KARUK TRIBE

DEPARTMENT OF NATURAL RESOURCES

P.O. Box 282 * Orleans, California 95556

2011

Quality Assurance Project Plan

For Water Quality Sampling and Analysis

CWA 106 grant identification # BG-97991209

Prepared by

Karuk Tribe Water Quality Program

Karuk Tribe Water Quality Program

Quality Assurance Project Plan

For Water Quality Sampling and Analysis

Water Quality Program
Karuk Tribe Department of Natural Resources
PO Box 282
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This QAPP has been approved by:

Karuk Water Quality Project Manager _____

Karuk Water Quality QA Officer _____

For EPA use:

Approved by EPA Project Manager: Date:

_____ _____

Expedited Review? □ Yes □ No

Received by QA Office: Date:

_____ _____

Reviewed by: Date:

_____ _____

Approved: Date:

_____ _____
Region 9 Quality Assurance Manager

1.2 Table of Contents

List of Appendices

1.3 **Distribution List**

The following is a list of individuals who will receive copies of the approved QAPP and any subsequent revisions or changes.

1.4

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1.5 Project Organization

Table 1 lists key players and contractors, including those collecting samples, contractors that will process samples and KTWQP staff that will oversee quality control (QC) procedures. Laboratories that will process samples are 1) Aquatic Research Inc. in Friday Harbor, Washington, 2) Aquatic Analysts Inc. in White Salmon, Washington, 3) the U.S. Environmental Protection Agency Region IX Laboratory in Richmond, California, and 4) the California Department of Fish and Game's Fish and Wildlife Water Pollution Control Laboratory in Rancho Cordova.

Table 1. All parties participating in collection, shipping and handling, analysis of Klamath River nutrient, phytoplankton and algae generated toxics data by the KTWQP and those responsible for implementation of QA/QC procedures

Title/Responsibility	Staff/Contractor	Phone Number
EPA Project Manager	Janis Gomes	(415) 972-3517
Project Manager	Crystal Bowman	(530) 469-3456
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Field Manager	Grant Johnson	(530) 469-3258
KTWQP Staff	Chook-Chook Hillman	(530) 469-3258
Quality Assurance Officer	Grant Johnson	(530) 469-3258
Contractor, Aquatic Ecosystems	Jacob Kann	(541) 482-1575
Contractor, Aquatic Research Inc.	Steve Lazoff	(206) 632-2715
Contractor, Aquatic Analysts	Jim Sweet	(509) 493-8222
USEPA Region 9 Lab	Andy Lincoff	(510) 412-2330
CA Fish and Game Lab	Dave Crane	(916) 358-4395

The Karuk Tribe Water Quality Program (KTWQP) is completing this *QAPP* to define how quality control (QC) procedures are implemented and to define how the KTWQP and its staff will work together on quality assurance (QA) to insure that data are properly collected and analyzed, managed and stored for on-going use, and results published in a timely fashion. Because of the systematic planning process documented in this *QAPP*, the KTWQP will supply quality assured data for management decisions related to the aquatic environment within Karuk

Ancestral Territory (KAT) and surrounding areas Figure 1. Figure 2 outlines the schedule for implementing this QAPP.

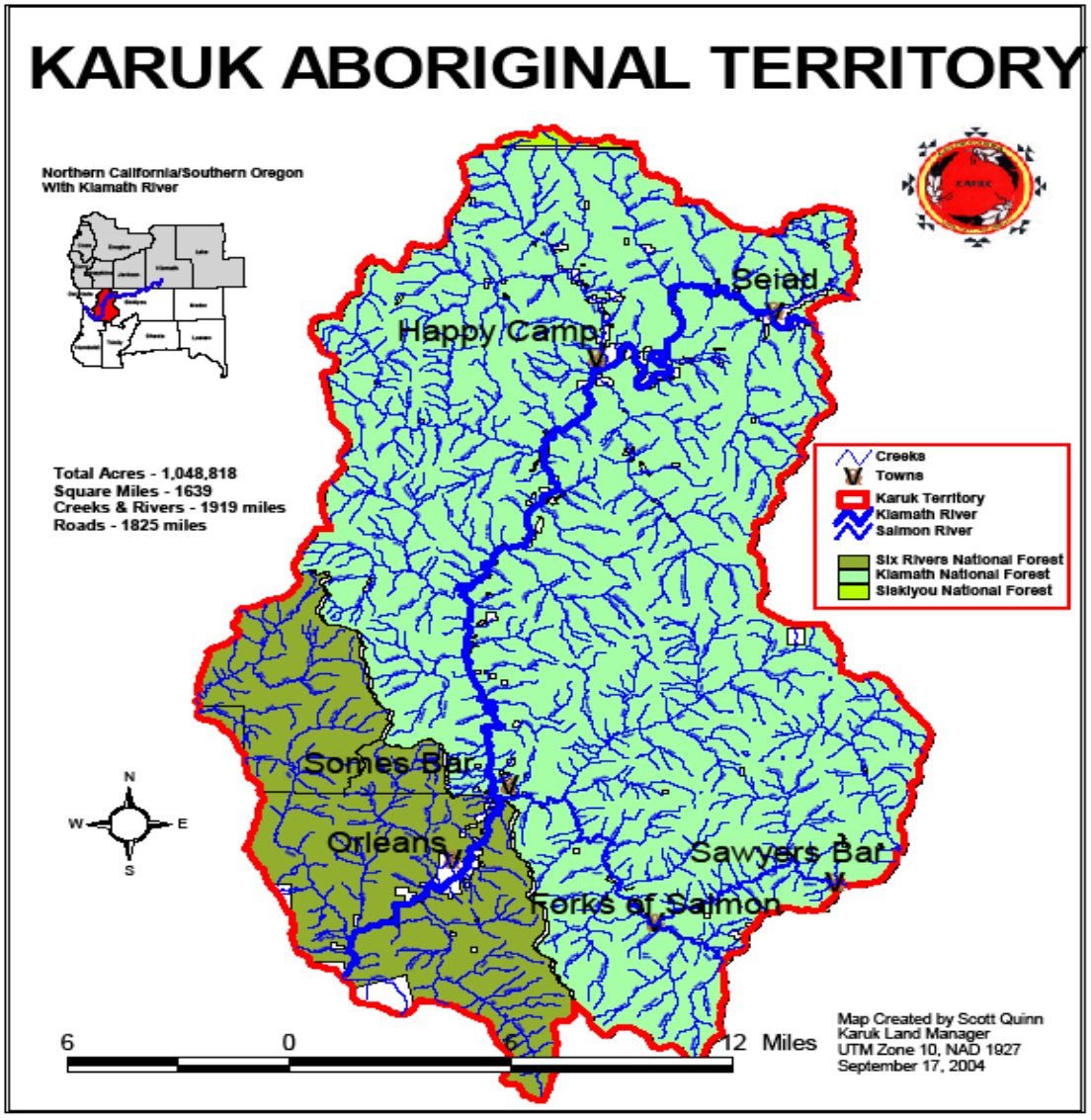

Figure 1. Map of Karuk Aboriginal Territory, including towns, counties and where it is relative to the State of California and Oregon. Map from Karuk Tribe.

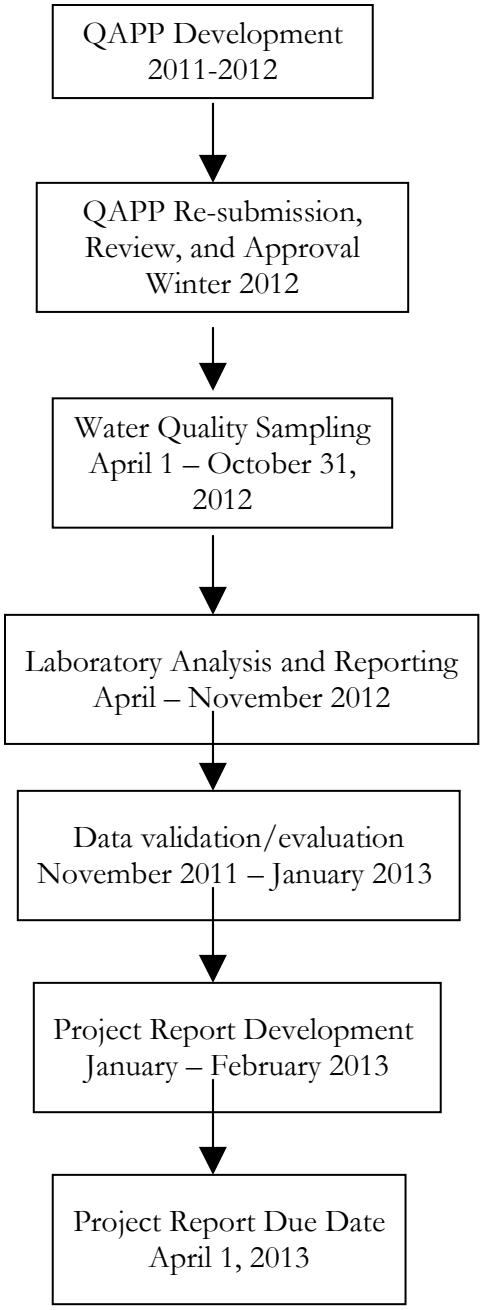

Figure 2. Schedule for Implementation

The KTWQP is organized as shown in Figure 3. The KTWQP Director has ultimate control over and responsibility for the WQ program. The KTWQP Director is responsible for program coordination, budget management, technical oversight and overall program quality.

The QA Officer will have responsibility and authority for:

- Ongoing review of monitoring methods and equipment calibration,
- Report Preparation
- Auditing field notebooks, databases, chain of custody forms, and
- Insuring adherence to field and laboratory QA/QC programs.

In short, the QA Officer will insure that QC procedures developed in this QAPP are carried out. The Data Manager and Water Quality Technicians will work under the supervision of the QA Officer and follow procedures as defined in this *QAPP*.

The Data Manager will:

- Transfer results from the field or laboratory into databases,
- Properly store data and archive to insure against loss,
- Run preliminary analysis of data, and provide charts for reports, and
- Assist with report preparation.

The WQ Technicians will:

- Collect field samples
- Fill out forms to record results and field conditions,
- Care for and calibrate equipment,
- Properly fix and ship samples needing laboratory analysis,

Any time there are problems perceived by the Data Manager or the WQ Technician with any part of the WQ Monitoring Program, they are to notify the KTWQP Project Manager so they can work collaboratively on resolving issues. The QA Officer will also periodically conduct audits to detect QA/QC problems or deficiencies.

If any tests of surface water exceed tribally adopted water quality standards, then the KTWQP Director will be notified so that they can inform the Karuk Tribal

Council. Following notification of the Tribal Council, the KTWQP would then inform the North Coast Regional Water Quality Control Board staff and work cooperatively with that agency for abatement of problems.

The KTWQP will send water quality samples needing laboratory analysis to Aquatic Research Inc., an accredited laboratory. Phytoplankton and algae samples will be sent to Jim Sweet of Aquatic Analysts to be processed and analyzed. Samples to be tested for microcystin toxins will be sent to the US EPA Region 9 Lab and CDFG Pollution Control Lab.

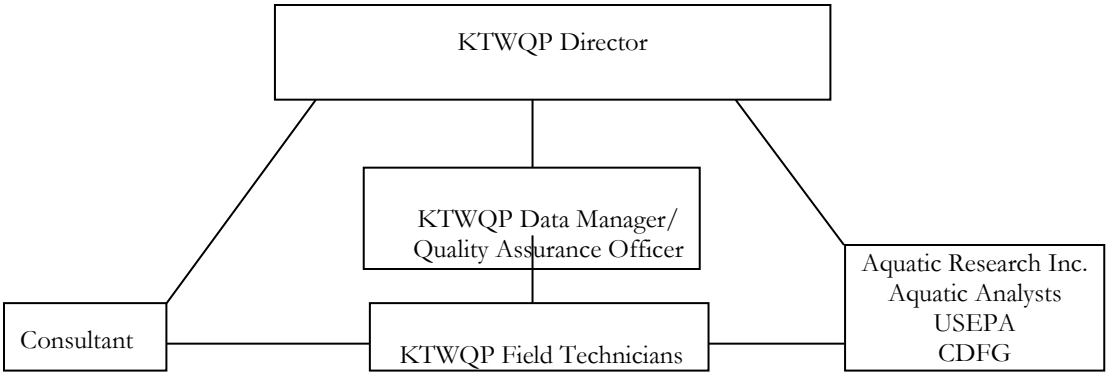

Figure 3. Program organization

1.5 Problem Definition/Background

1.5.1 Background

The Karuk Tribe is the second largest Tribe in California, with over 3,500 Tribal members currently enrolled. The Karuk Tribe is located along the middle Klamath River in northern California. Karuk Ancestral Territory covers over 90 miles of the mainstem Klamath River and numerous tributaries (Figure 4, Table 2). The Klamath River system is central to the culture of the Karuk People, as it is a vital component of our religion, traditional ceremonies, and subsistence activities. Degraded water quality and quantity has resulted in massive fish kills, increased populations of toxic algae, and pandemic fish diseases, in addition to the extreme limitations and burdens applied to our cultural activities.

Table 2. Atlas of Tribal Waters within Ancestral Territory

Atlas of Tribal Waters Within Ancestral Territory	
Total number of Klamath River miles	90
Total number of perennial stream miles	1,900
Total number of lake acres	442
Total number of wetland acres	UNKNOWN

It is the mission of the Karuk Tribe to protect, promote, and preserve the cultural, resources, natural resources, and ecological processes upon which the Karuk People depend. This mission requires the protection and improvement of the quality and quantity of water flowing through Karuk Ancestral Territory and Tribal trust lands. The Karuk Tribe's Department of Natural Resources has been monitoring daily water quality conditions in the Klamath River since January of 2000 and tributaries to the Klamath River since 1998. The Karuk Tribe has been collaboratively involved in maintaining water quality stations along the Klamath River and its tributaries with the United States Fish and Wildlife Service (USFWS), the United States Geological Survey (USGS), and the Yurok Tribe.

This data is important to state and federal processes currently underway and provides information for Tribal Council and resource managers to make informed decisions. The Klamath Hydroelectric Project (KHP) is undergoing relicensing by the Federal Energy Regulatory Commission (FERC). Along with this process both Oregon and California will have to issue 401 certifications for the KHP. The North Coast Regional Water Quality Control Board (NCRWQCB) is developing and/or implementing Total Maximum Daily Loads (TMDL's) for the Scott, Shasta, Salmon, and Klamath Rivers. Tribes, counties, and the state of California have developed draft guidance for public health for a toxic blue green algae *Microcystis aeruginosa* and associated toxin microcystin. The water quality data the Karuk Tribe collects is essential to providing quality data regarding processes that involve and affect the Karuk Tribe.

The general purpose studies undertaken by the KTWQP is to monitor the quality of water flowing into and out of Karuk Ancestral Territory and Tribal trust lands. The information produced allows the Karuk Tribe to give valuable input on land management decisions and demonstrates the Tribe's commitment to sound resource management. The data produced is indispensable in monitoring water quality conditions within the Klamath River System. We are building a long-term monitoring data set that lets us track these conditions and monitor for improvement.

1.5.2 Problem Definition

The Klamath River is listed as an impaired water body under Clean Water Act (CWA) section 303(d) in both California and Oregon (CSWRCB, 2005; ODEQ, 2006). Total Maximum Daily Load (TMDL) studies related to pollution abatement are complete for Upper Klamath Lake and its tributaries in Oregon (ODEQ, 2002) but in progress for the Lower Klamath (Link River and Keno Reservoir to the ocean) (St. John, 2005). Nutrient pollution in the Lower Klamath River can be traced to several sources: agricultural activities, the nitrogen fixing blue-green algae species *Aphanizomenon flos-aquae* that flourishes in Upper Klamath Lake and Klamath Hydroelectric Project reservoirs, and from the Lost River and Lower Klamath Lake basin via direct winter pumping and the Straits Drain (Kier Associates, 2007).

Nutrient pollution in the Lower Klamath River causes elevated pH and dissolved ammonia and depressed dissolved oxygen. Recent studies related to Klamath Hydroelectric Project (KHP) relicensing have brought to light linkages between nutrient pollution in the Lower Klamath River and fish health (Karuk, 2006). Algae beds and deposits of benthic organic matter in the Klamath River just below Iron Gate Dam provide ideal habitat for a polychaete worm that plays host to one of the Klamath River's most deadly fish diseases, the protozoan *Ceratomyxa shasta* (Stocking and Bartholomew, 2004; Stocking, 2006). The combination of direct stress to fish from water pollution in combination with increased abundance of pathogens has lead to more than 40% of

downstream migrant juvenile Chinook salmon dying before they reach the ocean in some years (Foot et al., 2003; Nichols and Foot, 2005).

The recent discovery of toxic algae species, such as *Microcystis aeruginosa* (MSAE), in KHP reservoirs (Kann and Corum, 2006; Kann and Corum, 2007; Kann, 2007) and the Klamath River (YTEP, 2005), now pose risks to human health in late summer and fall from recreational or cultural-use contact. Data collected under this QAPP will help better understand the complex nature of Klamath River nutrient pollution and the prevalence of algal toxins upstream and within KAT.

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 4). The KHP and diversion projects have altered natural flow regimes (Hardy and Addley, 2001) and algal and nutrient dynamics (Kann and Asarian, 2005; Kann and Asarian, 2006; Kann and Asarian, 2007). Copco and Iron Gate reservoirs, the lowest in the KHP, are often dominated by the nitrogen fixing blue-green algal species such as *Aphanizomenon flos-aquae* (Kann and Asarian, 2006; Kann and Asarian, 2007). The Klamath River is more often limited by nitrogen than phosphorus (NRC, 2004). Nutrient concentrations in reservoir outflows are periodically substantially higher than in reservoir inflows, making nutrients available for downstream growth of algae and macrophytes (Kann and Asarian, 2005), although patterns vary by year (Kann and Asarian, 2007).

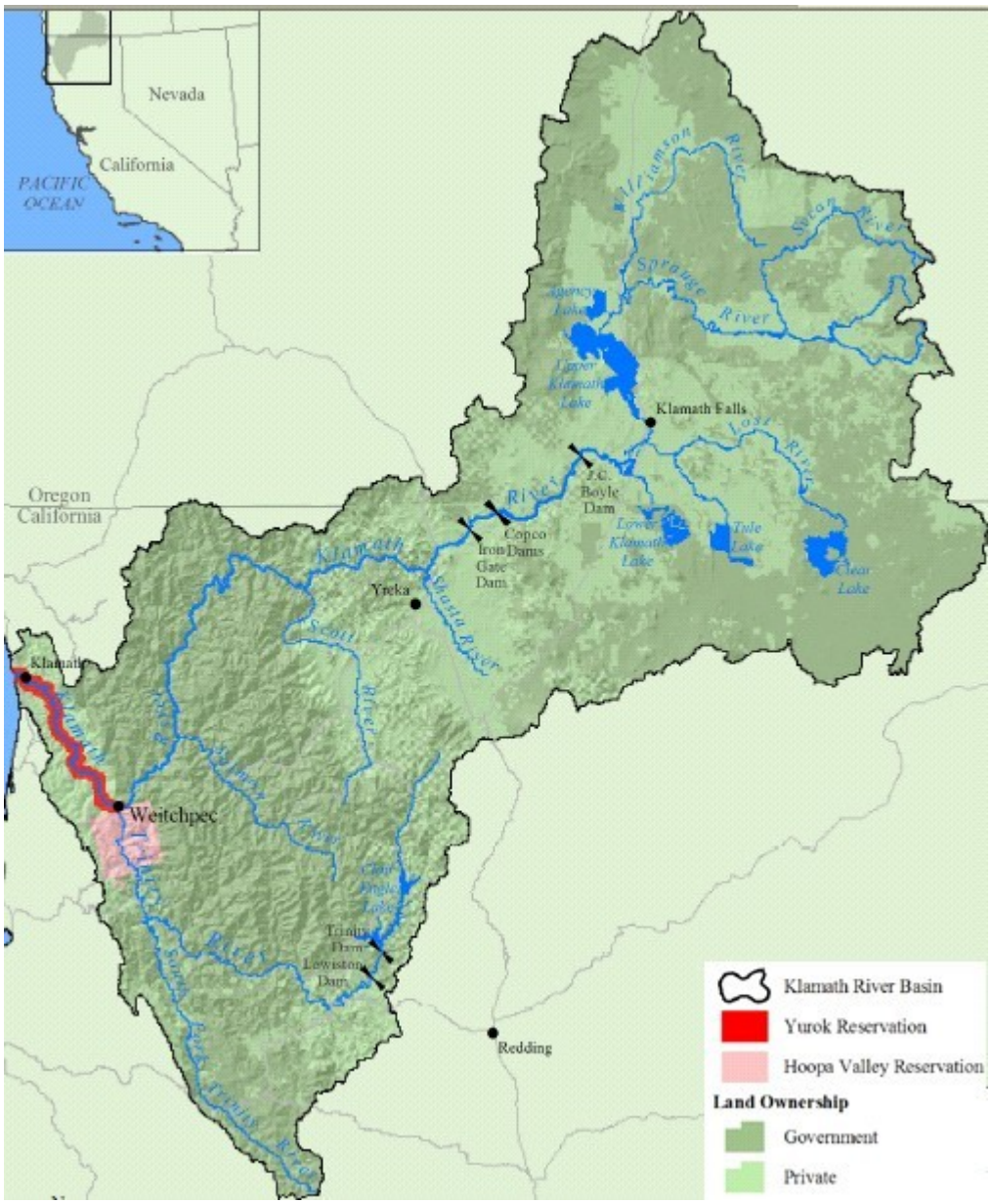

Figure 4. Klamath River Watershed

Photosynthetic activity in algae beds and by periphyton in downstream locations elevates pH during daylight hours and plant respiration at night contributes to depressed dissolved oxygen (D.O). High pH in combination with water temperatures of 25° C, which are common on the Klamath River in summer, cause a conversion of ammonium ions to dissolved ammonia (Goldman and Horne, 1983) that is toxic to salmonids at low levels (Heisler, 1990). Nutrient concentrations generally decline with increasing distance downstream of Iron Gate Dam due to dilution and natural river nutrient retention processes (assimilation into periphyton, denitrification, and/or settling)(Asarian and Kann

2006); however, there are still water quality problems on the KAT and other downstream reaches.

Severe nutrient-related water quality problems are apparent within the KAT; consequently, concern over impacts on the KAT require further study. For example, the average daily maximum pH at Orleans (RM 66) in August 2004 was 8.5, which exceeds NCRWQCB (2005) *Basin Plan* standards, and created stressful conditions for salmonids (Wilkie and Wood, 1995). NCRWQCB samples for dissolved ammonia at Ikes Falls (RM 70) in June 1996 were as high as 0.050 mg/l, which is recognized as lethal for salmonids (Heisler, 1990). In August of 1997, U.S. Fish and Wildlife Service (USFWS) Arcata Field Office (Halstead, 1997) measured D.O. as low as 3.4 mg/l at Big Bar (RM 50), which was causing mortality of hearty, warm water-adapted fish species such as suckers and dace, as well as salmonids.

A preliminary nutrient budget by reach for the Klamath River (Asarian and Kann, 2006) found insufficient quantity and quality of data to fully understand nutrient dynamics in the Klamath River. Problems included laboratory detection limits for nitrogen forms that were too high, insufficient temporal and spatial resolution of samples, and lack of periphyton/macrophyte data. Due to lower nutrient concentrations, detection limit issues were particularly important in the lower reaches of the Klamath River such as on the YIR.

Kann (2005) detected high concentrations of a toxic blue-green algae species MSAE in a fall 2004 reconnaissance sample. The Karuk Tribe followed up with more sampling of Iron Gate and Copco reservoirs and found the widespread presence of high concentrations of *Microcystis* in both Copco and Iron Gate Reservoirs in 2005-2007 (Kann and Corum, 2006; Kann and Corum, 2007; Kann 2007). A *Microcystis* bloom was documented in the Klamath River within the YIR boundaries in August and September 2005 (YTEP, 2006b). The timing is significant because of the presence of adult salmon and steelhead migrating upstream during this time period. This is also a time of increased cultural and recreational use of the Klamath River by both Tribal members and sport fisherman.

Coordination between the Karuk and Yurok Tribe will allow KTWQP to anticipate when MSAE levels may be high so that samples can be analyzed for microcystin by the United States Environmental Protection Agency (U.S. EPA) Region 9 Laboratory in Richmond,

California. Samples in 2007 found toxic blue-green algae species other than MSAE and tests for these and related toxins will also be conducted in 2008 (YTEP, 2008) at the California Department of Fish and Game's Fish and Wildlife Water Pollution Control Laboratory in Rancho Cordova.

The Karuk and Yurok Tribes have been collecting water quality samples throughout the Klamath River Basin for nutrient and algae analysis since 2001 (KTDNR 2008; YTEP, 2004a; 2004b; 2005). Both Tribes initially cooperated with the United States Fish and Wildlife Service (USFWS) between 2001 and 2005 and collected samples according to USFWS' previously formulated SAP. Currently, the KTWQP is operating under a self developed SAP because the Tribes no longer coordinate with USFWS for sample collection and analysis. YTEP samples in downstream reaches of the Klamath River and major tributaries on the YIR and has already filed a separate but similar SAP for nutrient, phytoplankton, periphyton and algal toxins because they have a separate chain of custody and quality assurance chain of command.

