



FIELD PROCEDURES – TABLE OF CONTENTS

(See "Data Sheets" section for sample data sheets.)

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SAFETY

This is Chapter 1 because it's Job 1. **Keep the following points in mind:**

- ***Safety is a group effort:*** We recommend that you don't go out alone (depending on circumstances) and make sure somebody knows where you're going and when you expect to be back. Emphasize safety with your entire group, and watch out for each other.
- ***Precautionary principle:*** If you are in doubt as to your ability to safely collect a sample, don't do it! Be aware of your physical limitations and those of the rest of your team, and the difficulty of collecting samples at certain locations under certain conditions.
- ***County Incident Reports*** (attached): Turn one in anytime there's an accident or near-miss.
- ***Cell phones:*** We can provide you with an emergency 911-cell phone on request, but they are not always reliable out in the woods.
 - If you have a cell phone, give your number to SK staff.
 - Before each outing, make sure your cell phone is fully charged and that you've updated your roaming capability (see your manual).
 - Exchange cell phone numbers with your fellow team members and re-confirm them each time you go out. Keep your cell phone on during the entire outing.
 - Upon reaching the site, determine the nearest location cell phone service can be accessed before beginning work. (If not at the site itself, try the top of the bank or ridge, a nearby clearing, or the place where you parked.) Record this information for the SK staff, who will enter it into the site-description information. Check this each time you go out.
 - Team leaders should predetermine emergency services cell phone GPS capability for the site where the team will be located; site descriptions in your forms folders will include latitude, longitude, and horizontal datum—the essentials required by emergency services.
 - Walkie Talkies are also available for cases where volunteers separate from one another.
- ***Orientation:*** If you don't know the area, take a good map with you.
- ***Traffic:*** Be careful when pulling off the road and leaving your car. If you are working near a road, wear orange vests (which we can supply) or other bright clothing.
- ***Medical conditions:*** Let your staff and team know if you have any special medical conditions, such as heart problems, diabetes, asthma, or extreme allergies. If your emergency contact number is other than your home phone, let your teammates know. **BRING ANY NEEDED MEDICATIONS WITH YOU INTO THE FIELD, AND LET THE REST OF YOUR TEAM KNOW WHERE YOU KEEP THEM.**
- ***Warm-up:*** Stretch before stream walking, especially quadriceps, calves and hamstrings. If you're limber, you'll find it easier to move when faced with sudden loss of footing.
- ***Awareness:*** Keep your eyes moving, scanning the stream in front of you when walking and looking around you when monitoring. (Note that jacket hoods block peripheral vision and ball-cap bills block hazards overhead.) Be conscious of your body placement as you rest or write—you want to be able to see around. Make a habit of looking for tracks.
- ***Walking:*** Boots with felt bottoms or corkers are the safest, though felt bottoms cause other problems—see Anti-Contamination Protocol. Many boots do not offer much support, so if you have weak ankles, wrap them for stability. Walking sticks have numerous uses: third leg, water depth/substrate tester, brush whacker, and weapon. Polarized glasses will help you see the creek bottom.
- ***Carrying equipment:*** The equipment bags are bulky and heavy; if your access trail is long or arduous, you may want to repack stuff into frame backpacks (available at the office).
- ***Fatigue:*** Note your energy level and those of your teammates. Know when to quit.



