Tribal Integrated Water Quality Monitoring Program

Surface Water & Fixed Station

Quality Assurance Project Plan Version 4.0

Confederated Tribes of
Coos, Lower Umpqua & Siuslaw Indians
Natural Resources Department

February 26, 2016

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A.1 Project/Task Organization

The Environmental Protection Agency (EPA) requires all grantees to complete a detailed Quality Assurance Project Plan (QAPP) prior to the collection of environmental data. A QAPP is drafted and submitted to EPA for final review and approval. The purpose of the following QAPP 4.0 is to update previous EPA-approved QAPPs to reflect changes to the Tribes' Water Quality Monitoring Program.

The project team organization provides the framework for conducting the sample collection tasks to meet project objectives outlined in this QAPP. The organizational structure and function also facilitate project performance and adherence to QA procedures and QA requirements. Key roles are filled by those persons responsible for ensuring program planning, sample collection, data generation, data verification, as well as the persons responsible for validating data for usability with final products and deliverables.

Below is an outline of the Tribes' Environmental Protection Division staff and respective description of responsibilities to fulfill for the water quality monitoring program.

Natural Resources
Environmental Protection: Organization & Responsibilities

Director: Responsible for project completion, reporting, and ensures that the EPA approved QAPP is implemented correctly. Provides oversight in program design and may participate in sample collection and analyses. May, at any time, perform quality assurance duties as needed.

Water Protection Staff: The water protection specialist, water protection specialist/biologist, and the air and water protection specialist are responsible for project design, water sampling, laboratory analysis of water samples and the calibration, deployment, auditing of extended deployment equipment, data management, data analyses, and reporting. They ensure that all water sampling is performed according to the most current EPA approved QAPP and are responsible for keeping an updated field record documenting data gathered for the project and ensuring that all equipment is in working order and calibrated prior to field deployment.

A.2 Problem Definition/Background

The Tribes currently own approximately 547 acres of land, 160 acres of which are held in trust by the Bureau of Indian Affairs and 387 acres are held in fee status. The Tribes' current land holdings are scattered among the Siuslaw River, Umpqua River, Tenmile Lakes, Coos River, and Sixes River watersheds and consist of riparian areas, wetlands, forestlands, coastal beach front, lakefront, rural residential and commercial development land uses. Impairments to water quality occur within all of these Tribal watersheds.

Tribal lands that contain or border water resources are generally impaired by non-point sources that do not originate from Tribal lands. Impaired water quality on and near these lands continues to be a problem that impacts the health and availability of Tribal resources. To address these water quality impairments, the Tribes' have established an

EPA approved 106 water quality monitoring program that includes the implementation of both seasonal and continuous (fixed station) monitoring.

The first Water Quality Monitoring Program (WMQP) QAPP was written and approved for surface water quality monitoring in December 2003. In January 2004, the WQMP collected pH, temperature, dissolved oxygen, turbidity, and salinity/conductivity data. In 2006, the WQP began to incorporate the use of continuous data loggers and bacteria monitoring (E. Coli and Enterococcus) at estuarine monitoring sites. Continuous monitoring of water quality enhanced the amount of water quality data and understanding of how water quality conditions change throughout tidal cycles. A key requirement within this new program guidance document was that Tribes collecting water quality data using funding from § 106 of the Clean Water Act were now required to collect and report on nine water quality parameters. The parameters identified in the guidance document are dissolved oxygen, pH, total phosphorus, total nitrogen, water temperature, turbidity, macroinvertebrates, bacteria (E. coli and/or Enterococcus), and basic habitat information. The WQMP worked to incorporate all nine EPA required water quality monitoring parameters. In April 2007, EPA approved QAPP 3.0 which enabled the WQMP to be considered a mature water quality monitoring program.

In 2011, a review of existing data and other fixed station monitoring programs led the Tribes to modify their monitoring program. To modify the CTCLUSI water quality monitoring program, the Tribes' decided that the fixed station monitoring data should be collected using methodology similar to that of other agencies collecting fixed station data in waters of or pertaining to Tribal lands. Fixed station monitoring is defined in this QAPP as monitoring data that is collected continuously at a regular interval at a fixed location.

This QAPP (4.0) is intended to integrate the Tribes' adapted Fixed Station Monitoring Program (2011) and Water Quality Program (2008) QAPPs. This QAPP (4.0) will be used to guide the focused development and expansion of the Tribes' Water Quality Monitoring Program and allow the Tribes' to easily communicate protocols and procedures with outside agencies and partners. The Tribes' integration of these QAPPs will enhance our ability to engage in comprehensive, interagency, fixed-station monitoring network efforts. These kinds of efforts are rapidly becoming the focus of many ongoing resource management and research projects currently monitored by the Tribes' base 106 water quality monitoring program.

This QAPP (4.0) describes the field and lab work that will be conducted by the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians' Integrated Water Quality Monitoring Program.

Data collected under this QAPP (4.0) will be used to assess whether Tribal, state, and/or federally designated beneficial uses are being supported and to help maintain a baseline of water quality conditions for waterbodies within the waters of or pertaining to Tribal lands.

A2.a Integrated Water Quality Monitoring Program (IWQMP)

Currently, the Tribes implement seasonal, discrete and continuous water quality monitoring. YSI EXO Sondes and/or YSI 6600 Sondes, which will soon be phased out by

EXO Sondes, are deployed to collect continuous water quality data from four fixed-stations. Two of the Tribes' fixed stations are located in lower Coos Bay and complement eight fixed-stations installed and maintained by the South Slough National Estuarine Research Reserve (SSNERR). The additional fixed-stations are located in the Lower Siuslaw Estuary and are the only fixed-stations currently installed in this region of the Siuslaw watershed. Discrete and continuous water quality monitoring, including toxic algal (HAB) sampling will be implemented near the Tribes' Camp Easter Seals property on Tenmile Lakes in the near future.

Additional fixed-station installations and monitoring conducted under this QAPP will be based on assessments of regional water quality data needs, Tribal land acquisitions, and watershed wide partnership opportunities between the Tribes and other agencies collecting water quality data within Tribal watersheds, as determined by the Director.

Additional seasonal and discrete monitoring will be performed as staff time allows. Inactive sites or other locations of interest to the Tribes' may be added to this Water Quality Program as amendments. Sites will be identified based on assessments of regional water quality data needs (303(d) listings), Tribal land acquisitions, and recreational Tribal membership use, and grounded in watershed wide partnership opportunities between the Tribes and other agencies to collect water quality data within Tribal watersheds, as determined by the Director. Importantly, seasonal adjustments to nutrient, chlorophyll and toxic algal sampling will be determined by data review and technical staff consensus.

Waterbodies that will be monitored under this QAPP include freshwater and tidally influenced rivers, estuaries, lakes, and near-shore areas located within the Tribes' 5-County Service Area.

A2.b Water Program Development

As a sovereign federally recognized Tribal Government, the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (Tribes) have both the rights and responsibilities with respect to the management and protection of Tribal resources. The Natural Resources Department is responsible for fulfilling these responsibilities and exercising these rights. The mission statement for the Environmental Protection Division of the Natural Resources Department is research, monitor, assess, manage, conserve, protect, enhance, utilize, and restore the natural resources within the Tribes' Ancestral Territory, consistent with Tribal values. In an effort to accomplish this mission and protect water quality and Tribal resources, the Tribes receive funding from EPA through §106 and §319 of the Federal Clean Water Act. This funding has enabled the Tribes to develop and implement a Water Quality Monitoring Program (WQMP). This funding is a critical component of the WQMP and the ability of the Tribes to collect high-grade water quality data. This data can be used to document short-term variability and long-term changes in water quality, and tie water quality to potential impacts on watershed health, Tribal and community health, and the health of Tribal resources.

A.3 Project Task/Description

The objective of the IWQMP is to collect high-grade water quality data that results in a representative data set that documents short-term variability and long-term changes in estuarine, stream, and lake water quality within Tribal watersheds. The data collected will assist in the research and development of TMDL's, strategic action plans addressing the effects of point and non-point source pollution and climate change, and potential restoration projects, including, but not limited to, wetlands and Tribal resources restoration projects, and provide valuable effectiveness data for these projects to determine mitigation and restoration achievements. Data collected from the project will also be used to determine the extent of impairments to Tribal waters and assist agencies in 303(d), 305(b), TMDL(s) development efforts. The data can also be used by collaborators that may be interested in how water quality is potentially impacting a resource or an ecosystem within a particular watershed.

The IWQMP promotes partnerships with local, state, federal, and Tribal stakeholders that are interested in improving water quality conditions. Currently, the Tribes actively collaborate with the Siuslaw Watershed Council (SWC) whom are currently limited to volunteers to perform water sampling and use our water quality data to supplement their data. The South Slough National Estuarine Research Reserve (SSNERR) is also another agency in which the Tribes collaborates. In the past, they have provided us with telemetry equipment that has allowed us to upload our continuous data from our BLM site on the Coos River via real-time in exchange for data sharing and other services.

The purpose of the Tribes' IWQMP is to determine whether water quality criteria/benchmarks are being met, and beneficial uses are being supported, for waterbodies of or pertaining to the reservation and other Tribal lands. Establishing a baseline of water quality conditions for all Tribal waters and periodically reassessing the baseline water quality to evaluate short-term variability and long term trends is an important component of this program objective in order to develop and implement strategic action plans to help mitigate the effects of point and non-point source pollution and climate change.

The Tribes' monitoring builds upon the existing state collected water quality data and supports ongoing watershed wide sampling and assessment activities implemented by Oregon Department of Environmental Quality (ODEQ), the Oregon Department of Agriculture (ODA); Department of State Lands (DSL)/SSNERR; the Coos Watershed Association (CWA); (SWC); the Siuslaw Estuary Partnership (SEP); the South Coast Coordinating Watershed Council and other local agencies/organizations. Water quality sampling conducted under this QAPP will complement all of the above monitoring efforts.

Objectives of the Tribes' Integrated Water Quality Monitoring Program are:

1. Collect high-grade water quality data year-round. Review, integrate, and synthesize existing water quality monitoring and watershed assessment data. Document short term and long-term water quality trends for Tribal waters.

2. Generate independent assessments and conduct analysis of potential impacts associated with tidal dynamics and watershed inputs that may be occurring to

Tribal resources and watersheds as well as from point and nonpoint source pollution and climate change.

3. Address relationship gaps between tidally influenced and watershed driven inputs, as well as impairments to water quality associated with bacteria, sediment, and nutrient transport within Tribal watersheds.
4. Assess local water quality issues such as low dissolved oxygen, eutrophication, toxic algae, chemical & biological (e.g. bacteria) contamination, habitat modification, and cumulative impacts.
5. Assess whether water quality standards are being met and beneficial uses are being supported. Establish baseline water quality conditions for all pertinent uses. Review and provide data for Water Quality Assessments, Listings (CWA 305(b), 303(d)), and TMDL(s).
6. Continue to develop and expand the monitoring program to include a wetland monitoring program, TMDL(s) monitoring program, fish/shellfish/lamprey tissue monitoring program, and oceanic planning.
7. Develop and implement a strategic action plan that addresses the projected effects of climate change on ambient waters and Tribal resources.
8. Continue to build partnerships with water quality stakeholders within the Tribes' Ancestral Watersheds.

A3.a Tribal Waters and Watershed Description

The following is a brief overview of each of the Tribal watersheds wherein the Tribes conduct water quality monitoring, and/or watersheds that are located within the Tribes' ancestral territory and potential impairments to those watersheds.

Siuslaw Watershed

The Siuslaw watershed is a 4th field HUC watershed that drains an area of approximately 4500 square miles in the Central Oregon Coast Range southwest of the Willamette Valley. The headwaters of the Siuslaw mainstem begin approximately 5 miles west of Cottage Grove and flow generally WNW through the Oregon Coast Mountain Range, past the small town of Swisshome, OR, for approximately 110 miles, and finally terminate in the Pacific Ocean at Florence, OR. Land use in the Siuslaw Watershed is dominated by forestry, with ranching, rural residences, and the City and Port of Florence also contributing to the landscape.

The Siuslaw River estuary is classified by the Oregon Department of Land Conservation and Development (DLCD) as a Shallow Draft Development estuary. These estuaries are managed for navigation and other public needs consistent with overall estuary management rules.

Water quality in several portions of the Siuslaw Watershed is impaired or is of potential concern. Impairments in headwater tributaries include alkalinity, ammonia, antimony, arsenic, aquatic weeds/algae, barium, biological criteria, cadmium, chloride, chlorophyll

a, chromium, copper, dissolved oxygen, iron, lead, manganese, nickel, nutrients, pH, phosphate phosphorus, phosphorus, sedimentation, selenium, silver, temperature, thallium, and zinc, while impairments in the estuary include elevated temperature, sedimentation, and dissolved oxygen. Other issues in the estuary and river include enterococcus (at the mouth of the river) and fecal coliform.

The Siuslaw River is 303(d) listed for alkalinity, ammonia, biological criteria, chloride, chlorophyll a, dissolved oxygen, fecal coliform, nutrients, pH, phosphate phosphorus, sedimentation, and temperature.

The North Fork Siuslaw River is 303(d) listed for sedimentation from river mile 0.4, and for temperature from the mouth year round. The USFS 1994 North Fork Siuslaw River Watershed Analysis indicates streambeds which have been scoured down to bedrock, and riparian forests reduced for pastures and home sites, as being the primary contributors to elevated stream temperatures. North Fork Siuslaw Tributaries – Condon Creek, Drew Creek, McLeod Creek, Morris Creek, Porter Creek, Russell Creek, and Taylor Creek– are included on the ODEQ 303(d) list: Condon Creek is impaired by alkalinity, ammonia, biological criteria, chloride, dissolved oxygen, pH, phosphate phosphorus, temperature; Drew Creek is impaired by sedimentation; McLeod Creek is impaired by both sedimentation and temperature; Morris Creek is impaired by sedimentation; Porter Creek is impaired by biological criteria and sedimentation; Russell Creek is impaired by biological criteria; and Taylor Creek is impaired by sedimentation.

Umpqua Watershed

The Umpqua watershed is a 3rd field HUC watershed. The 111 mile long Umpqua mainstem is formed by the confluence of the North Umpqua River, which begins at Lake Maidu near Mt. Thielsen and the South Umpqua River, which flows from the confluence of Black Rock Fork and Castle Rock Fork, near Fish Lake, approximately 6 miles northwest of Roseburg and flows northwesterly through the Coast Range and west past Scottsburg, OR. The Smith River is received by the Umpqua River from the north near Winchester Bay and terminates in the Pacific Ocean at Reedsport, OR. Land use in the Umpqua Watershed is dominated by forestry, with ranching, rural residences, and the City and Port of Reedsport contributing to watershed activities.

The Umpqua River estuary is classified by the Oregon Department of Land Conservation and Development (DLCD) as a Shallow Draft Development estuary. These estuaries are managed for navigation and other public needs consistent with overall estuary management rules.

Water quality is impaired at headwater tributaries where tide-gates and levees contribute to elevated temperatures, sedimentation, depressed dissolved oxygen, and barriers to fish passage. Other impairments include alkalinity, ammonia, antimony, arsenic, aquatic weeds/algae, barium, beryllium, biological criteria, cadmium, chloride, chlorophyll a, chromium, copper, iron, lead, manganese, mercury, nickel, pH, phosphate phosphorus, phosphorus, selenium, silver, thallium, and zinc. E. coli, enterococcus (at the mouth of the river) and fecal coliform are also a concern in the estuary and river.

The Umpqua River is 303(d) listed for alkalinity, ammonia, aquatic weeds/algae, chlorophyll a, dissolved oxygen, e. coli, fecal coliform, nutrients, pH, phosphate phosphorus, sedimentation, and temperature.

Tenmile Lakes Watershed

The Tenmile Lakes watershed is a 5th field HUC watershed that encompasses approximately 98 square miles. Land-use in the Tenmile Lakes watershed is dominated by forestry, followed by recreation, agriculture, and residential uses. The Elliot State Forest comprises roughly a third of the watershed. There are ten lakes within the watershed with a combined surface area of about 4.7 square miles or 5% of the watershed. These lakes and their drainages together can be further subdivided into three subbasins: the Eel Lake subbasin, Saunders Creek subbasin, and Tenmile subbasin.

The Eel Lake subbasin consists of North Clear Lake, Edna Lake, Teal Lake, Schuttpelz Lake, and Hall Lake, which are all drained by Clear Creek into Eel Lake. Eel Lake is drained by Eel Creek, which flows into Tenmile Creek. The Saunders Creek subbasin, covers the drainages of Saunders Lake, South Clear Lake, and Saunders Creek. Saunders Creek flows along the eastern edge of the dunes and into Tenmile Creek. The Tenmile Subbasin, the easternmost subbasin in the watershed, includes North and South Tenmile Lakes and their respective drainage areas. Tenmile Creek carries the water from this subbasin for about five miles, past the entrance of Eel and Saunders creeks, to the Pacific Ocean.

Tenmile Lake is the largest and farthest south in the chain of lake basins that drain the west side of the Coast Range south of the Umpqua River. Other major tributaries entering the various arms include: Shutter Creek, Adams Creek, Johnson Creek, and Benson Creek.

Water quality in several portions of the Tenmile Lakes watershed is impaired or is of potential concern. Impairments include alkalinity, ammonia, antimony, arsenic, aquatic weeds/algae, barium, biological criteria, cadmium, chloride, chlorophyll a, chromium, copper, dissolved oxygen, e. coli, iron, lead, manganese, nickel, pH, phosphate phosphorus, sedimentation, selenium, silver, temperature, thallium, turbidity, and zinc.

Tenmile Lake is 303(d) listed for alkalinity, ammonia, aquatic weeds/algae, chlorophyll a, dissolved oxygen, iron, nutrients, pH, phosphate phosphorus, sedimentation, and temperature. Tenmile Lakes Basin Partnership has indicated that many problems such as eutrophication, sedimentation due to land use patterns, and invasive species have contributed to current lake conditions. Potentially toxic algae blooms thrive in these conditions and need to be monitored.

Coos Watershed

The Coos watershed is a 4th field HUC watershed located in Oregon's South Coast Basin. The Coos watershed area is approximately 900 square miles and drains into the Pacific Ocean via the Coos River Estuary. The estuary has an estimated water surface area of 12,380 acres.The two major tributaries to the estuary are the Millicoma and the Coos River. Approximately 30 other tidally influenced sloughs and creeks enter the estuary directly, including, but not limited to: North, Haynes, Kentuck, Willanch, Catching, Isthmus, Coalbank, Pony, Joe Ney and South Sloughs, and Palouse, and Larson Creeks. The upper portions of the basin are comprised of BLM and private timber lands, whereas agriculture and grazing dominate the lower lands. The basin also

contains the communities of Coos Bay and North Bend. Swimming, boating, shellfish harvesting and fishing are popular recreational activities throughout the area.

Water quality in several portions of the Coos Watershed is impaired or is of potential concern. Impairments in headwater tributaries include acrolein, alkalinity, ammonia, antimony, arsenic, aquatic weeds/algae, barium, benzene, biological criteria, cadmium, carbon tetrachloride, chloride, chlorinated benzene, chloroform, chlorophyll a, chromium, copper, dichlorobenzenes, dichloroethane,1,2, dichloroethylenes, dichloropropene, dissolved oxygen, halomethanes, iron, lead, manganese, mercury, monochlorobenzene, nickel, nutrients, pH, phosphate phosphorus, polychlorinated biphenyls (PCB's), polynuclear aromatic hydrocarbons, sedimentation, selenium, silver, temperature, tetrachloroethylene 1,1,2,2, tetrachloroethylene, toluene, thallium, tributyltin, trichloroethane, 1,1,1, trichloroethane 1,1,2, trichloroethylene, toxics, turbidity, vinyl chloride, and zinc, while impairments in the estuary include elevated temperature, sedimentation, and dissolved oxygen. Other issues in the estuary and river include e coli., enterococcus (at the mouth of the river), and fecal coliform.

Coos Bay is 303(d) listed for ammonia, chlorophyll a, chromium, copper, enterococcus, fecal coliform, lead, pH, nickel, polychlorinated biphenyls (PCB's), polynuclear aromatic hydrocarbons, sedimentation, tributyltin, and zinc.

Sixes Watershed

The Sixes watershed is a 4th field HUC watershed that drains an area of approximately 134 square miles. Sixes River is almost entirely situated within Curry County except for a small arm of the Upper Sixes Main-Stem sub-watershed that extends into Coos County, flowing in a westerly direction and terminating in the Pacific Ocean just north of Cape Blanco. Forestry is the most dominant land use in the Sixes River Watershed. Grazing, rural residential development and other agricultural uses are dominant in the lower portion of the basin.

The Sixes River estuary is approximately 330 acres in area and has a watershed of approximately 129 square miles. Head of tide is about 2.5 miles from the mouth. The estuary is designated as a Nature Estuary under the Oregon Estuary Classification system, and it is listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetland's".

Water quality in several portions of the Sixes Watershed is impaired or is of potential concern. Impairments in headwater tributaries include alkalinity, ammonia, antimony, arsenic, aquatic weeds/algae, barium, biological criteria, cadmium, chloride, chlorophyll a, chromium, copper, dissolved oxygen, iron, lead, manganese, nickel, pH, phosphate phosphorus, phosphorus, sedimentation, selenium, silver, temperature, thallium, and zinc, while impairments in the estuary include elevated temperature, sedimentation, and dissolved oxygen. Other issues in the estuary and river include e coli., enterococcus (at the mouth of the river), and fecal coliform.

The Sixes River is 303(d) listed for alkalinity, ammonia, biological criteria, chloride, chlorophyll a, dissolved oxygen, pH, sedimentation, and temperature. Additional parameters of concern are e. coli and fecal coliform. Data collected for local watershed assessments for this area appear to indicate that water quality within the Sixes River is moderately impaired due to high nitrate, phosphorus, and fecal coliform levels.

Nitrate levels tend to exceed water quality standards during early winter high flow (storm) events. In addition, high phosphate and fecal coliform levels tend to occur from fall through early spring. Instances when phosphate and fecal coliform levels exceed standards may also correlate with high flow events.

A3.b Monitoring Locations, Monitored Parameters, and Monitoring Frequency

The locations and parameters monitored by the Tribes' 106 water quality monitoring program along with their monitoring frequency are listed in the table below. Additionally, 303(d) listed parameters for each waterbody monitored by the Tribes, some of which TMDL's have not been established, are listed in the table. Action limits for monitored parameters follow the 106 monitoring table.

Waterbody Name	Lat./Long	Parameters monitored	Monitoring frequency	303d List Parameter(s)
Siuslaw River, Cox Island – Siuslaw Watershed	43° 58' 27" N -124° 04' 16" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Year Round: 15 minute intervals	**Parameter:** Alkalinity **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic Life **Status:** Insufficient data, potential concern **Parameter:** Ammonia **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic Life **Status:** Attaining some criteria/uses **Parameter:** Biological Criteria **Season:** Year Round **Listed** :2010 **Beneficial Use(s):** Aquatic Life **Status:** Water quality limited, 303(d) list, TMDL needed **Parameter:** Chloride **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic Life **Status:** Insufficient data **Parameter:** Chlorophyll a **Season:** Fall, Winter, Spring; Summer **Listed**: 2004 **Beneficial Use(s):** Water supply; Water contact recreation; Fishing; Aesthetics; Livestock watering **Status:** Insufficient data; Attaining some criteria/uses **Parameter:** Dissolved Oxygen **Season:** Year Round (Non-spawning); Year Round **Listed:** 2004; 2002 **Beneficial Use(s):** Estuarine water, Cold-water aquatic life; Anadromous fish passage; Salmonid fish rearing; Salmonid fish spawning **Status:** Attaining some criteria/uses; Water quality limited, 303(d) list, TMDL needed **Parameter:** Fecal Coliform **Season:** Year Round **Listed:** 2004 **Beneficial Use(s)** Water contact recreation**,** Shellfish growing **Status:** Water quality limited, 303(d) list, TMDL needed. **Parameter:** Nutrients **Season**: Undefined **Listed**: 1998 **Beneficial Use(s):** Aesthetics **Status:** Insufficient data **Parameter:** pH **Season**: Year Round **Listed**: 2004 **Beneficial Use(s):** Water contact recreation; Salmonid fish spawning; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing **Status:** Attaining some criteria/uses **Parameter:** Phosphate Phosphorus **Season**: Summer **Listed**: 2004 **Beneficial Use(s):** Aquatic life **Status:** Insufficient data **Parameter:** Sedimentation **Season:** Undefined **Listed:** 1998 **Beneficial Use(s):** Salmonid fish rearing; Resident fish and aquatic life; Salmonid fish spawning **Status:** Insufficient data

		Laboratory: Bacteria (*e.coli and enterococcus*)	Monthly/After storm events	**Parameter:** Temperature **Season**: Year Round (Non-spawning) **Listed**: 2004 **Beneficial Use(s):** Salmon and trout rearing and migration **Status:** Water quality limited, 303(d) list, TMDL needed.
		Laboratory: Nutrients (TN and TP), and Chlorophyll	Seasonally to Quarterly (as staff and resources allow)	
North Fork Siuslaw River – Siuslaw Watershed	43° 58' 40" N -124° 04' 48" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Year Round: 15 minute intervals	**Parameter:** Sedimentation **Season:** Undefined **Listed:**1998 **Beneficial Use(s):** Resident fish and aquatic life , Salmonid fish rearing, Salmonid fish spawning **Status:** Water quality limited, 303(d) list, TMDL needed **Parameter:** Temperature **Season**: Year Round (Non-spawning) **Listed** :2004 **Beneficial Use(s):** Salmon and trout rearing and migration **Status:** Water quality limited, 303(d) list, TMDL needed.
		Laboratory: Bacteria (*e.col and enterococcus*)	Monthly/After storm events	
		Laboratory: Nutrients (TN and TP), and Chlorophyll	Seasonally to Quarterly (as staff and resources allow)	
North Tenmile Lakes—Tenmile Lakes Watershed	43° 35' 59.8" N -124° 7' 33.8" W or 43° 35' 56.7" N -124° 7' 25.6" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Year Round: 15 minute intervals	**Parameter:** Alkalinity **Season**: Year Round **Listed:** 2004 **Beneficial Uses**: Aquatic Life **Status:** Insufficient data **Parameter:** Ammonia **Season**: Year Round **Listed:** 2004 **Beneficial Uses**: Aquatic Life **Status:** Insufficient data **Parameter:** pH **Season**: Summer **Listed:** 2004 **Beneficial Uses**: Resident fish and aquatic life; Water contact recreation **Status:** Insufficient data **Parameter:** Phosphate Phosphorus **Season**: Summer **Listed:** 2004 **Beneficial Uses**: Aquatic life **Status:** Insufficient data **Parameter:** Dissolved Oxygen **Season**: Year Round (Non-spawning) **Listed:** 2004 **Beneficial Uses**: Cold-water aquatic life **Status:** Insufficient data **Parameter:** Iron **Season**: Year Round **Listed:** 2012 **Beneficial Uses**: Aquatic life **Status:** Insufficient data **Parameter:** Nutrients **Season**: Undefined **Listed:** 1998 **Beneficial Uses**: Aesthetics **Status:** Insufficient data **Parameter:** Sedimentation **Season**: Undefined **Listed:** 2010 **Beneficial Uses**: **Status:** Water quality limited, TMDL approved
		Laboratory: Bacteria (*e.coli*)	Monthly/After storm events	
		Laboratory: Nutrients (TN and TP), and Chlorophyll	Seasonally	
		Laboratory: Toxic Algae	Seasonally	
Coos River, Lower Bay, North Spit, BLM boat ramp – Coos Watershed	43° 24' 54.83" N -124° 16' 42.60" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Year Round: 15 minute intervals	**Parameter:** Ammonia S**eason:** Year Round **Listed:** 2004 **Beneficial Use(s):** Aquatic life **Status:** Insufficient data **Parameter:** Chlorophyll a **Season**: Summer **Listed:** 2004 **Beneficial Uses**: Water contact recreation;
		Laboratory: Bacteria (*e.coli and enterococcus)*	Monthly/After storm events	