Nutrient and toxic algae pollution in the Klamath River is causing stressful conditions for Pacific salmon species and their juveniles and providing an environment that fosters an increase in disease organisms (YTEP, 2006c). The reduced salmon production and loss of access to salmon as a food resource has had major health consequences on the health of Native Americans in the Klamath River basin (Norgaard, 2005).

Although MSAE may also be contributing to fish health problems, it also has the capacity to directly affect human health. As MSAE cells die and decay the hepatoxin microcystin is released, which can cause a range of reactions in humans and/or animals: rash, irritation, conjunctivitis, nausea, vomiting, diarrhea, liver damage, tingling, numbness, paralysis, and death (Chorus and Bartram 1999; Chorus 2001). Once ingested, microcystin is not excreted and instead bioaccumulates and can cause liver damage, decreased liver function and eventually mortality (WHO, 1998). Mortality in fish, domestic animals, and humans has been recorded following from both single-dose events and long-term exposure to microcystin (Carmichael 1994).

Trace amounts of microcystin were measured in the liver of a half-pounder steelhead from the Lower Klamath River (YTEP, 2006b), giving rise to concern for fish health and for the health of those who consume the fish. Sampling by the State Water Resources Control Board (SWRCB) showed microcystin in mussels, yellow perch, and hatchery

Figure 2 Scott River Basin

Chinook (Kann, 2008). Phytoplankton samples in 2007 also detected other toxin producing blue-green algae species and toxins other than those produced by MSAE have been detected in KHP reservoirs (YTEP, 2008). The presence, prevalence and effects on people and fish of these other toxins needs further exploration both on the KAT and upstream reaches.

Decline of the fishery

Historically, spring-run Chinook salmon were abundant in the rivers of the Klamath Basin, considerably outnumbering the fall Chinook run (Hume in Snyder 1931). "Salmon ascend the river in large numbers, before the waters subside in the spring", remarked Gibbs in 1851 (SRWC SAP 2005). Fall Chinook, winter and summer steelhead were also widespread in the Klamath Basin. (Maria, personal communication in SRWC SAP 2005). Today, the spring Chinook and summer steelhead run is virtually nonexistent in the Klamath River (KRBFTF, 1991. p. 2-87, 2-99, and 4-15; USFS, 2000b, p.3-9; USFS, 2000a).

Coho salmon would have flourished in the numerous ponds created by beavers in Mid-Klamath tributaries and the mainstem Klamath (SRWC SAP 2005 & Belchik, personal communication). Brown et al. (1994) state that California coho populations are probably less than 6% of what they were in the 1940s, and there has been at least a 70% decline since the 1960s. Coho salmon occupy only 61% of the SONCC Coho ESU streams that were previously identified as historical coho salmon streams (CDFG, 2002, p.2)

Land Use Factors

Consideration of factors limiting salmon and steelhead production, water quality and attainment of other beneficial uses in Mid-Klamath region must be tiered. There are some over-arching factors, such as flow depletion in tributaries and water diversions. These can then cause secondary water quality problems as transit time increases and stagnation of water occurs. In addition, alteration of timing and flow volume

subsequently affects sediment dynamics and the hydromorphology of these water ways. Limiting factors are most often linked to two current and one historical, land use activities; logging, agriculture, and historical mining. Current mining practices are being evaluated by CDFG at present.

Historically, gold was mined in the Mid-Klamath region. The type of mining performed in Northern California during the late 1800s was hydraulic mining, not chemical (like cyanide-leach mining), so less chemical contamination is associated with it. Surface and groundwater in the Mid-Klamath could potentially be contaminated with heavy metals that naturally occur in association with gold but are discarded in tailings, like arsenic. The use of mercury to separate gold from concentrates was common place. Dredge tailings from hydraulic mining can also serve as a source of sediment pollution.

Much of the land in Siskiyou County was logged, beginning in the latter half of the 19th century. Erosion due to clear-cutting and logging roads in the area, whether still used and maintained or abandoned, contributes significant amounts of sediment to the River system and has altered the natural hydrograph.

Beginning around 1850, ranching became a prevalent use of land on the Klamath and its tributaries. Grazing of cattle is still performed by landowners adjacent to the Klamath River and its tributaries. This could contribute to erosion of streams and bacterial contamination of surface waters when cattle are permitted access to streams. Agricultural practice near waterway may contribute contaminants such as pesticides, nitrates, and phosphates to the surface water.

Much of the Mid-Klamath region is owned and managed by the USFS. Historic timber practices could result in herbicide and pesticide contamination of surface and ground water.

Paved roads and resulting vehicle traffic are likely to contribute oils and other contaminants.

No heavy industry is presently in the area, so organic contaminants from pesticide manufacture, petroleum refinement and other industrial applications are unlikely.

Logging and Roads: Upland areas of the Klamath River have been extensively logged and have high road densities as demonstrated through the multiple Regional Water Board TMDL's across the Klamath basin. Compaction of soils and changes in routing of storm water on logged areas and logging roads are known to:

- Increase peak discharge (Montgomery and Buffington, 1993; Jones and Grant, 1996),
- Increase sediment yield (Hagans et al., 1986, de la Fuente and Elder, 1998), and
- Decrease large wood available for recruitment to streams (Reeves et al., 1993; Schuett-Hames et al., 1999).

The potential changes in aquatic conditions related to upland disturbance are described below.

Increased Peak Flows: Elevated peak discharge can increase median particle size distribution to those greater than optimal for salmonid use, wash out large wood, and trigger bank failures and channel scour. Channel changes can include decreased pool frequency and depth (Buffington and Montgomery, 1993). Wider and shallower channels also are more subject to warming. Although less well studied, hydrologic changes associated with compaction of a watershed can also lead to decreased summer base flows.

Increased Sediment Yield: Sediment yield is a noted problem in tributaries to the Klamath River mainstem (NCRWQCB, 2003; 2005). Fine sediment comes primarily from surface or gully erosion and Sommarstrom et al. (1990) identified road cuts and road fills on decomposed granitic soils as a major source of fines within the Scott watershed, a major tributary to the Klamath.

Fine Sediment: High levels of sand and fine sediment can fill interstitial spaces in stream gravels, decrease salmonid egg and alevin survival and reduce aquatic insect habitat. Decreased aquatic invertebrate production can diminish food resources for juvenile salmonids. Smaller sediment particles are highly mobile and may cause diminished pool frequency and depth, thus reducing salmonid juvenile carrying capacity and adult salmonid holding habitat.

Mass Wasting: The coarse and fine sediment yielded by mass wasting can cause channel aggradation, loss of pool habitat, changes in median particle size, decreased spawning gravel quality and channel adjustments that facilitate stream warming.

Large Wood Depletion: Changes in riparian conditions can increase ambient air temperature over streams and reduce relative humidity, thus leading to stream warming (Bartholow, 1989; Pool and Berman, 2001). Cold air moving down slope from Marble Mountain peaks in winter may also cause elevated risk for the formation of anchor ice along streams where canopy is lacking. Pools formed by large wood are extremely important as nursery areas for coho salmon juveniles (Reeves et al., 1988) that must spend one year in freshwater before migrating to the ocean. Large wood depletion can, therefore, cause diminished aquatic habitat complexity, reduced pool frequency and lower carrying capacity for juvenile coho. Large coniferous trees in riparian zones may take decades or centuries to grow to sufficient size to be useful in buffering air temperatures and providing wood of sufficient size to provide lasting habitat value (Shuett-Hames et al., 1999).

Agricultural Water Diversion: Flow depletion in Shasta and Scott Rivers, two major Klamath River tributaries, due to water extraction for agriculture causes warming as the water volume is reduced. Decreasing flows may cause riffles to become shallow or the formation of isolated pools. Growth of periphyton covering stream substrate will increase with warming water temperatures and would also be increased by nutrient rich agricultural return water, such as been demonstrated in the Shasta River. High rates of photosynthesis by algae in low flow conditions can cause large nocturnal and diurnal

fluctuations in pH and dissolved oxygen. The secondary effects related to high photosynthetic activity in stagnant, de-watered reaches are not targeted because loss of flow is an over-riding impact.

Purpose of Water Quality Investigations:

What was once a historically productive fishery has declined to numbers precluding tribal members from utilizing their fishing rights on ancestral waters and limiting their take for sustenance throughout the Klamath River system. The Indian people of the Karuk Tribe traditionally depended on the land and waters to provide for their physical and cultural needs. The state of the watershed today prevents this dependency. The Tribe's priority is a restored watershed that supports healthy populations of salmonids. This water quality study is a first step in understanding conditions in areas that have not been studied which may have contributed to population decreases of anadromous salmonids. It is also an opportunity to work collaboratively with other agencies and tribes to share information and to ultimately restore the watershed to historical conditions.

The goal of this QAPP is to provide the Karuk tribal community with a quantitative assessment of water quality effecting KAT, and to further expand the Tribe's scientific knowledge for tribal members, fisheries, future planning, and watershed activities. Additionally, these analyses will help identify any surface water contamination problems that could affect fish habitat, since wild salmon are an important resource to the Tribe and a vital piece of the Tribe's cultural heritage.

This QAPP will be used to develop baseline information in order to document water quality changes over time, screen for potential water quality problems, and to provide a scientific foundation in order to actively participate in the management of the Mid-Klamath watershed.

Principal data users/decision makers who will use the data to make decisions:

The first step to attainment of the goal of this QAPP is baseline data collection for water bodies in the Mid-Klamath watershed. Quality assured water quality data collected by the KTWQP will be used in management decisions regarding the watershed. Data will be shared with the U.S. EPA and NCRWQCB staff through timely reports on findings, including for use in TMDL updates. Other agencies and entities cooperating in Klamath watershed management, including the U.S. National Forest (Klamath and Six Rivers), may also receive KTWQP data after it has undergone QA/QC and analysis. The KTWQP will also share data with tribal members through annual reports and with the public upon request.

Brief Summary of existing information:

Klamath River nutrient pollution has been widely recognized since the 1950's (Phinney and Peak, 1962; CH2M Hill, 1985; Kier Associates, 1991). The adult salmon kill in September 2002 (CDFG, 2003; Guillen, 2003), chronic high mortality of juvenile salmon (Nichols and Foot, 2005) and discovery of problems with toxic algae in KHP reservoirs (Kann and Corum, 2006) all point to a water quality crisis. As noted above, sources of pollution include upstream agricultural operations and nitrogen fixing algae in Upper Klamath Lake, Lost River, Lower Klamath Lake and KHP reservoirs. The lowest two KHP reservoirs are also recognized as fostering toxic algae species as well. The extent of nutrient pollution and problems with algal toxins above and within KAT are not well studied and create a need for more information and the sampling regime discussed herein.

The Klamath River Water Quality Monitoring Coordination Workgroup that includes Tribes and State and federal agencies was formed after the September 2002 adult salmon kill and coordinated water quality sampling subsequently increased. Asarian and Kann (2006) used existing nutrient data to construct a nutrient budget by reach for the Klamath River and their study lists all nutrient related water quality samples collected between 1996-2004. They pointed out data gaps for nutrient sampling using adequate laboratory detection limits and the need for more periphyton samples. The Hoopa Tribal Environmental Protection Agency (TEPA, 2008) used existing data to characterize Klamath River nutrient pollution and to set limits on their Reservation waters just upstream of Weitchpec where they have been granted Treatment in the Same Manner as a State (TAS) and set water quality standards. Figure 5 is adapted from Hoopa TEPA

(2008) and shows all sampling sites in the years 2000-2004 by type for the lower and mid-Klamath River (note: no site was sampled for every parameter in every year).

In 1989 the Karuk Tribe formed the Department of Natural Resources which primarily focused on fisheries work. About ten years later, the KTWQP was started. Water quality data was collected in coordination with USGS and USFWS and generally focused on the KAT but also occurred upstream of the KAT. In 1995, USFWS monitored Klamath River water quality as linkages between water pollution and fish health became more apparent. Data have included grab samples for nutrients and those derived from continuous recording data probes that capture

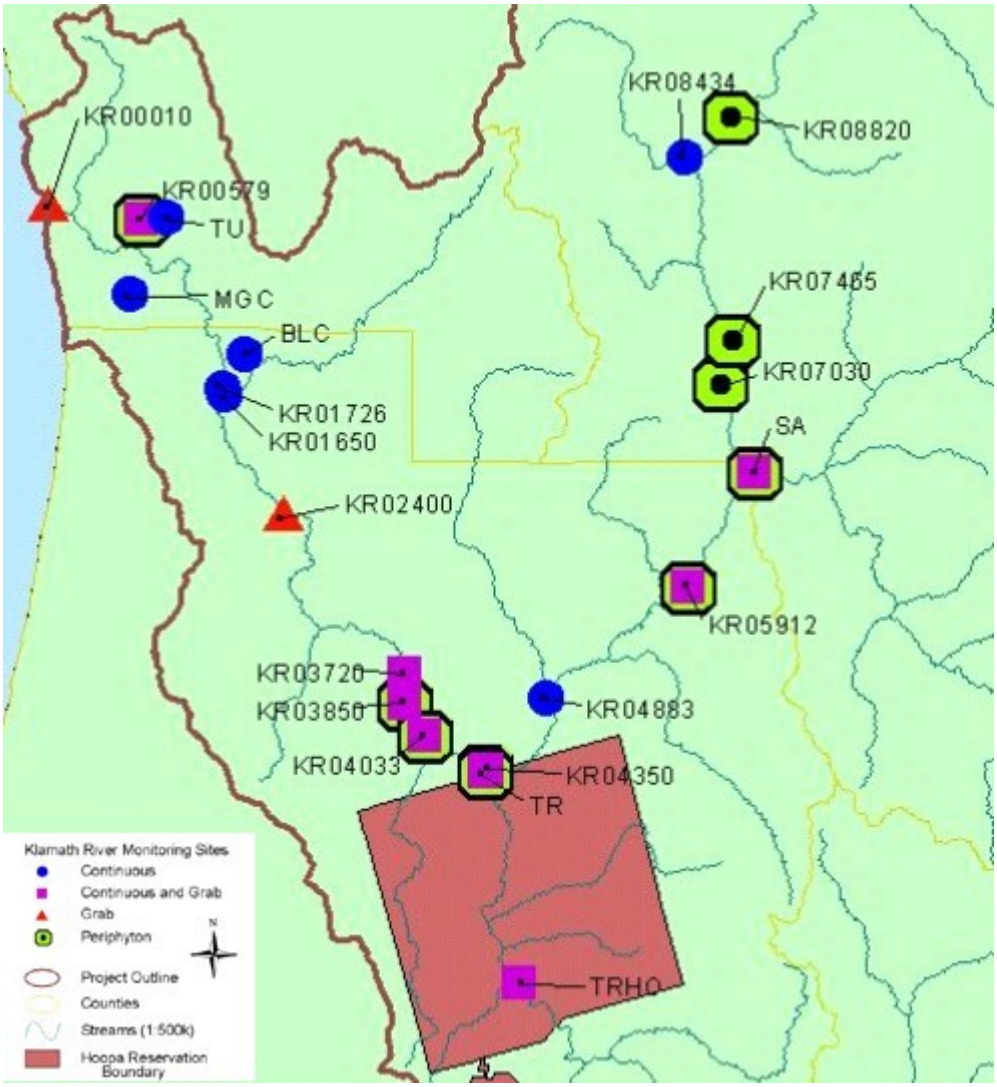

Figure 5. This map is taken from Hoopa TEPA (2008) (Figure 9) and shows all sites where nutrient related data were collected on the lower and mid-Klamath River by sample type from 2000-2004.

parameters such as pH, D.O., temperature and conductivity. In 2004, the Yurok Tribe, NCRWQCB, and PacifiCorp conducted a Klamath River periphyton study that included sites above and within the KAT, with results summarized by Eilers (2005) and Hoopa TEPA (2008).

The Karuk Tribe began cooperative water quality sampling, including nutrients, with USFWS in 2001. KTWQP has operated continuous water quality datasondes at several locations above and within KAT since that time for temperature, D.O., pH, and conductivity. Monitoring for toxic algae species began in 2005 and continued through 2008. Periphyton sampling occurred in 2008 and 2011. The KTWQP has been responsible for all of its sample collection, transportation to applicable laboratories, data storage, and data analysis related to nutrients since 2007. The KTWQP has been assisted by Aquatic Ecosystems for analysis of phytoplankton and toxic algae data. Nutrient data collected from 2001-2006 by KTWQP underwent extensive QA/QC examination. Data from 2007 and 2008 are currently being integrated into the Yurok Environmental Data Storage System (YEDSS). This innovative database is able to update the U.S. EPA's STORET system. Data will also be added to the comprehensive TMDL database, which is shared and augmented by the Klamath River Water Quality Monitoring Coordination Workgroup and used by the U.S. EPA and NCRWQCB for the Klamath River TMDL.

1.6 Project/Task Description and Sample Schedule

The KTWQP will implement a Water Quality Monitoring Program to collect quality assured water quality data for management decisions related to the aquatic environment within KAT and Mid-Klamath watershed. Water quality data collection will help establish baseline water quality conditions and quantitatively assess the quality of water resources and initiate long-term trend monitoring. Annually a report will be issued to US EPA summarizing monitoring results. To the degree they are useful, this quality assured data will be provided for to the North Coast Regional Water Quality Control Board for use in TMDL implementation.

The KTWQP will be sampling surface water for various parameters critical to fish and public health at numerous locations on the mainstem Klamath and its tributaries. Water quality sampling will take place in the following water bodies with varying numbers of stations at each site (Table 3):

Table 3. Site codes and locations of Karuk sampling stations for nutrients, algal toxins and Sondes. Nutrient Suite indicates collecting nutrients, algal toxins and phytoplankton. Sonde indicates real time monitoring and public health designates surface grab sampling for phytoplankton and algal toxins.

2009 Locations and Parameters Monitored						
Site ID	Latitude	Longitude	Nutrient Suite	Sonde	Public Health	Location
OR	N 41 18.336	W 123 31.895	X	X	X	Klamath River at Orleans
SA	N 41 22.617	W 123 28.633	X	X		Salmon River at USGS Gage
HC	N 41 43.780	W 123 25.775	X		X	Happy Camp
SV	N 41 50.561	W 123 13.132	X	X	X	Klamath River downstream of Seiad Valley
SC	N 41 46.100	W 123 01.567	X	X		Scott River at Johnson's Bar
BB	N 41 49.395	W 122 57.718	X		X	Brown Bear River Access
WA	N 41 50.242	W 122 51.895	X			Klamath River at Walker Bridge
SH	N 41 49.390	W 122 35.700	X	X		Shasta River at USGS Gage
IG	N 41 55.865	W 122 26.532	X	X	X	Klamath River below Iron Gate Dam @ Hatchery Bridge

Water quality parameters to be sampled for each water body are listed in Table 6. These include hand held instrument readings, continuous automated probe sampling, public health sampling, and nutrient sampling. The continuous data recorders in Klamath, Salmon, Scott and Shasta Rivers will be fixed to a cable, protected by a metal pipe, which will suspend the probe to avoid damage to equipment.

1

Monitoring will help discover whether there are water quality problems with waters within or adjacent to the KAT and the KTWQP will report any findings of action levels

of contaminants and work to abate any identified problems as described above. Turbidity monitoring data will likely be useful for tracking recovery of water quality for the TMDL implementation and evaluating watershed restoration efforts.

Monitoring Locations, Methods and Timing of Samples

Monitoring methods described below have been selected to best determine whether beneficial uses of water are being attained on KAT and what trends are for parameters limiting attainment of beneficial uses over time. Table 3 lists the KTWQP sampling sites for nutrients, phytoplankton, periphyton and algal toxins, including site codes, spatial coordinates, general location and a specific description of access. The sampling area includes 147 river miles of the mainstem Klamath River upstream and within KAT and the Salmon, Scott, and Shasta Rivers above their convergence with the Klamath River. The Salmon River is within KAT, whereas the Scott and Shasta Rivers are upstream of KAT. Scott and Shasta provide excellent spawning habitat for salmonids that are harvested on the KAT, thereby serving as important tributaries to the tribe's fishery. Although the Klamath River is bordered mostly by forests and wildlands, nutrient pollution and now toxic algae are creating water quality problems in KAT. A map of specific locations of the sampling sites is shown in Figure 6 and 7. Grab samples for nutrients, phytoplankton and algal toxins will be collected at eight sampling sites. Periphyton samples may be collected at four locations (OR, SV, WA, KRBI), and public health sampling of just phytoplankton and algal toxins may occur at six locations within the reservoirs (IR01, IRJW, IRCC, CR01, CRCC, CRMC).

The KTWQP monitoring locations (Table 3 and Figures 6 and 7) are arrayed so as to allow a comprehensive assessment of the Mid-Klamath watershed and to collect baseline data to facilitate participation in co-management of the watershed.

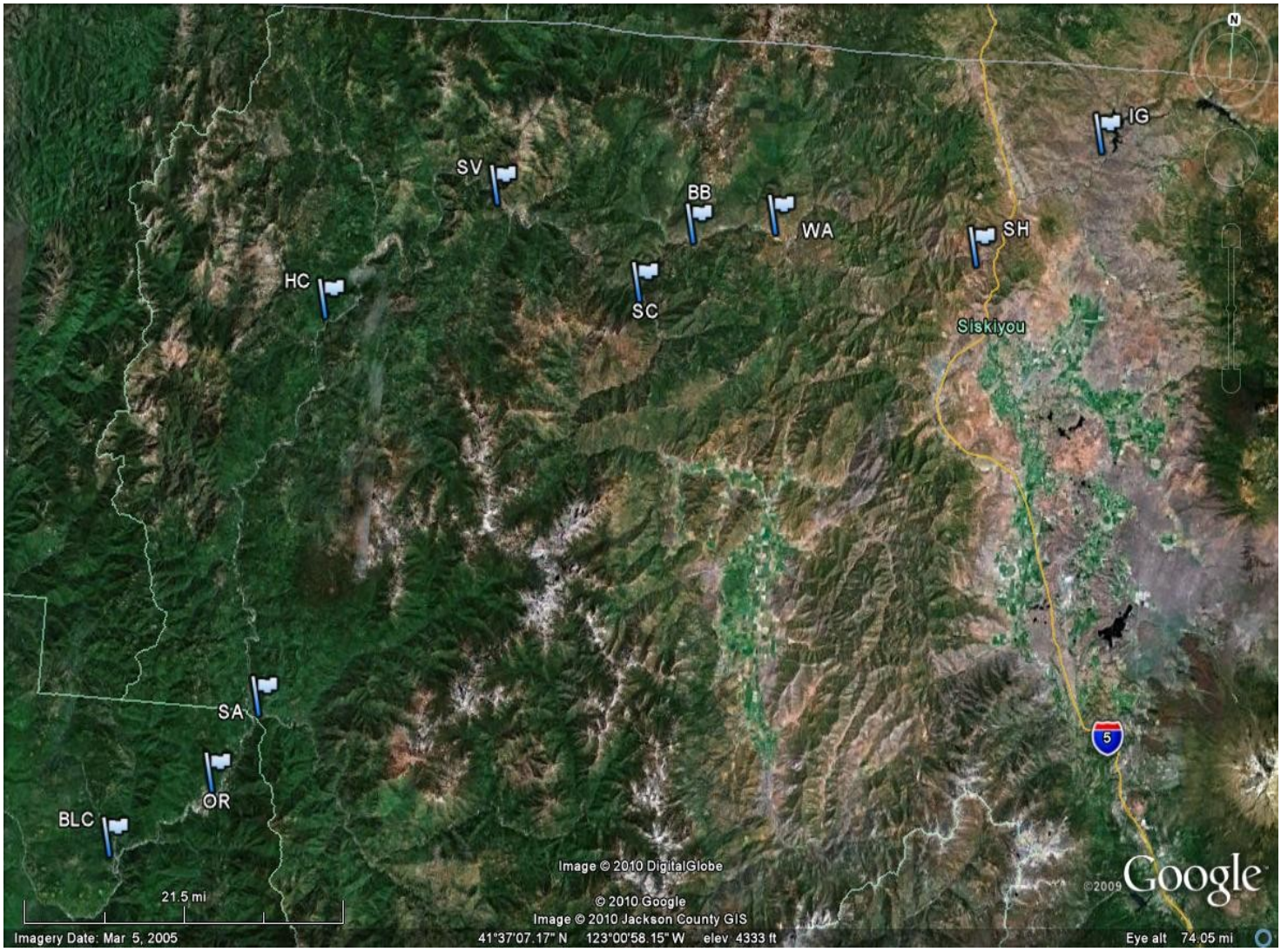

Figure 6. Overview of sampling sites

Currently, Real time water quality monitoring stations are located at three fixed points along the mainstem Klamath River. These stations create a longitudinal profile of water entering and exiting the Mid-Klamath region. Three continuous monitoring sites have been established on larger tributaries to the Klamath River, which are within and upstream of Karuk Ancestral Territory. The tributary sites are on the Salmon, Scott and Shasta Rivers. These sites are located near the mouths to highlight their influence on the mainstem Klamath. These tributaries also supported abundant runs of spring and fall Chinook, coho, steelhead, lamprey, and sturgeon (Salmon River only). A turbidity monitoring site has been added on Bluff Creek, a tributary within the Mid-Klamath. Bluff Creek was historically important to all Tribal Trust fish species. The health of these tributaries is closely tied to the well being of the Klamath River, the Karuk people, and the River's ability to support beneficial uses.

