Snohomish County Surface Water Management
Resource Monitoring Group

Standard Operating Procedures for the Collection, Processing, and Analysis of Stream Water Quality Samples

Samples Version 1.0

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Please note that Snohomish County Surface Water Management's (SWM) Standard Operating Procedures (SOPs) are adapted from Washington State Department of Ecology Standard Operating Procedure EAP 034 version 1.5, other published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Snohomish County use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by Snohomish County.

Although SWM follows the SOP in most cases, there may be instances in which the County uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)

Resource Monitoring Group

Standard Operating Procedure for the Collection and Processing of Stream Water Quality Samples

Introduction

Collection and processing of stream water quality samples supports Snohomish County Public Works Surface Water Management's (SWM) mission to protect and enhance water quality and aquatic habitat for future generations. The Resource Monitoring (RM) group holds primary responsibility for this work and uses the data to describe watershed health and inform efforts to protect human health and aquatic life.

1.0 Purpose and Scope

1 This Standard Operating Procedure (SOP) details a method used by RM group to collect and process water quality measurements and samples from streams and rivers. It may also contain methods that other entities would find useful for their monitoring work.

1.1 The scope of this SOP applies to general stream monitoring procedures used for run preparation, measurement and sample collection, processing, preservation, and shipment. The document generally describes quality assurance and quality control procedures.

1.2 The standard set of samples and field measurements collected, measured, or processed include: temperature, pH, conductivity, dissolved oxygen, turbidity, total suspended solids, fecal coliform bacteria, e.coli, ammonia, nitrate plus nitrite-nitrogen, total nitrogen (derived by combining NO_3 + NO_2 concentrations), total phosphorus, dissolved copper and zinc.

2.0 Applicability

This SOP is intended for any SWM program involving the collection, processing and analysis of water quality samples for core (water quality index) parameters from streams.

3.0 Definitions

3.1 Accuracy – The degree to which a measured value agrees with the true value of the measured property.

3.2 Bias – The difference between the population mean and the true value. Bias usually describes a systematic difference reproducible over time, and is characteristic of both the measurement system and the parameter being measured.

3.3 Conductivity –A measure of the ability of water to carry an electrical current. It is dependent upon the concentrations and types of dissolved ions and the water temperature. In general, a greater concentration of ions in the water will lead to a larger conductivity value.

3.4 Dissolved Oxygen (DO) – The concentration of dissolved oxygen (mg/L) in a water sample.

3.5 Fecal coliform – A group of bacteria that inhabit the intestinal tract of warm-blooded animals and remain viable in freshwater for a variable period of time. The presence of fecal coliform bacteria in water indicates fecal contamination of the water by a warm-blooded animal; harmful bacteria and viruses associated with fecal contamination may also be present.

3.6 E.coli – Escherichia coli, also known as E.coli is a gram negative facultative anaerobic, rod shaped, coliform bacterium commonly found in the lower intestine of warm-blooded animals.

3.7 Field Forms –Weather resistant hardcopy and/or digital field forms(iPADs®) are used to document any and all field activities, sample data, methods and observations for each and all sample sites.

3.8 Field Blank – Samples of ultra-clean de-ionized water provided by the lab and used to determine whether lab or field samples have been cross contaminated through sample collection, storage or transport.

3.9 Field Duplicate - Samples representative of the same water as the original sample, obtained at the same time and place. Generally obtained for 10% of collected samples to determine whether data quality objectives of bias, precision, accuracy and ultimately relative standard deviations are met.

3.10 MQO's – Measurement Quality Objectives are qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision error used as the basis for establishing the quality of data used to support decision making.

3.11 MSDS – Material Safety Data Sheets provides both workers and emergency personnel with the proper procedures for handling or working with a particular substance. MSDS's include information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, and first response.

3.12

3.13 NTU – Nephelometric Turbidity Units (units for reporting turbidity in freshwater)

3.14 Precision – The extent of random variability among replicate measurements of the same property.

3.15 pH – A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The pH scale ranges from 0 to 14.

3.16 Relative Standard Deviation/Percent Difference – A measure of precision through comparing the difference between two sample results and expressed as a percentage.

3.17 Run – Scheduled sampling event.

3.18 SWM Lab – Surface Water Management Lab and location of field equipment storage, calibration and sample processing.

3.19 Total Suspended Solids - Dry weight of suspended particles that are not dissolved in water.

3.20 Trip Blank – Samples of ultra-clean de-ionized water provided by the lab and used to identify contaminant carry over from the time samples are handled through field efforts.