		Laboratory: Nutrients (TN and TP), and Chlorophyll	Seasonally to Quarterly (as staff and resources allow)	Aesthetics; Livestock watering; Water supply; Fishing **Status:** Insufficient data **Parameter:** Fecal Coliform **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Shellfish growing; Water contact recreation **Status:** Water quality limited, 303(d) list, TMDL needed **Parameter:** pH S**eason:** Year Round **Listed:** 2004 **Beneficial Use(s):** Resident fish and aquatic life; Water contact recreation **Status:** Insufficient data **Parameter:** Sedimentation **Season:** Undefined **Listed:** 1998 **Beneficial Use(s):** Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life **Status:** Insufficient data
Coos River, Lower Bay, Empire Docks – Coos Watershed	43° 23' 39.37" N -124° 16' 49.80" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Year Round: 15 minute intervals	**Parameter:** Ammonia S**eason:** Year Round **Listed:** 2004 **Beneficial Use(s):** Aquatic life **Status:** Insufficient data **Parameter:** Chlorophyll a **Season**: Summer **Listed:** 2004 **Beneficial Uses**: Water contact recreation; Aesthetics; Livestock watering; Water supply; Fishing **Status:** Insufficient data **Parameter:** Fecal Coliform **Season:** Year Around **Listed**: 2004 **Beneficial Use(s):** Shellfish growing; Water contact recreation **Status:** Water quality limited, 303(d) list, TMDL needed **Parameter:** pH S**eason:** Year Round **Listed:** 2004 **Beneficial Use(s):** Resident fish and aquatic life; Water contact recreation **Status:** Insufficient data **Parameter:** Sedimentation **Season:** Undefined **Listed:** 1998 **Beneficial Use(s):** Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life **Status:** Insufficient data
		Laboratory: Bacteria (*e.coli enterococcus*)	Monthly/After storm events	
		Laboratory: Nutrients (TN and TP), and Chlorophyll,	Seasonally to Quarterly (as staff and resources allow)	
Pacific Ocean, Gregory Point – Coos Watershed	TBD	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Monthly/After storm events	**Adjacent Location Listings (Sunset Bay and Bastendorf Beach)** **Parameter:** Enterococcus **Season:** Fall, Winter, Spring; Summer **Listed:** 2010 **Beneficial Use(s):** Water contact recreation **Status:** Water quality limited, 303(d) list, TMDL needed
		Laboratory: Bacteria (enterococcus)		

Sixes River – Sixes Watershed	42° 48' 39.5" N 124° 26' 43.3" W	Field Measurements: Water Temperature, Dissolved Oxygen, Salinity/Specific Conductivity, pH, Turbidity, and Depth	Seasonally to Quarterly (as staff and resources allow)	**Parameter:** Alkalinity **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic life **Status:** Insufficient data, potential concern **Parameter:** Ammonia **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic life **Status:** Attaining some criteria/uses **Parameter:** Biological Criteria **Season:** Year Round **Listed** :2010 **Beneficial Use(s):** Aquatic Life **Status:** Water quality limited, 303(d) list, TMDL needed **Parameter:** Chloride **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Aquatic Life **Status:** Insufficient data **Parameter:** Chlorophyll a **Season:** Fall, Winter, Spring; Summer **Listed**: 2004 **Beneficial Use(s):** Fishing; Aesthetics; Livestock watering; Water supply; Water contact recreation **Status:** Insufficient data; Attaining some criteria/uses (Summer) **Parameter:** Dissolved Oxygen **Season:** Year Round (Non-spawning); Oct. 15 to May15 **Listed**: 2010; 2004 **Beneficial Use(s):** Cold-water aquatic life; Salmon and steelhead spawning **Status:** Water quality limited, 303(d) listed, TMDL needed. **Parameter:** E.Coli **Season:** Year Around **Listed**: 2004 **Beneficial Use(s):** Water contact recreation **Status:** Attaining some criteria/uses **Parameter:** Fecal Coliform **Season:** Year Around **Listed**: 1998 **Beneficial Use(s):** Water contact recreation **Status:** Attaining some criteria/uses **Parameter:** pH **Season:** Year Round **Listed**: 2004 **Beneficial Use(s):** Water contact recreation; Salmonid fish spawning; Resident fish and aquatic life; Anadromous fish passage; Salmonid fish rearing **Status:** Attaining some criteria/uses **Parameter:** Sedimentation **Season:** Undefined **Listed**: 1998 **Beneficial Use(s):** Salmonid fish rearing; Salmonid fish spawning; Resident fish and aquatic life **Status:** Insufficient data **Parameter:** Temperature **Season:** Year Round (Non-spawning) **Listed**: 2004 **Beneficial Use(s):** Salmon and trout rearing and migration **Status:** Water quality limited, 303(d) list, TMDL needed.
		Laboratory: Bacteria (*e.coli*)		
		Laboratory: Nutrients (TN and TP), Chlorophyll, Basic Habitat Information, and Macroinvertebrates		

Parameter Monitored	Reporting Limit	Source
Dissolved Oxygen (Ocean Waters)	No measurable reduction allowed	OAR 340-041-0016
Dissolved Oxygen (Estuarine Waters)	<6.5 mg/L	OAR 340-041-0016
Dissolved Oxygen (Cold Waters)	<8.0 mg/L 30 day mean min; <6.5 mg/L seven-day min mean; <6.0 mg/L absolute min	OAR 340-041-0016
Dissolved Oxygen (Cool Waters)	<6.5 mg/L 30 day mean min; <5.0 mg/L seven-day min mean; <4.0 mg/L absolute min	OAR 340-041-0016
Dissolved Oxygen (Warm Waters)	<5.5 mg/L 30 day mean min; <4.0 mg/L absolute min	OAR 340-041-0016
pH (Marine Waters)	May not fall outside of 7.0-8.5 range	OAR 340-041-0021
pH (Estuarine and Fresh Waters)	May not fall outside of 6.5-8.5 range	OAR 340-041-0021
Total Phosphorus (Streams)	>100 µg/L	USEPA
Total Phosphorus (Streams that enter lakes/reservoirs)	>50 µg/L	USEPA
Total Phosphorus (Lakes/reservoirs)	>25 µg/L	USEPA
Ammonia* (Salmonid Species Present)	May not fall outside 0.27mg/L- 33 mg/L once every 3 years depending on pH, temperature, and salinity	OAR 340-041-8033
Total Nitrogen (Marine Waters)	>0.20 mg/L	Commonwealth of the Northern Mariana Islands Water Quality Standards
Total Nitrogen (Fresh Waters)	>0.75 mg/L	Commonwealth of the Northern Mariana Islands Water Quality Standards
Chlorophyll a (Lakes with Thermal Stratification)	>0.01 mg/L	OAR 340-041-0019
Chlorophyll a (Lakes without Thermal Stratification, Reservoirs, Rivers, and Estuaries)	>0.015 mg/L	OAR 340-041-0019
Temperature (Salmon and Trout Rearing and Migration: Year Round)	>18° C (64.4 °F) seven-day avg. max temp	OAR 340-041-0028
Temperature (Salmon Habitat: Healthy Adult)	May not fall outside of 7.2-15.6 °C (>25 °C Lethal)	OWEB Water Quality Technical Manual
Temperature (Salmon Habitat: Healthy Juvenile)	12.2-13.9°C (>25 °C Lethal)	OWEB Water Quality Technical Manual
Turbidity	>10 FNU	DEQ WQS Turbidity Technical Review
Macroinvertebrates	IBI <20	Karr 1998
Bacteria (Enterococcus) Fresh and Marine Waters	70 CFU or 70 MPN per 100ml of water	EPA-823-B-14-001
Bacteria (E.coli) Marine Waters	235 CFU or 235 MPN per 100 ml of water	EPA-823-B-14-001
Basic Habitat Information	Proper Functioning Condition Rates as Non-functioning	Riparian Area Management TR 1737-15 1998
Salinity/Specific Conductivity	<150 µS/cm	OWEB Water Quality Technical Manual
Depth	N/A	N/A
HAB's (Anatoxin-A)	20 µg/L	OHA PHD Office of Environmental Public Health

HAB's (Cylindrospermopsin)	6 µg/L	OHA PHD Office of Environmental Public Health
HAB's (Saxitoxin)	100 µg/L	OHA PHD Office of Environmental Public Health
HAB's (Microcystin)	10 µg/L	OHA PHD Office of Environmental Public Health

* Ammonia Acute Criteria Values are pH, temperature, and salinity dependent; using the following formula found at: http://www.deq.state.or.us/wq/standards/docs/tables303140.pdf

A.4 Quality Objectives & Performance Measurement Criteria

Collecting high quality data is one of the most important goals of the Tribes' IWQMP.

Specific Quality Assurance (QA) objectives of this program are:

- Collect a sufficient number of samples, sample duplicates, and field blanks to evaluate the sampling and measurement error.
- Analyze a sufficient number of Quality Control (QC) standards, blanks and duplicate samples in the laboratory environment to effectively evaluate results against numerical QA goals established for precision and accuracy.
- Implement sampling techniques in such a manner that the analytical results are representative of the media and conditions being sampled.

The following Data Quality Indicators describe the quality of the data required to satisfy the goals and objectives of this project and is assessed by the following QA/QC parameters:

a) Precision
b) Accuracy/Bias
c) Sensitivity
d) Representativeness
e) Comparability
f) Completeness

A4.a Precision

Precision shall be estimated by measuring the variability of duplicate measurements. The best estimate of precision for the overall monitoring program is the comparison of duplicate samples collected in the field. The variability in the results obtained from field duplicate samples is the sum of the sampling and analytical variability (measurement uncertainty).

In general, the control limit for duplicate samples collected in the field are:

- +/- 20% Relative Percent Difference (RPD) for samples >5 times the Limit of Quantitation (LOQ) or +/- the LOQ for the difference between replicates when the concentrations are <5 times the LOQ.

Field Duplicates will be collected at a frequency of one per sampling expedition -or- one every 10% of samples, whichever is more.

- Duplicate samples should be collected as discrete samples.
- Field duplicates must be collected within 15 minutes and 15 meters of each other, where the sample matrix is assumed to be homogeneous.
- If it is determined the field duplicate data is heterogeneous within a fifteen minute period or fifteen foot radius, the data users should use their professional judgment to determine if other project data meets their data quality needs.

A4.b Accuracy/Bias

Accuracy is a measure of the error between reported test results and the true sample concentration. It shall be estimated by measuring the bias of Measurement Error, even though bias is due to both systematic error in sampling and measurement variability.

Systematic error attributable to sampling design shall be minimized and be considered acceptable by the following procedures. All instruments shall be calibrated using NIST traceable standards. Accuracy of the analytical systems will be checked using appropriate calibration standards or certified reference materials.

- The accuracy of these materials is to be documented and maintained by CTCLUSI personnel. The instrument's response to calibration standard or the certified reference material shall also be documented and fall within the method control limits. Prior to deployment or sample processing, no sooner than one hour, the equipment will be verified with standard or calibration solutions.

A4.c Sensitivity

Laboratory blank samples will be processed at a minimum of one per daily batch of field samples. Lab blanks and field duplicates will be used to assess sample handling contamination and method variation.

- Laboratory blanks will use the same distilled water that is used to dilute the samples.
- Laboratory blanks will be produced prior to field work

Method detection limits will be determined for all applicable analyses according to procedures described in 40 CFR part 136.

- Reporting limits will be established at a concentration above the detection limit by the laboratory based on their experience with similar samples.

A4.d Representativeness

Representativeness is a qualitative term that expresses the degree to which data accurately and precisely denote a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Representativeness of the field data will be assessed by verifying that the sampling program was implemented as proposed, and that proper sampling techniques were used.

The assessment of representativeness in the laboratory will consist of verifying that the proper analytical procedures and appropriate methods were used.

- Sampling procedures are designed so that results are representative of the matrix being sampled.
- Sample handling protocols for storage preservation and transportation have been developed to preserve the representativeness of the collected samples.
- Proper documentation will establish that protocols have been followed and sample identification and sample integrity assured.

The location of the sample collection will be referenced by latitude and longitude using a GPS. Continuous measurements and discrete samples will be collected where the water is well mixed and representative of ambient conditions.

Quality analytical measurements with poor field duplicate precision may point to sampling problems or heterogeneous samples and thus the samples may not be representative of ambient conditions. Data with poor field duplication will be evaluated with respect to representativeness as well as precision.

A4.e Comparability

To ensure data will be comparable to similar environmental data, CTCLUSI personnel will use documented procedures for sampling, sample handling, and sample analysis, which are written to comply with nationally acceptable methods.

This monitoring program will ensure comparability by following standardized sampling protocols and procedures developed by CTCLUSI for continuous and discrete water quality monitoring. These protocols and procedures will be modeled from other agencies that perform water quality monitoring.

Certain conditions may prohibit the use of a standard protocol as it is intended. Experience and knowledge will aid in the choosing the field methods employed.

- The observations of fouling, environmental conditions (garbage or spills), and weather conditions are recorded in the field notes to enhance data or explain variability.

Continuous monitoring comparability will include placing the retrieved, pre-deployed (calibrated) and calibrated handheld (EXO 1) sondes in a bucket with water from near to the sonde site and allowing all sondes to take a reading. Following the sonde reading, the retrieved, pre-deployed and handheld sonde data is compared.

A4.f Completeness

The monitoring strategy for this IWQMP is to collect continuous data at 15 minute intervals throughout the year, seasonal temperature sampling intervals are at 15 minutes, and discrete samples monthly (at most sites), unless unanticipated weather-related events, staffing, or equipment failure prevent sampling.

A.5 Special Training and Certification

Training is required for new staff or individuals who are not familiar with the equipment or procedures. For those unfamiliar with the equipment being used, training will include an introduction for all monitoring equipment employed for the IWQMP. Training will be provided or arranged by trained Water Protection staff or the Director. The training may be provided by ODEQ, SWMP, YSI personnel or other trained water quality monitoring professionals. The Director may determine that additional staff or volunteers are needed to assist with the monitoring program. The Director will be responsible to ensure that proper training and direction is provided to meet the projects data quality objectives.

Director: The Director has experience and education relevant to implementing Tribal Environmental Programs and providing oversight for these programs.

Water Protection Staff: Staff has received a college degree in Biology, Environmental Science or similar field. Staff has experience in biological or environmental monitoring, Tribal environmental programs, ecological assessments, or other environmental research.

A.6 Documentation and Records

A signed copy of the Tribes' EPA-Approved IWQMP QAPP will be distributed to all Water Protection staff and the Director.

The Natural Resources Program will maintain the original records used to report the data. Records shall be organized such that a data value can be traced back to the original observation.

All hand written data/observations collected in the field and laboratory will be documented on either weatherproof field books or field data sheets if water damage is a threat. Examples of the datasheets to be used for the project are attached (Attachment C). Additional data sheets or modifications to existing data sheets may take place to meet project goals. The datasheets will be archived following data collection and data will be incorporated into the existing water quality data into a spreadsheet file.

The Natural Resources Program will retain raw, completely unchanged data files for each sonde deployment; the secondary QAQC'd data files; all associated handwritten or digital calibration and field logs; and the metadata document accompanying the sonde datasets permanently stored on the Tribes' server.

All data stored in an Excel spreadsheet format will be quality control checked according to CTCLUSI protocols before being reported in the annual Water Quality Report and/or EPA's Water Quality Exchange (WQX).

One important part of data collection is creating the associated data documentation or metadata. CTCLUSI will produce an annual metadata document to accompany the monitoring data collected by this program.

Analytical reports and data generated by third party laboratories will be delivered to Water Protection Staff following completion. These data, including all QA/QC data results, will be delivered electronically and/or in paper form.

The contract laboratories must maintain an unequivocal link between the custody form, their archive database, and analytical reports.

Raw analytical data records must be maintained, which will include the following information: Date of analysis, analyst, identification of blanks, standards, and controls, archive/sample numbers, lot numbers, calculations, and associated information, detailed experimental observations, along with all instrument readings and final results.

B.1 Experimental Design (Sampling Process Design)

B1.a Sampling Sites and Sampling Types

The selected sampling sites and sampling frequency were chosen for their depiction of ambient water quality conditions in waters of or pertaining to Tribal lands. For sampling sites that are unable to be located on or next to a Tribal tract due to safety or access restrictions, a sampling site will be established that best represents the waters pertaining to the tract. Written permission will be obtained from the landowners prior to collecting water quality samples at locations that aren't on Tribal lands but pertain to them.

For sites that have access and sampling limitations, the Tribes' flat bottom boat will be used to access sampling sites to deploy and retrieve monitoring equipment.

HAB sampling sites will be chosen to characterize worst case conditions in an effort to pre-empt risks to Tribal and public health. Due to the mobile nature of algal blooms, sites will migrate. Staff will document locations of sampling sites with a GPS, and record landmarks in the field data sheet/logbook.

Continuous water monitoring will measure actual environmental conditions throughout the year at 15 minute intervals. Measurements will be collected where the water is well mixed and most representative of ambient conditions. All continuous monitoring sondes will remain submerged at low tides and at a fixed distance off the bottom (approximately 1 meter) to allow for tidal and flow amplitude measurements.

Discrete sampling will measure water quality parameters such as nutrients, chlorophyll a, macroinvertebrates, bacteria, and toxic algae in addition to DO, pH, water temperature, turbidity, salinity, specific conductivity and depth.

Seasonal temperature monitoring will commence May/June before higher temperatures and low water and will conclude in September after water temperatures have begun to drop. Seasonal sampling intervals will mirror continuous monitoring intervals.

Seasonal toxic algal monitoring will commence June/July during higher temperature influxes and will conclude in September after water temperatures have begun to drop. Seasonal sampling will be conducted monthly. Seasonal adjustments to toxic algal sampling will be determined by data review and technical staff consensus.

Seasonal macroinvertebrate and basic habitat information sampling will be conducted annually.

As part of the QAPP development, CTCLUSI has integrated sampling methods and standard operating procedures developed by other government agencies' monitoring water quality.

B1.b Sampling Network

The selected sites and sampling frequency were chosen for their depiction of ambient water quality conditions in waters of or pertaining to Tribal lands. The water conditions adjacent to Tribal lands most directly affect the Tribes; however, impacts to Tribal resources related to water quality are widespread. The Tribes have integrated their sampling network to provide the most benefit to Tribal members.

B1.c Locations and Sampling (includes Tables)

The IWQMP has identified nineteen water quality monitoring sites: nine estuarine sites, six beach sites, a stream site, a wetland site and two lake sites (see Table 1 & 2). Continuous and /or discrete samples of the previously listed ambient water quality (dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and physical (depth) parameters will be obtained by the implementation of YSI automated data loggers and/or the continued use of hand held meters. Hand grabs of water samples will be used to measure water bacteria, nutrients, chlorophyll, and toxic algae where applicable. Hand grab samples may also be used to measure turbidity when an YSI EXO 1 or 2 sonde equipped with a turbidity sensor is not available. Annual nutrient, macroinvertebrate, and habitat assessment data will be collected at stream, estuarine, and lake monitoring sites where applicable. Grab samples may also be taken for the purposes of measuring other parameters if a CTCLUSI SOP is developed and implemented that meets measurement performance criteria and/or is modeled from another monitoring program's current use protocol.

All sampling sites are located on or near tribal trust lands located on Central and Southern Oregon Coasts within Lane, Coos, and Curry Counties (See Maps 1-4). Sampling sites have been established in accordance to EPA's position on funding water

quality programs for Tribes. In a letter received by the Tribes from EPA dated August 25, 2003, the letter states *"For property that the United States holds in trust for the Tribe, otherwise known as tribal trust land, EPA's position is that the property has the status of an Indian reservation. The funds granted by EPA under section 106 of the CWA can be used to only fund water quality programs for reservation waters or to support activities that pertain to waters of the reservation."* **(Attachment A)** Any new tribal lands acquired after EPA approval of this QAPP will be covered under the most current EPA approved QAPP for water quality monitoring activities.

Project Parameters

As stated in EPA's *Final Guidance on Awards of Grants to Indian Tribes under Section 106 of the Clean Water Act*, EPA requires Tribes to report on the following nine water quality parameters:

1. Dissolved Oxygen
2. pH
3. Total Phosphorus
4. Total Nitrogen
5. Water Temperature
6. Turbidity
7. Macroinvertebrates
8. Bacteria (E. Coli and Fecal Coliform)
9. Basic Habitat Information

This QAPP includes monitoring protocols, quality assurances, and data management for all nine EPA required monitoring parameters. In addition, deployed YSI data loggers collect continuous data on salinity, specific conductivity, and water depth. Toxic algal blooms will also be monitored at sites that are expected to produce HAB's.

It is important to note that this water quality monitoring program is not designed or intended to answer every question regarding water quality conditions. The intent of this monitoring project is to provide data that will assist in directing future efforts and strategies to improve overall water quality conditions within the Tribes' Ancestral watersheds. The methods proposed within this QAPP are structured to provide an overall understanding of selected water quality conditions. For any parameters that stand out as a parameter of concern, a more comprehensive method, sampling frequency, and sampling duration may be developed to acquire a better understanding for the identified parameter of concern.

- Each site has been given a unique site identification name (see Tables 1-3). Under Site, ID the WQ denotes that the site is a water quality monitoring site. The letter **B**, **E**, **L**, **S**, or **W** identifies whether the site is a **B**each, **E**stuarine, **L**ake, **S**tream, or **W**etland monitoring site.

- Table 1 provides site information and the location for each **active** monitoring site under this QAPP. Estuarine monitoring sites are continuous data logging sites.

- Table 2 shows all **inactive** monitoring sites. These sites may have been active under previous EPA-approved QAPPs, but have been dropped due to access issues or poor sampling sites. Some of these identified sites are pending the fee to trust conversion with the U.S. Bureau of Indian Affairs.

- Table 3 provides information on the sampling site, method, and general comments for each active and inactive site.

Table 1. Active Tribal Water Quality Monitoring Sites, Locations, and EPA 303(d) Information (as of 12/31/2015)

Site ID	Tract	Site Type	BIA Tract Status	County	LAT & LONG (NAD 83/WGS 84 DATUM)	EPA 303 (d) Listing (source: www.deq.state.or.us)
WQE09	Hatch	Estuary	Trust	Lane	43° 58' 27" N 124° 04' 16" W	**Waterbody Name:** Siuslaw River, Cox Island, Siuslaw Watershed **Parameter:** Alkalinity; Year Round; River Mile 0 to 106; Listed 2004 **Parameter:** Ammonia; Year Round; River Mile 0 to 106; Listed 2004 **Parameter:** Biological Criteria; Year Round; River Mile 0 to 58.4; Listed 2010 **Parameter:** Chloride; Year Round; River Mile 0 to 106; Listed 2004 **Parameter:** Chlorophyll a; Fall, Winter, Spring; River Mile 5.7 to 105.9; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 5.7 to 105.9; Listed 2004 **Parameter:** Dissolved Oxygen; Year Round (Non-spawning); River mile 0 to 19.7; Listed 2004 **Parameter:** Fecal Coliform; Year Around; River Mile 5.7 to 105.9; Listed 2004 **Parameter:** Nutrients; Undefined; River Mile 5.7 to 105.9; Listed 1998 **Parameter:** pH; Year Round; River Mile 5.7 to 105.9; Listed 2004 **Parameter:** Phosphate Phosphorus; Summer; River Mile 0 to 106; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 5.7 to 105.9; Listed 1998 **Parameter:** Temperature; Year Round (Non-spawning; River Mile 0 to 106; Listed 2004
WQE12	Hatch	Estuary	Trust	Lane	43° 58' 40" N 124° 04' 48" W	**Waterbody Name:** North Fork Siuslaw River, Old Bridge Piling, Siuslaw Watershed **Parameter:** Sedimentation; Undefined; River Mile 0.4 to 27.3; Listed 1998 **Parameter:** Temperature; Year Round (Non-spawning); River Mile 0 to 27.3; Listed 2004
WQL18	Tenmile	Lake	Fee to Trust Process	Coos	43° 35' 59" N 124° 7' 34" W	**Waterbody Name:** North Tenmile Lake, Camp Easter Seals, Tenmile Lakes Watershed **Parameter:** Alkalinity; Year Round; River Mile 0 to 5; Listed 2004 **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** pH; Summer; River Mile 0 to 5; Listed 2004 **Parameter:** Phosphate Phosphorus; Summer; River Mile 0 to 5; Listed 2004 **Parameter:** Dissolved Oxygen; Year Round (Non-spawning); River Mile 0 to 5; Listed 2004 **Parameter:** Iron; Year Round; River Mile 0 to 5; Listed 2012 **Parameter:** Nutrients; Undefined; River Mile 0 to 5; Listed 1998 **Parameter:** Sedimentation: Undefined; River Mile 0 to 5; Listed 2010

Site ID	Tract	Site Type	BIA Tract Status	County	LAT & LONG (NAD 83/WGS 84 DATUM)	EPA 303 (d) Listing (source: www.deq.state.or.us)
WQE10	Wualach	Estuary	Trust	Coos	43° 24' 50" N 124° 16' 44" W	**Waterbody Name:** Lower Coos Bay, BLM Boat Ramp, Coos Watershed **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Fecal Coliform, Year Around, River Mile 0 to 12.3: Listed, 2004 **Parameter:** pH; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 7.8; Listed 1998
WQE02	Wualach	Estuary	Trust	Coos	43° 23' 39.19" N 124° 16' 49.42" W	**Waterbody Name:** Lower Coos Bay, Empire Docks, Coos Watershed **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Fecal Coliform, Year Around, River Mile 0 to 12.3, Listed, 2004 **Parameter:** pH; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 7.8; Listed 1998
WQB19	Baldich	Beach	Trust	Coos	TBD	**Waterbody Name:** Baldich Beach, Baldich, Coos Watershed **Adjacent Beach Parameter (Bastendorf):** Enterococcus; Year Around, River Mile 233.6 to 234.8; Listed, 2010 **Adjacent Beach Parameter (Sunset Bay):** Enterococcus; Year Around, River Mile 236.4 to 236.7; Listed, 2010