Monitoring Locations: Sampling sites (Table 3) were selected based on the following criteria:

- OR (Klamath River at Orleans) – Conditions of the Klamath River at the downriver end of the KAT. Just upstream of a USGS gage.
- SA (Salmon River near mouth) – Conditions of the Salmon River, an important tributary that enters the Klamath River near the center of the world for the Karuk Tribe. Site of a USGS gage. Major tributary that provides habitat for all Tribal Trust fish species.
- HC (Klamath River below Happy Camp) – About a ¼ mile upstream of Oak Flat Creek.
- SV (Klamath River below Seiad Valley) – This site is just downstream of Seiad Valley but upstream of the USGS gage. This is near the upstream end of the KAT thereby indicative of water quality conditions entering the KAT.
- SC (Scott River at Johnson's Bar) – This site is about one mile up from the confluence of the Scott and Klamath Rivers. It represents water

quality conditions coming out of the lower canyon reach of the Scott River.

- WA (Klamath River at Walker Bridge) – This site is located between two major tributaries, the Scott and Shasta Rivers and is downriver of the town of Klamath River. This site provides water quality information after the effects of the KHP have been reduced but before entering the KAT where more minor tributaries enter the River.
- BB (Brown Bear River Access) – Labeled USFS river access sign in the town of Klamath River.
- SH (Shasta River at USGS Gage) – This site is located at the USGS gage and is upstream of the confluence about 300 meters.
- IG formerly KRBI (Klamath River below Iron Gate) – This site is located immediately downstream of Iron Gate dam and upstream of the USGS gage. It is the start of the free-flowing River below the KHP.
- KRAC (Klamath River above Copco) – This site is located upstream of Copco Reservoir at the access bridge upstream of Shovel Creek. This is the end of the peaking reach just before the Klamath River enters the lower 3 reservoirs for the KHP.
- IR01 (Iron Gate Reservoir Open Water) – This site is located in Iron Gate at the center of the log booms in the lower portion of the reservoir. It represents open water conditions for toxic algae blooms.
- IRJW (Iron Gate Reservoir Jay Williams Boat Dock) – This site is located near the Jay Williams boat ramp. It is a common access point for recreators on Iron Gate and is a shoreline grab sample station.
- IRCC (Iron Gate Reservoir Camp Creek Recreation Area) – This site is located near the Camp Creek boat ramp. It is a common camping spot on Iron Gate and is a shoreline grab sample station.
- CR01 (Copco Reservoir Open Water) – This site is located in Copco Reservoir in the open water in the lower portion of the reservoir. It represents open water conditions for toxic algae blooms.

- CRCC (Copco Reservoir Copco Cove) – This site is located near the Copco Cove boat ramp. It is one of two public boat ramps on the reservoir and is a shoreline grab sample station.
- CRMC (Copco Reservoir Mallard Cove) – This site is located near the Mallard Cove boat ramp. It is a commonly used camping and recreation area on the reservoir and is a grab sample station.

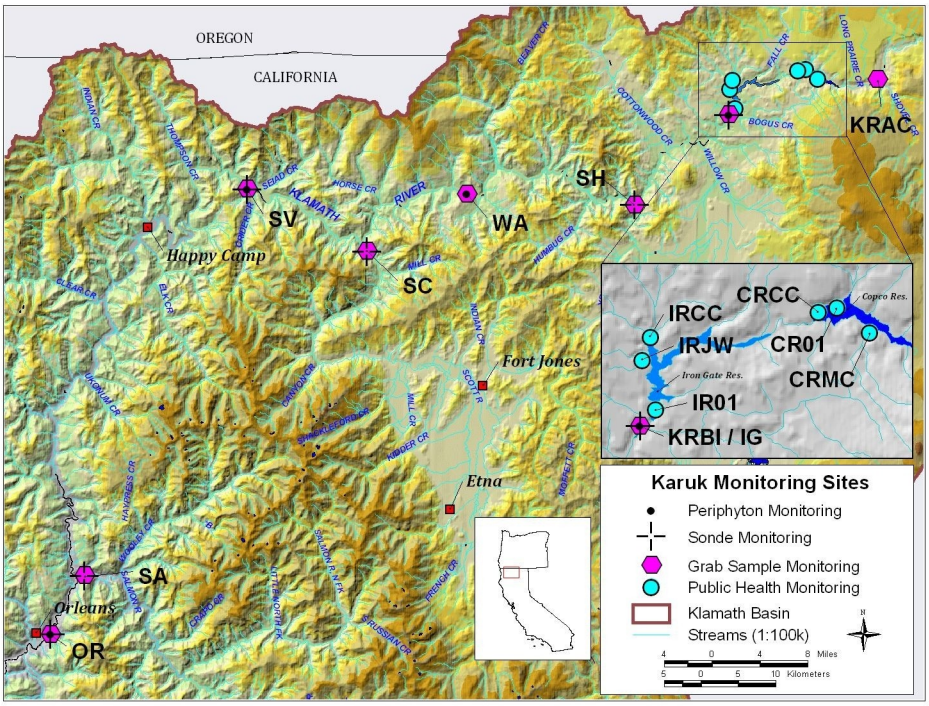

Figure 7. Sampling locations

Sample Frequency and Parameters

Sampling frequency is most easily discussed in sections. Nutrient sampling includes; total suspended solids, volatile suspended solids, chlorophyll, pheophytin, total nitrogen, total phosphorus, SRP, total ammonia, nitrite + nitrate, total organic carbon, total alkalinity, dissolved organic carbon and phytoplankton. Nutrient sampling frequency has been biweekly since (2001). Nutrient sampling generally starts in May and runs through October. Public health sampling includes, phytoplankton and two microcystin samples; one sent to EPA to be analyzed by ELISA and the other sent to CDFG Pollution control lab to be analyzed for anatoxin-a and LCMS/MS. Public health sampling occurs biweekly

starting in June and running through October; once high levels of microcystin are detected sampling goes to a weekly interval. Sondes are deployed in May and pulled the end of October. These instruments are calibrated biweekly. Turbidity monitoring on Bluff Creek and Salmon River is conducted from January to April.

Table 4. Sample locations and parameters

ID	Monitoring Locations	Photo Points	Temp.	pH	Conductivity	Turbidity	DO	Total Phosphorus	Dissolved Phosphorus	Total Nitrogen	Ammonium Nitrogen	Nitrate + Nitrite	Phytoplankton	Chlorophyll	Total Organic Carbon	Dissolved Organic Carbon	Pheophytin	Alkalinity	Volatile Suspended Solids	Total Suspended Solids	Phytoplankton	Microcystin	Total Suspended Solids
BLC	Bluff Creek near mouth	X	X	X	X	X	X																
OR	Klamath River near Orleans	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA	Salmon River near mouth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HC	Klamath River near Happy Camp	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SV	Klamath River near Seiad Valley	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SC	Scott River near mouth	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BB	Klamath River at Brown Bear River Access	X	X	X	X		X														X	X	
WA	Klamath River at Walker Bridge	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SH	Shasta River near mouth	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4. Sample locations and parameters

ID	Monitoring Locations	Photo Points	Temp.	pH	Conductivity	Turbidity	DO	Total Phosphorus	Dissolved Phosphorus	Total Nitrogen	Ammonium Nitrogen	Nitrate + Nitrite	Phytoplankton	Chlorophyll	Total Organic Carbon	Dissolved Organic Carbon	Pheophytin	Alkalinity	Volatile Suspended Solids	Total Suspended Solids	Phytoplankton	Microcystin	Total Suspended Solids
IG	Klamath River below Iron Gate	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR01	Iron Gate Reservoir	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
IRJW	Iron Gate Reservoir at Jay Williams boat dock	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
IRCC	Iron Gate Reservoir at Camp Creek Recreation Area	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CR01	Copco Reservoir	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CRCC	Copco Reservoir at Copco Cove	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CRMC	Copco Reservoir at Mallard Cove	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
KRAC	Klamath River above Copco	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

[1] As of 2008 reservoir sampling has been conducted by Pacific Corp.

1.7 Quality Objectives and Criteria for Measurement Data

Objectives and Project Decisions

The primary goal of this *QAPP* is to ensure that high quality data be generated by the KTWQP that this data can be used to answer questions about the quality of waters within KAT and to foster their protection or improvement over time.

Specific questions to be answered through these studies include:

Specific questions this study should answer include:

1) What are current in River conditions
2) What are current nutrient levels
3) Are there nutrient levels indicative of pollution in the Klamath River, including reaches within the KAT?

2) Do periphyton samples show a density of chlorophyll *a* indicative of nutrient pollution?

3) Are there dangerous levels of MSAE and microcystin toxin in the Klamath River, including reaches within the KAT?

4) Are there other potentially toxic blue-green species present in the Klamath River and algal toxins other than the most common microcystin variant?

KTWQP investigations occur within and above KAT. YTEP and Hoopa will provide data to answer the same questions for downstream reaches. In the longer term, theses samples will show pollution variation between water years and provide a basis to judge effectiveness of short-term and long-term management and regulatory actions taken to abate pollution throughout the Klamath River Basin. This will also allow participation of Tribes as resource co-managers and as full partners in adaptive management. Within the KAT specifically, the data may be used as justification for improvement of standards needed to protect Tribal members, the public and other beneficial uses.

Evidence gathered will help regulating agencies make informed decisions off of the 401 certification of the KHP and Klamath TMDL and prompt further action on non-point source pollution from agriculture through mechanisms such as the Klamath River and Lost River TMDL implementation. In the short term, action will be taken immediately to inform appropriate agencies and the public in the event that potentially dangerous levels of blue-green algae cell counts or toxins are discovered.

The Tribe's primary concern with surface water is to minimize the effects of human activity in the watershed, to bolster the health of the ecosystem, to preserve cultural resources, and to return fish populations to a sustainable level enabling tribal members to utilize their fishing rights on the Reservation. Current numbers of returning salmonids will not support a fishery on KAT as it once did.

Decisions to be made using the data

The surface water monitoring program is designed to characterize the surface water resources of Mid-Klamath. The baseline data generated from the first year of quarterly sampling will provide valuable information about the current condition of the Klamath River basin's water resources. On-going monitoring, conducted in the future, will allow the Tribe to begin to track changes in water quality over time and to assess current and potential future environmental impacts to Klamath River water quality.

Decisions to be made with the data include:

- If data for any analyte or field parameter (from an individual location or single quarterly sampling event) are found to exceed the project action limits, then the Tribal Council will be notified.
- If data are found to exceed the project action limits and appear to be increasing with time, then the Tribal Council will be notified and a plan for future investigations of potential sources will be discussed.
- If waters flowing onto the reservation are impaired (i.e., exceed project action limits or the national water quality standards), the issue will be brought to the attention of the Tribal Council for possible discussion with the US EPA Project Officer.

The Tribe will determine if any action is needed to reduce surface water pollution from tribal lands. Some examples of actions that could result from findings of poor water quality on the Reservation are:

- Remediation activities for point sources to stop contamination if a single point source is suspected

- Stream and watershed restoration activities (e.g. planting native flora for erosion control)
- Pollution prevention planning and establishment of educational programs on the Reservation to reduce anthropogenic sources of pollution

The Tribe will also use this information to act as co-managers in the Klamath River Watershed with federal, state, and local agencies. The information will be shared with these agencies in order to track changes over time and to ultimately improve the quality and quantity of fish populations in the Watershed.

Action Limits/Levels

Table 5. Specific Water Quality Objectives for Karuk Trust Lands

Constituent	Units	Limits	Waterbody		
			Klamath River	Tributaries	Ground Water
Conductivity	µmhos/cm @ 25°C	90% upper limit [1]	350	300	750
		50% upper limit [2]	275	150	600
Dissolved Oxygen	mg/L	minimum	8.0	7.0	---
		50% lower limit [2]	10.0	9.0	---
pH	standard units	maximum	8.5	8.5	8.5
		minimum	7.0	7.0	7.5
Hardness	mg/L as $CaCO_3$	50% upper limit [2]	80	60	200
Boron	mg/L as B	90% upper limit [1]	0.5	0.1	0.3
		50% upper limit [2]	0.2	0.0	0.1

1. upper and lower limits represent the 50 percentile values of the monthly means for a calendar year. 50% or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit.
2. upper and lower limits represent the 90 percentile values for a calendar year. 90% or more of the values must be less than or equal to an upper limit and greater than or equal to a lower limit.

Table 6. Water Quality Objectives for Aquatic Life & Organism Consumption

A		B Freshwater Aquatic Life		C Human Health (10-6 risk for carcinogens) For consumption of:	
# Compound	CAS Number	Criterion Maximum Conc. (c) (ug/L) B1	Criterion Continuous Conc. (c) (ug/L) B2	Water & Organisms (ug/L) D1	Organisms Only (ug/L) D2
1. Antimony	7440360			5.6 a	640 a
2. Arsenic	7440382	340 h,l,r	150 h,l,r		
3. Beryllium	7440417				
4. Cadmium	7440439	4.3 d,h,l,r	2.2 d,h,l,r		
5a. Chromium (III)	16065831	570 d,h,l,r	74 d,h,l,r		
5b. Chromium (VI)	18540299	16 h,l,r	11 h,l,r		
6. Copper	7440508	13 d,h,l,r	9.0 d,h,l,r	1,300 k	
7. Lead	7439921	65 d,h,l	2.5 d,h,l		
8a. Mercury	7439976	1.4 h,l,r	0.77 h,l,r		
8b. Methylmercury	22967926				0.3 mg/kg i
9. Nickel	7440020	470 d,h,l,r	52 d,h,l,r	610	4,600
10. Selenium	7782492	o,p	5.0	170 a	4,200 a
11. Silver	7440224	3.4 d,f,h,l			
12. Thallium	7440280			0.24 a	0.47 a
13. Zinc	7440666	120 d,h,l	120 d,h,l,r	7,400 a	25,000 a
14. Cyanide	57125	22 r,s	5.2 r,s	140 a	16,000 a,j
15. Asbestos	1332214			7 million fibers/L k	
16. 2,3,7,8-TCDD (Dioxin)	1746016			5.0 E-9 b	5.1 E-9 b
17. Acrolein	107028			190	290
18. Acrylonitrile	107131			0.051 a,b	0.25 a,b
19. Benzene	71432			0.61 - 2.2 a,b	14 - 51 a,b
20. Bromoform	75252			4.3 a,b	130 a,b
21. Carbon Tetrachloride	56235			0.23 a,b	1.6 a,b

A		B Freshwater Aquatic Life		C Human Health (10-6 risk for carcinogens) For consumption of:	
22. Chlorobenzene	108907			130 a	1,600 a,j
23. Chlorodibromomethane	124481			0.40 a,b	13 a,b
24. Chloroethane	75003				
25. 2-Chloroethylvinyl Ether	110758				
26. Chloroform	67663				
27. Dichlorobromomethane	75274			0.55 a,b	17 a,b
28. 1,1-Dichloroethane	75343				
29. 1,2-Dichloroethane	107062			0.38 a,b	37 a,b
30. 1,1-Dichloroethylene	75354			0.056 a,b	1.2 a,b
31. 1,2-Dichloropropane	78875			0.50 b	15 b
32. 1,3-Dichloropropene	542756			0.34 a,b	21 a,b
33. Ethylbenzene	100414			530 a	2,100 a
34. Methyl Bromide	74839			47 a	1,500 a
35. Methyl Chloride	74873				
36. Methylene Chloride	75092			4.6 a,b	590 a,b
37. 1,1,2,2-Tetrachloroethane	79345			0.17 a,b	4.0 a,b
38. Tetrachloroethylene	127184			0.69 b	3.3 b
39. Toluene	108883			1,300 a	15,000 a
40. 1,2-Trans-Dichloroethylene	156605			140 a	10,000 a
41. 1,1,1-Trichloroethane	71556				
42. 1,1,2-Trichloroethane	79005			0.59 a,b	16 a,b
43. Trichloroethylene	79016			2.5 b	30 b
44. Vinyl Chloride	75014			0.025 a,b	2.4 a,b
45. 2-Chlorophenol	95578			80 a	150 a
46. 2,4-Dichlorophenol	120832			77 a	290 a
47. 2,4-Dimethylphenol	105679			380 a	850 a
48. 2-Methyl-4,6-Dinitrophenol	534521			13	280
49. 2,4-Dinitrophenol	51285			69 a	5,300 a
50. 2-Nitrophenol	88755				
51. 4-Nitrophenol	100027				
52. 3-Methyl-4-Chlorophenol	59507				

A		B Freshwater Aquatic Life		C Human Health (10-6 risk for carcinogens) For consumption of:	
53. Pentachlorophenol	87865	19 e,r	15 e,r	0.27 a,b	3.0 a,b,j
54. Phenol	108952			21,000 a	1,700,000 a,j
55. 2,4,6-Trichlorophenol	88062			1.4 a,b	2.4 a,b
56. Acenaphthene	83329			670 a	990 a
57. Acenaphthylene	208968				
58. Anthracene	120127			8,300 a	40,000 a
59. Benzidine	92875			0.000086 a,b	0.00020 a,b
60. Benzo(a)Anthracene	56553			0.0038 a,b	0.018 a,b
61. Benzo(a)Pyrene	50328			0.0038 a,b	0.018 a,b
62. Benzo(b)Fluoranthene	205992			0.0038 a,b	0.018 a,b
63. Benzo(ghi)Perylene	191242				
64. Benzo(k)Fluoranthene	207089			0.0038 a,b	0.018 a,b
65. Bis(2-Chloroethoxy)Methane	111911				
66. Bis(2-Chloroethyl)Ether	111444			0.030 a,b	0.53 a,b
67. Bis(2-Chloroisopropyl)Ether	108601			1,400 a	65,000 a
68. Bis(2-Ethylhexyl)Phthalate (x)	117817			1.2 a,b	2.2 a,b
69. 4-Bromophenyl Phenyl Ether	101553				
70. Butylbenzyl Phthalate (w)	85687			1,500 a	1,900 a
71. 2-Chloronaphthalene	91587			1,000 a	1,600 a
72. 4-Chlorophenyl Phenyl Ether	7005723				
73. Chrysene	218019			0.0038 a,b	0.018 a,b
74. Dibenzo(a,h)Anthracene	53703			0.0038 a,b	0.018 a,b
75. 1,2-Dichlorobenzene	95501			420 a	1,300 a
76. 1,3-Dichlorobenzene	541731			320	960
77. 1,4-Dichlorobenzene	106467			63	190
78. 3,3'-Dichlorobenzidine	91941			0.021 a,b	0.028 a,b
79. Diethyl Phthalate	84662			17,000 a	44,000 a
80. Dimethyl Phthalate	131113			270,000	1,100,000
81. Di-n-Butyl Phthalate	84742			2,000 a	4,500 a

A		B Freshwater Aquatic Life		C Human Health (10-6 risk for carcinogens) For consumption of:	
82. 2,4-Dinitrotoluene	121142			0.11 b	3.4 b
83. 2,6-Dinitrotoluene	606202				
84. Di-n-Octyl Phthalate	117840				
85. 1,2-Diphenylhydrazine	122667			0.036 a,b	0.20 a,b
86. Fluoranthene	206440			130 a	140 a
87. Fluorene	86737			1,100 a	5,300 a
88. Hexachlorobenzene	118741			0.00028 a,b	0.00029 a,b
89. Hexachlorobutadiene	87683			0.44 a,b	18 a,b
90. Hexachlorocyclopentadiene	77474			47 a	1,300 a,j
91. Hexachloroethane	67721			1.4 a,b	3.3 a,b
92. Ideno(1,2,3-cd)Pyrene	193395			0.0038 a,b	0.018 a,b
93. Isophorone	78591			35 a,b	960 a,b
94. Naphthalene	91203				
95. Nitrobenzene	98953			17 a	690 a,j
96. N-Nitrosodimethylamine	62759			0.00069 a,b	3.0 a,b
97. N-Nitrosodi-n-Propylamine	621647			0.0050 a,b	0.50 a,b
98. N-Nitrosodiphenylamine	86306			3.3 a,b	6.0 a,b
99. Phenanthrene	85018				
100. Pyrene	129000			830 a	4,000 a
101. 1,2,4-Trichlorobenzene	120821			35 a	70 a
102. Aldrin	309002	3.0 f		0.000049 a,b	0.000050 a,b
103. alpha-BHC	319846			0.0026 a,b	0.0049 a,b
104. beta-BHC	319857			0.0091 a,b	0.017 a,b
105. gamma-BHC (Lindane)	58899	0.95 r		0.012 b	0.023 b
106. delta-BHC	319868				
107. Chlordane	57749	2.4 f	0.0043 f	0.00080 a,b	0.00081 a,b
108. 4,4'-DDT	50293	1.1 f	0.001 f	0.00022 a,b	0.00022 a,b
109. 4,4'-DDE	72559			0.00022 a,b	0.00022 a,b
110. 4,4'-DDD	72548			0.00031 a,b	0.00031 a,b
111. Dieldrin	60571	0.24 r	0.056 r	0.000052 a,b	0.000053 a,b

A		B Freshwater Aquatic Life		C Human Health (10-6 risk for carcinogens) For consumption of:	
112. alpha-Endosulfan	959988	0.22 f	0.056 f	62 a	89 a
113. beta-Endosulfan	33213659	0.22 f	0.056 f	62 a	89 a
114. Endosulfan Sulfate	1031078			62 a	89 a
115. Endrin	72208	0.086 r	0.036 r	0.059 a	0.060 a,j
116. Endrin Aldehyde	7421934			0.29 a	0.30 a,j
117. Heptachlor	76448	0.52 f	0.0038 f	0.000078 a,b	0.000079 a,b
118. Heptachlor Epoxide	1024573	0.52 f	0.0038 f	0.000039 a,b	0.000039 a,b
119. Polychlorinated Biphenyls (PCBs)			0.014 q	0.000064 a,b,q	0.000064 a,b,q
120. Toxaphene	8001352	0.73	0.0002	0.00027 a,b	0.00028 a,b
Total Number of Criteria (g)		23	21	96	95

a. This criterion reflects the Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of August 28, 2000. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case (unless otherwise noted).
b. This criterion is based on carcinogenicity of 10-6 risk.
c. Criterion Maximum Concentration (CMC) equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. Criterion Continuous Concentration (CCC) equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. The term "ug/L" means micrograms per liter.
d. Freshwater aquatic life criteria for metals are expressed as a function of total hardness (mg/L) in the waterbody. The equations are provided at paragraph (i) through (iv) of section 2. Values displayed in the table correspond to a total hardness of 100 mg/L.
e. Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH, and are calculated as follows: Values displayed in the table correspond to a pH of 7.8. CMC = exp(1.005(pH) - 4.869). CCC = exp(1.005(pH) - 5.134).
f. This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum data requirements and derivation procedures used to derive the 1980 criteria were different from those in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
g. These totals simply sum the number of criteria in each column. For aquatic life, there are 24 priority toxic pollutants with some type of freshwater or saltwater, acute or chronic criteria. For human health, there are 99 priority toxic pollutants with either "water + organism" or "organism only" criteria. Note that these totals count chromium as one pollutant even though EPA has developed criteria based on two valence states. In the matrix, EPA has assigned numbers 5a and 5b to the criteria for chromium to reflect the fact that the list of 126 priority pollutants includes only a single listing for chromium.
h. Criteria for these metals are expressed as a function of the water-effect ratio, WER, as defined in paragraphs (vii) through (ix) of section 2. CMC = (column B1 or C1 value) x WER; CCC = (column B2 or C2 value) x WER.
i. This criterion is a fish tissue residue criterion based on a total fish consumption weighted rate of 0.0175 kg/day. See EPA-823-R-01-001
j. No criterion for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for

Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even though the results of such a calculation were not shown in the document.
k. The CWA 304(a) criterion for this compound is the MCL or drinking water action level.

l. These freshwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. Criterion values were calculated by using EPA's Clean Water Act 304(a) guidance values (described in the total recoverable fraction) and then applying the conversion factors in (v) and (vi) of section 2.
o. The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/l and 12.82 µg/l, respectively.
p. This water quality criterion is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996 for the CMC, or 0.922 for the CCC) to convert this criterion to a value that is expressed in terms of dissolved metal. (See 40 CFR part 132.)
q. This criterion applies to total PCBs (that is, the sum of all homolog, all isomer, all congener, or all Aroclor analyses).
r. This criterion has been recalculated pursuant to the 1995 Updates: Water Quality Criteria Document for the Protection of Aquatic Life in Ambient Water, Office of Water, EPA-820-B-96-001, September 1996. See also Great Lakes Water Quality Initiative Criteria Document for the Protection of Aquatic Life in Ambient Water, EPA-80-B-95-004, March 1995.
s. This water quality criterion is expressed as µg free cyanide (as CN)/L.