- **High flows:** In higher flow situations plan your stream crossings at an angle, allowing the water to “carry” you to your destination. But don’t go in at all if the water’s too high and/or deep: The “rule of 10” states that you shouldn’t go into water where velocity (ft/sec) X depth (ft) ≥ 10 . If you can’t wade across, you can do many of the field procedures from the bank.
- **Log Jams:** All log jams, no matter how small, have the potential to cause injury—avoid them if possible. If you have to walk on them, choose the most stable and safe parts. Beware of bare logs or alders, which are slippery and may be rotten. Make sure your footing is on a stable log before resting all your weight on it. Attempt to have an escape plan if a particular log shifts. Avoid pulling yourself up via attached branches.
- **Bad water:** Our creeks are not all pristine, and even those that seem so might surprise you! Avoid hand-mouth contact; use gloves and hand-sanitizer provided in your kit.
- **Hazardous materials:** Watch out for broken glass, needles, feces, etc.
- **Materials Safety Data Sheets (MSDS’s):** In our ordinary monitoring procedures, the most dangerous chemical we use is alcohol for bug sampling, but we do use some other chemicals for equipment maintenance and calibration, as well as some special sampling procedures. MSDS copies are kept in the office and, when appropriate, the relevant field kit. Your County intake training will describe the County’s hazardous-materials handling procedures, and you can access Streamkeepers’ MSDS’s online at the [County MSDS site](#). To search:
 - In the “Locations” dropdown, choose “Roads Streamkeepers”.
 - Select the “Search” button.
 - Narrow results in the left-hand column by Manufacturer (e.g., Hach).
 - You will get a list of products by that Manufacturer.
 - For a given product, choose the PDF icon, and you’ll get the MSDS.
 - MSDS sections that might be particularly relevant include:
 - First Aid
 - Accidental Release Measures
 - Exposure Controls/Protective Equipment
 - You can then print, save, or send this MSDS.
- **Brush:** Some parts of the stream may be very brushy or worse. Help each other to avoid getting tangled or pricked, and work around what you have to. We have pruners and loppers in the field kits. Also beware of some of the more dangerous plants, such as poison hemlock and giant hogweed—you’ll learn about these during Noxious Weed training.
- **Protective gear:** Be prepared for rain, wind, and cold. For cold, bring a thermos or a St. Bernard, plus extra layers of clothing, rain gear, and a warm hat. For heat, bring a hat, sunblock, and plenty to drink. For brush and biting insects, long pants/sleeves and rubber garden gloves are good. We stock various kinds of gloves in the field kits, and we also have some sturdy long-sleeved gloves available for borrowing, or bring your own.
- **Rain:** If it begins to rain heavily, thunder, lightning, or hail, get out of the stream and into your car. If it seems to be a passing storm, try waiting it out and then returning to the stream. Note on your field form the time you left and returned, and about how much rain fell. Keep an eye on water levels if it has been raining anywhere in the watershed.
- **Dogs:** Use your best judgment if a menacing dog comes your way. Running is not the best reaction. Talk to the dog calmly and call for the owner.
- **Mushrooms:** Yes, mushrooms—stay away from these! Some of them can even poison a person through the skin!

Seasonal Safety Issues

Monitoring in Wet & Cold Weather Conditions

1. **FREEZING TEMPERATURES AND YOU:** Cold, wet conditions call for extra precaution against hypothermia; keep an eye on your teammates, particularly if it's wet. (And even if it's not raining, the vegetation will probably be wet enough to merit chest waders if you have them.) If you see someone with purple lips slurring their words, warm them up or send them home. Don't hesitate to use the space blanket in the first aid kit. The multimeter should not be stored or used below 0°C (32°F), so if it's that cold, postpone till a warmer day.
2. **WAYS TO MAKE MONITORING EASIER:**
 - a. **GLOVES:** The big orange gloves (in the plastic tub) are the best way to keep your hands warm if you have to hold an electronic probe underwater for a while. Short of those, the other gloves in the kit will also help somewhat.
 - b. **DRY WORK AREA:** We have big beach umbrellas available, along with rebar anchors, if you want a dry space for people and/or equipment. And we have extra tarps we can loan out.
 - c. **WATER CHEMISTRY IN THE CAR:** The next-to-last page of the Water Chemistry protocol has a box entitled "Minimizing Exposure in Poor Conditions". Use them!
3. **FLOOD CHANGES:** Due to flooding, many of your sites might have changed quite a bit or become hard to access. It would be a good idea to scout your sites beforehand, to make sure there aren't "issues" to be resolved. You might want to bring a hand saw, axe, etc. If the site has changed drastically and you have a detailed reach map of it, you might want to draw a new one. See the "Site Sketch Map" or "Reach Map" chapters for details.

Summer Safety

Remember the hazards of summer: heat stress, dehydration, sunburn, and stinging/biting insects.

Stinging Insects:

You may not feel the sting or bite when it happens, but you may soon notice swelling, redness, itching, or pain. Some people have to worry about much more than that, though. If you're allergic to bites or stings, they could cause hives, dizziness, stomach cramps, or nausea. In rare cases, people feel weak or have trouble breathing or swallowing. In the worst instances, that can lead to unconsciousness, and even anaphylactic shock or death.