Site ID	Tract	Site Type	BIA Tract Status	County	LAT & LONG (NAD 83/WGS 84 DATUM)	EPA 303 (d) Listing (source: www.deq.state.or.us)
WQS07	Sixes River	Stream	Trust	Curry	42° 48' 39.5" N 124° 26' 43.3" W	**Waterbody Name:** Sixes River, Sixes Watershed **Parameter:** Alkalinity; Year Around; River Mile 0 to 17.7; Listed 2004 **Parameter:** Ammonia; Year Round; River Mile 0 to 30.1; Listed 2004 **Parameter:** Biological Criteria; Year Round; River Mile 0 to 15.1; Listed 2010 **Parameter:** Chloride; Year Round; River Mile 0 to 30.1; Listed 2004 **Parameter:** Chlorophyll a; Year Round; River Mile 0 to 30.1; Listed 2004 **Parameter:** Dissolved Oxygen; Year Round (Non-spawning)/Oct. 15 to May 15; River Mile 0 to 30.1/4.4 to 29.4; Listed 2010/2004 **Parameter:** E. Coli; Year Round; River Mile 0 to 30.1; Listed 2004 **Parameter:** Fecal Coliform; Year Round; River Mile 0 to 30.1; Listed 1998 **Parameter:** pH; Year Round; River Mile 0 to 30.1; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 30.1; Listed 1998 **Parameter:** Temperature; Year Round (Non-spawning); River Mile 0 to 30.1; Listed 2004

Table 2. Inactive Tribal Water Quality Monitoring Sites, Locations, and EPA 303(d) Information (as of 12/31/2015)

Site ID	Tract Name	Site Type	BIA Tract Status	County	LAT. & LONG. (NAD 83/WGS 84 DATUM)	EPA 303 (d) Listing (source: www.deq.state.or.us)
WQE01	Miluk Village	Estuary	Trust	Coos	43° 21' 34" N 124° 18' 42" W	**Waterbody Name:** Lower Coos Bay, Coos Watershed **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Fecal Coliform, Year Around, River Mile 0 to 12.3, Listed, 2004 **Parameter:** pH; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 7.8; Listed 1998
WQE03	Kentuck	Estuary	Reservation	Coos	43° 25' 51" N 124° 10' 24.3" W	**Waterbody Name:** Kentuck Slough, Coos Watershed **Parameter:** Dissolved Oxygen; Year Round; River Mile 0 to 2.2; Listed 2010 **Parameter:** E. Coli; Fall, Winter, Spring; River Mile 0 to 2.2; Listed 2010 **Parameter:** Fecal Coliform; Year Around; River Mile 0 to 2.2, Listed 1998 **Parameter:** Sedimentation; Undefined; River Mile 0 to 2.2; Listed 1998
WQEO4	KCBY	Estuary	Fee to Trust Process	Coos	43° 21' 11" N 121° 12' 37" W	**Waterbody Name:** Coalbank Slough, Coos Watershed **Parameter:** Fecal Coliform; Year Around; River Mile 0 to 0.5; Listed, 1998 **Parameter:** Manganese; Year Round; River Mile 0 to 0.5; Listed 2012
WQE05	Hatch	Estuary	Trust	Lane	43° 58' 38" N 124° 04' 47" W	**Waterbody Name:** North Fork Siuslaw River, Under Bridge, Siuslaw Watershed **Parameter:** Sedimentation; Undefined; River Mile 0.4 to 27.3; Listed 1998 **Parameter:** Temperature; Year Round (Non-spawning); River Mile 0 to 27.3; Listed 2004
WQL06	Munsel Lake	Lake	Fee to Trust Process	Lane	44° 00' 25" N 124° 04' 49" W	**Waterbody Name:** Munsel Lake, Siuslaw Watershed **Parameter:** No listing at time of sampling
WQW08	Hatch	Wetland	Trust	Lane	43° 58' 45" N 124° 04' 58" W	**Waterbody Name**: Hatch Wetland, Siuslaw Watershed **Parameter:** No listing at time of sampling

Site ID	Tract Name	Site Type	BIA Tract Status	County	LAT. & LONG. (NAD 83/WGS 84 DATUM)	EPA 303 (d) Listing (source: www.deq.state.or.us)
WQE11	Miluk Village	Estuary	Trust	Coos	43° 22' 29" N 124° 17' 50" W	**Waterbody Name:** Lower Coos Bay, Coos Watershed **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Fecal Coliform, Year Around, River Mile 0 to 12.3, Listed, 2004 **Parameter:** pH; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 7.8; Listed 1998
WQB13	Coos Head	Estuary	Fee to Trust Process	Coos	43° 21' 02" N 124° 20' 08" W	**Waterbody Name:** Lower Coos Bay, Coos Watershed **Parameter:** Ammonia; Year Round; River Mile 0 to 12.3; Listed 2004 **Parameter:** Chlorophyll a; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Fecal Coliform, Year Around, River Mile 0 to 12.3, Listed, 2004 **Parameter:** pH; Summer; River Mile 0 to 12.3; Listed 2004 **Parameter:** Sedimentation; Undefined; River Mile 0 to 7.8; Listed 1998
WQB14	Coos Head	Beach	Fee to Trust Process	Coos	43° 20' 25" N 124° 21' 14" W	**Waterbody Name:** Pacific Ocean **Parameter:** Enterococcus; Year Round; River Mile 233.6 to 234.8; Listed 2010
WQB15	Baldich	Beach	Pending Transfer	Coos	43° 20' 22" N 124° 22' 17" W	**Waterbody Name:** Pacific Ocean **Parameter:** No Listing at time of sampling
WQB16	Baldich	Beach	Pending Transfer	Coos	43° 20' 26" N 124° 22' 28" W	**Waterbody Name:** Pacific Ocean **Parameter:** No Listing at time of sampling
WQB17	Baldich	Beach	Pending Transfer	Coos	43° 20' 06" N 124° 22' 21" W	**Waterbody Name:** Pacific Ocean **Parameter:** No Listing at time of sampling

Table 3. Site Identification, Tract Name, Waterbody Name and Watershed, Parameters, Measurement/Method, Status, and Comments

SITE ID	TRACT NAME	WATERBODY NAME AND WATERSHED	MEASUREMENT/METHOD	Status*	COMMENTS
WQE01	Miluk Village	Lower Coos Bay/Coos Watershed	**Dissolved Oxygen**: % Saturation & mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Salinity**: psu/ YSI Probe	Inactive	Discrete sampling site.
WQE02	Wualach	Lower Coos Bay/Coos Watershed	**Dissolved Oxygen**: % Saturation & mg/L/ YSI Sonde **pH**: pH value/ YSI Sonde **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Sonde **Turbidity**: FNU/ YSI Sonde **Bacteria (E. Coli and Enterococcus):** MPN/ IDEXX **Salinity:** psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Depth:** m/ YSI Sonde	Active	Continuous data logger site.
WQE03	Kentuck	Kentuck Slough/ Coos Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Bacteria (E. Coli & Enterococcus):** MPN/IDEXX **Salinity**: psu/ YSI Probe	Inactive	Inactive site.

SITE ID	TRACT NAME	WATERBODY NAME AND WATERSHED	MEASUREMENT/METHOD	Status*	COMMENTS
WQE04	KCBY	Coalbank Slough/Coos Watershed	**Dissolved Oxygen**: % saturation &mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX **Salinity**: psu/ YSI Probe **Depth:** m/ YSI probe	Inactive	Inactive site.
WQE05	Hatch	North Fork Siuslaw River/Siuslaw Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Salinity**: psu/ YSI Probe	Inactive	Inactive. WQE12 has replaced this site.
WQL06	Munsel Lake	Munsel Lake/Siuslaw Watershed	**Dissolved Oxygen**: % saturation &mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX **Salinity**: psu/ YSI Probe **Depth:** m/ YSI probe	Inactive	Inactive site.

SITE ID	TRACT NAME	WATERBODY NAME AND WATERSHED	MEASUREMENT/METHOD	Status*	COMMENTS
WQS07	Sixes River	Sixes River/Sixes Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **pH**: pH value/ YSI Sonde **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Sonde **Turbidity**: NFU/ YSI Sonde **Macroinvertebrates:** D-Frame Net/ 500 Micron Mesh **Bacteria (E. Coli):** MPN/ IDEXX **Basic Habitat Information:** O/E Taxa Score **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde	Active	Discrete stream monitoring site.
WQW08	Hatch	Wetland/Siuslaw Watershed	**Dissolved Oxygen**: % saturation/ YSI Probe **pH**: pH value/ YSI Probe **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ YSI Probe **Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX **Salinity**: psu/ YSI Probe **Depth:** m /YSI Sensor	Inactive	Discrete wetland monitoring site. Poor sampling location.
WQE09	Hatch	Siuslaw River/Siuslaw Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **pH**: pH value/ YSI Sonde **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Sonde **Turbidity**: NFU/ YSI Sonde **Bacteria (E. Coli and Enterococcus):** MPN/ IDEXX **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Depth:** m/ YSI probe	Active	Continuous data logger site.

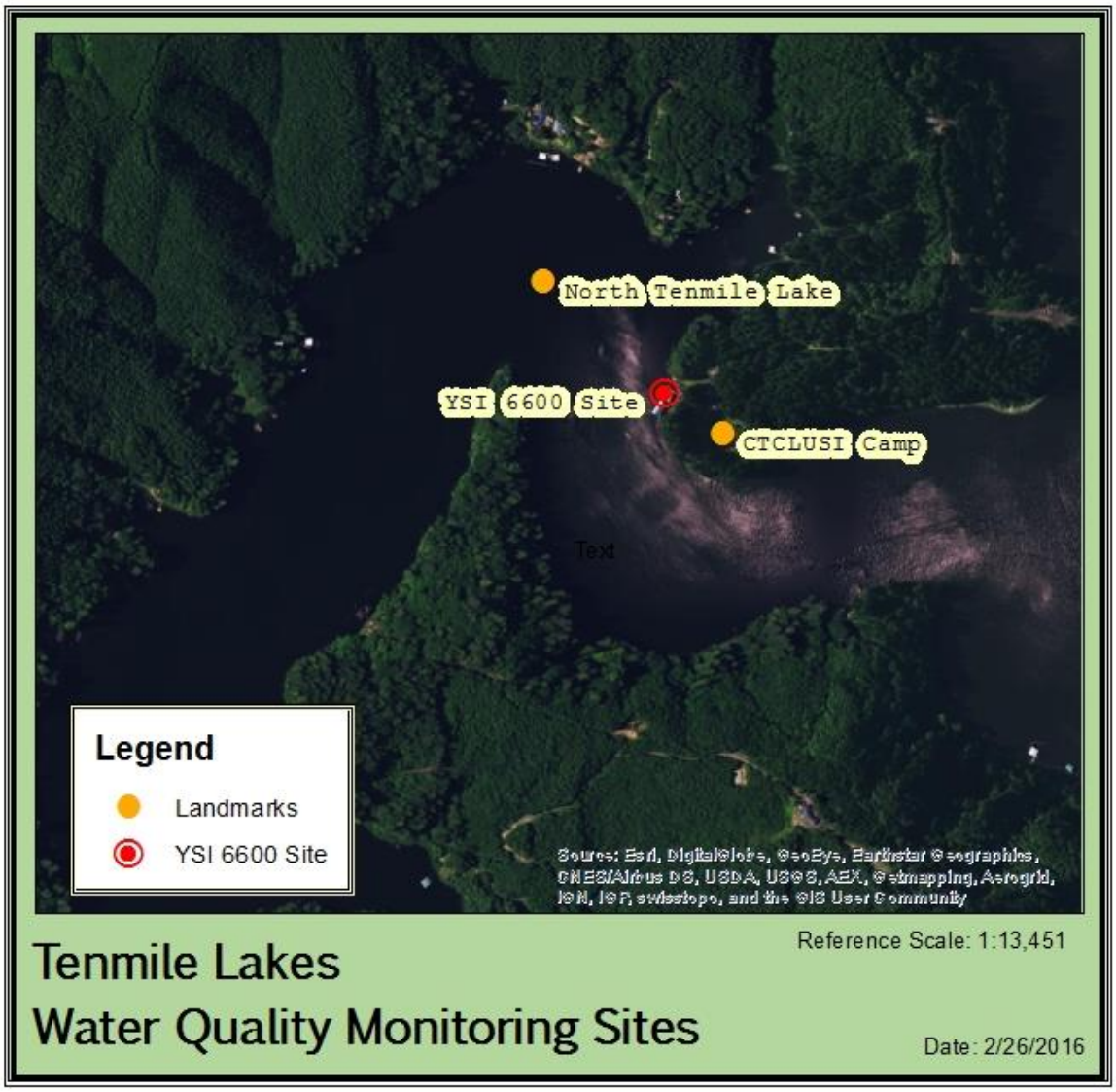
SITE ID	TRACT NAME	WATERBODY NAME AND WATERSHED	MEASUREMENT/METHOD	Status*	COMMENTS
WQE10	Wualach	Lower Coos Bay/Coos Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **pH**: pH value/ YSI Sonde **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SIOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Sonde **Bacteria (E. Coli and Enterococcus):** MPN/ IDEXX **Turbidity**: NFU/ YSI Sonde **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Depth:** m/ YSI probe	Active	Continuous data logger site.
WQE11	Miluk Village	Lower Coos Bay/Coos Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Probe **pH**: pH value/ YSI Probe **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Probe **Turbidity**: NFU/ Turbidimeter **Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX **Salinity**: NFU/ YSI Probe **Depth:** m/ YSI Sonde	Inactive	Inactive site.
WQE12	Hatch	North Fork Siuslaw River/Siuslaw Watershed	**Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **pH**: pH value/ YSI Sonde **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Water Temperature**: °C/ YSI Sonde **Turbidity**: NFU/ YSI Sonde **Bacteria (E. Coli and Enterococcus):** MPN/ IDEXX **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Depth:** m/ YSI Sonde	Active	Continuous data logger site.
WQB13	Coos Head	Coos Bay/Coos Watershed	**Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX	Inactive	Pending Fee to Trust Conversion.

SITE ID	TRACT NAME	WATERBODY NAME AND WATERSHED	MEASUREMENT/METHOD	Status*	COMMENTS
WQB14	Coos Head	Pacific Ocean/Coos Watershed	**Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX	Inactive	Pending Fee to Trust Conversion.
WQB15	Baldich	Pacific Ocean/Coos Watershed	**Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX	Inactive	Inactive site.
WQB16	Baldich	Pacific Ocean/Coos Watershed	**Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX	Inactive	Inactive site.
WQB17	Baldich	Pacific Ocean/Coos Watershed	**Bacteria (E. Coli & Enterococcus):** MPN/ IDEXX	Inactive	Inactive site.
WQL18	Tenmile	North Tenmile Lake/ Coos Watershed	**Water Temperature**: °C/ YSI Sonde **pH**: pH value/ YSI Sonde **Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **Turbidity**: NFU/ YSI Sonde **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Bacteria (E. Coli):** MPN/ IDEXX **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Depth:** m/ YSI Sonde **Toxic Algae:** Microcystins/ Hand Grabs	Active	Continuous data logger site pending Fee to Trust Conversion.
WQB19	Baldich	Baldich Beach/ Coos Watershed	**Water Temperature**: °C/ YSI Sonde **pH**: pH value/ YSI Sonde **Dissolved Oxygen**: % saturation & mg/L/ YSI Sonde **Turbidity**: NFU/ YSI Sonde **Salinity**: psu/ YSI Sonde **Specific Conductivity:** mS/cm/ YSI Sonde **Bacteria (Enterococcus):** MPN/ IDEXX **Nutrients:** TN (NO_3, NO_2, and NH4), TP (PO4), & $SiOH_4$/ University of Washington Lab **Chlorophyll:** CHLA/ Hand Grabs **Depth:** m/ YSI Sonde	Active	Discrete beach monitoring site.

WATER QUALITY MONITORING SITE MAPS

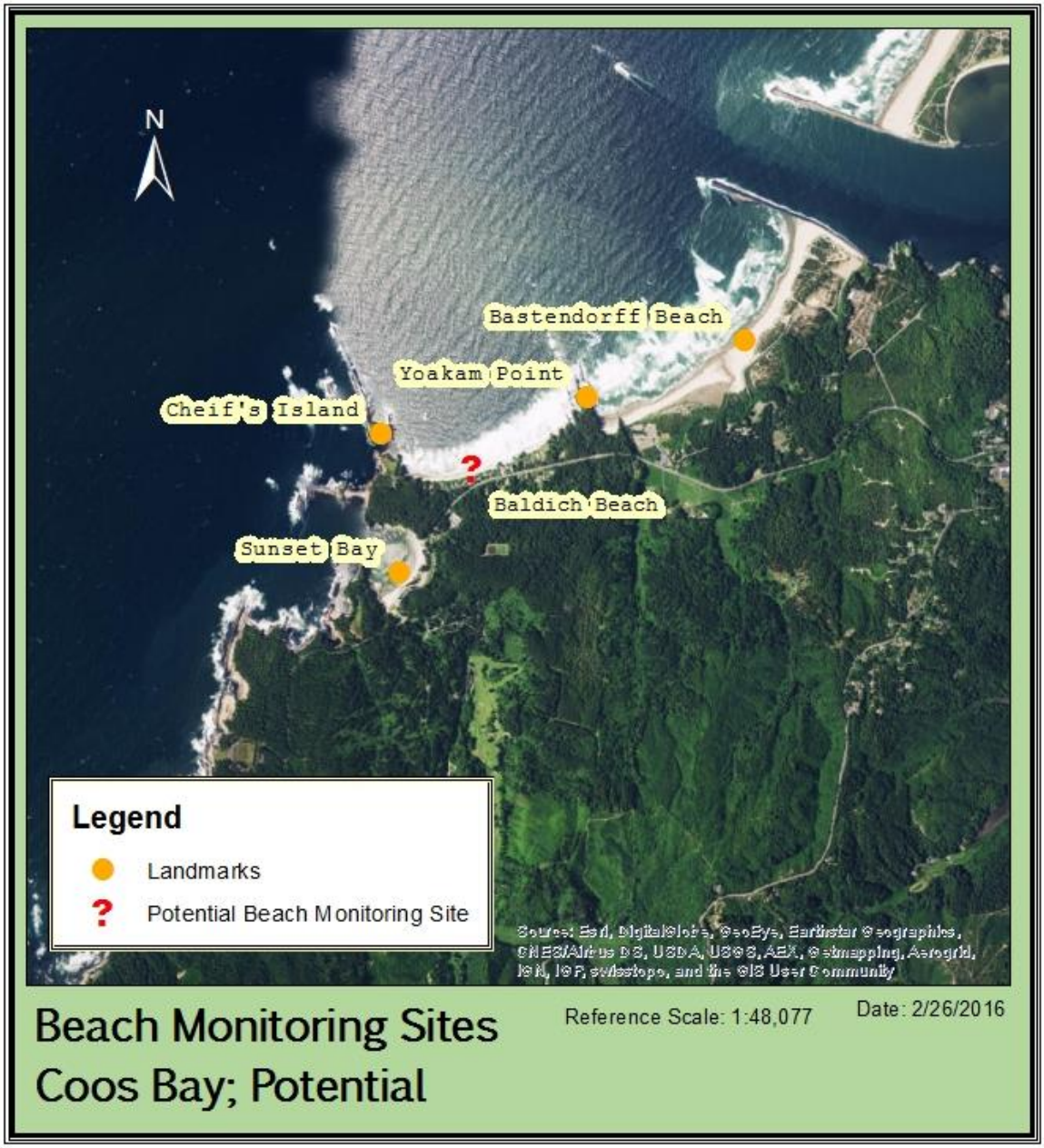
Map 1. Map of Siuslaw Watershed Monitoring Sites (near Florence, Oregon)

Map 2. Map of North Tenmile Lake Monitoring Sites (near Lakeside, Oregon)

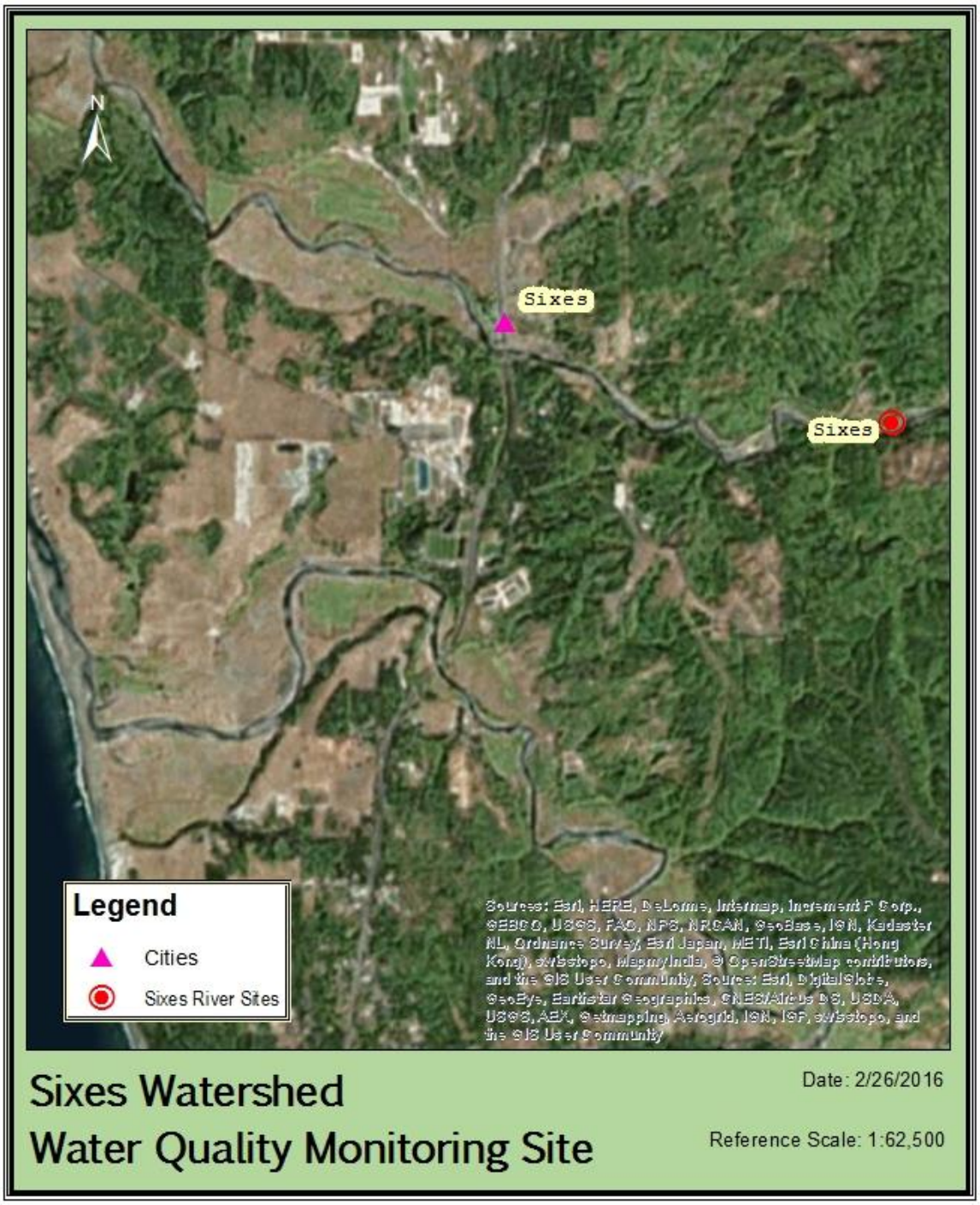


Map 3. Map of Coos Watershed Monitoring Sites (Coos Bay, Oregon)

Map 4. Map of Beach Monitoring Sites (near Charleston, Oregon)



Map 5. Map of Sixes Watershed Monitoring Site (Sixes Watershed, Oregon)



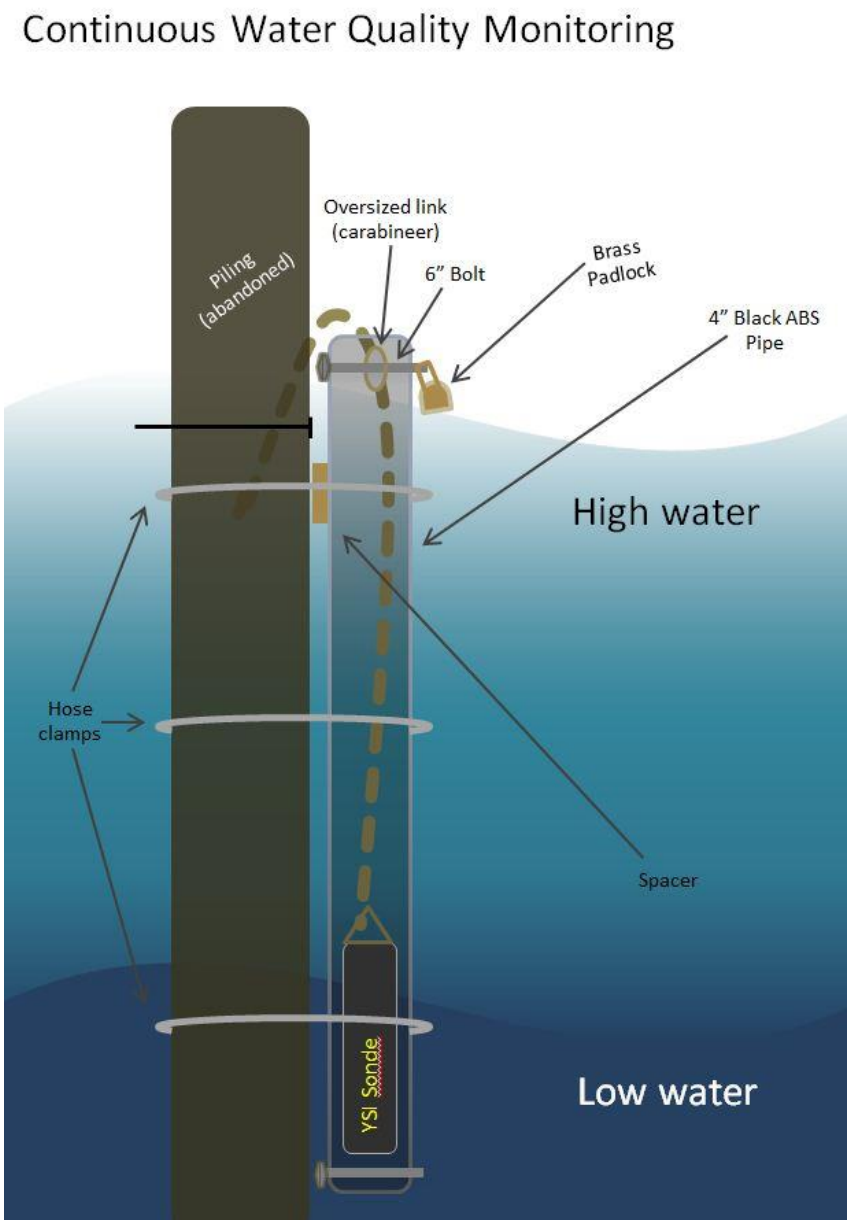
Estuarine Water Quality Monitoring Sites

Sites:
WQE02
WQE09
WQE10
WQE12

All YSI EXO2 Sonde Multi-Parameter Dataloggers for the monitoring project are programmed to record water quality parameters that include dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth. These parameters are indicative of general estuarine water column conditions and are often used by regulatory agencies to determine criteria for human uses. The YSI data loggers are programmed to collect water quality data at 15 minute intervals. Each data logger will be secured using a bracket structure to existing pilings that have been abandoned and are located outside of the main shipping channels. The brackets have been constructed based on the brackets constructed and deployed by South Slough National Estuarine Research Reserve (SSNERR, http://www.oregon.gov/DSL/SSNERR) water quality monitoring staff. Written approval will be obtained and placed in the project file prior to any data logger deployment on any private or public pilings.

