Quality Assurance Project Plan (QAPP)
for
Streamkeepers of Clallam County
Environmental Monitoring Program

December 2017

Revision of Streamkeepers' prior QAPP (Chadd, 2016)

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Available online at http://www.clallam.net/SK/QualityAssurance.html

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Approved by:

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Cover photo: Streamkeepers volunteers collect a benthic macroinvertebrate sample on Jimmycomelately Creek.

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2.0 Abstract

In 1999, Clallam County created the Streamkeepers program, an offshoot of a volunteer stream monitoring program, the "Eight Streams Project," operated under WSU Cooperative Extension of Clallam County from 1997-99. Both programs emerged from local watershed management plans which recommended the creation of volunteer "stream teams" to foster watershed stewardship and provide data useful for watershed management and restoration (Sequim Bay Watershed Management Committee, 1991; Dungeness Watershed Management Committee, 1993; Clallam County, 1995). A volunteer watershed-monitoring program gives interested citizens a way of becoming actively and meaningfully involved in a broad-based effort to learn about, protect, and restore watersheds across Clallam County.

Streamkeepers provides a suite of monitoring protocols, a corps of trained data collectors, quality assurance, and data management and reporting, to document the ambient (physical, chemical and biological) conditions of Clallam County waters. We conduct our own quarterly ambient monitoring program and also utilize our monitoring and QA protocols in conducting a variety of special monitoring investigations at clients' requests, in furtherance of those clients' watershed protection and restoration goals. Streamkeepers meets an ongoing need for data for a variety of purposes (Clallam County, 2004).

Per U.S. Environmental Protection Agency guidance in *EPA QA/G-5* (USEPA, 2002), this document describes a "generic QA Project Plan" that covers activities at multiple sites over multiple years, having the same project objectives and sampling and analytical processes. Data collected under this plan meet the requirements of *Washington Department of Ecology Water Quality Program Policy 1-11* (WA Dept. of Ecology, 2006). This plan is to be reviewed annually to determine if any changes are necessary to satisfy all current Ecology and EPA standards and to be supplemented as needed by separate QAPPs for special watershed monitoring projects.

3.0 Background

This document is an update of Streamkeepers' previous Quality Assurance Project Plan (Chadd, 2016). It meets the requirements of the Washington State Department of Ecology for agencies who wish to submit data to be considered for State Water Quality Assessments mandated by the federal Clean Water Act (WA Dept. of Ecology, 2006). There are no significant changes since our prior QAPP.

3.1 Study area and surroundings

The text for this section is based on *State of the Waters* (Clallam County, 2004), a comprehensive report on the watersheds of Clallam County funded by Ecology's State Centennial Clean Water Fund.

Clallam County comprises most of the northern half of the Olympic Peninsula at the northwestern corner of Washington State. It is surrounded by the marine waters of the Pacific Ocean to the west and the Strait of Juan de Fuca to the north. (See Figure 1 below.)

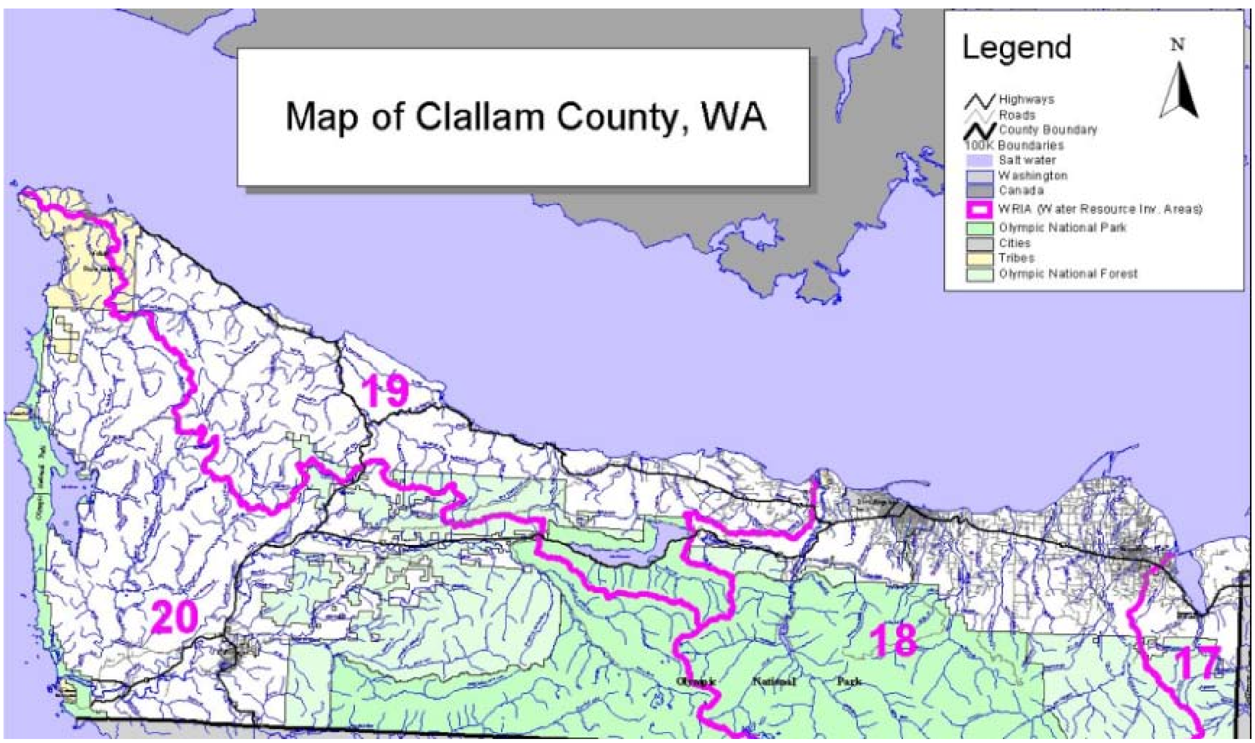

Figure 1. Clallam County, showing Water Resource Inventory Areas (WRIAs).

Clallam County's waters all flow from the Olympic Mountains that form the core of the Olympic Peninsula. The heart of the peninsula has been preserved as Olympic National Park, and has been described as "more than 1,400 square miles of rugged mountains, richly forested river valleys, and pristine wilderness coast." The waters of Clallam County provide abundant resources for fish, wildlife and humans, including recreational, aesthetic, economic and ecological benefits for citizens and visitors. Important recreational and commercial uses of these waters include boating, fishing, and shellfish harvesting. The County's rivers, creeks, lakes, wetlands and estuaries provide habitat for a diversity of fish and wildlife species, including many different stocks of salmonids. Its groundwater aquifers supply drinking water as well as baseflow to most streams and wetlands.

3.1.1 Logistical problems

We sample at sites on public property or private property where we have secured permission. Sometimes access is not possible due to environmental or property condition, or denial of permission. At some sites, wade-across flow measurements are not possible due to water depth and/or velocity, and at other times, water levels are too low for sampling. Tides sometimes do not allow sampling freshwater input at tidally-influenced sites.

3.1.2 History of study area

For more than a century, the forests of the Olympics were prized by loggers and other residents for their record-size trees. Logging and other development have left a legacy of impacts on both habitat and water quality across the peninsula. While each stream has its own distinctive characteristics, some qualities are common to all of them. Unless in the rainshadow of the Olympics, the watersheds generally have abundant rainfall in the winter that can result in hydrologic stress, especially if the stream is in a disturbed condition. Those streams originating high in the mountains often descend rapidly, then flow across a lower elevation floodplain, before entering salt water in the Pacific Ocean or Strait of Juan de Fuca. Geologic conditions provide for sediment-rich streams, with natural landslides regularly occurring on many peninsula rivers. When such streams were heavily forested, erosion usually proceeded at a more periodic rate. Once logged, especially in the steep upper watersheds, the amount of sediment entering the streams accelerated, often causing severe downcutting, erosion, blockages, and excessive fine sediments in streams, causing problems for aquatic wildlife, including spawning and rearing salmon.

Floodplain functions on peninsula streams have been subject to two major types of human impact. First, many channels have been disconnected from their floodplains. Second, many of the peninsula streams have lost their rich, deep riparian streamside corridors, which in the past provided shading, instream habitat, filtering, and aquatic food resources. Once removed, these benefits were no longer provided for fish, wildlife and water quality; many streams now lack forest cover and have limited large woody debris instream, resulting in poor channel habitat, increased summer water temperatures, low dissolved oxygen, and excessive turbidity. These situations are generally improving with more sensitive forest-practice regulations and numerous restoration projects, but recovery will take decades, and recovery end-states remain to be seen. Other floodplain impacts on some streams include dams, diking, channelization, riparian roads, animal access and other effects of development. While some streams on the peninsula maintain healthy ecosystems, human activities have directly impacted the quality of the water and habitat in the majority, compromising fish and wildlife resources as well as human uses. In an ecological context, “compromised” means showing signs of ecological degradation, with impacts expected to one or more salmon life-stages, for example (Clallam County, 2005).

3.1.3 Parameters of interest

Sources of ecological degradation

Sources of ecological degradation in the study area are numerous, varied and sometimes difficult to detect. Surface water runoff can contain a mixture of nutrients, bacteria, sediments, petroleum products, metals and other toxic ingredients. The cumulative effect of these “nonpoint source pollutants” on water quality and aquatic life can be significant. Human alterations to water quality and salmonid habitat can be expected to have different consequences for different fish and wildlife species. Across Clallam County, land use activities associated with forest practices, agriculture, rural development, and industry have had negative impacts on water quality and salmonid habitat.

Excessive sediment is one of the most common “pollutants” and a major limiting factor for salmonid production across the peninsula. It can cause channel instability and degrade water quality and salmon habitat. Excess silt in stream gravels can make it difficult for fish to spawn and stream invertebrates to survive. Causes of excessive sediment include increased input from landslides, removal of vegetation and other ground disturbance associated with logging and roads (particularly when built on steep slopes), agricultural practices, and construction activities. On the other hand, decreased amounts of gravels (medium-sized “sediment”) suitable for fish spawning is also sometimes a problem, and has been caused by dams, dikes and other floodplain constrictions.

Excessive nutrients and bacterial contamination are relatively common pollutants in peninsula streams, estuaries and groundwater. Food (e.g., shellfish) gathered where fecal coliform bacteria levels are high can be harmful if eaten by humans. It is not known if fecal coliform bacteria is specifically harmful to salmonids, although its presence may indicate that other pollutants are present that are known to be harmful to fish. Excessive nutrients often result in the rapid growth of algae in streams, causing problems for fish (including declines in dissolved oxygen and increases in temperature), and often aesthetic problems for humans. This contamination can be caused by trampling and unrestricted animal access into riparian corridors or into the stream itself, leaking septic and sewer systems, excessive fertilizers and chemicals applied to the land, and general stormwater runoff.

Low flows cause some salmon to spawn in less stable areas of the stream, possibly increasing the likelihood that fish redds will be washed out during high flow events. Low flows also cause higher water temperatures and lower dissolved oxygen conditions than those needed by many fish and the “high-quality bugs” that salmon need to sustain their populations. Causes of low flows include water withdrawals, the operation of dams and diversions, alteration of floodplains and wetlands, and most particularly changes in vegetation patterns, which accelerate runoff during the rainy season, decrease storage, and therefore reduce summer flows.

Anthropogenic changes can cause or exacerbate flooding, which can seriously degrade stream channel conditions and bring pollutants into the stream, and eventually out into estuaries and bays. These pollutants are harmful to many species, including humans if they eat shellfish or other food gathered from these waters. Flooding is often due to channelization, routing of stormwater through irrigation systems, the presence of roads and impervious surfaces, and increased stormwater from lands where native vegetation has been removed.

Need for Data

Because of these challenges, various parties in Clallam County have focused great attention and effort to restore salmon populations, shellfish beds, and ecological functions. Numerous stream restoration, mitigation, and Best Management Practices projects have been completed, are underway, or are planned; watershed planning councils have devised long-range watershed management plans; and funding is being directed to numerous groups seeking to improve streams and fish habitat. All of these efforts share a need for good, ongoing data on stream health.

3.1.4 Results of previous studies and origin of the current study

While numerous studies have been conducted on various streams, there has been little consistent baseline water quality data available that can be used to identify specific ongoing problems, plan watershed management, or track the effectiveness of restoration projects.

Responding to the above needs, several watershed management plans completed in the 1990s (Sequim Bay Watershed Management Committee, 1991; Dungeness Watershed Management Committee, 1993; Clallam County, 1995) recommended that volunteer "stream adoption" teams be established to help build stewardship of watershed resources by area citizens. The plans also suggested that these teams monitor water quality parameters and become involved in solving problems they identify. A volunteer monitoring program gives interested citizens a way of becoming actively and meaningfully involved in a broad-based effort to learn about, protect, and restore their local watersheds.

In 1996, the Eight Streams Project (a 3-year Washington State Centennial Clean Water Fund grant funded by Ecology and administered by Washington State University Cooperative Extension of Clallam County) initiated a volunteer stream monitoring program on streams in Port Angeles and Sequim, under a Quality Assurance Project Plan approved by Ecology (Washington State University Cooperative Extension, 1997). When the grant expired in 1999, Clallam County established Streamkeepers of Clallam County to continue the stream-monitoring component of the Eight Streams Project. Program staff, in consultation with volunteers and technical advisors, revised the sampling plan and procedures and received Ecology's approval on a new Quality Assurance Project Plan (Baccus and Chadd, 2000). This QAPP has been regularly revised to reflect Credible Data standards adopted by the State of Washington and regulated by Ecology (Washington State Department of Ecology, 2006).

Since its inception, Streamkeepers' volunteer monitoring program has provided a suite of monitoring protocols, a body of trained data collectors, quality assurance, and data management to document the ambient (physical, chemical and biological) conditions of Clallam County waters. We also apply these protocols to help partner agencies and citizens' groups carry out special monitoring investigations connected with watershed protection and restoration. The need for good data has been recognized and is expected to increase over time (Clallam County, 2004).

3.1.5 Regulatory criteria or standards

The data we collect informs decisions under multiple regulatory frameworks such as:

- The federal Clean Water Act and Endangered Species Act
- The state Growth, Shoreline, and Watershed Management Acts, and the local planning/regulatory documents which implement those Acts:
    - The Comprehensive Plans and Shoreline Master Programs for Clallam County and the Cities of Forks, Port Angeles, and Sequim
    - Multi-stakeholder Watershed Management Plans which set broad management strategies for state-designated Water Resource Inventory Areas (WRIAs) 18-20 in Clallam County

    - These plans may incorporate or result in other instruments such as the Elwha-Dungeness Water Management Rule, adopted by the State to help implement the WRIA 18 Watershed Plan by securing water supplies in the Sequim area for the benefit of people, agriculture, fish and wildlife.
- Local plans for stormwater, roads, etc.

An important recipient of Streamkeepers data is the Washington State Department of Ecology (Ecology). We submit all of our quality-controlled data to their Environmental Information Management (EIM) database for broad access and availability to other entities large and small (https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database). Ecology is delegated by the federal government to administer the Clean Water Act in the state. Under this Act, Ecology periodically calls for data and publishes a Water Quality Assessment listing all available water quality data and rating the state's water bodies according to state water quality standards (https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d). This Assessment states which water bodies are in need of cleanup or concern and constitutes an important planning tool for the protection and restoration of watersheds.

4.0 Program Description

4.1 Program goals

Streamkeepers was created to involve residents in caring for watersheds, primarily by monitoring them, providing credible and useful data to help guide decision-makers in the protection and restoration of the County's streams.

4.2 Program objectives

In terms of stream monitoring, Streamkeepers' objectives are as follows:

- Define and document baseline physical, chemical and biological conditions of local streams
- Measure spatial and temporal variability of stream attributes
- Look for signs of degraded stream condition in a geographically broad manner
- Help identify sources of degradation
- Assess trends in watershed degradation or restoration
- Provide information to assist in watershed planning, management, restoration and adaptive management

Streamkeepers gathers, manages, analyzes, and reports on data under the direction of and for the use of other entities—those agencies, organizations, and individuals actively working to protect and restore streams. Our data helps advance the missions of a multiplicity of local, state, tribal, and federal agencies, as well as non-governmental groups and individual citizens. In general, these entities use Streamkeeper data to:

- Design, adaptively manage, and evaluate watershed-management plans, restoration projects, ordinances and regulations
- Assure compliance with permitting requirements
- Discover and remediate pollution problems
- Increase knowledge about local watersheds

4.3 Information needed and sources

The Streamkeepers program is designed to gather information, but to the extent that data gathered needs to be compared temporally or spatially, other data sets may need to be accessed. In many cases, Streamkeepers has imported data from other relevant datasets into the Clallam County Water Resources database after performing quality control and describing metadata needed to properly interpret the data. Typically, when Streamkeepers performs such imports, we clean up errors and improve documentation.

4.4 Target population

The Streamkeepers program is primarily designed to assess the chemical, physical, and biological integrity of the County's streams. However, part of that assessment involves gathering data from riparian areas and entire watershed basins, and we are also equipped to apply some of our protocols to lakes, wetlands, and nearshore marine environments.

4.5 Study boundaries

As a program of Clallam County, the Streamkeepers program focuses on Clallam County's streams (see Figure 1 above). However, it can go beyond County boundaries upon request of outside parties, particularly if the study question crosses those boundaries.

Water Resource Inventory Area (WRIA) and 8-digit Hydrologic Unit Code (HUC) numbers for the study area

WRIAs:
- Western portion of WRIA 17
- All of WRIA 18 & 19
- Northern portion of WRIA 20

HUC numbers (8-digit):
- 17100101
- 17110020
- 17110021

4.6 Tasks required

In general, Streamkeeper volunteers use state-of-the-industry, detailed protocols to collect the data. These methods are described in more detail later in this document, and are described in full detail in the Streamkeepers Volunteer Handbook (Chadd, current year's edition). This set of Standard Operating Procedures generally undergoes revision each year, in order to:
- Better explain procedures and make data-collection more efficient
- Account for additional special circumstances
- Improve data quality

Revisions made will not in any case reduce data quality below the stated objectives for a given parameter.

4.7 Practical constraints

In an ideal world, we would gather continuous data on all of Clallam County's streams. However, we are limited by available funding, equipment, staff resources, technical expertise, and volunteer deployment. Hence, we must prioritize our efforts. This prioritization takes place on a continual basis, under the advisement of our Technical and Volunteer Advisory Committees (see next section). In devising our sampling plan, our advisors must balance two primary competing values: the continuity of long data sets, which enable evaluation of long-term trends and provide a stable reference for other data, versus the value of targeted flexibility and breadth of coverage. Another value to consider is volunteers' motivations: sometimes volunteers want to make a commitment to a particular stream, and other times they feel they have gathered enough data from a stream and want to move on. Usually the volunteers accept the recommendations of the technical advisors, but sometimes it works the other way around.

Other practical constraints on data completeness include volunteer availability, access to sites, landowner issues, equipment problems, and high/low flow sampling issues.

4.8 Systematic planning process

As an ongoing program rather than a specific project, Streamkeepers is governed by a systematic planning process which guides the program from year to year.

Streamkeepers is part of the Clallam County Department of Public Works-Roads. Our ultimate accountability is to the County Engineer and the Board of County Commissioners, and through them to the citizens of the County. Program direction is guided by the Streamkeepers Steering Committee, which itself consists of two committees: our Volunteer Advisory Committee and our Technical Advisory Committee.

The VOLUNTEER ADVISORY COMMITTEE is composed of any volunteers who care to participate. It recommends changes to any aspect of the program, including program components, activation or inactivation of sites and streams, and watershed protection and restoration projects. It meets as needed, convened by program managers or at the request of volunteers. It generally meets in the fall to review activities of the past year and make recommendations for the next.

The TECHNICAL ADVISORY COMMITTEE consists of people with technical expertise from local, state, tribal and federal agencies; academia; businesses and consulting firms; and knowledgeable local residents. This group connects the Streamkeepers program to other watershed management efforts and local technical expertise, and recommends priorities for sites, streams, parameters, special investigations, and data reporting, as well as by providing guidance on technical questions. It meets as needed, convened by program managers or at the request of advisors or volunteers. It generally meets in the fall to review activities of the past year and make recommendations for the next, either in parallel or in conjunction with the Volunteer Advisory Committee.

The STREAMKEEPERS STEERING COMMITTEE consists of the VOLUNTEER ADVISORY and TECHNICAL ADVISORY Committees. It makes final recommendations on program direction and approves Streamkeepers' work plan for the coming year.

STREAMKEEPERS PROGRAM STAFF works with these groups every year to evaluate the prior year's programming and plan the next. Staff often makes recommendations of its own.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 1. Organization of program staff and responsibilities.

Staff	Title	Responsibilities
Ed Chadd Clallam County Road Dept. Phone: 360-417-2281	Program Coordinator, Principal Investigator, Quality Assurance Officer, Data Manager	Clarifies scope of the program in consultation with Steering Committee. Writes the QAPP and field and equipment maintenance/calibration procedures. Recruits, trains, and directs volunteers. Oversees field sampling and transactions with laboratories. Supervises QA review of data, analyzes and interprets data, and oversees entry of data into Clallam County Water Resources database, upload of data to external repositories such as Ecology's EIM database, and reporting of data as requested.
Streamkeepers volunteers	Volunteer	Receive training and execute monitoring activities under this QAPP; assist Program Coordinator.
Streamkeepers volunteers	QC Reviewers	Receive special training from the Principal Investigator to review incoming data sheets for data completeness, cogency, consistency, and legibility.
Streamkeepers Steering Committee (consisting of Volunteer and Technical Advisory Committees)	Steering Committee	Sets direction for the program in consultation with Program Coordinator. See Section 4.8 above.
Ross Tyler Clallam County Road Dept. Phone: 360-417-2448	Manager and Supervisor for Program Coordinator	Provides internal review of the QAPP, reviews and approves the program scope and budget, and approves the final QAPP.
Sue Waldrip Clallam County Environmental Health Laboratory Phone: 360-417-2334	Laboratory Manager	Reviews QAPP, coordinates with Program Coordinator.

5.2 Special training and certifications

The Program Coordinator has experience in all of the procedures described or referred to herein and has received training from multiple organizations, including Ecology, the Adopt-A-Stream Foundation, the Student Watershed Research Project, River Network, Herrera Environmental Consultants, and the National Water Quality Monitoring Council.

5.3 Organization chart – see section 5.1 above

5.4 Program schedule

Streamkeepers is an ongoing program rather than a time-circumscribed project, and thus has no fixed start or end dates for sampling or reports. Our regular ambient sampling schedule is described in Table 2 below. Special-investigation sampling is conducted on a schedule determined by the proponent. Data is QC'd and entered into the Clallam County Water Resources database as soon as possible after field sampling or receipt of lab data, then checked against hard copies as soon as possible thereafter. We submit data to Ecology's Environmental Information Management (EIM) system either when a grant schedule requires it or when Ecology issues a call for data. Other reporting occurs on schedules determined by the end-users of the data. Data is reviewed by Principal Investigator prior to reporting.

Table 2. Streamkeepers' ambient monitoring schedule for parameters submitted to EIM.

Season:	**Water chemistry, flow**	**SxS Water chemistry**	**Benthic macroinvertebrate collection (for Benthic Index of Biotic Integrity)**
Winter	January	Side-by-Side sampling with WA Dept. of Ecology at least 4 times per year.	
Spring	April		
Summer	August		Aug. 1 – Sept. 30
Fall	Sept 15 - Oct 15		

5.5 Limitations on schedule

Scheduling may be impacted by a number of factors, including volunteer team availability, weather, equipment availability and condition. We occasionally sample outside of the sampling window, at the discretion of the Principal Investigator. Database records indicate what the sampling window should have been vs. when the sampling occurred.

5.6 Budget and funding

Budgeting is variable from year to year, but the following table presents a general idea of funding sources.

Table 3. Program budget and funding—typical annual figures.

Component	Typical funder	Approx. cost
Staff 0.5 FTE	Clallam County Road Fund	52,000
Supplies	Clallam County Road Fund	2,000
Fecal lab – Clallam County Environmental Health	Investigation proponent - $26 per sample	?[1]
Benthic macroinvertebrate lab – ES&C	Investigation proponent - ~$350 per sample	?[1]
Analytical lab – Ecology Manchester lab	Investigation proponent – prices vary	?[1]
	Total	54,000+

[1] Funding depends on special investigation proponents and their sampling plans.

6.0 Quality Objectives

6.1 Decision Quality Objectives (DQOs) – n/a

6.2 Measurement Quality Objectives

Although Streamkeepers gathers data on a wide variety of parameters, including fish and wildlife observations, invasive exotic plants, photos, and certain components of physical habitat, the remainder of this QAPP addresses itself to those parameters for which we submit data to Ecology for its Water Quality Assessment or grant fulfillment. These parameters are quantitative and are reported as a number value, with the parameter defined by metadata fields established by Ecology as well as others used by Streamkeepers.

Streamkeepers' measurement quality objectives (MQOs) for these parameters are presented in Table 4 below. Industry standard field methods will be used whenever possible to minimize measurement bias (systematic error) and to improve precision (random error), and all laboratory-bound samples will be collected, preserved, stored, and otherwise managed using accepted procedures for maintaining sample integrity prior to analysis.