- Bees may nest along stream banks, in the ground, and in hives in the trees. Watch for nests or "sentinel" bees. If you see bees, avoid them and notify your teammates. Our First Aid kits include "sting-ease" sticks which alleviate both stings and nettles. You might also wish to carry the antihistamine diphenhydramine (Benadryl) in liquid or dissolving strip form, to help alleviate a severe allergic reaction, and consider asking your physician for a prescription for Epi-pens that you can bring into the backcountry with you, to treat yourself or anyone else who might have an anaphylactic reaction to a bee-sting. Though rare, this is a potentially fatal event.
- When some biting insects sting, they release a pheromone that alerts others in the nest to come and help defend the nest - hence the sudden appearance of many angry insects when a moment ago there were none.
- When you run afoul of a bee/wasp, cover your face with your hands and move swiftly away. No running and no flailing - although an instinctive response, these actions may aggravate matters.
- Bright colors, floral patterns, and fragrances may indicate to them that you are food.



Spiders, Ticks and Mosquitoes:

There are insects like black flies and tiny red chiggers whose bites cause serious itching. They rarely lead to worse problems, however.

Spider bites are generally harmless, with a few exceptions, such as the bite of the black widow spider. This poisonous spider's body measures ¼- ½" long and is glossy black with a red hourglass mark on the stomach. It lives in woodpiles, sheds, and basements. The bite itself may not hurt but could cause bad stomach pain and cramps, difficulty breathing, and possibly nausea, sweating, twitching, shaking, and tingling in the hand. See a doctor immediately for black widow spider bites.

Also be alert for **brown recluse spiders**. They're smaller than black widows and have a white pattern that looks like a violin on their backs. Their bites can be painful and cause some of the same reactions as black widows, but they're not as dangerous.

Tick bites are a particular concern. Ticks are tiny bugs that live in tall grass or shrubs and often ride on deer, dogs, mice, or people. Some ticks carry serious illnesses such as Rocky Mountain spotted fever and Lyme disease, and while as of 2018 there have been no confirmed cases of Lyme disease from a tick bite in Clallam County, ticks in the county have tested positive for the bacteria that causes Lyme disease. You need to be aware of symptoms and treat illnesses early.

- Check yourself and your clothing for ticks when you finish an outdoor job. If one of these tiny insects is on your skin, remove it quickly. Grab the tick with fine-tipped tweezers, getting as close to the skin as possible. Then pull it straight up with steady even pressure so you get all its body parts. If you can't remove the tick yourself, get medical help to do so. Once it is out, wash the area gently with water and apply rubbing alcohol.
- See a doctor immediately if you develop a large red spot from the bite or if you develop swelling, fever, joint pain, or flu-like symptoms within a few weeks. Physicians can treat tick-borne diseases with antibiotics. However, fast treatment is essential for maximum effectiveness.

Mosquitoes can carry a number of dangerous and deadly diseases, including malaria, dengue and yellow fevers, several variations of encephalitis, and West Nile virus.

Good general summer precautions:

- Drink plenty of water.
- Protect yourself from the sun.
- Wear light-colored snug clothes that cover your body.
- Use insect repellent on skin and clothes. Follow label warnings.
- Don't use perfumes or colognes.
- Be aware of what's around you.

First Aid/CPR: There is a First Aid kit in each field kit with a variety of supplies and a First Aid booklet; see the list following this section. We urge you to get as much medical training as you can. You will receive some First Aid/CPR training as part of your County orientation, but other organizations, such as Fire Departments and Red Cross, also offer these courses on a regular basis. We stock a CPR mask in our first aid kits, but it's not a top-quality one such as a Laerdal; you may want to purchase one of these. (Note that as of November 2005, the American Heart Association advises that if you don't feel comfortable doing CPR with rescue breaths, chest compressions alone can be effective.) Wilderness First Aid books may be borrowed from the office.

Streamkeepers First Aid Items

Note: always ask for permission to treat first. If patient is not responsive, consent is implied if you are acting with good intentions and within your level of training, particularly if you are acting to prevent the patient's death before medical help arrives.

