KHSA Interim Measure 15: 2014 Water Quality Monitoring Study Plan

1. Introduction and Overview

On February 18, 2010, the United States, the States of California and Oregon, PacifiCorp, Indian tribes, and a number of other stakeholders signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA lays out the process for additional studies, environmental review, and a determination by the Secretary of the Interior regarding whether removal of four dams owned by PacifiCorp on the Klamath River (i.e., Iron Gate, J.C. Boyle, Copco 1, and Copco 2 dams) will advance restoration of the salmonid fisheries of the Klamath Basin, and is in the public interest (which includes effects on local communities and tribes).

The KHSA includes provisions and detailed actions for the interim operation of the dams and mitigation activities prior to removal of the dams or the termination of KHSA. One of these measures titled: Interim Measure 15 - Water Quality Monitoring states that PacifiCorp shall fund ($500,000 per year) long-term baseline water quality monitoring to support water quality improvement activities, dam removal studies, permitting studies (as necessary), and form a long-term record to assess trends and other potential changes in the basin. This includes funding for blue-green algae (BGA) and BGA toxin monitoring, as necessary to protect public health. This plan addresses the fifth year of monitoring under Interim Measure 15 (hereafter referred to as IM 15). Since the goals and objectives of IM 15 remain the same and the sampling entities and locations are unchanged since monitoring began in 2009, this document provides a summary of the of IM 15 goals and objectives, sampling strategies, and any updates and/or changes to the sampling from previous plans (Note: In 2009, sampling was done under an interim settlement agreement). Detailed discussions on goals, objectives and the rationale for the parameters sampled can be found in the previous study plans, available on the Klamath Basin Monitoring Program (KBMP) website (http://www.kbmp.net) under the Collaboration tab on the Home page). This website hosts all of the IM 15 study plans and results.

This study plan outlines the parameters to be sampled, their frequency and location by sampling entity for the monitoring period from February 2014 through December 2014.The IM 15 monitoring includes monitoring of the Klamath River mainstem (including reservoirs) from Link River dam downstream through the estuary (Figure 1). The 24 monitoring sites have been sampled under this planning process since 2009.This plan is being conducted as one of numerous monitoring and/or study efforts in the Klamath River Basin, including annual monitoring of: tributaries above Upper Klamath Lake, Upper Klamath Lake, and tributaries to the Klamath River including the Lost River basin. These other efforts are being captured in a basin-wide framework developed by KBMP.

The water quality parameters, locations, sampling frequency, and sampling methods for the 2014 IM 15 sampling represents consensus amongst the following participants:

PacifiCorp, California North Coast Regional Board, Oregon Department of Environmental Quality, the Karuk and Yurok Tribes, U.S. Bureau of Reclamation and the United States Environmental Protection Agency (Region 9). Modification to this plan beyond 2014 is anticipated as science and monitoring programs evolve. Any modifications will be done in consultation with the participants listed above.