Measurement Performance Criteria/Acceptance Criteria

Data Quality Indicators

Data quality indicators (DQI) relate to accuracy, precision, representativeness, comparability, completeness and methods detection limits. The quality control criteria established by KTWQP for data gathering, sampling, and analysis activities assures that important data gaps regarding Klamath River nutrient and toxic algae pollution can be filled with scientifically accurate data.

The general approach to assessing each DQI is described below. Some DQIs will be assessed quantitatively, while others will be assessed qualitatively. For quantitative assessments, example calculations have been provided and the QC samples (to assess each DQI) have been identified.

The frequency of the QC samples and the measurement performance criteria for each QC sample for each type of analysis are provided in Table 11. For quantitative assessment of laboratory methodology, the laboratory's QA Manual and analytical SOPs have been reviewed by the tribe's project team, and the associated laboratory QC (types & frequencies of QC samples and QC acceptance limits) have been determined to be adequate to meet the data quality needs of the project. As such, the laboratory QC have been accepted as the project's measurement performance criteria for the analytical

component, while project-specific criteria have been defined to assess the field sampling component.

For field measurements, the DQIs to be assessed quantitatively include precision and accuracy alone. The associated acceptance criteria (types & frequencies of QC checks and acceptance limits) for the project are summarized in Table 11 and 12.

Data quality will be assured by:

- Proper study design,
- Following standard methods,
- Using well calibrated equipment,
- Taking and maintaining good field records,
- Following chain of custody procedures for laboratory analysis,
- Prompt data entry in standard programs and formats,
- Data archiving with back ups to insure against loss, and
- Proper oversight of QA/QC procedures.

Hoopa TEPA (2008) found that nitrogen in the Klamath River is correlated with maximum pH, diel pH fluctuation, and minimum D.O.; therefore, nitrogen is an important index of nutrient pollution. KTWQP will adopt reference levels for key nutrients nitrogen, phosphorous and total inorganic nitrogen similar and MSAE and microcystin (Table 7) to those chosen as standards for the Klamath River on the Hoopa Valley Indian Reservation (Hoopa TEPA, 2008), which intersects with the river just above Weitchpec. An indication of high quality data will be sufficient resolution and accuracy to support comparison with these objectives. Similarly, Hoopa TEPA (2008) recognize that periphyton chlorophyll *a* levels can be used as an index of pollution, and recommended a maximum annual peak biomass limit of 150 mg/m^2 to protect water quality and fisheries.

Table 7. Limits of pollution for various nutrient parameters, MSAE and microcystin toxins.

Water Quality Parameter	**Recognized Pollution Level**
Total Nitrogen (TN) (mg/L)	0.2 mg/l
Total Phosphorus (TP) (mg/L)	0.035 mg/l
Periphyton Chlorophyll *a* (mg/m^2)	150 mg/m^2
Microcystis aeruginosa cell count	40,000 cells/ml

Microcystin Toxin	1 µg/l

Microcystin is a newly studied issue in California, but a consortium of State agencies has set provisional standards for hazardous conditions for recreational water bodies (CSWRCB, CDPH, and OEHHA, 2007). The standards for public health protection and limits of pollution levels are 40,000 cells of MSAE and/or 8 µg/L to trigger posting of a water body to close for recreational contact. This is consistent with Oregon's standards (ODHS 2005) limits for MSAE and microcystin. KTWQP and YTEP will issue warnings and communicate with all appropriate agencies should Klamath River samples exceed these thresholds.

The primary DQI specific to this project is whether uncertainty associated with each measurement is low enough to provide sufficient resolution to determine values relative to the above references.

Accuracy: *Accuracy* is the degree of agreement of a measurement with the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) that result from sampling and analytical operations. Accuracy of water quality and quantity measurements contained in this QAPP is a function of the equipment used during sampling.

Accuracy/bias will be assessed as related to recovery, as well as in regards to potential contamination sources. Both of these terms will be evaluated quantitatively.

Accuracy/bias related to recovery is an assessment of the laboratory analytical methods alone. For Laboratory Control Samples (LCS), it will be expressed as % Recovery by the following equation:

$$\% \text{ Recovery} = \frac{X}{T} \times 100$$

where,

X = Measured concentration

T = True spiked concentration

or, for Matrix Spike (MS) samples, by the following equation:

$$\% \text{ Recovery:} \quad \frac{X_{ms} - X_{fs}}{} \times 100$$

X_a

where,

X_{ms} = the amount of target analyte measured in the matrix spike sample

X_{fs} = the amount of target analyte measured in the corresponding field sample

X_a = the amount of target analyte spiked (into the matrix spike sample)

The frequency of the LCS and/or MS samples associated with the analytical parameters will be one for every 20 samples or 5%. No LCS or MS samples will be analyzed as part of the field measurements.

Accuracy/bias as related to contamination involves both a field sampling and laboratory component. To assess all steps of the project (from sample collection through analysis), field blanks will be collected and analyzed. Field blanks are planned to be collected at a frequency of 5% (or 1 blank/20 field samples) for off-site analysis of metals and anions. To assess potential laboratory contaminant sources alone, laboratory blanks will be prepared and analyzed at a one per batch or 5% frequency. No blanks will be analyzed as part of the field measurements.

Precision of field results will be tested using duplicate samples, taken as field splits, with a target of less than 20% relative percent difference (RPD).

Precision: *Precision* is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions.

Precision will be assessed quantitatively with duplicate samples and expressed as relative percent difference (RPD) by the following equation:

$$RPD\ (\%) = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

where,

RPD (%) = relative percent difference

X_1 = Original sample concentration

X_2 = Duplicate sample concentration

$|X_1 - X_2|$ = Absolute value of $X_1 - X_2$

To assess precision associated with all steps of the project (from sample collection through analysis) field duplicates will be collected and analyzed. Field duplicates will be collected at a frequency of 10% (1 duplicate/10 field samples) for each analytical parameter and 5% (1 duplicate each of 2 days/10 field samples) for each field measurement parameter. To assess laboratory precision alone, laboratory duplicates will be prepared and analyzed at a 5% frequency.

Comparability: Samples will be taken with comparable methods across the universe of samples on the Klamath River and its tributaries so will be comparable within each year. Methods are also consistent with previous samples that make up baseline and trend data for nutrients, phytoplankton, periphyton and algal toxins.

Completeness: Given the high quality of past samples taken by KTWQP, completeness on this project is expected to be over 90%, which is highly desirable because samples will only be taken bi-weekly (every two weeks).

Representativeness: This is the expression of the degree to which data accurately and precisely represent a characteristic of an environmental condition or a population. Field crews collecting samples will ensure representativeness of samples by selecting free-flowing water from established sampling locations and using a churn splitter to mix sample water once collected (Lurry and Kolbe, 2000) and by following protocols (Eilers, 2005; U.S. EPA, 2002) for periphyton.

See Table 9 for comparability measures and detection limits for nutrient samples, including U.S. EPA or American Public Health Association (APHA) (Eaton et al., 1995) approved sampling methods.

In order to support project decisions, data generated must be of known and acceptable quality. To define acceptable data quality for this project, data quality indicators (DQIs) were identified for each analytical parameter, and decisions were made regarding how each DQI would be assessed. The DQIs include: precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity.

Sensitivity- the ability of a method to detect and quantify an analytical parameter of concern at the concentration level of interest will be assessed semi quantitatively. No actual QC samples are involved. Instead, the laboratory to perform the analyses has provided their QLs and DLs and demonstrated that these are lower than the project action

limits (as shown in Tables 5, 6 and 7) for the majority of the analytical parameters. For field measurements, the sensitivity is defined by the instrument manufacturer (Table 8).

Table 8. Precision of sampling equipment by the KTWQP

Matrix	Parameter	Measurement Method	Precision	Accuracy	Measurement Range
Water	Temperature	Onset HOBO Water Temp Pro Loggers	±0.2°C at 0° to 50°C (±0.36°F at 32° to 120°	±0.2°C at 0° to 50°C (±0.36°F at 32° to 120°	0° to 50°C (32° to 122°F) in water (non-freezing)
Water	Temperature	YSI 556 & 6600 MPS Multi Probe System: YSI Precision ™ Thermistor	0.1°C	± 0.15°C	YSI 556= -5 to 45°C YSI 6600= -5 to 60°C
Water	pH	YSI 556 & 6600 MPS Multi Probe System: YSI Glass Combination electrode	0.01 units	±0.2 units	0 to 14 units
Water	Dissolved Oxygen	YSI 6600 MPS Multi Probe System Steady state polarographic	0.01 mg/L	±2% @ 0 to 20 mg/L ±6% @ 20 to 50 mg/L	0 to 50 mg/L
Water	Conductivity	YSI 6600 MPS Multi Probe System: YSI	0.001 mS/cm to 0.1 mS/cm range-	± 0.5% + 0.001 mS/cm	YSI 556= 0 to 200 mS/cm YSI 6600= 0 to 100mS/cm

Table 8. Precision of sampling equipment by the KTWQP

Matrix	Parameter	Measurement Method	Precision	Accuracy	Measurement Range
		4-electrode cell with autoranging	dependent		
Water	Turbidity	YSI 6600 MPS Multi Probe	0.01 NTU	± 2%	0-1000 NTU

1.8 Special Training Requirements/Certificates

No special training of field personnel is required for this project. The KTWQP Director is an experienced scientist who has been leading and training employees in conducting water quality investigations for over five years. She has been trained by US Forest Service, Siskiyou and Shasta Resource Conservation District's, and the Northern California Resource Center to calibrate, deploy and download HOBO temp loggers, flow meters, and hydolabs / data sondes according to established protocols. She has been trained to sample benthic macroinvertebrates under the guidance of Jim Harrington from California Department of Fish and Game. In addition, the field staff will be attending a 3-day bioassessment workshop, which will include sampling procedures for benthic macroinvertebrates. The KTWQP Environmental Director will oversee initial sampling events to ensure that field staff is following the guidelines of this QAPP.

The WQ Technician will keep clear records about how instructions from the Director were followed and make notes about any conditions that might cause anomalies in data. The KTWQP QA Officer will inspect the field and sampling equipment and periodically audit the WQ Technician to make sure that proper maintenance is taking place and is being documented.

The collection of all surface water samples using hand held equipment will use standard field methods as described in this QAPP, which are derived from

recognized U.S. EPA (1983; 2004) and U.S. Geologic Survey (USGS, 1998) protocols.

1.9 Documents and Records

QA Project Plan Distribution

It is the responsibility of the KTWQP Director/QA Officer to prepare and maintain amended versions of the QA Project Plan and to distribute the amended QA Project Plan to the individuals listed in Section 1.3. This *QAPP*, once approved, will be kept in printed form for ease of reference of the WQ Technician, QA Officer and KTWQP Director. When updated plans are approved, one copy of an older version will be retained in the KTWQP library, but clearly stamped to indicate that it is no longer current. In addition, each page of the *QAPP* will be clearly labeled as to the version and date of revision.

Field Documentation and Records

In the field, records will be documented in several ways, including field logbooks, photographs, pre-printed forms (such as labels and chain-of-custody forms), corrective action reports, and field audit checklists and reports. Field activities must be conducted according to this QAPP. All documentation generated by the sampling program will be kept on file in the office of the Karuk Tribe Water Quality Program.

Field Notebooks

Bound field logbooks will be used to record field observations, sampling site conditions, and on-site field measurements. These books will be kept in a permanent file in the KTWQP office. At a minimum, information to be recorded in the field logbooks at each sample collection/measurement location includes:

←

- Sample location and description,
- Site or sampling area sketch showing sample location and measured distances,
- Sampler's names,
- Date and time of sample collection,

- Designation of sample as composite or grab (for this project, all are grab samples),
- Type (media or matrix) of sample (for this project, all are surface water samples),
- Type of sampling equipment used (for this project, only sample bottles will be used),
- Type of field measurement instruments used, along with equipment model and serial number,
- Field measurement instrument readings,
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, color),
- Preliminary sample descriptions (e.g., clear water with strong ammonia-like odor),
- Sample preservation,
- Lot numbers of the sample containers, sample identification numbers and any explanatory codes,
- Shipping arrangements (overnight air bill number), and
- Name(s) of recipient laboratory(ies).

In addition to the sampling information, the following specific information will also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities,
- Time of arrival/entry on site and time of site departure,
- Other personnel on site,
- Deviations from the QAPP or SOPs required in the field, and
- Summary of any meetings or discussions with tribal, contractor, or federal agency personnel.

Separate instrument/equipment notebooks or logbooks will be maintained for each piece of equipment or instrument. These logbooks will be used to record field instrument calibration and maintenance information. Each logbook with include the name,

manufacturer, and serial number of the instrument/equipment, as well as dates and details of all maintenance and calibration activities.

Photographs

Digital photographs will be taken at each sampling location and at other areas of interest near the sampling area for every sampling event. The photographs will serve to verify information entered into the field logbook. Digital photographs will be archived in a permanent digital file to be kept in the KTWQP office.

For each photograph taken, the following information will be written in the field logbook or recorded in a separate field photography logbook:

- Time, date, location, and weather conditions,
- Description of the subject photographed,
- Direction in which the picture was taken, and
- Name and affiliation of the photographer.

Labels

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The Laboratory will provide sample labels (see Appendix A1) for this project. The samples will have pre-assigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information:

- Sampling location or name,
- Unique sample number,
- Sample description (e.g., grab, composite),
- Date and time of collection,
- Initials/signature of sampler,
- Analytical parameter(s), and
- Method of preservation.

Each sample for a given parameter will have a unique identifier. The sample identification numbering scheme is site, date, and method of collection (e.g. open water composite or surface grab).

Example sample label *SA032211-OC*

SA = site identification

032211 = date

OC = Open Channel

Field Quality Control Sample Records

Field QC samples (duplicates and blanks) will be labeled as such in the field logbooks. They will be given unique (fictitious) sample identification numbers and will be submitted "blind" to the laboratory (i.e., only the field logbook entry will document their identification and the laboratory will not know these are QC samples). The frequency of QC sample collection will also be recorded in the field logbook.

Sample Chain-of-Custody Forms and Custody Seals

Chain-of-custody forms and custody seals (see Appendix C2) will be provided by the laboratory. The forms will be used to document collection and shipment of samples for off-site laboratory analysis, while the seals will serve to ensure the integrity of (i.e., there has been no tampering with) the individual samples.

All sample shipments will be accompanied by a chain-of-custody form. The forms will be completed and sent with each shipment of samples to the laboratory. If multiple coolers are sent to a laboratory on a single day, forms will be completed and sent with the samples for each cooler. The original form will be included with the samples and sent to the laboratory. Copies will be sent to the KTWQP Director/QA Officer.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the field personnel, who

will sign the chain-of-custody form in the "relinquished by" box and note the date, time, and air bill number.

The shipping containers in which samples are stored will also be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping, as well as during shipping. All custody seals will be signed and dated.

Laboratory Documentation and Records

The analytical laboratory will keep a sample receiving log and all completed chain-of-custody forms submitted with the samples collected for this project. The analytical laboratory will also keep records of all analyses performed, as well as associated QC information, including: laboratory blanks, matrix spikes, laboratory control samples, and laboratory duplicates. Hard copy data of the analytical results will be maintained for six years by the laboratory.

The data generated by the laboratory for each sampling event will be compiled into individual data packages/reports. The data packages will include the following information:

- Project narrative including a discussion of problems or unusual events (including but not limited to the topics such as: receipt of samples in incorrect, broken, or leaking containers, with improperly or incompletely filled out chain-of-custody forms, with broken chain-of-custody seals, etc.; receipt and/or analysis of samples after the holding times have expired; summary of QC results exceeding acceptance criteria; etc.),
- Sample results and associated QLs,
- Copies of completed sample receiving logs and chain-of-custody forms, and,
- QC check sample records and acceptance criteria (to be included for all QC samples listed in Table 11 and 12, including the temperature blank check).

All data packages will be reviewed by the Laboratory QA Officer to ensure the accurate documentation of any deviations from sample preparation, analysis, and/or QA/QC procedures; highlights of any excursions from the QC acceptance limits; and pertinent sample data. Once finalized, the Laboratory QA Officer will provide the data

packages/reports to the Laboratory Project Manager who will sign them and submit them to the KTWQP Director/QA Officer. Laboratories will provide the following QC data for each parameter analyzed; laboratory duplicate results and associated RPD, spike results and associated % recovery, blank results, and QC check information. Any problems identified by the Laboratory QA Officer will be documented in the narrative part of the tribe's report.

Information about the documentation to be provided by the analytical laboratory is also contained in each laboratory's QA Manual (Appendix C3).

Technical Reviews and Evaluations

As part of the QA efforts for the project, on-going technical reviews will be conducted and documented. These reviews are associated with both field activities and the data generated by the off-site laboratory.

Field Audit Reports

The KTWQP Director/QA Officer will observe selected sampling events to ensure that sample collection and field measurements are going according to plan. The results of the observations will be documented in a designated QA Audit Logbook. Once back in the office, the KTWQP QA Officer will formalize the audit in a Field Audit Report to be forwarded to the KTWQP Director and the KTWQP Water Quality Technician/Field Sampler.

Corrective Action Reports (following Field Audits)

Corrective action reports will be prepared by the KTWQP Water Quality Technician/Field Sampler in response to findings identified by the KTWQP Director/QA Officer during field visits and audits. The reports will focus on plans to resolve any identified deficiencies and non-compliance issues that relate to on-going activities and problems of a systematic nature, rather than on one time mistakes. Corrective Action reports do not have a specific format, but will be handled as an internal memorandum.

Field Activities Review Checklist

At the end of each sampling event, a technical review will be conducted of field sampling and field measurement documentation to ensure that all information is complete and any deviations from planned methodologies are documented. This review is described in Section 3.1. The review, as well as comments associated with potential impacts on field samples and field measurement integrity, will be documented on a Field Activities Review Checklist (as provided in Appendix B1.)

Laboratory Data Review Checklist

Following receipt of the off-site laboratory's data package for each sampling event, The KTWQP QA Officer/Data Manager will conduct a technical review of the data to ensure all information is complete, as well as to determine if all planned methodologies were followed and QA/QC objectives were met. The results of this review, as well as comments associated with potential impacts on data integrity to support project decisions, will be documented on a Laboratory Data Review Checklist (as provided in Appendix B2).

Project Document Backup and Retention

Hardcopies of field notebooks, checklists, laboratory results and other paperwork will be maintained in the KTWQP office water quality file for six years. After six years, project files will be placed in long term storage. The Tribe's policy is to maintain records indefinitely.

Electronic data will be backed up on CDs at year end and placed into project files for storage. Additionally, an external hard-drive will be used to backup all project data from computer hard-drives. These drives will be stored in a fireproof safe nightly.

Biannual and Annual Reports

The KTWQP Director/QA Officer is responsible for the preparation of biannual and annual reports (summarizing the year's activities) to be submitted to the US EPA Grants Project Officer.

The biannual report should include, at a minimum:

- Table summarizing the results (including both laboratory data and field measurements),
- Final laboratory data package (including QC sample results),
- Brief discussion of the field and laboratory activities, as well as any deviations or modifications to the plans,
- Copies of Field Audit Reports and any associated Corrective Action Reports,
- Copies of Field Activities Review Checklists and Data Review Checklists,
- Discussion of any problems noted with the data, either from laboratory or field measurements,
- Discussion of any data points showing exceedence of Action Levels, and

← Recommendations/changes for the next sampling event.

The annual reports should include, at a minimum:

- Description of the project,
- Table summarizing the results (of all project data collected to date, including both laboratory data and field measurements),
- Final laboratory data package (including QC sample results),
- Discussion of the field and laboratory activities, as well as any deviations or modifications to the plans,
- Trends observed as a result of the year's monitoring efforts,
- Copies of Field Audit Reports and any associated Corrective Action Reports (for the fourth quarter),
- Copies of Field Activities Review Checklists and Data Review Checklists (for the fourth quarter),
- Evaluation of the data in meeting the project objectives, including data exceeding Action Levels,
- Recommendations to the Tribal Council regarding exceedence which are occurring on an on-going basis, and
- Recommendations/changes for future project activities (e.g., adding/deleting sampling locations and/or analyses, modifications to SOPs, amendments to the QA Project Plans, etc.).

2.0 Data Generation and Acquisition

This section of the QA Project Plan describes how the samples will be collected, shipped, and analyzed.

2.1 Sampling Design

A total of 8 locations will be sampled for surface water monitoring program. These locations will be along the Klamath River and at the mouths of major tributaries. The sample locations, names, and rationale for selecting each site are summarized in greater detail in section 1.6 of this document. Sample sites are in locations that provide a longitudinal profile or the Klamath River from Iron Gate Reservoir to Orleans. Also, included are inputs from the Shasta, Scott and Salmon Rivers. Sampling locations are depicted in Figure 6. The samples to be collected at each site are summarized in Table 4.

The baseline monitoring program will include monthly to bimonthly analyses throughout the year at 8 locations identified on Table 4 and shown on Figure 6. Analyses will include alkalinity, total phosphorus (TP), orthophosphate (SRP), ammonia, nitrate and nitrite, total nitrogen (TN), chlorophyll a, pheophytin, total organic carbon (TOC), dissolved organic carbon (DOC), total suspended solids (TSS), and volatile suspended solids (VSS).

Sample locations will also be field tested for temperature, pH, dissolved oxygen, conductivity (as specific conductance), turbidity in the winter and BGA in the summer. Samples will be collected throughout each calendar year. In addition, a parameter may be removed from the monitoring program if the sampling results indicate it is not of concern or added if new land uses develop after the monitoring program begins or the monitoring data indicates other potential parameters to include. If the sample collection changes, this will be noted in the quarterly reports to the US EPA Grants Project Manager and documented in an amendment to the QA Project Plan.

Periphyton sampling only takes place at the four locations in the mainstem Klamath below the KHP. Sites may be expanded to include the major tributaries if funding is available in the future. Also, sites may be reduced if funding is not available to continue periphyton sampling.

The KTWQP also conducts continuous monitoring at 6 sites during the spring, summer and fall months. Monitoring locations are summarized in Figure 6.

The sample locations and ID for each sampling location are included in Table 3. The samples to be collected are also summarized in Table 3.

All sampling locations will be recorded using global positioning system (GPS) equipment following the procedures included in Appendix C1. Additionally, photo documentation will occur at each sampling location during every sampling event.

2.2 Sampling Methods

KTWQP follows standard water quality grab sample procedures for nutrients, phytoplankton, and algal toxins using a churn to mix samples and following an appropriate regimen of blanks, duplicates and other steps to assure quality. Periphyton samples follow procedures as defined by the U.S. EPA (2002) and USGS (Porter et al., 1995) as previously used on the Klamath River by Eilers (2005). Calibration and maintenance of datasondes adheres to protocols established by USGS and the manufacture.

Standard methods will be used for collecting nutrient, phytoplankton, periphyton and algal generated toxics with specific equipment and steps for use described below. All samples are shipped to the laboratory on ice the same day samples are collected.

Field equipment for nutrient, phytoplankton and toxin samples, include a churn splitter and bottles provided by laboratories. A YSI datasonde is used to capture ambient water quality (temperature, pH, D.O. and conductivity). The churn splitter requires cleaning with distilled water in the field (see Churn Cleaning SOP, Appendix E3).

The following are the items on the KTWQP grab sampling check list that staff refer to before going into the field to collect nutrient, phytoplankton or algal toxin data:

1. Portable Water Quality instrument = YSI instrument
2. Ice (in bottles or packs)
3. Sample Bottles (from laboratory)
4. Camera
5. Extra labels for sample bottles
6. Coolers
7. Churn splitter
8. Van Dorn sampler
9. Clip board

a. Data sheet
b. Pencils
c. Permanent markers
d. Field notebook
e. Chain of Custody forms
f. Protocol Instructions
g. Shipping forms

10. Nitrile Gloves
11. Watch
12. Waders and boots
13. Distilled Water- 5+ gallons

Table 9. Nutrient, phytoplankton, periphyton an algal toxin parameters and the laboratory to which each will be shipped for analysis.