Items in Streamkeepers First Aid Kits

Item	Quantity	Comments
CPR Microshield	1	Offers protection when giving rescue breaths
Emergency blanket	1	For hypothermia, but can also be used as a tarp or to scare away animals
LED Light (reg. kits)	1	
Sting relief tube (reg. kits)	1	May give some relief from stinging nettles as well as insect bites
Cake icing tube w/instructions	1-4.25 oz	For hypoglycemic (low blood sugar) episodes; take 1 Tbsp., wait 15 min., repeat as often as needed
Cold Pack	1	
Gloves – large	At least 2 pair	To maintain a barrier vs. blood-borne pathogens
Gloves – medium	At least 2 pair	
Triangular Bandage	1	For making slings or other wraps
Adhesive Tape	1 roll	
Stretch Bandage	1 roll	
Ace Bandage	1	
Moleskin/Molefoam	1 pad	
Abdominal Pad (5in x 9in)	1	For direct application to profusely bleeding wounds; place additional pads on top of one another as needed
Gauze Sponges (4in x 4in)	1 pkg	
Non-Adherent Sterile Pad	2	
Antiseptic Wipes	5+	To clean wounds once bleeding has stopped
Misc. Band-Aids	Many	
Compound Benzoin Tincture Swab	1	Use on skin surrounding wound if wet conditions make bandages hard to stick
Safety Pins	3	
Tweezers	1	
Chrome Snippers	1 Pair	To cut away clothing to perform first aid
Biohazard Bags	2	For materials contaminated with bodily fluids
First Aid Report Form	2 Forms	These can guide you to things to look for while waiting for emergency assistance
Pencil	1	
Emergency First Aid Booklet	1	

Items Recommended to Bring Yourself

1. High-quality CPR mask with a good seal and breathing tube, such as Laerdal Pocket Mask (if you're prepared to perform rescue breathing).
2. Ibuprofen (to relieve pain, inflammation, headache): take up to 4 x 200 mg.
3. Chewable aspirin for angina (heart stress): up to 648 mg, chew or crush & place under tongue; do not use if internal bleeding is suspected
4. Antihistamine, e.g., diphenhydramine (Benadryl), preferably in dissolving strip form; for allergic reactions including anaphylaxis (see below).
5. Epi-Kit (bee-sting kit) with injectable epinephrine: for anaphylaxis; requires a prescription—your doctor will ask you to prove that you know when and how to use; expensive; must be accompanied by antihistamine (see above) or the patient will probably “rebound” after a few minutes when epinephrine wears off; they may “rebound” anyway, so be prepared to administer a second injection; Patient must be transported to nearest emergency room for further treatment.



CLALLAM COUNTY INCIDENT REPORT

REPORT INCIDENTS IMMEDIATELY TO YOUR SUPERVISOR

Return completed report to Human Resources

<input type="checkbox"/> Employee	<input type="checkbox"/> Volunteer	<input type="checkbox"/> Equipment	<input type="checkbox"/> Other
Name:		Dept:	
Home Address:		City, State Zip:	
Job Title:		Supervisor:	
Time Work Began:	Incident Date:	Incident Time:	
Incident Location:	Were Police Called? <input type="checkbox"/> No <input type="checkbox"/> Yes		
	Officer Name:		
	Case Number:		
Medical Treatment?	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Emergency Room	<input type="checkbox"/> Hospitalized Overnight
Health Care Provider Name/Address:			
Witness 1 Name & Phone:			
Witness 2 Name & Phone:			
Witness 3 Name & Phone:			
What happened: (Describe how incident occurred in detail; include who, what, where, when, why, how. Use back of form if needed):			
What was the injury/illness and part of body affected?			
Was property damaged? <input type="checkbox"/> No <input type="checkbox"/> Yes (If Yes, list type and amount of damage: personal property; vehicle including year, make & model; Equipment Type, etc.) Any vehicle involved in a collision in this state in which any person is injured, including one's self, or in which any person's property sustains damages in the amount of \$700.00 or more is required to complete the <i>State of Washington Vehicle Collision Report</i> . A copy must be given to Human Resources.			
Employee/Volunteer Signature: _____			Date: _____
SUPERVISOR'S SECTION BELOW:			
Supervisor Name: _____		Supervisor Title: _____	
Do you agree with the incident description above? <input type="checkbox"/> Yes <input type="checkbox"/> No (<i>Explain</i>)			
How do you feel this incident could have been prevented?			
What type of corrective action do you have planned?			
Supervisor's Signature: _____			Date: _____
Department Head's Signature: _____			Date: _____

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7/2015

TEAM RHYTHM AND STREAM ETIQUETTE

QUARTERLY MONITORING SEQUENCE

This is roughly the way things work each quarter to get a team's monitoring done. Different people on the team might take on different tasks.

