Redwood Community Action Agency's Humboldt Bay First Flush QUALITY ASSURANCE PROJECT PLAN

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3. Distribution List

Technical Advisors, Team Leaders (volunteers), and interested Field Monitors (volunteers) will receive copies of this Quality Assurance (QA) plan, and any approved revisions of this plan. Once approved, this QA plan will be available to any interested party by requesting a copy from the Redwood Community Action Agency.

4. Project Organization

Redwood Community Action Agency (RCAA) is a private non-profit organization, based in Eureka California, dedicated to developing community self-sufficiency in Humboldt County of northern California. For the past twenty years, the Natural Resources Services Division (NRS) of RCAA has helped private landowners, government agencies, timber and fisheries industries, tribes, and community-based groups to improve north coast quality of life and the productivity of area natural resources. RCAA has been involved with volunteer citizen water quality monitoring since 2003 when NRS Division staff acted as a Coastal Monitoring Coordinator for Coast Wide Snapshot Day. Since that time NRS has been working with volunteers and school groups interested in water quality monitoring in and around Humboldt Bay watershed. Mostly rural in nature, the Humboldt Bay watershed contains the ancient redwoods of the Headwaters forest, highly productive industrial timberlands, prime agricultural lands, and the urban cities of Eureka and Arcata.

4.1 Project Management

The Humboldt Bay First Flush Project will be organized and coordinated by Nicole Murano of Redwood Community Action Agency. The project organizer will also be the Monitoring Leader (training all of the Team Leaders and Field Monitors), Data Manager, and the Quality Assurance Officer. Ms. Murano has a Bachelor of Science from Humboldt State University and has two years of experience working in the field of water quality monitoring including study design, and volunteer trainings and coordination. The project organizer has participated in a three days of hands-on training sessions on water quality monitoring conducted by the Clean Water Team of the State Water resources Control Board.

4.2 Team Leaders, Hubsters, and Field Monitors

RCAA staff members and additional volunteers will be trained as Field Monitors, Hubsters, and Team Leaders according to the protocols in this QAPP. Team Leaders will be provided with more training than the Field Monitors. Team Leaders will be responsible for making critical decisions regarding the time to begin monitoring after being given the alert from the Monitoring Leader. Team Leaders will be responsible for alerting the Field Monitors on their team and delegating to their team members during the First Flush monitoring event. Team Leaders and Field Monitors will select their preferred monitoring stations at the initial First Flush training. Hubsters are responsible for waiting for Team Leaders and Field Monitors at a central “hub”. It is the responsibility of the Hubster to verify data sheets and labels on sample bottles as the monitoring teams return from their assigned station. Hubsters also check cooler temperatures to ensure samples remain cold enough for laboratory requirements.

4.3 Technical Advisors

Technical Advisors will be solicited for technical advice regarding project logistics (including appropriate rain levels for timing of monitoring, and sampling protocols) and Quality Assurance elements of the Humboldt Bay First Flush Project. Furthermore, they will assist with review of data to ensure compliance with Data Quality Objectives identified in this QAPP.

1. Greg Dale, Coast Seafoods Company California Operations Manager, and Shellfish Technical Advisory Committee member, project design team and monitoring team

2. Randy Klein, Hydrologist

3. Randy Turner, Fisheries Biologist, USFWS

4. Lena Cox, Water Quality Supervisor, City of Eureka Engineering Department

5. Problem Definition/Background

5.1. Problem Statement

This Quality Assurance Project Plan covers a volunteer citizen monitoring project called Humboldt Bay First Flush (HBFF). The project is a part of the SWRCB funded program Humboldt Bay Water Quality Improvement Program (HBWQIP). The goal of the HBWQIP is to protect and improve the water quality and environment of the Humboldt Bay and its tributaries through (1) coordinated monitoring of non-point source pollution and (2) conducting public education, outreach, and participation program to reduce pollution from urban runoff and septic systems. The HBFF Project is a hands-on activity to engage and educate local citizens regarding the effects of non-point source pollution in our watersheds.

The Humboldt Bay watershed's water quality is impacted by unnaturally high levels of sediment, primarily from accelerated erosion related to timber harvesting and road construction operations. In addition, bacterial contamination from confined animal facilities, manure application, sub-standard septic systems, and polluted urban runoff are impacting coastal resources.

5.1.1. Humboldt Bay First Flush Goals and Objectives

5.1.1.1. Project Goal

The goal of the HBFF Project is to inform and engage the community in watershed stewardship by involving them in a hands-on monitoring project that highlights two "typical" urban streams that flow through a variety of land use. Resultant data and associated media and project reports will bring attention to the issues of non-point source pollution and how citizens can assist with reducing NPS pollution in our watersheds.

5.1.1.2. Project Objectives

This project will provide information regarding stormwater pollution in the urban drainages of Martins Slough (a tributary of 303(d) listed Elk River which is sediment impaired) and Janes Creek. The focus of the project is on physical, biological, and chemical water quality monitoring that will assist in identifying potential stormwater constituents of concern to aquatic resources. Information obtained will be provided to the regulatory agencies.
Objectives are

- To evaluate the quality of water flowing through two urban streams during the first significant rain of the season. The water quality will be compared to specific water quality criteria.
- To build awareness of water quality issues, aquatic resources and pollution prevention.

5.2 Intended Usage of Data

Volunteer data will not be used for legal or compliance uses. Data will be useful in providing information for pollution prevention. The data will also be made available to the public for purposes of watershed education. Lastly, it will be made available to the regulatory and resource management agencies to supplement their existing data collection efforts.

Data will be compiled and maintained at Redwood Community Action Agency 904 G Street in Eureka, CA. The information will be shared with the State Water Resources Control Board, the North Coast Regional Water Quality Control Board, and upon request to other state, federal, and local agencies and organizations.

6. Project/Task Description

6.1 General Overview of Project

The Humboldt Bay First Flush Project design is based upon First Flush monitoring that has been done in Monterey Bay area and the Russian River. Citizen monitors will be monitoring water quality in two drainages of the Humboldt Bay Watershed, specifically Martins Slough which drains into Elk River Slough and then into South Humboldt Bay and Janes Creek which flows into North Humboldt Bay. These watersheds were chosen because both watersheds are small (less than 4000 acres), urbanization (impervious surface) significant, therefore, these watersheds would likely respond rapidly to the first big rain event (>.5 inches). See section 10.1 for more detail on watershed and station selection. Monitoring will include pre-First Flush "dry sampling" monitoring, First Flush "wet sampling" monitoring, and post-First Flush "dry sampling" monitoring the following summer.

6.1.1. Monitoring "Trigger" (Timing of monitoring event)

Based upon watershed size and urbanization, a rainfall threshold of .5 inches is the trigger for wet sampling monitoring. Dry sampling will occur once the QAPP is approved and during the summer of 2005, well after the First Flush monitoring event.

6.1.2. Parameters

Table 6.1 summarizes the physical, chemical and biological parameters to be measured, the protocols to be followed, and whether the samples will be analyzed by the monitoring group or sampled for later analysis by a professional lab. This project will include 2 dry sampling events, (one pre-event in October 2004 and one post-event during summer 2005) and during the First Flush described above in 6.1.1.

Table 6.1 Summary of Monitoring activities

Parameter	Type of monitoring	Laboratory	Protocol
Flow	Field w/staff gage and velocity	na	Clean Water Team (CWT) SOP-4.1.1.3
Temperature	Field w/bulb thermometer.	na	CWT SOP-3.1.2.1
pH	Field w-pH strips	na	CWT SOP-3.1.4.2
Conductivity (fresh water)	Field w/pocket meter	na	CWT SOP-3.1.3.1
Turbidity	Sample to Lab	Salmon Forever w/HACH turbidimeter	Salmon Forever SOP (2001 QAPP)
Suspended Sediment Concentration	Sample to Lab	Salmon Forever	Salmon Forever SOP (2001 QAPP)
Nitrate	Sample to Lab	North Coast Laboratories	Collection protocol Appendix 4
Ortho-Phosphate	Sample to Lab	North Coast Laboratories	Collection protocol Appendix 4
Metals	Sample to Lab	North Coast Laboratories	Collection protocol Appendix 4
Oil and Grease	Sample to Lab	North Coast Laboratories	Collection protocol Appendix 4
Bacteria (Total and Fecal)	Sample to Lab	North Coast Laboratories/City of Eureka	Collection protocol Appendix 4

All of the water quality data will be compared to the Water Quality Objectives in the Regional Water Quality Control Board Basin Plan. Data that are not comparable to the Basin Plan will be reviewed with the project's Technical Advisors.

6.2. Project Timetable

Table 6.2 identifies the schedule of major activities associated with this project.

Table 6.2 Project Schedule

Activity	Date
Identify monitoring leaders	July 2004
Obtain training for monitoring leaders	July 2004
Identify monitoring stations	July 2004
Recruit monitors	Early September 2004
Obtain and check operation of instruments	August 2004
Train monitors	September 19 and 20, 2004, and at October dry sampling dates
Initiate dry sampling monitoring	Early October
Initiate First Flush monitoring	Unknown date(s)
Initiate data entry	Immediately after results are in
Calibration and quality control sessions	August 23, 2004
Review data with technical advisors	After data has been received
Compile data and write report for SWRCB	January 2005

7. Data Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative the measurements will be. These data quality objectives were suggested by the SWRCB's Clean Water Team, by considering the specifications of the instruments and methods which we will employ, and by considering the utility of the data.

Data quality objectives are summarized in Table 7-1.

Table 7.1. Data Quality Objectives for Water Quality Parameters

Parameter	Method/range	Units	Detection Limit	Resolution	Precision	Accuracy	Completeness
Temperature	Thermometer (-5 to 50)	^{o}C	-5	0.5 ^{o}C	± 0.5 ^{o}C	± 0.5 ^{o}C	80%
pH	Non-bleeding strips (range 4.5-10.0)	pH units	4.5	0.5 unit	± 0.5 units	± 0.5 units	80%
Conductivity	conductivity meter	µS/cm	10	10 µS/cm	± 10%	± 10%	80%
Total Bacteria	SM 19 Ed. 922188 C+E MOD	MPN	2	na	na	na	80%

Fecal Coliform	SM 19 Ed. 922188 C+E MOD	MPN	2	na	na	na	80%
Nirates	EPA 300.0	mg/L	.10	na	± 20%	± 10%	80%
Ortho-Phosphate	EPA 365.2	mg/L	.010	na	na	± 10%	80%
Oil and Grease	EPA 1664		5.0	na	na	64-116	80%
Metals (Cadmium and Chromium)	EPA 200.7	µg/L	10	na	na	± 15%	80%
Turbidity	Hach 2100P(0-1000)	NTUs	0	.01	± 5%	±2%	80%
Suspended Sediment Concentration	Vacuum/filter (St. Method # 2540B) .0001-2g/L	g/L	0	na	± 5%	± 2%	80%

7.1. Accuracy

For temperature, pH, and conductivity the accuracy of the monitoring instruments will be checked by performing tests with standards at the quality control sessions held before monitoring begins. The concentration of the standards will be within the mid-range of the equipment. The Data Quality Form: Accuracy, found in Appendix 1, will be used to record accuracy.