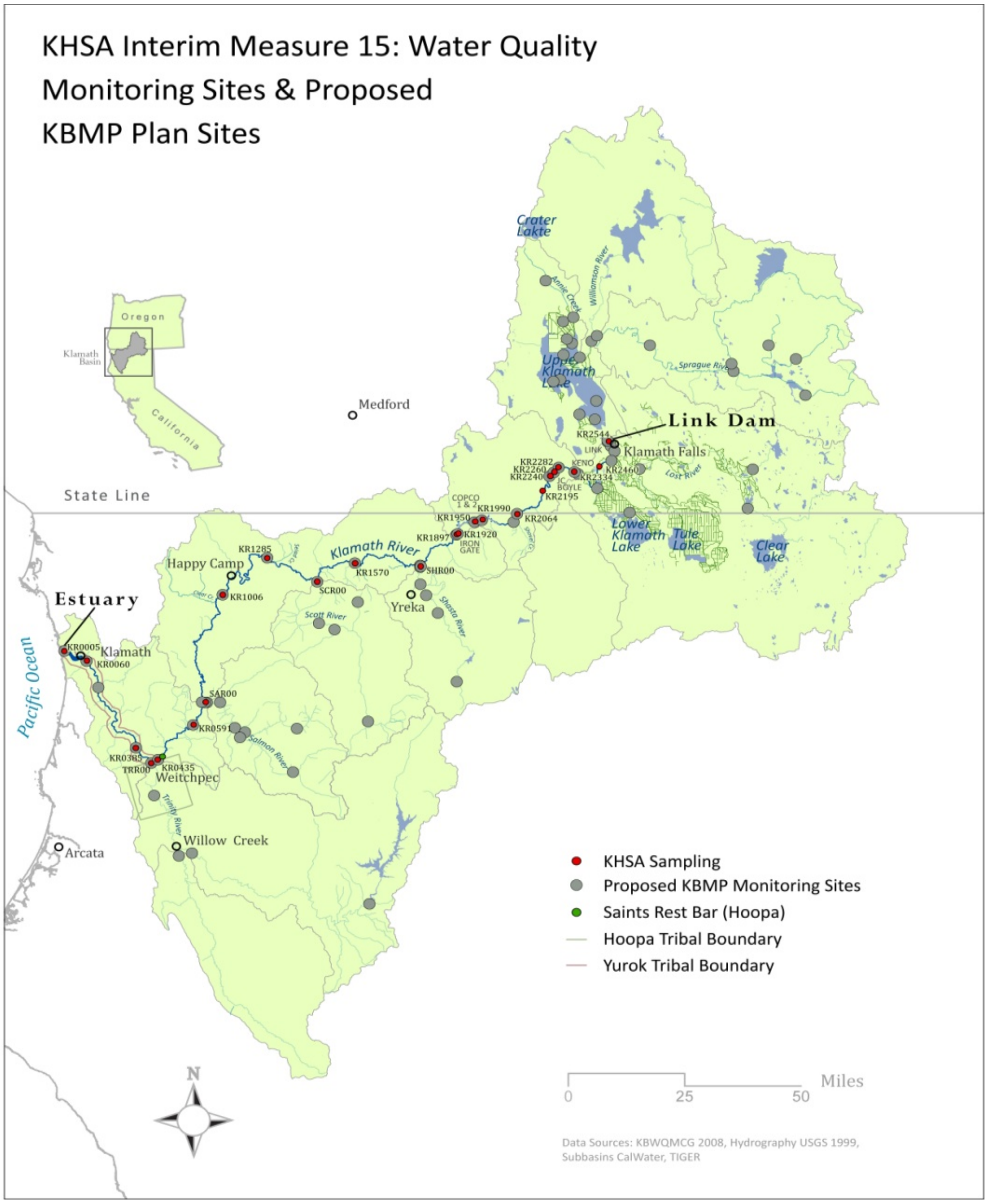

Figure 1.KHSA IM 15 Monitoring stations within the KBMP framework.

2. Objectives

The IM 15 monitoring objectives remain the same as previous years and include both public health monitoring for cyanobacteria and toxins, and baseline monitoring. These key objectives are:

- Provide data on cyanobacteria and related toxins in a timely manner to support public health decisions.
- Support the science in the dam removal framework.
- Improve the current understanding of seasonal, annual, and long-term variations in a wide range of water quality parameters for Klamath River from Link Dam to the estuary. A system wide approach is necessary because influences from upstream sources extend downstream.
- Support a long-term monitoring program that helps capture the effects of other activities in the system potentially affecting water quality in the Klamath River, including those related to: regulatory actions (e.g., Biological Opinions, TMDL implementation, adjudications, etc.), potential climate change, fires, and land use activities, as well as other factors.
- Provide a long-term baseline data set of water quality conditions that can be readily extended to assess impacts of management actions and restoration processes, including:
    - Clearly identifying current conditions for a wide range of hydrology, meteorology, and water quality conditions.
    - Identifying and quantifying potential water quality changes, impacts, and implementation measures.
    - Determining progress towards restoration of the river system and evaluation of possible mitigation measures to minimize long term impacts or promote/accelerate recovery
- Collect data under a consistent Quality Assurance (QA) framework
- Disseminate data in a timely fashion.

3. Monitoring Components

The 2014 IM 15 monitoring activities include the following two components; public health monitoring, and baseline monitoring.

