

Final Study Plan

Klamath Hydroelectric Project Interim Measure 11 Study Activities for 2019

January 17, 2019

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 (IM) 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). Specifically, proposed 2019 Activities described in this study plan that are related to IM 11 include:

1. Development of a Water Budget and an Assessment of Nutrient Loading from Two Agricultural Operations, Phase 2
2. Evaluation of the Iron Gate Intake Barrier Curtain System for Water Quality Improvement of Powerhouse Releases
3. Assessment of Irrigation Water Conservation Opportunities for Water Quality Improvement in the Upper Klamath Basin
4. Agency/Barnes Lake Restoration Project - Water Quality Evaluation
5. Design and Installation of a Biochar Filtration System to Improve Water Quality in Upper Klamath Lake

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.

1: Development of a Water Budget and an Assessment of Nutrient Loading from Two Agricultural Operations, Phase 2

Purpose and Objectives

Hydrologic modification throughout the Upper Klamath Basin has resulted in pump and pipe systems that convey water to Upper Klamath Lake and the Klamath River. The pump systems around Upper Klamath Lake allow for the removal and management of water from drainage areas that are composed of agricultural, natural areas, infrastructure (such as roads, highways, railroads), golf courses, and rural residential properties. Agricultural operations are a large component of the land use in these drainage areas. Anthropogenic nutrient loading is linked to increased algae blooms that exacerbate low dissolved oxygen conditions throughout the summer months -- a key factor impacting federally listed shortnose suckers (*Chasmistes brevirostris*) and Lost River suckers (*Deltistes luxatus*) and contributing to poor water quality in lower reaches of the Klamath River. Emergent wetlands naturally sequester nutrients and were once abundant throughout Upper Klamath Lake; however dramatic declines in the abundance and distribution of these habitats have resulted in a decreased capacity of the system to sequester nutrients. Due to infrastructure, size, and hydrology (timing and volume), existing wetlands have limited nutrient sequestration capability, and now inputs often exceed retention.

Recently, phosphorus (P) concentrations in several outflow locations throughout Upper Klamath Lake have been identified as periodically exceeding TMDL targets. Several of these monitored sites return irrigation flows to the lake after winter flooding -- a long standing agricultural practice that is integral to organic farming programs and an important food resource for migratory waterbirds in the fall and spring. Agricultural producers, the USFWS, and Trout Unlimited believe that properly developed/designed wetlands used in conjunction with vegetation harvest that assists in nutrient export, as well as on-farm water best management practices can play a valuable role in reducing nutrient levels in water returning to the lake. However, an assessment of specific locations, historic and current land use, nutrient budgets, water budgets, and seasonal variation needs to be conducted to ensure investments into water quality improvement projects are targeted and effective.

In 2018, TU received IM11 funding to begin an assessment of the Running Y farm located in the historic Wocus Marsh Arm of Upper Klamath Lake and the Caledonia Farm located adjacent to Howard Bay of Upper Klamath Lake (Figure 1) to determine a water budget and temporal and spatial variability of soluble and particulate P and N. This proposal continues the project through 2020 to complete all tasks outlined in the original scope.

Information derived from this assessment will:

- Support the development of best management practices for agricultural return flows to Upper Klamath Lake, and provide data to determine appropriate practices for future implementation. Example future practices include (but are not limited to) treatment wetlands to filter discharge, on-farm wetland rotation, filtration through biochar or other appropriate materials, and tailwater reduction or recycling.
- Facilitate land management programs including wetland development and agricultural/wetland rotations that can contribute to nutrient sequestration and export;
- Provide data that will help support long term land management plans to ensure sequestration benefits can be achieved for future years;

- Guide development of agricultural management plans that utilize the timing of return flows and water retention in developed wetlands to reduce P and N contributions into Upper Klamath Lake; and
- Support a sustainable agricultural business model and ensure important migratory bird habitat that is integral to Pacific Flyway management objectives remains available throughout the Klamath basin.

Results from this effort will be applicable throughout the Upper Basin for future return flow management, appropriate non-wetland water quality strategies, future wetland development, and wetland management plans that help reduce discharges below Oregon Department of Environmental Quality target compliance concentrations. The proposal addresses Interim Measure 11, which is intended to improve water quality in the Klamath River during this interim period before dam removal.

Project partners are working in close collaboration with additional agencies, including ODA, ODEQ, The Klamath Tribes, NRCS, and USGS. Collaboration with all of these partners will continue throughout the assessment process.

Phase 1 2018:

- Task 1 – Existing data analysis and farm operations summary
- Task 2 – Development of detailed monitoring plan in conjunction with ODA

Summary. In 2018, TU worked closely with ODA and the landowners to summarize existing operations and develop monitoring plans. In addition, the landowners hired a consultant to produce a report about the existing wetlands on the Caledonia and Running Y farms. Because of the work done by ODA and this consultant, TU was able to focus funds on filling data collection gaps. Specifically, TU has purchased multiple flow meters for the inlets and outlets of the two farms in order to obtain continuous flow data. Up to this point, monitoring has only included water quality parameters and no flow information, which makes it impossible to calculate loads.

TU has submitted the Draft ODA Monitoring Report, the Draft TU Monitoring Plan, and the DSL Plan to PacifiCorp for review. Phase 1 is essentially complete.