As seen below, a 4” diameter ABS tube will be fastened to an existing piling. The data logger will then be attached to a chain and lowered to approximately 1 meter above the bottom of the sampling site. Holes will be drilled towards the bottom of the ABS pipe to ensure that the data logger is obtaining a representative sample of estuarine conditions. The ABS tube will then be capped and a stainless steel bolt will be driven through the chain and ABS. The bolt will be drilled out on the thread end and a brass lock will be fastened to the bolt to deter potential theft.

CTCLUSI YSI EXO2 Sonde Schematic:



Water quality protection staff will exchange the field YSI data logger with an office YSI calibrated data logger each month or earlier based on the rate of bio-fouling observed during the data logger retrieval process and/or weather conditions. Replacement YSI EXO2 Sonde dataloggers will be prepped and calibrated for rotations prior to each data logger's retrieval. YSI EXO2 Sondes deployed during the previous maintenance retrieval and deployment cycle will be replaced with the prepped and calibrated YSI EXO2 Sondes. The replacement process has been established to ensure data collection continuity and minimize staff field time. The retrieved YSI EXO2 Sonde will then be transported back to the office for data upload, equipment maintenance, and calibrations to prepare for the next day's field retrieval and deployment process.

Concurrent to YSI EXO2 Sonde retrievals and deployments, a calibrated YSI EXO Handheld (HH) will be used to conduct a data logger field audit. Audits will be completed as close to an YSI EXO2 Sonde 15-minute log cycle as possible. All audit data will be incorporated with existing water quality data for quality comparison.

Nutrient sampling will also be implemented at these sites. Grab samples will be taken at each monitoring site seasonally to quarterly, depending on staff availability and resources. Discrete data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will also be collected using an YSI Exo Hand-held during nutrient sampling. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis. In addition to seasonal/quarterly grab sampling, a diel sampling program may be implemented concurrent to nutrient grab sampling. If feasible, an ISCO 6712 autosampler may be deployed seasonally to quarterly at one or more of the estuarine sampling sites. The ISCO 6712 autosampler will be programmed to collect 1-L samples every 2.5 hours over a 25 hour tidal cycle. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis.

A water sample will be collected at each monitoring site once every month for an in-house bacterial analysis using IDEXX brand *Colilert -18* reagent and the IDEXX QuantiTray 2000 analytical system. Water samples of approximately 100ml (with adequate head-space for mixing), will be collected using disposable, pre-sterilized IDEXX sample bottles. All bacteria samples will be placed in a cooler on ice while in transport to the lab.

All water quality parameters may be monitored after extreme storm events and around possible anthropogenic inputs dependent on staff availability and resources.

Stream Water Quality Monitoring:

Site:
WQS07

Dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth data will be collected seasonally to quarterly once per month at the stream site using an YSI Exo Hand-held. A water sample will also be collected at each site for an in house bacterial analysis (*E. Coli*). Water samples of approximately 100ml (with adequate head-space for mixing), will be collected using disposable pre-sterilized IDEXX sample bottles. In addition, water bacteria samples may be taken from the stream monitoring site within 24 hours following an extreme storm event or around possible anthropogenic inputs, depending on staff availability and resources.

Calibrated and audited Hobo water temperature data loggers will be deployed from May through September and record data at 15 minute intervals. Data summaries will include season peak temperature, the seven day average maximum temperature, and the maximum daily change in temperature.

Quarterly/seasonal macroinvertebrate sampling, nutrient sampling, and aquatic habitat assessments will also be implemented at this site. At each stream reach, macroinvertebrate samples will be collected by compositing D-Frame Net kick samples

from a selected habitat unit (e.g. pools, riffles). Samples will be preserved in the field with ethanol. Subsampling the composite sample will be necessary since the composite usually contains far more material and macroinvertebrates than is desirable to process and identify. Sub sampling and identification will be performed by qualified contractors.

Grab samples for nutrients will be taken seasonally to quarterly, depending on staff availability and resources. Discrete data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will also be collected using an YSI Exo Hand-held during nutrient sampling. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis. If feasible, an ISCO 6712 autosampler may be deployed seasonally to quarterly at this site. The ISCO 6712 autosampler will be programmed to collect 1-L samples every 2.5 hours over a 25 hour cycle. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis.

Aquatic habitat surveys will be conducted using the ODFW protocol *Aquatic Inventories Project: Methods for Stream Habitat Surveys* (Moore, et al., 2004). Aquatic habitat survey areas will be split into reaches within each site and assigned a name. A map of aquatic habitat study reaches will be produced. Reach beginnings and endings will be determined by a number of factors including changes in habitat type, land-use changes, and access to private property.

All water quality parameters may be monitored after extreme storm events and around possible anthropogenic inputs depending on staff availability and resources.

Lake Water Quality Monitoring:

Site:
WQL18

Dissolved oxygen, pH, water temperature, salinity, specific conductivity, depth, and data will be collected at 15 minute intervals using an YSI 6600 data logger. The data logger will be secured using a bracket structure to an existing submerged structure in close proximity to the tract that remains submerged year-round at a fixed, accessible depth that is representative of lake conditions. The brackets have been constructed based on the brackets constructed and deployed by South Slough National Estuarine Research Reserve (SSNERR, http://www.oregon.gov/DSL/SSNERR) water quality monitoring staff. Turbidity samples will be collected using an YSI EXO Handheld equipped with a turbidity sensor. In the event that a probe must be deployed without an equipped turbidity sensor, turbidity data will be collected via grab samples for analysis using the Hach 2100-P Turbidimeter.

Concurrent to YSI 6600 datalogger retrievals and deployments, a calibrated YSI EXO Handheld (HH) will be used to conduct a data logger field audit. Audits will be completed as close to an YSI 6600 datalogger's 15-minute log cycle as possible. All audit data will be incorporated with existing water quality data for quality comparison

Grab samples for nutrients will be taken seasonally to quarterly, depending on staff availability and resources. Discrete data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will also be collected

using an YSI Exo Hand-held during nutrient sampling. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis. If feasible, an ISCO 6712 autosampler may be deployed seasonally to quarterly at this site. The ISCO 6712 autosampler will be programmed to collect 1-L samples every 2.5 hours over a 25 hour cycle. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis.

Year round monthly water samples will be collected at the same site for in house analysis of *E-Coli.* Water samples of approximately 100ml (with adequate head-space for mixing), will be collected using disposable pre-sterilized IDEXX sample bottles. In addition, water bacteria samples may be taken from the lake monitoring site within 24 hours following an extreme storm event or around possible anthropogenic inputs, depending on staff availability and resources.

Toxic algal samples will be collected at sites where visual assessment or recreational risk deems thus. Samples will be collected spring through fall when risks to public health are the highest. 1L samples will be collected using wide mouth, sterilized Nalgene bottles. Samples will be sent to an outside lab for analysis. Abraxis Microcystins Strip Kits will be used to assess immediate risk prior to Tribal recreational events.

All water quality parameters may be monitored after extreme storm events and around possible anthropogenic inputs depending on staff availability and resources. In addition, HAB samples may be taken from the lake within 24 hours of a major weather event or around possible anthropogenic inputs, depending on staff availability and resources.

Beach Water Quality Monitoring:

Sites:
WQB19

Grab samples for nutrients will be taken seasonally to quarterly, depending on staff availability and resources at beach sites. Discrete data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will also be collected using an YSI Exo Hand-held during nutrient sampling. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis. If feasible, an ISCO 6712 autosampler may be deployed seasonally to quarterly at this site. The ISCO 6712 autosampler will be programmed to collect 1-L samples every 2.5 hours over a 25 hour tidal cycle. After samples are collected, they will be filtered into 50ml sample bottles, frozen, and sent to an outside lab for analysis.

Monthly water samples will be collected for in house analysis of *enterococcus.* Microbiological analysis of water samples collected at these sites will assist with the assessment of potential bacterial contamination or impacts to Tribal waters. Microbiological analysis will be conducted using IDEXX brand *Enterolert* reagent and the IDEXX Quanti-Tray 2000 analytical system. Dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, depth, data will be collected monthly at beach sites using a YSI Exo Hand-held to help interpret results or modify the sampling design.

Water samples of approximately 100ml (with adequate head-space for mixing), will be collected using disposable, pre-sterilized Idexx sample bottles. Once samples are

collected, they will be placed on ice in a cooler for transport back to CTCLUSI's in house lab facilities. Field duplicates (minimum 50% frequency) and sterile water transfer blanks will be processed on every beach monitoring sampling event.

All water quality parameters may be monitored after extreme storm events and around possible anthropogenic inputs depending on staff availability and resources.

B1.d Measured Parameter and Associated Equipment

The following are the water quality parameters and manufacturer's specifications for the equipment to be used for the project. For sampling sites that are found to have water quality impairments that are approaching or exceeding current water quality standards, a more comprehensive and precise monitoring strategy will be developed to better capture the magnitude of the impairment/s. For sampling sites that are found to have HABs, sites will be monitored for toxins. If levels are exceeded, Tribal water recreation activities will be cancelled and the Oregon Public Health Department will be notified.

Dissolved Oxygen

Dissolved oxygen serves as an indicator of the biological health of a water body. Dissolved oxygen concentrations vary naturally with water temperature and altitude. If more oxygen is consumed than is produced, and oxygen levels drop below their natural levels, some sensitive animals may weaken, move away, or die. Dissolved oxygen levels are affected by changes in water temperature and levels of organic materials. Changes in water temperature can occur as a result of thermal discharges from manufacturing or power plants, reduction of riparian shade, or sedimentation. Industrial, municipal wastes and algal blooms can raise levels of organic materials.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

At selected sites, dissolved oxygen data will be collected using an YSI EXO2 Sonde equipped with a dissolved oxygen sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications of this sensor are acceptable for the project.

YSI EXO2 Dissolved Oxygen Sensor Specifications (source: www.ysi.com)

Optical Dissolved Oxygen % Saturation:	NA
Range:	0 to 500%
Accuracy:	0 to 200% : ± 1% of the reading or 1% air saturation; whichever is greater; 200 to 500% air saturation, ± 5% of the reading
Resolution:	0.1%
Optical Dissolved Oxygen (mg/L):	NA
Range:	0 to 50 mg/L
Accuracy:	0 to 20 mg/L: ± 0.1 mg/L or 1% of the reading, whichever is greater; 20 to 50 mg/L:± 5% of the reading
Resolution:	0.01 mg/L

YSI EXO Handheld (HH) (discrete sampling)

At selected sites, dissolved oxygen data will be collected using an YSI EXO1 probe. Dissolved oxygen data collected from the YSI EXO2 Sonde will also be audited using the YSI EXO1 probe. The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI EXO1 Dissolved Oxygen Sensor Specifications (source: www.ysi.com)

Optical Dissolved Oxygen % Saturation:	NA
Range:	0 to 500%
Accuracy:	0 to 200% : ± 1% of the reading or 1% air saturation; whichever is greater; 200 to 500% air saturation, ± 5% of the reading
Resolution:	0.1%
Optical Dissolved Oxygen (mg/L):	NA
Range:	0 to 50 mg/L
Accuracy:	0 to 20 mg/L: ± 0.1 mg/L or 1% of the reading, whichever is greater; 20 to 50 mg/L:± 5% of the reading
Resolution:	0.01 mg/L

Water pH

pH is a measurement of water acidity. pH affects many chemical and biological processes in the water. Most aquatic animals prefer a pH range of 6.5 - 8.0. pH outside of this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also cause conditions that are toxic to aquatic life by allowing toxic elements and compounds to become mobile. Changes in pH can be caused by acid rain, mining activities, and wastewater discharge.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

At selected sites, water pH will be collected using an YSI EXO2 Sonde equipped with a pH sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications for this sensor are acceptable for the project.

YSI EXO2 pH Sensor Specifications (source: www.ysi.com)

Range:	0 to 14 units
Accuracy:	±0.1 units w/in ±10°Cof calibration temp; ±0.2 pH units for entire temp range
Resolution:	0.01 units

YSI EXO Handheld (HH) (discrete sampling)

At selected sites, pH data will be collected using an YSI EXO1 probe. Water pH data collected from the YSI EXO2 Sonde will also be audited using an YSI EXO1 probe. The

manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI EXO1 pH Sensor Specifications (source: www.ysi.com)

Range:	0 to 14 units
Accuracy:	±0.1 units w/in ±10°Cof calibration temp; ±0.2 pH units for entire temp range
Resolution:	0.01 units

Nutrients and Chlorophyll

Phosphorus is an essential nutrient for plants and animals, which is why it is often an ingredient in fertilizers. Because it is naturally in short supply (i.e., the “limiting nutrient”) in most fresh water bodies, even small increases in phosphorus can cause undesirable consequences, such as algae blooms, accelerated plant growth, and low dissolved oxygen (decomposition of additional vegetation will consume more oxygen). Phosphorus is considered limiting in most fresh water systems because it is not as abundant as carbon and nitrogen, which are available in the atmosphere. Sources of phosphorus include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and croplands, runoff from animal manure storage areas, disturbed land areas, drained wetlands, water treatment, decomposition of organic matter, and commercial cleaning preparations.

Plants and animals need nitrogen, but excess nitrogen can cause low levels of dissolved oxygen and alter the types of plants and animals in the water body. The forms of nitrogen most commonly found in water are ammonia, nitrates, and nitrites. Sources include wastewater treatment plants, runoff from fertilized lawns and croplands, failing septic systems, runoff from animal manure and storage areas, and industrial discharges that contain corrosion inhibitors. Total nitrogen may be measured using kits, probes, or meters, or by using a contract laboratory. Total nitrogen is the sum of total kjeldahl nitrogen TKN, which is the sum of organic nitrogen and ammonia, nitrate and nitrite. Total N can be derived by monitoring for TKN, nitrate, and nitrite individually and adding the components together, but you can also measure total nitrogen directly using kits readily available on the market. The main objective of nutrient monitoring will be to determine whether nutrient concentrations are driven by tidal fluctuations, oceanic forcing, or watershed inputs. Understanding the seasonal and tidal dynamics of nitrogen and phosphorus concentrations is particularly important because high levels of these nutrients can lead to over-enrichment and problems associated with eutrophication. Water quality data chronicles essential baseline information and improves our understanding of tidal dynamics and watershed inputs. Adding nutrients to our framework of water quality parameters provides a second tier of factors that will ultimately afford better capability to characterize how Tribal stream, estuarine, and coastal systems function.

Chlorophyll a: Estuarine phytoplankton are a major source of autotrophic primary production in the open water habitat estuarine sites monitored by our program. Assemblages of estuarine phytoplankton are influenced seasonally and spatially by variations in ocean forcing, nutrient availability, solar energy, and riverine inputs. The

typical succession pattern in Pacific Northwest estuaries begins with low densities of phytoplankton in late fall and winter (due to reduced light and high turbidity), followed by a bloom of small diatoms in late winter/early spring. The diatom blooms usually terminate in late spring when nitrogen sources are depleted. Phytoplankton densities remain low in the summer months when nutrient availability is low and grazing pressure is high (Karentz and McIntire, 1977); Pequegnat and Butler, 1982; Nybakken, 1993). Relatively high concentrations of chlorophyll measured throughout the summer suggest that nutrient availability in the marine-dominated region of the estuary may be pulsed and tightly linked to seasonal upwelling in summer (Cowlishaw, 2001).

CTCLUSI Nutrient Sampling Procedure

Semi-annual/quarterly discrete and/or continuous (diel) sampling will enhance our understanding of nutrient and phytopigment concentrations within estuaries and rivers monitored by our program, and help determine whether nutrient inputs are delivered by the ocean or freshwater systems.

Samples collected at or near sites equipped with YSI dataloggers will be reflective of the water mass sampled by the datasonde. Any fluctuations in nutrient levels in response to meteorological events and/or seasonal ocean conditions will also be evident.

Collecting samples through a diel cycle will highlight any fluctuations in nutrient and phytopigment loads as a function of tidal forcing at our estuarine sampling sites. The levels of nutrients and phytopigments at different tidal stages should determine the impact of ocean versus freshwater input. Offshore upwelling is a significant contributor to nutrient mixing in the Lower Columbian Bioregion and is responsible for high levels of biotic productivity. This phenomenon is also believed to be correlated with hypoxic conditions that periodically occur off the Oregon Coast.

CTCLUSI does not have a way to accurately measure nutrients or chlorophyll in house; therefore, samples will be collected and sent to the University of Washington Marine Chemistry Laboratory for analysis.

University of Washington Marine Chemistry Laboratory Accreditation Codes and Detection Limits

Analysis	Method References	EPA/SM#	NELAC Code	Detection_Limits
PO_4	UNESCO(1994)	EPA 365.5_1.4_1997	WM920270	0.03uM*, 0.0009mg/L
$SiOH_4$	UNESCO(1994)	EPA 366	WM920240	0.59uM, 0.0166mg/L
NO_3	UNESCO(1994)	EPA 353.4_2_199	10068209	0.15uM, 0.0021mg/L
NO_2	UNESCO(1994)	EPA 353.4_2_1997	10068209	0.02uM, 0.0003mg/L

Analysis	Method References	EPA/SM#	NELAC Code	Detection_Limits
NH_4	UNESCO(1994)	EPA 349	WM920220	0.12uM, 0.0017mg/L
Total N	Valderrama(1981)	SM 4500-P J	WM920270	0.44uM, 0.0062mg/L
Total P	Valderrama(1981)	SM 4500-P J	WM920270	0.04uM, 0.0011mg/L
Salinity	UNESCO(1994)	SM 2520 B-93	20040055	0.002PSU
Chlorophyll_a	UNESCO(1994)	EPA 445	WM100080	0.02ug/L
DOC	UNESCO(1994)	SM 5310 B-00	20137819	100ug/L
POC	UNESCO(1994)	EPA 440.0	10081206	10ug
PN	UNESCO(1994)	EPA 440.0	10081206	1ug
Dissolved O_2	UNESCO(1994)	EPA 360.2	50001600	0.5uM kg^{-1}

* µM (micromolar or 10^{-6} moles per liter)- amount of solute per unit volume of solution

Water Temperature

Temperature affects dissolved oxygen levels. Rates of photosynthesis of aquatic plants, metabolic rates of aquatic organisms, and sensitivity of aquatic organisms to toxic wastes, parasites, HABs, and diseases are also affected by temperature. Optimal temperature ranges depend on the species present in the water body. If temperatures are outside the optimal range for the species in a water body for extended periods of time, organisms will be stressed and may die. For fish, there are two kinds of limiting temperatures — the maximum temperature for short exposures and a weekly average temperature that may vary by time of year and life cycle stage. Reproductive stages are the most sensitive to temperature changes. Causes of temperature change include weather, removal of riparian shade, dams and other barriers that confine water bodies, industrial discharges, and storm-water runoff.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

Water temperature data will be collected at selected sites using an YSI EXO2 Sonde equipped with a conductivity/temperature sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications of this sensor are acceptable for the project.

YSI EXO2 Conductivity/Temperature Sensor Specifications (source: www.ysi.com)

Range:	-5 to 35°C; 35 to 50°C
Accuracy:	± 0.0.1°C; ± 0.0.5°C:
Resolution:	0.001°C

YSI EXO Handheld (HH) (discrete sampling)

At selected sites, water temperature data will be collected using an YSI EXO1 probe. Water temperature data will also be collected from a calibrated YSI EXO1 probe to audit YSI EXO2 Sonde data. The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI EXO1 Conductivity/Temperature Sensor Specifications (source: www.ysi.com)

Range:	-5 to 35°C; 35 to 50°C
Accuracy:	± 0.0.1°C; ± 0.0.5°C:
Resolution:	0.001°C

HOBO Water Temperature Pro V2 Datalogger (May-September Only)

Water temperature will be measured using temperature data loggers at selected active sites during the months of May-September. The manufacturer has determined accuracy and precision of these data loggers. The specifications of these data loggers are acceptable for the project.

HOBO Water Temperature Pro V2 Datalogger Specifications (source: www.onsetcomp.com)

Range:	-40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water
Accuracy:	±0.21°C from 0° to 50°C (±0.38°F from 32° to 122°F)
Resolution:	0.02°C at 25°C (0.04°F at 77°F)

Eutechnics Model 4400 NIST Traceable Digital Thermometer

Water temperature audits will be conducted using a NIST traceable digital thermometer when an YSI EXO or 6-series sonde is unavailable. The manufacture has determined the accuracy and precision of the digital thermometer. The specifications of this digital thermometer are acceptable for the project. Eutechnics Model 4400 Digital Thermometer specifications can be found at:
http://www.alphatechnics.com/products/precisionthermometers/Model_4400_Thermometer.pdf

Turbidity

Turbidity measures the clarity of a water body. It is closely related to erosion and sediment that carry nutrients and bacteria into streams and lakes. Suspended particles absorb more heat, raising water temperature, which in turn affects the oxygen level of a water. When sediments eventually settle to the bottom of water bodies, suspended materials can clog fish gills, and smother fish eggs and macroinvertebrates. Sediment can also change the physical structure and hydrology of habitats. Causes of high turbidity include soil erosion, wastewater discharge, urban runoff, farming and forestry practices, and excessive algae growth.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

Water turbidity data will be collected at selected sites using an YSI EXO2 Sonde equipped with a turbidity sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications of this sensor are acceptable for the project.

YSI EXO2 Turbidity Sensor Specifications (source: www.ysi.com)

Range:	0 to 4000 FNU
Accuracy:	0 to 999 FNU: 0.3 FNU or ±2 % of reading, whichever is greater; 1000 to 4000 FNU: ±5 % of reading
Resolution:	0 to 999 FNU = 0.01 FNU; 1000 to 4000 FNU = 0.1 FNU

YSI EXO Handheld (HH) (discrete sampling)

Turbidity data will be collected at selected sites using an YSI EXO1 probe. Turbidity data will also be collected from a calibrated YSI EXO1 probe to audit YSI EXO2 Sonde data. The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI EXO1 Turbidity Sensor Specifications (source: www.ysi.com)

Range:	0 to 4000 FNU
Accuracy:	0 to 999 FNU: 0.3 FNU or ±2 % of reading, whichever is greater; 1000 to 4000 FNU: ±5 % of reading
Resolution:	0 to 999 FNU = 0.01 FNU; 1000 to 4000 FNU = 0.1 FNU

Macroinvertebrate Assemblage

Macroinvertebrates are indicators of the biological integrity of a water body. The numbers of certain macroinvertebrate species in a water body can be compared to established indices to determine the health of a stream. Macroinvertebrates respond to different stressors in different ways, so it is often possible to use the macroinvertebrate population to determine what kinds of stressors are affecting the water body.

The macroinvertebrate assemblage includes all aquatic invertebrates larger than 0.5 mm. The dominant invertebrates in minimally altered streams tend to be species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). These three groups are referred to as the “EPT” taxa. Many other groups of invertebrate taxa are also present in healthy streams, and the number (diversity) and type (structure) of species present depends on the habitat and water quality of the stream sampled.

CTCLUSI Macroinvertebrate Sampling Procedure

Our program’s macroinvertebrate sampling design and data collection will be guided by James R Karr’s Seven Foundations of Biological Monitoring and Assessment. Evaluating the biological community of a stream through an assessment of the macroinvertebrates

not only provides a sensitive and cost effective means of determining stream conditions, but it also provides an integrative view of the anthropogenic influences on streams and indicators that can be used to diagnose causes of degradation. The Benthic Index of Biological Integrity (BIBI) for Pacific montane streams will be used to identify the biological integrity of the water and help further classify water pollution problems. Streams with a BIBI score of 0-24 are considered to have low biological integrity, a BIBI score of 25-39 is considered to have moderate biological integrity, and a BIBI score of more than 40 is considered to have high biological integrity.

The goal of the protocol described in this QAPP is to collect an unbiased, representative sample of benthic macroinvertebrates in wadeable streams and rivers. At each stream reach, samples will be collected by compositing D-Frame Net kick samples from a selected habitat unit (e.g. pools, riffles). Samples will be preserved in the field with ethanol. Subsampling the composite sample is necessary since the composite usually contains far more material and macroinvertebrates than is desirable to process and identify. Sub sampling and identification will be performed by qualified contractors.

Bacteria

E. coli and enterococcus are used as indicators of the presence of pathogens in drinking and recreational waters. They indicate the possible presence of disease-causing bacteria, viruses, and protozoans. If pathogens are present, fishing and swimming in the water may cause health risks. These pathogens can also cause cloudy water, unpleasant odors, and increased oxygen demand (reducing levels of dissolved oxygen). Sources of bacteria include wastewater treatment plants, septic systems, storm-water runoff, animal carcasses, and runoff from animal manure and manure storage areas. (Source: http://www.epa.gov/owm/cwfinance/106tgg07.htm)

IDEXX Colilert-18 and IDEXX Enterolert Procedure

Escherichia Coli and Enterococcus quantities will be documented using an IDDEXX Labs Colilert-18 and Enterolert Labs Procedure. In July of 2003, the EPA approved Colilert®, Colilert®-18, Enterolert™, Quanti-Tray® and Quanti-Tray®/2000 for the analysis of Escherichia coli (*E. coli*), enterococci,Cryptosporidium and Giardia in fresh ambient water matrices, and enterococci in marine ambient water matrices (40 CFR Part 136 Vol. 68, No. 139). The Colilert-18 and Enterolert procedure methods for quantifying bacteria levels is acceptable for this project. Additional information for this procedure can be found on the web at: https://www.idexx.com/water/products/colilert-18.html and https://www.idexx.com/water/products/enterolert.html.

Aquatic Habitat Surveys

Basic habitat information refers to physical attributes of a water body and its surrounding area that influence its condition. Physical habitat varies naturally, as do biological and chemical characteristics. Degradation of aquatic habitats by anthropogenic activities, however, is recognized as one of the major causes of water pollution and water quality impairment. Aquatic habitat conditions arise from the interactions between landform and

land-use. Aquatic habitat survey data collected by our program will be used to qualify and quantify current stream conditions. The information gathered by the habitat survey will also help to determine the proper functioning condition of a stream as outlined in the : Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas Technical Reference 1737-15 (Don Prichard & Work Group, 1998).

Habitat Survey Procedure

The aquatic habitat survey parameters implemented by our program include unit type, substrate type, pool depth, riffle sediment, large woody debris, and bank stability. Channel morphology data will also be collected as part of aquatic habitat surveys. Aquatic habitat surveys will be conducted using the ODFW protocol *Aquatic Inventories Project: Methods for Stream Habitat Surveys* (Moore, et al., 2004). Aquatic habitat survey areas will be split into reaches within each site and assigned a name. A map of aquatic habitat study reaches will be produced. Reach beginnings and endings will be determined by a number of factors including changes in habitat type, land-use changes, and access to private property.

Salinity/Specific Conductivity

Salinity is generally defined as the total amount of dissolved solids in a volume of water. The salinity of seawater in the open ocean is remarkably constant at about 35 parts per thousand (ppt). Salinity in an estuary varies according to location, tidal fluctuations and the volume of freshwater runoff.