7. 2. Comparability

Comparability is the degree to which data can be compared directly to similar studies. RCAA will use the methods described in the following resource documents to ensure that their data can be compared to others:

- U.S. EPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries,
- SWRCB Clean Water Team Compendium for Water Quality Monitoring and Assessment

Before modifying these methods, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. Their concerns about data quality will be addressed before proceeding with the monitoring project.

7. 3. Completeness

It is expected that 80 percent of all measurements will be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. The Data Quality Form: Completeness, found in Appendix 1, will be used to record completeness.

7. 4. Precision

Precision will be evaluated by repeated measurements taken by the Monitoring Leader on the same sample at quality control sessions and the same volunteer (Team Leader or Field Monitor) performing duplicate samples in the field (for temperature, pH, and conductivity). Precision for parameters that will be going to a participating laboratory for analysis will be determined by having the same analyst complete the

procedure for laboratory duplicates of the same sample (for 5% of laboratory samples). The Data Quality Form: Precision, found in Appendix 1, will be used to record precision.

7. 5. Representativeness

Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source),
- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek),
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 10, 11 and 12, by following the established methods, and by obtaining approval of this document.

7. 6. Method Detection Limit and Sensitivity

The Method Detection Limit is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities of conventional water quality parameters are noted in Table 7.1.

8. Training Requirements

8.1 Pre- and post-monitoring Quality Assurance Sessions

The Monitoring Leader will hold a pre-monitoring as well as one post-monitoring quality control session that will consist of equipment calibration and maintenance checks, as well as accuracy and precision checks. The post calibration session will only be for electrical conductivity meters to account for drift.

The Monitoring Leader will examine kits for completeness of components: date, condition, and whether the equipment is in good repair. The Monitoring Leader will check data quality by testing equipment against blind standards during an equipment calibration session.

8.2 Comprehensive Volunteer Training

Volunteer Team Leaders and Field Monitors will be trained by the trained Monitoring Leader and will be evaluated by their performance of analytical and sampling techniques, by comparing their results to known values, and to results obtained by trainers and other trainees. All First Flush volunteers (including Team Leaders and regular Field Monitors) will attend a minimum of two three-hour training sessions. Sampling design, sample collection protocols, and safety techniques will also be discussed.

9. Documentation and Records

All field results will be recorded at the time of completion, using RCAA's First Flush Monitoring Field Data Sheet (see Appendix 2). Data sheets will be reviewed for outliers and omissions before leaving the sample site. Data sheets will be signed after review by the citizen monitoring leader. Data sheets will be stored in hard copy form at the location specified in Section 5.2. Field data sheets will be archived for three years from the time they were collected. If data entry is ever performed at another location, duplicate data sheets will be used, with the originals remaining at the headquarters site. Hard copies of all data as well as computer back-up disks are maintained at headquarters.

All completed data quality control forms and maintenance logs will also be kept at the headquarters location specified in Section 5.2. The maintenance log details the dates of equipment inspection, battery replacement and calibrations, as well as the dates that reagents and standards are replaced.
A final report will be produced that will incorporate a description of event success, lessons learned, and monitoring data results, including a discussion of whether DQOs and WQOs were met.

10. Sampling Process Design

10.1. Rationale for Selection of Watersheds and Sampling Stations

The Humboldt Bay First Flush project team chose two watersheds (one in Eureka and one in Arcata, the two most urbanized cities located on Humboldt Bay), which displayed a variety of land use upstream and had much impervious surface in the drainage area. In Arcata, Janes Creek watershed is comprised of 1,802 acres with impervious area of approximately 14%. In Eureka, Martins Slough watershed has an area o 3556 acres. The urbanized area occupies 34 percent of the watershed are totaling 1194 acres. Urbanization, agriculture, and timber harvesting are among the land uses affecting Janes Creek and Martin Slough. Stream channel impacts vary from stream channel manipulation, increased storm water runoff and increased impervious surface cover to loss of vegetative riparian corridors. The results of these impacts includes, but are not limited to: increased nutrient and sediment loads, escalated water temperatures, and decreased fish and wildlife habitat. First Flush monitoring at three stations one each stream during the first significant storm of the season will provide profiles of impacts to each stream during potentially the worst case scenarios. Pre-First Flush and post-First Flush sampling will provide background information for each watershed.

Sampling stations are indicated on the maps in Appendix 3. The following criteria were evaluated when choosing sampling locations:

- access is safe,
- permission to cross private property is granted,
- sample can be taken in main river current or where homogeneous mixing of water occurs,
- sample is representative of the part of the water body of interest, and
- location complements or supplements contemporary data collected by other monitoring groups.

10.2. Sample Design Logistics

Based upon First Flush monitoring that has occurred in the Russian River and Monterrey Bay Area, RCAA chose the ‘deterministic’, i.e., knowledge-based approach, rather than the ‘probabilistic’ i.e., random approach. This ‘directed’ sampling design principle led us to build the study logistics based on what we already know about first flushes in a way that will enable sampling during the first two hours of runoff. It also led us to choose locations based on our knowledge of what each tributary represents.

Application of this ‘directed’ approach yielded a long list of sampling locations that provides a good representation of all the land uses and activities in the Humboldt Bay watershed. Due to funding limitations and local analytical laboratory capacities the list of potential sampling locations was shrunk to contain sites that had high probability of generating runoff soon after the rain starts. These sites were in urban, highly paved and roofed landscapes, and the study question was amended to specify this. Other constraints, stemming from recruitment realities, were related to the number of available teams and to their whereabouts; this narrowed the list even more. Health and safety constraints, legal constraints, and other criteria were also instrumental in determining locations.

First Flush sampling efforts, by their very nature, always include a combination of established sampling design principles and some unpredicted, opportunistic, or responsive element.

10.2.2. Dry Sampling and Wet Sampling

Pre-First Flush **dry sampling** will occur before the first big rain once the QAPP is approved by the SWRCB. Post-event dry sampling will occur well after the First Flush event (likely summer 2005). The Monitoring Leader, Team Leaders, and Field Monitors will sample each station one time before the event. At this point, the Team Leader will give the Team Leaders the monitoring instruments and sample collection containers for the future wet sampling event. **Wet sampling** refers to the monitoring of the First Flush rain event. Team Leaders and Field Monitors will arrive at the station at the beginning of the rain event (once the Monitoring Leader alerts them by telephone) and measure the electrical conductivity until it appears to be capturing stormwater runoff. This will be determined by a evident rise in stage, and/or an initial drop in conductivity due to rain dilution and then a rise in conductivity due to stormwater constituents in the stream. The volunteers will also be using visual observations of oil sheen and cigarette butts entering the stream. It is the responsibility of the Team Leaders to determine the appropriate time to begin wet sampling during the First Flush event.

10.2.3. Wet Sampling Phone Tree and Pre-First Flush monitoring set-up

A phone tree will be designed that will include the Team Leader, six Team Leaders (one for each station), and several Field Monitors for each monitoring team. The Team Leader will alert the Team Leaders when the First Flush monitoring will likely occur. There will be a yellow-orange-red alert system based upon the following situations:

- **Yellow Alert**: Team Leaders are contacted and told that a system with >40 percent chance of bringing >.5" of rain is forecast that may come in within 2-4 days
- **Orange Alert**: A system with >40 percent chance of bringing >.5" of rain is forecast within 24 hours. Team Leaders are contacted and asked if they are available and where they can be reached in next 24 hours.
- **Red Alert**: >.5" of rain within 24 hours. The rain is off shore and is continuous (no gaps, sheeting) Leaders are called and will contact team members with next steps to mobilize. The Team Leaders will meet the other Field Monitors from his/her team at the appropriate station. The Team Leader has a bin full of monitoring equipment, write in the rain data sheets, and sample bottles for the laboratory.

10.2.3. Monitoring Stations

Six monitoring teams will be assigned to specific stations (see map in Appendix 3). Both streams to be monitored during this project have base flow, but are relatively stagnant until the first rains of the season. All six monitoring stations have temporary staff gages installed for the purpose of this project.

10.2.4. Types and Numbers of Samples

(1) Rainfall will be gleaned from precipitation reports from weather stations in the Humboldt Bay watershed.
The following parameters were measured in the field:
(2) Stage – water level - was read from staff gauges at selected time periods during the hours of field activity and velocity will be measured by Team Leaders or Field Monitors at each station during the monitoring. Flow will be determined based upon this velocity, stage reading, and cross sections that have been established.
(3) Electrical conductivity, (4) pH, and (5) Temperature will be measured in the field using pocket conductivity meters, pH strips, and bulb thermometers provided by the Monitoring Leader. Water **(6) murkiness** will be observed and recorded frequently during the hours of field activity.

Water samples will be collected in previously decontaminated sampling devices or directly into sample containers provided by the laboratories. If a sampling device is used instead of directly into the sampling container, the devices will be rinsed in creek water three times prior to sample collection. Each sample will be transferred into pre-cleaned or sterile containers, all sharing the same Sample ID. This process will be repeated every 30 minutes, yielding three independent samples for each parameter at each station.

Teams will measure and record conductivity, pH, temperature, and stage while – or immediately after – the sample containers are being filled. Randomly selected teams will collect field duplicates or field blanks while in the field.

All data sheets and samples will be delivered to the Hubs (one in Eureka and one in Arcata), logged into the chain of custody forms, and put into coolers (ice chests) for the participating laboratories (North Coast Laboratories, City of Eureka Wastewater Treatment Lab, and Salmon Forever Laboratory. The Hubster will check for appropriate labeling of sample bottles and clarity and completeness of data sheets before Team Leaders can leave the Hub.

11. Sampling Method Requirements

Appendix 4 describes the appropriate sampling procedure for collecting stormwater samples. Monitors will be using buckets and hand held plastic containers depending upon the monitoring site and flow conditions. Sampling devices and sample bottles (that are not pre-sterilized and do not contain preservatives/fixing agents) will be rinsed three times with sample water prior to collecting each sample. Sterile bottles and sample bottles which do contain preservatives/fixing agents (e.g., acids, etc.) will not be rinsed with sample water prior to collecting the sample. For sample bottles containing preservatives/fixing agents (Coliform) a sampling device to collect the sample prior to transferring the sample into the bottle will be used.

Whenever possible, the collector will sample from a bridge or from the bank so that the water body is not disturbed from wading. All samples will be taken approximately in mid-stream, at least one inch below the surface (ideally about 4 inches below the surface). Volunteers will not be wading for the First Flush event; however, if it is necessary to wade into the water (for instance during dry sampling), the sample collector will stand downstream of the sample, taking a sample upstream. If the collector disturbs sediment when wading, the collector will wait until the effect of disturbance is no longer present before taking the sample.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 11.1 Sampling Method Requirements

Parameter	Sample Bottle	Preferred / Maximum Holding Times
Conventional Parameters		
Temperature	clear plastic bottle or sample directly	immediately
pH	plastic bottle or sample directly	immediately
conductivity	plastic bottle or sample directly	immediately / refrigerate up to 24 hours
turbidity	plastic bottle	immediately / store in dark for up to 24 hr.
Laboratory Analysis of Chemical Parameters		
Total Suspended Solids	Plastic bottle	immediately/up to 7 days
turbidity	plastic bottle	immediately / store in dark for up to 24 hr.
Nitrate N	plastic bottle	immediately / refrigerate in dark for up to 48 hours.
Ortho-Phosphate	plastic bottle	immediately / refrigerate in dark for up to 48 hours
Metals	plastic sampling bottle	Lab will fix with hydrochloric acid immediately upon receipt; holding time 6 months

Oil and Grease	acid and d.i. water rinsed glass sampling bottle, teflon liner in lid	refrigerate to 4 degrees C, send to lab immediately/up to 28 days
Biological Samples		
Bacteria	sterile plastic sampling bottle with sodium thiosulfate	Refrigerate to 4 degrees C in the dark; deliver to the lab within 4 hours, start analysis within 6 hours

12. Sample Handling and Custody Procedures

12.1. Sample Handling

Identification information for each sample will be recorded on the field data sheets (Appendix 2) when the sample is collected.