Phase 2, 2019-2020:

Phase 2 would incorporate two main tasks:

- Task 3 – WQ and flow data collection
- Task 4 – Data analysis and development of nutrient and water budget

Task 3 – WQ and flow data collection

Nutrient samples and flow measurements will be collected approximately bi-weekly at approximately eight (8) locations throughout the Caledonia and Running Y properties. Because samples will be collected only when water is flowing, we anticipate sampling in the months of January-March, June-September, and December-February. Locations are shown in the attached TU Monitoring Plan. The exact timing of sample collection may change to capture inflow and pump-off events as well as irrigation events.

Task 4 – Data analysis and development of nutrient and water budget for each property

Based on data and information collected in Tasks 1 and 3, contractor will develop a water and nutrient budget for the Caledonia and Running Y properties and will evaluate water quality improvement actions that may be appropriate for each site. This report will include an analysis of the existing wetlands (Golf

Course and Mouse Field) and will evaluate their potential to provide water quality treatment with or without modifications.

Schedule and Deliverables

Task	Tentative Schedule	Deliverable
1. Existing Data Analysis and Farm Operations Summary	Complete	
2. Develop Detailed Monitoring Plan	Complete	Monitoring Plan
3. Water Quality and Flow Data Collection	January 2019 to February 2020	Summary of Monitoring Data
4. Data Analysis and Nutrient and Water Budget Development	August 2019 to March 2020	Final Report

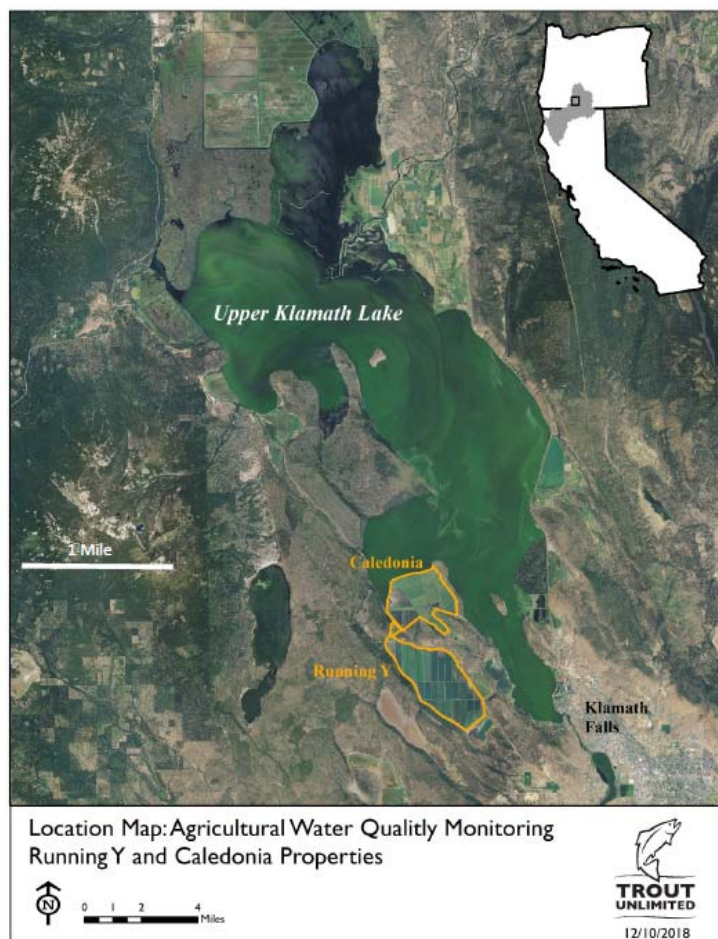


Figure 1. Project Location

2: Evaluation of the Iron Gate Intake Barrier Curtain System for Water Quality Improvement of Powerhouse Releases

Purpose and Objectives

The purpose of this activity is to continue to evaluate the effectiveness of the intake barrier system in Iron Gate reservoir to improve water quality in Iron Gate powerhouse releases to the Klamath River. During 2015-2018, annual studies have been conducted to continue evaluation of the operation of the curtain upstream of the intake as a means of reducing algae entrainment into the intake (Watercourse 2016; PacifiCorp 2017). A comprehensive analysis of the data collected between 2015 and 2018 is currently being prepared. Work in 2019 will build on previous years of data collection and continue to inform management and operation of the system.

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 reducing the potential entrainment of biomass from blooms of cyanobacteria (blue-green algae) and potential associated algal toxins (i.e., microcystin). These studies have provided valuable insights into the performance of the curtain system under varying conditions. This work has collectively indicated that the curtain functions as it was designed and selectively limits the entrainment of surface water in Iron Gate reservoir. The curtain has been deployed to different depths for different periods of time over the last 4 years and the after-deployment sampling was not always conducted at all deployment depths. This has resulted in small sample sizes at different curtain depths. Rather than

Task and Work Elements

The tasks and work elements associated with this activity in 2019 will include the following:

- The curtain will again be deployed in the summer-fall of 2019 to be operational during the period when blooms of cyanobacteria are most prevalent in Iron Gate reservoir (approximately mid-July through October).
- Mixing downstream of the curtain in the reservoir to enhance DO?
- Field data collection at the curtain in 2019 will focus on collecting information to support the evaluation of curtain effectiveness and improve the understanding of curtain function. This will include detailed vertical profiles immediately before and after curtain deployment; profiles will be repeated a few days after curtain deployment. PacifiCorp will again deploy of data sondes and thermograph arrays upstream and downstream of the curtain to continuously monitor conditions throughout the summer. If the data analysis task discussed above indicates the need for specific data collection efforts in addition to those discussed here, specific study plans will be developed for those investigations.