3.1 Public health monitoring of Cyanobacteria and toxins

To assess potential risks to public health, due to exposure to cyanobacteria and their toxins occurring in the Klamath River, this monitoring component includes water column and shoreline water sampling within the Klamath River and reservoirs. A number of species of cyanobacteria have been documented in the Klamath River and reservoirs; the most abundant species include: *Aphanizomenon flos-aquae*, *Microcystis aeruginosa*, *Anabaena flos-aquae*, and *Oscillatoria sp*. Since 2004, Klamath River monitoring has documented elevated levels of toxin-producing cyanobacteria primarily *Microcystis aeruginosa* (MSAE) and the toxin microcystin. Microcystins are a class of toxic chemicals produced by some strains of cyanobacteria including MSAE, and are released into waters when cyanobacterial cells die or cell membranes degrade. MSAE blooms and microcystins at elevated levels can present risks to human health and to terrestrial and aquatic species, and result in impairments to a number of beneficial uses for the waterbody. Microcystin toxins are capable of inducing skin rashes, sore throat, oral blistering, nausea, gastroenteritis, fever, and liver toxicity (WHO 2003, OEHHA 2012).

The locations, parameters, and frequency associated with public health monitoring are listed in Tables 1 and 2, respectively.

3.2 Baseline water quality monitoring of the Klamath River

This component is designed to characterize water quality conditions by monitoring for basic water quality parameters (temperature, dissolved oxygen (DO), pH, and conductance) as well as a suite of nutrients and other related indicators. Results from baseline monitoring will be used to support water quality improvement activities, dam removal studies, permitting studies (as necessary), and form a long-term record to assess trends and other potential changes in basin water quality.

The locations, parameters, frequency and sampling entity associated with baseline monitoring are listed in Appendix A.

4. Quality Assurance, Data Management, and Dissemination

4.1 KHSA Program Quality Assurance Strategy for 2014

The IM 15 sampling entities have developed common sample collection methods, addressed the use of different laboratories, and refined data management and dissemination strategies. These include:

4.1.1 Quality Assurance

QA requirements have been evaluated, compared and documented through the *2010 Klamath River Baseline Sampling Program QA Comparison* (on the KBMP website, http://www.kbmp.net), which compares participating entity's existing QA plans and standard operating procedures. Except where otherwise specified, it is the responsibility of each monitoring entity to individually contract the services of laboratories for the analysis of water quality samples. In contracts with the laboratories, each reach monitoring entity includes requirements for a minimum level of laboratory QA procedures.

Water samples for public health monitoring are collected in accordance with the *Standard Operating Procedures (SOP), Environmental Sampling of Cyanobacteria for cell enumeration, identification and toxin analysis* (Cyanobacteria SOP, KBGAWG 2009). This SOP, developed for the Klamath River by the Klamath BGA Workgroup, is posted on the KBMP website.

4.1.2 Laboratories

Participants in the KHSA monitoring use common laboratories (labs) where possible and practical; however, there are instances where different labs are being used. The analysis of water quality samples by multiple labs requires additional QA procedures to enable comparisons of performance by participating labs. To support such a comparison, a number of nutrient samples (described in the QA requirements) are divided into splits and those splits sent to each of the lab doing nutrient analyses. The lab comparison memos prepared for 2009 through 2013 are available on the KBMP website. Duplicate samples will be collected by the Karuk Tribe, at the Klamath River site near Seiad Valley four times over the sampling season (April, July, September and October 2014). The results from this effort will be summarized in a lab comparison memo and posted on the KBMP website.

4.1.3 Data Management and Dissemination

In an effort to maintain continuity with the long-term basin wide water quality monitoring plan, KBMP in partnership with the California Environmental Data Exchange Network (CEDEN), has developed a searchable web-based database for the collection and dissemination of data characterizing the Klamath River Basin. This database is available on the KBMP website. All long-term baseline monitoring data are provided to

KBMP for inclusion in CEDEN, and final reports are posted at KBMP (as well as the PacifiCorp web site, http://www.pacificorp.com/es/hydro/hl/kr.html). At the end of the monitoring year, a report is developed summarizing the program results and presenting the inter-lab comparison findings.

Blue-green algae public health monitoring data, posted following lab analysis, and an interactive map are also available on the website. Each monitoring entity is responsible for maintaining all data collected, in usable spreadsheets (e.g. Excel). Public health monitoring of cyanobacteria and toxins requires prompt and effective communication of data to the local and state agencies to support management decisions regarding the need to post waterbodies with informational signage or issue health advisories. Thus, results from cyanobacteria cell count and toxin analyses are forwarded promptly to the appropriate local and state health agencies (e.g., ODEQ, California Regional Board and State Board, and County Health Departments). For public health cyanobacteria analyses (cell count and toxin levels), each sampling entity is responsible for producing a memorandum every two weeks with the most recent analytical results and distributing that memo to regulatory agencies and interested parties including KBMP (submitted in spreadsheet format). These public health memos, as well as annual summary reports for the baseline monitoring, are posted on the KBMP website.