Samples that are not processed immediately in the field will be labeled with the waterbody name, sample location, sample number (1, 2 or 3), date and time of collection, and sampler's name. If the sample is a duplicate or a field blank, a "D" or an "FB", respectively will be placed on the label immediately following the sample number.

12.2. Custody Procedures

The conventional water quality monitoring tests will, in most cases, be conducted immediately by the same person who performs the sampling. In certain circumstances (such as driving rain or extreme cold), samples will be taken to a nearby residence for analysis.

When samples are transferred from one volunteer to another for analysis, and to an outside professional laboratory, then a Chain of Custody form will be used. This form identifies the waterbody name, sample location, sample number, date and time of collection, and the sampler's name. It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. In cases where the sample remains in the custody of the monitoring organization, then the field data sheet will double as the chain of custody form. When samples leave the custody of the RCAA, then the Chain of Custody forms provided by the North Coast Laboratories will be used. Chain of Custody forms will be kept with data sheets and monitoring data results at Redwood Community Action Agency and will be available upon request. **Dry sampling:** The Monitoring Leader will deliver all samples to participating laboratories immediately after collection and will use the Chain of Custody form. **Wet sampling:** First Flush Team Leaders will be going to a central "hub" location immediately following sampling where a transfer will occur (Team Leader to Hubster). The Hubster will then deliver samples to the laboratories. Chain of Custody forms will document both transfers.

12.3. Disposal

All analyzed samples or spent chemicals will be disposed of according to guidelines of the professional laboratories that RCAA will be employing.

13. Analytical Methods Requirements

Water chemistry is monitored using protocols outlined in the *Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment*. The methods were chosen based on the following criteria:

- capability of volunteers to use methods,
- provide data of known quality,
- ease of use,

- methods can be compared to professional methods in *Standard Methods*.

If modifications of methods are needed, comparability will be determined by side-by-side comparisons with a US EPA or APHA Standard Method on no less than 50 samples. If the results meet the same precision and accuracy requirements as the approved method, the new method will be accepted, appropriate trainings will occur, and the QAPP will be updated.

Table 13.1 outlines the methods to be used, any modifications to those methods, and the appropriate reference to a standard method.

Table 13.1 Analytical Methods for Field Conventional Water Quality Parameters

Parameter	Method	Modification	Reference (a)
Temperature	Thermometric	Alcohol-filled thermometer marked in 0.5^{o}C increments	2550 B.
pH	Litmus indicator strips	Non-bleeding	Macherey-Nagel
Conductivity	Electrometric	none	2520 B.

14. Quality Control Requirements

Quality control samples will be taken to ensure valid data are collected. Quality control samples will consist of blanks and duplicate samples. Teams will be selected randomly to collect field blanks and duplicate samples. A quality control session will be held before any monitoring occurs to verify the proper working order of equipment.

14.1. Blanks, Replicates, and Standardization

Field/Laboratory Blanks:

Duplicate field samples will be provided for 5% of the total samples. Distilled water will be taken into the field and handled just like a sample. It will be poured into the sample container and then analyzed. Field blanks will be recorded on the field data sheet and on the sample bottle, “FB”.

Duplicate Samples: Duplicate field samples will be provided for 5% of the total samples. Duplicate samples will be collected as soon as possible after the initial sample has been collected, and will be subjected to identical handling and analysis. Duplicate samples will be recorded on the field data sheet and labeled “Dup”.

Standardization of Instruments and Procedures: At the pre-monitoring Quality Assurance session the temperature measurements will be standardized by comparing our thermometers to a NIST-certified or calibrated thermometer in ice water and ambient temperature water. All conductivity meters and pH strips will be evaluated at the Quality Assurance session with appropriate standards.

Table 14.1 summarizes the quality control regimen.

Table 14.1 Summary of Quality Control Requirements

Parameter	Blank	Duplicate Sample	Split Sample to lab	RCAA QC session
Water quality				

Temperature	none	1 per team	none	Pre-monitoring
Dissolved oxygen	none	1 per team	none	Pre-monitoring
pH	none	1 per team	none	Pre-monitoring
conductivity		1 per team	none	Pre-monitoring
turbidity		5% of total samples	none	n/a
Total Suspended Solids		5% of total samples	none	n/a
Nutrients (comparators)				
Nitrate		5% of total samples	none	n/a
Ortho-Phosphate		5% of total samples	none	n/a
Urban Pollutants				
Oil and grease		5% of total samples	none	n/a
Metals (cadmium and chromium)		5% of total samples	none	n/a
Biological Parameters				
Total Coliform and Fecal Coliform Bacteria		5% of total samples	none	n/a

15. Instrument/Equipment Testing, Inspection and Maintenance

A maintenance log is kept by the Monitoring Leader. This log details the dates of instrument and sampling gear inspection, calibrations performed in the laboratory, battery replacement, the dates reagents and standards are replaced, and any problems noted with instruments, samplers, or reagents.

15.1. Temperature

Before each use, thermometers are checked for breaks in the column. If a break is observed, the alcohol thermometer will be placed in nearly boiling water so that the alcohol expands into the expansion chamber, and the alcohol forms a continuous column. Bulb thermometers will be checked for accuracy by comparing with a certified thermometer.

15.2. Conductivity

Before each use, conductivity meters will be checked to ensure they are clean and in good working order. Conductivity meters will be calibrated before each use. Buffers will be checked and will be replaced before they expire. Conductivity standards will be stored with the cap firmly in place and in a dry place kept away from extreme heat. Conductivity standards will not be re-used.

15.3. pH

Before each use, pH strips are checked to see if they are clean and in good working order. A pH strip from each box is tested for accuracy before being used. Buffers will be checked and will be replaced before they expire. pH buffers are stored with the cap firmly in place and in a dry place kept away from extreme heat. pH buffers will not be re-used.

16. Instrument Calibration / Standardization and Frequency

The Monitoring Leader will calibrate and check the accuracy of instruments. Standards will be purchased from a chemical supply company. Calibration records will be kept in the maintenance log at the headquarters location (described in Section 5.2.) where it can be easily accessed before and after equipment use. Calibrations will not be performed by monitors in the field. The frequency of calibration is described in Table 16.1.

Table 16.1 Instrument Calibration/Accuracy Check and Frequency

Conventional Water Quality Parameters		
Equipment Type	**Calibration/Accuracy Check Frequency**	**Standard or Calibration Instrument Used**
Temperature	Pre-monitoring	NIST calibrated or certified thermometer
pH	Pre-monitoring	pH 7.0 buffer and one other standard (4 or 10)
conductivity	Pre-monitoring	Conductivity standard and distilled water

17. Inspection/Acceptance Requirements

Upon receipt, buffer solutions and standards will be inspected by the Monitoring Leader for leaks or broken seals, and to compare the age of each reagent to the manufacturer's recommended shelf-life. All other sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation.

Before usage, thermometers will be inspected for breaks. Breaks will be eliminated by heating (see Section 15.1). If not, they will be returned to the manufacturer.

18. Data Management

Field data sheets are checked and signed in the field by the Team Leader. The Hubsters and the Monitoring Leader will identify any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate. Such data will be marked as unacceptable by the monitoring leader and will not be entered into the electronic data base.

Independent laboratories will report their results to the Monitoring Leader. The leader will verify sample identification information, review the chain-of-custody forms, and identify the data appropriately in the database. These data will also be reviewed by the Technical Advisors.

The Monitoring Leader will review the field sheets and enter the data deemed acceptable and will sign and archive the field data sheets. Data will be entered into a spreadsheet (MS Excel) in a way that will be compatible with EPA's STORET and the Regional WQCB's database guidelines. Following initial data entry the Monitoring Leader and will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

The Monitoring Leader will write and provide to the State and Regional a final report including a data summary and recommendations for future monitoring. Raw data and quality assurance information will be provided to the SWRCB and/or Regional WQCB upon request.

19. Assessment and Response Actions

The Monitoring Leader will review all field and data activities with the assistance of the technical advisory committee when monitoring is complete.

The State Water Board or Regional Board staff, or its designee, may evaluate field and laboratory performance and provide a report to the citizen monitoring group. All field and laboratory activities, and records may be reviewed by State and EPA quality assurance officers as requested.

20. Reports

The Technical Advisors will review draft reports to ensure the accuracy of data analysis and data interpretation. Raw data will be made available to data users per their request. Redwood Community Action Agency will report the data to volunteers and the public after quality assurance has been reviewed and approved by their Technical Advisors. Every effort will be made to submit data and/or a report to the State and/or Regional Board staff in a fashion timely for their data uses.

21. Data Review, Validation, and Verification

Data sheets and data files will be reviewed by the Monitoring Leader with assistance from the Technical Advisors to determine if the data meet the Quality Assurance Project Plan objectives. The Team Leader will identify outliers, spurious results or omissions and will also evaluate compliance with the data quality objectives. Technical Advisors may suggest actions that will be implemented by the Monitoring Leader for future monitoring projects. Problems with data quality and corrective action will be reported in final reports.

22. Reconciliation with DQOs

The Monitoring Leader will review data after both dry sampling dates and the First Flush event to determine if the data quality objectives (DQOs) have been met.

If data do not meet the project's specifications, the following actions will be taken. First, the technical advisors working with the monitoring leader(s) will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. They will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the technical advisors and the TAC will review the DQOs and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to DQOs will be appended to this QA plan with the revision date and the reason for modification. The appended QAPP will be sent to the SWRCB. When the appended QAPP is approved, the Monitoring Leader will ensure that all data meeting the new DQOs are entered into the database. Archived data can also be entered.

APPENDIX 1. Field Data Sheet and Data Quality Summary Forms

Humboldt Bay First Flush Monitoring Field Data Sheet

Date_____

Creek_____ **Station ID**_____ Team Name (if applicable)_____

Names	Phone
Team Leader:	

Time rain started_____

Staff gage reading_____

Velocity_____

Instrument ID: Conductivity meter: EC-RCAA-_____ pH strips: PHST-RCAA-____
Thermometer: TB-RCAA-_____

Stream Measurements Upon Arrival:

TIME	STAGE	MURKINESS	CONDUCTIVITY	COMMENTS/OBSERVATIONS

Sample collection (Please describe on the back of this sheet how you took the sample from the creek into the sample containers).