In sampling design, methods and MQOs are chosen to fit the particular purpose for which the data will be used. For example, data destined for submittal to Ecology's Water Quality Assessment will be according to Ecology's credible-data requirements.

Stormwater, sediment, and nutrients parameters: In addition to the MQOs below, we have written QAPPs for the sampling of stormwater, stream sediment, and nutrients, each approved by EPA or Ecology; see http://www.clallam.net/SK/stormwatermonitoring.html, http://www.clallam.net/HHS/EnvironmentalHealth/documents/qapp.pdf, and http://www.clallam.net/SK/doc/clnwtrdpolid.pdf. These QAPPs are incorporated by reference into this document (Chadd et al., 2008; Chadd et al., 2009; Knapp et al., 2009; Chadd et al., 2010; Soule and Chadd, 2013; Clallam County Departments et al., 2015).

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Table 4. Measurement Quality Objectives. (Frequency of sampling is described in Section 7.1, Study Design.)

* = protocol in Streamkeepers Volunteer Handbook; SM = Standard Methods (APHA); NA = not applicable

% bias = Abs(standard value – measured value) / standard value x 100%, where Abs = absolute value

RSD = relative standard deviation (also known as the coefficient of variation or CV), which, when n = 2 (as when comparing a sample with a replicate), is defined as follows:

RSD = Abs(difference/sum) x Sqrt(2) x 100%, where Abs = absolute value and Sqrt = square root

Parameter (Analyte), matrix	**Method, Source**	**Sample holding time & analyzers**	**Units**	**Expected range of results**	**Resolution**	**Detection limit**	**Reporting limit**	**Bias (vs. standard)**	**Precision (vs. replicates)**
*Barometric pressure, air	Barometer, ASTM D3631	In situ or nearby weather station	in Hg	27 - 31	0.01	20.5, 32.5	20.5, 32.5	0.05 vs. weather station	0.05
*Benthic (invertebrate) Index of Biotic Integrity, tissue	Surber sampler, 500µ mesh, King County 2014	ID & QC by professional taxonomic lab	$B\text{-}IBI_{0\text{-}100}$	0 - 100	1	0, 100	0, 100	NA; min. detectable difference = ± 14.11	St. Dev. = 7.2; Signal/ Noise ratio = 10.76
*Dissolved Oxygen, water	Membrane electrode, SM4500 O-G	In situ	mg/L	6 - 15 (70-120% saturation)	0.1 (1% sat.)	0.1	0.3	0.3	0.3
*Dissolved Oxygen, water	Azide Modifi-cation, SM4500 O-C; Ward 2016	4 days in dark after adding flocculants	mg/L	6 - 15 (70-120% saturation)	0.1	0.1	0.2	0.2 (Hallock and Ehinger 2003)	0.2
*Dissolved Oxygen, water	Luminescence sensor, ASTM D888 Test Method C	In situ	mg/L	6 – 15 (70-120% saturation)	0.1 (1% sat.)	0.1	0.2	0.2 or 2%	0.2 or 2% RSD

Parameter (Analyte), matrix	Method, Source	Sample holding time & analyzers	Units	Expected range of results	Resolution	Detection limit	Reporting limit	Bias (vs. standard)	Precision (vs. replicates)
E. coli & Total coliform, water	Colilert© chromogenic substrate test, SM9223	Sterilized poly bottle; analyzed by staff or trained volunteers	MPN CFU/ 100 mL, or presence/ absence	0 - 20,000	1	1	1	See 95% Confidence Limits from SM9221C	10 or 85% RSD
*Enterococcus, water	Enterolert© enzyme substrate; SM9230	Sterilized poly bottle ≥125 mL; accredited laboratory; 8 or 24 hr at <10°C[2]	Most Probable Number (MPN)/ 100 mL	0 - 2000	1; MDL = 100 ÷ volume filtered	1	1	NA	10 or 85% RSD
*Fecal coliform, water	Membrane filtration, SM9222D; USEPA 2005; CCEHL 2006	Sterilized poly bottle ≥125 mL; accredited laboratory; 8 or 24 hr at <10°C[2]	Colony-forming units (CFU)/ 100 mL	0 - 20,000	1; MDL = 100 ÷ volume filtered	1	1	NA	10 or 85% RSD (i.e., Base 10 log-transformed values ± 0.6)
*Flow, water	Wade-across (SWFMC), Schuett-Hames et al. 1994	In situ current & depth measurements	Cubic feet per second (cfs)	0 - 1000	0.1	0.1	0.1	Presumed 10%	10% RSD
*Flow, water	Single-point hydraulic (MID-SECTION), Perry 2003	In situ	Cubic feet per second (cfs)	0 - 1	0.01	0.01	0.01	Presumed 10%	10% RSD
*Flow, water	Bucket (SWFMB), Perry 2003	In situ	Cubic feet per second (cfs)	0 - 1	0.001	0.001	0.001	Presumed 10%	10% RSD

[2] Per USEPA 40 CFR, Part 136 (2012), 0-10°C. Samples which have been collected and iced within two hours of lab delivery may be warmer, as long as they show signs of having been chilled down since collection time (Rosenbower, 2016).

Parameter (Analyte), matrix	Method, Source	Sample holding time & analyzers	Units	Expected range of results	Resolution	Detection limit	Reporting limit	Bias (vs. standard)	Precision (vs. replicates)
*Flow, water	Floating object (SWFM FLOAT), Michaud 1994 ; Murdoch et al. 1996	In situ	Cubic feet per second (cfs)	0 - 1000	0.1	0 (if no flow)	0 (if no flow)	Unknown—all data will be qualified as EST	20% RSD
*Flow, water	Wade-across (SWFMC), Schuett-Hames et al. 1994	In situ current & depth measurements	Cubic feet per second (cfs)	0 - 1000	0.1	0.1	0.1	Presumed 10%	10% RSD
*Nitrate-Nitrogen, water	Nitrate ion electrode method, SM4500N03-D; CCEHL 2006	Accredited laboratory; sterilized bottle; 24 hr. at ≤6° C (USEPA, 2012)	mg/L	0 - 5	0.1	0.1	0.1	± 20%	7% RSD
*pH, water	Gel probe or liquid with reference, SM4500-H+	In situ or 2 hr.	pH units	6.5 - 8.5	0.1	0.1, 14	4, 10	0.2	0.2
Precipitation, water (incl. 24 hr.)	Weather station	In situ	in	0 - ?	0.01	0	0	NA	NA
*Salinity, water	Electrode, SM2520B-F	In situ	PSS (ppt)	0 - 32	0.1	0.1	0.1	Calibrated with Specific Conductivity	0.1 or 5% RSD
Settleable solids, water	Volumetric, SM2540F	Grab sample, Imhoff cone	mL/L	0 - 500	1	1	1	NA	1 or 5% RSD

Parameter (Analyte), matrix	Method, Source	Sample holding time & analyzers	Units	Expected range of results	Resolution	Detection limit	Reporting limit	Bias (vs. standard)	Precision (vs. replicates)
*Specific Conductivity (at 25 deg C), water	Electrode, SM2510B	In situ	μS/cm	25 – 400 (fresh) - 49,000 (marine)	1	1	1	5%	5% RSD
Stage, water	Staff gage or reference point, Shedd 2008	In situ	ft	NA	0.01	NA	NA	NA	± 0.01
*Temperature (grab), water	Thermistor, SM2550	In situ	°C	0 - 20	0.1	-5	-5	0.2	0.2
*Temperature (grab), water	Thermometer, USGS 1998	In situ	°C	-5 - 35	1	Per instrument	Per instrument	1	1
*Temperature (grab), air	Thermometer, USGS 1998	In situ	°C	-5 - 35	1	Per instrument	Per instrument	1	1
Temperature (continuous), water	Data logger thermistor, Dunham et al. 2005	In situ	°C	0 - 20	0.1	-5	-5	0.2	0.2
*Turbidity, water	Nephelometric, white light spectral, SM2130B	48 hr. in darkness at ≤6°C (USEPA, 2012), bottle >500 mL	NTU	0 - 1000	0.01	0.1	0.5	0.5 or 7%	1 or 7% RSD
*Turbidity, water	Nephelometric, near-infrared, ISO 7027	In situ or 48 hr. in darkness at ≤6°C (USEPA, 2012), bottle >500 mL	FNU	0 - 1000	0.1	0.1	0.5	0.5 or 7%	1 or 7% RSD

6.2.1 Targets for Precision, Bias, and Sensitivity

6.2.1.1 Precision

Precision is a measure of the variability in the results of replicate measurements due to random error and is usually assessed by analyzing duplicate samples or field measurements. Field measurement precision is estimated by analysis of replicate measurements at one site (randomly selected) per team per sampling season, or at least one replicate per ten measurements. Details on field replicate measurement procedures are described in the "Water Chemistry—General Guidelines" section of the Streamkeepers Volunteer Handbook (Chadd, current year's edition). The variation between these measurement and replicate values is a measure of variability due to short-term environmental factors, instrument operation, and measurement procedure. See Table 4 above for acceptance criteria and control limits based on comparing replicates with paired measurements.

6.2.1.2 Bias

Bias is the difference between the population mean and the true value. Bias is usually addressed by calibrating field and laboratory instruments, and by analyzing lab control samples, matrix spikes, and standard reference materials. For field measurements, bias is assessed by comparing instrument readings with NIST-traceable standard reference materials. See Table 4 above for acceptance criteria and control limits based on bias analysis.

6.2.1.3 Sensitivity

Sensitivity is a measure of the capability of a method to detect a substance. It is commonly described as detection limit, the lowest quantity of a physical or chemical parameter detectable (above background noise) by a field instrument or laboratory method. Furthermore, we set reporting limits at values we feel confident reporting, usually with less sensitivity than detection limits. Detection and reporting limits are presented in Table 4 above.

6.2.2 Targets for Comparability, Representativeness, and Completeness

6.2.2.1 Comparability

Standardized sampling methods are summarized in Table 4 above, and standardized operating procedures (SOPs) for sampling are detailed in Streamkeepers' Volunteer Handbook (Chadd, current year's edition). Data checking procedures are described at http://www.clallam.net/SK/doc/Qrtlydtashtckpl.pdf. Standard data reduction will be by daily average or per client request. Storm-targeted samples will be indicated clearly as such and will not be averaged from different times during a sampling day.

Streamkeepers data is often combined with other data sets for analysis. The following rules will govern such combination:

1. The purpose of the analysis will dictate the stringency of combination rules. For general watershed characterization studies, all data believed to be reasonably accurate might be

accepted, including data not gathered under a Quality Assurance Project Plan (QAPP), or for which the QAPP was not completely followed, or for which QA procedures were not completely documented. This was the case for Clallam County's *State of the Waters* report (Clallam County, 2004). More rigorous standards will be applied for more rigorous purposes: for example, for Ecology's Water Quality Reports, only data gathered to the specifications of Ecology's "credible data" policy (WA Dept. of Ecology, 2006) will be accepted for submission. In the latter case, data submitted is always connected with the particular study under which it was gathered, along with appropriate information about each study.

2. Streamkeepers special investigations in which data is collected under this QAPP will be considered equivalent to Streamkeepers ambient-monitoring data. Some common-sense adjustments may be made to QA procedures in order to assure comparability: for example, if an investigation is not organized according to stream-teams, replicates will be collected at 1/10 of the sampling sites rather than at one of the team's sites for a given sampling season.
3. Data collected under a separate QAPP, but which references the Streamkeepers Handbook for field and QA procedures, will be considered equivalent to Streamkeepers data.
4. Where possible, non-Streamkeepers data sets are analyzed, documented, and incorporated into the Clallam County Water Resources database, with appropriate metadata applied.

6.2.2.2 Representativeness

Sampling is designed to be representative of existing conditions in the following ways:

- Overall site & stream selection: Both streams and monitoring sites are targeted at salient features chosen by our advisory groups (see site selection criteria); because random sampling was not used in their selection, these streams and sites are not chosen to be representative of any larger geographic area.
- Chemical water quality sample representativeness is sought at a given site by taking the sample at or near the point in the channel where water is well mixed and most representative of ambient conditions, and by maintaining probes in the stream until a stable reading is achieved. When sampling in tidally-influenced conditions, if the goal is to sample the freshwater input to the salt water body, the sample may be collected at a point higher in the water column to maximize the freshwater component being sampled.
- Macroinvertebrate sample representativeness: We collect from 8 square-foot areas of substrate per sample, spaced out between multiple riffles, in mid-channel riffle habitat, between August 1 and Sept. 30. If riffles are not available, we use a glide or the fastest part of the stream. Each sample is then sub-sampled to a target of 500 specimens. The purpose of these procedures is to collect a representative sample from a common and easily identified habitat that can be compared to other similar samples across the region and state (King County, 2014). When possible, we sample at least 165 feet upstream or 660 feet downstream of a bridge or other large human-made structure, to minimize the localized effect of that structure (Fore, 1997).

- Assumptions regarding sampling intervals: Streamkeepers' advisors have recommended a basic format of quarterly sampling, based on assumptions of general seasonal variation of data, in order to gather data representative of the different seasons:
  - Winter: January; cold temperatures, high baseflows, storms
  - Spring: April; high baseflows, warmer temperatures, snowmelt, plant budding
  - Summer: August; low flows, high temperatures, full leaf-out
  - Fall: September 15 – October 15; often either lowest flows or first storms of the season; leaf fall and plant die-off
  - B- IBI sampling of benthic macroinvertebrates is Aug. 1 – Sept. 30 (King County, 2014).
- Exceptions to sampling intervals: This quarterly format is amended in individual cases on the recommendations of advisors (the most frequent amendment being to limit sampling to summer and fall, to try to catch the low-flow period). Volunteers can sample at any point within the sampling window, and in some cases may sample a few days outside of the sampling window for a given season, if program managers approve (generally, as long as the weather is not radically different than during the sampling window). Furthermore, special studies will dictate different sampling schedules. For example, a stormwater study will be timed to track a storm event, a summer low-flow study will be timed to catch the lowest flows, and a study of pollutants in recreational areas will focus on times of heaviest use. In all cases, special-purpose sampling will be indicated as such in comments connected with the data in the Clallam County Water Resources database.
- Limitations on representativeness:
  - Intervals: Our seasonal samples are assumed to be adequate for generalized watershed characterization, but they tend to miss extreme events, which are crucial to understanding certain watershed-process phenomena such as flood impacts, "first-flush" effects, and extreme low flows or temperatures. For example, an Ecology study at 42 stations indicated that monthly spot-sampling, on average, underestimated the summer maximum temperature by 3.7°C and the maximum seven-day average of daily maxima by 2.9°C (Hallock and Ehinger, 2003). On request and when possible, we will implement continuous sampling.
  - Timing within sampling window: Most sampling windows are a month long, and samples can be collected any time during that period. Results may need to be normalized per Julian date, and caution must be used in interpretation. However, year-to-year differences in seasonal patterns are probably more significant than the date of sampling within a given month.
  - Time of day: Samples are not collected at a uniform time of day, and therefore diel variations may influence data for certain parameters, particularly temperature, pH, and dissolved oxygen. Data analysis will need to consider such diel effects.
  - Chance events: A summer rainstorm can significantly impact water-quality parameters, so recent higher-flow events may need to be considered when analyzing data.
  - Order of sampling: During ambient monitoring, if there are multiple sampling sites on a given stream, sites are generally visited from upstream to downstream, to minimize the possibility of cross-contamination of exotic organisms from generally-more-impacted downstream sites to generally-less-impacted upstream sites (Washington State Department of Fish & Wildlife, 2012). This is the opposite of the progression that Streamkeepers used to follow, and it presents a number of problems:

- Downstream contamination caused by samplers walking in the stream.
- Possibly biased turbidity data during and after a storm event, because turbidity tends to rise sharply and then decline slowly. Therefore, if a downstream sample has a higher turbidity than an upstream sample taken earlier the same day, the difference may be due to the possibility that turbidity was rising in the entire system due to the rising curve of a storm event.
- A similar reasoning holds for temperature measurements, which tend to rise diurnally; a higher temperature taken at a downstream site later in the day may be the result of timing, not geography.
- In all cases, times are recorded along with measurements to make temporal relationships clear.

6.2.2.3 Completeness

Because Streamkeepers is a volunteer-based program, we cannot guarantee the same level of completeness as a program with a paid staff. (There may be exceptions to this qualification, if a special-investigation client requires a certain completeness standard and funds Streamkeepers staff to guarantee it.) In general, we aim to gather at least 90% of the data outlined in our annual work and sampling plans (http://www.clallam.net/SK/programplanning.html). Occasionally volunteers are unavailable to monitor their assigned streams; whenever possible, staff will assign alternate teams and/or individuals to complete the data collection, or assist with data collection themselves. Custodial sample loss will be minimized with sturdy sample storage vessels and adequate labeling of each vessel. When doing a study based on Streamkeepers data, it is up to the analyst to evaluate the completeness of the data set and qualify conclusions accordingly.

7.0 Sampling Process Design (Experimental Design)

7.1 Study Design

As described in Section 4, “Program Description” (see “Goals,” “Objectives,” and “Constraints”), the Streamkeepers program is a long-term effort which maximizes available human, capital, and financial resources to facilitate stewardship of Clallam County’s watersheds. Because resources and needs change over time, a single sampling design would not be appropriate. However, the basic design of the Streamkeepers monitoring program can be described as follows:

1) *Long-term Ambient Monitoring:* Regularly scheduled field sampling events to collect data on a suite of parameters of watershed health at established sites. Parameters, sites, and scheduling are determined in consultation with Streamkeepers’ supervisors and advisory committees, as described in “Organization and Schedule” above.

2) Special Investigations: Special investigations performed at the request of a partner entity, to that entity’s specifications. These investigations may be performed under Streamkeepers’ QAPP, a separate QAPP, or no QAPP, depending on the requirements of the investigation. Streamkeepers’ supervisors and advisory committees are kept apprised of these investigations, and their feedback is invited.

We understand that certain investigations may only meet limited interpretive goals. For instance, an investigation targeting high or low flows will not reflect general ambient conditions, and an investigation collecting data during a brief time window will not in itself allow for analysis of trends. The purpose of any special investigations will be included as a comment alongside the data in the Clallam County Water Resources database. Ecology guidelines particularly specify such a comment to accompany any sampling that targets a storm event.

7.1.1 Field measurements

Field measurements and samples to be collected are described in Section 6.2, “Measurement Quality Objectives.”

7.1.2 Sampling location and frequency

1) *Long-term Ambient Monitoring*

Streamkeepers’ monitoring focuses on wadeable streams, most of which arise in the foothills of mountains and are of relatively short length—often just a few miles. The choice of which streams to monitor is made by consultation between Streamkeepers staff, supervisors, and advisory groups. These choices are reflected in our annual work plans and sampling plans, available on our website: http://www.clallam.net/SK/programplanning.html.

Targeted sampling locations are a matter of consensus judgment. We generally try to establish three or more monitoring sites on a given stream: ideally, one at or near the mouth, one at a transition point between more- and less-intensively-developed areas, and one above the developed areas. This arrangement allows comparison between stream characteristics at different elevations and levels of human impact. The exact number and location of monitoring sites will depend on characteristics specific to each creek (including access, owner permission, creek geography and history, etc.). Because we are an ongoing program designed to meet the long-term informational needs of local resources managers, the sites change over time. For instance, after several years of monitoring a particular site, we may decide that an adequate baseline of data has been collected and therefore mothball the site; or another entity may decide to take over monitoring in a given area. Specific streams and sites monitored are reviewed annually and may be adjusted each year, according to the recommendations of Streamkeepers' supervisors, technical advisors and volunteers. These changes are reflected in the Streamkeepers workplan devised prior to each calendar year accompanied by individual plans for water quality and benthic macroinvertebrates, and posted on our website: http://www.clallam.net/SK/programplanning.html. All sites are entered as points in Clallam County's Geographic Information System (GIS) and shared with Ecology's EIM database.

Selection criteria for ambient monitoring sites include the considerations presented in Section 6.2.2.2, such as the following:

- Site is typical of its location in the watershed.
- Sites in a stream system collectively present a representative view of the stream as a whole.
- Sites in a stream system collectively help to isolate problem areas in a watershed.
- Reasonable and safe access by volunteers.
- Publicly owned land or permission of landowner to access and mark sites.
- Site contains both pools and riffles, if possible.
- Above saltwater and tidal influence, if possible, unless the tidal location is important.

Any sampling for laboratory analysis (e.g., fecal coliform, nutrients, invertebrates) is constrained by funds available for laboratory fees, and therefore such sampling cannot be guaranteed. Streamkeepers is often able to form partnerships to perform such sampling, but in such a case, the sampling is a special investigation (see below) and sites are determined by the funder.

Micro-location of sampling at a site is generally made by the field team in situ, because certain conditions must prevail for certain types of sampling, e.g., flow, water chemistry, or benthic macroinvertebrate collection. Details of how to determine the best spot for a given procedure are described in Streamkeepers' Volunteer Handbook (Chadd, current year's edition).

2) Special Investigation Work

Special investigation monitoring sites are selected by the proponent to meet their own objectives. Often, the sites chosen are sites already established by Streamkeepers, which offer the advantage of an existing body of data and known access and permission.

7.1.3 Parameters to be determined

The primary parameters investigated by Streamkeepers' ambient monitoring program are described in Table 5 below, including rationale and desired value range. A complete list of parameters to be determined is presented in Section 6.2, "Measurement Quality Objectives."

Table 5. Primary parameters of interest in Streamkeepers' ambient monitoring.
Monitoring Quarters: Winter: January, Spring: April, Summer: August, Fall: Sept. 15 - Oct. 15

Type of Parameter	Parameter	When	Why	Desired Level or Range
Chemical	Dissolved Oxygen	quarterly	Oxygen in water is vital to growth and development of aquatic life.	> 9.5 mg/L for most streams and 8.0 mg/L for the rest*
	pH	quarterly	A healthy stream is neither excessively acid nor alkaline; some aquatic life forms can only live within a narrow pH range, others are more tolerant.	6.5-8.5*
	Salinity	quarterly	In tidally-influenced waters, salinity readings give an idea of the relative degree of freshwater vs. saltwater influence at the sampling point.	Fresh water should generally be 0.1 PSS (Practical Salinity Scale) or less. Open ocean is about 35 PSS.
	Specific Conductivity (at 25°C)	quarterly	A healthy stream has low conductivity. High electrical conductivity indicates various chemical and biological pollution problems.	No standard established for streams, but readings >300 µS/cm may be cause for concern
	Temperature	quarterly	Consistently cool streams provide better habitat for salmonids. Streams that are unusually warm indicate watershed problems.	< 16° C for most streams and < 18° C for the rest*; consistent, cool temperatures
	Turbidity	quarterly	Turbidity (cloudiness in water) results from suspended solids such as mud. High levels of suspended sediment destroy fish habitat.	No more than 5 NTU above "natural" levels (or 10% above if "natural" level is >50).* (An "NTU" is a measure of turbidity.)
Biological	Benthic macroinver-tebrates (B-IBI$_{100}$)	Annually, Aug 1-Sept 30	Diverse populations of macroinvertebrates signal a healthy stream system capable of supporting fish.	Large diversity of creatures, especially those requiring undisturbed conditions.
	Fecal Coliform and other bacterial concentra-tions	quarterly as funding permits or as requested by other sponsors	Fecal bacteria indicate human and animal waste in runoff water. Fecal matter in streams enriches water with nitrogen, contaminates shellfish, and makes people sick.	Geometric mean of 50 colonies per 100 mL and <10% of readings below 100 colonies for most waters, and geometric mean of 100 & <10% below 200 for the rest*

* Source: State water quality standards, Chapter 173-201A WAC. Clallam County streams for which standards are more lenient are: the Dungeness River and tributaries downstream of Canyon Creek (RM 10.8), Port Angeles Harbor tributaries from Tumwater to Lees Creeks, and the Dickey River. Current state standards for temperature, dissolved oxygen, and fecal coliform are categorized according to designated uses for aquatic life, recreation, etc.

7.2 Maps or diagram

For an overall map of the study area, see Figure 1 in Section 3. For a list of specific locations proposed for sampling, see the current Streamkeepers Work Plan at http://www.clallam.net/SK/programplanning.html.

7.3 Assumptions underlying design

Assumptions underlying design include:

- Representativeness of sites and sampling intervals (see Section 6.2.2.2).
- Appropriateness of parameters selected to describe water quality conditions.
- Efficacy of basing sampling strategy on the stated needs of outside agents.
- The value of long-term data sets.
- The increasing ratio of signal to noise as data sets grow.

7.4 Relation to objectives and site characteristics

The sampling program and field data collection methods are designed to meet program goals and objectives within the limitations of funding, staffing, volunteer effort, and technical limitations. Partner agencies understand that Streamkeeper volunteers are primarily limited to wadeable streams, but "wadeable" is somewhat open to interpretation. We generally follow the "Rule of 10": if velocity (in ft/sec) * depth (in ft) > 10, we stay out. Sometimes the limit is less than 10.

7.5 Characteristics of existing data

Most current water-quality data for wadeable streams that is available in the study area comes from Streamkeepers sampling, and therefore it is a fairly consistent and comparable data set. Ambient monitoring and special investigation sites change over time, but in general, the data available is thought to provide a reasonable representation of water quality in the study area, and therefore it was heavily relied upon for the only comprehensive report on water quality written by Clallam County (Clallam County, 2004).