Parameter	**Laboratory**	**Method**	**Reporting Limit (mg/L)**	**MDL (mg/L)**
Total Phosphorus	AR	SM18 4500PF	0.002	0.002
Soluble Reactive Phosphorus	AR	SM18 4500PF	0.001	0.001
Total Nitrogen	AR	SM204500NC	0.100	0.045
Nitrate + Nitrite	AR	SM 184500NO3F	0.010	0.005
Ammonia	AR	SM 184500NH3H	0.010	0.006
Chlorophyll *a* / Pheophytin *a*	AR	SM1810200H	0.0001	0.0001
Phytoplankton speciation and enumeration	AA	APHA Standards	NA	
Total Organic Carbon	AR	SM205310B	0.250	0.095
Total Suspended Solids	AR	SM20 2540D	0.50	0.30
Volatile Suspended Solids	AR	SM20 2540E	0.50	0.40
Alkalinity	AR	SM182320B	1.00	0.20
Carbonaceous Biochemical Oxygen Demand	AR	SM20 5120B	2.00	1.00
Microcystin-LR	US EPA	ELISA	1.8 µg/l	1.8 µg/l
Microcystin (LR,LA,YR,RR,LF,LW) Anatoxin-a	CA Fish and Game	LC-MS/MS	1.0 µg/l	1.0 µg/l
Periphyton Chlorophyll-a	AR	APHA Standards	1 mg/m^2	1 mg/m^2

		(10200.H.3)		
Periphyton speciation and enumeration	AA	APHA Standards	NA	NA

The following equipment is needed to follow the methods of Eilers (2005), U.S. EPA (2002) and USGS (Porter et al., 1995) for collection of periphyton samples:

1) Flow meter
2) Measuring tape
3) Measuring staff/yard stick for water depth
4) Grid (1.5 square feet) used to determine algae cover at sample sites
5) Tub for keeping rocks selected for sampling submerged to carry to sampling site.
6) Microscope slides (1 " by 3") to judge sampling area and for sample application
7) Scraping tools such toothbrushes, scrapers, razor blades and spatulas
8) Tray or pan used for working surface
9) Jars for capturing sample scrapings
10) Coolers with ice for shipping samples to labs
11) Sample jars with Lugol's solution for periphyton speciation and enumeration (from Aquatic Analysts)
12) Sample jars with chemical preservative (MgCO3) for fixing chlorophyll *a* (from Aquatic Research)

The Karuk Tribe has multiple YSI datasondes and flow meters to provide replacement equipment, in the event of any equipment malfunction.

The KTWQP YSI multi-channel datasondes are very reliable, if properly calibrated. KTWQP staff calibrate the YSI datasonde before use in the field daily following YSI instructions and other standard procedures for calibration (U.S. EPA, 2001) that are attached as Appendix C. Every winter the YSI recorders are sent back to the factory and any defective sensors replaced.

Field screening is not appropriate for the sampling regime proposed under this QAPP.

Grab samples will be collected within one to two days at all locations using standard techniques from USGS (Lurry and Kolb, 2000). Timing of samples will be bi-weekly (every two weeks) between May and October. General water quality parameters (temperature, dissolved oxygen, conductivity, and pH) will also be measured simultaneously with a YSI datasonde that has been calibrated (using procedures in Appendix C) and data recorded onto the grab sample datasheet.

At the locations previously selected (Table 3), water samples will be collected with a churn splitter to ensure that the sample is homogeneously mixed before the sample bottles are filled (Figure 8). Depending on location, two collection methods may be used. For most sites, the churn is fully submerged into the stream and filled to the lid with flowing water, not stagnant water. For sites from a bridge (WA and KRAC), a Van Dorn sampler is used to collect 3 samples from across the channel. The samples are poured into the churn and treated the same as all other sites. Prior to filling the churn for nutrient, phytoplankton and algal toxin sampling, the churn will be rinsed three times with distilled water. The goal of rinsing is to remove substances adhering to equipment from previous exposure to environmental and other media (Lurry and Kolb, 2000). After rinsing with distilled water, the churn is rinsed three times with stream water. Samples are collected from uniformly mixed water by wading out into the water channel from the bank and the churn is fully submerged into the stream and filled to the lid with sample water. Completely filling the churn allows for all sample bottles to be filled from one churn; thereby minimizing differences in water properties and quality between samples.

Figure 8. KTWQP staff collects Klamath River water using a Van dorn sampler and then deposits in churn to ensure representativeness of sample. Photo taken in 2006 at Klamath River above Copco Reservoir.

Proper use of the churn guarantees that the water is well mixed before the sample is collected. The churn should be stirred at a uniform rate by raising and lowering the

splitter at approximately 9 inches per second while bottles are being filled (Bel-Art Products, 1993). If filling is stopped for some reason, the stiffing rate must be resumed before the next sample is drawn from the churn. As the volume of water in the churn decreases, the round trip frequency increases as the velocity of the churn splitter remains the same. Care must be taken to avoid breaking the surface of the water as the splitter rises toward the top of the water in the churn.

Sample bottles and chemical preservatives used will be provided by the associated laboratories and are considered sterile prior to field usage. Sample bottles without chemical preservatives will be rinsed with stream water from the churn three times before filling with sample water. In the case of bottles that contain chemical preservatives, bottles are not rinsed before sample collection and care is taken to avoid over-spillage that would result in chemical preservative loss. Collected samples are placed in coolers on ice for transport to contracted laboratories for analysis.

For quality assurance/ quality control (QA/QC) purposes duplicate and blank bottle sets are prepared and collected for one site each sampling period. These additional bottle sets are handled, prepared and filled following the same protocol used for regular bottle sets and samples.

Periphyton samples will be collected at the four mainstem Klamath River sampling sites below the KHP at the same time as the water quality grab samples. Periphyton sampling techniques employed are those recommended by U.S. EPA (2002) and USGS (Porter et al., 1995) and previously applied on the Klamath River by Eilers (2005). This section discusses samples of periphyton that will be analyzed for species diversity, while parallel samples are also collected at the same time for chemical analysis (chlorophyll *a*, which is a measure of weight per unit area (mg/m^2) of streambed. Site selection is not random, but rather chosen to represent periphyton communities in exposed sites that are probably most prevalent because of the Klamath Rivers width, as opposed to very-near shore or deep water assemblages, which are less extensive and less likely to affect water quality.

1. Select five representative cobbles from the stream bed at each sampling location. Rocks selected should not include extremes of algal cover. The specific stream bottom area sampled should meet the following criteria:

- Depth: 1 to 2 feet (use current meter staff)
- Velocity: 1 to 2 feet per second (current meter)
- Exposure: Clear solar path (i.e., no serious topographic or riparian shading)

2. Record the stream velocity, water depth, distance from the shore and the stream width for the location in which rocks will be removed for sampling on the datasheet.

3. Place 1.5 square foot grid on stream bed where cobbles are to be collected and make note of percent cover of algae within the total grid area (Figure 9).

4. Record any general observations that may be useful such as weather conditions and/or any drastic change in stream flow that could influence the periphyton community (i.e., recent rain event that caused increase in flow or scheduled flow releases or reductions).

5. Place cobbles selected for sampling in a tub containing water of sufficient depth to keep them submerged and transport to a convenient sample-processing area.

6. Select an area the size of a 1 inch by 3 inch microscope slide on sampled cobble that is representative and can be easily scraped (Figure 10). Two samples per location are collected for species identification and enumeration and also for chemical samples.

7. Scrape area of selected cobbles into sample jars that contain Lugol's solution for cell preservation to aid species identification. The tray over which the sample has been processed is then carefully poured into the sample jar.

8. Label sample jars.

9. Pack labeled jars in cooler and complete field datasheets.

Although biological samples for species diversity do not require rush shipping, they are shipped the same day as collected along with chlorophyll *a* samples that do require 48 hour delivery.

Grid estimation of periphyton cover helps to gauge changes from month to month. Grid data are recorded on a separate datasheet (Appendix D1). Effort is made to select an area that has not been disturbed by the sampling crew but still meets the same depths and velocities of location where the rock samples were taken. Use view finder of camera used for field documentation to visually inspect the amount of periphyton or macrophyte in each quadrant and record. Two samples should be taken, if one is not sufficiently representative.

Figure 9. This photo shows the 1.5 ft^2 grid for field estimation of periphyton cover in the vicinity of sample collection. Photo courtesy of YTEP.

Figure 10. Sample area equivalent to a 1" X 3" microscope slide is selected prior to scraping. Photo was taken by KTWQP staff at Klamath River Orleans site in June 2006.

Periphyton collection for chlorophyll *a* is identical to steps described above for species diversity sampling with the following noted exceptions. Distilled water may be used in washing contents of trays over which samples have been processed. These samples also require immediate refrigeration and so are placed in coolers with ice that have been brought into the field and which will be used for shipping samples to the laboratory. Samples are shipped via overnight carrier in a sealed cooler packed with blue ice so that lab analysis is conducted within 48 hours. The wet ice will be double bagged to prevent leakage. The laboratories have specified they prefer blue ice over double bagged wet ice when we ship overnight to their labs. Grab samples for phytoplankton are also analyzed by Aquatic Research for chlorophyll-a and pheophytin-a using a spectrophotometer, but sampling protocols do not vary from standard collection methods for nutrients, algal toxins or phytoplankton cell counts.

If a QC sample is to be collected at a given location, all containers designated for a particular analysis for both the sample and QC sample will be filled sequentially before containers for another analysis are filled. For field duplicate samples, containers with two different sample designations will be filled alternately.

Preservatives will be added after sample collection, if required, to avoid losing the preservatives and dilution of preservatives during sampling. Once the samples are collected and preserved, they will be kept chilled (if appropriate) and processed for shipment to the laboratory. Care will be taken to not touch the lip of the sample bottle during sample collection and preservation, so as not to potentially contaminate the sample. Table 10 summarizes the sample bottle/containers, volumes, and preservation requirements for each analysis and field measurement.

Table 10. Laboratory methodologies, containers, preservatives and holding times

Parameter	**Method**	**Containers (number, size/volume, type)**	**Preservation Requirements (chemical, temperature, light protection)**	**Maximum Holding Times[2]**
Total Phosphorus	SM18 4500PF	1 X 250ml, polyethylene bottle	4C	28 Days
Soluble Reactive	SM18 4500PF		4C	48 hours

Phosphorus				
Total Nitrogen	SM204500NC		4C	28 days
Nitrate + Nitrite	SM184500NO3F		4C	48 hours
Ammonia	SM184500NH3H		4C	48 hours
Alkalinity	SM18 2320B		4C	14 days
Chlorophyll *a* / Pheophytin *a*	SM1810200H	1 X 1L, polyethylene bottle	4C	
Total Organic Carbon	SM205310B	1 X 100ml, amber glass bottle	4C	28 day
Dissolved Organic Carbon				
Total Suspended Solids	SM20 2540D	1 X 1L, polyethylene bottle	4C	7days
Volatile Suspended Solids	SM20 2540E			
Periphyton speciation and enumeration	APHA Standards	1 X 250ml, brown polyethylene bottle	Lugol's Iodine	1 year
Periphyton Chlorophyll *a*	SM1810200H	1 X 250ml, brown polyethylene bottle	$MgCO_3$	48 hours
Microcystin (CDFG)	Anatoxin, LCMS/MS	1 X 125ml, amber glass bottle	Freeze and ship at <4C	14 days
Microcystin (EPA)	ELISA	1 X 125ml clear glass bottle	Freeze and ship at <4C	14 days
Carbonaceous Biochemical Oxygen Demand	SM20 5120B	500ml polyethylene bottle	4C	48 hours

For other contaminants that require a preservative, guidelines presented in the QA manuals from contracted laboratories will be used (see Appendix A3). If the option is given of a shorter hold time with no preservative, or a longer hold time with a

preservative added to the sample, the longer hold time with a preservative will be the method chosen. After samples are taken, the bottles will be properly labeled, and placed into the appropriate cooler. All samples will be double-checked for the proper sample level, any potential leakage, and proper labeling before being sealed and shipped to the lab. If the level of sample is different from the water level marked in the field at the time of sampling, the sample will be recorded as potentially tainted in the sampling log book.

Field Health and Safety Procedures

A brief tail-gate safety meeting will be held the first day of each sampling event to discuss emergency procedures (e.g., location of the nearest hospital or medical treatment facility), local contact information (e.g., names and telephone numbers of local personnel, fire department, police department), as well as to review the tribe's contingency plan.

When wading, care will be taken to avoid slipping on rocks and algae. Also, due to weather conditions during the sampling events and the possibility of health concerns (e.g., heat stress) from working in high temperatures, field personnel will be advised to drink plenty of water and wear clothing (e.g., hat, long-sleeved shirt) that will cover and shade the body.

Potential routes of exposure related to field sampling and measurement activities are through the skin (e.g., from direct contact from the surface water) and/or by ingestion (e.g., from not washing up prior to eating).

Field Measurements

Surface water samples will be analyzed at each sample collection location for the following field measurement parameters: pH, dissolved oxygen, conductivity (as specific conductance), turbidity, and temperature. Field measurements will be taken at each location prior to sample collection laboratory analysis. All field instruments will be calibrated (according to the manufacturer's instructions) at the beginning of each date of sampling and checked at the end of each day. Field instrument calibration and sample measurement data will be recorded in the field logbook.

Field Variances

As conditions in the field vary, it may become necessary to implement minor modifications to the sampling procedures and protocols described in this QA Project Plan. If/when this is necessary; the KTWQP Field Sampler will notify the KTWQP Director/QA Officer of the situation to obtain a verbal approval prior to implementing any changes. The approval will be recorded in the field logbook. Modifications will be documented in the Quarterly Reports to the US EPA Grants Project Officer.

Decontamination Procedures

For the currently planned sample collection activities, samples will be collected directly into sample bottles/containers provided from the laboratory. As such, no field decontamination of these bottles (used as the sampling equipment) is necessary. The bottles will be provided and certified clean by the laboratory according to procedures described in the laboratory's QA Manual provided in Appendix C3.

In the case that there is a need to collect surface water samples by an alternative method decontamination of reusable sampling equipment coming in direct contact with the samples will be necessary. Decontamination will occur prior to each use of a piece of equipment and after use at each sampling location. Disposable equipment (intended for one-time use) will not be decontaminated but will be packaged for appropriate disposal. All reusable/non-disposable sampling devices will be decontaminated according to US EPA Region 9 recommended procedures using the following washing fluids in sequence:

- Non-phosphate detergent and tap water wash (using a brush, if necessary),
- Tap-water rinse, and
- Deionized/distilled water rinse (twice).

Equipment will be decontaminated in a predesignated area on plastic sheeting. Cleaned small equipment will be stored in plastic bags. Materials to be stored more than a few hours will also be covered.

Disposal of Residual Materials

This section does not apply to the type of sampling conducted under this QAPP.

Quality Assurance for Sampling

Detailed instructions for collection of all field QC samples are discussed in Section 2.5 and listed in Table 11.

Documentation of deviations from this QA Project Plan is the responsibility of the KTWQP QA Officer. Deviations noted during the field audit will be documented in the QA Audit Logbook, recorded in the Field Audit Reports, and discussed in the biannual reports.

Additional deviations from the QA Project Plan may be implemented as field variances or modifications. These deviations will be communicated to the KTWQP Director/QA Officer by the KTWQP Technician/Field Sampler for approval. The approval will be recorded in the field logbook, and the modifications will be documented in the Quarterly Reports.

Table 11. Summary of Field and QC Samples Water Monitoring Program
Karuk Tribe

Matrix/ Media	Analytical Parameter[i]	No. of Sampling Locations	Depth (surface, mid, or deep)[ii]	No. of Field Duplicates[iii]	Inorganics No. of:[iv] Dup	MS	No. of Field Blanks[v]	Total No. of Samples
Analyses:								
Surface Water	Total Phosphorus	7	Surface (grab)	12	NAS	NAS	12	119
Surface Water	Dissolved Phosphorus	7	Surface (grab)	12	NAS	NAS	12	119
Surface Water	Total Nitrogen	7	Surface (grab)	12	NAS	NAS	12	119
Surface Water	Ammonium Nitrogen	7	Surface (grab)	12	NAS	NAS	12	119
Surface Water	Nitrate + Nitrite	7	Surface (grab)	12	NAS	NAS	12	119
Surface Water	Phytoplankton	7	Surface (grab)	12	0		0	119
Surface Water	Chlorophyll	7	Surface (grab)	12	NAS	NAS	12	119

[i] All analyses will be performed at an off-site laboratory. There will be no field screening analyses. Field measurements will be performed at each sample collection location.

[ii] Samples will be collected at depth of 6-12 inches. If depth of water is less than 12 inches, sample will be collected at mid depth and noted in the field logbook.

[iii] Field duplicates will be collected at a frequency of 10% of the samples collected for laboratory analysis.

[iv] Include number of associated analytical QC samples if collection of additional sample volume and/or bottles is necessary. If the QC samples listed are part of the analysis but no additional sample volume and/or bottles are needed, include "NAS" (for "no additional sample") in the column. (Note: MS=matrix spike, MSD=matrix spike duplicate, dup=laboratory duplicate/replicate.) No laboratory spikes or duplicates are conducted for phytoplankton enumeration and identification.

[v] Field blanks will be collected at a frequency of 10% of the samples collected, except for phytoplankton. Blanks have been proven unnecessary for this analysis.

2.3 Sample Handling and Custody

This section describes the sample handling and custody procedures from sample collection through transport and laboratory analysis. It also includes procedures for the ultimate disposal of the samples. All samples will be fully documented and complete notes will accompany every sampling event, including photo monitoring.

Field Notes and Logbooks

Sampling from each day of data collection will be recorded in the field notebook, which includes:

1. Survey crew identification
2. Date and time
3. Station ID
4. Sample ID
5. Ambient water quality measurements (temperature, pH, D.O., conductivity)
6. Number of bottles collected of each sample type (nutrients, phytoplankton, periphyton, and toxins)
7. Sample collection device
8. Details of undocumented sample locations
9. Note fields for recording site conditions

As noted above, grid information on the percent cover of the stream bottom by periphyton is also recorded on the Grid Data Sheet (Appendix D). All water quality information is recorded with a YSI datasonde that is calibrated before going into the field every day samples are collected. Since this is the only source of field-recorded water quality data, YSI instrument calibration is not noted on sampling data sheets.

Photographs

Photographs will be taken at each sampling location during each sampling event. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook:

- Time, date, location, and weather conditions
- Description of the subject photographed

- Name of person taking the photograph

Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. At a minimum, the sample labels will contain the following information: station location, date of collection, analytical parameter(s), and method of preservation. Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number

Chain of Custody

All sample shipments for analyses will be accompanied by a KTWQP Nutrient, Phytoplankton and Periphyton, or Algal Toxin Chain of Custody Form (Appendix A2). These forms will be completed and sent with each sample for each laboratory and each shipment (i.e., each day). If multiple coolers are sent to a single laboratory on a single day, duplicate forms will be completed and sent in each cooler.

Until the samples are shipped, the custody of the samples will be the responsibility of KTWQP staff assigned to collection and shipment of samples and the Project Manager. The chain of custody form includes date and time of transfer to carrier and carrier shipping number. Each laboratory listed above will be responsible for chain of custody once they have received from the shipping company.

Sample Packaging and Shipment

Sturdy coolers suitable for secure sample transit are provided by the laboratories and KTWQP staff makes sure that packing materials and ice are supplemented to protect samples in transit. The KTWQP Algal Toxin Chain of Custody Form supplies U.S. EPA staff at the Region 9 Richmond Laboratory with a Regional Analytical Program (RAP) number. Shipment of samples will not include a copy of the KTWQP field notebook, so that labs cannot introduce bias because locations are unknown to them.

1. All samples are removed from coolers
2. Place bubble wrap around the inside edge of the cooler to prevent breakage during shipment, and/or wrap bottles individually.
3. Prepare bags of ice to be used to keep the samples cool during transport when wet ice is used. Pack the ice in doubled, zip-locked plastic bags.
4. Check the sample bottle screw caps for tightness.

5. Ensure sample labels are affixed to each sample container and protected by a cover of clear tape.
6. Wrap all glass sample containers in bubble wrap to prevent breakage.
7. Samples are placed in cooler and entered on COC
8. Place the bagged ice or blue ice on top and around the samples to chill them to the correct temperature.
9. Fill the empty space in the cooler with bubble wrap, Styrofoam peanuts, or any other available inert material to prevent movement and breakage during shipment.
10. Enclose the appropriate chain-of-custody(s) in a zip-lock plastic bag
    Close the lid of the cooler. Tape the cooler shut

Daily, the KTWQP Field Samplers will notify the Laboratory Project Manager of the sample shipment schedule. The laboratory will be provided with the following information:

- Sampler's name,
- Name and location of the site or sampling area,
- Names of the tribe and project,
- Total number(s) and matrix of samples shipped to the laboratory,
- Carrier, air bill number(s), method of shipment (e.g., priority next day),
- Shipment date and when it should be received by the laboratory,
- Irregularities or anticipated problems associated with the samples, and
- Whether additional samples will be shipped or if this is the last shipment.

Sample Custody

The field sampler is responsible for custody of the samples until they are delivered to the laboratory or picked up for shipping. (Note: As few people as possible will handle the samples to ensure sample custody.) Chain-of-custody forms must be completed in the field. Each time one person relinquishes control of the samples to another person, both individuals must complete the appropriate portions of the chain-of-custody form (see Appendix A2) by filling in their signature as well as the appropriate date and time of the custody transfer.

During transport by a commercial carrier, the air bill will serve as the associated chain-of-custody. Once at the laboratory, the sample receipt coordinator will open the coolers and sign and date the chain-of-custody form. The laboratory personnel are then responsible for the care and custody of samples. The analytical laboratory will track sample custody through their facility using a separate sample tracking form, as discussed in the laboratory QA Manual included in Appendix A3.

A sample is considered to be in one's custody if:

- The sample is in the sampler's physical possession,
- The sample has been in the sampler's physical possession and is within sight of the sampler,
- The sample is in a designated, secure area, and/or
- The sample has been in the sampler's physical possession and is locked up.

Sample Disposal

Following sample analysis, each laboratory will store the unused portions for an established length of time (see lab QA/QC Manual's in Appendix A3). At that time, the laboratory will properly dispose of all the samples (if applicable). Sample disposal procedures at the laboratory are discussed in the laboratory's QA Manual included in Appendix A3.

Analytical Methods

The field measurement and off-site laboratory analytical methods are listed in Table 8 and 10 and discussed below.

Field Measurement Methods

See Section 2.2

Laboratory Analyses Methods (Off-Site)

Surface water samples will be analyzed at Aquatic Research Inc., North Coast Laboratories, Ltd., and Aquatic Analysts. Analyses will be performed following either EPA-approved methods or methods from *Standard Methods for the Examination of*

Water and Wastewater, 20th Edition, as summarized in Table 10. SOPs for the analytical methods are included in Appendix A3. The Laboratory QA/QC Officer must notify the Laboratory Project Manager if there is any knowledge of the SOPs not being followed.

Both the laboratory and consultant will summarize the data and associated QC results in a data report, and provide this report to the KTWQP Director. The KTWQP Director/QA Officer will review the data reports and associated QC results to make decisions on data quality and usability in addressing the project objectives.

2.5 Quality Control Requirements

This section identifies the QC checks that are in place for the sample collection, field measurement, and laboratory analysis activities that will be used to access the quality of the data generated from this project.

Field Sampling Quality Control

Field sampling QC consists of collecting field QC samples to help evaluate conditions resulting from field activities. Field QC is intended to support a number of data quality goals:

- Combined contamination from field sampling through sample receipt at the laboratory (to assess potential contamination from field sampling equipment, ambient conditions, sample containers, sample transport, and laboratory analysis) - assessed using field blanks;
- Sample shipment temperature (to ensure sample integrity and representativeness that the sample arriving at the laboratory has not degraded during transport) - assessed using temperature blanks; and
- Combined sampling and analysis technique variability, as well as sample heterogeneity - assessed using field duplicates.

For the current project, the types and frequencies of field QC samples to be collected for each field measurement and off-site laboratory analysis are listed in Tables 11 and 12. These include field blanks, temperature blanks (as included in a footnote to the table), and field duplicates.

Field Blanks - Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sample collection due to exposure from ambient conditions or from the sample containers themselves. Field blank samples will be obtained by pouring deionized water into a sample container at the sampling location. Field blanks will not be collected if equipment blanks have been collected during the sampling event. If no equipment blanks are collected (and none are planned because samples will be collected directly into sample containers), one field blank will be collected for every 10 samples or a frequency of 10%. Field blank frequency is outlined in Table 11.

Field blanks will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each blank. Field blanks will be submitted blind to the laboratory for invalidation of results, greater attention to detail during the next sampling event, or analysis of metals, hardness, and anions. No field blanks are planned for periphyton identification/enumeration or phytoplankton identification/enumeration. Field duplicates will be used to assess laboratory results.

If target analytes are found in field blanks, sampling and handling procedures will be reevaluated and corrective actions taken. These may consist of, but are not limited to, obtaining sampling containers from new sources, training of personnel, discussions with the laboratory other procedures felt appropriate.

Field Duplicate Samples - Field duplicate samples will be collected to evaluate the precision of sample collection through analysis. Field duplicates will be collected at designated sample locations by alternately filling two distinct sample containers for each analysis. Field duplicate samples will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each duplicate. The samples will be submitted as “blind” (i.e., not identified as field duplicates) samples to the laboratory for analysis.

For the current project, field duplicates will be collected for each analytical parameter, and field measurement parameter, at the frequencies shown in Table 11. The duplicates samples will be collected at random locations for each sampling event. Criteria for field duplicates for the analytical and field measurement parameters are provided in Tables 11 and 12, respectively. If criteria are exceeded, field sampling and handling procedures will be evaluated, and problems corrected through greater attention to detail, additional training, revised sampling techniques, or whatever appears to be appropriate to correct the problems.

Field Measurement Quality Control

Quality control requirements for field measurements are provided in Table 12.