Schedule and Deliverables

The curtain will be deployed in the summer-fall of 2019. Field data collection will occur to bracket the curtain deployment period per the monitoring plan. Final data analysis and reporting would occur after data collection is complete and likely be completed in 2020.

3: Assessment of Irrigation Water Conservation Opportunities for Water Quality Improvement in the Upper Klamath Basin

Purpose and Objectives

Goal: Prepare a high-level assessment of irrigation water conservation opportunities in the Klamath Basin that provide benefits of both water quantity management and water quality improvement.

Use materials developed under this assessment to help focus future investment of funds allocated to the Irrigation Efficiency and Water Management category of the Priority List of Projects (PLP) under Interim Measure (IM) 11 (Water Quality) of the Klamath Hydroelectric Settlement Agreement. In addition, use the assessment to help stakeholders plan for implementation of additional irrigation water conservation projects funded by other outside funding sources.

Scope: Work under this assessment would be conducted in two phases as outlined below.

Phase 1 – Scoping:

In the first phase, the project team will further define and detail the scope of the assessment. This will include meeting with select stakeholders to discuss the goals, purpose, and desired outcomes of the proposed study and to gather input and insights to further focus the study work plan. Prior studies and projects that should be considered and additional stakeholders that should be consulted will be identified and a detailed scope of work and budget for Phase 2 will be prepared.

Potential stakeholders that will be consulted in Phase 1 include (but are not necessarily limited to): members of the Interim Measures Implementation Committee (IMIC), U.S. Bureau of Reclamation, Klamath Water Users Association (KWUA), Natural Resources Conservation Service (NRCS), Farmers Conservation Alliance (FCA), Klamath Irrigation District (KID), Klamath Tribes, U.S. Fish & Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (ODFW), Trout Unlimited (TU), and Modoc Point Irrigation District.

Phase 2 – Project Execution:

In the second phase, the project will be further detailed and defined as the work product of Phase 1. However, a draft list of tasks for Phase 2 is presented below for initial project planning purposes.

1. Information gathering from stakeholders.
2. Definition of project study area and subareas and water user categories to stratify potential project opportunities.
3. Evaluation of relevant completed projects to compile examples of project costs and benefits.
4. High level assessment of irrigation water conservation opportunities stratified by basin subarea and water user category. Where specific projects have already been identified and provided by participating stakeholders, these projects will be summarized. However, the assessment will primarily address categories of project opportunities with considerations for project cost, water quantity and quality benefits, and implementation requirements.
5. Description of potential opportunities to increase environmental flows, habitat recovery, and water quality improvement.
6. Discussion of future IM 11 funding priorities based upon results of the assessment.

Schedule and Deliverables

Work on this task would start in winter of 2019 and be completed in the summer of 2019.

Deliverables associated with the two phases are work include development of a detailed Phase 2 work plan for as the deliverable for Phase 1. The deliverable for this Phase 2 of the task will be a report on irrigation water conservation opportunities stratified by basin subarea and water user category.

4: Agency and Barnes Lake Water Quality Evaluation

Feasibility Assessment – Agency Wetlands Water Quality Treatment

Hydrologic modification throughout the Upper Klamath Basin has led to the diking and draining of thousands of acres of emergent wetlands surrounding Upper Klamath Lake. Dramatic declines in the abundance and distribution of these wetland habitats have resulted in a decreased capacity of the system to sequester nutrients. Due to infrastructure, size, and hydrology (timing and volume), existing wetlands have limited nutrient sequestration capability, and now inputs often exceed retention. Excessive nutrient loading into Upper Klamath Lake is linked to increased algae blooms that exacerbate low dissolved oxygen conditions throughout the summer months -- a key factor impacting federally listed shortnose suckers (*Chasmistes brevirostris*) and Lost River suckers (*Deltistes luxatus*). In addition, poor water quality persists downstream into the lower reaches of the Klamath River, causing additional algae blooms and toxic conditions.

Over the last two years, TU has worked closely with the USFWS, private landowners, TNC, NRCS, and other stakeholders to support the development of a large wetland restoration project adjacent to the Upper Klamath National Wildlife Refuge, and previously referred to as the “Agency-Barnes Ranch.” The project encompasses an area of 14,000 acres, 70% of which is federally owned. The remaining 30% is privately owned but the properties have been enrolled in USFWS and NRCS easements to facilitate conservation and restoration on a large scale.

Preliminary designs are underway for the wetland restoration, as well as the restoration of Sevenmile and Fourmile Creeks. However, current designs do not have a substantial water quality improvement component, and without additional funding there is no capacity to include water quality into the design process. Because of the importance of functional lake fringe wetlands to sequester nutrients, it is critical that nutrient management is assessed and maximized during the design process, in conjunction with the other project needs (e.g. instream habitat, waterfowl habitat, etc.).