Salinity levels in estuaries are generally highest near the mouth of a river where ocean water enters, and lowest upstream where freshwater flows in. However, actual salinities at specific locations in the estuaries vary through the tidal cycle. Overall salinity levels in the estuaries decline in the spring when snowmelt and rain produce elevated freshwater discharges from streams and groundwater.

Variations in salinity produce changes in species composition, distribution and abundance in an estuary. Estuarine organisms have different tolerances and responses to salinity changes. For example, benthic (bottom-dwelling) organisms are able to tolerate changing salinities, but salinities outside an acceptable range will affect growth and reproduction.

Salinity is also important because it affects chemical conditions within the estuary, particularly dissolved oxygen levels. The amount of dissolved oxygen (solubility) decreases with increasing salinity. The solubility of oxygen in seawater is about 20 percent less than in freshwater of the same temperature.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

At selected sites, salinity and conductivity data will be collected using an YSI EXO2 sonde equipped with a conductivity/temperature sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications of this sensor are acceptable for the project.

YSI EXO2 Conductivity/Temperature Sensor Specifications (source: www.ysi.com)

Salinity:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	±1.0% of reading or 0.1 ppt, whichever is greater
Resolution:	0.01 ppt
Specific Conductivity:	Calculated from conductivity and temperature
Range:	0 to 200 mS/cm
Accuracy:	±0.5% of reading or 0.001 mS/cm, whichever is greater
Resolution:	0.001, 0.01, 0.1 mS/cm (auto-scaling)

YSI EXO Handheld (HH) (discrete sampling)

At selected sites, salinity/conductivity data will be collected using an YSI EXO1 probe. Salinity/conductivity data collected from the YSI EXO2 sonde will also be audited using an YSI EXO1 probe. The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI EXO2 Conductivity/Temperature Sensor Specifications (source: www.ysi.com)

Salinity:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	±1.0% of reading or 0.1 ppt, whichever is greater
Resolution:	0.01 ppt
Specific Conductivity:	Calculated from conductivity and temperature
Range:	0 to 200 mS/cm
Accuracy:	±0.5% of reading or 0.001 mS/cm, whichever is greater
Resolution:	0.001, 0.01, 0.1 mS/cm (auto-scaling)

Water Depth

Water levels in the estuary vary primarily with the tide, weather conditions and the amount of upland stream flow and runoff. Physical, chemical and biological conditions within the estuary vary with water level.

Changes in water volume in the channels and bays of the estuary change the concentration of dissolved and suspended materials in the water. During periods of high runoff due to storms, the amount of suspended sediment in the water tends to increase because of erosion in the watershed. Rainfall and runoff also interact with toxic algae blooms in lakes. Cool rainfall can kill blooms, while runoff can increase eutrophication and accelerate bloom growth in warm periods following rain events.

Depending on the pollutant source, bacterial levels may also increase as runoff increases. Conversely, turbidity levels may increase during periods of low water volume because of the action of wind and waves on muddy bottom sediments at low tide.

YSI EXO2 Sonde Multi-Parameter Datalogger (continuous sampling)

Water depth data will be collected at selected sites using an YSI EXO2 Sonde equipped with a depth sensor. The manufacturer has determined the accuracy, precision, and range of this sensor. The specifications of this sensor are acceptable for the project.

YSI EXO2 Depth Sensor Specifications (source: www.ysi.com)

Depth and Level:	-10 m
Range:	0 to 10 m (0 to 33 ft)
Accuracy:	±0.04% FS (±0.004 m or ± 0.013 ft)
Resolution:	0.001 m (0.001 ft)(auto-ranging)
Depth and Level:	-100 m
Range:	0 to 100 m (0 to 328 ft)
Accuracy:	±0.04% FS (±0.04 m or ± 0.13 ft)
Resolution:	0.001 m (0.001 ft)(auto-ranging)

YSI EXO Handheld (HH) (discrete sampling)

At selected sites, water depth data will be collected using an YSI EXO1 probe. Water depth data will also be collected from a calibrated YSI EXO1 to audit YSI EXO2 Sonde data. The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this sensor are acceptable for the project.

YSI EXO1 Depth Sensor Specifications (source: www.ysi.com)

Depth and Level:	-10 m
Range:	0 to 10 m (0 to 33 ft)
Accuracy:	±0.04% FS (±0.004 m or ± 0.013 ft)
Resolution:	0.001 m (0.001 ft)(auto-ranging)
Depth and Level:	-100 m
Range:	0 to 100 m (0 to 328 ft)
Accuracy:	±0.04% FS (±0.04 m or ± 0.13 ft)
Resolution:	0.001 m (0.001 ft)(auto-ranging)

Harmful Algal Blooms (HABs)

Harmful algal blooms are actually an over growth of certain species of cyanobacteria that are referred to as “algae” or “blue-green algae” and share the same photosynthetic properties, but are, in fact, bacteria. Cyanobacteria naturally occur in fresh and marine aquatic water bodies, and when present in large quantities or “blooms, can negatively impact water contact recreation, drinking water, aquatic life, aesthetics, and other beneficial uses of water bodies.

Biomass from blooms can cause anoxia, hypoxia, and habitat alteration. Cyanobacteria can also produce neurotoxins and hepatoxins as well as lipopolysaccharides that can pose a significant danger to the health of Tribal members and Tribal resources.

Increased inputs of nutrients from storm-water run-off, failing septic systems, and certain human land use practices, such as agriculture, promote cyanobacterial growth and can lead to increased occurrences of HABs. Stagnant water, low flows, sustained high temperatures, and increased intensity and duration of sunlight create ideal conditions for freshwater HABs. Climate change may also promote the growth and dominance of HABs in addition to nutrient inputs from anthropogenic sources.
(Source: http://www.epa.gov/sites/production/files/2015-07/documents/habs_faqs-and-resources_v1-july2015.pdf)

HABs Sampling Procedure

HABs sampling design and data collection will be modeled after OHA's *Sampling Guidelines: Cyanobacterial Harmful Blooms in Recreational Waters,* which can be found at:
http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Documents/HABSamplingGuidance%2020150424x.pdf.

The type of sampling procedure instituted will be contingent on the timing and frequency of Tribal recreational and cultural activities.

Backup Equipment

YSI 6600 EDS Multi-Parameter Datalogger (continuous sampling)

An YSI 6600 EDS V2 or 6600 Datalogger will be used as a backup for all YSI EXO2 Sondes. The manufacturer has determined the accuracy, precision, and range of this sonde. The specifications of this sonde is acceptable for the project.

YSI 6600 Extended Deployment System V2 Specifications (source: www.ysi.com)

Optical Dissolved Oxygen % Saturation:	NA
Range:	0 to 500%
Accuracy:	0 to 200% : ± 1% of the reading or 1% air saturation; whichever is greater; 200 to 500% air saturation, ± 15% of the reading
Resolution:	0.1%
Optical Dissolved Oxygen (mg/L):	NA
Range:	0 to 50 mg/L
Accuracy:	0 to 20 mg/L: ± 0.1 mg/L or 1% of the reading, whichever is greater; 20 to 50 mg/L:± 15% of the reading
Resolution:	0.01 mg/L
Temperature:	6560 Sensor
Range:	-5 to +50°C

Accuracy:	± 0.15°C
Resolution:	0.01°C
Conductivity:	6560 Sensor
Range:	0 to 100 mS/cm
Accuracy:	± 0.5% of reading + 0.001 mS/cm
Resolution:	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	± 1.0% of reading or 0.1 ppt, whichever is greater
Resolution:	0.01 ppt
pH:	6561 sensor
Range:	0 to 14 units
Accuracy:	±0.2 units
Resolution:	0.01 units
Shallow Depth	NA
Range	0 to 30 feet (0 to 9.1 m)
Accuracy	± 0.06 feet (0.02)
Resolution	0.001 feet (0.001m)

YSI 650 MDS Multi-Parameter Meter

An YSI 650 MDS Meter equipped with a 600 XLM sonde will be used as a backup for the YSI EXO Handheld (HH). The manufacturer has determined the accuracy, precision, and range of this probe. The specifications of this probe are acceptable for the project.

YSI 600 XLM Specifications (source: www.ysi.com)

Dissolved Oxygen % Saturation:	6562 Rapid Pulse Sensor
Range:	0 to 500%
Accuracy:	0 to 200%: ± 2% of the reading or 2% air saturation, whichever is greater: 200 to 500% air saturation, ± 6% of the reading
Resolution:	0.1% air saturation
Dissolved Oxygen (mg/L):	6562 Rapid Pulse Sensor
Range:	0 to 50 mg/L
Accuracy:	0 to 20 mg/L: ± 0.2 mg/L or 2% of the reading, whichever is greater; 20 to 50 mg/L: ± 6% of the reading
Resolution:	0.01 mg/L
Temperature:	6560 Sensor
Range:	-5 to +50°C
Accuracy:	± 0.15°C
Resolution:	0.01°C
Conductivity:	6560 Sensor
Range:	0 to 100 mS/cm
Accuracy:	± 0.5% of reading + 0.001 mS/cm

Resolution:	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	± 1.0% of reading or 0.1 ppt, whichever is greater
Resolution:	0.01 ppt
pH:	6561 Sensor
Range:	0 to 14 units
Accuracy:	±0.2 units
Resolution:	0.01 units
ORP:	NA
Range:	-999 to +999 mV
Accuracy:	± 20 mV
Resolution:	0.1 mV
Shallow Depth and Level:	NA
Range:	0 to 30 feet (0 to 9.1 m)
Accuracy:	± 0.06 feet (0.02)
Resolution:	0.001 feet (0.001m)

Hach 2100-P Turbidimeter

In the event that a probe must be deployed without an equipped turbidity sensor, turbidity data will be collected via grab samples for analysis using the Hach 2100-P Turbidimeter. The manufacturer has determined the accuracy and precision of this meter. The maximum accuracy is ± 2% of reading plus stray light from 0-1000 NTU. The resolution is 0.01 NTU on lowest range. The range can be either automatic or manual scale adjusted from .01NTU to 1000NTU. The specifications for this meter are acceptable for the project.

B.2 Sampling Methods

Sondes

Sonde calibration, maintenance, data collection, deployment and retrieval methods implemented by this program will follow standard operating procedures outlined in the ODEQ Water Monitoring and Assessment Mode of Operations Manual (MOMs), Centralized Data Management Office (CDMO) National Environmental Research Reserve (NERR) System Wide Monitoring Program (SWMP) YSI/Xylem EXO Multi-Parameter Water Quality Monitoring Standard Operating Procedures (SOP) (pending release), and CDMO NERR SWMP YSI 6-Series Multi-Parameter Water Quality Monitoring SOP.

All water quality data will be collected in 15-minute intervals at a known, fixed distance from the bottom (between 0.5 and 1 meters above the substrate). The YSI sonde must be configured to collect the following parameters.

Parameter	Units	Format
Date	mm/dd/yyyy	mm/dd/yyyy
Time	mm/dd/yyyy	mm/dd/yyyy

Dissolved Oxygen - percent	% Saturation	0.0
Dissolved Oxygen - conc	mg/L	0.00
pH	pH units	0.00
Water Temperature	°C	0.000
Turbidity	FNU	0.00
Salinity	psu	0.00
Specific Conductivity	mS/cm	0.0000
Shallow Depth	m	0.000

Discrete Sample Collection

At all sample sites, field data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will be recorded using a Hand-held YSI EXO equipped with either an YSI EXO1 sonde or EXO2 sonde. Efforts will be made to sample during spring tides at low-low and high-high tide, although this will not always be feasible due to the timing of tides and schedules of staff. Efforts will also be made to sample following a 72-hour dry period unless it substantially impacts the interval between quarterly/semi-annual runs.

Nutrient Sampling Protocol

Equipment Needs

- Sample bottles for inorganic nutrients
- Sample bottles for chlorophyll
- 60 ml syringes for nutrient
- Filtration apparatus for chlorophyll
- Syringe filters (surfactant free cellulose, 25mm, .45 micron pore size) for nutrients
- GF/F filters for chlorophyll
- 20 ml graduated cylinder

Field Grab Samples

At all sites, field calibration data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth will be recorded with a hand-held YSI equipped with a YSI EXO1 sonde or YSI Exo 2 sonde, whichever is available.

At each site, three consecutive samples (duplicates) will be collected using a 2-L Van Dorn bottle held at 0.5 m to 1.0 m above the channel bottom, the same level as the YSI samples. Samples from the Van Dorn bottle will be decanted into amber, wide-mouthed, Nalgene bottles. Efforts will be made to sample during spring tides at low-low and high-high tide, although this will not always be feasible due to the timing of tides and schedules of staff. Efforts will also be made to sample following a 72-hour dry period unless it substantially impacts the interval between quarterly/semi-annual runs.

Sample bottles and equipment will be rinsed in tap water three times, acid washed (10% HCL), then washed in deionized water three times, and finally rinsed in ambient water in the field three times. After a sample is collected, sample bottles will be immediately capped, placed on ice in the dark, and returned to the CTCLUSI laboratory. In the laboratory, samples will remained stored at 4ºC until filtration. Samples will be filtered within 24 hours of collection and overnighted to a contract lab for further processing.

Diel Sampling Protocol

A diel sampling program may be implemented concurrent to the nutrient grab sampling. If feasible, an ISCO 6712 autosampler may be deployed seasonally to quarterly at one or more of the estuarine sampling sites. The ISCO 6712 autosampler will be programmed to collect 1-L samples every 2.5 hours over a 25 hour tidal cycle. After samples are collected, they will be filtered into 50ml sample bottles within 24 hours of retrieval and overnighted to a contract lab for further processing. ISCO sample bottles will be rinsed in tap water three times, acid washed (10% HCL), then rinsed in deionized water three times.

During deployment, if necessary, a 25-pound weight will be lowered to the channel bottom and the suction head of the ISCO clipped to the line. The suction head will be lowered within 0.5 m to 1.0 m of the channel substrate in order to sample the water at the same level as an YSI datalogger. A second weight will be clipped to the line and lowered to just below the low-tide level in order to maintain the suction line in a horizontal orientation during tidal exchanges. The suction line will be secured to the dock or piling to ensure a smooth, continuous rise to the pump head. The central well of the ISCO will be filled with ice to maintain the 4°C sample storage requirement.

On particularly warm days, ice will be replenished two or three times to ensure the integrity of the samples. When the diel sampling is complete, the ISCO sample bottles will be capped, stored on ice in the dark and returned immediately to the lab where they will be stored at 4°C until filtration.

Laboratory Filtration of Samples

Samples will be stored at 4°C in the dark until they are filtered. Immediately prior to filtration, samples will be agitated to ensure homogenization. Chlorophyll and phaeophytin will be processed with a vacuum filtration apparatus. Inorganic nutrients, total nitrogen and phosphorus, and dissolved organic carbon will be filtered using a syringe and Acrodisc filters. Filters and filtrates will be stored at -20°C prior to mailing. As close as possible to the overnight shipment pickup time, the frozen samples will be packed in a styrofoam container, surrounded with bags of ice, and sent to the University of Washington Marine Chemistry Laboratory for analysis.

Laboratory Methods

i. Parameter: NH_4 Filtered (F)

Method Reference: Slawyk, G. and MacIsaac, J.J. (1972) Comparison of two automated ammonium methods in a region of coastal upwelling. *Deep Sea Research* 19:521-524.

Method Descriptor: A water sample is treated with phenol and alkaline hypochlorite in the presence of NH_3 to form indophenol blue (Berthelot reaction). Sodium nitroferricyanide is used as a catalyst in the reaction. Precipitation of Ca and Mg hydroxides is eliminated by the addition of sodium citrate-complexing reagent. The sample stream is passed through a 55 ^{o}C heating bath, then through a 50 mm flowcell and absorbance is measured at 640 nm on a Technicon Model AAII.

Preservation Method: Sample is filtered through a 0.45 µm disposable disk filter and stored at –20°C until analyzed.

ii. Parameter: NO23F, NO_3F and NO_2F

Method Reference: Armstrong, F. A., C. R. Stearns, and J. D. H. Strickland. 1967. The measurement of upwelling and subsequent biological processes by means of the Technicon AutoAnalyzer and associated equipment. *Deep Sea Research* 14:381-389.

Method Descriptor: For nitrate+nitrite (NO23) analysis, a water sample is passed through a cadmium column where the nitrate (NO_3) is reduced to nitrite (NO_2). This NO_2 is then diazotized with sulfanilamide and coupled with N-(1-naphthyl)-ethylenediamine to form an azo dye. The sample is then passed through a 15 mm flowcell and absorbance is measured at 540 nm on a Technicon Model AAII, giving NO23. A 50 mm flowcell is required for NO_2. The procedure is the same for the NO_2 analysis less the cadmium column. NO_3 concentration equals the NO23 concentration minus the NO_2 concentration.

Preservation Method: Sample is filtered through a 0.45 µm disposable disk filter and stored at –20°C until analyzed.

iii. Parameter: PO_4F

Method Reference: Bernhardt, H. and A. Wilhelms. 1967. The continuous determination of low level iron, soluble phosphate, and total phosphate with the AutoAnalyzer. *Technicon Symposium* 1:386.

Method Descriptor: Ammonium molybdate is added to a water sample to produce phosphomolybdic acid, which is then reduced to phosphomolybdous acid (a blue compound) following the addition of dihydrazine (or hydrazine) sulfate. The sample is passed through a 50 mm flowcell and absorbance is measured at 820 nm on a Technicon Model AAII.

Preservation Method: Sample is filtered through a 0.45 µm disposable disk filter and stored at –20°C until analysis.

iv. Parameter: CHLA, PHEA

Method References: EPA 1997. In vitro determination of chlorophyll a and phaeophytin a in marine and freshwater algae by fluorescence. Method 445.0. UNESCO. 1994. Protocols for the joint global ocean flux study (JGOFS) core measurements. pp. 97-100.

Method Descriptor: CHLA is extracted in 10 ml 90% acetone and fluorescence is measured and recorded (Fo) with a Turner model TD700 fluorometer using the multi-option raw fluorescence mode. Several drops of 10% hydrochloric acid are added to convert the CHLA to PHEA. The fluorescence is again measured and recorded (Fa). The concentration (µg/L) of CHLA and PHEA are calculated using the Fo/Fa ratio.

Preservation Method: A known volume of sample is filtered onto a 25 mm GF/F filter, folded in half and wrapped in aluminum foil. Foil is stored at –20°C until analysis.

Reporting of missing data and data with concentrations lower than method detection limits

Nutrient/Chl A comment codes and definitions are provided in the following table. Missing data are denoted by a blank cell (“ ”) and comment coded with an “M”. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. Concentrations that are less than this limit are denoted by a –9999 and comment coded with a “B” placed in the $NO_{23}F$

comment code column. Calculated parameters are comment coded with a “C” and if any of the components used in the calculation are below the MDL, the calculated variable is denoted by –9999 and also comment coded with a “B”. If a calculated value is negative, the value is reported as a –9999. In a few cases, values were close to the top of the stated range for a particular parameter. In these instances, the University of Washington Marine Chemistry Laboratory manager stated that, “Chances are, if a number went above the stated range the sample was diluted; however, if the concentration is close to the top of the stated range I probably just ran a higher standard.” Because of this, the comment code “A” was not used.

Variable Comment Codes:

Comment Code	Definition
A	Value above upper limit of method detection
B	Value below method detection limit
C	Calculated Value
D	Data deleted or calculated value could not be determined due to deleted data; see metadata for details
H	Sample held beyond specified holding time
K	Check metadata for further details
M	Data missing, sample never collected, or calculated value could not be determined due to missing data
P	Significant precipitation (reserve defined; see metadata part 16 for further details)
S	Data suspect; see metadata for further details
U	Lab analysis from unpreserved sample

Macroinvertebrate Sampling Protocol

Two variants of the field collection protocol used by Oregon Department of Environmental Quality (DEQ) are described here. One is targeted habitat sampling, which is the standard DEQ protocol, and the other is transect sampling, a protocol used only for EPA-funded studies such as the Environmental Monitoring and Assessment Program (EMAP) (Peck, et. al., 2000). Our program will likely implement the EMAP protocol.

Equipment Needs

- 500 um mesh D-Frame kick net
- Three gallon sieve bucket
- Scrub brush
- Long-sleeved rubber gloves
- Ziploc bags or Nalgene containers
- Sample label
- Waders with slip-resistant soles

Standard Oregon DEQ

- 8 kick composite (each kick 1 foot * 1 foot)
  ---prior to 2003, DEQ collected four 2-foot^2 kicks

- 9 cell grid overlay to select sites
    - collect riffles at all sites (if no riffle collect a pool sample)
    - collect riffles AND pools at reference sites only

EMAP

- 8 kick composite (each kick 1 foot * 1 foot)
- 9 cell grid overlay to select sites
- Collect riffles AND transect samples at ALL sites
- Collect pool samples only if riffle habitat is unavailable

Targeted Habitat Sampling

1. Beginning at the downstream end of the reach, select the first riffle or pool habitat unit (riffles at all sites, pools only if reference site or no riffles present). Collect one kick sample from each riffle or pool unless fewer than eight are present within reach. In that case, evenly spread the eight samples across the number of riffles or pools within the reach. EXCLUDE margin habitats (area within 5% of channel margins).

Visualize a 3x3 grid over each riffle (or habitat unit) to be sampled (see figure 1). For the first habitat unit, select the lower-left square; for the second habitat unit, select the lower-center; the third, the lower-right; for the fourth, select the middle-left; for the fifth select the middle-center; for the sixth select the middle-right; for the seventh select the upper-left; for the eighth select the upper-center. Collect the kick sample in the center of each grid square.

7	**8**	
4	**5**	**6**
1	**2**	**3**

Figure 1. Visualize a grid overlay to select kick sites at each habitat unit (riffle or pool).

2. After locating the random sample location, place the net into the stream with the flat part of the hoop resting on the bottom and perpendicular to the stream flow. As much as possible, make sure to remove any substrate that prevents the flat part of the kick-net from sitting flush with the bottom. It may also be useful to remove large substrate particles downstream of the flat portion of the loop that may affect the flow entering the net. Collect the macroinvertebrate sample by disturbing a 30 by 30 centimeter area (1ft x 1ft).

3. Inspect the benthos in a 1 ft X 1ft area (approximately as wide as the kick net) of stream bottom directly in front of the net for any large organisms such as mussels. Pick these and place in the sieve bucket.

4. Carefully rub by hand all substrate larger than five centimeters (golf ball size and larger) in front of the net to dislodge any clinging macroinvertebrates. Then, with a small scrub brush, dislodge organisms still clinging to the larger substrate particles.

After rubbing, place the substrate outside of the sample plot. (Hand scrubbing is recommended prior to using the brush to prevent damage from occurring to fragile macroinvertebrate specimens. Also, be gentle with the brush, so as not to chew up the macroinvertebrates.)

5. Thoroughly disturb the remaining substrate in the 1ft * 1ft area with your hands or feet for 30 seconds to a depth of five to ten centimeters.
   - **NOTE:** Collecting a sample in slow moving water is a little more difficult. It may involve pulling the net through the water as the substrate is disturbed to capture suspended organisms.

6. After the sample is collected and the net removed, return the large substrate to the sample plot.

7. The contents of the net are placed in a sieve bucket and the sampling procedure is repeated for that habitat type. Always sample downstream to upstream.

8. All kick samples for the same habitat type are composited in the sieve bucket. Large organic material and rocks are rinsed, carefully inspected for clinging macroinvertebrates, and removed. As much fine sediment as possible should be washed away. Leaf packs from pool samples may require considerable rinsing and removal of debris before preserving the composite sample.

9. The composite sample is placed in a labeled jar or double zip-lock bag and preserved with 95% denatured ethanol for sorting and subsampling in the lab. Pour enough ETOH in the container to equal the volume of sample. It is necessary to replace the alcohol in the sample with fresh alcohol within one week to ensure adequate preservation. Typically, each sample should have its ethanol changed at the end of each field week, unless the ethanol is still clear (not green or brown). Place a label (Rite in the Rain paper) written in pencil containing site and habitat unit information inside the container. Label the outside container with a pencil written on a label, then tape the label to the outside of the jar. Do not use markers as most inks are soluble in alcohol.

10. After samples are collected in the field, several steps should be taken before they can be put away. We recommend changing the alcohol preservative within a few days of collection. This is especially important if the sample contains a lot of wet organic material (leaves, moss, etc.) that would dilute the alcohol. Containers should be checked for leaks and complete labeling. Samples need to be stored in a neat and systematic manner.

Transect sampling (EMAP only)
Select the transect A sample location at the middle of the left one-third of the stream. For transect B, set the net in the middle of the center one-third of the stream. For transect C, set the net in the middle of the right one-third. For transect D, start back at the left one-third. Repeat the cycle for all 11 transects. (Be sure to follow the L, C, R, L, C, R pattern. DO NOT oversample the middle section.) EXCLUDE the margins. (See Peck et al 2000, for further details.)

The remaining sampling and processing techniques are the same as described above.

Sample Tracking and Record Keeping Method

1. In order to adequately track each invertebrate sample, the following parameters are needed:
   - Station (the number DEQ uses to represent a unique sampling location),
   - Site name,
   - Site ID (depending on project),
   - Collection date,
   - Habitat sampled,
   - Whether or not the sample was a field duplicate
   - The number of jars used for the entire sample
   - Collector's initials.

   (Each of these parameters should re-verify against the "Sample Tracking" form, which is turned into the Tracker's office for entry into LIMS.)

2. Tags with all of the information listed above should be placed <u>inside</u> the container and also attached to the outside (staple or tape). Be sure to use a pencil, not a marker.

3. Samples with "clean" ethanol should be placed in the Bio Lab on the benches identified for bug storage. Be sure to place the samples in the appropriate area designated by project.

4. At periodic intervals throughout the field season, office personnel will move the accumulated bug samples out to the bunker for storage until they are shipped. For samples going to Rhithron Biological Associates (all projects other than EMAP), use the blue or green tupper-ware bins. Label the outside of the bin with the project name and a unique bin number. For EMAP samples going to EPA in Corvallis, use the white screw-top buckets. Each screw-top bucket should have a unique number (if it does not, assign one).

5. Record the bin/bucket number that each sample is placed into on a hard copy of the "Sample Shipping" form. When a bin/bucket is full, make a photocopy of the shipping form for our records, and place the original inside the bin/bucket. Be sure to note jar numbers. (For example, if a sample has 6 jars, you may need to place "jars 1-3 of 6" in bin # 3, and "jars 4-6 of 6" in bin # 12.)

Laboratory Filtration of Samples

Macroinvertebrate samples will be stored in a 70% EtOH solution until they can be sent to Aquatic Biology Associates for macroinvertebrate analysis. Samples will not be held longer than 7 days after sampling.

Bacteria Sampling Protocol

Equipment Needs

- Sample bottles for E. coli and Enterococcus
- Ice chest

Field Grabs
Attach an unopened 120ml Idexx Shrink wrapped bottle onto the end of a two meter telescoping wand. Before carefully removing the shrink wrap from the bottle, position yourself at the site's sampling location. When you have safely positioned yourself at your sample location, carefully remove the shrink wrap from the sample bottle.