Laboratory Analyses Quality Control (Off-Site)

Laboratory QC is the responsibility of the personnel and QA/QC department of the contracted analytical laboratories. Each laboratory's Quality Assurance Manuals detail the QA/QC procedures it follows. The following elements are part of standard laboratory quality control practices:

- Analysis of method blanks,
- Analysis of laboratory control samples,
- Instrument calibration (including initial calibration, calibration blanks, and calibration verification),
- Analysis of matrix spikes, and
- Analysis of duplicates.

The data quality objectives for Aquatic Analysts, California Laboratory Services, and North Coast Laboratories (including frequency, QC acceptance limits, and corrective actions if the acceptance limits are exceeded) are detailed in the QA Manuals and SOPs (as in Appendix A3). Any excursions from these objectives must be documented by the laboratory and reported to the Project Manager/QA Officer.

The Tribe has reviewed each laboratory's control limits and corrective action procedures and feels that these will satisfactorily meet tribal project data quality needs.

A summary of this information is included in section 2.5. These include laboratory (or method) blanks, laboratory control samples, matrix spikes, and laboratory duplicates.

Method Blanks - A method blank is an analyte-free matrix, analyzed as a normal sample by the laboratory using normal sample preparation and analytical procedures. A method blank is used for monitoring and documenting background contamination in the analytical environment. Method blanks will be analyzed at a frequency of one per sample batch (or group of up to 20 samples analyzed in sequence using the same method).

Corrective actions associated with exceeding acceptable method blank concentrations include isolating the source of contamination and re-digesting and/or re-analyzing the associated samples. Sample results will not be corrected for blank contamination, as this is not required by the specific analytical methods. Corrective actions will be documented in the laboratory report's narrative statement.

Laboratory Control Samples - Laboratory control samples (LCS) are laboratory-generated samples analyzed as a normal sample and by the laboratory using normal sample preparation and analytical procedures. An LCS is used to monitor the day-to-day performance (accuracy) of routine analytical methods. An LCS is an aliquot of clean water spiked with the analytes of known concentrations corresponding to the analytical method. LCS are used to verify that the laboratory can perform the analysis on a clean matrix within QC acceptance limits. Results are expressed as percent recovery of the known amount of the spiked analytical parameter.

One LCS is analyzed per sample batch. Acceptance criteria (control limits) for the LCS are defined by the laboratory and summarized in their associated QA Manuals (Appendix A3). In general, the LCS acceptance criteria recovery range is 70 to 130 percent of the known amount of the spiked analytical parameter. Corrective action, consisting of a rerunning of all samples in the affected batch, will be performed if LCS recoveries fall outside of control limits. Such problems will be documented in the laboratory report's narrative statement.

Table 12. Quality Control Requirements for Surface Water Field Measurements

Field Parameters: Temperature, pH, Dissolved Oxygen, Turbidity, Conductivity

QC Sample	Data Quality Indicator (DQI)	Frequency/ Number	Methods/SOP QC Acceptance Limits	Acceptance Criteria/ Measurement Performance criteria	Corrective Action
Temperature- YSI 6600 MPS Multi Probe System: YSI Precision ™ Thermistor					
Field Duplicate	Precision (S & A)	1/5 field samples	N/A	± 0.15°C	Collect & analyze 3rd sample. Qualify data if still exceeding criteria
QC Check Sample	Accuracy	N/A	N/A	N/A	None. Sensor not used if it didn't meet annual calibration criteria.
Temperature- Onset HOBO Water Temp Pro Loggers					
Field Duplicate	Precision (S & A)	1/5 field samples	N/A	±0.2°C	Collect & analyze 3rd sample. Qualify data if still exceeding criteria
QC Check Sample	Accuracy	N/A	N/A	N/A	None. Sensor not used if it didn't meet annual calibration criteria.
pH- YSI 6600 MPS Multi Probe System: YSI Glass Combination electrode					
Field Duplicate	Precision (S & A)	1/5 field samples	N/A	±0.2 units	Collect & analyze 3rd sample. Qualify data if still exceeding criteria
QC Check Sample	Accuracy	1/batch each day	±0.5 units of true value for both calibration check standards	±0.5 units of true value	Qualify associated field data
Dissolved Oxygen- YSI 6600 MPS Multi Probe System Steady state polarographic					
Field Duplicate	Precision (S & A)	1/5 field samples	N/A	±20% RPD	Collect & analyze 3rd sample. Qualify data if still exceeding criteria
Conductivity- YSI 6600 MPS Multi Probe System: YSI 4-electrode cell with autoranging					
Field Duplicate	Precision (S & A)	1/5 field samples	N/A	±20% RPD	Collect & analyze 3rd sample. Qualify data if still exceeding criteria
QC Check Sample	Accuracy	1/batch each day	±10% of true value or ±20 µS/cm (whichever is greater) for both	±10% of true value	Qualify associated field data

Matrix Spikes - Matrix spikes (MS) are prepared by adding a known amount of the analyte of interest to a sample. MS are used as a similar function as the LCS, except that the sample matrix is a real-time sample rather than a clean matrix. Results are expressed as percent recovery of the known amount of the spiked analytical parameter. Matrix spikes are used to verify that the laboratory can determine if the matrix is causing either a positive or negative influence on sample results.

One matrix spike is analyzed per sample batch. Acceptance criteria of the MS are defined by the laboratory and summarized in each QA Manual (Appendix A3). In general, the MS acceptance criteria recovery range is of 70 to 130 percent of the known amount of the spiked analytical parameter. Generally, no corrective action is taken for matrix spike results exceeding the control limits, as long as the LCS recoveries are acceptable. However, the matrix effect will be noted in laboratory report's narrative statement and documented in the Tribe's reports for each sampling event.

Laboratory Duplicates - A laboratory duplicate is a laboratory-generated split sample used to document the precision of the analytical method. Results are expressed as relative percent difference between the laboratory duplicate pair.

One laboratory duplicate will be run for each laboratory batch or every 10 samples, whichever is more frequent. Acceptance criteria (control limits) for laboratory duplicates are specified in the laboratory QA Manual and SOPs, Appendix A3. If laboratory duplicates exceed criteria, the corrective action will be to repeat the analyses. If results remain unacceptable, the batch will be rerun. The discrepancy will be noted in the laboratory report's narrative statement and documented in the Tribe's reports for each sampling event.

ALL SAMPLES ARE SURFACE WATER MATRIX. ALL SAMPLES ARE COLLECTED BY THE SAME PROCEDURE. NO ADDITIONAL QC CHECKS ARE PLANNED BEYOND THOSE IDENTIFIED ABOVE FOR ACCURACY AND PRECISION.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Field Measurement Instruments/Equipment

Sampling equipment under the care of the KTWQP will be maintained according to the manufacturer's instructions. Maintenance logs will be kept in the office of the KTWQP Director/QA Officer. Each piece of equipment will have its own maintenance log. The log will document any maintenance and service of the equipment. A log entry will include the following information:

- Name of person maintaining the instrument/equipment,
- Date and description of the maintenance procedure,
- Date and description of any instrument/equipment problem(s),
- Date and description of action to correct problem(s),
- List of follow-up activities after maintenance (i.e., system checks), and
- Date the next maintenance will be needed.

Laboratory Analysis Instruments/Equipment (Off-Site)

Inspection and maintenance of laboratory equipment is the responsibility of the Aquatic Analysts, Aquatic Research, U.S. EPA and California Department of Fish and Game and is described in each laboratory's QA Manual included as Appendix A3.

2.7 Instrument/Equipment Calibration and Frequency

Field Measurement Instrument/Equipment

Calibration and maintenance of field equipment/instruments will be performed according to the manufacturer's instructions (see Appendix C) and recorded in an instrument/equipment logbook. Each piece of equipment/instrument will have its own logbook.

The project-specific criteria for calibration (frequency, acceptance criteria, and corrective actions associated with exceeding the acceptance criteria) are provided in Table 13.

Laboratory Analysis Instruments/Equipment

Laboratory instruments will be calibrated according to the appropriate analytical methods. Acceptance criteria for calibrations are found in each of their QA Manuals included as Appendix A3.

Table 13. Field Equipment Calibration, Maintenance, Testing and Inspection

Analytical Parameter	Instrument	Calibration Activity	Maintenance & Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action
Temperature (sensor)	6600 MPS Multi Probe System: YSI Precision ™ Thermistor		See Manufacturer's manual	Initial Post: Once a week check and calibrate as needed	± 0.15°C of true value at both endpoints	Remove from use if doesn't pass calibration criteria
Temperature (sensor)	Onset HOBO Water Temp Pro Loggers	Initial: Water bath calibration against NIST thermometer (US Fish and Wildlife Protocol)	See Manufacturer's manual		±0.2°C of true value at both endpoints	Remove from use if doesn't pass calibration criteria
pH (electrode)	6600 MPS Multi Probe System: YSI Glass Combination electrode	Initial: two-point calibration bracketing expected field sample range (using 7.0 and 10.0 pH buffer); followed by one-point check with 7.0 pH buffer Post: single-point check with 7.0 pH buffer	See Manufacturer's manual	Initial Post: Once a week check and calibrate as needed	Initial: Two point calibration done electronically; one-point check (using 7.0 pH buffer) ±0.1 pH units of true value Post: ±0.5 pH units of true value with both 7.0 pH and 10.0 pH buffer	Recalibrate Qualify data
Dissolved oxygen (sensor)	*6600 MPS Multi Probe Optical Sensor*	Initial: One-point calibration with saturated air (need temp, barometric pressure). Post: single-point check at full saturation	See Manufacturer's manual	Initial Post: Once a week check and calibrate as needed	Initial: one-point calibration done electronically. Post: ±0.5 mg/L of true saturated value	Recalibrate; Qualify data
Turbidity (sensor)	*YSI 6600 MPS Multi Probe System*	Initial: two point calibration using 0 NTU (or deionized water) and 126 NTU standards to bracket expected sample	See Manufacturer's manual	Initial Post: Once a week check and calibrate as	Initial: two-point calibration done electronically; one-point check (using 126 NTU standard) ±10% of true value Post: two-point check with	See Manufacturer's manual

2.8 Inspection and Acceptance of Supplies and Consumables

Field Sampling Supplies and Consumables

Sample containers and preservatives will be provided by the analytical laboratory. Containers will be inspected for breakage and proper sealing of caps. Other equipment such as sample coolers and safety equipment will be acquired by the Tribe. If reusable sampling equipment is acquired in the future, materials/supplies necessary for equipment decontamination will be purchased by the Tribe; however, this is not necessary for the present study. Any equipment deemed to be in unacceptable condition will be replaced.

Field Measurement Supplies and Consumables

Field measurement supplies, such as calibration solutions, will be acquired from standard sources, such as the instrument manufacturer or reputable suppliers. Chemical supplies will be American Chemical Society reagent grade or higher. The lot number and expiration date on standards and reagents will be checked prior to use. Expired solutions will be discarded and replaced. The source, lot number, and expiration dates of all standards and reagents will be recorded in the field log books.

Laboratory Analyses (Off-Site) Supplies and Consumables

Each of the laboratory's requirements for supplies and consumables are described in its QA Manual which is provided in Appendix A3.

Data Acquisition Requirements (Non-Direct Measurements)

To supplement field measurements and laboratory analytical activities conducted under this project, other potential "external" data sources will be researched. These sources include, but are not limited to, the U.S. Geological Survey, the North Coast Regional Water Quality Control Board, the California Department of Water Resources, the U.S. Environmental Protection Agency, the United States Forest Service, the Hoopa Tribe, and the Yurok Tribe. The primary use of this external data will be to help focus the Tribe's data collection efforts (for example, the information

may be used to identify new sites in the Klamath River watershed for future sampling).

If it appears that the "external" data might facilitate water body evaluation, the data will first be reviewed to verify that they are of sufficient quality to meet the needs of the project by examining:

(1) the sample collection and location information;
(2) the data to see whether they are consistent with known tribally-collected data from the same general vicinity; and
(3) the QA/QC information associated with the data.

If the data are of insufficient or unknown quality, limitations will be placed on its use in supporting project decisions. In general, it is anticipated that decisions for the current project will be based on data collected by the Tribe following this current QA Project Plan.

2.9 Data Management

All data collected by the KTWQP will be maintained in appropriate bound notebooks and electronic databases. Data from the laboratory will be requested in both hard copy and electronic form. The electronic and hard copy results will be compared to ensure that no errors occurred in either format. If discrepancies are noted, the laboratory will be contacted to resolve the issues.

3.0 ASSESSMENT AND OVERSIGHT

This section describes how activities will be checked to ensure that they are completed correctly and according to procedures outlined in this QA Project Plan.

Assessment/Oversight and Response Actions

During the course of the project, it is important to assess the project's activities to ensure that the QA Project Plan is being implemented as planned. This helps to ensure that everything is on track and serves to minimize learning about critical deviations toward

the end of the project when it may be too late to remedy the situation. For the current project, the ongoing assessments will include:

- Field Oversight
- Readiness review of the field team prior to starting field efforts,
- Field activity audits, and
- Review of field sampling and measurement activities methodologies and documentation at the end of each event, and
- Laboratory Oversight - evaluation of laboratory data generated for each quarterly sampling event.

Details regarding these assessments are included below.

Field Oversight

Readiness Reviews

Sampling personnel will be properly trained by qualified personnel before any sampling begins and will be given a brief review of sampling procedures and equipment operation by the KTWQP Director/QA Officer before each sampling event. Equipment maintenance records will be checked to ensure all field instruments are in proper working order. Adequate supplies of all preservatives and bottles will be obtained and stored appropriately before heading to the field. Sampling devices will be checked to ensure that they have been properly cleaned (for devices which might be reused) or are available in sufficient quantity (for devices which are disposable). Proper paperwork, logbooks, chain of custody forms, etc. will be assembled by the sampling technician. The KTWQP Director/QA Officer will review all field equipment, instruments, containers, and paperwork to ensure that all is in readiness prior to the first day of each sampling event. Any problems that are noted will be corrected before the sampling team is permitted to depart the Tribe's facilities.

Field Activity Audits

Once a month, the KTWQP Director/QA Officer will assess the sample collection methodologies, field measurement procedures, and record keeping of the field team to ensure activities are being conducted as planned (and as documented in this QA Project

Plan). Any deviations that are noted will be corrected immediately to ensure all subsequent samples and field measurements collected are valid. (Note: If the deviations are associated with technical changes and/or improvements made to the procedures, the KTWQP QA Officer will verify that the changes have been documented by the KTWQP Technicians in the Field Log Book and addressed in an amendment to this QA Project Plan.) The KTWQP QA Officer may stop any sampling activity that could potentially compromise data quality.

The KTWQP QA Officer will document any noted issues or concerns in a QA Audit Logbook and discuss these items informally and openly with the KTWQP Water Quality Technicians while on site. Once back in the office, they will formalize the audit findings (for each event) in a Field Audit Report which will be submitted to the KTWQP Director and the KTWQP Technicians.

The KTWQP Technician will prepare a Corrective Action Report to address any audit findings discussed in the Field Audit Report. The Corrective Action Report will be issued as an internal memorandum the KTWQP Director/QA Officer in response to problems noted during on-site audits and will document steps taken to reduce future problems prior to the next sampling event.

Post Sampling Event Review

Following each sampling event, the KTWQP Data Manager will complete the Field Activities Review Checklist (Appendix B1). This review of field sampling and field measurement documentation will help ensure that all information is complete and any deviations from planned methodologies are documented. This review will be conducted in the office, not in the field. The results of this review, as well as comments associated with potential impacts on field samples and field measurement integrity will be forwarded to the KTWQP Director to be used in preparing the reports for each event and also to be used as a guide to identify areas requiring improvement prior to the next sampling event.

Laboratory Oversight

Following receipt of the off-site laboratory's data package for each sampling event, the KTWQP QA Officer will review the data package for completeness, as well as to ensure that all planned methodologies were followed and that QA/QC objectives were met. The results of the review will be documented on the Laboratory Data Review Checklist (Appendix B2). (Note: The KTWQP Director/QA Officer has the authority to request re-testing or other corrective measures if the laboratory has not met the project's QA/QC objectives and/or has not provided a complete data package.)

Due to the scope and objectives of the current project, the Tribe is not planning any laboratory audits at this time. However, the Tribe will check periodically with the state of California certification agency to make sure that the laboratory remains in good standing for those methods that the tribe is requesting.

The laboratories' QA Manuals describe the policies and procedures for assessment and response in the laboratory.

Reports to Management

Biannually, the KTWQP Director will prepare and submit a report on that quarter's sampling activities. Contents of this report have been described previously in Section 1.9. This report will be submitted to the Tribal Council for approval. After approval, the report will be submitted to the US EPA Grants Project Officer.

Once a year a report summarizing the year's reports will be prepared which will show any data trends that have occurred. The report will also discuss how any actions taken during the year may have affected the trends. This report will also be submitted to the Tribal Council for approval. After approval, the report will be submitted to the US EPA Grants Project Officer.

4.0 DATA REVIEW AND USABILITY

Prior to utilizing data to make project decisions, the quality of the data needs to be reviewed and evaluated to determine whether the data satisfy the project's objectives. This process involves technical evaluation of the off-site laboratory data, as well as review of the data in conjunction with the information collected during the field sampling and field measurement activities. This latter, more qualitative review provides for a clearer understanding of the overall usability of the project's data and potential limitations on their use. This section describes the criteria and procedures for conducting these reviews and interpreting the project's data.

4.1 Data Review, Verification, and Validation Requirements

The setting of data review, verification, and validation requirements helps to ensure that project data are evaluated in an objective and consistent manner. For the current project, such requirements have been defined for information gathered and documented as part of field sampling and field measurement activities, as well as for data generated by the off-site laboratory.

Field Sampling and Measurement Data

Any information collected during sample collection and field measurements is considered field "data." This includes field sampling and measurement information documented in field logbooks (as listed in Section 1.9), photographs, and chain of custody forms.

Once the KTWQP Technician returns to the office following a sampling event, they turn in the field data to the KTWQP Data Manager who is responsible for conducting a technical review of the field data to ensure that all information is complete and any deviations from the planned methodologies are documented. For the purpose of this project, the review will be documented using the Field Activities Review Checklist provided in Appendix B1. This checklist comprehensively covers the items to be reviewed and leaves room to capture any comments associated with potential impacts on field samples and field measurement integrity based on the items listed.

Laboratory Data

For the data generated by an off-site laboratory, the laboratory is responsible for its own internal data review and verification prior to submitting the associated data results package to the KTWQP QA Officer. The details of the review (including checking calculations, reviewing for transcription errors, ensuring the data package is complete, etc.) are discussed in the laboratory's QA Manual included as Appendix A3. Details of the information that will be included in each data package is listed in Section 1.9 of this QA Project Plan.

Once the laboratory data are received by the Tribe, the KTWQP QA Officer is responsible for further review and validation of each data package. For the purpose of this project, data review and validation will be conducted using the Data Review Checklist provided in Appendix B2 in conjunction with the QC criteria (i.e., frequency, acceptance limits, and corrective actions) defined in Tables 10, 11 and 12. This review will include evaluation of the field and laboratory duplicate results, field and laboratory blank data, matrix spike recovery data, and laboratory control sample data pertinent to each analysis. The review will also include ensuring data are reported in compliance with the project action limits and quantification limits defined in Tables 8-13; the sample preparation/analytical procedures were performed by the methods listed in Table 11; sample container, preservation, and holding times met the requirements listed in Table 12; the integrity of the sample (ensuring proper chain of custody and correct sample storage temperatures) is documented from sample collection through shipment and ultimate analysis, and the data packages. The Data Review Checklist comprehensively covers the review of all these items. (Note: Calibration data will not be requested for the project at this time.)

The KTWQP QA Officer will further evaluate each data package's narrative report and summary tables to see whether the laboratory "flagged" any sample results based on poor or questionable data quality and to ensure that any exceedances of the laboratory's QC criteria (as listed in Table 11) are documented. If a problem was noted by the laboratory, the KTWQP QA Officer will evaluate whether the

appropriate prescribed corrective action was taken by the laboratory, the action successfully resolved the problem, and the process and its resolution were accurately documented.

An effort will be made to identify whether any data quality problem is the result of laboratory issues and/or if it may be traced to some field sampling activity. If the laboratory is determined to be responsible, the KTWQP QA Officer will request information from the laboratory documenting that the problem has been resolved prior to submitting future samples. If some aspect of the field operation (e.g., sample collection, sample containers and/or preservation, chain-of-custody, sample shipment, paperwork, etc.) is identified as the possible problem, efforts will be made to retrain the Tribe's field staff to minimize the potential of the problem recurring. If the problem is believed to be due to the sample matrix, the KTWQP Director/QA Officer will discuss the use of alternative analytical methods with the laboratory; and, if an alternative method is available that might minimize the problem, the QA Project Plan will be modified and/or amended accordingly.

If any of the QC criteria and/or the project requirements (as discussed above) are exceeded, the associated data will be qualified as estimated and flagged with a "J". If grossly exceeded, the associated data will be rejected and the need for re-sampling will be considered. However, since the data are being generated for a baseline assessment, it is generally felt that paying special attention to some troublesome sample collection or analytical concern during the next sampling event will be sufficient and re-sampling will not be necessary.

4.2 Verification and Validation Methods

Defining the data verification and validation methods help to ensure that project data are evaluated in an objective and consistent manner. For the current project, such methods have been described for information gathered and documented as part of the field sampling and field measurement activities, as well as the data generated by the off-site laboratory.

Field Sampling and Measurement Data

The methods associated with verification and validation of the field sampling and measurement data are included within the discussion provided in Section 4.1.

Laboratory Data

The methods associated with verification and validation of the laboratory data are included within the discussion provided in Section 4.1.

4.3 Reconciliation with User Requirements

The purpose of the continued monitoring of the KAT is to assess the surface water resources and determine whether analytes of concern exceed national and tribal water quality standards. This also provides the Tribe with the opportunity to begin efforts of co-management in the Mid-Klamath watershed. Data must fulfill the requirements of this QA Project Plan to be useful for the overall project. Information needed to support decision making under the surface water monitoring program is contained in this QA Project Plan, field documentation, the laboratory "data package" report, the Field Activities Review Checklist, the Laboratory Data Review Checklist, and the Field Audit Report and associated Corrective Action Report. This section describes the steps to be taken to ensure data usability (after all the data have been assembled, reviewed, verified, and validated) prior to summarizing the information in the Biannual and Annual Reports.

Once all the data from the field and laboratory have been evaluated (as described in Sections 4.1 and 4.2), the KTWQP Director/QA Officer will make an overall assessment concerning the final usability of the data (and any limitations on its use) in meeting the project's needs. The initial steps of this assessment will include, but not necessarily be limited to:

- Discussions with the KTWQP Water Quality Technician,
- Review of deviations from the QA Project Plan or associated SOPs to determine whether these deviations may have impacted data quality (and determining

whether any impacts are widespread or single incidents, related to a few random samples or a batch of samples, and/or affecting a single or multiple analyses),

- Evaluation of the field and laboratory results and QC information,
- Review of any other external information which might influence the results, such as activities up stream, meteorological conditions (such as storm events proceeding sampling that might contribute to high turbidity readings), and data from other sources,
- Evaluation of whether the completeness goals defined in this QA Project Plan have been met,
- Examination of any assumptions made when the study was planned, if those assumptions were met, and, if not, how the project's conclusions are affected.

After all this information has been reviewed, the KTWQP Director/QA Officer will incorporate their perspective on the critical nature of any problems noted and, ultimately, identify data usability and/or limitations in supporting project objectives and decision making. All usable data will then be compared to the Project Action Limits (as listed in Table 5) to identify whether these limits have been exceeded. Decisions made regarding exceeding the Project Action Limits will follow the "...if...then..." statements included in Section 1.7.

In addition, the KTWQP Director/QA Officer will assess the effectiveness of the monitoring program and data collection at the end of each calendar year. Sampling locations, frequency, list of analytical parameters, field measurement protocols, choice of the analytical laboratory, etc. will be modified as needed to reflect the changing needs and project objectives of the Karuk Tribe. This QA Project Plan will be revised and/or amended accordingly.

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Appendix A: Laboratory Documents

Appendix A1: Sample Labels from Labs

Appendix A2: Sample Chain of Custody and Custody Seals

Chain of Custody for Klamath River and Reservoir Nutrient Loading

Karuk DNR PHONE 530-469-3258 CONTACT Grant Johnson Collected By	39051 Hwy 96 Orleans, CA 95556 EMAIL cbowman@karuk.us, gjohnson@karuk.us SIGNATURE

	Sample ID	Date	Time	Lab ID	TP	PO_4-P	TN	NH_4-N	NO_3+NO_2-N	Alk	T O C	DOC	Chloro	Phaeo	VSS	TSS	CBOD		
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			

Date Shipped _____ Carrier/ Shipping #_____
Date Received_____
Received by _____
Notes _____

Circle One:

For Nutrients Ship to:
Aquatic Research Inc.
3927 Aurora Ave N
Seattle, WA 98103
(206) 632-2715

Invoices should be sent to:
Crystal Bowman
Karuk Tribe
Department of Natural Resources
PO Box 282
Orleans CA 95556
(530) 469-3258

Appendix A3: Lab and Consultant QA Information – Attached as separate documents

Appendix B: KTWQP Water Quality Checklists and Worksheets

Appendix B1: KTWQP Field Activities Review Checklist

Sampling Location(s): Date(s) of Sampling: _____

Mark each topic "Yes," "No," or "NA" (not applicable), and comment as appropriate.

