

Final Study Plan

Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2016

Revised October 12, 2016

Introduction

The Klamath Hydroelectric Settlement Agreement (KHSA; as amended on April 6, 2016) includes Interim Measure 11 (Interim Water Quality Improvements), which is intended to address water quality improvement in the Klamath River during the interim period leading up to potential dam removal. Regarding Interim Measure 11, the KHSA states “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.” The measure calls for PacifiCorp to spend up to \$250,000 per year¹ for studies or pilot projects in consultation with the Interim Measures Implementation Committee² (IMIC).

This study plan describes the proposed studies or pilot projects that PacifiCorp will conduct during 2016 (and extending into 2017) to address the Interim Measure 11 objectives as described above. These proposed studies or pilot projects will be a continuation of, or build upon, Interim Measure 11 studies and pilot projects that have been conducted since 2010. A draft study plan was initially circulated to the IMIC in July 2016. A follow-up distribution in early September 2016 provided detailed proposals for several activities along with a break-down of costs and solicited IMIC input. Overall, comments from the IMIC members indicated a desire to not fund the Sprague River riparian revegetation project or the metagenomic analysis of Klamath River algae; these two activities have been removed from this study plan. Members also proposed two new activities: (1) Identification and Prioritization of Diffuse Source Treatment Wetland (DSTW) sites in the Wood River; and, (2) Link River Algae Removal Demonstration Project. Both of these are included in this study plan. Therefore the current list of proposed 2016 activities related to Interim Measure 11 includes:

1. Development of a Priority List of Projects
2. Continued Development of the Water Quality Accounting Framework
3. Identification and Prioritization of Wood River and Sprague River DSTW Sites
4. Continued Evaluation of Intake Barrier System for Water Quality Improvement from Iron Gate Powerhouse Releases
5. Continued Coordination on a Demonstration Wetlands Facility
6. Link River Algae Removal Demonstration Project

¹ Per year until the date that the Dam Removal Entity (DRE) accepts a Surrender Order issued by the Federal Energy Regulatory Committee (FERC) regarding the Klamath Hydroelectric Project. The KHSA indicates that up to 25 percent of the funding in this measure for pre-surrender-order-acceptance studies and post-surrender-order-acceptance implementation may be directed towards in-reservoir water quality improvement measures, including but not limited to J.C. Boyle reservoir.

² The IMIC is comprised of representatives from PacifiCorp and other parties to the KHSA. The purpose of the IMIC is to collaborate with PacifiCorp on ecological and other issues related to the implementation of the Non-Interim Conservation Plan Interim Measures set forth in Appendix D of the KHSA.

The work involved for each of these studies is summarized below. Detailed scopes of work or study plans have been distributed for some of these (e.g., Water Quality Accounting Framework, Intake Barrier System Evaluation) and others are still being developed (e.g., Link River Algae Removal Demonstration Project, Wood River DSTW Identification and Prioritization).

1: Development of Priority List of Projects

Purpose and Objectives

The purpose of Activity 1 of Interim Measure 11 is to develop a priority list of projects to be implemented after the DRE's acceptance of the FERC surrender order (per the KHSA as amended on April 6, 2016). The priority list will be informed by, among other things but not limited to, the information gained from the specific studies previously conducted under Interim Measure 11, the Interim Measure 10 *Klamath Water Quality Improvement Project Report*, Bureau of Reclamation's *Water Quality Improvement Plan for the Klamath Project*, and other sources as they are available (e.g., the USFWS is currently developing the *Integrated Fisheries and Monitoring Plan for the Klamath Basin*).

Following the DRE's acceptance of the FERC surrender order, PacifiCorp will provide funding of up to \$5.4 million for implementation of projects approved by the Oregon Department of Environmental Quality (ODEQ), the North Coast Regional Water Quality Control Board (Regional Board), and the State Water Resources Control Board (State Board), and up to \$560,000 per year to cover project operation and maintenance expenses related to those projects.