WHEN OPENING THE SAMPLE BOTTLE DO NOT LET THE INSIDE OF THE CAP OR THE RIM OF THE BOTTLE CONTACT ANYTHING!

Rotate the telescoping wand, with the now open bottle attached to it, so that the mouth of the sample bottle is pointing directly downward above the water's surface. Quickly submerge the downward pointing bottle to a one meter depth (or as deep as you can so that the end of the wand is suspended halfway between the water surface and the substrate). Now, rotate the telescoping wand so the bottle is upright and facing the direction of water flow. Shake the bottle to remove air bubbles and fill to the top to make sure surface water will not enter the bottle as you remove it. Carefully replace the cap.

Within one minute of collection, place capped sample bottle upright in ice chest and surround with ice. Record time that sample was collected and place in ice chest. Samples will be held no more than a maximum of 6 hours and transported directly from the field to the laboratory for immediate processing.

Sample Preparation and Laboratory Protocol

Equipment Needs

- IDEXX 120ml bottles for E. coli and Enterococcus
- Colilert – 18 and Enterolert
- Quanti-Trays
- Quanti-Tray sealer
- Incubators

A 1:10 dilution is used when running E-Coli and Enterococcus testing procedures. Field samples are allowed to reach room temperature (per Idexx recommended protocols) before they are diluted. Prior to pipetting 10 ml from the original sample, gently swirl the sample to redistribute potentially settled material.

Pipette 10ml of water sample into a sterile, freshly opened, 120ml IDEXX sample bottle and quickly cap (again, being careful not to touch the inside of the cap or rim of the bottle). After preparing all the samples taken for that day in the same way, add distilled water to each one so that the bottle is filled to the 100ml line. Add 1 package of IDEXX Enterolert or Clilert-18 reagent, depending on the species of bacteria being tested for, and swirl until thoroughly dissolved.

Open the Quanti-Tray/2000 and hold it in a U-shape as you pour the entire sample into it, touching only the foil tab. Tap the small wells two or three times to eliminate air bubbles. Send the sample Quanti-Tray/2000 in the red rubber insert through the sealing machine.

Incubate the trays filled with Colilert-18 for 20 hours at 35 +/-0.5 degrees Celsius. At the end of incubation, read and record the results of the test. If the wells in the Quanti-

Tray/2000 do not have a yellow color, the test is negative. Wells that have turned as yellow as the comparator indicate the presence of total coliform bacteria. Record the number of small wells that turned yellow and separately record the number of large wells (including the large well at the top of the tray) that turn yellow. This is the MPN for total coliforms in the sample.

If the wells are at least as yellow as the comparator, check each well for fluorescence by placing the UV light within five inches of the sample in a dark place. Read and record the number of small wells that fluoresce and separately record the number of large wells that fluoresce (including the large well at the top of the tray).This is the MPN for E.coli in the sample.

Incubate the trays filled with Enterolert for 24 hours at 41 +/-0.5 degrees Celsius. At the end of incubation, read and record the results of the test. Read and record the number of small wells that fluoresce and separately record the number of large wells that fluoresce (including the large well at the top of the tray). This is the MPN for enterococcus in the sample. There will only be a slight yellowish tint to the Enterolert samples.

*The incubator will hold a maximum of twelve trays stacked in rows of no more than three trays.

**Refer to the MPN table to obtain the Most Probable Number (MPN) of total coliform, e.coli and enterococcus in the samples. Multiply the result by the dilution factor of 10.

Aquatic Habitat Assessment Protocol

The following description is a broad overview of the extensive habitat assessment utilized by our program. For more detailed descriptions of these protocols, please refer to the ODFW protocol *Aquatic Inventories Project: Methods for Stream Habitat Surveys* (Moore, et al., 2004) at http://oregonstate.edu/Dept/ODFW/freshwater/inventory/pdffiles/habmethod.pdf.

The process of conducting a stream survey involves collecting general information from maps and other sources and the direct observation of stream characteristics in the field. This information is both collected and analyzed based on a hierarchical system of regions, basins, streams, reaches, and habitat units.

A collection of general information on regions and basins will need to be performed before field data collection based on stream, reach and channel unit characteristics is conducted. Region and basin data will primarily come from ODFW-EPA region and sub region classifications, and from map analysis.

The following instructions and definitions provide the outline for these activities and a description of the tasks involved in conducting CTCLUSI's stream habitat assessment/inventory.

Identification of channel unit characteristics, counts and relative distribution of several unit attributes, and verification of length and width estimates for a subset of units will be conducted at each stream site. Descriptions of reach characteristics, riparian conditions, identifications of habitat unit types, and quantifications of the amount of large woody debris will also be recorded.

Equipment Needs

1. Maps - 7.5 minute quad (1:24,000 scale) USGS topographic maps of the stream and basin. Road map coverage by county or fire district. Oregon Atlas and Gazetteer (Delorme Mapping).

2. Recording Materials - Waterproof field book, survey forms for each portion of the survey, waterproof paper, and pencils.

3. Clothes - Neoprene chest waders, wading shoes, and/or hip boots (non-slip soles of felt, studded “corkers”, outdoor carpet or similar material is advised), rainwear, snag and thorn proof clothing appropriate for the weather.

4. Two-meter-long staff (marked in meters and tenths), compass, 60 meter fiberglass measuring tape, day pack, polarized glasses, thermometers, clinometer, clipboard, vest, flagging, permanent markers, and date-back camera, GPS unit.

Basin Information

Basin information is gathered prior to and during the course of the survey. Some of this information (primarily map work and regional classification) must be collected in the office. Relevant information acquired in the field will also be included in Field Books and on the Data Sheets. These summaries are used to group and classify streams and to provide general information for the final stream reports.

1. Basin name: Use the name of the large river commonly used to describe a region. For example, use McKenzie R for Lookout CR, not Willamette or Columbia.

2. Stream name: Use a standardized system of the name followed by descriptors of forks etc. Examples: Alsea R, Drift CR, Lobster CR, E FK.
   Spell out descriptive or non-standard types such as Branch, Slough, or Swale. Spell out compass direction only for larger streams and when the usage is common, such as North Umpqua. Use the same name format on all data sheets.

3. Stream order, drainage area, and drainage density of the study stream. Determined from blue line tributaries (perennial and intermittent) shown on U.S.G.S. 7.5 minute topographic maps.

4. Elevation (m) at the confluence with the receiving channel and at the end of the survey.

5. ODFW-EPA Regions and Sub regions, geology, and soils of the basin.

6. Stream Flow: Location of USGS or other gauging stations. The location and stage height at any gauging station, marked bridge, or staff gauge will also be recorded during the survey.

7. General community structure and size composition of riparian vegetation. Identified by separate census or sample in each basin.

8. Description of fish species and stocks present, management concerns, and linkage to other databases or research projects.

9. Flow Regulation: Description of existing or proposed dams and diversions influencing the basin and segment.

10. General description of land use and ownership in the basin (e.g. managed timber, rural residential, agricultural, livestock grazing).

11. Contacts: Names, addresses, and phone numbers of key people to contact with respect to survey. Include ODFW district biologists, interested private individuals, landowners contacted for access, etc.

Map Work

Do not go into the field without a topographic map! Data that cannot be linked to the maps is essentially useless. Use the maps to orient to the stream and to identify the location of reach changes, named tributaries, roads, and bridge crossings. Mark all reach changes and important features on the map. Write the channel unit number on the map at the place that corresponds to the location of named tributary junctions, bridges, and other landmarks. Clearly mark where you start and end the survey.

A good correspondence between landmarks on the map and the data collected is an essential part of our survey effort. Information from the surveys will be utilized and integrated with Geographic Information System (GIS) analysis. Well documented and accurate maps are required for this process. In addition to a well-marked map, it is essential that the habitat survey follow the USGS named stream on the topo map, regardless of the amount of flow.

If using a GPS unit, record the Easting and Northing UTM coordinates at the beginning of the reach and at the end of all surveys. When reading the numbers from your GPS unit, the top number is the **Easting coordinate** and corresponds to small numbers along the top of your USGS quad map. The bottom number is the **Northing coordinate** and corresponds to similar numbers along the side of your USGS map. Your location should be where a vertical line from the Easting mark and a horizontal line from the Northing mark intersects.

Field Book

Maintain a succinct log of your activities in the field book. Each day, record the date and name of the stream where you worked. Enter the approximate distance covered and number of hours spent working on the stream. Keep track of your travel time separately. Record relevant details about access to the stream, contact people from cooperating industry or agency groups, and people you contact to gain permission to survey. Record the names and phone numbers of people you may contact as you complete the survey.

Write a paragraph or so of a general description for sections of each stream in the field book or on a separate stream report form. Pay particular attention to descriptions of the riparian zone, additional details concerning land use, or factors that influence the fish populations. This is the appropriate place to express your opinions.

Other comments, sketches of complex features, suggestions, complaints, etc. are often useful.

Photographs
A good photographic record of the stream survey provides additional information and documentation. Take pictures that typify reach changes, riparian zones, and other stream characteristics as described in the following sections of these instructions. Be sure that the date-back feature of the camera is functioning correctly and to turn off the flash. For each picture, record the channel unit number, date, time, and a description of the subject on the Photo Record sheet.

Reach Form
A reach is a length of stream defined by some functional characteristic. A reach may be simply the distance surveyed. More frequently, reaches are defined as: stream segments between named tributaries, changes in valley and channel form, major changes in vegetation type, or changes in land use or ownership.

Enter a new line on the reach data sheet at any significant change in any one of the reach variables (valley type, channel form, adjacent landform, valley width index, vegetation, or land use) *and/or* at the confluence with tributaries named on 7.5 minute topographic maps. When a new reach is identified by a named tributary, write the name in the Reach Note column. Also describe a new reach if an unnamed tributary contributes significant flow (approx. 15-20% of the total). Do not invent names for unnamed tributaries, instead identify them as Trib. 1, Trib. 2, etc. and record them on the data sheet and the map.

Changes in reach characteristics are used to verify survey location and to identify reach and stream segments within our basin classification system. Circle the variable that resulted in the new reach entry.

Flagging is used to mark specific points during a survey. Hang a strip of plastic flagging at each reach change, named tributary junction, and at riparian transects. Mark the flagging with the unit number, unit type, date, and "ODFW-AQ.-INV.". These flags will be used to locate specific reaches and units for fish sampling and to link units and locations for repeat habitat surveys. Randomly selected stream segments will be selected for repeat surveys during the field season. Results will be compared to check on variability between crews and for habitat changes at different stream flow.

The following sequence corresponds to the listing of variables on the data sheet:

1. **Date.**

2. **Reach:** The numbered sequence of reaches as they are encountered. Each reach is comprised of variable numbers of channel units.

3. **Unit Number:** Sequence number of the first unit recorded in a reach.

4. **Channel Form:** Determined by the morphology of the active channel, hill slopes, terraces, and flood plains. Identify the channel form and enter the appropriate two-letter code in this column.

First look at the ratio of the active channel width to the valley width to determine the **Valley Width Index**. This ratio determines if you are in a broad or narrow valley floor type. If the VWI is 2.5 or less you have a narrow valley type and if the VWI is greater than 2.5 you have a broad valley type.

Next, look at the types of land forms adjacent to the stream channel to characterize and complete your classification.

The channel is constrained when adjacent land forms restrict the lateral movement of the channel. In constrained channels, stream flows associated with all but the largest flood events are confined to the existing channel configuration.

Narrow Valley Floor Types (VWI δ 2.5)---Always constrained, defined by the characteristics of the constraining feature.

CB Constrained by **B**edrock (bedrock dominated gorge)
CH Constrained by **H**ill slope
CF Constrained by alluvial **F**an

Broad Valley Floor Types (VWI > 2.5)---The valley is several times wider than the active channel. The channel, however, may be either unconstrained or constrained depending on the height and configuration of the adjacent landforms.

1. Unconstrained Channel (terrace height is less than the flood prone height* and the flood prone width* is > than 2.5X active channel width). Low terraces, overflow channels, and flood plains adjacent to the active channel.

US Unconstrained-predominantly **S**ingle channel.
UA Unconstrained-**A**nastomosing (several complex, interconnecting channels)
UB Unconstrained-**B**raided channel (numerous, small channels often flowing over alluvial deposits)

2. Constrained Channel (terrace height is greater than the flood prone height*). Adjacent land forms (terraces, hillslopes) are not part of the active flood plain.

CT Constraining **T**erraces. (terrace height > flood prone height and Flood prone width < 2.5 X active channel width).
CA Constrained by **A**lternating terraces and hill slope. Same rule for terrace height but the channel may meander across the valley floor. The stream channel is confined by contact with hill slopes and high terraces.
CL Constrained by **L**and use (road, dike, landfill)

Example Reach Sheet

REACH SHEET

PAGE: 1 OF: 1

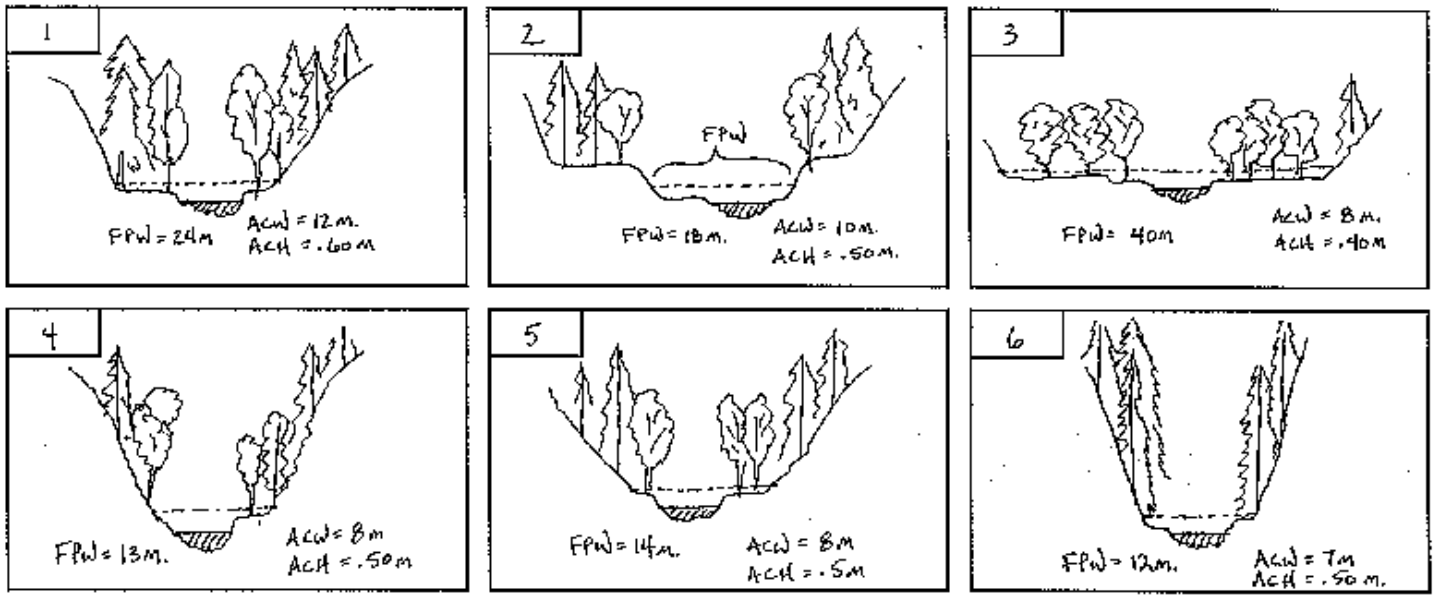
STREAM: EXAMPLE CREEK

CREW: JANE DOE, JOHN DOE

BASIN: N. SOMEWHERE R.

USGS 7.5' MAP NAMES: CEDAR BUTTE

DATE	REACH #	UNIT NUMBER	CHANL FORM	VALLEY FORM	VWI	VEG CLASS DOM.	VEG CLASS SUB-DOM.	LAND USE DOM.	LAND USE SUB-DOM.	WATER TEMP	STRM FLOW	LOCATION TWN-RNG-SEC-1/4	PHOTO# /TIME	REACH NOTE
7/2/98	1	1	CH	MV	2	M30	D3	LT	YT	14°C	MF	T2S-R5W-20NW	10/09:12	BEGIN SURVEY @ CONFLUENCE W/ MAPLE CK.
7/2/98	2	97	CT	CT	3	M30	—	LT	RR	14°C	MF	T3S-R5W-20SE	15/11:30	TRIB JCT. - BLK CK.
7/3/98	3	180	US	MT	5	D15	S	YT	—	15°C	MF	T2S-R5W-29NE	16/10:15	
7/3/98	4	257	CH	MV	1.5	D30	S	ST	YT	15°C	MF	T3S-R5W-15E	20/13:10	COUNTY ROAD # 17A
7/7/98	5	391	CH	MV	1.5	D30	S	ST	YT	14°C	MF	T3S-R5W-15W	22/11:15	TRIB JCT. - BEAR CK.
7/7/98	6	440	CH	SV	1.0	C30	—	LT	—	14°C	MF	T3S-R5W-10NE	26/14:15	



Proper Functioning Condition Assessment

Proper functioning condition is a qualitative assessment that will also be used to assess the condition of riparian-wetland areas that considers hydrology, vegetation, and erosion/deposition (soils) attributes and processes. PFC is also an on-the-ground condition that refers to how well the physical processes are functioning in a riparian-wetland area in order to remain resilient during high flow events with a high degree of variability. The following checklist will be employed in the field to determine the PFC:

PFC Checklist

Standard Checklist

Name of Riparian-Wetland Area: _____

Date: _____ Segment/Reach ID: _____

Miles: _____ Acres: _____

ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Floodplain above bankfull is inundated in relatively frequent events
			2) Where beaver dams are present they are active and stable
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology and hydrologic regime)
			4) Riparian-wetland area is widening or has achieved potential extent
			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is composed of those plants or plant communities that have root masses capable of withstanding high-streamflow events
			10) Riparian-wetland plants exhibit vigor
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of course and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e. rocks, overflow channels, course woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Remarks

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Summary Determination

Functional Rating:

Proper Functioning Condition _____
Functional—At Risk _____
Nonfunctional _____
Unknown _____

Trend for Functional—At Risk:

Upward _____
Downward _____
Not Apparent _____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Flow regulations ___ Mining activities ___ Upstream channel conditions
___ Channelization ___ Road encroachment ___ Oil field water discharge
___ Augmented flows ___ Other (specify)_____

HAB's Sampling Protocol

Protocol for testing waters for toxins associated with HABs will follow the guidelines set forth by the Oregon Health Authority. Sampling sites will be chosen through visual assessment to determine worst case conditions. The Tribes will test for the presence of toxins rather than cell enumeration and identification, at the discretion of water protection staff, if immediate results are necessary preceding any water related recreational activities. Prior to and during Tribal recreational events, Abraxxis Microcystin Test Strip Kits will be used to determine if toxins are present in areas that activities will take place. If toxins are found, the Oregon Health Authority will be notified. If immediate results are not needed, samples will be taken and sent to an outside lab for analysis, Lake Superior State University Environmental Analysis Laboratory.

Visual Assessment

On sampling days, water protection staff will inspect visible waters for algal blooms, document their appearance and location in a logbook, and take photos.

Equipment Needs

Field Assessment Sheet
Arm-length Disposable Waterproof Gloves
Hip Waders
Eye Protection/Safety Glasses
Waterproof Permanent Marker
4 liter stainless steel bucket (if compositing sample)
Cooler or insulated shipping box
Ice Pack(s)
GPS Unit (recommended)
500 mL HDPE Plastic Sample Bottles
Lugol's Preservative Solution
Long-handled Stainless Steel Stirring Spoon (if compositing sample)

Sample Collection

At all sites, field calibration data including dissolved oxygen, pH, water temperature, turbidity, salinity, specific conductivity, and depth and will be recorded with a Hand-held YSI EXO equipped with either an YSI EXO1 sonde or EXO2 sonde. Samples will be collected as close to the middle of the day as staff scheduling permits in order to capture a representative sample, because cyanobacteria move closer to the surface as temperatures increase. Single-point or composite samples will be collected at sites as the water protection staff deems necessary. Single grab samples will be gathered to represent worst case conditions. Composite samples will contain three samples collected at varying points and depths within an algal bloom. The goal of a composite sample will be to determine worst case conditions. Samples will be collected in near-shore areas where cyanobacteria are more likely to accumulate and pose risks to public health. Efforts will be made to sample monthly, spring through fall, although this will not always be feasible due to the timing of blooms and staff availability. Efforts will also be made to sample following a report of a large bloom or animal death, and after heavy rain events. Monitoring will occur if levels are found to exceed standards, and the Oregon Health Authority will be notified of level activity.

Sample Event Preparation

Identification information, time, GPS location, visual water quality observations, and recreation observations will be recorded in the field data sheet logbook. With a waterproof permanent marker, each bottle will be labeled with the sample location/number and "Cell & Enumeration" or "Toxins" as needed.

Collecting Samples
Samples will be taken wearing necessary personal protective equipment. Sampling areas will be selected based on visual assessment to represent worst case conditions and/or risk of exposure. Water protection staff will wade or boat slowly to the sampling location from the downwind side and avoid agitating the water or sediment. The person(s) sampling will disturb the water at the sample location for approximately ten seconds to simulate conditions created by a swimmer or wader coming into contact with the cyanobacteria. The sampler will take a 1L Nalgene bottle, tilt the bottle approximately 45 degrees and allow it to fill as it is submerged 3 to 6 inches below the surface. The cap will be replaced and any cyanobacteria that have adhered to the outside of the bottle will be removed. The bottle will be turned gently end-over-end four times to mix the sample.

Composite Sampling
Because cyanotoxins are organic compounds, sampling equipment used to collect and combine samples will be made of fluorocarbon polymers (such as Teflon®); metals (such as stainless steel); or glass. The bucket used for sampling will be rinsed with fresh water or with lake water relatively free from algae. The person sampling will pour the three 1L sample bottles representing the sampling area into the bucket. Using a long-handled stainless steel stirring spoon, the sampler will thoroughly mix the sample. Care will be taken to not rupture or lyse cells, especially if cell enumeration is the desired outcome of sampling. Water protection staff will pour 1L of the composite sample into a rinsed sampling bottle, then replace the cap and remove any cyanobacteria adhered to the outside of the bottle. The bottle will be turned gently end-over-end four times to mix the sample.

Sample Preservation– (confirm with laboratory)

Cell Enumeration & Species Identification Samples
Using proper personal protection equipment, and in a well ventilated area, the sample will be preserved in the following manner. The cap will be removed from the sample bottle, and enough will be poured out to leave one inch of air space for mixing. Using a pipette, 5mL of Lugol's Solution (or other preserving agent recommended by the lab) will be added to the sample. The cap will be returned, closed tightly, and the bottle will be turned end over end gently four times to mix the solution with the sample. The samples will be placed on ice or ice packs as soon as possible in a cooler or insulated box and shipped overnight within 24 hours to the Lake Superior State University Environmental Analysis Laboratory or other chosen laboratory.

Toxin Samples
CTCLUSI cannot process toxin levels in house. Samples will be placed on ice or ice packs as soon as possible in a cooler and shipped overnight within 24 hours of sampling to the Lake Superior State University Environmental Analysis Laboratory or other chosen laboratory.

Laboratory Methods

Instrumentation includes**:**

- Waters 2695 HPLC PDA/Fluorescence
- Molecular Devices SpertraMax M2e Mircoplate Reader

- Bio-Tek Instruments FLx 800 Fluorescence Microplate Reader
- VirTis Benchtop K Lyopholizer

High Performance Liquid Chromatography/Photo Diode Array (HPLC/PDA)

Analysis	Sample/Size
Extra-cellular priority cyanotoxins	Water / 0.5 L
Total priority cyanotoxins	Water / 0.5 L
Note: Priority toxins include Anatoxin-a, Cylindrospermopsin, and Microcystin RR, LR, LA, YR, and LF.	

Enzyme Linked Immunosorbant Assay (ELISA)

Analysis	Sample/Size
Microcystin	Water / 0.0l L
Cylindrospermopsin	Water / 0.0l L
Saxatoxin	Water / 0.0l L

B.3 Sample Handling and Custody Procedures

Sample Handling

Identification information for each sample will be recorded on the field data sheets when the sample is collected. Samples that are not processed immediately in the field will be labeled with the water body name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve the sample (if any).

Samples for *E. coli* or *Enterococcus* analysis will be transported from the field by Water Protection staff directly to the CTCLUSI laboratory for analysis within the required 6-hour holding time.

Samples for inorganic nutrients and chlorophyll are transported from the field by Water Protection staff to the CTCLUSI laboratory, where they are filtered and frozen. Filters and filtrates are stored at -20°C prior to mailing. As close as possible to the overnight shipment pickup time, frozen samples are packed in a styrofoam container or plastic cooler, surrounded by bags of ice, and sent to the University of Washington Marine Chemistry Laboratory for analysis within 24 hours of sampling.

Samples for macroinvertebrates will be preserved in 70% EtOH solution until they can be mailed to Aquatic Biology Associates for macroinvertebrate analysis. Samples will not be held longer than 7 days after sampling.

Samples for HABS will be transported from the field by Water Protection staff to the CTCLUSI Laboratory, from where they will be packed in a styrofoam container or plastic cooler, surrounded by bags of ice, and sent to an outside laboratory (Aquatic Analysts) for analysis within 24 hours of sampling.

Custody Procedures

Samples that are transferred from one staff member to another, or to an outside professional laboratory, should use a Chain of Custody form. The Chain of Custody form should identify the water body name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). The Chain of Custody form should also indicate the date and time of transfer, and the name and signature of the sampler and the sample recipient. It is recommended that the Chain of Custody form used be the one provided by the outside professional laboratory. When quality control checks are performed by a professional lab, their samples will be processed under their chain of custody procedures with their labels and documentation procedures (Attachment D).

In the field and during transport back to the lab, all water samples will be in the direct control of the sampler unless a chain of custody form has been completed. The sampler is always responsible for maintaining sample security and organization to ensure that all samples collected in the field are of the location stated on the sample bottle, and that no other person can potentially tamper with the sample (lock vehicle doors, secure coolers, maintain constant visual contact with samples, etc.

Water Protection staff will prepare field data sheets (chain of custody forms) prior to field sampling events that will be submitted to an outside laboratory. Separate field data sheets will be maintained for each event.

B.3a Sample Receipt and Log-in Procedures

The CTCLUSI or independent laboratory will receive the field data sheet with the following information: sampling location, sample ID number, date sampled, time sampled, sampler, weather condition, sampling point description, container number, equipment ID numbers, and test(s) requested.

Please note that independent laboratories will, in general, follow similar procedures below. However, specific documentation and custody procedures will be as per their protocol.

The laboratory receiving the samples will verify the information contained on the custody form and check to make certain that samples meet appropriate handling and preservation requirements by:

- Matching actual sample container #'s with those listed on the custody form;
- Checking that appropriate containers were used for the analytes requested;
- Testing pH to determine whether samples requiring acid or base preservation were preserved correctly;
- Consulting technical personnel when field observations raise concern to ensure tests requested are appropriate;

Samples improperly documented, preserved, or exceeding holding time are either rejected by the sample coordinator for analysis, or analyzed and the result reported as an “estimate”. The sampler is notified and re-sampling is recommended.