_____ All required information was entered into field logbooks in ink, and logbook pages were signed & dated. Comment:

_____ Deviations from SOPs , along with any pertinent verbal approval authorizations and dates, were documented in field logbooks. Comment:

_____ Samples that may be affected by deviations from SOPs were flagged appropriately. Comment:

_____ Field measurement calibration standards were not expired and were in the correct concentrations. Comment:

_____ Field calibrations were performed and results were within QAPP-specified limits for all parameters (Temperature, pH, Dissolved Oxygen, Conductivity, and Turbidity). Comment:

_____ Field measurement QC samples were within the QAPP-specified limits for all parameters. Comment:

_____ Field measurement data were recorded in the appropriate logbooks(s). Comment:

_____ Samples were collected at the correct sites. Comment:

_____ The correct number of samples for each type of analysis and the correct volume was collected. Comment:

_____ Certified clean sample containers, appropriate for the intended analysis, were used. Comment:

_____ Requested/required field quality control (QC) samples (Field blanks and field duplicates) were collected, and at the correct frequency. Comment:

_____ Samples were preserved with the correct chemicals, if required. Comment:

_____ Samples were stored and/or shipped at the proper temperature. Comment:

_____ Chain-of-custody documents were completed properly. Comment:

_____ Custody seals were applied and intact when relinquishing custody of the samples. Comment:

_____ Sample holding times were not exceeded during field operations. Comment:

Reviewer's Name (print):

Reviewer's Signature:

_____

Reviewer's Title:

_____

Karuk Tribe Water Quality Program:

Date of Review: ___/___/_____

Appendix B2: KTWQP Laboratory Data Review Checklist

Sampling Project:_____

Date of Sampling:_____

Analytical Laboratory:_____

Mark each topic "Yes," "No," or "NA" (not applicable), and comment as appropriate.

_____ Final data package includes chain-of-custody forms.
Comment:

_____ Chain-of-custody forms were properly completed and signed by everyone involved in transporting the samples. Comment:

_____ Laboratory records indicate sample custody seals were intact upon receipt.
Comment:

_____ Samples arrived at the laboratory at the proper temperature.
Comment:

_____ All requested analyses were performed and were documented in the analytical report.
Comment:

_____ Analyses were performed according to the methods specified in the approved QA Project Plan.
Comment:

_____ Holding times for extraction and analysis were not exceeded.
Comment:

_____ Method detection and/or quantitation limits were included in the report.
Comment:

_____ A Narrative summarizing the analyses and describing any analysis problems was included in the final report. Comment:

_____ Data qualifiers and flags were explained in the analytical report.
Comment:

____ Method (laboratory) blank results were included for all analyses, at the appropriate frequency, and showed no laboratory contamination. Comment:

_____ Initial calibration data (if requested from the laboratory) were within QAPP, method, or laboratory SOP defined acceptance criteria for all analyses. Comment:

_____ Continuing calibration data (if requested from the laboratory) were within QAPP, method, or laboratory SOP defined acceptance criteria for all analyses. Comment:

_____ Matrix spike data were included for all pertinent analyses for every 20 samples.
Comment:

_____ Laboratory Control Sample data were included for all analyses for every 20 samples.
Comment:

_____ Laboratory Duplicate data were included for all analyses for every 20 samples.
Comment:

_____ Field blanks do not contain analytes of interest or interfering compounds and included for all pertinent analyses for every 20 samples. Comment:

_____ Field Duplicates are within QAPP-defined acceptance criteria and included for all analyses for every 10 samples. Comment:

_____ Matrix spike results were listed and within QAPP or laboratory defined acceptance criteria.
Comment:

_____ Matrix interferences were definitively identified either through a second analysis or use of Laboratory Control Sample Results. Comment:

_____ Laboratory Control Sample results were within QAPP or laboratory defined acceptance criteria.

Comment:

_____ Laboratory Duplicate results were within QAPP or laboratory defined acceptance criteria.
Comment:

_____ Reported results were within method detection or quantitation limits.

Comment:

Reviewer's Name (print):

Reviewer's Signature: _____

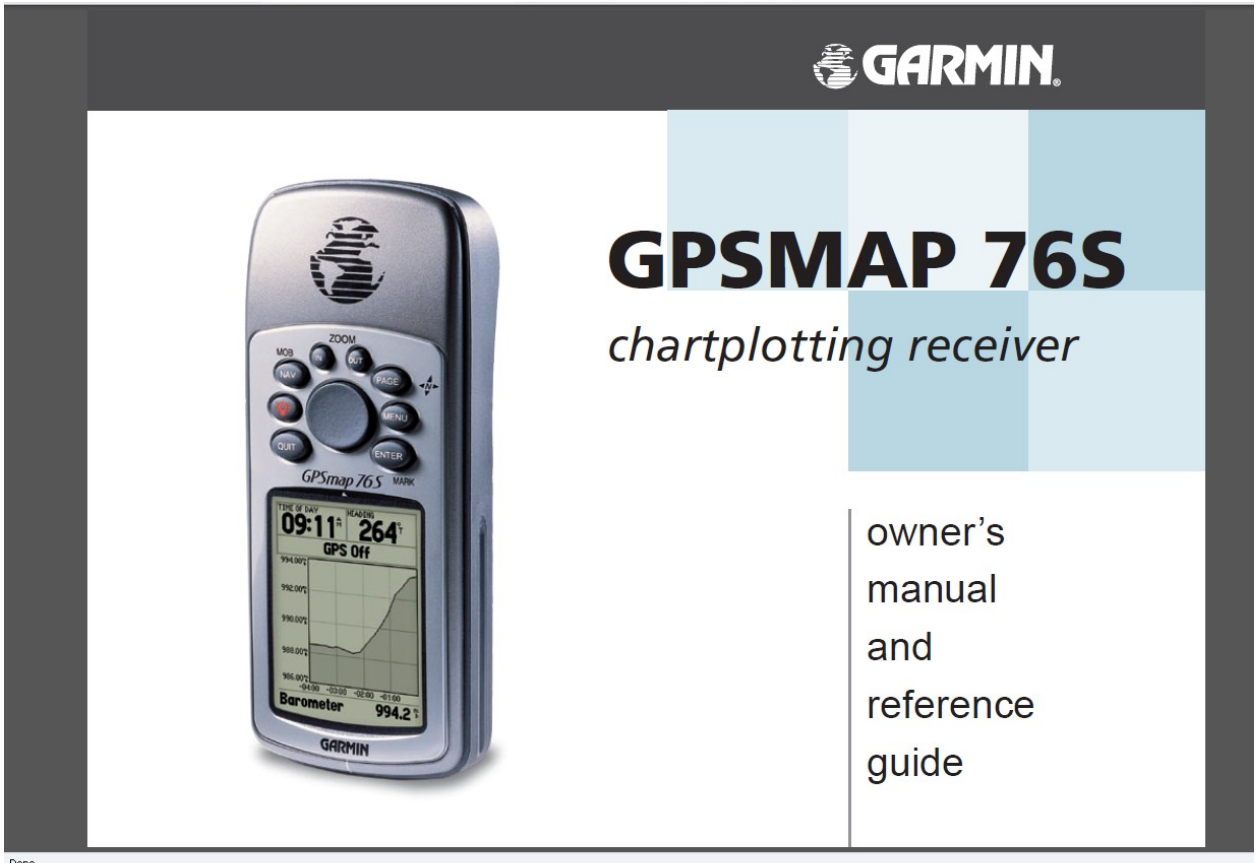
Reviewer's Title: _____

Karuk Tribe Water Quality Program:

Date of Data Review: __/___ /_____

Appendix C: Field Equipment Manuals and Instructions

Appendix C1: GPS Unit Manual– Attached as separate documents



http://www8.garmin.com/manuals/GPSMAP76S_OwnersManual.pdf

Appendix C2: Swoffer Flow Meter Manual– Attached as separate documents

Appendix C3: Onset HOBO Water Temp Pro Loggers– Attached as separate documents

http://www.onsetcomp.com/files/manual_pdfs/10366-C-MAN-U22-001.pdf

Appendix C4: Van Dorn Sample Bottle Instructions

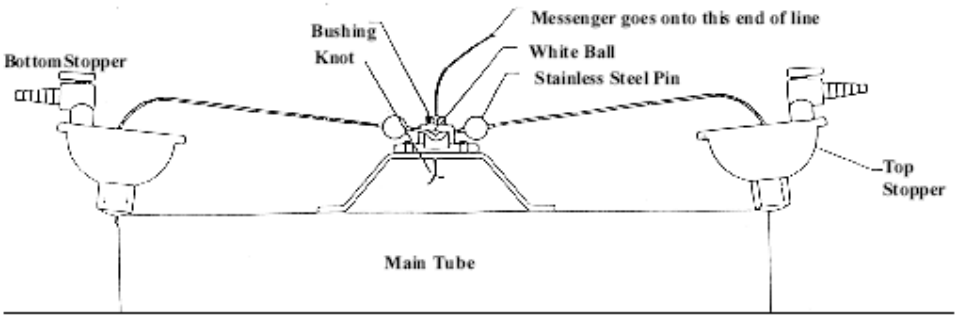
Wildlife Supply Company®

1120-1180 Vertical Alpha™ Bottles Operating Instructions

- The bottle release mechanism is designed to be used *only* in a *non-series* operation mode.
- A messenger is required to activate the tripping mechanism. Wildco® recommends an 11 oz. messenger (such as **45-B10**) unless there is a very long air drop and the bottle is close to the surface of the water, in which case a lighter-weight messenger may work along with a shock absorber (**45-B40**).
- **Do not use a messenger heavier than 11 oz**! Damage to your sampler may result.

Procedure:

1. Make a preliminary inspection prior to use of the bottle. Close the air vent and the drain valve.
2. Place the bottle so that the bushing on the trip mechanism is on the top of the handle.
3. Run a line or cable through the hole in the trip assembly and knot the line or secure the cable so that it cannot pull back through the hole. It must be securely fastened to hold the weight of the bottle when filled with the sample.
4. Find the two stainless steel (SS) pins in the trip assembly. Both pins are 1/16" above the plastic trip assembly.
5. Grasp one of the round, white balls on the cable assembly. Pull the stopper out of the end of the main tube.
6. Repeat the above instructions with the other stopper and hook the cable loop on the pin which projects above the plastic trip assembly. The bottle is now in the "SET" position.
6. Hook the other cable loop on the pin which projects above the plastic trip assembly. The bottle is now in the "SET" position.
7. Lower the bottle to desired depth in the water, keeping the line taut. Pull bottle sideways to obtain a water sample for the desired depth. Drop messenger down the line. It will strike the tripping mechanism, causing the cables to release and the stoppers to close, trapping the sample inside the bottle.



Warranty and Parts:

We replace all missing or defective parts free of charge. All products guaranteed free from defect for 90 days. Does not include accident, misuse, or normal wear and tear and applies to original purchaser only. **Made in U.S.A.**

P/N 005517

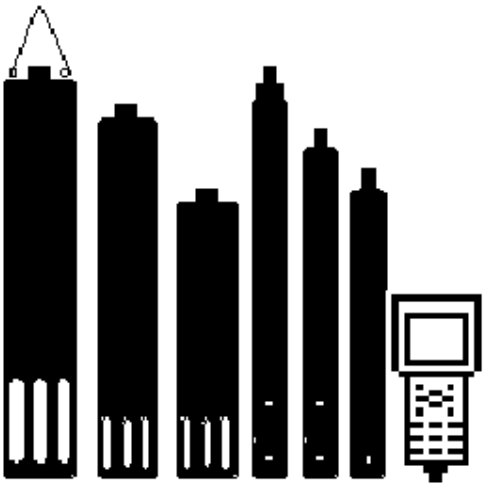
Recommended Accessories:

- **45-B10** *11 oz. split messenger*
- Line, cable and chain. *Polyester line, 5 mm (3/16") diameter, or steel cable, 3 mm (1/8") diameter.*
- Winches and winch mount
- **910-G22** *Molded Plastic Utility Case, Large*
- Hand reel
- **45-B40** Messenger Shock Absorber

95 Botsford Place, Buffalo, N.Y. 14216 U.S.A. • Toll-free Phone: 800-799-8301 • FAX: 800-799-8115
International Phone: 716-877-9518 • FAX: 716-874-9853 • goto@wildco.com • www.wildco.com.com

Appendix C5: YSI 6600 EDS Multiprobe System Manual– Attached as separate documents

YSI *incorporated*



6-SERIES

6600 Sonde
6600 EDS Sonde
6920 Sonde
6820 Sonde
600XLM Sonde
600 OMS Sonde
600XL Sonde
600QS Sonde
600R Sonde
650 MDS Display/Logger

Environmental Monitoring Systems

Appendix D: Data Sheets

Appendix D1: Periphyton

Collected By:

Site Info				
Site Name	Date (mm/dd/yy)	Time	Tw (C)	DO

Site #: _____ Site N

KEY: P = > 75%

M = > 75%

P / M = Mixed

O = Other

KLAMATH RIVER PERIPHYTON SAMPLING DATASHEET

Date:_____ **Transect:** A B C **Crew:**_____ **Weather:**

Time: **Wetted Width:**_____ m

Sampling Zone 1 **Distance from Shore:** m **Depth:** m

Substrate Sampled:
Cobble _____ Bedrock/Boulder _____
Gravel _____ Macroalgae _____
Sand _____ Macrophyte _____
Silt Wood

Collection Device:
A. Rubber Delimiter _____
B. PVC Delimiter _____
C. Syringe Scrubber _____
D. Other (specify area)

Sampling Zone 2 **Distance from Shore:** m **Depth:** m

Substrate Sampled:
Cobble _____ Bedrock/Boulder _____
Gravel _____ Macroalgae _____
Sand _____ Macrophyte _____
Silt Wood

Collection Device:
A. Rubber Delimiter _____
B. PVC Delimiter _____
C. Syringe Scrubber _____
D. Other (specify area)

Sampling Zone 3 **Distance from Shore:** m **Depth:** m

Substrate Sampled:
Cobble _____ Bedrock/Boulder _____
Gravel _____ Macroalgae _____
Sand _____ Macrophyte _____
Silt Wood

Collection Device:
A. Rubber Delimiter _____
B. PVC Delimiter _____
C. Syringe Scrubber _____
D. Other (specify area)

Area Sampled: (14.0* # of A's) + (12.6* # of B's) + (5.3* # of C'c) + (specified area* # of D's) = Area Sampled

(14.0*____) + (12.6*____) + (5.3*____) + (____*____) = _____ cm^2

Notes

KLAMATH RIVER PERIPHYTON SAMPLING DATASHEET

Date: _____

Length of Reach: m

Transect A

Area Sampled:_____ cm^2 **Bottles Filled:** Species ID _____ Volume: _____ mL

Chlorophyll a _____ Volume: _____ mL

Total N/Total P _____ Volume: _____ mL

Total Organic Carbon Volume: mL

Transect B

Area Sampled:_____ cm^2 **Bottles Filled:** Species ID _____ Volume: _____ mL

Chlorophyll a _____ Volume: _____ mL

Total N/Total P _____ Volume: _____ mL

Total Organic Carbon Volume: mL

Transect C

Area Sampled:_____ cm^2 **Bottles Filled:** Species ID _____ Volume: _____ mL

Chlorophyll a _____ Volume: _____ mL

Total N/Total P _____ Volume: _____ mL

Total Organic Carbon Volume: mL

Reach Composite

Area Sampled*:_____ cm^2 **Bottles Filled:** Species ID _____ Volume: _____ mL

*(Transect A + Transect B + Transect C)

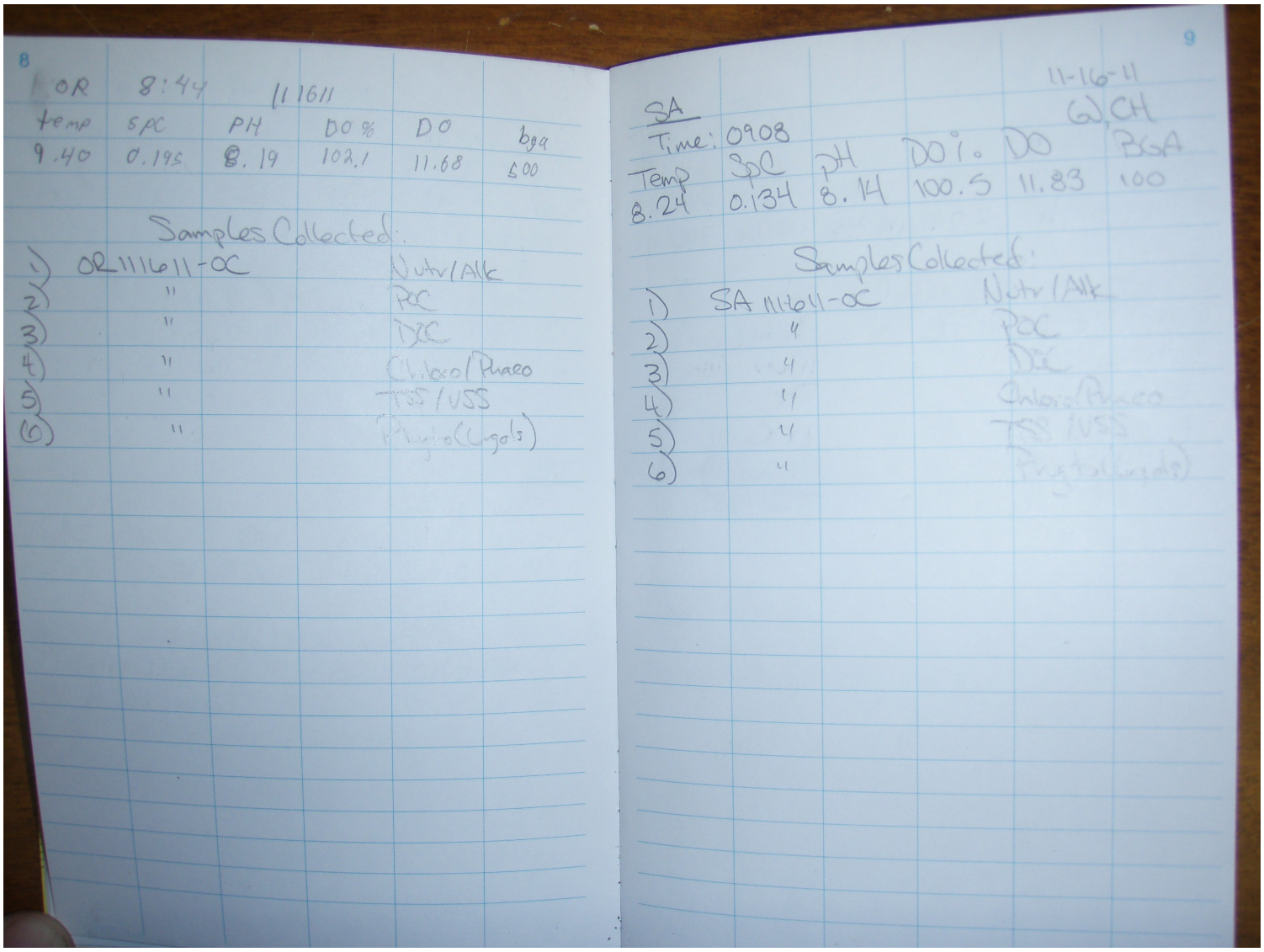
Chlorophyll a _____ Volume: _____ mL

Total N/Total P _____ Volume: _____ mL

Total Organic Carbon Volume: mL

Notes

Appendix D2: Surface Water Samples



8

OR 8:44 11/6/11

temp	SpC	PH	DO %	DO	bga
9.40	0.195	8.19	102.1	11.68	500

Samples Collected:

1) OR111611-OC Nutr/Alk
2) " POC
3) " DOC
4) " Chlorol/Phaeo
5) " TSS/VSS
6) " Phyto (Lugols)

9

11-16-11

SA

Time: 0908

Temp	SpC	pH	DO%	DO	BGA
8.24	0.134	8.14	100.5	11.83	100

Samples Collected:

1) SA 111611-OC Nutr/Alk
2) " POC
3) " DOC
4) " Chlorol/Phaeo
5) " TSS/VSS
6) " Phyto (Lugols)

Appendix D3: Audit/Calibration for YSI Datasonde

DATASONDE AUDIT/ CALIBRATION SHEET

Site:_____
Date:_____
AIR T (°C)_____
BP (mmHg)_____
DataSonde SN#:_____

Reference Sonde SN#:_____
Calibrator:_____

Extraction

	Time	Temp	Sp. Cond	DO(mg/L)	pH	DO%	BGA	Turbidity
Initial Readings (Reference)								

Pre/Post Cleaned

Status:	Instrument:	Time	Temp (°C)	Sp. Cond.	DO (mg/L)	pH	DO%	BGA	Turbidity
Pre-Cleaned	Site Sonde:								
Pre-Cleaned	Reference Sonde:								
Post-Cleaned	Site Sonde:								
Post-Cleaned	Reference Sonde:								

Calibration

	DO %	DO mg/L	Sp. Cond	pH 7	pH 10	BGA	Turbidity	Turbidity 2
Temp of Standard								
Value of Standard								
Initial Reading								
Calibrated to								
Lot Number								

Do Gain

File Creation

Clock Calibrated:_____ Battery Volts (Before/After) ____/____
Downloaded File Name:_____
Start Date:_____ New File Name:_____ Wiper Pad Changed:_____
Finish Date:_____ Time:_____
Time:_____

Redeployment

	Time	Temp	Sp. Cond	DO(mg/L)	pH	DO%	BGA	Turbidity
Redeployment (Reference)								

Temp	pH 7	pH 10
10	7.06	10.15
15	7.04	10.10
20	7.02	10.05
25	7.00	10.00
30	6.99	9.96

revised 05/04/11 G.

Appendix E: Existing Protocols

Appendix E1: Mid-Klamath River Nutrient, Periphyton, Phytoplankton and Algal Toxin Sampling Analysis Plan (SAP) – Attached as separate documents

Appendix E2: Blue Green Algae SOP– Attached as separate documents

Appendix E3: Churn Cleaning SOP

Decontamination of Sampling Equipment and Supplies

Equipment decontamination is intended to remove residues from the environment, prior sampling, and handling or manufacturing activities adhering to equipment or other supplies that will come into contact with the sample. Equipment used for sampling (sample collection, processing, and handling) must be cleaned before being used. Sampling equipment must be cleaned before the first use each sampling day and re-cleaned before use at the next site to avoid cross contamination between sampling sites.

- Clean equipment. If the sampling equipment will not be reused during a field trip, after using triple rinse the sampler components thoroughly with clean water (tap, distilled or deionized water) before they dry and place the sampler in a plastic bag for transport to the office laboratory for cleaning. If the sampling equipment will be reused during the field trip, triple rinse the sampler components with distilled or deionized water before they dry. Field-clean the sampler at the next sampling site before use.

Generally the sequence for cleaning equipment for sampling cyanobacteria or cyanotoxins can be summarized as follows: detergent wash; tap/De-I rinse; De-I soak; and air dry.
The following detailed equipment cleaning procedures should be used:

- Use gloves, which are changed between each step.
- Scrub the equipment / tubing in tap or De-I water with a nonmetallic, non-colored brush to remove visible debris.
- Soak the equipment and tubing for 30 minutes in 0.2-percent Liquinox solution or another phosphate-free detergent
- Thoroughly rinse the equipment and tubing with tap water.
- Rinse the equipment three times with De-I water.
- Allow everything to air dry completely.

Avoid using samplers with plastic components, as the plastic may adsorb cyanotoxins and cross-contaminate samples. Do not forget to decontaminate equipment before use. Once the equipment is decontaminated, wrap inorganic equipment in plastic and organic equipment in aluminum foil for storage and transport.

Churn Splitter Cleaning and Rinsing

- For purposes of this section regarding Churn splitter cleaning and rinsing, churn splitter refers to churn splitter container, lid, and churning disk.
- At the beginning of each sampling day, triple rinse churn splitter with distilled water or de-I water. If the site is an open water baseline site (see section 3.2.4) then also rinse it one

time with native (stream or reservoir) water. Do not rinse with native water before collecting public health surface grab samples (see section 3.2.3). For each rinse, water is run through the discharge spout. After collecting each sample, remove visible debris and triple rinse the churn again with distilled or de-I water.

- Rinsing with HCL is not necessary for sampling for cyanobacteria and cyanotoxins.

Appendix E4: Calibration for YSI

YSI Calibration SOP 110509 GJ

Upon arrival at each monitoring site, numerous tasks must be performed to successfully meet the QA/QC protocol and service the Sonde. Properly filling out the calibration sheet is critical to collecting all the data that is needed for the evaluation of the sonde file. Here is an overview of a typical field tour consisting of extracting the sonde, performing scheduled maintenance and redeploying.