8.0 Sampling Procedures

8.1 Field measurement and field sampling SOPs

A basic schema of sampling and measurement procedures is presented in Table 4, "Measurement Quality Objectives," in Section 6.2. The Field Procedures section of the Streamkeepers Volunteer Handbook (Chadd, current year's edition), incorporated by reference into this document, gives further details relating to:

- collection of samples and associated field QC samples
- analytical methods for measurements/analyses done in the field as well as the laboratory
- required equipment and in-situ calibration and maintenance procedures
- required content and format of field log entries
- requirements for photographic documentation
- sampling equipment and methods for its preparation and decontamination
- sample containers, sample size, labeling, preservation, holding time requirements, and chain of custody.

The Handbook is revised on a regular basis, so detailed procedures for a given year are given in the Handbook governing that year, and past editions are available from the Streamkeepers office. However, these revisions do not change the Measurement Quality Objectives but rather:

- better explain procedures and make data-collection more efficient
- account for additional special circumstances
- reduce the occurrence of "flagged" data

Revisions to the Handbook and QAPP will not reduce data quality below the stated objectives for a given parameter or compromise comparability with past data for the same parameter.

8.2 Containers, preservation methods, holding times

See Section 6.2 and particularly Table 4.

8.3 Invasive species evaluation

Invasive species, if present at sampling sites, may contaminate sampling equipment, field wear, etc. The Anti-Contamination protocol in the Streamkeepers Volunteer Handbook (Chadd, current year's edition) follows Ecology's SOP EAP070 and addresses invasive species transport and contamination.

8.4 Equipment decontamination

Waters sampled may contain high levels of pathogens or toxins. The Safety protocol in the Streamkeepers Volunteer Handbook (Chadd, current year's edition) addresses procedures to protect samplers and prevent contamination, and Streamkeepers volunteer training includes discussion and demonstration of safety techniques.

8.5 Sample ID

Sample IDs depend on the nature of the sample and laboratory as well as stage in the process:

- Bacterial samples have a random number on the bottle, which is cross-referenced to site/date/time on the data sheet.
- Samples bound for other analytical laboratories will follow conventions established by the lab. In some cases, the other bottles from a site will be marked with the number on the bacterial bottle; in other cases such as Ecology's Manchester Laboratory, there will be a pre-assigned Work Order number, followed by a consecutive number.
- Benthic macroinvertebrate samples are labeled on both the inside and outside with the site, date, samplers, and consecutive jar number.
- Once entered into the Clallam County Water Resources database, each sample container deployed is assigned an automated Batch ID, which is then uploaded to Ecology's EIM database as the Sample ID.

8.6 Chain-of-custody

Sample chain-of-custody procedures are described in the Streamkeepers Volunteer Handbook (Chadd, current year's edition). Besides these procedures, Streamkeepers maintains chain-of-custody records for benthic macroinvertebrate samples, which include the year, site, and # of containers of the sample, and initials and date for receipt in Streamkeepers' office, submission to and return from ID & QC labs, and placement in long-term storage. Streamkeepers and the primary and secondary (quality-control) taxonomy laboratories together arrange for the delivery and return of these samples.

8.7 Field log requirements

Required content and format of field log entries are described in the Streamkeepers Volunteer Handbook (Chadd, current year's edition).

8.8 Other activities

<u>Training:</u> Streamkeepers typically offers annual training to volunteers, based on the procedures in the Volunteer Handbook (Chadd, current year's edition). Volunteers see the procedures demonstrated and have the opportunity to practice them, under supervision of staff or

experienced volunteers. Attendance at all training events is recorded in the Clallam County Water Resources database. New volunteers are then assigned to teams with experienced volunteers guiding them through procedures. Usually several outings are required before new volunteers feel comfortable performing procedures on their own. Only volunteers trained in a given procedure will be allowed to attach their initials to data gathered under that procedure. The database connects all data with a sampler, whose training history is recorded in a separate table in the database.

Maintenance, Calibration, and Quality Control of Test Equipment: Detailed procedures for maintenance and calibration of test equipment prior and subsequent to field sampling are posted on Streamkeepers' website: http://www.clallam.net/SK/QualityAssurance.html. These procedures cover all analytical instruments in use. As with Streamkeepers' field procedures, these procedures get revised on a regular basis to better explain procedures, deal with special situations, or reflect our deeper understanding of maintenance and calibration issues; these revisions will never reduce data quality below the stated objectives for a given parameter or compromise comparability with past data for the same parameter. Maintenance and calibration procedures are summarized in Section 10.1 below.

9.0 Measurement Methods

9.1 Field procedures table/field analysis table

Field procedures are summarized in Table 4 in Section 6.2, and described in detail in the Streamkeepers Volunteer Handbook (Chadd, current year's edition).

9.2 Lab procedures

Lab procedures for bacteria and benthic macroinvertebrates are described in Table 4 in Section 6.2. As explained above, Streamkeepers has no programmatic funding for laboratory samples and therefore conducts such sampling only under special investigations, which are described in the following QAPPs, incorporated by reference in this document, for nutrients, metals, organics, pesticides, and suspended and benthic sediment (Chadd et al., 2008; Chadd et al., 2009; Knapp et al., 2009; Chadd et al., 2010; Soule and Chadd, 2013; Clallam County Departments et al., 2015):
http://www.clallam.net/SK/stormwatermonitoring.html
http://www.clallam.net/HHS/EnvironmentalHealth/documents/qapp.pdf
http://www.clallam.net/SK/doc/clnwtrdpolid.pdf)

9.3 Sample preparation method(s)

Sample preparation methods are described in the documents referenced in Section 9.2.

9.4 Special method requirements

Special method requirements are described in the documents referenced in Section 9.2.

9.5 Lab(s) accredited for method(s)

When lab data is to be uploaded to Ecology's EIM database, accredited labs will be used. Labs that have been used recently include Clallam County Environmental Health Laboratory and Spectra Labs (bacteria), Ecology's Manchester Environmental Laboratory (nutrients, metals, organics, suspended and benthic sediment, pesticides), and Environmental Services and Consulting (benthic macroinvertebrates).

10.0 Quality Control (QC) Procedures

10.1 Table of field and lab QC required

QC procedures for Streamkeepers' regular ambient monitoring parameters are summarized in Table 6 below. QC procedures for additional field and lab procedures are detailed in the documents referenced in Section 9.2.

Table 6. Maintenance, calibration, and QC for Streamkeepers' regular ambient monitoring parameters.

* indicates procedures covered by Streamkeeper SOP's (http://www.clallam.net/SK/QualityAssurance.html)

For definitions of "EST", "REJ", and "J", see Section 10.2 below.

"Session" refers to a month-long quarterly monitoring window during which sampling is performed.

% bias = Abs(standard value – measured value) / standard value x 100%, where Abs = absolute value

RSD in the table below refers to the relative standard deviation (also known as the coefficient of variation or CV), which, when n = 2 (as when comparing a sample with a replicate), is defined as follows:

RSD = Abs(difference/sum) x Sqrt(2) x 100%, where Abs = absolute value and Sqrt = square root

Equip-ment / Procedure/ Standard	Office prep (beginning of each session or as noted)	Main-tenance measures (office & field)	Field prep/ checks	Quarterly bias post-session checks (plus mid-session as possible)	Bias evaluation with standard reference materials	Replicates for precision checks	Precision evaluation per rep/sample difference
Tempera-ture logger (contin-uous)	2-point calibration with NIST-traceable thermo-meter (see Dunham et al. 2005)	Periodic station checks (see Dunham et al. 2005)	Side-by-side measure-ment with calibrated thermistor (see Dunham et al. 2005)	Side-by-side measure-ment with NIST-traceable thermometer; 2-point calibration check with NIST-traceable thermometer	"EST" if >±0.2°C "REJ" if >± 0.5°C	NA; side-by-side testing done with NIST-traceable thermo-meter	NA
*Ther-mistor	2-pt. (~0° & 20°C) check vs. NIST-traceable thermo-meter	Keep sensor clean		Post-session 2-pt. calibration check vs. NIST-traceable thermometer	"EST" if >±0.2°C "REJ" if >± 0.5°C	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if >±0.2°C; "REJ" if >± 0.5°C

Equip-ment / Procedure/ Standard	**Office prep (beginning of each session or as noted)**	**Main-tenance measures (office & field)**	**Field prep/ checks**	**Quarterly bias post-session checks (plus mid-session as possible)**	**Bias evaluation with standard reference materials**	**Replicates for precision checks**	**Precision evaluation per rep/sample difference**
*NIST-traceable thermo-meter	Check/ calibration performed as needed by an ISO-compliant laboratory		Laboratory check will qualify post-checks of thermistors performed with this instrument		"EST" if >±0.05°C or "REJ" if >±0.1°C in range including data		
*Baro-meter	1-point check vs. weather station	Handle with care		1-point check vs. weather station	"EST" if >± 0.05 in.Hg; "REJ" if >± 0.1 in.Hg	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if >± 0.05 in.Hg; "REJ" if >± 0.1 in.Hg
*Dis-solved Oxygen meter (membrane electrode)	Side-by-side testing vs. replicated Winkler titrations (with membrane/ fluid replacement & electrode cleaning)	Membrane & fluid replace-ment & electrode cleaning at least quarterly	Check/rinse probe; in-situ saturated air calibration at stream temper-ature, with pressure adjustment; drift check of meter following measure-ment; recalibrate & resample if check fails	Post-session side-by-side testing vs. replicated Winkler titrations	Meter listed at ±0.3 mg/L & Winkler listed at ±0.2 mg/L (Hallock & Ehinger, 2003); therefore, "EST" if difference >±0.5 mg/L; "REJ" if difference >±1 mg/L	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if >± 0.3 mg/L; "REJ" if >± 0.55 mg/L

Equip-ment / Procedure/ Standard	**Office prep (beginning of each session or as noted)**	**Main-tenance measures (office & field)**	**Field prep/ checks**	**Quarterly bias post-session checks (plus mid-session as possible)**	**Bias evaluation with standard reference materials**	**Replicates for precision checks**	**Precision evaluation per rep/sample difference**
*Dissolved Oxygen meter (optical lumines-cent)	Two-point calibration with sodium sulfide (zero) and fully-saturated air or water	Keep moist in storage cup when not in use; remove probe for long-term storage	Check probe & rinse as necessary	Post-session recheck vs. theoretical solubility in saturated air or water, and/or side-by-side testing vs. replicated Winkler titrations	No qualifier if ≤ ±0.2 mg/L from theoretical or ≤ ±0.4 from Winkler[3]; "REJ" if ≥ ±0.6 from theoretical and ≥ ±0.8 from Winkler; else EST	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if >± 0.2 mg/L; "REJ" if >± 0.4 mg/L
*Conduc-tivity meter	Calibration with NIST-traceable standard	Electrode cleaning solution	Check /rinse electrodes	Post-session check against NIST-traceable standard	"EST" if >±10% of standard value; "REJ" if >±15% of standard value	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if RSD >5%; "REJ" if RSD >10%
*pH meter	3-point calibration with NIST-traceable standards	Clean/ replace probe as needed if perfor-mance fails	2-point calibration at beginning of each team's session	Post-session 3-point check with NIST-traceable standards	"EST" if post-checks bracketing range of field values are >±0.2 pH unit; "REJ" if >±0.5 pH[4]	1 replicate per team per session (or minimum 1/10 ratio)	"EST" if >±0.2 pH unit; "REJ" if >±0.5 pH unit

[3] Meter accuracy listed at ±0.2 mg/L & Winkler accuracy listed at ±0.2 mg/L (Hallock & Ehinger, 2003).

[4] For pH, if one or more post-checks vs. a buffer is outside the acceptable range, values taken with the meter might still be acceptable. For example, if the field reading was 6.8, and the drift checks showed the meter within specs with the pH 7 standard but deviating by 0.3 with the pH 4 standard, the calibration curve would be such that the 6.8 reading would be well within the meter's accurate range. Curve calculations from drift readings can determine this issue.

Equip-ment / Procedure/ Standard	Office prep (beginning of each session or as noted)	Main-tenance measures (office & field)	Field prep/ checks	Quarterly bias post-session checks (plus mid-session as possible)	Bias evaluation with standard reference materials	Replicates for precision checks	Precision evaluation per rep/sample difference
*Turbidity meter (bench-style)	4-pt. calibration with NIST-traceable standards	Keep sampling well & outsides of vials dry and clean; avoid scratching vials	Poly bottle ≥ 100 mL; observe holding specs. Mix sample well before reading. Zero meter and 1-pt. check with NIST-traceable standards; triplicate samples	Post-session 4-pt. check with NIST-traceable standards prior to next calibration, plus check of field standards	"EST" if post-checks bracketing range of field values show difference > both 0.5 and 7% of standard value; "REJ" if difference > both 1.0 and 10% of standard value	1 replicate set (of 3) per team per session (or minimum 1/10 ratio)	"EST" if difference > 1 NTU (the field MDL) and > 7% RSD; "REJ" if difference > 1 NTU (the field MDL) and >14% RSD
*Turbidity meter (in-situ)	Two-point calibration with DI water and NIST-traceable standard	Keep moist in storage cup when not in use; remove probe for long-term storage	Check probe & rinse as necessary; take average of multiple samples	Two-point check with DI water and NIST-traceable standard	"EST" if post-checks bracketing range of field values show difference > both 0.5 and 7% of standard value; "REJ" if difference > both 1.0 and 10% of standard value	1 replicate set per team per session (or minimum 1/10 ratio)	"EST" if difference > 1 NTU (the field MDL) and > 7% RSD; "REJ" if difference > 1 NTU (the field MDL) and >14% RSD

Equip-ment / Procedure/ Standard	**Office prep (beginning of each session or as noted)**	**Main-tenance measures (office & field)**	**Field prep/ checks**	**Quarterly bias post-session checks (plus mid-session as possible)**	**Bias evaluation with standard reference materials**	**Replicates for precision checks**	**Precision evaluation per rep/sample difference**
*Pocket thermo-meter (for air temp)	2-pt. (~0° & 20°C) calibration vs. NIST-traceable thermo-meter		Make sure thermo-meter is dry; 2nd reader encouraged	Post-session 2-pt. check vs. NIST-traceable thermometer	"EST" if >±1°C; "REJ" if >±2°C	NA	NA
*Field standards (if used for field calibration)	Tested with freshly-calibrated instruments	Keep well-sealed and within tem-perature specifi-cations	Used to check and/or calibrate instruments in the field	Re-check vs. office standards or freshly-calibrated instruments	At end of sampling period, instruments are re-calibrated with field standards and then tested with office standards; apply control criteria applicable to that instrument		
*Nitrate-Nitrogen (lab)	In-lab calibration per CCEHL 2016		Proper collection technique	Pre- and post-sample blanks; post-sampling meter check	Adjust data per blanks; "J" if post-check >±20% of standard value; "REJ" if post-check >±30% of standard value	Field and lab replicates for 1/10 of samples	"J" if RSD >± 7%; "REJ" if RSD >14%
*Fecal Coliform (lab); (also may test for total coliform/E. coli and entero-coccus)	Verification of colonies once a month; annual proficiency testing with state; see CCEHL 2013	Checks of medium, filters, funnels, thermo-meter, rinse & dilution water;	Sterilized bottles, 4 oz. (125 mL) minimum; observe holding specs	Pre- and post-sample blanks; control blanks for 1/10 of samples	Adjust/flag data as needed per blank results	Field replicates for 1/10 of samples; lab replicates for 1/20 of samples	See Table 7 below

Equip-ment / Procedure/ Standard	Office prep (beginning of each session or as noted)	Main-tenance measures (office & field)	Field prep/ checks	Quarterly bias post-session checks (plus mid-session as possible)	Bias evaluation with standard reference materials	Replicates for precision checks	Precision evaluation per rep/sample difference
Coliscan Easygel (total coli-form & E. coli)		Preserve broth per mfr. instructions	Observe holding times; take post-sample blanks	Replicates of 1/10 of samples for lab fecal coliform counts	NA; flag at staff discretion	Field replicates for 1/10 of samples; lab replicates for 1/20 of samples	"REJ" if RSD > 85%
*Flow meter	Retesting of rotor/ prop units 2x/year	Replace rotor/prop units when <90% of new perfor-mance	Spin, count, and blow tests of rotor/prop units; spares provided	Comparison with stream gage data	NA	Occasional field replicates or side-by-side sampling	NA
Flow—stage gage	Stage/ discharge curve, least-squares method (Bovee and Milhous, 1978)	Choose a stable channel segment; field-reference the gage; check plumb	6-8 wade-across measure-ments to establish the curve	2-3 wade-across measure-ments per year to maintain the curve	"EST" if calculated value <0.4 times the min. or >2.5 times the max. discharge measured	NA	NA
Imhoff Cone (settleable solids)		Keep clean	Proper collection technique		NA	Replicates not normally taken	NA

10.2 Corrective action processes

<u>Data Qualifiers:</u>

Data qualifiers are applied as above. Laboratories will be directed to apply qualifiers per QAPPs written for those analytes. Qualifiers will apply to all samples in the grouping covered by that replicate/sample pair—for example, the entire group of samples taken by a field team during a quarterly session, or the group of samples from which a grab-sample field replicate was taken. These qualifiers are only applied if they downgrade already-applied data qualifiers; for example, if QC reviewers have already applied a "REJ" qualifier to a result, a downgrade value of "EST" based on replicate/sample comparison will not change the "REJ" designation for that result.

Streamkeepers will use data qualifier codes described in Ecology's EIM database. For non-lab data, possible qualifiers include:

- **No qualifier:** Monitoring procedures have been followed and documented, and all QC screens have passed; the data is acceptable per that parameter's Measurement Quality Objectives (Section 6.2).
- **EST (estimate):** Monitoring procedures have not all been followed and/or documented, or one or more QC screens have not passed; but QC reviewers believe the data to be reasonably trustworthy for non-regulatory purposes.
- **REJ (rejected):** Monitoring procedures have not all been followed and/or documented, or one or more QC screens have not passed; and QC reviewers believe the data to be untrustworthy for any purposes.

After a monitoring event, QC reviewers examine data sheets and communicate with the monitoring team to ascertain if there have been deviations from standard operating procedures; on this basis, reviewers apply data qualifiers as appropriate. Further QC screens and corrective actions are described below.

For lab-generated data, the lab or Streamkeepers will apply qualifiers as appropriate per Ecology's EIM database. In some cases, the lab (e.g., Clallam County's Environmental Health Lab) will report lab replicate data and Streamkeepers' QC reviewer applies the appropriate qualifier, usually either REJ (see above) or J (the equivalent of EST in a lab environment).

Controls for Bias and Precision:

Bracketing qualifiers based on QC controls: For each QC test performed, qualifiers indicated will be applied to all data governed by that test. Such qualifications will occur at a variety of levels, from an individual result up to an entire multiple-visit sampling session. In general, a drift-check of an instrument will apply to all data taken with the instrument since its last substantive maintenance or replacement (e.g., change of a membrane or probe solution), calibration, or equivalent drift check. For example, pH meters are subject to periodic in-field drift checks with field standards as well as periodic drift checks with office standards; in each case, any qualification resulting from these checks would apply to all data taken since the last equivalent check.

Post-period drift check is sufficient: Instrument drift away from accuracy is presumed to progress in a single direction, either above or below the accuracy target. Therefore, in a case where an instrument was checked for accuracy only subsequent to a sampling episode, if the instrument passes its QC post-check, it is presumed that the instrument performed to specifications prior to that check (Katznelson, 2011), so long as no substantive maintenance or replacement of instrument parts was performed in between. This situation is to be avoided, because samplers run the risk of downgrading an entire set of data due to not having checked instrument accuracy at the outset.

Water quality parameters—bias: Bias of water quality measurements is estimated by performance evaluation measurements of the equipment, both in the field and at the office; see Table 6 above and the discussion below for details.

Office calibration, validation, and drift checks: Instruments are given a complete calibration or validation (depending on whether they can be calibrated) at the office prior to the sampling session and then drift-checked at the end, using NIST-traceable non-expired “office” standards, certified equipment, and Standard Methods (APHA, 1998). These office checks are the ultimate check of instrument performance. Calibrations and checks may also be performed within sampling sessions.

Field calibration, validation, and drift checks: In certain cases, samplers calibrate, zero, and test instruments prior to sampling with NIST-traceable non-expired “field” standards (see Table 6). Field calibrations minimize instrument drift, and where field calibration is not possible or practical, field calibration tests provide an interim check on instrument performance, to alert samplers to possible problems requiring recalibration or replacement. After sampling, instruments may be checked again for drift; if drift exceeds the target control values, the instrument should be recalibrated or replaced and the field measurements retaken, or the data will be downgraded per Table 6.

Checks of field standards: Field standards are checked for drift against the office standards at the end of their sampling periods.

Detailed equipment calibration, validation, and maintenance procedures are described on Streamkeepers’ website at http://www.clallam.net/SK/QualityAssurance.html and are hereby incorporated by reference into this document.

Water quality parameters—precision: Precision of water quality measurements is evaluated by analysis of replicate samples taken in the field at one site (randomly selected) per team per sampling session, or at least one replicate per ten samples. Details on field replicate-sampling procedures are described in the “Water Chemistry—General Guidelines” section of the Streamkeepers Volunteer Handbook (Chadd, current year’s edition). The variation between these sample and replicate values is a measure of variability due to short-term environmental factors, instrument operation, and sampling procedure. See Table 6 above for acceptance criteria and control limits based on comparing replicates with their paired samples.

Grab samples for laboratory analysis: When grabbing samples for laboratory analysis, in cases where non-detects are common, we target field and lab replicates at sites likely to have high counts, on the notion that replicated samples with non-detects provide little information (Lombard, 2007). The following QC criteria for bacterial samples are based on comparing field and laboratory replicates with their paired samples, recognizing that there is always the possibility of real environmental variation when grabbing bacterial samples:

Table 7. Analytical laboratory quality control measures for bacterial samples.

Control measure used: variance between sample and field or lab replicate
If absolute difference ≤ 10 or difference between base-10 logs ≤ 0.6 (Relative Standard Deviation ≤ 85%): No qualifier
Otherwise, qualify per best professional judgment of QC and laboratory analysts, including the following options: --If other rep/sample pairs from that Tour were within tolerance, flag only the data from that Visit as "REJ" (unacceptable) or “J” (estimate), and do not flag the other data, unless there is reason to question the entire Tour’s batch of samples; --If other rep/sample pairs from that Tour exceeded tolerance, consider flagging all the data from that Tour. --If there are no other rep/sample pairs in that Tour, use best professional judgment of QC and laboratory analysts to decide whether to flag other data.

--It may be useful in some cases to analyze sample-replicate variances for larger data sets for comparison.

Benthic macroinvertebrate samples: Field quality-control measures include checking the sampling net before and after each use to check for tears or organisms left in the net, as well as timing the digging, per the "Benthic Macroinvertebrate Sampling" protocol in the Streamkeepers handbook (Chadd, current year's edition). Field and lab protocols are per King County, 2014. Laboratory quality-control measures are as follows: 10% of the samples from a given year are rechecked by a second, certified taxonomist, for both sorting efficiency and ID accuracy. If the QC taxonomist finds sampling, sorting, or taxonomic identification problems, the data are modified, qualified, re-identified, or discarded, depending on the degree of the problem, following discussion between the taxonomy laboratories and Streamkeepers QC analysts. A taxon found to have been systematically mis-identified will be reclassified for that year's sample batch. In case of dispute, specimens may be sent to additional taxonomists for resolution. If uncertainties in sample interpretation persist, resolution will be sought from a professional bio-statistician familiar with the genesis of the B-IBI. To facilitate consensus identification of taxa, Streamkeepers maintains a synoptic reference collection of best-quality specimens of all taxa found, labeled and confirmed by at least one additional taxonomist. Taxonomists performing ID are instructed to add to this collection when they find new taxa. Furthermore, Streamkeepers maintains a number of more specific documents concerning classification of local fauna, taxonomic procedures, sorting, and subsampling, all of which are incorporated by reference into this document (http://www.clallam.net/SK/QualityAssurance.html); taxonomists are expected to use these documents as guides, revising them in consultation with other professionals as needed. To the extent possible, we engage services of laboratories with knowledge of the local macroinvertebrate fauna. The following control limits apply to the taxonomic laboratory work:

Table 8. Taxonomic laboratory quality control measures for benthic macroinvertebrate samples.

QC activity	QC target	QC actions
Sorting efficiency and ID accuracy	Sorting and ID errors do not result in a change in the target index score greater than the index's sensitivity (±14.11 for the B-IBI$_{100}$; King County, 2014)	Systematic mis-ID's will be systematically corrected; if target not met for 1 replicate (or <10% of all QC'd replicates), flag data by individual sample; if target not met for >1 or >10% of all replicates, determine whether problem was systematic or specific, and qualify data accordingly. In an extreme case, all data taken in that year will be flagged or samples re-identified.
Synoptic reference collection	Vouchered collection of all taxa identified, confirmed by two taxonomists	If the first two taxonomists disagree on ID, the specimens are sent to additional taxonomists as needed.