- **Team leaders decide on monitoring dates** with their teams, reserve a field kit, and post the monitoring event on the online SK calendar, **and send a message to their teams.**
- **Teams check out field kits**, inventorying them as needed before taking them out. (Generally, our office volunteers will have done the inventory for you—check this on the inventory sheet.)
- **Store your kit safely** when not in use, and do not leave the “clean bag” in your car or garage if temperatures are below freezing or above 45°C (113°F).
- **Visit all sites (from highest to lowest)** on a given stream on the same day. This is important for certain types of upstream/downstream comparisons. If you have to spread out the visits over more than one day, please note on your data sheets whether there was a precipitation event (and how many inches) in between.
- If a site has no flow, you should still fill out a data sheet; zero flow is important information. You can still look for wildlife and weeds, and take photos.
- At a given reach, **begin with fish and wildlife observations**—you're most likely to see things before you've mucked around very much.
- Be sure to take all chemical tests and macroinvertebrate samples **upstream** of any places where you have walked in the creek.
- **Update your reach map or sketch map** as needed, preferably with a pencil; initial and date any changes you make; and describe these changes on your field data sheet, along with a note for staff to recopy the updated reach map for the office file. If the changes in the reach are substantial, plan a day with your team to redraw the map.
- **Before leaving your site, check to see that you've packed all the equipment.** (Did you get the thermometer that you hung up in that tree?)
- **Turn in your equipment on time.** Remember to:
 - Leave separate notes for staff if equipment needs maintenance, replacement, or calibration.
 - Turn in your volunteer hours sheet, completely filled out for each volunteer.
 - Check over all field sheets for completeness and clarity before turning them in.
 - If possible, dry out anything that got wet.
 - If you have time, check in your field kits using the inventory sheets on the clipboards. (Otherwise, our office volunteers can often perform this task.)
- **Office Etiquette:** Please don't come inside the Courthouse wearing muddy boots. If it's inconvenient to change, you can just take your boots off and leave them outside the entrance, then come inside in your stocking feet. Also please don't prop open the back door; when you get alcohol, borrow a passkey from a staff person so you can return to the building.

LEGAL AND COURTESY ISSUES

- **Trespassing:** Be careful not to trespass. We have permission to monitor at all of our regular monitoring reaches, but that does not give you the right to walk all up and down the stream. In Clallam County, even parts of some stream bottoms are privately owned.
- **Neighborliness:** Where we do have permission to access private property, remember that we are guests and ambassadors for the Streamkeepers program. When you see people out in the field, wave and say hello. Let them know about the important work you're doing. Business cards are in the field kit, and your Volunteer Handbook serves as a rather substantial “greeting card.” If a property owner asks you to do something or not do something when on their

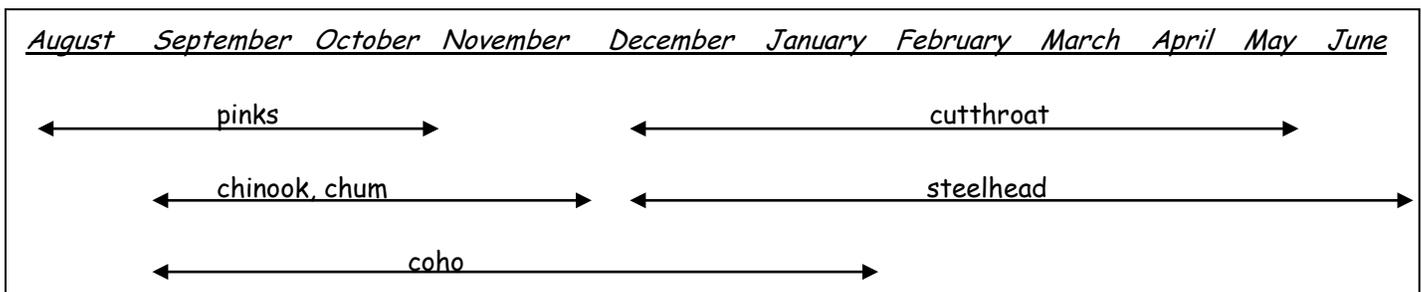
property, please let staff know so we can enter that information into the database and print it out for future samplers.