Sample ID	Time	Stage	Conductivity	Dup	pH	Dup	Temp	Dup	Comments

Data Quality Form: Completeness

Redwood Community Action Agency			Humboldt Bay First Flush	
Name			QA Officer:	
Date				
Parameter	**Collection Period**	**No. of Samples Anticipated**	**No. Valid Samples Collected and Analyzed**	**Percent Complete**
Temperature ^{o} C				
pH standard units				
Conductivity (us)				

Comments:

Precision Form

Date:

Time:

Project (Event):

Parameter:

Instrument ID	Custodian	Reading 1	Reading 2	Reading 3

Accuracy Check Form

Date:

Time:

Project (Event):

Parameter:

Standard ID or NIST thermometer ID Number:

Instrument ID	Custodian	Unit	Instrument description	Standard/NIST True Value	Instrument Value

Calibration Form

Date:

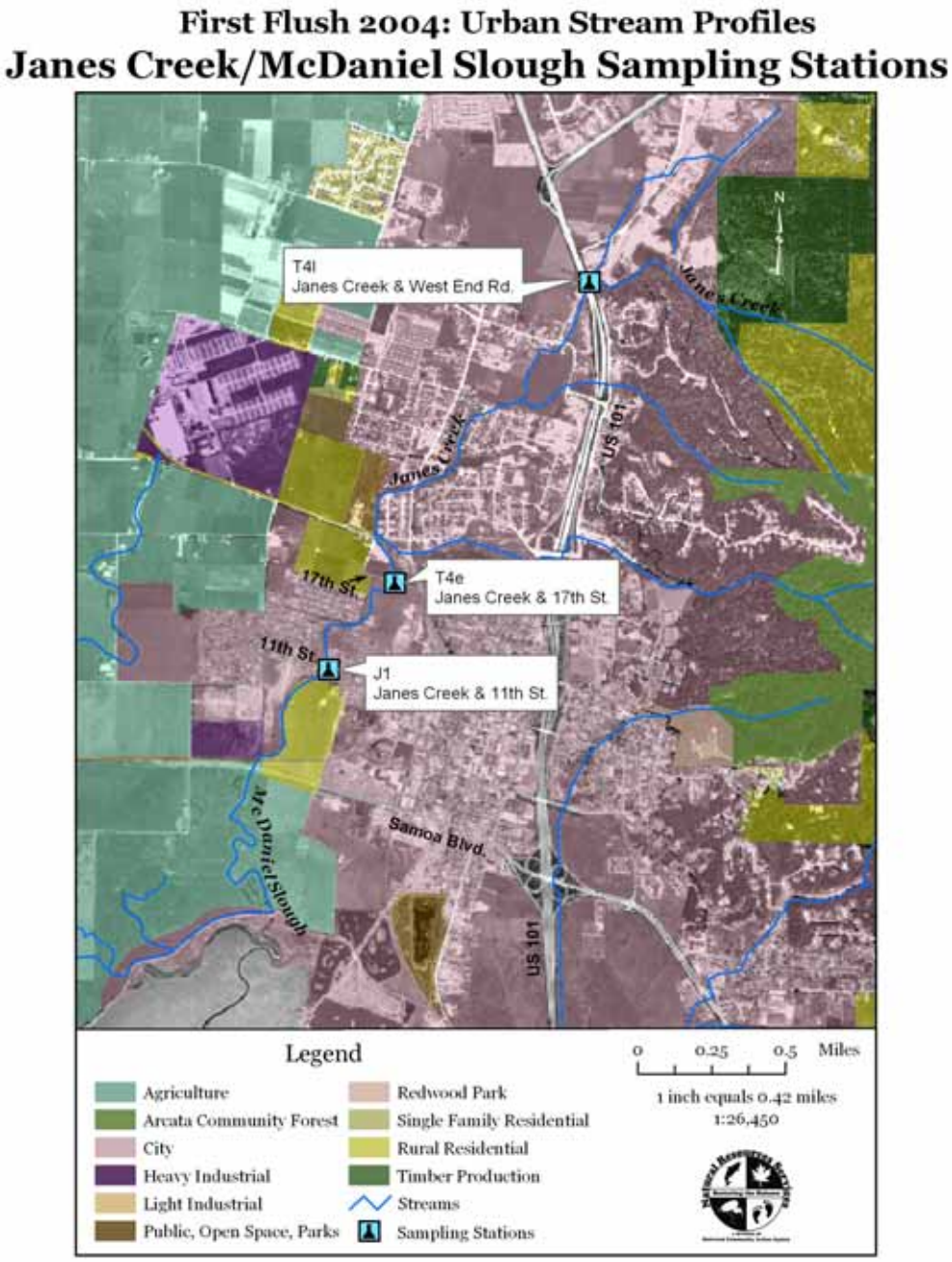
Time:

Project:

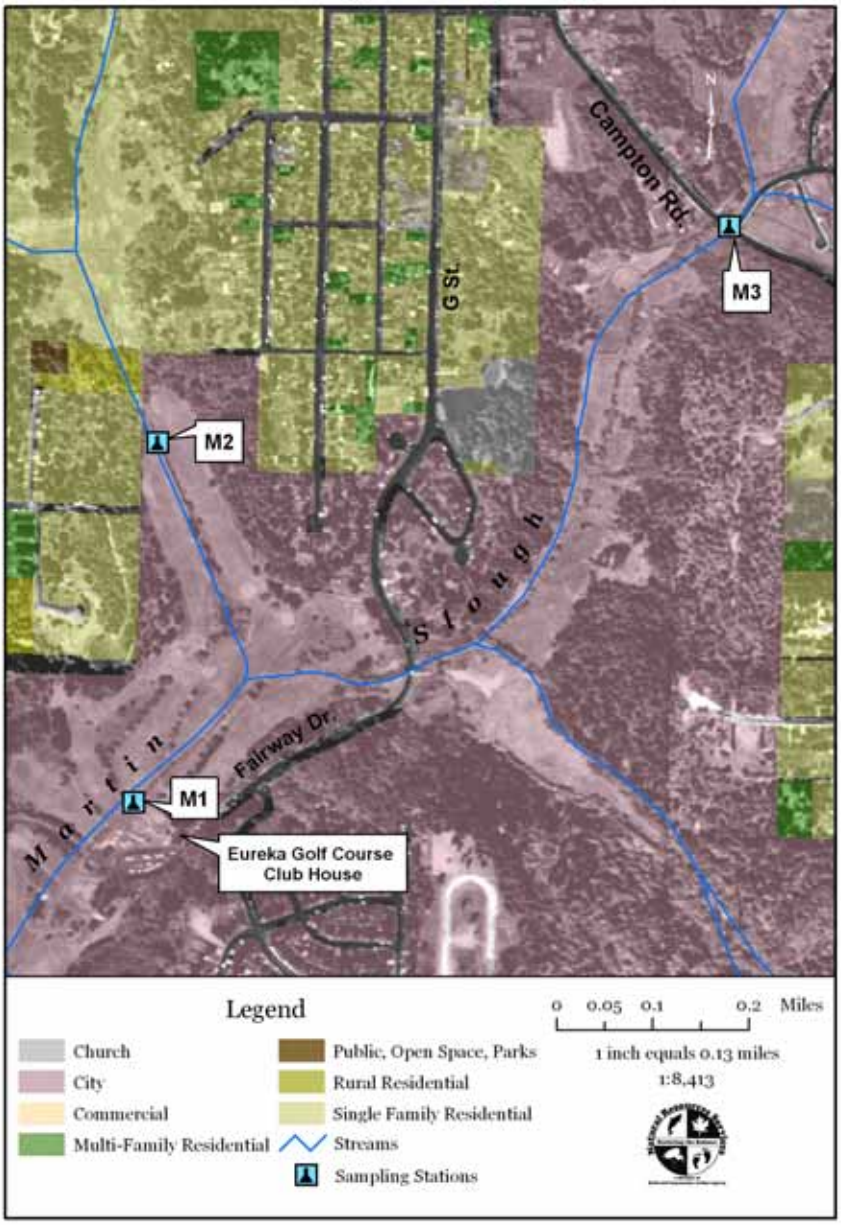
Parameter:

Instrument ID	Custodian	Instrument description	Standard	Time	Temp	Initial Reading	Final Reading

APPENDIX 2. Maps of First Flush Sampling Sites



First Flush 2004: Urban Stream Profiles
Martin Slough Sampling Stations



APPENDIX 3. Standard Operating Procedures

Standard Operating Procedure (SOP) 3.1.2.1

By Revital Katznelson, Ph.D.

Measurements of Temperature with Bulb and Min-Max Thermometers

This SOP provides instructions for the use of devices that record temperature-dependent change in volume, such as bulb thermometers made with mercury or dyed alcohol solution in a bulb and thin capillary, or U-shaped tube thermometers filled with mercury and equipped with minimum-maximum stopper locks. To facilitate data management, please use thermometers that report the temperature in °C if you can.

Note: Use of mercury thermometers is being phased out.

Bulb Thermometers

Bulb thermometers come in all kinds, lengths, and shapes, and are usually made of glass (although some thermometers are made of plastic). Many glass thermometers are sold with an "armor" made of a perforated metal or plastic sheath, to protect the delicate glass.

Step 1: To measure temperature of a solution with a bulb thermometer, immerse the thermometer in the tested solution.

Step 2: Allow a minute or so for equilibration, then read while still immersed in the solution.

Step 3: Reporting the data:

- Add or confirm the Instrument ID on the field data sheet
- Make sure that both the temperature value and the unit are recorded

Minimum-Maximum Thermometers

U-shaped tube thermometers are usually filled with mercury and have an air reservoir on one end (on the left side for this SOP). Movement of the mercury in the U pushes the minimum or the maximum stoppers up where they remain even after the temperature changes. This happens because the stoppers are made of metal rods, and there is a flat magnet closely behind the tube, so they get stuck. Min-Max thermometers can be used in water or air. They can be deployed over a desired period of time to obtain records of the minimum and the maximum that had occurred during that deployment period, without having to be present. Unfortunately, they can record only one minimum and one maximum value per one deployment period, and need to be reset manually prior to a subsequent deployment.

Step 1: Inspect the device before use, to ensure that there are no air bubbles in the continuum of mercury in the U-shaped tube.

Step 2: To reset the thermometer, hold it upright and press the central ridge toward the back – this will push the magnet (that holds the stoppers in place) backwards and release the stoppers. Wait until both stoppers slide down and reach the tops of the mercury columns.

Step 3: Deploy the device for the desired period of time at the desired location. Make efforts to deploy in an upright position. Note that the entire device has to be in the ambience of the environment you are recording: it does not have a sensitive point like bulb thermometers or thermistor probes.

Step 4: Retrieve the thermometer and read the temperature scales at the following places:

- Current temperature – where the mercury levels are at the time of retrieval (they should be identical on both arms; note that the scale on the left arm is upside-down)
- Minimum temperature – where the bottom of the left-arm stopper is upon retrieval (note that the scale is upside-down)
- Maximum temperature - where the bottom of the right-arm stopper is upon retrieval.

Step 5: Record the three values on your data sheet, reporting the data:

- Add placeholders for Minimum and Maximum temperatures on your data sheet, if absent.
- Add or confirm the Instrument ID on the data sheet
- Make sure that both the temperature values and the units are recorded

Step 6: Reset the device as in Step 2 to prepare it for the next deployment.