Training: Streamkeepers typically offers annual training to volunteers, based on the procedures in the Volunteer Handbook (Chadd, 2015). Volunteers see the procedures demonstrated and have the opportunity to practice them, under supervision of staff or experienced volunteers. Attendance at all training events is recorded in the Clallam County Water Resources database. New volunteers are then assigned to teams with experienced volunteers guiding them through procedures. Usually several outings are required before new volunteers feel comfortable performing procedures on their own. Only volunteers trained in a given procedure will be allowed to attach their initials to data gathered under that procedure. The database connects all data with a sampler, whose training history is recorded in a separate table in the database.

Side-by-Side Sampling—External: Streamkeepers volunteers or staff participate at least four times per year in Ecology's Side-by-Side Sampling program (http://www.ecy.wa.gov/programs/eap/fw_riv/SxSIndex.html), testing water bodies at the same time Ecology tests them as part of their monthly Ambient Monitoring Program; data is submitted to Ecology in the specified format within 60 days of collection. This program affords both parties the opportunity for additional validation of their data. Every attempt will be made to discuss, understand, and correct any sign of systematic bias that exceeds the QA standards of either party.

Side-by-Side Sampling—Internal: Streamkeepers staff or experienced volunteers may perform split sampling alongside a Streamkeepers volunteer team, per the judgment of the Streamkeepers program manager. Results are compared and actions taken as appropriate, such as qualifiers on past data for that individual or team; additional training for that individual, team, or the entire volunteer corps; or additions/revisions to field procedures. Targets are the same as the precision targets for the parameter as described in Table 5. If targets are not met, corrective actions will include data qualifiers, additional training, and revised instructions, as appropriate.

Other General QC Measures:

- Clear, user-friendly, and detailed instructions for all procedures, minimizing judgment calls
- Equipment calibrated, checked, and maintained prior to sampling
- Multiple observers when possible
- Each sampling team has an experienced leader
- Photo documentation of physical-habitat data
- Questionable noxious weed samples brought in for professional ID
- Staff review of data, including comparing values year-to-year
- Values compared to external data from other agencies, such as stream gage data.

11.0 Data Management Procedures

11.1 Data recording/reporting requirements

Data recording and checking: Streamkeepers' field data are generally collected on custom-designed data sheets, most of which are available on Streamkeepers' website: http://www.clallam.net/SK/monitoringusables.html. Field samplers record and initial data on these sheets. When all data have been collected at a site, the team leader looks over the sheets for completeness, legibility, and obvious errors, and gets further information from team members as appropriate. Any problems with data collection are noted in a "Comments" section of the data sheet. The team leader initials and dates this review, then initials and dates again when turning the sheets in to the office. Then staff initials and dates receipt and QC analysts review the data. The QC review is a thorough process that includes troubleshooting for decimal and rounding errors, data entered into the wrong field, incomplete data, etc.—see http://www.clallam.net/SK/doc/Qrtlydtashtckpl.pdf.

Database entry and checking: Once data sheets have been reviewed, volunteers enter the data into the Clallam County Water Resources (CCWR) database (Microsoft Access software). Detailed procedures are provided to the volunteers, both in written form (see Appendix B) and in one-on-one training, and staff members are available to volunteers as they perform data entry. Volunteers subsequently check the database entries against the field sheets, and then later perform an additional troubleshooting double-check.

Automated data checks: Our intention is to program the CCWR database to automatically perform the statistical checks described in the "Quality Control" section above, and in some cases to downgrade data automatically as appropriate (leaving a record of the downgrade). In other cases the database displays a message instructing QC reviewers to examine data and apply qualifiers as appropriate. These automated routines ensure compliance with QC procedures. In lieu of automation, data qualifiers are assigned manually by QC reviewers.

Final Sign-Off of Data: Once all of the above checks have been performed, the Streamkeepers QA Officer does a final review of data, including examination of outliers, and signs off that the data are ready for publication.

Data reporting: The CCWR database includes a number of custom-made reports, including one for standard water-quality results in tabular format and another for all results, with one record per result. In all cases, daily averages are computed unless the sampling targeted a storm. Numerous other reports have been created at the request of clients.

Benthic macroinvertebrate data: In 2011, a consortium of Puget Sound local governments adopted standard sampling and analytical protocols for the computation of the Benthic Index of Biotic Integrity (B-IBI) and programmed the algorithms into the Puget Sound Benthos website maintained by King County (http://pugetsoundstreambenthos.org/). This database is designed to store and report regional data, and Streamkeepers' intention is to enter the taxonomic sampling data into the CCWR database and then upload the information to the Puget Sound Benthos database, where anyone will be able to access it. Ecology will use this platform as a data source for its Water Quality Assessments.

11.2 Laboratory data package requirements

Laboratories must provide data in conformance with this QAPP. The data can be in a variety of formats, per arrangement with Streamkeepers staff.

11.3 Electronic transfer requirements

As stated above, arrangements for data transfer will be made between Streamkeepers and the laboratory. Usually data will be transferred in spreadsheet format.

11.4 Acceptance criteria for existing data

The Clallam County Water Resources database contains data sets dating back to 1986. All data is identified by project or program, including appropriate metadata, so data users can evaluate the usability of those data sets.

11.5 EIM/STORET data upload procedures

All qualified water quality data in the Clallam County Water Resources database will be entered into Ecology's EIM database, following all current Ecology business rules and the EIM User's Manual for loading, data quality checks, and editing. The data will be submitted to EIM either when Ecology calls for data or at the close of an Ecology grant involving data collection.

12.0 Audits and Reports

12.1 Number, frequency, type, and schedule of audits

Streamkeepers program coordinators are responsible for overseeing implementation of this QAPP. Qualitative audits of conformance occur on a continual basis, at a variety of levels:

- Team members check one another's work as they follow procedures in the Volunteer Handbook.
- Experienced field team leaders oversee the work of their teams and review data sheets.
- QA Officer or QC Reviewers review all data sheets prior to database entry (see http://www.clallam.net/SK/doc/Qrtlydtashtckpl.pdf) and communicate with teams about any omissions or problems they find.
- Multiple checks, both human and automated, occur as data is transferred from field sheets to electronic form. At least two people are involved in the data-entry and verification process to avoid errors from fatigue or oversight.
- Procedures described above in "Quality Control" are performed.
- Principal Investigator reviews datasets to troubleshoot outliers.
- Streamkeepers' data reports are shared with Streamkeepers' advisory committees and outside agencies. This audience provides considerable peer review.

In all cases, as problems are found, they are corrected or flagged, and discussed with the relevant personnel. These findings are recorded in a "Comments" field connected to the data in the CCWR database. Streamkeepers staff do not write formal performance reports, but they are intimately involved in both day-to-day operation of the program and implementation of QC procedures, and accordingly are continually making improvements to the overall operation of the program. Improvements to procedures are written into revisions of the documents that govern the program. The Streamkeepers Volunteer Handbook (Chadd, current year's edition) has been revised annually from 1999 to date.

12.2 Responsible personnel – see Section 12.1

12.3 Frequency and distribution of report

Streamkeepers reports on data on occasions such as the following:

- When Ecology calls for data for its Water Quality Assessment.
- When an outside client requests a report.
- When Streamkeepers staff, volunteers, or advisors see a need for a summary report.

Otherwise, as possible, Streamkeepers staff will update data reports available on Streamkeepers' website at http://www.clallam.net/SK/studies.html.

12.4 Responsibility for reports

Streamkeepers program coordinators are responsible for reports.

13.0 Data Verification

13.1 Field data verification, requirements, and responsibilities

As described in Section 12, Streamkeepers data undergoes verification and validation at a number of stages and levels. Performance of these measures is overseen by the Streamkeepers program coordinator, who verifies that QC results have been evaluated and data qualifiers have been applied as necessary.

13.2 Lab data verification

Laboratories will perform laboratory QC per requirements of this QAPP and standard laboratory practices. After the laboratory verification, the Streamkeepers QA Officer or QC Reviewers will perform a secondary verification of each data package, involving detailed review of all parts of the package with special attention to laboratory QC results. They will bring any discovered issues to the laboratory's attention for resolution.

13.3 Validation requirements, if necessary

Independent data validation by an outside party is outside the normal scope of the Streamkeepers program. Special investigations may require and fund such independent audits.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining whether program objectives have been met

Because the Streamkeepers ambient-monitoring program is an ongoing program rather than a discrete data-gathering project, there is no single set of requirements for representativeness, completeness, and comparability. Those issues depend on the particular use to which the data will be put, and data quality assessment must occur on a case-by-case basis. For example, Clallam County's *State of the Waters* report (Clallam County, 2004) contains extensive evaluation of the quality of the data used for that report, including an appendix devoted to "Uncertainty Analysis for Health Ratings." In general, Streamkeepers' data-quality requirements are determined by the Objectives listed in Section 4.2 above. In this sense, usability of data will be determined as follows:

Table 9. Data-quality requirements for Streamkeepers' ambient monitoring data

Objective	Data-Quality Requirements
Define and document baseline physical, chemical and biological conditions of local streams	Determination of whether adequate baseline has been established (e.g., Clallam County, 2004)
Measure spatial and temporal variability of stream attributes	Adequacy of data for statistical analysis of seasonal and geographical differences
Look for signs of degraded stream condition in a geographically broad manner	Adequacy of data to generalize to broader geographic areas
Assess trends in watershed degradation or restoration	Adequacy of data to show statistical proof of trends
Analyze data to understand the relationship between land use and watershed condition	Adequacy of both stream and land-use data
Provide information to assist in watershed planning, management, restoration and adaptive management	Usability of data for planning and management purposes
Submit data to Ecology's Side-by-Side sampling program	Data submitted in Ecology's required format and to Ecology's standards
Submit data to Ecology for Water Quality Assessment	QAPP must be followed and data with certain qualifiers will be excised

These determinations will be carried out by those analyzing the data, who could be Streamkeepers staff, advisors, volunteers, Clallam County officials, or outside clients. To the extent that the data are found inadequate for one or more of the above objectives, Streamkeepers' sampling plan and QAPP may be modified over time to correct those deficiencies.

Special monitoring investigations undertaken by Streamkeepers may have more discrete objectives, and those investigations may specify data quality goals and reporting requirements, at the discretion of the investigation sponsor. When necessary, those investigations will submit their own QAPPs, or Streamkeepers may submit addenda to this QAPP.

All activities of the Streamkeepers program are evaluated annually by Streamkeepers' advisory groups (Section 4.8), and it is with these groups that the ultimate evaluation of program effectiveness lies. Annual work plans that are vetted by these groups include specific objectives for each year as well as an evaluation of the degree of achievement of those objectives at the end of the year.

14.2 Data analysis and presentation methods

Data analysis and presentation methods will depend on the needs of the user. In general, it is expected that raw data will be reported unless the client asks for a particular type of analysis. At a minimum, data will be reported to Streamkeepers' advisory groups, who will serve as data reviewers. Certain standard reports are built into the Clallam County Water Resources database, including one for conventional water-quality parameters and another for more detailed data in format compatible with Ecology's Environmental Information Management database.

14.3 Treatment of non-detects

Non-detects will be included in data reports. Treatment will depend upon the client but may be one of the following:

- Non-detect may be replaced with the detection limit, half the detection limit, or zero.
- Data reported at values below the determined detection limit may be reported as is, with accompanying information regarding the detection and reporting limits for the parameter/method.

14.4 Sampling design evaluation

The Streamkeepers program was designed to conform to the needs of its data end-users, and annual re-evaluation assures that users' needs are being met. At this point, users' main needs are for a snapshot of watershed health and identification of problems in areas of interest, and the sampling program described here is generally believed to meet those needs.

14.5 Documentation of assessment

Streamkeepers' annual program-evaluation meetings include an assessment of the adequacy of the monitoring program to meet end-users' needs. Those evaluations are summarized in Streamkeepers' annual work plans—see http://www.clallam.net/SK/programplanning.html.

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16.0 Figures

The figures in this QAPP are inserted after first mention in the text.

17.0 Tables

The tables in this QAPP are inserted after first mention in the text.

Appendices—see following pages

Appendix A. Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

Ambient: Background or away from point sources of contamination. Surrounding environmental condition.

Anthropogenic: Human-caused.

Baseflow: The component of total streamflow that originates from direct groundwater discharges to a stream.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

Diel: Of, or pertaining to, a 24-hour period.

Dissolved oxygen (DO): A measure of the amount of oxygen dissolved in water.

Enterococci: A subgroup of the fecal streptococci that includes *S. faecalis*, *S. faecium*, *S. gallinarum*, and *S. avium*. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nutrient: Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Riparian: Relating to the banks along a natural course of water.

Salmonid: Fish that belong to the family *Salmonidae*. Any species of salmon, trout, or char.

Sediment: Soil and organic matter that is covered with water (for example, river or lake bottom).

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Streamflow: Discharge of water in a surface stream (river or creek).

Total suspended solids (TSS): Portion of solids retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act, requiring Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

Ecology	Washington State Department of Ecology
e.g.	For example
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
et al.	And others
GIS	Geographic Information System software
i.e.	In other words
MQO	Measurement quality objective
QA	Quality assurance
QC	Quality control
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
SRM	Standard reference materials
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cfu	colony forming units
ft	feet
g	gram, a unit of mass
mg	milligram
mg/L	milligrams per liter (parts per million)
NTU	nephelometric turbidity units
psu	practical salinity units
uS/cm	microsiemens per centimeter, a unit of conductivity

Quality Assurance Glossary

Accreditation: A certification process for laboratories, designed to evaluate and document a lab's ability to perform analytical methods and produce acceptable data. For Ecology, it is "Formal recognition by (Ecology)…that an environmental laboratory is capable of producing accurate analytical data." [WAC 173-50-040] (Kammin, 2010)

Accuracy: The degree to which a measured value agrees with the true value of the measured property. USEPA recommends that this term not be used, and that the terms precision and bias be used to convey the information associated with the term accuracy. (USGS, 1998)

Analyte: An element, ion, compound, or chemical moiety (pH, alkalinity) which is to be determined. The definition can be expanded to include organisms, e.g., fecal coliform, Klebsiella. (Kammin, 2010)

Bias: The difference between the population mean and the true value. Bias usually describes a systematic difference reproducible over time, and is characteristic of both the measurement system, and the analyte(s) being measured. Bias is a commonly used data quality indicator (DQI). (Kammin, 2010; Ecology, 2004)

Blank: A synthetic sample, free of the analyte(s) of interest. For example, in water analysis, pure water is used for the blank. In chemical analysis, a blank is used to estimate the analytical response to all factors other than the analyte in the sample. In general, blanks are used to assess possible contamination or inadvertent introduction of analyte during various stages of the sampling and analytical process. (USGS, 1998)

Calibration: The process of establishing the relationship between the response of a measurement system and the concentration of the parameter being measured. (Ecology, 2004)

Check standard: A substance or reference material obtained from a source independent from the source of the calibration standard; used to assess bias for an analytical method. This is an obsolete term, and its use is highly discouraged. See Calibration Verification Standards, Lab Control Samples (LCS), Certified Reference Materials (CRM), and/or spiked blanks. These are all check standards, but should be referred to by their actual designator, e.g., CRM, LCS. (Kammin, 2010; Ecology, 2004)

Comparability: The degree to which different methods, data sets and/or decisions agree or can be represented as similar; a data quality indicator. (USEPA, 1997)

Completeness: The amount of valid data obtained from a project compared to the planned amount. Usually expressed as a percentage. A data quality indicator. (USEPA, 1997)

Continuing Calibration Verification Standard (CCV): A QC sample analyzed with samples to check for acceptable bias in the measurement system. The CCV is usually a midpoint calibration standard that is re-run at an established frequency during the course of an analytical run. (Kammin, 2010)

Control chart: A graphical representation of quality control results demonstrating the performance of an aspect of a measurement system. (Kammin, 2010; Ecology 2004)

Control limits: Statistical warning and action limits calculated based on control charts. Warning limits are generally set at +/- 2 standard deviations from the mean, action limits at +/- 3 standard deviations from the mean. (Kammin, 2010)

Data Integrity: A qualitative DQI that evaluates the extent to which a data set contains data that is misrepresented, falsified, or deliberately misleading. (Kammin, 2010)

Data Quality Indicators (DQI): Commonly used measures of acceptability for environmental data. The principal DQIs are precision, bias, representativeness, comparability, completeness, sensitivity, and integrity. (USEPA, 2006)

Data Quality Objectives (DQO): Qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.
(USEPA, 2006)

Data set: A grouping of samples organized by date, time, analyte, etc. (Kammin, 2010)

Data validation: An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the usability of a specific data set. It involves a detailed examination of the data package, using both professional judgment, and objective criteria, to determine whether the MQOs for precision, bias, and sensitivity have been met. It may also include an assessment of completeness, representativeness, comparability and integrity, as these criteria relate to the usability of the data set. Ecology considers four key criteria to determine if data validation has actually occurred. These are:
- Use of raw or instrument data for evaluation.
- Use of third-party assessors.
- Data set is complex.
- Use of EPA Functional Guidelines or equivalent for review.

Examples of data types commonly validated would be:
- Gas Chromatography (GC).
- Gas Chromatography-Mass Spectrometry (GC-MS).
- Inductively Coupled Plasma (ICP).

The end result of a formal validation process is a determination of usability that assigns qualifiers to indicate usability status for every measurement result. These qualifiers include:
- No qualifier, data is usable for intended purposes.
- J (or a J variant), data is estimated, may be usable, may be biased high or low.
- REJ, data is rejected, cannot be used for intended purposes (Kammin, 2010; Ecology, 2004).

Data verification: Examination of a data set for errors or omissions, and assessment of the Data Quality Indicators related to that data set for compliance with acceptance criteria (MQOs). Verification is a detailed quality review of a data set. (Ecology, 2004)

Detection limit (limit of detection)**:** The concentration or amount of an analyte which can be determined to a specified level of certainty to be greater than zero. (Ecology, 2004)

Duplicate samples: Two samples taken from and representative of the same population, and carried through and steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variability of all method activities including sampling and analysis. (USEPA, 1997)

Field blank: A blank used to obtain information on contamination introduced during sample collection, storage, and transport. (Ecology, 2004)

Initial Calibration Verification Standard (ICV): A QC sample prepared independently of calibration standards and analyzed along with the samples to check for acceptable bias in the measurement system. The ICV is analyzed prior to the analysis of any samples. (Kammin, 2010)

Laboratory Control Sample (LCS): A sample of known composition prepared using contaminant-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is prepared and analyzed in the same batch of regular samples using the same sample preparation method, reagents, and analytical methods employed for regular samples. (USEPA, 1997)

Matrix spike: A QC sample prepared by adding a known amount of the target analyte(s) to an aliquot of a sample to check for bias due to interference or matrix effects. (Ecology, 2004)

Measurement Quality Objectives (MQOs)**:** Performance or acceptance criteria for individual data quality indicators, usually including precision, bias, sensitivity, completeness, comparability, and representativeness. (USEPA, 2006)

Measurement result: A value obtained by performing the procedure described in a method. (Ecology, 2004)

Method: A formalized group of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, data analysis), systematically presented in the order in which they are to be executed. (EPA, 1997)

Method blank: A blank prepared to represent the sample matrix, prepared and analyzed with a batch of samples. A method blank will contain all reagents used in the preparation of a sample, and the same preparation process is used for the method blank and samples. (Ecology, 2004; Kammin, 2010)

Method Detection Limit (MDL): This definition for detection was first formally advanced in 40CFR 136, October 26, 1984 edition. MDL is defined there as the minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99% probability of being identified, and reported to be greater than zero. (Federal Register, October 26, 1984)

Percent Relative Standard Deviation (%RSD): A statistic used to evaluate precision in environmental analysis. It is determined in the following manner:

$$\%RSD = (100 * s)/x$$

where s is the sample standard deviation and x is the mean of results from more than two replicate samples (Kammin, 2010)

Parameter: A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene and nitrate + nitrite are all "parameters." (Kammin, 2010; Ecology, 2004)

Population: The hypothetical set of all possible observations of the type being investigated. (Ecology, 2004)

Precision: The extent of random variability among replicate measurements of the same property; a data quality indicator. (USGS, 1998)

Quality Assurance (QA): A set of activities designed to establish and document the reliability and usability of measurement data. (Kammin, 2010)

Quality Assurance Project Plan (QAPP): A document that describes the objectives of a project, and the processes and activities necessary to develop data that will support those objectives. (Kammin, 2010; Ecology, 2004)

Quality Control (QC): The routine application of measurement and statistical procedures to assess the accuracy of measurement data. (Ecology, 2004)

Relative Percent Difference (RPD): RPD is commonly used to evaluate precision. The following formula is used:

$$[Abs(a-b)/((a + b)/2)] * 100$$

where "Abs()" is absolute value and a and b are results for the two replicate samples. RPD can be used only with 2 values. Percent Relative Standard Deviation is (%RSD) is used if there are results for more than 2 replicate samples (Ecology, 2004).

Replicate samples: Two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability of the material sampled. (USGS, 1998)

Representativeness: The degree to which a sample reflects the population from which it is taken; a data quality indicator. (USGS, 1998)

Sample (field): A portion of a population (environmental entity) that is measured and assumed to represent the entire population. (USGS, 1998)

Sample (statistical): A finite part or subset of a statistical population. (USEPA, 1997)
Sensitivity: In general, denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit. (Ecology, 2004)

Spiked blank: A specified amount of reagent blank fortified with a known mass of the target analyte(s); usually used to assess the recovery efficiency of the method. (USEPA, 1997)

Spiked sample: A sample prepared by adding a known mass of target analyte(s) to a specified amount of matrix sample for which an independent estimate of target analyte(s) concentration is available. Spiked samples can be used to determine the effect of the matrix on a method's recovery efficiency. (USEPA, 1997)

Split sample: A discrete sample that is further subdivided into portions, usually duplicates. (Kammin, 2010)

Standard Operating Procedure (SOP): A document which describes in detail a reproducible and repeatable organized activity. (Kammin, 2010)

Surrogate: For environmental chemistry, a surrogate is a substance with properties similar to those of the target analyte(s). Surrogates are unlikely to be native to environmental samples. They are added to environmental samples for quality control purposes, to track extraction efficiency and/or measure analyte recovery. Deuterated organic compounds are examples of surrogates commonly used in organic compound analysis. (Kammin, 2010)

Systematic planning: A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning. (USEPA, 2006)

References for QA Glossary

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Appendix B. Clallam County Water Resources Database instructions

General instructions for logging on and opening the data base.

- Turn on computer and monitor.
- After a long start-up, you will be asked to hit "Ctrl,Alt,Delete" which will take you to the log-in window.
- A new password is assigned the first of each month. Ask staff or volunteer for current password.
- On most computers, the desktop has an icon that says, "CCWR_User". Double-click on this. If the icon isn't there, ask for help or if you feel comfortable with the computer browse to the K:\streamkeepers\Data\dataBase folder and select CCWR_User.mdb.
- A screen will ask for a database password: "streams".
- The database switchboard will appear. It has four tabs horizontally across the top of the page:

  Projects/Sites
  People/Teams
  Data Entry/Editing
  Reports

- Click on the Data Entry /Editing for quarterly monitoring, grab tours, and macroinvertebrate collection data entry.

Glossary of terms

- Episode: Either summer, winter, spring or fall quarterly monitoring
- Tour: When a team that is assigned to monitor certain streams, visits the stream/streams to monitor it is a tour. A tour may occur on one day or over a period of weeks during a quarter.
- Visit: A visit is a particular monitoring site on a stream.
- Batch: The data collected from a specific instrument or from the contents of a container during a visit.
- Field Replicate: A duplicate sampling by an instrument during a visit.
- Sub-batch: When multiple readings are taken from a single field sample. Examples: YSI multimeter gives multiple readings [temp, DO, Conductivity, Salinity] from one water sample. The turbidity meter measures the turbidity in three small samples from one bottle of stream water.
- Field Replicate: Field replicate is a duplicate deployment of an instrument to test the accuracy of the first reading, so it's considered a separate batch.
- Run Time Error: If data entry is interrupted by an error message, close the data base and reenter or if necessary, reboot the computer.