- **Illicit Discharges:** If you see (or smell) anything other than rainwater entering any creek, ditch or storm water conveyance, report it to Streamkeepers.

CARING FOR THE CRITTERS

All streams support a large array of interconnected communities—from fish to invertebrates to lower organisms such as algae. Walking in a stream will cause some disruption to these links. The key is to be aware and minimize any damage. If possible, walk along the banks (this includes exuberant canine companions!). When you have to walk in the stream channel, be aware of your travel path.

Virtually any time of year, some type of salmonid spawning activity could be taking place in a stream. In general, the North Olympic Peninsula spawning seasons are as follows:



After spawning, eggs will develop at different rates depending on water temperature. Ninety-five days is the average from egg fertilization to first feeding of fry. Detection of developing eggs under a blanket of gravel can be a challenge. Chinook and coho build classic redds that look like pockets (pits) in the gravel with mounds (tailouts) of clean gravel behind them. The eggs are in the tailouts, which can extend 1 - 2.5 meters downstream. Salmon that spawn en masse, such as pinks and chums, tend not to build redds that are distinctive other than cleaned gravel. Also, high flows can smooth out the contours on these sites. Knowledge of substrate size, spawning location, and spawning characteristics of salmonid species may help minimize potential damage. Below is a generalized chart describing salmonid redds:

SPECIES	SPAWNING GRAVEL SIZE	REDD LOCATION	SPAWNING CHARACTERISTICS
Chum	Small	Typically low in river systems	Mass spawning is typical
Pink	Small-Mid	Typically low in river systems	Mass spawning is common
Sockeye	Small	Along lake shores or adjacent streams	Mass spawning
Chinook	Cobble (tennis to basketball size)	Mainstem rivers and lower tributaries	Distinct redds
Coho	Small-Mid	Side channels, tribs, margins of rivers	Distinct redds
Steelhead	Small-Mid	Mainstem and tribs	Distinct redds or nests (small redds)
Cutthroat	Small	Tribs and small streams	Mini redds

Special thanks to Theresa Powell & Camille Speck, biologists with the Washington State Department of Fish & Wildlife, for their valuable input on this chapter.

ANTI-CONTAMINATION PROTOCOL

The State is concerned about the spread of exotic invasive plants and animals into our streams due to people like us mucking around at one site and then visiting another. For that reason, they're asking us to take measures to prevent cross-contamination. Here are general rules to follow (Parsons 2013):

1. Please visit sites from upstream to downstream, because the upstream sites tend to be the least disturbed. However, in some cases it's OK to go from downstream to upstream to avoid contaminating samples with your own upstream movement in the stream:
 - A. Where sites are very close together (as sometimes is the case for grab sampling).
 - B. Where the disturbance-level of the stream is clearly uniform (as in a highly-impacted urban area).
 - C. If it's critically important that you not disturb the stream upstream of where you're sampling, follow the decontamination protocol closely with your boots and other things that enter the stream, and you should be safe to go from downstream to upstream.
2. If you can avoid going into the water, please do (for example, when doing grab sampling), and avoid touching the bottom or any vegetation with sampling poles, probes, etc.
3. Anything that enters the water at a site (boots, flow meter wand, Surber sampler, etc.) needs to be treated as follows when leaving the site:
 - A. Thoroughly inspect whatever has contacted the water and use a brush and rinse water (either from the stream or your field kit) to remove all dirt, debris, and organisms.
 - B. If you're not sure you've removed everything or have felt boot bottoms, spray thoroughly with hydrogen peroxide, or a cleaning agent with quaternary ammonia compounds (such as Formula 409 regular or Simple Green Pro 3) and enclose in a plastic bag for at least 15 minutes (10 minutes for quaternary ammonia products), while traveling to your next site.
 - C. If you've used a quaternary cleaning agent, you'll have to rinse those items away from the stream before sampling at the next site. You can use the tub in the field kit to carry water from the stream.
 - D. A decontamination kit consisting of a brush, disinfectant, big plastic bags and ties is in the Streamkeeper field kit's "dirty bag".
4. If possible, take multiple pairs of boots to make the decontamination process go more smoothly.