3.21 Turbidity – The measure of relative clarity of liquid expressed as the amount of light that is scattered by material in a sample or Nephelometric Turbidity Units.

3.22 µmhos – micro mhos (mho = 1/ohm = 1 Siemen) per centimeter

3.21 Water Quality Index – A tool to summarize and report on water quality conditions. It's a unitless number ranging from 1 to 100; a higher number indicative to better water quality.

4.0 Personnel Qualifications/Responsibilities

4.1 Field operations require training specified by job title in SWM's Safety Training database.

4.2 This SOP pertains to all Natural Resource Scientists, Environmental Specialists, Interns and Environmental Technicians in the RM group or other staff using this SOP.

4.3 All field staff must have read the instrument manual, this SOP, completed field training and be familiar with procedures for data collection.

4.4 All field staff must be familiar with the electronic data recording tablet.

4.5 The field lead directing sample collection must be knowledgeable of all aspects of the project's Quality Assurance Monitoring Plan (QAMP) to ensure that credible and useable data are collected. All field staff should be briefed by the field lead or project manager about the sampling goals and objectives prior to arriving at the site.

5.0 Equipment, Reagents, and Supplies

5.0.1 iPad w/ car charger
5.0.2 Phone/camera
5.0.3 Vehicle Gas Card and Personal PIN number
5.0.4 Quality Assurance Management Plan
5.0.5 Any rights of entry
5.0.6 Bridge sampler (as necessary)
5.0.7 Extension pole with bottle clamp
5.0.8 Field Forms/Pencil/Pen
5.0.9 Chain of custody
5.1.0 Instrument Calibration Log Form
5.1.1 Sample Run Checklist
5.1.2 Sample coolers w/ bags of ice
5.1.3 Sample bottles/w labels
5.1.4 Bagged Ice
5.1.5 Gel-Ice (Blue Ice) as necessary
5.1.6 Deionized water for field/trip blanks
5.1.7 Calibration standards
5.1.8 Hach 2100P Turbidimeter
5.1.9 Hach/Hydromet – Hydrolab MS5 and/or HL4
5.2.0 Hardness – 250m wide mouth poly bottle preserved with HNO3 to pH<2 3
5.2.1 Total Phosphorus – 250 ml poly bottle preserved with H_2SO4 to pH<2
5.2.2 Nitrate-Nitrite – N – 250 ml poly bottle preserved with H_2SO4 to pH<2
5.2.3 Total Suspended Solids – 500ml poly bottle
5.2.4 Fecal coliform / E.coli bacteria – 250m sterile poly bottle with EDTA/Sodium Thiosulfate

5.2.5 Deionized water (DI water) used to rinse sampling bottles and equipment.

5.2.6 Tap water

5.2.7 1L sample bottle for turbidity sampling

5.2.8 500mL Teflon FEP bottles pre-filled with de-ionized water by the lab

5.2.9 125 mL narrow mouth poly bottle containing H2S04 preservative for hardness sample disposable 0.45 micron cellulose acetate filter unit (pre-cleaned)

5.3.0 Spare sample bottles/labels

5.3.1 Nitrile disposable gloves

5.3.2 Eyewash Stations

5.3.3 First aid kit

5.3.4 Personal protective equipment (boots, gloves, hardhat, eye/ear protection, traffic control devices)

6.0 Summary of Procedures

6.1 Pre Project/Sample Planning: Work with project managers/leads to determine the location of proposed and/or confirmed sampling locations. In some cases permission to access private property is needed and requires attention to landowner requests prior to sampling. Reconnaissance of sample sites prior to obtaining samples may be necessary to identify logistical, access or safety related issues.

6.2 Run Preparation. This should begin several days in advance of a run and requires requests for sample bottles from the contract lab and notifications of sample pick up. It may also require coordination with landowners where access to private property is necessary and has been granted.

6.3 Staff should always prepare for a run using the equipment checklist to ensure that all sampling equipment, supplies, sample containers, and personal protective equipment are available and loaded to the vehicle.

6.4 Daily Pre-Departure Procedures

6.4.1 Turn on the cell phone. Enable "Location Services" for safety purposes when sampling alone.

6.4.2 Review equipment checklist and gather any equipment/materials necessary.

6.4.3 Pre-labeling bottles and chain of custody: To the extent possible, it may expedite field sampling if sample bottle labels and the chain of custody can be partially filled out prior to field work.