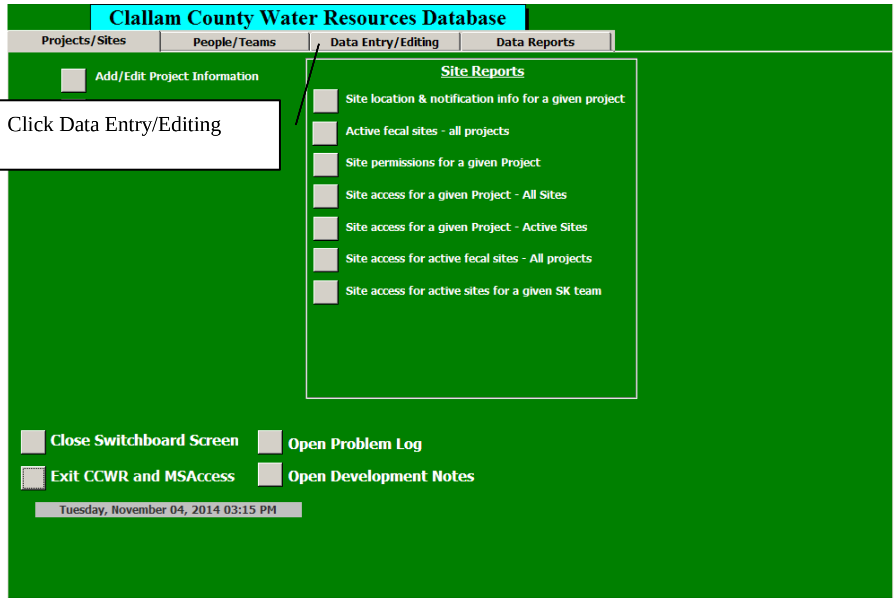
Data sheet filing

- Field data sheets are filed in the file cabinet labeled "Data".
- The oldest data is in the back of the cabinet advancing forward to the most recent data.
- Each file folder contains a quarters worth of data starting with the winter then progressing to Spring, Summer, Fall for each year.
- Each file contains an Episode Cover Sheet, a folder for data "To enter", "To Check", and "To Double Check".
  - The Episode cover sheet is loose and is to remain on top and separate from the Tour data.
  - Each Tour is clipped together with the Tour cover sheet on top.
  - If you are unable to complete entering the tour data, put the sheet being worked on top of the other tour sheets and clip it together.
  - Put a note on the tour containing your name and the date.
  - Generally the same people who started entering/checking a tour should finish it.

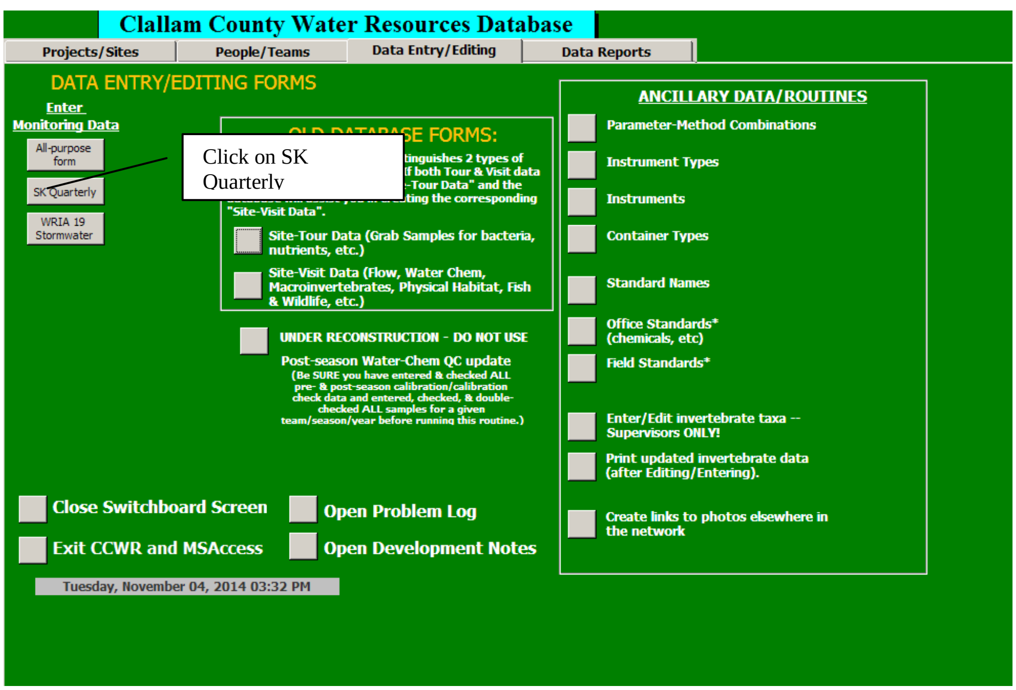
- Once the field sheet data has been entered into the data base the sheets are moved into the "To Check" folder, and once checked, into the "To Double Check" folder after which the field sheets are moved to permanent storage.

Entering Streamkeepers Quarterly Monitoring data.

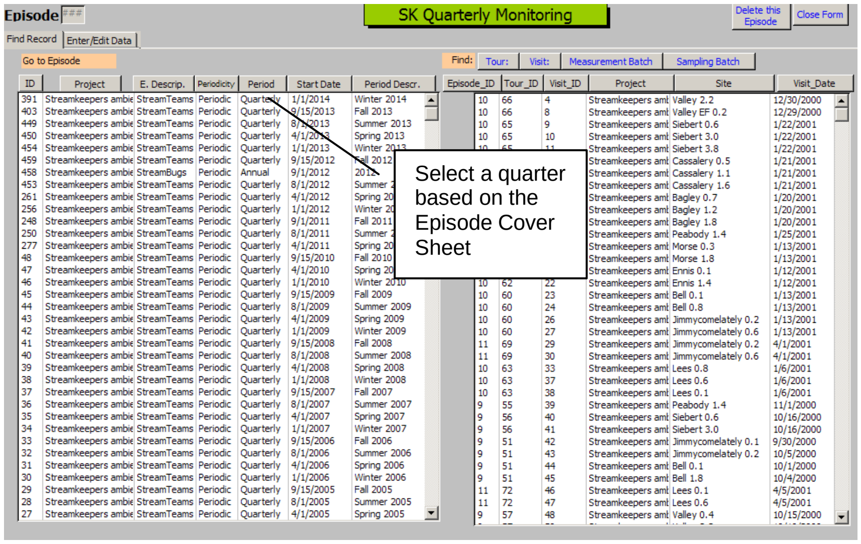
- To enter information from the quarterly monitoring Tour Cover Sheet, click on the "Data Entry/Editing tab of the database switchboard.



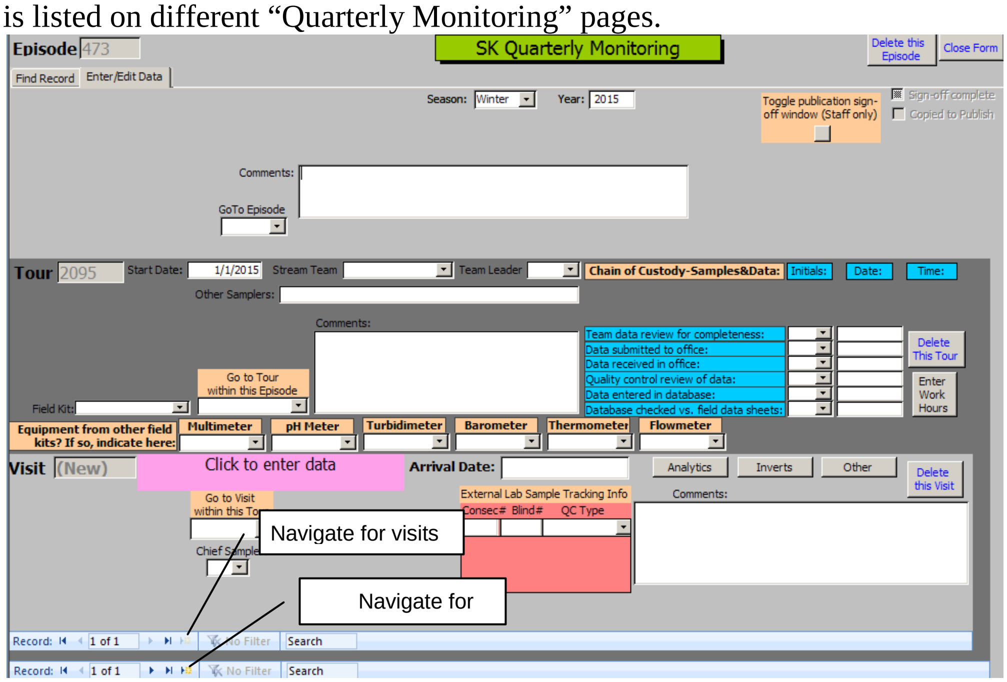
- Next click on the "SK Quarterly" box.



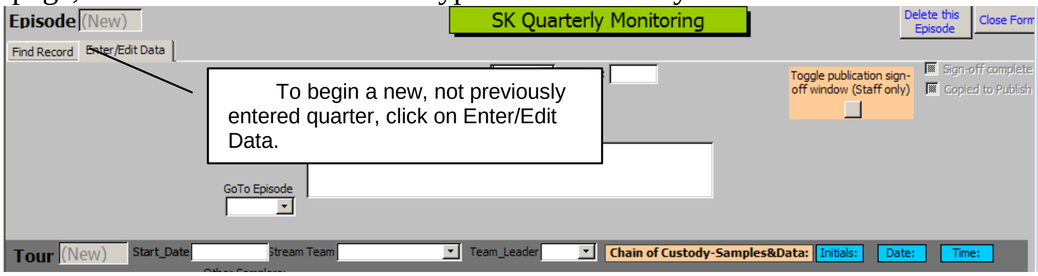
- When the “SK Quarterly Monitoring” page opens, select the desired quarter.



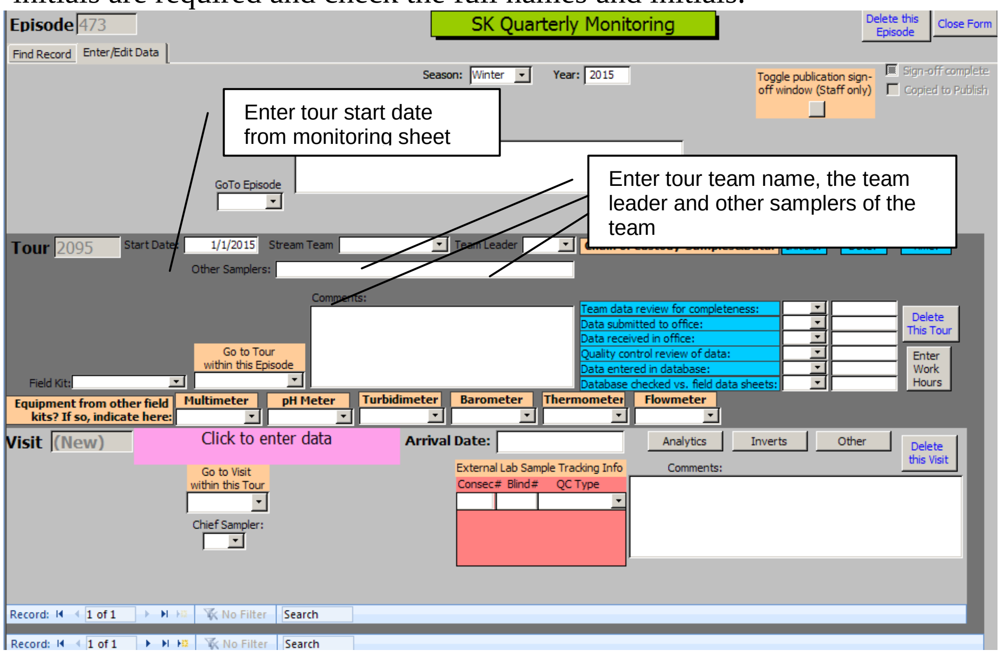
- To navigate the Quarterly Monitoring page look to the bottom left “Record” bars with right and left facing arrows.
  - Use the arrows to find previously entered data, to add data or to check existing data.
  - The top bar is to navigate to different visits within a tour. Example: Salt 1.5 and Salt 6.4.
  - The bottom bar is to navigate to different tours within a quarter. Example: Salt Creek and Peabody Creek. These tours both were monitored in the same quarter but the data is listed on different “Quarterly Monitoring” pages.



- If data has not previously been entered for the quarter, click on "Enter/Edit Data" tab and at the top of the page, scroll to the "Season" and type in the desired year.

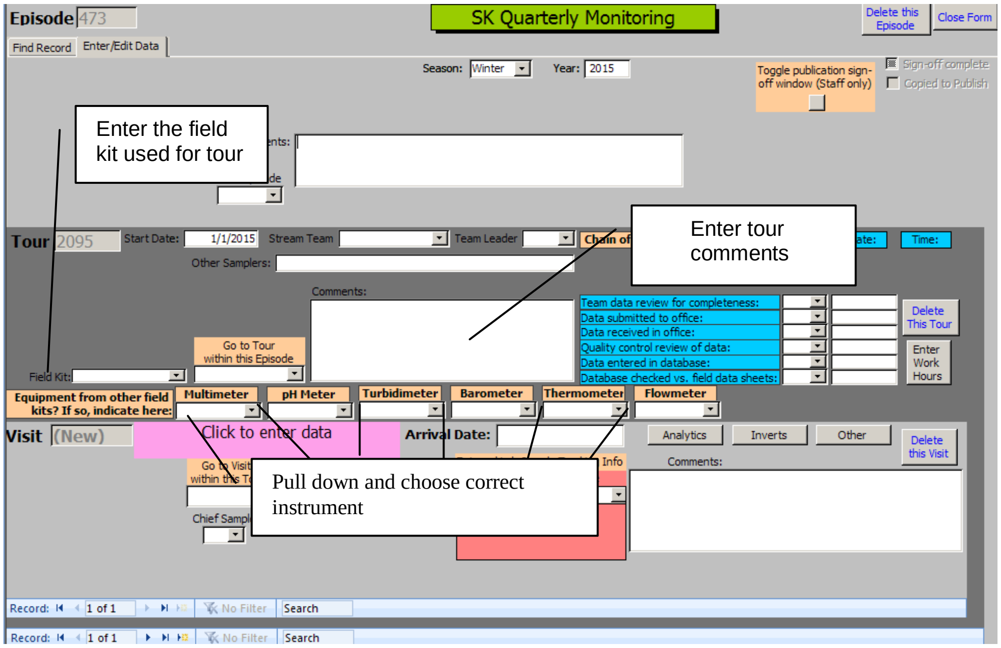


- Enter the tour start date in the "Start Date" box. Using the scroll down menu enter the "Stream Team". The assigned team is given the name of the creeks being monitored. Enter the three initials of the "Team Leader" and the "Other Samplers" (first and second initials and full last name).
  - If unsure of the three initials of a team leader or member use the pull menus where initials are required and check the full names and initials.

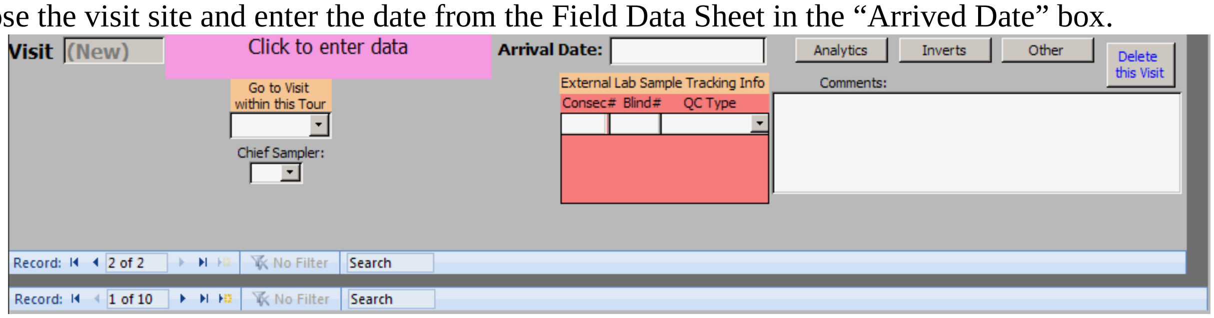


- In the "Field Kit" box use the pull down menu to enter the kit number that can be found in the Field Kit name box on the Tour Cover Sheet. The type of instruments from this kit will automatically populate the data entry sheets. Exceptions are noted in the Field Kit deviations section of the Monitoring Field Data Sheet or in the comments section. If instruments other than those in the field kit are recorded on the field monitoring sheet, use the "Equipment from other field kit? If so indicate here" box and use the pull-down menu to choose the correct instrument.

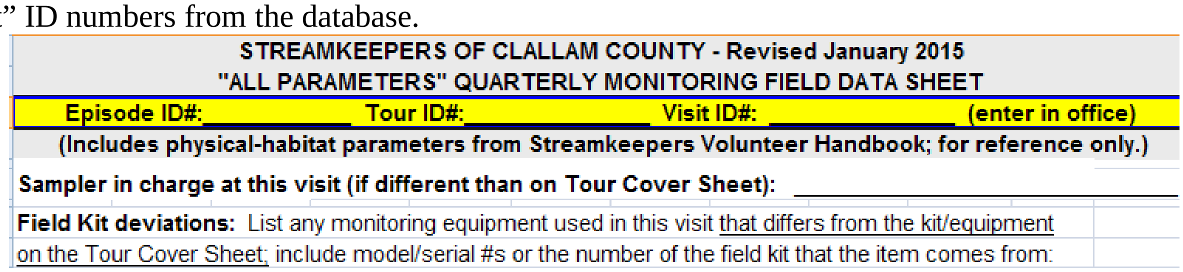
- Enter comments from the Tour Cover Sheet into the tour “Comments” section.



- Information for the blue boxes, “Team data review for completeness:”, “Data submitted to office:”, “Data received in office:”, “Quality control review of data:” can be found on the Tour Cover Sheet.
- After data entry for a tour is complete, enter your three initials and the date in the “Data entered in database:” box .
- Click the pink bar to enter data into the “Visit” section of the “Quarterly Monitoring” sheet.
- After clicking the pink bar the box to enter “Site” will appear. Use the pull-down menu to choose the visit site and enter the date from the Field Data Sheet in the “Arrived Date” box.



- If the “Chief Sampler” for the visit is different than the “Tour” “Team Leader”, enter the initials in the box.
- Enter any visit comments from the Field Data Sheet to the “Comments” box.
- At the top of the Field Data Sheet enter the computer assigned “Episode” ID, “Tour” ID and “Visit” ID numbers from the database.



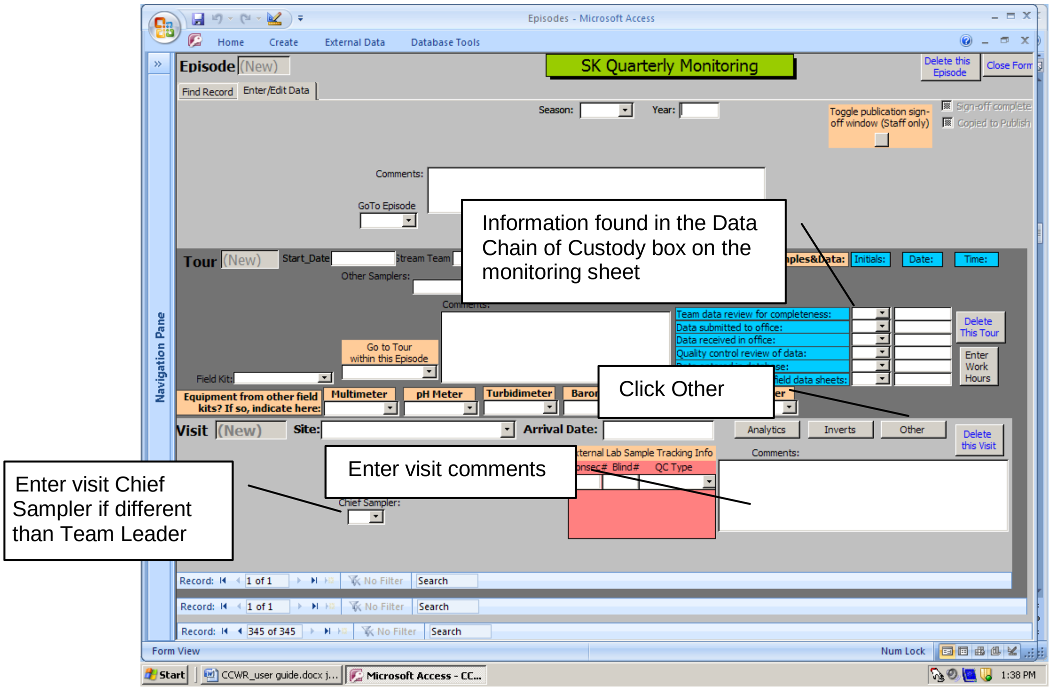
STREAMKEEPERS OF CLALLAM COUNTY - Revised January 2015
"ALL PARAMETERS" QUARTERLY MONITORING FIELD DATA SHEET

Episode ID#:________ Tour ID#:________ Visit ID#: ________ (enter in office)

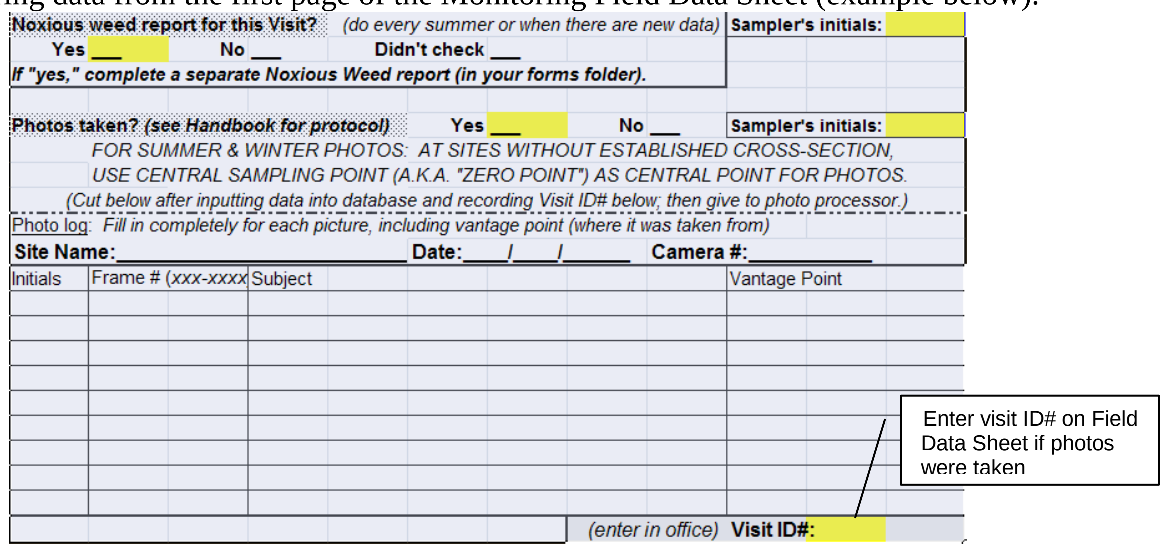
(Includes physical-habitat parameters from Streamkeepers Volunteer Handbook; for reference only.)

Sampler in charge at this visit (if different than on Tour Cover Sheet): ________

Field Kit deviations: List any monitoring equipment used in this visit that differs from the kit/equipment on the Tour Cover Sheet; include model/serial #s or the number of the field kit that the item comes from:



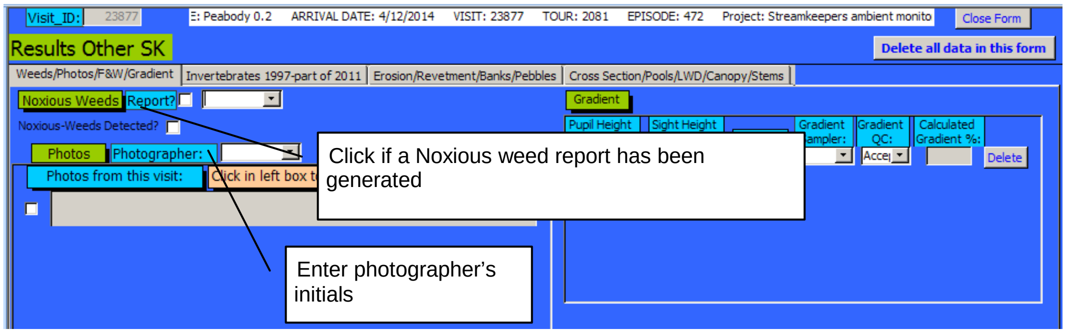
- o Click on the “Other” box as shown below to begin entering data from the Monitoring Field Data Sheet.
- o Start entering data from the first page of the Monitoring Field Data Sheet (example below).