Monitoring Tips

Bulb thermometers used for environmental monitoring **are different from thermometers used to measure body temperature** in that they do NOT have that tiny twist in the capillary tube (which prevents the mercury from rolling back after removal from the body and requires vigorous shaking of the thermometer before the next measurement). Consequently, the operator of an environmental bulb thermometer, when measuring water temperature, MUST read the temperature **while the bulb is still in water**! The same requirement applies to thermistor probes. This can be made easier by taking some of the creek water into a cup, keeping the thermometer in it and bringing it to eye level for rapid reading. The Kemmerer sampling apparatus provided by LaMotte has a special hole for the thermometer, so that the thermometer remains in the sampling apparatus while filling and retrieving, and can be read directly through the transparent wall of the apparatus immediately after retrieval.

When you measure air temperature, remember that a wet thermometer is "contaminated" in the sense that the water will alter your values. To avoid this, either dry the thermometer thoroughly before measuring air temperature, or dedicate one thermometer for water and a second thermometer for air only - and keep the second one dry at all times (buying two and dedicating may be the only solution if you are using the LaMotte armored thermometers with the blue plastic perforated sheath (i.e., the coating with holes), because there is no way of drying everything inside the armor within the time it takes to hop from one station to the next).

Whether you are using a bulb thermometer or a Minimum-Maximum thermometer, remember:

- never shake the thermometer upside down
- always keep flat or upright, never upside down
- avoid exposure to extreme heat

If you are using one of the older models of Minimum-Maximum thermometers and you MUST open the device, do it inside a white bag to catch the tiny spring that WILL fly out and which cannot be replaced.

Sources and Resources

This SOP is a part of the guidance compendium created by the Clean Water Team, the Citizen Monitoring Program of the State Water Resources Control Board.

SOP-3.1.4.2

DQM Standard Operating Procedure (SOP) 3.1.4.2

By Revital Katznelson, Ph.D.

Measurement of pH with non-bleeding pH Strips

(This paragraph is common to all DQM SOPs. If you have seen it already, please skip to Section 1 below). This is a new type of guidance, created as part of the Data Quality Management (DQM) System implemented by the Clean Water Team (CWT) to support collection of reliable data of known quality in a fully documented, scientifically defensible manner.

1.0 About this SOP

These instructions describe how to measure pH using one of several pH strip kits. Each plastic strip has one or more (usually three) panels of paper stuck to it. Each panel has a specific pH indicator bound to it permanently (so the indicator molecules do not dissolve away when the strip is placed in water). The strips come in a plastic box that also has a chart with color combinations that represent known pH values. The Instrument code used for pH strips in this and other DQM materials is "PHST". A PHST kit (or a "pH Strip kit" includes a hundred strips, the color chart, and the box that contains them. Please refer to DQM-IP-3.1.4(pH), available with the Clean Water Team, for background information on the different ways to measure pH.

(This paragraph is common to all Instrument-specific DQM-SOPs). The sections of this SOP are organized as follows: Equipment list, maintenance and storage, accuracy checks, pH measurement, monitoring tips, and detailed guidance on how to control, check, record, and report (CCRR) the accuracy and the precision of the measurements. Contact information for further assistance is provided at the end of this SOP. In must be noted that there are many other SOPs, available from different organizations, which also provide instructions for the use of pH kits. However, the objective of this particular SOP is to provide a new type of guidance as part of the Data Quality Management (DQM) System implemented by the Clean Water Team (CWT) of the State Water Resources Control Board. It provides guidance at the level of detail and specificity that will allow users to generate reliable data of known quality in a fully documented, scientifically defensible manner.

2.0 Equipment List

Apart from this SOP and the pH Strip kit itself, you will need the following:

- Standard pH buffer
- Two small (1-oz) cups for Standard buffers, each dedicated for a specific Standard and labeled with that Standard's unique ID.
- a medium (9-oz) cup for sample solution, labeled "sample"
- "Distilled water" in a squirt bottle
- Liquid Waste Container (a wide-mouth jar for used reagents and buffers)
- "Field Data Sheet for Water Quality Monitoring" and instructions in SOP-9.2.1.1(Field)

• “Calibration and Accuracy Checks Sheet” and instructions in SOP-9.2.1.2(Calib)

The "distilled water" referred to in the instruction is sold in supermarkets as "distilled water", "deionized water", "purified water", or "drinking water”, and these are normally prepared by ion-exchange resins or reverse osmosis. The essential feature is zero conductivity and lack of contaminants.

3.0 Maintenance and Storage

The pH Strip kits are low-maintenance devices and can be stored anywhere, preferably in the dark. Avoid exposure of the strips or the color charts to direct sunlight.

4.0 Accuracy Checks and Record Keeping

You cannot adjust the output of a pH strip but you can test whether the output is accurate by checking what the strip “reads” in a Standard buffer solution. Make sure you have colorless standards. Use at least two Standard buffers, one of pH 7 and the other at pH 9 or 10. The buffers for pH 4 are available but they are less useful for the range of pH you may encounter in the environment.

Step 4.1: Pour a small amount of the buffer into the dedicated 1-oz cup.

Step 4.2: observe the change in color of the different panels on the strip, until the color stabilizes (does not appear to be changing any more). This step is fairly rapid in Standard Buffers.

Step 4.3: take the strip out of the solution, shake the excess liquid off it so it does not reflect light, and compare it to the color chart on the box. Use natural light in the shade.

Step 4.4: Record your activities on the “DQM Calibration and Accuracy Checks Sheet” as provided with its generic instructions (SOP-9.2.1.2); this form captures all the documentation you will need to provide.

The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board, DQM-SOP-3.1.4.2(PHST)V1c 4/27/04 Page 2 SOP-3.1.4.2

5.0 pH measurements

Step 5.1 Record the Instrument ID which is written on your kit in the appropriate field, in the pH row on the “DQM Field Data Sheet for Water Quality Monitoring”

Step 5.2 Pour some of your water sample into the 9-oz plastic cup

Step 5.3: Observe the change in color of the different panels on the strip, until the color stabilizes (does not appear to be changing any more). This step may take several minutes if the conductivity of your sample is low (not too many “pH thingies” out there to interact with the bound indicators) or when the temperature is low (the “pH thingies” move slower when it is cold).

Step 5.4: Take the strip out of the solution, shake the excess liquid off it so it does not reflect light, and compare it to the color chart on the box. Use natural light in the shade.

Step 5.5 Identify the value represented by the color chart combination that best fits the colors on the pH strip you had in your sample, and record it in the Result column in the “DQM Field Data Sheet for Water Quality Monitoring”. Note: the colors of the pH strip panels may change over time when the strip is exposed to air, introducing an error, so make sure you complete your comparisons within less then one minute. If you think that the color in the sample is between two combinations, e.g., between pH 7 and pH 7.5, write “7.3” in the Result column and “7-7.5” in the Bracket column in the “DQM Field

Data Sheet for Water Quality Monitoring". In this case, the number 7.3 will go into the database, and the data users will know that you thought it was more than 7 and less than 7.5 but did not have a panel for the exact value.
Step 5.6 After completing the test and recording the result, dispose of the used strip in the solid trash bag. The sample itself can be poured on the ground near the creek.
6.0 Monitoring Tips
When you familiarize yourself with a new kit, experiment with doing the color comparison at different light conditions, e.g., in direct sunlight, in the shade, under artificial light source, with the light ahead of you or behind you, etc. You will see differences and develop a sense of what's the best lighting for your kit. Then, be consistent in the way you do the color comparison.
Different people may have different perception of color. It is recommended to have at least two people "read" the output of your pH strip (within the first minute

after exposure to air) and to record the second opinion on the same row as the Result, in the "2nd /dup/rep/dil" column of the "DQM Field Data Sheet for Water Quality Monitoring" (see SOP-9.2.1.1).
7.0 Accuracy and Precision CCRR (control, check, record, and report)
7.1 Accuracy

Accuracy is the extent of agreement between an observed value (measurement result) and the accepted, or true, value of the parameter being measured. Because you cannot adjust the reading of your PHST kit, the only way you can control its accuracy is to protect it from direct sunlight and other deteriorating factors. However, you can check the accuracy of your kit by testing a Standard Buffer. Follow the instructions in Section 4.0 above and record your activities on the "DQM Calibration and Accuracy Checks Sheet". To support your accuracy check with other, independent checks, take your kits and Residential Standards to Instrument Calibration events and try different Standard buffers, and also compare your results with the reading of a calibrated pH electrode.
How often should you run accuracy checks? Once every few weeks is usually sufficient. Generally, frequency of accuracy checks will vary depending on the scenario:

- Snapshots and other one-time monitoring events – conduct an accuracy check with two Standard buffers before the event or as soon as you can after the event. Put a pH strip in each Standard and record the reading of your pH strips after they have stabilized (i.e. stopped changing color)
- Routine monitoring – conduct accuracy checks with two buffers every 10 weeks, as instructed for Snapshots above.

Standard buffers have a tendency to change over time as well, and it is a good practice to compare your "Resident" Standard with an External Standard from time to time. The potential drift in the Resident Standard is your second measure of accuracy. Comparisons with External Standard can be done at regional Intercalibration Exercise events, otherwise known as "instrument calibration party"; it is your responsibility to attend,

bring your own Resident Standard and keep records as to how it compares to the External Standard on a copy of the Comparisons of Standard data sheet.
Because the measurement increment (i.e., resolution) of most PHST kits is around 0.5 pH units, chances are that drift in the reagents' response, or fading of the color chart, or drift in the Resident Standard will be smaller than the measurement increment. Thus, often the inaccuracy of the kits is contained within the resolution, and will be reported as "less than the resolution" based on your

supporting accuracy checks. In fact, if the kit is inaccurate to an extent that is larger than 0.5 pH units, it is recommended to replace the entire kit.

7.2 Precision

The precision of your kit is a measure of how close repeated measurements, done with the same kit, are to each other. You can control the precision of your instrument or kit by eliminating sources of error or reducing their effect on the result of the measurements, for example by waiting for the reading to stabilize, using the same illumination conditions every time, and adhering to consistent measurement conditions in terms of sample volume, temperature, mixing, etc.
To check precision, collect two samples from the creek at the same time and measure their pH; these "field duplicates" are a part of your routine Field QA/QC. You can also have two people measure pH of the same sample, or otherwise generate sets of "replicate" results that pertain to the same sample. Record the additional measurement results in the "2nd/rep/dup/dil" field on your "DQM Field Data Sheet for Water Quality Monitoring" (see DQM-SOP-9.2.1.1). Generate such pairs every ten weeks and every time you introduce new monitors to your team. As in the case of accuracy, chances are that the error related to low precision falls within the resolution and will be reported as "less than the resolution" based on your supporting precision checks.

7.3 Blanks

Blanks are meaningless in the case of pH strip kits (and all other pH measurement devices) because the indicators will have their own color even in distilled water. Actually, pH of zero is as acid as it ever gets!