Contract laboratories must maintain an unequivocal link between the custody form, their LIMS database, and analytical reports.

Raw analytical data records must be maintained, which include the following information:

- Date of analysis
- Analyst
- Identification of blanks, standards, and controls
- Sample number, treatment such as dilutions, analyte additions or special calculations and associated information
- Unusual observations
- All instrument readings and final results (including units) may be maintained as electronic data.

B.3b Field Notebook

Where applicable, a bound field notebook will be maintained by CTCLUSI Water Protection field staff to provide a daily record of significant events, observations, and measurements during field investigations. This record will include water level data, field measurements, personnel, weather observations, and physical conditions. The field notebooks will be kept as a permanent record.

B.4 Analytical Methods

All parameters will be measured using the protocols described in the sampling methods section of this document.

B.5 Quality Control

Quality Control for Fixed Station Monitoring

Software Requirements

- An internet browser such as Internet Explorer or Mozilla Firefox for data submission to externally supported data transfer sites

- Microsoft Excel to perform QAQC of data collected by the sondes

- Microsoft Word for the creation of metadata (data documentation).

Audit Measurements
In the field, during the sonde swap process, a three-way *in-situ* field audit will be conducted. The new (freshly calibrated) sonde reading will be checked against the old (retrieved) sonde reading and a third reading using a calibrated YSI EXO Handheld equipped with a EXO1 or EXO2 sonde taken at the site. The last reading of the retrieved sonde will be compared to the YSI EXO Handheld sonde results and the first reading of the newly deployed sonde. This three-way comparison assures that the new and old sondes are both reading each parameter within a certain tolerance.

Calibration Log
Calibration and field logs must be filled out with every sonde deployment. These work sheets will aid in data QAQC procedures and help identify faulty equipment. After completion, these worksheets will be reviewed by Water Protection staff. Careful review of these documents is vitally important in identifying anomalous data and faulty sondes/sensors.

Entry Verification
Anomalous data are evaluated to determine whether to flag or delete the suspect data. Data are flagged if the values are: 1) outside the range expected for the site, 2) outside the range of measurements and accuracy established for the sensors, or 3) outside the range established for good water quality conditions at the particular site (*i.e*., variable DO or sudden data spikes). Data outside the acceptable range of water quality parameters for a monitoring site are investigated for validity based on weather data, field observations, data printouts, and instrument diagnostics. Data are deleted if the anomalies are attributed to: 1) sensor malfunction — if the voltage reading of the sensor is outside the range established for the sensor or if the sensor will not calibrate, 2) exposure of sensors during low tide if it can be determined that freshwater inflow was not responsible — identified by unusual Depth, Temperature, and Specific Conductivity data, or 3) fouling of sensors by aquatic organisms, debris or sediment — detected by comparing *in situ* sensor with measurements. Because the Depth sensor is non-vented, negative values are not rejected unless they corresponded to Specific Conductivity or other data indicating that the sonde was out of the water. In addition, sensor readings that differ significantly (>10%) from standard solutions (*e.g*., Specific Conductivity) suggest that the sensor was fouled during deployment and they are flagged in the metadata.

Quality Control for Laboratory Analysis

<u>Nutrients and Chlorophyll a</u>

Sample Collection
Collecting a representative sample can be difficult, but is crucial for obtaining valid data. Duplicate, split and field blank samples will be collected to measure variability from sample-to-sample. An important factor in collecting a representative sample is the use of proper sample containers, equipment, supplies, and appropriate preservation. Analytical water samples should always be collected using containers, equipment or supplies obtained directly from the manufacturer or independent laboratory. This insures that the container or sampling equipment has been properly sterilized or cleaned.

1) **Precision**
   i) **Field variability.** Three successive grab samples will be collected for the grab sample program.
   ii) **Laboratory variability.** The University of Washington Marine Chemistry or other outside laboratory will run test standards and check samples in duplicate or triplicate.
   iii) **Inter-organizational splits.** None.

2) **Accuracy**
   i) **Sample spikes.** None.
   ii) **Standard reference material analysis.**
   In order to ensure that quality control measures were being performed by the analytical laboratory, and to determine the quality of analysis, the National Estuarine Research Reserve (NERR) quality assessment program conducted a laboratory comparison study. In August 2003, a commercially-available, certified seawater reference sample for nutrients was purchased. A sealed, 50-ml aliquot was mailed to the University of Washington laboratory for analysis. Staff were asked to report nitrite, nitrate + nitrite, and orthophosphate concentrations expressed as mg/L as N or P. Results were (reference material values with overall uncertainty values in parentheses) orthophosphate 0.053 mg/L (0.048 +/- 0.002 mg/L, a +10.4% deviation), nitrite 0.046 mg/L (0.043 +/- 0.002 mg/L, a +7%deviation) and nitrate + nitrite 0.342 mg/L (0.332 +/- 0.013 mg/L, a +3% deviation).
   iii) **Cross calibration exercises.**
   The University of Washington Marine Chemistry Laboratory runs two commercially available performance evaluation samples per year as part of its accreditation with the State of Washington. It also informally cross-checks results with peer laboratories.

Entry Verification
Analysis results will be sent from the University of Washington Marine Chemistry Laboratory or other outside laboratory in Excel format. Files will consist of sampling station ID, date, replicate number, and parameter values expressed in unit concentrations.

For all analyses requiring filtration, the MDL is variable as detection limit is lowered with more filtration.

Notes:
[1] Fluorometric analysis performed on Turner model TD700. Published detection limit is the lowest extract concentration measurable.
[2] Performed on Shimadzu TOC-5000 Total Organic Carbon Analyzer
[3] Limited by balance used to weigh filters
[4] Performed on CEC 440-SHA Elemental Analyzer (Leman Labs, Inc. currently supported by Exeter Analytical, Inc.).

Macroinvertebrates

Quality assurance procedures (QA) assess the environmental variability, sampling procedure validity, and repeatability of the sample methods. The quality assurance

procedures involve a system of the following standard methods and protocols and duplicate sampling.

Sample Collection
Ten percent of all stream sites sampled, or one sample per survey, whichever is greater, should have a duplicate set of field samples collected. The duplicate sample is from the same sample reach. Field QA samples look at the natural variability within a riffle and insure that the field sampling method is repeatable. This sample is sorted and identified the same as any other sample.

Type collection
It is useful to maintain a macroinvertebrate type collection for each major basin, watershed, project, or ecoregion studied. This collection has a representative of each taxon identified and serves as a basin record, and as a reference for checking identifications.

Safety
It is difficult to provide detailed safety procedures for macroinvertebrate sample collection and processing due to the wide variety of circumstances that could be encountered in collecting and processing macroinvertebrate samples. The items listed below serve as a general guide:

1) Field crew members should stay within shouting distance, if not visual contact, at all times.

2) Field crew members should be familiar with how to minimize their risk of attack by cougars and bears.

3) Field crews should use caution when collecting samples and walking in deep streams, fast moving water, or when walking on slippery or loose surfaces. If the randomly selected sample location is unsafe to sample but a similar spot nearby can be sampled safely, then the safe spot should be sampled. The macroinvertebrate sampler should ask other field crew members for assistance in collecting the sample, if needed.

4) Use adequate ventilation when using denatured ethanol. Avoid prolonged contact with skin. Transport ethanol containers inside a cooler or other container with a tight fitting lid to contain leaks and fumes.

5) Ethanol is flammable. Avoid exposure to flames and extreme heat.

Entry Verification
Analysis results will be sent from Aquatic Biology Associates or other outside laboratory in Excel format. Files will consist of sampling station site, date, sampling method, subsampling method, total number of macroinvertebrate taxa as well as total number of ephemeroptera, plecoptera, trichoptera, long-lived, tolerant, intolerant, and clinger taxa. Other community composition metrics that are indicative of biological conditions, such as the percentages of parasite, predator, collector, Baetis tricaudatus, Oligochaeta, Simuliidae, and Chironomidae, will also be included in the Benthic Invertebrate Index of Biological Integrity.

Level of identification for aquatic macroinvertebrate orders used by DEQ:

Ephemeroptera - genus level except as noted below:
Baetidae - genus only except for *Baetis tricaudatus or bicaudatus*
Ephemerellidae - species in almost all cases
Heptageniidae - genus only except for *Epeorus* (*albertae, longimanous, grandis*, etc.)
Leptophlebiidae – genus except for *Paraleptophlebia bicornuta*

Plecoptera- genus level except as noted below:
Capniidae - family only
Chloroperlidae – genus in late instars
Leuctridae - genus
Nemouridae - genus except species for *Zapada* (*cinctipes, frigida* etc.)
Peltoperlidae - genus
Perlidae - species
Perlodidae - genus
Pteronarcidae – genus except for *Pteronarcys californica*
Taeniopterygidae- genus

Trichoptera - genus level except as noted below:
Rhyacophila- to group except:
Betteni gr.- *R. malkini*
Lieftinchi gr. - *R. arnaudi*
Sibirica gr. - *R. blarina* and *R. narvae*

Coleoptera - Generally keep everything at family level except for genus level for Psephenidae, Hydrophilidae, Haliplidae, and Elmidae.

Diptera - genus level for all families except for:
Chironomidae - sub family (starting in 2006, DEQ will be identifying midges to genus/species, but this level of taxonomy is not required to run DEQ's bug models).
Ceratopogonidae - sub family.
Tabanidae, Dolichopodidae, Ephydridae, Sciomyzidae, Syrphidae - family level only.

Gastropoda - genus level where possible (generally not possible for Physidae).

Hemiptera - genus level apart from Corixidae (family only). (In many cases we should not be counting marginally aquatic Hemipterans such as Gerridae.

Odonata - genus level.

Crustaceans - usually genus level.

Pelecypoda - family level only.

Lepidoptera/Megaloptera - genus level.

Microbiological

Quality Assurance/Quality Control
A 1:10 dilution will be used when running analytical *E-Coli* and *enterococcus* procedures. Microbiological field samples will be allowed to reach room temperature (per IDEXX recommended protocols) before they are diluted. 10ml of each water sample will be pipetted into a sterile, freshly opened, 120ml IDEXX sample bottle and quickly capped. After preparing all the samples taken for that day in the same way, distilled water will be decanted into the lab sample bottle so that the bottle is filled to the 100ml line.

Blanks
For every microbiological sampling event, blanks of sterile water used for the 1:10 sample dilutions will be run.

Replicate Samples
One sample site will be chosen as a replicate site for each sampling event.

Split Samples
For every 10 samples taken, a split sample will be randomly chosen.

The Tribes' IDEXX Lab will be quality controlled as specified in the IDEXX User Manual.

The analyst must flag all results that are associated with a QC measure that fails to meet control limits. A comment will be linked to the result explaining the QC failure.

HAB's
CTCLUSI will use use quality assurance/quality control procedures that meet quality objectives for HAB sampling.

Sample Collection
Duplicate, split and field blank samples will be collected to measure variability from sample-to-sample. Ten percent of all sites sampled, or one sample per survey, whichever is greater, should have a duplicate set of field samples collected. The duplicate sample will be from the same sampling location. A split sample will be randomly chosen per Water Protection Staff's discretion. Field QA samples look at the natural variability within a site and insure that the field sampling method is repeatable. This sample is sorted and identified the same as any other sample.

Safety
Because cyanobacteria can produce neurotoxins and hepatoxins as well as lipopolysaccharides that can irritate the skin, person protective equipment, such as hip waders, long rubber gloves, and eye protection, will be worn during the sampling collection process. Also, sampling locations will be contingent upon ease of access and lack of physical barriers that may infringe upon safety.

Entry Verification
Analysis results will be sent from Lake Superior State University Environmental Analysis Laboratory or other chosen laboratory in Excel/electronic format. Deliverables will

consist of individual sample reports, similarity indices, data summaries, combined species lists, and a brief narrative discussion of the results.

Individual sample reports include sample identification, a trophic state index, total sample density, total sample biovolume, and a list of algae species with their absolute and relative densities and biovolumes. All data are reported in Excel format.

Data summaries include sample identification, total density, total biovolume, the trophic state index, and the top 5 most common algae species (codes) and their relative densities. The summary format (Excel) allows for easy calculations and graphs of algae sample data.

Combined species lists of all species within related groups of samples allow greater sensitivity in comparing different lakes, sites, dates, or depth. Algae species are compiled according to their relative densities.

Lake Superior State University Environmental Analysis' Laboratory Quality Assurance:

Data Quality Objectives

The EAL's organizational structure and Quality Assurance program is designed to effectively and efficiently accomplish established data quality objectives for all of its analytical services. The quality of measurements made by the laboratory is determined by the following data quality objectives or characteristics: representativeness, accuracy, precision,

Specific objectives for each characteristic are generally established to assist in the selection of appropriate sampling and analytical protocols and to identify applicable documentation, sample handling procedures, and measurement system procedures. These quality objectives are established based on collection site conditions, specific requirements of the project, knowledge of available analytical systems, and are addressed whenever appropriate for the data generated.

Quality Assurance Policy

The goal of the EAL is to use the concept of complete quality management to produce analytical results of known, documented, and acceptable quality. The validity of data resulting from day-to-day analysis depends on a strong, effective, and consistently practiced quality assurance program. The EAL's Quality Assurance Manual (QAM) outlines that program for all aspects of laboratory chemical and microbiological testing operation. The EAL's objectives for precision, accuracy, and detectability of analytical results, and the associated quality control measures are described.

The EAL quality assurance program is designed to be dynamic in nature. It currently encompasses activities for traditional wet chemical analysis techniques, classical and state-of-the-art instrumental analysis methods, and field measurements using portable analysis equipment. The program is designed to facilitate the fulfillment of both the EAL's and the client's goals for its analytical products. It also satisfies appropriate university, local, state, and federal regulatory requirements. The QAM is updated at a

minimum annually, based on the results of quality assurance monitoring of analytical processes, internal and external assessments, and evolving regulatory policies.

EAL Standard Operating Procedures (SOPs) for all analytical services, which contain specific details of laboratory and method quality assurance practices, are maintained in a separate manual. SOPs are updated as required and reviewed annually.

The Laboratory Manager of EAL assumes responsibility for ensuring that all laboratory staff understand laboratory quality assurance/quality control practices any revisions and implement them immediately. As part of his or her initial orientation, each laboratory staff/student member is required to read the QAM. The employee is required to document, through their signature, that they have read and fully understand the scope of this document. Signed statements to this effect are placed in the employee's quality assurance training file. Employees are expected to practice policies outlined in these documents as a matter of habit.

The EAL is committed to preforming work ethically and following the highest standard of honesty and integrity. This is dependent on a environment free of financial, commercial, and other pressures that can adversely affect the quality of analyzes. EAL quality control systems are in place to identify analytical quality deficiencies. Each staff member is required to implement the guidelines of the QAM and implement corrective action where quality deficiencies are observed. The Laboratory Manager maintains the authority to stop work for any deficiencies of quality from any source.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

Field monitoring and laboratory equipment will be tested for accuracy in accordance with the procedures outlined in the National Estuarine Research Reserve System-Wide Monitoring Program (SWMP), YSI EXO Multi-Parameter Standard Operating Procedures in conjunction with the YSI EXO manual and the ODEQ Water Monitoring and Assessment Mode of Operations Manual (MOMs), and YSI 6-Series Multi-Parameter Standard Operating Procedures in conjunction with the YSI 6-Series manual and the ODEQ Water Monitoring and Assessment Mode of Operations Manual (MOMs). Deficiencies in inspection and acceptance testing will be described and documentation provided upon request.

Incubator temperatures will be recorded before microbiological analysis, during, and after analysis, with each reading separated by at least 4 hours.

B.7 Instrument/Equipment Calibration and Frequency

All equipment will be calibrated prior to deployment as stated in the equipment operations manuals. Equipment that fails to calibrate, or is malfunctioning in any other way, will not be used to collect water quality data until the equipment is repaired. Equipment log sheets will be placed in a folder to document all calibrations and testing. Water Protection staff will ensure that all equipment is in proper working order for the project.

YSI Sondes:
The YSI EXO1, EXO2, and 6-series Sondes will be calibrated prior to each deployment and/or field sample as outlined in the YSI Environmental Operations Manual.

Hobo Dataloggers:
The calibrations and audits of the water temperature dataloggers will be performed in accordance to the guidance found in Chapter 6 of the *The Oregon Plan for Salmon and Watersheds Water Quality Monitoring Technical Guide Book, July 1999*.

Bacterial Sampling:
The IDEXX lab will be calibrated and audited using the methods and frequency instructed by the equipment operations manual.

Hach 2100-P Turbidimeter:
The Hach 2100-P Turbidimeter will be calibrated and audited in accordance with the procedures outlined in the equipment operations manual.

Eutechnics Model 4400 NIST Traceable Digital Thermometer:
The Eutechnics Model 4400 NIST Traceable Digital Thermometer will be calibrated and audited in accordance with the procedures outlined in the equipment operations manual.

B.8 Inspection/Acceptance of Supplies and Consumables

All equipment, supplies, and consumables used for this project will be inspected prior to field deployment. Anything defective or not meeting project goals as determined by Water Protection Staff will not be used in the project.

Water Protection Staff will also be responsible for maintaining records of traceability for all reagents and standards. Water protection staff must validate the usability of standards and reagents upon receipt and when expiration dates are exceeded.

C.1 Data Acquisition Requirements

Secondary data from outside sources may be used in the project to assist in understanding influences impacting water quality conditions. The outside sources may be topographic maps, point sources, outfall locations, water quality data, GIS data, etc.

C.2 Data Management

The monitoring equipment used for this project is designed to store and transfer large amounts of data directly into a computer using the software provided by the manufacturer. All other field data collected will be recorded on rain proof field data sheets that will include basic information such as station id, date, time, water/weather conditions, tide, and any other information deemed useful for the project.

For bacterial data, data sheets will be input into a Microsoft Excel spreadsheet format and included into existing water quality data. (See attached bacteria data sheets)

The raw data uploaded into an Excel spreadsheet format will be updated into the comprehensive relational database developed by CTCLUSI. This database is currently in use for data organization, storage, and analysis for all data acquired from the integrated water quality monitoring program. Water data will be packaged and submitted into EPA's STORET Data Warehouse using the WQX framework.The CTCLUSI database is also compatible with Oregon Department of Environmental Quality's LASAR reporting format.

Separate field sheets will be maintained for each sampling event. Information recorded on data sheets is to include: project name, date and time of sampling events, site location, general weather and water conditions, general observations, field results and equipment ID numbers. Water Protection Staff will review data sheets for all continuous, field and laboratory data. The chain of custody and field data sheets will be scanned and maintained on the Tribes' server.

Water Protection Staff will maintain records of calibration, deployment, and post deployment readings to provide essential information for data QA/QC procedures necessary to identify faulty equipment. All log sheets, files, and notebooks will be made available upon request.

Water Protection Staff are responsible for providing a comprehensive metadata document including all agency contacts, data referencing/ownership, distribution, sensor specifications, site descriptions, research methods, and research objectives. Metadata explains all aspects of the data from the research objectives to the data QA/QC. The metadata documentation is based on the water quality metadata management chapter procedures and template provided in the CDMO NERR SWMP Data Management Manual.

C.3 Assessments and Response Actions

The Director of the Natural Resources Department will ensure that all Water Protection Staff are capable of successfully performing the tasks outlined in this QAPP. The Director may at any time during the project perform any audits that are necessary to maintain project objectives. This may include the evaluation of staff performance, audits of systems, and audits of data quality. Any problems identified by the Director will be addressed and fixed immediately.

C.4 Reports to Management

Staff will prepare and submit quarterly data reports to the Director. The reports will include all data collected and brief updates on the status of any projects. A yearly Tribal Water Quality Assessment Report will be completed for each water year (October – September). The report will then be submitted to the Director for final review and approval. The report will then be submitted to Tribal Council and EPA for review, comments and overall program guidance.

D.1 Data Review, Verification and Validation

Water Protection Staff will determine if the data collected meets the QAPP objectives and will review all data resulting from the project as data becomes available. Suspect data and inconsistencies will be flagged and documented for further review. Project quality objective and measurement performance criteria discussed in section A. 4 will be used to verify and validate data collected by this program.

Decisions to accept, qualify, or reject data will be made by Water Protection Staff. The Director and Water Protection Staff will conduct data review and validation for all data collected for the project prior to any data submittal to EPA.

D.2 Verification and Validation Methods

Water Protection Staff will perform data validation and verification of all water quality data collected and entered. Water Protection Staff will check the data entered into the Excel spreadsheets with the field sheets to verify that the data entered into the spreadsheet is accurate. Information recorded on field data sheets includes: project name, date and time of sampling events, site location, general weather and water conditions, general observations, field results and equipment ID numbers. In addition, each field day sampling event will be given a field data coversheet that will include a calibration record, data completeness check, name of individual who performs data entry, initial of data quality control individual, and notes on missed sampling dates, sites etc. A combination of Excel and relational database applications will be used to review all data collected by this program for outlier, suspect, and anomalous data. Water Protection Staff will randomly compare 10% of the field data sheets with the Excel worksheets, and verify that the Water Protection Staff entered the data in correctly. If staff identifies an error in the transfer of data, all Water Protection Staff will work together to correct the error and re-check all data transferred into the worksheets. Once accomplished, Water Protection Staff will resubmit the worksheet and randomly compare 10% of the data entered. The same process will occur until the data is checked and no errors are found.

D.3 Reconciliation with User Requirements

As soon as possible, after each sonde deployment or sampling event, determinations for precision, accuracy/bias, sensitivity, representativeness, comparability, and completeness will be made and corrective actions implemented if needed. The cause of any data quality and collection failures will be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling error, Water Protection Staff will be retrained. Any limitations on data use will be detailed in the metadata. Data may be discarded if data is determined to be a false representation of the parameter's assessment. Data discarded will have a section within the final report discussing why the data was omitted and potential adjustments that need to be made to keep true representative data for the project.

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Attachments

A U.S. EPA Letter
B Map of Tribal Watersheds
C Lab and Field Data Sheets
D Chain of Custody Procedure
E Chain of Custody Forms
F University of Washington School of Oceanography Nutrient and Chlorophyll Sampling Standard Operating Procedures
G Contract Lab Certifications

Attachment A: U.S. EPA Letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

AUG 25 2003

Reply To Attn Of: Oregon Operations Office
Clarence Ortman

Ronald Brainard, Chairman
Confederated Tribes of Coos, Lower Umpqua & Siuslaw
1245 Fulton Ave.
Coos Bay, OR 97420

Dear Chairman Brainard:

We have received letter sent by Francis Somday, Tribal Administrator, to Clarence Ortman, dated May 29, 2003. This concerns updating the file for the grant under Section 106 of the Clean Water Act (CWA) to include additional property for the Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (the Tribe).

Specifically, Mr. Somday requested that the current CWA 106, Treatment-As-A-State (TAS) document be updated to include a parcel known as "Miluk Village Property, Tax lot #4300", as shown on a map enclosed with his letter.

This letter will act as notification that your map and legal description will be included in our permanent file in Seattle. For property that the United States holds in trust for the Tribe, otherwise known as tribal trust land, EPA's position is that the property has the status of an Indian reservation. The funds granted by EPA under section 106 of the CWA can be used only to fund water quality programs for reservation waters or to support activities that pertain to waters of the reservation.

If you have any more questions, feel free to contact Clarence Ortman, of my staff, at (503) 326-7024.