Noxious weed report for this Visit? (do every summer or when there are new data) Sampler's initials:
Yes ___ No ___ Didn't check ___
If "yes," complete a separate Noxious Weed report (in your forms folder).
Photos taken? (see Handbook for protocol) Yes ___ No ___ Sampler's initials:
FOR SUMMER & WINTER PHOTOS: AT SITES WITHOUT ESTABLISHED CROSS-SECTION,
USE CENTRAL SAMPLING POINT (A.K.A. "ZERO POINT") AS CENTRAL POINT FOR PHOTOS.
(Cut below after inputting data into database and recording Visit ID# below; then give to photo processor.)
Photo log: Fill in completely for each picture, including vantage point (where it was taken from)
Site Name:__________ Date:___/___/_____ Camera #:__________

Initials	Frame # (xxx-xxxx	Subject	Vantage Point

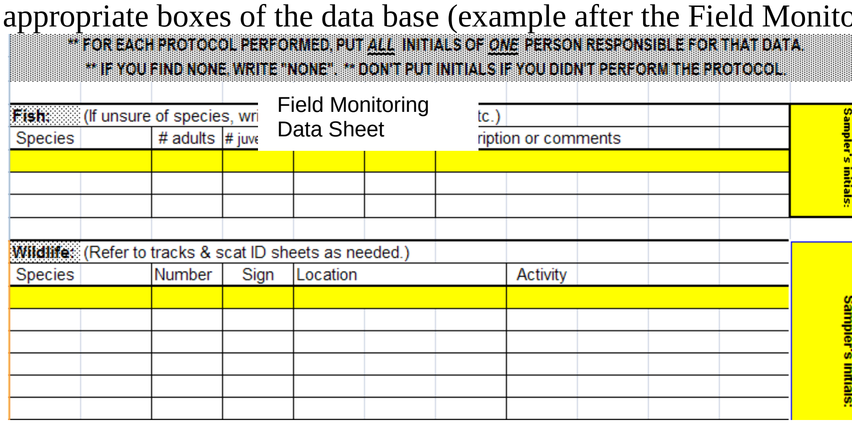
(enter in office) Visit ID#:

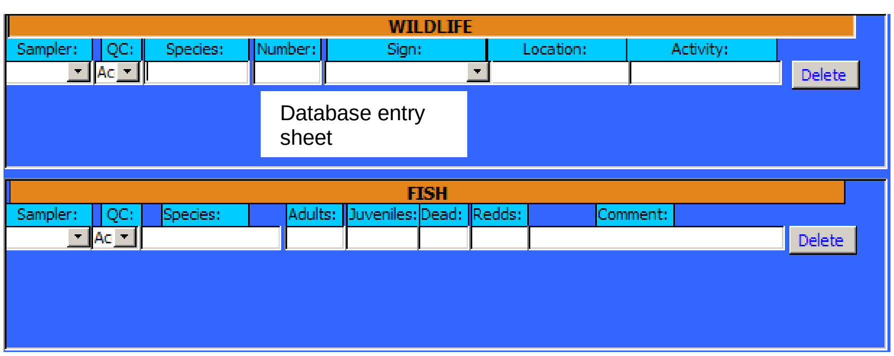
- o Enter data from the Field Data Sheet (above) to the page in the data base that opens after clicking “Other” in the database.



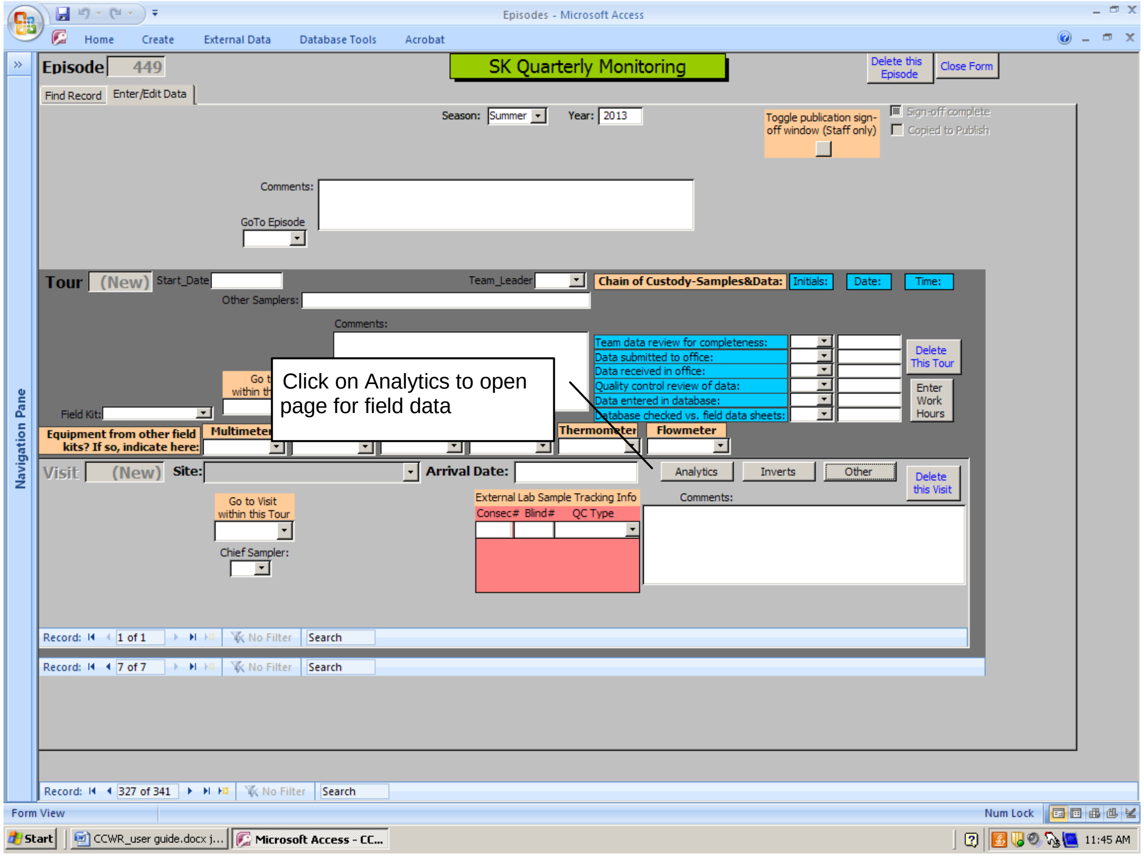
- o On the Field Monitoring Data Sheet is a box for Noxious weed report for this visit? If Yes has been checked, look for the Noxious Weed report in the Field Monitoring Data Sheets.
- o This report needs to be photocopied (Instructions for photocopying are in the Volunteer Notebook). The photocopy is placed in an interoffice mailing envelop addressed to Kathy Lucero at mail stop WEEDS or ask Staff for help. Indicate on the Noxious Weed report that a copy was sent to WEEDS. Add your initials and date.
- o Check the “Noxious Weed Report?” box on the data entry page.
- o If photos were taken in the field, the Photo Log at the bottom of the Field Monitoring Data Sheet will have been filled out. Enter the initials of the photographer in the “Photographer” box on the data entry page. Cut off the Photo Log being careful not to cut off pertinent data from the back of the Log or if necessary photocopy the page and cut the Photo Log from the photocopy. At the bottom of the Photo Log is a box to enter Visit ID#. Enter the “Visit ID” found at the top of the data entry page.
- o File the log in the pull out bin in the coffee room labeled Photo Log or ask staff.

o Enter Fish and Wildlife information and the sampler’s initials from the Field Monitoring Data Sheet (below) into the appropriate boxes of the data base (example after the Field Monitoring Data Sheet).

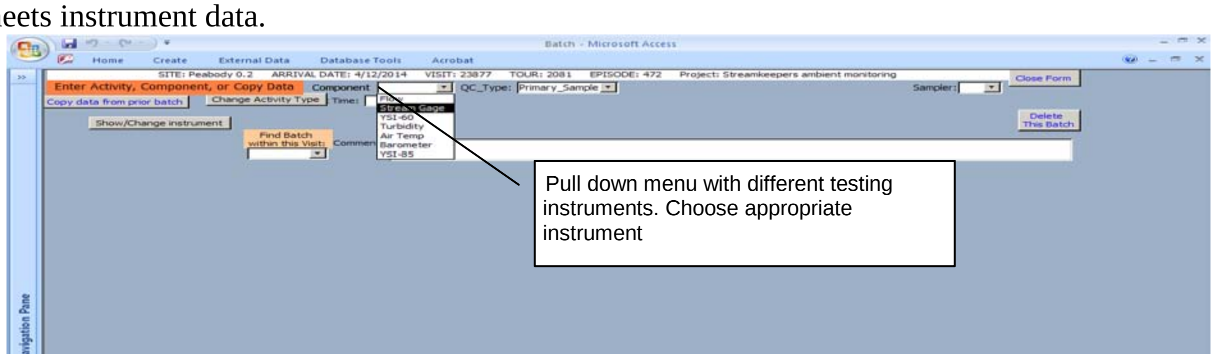




- Click on “Close Form” at top right of page.
- Closing the form will display the “SK Quarterly Monitoring” page.

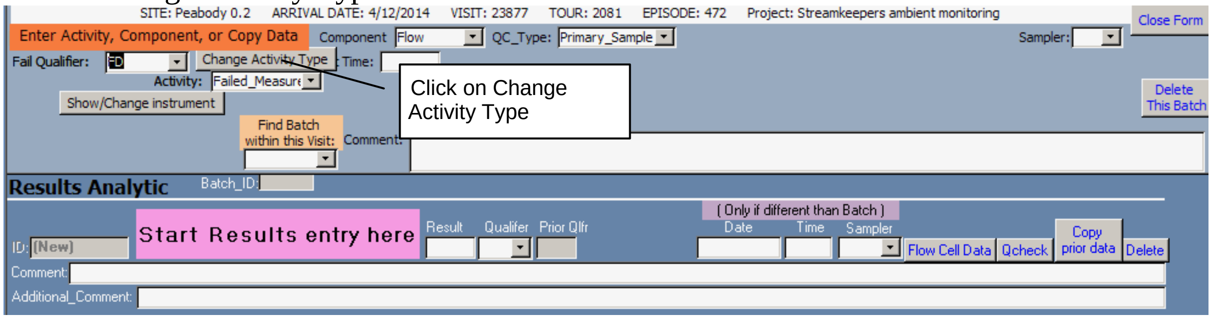


- Click on “Analytics” to enter field data for Flow, YSI 60 Ph, Turbidity, Air temperature, Barometric pressure, YSI-85 multimeter.
- From the pull-down menu choose the instrument that corresponds to the Field Monitoring Data Sheets instrument data.

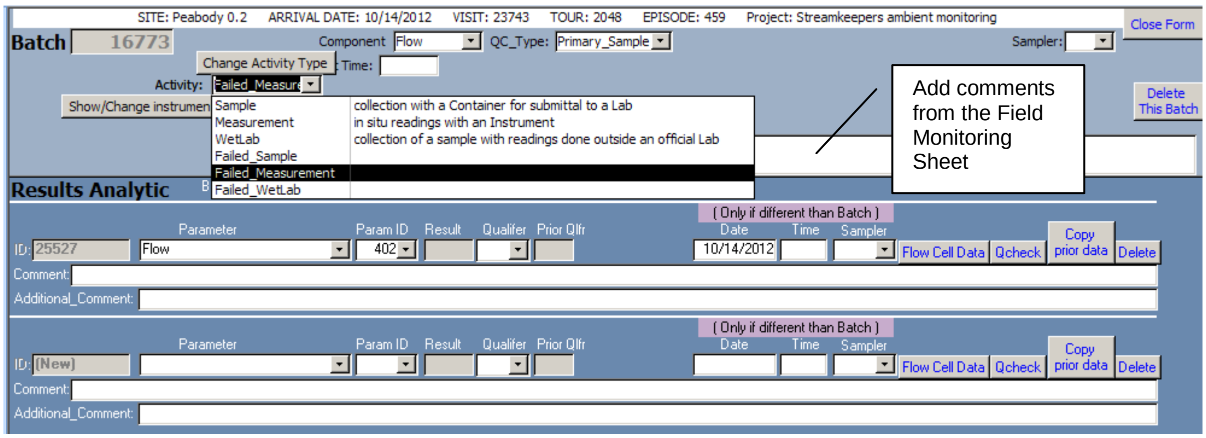


- Choose “Primary Sample” from the pull-down menu.
- Enter the “Sampler” initials and the “Time” the sampling began.

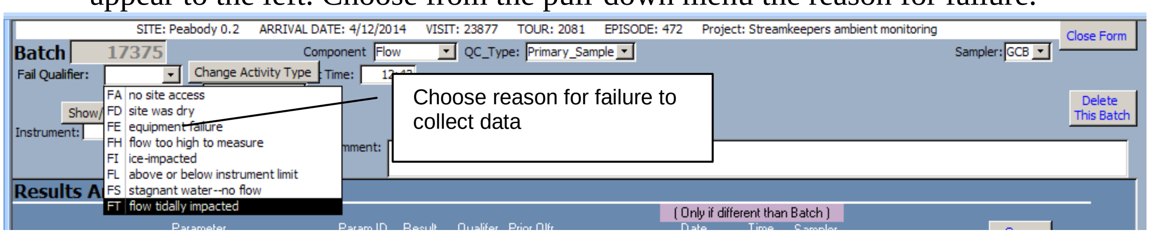
- Click on “Change Activity Type”.



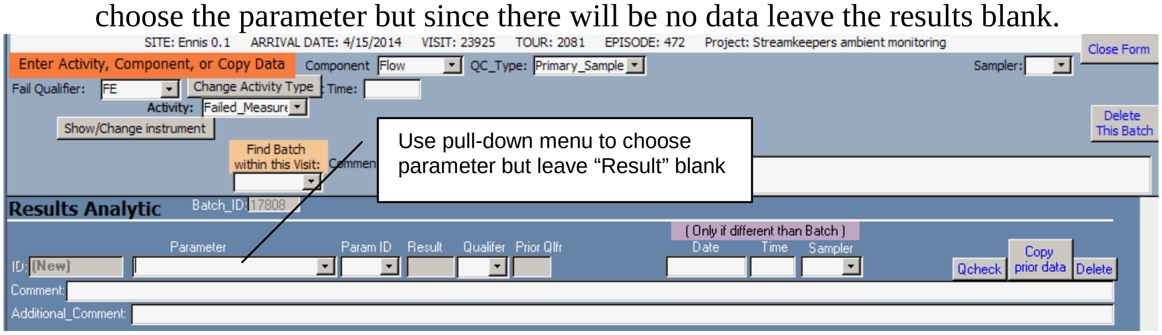
  - The “Change Activity Type” is generally “measurement”, however if the field team was unable to collect data click on the “Change Activity Type” bar and using the pull-down menu choose “Failed_Measurement” or if the component is turbidity, “Failed_WetLab”.
  - Enter any comments made by the field team as to why they were unable to collect data.



  - After the “Change Activity Type” indicates a failure a “Fail Qualifier” box will appear to the left. Choose from the pull-down menu the reason for failure.

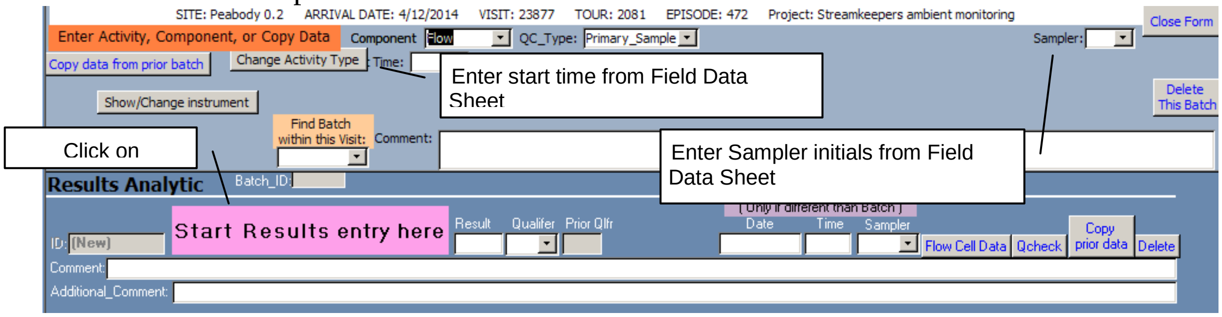


  - In the “Results Analytic” section in the “Parameter” box use the pull-down menu and choose the parameter but since there will be no data leave the results blank.

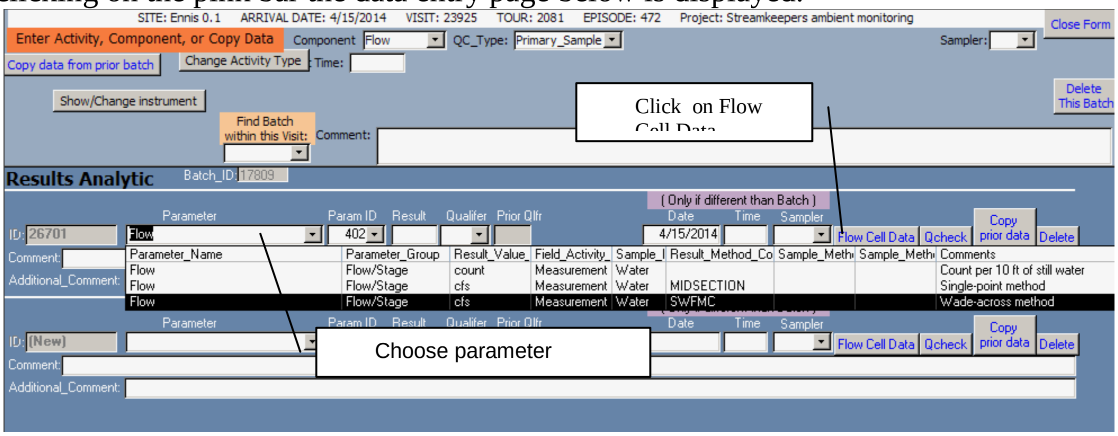


The procedure for any failure to collect data on any instrument is entered the same way for all monitoring equipment.

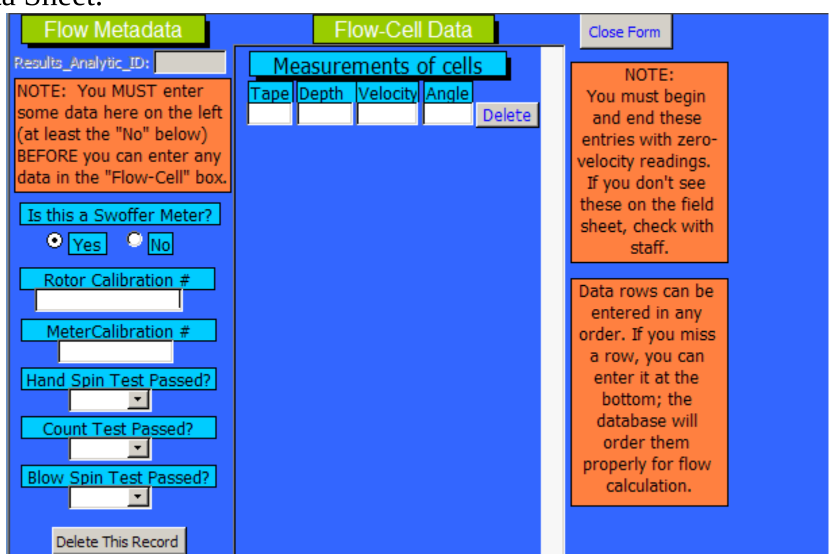
- If measurements were taken and data was entered on the Field Monitoring Sheet, after entering the "Component" (in this case flow) enter the time and the sampler's initials in the appropriate boxes then click on the pink bar.



- After clicking on the pink bar the data entry page below is displayed.



- Click on "Flow Cell Data" after which a page will appear to enter data from the Field Monitoring Data Sheet.



- Answering the question in the box "Is this a Swoffer meter?" depends on what kit the flow meter is from or if there is a comment in the Field Kit deviations on the Field Data Sheet. There are two brands of flowmeter, the Swoffer and the Marsh-McBirney that are used by Streamkeepers. The Swoffer which requires calibration and the Marsh-McBirney which does not. If a Swoffer is being used "Is this a Swoffer meter?" will be checked "Yes" and if the Marsh-McBirney is being used the answer will be "No".
- If the answer is yes and a Swoffer meter was used then enter the calibration information at the top of page on the Field Monitoring Data Sheet under the Flow section (see example below). Enter the Rotor calibration and Meter Calibration on the data entry sheet.

If using a Swoffer meter:				
	Rotor #:		Rotor calibration # (on bag):		Calibration date:
	Hand-spin test (circle one): pass / fail		Meter calibration # (switch on "calibrate"):	
	Count test (circle one): pass / fail		Blow-spin test (circle one): pass / fail	

- o Indicate on the data entry sheet if the Hand Spin Test passed, the Count Test passed and the Blow Spin Test passed.
- o If a Marsh-McBirney meter was used the calibration and tests passed boxes will remain bla
- o Enter the data from the Field Monitoring Data Sheet (below) into the "Flow-Cell Data" section (Tape, Depth, Velocity).

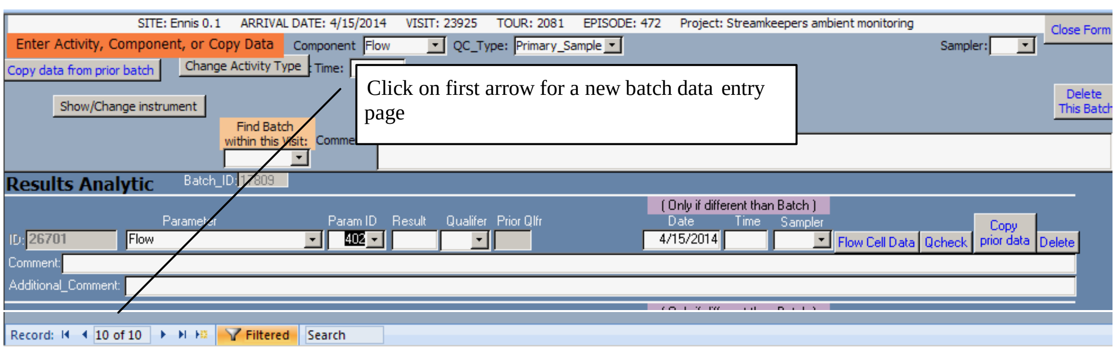
Include zero velocity readings 0.3 ft. to the outside of the first and last "prop-turning" locations where possible.
*When velocity is zero, indicate why: insufficient depth (**insf/d**) insufficient velocity (**insf/v**) or both (**insf/dv**)*

Tape to nearest 0.1'	Depth to 0.01 ft.	Velocity* to 0.01 ft. per sec	Angle** to nearest 10°	Tape to nearest 0.1'	Depth to 0.01 ft.	Velocity* to 0.01 ft. per sec	Angle** to nearest 10°
	0	(wetted edge @ dry land)					
					0	(wetted edge @ dry land)	

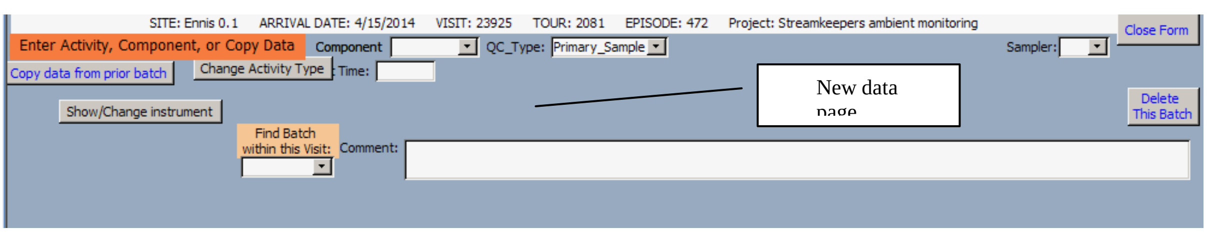
Sampler's initials:

*(*For depths >2 ft., record velocity readings at both 2/10 and 8/10 depths, and record both to be averaged.)*
*(**Estimate the tell-tail's deviation from straight downstream, then face the prop in the direction of the current.)*

- o Click "Close Form" when finished.
- o After entering flow data, click on the first arrow of the tool bar for a new batch data entry page.



- o New batch page (see below). The remaining data (pH, turbidity, air temperature, barometric pressure, and YSI multimeter) can be entered in the same way as the flow data by adding a new batch data page for each instrument, choosing the instrument, entering the date of collection, the initials of the sampler, and the time of collection.



- o The data from the Field Monitoring Data Sheet contains the remaining data to be entered into the data base.
- o The yellow bars indicate the information to transfer to the data base.
  - ▪ The pH part of the data sheet has two data points to enter into the data base: pH reading and Time.

YSI-60 pH meter calibration *(must do at the beginning of each sampling day)*									
Has this already been done today? **Yes / No** If "yes," on what data sheet is the information? _ _ _ _ _ _ _ _ _ _									
(If not, you'll need to do it now. Second row					***pH7 pre-cal rdgs***		***pH7 post-cal rd***		
Meter #	*Time (24-hr notation)*	*Sam-pler's Initials*	*pH7 exp date*	*pH10 exp date*	*temp (to 0.1)*	*pH (to .01)*	*temp (to 0.1)*	*pH (to .01)*	*Expected pH, from chart on back, to .01*
pH reading:		(to nearest 0.1; expected range 6.5 - 8.5)						**Time:**	
pH meter post-check with pH 7 buffer (do at every site, after any replicates)		*temp (to 0.1)*	*meter pH (to 0.01)*	*Expected pH (from chart on back, to .01)*	*Difference between meter pH & expected pH (to .01)*				
Time:	**Initials:**								

- The Turbidity part of the data sheet has collection time, the sampler's initials and the three turbidity data points (NTU's) to be entered into the data base.
- If the turbidity instrument reading was not taken in the field enter the date and time indicated on the data sheet.
- Included in the picture below are the instrument readings for the Air temperature and the Barometric pressure. Both require an entry for time, initials and the monitored data point.