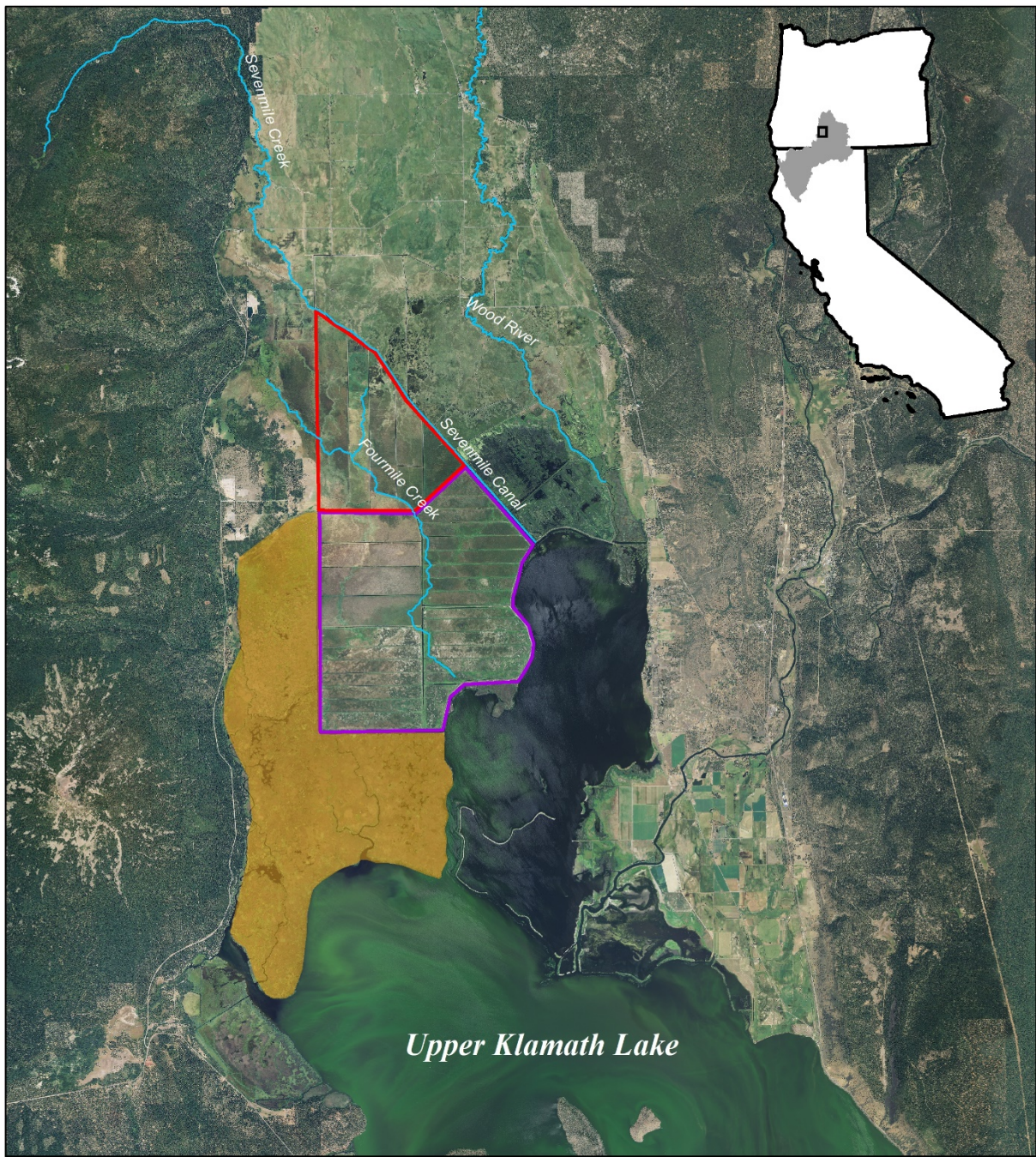
This project will address the following:

- Analyze existing data to determine nutrient loads and water volumes flowing into the Agency Wetlands project site, specifically those contributions from West Canal and Central Canal.
- Model multiple inundation and vegetation scenarios to evaluate treatment capacity of restored wetlands
- Develop preliminary water quality treatment designs that can be incorporated into the USFWS NEPA process for the full wetland restoration design.

The proposal addresses Interim Measure 11, which is intended to improve water quality in the Klamath River during this interim period before dam removal.

IM11 Funding Request: \$30,000

(secured match from The Nature Conservancy: \$20,000)



Agency Wetlands: Water Quality Feasibility Assessment



0 0.75 1.5 3 Miles



Private w/ Easement



Federal - diked and drained



UKNWR - existing wetland



12/13/2018

5: Design and Installation of a Biochar Filtration System to Improve Water Quality in Upper Klamath Lake

Design and installation of a biochar filtration system to improve water quality in Upper Klamath Lake

Conceptual Proposal for Phased Technology Assessment submitted to the IM-11 Committee on December 13, 2019

Partners include: BioLogical Carbon, Delaney Forest Products, the Oregon Department of Agriculture's Water Quality Program, the Klamath Watershed Partnership (grantee)

With support from: Todd Jarvis—Oregon State University, Institute of Natural Resources, Jeff Nason—Oregon State University, Chemical, Biological, and Environmental Engineering, Myles Gray—stormwater engineer at Geosyntec, Sarah Burch—Ph. D post-doctoral student in Water Resources Engineering at Oregon State University

Background

The Oregon Department of Agriculture's Water Quality Program has been working with landowners and local conservation partners & agencies to develop projects to improve water quality around Upper Klamath Lake since March 2018. This work was in response to concerns about the endangered Sucker species in the Lake and the detrimental effect of poor water quality and algal blooms on the species. The goal is to significantly reduce phosphorous contributions from agricultural operations to Upper Klamath Lake. The Upper Klamath Lake TMDL states that 13% of the external phosphorous loading to the Lake is from the pumps directly contributing to the Lake.

A project type with high potential to result in significant phosphorous reduction from agricultural runoff is the use of biochar and other filtration mediums at locations where tailwater is concentrated at irrigation canal pumping stations (or within irrigation canals). In the summer of 2018, ODA reached out to Matt Delaney and John Miedema and asked them to help develop a solution.