For more information, see this web page from the Washington Dept. of Ecology:
<http://www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html>

QUALITY ASSURANCE

...or, How to Get Your Data into the Database & Not the Dustbin!

In order to gather data that others will trust and use, Streamkeepers performs its monitoring procedures under a Quality Assurance Project Plan that gets submitted to the Washington State Department of Ecology. In order to be current with scientific standards, we need to follow certain procedures to maintain a consistent quality of data. This chapter outlines some of those procedures.

GROUND RULES FOR MONITORING

- Rule #1: Follow the written protocols. They are the key to data credibility. If you have questions about the correct procedure or interpretation, ask your team leader or note your questions on the data sheet or in a separate note to program staff.
- Take field notes. Include weather observations, appearance of the reach or water, equipment problems or substitutions, and any modifications to the written protocols.
- Think about your data and whether it seems reasonable. Compare it to your common sense, past data at that site, data from similar sites, or the typical data ranges given to you on your data sheet. If you are at all uncertain about the data you've taken, try taking the data again. Note what you did, and your results, on your data sheet.
- If you're getting tired and sloppy, take a break or go home—no data is better than junk data!

HANDLING THE ELECTRONIC EQUIPMENT

Electronic meters require special care to work properly and last a long time:

- Don't drop them or the bag they're carried in. Remember to turn them off when you're finished, and set them in the bag in such a way that they won't turn on accidentally.
- Cables are most vulnerable near their junctions. Avoid putting too much stress on them at these points—for instance, by kinking, pinching, or yanking on them where they meet the probe or meter, or by storing them in such a way that they are kinked.
- Don't store meters in freezing temperatures or in a closed car on a hot day.

RECORDING DATA

- When signing in on the Tour Cover Sheet (see Data Sheets section) at the beginning of the day, all samplers should include their full initials plus full last names.
- For each component measured, one sampler will initial, indicating responsibility for the data. This should be a person who has been trained in that component. If none of the samplers have been trained, note that on the data sheet.
- Fill in all blanks on the data sheets. Remember especially the lines at the top of each page where you enter the name of the site and the date; otherwise, your data could get lost!
- If you forget your site name (usually, stream name + stream miles), there should be a list on your field forms folder. Or write the stream name plus a description of the site location.
- Write legibly. Your fellow volunteers have to enter your data into the database!
- For any procedure, if you looked for whatever the data sheet asks for (fish, wildlife, weeds, flow, etc.) and found none, write "NONE" and your initials on the data sheet.
 - Record all times using 24-hour (military) notation, whereby:
 - 8:00 a.m. = 0800
 - Noon = 1200
 - 12:30 p.m. = 1230
 - 1:00 p.m. = 1300
 - 8:00 p.m. = 2000
 - Midnight = 0000

STREAMKEEPERS' NUMBER-ROUNDING CONVENTION

Your protocols and field sheets will tell you how many decimal places to include when you record numbers. Sometimes, our electronic meters will give you more decimal places than you are supposed to record. Please record only the number of decimal places asked for in the protocol.

When rounding a decimal that's halfway between, we do NOT simply "round up," because that would bias the data, slightly, over time. Instead, Streamkeepers' rounding convention is summed up by the phrase, *"If halfway, round to the nearest even."*

Details are below; pay close attention to the "tricky part," that is #3 & 4:

1. If the figure beyond the last figure to be retained is less than 5, do not change the last figure to be retained. Example: rounding 34.44 to the nearest tenth gives 34.4.
2. If the figure beyond the last figure to be retained is greater than 5, then increase the last figure to be retained by 1. Example: rounding 34.46 to the nearest tenth gives 34.5.
3. If the figure beyond the last figure to be retained is 5 (followed by zeroes or with no following figures)...
 - a) keep the last figure to be retained if it is even, or
 - b) increase the last figure to be retained if it is odd.
 - c) Example: rounding 34.45 to the nearest tenth gives 34.4. Rounding 34.55 to the nearest tenth gives 34.6.
4. If the figure beyond the last figure to be retained is 5, followed by figures other than zeroes, regard the "5" as really greater than 5 and use Rule 2 above. Example: rounding 34.451 to the nearest tenth gives 34.5.