5. Sampling Constituents and Frequency

The sampling locations for IM 15 have remained consistent over the years. The 2014 sampling locations for public health monitoring are listed in Table 1, and the sampling constituents and frequency can be found in Table 2. The baseline monitoring is summarized in Appendix A where, the sampling entity, the parameters samples, and the sampling frequency are listed by location.

5.1 Public health monitoring of cyanobacteria and toxins

Risks to public health related to cyanobacteria and toxin exposure will be evaluated through toxin analysis, identification and enumeration of cyanobacteria, and the identification of the presence of scums.

5.1.1 Locations

Public health monitoring for cyanobacteria and microcystin toxin in water samples will occur during 2014 at a total of 12 designated locations used for public access and recreation. These are listed in Table 1, and include:

- Four shoreline sites in coves on Copco (Mallard Cove and Copco Cove) and Iron Gate reservoirs (Camp Creek and Williams Boat Ramp). These cove sites provide public access, are known areas of likely accumulation during blooms, and have been monitored since 2005.

- Eight (8) river sites stretching from Iron Gate dam (River Mile (RM) 189.7) to Turwar (RM 6.0). Most of these sites have been monitored since 2005, and all represent areas of public access.

Table 1: 2014 Klamath River sampling sites for public health monitoring of cyanobacteria and cyanotoxins in surface water samples.

Location	**RM**	**Sampling Entity**
Copco Reservoir and Mallard Cove	200.8	PacifiCorp
Copco Reservoir at Copco Cove	198.5	PacifiCorp
Iron Gate Reservoir at Camp Creek	192.8	PacifiCorp
Iron Gate Reservoir at Williams Boat Ramp	192.4	PacifiCorp
Klamath River below Iron Gate Dam (Hatchery Bridge)	189.7	PacifiCorp
Klamath River at I-5 Rest Area	176	Karuk
Klamath River at Brown Bear River Access	157.5	Karuk
Klamath River at Seiad Valley	128.5	Karuk
Klamath River at Happy Camp	108.4	Karuk
Klamath River at Orleans	59.1	Karuk
Klamath River at Weitchpec	43.5	Yurok
Klamath River at Turwar	6.0	Yurok

Table 2: Klamath River IM 15 Monitoring Program 2014 – Summary Table of Public Health monitoring locations, constituents, method, and frequency.

Site ID	Location	Phyto-plankton Species	Microcystin - EPA	LC/MS/MS water for cyanotoxins	Sampling Entity
CRMC	Copco Reservoir at Mallard Cove	BM7-mod	BM7-mod	S	PacifiCorp
CRCC	Copco Reservoir at Copco Cove	BM7-mod	BM7-mod	S	PacifiCorp
IRCC	Iron Gate Reservoir at Camp Creek	BM7-mod	BM7-mod	S	PacifiCorp
IRJW	Iron Gate Reservoir at Williams Boat Ramp	BM7-mod	BM7-mod	S	PacifiCorp
KRBI	Klamath River below Iron Gate Dam (Hatchery Bridge)	BM/W	BM/W	-	PacifiCorp
IB	Klamath River at I-5 Rest Area	BM/W	BM/W	BM5	Karuk
BB	Klamath River at Brown Bear River Access	BM/W	BM/W	-	Karuk
SV	Klamath River at Seiad Valley	BM/W	BM/W	-	Karuk
HC	Klamath River at Happy Camp	BM/W	BM/W	-	Karuk
OR	Klamath River at Orleans	BM/W	BM/W	-	Karuk
WE	Klamath River at Weitchpec	BM/W	BM/W	-	Yurok
TG	Klamath River at Turwar	BM/W	BM/W	-	Yurok

Frequency	# of sample events	Sampling frequency description
BM7-mod	9	1x month in May and at least 2x month June through November
BM/W	16	Timing of public health monitoring will be at the discretion of the sampling entity.
BM5	10	2x month June-October
S	4	Analysis for anatoxin-a will be tied to the temporal and density distribution of *Anabaena* in the reservoirs but 4 test analysis are budgeted.