7.4 CCRR Definitions

(This section is common to all Instrument-specific DQM-SOPs) These terms are defined here because they are essential for understanding the instructions. These and many other terms are defined in the Glossary at the end of the generic SOPs for Field Operators (DQM-SOP-9.2.1.1(Field) and DQM-SOP-9.2.1.2(Calib), and in the comprehensive Compendium glossary..
Instrument: a probe, electrode, reagent kit, indicator strip, or any other type of device used for field or laboratory measurements.
Accuracy Check: Comparison of the reading, or output, of a measurement device with a value believed to be the "true" value. The "true" value may be represented by any Standard Material (e.g., known natural reference conditions such as freezing point, Standard Solution, etc). An "Accuracy Check" is different from a

Calibration, since it is only a comparison and does not result in an adjustment of the reading of the measurement device.
Calibration (or Calibration Adjustment): Modification of the output of an adjustable-reading instrument, to make it reflect a value that represents the "true value" (as manifested by a given Standard or by a natural value). Note: The EPA's definition for "Calibration" is, essentially, a combination of "accuracy check (comparison) and adjustment if needed"; it is not specific enough for communication of what you did when you say "I calibrated the instrument".
Standard Material: A catch-all term for Solutions (e.g., Standard Buffer), devices (e.g., Certified thermometer), or natural reference points (e.g., Water saturated with dissolved oxygen at a given temperature), that represent a value believed to be the "true" value.
Standard Solution: A solution containing a known concentration of a substance or has a known property, prepared or purchased for use in the analytical laboratory or in the field. Each bottle of these types of Standards has a unique Standard ID, for example "STB-EC2". Every bottle of Standard with its unique ID can be described in one or more of the following definitions:

- "Resident Standards" – solutions that each monitoring entity or group owns and uses routinely for calibration and/or accuracy checks.
- "External Standards" - solutions used in events such as Intercalibration Exercises, often brought by the QA/QC officer for comparison with the Resident Standards brought by the participating groups;
- "Certified Standards" include any Standard that is traceable to NIST or ASTM. Resident and External Standards can all be Certified Standards as well. A Certified Standard is considered the "ultimate authority" if valid, i.e., if the bottle was (a) used before the expiration date; (b) has been stored tightly capped; and (c) has not been exposed to extreme temperatures or sunlight.

8.0 Sources and Resources
(This section is common to all DQM-SOPs, except for the title and SOP number in the citation). This SOP is an integral part of the Data Quality Management (DQM) System implemented by the Clean Water Team, the Citizen Monitoring Program of the California State Water Resources Control Board.
For an electronic copy, to find many more CWT guidance documents, or to find the contact information for your Regional CWT Coordinator, visit our website at
www.swrcb.ca.gov/nps/volunteer.html
If you wish to cite this SOP in other texts you can use "CWT 2004" and reference it as follows:

"Clean Water Team (CWT) 2004. Measurement of pH with non-bleeding pH Strips, DQM SOP-3.1.4.2. in: The Clean Water Team Guidance Compendium for Watershed

Monitoring and Assessment, Version 2.0. Division of Water Quality, California State Water Resources Control Board (SWRCB), Sacramento, CA."

The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board, DQM-SOP-3.1.4.2(PHST)V1c 4/27/04 Page 7

DQM Standard Operating Procedure (SOP) 3.1.3.1 (V3)

By Revital Katznelson, Ph.D.

Measurement of Electrical Conductivity Using a Pocket Meter

(This paragraph is common to all DQM SOPs. If you have seen it already, please skip to Section 1 below). This is a new type of guidance, created as part of the Data Quality Management (DQM) System implemented by the Clean Water Team (CWT) to support collection of reliable data of known quality in a fully documented, scientifically defensible manner.

1.0 Overview

These instructions describe how to measure conductivity using the battery-operated pocket meters manufactured by Oakton (and sold by numerous vendors) as the TDSTestr series or the EC-Testr series. Please refer to IP-3.1.3(EC), available with the Clean Water Team, for background information on total dissolved solids (TDS) and conductivity; this will explain the relationship between the term "TDS" in the product name and the output of these meters in conductivity reporting units, microsiemen or milisiemen. The reader is encouraged to select instruments that report in microsiemen. The TDSTestr3 model (recently renamed EC-Testr Low) provides for the range of 10 to 1990 microsiemen, and the range of the TDSTestr4 (now called EC-Testr High) is 0.1 to 19.90 milisiemen. Both are available in a waterproof model. If you anticipate monitoring water bodies with very little salts (e.g., waters dominated by rainwater or snowmelt), look for the more sensitive meters, e.g. those that have a resolution of 1 uS and a range of 1-200 uS. The old models had a screw for manual calibration, while some of the new models have arrow-buttons for manual calibration or an automatic calibration feature. All pocket meters of the TDSTestr series have a built-in automatic temperature compensation (ATC) device. Other TDS or EC meters may have minute differences in the appearance but the procedures and record keeping steps are probably identical.

(This paragraph is common to all Instrument-specific DQM-SOPs). The sections of this SOP are organized as follows: Equipment list, maintenance and storage, calibration and record keeping, conductivity measurement, monitoring tips, and detailed guidance on how to control, check, record, and report (CCRR) the accuracy and the precision of the measurements. Relevant definitions as well as contact information are provided at the end of this SOP. In must be noted that there are many other SOPs, available from different organizations, which also provide instructions for the use of pocket conductivity meters. However, the

objective of this particular SOP is to provide a new type of guidance as part of the Data Quality Management (DQM) System implemented by the Clean Water Team (CWT) of the State Water Resources Control Board. It provides guidance at the level of detail and specificity that will allow users to generate reliable data of known quality in a fully documented, scientifically defensible manner.

2.0 Equipment List

Apart from this SOP and the Pocket Meter itself, you will need the following:

1. Calibrator Standard
2. a small (1-oz) cup for Standard
3. a medium (9-oz) cup for sample solution
4. “Distilled water” in a squirt bottle
5. Liquid Waste Container, a wide-mouth jar for rinse water and used Calibration Standard
6. “Field Data Sheet for Water Quality Monitoring”
7. “Calibration and Accuracy Checks Sheet”.

The "distilled water" referred to in the instruction is sold in supermarkets as "distilled water", "deionized water", "purified water", or "drinking water”, and these are normally prepared by ion-exchange resins or reverse osmosis. The essential feature is zero conductivity and lack of contaminants.

3.0 Maintenance and Storage

The conductivity pocket meters are low-maintenance devices and can be stored dry. If the electrodes show a visible layer of covering material, clean them with solution as recommended per manufacturer instructions.

4.0 Calibration and Record Keeping

The temperature of the Calibrator Standard during calibration is very important, because conductivity is highly dependent on temperature. Your Calibrator Standard shows the conductivity value your instrument should be adjusted to at a specified temperature, usually 25 C. Even if you have the automatic temperature compensation (ATC) feature, calibrate your meter at 25 C (see instructions below). When you calibrate your instrument, use a copy of the “DQM Calibration and Accuracy Checks Sheet” provided with this SOP or by your technical liaison: this form has placeholders (“fields”) for all the documentation you will need to provide, and is essentially identical to the spreadsheet table in your Excel Project File. The recommended procedure for calibration of the manually-calibrated model involves the following steps:
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Step C1: Enter the date, time, Instrument ID, Calibrator Standard ID, and other relevant information into your “DQM Calibration and Accuracy Checks Sheet”.

Step C2: Pour about 15 ml of the Calibrator Standard into a small (1-oz) plastic cup and heat it in your hands, checking the temperature continuously until it reaches 25 C.

Step C3: Rinse the tip of your conductivity meter with DI and gently shake off the excess DI. Dip the conductivity meter in the warmed Calibrator Standard solution and record the reading value prior to calibration on your “DQM Calibration and Accuracy Checks Sheet”.

Step C4: If the reading is more than 20 microS from the specified (theoretical) Calibrator Standard value (for the Testr3 model), hold the instrument inside the Calibrator Standard solution in its cup without touching the cup itself and turn the calibration screw with a

tiny screwdriver until the reading is the closest you can get to the standard (it will probably fluctuate by 10 microS back and forth – we have to live with that). Caution! Do not turn the screw more than a fraction of a circle at a time, and watch the response. In other words, do not lose the calibration "thingie" that is held by the calibration screw (as sometimes happens when people turn the screw too much, the "thingie" falls off the screw, and gets lost inside the instrument). If you have a newer model with calibration arrow buttons, use those to adjust the reading up or down while the instrument is in the solution, at 25 C, and is not touching the cup itself.

Step C5: If you have made any adjustments, enter "manual cal" in the "Action" field on your "DQM Calibration and Accuracy Checks Sheet", and record the reading after calibration in the appropriate field. If the result showed the theoretical value of your Calibration Standard, and you did not adjust the screw, write "none" in the "Action" field.

Step C6: Rinse the tip of your conductivity meter thoroughly with DI and gently shake off the excess DI.

Note: If your instrument has automatic calibration, make sure that the Calibrator Standard used is the correct one as specified by the manufacturer (and if it is not specified in the manufacturer's instructions, do not use the instrument). As in the case of manual adjustment, always use Calibrator Standard at 25 C (even if the manufacturer's instructions do not tell you to). Keep all records in the relevant fields of the "DQM Calibration and Accuracy Checks Sheet" as instructed above (in steps C1, 2,3) for the manual calibration. In the "action" field, write "none" if you have not adjusted the reading and skip the next field; or "auto cal" if you have used the automatic calibration feature (and be sure to enter the theoretical value of the Calibrator Standard you have used in the appropriate field).

5.0 Conductivity measurements

Step 5.1 Pour some of your water sample into a small clean container. If your meter is not the waterproof model, fill container with enough sample liquid to submerge 1" of the tip (not more).

Step 5.2 Record the Instrument ID which is written on your meter in the appropriate field, in the conductivity row on the "DQM Field Data Sheet for Water Quality Monitoring"

Step 5.3 Remove the conductivity meter protective cap. Turn the meter on, and dip the electrode into sample solution. Do not wet above the cap line! Watch for the flashing range indications and the units on the display panel.

Step 5.4 Stir gently every few seconds, until the readings stabilize. This probe automatically compensates for temperature, so it may take a couple of minutes for the values to stabilize. If you do not have an ATC feature, put a thermometer in the cup together with your conductivity meter and record the temperature in the cup in the Comment field, conductivity row, of your "DQM Field Data Sheet for Water Quality Monitoring".