Turbidity: Last calibration date on turbidimeter: ___ / ___ / ___ *(Only record if not reporting to Streamkeepers.)*

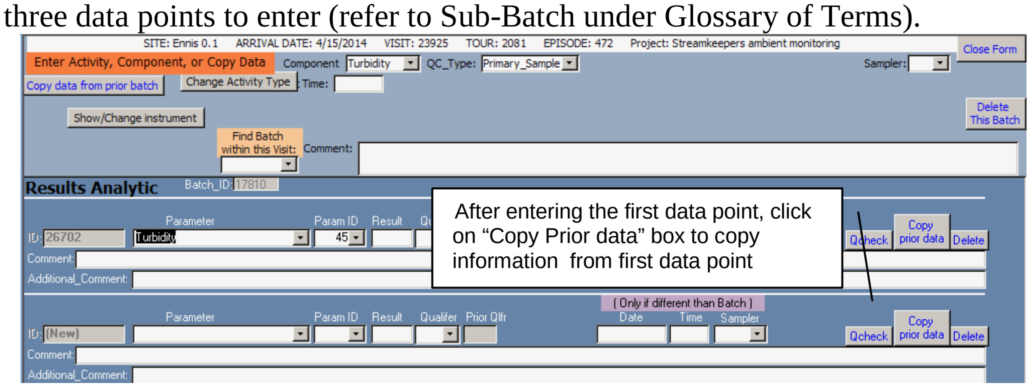
Field calibration check: *Perform using sealed "reference standard" vial with a value of about 10.*

- # of NTU's listed on this reference vial:______ Expiration date:___/___/___
- Turbidimeter reading for this reference vial:_______ (to nearest 0.01 NTU)

Rdgs to nearest **whole #** of NTU's: **1____ 2____ 3____ Avg____** *(Expected values <5 unless water is high)*

Collection Time:		**Initials:**		**Reading date/time if not done in field:**		**Initials:**	
Air temperature/thermometer:		°C (to nearest whole °C)		**Time:**		**Initials:**	
Barometric pressure:		Units: **in / mm / mbar** (to nearest 0.01)		**Time:**		**Initials:**	

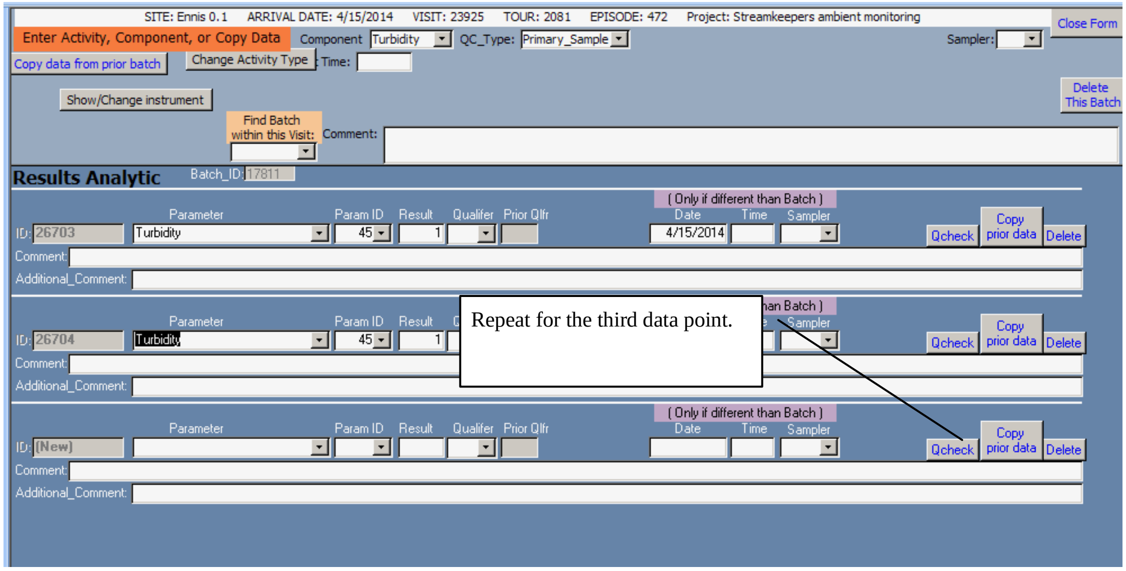
Turbidity has three data points to enter (refer to Sub-Batch under Glossary of Terms).



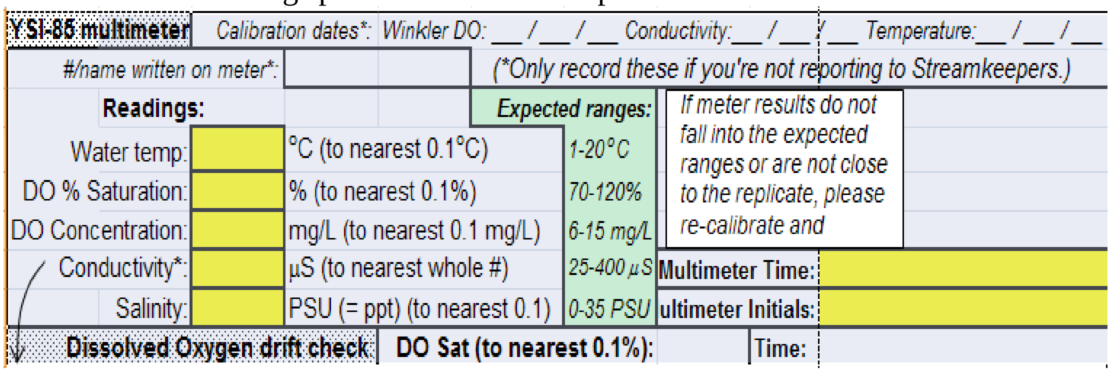
Enter first data point then click on the "Copy prior data" box which will copy the previous data point into the second "Result" box.

Repeat for the third data point.

- If all three data points are not identical, correct by manually deleting and adding the correct number.



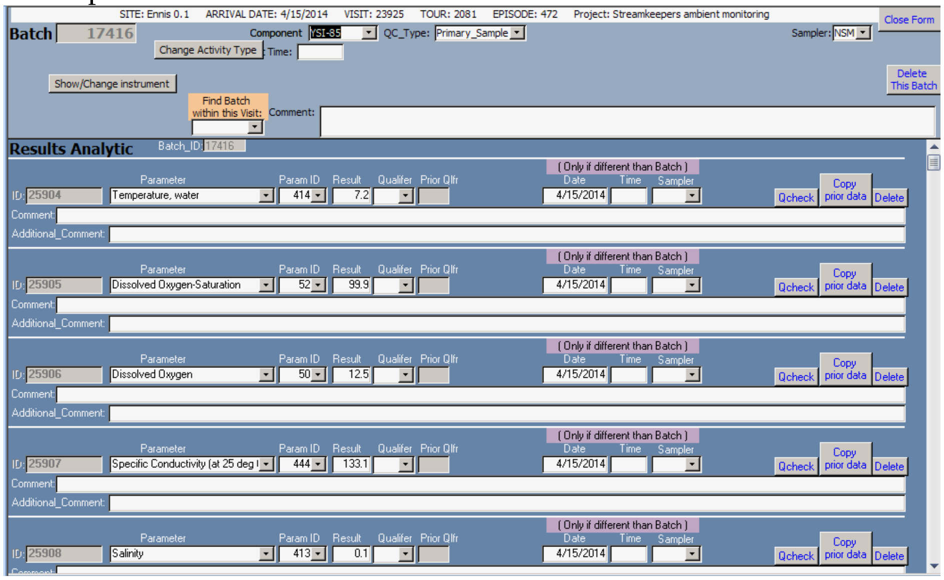
- The YSI-85 part of the Field Monitoring Data sheet contains 5 instrument readings. The five readings plus the time and sampler's initials are entered into the data base.



YSI-85 multimeter	*Calibration dates*: Winkler DO: __ / __ / __ Conductivity: __ / __ / __ Temperature: __ / __ / __*		
#/name written on meter:*		*(*Only record these if you're not reporting to Streamkeepers.)*	
Readings:		***Expected ranges:***	*If meter results do not fall into the expected ranges or are not close to the replicate, please re-calibrate and*
Water temp:	°C (to nearest 0.1°C)	*1-20°C*	
DO % Saturation:	% (to nearest 0.1%)	*70-120%*	
DO Concentration:	mg/L (to nearest 0.1 mg/L)	*6-15 mg/L*	
Conductivity*:	µS (to nearest whole #)	*25-400 µS*	**Multimeter Time:**
Salinity:	PSU (= ppt) (to nearest 0.1)	*0-35 PSU*	**ultimeter Initials:**
Dissolved Oxygen drift check	**DO Sat (to nearest 0.1%):**		**Time:**

- o The YSI-85 collects 5 data points: water temperature, % disolved oxygen saturation, dissolved oxygen in mg/L, specific conductivity and salinity.
- o Use the pull down menu in the "Parameter" box to enter the parameter.

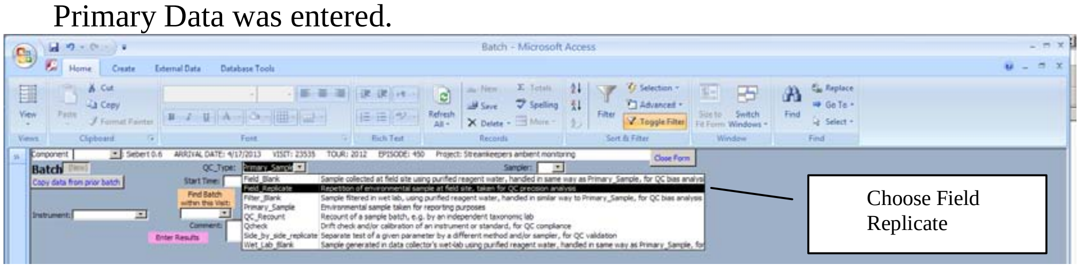
- After entering a data point another blank parameter box will appear for the next data point entry until the five data points have been added.



- If the Field Data Sheets contains data for replicate samples enter the data from each instrument on separate data entry pages.

Field Replicates:	*Please check sample/replicate deviations and re-test as necessary; see Handbook*			
YSI-60:	pH:	(to nearest 0.1 pH unit)	**Time:**	**Initials:**
Turbidity readings to nearest **whole #** of NTU's:	1____ 2____ 3____ Avg____		**Time:**	**Initials:**
Pressure:	Barometric pressure:	Units: **in / mm / mbar** (to nearest 0.01)	**Time:**	**Initials:**
YSI-85:	Water temp:	°C (to nearest 0.1°C)	**Time:**	**Initials:**
	DO % Saturation:	% (to nearest 0.1%)		
	DO Concentration:	mg/L (to nearest 0.1 mg/L)		
	Conductivity*:	µS (micro-Siemens--to nearest whole #)		
	Salinity:	PSU (= ppt) (to nearest 0.1)		
Dissolved Oxygen drift check:	**DO Sat (to nearest 0.1%):**		**Time:**	**Initials:**

  - Choose an instrument from the pull down menu in the "component" box of the data entry page (see example below).
  - From "QC Type:" choose "Field Replicate" from the pull down menu.
  - In the "Replicate of:" box choose the batch ID or instrument that this is a replicate of.
  - Enter as before the sampler's initials and the time the field data was collected.
  - Enter the data from the Field Replicate section of the Field Data Sheet just as the Primary Data was entered.

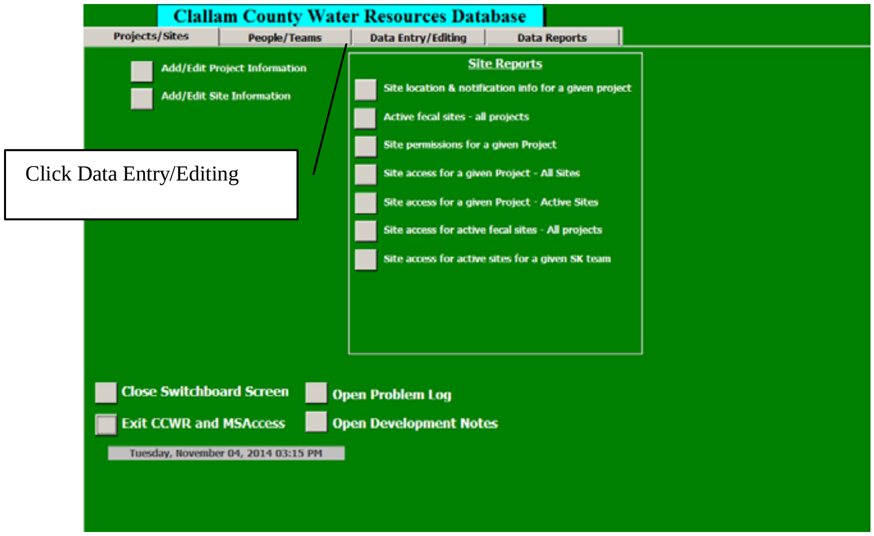


All Purpose Form

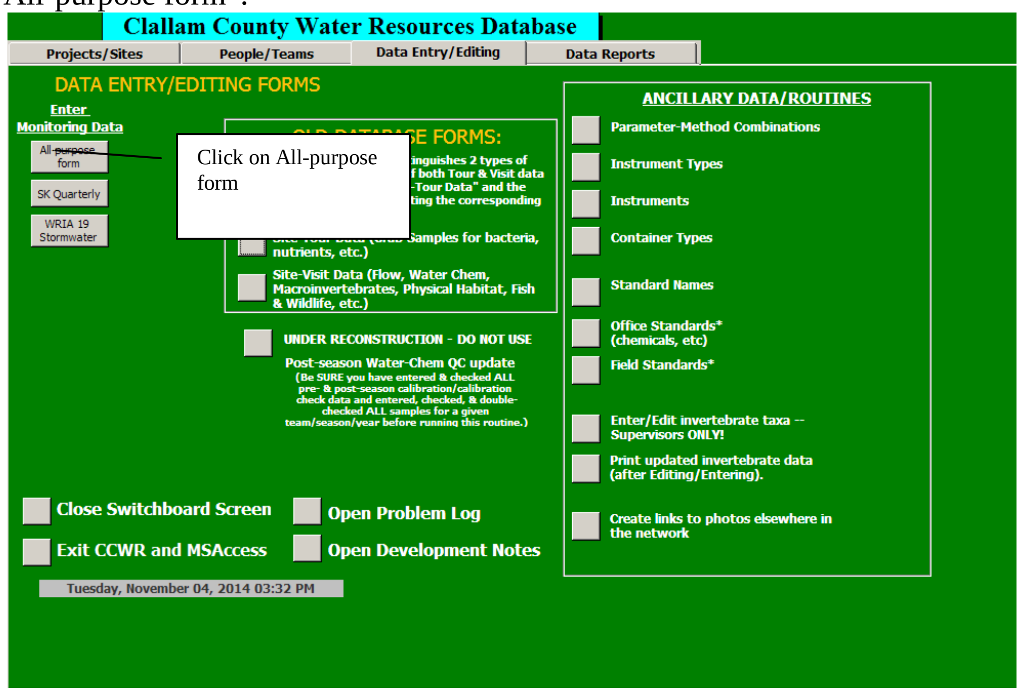
- The All Purpose Form is used to enter grab sample data, bug data and any other data that does not have a customized form for special projects such as Quarterly data.
- Because the field data sheets are generic and used for several field data collecting projects the field data sheets may not fit the database format exactly. Therefore, the data entry person may have to search the field data sheets to find information that is asked for in the data base. For example, the Bug Sampling Tour Cover Sheet has no specific place for field replicate data. The

data collecting team will indicate that the data is a replicate but the database entry person will have to find it. Ask a Streamkeepers person that is in the office if you have questions concerning where to find field data that is required for the database.

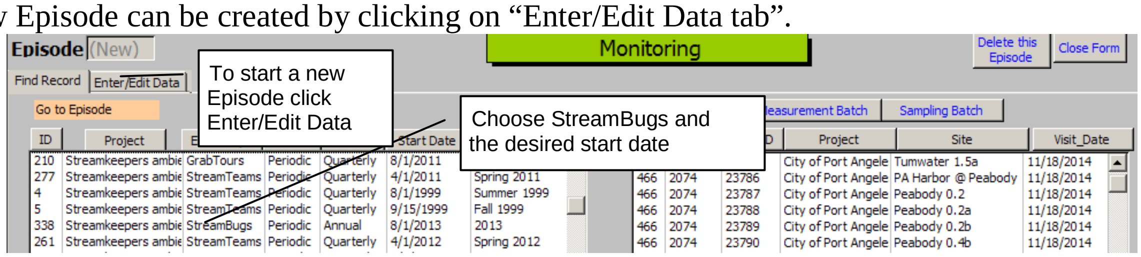
- To enter information from the field monitoring sheets, click on the “Data Entry/Editing tab of the database switchboard.



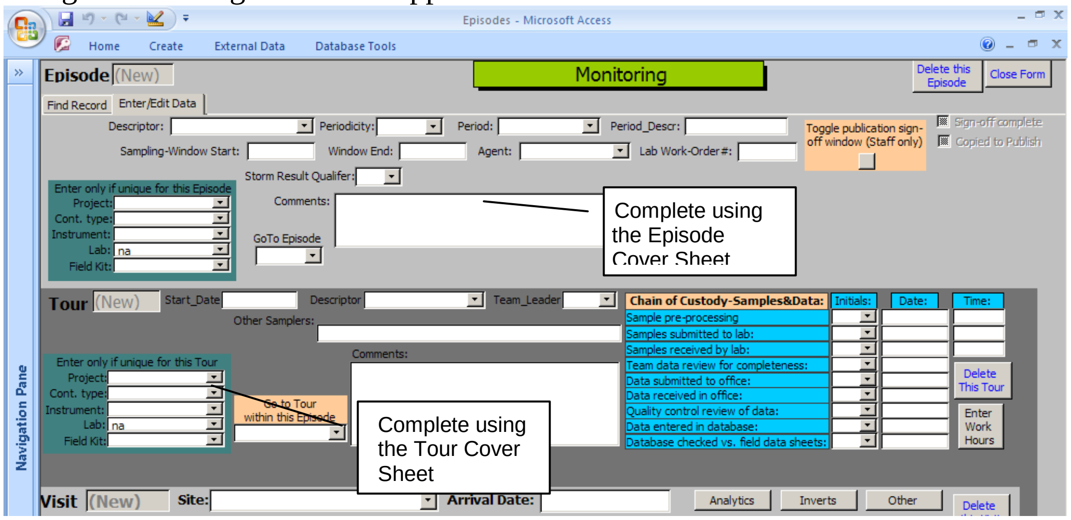
- Click on “All-purpose form”.



- Choose an Episode using the field Episode Cover Sheet. If there is no data entry for the Episode a new Episode can be created by clicking on “Enter/Edit Data tab”.

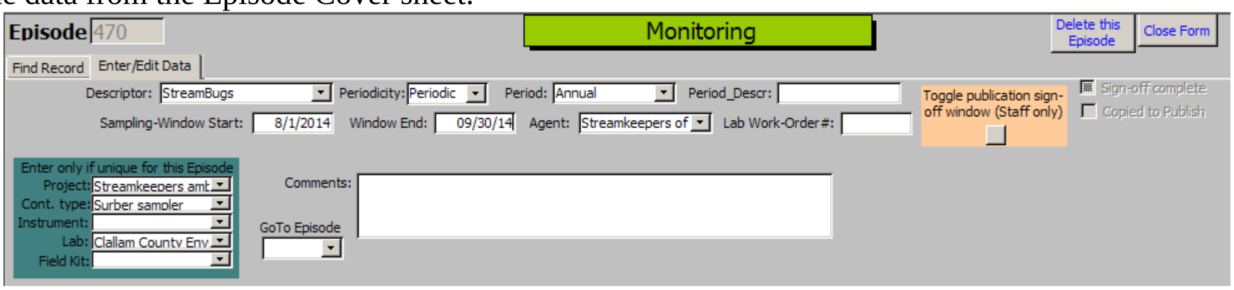


o The following “Monitoring” form will appear on screen.



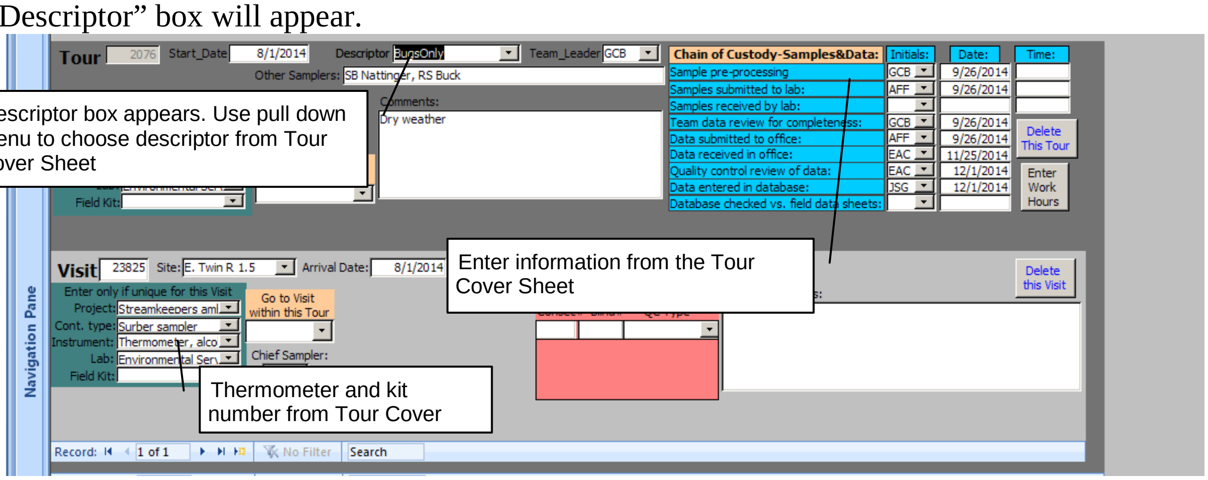
o If this is a new episode, using the pull-down menus, enter the data from the Episode Cover sheet for “Descriptor:”, “Periodicity:”, Period:”, “Period Descr:”, “Sampling-Window Start:”, “Window End:”, and “Agent:”

o In the blue-green box “Enter only if unique for the Tour” box using the pull-down menus enter the data from the Episode Cover sheet.



o After completing the Episode information, enter the Tour information (see above).

o Enter the “Start Date” using the Start Date from the Tour Cover Sheet. After the date is entered the “Descriptor” box will appear.

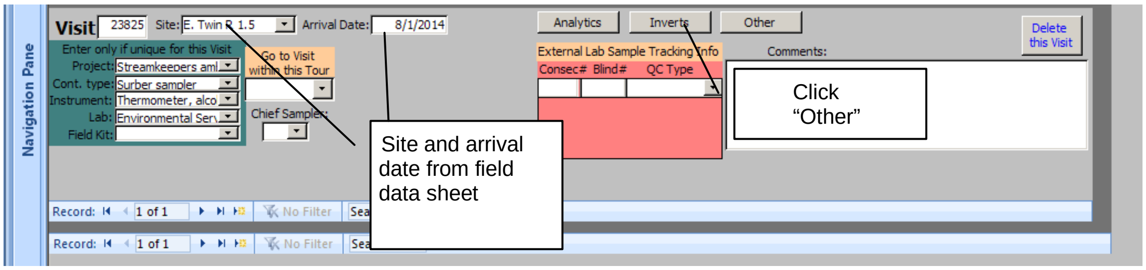


o Enter the team leader’s initials from the Tour Cover Sheet into the “Team Leader” box.

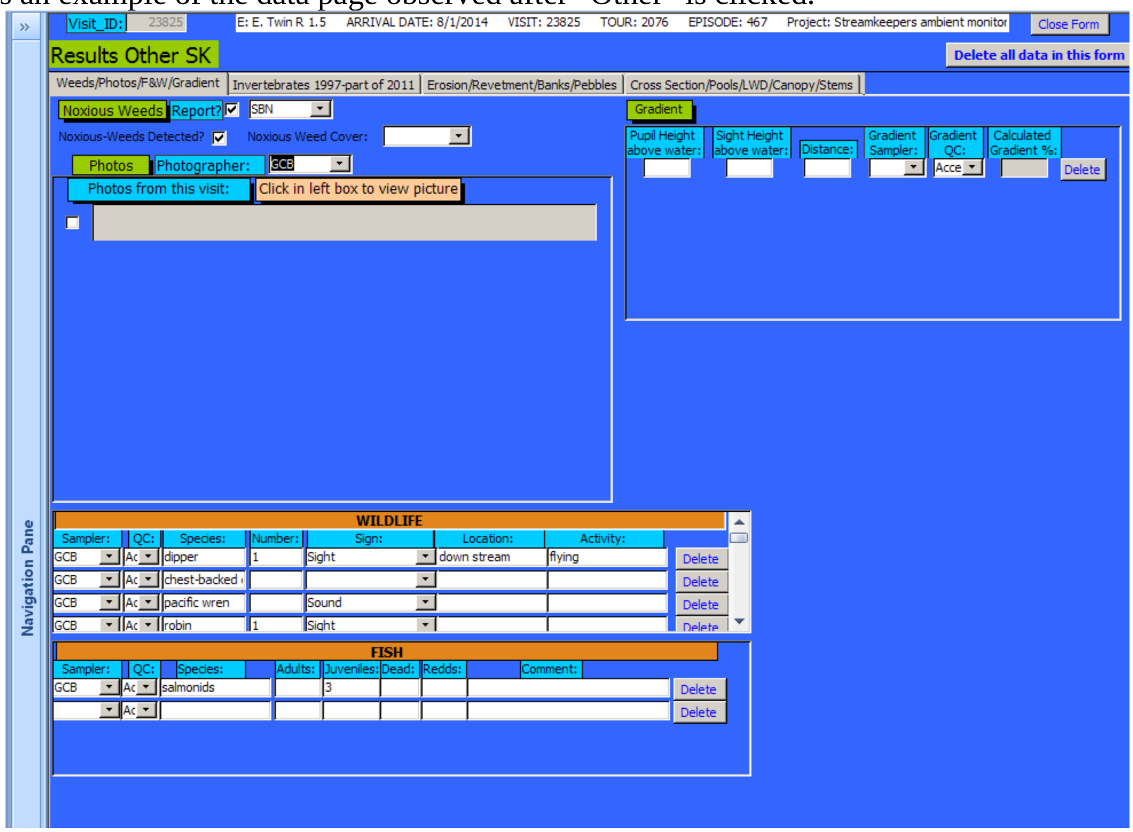
o In the “Other Samplers” box enter the first two initials and full last name of the other team members on the Tour Cover Sheet.

o Tour comments can be added to the “Comments” box.