Task and Work Elements

The tasks and work elements associated with this activity in 2016 would include the following:

- Coordinate with the IMIC to determine the specific scope for this assessment and to evaluate the draft evaluation matrix and scoring process. Additional meetings and outreach may be necessary to comprehensively identify source material to be used in prioritizing the list of projects.
- PacifiCorp will review the available source material to create a comprehensive list of possible projects for evaluation. This will include the Interim Measure 10 *Klamath Water Quality Improvement Project Report*, Bureau of Reclamation's *Water Quality Improvement Plan for the Klamath Project*, previous Interim Measure 11 technical reports, and other appropriate and available sources.
- To facilitate IMIC coordination, input, and eventual decision making, PacifiCorp will prepare a comprehensive matrix of measures and studies assessed and evaluated. This documentation will include summary findings with regard to relative effectiveness, costs, data gaps, uncertainties, and other information needs. This matrix of projects along with the final scoring questions will be provided to the IMIC for project scoring.
- The scoring questions will provide a basis for the IMIC to assess and score the different water quality improvement projects in regards to their suitability for further study or implementation planning prior to the DRE's acceptance of the FERC surrender order. PacifiCorp will collect these scores and prepare a comprehensive matrix for discussion and review by the IMIC.

Schedule and Deliverables

IMIC meetings and conference calls will occur either within existing IMIC meetings or on a schedule to be determined. One of the specific deliverables will consist of a planning matrix to assist the IMIC in developing a priority list of projects for implementation and/or further evaluation. The final product of this effort would be a report documenting the process, decision matrix, data sources, and presenting the prioritized list of projects.

2: Continued Development of the Water Quality Accounting Framework

Purpose and Objectives

The purpose of Activity 2 of Interim Measure 11 is to continue development of the Klamath water quality improvement tracking and accounting program (KTAP). The key concept behind the program is to facilitate opportunities for collaboration among Basin stakeholders to reduce nutrient, thermal, and other pollutant loads, and provide a means of accounting for overall water quality benefits within the basin. Additional work during 2016 will include continued collaboration with the KTAP technical group, continued coordination with agencies and stakeholders on water quality accounting or credit trading developments, and continued implementation of KTAP protocols and methods.

Task and Work Elements

The tasks and work elements associated with this activity in 2016 will include the following:

- Refine the quality assurance/quality control procedures. Because information submitted into KTAP comes from a variety of sources each with different levels of details, creating a standardized database of projects is a challenge. Development of a standardized quality assurance/quality control process will help improve the end-usability of the collected data.
- Work with local resource managers to improve the reporting resolution of two to three reporting zones. Data is displayed by reporting zones, many of which are very large (e.g., the entire Lost River sub-basin is one zone). Working with local resource managers to define useful boundaries for smaller reporting zones and then converting existing data into these new zones, will improve the usefulness of the database. Budget is included for completion of this in two or three zones depending to be identified.
- Participate with the KTAP Working Group and other interested stakeholders to further refine KTAP methods and tools.
- Develop an annual report. Included in this task is the active solicitation of project submission. KTAP relies on voluntary submission of data and ongoing outreach to restoration practitioners, land managers, conservation organizations, etc. It is important to obtain those submissions and submitted projects will be reviewed and an annual report will be prepared.

PacifiCorp supports continued efforts to broaden the applicability of water quality accounting in the Klamath Basin. To this end, PacifiCorp will provide funding to the Willamette Partnership through Interim Measure 11 Activity 2 to implement the items discussed above. This will allow for the continued development of information sharing mechanisms and tools to deliver project-scale information into the KTAP database.

Schedule and Deliverables

The following deliverables have been identified in the 2016 study plan by Willamette Partnership: Results of a survey of research community needs, a quality control/quality assurance and data management strategy, refine reporting zones, 2016 annual report. The specific schedule for this study during 2016 is included in the Willamette Partnership proposal, but would likely need to be adjusted once contracting is complete.

3: Identification and Prioritization of Wood River and Sprague River Diffuse Source Treatment Wetland Sites

Purpose and Objectives

With funding from the California State Coastal Conservancy, California State Water Resources Control Board, and PacifiCorp, Trout Unlimited, USFWS, The Klamath Tribes, and Stillwater Sciences are currently working on

design and implementation of pilot DSTWs in the Wood River Valley. These pilot DSTWs are located on irrigation ditches near Sevenmile Creek. Treatment effectiveness of the pilot wetlands will be assessed through targeted monitoring, including hydrology (e.g., surface flow, shallow groundwater flow, evapotranspiration, and residence time), water quality (e.g., water temperature, dissolved oxygen, pH, turbidity, suspended sediment, and nutrients), and vegetation species composition and percent cover.