6.4.4 It may be helpful to use ArcGIS and mapping software to ensure you understand the best place to park at each sample location.

6.4.5 Obtain any right of entry paperwork necessary.

6.4.6 Check out on the white board and hardcopy check in/out sheet to ensure a supervisor, management team member or project manager knows where you are going and when you expect to return. *Note Cell phones need to be kept on during work hours to allow the lab courier or other staff to get shipment information or to discuss other program related needs.*

6.4.7 Refill the de-ionized water containers.

6.4.8 Put several scoops of ice into bags, load each sample cooler needed and load the coolers into the vehicle.

6.4.9 Calibrate the Hydrolab® instrument being used in accordance with Standard Operating Procedure SWM_RM_001.

7.0 Field Measurement Procedures

7.0.1 Field measurements are obtained using properly set up and calibrated Hydrolab® Surveyor 4 and Hach 2100P Turbidimeters.

7.0.2 Set up a manually triggered file in the Surveyor 4 to gather field measurements using the Hydrolab® during the sample run.

7.0.3 Ensure the Surveyor 4's internal battery is fully charged.

7.0.4 Upon arrival to the sample location, power the Surveyor 4 on, unscrew the calibration cup and affix the weighted sensor guard over the sensors.

7.0.5 Put on Nitrile gloves

7.0.6 Submerge all sensors to mid-depth (where feasible) and point into flow. Do not allow sensors to contact the stream bottom. It is preferable to place the instrument downstream of where collection of water for lab analysis will occur.

7.0.7 If flow is not deep enough for sensor submersion, triple rinse the calibration cup, collect a stream sample in it and submerge sensors.

7.0.8 If ice or high water make it difficult to obtain measurements from shore, using the sample pole, drape the Hydrolab® and cable over the end and extend the pole and instrument out over and into the water.

7.0.9 Wait for temperature to stabilize such that it doesn't vary more than 0.1 Deg C. Collection of water samples for lab analysis may occur while temperature is stabilizing.

7.1.0 If collecting field measurement duplicates, leave the instrument in-stream, collect samples for lab analysis, return to the Hydrolab® and record duplicate field measurements.

7.1.1 Manually trigger the Surveyor 4 to capture measurements.

7.1.2 Remove the instrument from the water.

7.1.3 Review field measurements stored in the Surveyor 4 and record on hardcopy and/or in digital field sheets.

7.1.4 Rinse sensors with de-ionized water between sample stations.

7.1.5 Samples for **turbidity measurements** are gathered and analyzed in accordance to procedures identified in the Hach 2100P user's manual. A summary is included below..\..\..\..\..\Wq\Equipment\Hach_Turbidimeters\2100P_users_manual.pdf

7.1.6 Using an unpreserved 1L Nalgene sample bottle, plunge neck down through the water to fill and pour out downstream. Repeat this three times to “triple rinse” the bottle. Obtain a 1L sample on the fourth plunge.

7.1.7 Thoroughly mix the 1L sample by shaking for 30 seconds

7.1.8 Triple rinse a clean (non-scratched) 25ml glass turbidity vial with the 1L sample.

7.1.9 Fill the vial with the fourth pour and cap.

7.2.0 Place the turbidimeter on a level, stationary surface.

7.2.1 Wipe the vial with a lint-free cloth. (Apply silicon oil to vial and wipe as necessary)

7.2.2 Turn the turbidimeter on and orient the sample vial such that the diamond is aligned with the raised mark on the instrument.

7.2.3 Select the signal averaging mode on the turbidimeter.

7.2.4 Press read and record the value on the hardcopy and/or digital field sheet.

7.2.5 If called for, measure the stream stage height and record result on the hardcopy and/or digital field form.

7.3 Field Sampling Procedures

7.3.1 Extension Pole Method. This method is typically used to reach a more representative undisturbed sample location from the stream bank or to sample a shallow stream from a bridge.

7.3.2 Put on Nitrile gloves and complete fields on sample bottle label.

7.3.3 Carry all equipment to a well-mixed location, such as the deepest part of the active channel or other location where a representative sample may be collected. Do not contaminate the sample location by wading upstream of it.

7.3.4 As described in section 7, submerge the Hydrolab® sensors and wait allow temperature to stabilize such that it doesn’t vary more than 0.1 Deg C.