- In the “Chain of Custody-Samplers & Data” box enter the initials and dates from the Tour Cover Sheet. Do not enter data if the Data Sheet QC Review box has no initials. Wait until the review is done before entering the data.
- Add your initials to the Tour Cover Sheet in the Field Data Sheets Entered In Database and the “Data entered into database” box of the “Chain of Custody-Samplers & Data” section.
- Use the pull down menu to complete the “Enter only if unique for the Visit” box.
- Enter the “Site” and the “Arrival Date” for the visit found at the top of the second page of the field data sheet.
- Click on “Other”.



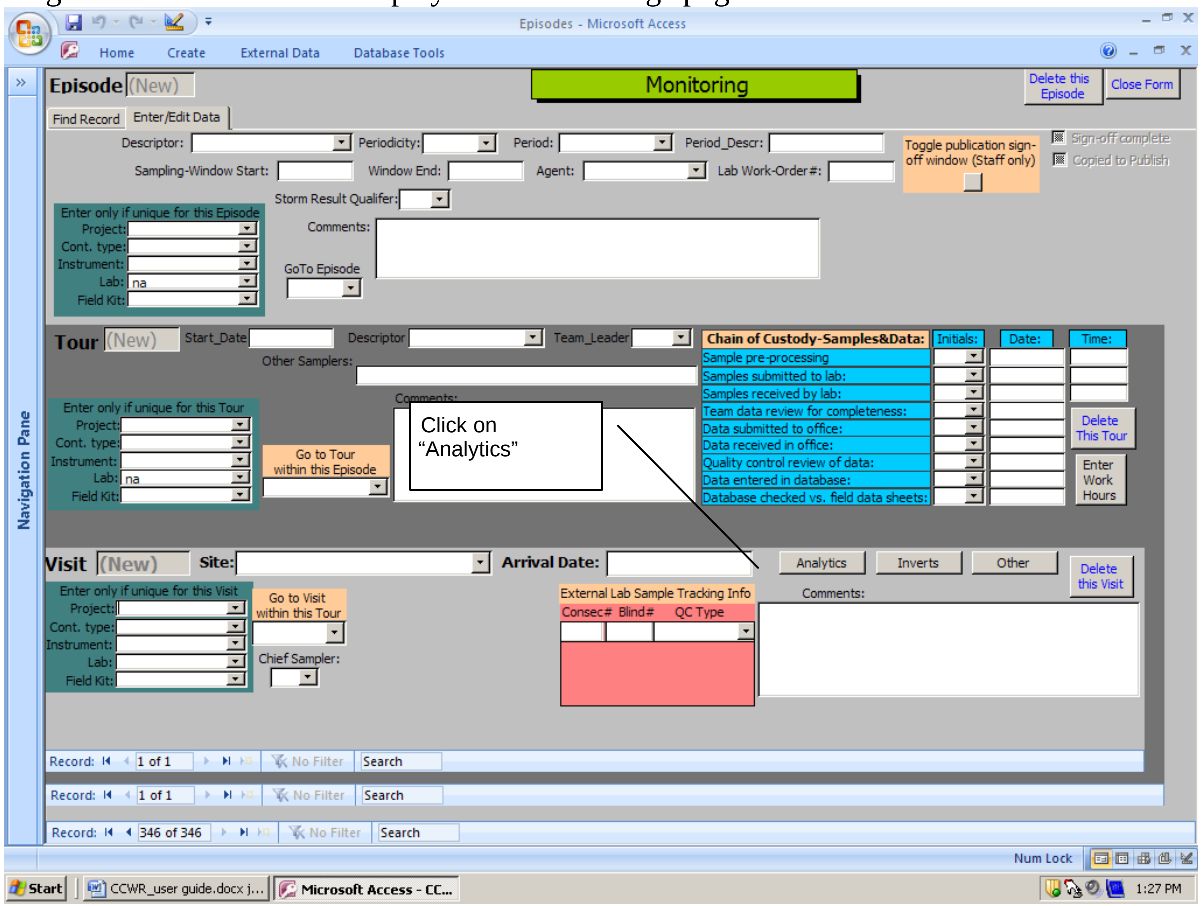
- Below is an example of the data page observed after “Other” is clicked.



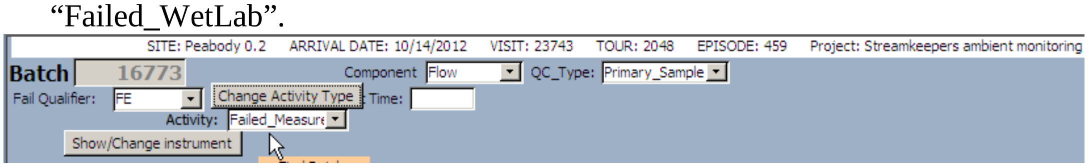
- On the Field Monitoring Data Sheet is a box that can be checked if there is a Noxious weed report for this visit? If Yes has been checked, look for the Noxious Weed report in the Field Monitoring Data Sheets.
- This report needs to be photocopied. The photocopy is placed in an interoffice mailing envelop addressed to Kathy Lucero at mail stop WEEDS or ask Staff for help. Indicate on the Noxious Weed report that a copy was sent to WEEDS. Add your initials and date.
- Check the “Noxious Weed Report?” box on the data entry page.
- If photos were taken in the field, the Photo Log at the bottom of the Field Monitoring Data Sheet will have been filled out. Enter the initials of the photographer in the “Photographer” box

on the database entry page. Cut off the Photo Log being careful not to cut off pertinent data from the back of the Log. At the bottom of the Photo Log is a box to enter Visit ID# generated by the database. Enter the "Visit ID" found at the top of the database entry page.

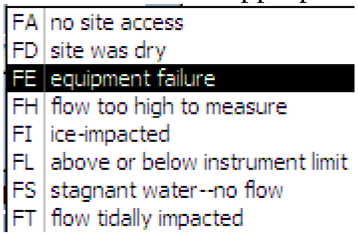
- File the log in the pull out bin in the coffee room labeled Photo Log or ask staff.
- Complete the "Wildlife" and "Fish" boxes with information from the Field Monitoring Data Sheet. Enter "Sampler" box with sampler's initials. Enter "Species" in the box and the number observed in the "Number:" box. The pull down menus can assist in entering "Sign:", "Location:" and "Activity" with data from the Field Data Sheet.
- Close the form at top right of page.
- Closing the "Other" form will display the "Monitoring" page.



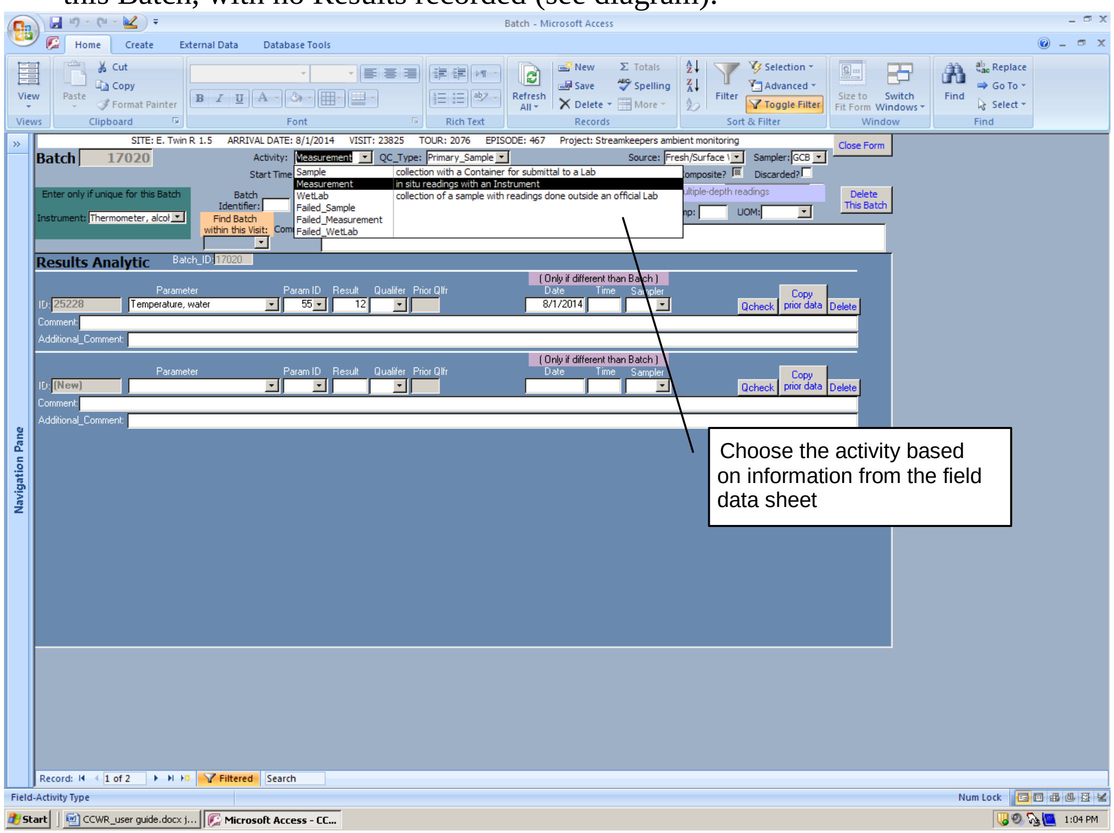
- Click on "Analytics" The page below is an example of the "Analytics" page.
- The "Batch" number is automatically assigned.
- Using the Tour Cover Sheet and the pull-down menus on the Monitoring page, enter information for "Activity", "Source", and "QC Type" box.
  - From the pull-down menu reads the explanation of what each term means and choose the best fit based on the information on the field data sheets.
  - When samplers are unable to gather data and explain why, this needs to be recorded in thedatabase. For SK Quarterly data, you'll need to "Change Activity Type" (see diaghram below) to "Failed_Measurement", or, if the Component is Turbidity, "Failed_WetLab".



- Once you do this, the “Fail Qualifier” field will show up above and to the left. Choose the appropriate reason for the failure. Here are the choices:

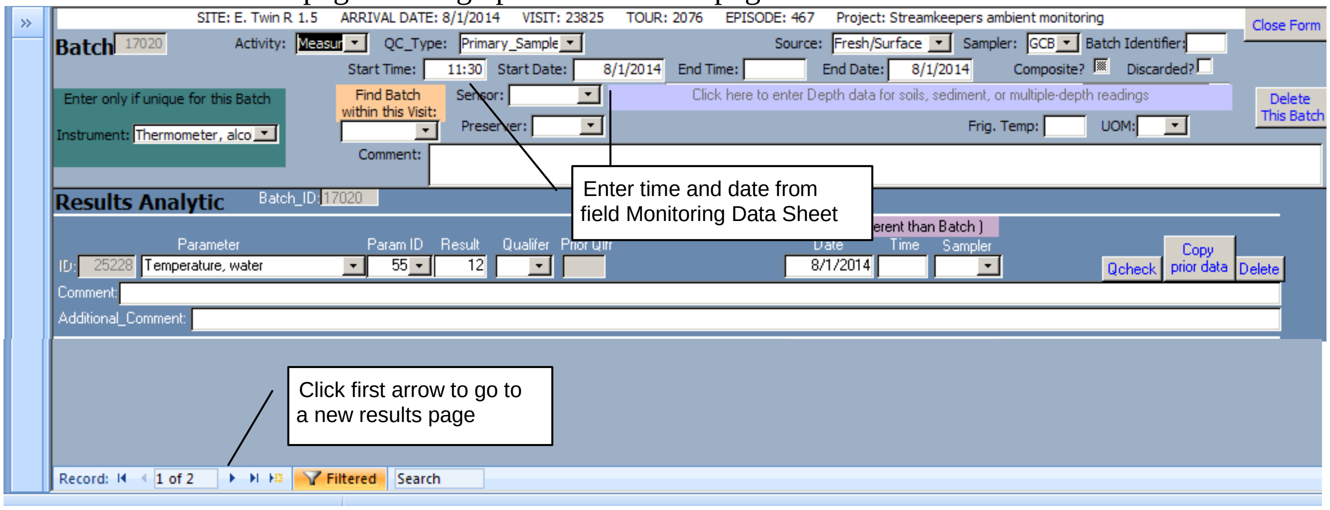


- If there are additional comments about the failure, put them in the Batch comment field.
- Failed measurements: All-purpose form: When samplers are unable to gather data and explain why, this needs to be recorded in the database. For the All-purpose form, you’ll need to “Change Activity Type” (see diagram below) to “Failed_Measurement”, “Failed_Sample”, or “Failed_WetLab” (see distinctions described above). Once you do this, the “Fail Qualifier” field will show up (see diagram). Choose the appropriate reason for the failure. If there are additional comments about the failure, put them in the Batch comment field. Then go the the Results_Analytic form and enter all Parameters that were unable to be sampled in this Batch, with no Results recorded (see diagram).

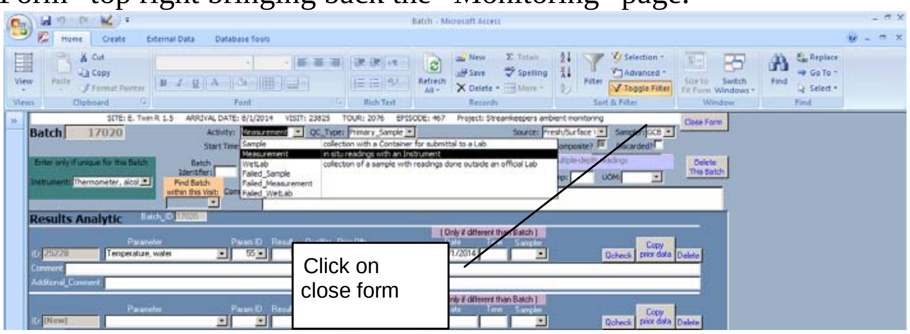


- o In the “Sampler” box enter the samplers initials from the field Monitoring Data Sheet.
- o Enter the “Start Time” and “Start Date” from the Temperature °C box on the field Monitoring Data Sheet.
- o In the “Results Analytic” section, choose the “Parameter” from the pull-down menu then enter the “Results” based on the field Monitoring Data Sheet information.

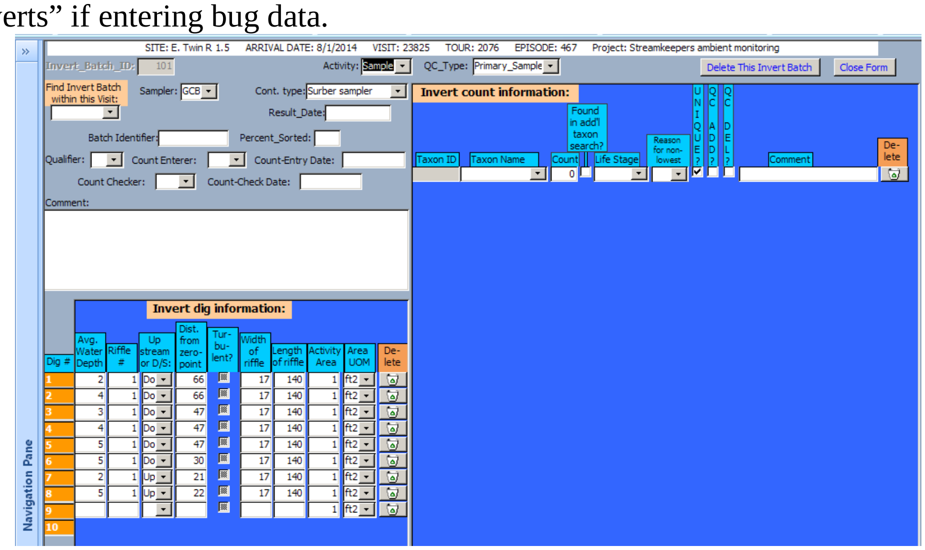
- To enter a different parameter (ex. air temperature) click on the first arrow of the “Records” box at the left bottom of the page to bring up a new “Batch” page.



- Click on “Close Form” top right bringing back the “Monitoring” page.

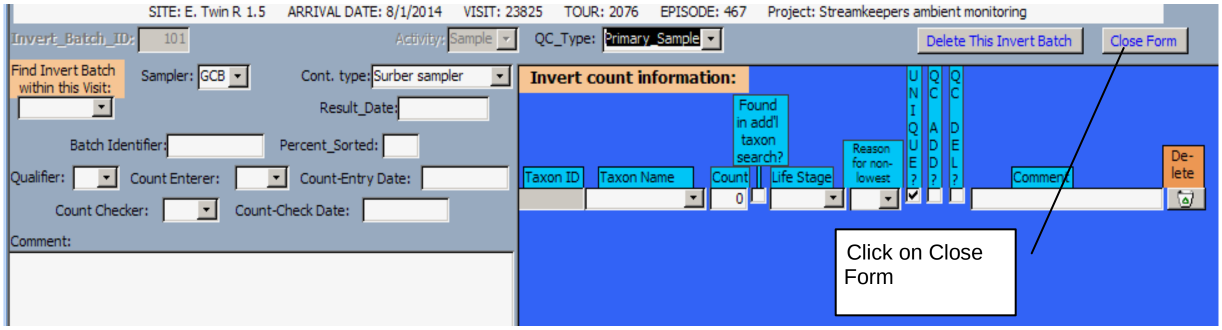


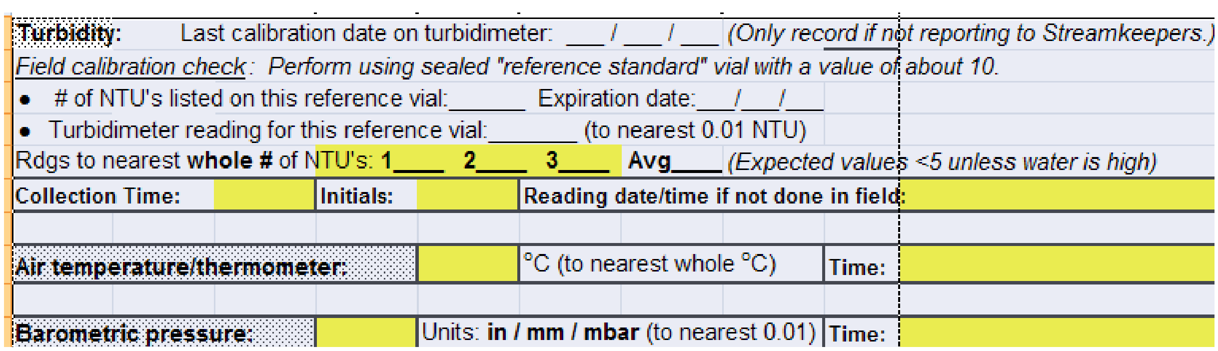
- Click on “Inverts” if entering bug data.



- In the “Activity” box use the pull-down menu to choose “Sample”.
- In the “QC Type” box choose “Primary Sample”.
- Enter the “Sampler” initials from the Macroinvertebrate Sampling box of the field Monitoring Data Sheet.
- Use the pull-down menu of the “Cont. Type” box to choose “Surber Sampler”.

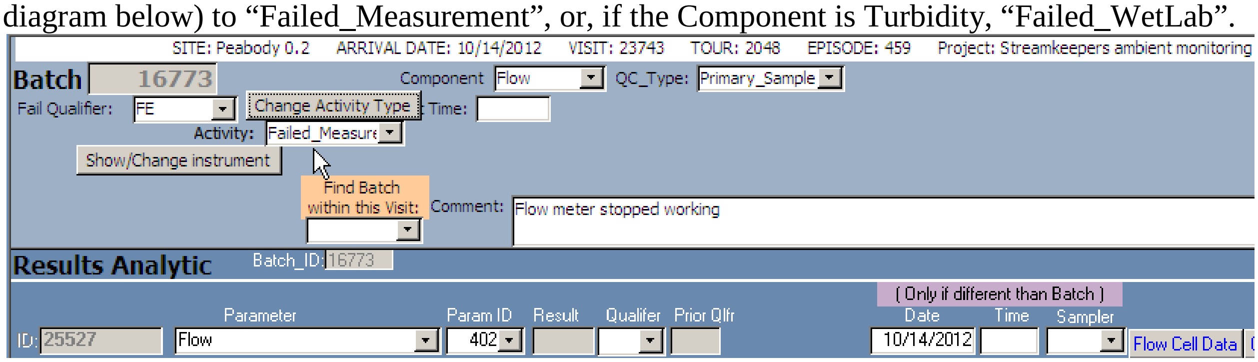
- The data to be entered into the "Invert dig information" is in the vertical direction while the field Monitoring Data Sheet data has been entered horizontally. Keep this in mind when entering the data into the data base.
- The pull-down menu can be used to enter "Up" or "Down" into the "Up stream or D/S" boxes.
- If the Riffle width and Riffle length on the field Monitoring Data Sheets have not all been filled out by the sampler it can be assumed that the widths and length are the same for all of the boxes and should be entered into the "Invert dig information" boxes.
- If replicate samples have been taken in the field click on the first arrow at the "Record" bar to bring up a new batch page. Enter data the same as for the primary samples.
- Click on "Close Form".



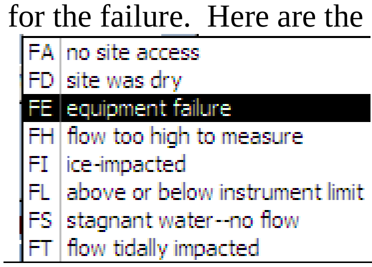


Turbidity:	Last calibration date on turbidimeter: ___ / ___ / ___ *(Only record if not reporting to Streamkeepers.)*										
Field calibration check: Perform using sealed "reference standard" vial with a value of about 10.											
• # of NTU's listed on this reference vial:______ Expiration date:___/___/___											
• Turbidimeter reading for this reference vial:_______ (to nearest 0.01 NTU)											
Rdgs to nearest **whole #** of NTU's: **1____ 2____ 3____ Avg____** *(Expected values <5 unless water is high)*											
Collection Time:		**Initials:**		**Reading date/time if not done in field:**							
Air temperature/thermometer:		°C (to nearest whole °C)		**Time:**							
Barometric pressure:		Units: **in / mm / mbar** (to nearest 0.01)		**Time:**							

Failed measurements: SK Quarterly form: When samplers are unable to gather data and explain why, this needs to be recorded in the database. For SK Quarterly data, you'll need to "Change Activity Type" (see diagram below) to "Failed_Measurement", or, if the Component is Turbidity, "Failed_WetLab".



Once you do this, the "Fail Qualifier" field will show up above and to the left. Choose the appropriate reason for the failure. Here are the choices:



If there are additional comments about the failure, put them in the Batch comment field.
Then go the the Results_Analytic form and enter all Parameters that were unable to be sampled in this Batch, with no Results recorded. If a multimeter failed, you'd enter all the Parameters that meter would have measured.

Failed measurements: All-purpose form: When samplers are unable to gather data and explain why, this needs to be recorded in the database. For the All-purpose form, you'll need to "Change Activity Type" (see diagram below) to "Failed_Measurement", "Failed_Sample", or "Failed_WetLab" (see distinctions described above). Once you do this, the "Fail Qualifier" field will show up (see diagram). Choose the appropriate reason for the failure. If there are additional comments about the failure, put them in the Batch comment field. Then go the the Results_Analytic form and enter all Parameters that were unable to be sampled in this Batch, with no Results recorded (see diagram).

Appendix C. Links to Streamkeepers documents referenced in this document

Document	Link
Annual work & sampling plans	http://www.clallam.net/SK/programplanning.html
Chemical Hygiene Plan	http://clallam.net/streamkeepers/assets/applets/SKChemicalHygienePlan.pdf
Data checking protocol	http://www.clallam.net/SK/doc/Qrtlydtashtckpl.pdf
Data entry sheets	http://www.clallam.net/SK/monitoringusables.html
Equipment calibration/ maintenance & benthic macroinvertebrate laboratory procedures	http://www.clallam.net/SK/QualityAssurance.html
QAPPs & monitoring plans for stormwater	http://www.clallam.net/SK/stormwatermonitoring.html
QAPP for nutrients 1	http://www.clallam.net/HHS/EnvironmentalHealth/documents/qapp.pdf
QAPP for nutrients 2	http://www.clallam.net/SK/doc/clnwtrdpolid.pdf
Studies and reports	http://www.clallam.net/SK/studies.html
Volunteer handbook, including Field Procedures	http://www.clallam.net/SK/volunteerhandbook.html