The goal of this work is to provide water quality information (specifically relating to phosphorus) to help refine DSTW design and long-term operations and maintenance needs. This data will also help with proper identification of high priority DSTW sites in the Wood River and Sprague River valleys. Collectively these two rivers provide over 50 percent of the external phosphorus loading to Upper Klamath Lake.³ The existing topography and agricultural ditch network make both of these watersheds potentially ideal locations for DSTWs. The purpose of this effort is to better inform DSTW design and long-term operation and maintenance decisions by providing information regarding the particle size distribution (PSD) and phosphorus associations with different particle sizes, for different sources of water (e.g., irrigation tailwater, storm event runoff, groundwater springs). Collectively this will help pilot DSTWs in both the Wood River and Sprague River valleys.

Task and Work Elements

Water samples will be collected during 2017 at multiple locations in both the Wood River and Sprague River watersheds. Identification of sampling locations will focus on:

- 1) Agricultural canals, stream reaches, and/or natural groundwater upwelling areas that have previously exhibited phosphorus levels that are elevated above background levels
- 2) Agricultural canals/interior ditches that have not yet been sampled, but are proximal to locations that ongoing studies in the Wood River and Sprague River valleys have identified as suitable locations for DSTWs

The proposed project would be closely coordinated with the other ongoing DSTW studies and would make use of associated geographic information system analyses (for screening suitable DSTW sites), follow up and outreach with landowners, and initial flow and nutrient monitoring to establish baseline conditions and inform design at each pilot DSTW site. Each selected agricultural canal or interior ditch location would be sampled during both the irrigation and non-irrigation season to allow characterization of PSD and phosphorus associations in seasonal runoff and irrigation tailwater. Sampling at these same locations would also occur during storm and irrigation events. Groundwater upwelling springs and stream reach locations would be sampled seasonally.

Results of the PSD and phosphorus association sampling would be used to inform our understanding of background conditions from natural sources of phosphorus in both the Wood River and Sprague River valleys. This data would help us understand the seasonal aspects of PSD and phosphorus associations and in storm event runoff and irrigation tailwater. Collectively, this information would help inform strategic placement, expected performance, and design approaches for pilot DSTWs. Proper siting and effective design of DSTWs will ultimately enhance future DSTW distribution and acreage in these two watersheds. The PSD and phosphorus association data will allow an initial assessment of whether increased phosphorus removal efficiency at pilot DSTW sites is likely to be needed in particular locations, and whether this could be accomplished via design features such as equalization basins and/or coagulant dosing areas.

Schedule and Deliverables

Collection of water samples would follow identification of sites and likely begin in early 2017 and extend throughout the year. Some of these events would be regularly scheduled seasonal sampling while other samples would be collected following storm events or irrigation activity.

³ Walker, W., J. Walker, and J. Kann. 2012. Evaluation of water and nutrient balances for the upper Klamath Lake basin in water years 1992–2010. Prepared for Klamath Tribes Natural Resources Department. Prepared by Environmental Engineers and Aquatic Ecosystem Sciences.

Project success will be demonstrated through data collection and interpretation linked to design and operation recommendations for future DSTWs. Ultimately the information collected from this study will feed into the existing DSTW pilot studies. Final deliverables for this particular task are still being developed but are expected to include a technical memorandum that documents the sites, sampling methods, and results of PSD and phosphorus evaluations. With a better understanding of PSD and phosphorus information, appropriate adjustments in DSTW design and maintenance activities, the ultimate expected environmental outcome is broad-scale, measurable reductions in external phosphorus loading to Upper Klamath Lake from the Wood River and Sprague River valleys.