5.1.2 Sampling Frequency

Sampling for public health monitoring under this plan will occur at each of the identified sites as listed in Table 2:

For Copco and Iron Gate Reservoirs:
Public health sampling in Copco and Iron Gate reservoirs will begin in May, and then continue until the reservoirs are posted with health advisories, which usually happen by the end of July. Once the reservoirs are posted, public health sampling will not be rushed and these data will not be available for the bi-weekly BGA memos; however, the memos will include the microcystin toxin data as it is received from the laboratory. Based on the previous year's public health sampling (2005-2013) in the reservoirs, MSAE cell counts and/or microcystin levels will remain elevated until cooler weather and shorter days terminate the blooms. Reservoir samples will again be rushed during October to provide the data needed to de-post the reservoirs. All of the reservoirs public health sampling results will be included in a final public health memo

Following the schedule in Table 2, samples will be collected and submitted for identification and enumeration of toxigenic phytoplankton species and analysis of total microcystins by Enzyme-Linked ImmunoSorbent Assay (ELISA). This data will then be provided to regulatory agencies (e.g., California's North Coast Regional Water Quality Control Board) to inform whether criteria have been met to warrant the posting of public health advisories and to provide the necessary information to lift the public health advisories.

Although the results for anatoxin-a have been non-detect for samples analyzed to date, up to four reservoirs samples will be analyzed for anatoxin-a when elevated cell levels of *Anabaena* are present. These samples will be collected and frozen, and those samples having cell identification / enumeration results exceeding 40,000 *Anabaena* cells/mL will be submitted for anatoxin-a analysis.

For the Klamath River below Iron Gate dam:
A total of at least sixteen shoreline samples will be collected for toxigenic algae speciation and microcystin (ELISA) analysis to track cyanobacterial bloom conditions in the Klamath River below Iron Gate dam. To confirm ELISA results for microcystin, to see which microcystin congeners are present, and to test for the presence of anatoxin-a, a total of ten water samples will be collected at one location (I-5 Rest Area (Table 2)) for analysis by LC/MS/MS, on a bimonthly basis from June through October.

5.1.3. Sampling Procedures

Under the IM 15 monitoring program, water samples will be collected for phytoplankton species cell identification/enumeration to determine the presence and abundance of cyanobacterial species (e.g., *Anabaena sp.*, *Aphanizomenon sp.*, *Microcystis sp.*, etc.). Depending on the severity (e.g., density and size) of the algal bloom and timing (e.g., pending decision to post a reach due to species and cell density) sampling entities will specify whether a 48-hour rush or a 2-week turnaround will be requested for the phytoplankton sample analysis.

Water samples will also be collected for cyanotoxin analysis by one or two methods:

- ELISA for total microcystins, analyzed by the U.S. EPA Region 9 laboratory, in accordance with the U.S. EPA Region 9 Laboratory Standard Operating Procedure (SOP 1305 for Microcystin analysis by ELISA), and

- Liquid Chromatography - tandem Mass Spectrometry (LC/MS/MS) for microcystin congeners and anatoxin-a analysis (per Mekebri et. al., 2009), at the California Department of Fish and Game laboratory in Rancho Cordova, CA.

Sample collection and preservation will be conducted in accordance with the Cyanobacteria SOP (KBGAWG 2009).

5.2 Comprehensive Baseline Water Quality Monitoring of the Klamath River

5.2.1 Locations

The baseline water quality monitoring locations, constituents, and sampling frequency are presented in Appendix A. Twenty mainstem sites including the Klamath River estuary, and the mouths of four major tributaries, are identified for baseline monitoring.

5.2.2 Sampling Constituents and Frequency

Listed below are constituents sampled for the baseline monitoring plan. The baseline monitoring will begin in February 2014 and continue through December 2014.

Data Collection Using Sondes

For each of the following parameters, capturing sub-daily variability is important to understanding the dynamics present in the system. Continuous monitoring devices, with probes for the following parameters, at a minimum, will be deployed to address the period May to November.

- Temperature
- Dissolved Oxygen
- pH
- Conductance

Data Collection by Sampling

Table 3 outlines the sampling locations and frequency. The following parameters will be sampled during 2014 at least monthly, with a few exceptions.