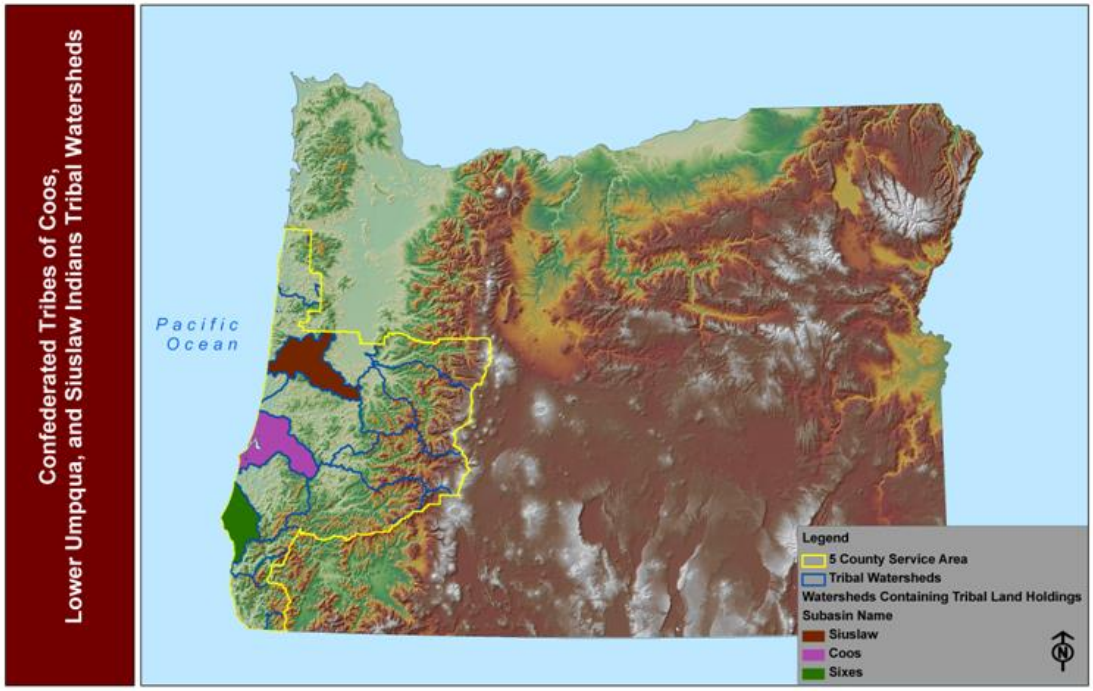
Sincerely,

L. John Iani
Regional Administrator

cc: Francis Somday
Howard Crombie
Clarence Ortman

Printed on Recycled Paper

Attachment B: Map of Tribal Watershed



Attachment C: Lab and Field Sheets

YSI EXO Sonde Calibration Worksheet Sample

Printed on 11/20/2015 at 12:31 PM

Calibration Worksheet

pH 15K101143

	UTC Time	Coordinated Universal Time
Start Date/Time	11/21/2015 04:24:20 AM	11/21/2015 04:24:20 AM
End Date/Time	11/21/2015 04:30:28 AM	11/21/2015 04:30:28 AM
Previous Calibration Date/Time	1/1/1970 08:00:00 AM	1/1/1970 08:00:00 AM

Sensor Type	pH	Sonde Type	EXO1 Sonde
Sensor SN	15K101143	Sonde SN	13H102715
Sensor Firmware Version	3.0.0	**Sonde Firmware Version**	1.0.18
Calibration Parameter	pH	Sonde ID	Sonde 13H102715

QC Score

	Cal Point 1	Cal Point 2	Cal Point 3
Standard	7.00 pH	10.00 pH	
Pre Calibration Value	7.08 pH	10.15 pH	
Post Calibration Value	7.00 pH	10.00 pH	
Raw Value (pH mV)	-4.50	-183.79	
Temperature	21.87 ° C	21.87 ° C	
Additional Input 1 (N/A)			
Additional Input 2 (N/A)			
Additional Input 3 (N/A)			
Type	**YSI pH 7 Buffer**	YSI pH 10 Buffer	
Manufacturer	YSI	YSI	
Lot Number			
Calibration Point Accepted	YES	YES	
Stability Achieved	YES	YES	

Completed	YES
Applied	YES
Valid	YES
Sensor Removed	NO
Uncalibrated	NO

Hardware	EXO Desktop
KOR Version	1.0.12
Worksheet Version	1

Additional Post Calibration Info:
pH 7.00 and 10.00 Delta Slope 179.29 mV
59.76 mV per pH unit

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
YSI 6600 EDS Deployment & Retrieval Sheet

Site Name: _____

Maintenance

Date of Calibration _____ Technician(s) _____

Turbidity Wiper Replaced	**Y or N**	Wiper parks 180º from optics?	**Y or N**
Chlorophyll Wiper Replaced	**Y or N**	Wiper parks 180º from optics?	**Y or N**
Replace Batteries?	**Y or N**	Replace DO Membranes	**Y or N**
		Membrane Integrity Test	_____ **initial**

Identification Numbers

Sonde	_____	DO	_____	Conductivity	_____
pH	_____	Turbidity	_____	Chlorophyll	_____

Comments _____

PRE/ POST DEPLOYMENT CALIBRATIONS: (Turn on pH mV and DO Chrg in report menu)

	Pre-Deployment					
	Pre-Deploy.	At Calib	Error Msg.	Sensor Diagnostics		Post-Deploy.
% DO @ 100% sat	%	%	Y or N	DO Chrg. (range 25-75)		%, %
Baro Press (mm)	mm	mm		DO Gain (0.8-1.7)		mm
				DO Warm Up Test (Hi/Low)	P or F	P or F
Depth (m)	m	m	Y or N			m
Sp Cond (mS/cm)	mS/cm	mS/cm	Y or N	Cell Const (4.6-5.45)		mS/cm
pH @ Buffer 7			Y or N	pH 7 (0 ± 50 mV)		
pH @ Buffer 10			Y or N	pH 10 (-180 ± 50 mV)		
pH @ Buffer 4			Y or N	pH 4 (+180 ± 50 mV)		
Calculate pH Slope				pH 7 to 10 (165-180)		
Turb. @ _____NTU	NTU	NTU	Y or N			NTU
Turb. @ _____NTU	NTU	NTU	Y or N			NTU
Chl. @_____ug/L	ug/L	ug/L	Y or N			ug/L
Chl. @_____ug/L	ug/L	ug/L	Y or N			ug/L
Battery Voltage	v					v

Programming:

Set Clock (status)	Y or N	**Free Bytes (status)**	K
Interval	min	**Start Date**	
Duration	days	**Start Time**	
Format Flash Disk	Y or N	**Data Filename**	
Free Memory	days		

Parameters Date, Time, TºC, SpCon, Sal, DO%, mg/L, Depth, pH, Turb., Chl., Batt.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
Site Conditions Field Sheet

Date: _____
Time: _____ **Station Name:** _____
Water Body Name: _____ **Recorder:** _____

Weather Conditions: (Circle One)
Clear Overcast Showers Rain

Air Temperature/Time: _____ ºC/ _____

Type of Flow: (Circle One)
None Intermittent Trickle Steady Heavy

PROPERTIES OF WATER

Clarity:
Clear Cloudy Milky Muddy Other: _____

Color:
Clear Green Brown Other Other: _____

Odors:
None Rotten Eggs Sewage Chlorine Musty Ammonia
Other: _____

Floatables:
None Oily Sheen Garbage Sewage Other: _____

Biological Floatables:
None
Algea (% Coverage in Water) _____
Foam (%Coverage in Water) _____ Foam Color _____
Foam Height

DEBRIS

Density of Trash:
None Light Moderate High Approx. # of Items _____

Type of Trash: (% type of item)
_____ % Organic (food items)
_____ % Recyclables-not plastics
_____ % Plastics
_____ % Large Items (cars, appliances, etc.)

FIELD NOTES

_____
_____
_____
_____
_____

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
Water Quality Parameters Field Sheet

Date: _____ **Station Name:** _____
Time: _____ **Recorder:** _____
Water Body Name: _____ _____

DISSOLVED OXYGEN
Equipment Used: YSI EXO1 Other _____
DO Audit: Yes No
Results: Stored on Equipment Observed: % Saturation mg/L
a. _____ a. _____
b. _____ b. _____
c. _____ c. _____
Comments: _____

pH
Equipment Used: YSI EXO1 Other _____
pH Audit: Yes No
Results: Stored on Equipment Observed: _____ 1st Reading
_____ 2nd Reading
_____ 3rd Reading
Comments: _____

WATER TEMPERATURE
Equipment Used: YSI EXO1 Other _____
NIST Audit: Yes ºC No
Results: Observed: _____ ºC
_____ ºC
_____ ºC
Comments: _____

TURBIDITY
Equipment Used: YSI EXO1 Other _____
Turbidity Audit: Yes No
Results: Stored on Equipment Observed: _____ FNU
_____ FNU _____ FNU Mean
_____ FNU
Comments:

SALINITY
Equipment Used: YSI EXO1 Other _____
Salinity Audit: Yes No
Results: Stored on Equipment Observed: _____ ppm
_____ ppm
_____ ppm
Comments: _____

SPECIFIC CONDUCTIVITY
Equipment Used: YSI EXO1 Other _____
Sp. Cond Audit: Yes No
Results: Stored on Equipment Observed: _____ mS/cm
_____ mS/cm
_____ mS/cm
Comments: _____

SHALLOW DEPTH
Equipment Used: YSI EXO1 Other _____
Audit: Yes No
Results: Stored on Equipment Observed: Top Bottom
_____ m _____ m
_____ m _____ m
_____ m _____ m
Comments: _____

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
E. Coli Bacteria Data Sheet

Date	Site	Time Collected	Time to Lab	Time In	Read Date	Read Time	Large Wells	Small Wells	E. coli MPN/100ml	Dilution	Total

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
Coliform Bacteria Data Sheet

Date	Site	Time Collected	Time to Lab	Time In	Read Date	Read Time	Large Wells	Small Wells	Entero MPN/100ml	Dilution	Total

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Water Quality Monitoring Program
Total Coliforms Bacteria Data Sheet

Date	Site	Time Collected	Time to Lab	Time In	Read Date	Read Time	Large Wells	Small Wells	Entero MPN/100ml	Dilution	Total

Attachment D: Legal Sample Chain-Of Custody Procedure (From DEQ LAB: Field Sampling Reference Guide Revision 6.0)

Purpose

To provide appropriate support to litigation, the Tribal Water Quality Monitoring Program must demonstrate the integrity of samples submitted for analysis, and test results, by documenting chain of possession or custody.

Written procedures must be available and followed whenever samples destined to become evidence are collected, transferred, stored, analyzed, or discarded. Their primary objective is to create an appropriate and accurate record that can be used to trace the possession of a sample from its collection, through analysis, until its introduction as evidence. A sample is considered to be *in custody* if it is:

a. In actual physical possession.
b. In view, after being in physical possession.
c. In physical possession, and then placed in secure storage.
d. In a secured area where access is restricted to authorized personnel.

Pre-sampling

Prior to any "Legal" sample collection, the Director should be appraised of the project's regulatory objectives, proposed sampling locations and procedures, matrices, analytical requirements, and chain-of-custody procedures to be followed. This is especially true for any project collecting LEGAL samples, or when non-routine sampling procedures are employed.

When criminal action is contemplated the potential litigant also must be informed that samples are to be collected. Since analytical results may be used as evidence, the potential litigant is entitled to collect duplicate samples and have them analyzed by someone else, or observe the analysis being done by the CTCLUSI laboratory.

Sample Collection

The minimum number of persons should be involved, and each should be trained in proper collection and handling of samples.

Written procedures for collection, preservation, and handling, specific for each sample type and analysis must be followed, and any deviations documented.

Field records must be complete, dated, and initialed at the time the sample is collected. Field sheets should have the following information:

a. Specific sampling location
b. Date and time sample collected
c. Purpose
d. Sample container number
e. Preservatives added and quantity
f. Analyses required
g. Pertinent field data (e.g., pH, temperature)
h. Name of collector(s):

The sample collector is responsible for the care and custody of the samples (including documentation) until the samples are properly shipped to the Laboratory, or custody is transferred to another person.

Color slides or photographs of the sampling location are recommended to facilitate identification and subsequent recollection by the sample collector(s). Sign and write date, time, and location on the back of each photo. Handle photographs according to chain-of-custody procedures. Keep and protect negatives (if appropriate) as part of the documentation.

Transfer of Custody

When transferring possession/custody of samples, the date and time of transfer must be recorded, and all persons involved must sign the record. The sample collector is responsible for proper packaging, security, and transport of samples to the Laboratory for analysis, as well as providing all necessary sample documentation.

Samples shipped to the Laboratory, either by mail or private carrier, must be in a shipping container sealed with security tape or a Numbered Security Seal.

The number embossed on the security seal must be recorded on the field sheet, which accompanies the samples.

Once locked, a wire cutter is required to remove the seal, assuring the integrity of the samples. The sample collector should retain a copy of the field sheet.

The Laboratory as part of the permanent chain-of-custody documentation will retain copies of receipts from post offices, or bills of lading.

Adhesive-backed "security seals", which theoretically sustain damage when removed, cannot always be relied upon. Experience has shown these seals do not adhere to some plastic ice chests (e.g. they can be removed without damage!).

An effective security tape is filament packing tape wrapped several times completely around the cooler. The tape should be signed or initialed and dated using a permanent marker pen across the tail-end of the tape.

Laboratory Custody

The Sample Tracker is the principal custodian of samples in the Laboratory. Water Protection Staff are also designated to act as sample custodians. Samples should be handled by a minimum number of persons.

A log book in which to record sample transfers, and a secure place to keep Chain-of-Custody forms accompanies each refrigerator.

Attachment E: Chain of Custody Forms

CTCLUSI Chain of Custody

Entered Into Database:	Yes by
Database Reviewed:	Yes by

SURVEY: _____ Date Sampled: _____

Major Basin: _____ Date Received in Lab: _____ Date Reported: _____

Collected by: _____ Weather: _____

BACTERIA ANALYSIS REPORT

Item #	SITE #	SITE NAME	DO Poly	Time (HH MM)	Temp. (DegC)	FCond. (mhos)	D.O. (mg/l)	DO Sat. (%)	Field Turb. (NTU)	Bact Bottle	Date/Time in / Date/Time out	Temp in / Temp out	T. coliform / *E.coli*
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
		ACCUARCY DATA QUALTY LEVEL BASED ON STANDARDS CHECKS			NA		NA	NA		Cond: A ≤ ±7%, B ≤ ±10%; Turb ≤ ±5%, B ≤ ±30%			
		PRECISON DATA QUALITY LEVEL BASED ON DUPLICATE SAMPLES								Temp: A ≤ ±0.5, B ≤ ±1; Cond: A ≤ ±10%, B ≤ ±15%; DO: A ≤ ±0.3, B ≤ ±1; Turb ≤ ±5%, B ≤ ±30%			

Bacteria Analyst

Comments: _____

PAGE_____OF_____

Aquatic Biology Associates Sample Log

Sample Log

Client:
Contact person:
Phone :
e-mail:
Project name:
Date sent:

	Sample	Station	Date	Number of Sample Bottles	Sampler	Mesh size	Area sampled
1	e.g Sun Creek	@ mouth	9/14/2009	2	D-frame net	500 micron	8 square feet
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

You may add columns and rows to better reflect your project and sample information.

Lake Superior State University Chain of Custody

LAKE SUPERIOR STATE UNIVERSITY

Environmental Analysis Laboratory

Chain Of Custody Report
Project:
Contact Information:

No	Sample I.D.	Date of Collection	Collection Time	Location and/or Description (To Include GPS Information When Availble)	Sample Mass/Volume	Analysis Desired
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Released By:_____ Date:_____ Received By:_____ Date:_____

Released By:_____ Date:_____ Received By:_____ Date:_____

Attachment F: University of Washington School of Oceanography Nutrient and Chlorophyll Sampling Standard Operating Procedures (http://www.ocean.washington.edu/file/Sampling+Procedures)

UNIVERSITY OF WASHINGTON, MARINE CHEMISTRY LABORATORY

Please read and familiarize yourself with your procedure before sampling. If you have any questions or need any clarifications on your sampling protocol, please don't hesitate to contact us beforehand. (206)543-9235.
Happy sampling!
Kathy, Aaron, and Loren.

Sampling Procedures for:

- Chlorophyll A
- Nutrients
- TNP

Sampling Procedure:
Chlorophyll a

Equipment:
Clean bottles
Filtration apparatus
Graduated Cylinder(s)
GF/F filters

Procedure:

Take water sample directly into a clean (acid-washed, rinsed 3X with distilled water) bottle. Pre-rinse bottle 3X with sample water prior to sampling.

Water samples should be stored in the dark and chilled until filtered. **For best results, filter the water as soon as possible**, ideally right away, but THEY SHOULD BE FILTERED W/IN 24hrs!!! MAX!!!

Vigorously shake bottle then filter a **known volume** of water through the GF/F filter-and **record the filtration volume!**

Need to filter enough so that there is a small amount of color on the filer. As with any analysis that requires filtration, the more you can filter, the better, but you also don't want to clog the filter.

Fold filter in half and store in the supplied 15ml screw top tubes. Store/ship frozen and minimize the filter's exposure to light.

Paper log sheets must accompany samples received in the lab.
Log sheet information must include:
Billing/Contact information, affiliation, sample ID, site and date, **filtration volumes**, and whether the sample is from a marine (oceanic, coastal, Puget Sound, estuary etc.) or freshwater environment (lake, stream pond etc.)

Sampling Procedure:
Nutrient Samples.

Equipment:
Sample bottles (60 ml HDPE)
60 ml syringes
Syringe filters (surfactant free cellulose, 25mm, .45micron pore size, Nalgene)

PROCEDURE
From the rosette bottle, draw water into the sample bottle to rinse the bottle twice...don't forget to rinse the cap too
Remove the plunger from the syringe and rinse the syringe with sample water twice
Fill the syringe fully with sample water...insert plunger
Invert syringe and expel the air bubble
Attach a filter to the syringe; filter about 5 ml of sample into sample bottle to rinse
Filter about 45-50 ml of sample into the nutrient bottle...the bottle should be NO MORE than 2/3 full

DO NOT OVERFILL THE BOTTLE!! WATER EXPANDS WHEN FROZEN AND IF THE BOTTLE IS TOO FULL THE ICE WILL FORCE ITS WAY OUT OF THE CAP AND TAKE THE NUTRIENT S WITH IT.

Securely cap the bottle and freeze upright in a -10 degree freezer.

Discard filter

Make sure you have filled out log sheets legibly and included them with the samples when you bring them to the lab for analysis.

Log sheet information must include: Billing/Contact information, affiliation, sample ID/Date, AND whether sample(s) are freshwater or saltwater, ideally an approximate salinity should be given.

Sampling Procedure:
Total Nitrogen/Phosphorous (TNP) Samples.

Equipment:
20ml Graduated Cylinder (The TNP Sampler)
Wide-Mouth Polypropylene (PP) 60ml bottles
Sharpie Pen or Marks a lot Magic marker

Procedure:
Take water sample directly into TNP sampler (pre-rinse 2-3X w/sample)
Pour 20mls into the bottle. If you're sampling from a freshwater or high organic site, take 40mls.
Label bottle with marker or record the bottle #--DO NOT label with tape or paper. Bottles will be autoclaved and tape and other labels cannot withstand the temperature and pressure.

Paper log sheets must accompany samples received in the lab.
Log sheet information must include:

Billing/Contact information, affiliation, sample ID/Date, AND whether sample(s) are freshwater or saltwater, ideally an approximate salinity should be given.

Attachment G: Contract Lab Certifications

Aquatic Biology Associates, Inc.
Corvallis, OR

Laboratory Protocols and QA/QC Guidelines for
Processing Freshwater Benthic Macroinvertebrate Samples

Standard Operating Procedures for Sample Handling, Sub-sampling and Sorting

Aquatic Biology Associates, Inc., 3490 NW Deer Run Rd., Corvallis, OR 97330.
541-752-1568, bob@aquaticbio.com

Please see our web site at www.aquaticbio.com for information on preservation, labeling and shipping of samples.

Standard operating procedures: The following QA/QC procedures are routinely followed at Aquatic Biology Associates, Inc. (ABA) for processing benthic macroinvertebrate samples. Procedures will be altered to fit the needs of the individual client on specific projects.

Sample tracking: Upon receipt, samples are unpacked and their condition and preservative levels checked. Jar labels are checked to ensure they are intelligible and that the experimental design is understandable. Clients are encouraged to include a packing list or chain-of-custody form with each set of samples, so that arrival of the full sample set can be verified. Please include your e-mail address so that we can notify you of sample arrival. We will inform you if samples have been damaged in shipping, or if the labeling system is not understandable.

Labeling conventions: Clients are encouraged to follow these suggested labeling conventions to avoid confusion: **state/province** (e.g. WY), **agency/client** (e.g. WY DEQ), **water body** (e.g. Boulder Cr. u/s confl. Deer Creek), **site** (e.g. Site 1), **replicate** (e.g. 1,2,3...or A,B,C...if applicable), **habitat (**e.g. riffle), **sample type and area** (e.g. d-frame net, 8 ft^2), **date** (month/day/year), **client tracking code** (if applicable).

If a single sample has been split between two or more jars because of its size, please mark the different jar labels, e.g. **1 of 2** and **2 of 2.** Do not use this convention to refer to separate replicate samples taken at a single site, otherwise we will assume that they are all one sample.

Please be aware that even supposedly indelible inks (ink pens or Sharpie® markers) can smear, run or be rubbed off the outside of plastic sample jars, especially if the alcohol preservative leaks. To avoid loss of sample data, clients

are encouraged to label both the outside of the sample jar, and include a label on the inside of the jar written in pencil on Rite-in-the-Rain® paper.

ABA will make additional interior sample labels that will follow the sample through the entire laboratory process.

Sample preparation: The entire sample is first placed on a sieve of the pore size specified by the client (500 micron is the most common), and then rinsed with cold water to remove old preservative and fine sediments. Samples are then transferred to a white plastic tray and floated in cold water. Large debris is rinsed and removed. The sample is then elutriated back onto the sieve until all organic matter and invertebrates are floated off the heavier mineral residue. The mineral residue remaining in the white pan after elutriation is searched for stone-cased caddisflies and mollusks that have not floated off. If there is any doubt as to whether the mineral residue has been cleared of all invertebrates, it will be recombined with the organic fraction for sorting. Prepared samples are re-preserved in 80% ethanol.

Sub-sampling: Unless otherwise specified by the client, a portion of each sample will be sorted to obtain a count of 500-600 organisms. If invertebrate densities are low (<600 organisms), samples will be processed in their entirety. The Caton sub-sampling tray is used to obtain 500-600 organisms in a random manner (Caton, L.W. 1991. *Improved sub-sampling methods for the EPA "Rapid Bioassessment" benthic protocols.* Bulletin of the North American Benthological Society, Volume 8, Number 3, pages 317-319). After sub-sampling, the unused sample portion is archived until the project is completed to the client's satisfaction. Unused sample fractions will be returned to the client upon request.

Sample sorting: Trained technicians remove all invertebrates from the sample residue by randomly selecting squares from the Caton sub-sampling tray and using dissecting scopes at 6X or 12X power to remove all invertebrates. Smaller projects are assigned to a single technician. For larger projects, several technicians are given the responsibility for the sorting. The sorting technician places the 500-600 organism subsample acquired into a single sorting vial. Sample sorting logs are kept by each technician to record sample label data, fraction sorted (e.g. number of squares of the Caton tray), hours required to complete sorting, and comments on the sample matrix, and any problems. Sorted sample sets and logs are given directly to Robert W. Wisseman, lead taxonomist of ABA.

Large/rare organism search: After randomly acquiring the 500-600 organism subsample for each sample, the sorting technician conducts search of the remaining sample matrix by eye for large or rare organisms (e.g. crayfish, mussels, large cranefly larvae). This is accomplished by refloating the unsorted remainder of the sample matrix in the Caton tray in cold water. The technician takes approximately 5-10 minutes searching the matrix for larger invertebrates,

particularly concentrating on taxa not acquired during the 500-600 organism sub-sampling process. Technicians also retrieve late instar larvae or mature specimens in good condition to aid in taxonomic identification. Adult aquatic beetles, caddisfly pupae, water surface or semi-aquatic taxa, and some empty mollusk shells are also retrieved. These specimens are archived because of their value in providing species level information to taxonomists and aquatic ecologists.

All of the specimens collected from the remainder of the sample matrix during the large/rare search are placed in a separate, labeled vial that accompanies the vial containing the 500-600 organism subsample through the taxonomic identification process. If there are taxa in the large/rare vial that are not found in the subsample, their occurrence for entire sample will be recorded on the sample bench sheet as an abundance of one. This is the default procedure for ABA. Clients may specify the manner in which data from the large/rare search is recorded, or to dispense with the large/rare search altogether.

Taxonomic QA/QC

Robert Wisseman, Senior Scientist, is the lead taxonomist at Aquatic Biology Associates, Inc. (ABA). He has 30 years of experience with the freshwater invertebrates of western North America, and is a recognized expert on western caddisflies (Trichoptera). Robert performs the initial identification and enumeration on all samples. If identification of the Chironomidae (midges) is required to the genus/species group level, they are referred to James DiGiulio, our chironomid specialist. Jim has 13 years of experience identifying chironomids, and is in active communication with other chironomid specialists in western North America to resolve problematic taxa. ABA routinely uses outside specialists throughout North America when unusual or problematic taxa are encountered.

All invertebrate identification at ABA is performed by Robert Wisseman, James DiGiulio, or certified outside specialists. Identifications are not relegated to junior or trainee taxonomists. Robert uses a Leica MZ16 dissecting scope (10-100X) with dark-field capabilities to insure pertinent taxonomic characters can be viewed clearly. Jim conducts extensive clearing and slide mounting of

chironomid larvae to insure accurate identification. Identifications and counts are recorded on bench sheets along with any comments. These bench sheets are carefully reviewed after identification is completed on each sample.

Robert Wisseman performs all data entry for all projects. Bench sheets from a project are first carefully reviewed for errors and taxonomic consistency. Archived samples are re-identified if errors cannot be resolved. When the development stage of a given taxa precludes identification to the lowest practical taxonomic level, Robert insures during his review that the taxonomic level remains consistent across an entire data set. Sample information, taxa, and abundances from each sample is checked and verified by Robert before moving on to the next sample during data analysis.

Standard taxonomic effort varies considerably across states and programs in western North America. Robert first advises clients on what the most appropriate taxonomic effort is to meet project objectives. In the Pacific Northwest ABA's default standard taxonomic effort is consistent with the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) level 2 http://www.pnamp.org/project/4210 . In the Southwest our default effort is consistent with those proposed by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT http://www.safit.org/ste.html). In the Northwest our default effort is consistent with guidelines proposed by the Northwest Bioassessment Workgroup, EPA western EMAP, WA DOE, and OR DEQ.

Taxonomic verification is handled in a variety of ways at ABA, depending on client preferences. Some options are:

1. Retain a synoptic collection of all invertebrate taxa identified from a project that can be reviewed by an outside specialist or laboratory.

2. Archive all samples in their entirety. Clients can designate a subset of samples to be sent to another lab for identification and comparison. To avoid conflicts of interest and to keep blind which samples may be selected for Taxonomic QA, the client is encouraged to contract directly with an outside lab of their choice.

Robert W. Wisseman, M.S. Senior Scientist

Bob received his B.A. degree in Environmental Studies from The Evergreen State College in Washington in 1976. As part of his undergraduate training he participated in bioassessment studies of an urban lake in Tacoma and intertidal invertebrate studies in the Nisqually Delta Estuary. In 1987 he received his M.S. degree in Aquatic Entomology from Oregon State University. Although caddisflies were the focus of his thesis and published papers, Bob gained broad experience in stream ecology as a Research Assistant at OSU from 1980-86. Using benthic invertebrate communities in freshwater to assess biological integrity was an emerging field in the 1980s. Since 1990 and continuing today, Bob assists the US Environmental Protection Agency, other federal agencies, and many western states and Canadian provinces in developing their biomonitoring programs. With his acquired knowledge of the taxonomy and biology of freshwater invertebrates, Bob began an independent laboratory as a sole proprietor in 1984. In 1995 Bob's wife Mary Jo, joined his business and Aquatic Biology Associates, Inc. was formally incorporated. Bob is certified by the North American Benthological Society in Western EPT taxa, and is a recognized expert in western North American caddisflies. Bob is currently the chairman of the taxonomic workshop committee for the Southwest Association of Freshwater Invertebrate Taxonomists. Previously, he organized taxonomic workshops for the Northwest Bioassessment Workgroup, which brought taxonomic specialists from throughout North America to the Northwest for multiday training sessions.

James A. DiGiulio, M.S. Chironomid Taxonomist

Jim earned a B.S. in Zoology from the University of Michigan in 1973 and a Masters in Zoology from the University of Texas in 1983. While in Texas he collected and identified polychaete worms and mollusks from the Gulf Coast for the Bureau of Economic Geology. After moving to Oregon, Jim conducted doctoral research on the systematics of chalcid wasps at Oregon State University. He identified Diptera and Hymenoptera for the US Department of Agriculture. A NSF grant allowed him to assist in the production of a taxonomic handbook on North American chalcid wasps. In 1989 Jim started his own company, Valley Venoms and Allergens, Inc., which keeps him busy during the summer months. The live vespid wasps Jim collects are sold to pharmaceutical labs in North America which use the venom to make allergy shots for people with bee and wasp sting allergies. Jim joined Aquatic Biology Associates in 1990, first sorting stream samples and identifying aquatic Hemiptera. In 1998 he began identifying chironomid midges for Aquatic Biology Associates and other labs. Jim is a NABS certified taxonomist in Level 2, Group 3, Western Chironomidae, and a member of the North American Benthological Society and Entomological Society of America.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

UW Oceanography Marine Chemistry Lab

Seattle, WA

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. Accreditation for U.S. Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846) is for the latest version of the method. SM refers to EPA approved editions of "Standard Methods for the Examination of Water and Wastewater." ASTM is the American Society for Testing and Materials. Other references are described in notes.

Matrix/Analyte	Method	Notes
Non-Potable Water		
Ammonia	EPA 349.0	1,2
Nitrate	EPA 353.4_2_1997	1,3
Nitrite	EPA 353.4_2_1997	1
Orthophosphate	EPA 365.5_1.4_1997	1,3
Silicate, Dissolved	EPA 366.0	3
Particulate Organic Carbon	EPA 440_1.4_1997	3
Particulate Organic Nitrogen	EPA 440_1.4_1997	3
Chlorophylls	EPA 445.0	3
Salinity	SM 2520 B-93	3
Dissolved Oxygen	SM 4500-O C-01	3
Nitrogen, Total	SM 4500-P J	4
Phosphorus, total	SM 4500-P J	1,4
Dissolved Organic Carbon	SM 5310 B-00	3

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