7.3.5 If called for, measure the stage height and record the measurement in the hardcopy and/or digital field form.

7.3.6 Ensure all information is filled out on bottle labels, including time of sampling.

7.3.6 Secure a sample bottle to the extension pole clamp, remove the cap and place where cross contamination will not occur. If obtaining field duplicates, secure a second sample bottle on the pole next to the first.

7.3.7 Extend the pole to the desired sample location, invert the bottle and in one quick motion, plunge the mouth of the bottle into the water, and tip the mouth toward the water surface moving in a downstream to upstream motion.

7.3.8 Wait until the bottle(s) have filled, (but not overfilled), remove the bottle(s), cap it and remove from the clamp. Place into receptacle for transport to the vehicle.

7.3.9 Repeat this bottle filling process for the remaining samples. Return to the vehicle and place samples on ice.

7.4.0 Hand Dip Method. This method is typically used to collect samples from a small or shallow stream.

7.4.1 Put on Nitrile gloves and complete fields on sample bottle label.

7.4.2 Carry all equipment to a well-mixed location, such as the deepest part of the active channel or other location where a representative sample may be collected. Do not contaminate the sample location by wading upstream of it.

7.4.3 As described in section 7, submerge the Hydrolab® sensors and wait allow temperature to stabilize such that it doesn't vary more than 0.1 Deg C.

7.4.4 If called for, measure the stage height and record the measurement in the hardcopy and/or digital field form.

7.4.5 Grab the base of the sample bottle with one hand, invert the sample bottle, remove the cap, and reaching upstream – plunge the bottle into the water and tip the mouth toward the water surface moving in a downstream to upstream motion.

7.4.6 Wait until the bottle has filled, (but not overfilled), remove the bottle, cap it and place into receptacle for transport to the vehicle.

7.4.7 Repeat this bottle filling process for the remaining samples – including field duplicates. Return to the vehicle and place sample set in the one-gallon freezer bag, partly seal, and store on ice.

7.5 Field Blank Collection

7.5.1 Transport a laboratory supplied container of ultra-clean de-ionized water to the field.

7.5.2 At a predetermined sample location, transfer the ultra-clean de-ionized water from the lab supplied container into a field sample bottle for the parameter(s) of interest.

7.5.3 Label the field blank sample container as determined by the project manager or quality assurance project plan and preserve the sample on ice.

7.5.4 Ensure the field blank is identified on the chain of custody for submittal to the lab.

7.6 Field Duplicate Collection

7.6.1 As dictated by the project QAPP and field sample QC schedule, field duplicate samples are collected simultaneously with the primary sample and treated in the same manner as the primary during all phases of collection, handling and analysis.

7.6.2 Repeat steps 7.0 – 7.47 for collection of field duplicates.

7.7 Trip Blank Collection

7.7.1 Trip blank samples are collected/processed using ultra-clean de-ionized water as supplied by the contract lab.

7.7.2 As dictated by the project QAPP and field sample QC schedule, fill necessary sample bottles with ultra-clean de-ionized water while at the predetermined QC sample location.

7.7.3 Samples are treated in the same manner as the primary during all phases of handling, transport and analysis.

8.0 Records Management

8.1 Records created are inclusive of history of programmatic changes/issues/resolution, equipment maintenance, calibration records, field forms, chains of custody, electronic data/observations, and hardcopy reports.

8.2 Samples are documented and tracked using chain of custody forms and resulting electronic field data and lab results.

8.3 The field lead is responsible for ensuring hardcopy and/or electronic field forms are complete and reviewed for correctness and completeness.

8.4 Data are verified for usability and populated into SWM's database.

8.5 Hardcopy records are archived every 5 years and stored in perpetuity.

9.0 Safety

9.1 Persons involved with collection of samples could be subjected to unsafe environments. Hazards include, but are not limited to roadside traffic, slips, trips, falls, drowning, heat and cold stress, exposure to chemicals and biological pathogens.

9.2 Staff are provided appropriate PPE to minimize hazards. Teams of two especially for sites where samples are gathered on larger streams/rivers during moderate to high flow events.

9.3 Washington State Department of Labor and Industries requires the employers provide a safe work environment through communicating hazards and providing adequate training.

9.4 Required safety training, inclusive of General Field Safety, Chemical Hygiene, Hazwoper, Roadway Safety and Swiftwater awareness have been identified by position.

10.0 References

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