Step 5.5 Record units on your "DQM Field Data Sheet for Water Quality Monitoring", as micromhos per centimeter (microsiemen) or as millisiemen, depending on the instrument you have used.
Step 5.6 Hold the instrument inside the solution in the cup without touching the cup itself and read the result. Record the Result value (reading) on the "DQM Field Data Sheet for Water Quality Monitoring", making sure the Instrument ID has been entered correctly.
Step 5.7 Turn off meter. Remove meter from sample. Rinse tip with distilled water and cap.
6.0 Monitoring Tips
The meters do not have an automatic OFF function, so care must be taken to turn them off. They require 4 button batteries of 1.5 V. Make sure you get the type that is equivalent to the type you already had in the meter. Under normal use, batteries can function for over 30 field days. It is always a good idea to keep a spare set with the field kit.
If you are using the low-range meter (0 to 1990 microsiemen) in slightly salty waters you may find that the conductivity is outside the range of your meter. You

can still gather data by diluting your sample in distilled water. Use the small, 1 oz cup, to take one full-cup volume of sample into a larger cup, and then to take one full 1-oz cup of distilled water into the same larger cup. Mix and measure the conductivity of the mixture. If it is within range, record the reading and note that it should be multiplied by 2. However if it is still out of range you can keep adding increments of full 1-oz cup of distilled water – keeping track of how many you have added – till your meter can read it within range, and then record the reading and the total number of full 1-oz cups (including the one with sample). When you dilute a sample, always record the result of the actual measured value in the "2nd/rep/dup/dil" cell and always record the dilution factor; thus you will be writing something like "1300uS x 3 dil".
7.0 Accuracy and Precision CCRR (control, check, record, and report)
7.1 Accuracy

Accuracy is the extent of agreement between an observed value (measurement result) and the accepted, or true, value of the parameter being measured. The best way to control accuracy is to calibrate often, and at the prescribed temperature! The temperature of the Standard during accuracy checks and calibration adjustments is very important, because conductivity is highly dependent on temperature. For routine monitoring, when a conductivity meter is used only by one crew, the accuracy checks and calibration adjustments should be done at ambient temperature. However, in situations where many crews are using the same instrument sequentially (typically for mass monitoring events, e.g., snapshot monitoring day), it is recommended to check and calibrate at 25 C every time so all users will have the same reference point for the instrument drift.
7.1.1 First measure of inaccuracy: Drift from the calibrated state:.
How often should you check/calibrate? That would probably depend on the drift of your instrument, i.e., on how fast it moves away from the correct value as represented by your

Standard. When you are not familiar with your instrument, check the calibration status every trip to see if the instrument still reads the Standard correctly, and calibrate again if needed. Follow the instructions in Section 4.0 above when recording your activities on the "DQM Calibration and Accuracy Checks Sheet". Always record the value your instrument reads before calibration to keep careful documentation of the drift; this is your first measure of accuracy.

Once you are more comfortable with your instrument you can pace your accuracy checks at longer time intervals. The recommended frequency of accuracy checks (and calibration adjustments if needed) is different for two distinct Scenarios:

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- Snapshots and other one-time monitoring events – do an accuracy check (and adjust reading if needed) before the event. Then do an accuracy check immediately after the event; record the drift between the two.
- Routine monitoring – if you conduct accuracy checks/calibration every second trip; record the drift that occurred between the calibration at the start of the first trip and the reading of the accuracy check (before calibration adjustment) at the start of the third trip.

7.1.2 Second measure of inaccuracy: Deterioration of the Standard

Many groups use their "Resident" Standard for routine accuracy checks and calibration adjustments. However, Standards do change over time, and it is prudent to perform "Comparison of Standards" wherein the Resident is compared to an External Standard (or the old bottle of Standard is compared to the new one). Any instrument with good resolution can be used for this type of comparison (preferably after it has been checked/calibrated against one of the Standards). Comparisons of "Resident" to External Standards are needed to account for drift in the Resident Standard itself, which is your second measure of accuracy. Comparisons with External Standard can be done at regional Intercalibration Exercise events, otherwise known as "instrument calibration party", particularly when CWT coordinators bring fresh batches of certified Standards. If you are a Technical Leader or a Trainer it is your responsibility to attend, compare your Standard with the External Standard, and make sure you know how far you may be from the true value. The CWT provides a Field Data Sheet for Comparisons of Standards to capture that information.

7.1.3 Drift and Data Quality Indicators for Accuracy

Your Trainer will use your calibration and accuracy checks records to calculate inaccuracy –sometimes called bias – based on the Drift. Note that this drift, i.e., the differential between the reading of the instrument in the Standard and the "true" value of the Standard, has to reflect accuracy checks done before calibration adjustments, and is relevant to the set of Results that were collected prior to that accuracy check. In other words, you essentially adjust the reading in the morning – to make your data as accurate as possible by eliminating the drift – and then you do an accuracy check at the end of day. Assuming that the instrument drifts from the calibrated state in one direction only, the drift you see in the evening reflects the worst case distance that your day's Results

can be from the "true" value. If you attach that distance (i.e., the drift you found in the evening) to the results of that day, the person using your data will know that it could not be further than that.

The same principle applies if you conduct periodic accuracy checks and calibration adjustments (rather than morning calibration adjustment and evening accuracy check). For each monitoring period (say, Trips # 4 to # 6), the reading

in the Standard - as captured at the end of Trip # 6 of that period (and before any adjustment) - is the Drift you report in association with all the Results collected during Trips #4, #5, and # 6 of that period. If you find that your Resident Standard has drifted (as compared to Certified standard) over the time that includes Trips #4 to #6, add the extent of the Standard Drift to the drift from the calibrated state you found for Trips #4, #5, and # 6 of that period.

This data quality indicator, or measure of inaccuracy, can be reported either as the differential (in uS) or as a percent of the Result value. Further guidance for the Trainer on how to use the Data Quality Management tools to report inaccuracy will be provided in DQM-SOP-9.3.2.2(err).

7.2 Precision

The precision of your instrument is a measure of how close repeated measurements, done with the same instrument, are to each other. You can control the precision of your instrument by eliminating sources of error or reducing their effect on the result of the measurements, for example by waiting for the reading to stabilize, avoiding contact between the instrument and the cup when taking the reading, and adhering to consistent measurement conditions in terms of sample volume, temperature, mixing, etc.

To check precision, collect two samples from the creek at the same time and measure their conductivity; these "field duplicates" are a part of your routine Field QA/QC. You can also have two people measure conductivity of the same sample, or otherwise generate sets of "replicate" results that pertain to the same sample. Generate such pairs every third trip, and every time you introduce new monitors to your team, and record the additional measurement results in the "2nd/rep/dup/dil" field on your "DQM Field Data Sheet for Water Quality Monitoring".

You should have several pairs of repeated measurements (replicates or duplicates) for each Project. Once entered into the DQM Project File, your Trainer or Technical leader will use them to calculate and report the precision of your instrument as the Relative Percent Difference (RPD) per DQM-SOP-9.3.2.2(err). RPD is the arithmetic difference between the two Results, multiplied by 100 and divided by their average, and is usually reported as absolute numbers because negative numbers are not indicators of bias in this case. In the rare situation where you obtains triplicates or even more than three repeated measurements of the same sample, calculate the Coefficient of Variation (%CV), which is the standard deviation multiplied by 100 and divided by the mean. Note that RPDs and %CV are not the same, kind of like apples and oranges, and you cannot add them up. Please seek further guidance on these Precision measures.

If the resolution of your instrument is low – as is the case when you use the TDSTestr4 that has increments of 100 microsiemen – you may not be able to see any difference between your repeated readings (especially if you are monitoring waters of low conductivity), because these differences are minute in comparison to the increments available on the instrument. In that case you can report your precision as "better than the resolution of the instrument". This statement emphasizes the need to get the instrument with the resolution and range that are appropriate for your work.

7.3 Blanks

Testing the response of your instrument in distilled or deionized water is a very good practice (if you know that your water is indeed of zero conductivity…). Keep routine checks and record them on the "DQM Calibration and Accuracy Checks Sheet" as separate accuracy check records (i.e., enter "DI" in the Tested Material cell). Note: I have never seen a drift from zero, and I do not know if these instruments can show negative values (RK, 7/8/02). If you trust your DI and your instrument reads something different than zero in it, call your tech support coordinator…

7.4 CCRR Definitions

(This section is common to all Instrument-specific DQM-SOPs) These terms are defined here because they are essential for understanding the instructions. These and many other terms are defined in the Glossary at the end of the generic SOPs for Field Operators (DQM-SOP-9.2.1.1(Field) and DQM-SOP-9.2.1.2(Calib), and in the comprehensive Compendium glossary..

Instrument: a probe, electrode, reagent kit, indicator strip, or any other type of device used for field or laboratory measurements.

Accuracy Check: Comparison of the reading, or output, of a measurement device with a value believed to be the "true" value. The "true" value may be represented by any Standard Material (e.g., known natural reference conditions such as freezing point, Standard Solution, etc). An "Accuracy Check" is different from a Calibration, since it is only a comparison and does not result in an adjustment of the reading of the measurement device.

Calibration (or Calibration Adjustment): Modification of the output of an adjustable-reading instrument, to make it reflect a value that represents the "true value" (as manifested by a given Standard or by a natural value). Note: The EPA's definition for "Calibration" is, essentially, a combination of "accuracy

check (comparison) and adjustment if needed"; it is not specific enough for communication of what you did when you say "I calibrated the instrument".

Standard Material: A catch-all term for Solutions (e.g., Standard Buffer), devices (e.g., Certified thermometer), or natural reference points (e.g., Water saturated with dissolved oxygen at a given temperature), that represent a value believed to be the "true" value.

Standard Solution: A solution containing a known concentration of a substance or has a known property, prepared or purchased for use in the analytical laboratory or in the field. Each bottle of these types of Standards has a unique Standard ID, for example "STB-EC2". Every bottle of Standard with its unique ID can be described in one or more of the following definitions:

- "Resident Standards" – solutions that each monitoring entity or group owns and uses routinely for calibration and/or accuracy checks.
- "External Standards" - solutions used in events such as Intercalibration Exercises, often brought by the QA/QC officer for comparison with the Resident Standards brought by the participating groups;
- "Certified Standards" include any Standard that is traceable to NIST or ASTM. Resident and External Standards can all be Certified Standards as well. A Certified Standard is considered the "ultimate authority" if valid, i.e., if the bottle was (a) used before the expiration date; (b) has been stored tightly capped; and (c) has not been exposed to extreme temperatures or sunlight.

8.0 Sources and Resources

(This section is common to all DQM-SOPs, except for the title and SOP number in the citation) This SOP is an integral part of the Data Quality Management (DQM) System implemented by the Clean Water Team, the Citizen Monitoring Program of the California State Water Resources Control Board.

For an electronic copy, to find many more CWT guidance documents, or to find the contact information for your Regional CWT Coordinator, visit our website at www.swrcb.ca.gov/nps/volunteer.html

If you wish to cite this SOP in other texts you can use "CWT 2004" and reference it as follows:

"Clean Water Team (CWT) 2004. Measurement of Electrical Conductivity Using a Pocket Meter, DQM SOP-3.1.3.1. in: The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment, Version 2.0. Division of Water Quality, California State Water Resources Control Board (SWRCB), Sacramento, CA."

SOP-4.1.1.3 Stream Flow Using Float to Measure Velocity

Adapted from *Streamkeeper's Field Guide* (Murdoch, Cheo, and O'Laughin1996, p. 108) by Abramson M., Padick C., Takata-Schuemen E., and Taylor G. for The Malibu Creek Watershed Stream Team Field Guide.

Stream flow is measured by calculating the volume of water that passes a particular point in a stream within a specified amount of time. To calculate flow you must know two things: how much water a section of stream holds (volume), and how fast that water is moving (velocity). Stream flow can be determined by measuring the velocity of water and the cross sectional area of the stream. The formula to use when calculating stream flow is:

stream flow = velocity x cross sectional area

To measure velocity a float (orange peel) will be used to determine how fast the water is flowing. To calculate the cross sectional area of the stream, a stadia rod will be used to measure water depth at 1-foot intervals across the width of the stream (Figure 5-3).

Procedures for determining stream flow:

Pick a 20-foot long section of the stream that is straight and of uniform width. Water should be flowing evenly within this section without turbulence, obstacles or other disturbances. This section of the stream should be shallow enough for you to safely wade across and conduct the stream flow test.