- Arrive on site and acclimate pH and conductivity standards and a liter of DI water to ambient stream temperature in order to accurately calibrate the Sonde. Place ice packs and calibration standard bottles in small cooler. Monitor the temperature of the standards to ensure they do not get too cold.

- Record current barometric pressure at the site along with other environmental conditions, such as; weather, changing water levels, color of water, etc on the datasheet. Reference Sonde (Quanta) should be calibrated weekly to insure accuracy. Once on site inspect Quanta DO membrane and re-calibrate the dissolved oxygen (percent saturation) to current site barometric pressure and deploy next to the sonde at least ten minutes before the half hour.

Download site sonde data

- Sonde menu
- Press enter
- Highlight File and press enter
- Select upload and press enter
- PC6000 Format press enter

- **Audit the site sonde** (datasonde that is dedicated to the site) by placing the reference sonde as close as possible to the lock box that contains the site sonde. As close to the half hour or top of the hour as possible, record the reference sonde water quality parameters on the datasheet. Remove the lock box containing the site sonde from the water approximately 5 minutes after the 30 minute or top of the hour reading. Carefully remove the site sonde from the housing trying not to disturb any fouling on the probes.

- Fill bucket with river water or tap water depending on time of season.

- Connect site sonde to hand held and put in run mode by going to the sonde menu, highlight run and press enter, unattended, and look at file to ensure that it has been logging. At the bottom of the unattended setup screen highlight stop logging.

- Press escape and highlight Discrete Sample and press enter, highlight start sampling and press enter. Sonde will stabilize for 120 seconds and then begin to show WQ parameters.

- Place both the site sonde and reference sonde in the bucket and record pre-cleaning readings after WQ parameters have stabilized (Temp, SpCond, DO, pH) of site sonde in addition to readings of reference sonde (quanta) in bucket.

- Turn off reference sonde. Remove site sonde and thoroughly clean. Use an Alan head wrench to remove the wiper brush. Install wiper pad with no brush.

- Take the big brush and thoroughly clean the inside and outside of the sonde lock box and clean the site sonde sensor guard with a toothbrush and Q-tips.

- Take a Q-tip and clean out the data line connection on the datasonde and on the data line ensuring it is free of water and sand. Spread a thin coat of silicone on the o-ring on the connector.

- Cleaning site sonde: **Note: only site sonde is cleaned during cleaning process**

- **To Check Site Sonde Battery Make Sure The Option of "Power Sonde" Under The System Setup Menu On The Handheld Is Turned Off.**

- YSI Sonde cleaning
    - Wash the outside and probe guard with towel and toothbrush
    - **To clean the Optical DO and BGA probes carefully wipe the surface of the probes with a moist Chem Wipe or Q-tip-DO NOT use any alcohol or Hydrogen peroxide**
    - To clean Clark's DO membrane wipe softly with Q-tip Clean pH probe with spray bottle. Wipe *carefully* with Q-tip only if necessary
    - Clean Conductance probe with pipe cleaner. Rinse with spray bottle.
    - Clean Temperature probe with Q-tip. Rinse with spray bottle
    - Use Q-tip, toothbrush and spray bottle
- Replace site sonde and reference sonde in bucket and record post-clean readings of YSI site sonde and reference sonde in bucket after WQ parameters have stabilized.

Calibrate Conductivity

- Rinse probes three times with DI water.
- Rinse probes three times with specific conductivity standard.

- Fill calibration cup with fresh specific conductivity standard.
- Note temperature and look up standard correction
- Under the main menu highlight calibrate and hit enter
- Highlight Conductivity and hit enter
- Highlight SpCond and hit enter
- Enter the value of calibration standard (for 1,000 μS/cm, enter 1.0) and press enter.
- Wait at least 30 seconds until specific conductivity stabilizes and record the temperature and initial specific conductivity value onto data sheet.
- Press enter to calibrate the sonde
- Never accept an "Out of Range" message – if this occurs ensure there are no bubbles in the hole where the Sp Cond probe is located and that the standard covers the hole completely
- Record the final value of specific conductivity onto data sheet.
- Press Escape several times to go to the Main Menu and highlight Advanced and hit enter
- Highlight Cal constants and hit enter
- Record conductivity cell constant onto data sheet and verify the number ranges between 4.5 to 5.5
- Dump conductivity standard into rinse jar.

Calibrate pH

- Rinse three times with DI water
- Rinse three times with pH 7.0_ standard.
- Fill calibration cup with fresh pH 7.0_ standard ensuring that the temp probe is covered with calibration standard
- Press Escape twice to the main menu and highlight run and hit enter
- Highlight discrete sample and hit enter
- Highlight start sampling and hit enter
- Wait until temp stabilizes and record the temperature of the pH 7.0_ standard and the temperature compensated value for the pH standard, this is done to determine the temperature compensation for the pH standard, for example if the temp is 18 degrees C then determine the value of the pH 7 standard at 20 degrees C on the look up table on the datasheet and fill it out in the pH standard line on the datasheet
- Press escape 3 times to go to the Main Menu
- Highlight calibrate and hit enter
- Highlight ISE1 pH and press enter
- Highlight 2 point and press enter
- Enter the temperature compensated value for the pH 7._ calibration standard for the first calibration point and hit enter.
- Wait at least 30 seconds until pH stabilizes and record the initial pH 7._ value onto the data sheet.
- Press enter to calibrate the sonde

- **DO NOT press enter or escape!**
- Record the final value of pH onto data sheet.
- Record pH mv onto data sheet and verify that the value ranges between -50 and +50
- Dump pH standard into rinse jar.
- Rinse three times with DI water.
- Rinse three times with pH 10._ standard.
- Fill calibration cup with fresh pH 10._ standard., ensuring that the pH probe is completely submerged
- Record the temperature of the pH 10.0_ standard and the temperature compensated value for the pH standard onto the datasheet
- Press Enter once and enter the temperature compensated pH 10.0_ value as the second point and hit ENTER.
- Wait until pH stabilizes and record the initial pH 10 value onto data sheet
- Press enter to calibrate the sonde
- Record the final value of pH onto data sheet
- Record pH mv onto data sheet and verify that the value ranges between -130 and -230
- Calculate the pH slope onto data sheet by subtracting the difference between the two numbers and enter the value onto the datasheet, ensure the value ranges between 165 and 180. A value of 165 or less indicates a failing probe.
- Dump pH 10.0_ standard into rinse jar
- Rinse three times with DI water

Calibrate BGA Probe (SV)

- Fill calibration cup ¾ of the way with DI water so that the BGA and temp probe are fully immersed.
- If using a short calibration cup, be sure to engage only one thread on the calibration cup during this procedure to avoid a small interference from the cup bottom
- Highlight Run in the main menu and press enter, highlight discrete sample and press enter, highlight interval and change it from 0.5 to 4 and highlight start sampling and press enter.
- On the 650 activate the wiper to clean the optics to remove any bubbles that may be present. Wiper should stop 180^0 to probe lens.
- **After BGA has stabilized.** Record initial temperature and BGA on data sheet. Press enter.

Calibrate Optical DO Probe

Wrap the wet towel over the sensor guard to provide insulation. Place the entire sonde with wet towel into the DO calibration chamber (insulated cooler with ice packs) and make sure the sonde will not fall over.

- Go to the sonde main menu, highlight run and press enter, highlight discrete run, highlight interval and change it from 0.5 to 4 and highlight start sampling and press enter. T**he ODO should be stable because it has been in the stable environment of the cooler.** Record initial temperature and ODO in mg/L on data sheet.
- Highlight calibrate and press enter. Highlight Optic T- Dissolved Oxy and press enter, highlight DO% and press enter. Enter the current BP, round off to the nearest whole number and press enter.
- The sonde will stabilize for 120 seconds and automatically calibrate ODO. Record the final ODO value onto datasheet in mg/L after calibration.
- Escape to the Advanced menu highlight cal constants and press enter and record the DO gain and verify range of DO gain is within 0.5 to 1.7
- Disconnect the sonde and 650.
- Take off the wiper pad and install the clean wiper brush. Ensure that you can place a piece of paper between the bottom of the plastic wiper arm and the probe face.
- Gently press the wiper against the face of the probe until the foam pad is compressed to roughly one half of the original thickness and then tighten the setscrew.
- Install sensor guard and deploy sonde at least 5 minutes before it is set to take a measurement. Record the time of deployment

To create a new file:

On 650 handheld highlight sonde menu (it will now connect to sonde and beep. Notice small sonde icon on bottom right of 650 screen.)

Highlight run → unattended sample

Set interval to 00:30:00 and ensure that duration is 30 days.

Type filename: two letter site name then date ie IG062507

Type site name: Ie: Iron Gate

Write down battery voltage on audit sheet.

Start logging→ are you sure? → yes

That will take you to logging screen where you will record start date/time and end date/time.

To double check that it is logging→ on sonde main screen→ status. Look to see if logging is active.

- Place the reference sonde (Quanta) next to the datasonde at least 5 minutes before it is set to take a measurement and record WQ parameters as close as possible to the half hour or top of the hour.

H350 XL Datalogger Instructions at USGS sites

Klamath River at Orleans (OR) and Klamath River at Seiad Valley (SV)

Equipment needed:

- Compact Data Card
- Key to enter lock box
- This SOP

To Download Data

- Insert 256 MB Compact Flash Card with PC Card Adapter into Datalogger
- Scroll Down to 'Data Options'
- Press Arrow →
- Scroll Down to 'Copy Data to Card?'
- Press Enter
- Wait Until Datalogger reads 'Done, Press Cancel'
- Press Esc/Cancel to Main Menu
- Remove Data Card by pushing eject button next to card slot

Appendix E6: Periphyton SOP (2011)

The following methods were adopted from the USGS's *METHODS FOR COLLECTING ALGAL SAMPLES AS PART OF THE NATIONAL WATER-QUALITY ASSESSMENT PROGRAM* http://water.usgs.gov/nawqa/protocols/OFR-93-409/alg1.html ***By: Stephen D. Porter, Thomas F. Cuffney*, Martin E. Gurtz, and Michael R. Meador**

Background:

Benthic algae (periphyton) and phytoplankton communities are characterized in the U.S. Geological Survey's National Water-Quality Assessment Program as part of an integrated physical, chemical, and biological assessment of the Nation's water quality. Water quality can be characterized by evaluating the results of qualitative and quantitative measurements of the algal community. Qualitative periphyton samples are collected to develop of list of taxa present in the sampling reach. Quantitative periphyton samples are collected to measure algal community structure within selected habitats. These samples of benthic algal communities are collected from natural substrates, using the sampling methods that are most appropriate for the habitat conditions. Estimates of algal biomass (chlorophyll content and ash-free dry mass) also are optional measures that may be useful for interpreting water-quality conditions.

Periphyton Microhabitats

Periphyton microhabitats are relatively small areas of submerged surfaces in streams and rivers that support the attachment of algae or are otherwise associated with the accumulation of algal biomass. Periphyton may be collected by scraping, brushing, siphoning, or by other methods appropriate to each microhabitat.

Epilithic - periphyton attached to rocks, bedrock, or other hard surfaces. Remove rocks from water and scrape (or hand pick) algal material into a sample container using a pocket knife or brush. Bedrock may be sampled using a PVC pipe sampler or the periphyton sampling device described in the section, "Quantitative Targeted-Habitat Periphyton Samples." It is desirable to collect epilithic samples that represent all combinations of microalgal texture and pigmentation present on rocks within the sampling reach in erosional and depositional areas.

Epidendric - periphyton attached to submerged tree limbs and roots, or on other wood surfaces. Collection methods are similar to those described for epilithic microhabitat.

Epiphytic - periphyton attached to submerged aquatic plants or macroalgae. Scrape or brush algal biomass attached to roots, stems, and leaves of aquatic vascular plants into a sample container. Squeeze the liquid contents of filamentous algal mats and aquatic vascular plants into the same container.

Epipelic - periphyton associated with fine streambed sediments. Motile algal taxa, such as diatoms, euglenophytes, and blue-green algae, occur in the top 5-10 mm of the surface sediment. Filamentous algae also can be loosely associated with, but not necessarily attached to, the streambed in depositional areas of the sampling reach. Collect epipelic algae with a disposable pasteur pipette and bulb or with a larger suction device, such as a poultry baster. The epipelon also may be collected with a spoon or scoop in wadeable streams or from the upper surface of sediment samples collected with an Ekman or Ponar dredge in nonwadeable streams and rivers. Periphyton collections should be attempted only when there is visible pigmentation, such as brow nish-gold or dark green, associated with the streambed. An attempt should be made to exclude excessive amounts of inorganic silt from the periphyton sample.

Epipsammic - periphyton associated with coarse streambed sediments, such as sand. Collection methods are similar to those described for epipelic microhabitat. Only the top 510 mm layer of sand should be collected.

The collection of representative, quantitative periphyton samples from natural substrates is preferred but presents special sampling challenges that directly affect the accuracy and precision of various structural estimates of algal standing crop. Because algal colonization (immigration and reproduction) is affected by numerous factors, such as light intensity, depth, velocity, and substrate texture, the distribution of periphyton in flowing streams is typically heterogeneous, or patchy. Although the use of artificial substrates (glass slides, clay tiles, or other introduced materials) may reduce the variability associated with natural substrates, careful sampling of natural substrates is likely to yield more complete information regarding the structure of the periphyton community and relations with benthic herbivores (invertebrates and fish).

Artificial substrates can be considered for stream reaches where natural substrates cannot be sampled because of safety issues or habitat inaccessibility, or when uniformity of substrate surfaces is an important consideration for interpreting water quality. However, quantitative algal data from artificial substrates are not directly comparable to data from natural substrates. Methods for using artificial substrates are discussed later in this document.

Macroalgae

Quantitative periphyton samples of macroalgae (for example, filamentous assemblages of *Cladophora*) require sampling from relatively larger areas than suggested for microalgae in order to provide a characterization of conditions in the sampling reach. Estimates of macroalgal biomass can be valuable for water-quality modeling and eutrophication-process studies, such as the effect of benthic macroalgae on diel cycles of dissolved-oxygen concentrations, pH, and alkalinity in the water of nutrient-enriched streams and rivers. A limitation of quantitative collection methods for macroalgae is that the microalgal community component can be severely under-represented or absent. Therefore, a quantitative microalgal sample should be collected in conjunction with the macroalgal sample to assess the autecological character of the periphyton community.

Quantitative samples are collected to determine the biomass of macroalgae that is attached to a defined area of the streambed. Sample-collection methods described for macroalgae are also applied to quantitative sampling of aquatic mosses. A qualitative sample of the macroalgal or aquatic moss assemblage should also be collected for species identification if the taxon is not recognizable in the field. Periphyton biomass can be measured as dry mass (DM), ash-free dry mass (AFDM), or photosynthetic-pigment content (for example, chlorophyll *a* and *b* (CHL) concentrations).

Quantitative samples of macroalgae can be collected with benthic invertebrate sampling gear, such as a Surber sampler, Hess sampler, or box sampler (Cuffney and others, 1993), or with other devices, such as a cylindrical coring device or template, that defines a measured area of stream bottom. The sampling device is placed over a representative macroalgal assemblage, and algae within the template of the sampling device are removed by hand or with the use of a brush or scraper. Quantitative macroalgal samples also can be collected by scraping or brushing algae from the surface of representative rocks and estimating surface area by the foil-template method.

Sample processing methods for macroalgae differ with respect to the nature of the biomass measurement. If macroalgal samples are to be analyzed for AFDM, pour off any residual stream water from the sample, place the sample in a plastic bag with a sample label, chill the sample, and transport the sample to the laboratory. Record the area of the macroalgal sample on the field data sheet (fig. 5) and on the sample label. If weather conditions permit, the macroalgal sample can be air dried during the site visit; the dried sample is placed in a plastic bag or other container with a sample label. Air-dried samples of macroalgae do not require chilling. Determinations of AFDM can provide an inexpensive estimate of algal biomass in a stream reach, indicating relative differences in loads of nutrients and other water-chemistry constituents among streams in a basin. If project personnel have access to an analytical balance, drying oven, and muffle furnace, AFDM can be determined by laboratory methods describe d in Britton and Greeson (1988) or Clesceri and others (1989).

The biomass of macroalgae also can be estimated by determining the CHL content of the periphyton assemblage. This determination is particularly appropriate for studies designed to address the effects of benthic algal processes on water quality, such as relations with instream concentrations of dissolved oxygen, alkalinity, and pH. Processing of a macroalgal sample for CHL analysis is accomplished by (1) obtaining a representative subsample volume from the total volume of the macroalgal sample, (2) collecting the sub- sample volume on a glass-fiber filter (Whatman GF/F or equivalent) using a filtration apparatus and hand vacuum pump, and (3) wrapping the filter in aluminum foil, placing the foil into a pre-labeled container, and transporting the container to the laboratory on dry ice. Specific details of the filtration procedure are discussed in the collection procedures for microalgae.

Obtaining representative chlorophyll subsamples from samples of macroalgae can be a challenge, particularly for filamentous taxa such as *Cladophora glomerata*. The recommended sample-processing method used will depend in part on the capabilities of the analytical laboratory and on recommendations from the regional biologist. Several sample-processing methods are suggested below. The analytical laboratory should be contacted prior to the collection of quantitative macroalgal samples for CHL determinations, particularly if sample-processing methods (2) or (3) are selected.

- 1. Cut algal filaments into smaller lengths with scissors; add sufficient stream water to constitute a known volume (for example, 1 L) of algae-water suspension; pour the suspension into a churn splitter (Ward and Harr, 1990), and withdraw a subsample volume (for example, 50 mL) for filtration. The specific subsample volume withdrawn from the churn splitter is related to the volume of algal biomass in the algae-water suspension. Sufficient subsample volume should be withdrawn to ensure that adequate algal biomass (green or brown color) is retained on the surface of the glass-fiber filter after the filtration process. Include the following information on the field data sheet (fig. 5) and on the sample label (fig. 3): area of the macroalgal sample, volume of algae-water suspension, and volume of subsample filtered.
- 2. Collect and process a quantitative macroalgal sample for DM and AFDM. Collect a smaller representative amount of macroalgal biomass from the same general stream location; place the biomass into an externally labeled sample container, and transport the sample to the laboratory on dry ice. Request that the laboratory report the CHL concentration in relation to the biomass of the sample, for example, milligrams of CHL per gram of DM. Estimate the CHL concentration per unit area by multiplying the laboratory datum by the result of the DM determination.
- 3. Collect a quantitative macroalgal sample and submit the entire sample to the laboratory for CHL analysis. All samples for CHL analysis must be placed into containers that prevent exposure to sunlight and must be shipped to the laboratory on dry ice. Record the area of the macroalgal sample on the field data sheet and on the sample label.

Methods:

Our general approach came from the USGS methods and Mike Deas' discussion with S. Porter and consisted of:

a) a fixed area sample (a 1x3" microscope) slide area of substrate was sampled.
b) Two samples per location are collected for (a) chlor a (c) species identification and enumeration
c) To identify sites that had consistent characteristics we used the following criteria
    a. Depth: 1 to 3 feet (used current meter staff)
    b. Velocity: 1 to 3 feet per second (current meter)
    c. Exposure: clear sky (i.e., no serious topographic shading, no riparian shading)

b) Thus the sites were not "random" – instead the community that was probably most prevalent in the river (i.e., not the very-near shore assemblage, not the deep water assemblage) was selected
c) Contact the specific lab/analyst to identify sample preservative and handling methods and to request sample bottles in advance. Currently, YTEP is using Aquatic Analysts to process our samples for periphyton spp. ID and counts and we are using Aquatic Research Inc to process our samples for periphyton chl. a. We've been shipping both samples on wet ice in an insulated cooler and have had good luck – as per analyst request.

At each sampling location, a representative area was identified that has the above depth and velocity characteristics and 10 cobbles are selected that could readily be sampled care is taken to avoid collecting rocks in extremes of algal cover and physical site conditions (see 1x3sample.jpg). At each sampling location, 10 rocks (five rocks are scraped for the chl.a sample and five rocks are scraped for the speciation and enumeration sample) are placed in a plastic tub below the water surface to reduce loss of periphyton. The rocks are transported in the tub to a convenient sample-processing area.

Record the stream velocity, water depth, distance from the shore and the stream width for the location in which rocks will be removed for sampling on the datasheet (see grid datasheet031308.doc). Also, record any general observations that may be useful such as weather conditions and/or any drastic change in stream flow that could influence the periphyton community (i.e, recent rain event that caused increase in flow or scheduled flow releases or reductions).

Rocks were sampled by selecting five rocks that were large enough to place a 1 inch X 3 inch microscope slide, firmly hold microscope slide to rock (pinning down the algae), then with a brush clean off that face of the rock. This allows you to wash away all the excess material around the microscope slide, then brush your 1x3 sample into a small plastic tray or directly into the sample jar other tools that are available at the hardware store to aid in the brushing process includes: toothbrushes, scrapers, razor blades and spatulas. Then carefully pour the contents of the tray into the sample bottle. Using distilled water is recommended to help wash all of the trays contents into the sample jar. **POUR DI WATER INTO THE CHL. A PERIPHYTON SAMPLE JAR ONLY.**

Place the chl.a sample jar on ice immediately. The algae speciation and enumeration sample jar does not need to be stored on ice before it is delivered to the lab. The periphyton chl.a sample jar has a preservative of saturated solution of $MgCO_3$ already placed in the sample jar for this test and the sample jars can be requested in advance from the lab performing the analysis. The periphyton speciation and enumeration sample jar has Lugol's solution that preserves the sample for the cell ID and counts by the lab. The chl.a sample must be mailed overnight in a sealed cooler packed with wet or dry ice so the lab can perform the analysis within the 48 hour hold time. Normally, both sample jars are mailed off to the lab so they receive both samples in a timely manner.

Percent cover is measured by using a grid made out of a mesh that is approximately 1.5 square feet that is laid on the river bed to determine approximate percentage of cover (see grid.jpg). This grid data is recorded on a separate datasheet (see grid datasheet031308.doc). The information that is collected here helps measure the percent of the gravel covered by periphyton and can help characterize how dense the algae is from month to month. Place the mesh on the stream bed in an area adjacent to the area where the sampler removed the rocks that were scraped. Effort is made to select an area that has not been disturbed by the sampling crew but still meets the same depths and velocities of location where the rocks were collected for scraping. Place your feet on the edges of the grid so that it does not float away in the river current. With the view finder visually inspect the amount of periphyton or macrophyte in each quadrant and record the amount that is covering the stream substrate and record this information on the datasheet. The datasheet contains room for two locations to place the mesh grid to record percent cover. If the sampling location has a homogenous benthic periphyton distribution then only one location is necessary. If the benthic algae community is distributed in a more patchy heterogenous nature record percent covers in two locations to reflect the representative nature of the sampling site.

Record water quality parameters onto the datasheet (see algaedatasheet031008.doc) with a freshly calibrated multi-parameter water quality probe and record the type of sample collected, date and time and any other pertinent observations that may be useful when reporting this data.

Appendix F: Existing Water Quality Standards

Appendix F1: Basin Plan MCL Tables

Appendix F2: EPA Surface Water Quality Standards

United States
Environmental Protection
Agency

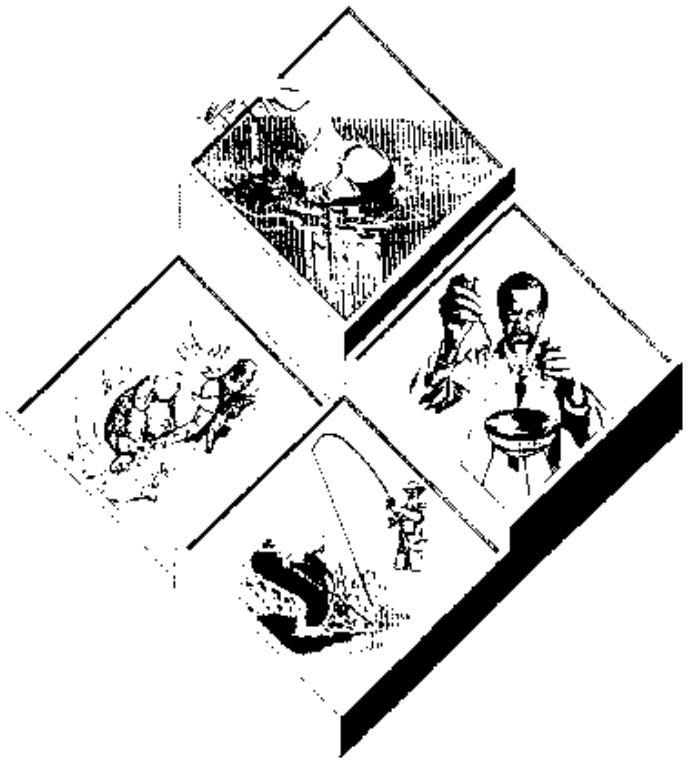
Office of Water
(4305)

EPA 823-B-94-005a
August 1994

EPA

Water Quality Standards Handbook:

Second Edition



"... to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

Section 101(a) of the Clean Water Act

Contains Update #1
August 1994