4: Continued Evaluation of Intake Barrier System for Water Quality Improvement from Iron Gate Powerhouse Releases

Purpose and Objectives

The purpose of Activity 4 is to continue to evaluate an intake barrier system for water quality control from Iron Gate reservoir to improve water quality in Iron Gate powerhouse releases to the Klamath River. The concept behind the curtain is to control the depth at which water is withdrawn from the reservoir into the intake, and thereby potentially enhance water quality downstream of Iron Gate dam by excluding or reducing the potential entrainment of biomass from blooms of cyanobacteria (blue-green algae) and potential associated algal toxins (i.e., microcystin). The goal of the system is to improve water quality conditions during the interim period prior to planned dam removal.

Task and Work Elements

The tasks and work elements associated with this activity in 2016 are described in the Monitoring Plan. They include deployment of data collection devices (thermographs and data sondes), characterization of the photic zone, an evaluation of the heterogeneity upstream of the curtain, an autosampler study, and detailed vertical profiles of cyanobacteria. A detailed study plan for this activity that has been prepared by PacifiCorp, reviewed by the IMIC, and finalized based on comments received.

Schedule and Deliverables

Specific schedule and deliverables for this activity are related to completion of field sampling in 2016 followed by data analysis and report preparation in early 2017.

5: Continued Coordination on a Demonstration Wetlands Facility

Purpose and Objectives

The purpose of Activity 5 of Interim Measure 11 is to continue Interim Measure 11 activities related to anticipated development of wetland systems for water quality improvement in the upper Klamath River basin. Constructed and diffuse source wetland treatment systems have been identified as potentially important means of improving water quality conditions in the upper Klamath River (Klamath Basin Nutrient Reduction Workshop⁴). In 2014, as part of Interim Measure 11 studies, a conceptual design and implementation plan for a demonstration wetlands facility (DWF) in the upper Klamath Basin was completed by CH2M HILL (2014)⁵ in collaboration with a Technical Advisory Committee (TAC) representing the IMIC. The DWF would provide an

⁴ The Klamath Basin Nutrient Reduction Workshop was held in September 2012 in Sacramento, California as an activity conducted pursuant to Interim Measure 10 of the KHSR. Constructed and diffuse wetland treatment systems were identified at the workshop as key options for nutrient and organic matter reduction in the upper Klamath Basin (Stillwater et al. 2013).

⁵ CH2M HILL. 2014. Demonstration Wetland Facility Preliminary Research and Implementation Plan. Klamath River, Oregon. Prepared for PacifiCorp, Portland, OR. Prepared by CH2M HILL, Portland, OR. October 27, 2014.

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.

In 2016, PacifiCorp proposes to continue coordination efforts with the IMIC and other stakeholders to further the potential implementation of the DWF, including locating potential sites for the DWF. The DWF itself would be constructed, operated, and maintained by stakeholder “partners” that have an interest in pursuing the unique and important wetland research and demonstration opportunities that the DWF would provide to inform basin-wide planning for water quality improvement strategies.

Task and Work Elements

The tasks and work elements associated with this activity in 2016 will include the following:

- Continue to coordinate with the IMIC and other interested stakeholder partners to identify partnership opportunities with organizations that could contribute technical expertise, matching funds, or other in-kind assets for the continued planning and eventual implementation and operation of the DWF⁶.
- Continue to coordinate with the IMIC and other potential stakeholder partners to locate potential candidate sites for the DWF on suitable available properties (public or private) in the Klamath Basin and assess potential landowner interest in participating in a wetland demonstration.
- Continue to coordinate with the IMIC and other potential stakeholders on additional steps to further implement the DWF Research and Implementation Plan developed in 2014 (CH2M HILL 2014).

From the above steps, further actions as appropriate for final planning and implementation will be determined.

Schedule and Deliverables

Specific schedule and deliverables for this study during 2016 are still under development or to-be-determined.