1. To measure the cross sectional area of a stream, place a stake at the wetted edge on each streambank.

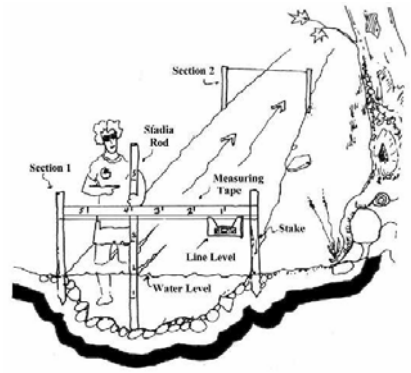
2. Tie a string line to both stakes running across the stream, use the line level in the field kit to insure the string line is level.

3. Attach the loose end of the tape measure to one of the stakes using the spring clamp in the field kit, while one of your teammates holds the other end of the tape measure on the opposite streambank. The tape measure should be placed directly beside the level string line. Note: This location will be the starting line for the stream flow velocity trials.

4. Have one person take the stadia rod to measure the depth of the water at 1-foot intervals across the stream use the tape measure to establish these points. Always stand downstream of the tape line and stadia rod.

5. Continue to measure at 1-foot intervals until you reach the edge of the water on the opposite side of the stream bank. Call out the depth measurements at every 1-foot interval so it can be recorded on the Stream Flow Field Sheet. Please read the section on How to Read the Stadia Rod.

6. Add up the depths on the Stream Flow Field Sheet. This is the cross sectional area for that section of the stream.



Note: Leave the string line attached to the stakes running across the stream. You will use this as a marker for the velocity measurement.

7. Repeat this procedure 20 feet downstream from where the first cross section was measured. This is where the finishing line for your stream flow velocity trials will take place. Compute the cross sectional area for this section and record this on the Stream Flow Field Sheet.

8. Add the two cross sectional area figures together and divide by two to get an average cross sectional area. Record this information on the Stream Flow Field Sheet.

Now you are ready for the velocity float trial part of the stream flow test.

1. Measure the length of the stream where the velocity float trials are to be conducted and record this information on the Stream Flow Field Sheet. This distance should be 20 feet, from starting line to finish line.

2. One team member stands in the stream at the starting line with an orange peel. Another team member stands downstream at the finish line waiting to retrieve the orange peel as it crosses the finish line. A third team member is standing on the bank next to the finish line with a stopwatch and clipboard.

The team member at the starting line drops an orange peel and as it passes the starting line, yells, “go”. The person on the bank starts the stopwatch. When the orange peel passes the finish line the watch is stopped, the orange peel retrieved, and the time recorded on the Stream Flow Field Sheet.

4. Repeat this test five times moving from the left to the right side of the stream along the starting line. Doing this will give you a more representative depiction of stream flow along that section of the stream. Record the results on the Stream Flow Field Sheet each time.

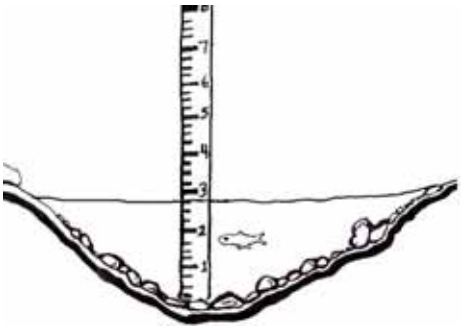
5. Add up the times for each of the velocity float trials and divide by the number of trials (5) to get an average velocity time. Record the results on the Stream Flow Field Sheet.

6. Use the Stream Flow Field Sheet to calculate surface velocity. Divide distance (20 feet) by average velocity time to get average surface velocity in feet per second. Next, multiply this result by the velocity correction factor of 0.8 to get average corrected velocity. The velocity correction factor has been added to adjust for the fact that water velocity at the surface is faster than water velocity closer to the bottom of a stream. Use this factor to get a more accurate stream flow calculation.

7. Finally, calculate stream flow by multiplying average correction velocity by average cross sectional area. Your result will in CFS (cubic feet per second). Record this number on the Stream Flow Field Sheet.

Reading the Stadia Rod

Hold the stadia rod plumb (straight up and down) and on the stream bottom. You are taking measurements at every foot along the horizontal tape measure that is stretched across the stream. The team is measuring at the four-foot mark on the tape measure. The stadia rod touches the top of the stream water at the two-foot mark. Record 2 foot on the Stream Flow Field Sheet in the box directly along side of the 4 foot horizontal box.



Appendix 4. Handouts for Volunteers

RCAA's Humboldt Bay *First Flush Logistics*

Phone Tree Organization- who calls who??

Weather watcher "captain" → volunteer coordinators (Nicole & Morguine)→ Volunteer Team Leaders→ team members

When does the weather watcher activate the phone tree?

- **Yellow Alert**: a system that may come in within 2-4 days
- **Orange Alert**: a system with >40 percent chance of bringing >.5" of rain is forecast within 24 hours. Team Leaders are contacted and asked if they are available and where they can be reached in next 24 hours.
- **Red Alert**: >.5" of rain within 24 hours! Teams are mobilized! Team Leaders are called and will contact team members with next steps.

When to Mobilize?

- Red Alert has been received
- Surface is thoroughly wet, visible water ponding/flowing (rural) or moving from road to gutter (urban)

When arriving at Station:

SAFETY FIRST SAFETY FIRST SAFETY FIRST. Please do not wade. Do not go alone. Don't endanger yourself.

1. Record the time of first set of measurements on the Data Sheet
2. Read staff gauge and record on the Data Sheet
3. Observe water clarity; record categories **clear water**, **cloudy water** (>4" visibility), **murky** (<4" visibility). *Looking at center of water column*
4. Measure conductivity periodically and record on the Data Sheet

When to collect the first set of data?

- Immediately if your station is on a dry drainage and there is flow.

- In creeks that have base flow – when you see
  (1) a significant drop in conductivity
  (2) visible increase in murkiness, and/or
  (3) visible rise in water level (stage).
  Use your best judgment; you may not see all three changes happen.

How many samples should be collected?

Three sets, at 30 minute intervals. If you received extra bottles for Field Duplicates, use them during the second or third set. Duplicates get the same Sample ID plus the letters "**dup**". If you received extra bottles for Field Blanks, label them with the letters "**FB**".

What data is collected?

- Conductivity
- Temperature
- pH
- Flow (water velocity)
- Lab Samples
  - oil and grease (two bottles)
  - total and fecal coliform
  - total suspended solids and nitrates
  - metals (Cadmium and chromium)
  - phosphates

How to collect each set of lab samples?

1) Using waterproof sharpie, label all three sample containers with Sample ID (Station ID plus sequential number to indicate set 1, 2, or 3), date, and sampling time on each
2) Dip container into creek water using methods described at the HBFF training and seal tightly
3) Log information into the Data Sheet.
4) Put samples in the cooler on ice.

Where to deliver the samples?

When all samples have been collected, bring the samples and all borrowed equipment to your local Hub (location TBA). The Hubster will take a moment to go over your data sheet and samples with you before you go home to take a hot shower.

HUMBOLDT BAY FIRST FLUSH
SAFETY GUIDELINES

Safety should always be the first and most important concern for volunteer monitors. Coordinators should always make sure that volunteers have all of the necessary safety equipment. Training will be conducted by Redwood Community Action Agency and the following simple rules shared with all volunteers before they go into the field:

- Always be aware of your surroundings. Never risk your own personal safety.
- Never monitor alone
- Wear appropriate clothing and shoes for work in the environment.
- Protect yourself from exposure to the elements, poison oak, polluted water, etc.
- Be aware of wildlife, snakes and insects such as ticks, hornets, and wasps.
- Do not enter streams if water is above knee height and moving swiftly.
- Do not walk on unstable stream banks
- Take care not to disturb streamside vegetation.
- Equip your team with the necessary sampling equipment,
    - Sample containers
    - Monitoring equipment
    - Bucket and rope or pole and beaker for sampling from bridge if stream or river is too large to enter,
    - Sufficient gloves,
    - De-ionized water, etc.
- If asked to leave a monitoring site, do so without question.

RCAA First Flush Laboratory Samples

Laboratory analysis will include nitrate (as nitrogen), orthophosphate (as phosphorus), total coliform, fecal coliform, metals, total suspended solids, and turbidity, and oil and grease. Samples that will be collected for analysis in a laboratory will be collected in containers provided by the laboratory.

SAMPLE COLLECTION METHODS (adapted from EPA Volunteer Estuary Monitoring 2nd Ed. And Revital Katznelson's composite collection method):

1) Label sample containers with the date, time, name of sampler, waterbody, and sample ID. Make sure you write the sample location, sample ID, sampler's name, date and time on the bottle **before** it gets wet.
2) Wear clean latex or rubber gloves.
3) Do not rinse collection bottles before filling them, some of them have been sterilized.
4) Unscrew the bottle caps immediately prior to sampling. Avoid touching the inside of the bottle, its lip or the cap (especially important for Coliform samples).
5) Rinse the 5 gallon bucket three times and then collect the sample holding the mouth f the bucket in the same direction as the current is flowing. This will avoid getting too much "unrepresentative" debris. Take care to not disturb bottom sediment!
6) Rinse the plastic sampling container three times as well and then hold near its base and plunge it (opening downward) below the water surface in the bucket.
7) Pour water samples from plastic sampling cup into all sample bottles incrementally (in thirds). In this way all of the samples essentially have the same water inside.
8) Recap the bottles carefully, remembering not to touch the inside of the bottle or its lip.
9) Fill in the data sheet with appropriate sample ID and sample time.
10) Place samples in cooler for transport to First Flush hub.

All samples will be stored and transported in an insulated cooler with cold packs or ice. Loose ice is not recommended because the samples will end up submerged in water if the ice has time to melt. If using ice, put it in sealed zip-lock bags for transportation in the cooler. Other important things to remember are:

- Keep coolers out of direct sunlight or a warm vehicle
- Protect against jolts or any disruption of the sample containers
- Ensure the sample container lids are secured tightly
- If available, place the sample containers in zip-lock bags to prevent submersion in water and also to protect the sample labels from smearing.
- Use sealed, frozen cold packs instead of ice when available.

Laboratory Sample Quality Assurance

- 5% duplicates for laboratory samples will be collected for laboratory analysis. All teams will not have to take Duplicates.

  - A **duplicate** is a second container filled at the same time in the same location.
- 1 field blank will be collected for each lab conducting bacteria analysis. All teams will not have to take a field blank.
  - A **field blank** is a sample container filled with distilled water while in the field.
- Hubsters will ensure that the coolers containing the lab samples are kept at or below 6°C. This will be checked using a temperature blank in each sample cooler. A **temperature blank** is a container of distilled water that will remain in the sample cooler. It will be used to record the temperature of the samples when they are turned in to the CMC. **Do not directly measure the temperature of the samples for the laboratory. It may contaminate the sample.**
- Hubsters will ensure samples are delivered to labs within the appropriate holding times for each parameter as detailed in RCAA's First Flush Quality Assurance Project Plan.

All samples will be immediately placed in a cooler until delivered to the lab. Acceptable sample holding times are documented in the Quality Assurance Project Plan for this event.