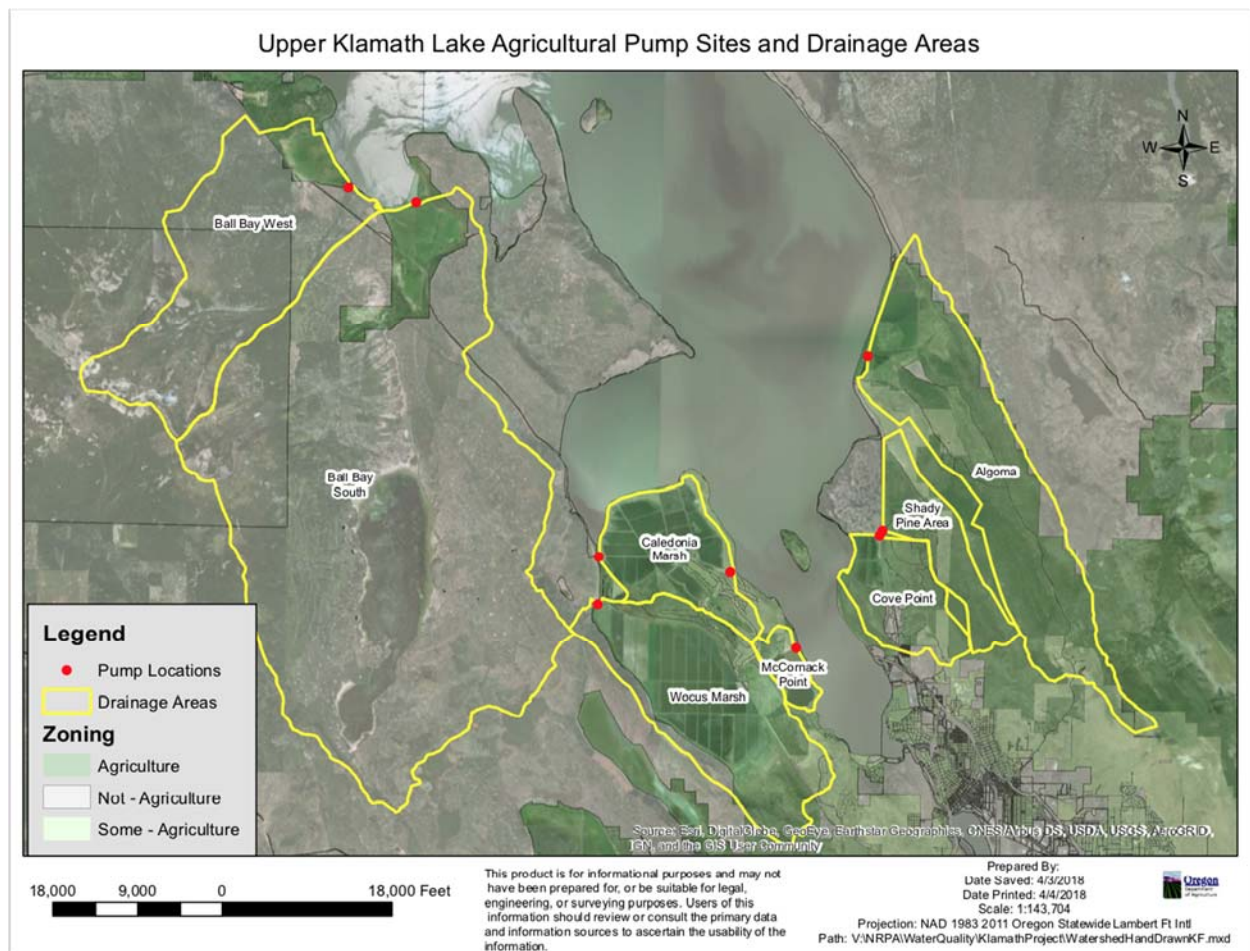


Figure 1: Map displaying the pump site locations contributing water directly to Upper Klamath Lake and the approximate perimeters of the associated drainage areas.

Biochar represents a tremendous opportunity to solve significant environmental challenges in Oregon while also creating new technologies, products, and jobs in our state. We are seeking funding from the Interim Measure 11 Committee to execute a small-scale technology pilot project in the Upper Klamath Lake watershed. The pilot project involves deploying biochar media to filter phosphorus from agricultural runoff to help farmers meet water quality standards set by the Oregon Department of Environmental Quality (DEQ) and the Oregon Department of Agriculture (ODA)

Our team has the knowledge, skills, and experience to develop a commercially viable biochar media and system to address one of Oregon's biggest problems

(agricultural runoff and degradation of water quality). We are seeking funding to support a proof of concept pilot project.

Statement of qualifications

Delaney Forestry Services believes that with the right combination of research and business expertise we can create solutions that are good for farmers, good for land managers, and good for the environment. Over the last four years, Matt Delaney and John Miedema (BioLogical Carbon) have collaborated on various projects related to biochar.

Earlier this year, Matt and John completed a three year US Forest Service grant that tested biochar's ability to enhance Oregon blueberry production. Working with Oregon State University and Family Forests of Oregon we conducted scientific research on biochar's ability to improve blueberry cultivation. We are finalizing all the data on that trial but early signals are quite positive (OSU researchers measured a 50% boost in fruit yield) and we are preparing to develop biochar soil amendments for blueberry growers next year.