- CBOD
- Inorganic/Organic Nitrogen (ammonia, nitrate, nitrite, organic N)Total Nitrogen
- Inorganic/Organic Phosphorus (orthophosphate, organic P)
- Particulate and Dissolved Carbon
- Total and Volatile Suspended Solids (TSS / VSS)
- Alkalinity
- Water Column Chlorophyll a/pheophytin
- Microcystin
- Phytoplankton
- Particulate and Dissolved Organic Carbon
- Particulate Nitrogen
- Particulate Phosphorous and Particulate Inorganic Phosphorus
- Dissolved Organic Nitrogen and Phosphorus

Most of the parameters listed above have been part of settlement agreement monitoring programs since 2009. Slight modifications have been made (e.g. particulate and dissolved organic carbon, particulate N and turbidity were added to the parameters sampled in 2012). Modifications to the sampling are anticipated as management actions change and science and monitoring program designs evolve.

6.0 SPECIAL STUDIES

In 2014, IM 15 continued to fund a periphyton study in the Klamath River to characterize the periphyton community. The sampling plan details are in Appendix B. This study builds on the 2011, 2012 and 2013 periphyton studies. IM 15 funds were also used to collect one sediment sample and 20 water quality samples in the Klamath River Estuary as part of a larger estuary study.

References

Klamath Blue Green Algae Working Group (KBGAWG), 2009. Cyanobacteria Sampling SOP, Standard Operating Procedures Environmental Sampling of Cyanobacteria for Cell Enumeration, Identification and Toxin Analysis; Developed for the 2009 AIP Interim Measure 12, Water Quality Monitoring Activities, Klamath River, V6, June 24, 2009

Mekebri, A., G.J. Blondina, and D.B. Crane. 2009. Method validation of microcystins in water and tissue by enhanced liquid chromatography tandem mass spectrometry. Journal of Chromatography A. 1216 (2009) 3147-3155.

OEHHA 2012. Toxicological Summary and Suggested Action Levels to Reduce Potential Adverse Effects of Six Cyanotoxins. Final Report-May 2012. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California 95812-4010

WHO. 2003. Cyanobacterial Toxins: Microcystin-LR in Drinking Water. Background document for the development of WHO Guidelines for Drinking-Water Quality. World Health Organization. Geneva.

APPENDIX B

2014 KHSA Special Studies

Special Study 1: Periphyton Study Plan

PURPOSE

The benthic community is often an important element of aquatic system condition, supporting a diverse flora and fauna that plays a role in the physical, chemical, and biological response in riverine systems (Naimen et al, 2009). An important element of the benthic community is the periphyton community. Although periphyton data in the Klamath River has been collected in the basin for several years, the record is spatially and temporally incomplete.

Due to lack of precipitation, extremely low flows are expected on the Klamath River and its tributaries in summer 2014. Years with extremely low flows are particularly valuable. Therefore, 2014 presents a unique opportunity to observe periphyton communities. Climate change is expected to decrease snowpack and summer stream flows in future years/decades, and thus 2014 may provide a preview of future conditions.

Benthic periphyton sampling is being proposed to a) form an initial baseline sampling program to define current conditions, b) continue to identify potential a systematic approach for characterizing the periphytic algal community in the Klamath River by continuing to collect samples at the same sites as in 2011 and 2012 with comparable methods, and c) observe periphyton communities in an extremely low flow year. Proposed sites extend from Iron Gate Dam to Turwar Gage. The proposed sampling would employ KHSA Interim Measure #15 funding in 2014. The Yurok and Karuk Tribes will complete baseline sampling as in previous years. No exploratory element will be included in this study. Effort will be made to look at the 2011-2013 results when summarizing the 2014 data set.

PROJECT HYPOTHESIS

Several hypotheses outlined for study in 2014 have been identified as part of previous studies:

- Periphyton species composition (spp. ID and enumeration) and algal biomass changes through time at individual sites during the principal growing season (June to November) in response to physical, chemical, and biological conditions.

The first hypothesis has been illustrated through at least three years of data (2004, 2011, 2012, 2013), but additional years are desired to identify potential inter-annual variability and consistent trends.

STUDY DESIGN AND HYPOTHESES

Longitudinal Monitoring

The purpose of this sampling study is to compare periphyton species and algal biomass spatial and temporal trends in the Klamath River from June to November (approximately middle of month sampling time) utilizing a standard sampling method. Each sampling entity will be responsible for collecting samples consistent with the final sampling protocol (to be updated from the 2013 protocol) and proper sample handling to submit samples to the laboratory for analysis. The same laboratory will be selected to process the species identification and enumeration samples (Aquatic Analysts Inc.) and periphyton algal biomass (Aquatic Research Inc.)