6: Link River Algae Removal Demonstration Project

Purpose and Objectives

In 2015 and early 2016, an assessment of potential algae harvesting and removal techniques was completed.⁷ Overall, this effort indicated that while it would likely be expensive, it would be feasible to build an algae removal system. There were some regulatory hurdles (e.g., Endangered Species Act, water rights, and other permits) that needed clarification and the topic of algae disposal also needed to be addressed. In part because this previous work found no fatal flaws with algae removal as a possible option for reducing nutrient loading at Link River dam, there remains considerable interest surrounding investigations to determine the feasibility of such an effort. A pilot facility that could be located near Link River dam was proposed by IMIC members. The pilot facility could be located between the A-Canal and Link River dam, upstream of the log boom at the dam. The harvesters would consist of a series of rotating cylindrical drums, arranged in a line and attached on the eastern shoreline. Dewatering units would be located on the eastern shoreline. The conceptual design for the pilot would include screens occupying approximately 48 feet of the channel’s 170 foot total width.

The development and implementation of a complete pilot project is beyond available funding for IM11 in 2016. To facilitate progress in 2016, the overall pilot project was divided into four phases:

⁶ PacifiCorp’s obligations for the work elements conducted under this study will be limited to activities that can be completed according to the Interim Measure 11 fund amount specifically dedicated to this study. If activities as defined in the final Study Plan might exceed the Interim Measure 11 fund amount, the additional fund amount will need to be supplied by other separate funding sources.

⁷ For details see: CH2M. 2016. Interim Measure 11, Activity 7 – Assessment of Potential Algae Harvesting and Removal Techniques at Link River Dam. Technical Memorandum prepared for PacifiCorp. 66 pp. Available online at: <http://www.pacificcorp.com/es/hydro/hl/kr.html#>

Phase 1: Conceptual pilot project design, pilot project description, and investigations into permitting and algae disposal

Phase 2: Pilot facility design, description, and cost estimate, pilot facility operational plan and cost estimate, permitting strategy and permit applications, regulatory approvals, algae composting and disposal study plan, and monitoring plan development

Phase 3: Final regulatory approvals, contractor selection, and pilot facility fabrication and installation

Phase 4: Operations of pilot facility, algae disposal study, monitoring, and analysis and reporting

At any phase in this process it is possible that a fatal flaw might emerge that precludes implementation of a pilot project. The risk associated with any such flaws are reduced by breaking the pilot project down into phases. At the conclusion of the pilot project, analysis of monitoring data along with review of actual operational costs should allow a decision regarding the feasibility of a full-scale facility and development of design for that facility, if appropriate. The work necessary to successfully complete Phase 1 is discussed in additional detail below.

Task and Work Elements

The following tasks would be undertaken to complete evaluation of the Phase 1 assessment tasks for an algae removal facility:

- Prepare a summary description of the proposed technology and the conceptual pilot project. A summary will describe: (1) proposed technology; (2) anticipated pilot project system location; (3) construction, installation, and operations and maintenance; (4) mesh sizes and approach water velocities at screens; (5) water pumping (screening) and water loss (that amount remaining in the wet algae that is not returned to the river) rates; and, (6) amounts of harvested material.
- While the previous work did not reveal any fatal flows in the permitting process, the necessary specific approvals and timelines were vague. To help resolve this, once a project description is available for the pilot facility, detailed discussions with the regulatory agencies will occur. These discussions will include presentation of the conceptual plan, clarification of permitting requirements, consultation pathways, and timelines for approvals. This discussion will include investigations of the permitting process for disposal of harvested material. Permit applications are not anticipated in Phase 1.
- To clarify the disposal pathways, discussions with local partners will occur in this Phase 1 assessment. This includes conversations with organizations such as Oregon Department of Environmental Quality, Klamath Soil and Water Conservation District, Natural Resource Conservation Service, Oregon Institute of Technology, and the Oregon State University Extension Service. Other work in the disposal task includes estimating transport and disposal costs of harvested material. The outcome of this task will be a matrix of disposal options with that can be turned into an algae disposal study plan during Phase 2 if the project advances further. Such a Phase 2 study plan would investigate the toxin degradation process and different possible disposal pathways for harvested material (e.g., composting, supplements, fertilizer, etc.).
- Completion of the steps described above will allow for preparation of a report that presents the conceptual design, presents a permitting strategy, defines the algae disposal investigation process, and establishes the timelines to implement potential Phase 2 work.

Schedule and Deliverables

Assuming work begins in fall 2016, it is expected that the work discussed above could be completed in June 2017. Deliverables associated with this process include a conceptual project description and evaluations of permitting and algae disposal requirements.