In 2014, Matt Delaney lead a successful grant writing team that involved the Family Forests of Oregon, OSU, and John Miedema. We tested if biochar (made from wood residues) could remove pollutants from wastewater, including phosphorus. Our team determined that biochar (when blended with certain ingredients) was effective at removing phosphorus from water. The full report can be found on the Delaney Forestry Services web site⁶.

In 2016, Matt Delaney and John Miedema worked with Oregon State University (OSU) researcher Sarah Burch to test biochar's ability to remove copper and zinc and other pollutants from wastewater. Our team learned that biochar can remove pollutants better than existing commercially available medias (like activated carbon). We then worked with Karl Mundorff and others at the OSU Advantage Accelerator⁷ in 2017 to develop a strategy to bring the biochar media and filtration systems to market.

These are just a few examples of how Delaney Forestry Services and Biological Carbon work together with researchers, to create tailored products to address difficult and challenging environmental issues in Oregon. Most of the biochar our team produces is made using logging or mill residues, but our team also has

experience with Oregon agricultural residues. That is one of the many appealing aspects of our approach to biochar product development, we are committed to using low-value waste biomass that would otherwise a) create air pollution during forest slash pile burning, b) lost due to a wildfire, or c) left in a field to decompose.

⁶ Delaney Forestry Services. 2014. Biochar for remediation of water pollution in Sweet Home, Oregon.

http://delaneyforestry.com/wp-content/uploads/2015/05/dfs_biochar_pollution_remediation.pdf ⁷ OSU Advantage Accelerator. <https://advantage.oregonstate.edu/advantage-accelerator>

Proposed Actions and Deliverables

Phase 1: Laboratory testing utilizing stock materials, local Klamath materials, and tailwater from Upper Klamath Lake Farms

- Assess treatment effectiveness and lifetime of different filter media options
- Compile hydraulic data for filter media options
- Assess likely media replacement cycles for operations & maintenance cost estimates

Phase 2: Site specific design of pilot filtration system

- Following Phase 1, use hydraulic and pollutant removal data to develop a filtration system design
- Design site-specific, practical, low cost, low maintenance filtration system; taking into consideration long-term operations & maintenance by agricultural landowners

Phase 3: Installation & testing of pilot filtration system on a farm adjacent to Upper Klamath Lake

Reporting: Major project findings will be documented and reported to the IM-11 Committee and the Oregon Department of Agriculture prior to December 2019.

Phase 4: (Not included in this proposal) Installing similar site-specific filtration systems at other agricultural pump sites around Upper Klamath Lake and agricultural operations throughout the Klamath Basin

Phase 5: (Not included in this proposal) Investigation of a broader biochar framework for the Klamath area using local forest bi-products, local biochar generation, filtration of phosphorous from runoff and waterways, and utilization of biochar as a soil amendment for local agricultural operations.

Project Elements

Biochar production: Biochar medias will be produced from Oregon forest &/or agricultural residuals and will be assembled by BioLogical Carbon in Philomath. Our project team member, John Miedema has a research scale biochar retort at his location in Philomath. His machine can make about 100 pounds of biochar per day, which will be sufficient for Phase 1,2,& 3 activities.



Column test: Test biochar medias in a laboratory using nutrient polluted waters from Upper Klamath Lake. A column test involves running these polluted water through a series of 3" diameter PVC pipes that are packed with different biochar based treatment medias. This column test will provide us with data on rate of phosphorus removal using different combinations of our biochar and other

specialty materials to remove phosphorus and achieve the regulatory standard that Oregon Department of Agriculture requires.



Field deployment: once we dial in the biochar medias in the lab, our next task will completion of a final treatment system design, followed by deployment at one farm property adjacent to Upper Klamath Lake.

ODA has indicated that they are interested in two general categories of treatment approaches, either an “in canal” passive gravity system (i.e. bioswale) or a system where water is pumped through treatment filters at irrigation pumping stations and having the water filter through the biochar media.

There are pros and cons of each approach, however a passive gravity system is likely to be the lowest cost option. However, we plan to work with ODA on a system that is suitable (and economical) for each farmer while also meeting the regulatory standards for nutrient concentrations.

Potential design options include, but are not limited to, the following:

Filter Designs

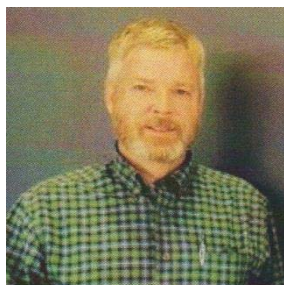
Filter Type	Description	Pros	Cons
Filter check dams or gabions	<ul style="list-style-type: none"> Horizontal filtration located within existing channel 	<ul style="list-style-type: none"> Lowest Cost 	<ul style="list-style-type: none"> Problematic hydraulics so clog rapidly Need to be designed to withstand flood flows Not allowed to increase flood elevations Remains saturated so media degradation can occur
Passive downflow filter	<ul style="list-style-type: none"> Downflow media filter with perforated underdrain Located offline from flow 	<ul style="list-style-type: none"> No pumping required Effective hydraulics 	<ul style="list-style-type: none"> Requires trenching so could be expensive May not be suitable location
Pumped downflow filter	<ul style="list-style-type: none"> Downflow media filter with perforated underdrain Pump station to convey treatment flow rates to filter outside of flood zone 	<ul style="list-style-type: none"> Outside of flood zone Effective hydraulics Flexibility to filter only when needed which can increase lifetime of media 	<ul style="list-style-type: none"> Higher cost

The Klamath Watershed Partnership will serve as the grantee and administer the grant from the IM-11 Committee (Please see attached letter of support). The Klamath Watershed Partnership's non-profit tax ID is: 93-1215213.

