan tasks from the prior year, a description of the prioritized tasks for the upcoming year, and their estimated costs. PacifiCorp or BLM will mutually establish the annual delivery date of the Work Plan taking into consideration fiscal and maintenance calendars and may request a meeting to coordinate the content of the plan. PacifiCorp will provide funding within 60 days of concurring with the Work Plan. Administrative services, environmental review or permitting efforts, if necessary, to implement actions under the funds shall not require additional PacifiCorp funding beyond the amounts specified below.

A. PacifiCorp shall provide up to $15,000 per year to BLM towards projects identified

through the coordination process described above for the purpose of road maintenance in the Klamath Canyon. This funding will be used to annually maintain the access road from State Highway 66 to the J.C. Boyle Powerhouse and terminate at the BLM Spring Island Boat Launch. Remaining funds will be used to do non-recurring road maintenance work on roads within the Canyon as mutually agreed upon in writing by BLM and PacifiCorp.

B. PacifiCorp shall provide up to $10,000 per year to BLM for use by the Oregon Department of Agriculture (ODA) towards projects identified through the coordination process described above for the purpose of integrated weed management of invasive weed species along the road system and river corridor within the Klamath Canyon. Noxious weed control projects will be coordinated with Siskiyou County to ensure that weeds are controlled along the river corridor from the Oregon-California boundary to the top of Copco Reservoir.

C. PacifiCorp shall provide up to $10,000 per year to BLM towards projects identified through the coordination process described above for the management of the following 5 BLM cultural sites which are within, or partially within, the T1 terrace of the J.C. Boyle full flow reach: 35KL21/786, 35KL22, 35KL24, 35KL558, and 35KL577. Management of additional sites with these funds can occur with mutual written agreement between PacifiCorp and BLM.

D. PacifiCorp shall provide up to, but no more than, $130,000 in funding for the development and implementation of a Road Management Plan to be implemented during the Interim Period. The Road Management Plan shall be developed by BLM and PacifiCorp and will determine priorities for operation and maintenance, including remediation or restoration of redundant or unnecessary facilities, of the shared BLM/PacifiCorp road system within the Klamath River Canyon from J.C. Boyle Dam to the slack water of Copco Reservoir.

The BLM has continued to use funding under this interim measure for cultural resources, road maintenance, and invasive weed management. Recent actions implemented under this interim measure include:

- Cultural Resources: The BLM conducted detailed monitoring and updated baseline data at multiple sites. Two additional existing sites were added to this effort in 2015 and the recording of a new site took place that same year. Baseline data consisted of constructing detailed site maps, capturing spatial data, and documentation of any changes to the sites (e.g., disturbances, newly found artifacts or features, etc.). The work included sites that were identified in the KHSA Interim Measure 21, as well as additional sites within the Klamath River Canyon as agreed to by PacifiCorp and BLM. In 2017, PacifiCorp worked with BLM and the Klamath Tribes to rehabilitate and install protection measures for a sensitive cultural resource damaged by illegal off-road vehicle use. The project was part of a transportation management effort and used funds from Interim Measure 21D, Road Management Planning.
- Road Management Plan: PacifiCorp and BLM worked collaboratively to complete road management measures including limiting access and closing roads on both PacifiCorp and BLM property at Frain Ranch in the Klamath River Canyon. The objective of the measures was to reduce damage to sensitive resources caused by unauthorized use of off-highway-vehicles.
- Road Maintenance: Annually, BLM grades and does other maintenance work on approximately 13 miles of the Topsy Road and approximately 8 miles of the John C. Boyle Road from Highway 66 to the closure gate. In 2016, BLM graded and took other maintenance actions on the John C. Boyle Road/Copco Big Bend Road (road 40-6E-

1.2). This work resulted in grading of about 8 miles with another 4.5 miles of spot rocking.

- Invasive Weed Management: The BLM has continued to address invasive weed management throughout the 4,390 acres of the Klamath River Canyon in both Oregon and California. They have applied spot treatments to a total of about 100 acres in the canyon and another 5 acres on the Klamath plateau. These spot treatments of weeds within the Klamath River Canyon in both Oregon and California were completed in 2016.

[1] PacifiCorp. 2013a. Interim Operations Habitat Conservation Plan for Coho Salmon: Iron Gate Gravel Augmentation Plan, Version 1.0. February. 26 pp.

[2] PacifiCorp. 2013b. Interim Operations Habitat Conservation Plan for Coho Salmon: Water Quality Monitoring Plan, Version 1.0. January. 24 pp

[3] PacifiCorp. 2013c. PacifiCorp Klamath Hydroelectric Project. Interim Operations Habitat Conservation Plan for Lost River and Shortnose Suckers. November. 146 pp.

[4] California Department of Fish and Wildlife and PacifiCorp. 2014. Hatchery and Genetics Management Plan for Iron Gate Hatchery Coho Salmon. Prepared for National Marine Fisheries Service. September. 163 pp.