Nine sites have been identified for sampling periphyton in 2014 (Table 1). These sites may change in location depending on access and local conditions (e.g., safety, adequately substrate, lack of disturbance, shade, or other factors).

Table1. Sampling sites on the Klamath River for the 2014 Periphyton Study

Location	Approximate River Mile
below Iron Gate Dam	189
Interstate 5 Bridge	179.3
below Beaver Creek(nr Quigley's store)	160.5
Seiad Valley (Sluice Box river access)	130
Happy Camp	103
Orleans	60
Weitchpec	43.5
Turwar	6
Trinity River (mouth)	

In addition to the five-rock composite samples, additional observations will be collected at each site to enhance the interpretation of the species identification and enumeration. Specifically, the following observations will be included in the data sheet and reported in an end of season data report:

- Depth and velocity measurements at the sampling location. As per existing protocols, substrate is to be sampled in 1 to 3 feet of water where velocities are 1 to 2 feet per second. In the field this information is estimated at the time of sampling, but specifically measuring and recording this information will be included in 2014. Mean profile velocities (e.g., 60% depth) will be recorded with a current meter.
- Photosynthetically available radiation (PAR) will be measured with a PAR meter at multiple depths at the sampling site (in a nearby, representative area in minimum of 3 feet of water). These data will be recorded and processed to estimate light extinction characteristics for each site during each visit.
- A qualitative description of the substrate will be included (e.g., previous year screen counting grid).

Species identification and enumeration metrics will be reported for each sampling site.

<u>Deliverable</u>: Technical memorandum including the sampling plan, data (including field observation), final sampling protocol.

SAMPLING METHOD

As part of this study, the project team will expand on the sampling program developed in 2013 and consider specific conditions within the Klamath River. Updated protocols will be discussed, future research areas identified, and the final set of working protocols included in final documentation.

DATA SUMMARY AND REPORTING

The Tribes will generate agreed upon metrics to summarize sampling results and compile the technical memoranda identified above.

REFERENCES

Naiman, R.J., H. Decamps, M.E. McClain. 2005. *Riparia: Ecology, Conservation, and Management of Streamside Communities*. Elsevier Academic Press. Boston. 430 pp.

Special Study 2: Klamath River Estuary Study

The Yurok Tribe will collect one sediment sample and 20 water quality samples in the Klamath River Estuary as part of a larger estuary study. Samples will be collected beginning July 2014 and extend through end of October 2014. Data processing and summary report will be performed through the end of December with a final report completed by March 30, 2015.