60% of the budgeted amount will be paid upon execution of a contract between the Klamath Watershed Partnership & Delaney Forestry Services.

25% after we complete the installation of our technology & biochar media at the project site (field deployment), and 15% upon completion of the final report and delivery of findings to the IM-11 Committee. All milestones triggering payment will be achieved and documented, prior to December 2019.

Team Members



Matt Delaney, is a forester and small business owner (Delaney Forestry Services LLC, Oregon Secretary of State Business Registry Number #1028057-93). He holds a M.S. degree in forestry from the University of Illinois and a B.S. in Environmental Studies from the SUNY College of Environmental Science and Forestry. Over his nearly 20 year

career, he has worked on a variety of forestry and other natural resource projects helping to implement \$20 million dollars' worth of projects throughout the United States and Internationally on over two million acres of land. In the spring of 2015, Matt Delaney led a grant writing team that secured a US Forest Service Wood Utilization Assistance program award to develop biochar markets made from low-value forest biomass. He is currently working with a diverse team of researchers at Oregon State University and the USDA

Agricultural Research Service in addition to private sector industry partners, to develop markets for biochar products made from low-value biomass. He is currently working with these partners to commercialize biochar products based on research for Oregon agricultural applications (blueberry biochar amendments). In his work with John Miedema, Matt is providing advisory services to help convert numerous biochar related research studies in Oregon and bringing them to a commercialized level. Examples include, biochar compost (working with BioLogical Carbon and Rexus Inc.), USDA ARS & OSU research on biochar products to control turf grass pathogens, and Oregon State University investigations of juniper wood product potential.



John Miedema is a recognized leader and developer of biochar technology and medias. He is Founder and CEO at BioLogical Carbon Inc. (BCI) in Philomath, Oregon. BCI's primary mission is applied research and production of high quality biochar products for filtering water pollutants, remediation of environmental toxins and building soil fertility.

As the Director of Biomass Energy for Thompson Timber and Starker Forests in Philomath, Oregon, John built an integrated pyrolysis and gasification facility for biochar research at a log-chipping yard. At this site today, and with local partners, BCI produces biochar-based medias with various streams of underutilized feedstock from the farming, livestock, timber and mining industries. These "designer" chars and medias are being used in research at a number of university, government and private projects. John is also the founder of the Pacific Northwest Biochar Initiative and has taken a leadership role in biochar advocacy and research since 2007.

John Miedema works with a variety of private companies, university researchers, and federal agencies on biochar product development, filtration design, and installation of filtration solutions.

If funding is secured for this project, John would draw on his expert team of collaborators to create and design a filtration solution for Upper Klamath Lake.

His collaborators include:

- Todd Jarvis—Oregon State University, Institute of Natural Resources.
<https://inr.oregonstate.edu/people/w-todd-jarvis>
- Jeff Nason—Oregon State University, Chemical, Biological, and Environmental Engineering
<https://cbee.oregonstate.edu/people/jeffrey-nason>
- Myles Gray—stormwater engineer, Geosyntec



Sarah Burch is a Ph. D post-doctoral student in Water Resources Engineering at Oregon State University.

Her PhD research evaluates sustainable stormwater treatment for metals using biochar, a co-product of biomass energy production. The goal of her research is to identify specific mechanisms for pollutant removal by biochar. Her expertise includes working on batch and column experiments with characterization of biochar materials and modeling

results.

Sarah has experience in environmental consulting in New York, Connecticut, and Ohio and an MS/BS degree in environmental engineering from Rensselaer Polytechnic Institute. Sarah is interested various remediation applications of biochar and has collaborated in additional industrial and research investigations.



Klamath Watershed Partnership

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Phone (541) 850-1717 ~ Fax (541) 850-8001

December 14, 2018

Demian Ebert
PacifiCorp
Principal Environmental Scientist
825 NE Multnomah, Suite 1500
Portland, OR 97232

Demian:

I am pleased to write this letter in support of the Oregon Department of Agriculture (ODA) efforts to assist farmers and ranchers with innovative methods for improving water quality conditions in the Klamath Basin. Klamath Watershed Partnership (KWP) represents the watershed council for the Upper Klamath Basin of Oregon and is involved in a wide variety of restoration and technical assistance projects associated with overall watershed health. KWP is committed to working with agencies such as ODA to increase the efficiency and effectiveness of water quality improvements in the Klamath Basin.

The most recent discussions regarding biochar filtration and the opportunity to team with BioLogical Carbon on pilot projects is a great step forward. Treatment of agricultural runoff in the Klamath Basin has been a problem, restricting options for irrigation and economic development in conjunction with a healthy environment. Phosphorous loading as a result of tailwater returns has been a concern for fisheries and strains the relationship between farmers and tribal groups. With the potential to use biochar filtration for treating these returns, we can create new options to assist landowners. Additional support is needed to determine the options available with biochar filtration and KWP stands behind the effort to make this a viable solution.

In support of the innovative biochar filtration projects, KWP can provide time dedicated to grant writing, match funding support, and administrative support. We will assist ODA in their efforts to pursue new ideas that help the community maintain our agricultural heritage while protecting the environment and saving natural resources for future generations. Feel free to contact me if you have any questions.