[5] PacifiCorp. 2013. Klamath Hydroelectric Settlement Agreement: Implementation Report. June. 40 pp.

[6] CH2M. 2016a. Interim Measure 11, Activity 4 – Conceptual feasibility study of oxygenation systems at Keno Reservoir. Prepared for PacifiCorp. July. 35 pp.

[7] CH2M. 2015, Interim measure 11 study of nutrient reduction methods: Jar test results and summary report. Prepared for PacifiCorp. March. 50 pp

[8] CH2M. 2016c. Interim Measure 11, Activity 7 – Assessment of potential algae harvesting and removal techniques at Link River dam. Prepared for PacifiCorp. July. 66 pp.

[9] CH2M. 2017b. Interim Measures Implementation Committee: Interim Measure 11 – Link River Algae Removal Demonstration Project: Phase 1 Final Report. Prepared for PacifiCorp. July. 25 pp.

[10] CH2M. 2016b. Interim Measure 11, Activity 6 – Study of algal conditions management within a reservoir cove using physical measures. Prepared for PacifiCorp. July. 22 pp.

[11] CH2M. 2014. Demonstration wetland facility preliminary research and implementation plan Klamath River, Oregon. Prepared for PacifiCorp, Portland, OR. 240 pp

[12] Watercourse. 2015. 2014 Localized treatment of long Gulch Cove in Iron Gate Reservoir using hydrogen peroxide based algaecide. Prepared for PacifiCorp, Portland, OR. April. 58 pp.

[13] Otten, T.G., S. Mackey, and T.W. Dreher 2015a. Comparison of Microcystis populations in Copco/Iron Gate reservoirs and in the Klamath system upstream and downstream: Are the populations linked or largely independent? Prepared for PacifiCorp. April. 15 pp.

Otten, T.G., J.R. Crosswell, S. Mackey, and T.W. Dreher. 2015b. Application of molecular tools for microbial source tracking and public health risk assessment of a Microcystis bloom traversing 300 km of the Klamath River. Harmful Algae 46(2015) 71-81

[14] Otten, T. and T. Dreher. 2017. Multi-year analysis of *Microcystis* population structure and toxigenicity in Copco and Iron Gate Reservoirs. Prepared for PacifiCorp. April, 24 pp.

[15] Miao, E., and M. Deas. 2014. Assessment of an Intake Barrier for Water Quality Control at Iron Gate Reservoir – 2013 Study Results. Prepared for PacifiCorp Energy, prepared by Watercourse Engineering, Inc. April.

Watercourse Engineering Inc. (Watercourse). 2016. Water Quality Effects of an Intake Barrier Curtain to Reduce Algae Concentrations Downstream of Iron Gate Reservoir. Prepared for PacifiCorp. July.

PacifiCorp 2017. 2106 Evaluation of an Intake Barrier Curtain in Iron Gate Reservoir to Improve Water Quality in the Klamath River. October. 113 pp.

[16] Deas. M.L. and E. Miao. 2010. Exploratory velocity measurements in Iron Gate Reservoir with an acoustic doppler current profiler. Prepared for PacifiCorp. July. 14 pp.

[17] Watercourse Engineering, Inc. (Watercourse). 2013. Appendix B *in* 2012 Assessment of an intake cover for water quality control at Iron Gate Reservoir. Prepared for PacifiCorp. July

[18] Watercourse Engineering, Inc. (Watercourse). 2015. Conceptual design evaluation for full-scale particulate organic matter removal from Klamath River source water using stormwater treatment

technology. Prepared for PacifiCorp Energy, Portland OR. March. 54 pp.

[19] CH2M. 2017a. Interim Measures Implementation Committee: Interim Measure 11 – Development of a priority list of projects: Phase 1 Final Report. Prepared for PacifiCorp. June. 56 pp

CH2M. 2018. Interim Measures Implementation Committee: Interim Measure 11 – Development of a priority list of projects: Phase 2 Final Report. Prepared for PacifiCorp. February. 48 pp

[20] Vaughn, J. and M. Deas. 2017. Technical Memorandum regarding Quality Assurance Review of KHSA 2009-2015 datasets. Prepared for PacifiCorp. September 22. 5 pp.

[21] Yurok Tribe and Karuk Tribe. 2015. 2014 Klamath River Periphyton Study: Summary Report. 41 pp.

[22] Otten, T. 2107a. Application of genetic tools for improved cyanobacterial bloom monitoring in the Klamath River system: Implications for public health monitoring. Prepared for PacifiCorp, Portland, OR. April. 29 pp

Otten, T. 2107b. Application of genetic tools for improved cyanobacterial bloom monitoring in the Klamath River system: The molecular identification of anatoxin-a producers. Prepared for PacifiCorp, Portland, OR. August. 32 pp