Appendix A
2014 KHSA (Interim Measure 15) baseline water quality monitoring

Location	Temperature (oC)	Dissolved Oxygen (mg/l)	pH (log[H+])	Conductance (uS/cm)	Total N (mg/l)	Ammonia N (mg/l)	Nitrite+Nitrate (mg/l)	Total P (mg/L)	Ortho P (mg/L)	Particulate P and Particulate Inorganic P (mg/l)	Dissolved Organic N & P (mg/l)	Particulate and Dissolved C (mg/l)	Particulate N (mg/l)	TSS/VSS (mg/l)	Alkalinity (mg/l)	Water Column chl_a/Pheo	Phytoplankton species	Microcystin (ug/l)	LCMS confirmation	CBOD, mg/l	turbidity, (NTU)	Sampling Entity
Sampling Method:	*T,P*	*P*	*P*	*P*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	*G*	
Link Dam (RM - 254.4)	H	H	H	H		M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	BM/S		M2/BM2	M2/BM2**	**USBR**
Keno Reservoir at Miller Island (RM - 234.9)	H	H	H	H		M	M	M	M			M		M	M	M	M	M/S		M	M	**USBR**
KR below Keno Dam (RM -233.4) near a USGS gage	H	D	D	D		M2/BM2	M2/BM2	M2/BM2	M2/BM2	M		M	M	M	M2/BM2**	M	M	M/S		M2/BM2	M2/BM2**	**USBR**
KR above J.C. Boyle Reservoir (RM-228.2)	H	D	D	D	M	M	M	M	M			M		M	M	M	M-					**PacifiCorp**
J.C. Boyle Reservoir[a] (RM-226.0)	VP	VP	VP	VP												M/S	M/S	M/S				**PacifiCorp**
KR below J.C. Boyle Dam (RM-224.0)	H	D	D	D	M	M	M	M	M			M		M	M	M	M-					**PacifiCorp**
KR below USGS Gage (RM-219.5)	H	D	D	D	M	M	M	M	M			M		M	M	M	M	M/S			M	**PacifiCorp**
KR near Stateline (RM-206.4)	H	D	D	D	M2/BM2	M2/BM2	M2/BM2	M2/BM2	M2/BM2	M		M	M	M	M	M	M	M/S		M2/BM2	M	**PacifiCorp**
Copco Reservoir[b] (RM-199.0)	VP	VP	VP	VP	M	M	M	M	M			M		M	M	M	M-	M/S				**PacifiCorp**
KR below Copco Dam (RM-195.0)	H	D	D	D	M	M	M	M	M			M		M	M	M	M-	M/S				**PacifiCorp**
Iron Gate Reservoir[c] (RM-192.0)	VP	VP	VP	VP	M	M	M	M	M			M		M	M	M	M-	M/S				**PacifiCorp**
KR below Iron Gate Dam (RM-189.7)	H	H	H	H	M/BM	M/BM	M/BM	M/BM	M/BM	M/BM		M/BM	M/BM	M/BM	M/BM	M/BM	M/BM	BM/S		M2/BM2	M/BM	**PacifiCorp**
KR at Walker Bridge (RM- 176.7)	H	D	D	D	M	M	M	M	M			M		M	*	M	M-	M/S	S2			**Karuk**
KR below Seiad (RM - 128.5)	H	H	H	H	M	M	M	M	M	M		M	M	M	*	M	M	M/S		M	M	**Karuk**
KR near Happy Camp (RM-93.5)	H	D	D	D	M	M	M	M	M			M		M	*	M	M-	M/S				**Karuk**
KR at Orleans (USGS) (RM-59.1)	H	H	H	H	M	M	M	M	M			M		M	M	M	M	M/S			M	**Karuk**
KR at Weitchpec (RM-43.5)	H	H	H	H	M	M	M	M	M			M		M	*	M	M-	M/S	S2			**Yurok**
KR below Trinity River (RM-38.5)	H	H	H	H	M	M	M	M	M			M		M	*	M	M-	M/S				**Yurok**
KR near Klamath (RM-6.0)	H	H	H	H	M	M	M	M	M	M		M	M	M	*	M	M	M/S			M	**Yurok**
KR Estuary[d] (RM-0.5)	HP	D	D	D	M	M	M	M	M			M		M	*	M	M-	M/S				**Yurok**
Shasta River near mouth	H	H	H	H	M	M	M	M	M			M		M	*	M	*				M	**Karuk**
Scott River near mouth	H	H	H	H	M	M	M	M	M			M		M	*	M	*				M	**Karuk**
Salmon River near mouth	H	H	H	H	M	M	M	M	M			M		M	*	M	*				M	**Karuk**
Trinity River near mouth	H	H	H	H	M	M	M	M	M			M		M	*	M	*				M	**Yurok**

[a] Sampling at one depth in J.C. Boyle reservoir (0.5 m depth = surface)

[b] Sampling at 3 depth Intervals in Copco reservoir (0.5 m, thermocline and 0.5m from the bottom)

[c] Sampling at 3 depth intervals in Iron Gate reservoir (0.5, thermocline and 0.5m from the bottom)

[d] Hourly sampling in the estuary at 4 locations (two in lower estuary, one in mid estuary and one in upper estuary)at two depths (0.5m and bottom)

KEY

Sampling Method

T – thermistor
P – probe or data sonde
G – grab sample
D – discrete sample

Sampling Frequency

VP – vertical profile at stated sampling frequency
H – hourly measurements by sondes (in some instances sub-hourly data may be desired)
M – monthly sampling, excluding January
M/S – monthly sampling, seasonally from May through October
M/BM – Bi-monthly sampling May - October and monthly sampling the remainder of the year
M2/BM2 – Bi-monthly sampling June-September and monthly the remainder of the year
BM/S –Bimonthly sampling July-Oct
S2 – monthly sampling July - Oct
* - Not sampled This parameter is covered M/S by Tribal WQ Workgroup
M- = Monthly Sampling with exception of December, January and February
M2/BM2 **– Bi-monthly sampling June-September and monthly the remainder of the year and consider adding May and October to go to M/BM
HP - Hourly measurements in a profile