Sincerely,

Bill Lehman
Executive Director
Klamath Watershed Partnership
205 Riverside Drive, Suite C
Klamath Falls, OR 97601
Phone: 541-850-1717
E-mail: blehman@klamathpartnership.org



September 27, 2018

Delaney Forestry Services LLC
38674 Harrington Drive
Lebanon, Oregon 97355

Dear Mr. Matt Delaney:

The Oregon Department of Agriculture (ODA) is pleased to support the proposal "Implementation of biochar filtration project to improve water quality in Upper Klamath Lake". The innovative project has the potential to create a very useful tool for reducing nutrient loading from agricultural operations to Upper Klamath Lake.

Upper Klamath Lake is plagued by poor water quality that has led to pervasive annual harmful algal blooms and conditions that are believed to be a significant factor in the decline of endangered sucker species in the Lake. Water from Upper Klamath Lake flows to the Klamath River system downstream. The Klamath River is notoriously struggling for improved water quality for the health and viability of the salmon species in the River.

The reduction of nutrient loading, specifically phosphorus loading, to Upper Klamath Lake from agricultural operations will help agriculture meet their requirements for the Upper Klamath Lake TMDL (Total Maximum Daily Load) and improve the quality of water that moves downstream.

The Oregon Department of Agriculture's Water Quality Program staff have been working with all the agricultural landowners around the Lake to improve water quality. We are currently monitoring agricultural water quality and quantity, as well as developing on-farm projects to improve water quality.

ODA's staff began discussions with Delaney Forest Services in early summer 2018 regarding the use of biochar as a filtration medium to reduce phosphorus loading to the Lake. If this biochar filtration pilot project proves to be a success, which we expect it to be, the new designs and filters could be used at all the agricultural pump outlets to Upper Klamath Lake. The technology could also be spread to other areas of the Klamath Basin. As the grant application describes, this technology has the potential to be used on a broad scale to improve agricultural water quality.

ODA has already provided support to the project by coordinating communication between Delaney Forestry Services LLC, the Klamath Watershed Partnership, and Klamath agricultural producers. ODA has also communicated with staff from Oregon DEQ, the California North Coast Waterboard, the Klamath Tribes Research Station, and others regarding this pilot project. We are excited to continue to assist by facilitating

additional coordination, site visits, input on design ideas, and placement, implementation, and monitoring of the pilot project.

We are also pleased to know that you plan to partner with Oregon State University in this project, given OSU's long history and wealth of knowledge on agricultural sciences, economics, and education.

We look forward to working with you on this project.

Sincerely,

A handwritten signature in black ink that reads "Stephanie Page". The script is fluid and cursive, with the first letters of each name being capitalized and prominent.

Stephanie Page, Director
Natural Resources and Pesticide Programs
(503) 986-4713

6: Potential Purchase of Barkley Springs/Knoll Ranch

The Barkley Springs area located on the east side of Upper Klamath Lake historically was an important cultural and village site for the Klamath Tribes. The springs were also an important spawning and rearing habitat for the C'waam and Koptu. Construction of the railroad, highway, park, and farming operations have degraded the springs and nearby aquatic habitats. Some habitat restoration work has recently occurred with the construction of a meandering stream channel connecting a large spring pond to the adjacent lake channel. However, there is much more that could be done at the site for habitat restoration and cultural and heritage resources. Further, the adjacent agricultural operation continues to use Barkley Springs for irrigation resulting in depletion of the spring discharge and dewatering of the lake channel. These activities entrain fish into the irrigation canals and strand fish in the lake channel. Also, during the late winter high nutrient agricultural drainage is pumped into Upper Klamath Lake.

Trout Unlimited, US Fish and Wildlife Service, Knoll Ranch, The Klamath Tribes and Klamath Irrigation District began discussions in March 2018 to identify actions that would benefit endangered suckers and other native aquatic species in Upper Klamath Lake and provide ground water irrigation rights equivalent to the relinquished surface water right from Barkley Springs and UKL. The Knoll Ranch indicated they would be willing to sell or donate approximately 7 acres including Barkley Springs at Hagelstein Park if an irrigation well and infrastructure was secured at no cost to Knoll Ranch. There were additional discussions that the Knolls' agricultural land could potentially be restored back to wetland and sucker rearing habitat.

The Knolls are willing to consider sale of their entire property (754 acres) which includes Barkley Springs to the Klamath Tribes. Purchase of the property by the Tribes/USFWS or another conservation group will eliminate diversion of up to 2.5 cfs of high quality spring flow from Barkley Springs; diversion of up to 10 cfs from UKL; discharge of approximately 2-3,000 acre-feet of high nutrient agricultural drainage to UKL annually; provide opportunities for up to 750 acres of wetland restoration; provide opportunities to restore 7 acres of high quality sucker spawning and rearing habitat at Barkley Springs; eliminate two unscreened diversions (one at Barkley Springs and one at Algoma Pond); provide opportunities for permanent protection of an important cultural resource site; and provide opportunities for recreational, cultural, and spiritual use of a tribally owned property.

The Klamath Tribes could potentially take advantage of several public programs to fund the purchase of the property. Acquisition funding is potentially available from the Endangered Species Land Acquisition Grant Program (Section 6) and PacifiCorp IM-11 funds. Conservation easement funds are available from the Oregon Watershed Enhancement Board and Natural Resources Conservation Service (NRCS). Wetland Reserve Easements through NRCS pay 100 percent of the easement value for permanent easements and 75-100 percent of the restoration costs. Habitat restoration funding is also available through the US Fish and Wildlife Service Partners for Fish and Wildlife Program and National Fish and Wildlife Foundation. The Tribes could also sell the property to the Nature Conservancy or US Fish and Wildlife Service National Wildlife Refuge for permanent protection of natural habitats.