SAMPLES OF STREAMKEEPERS' ROUNDING CONVENTION:

This number...	...when rounded to this many decimal places...	...rounds to this number:
43.64	.1 (nearest tenth)	43.6
43.66	.1 (nearest tenth)	43.7
43.65	.1 (nearest tenth)	43.6
43.75	.1 (nearest tenth)	43.8
43.85	.1 (nearest tenth)	43.8
43.851	.1 (nearest tenth)	43.9
43.855	.1 (nearest tenth)	43.9
43.855	.01 (nearest one-hundredth)	43.86
43.995	.01 (nearest one-hundredth)	44.00

COMPASS USE

Streamkeeper volunteers use the compass for two separate operations: either working “from terrain to map” (taking a compass bearing from a given line in the field) or working “from map to terrain” (following a bearing given on a stream reach map). The first operation is used when surveying the stream reach map, and the latter would be used to reestablish your reach lines during future monitoring visits, or to find stream reach monuments after a reach has been established if thick growth or flooding alters the terrain.

THE COMPASS

The compass supplied with the field kits has been set to account for the 20-degree east declination for the Peninsula, the difference between the magnetic pole and true north, so all of our readings will reference to true north. Remember to keep the compass level and away from iron and steel objects like belt buckles, rings, rebar, or clipboards when taking

a bearing. The compass can be used in a number of different ways, as explained below.

DEFINITIONS

A few definitions are useful for an understanding of compass use:

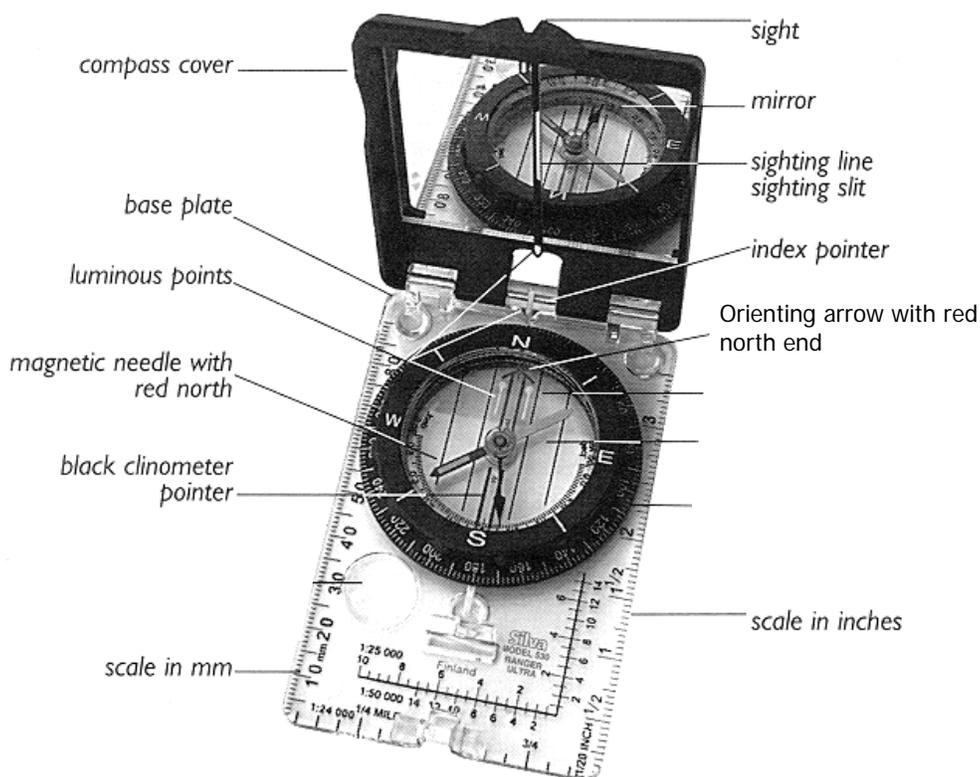
Bearing: The *direction* from one place to another, measured in degrees of angle with respect to an accepted reference line. This reference is the line to true north.

Taking a bearing: To *measure* the direction from one point to another, either on a map or in the field.

Following a bearing: To set a certain bearing *on the compass* and then to follow that bearing along a line in the field.

Boxing the needle: To *align* the red end of the magnetic compass needle inside the orienting arrow of the compass housing.

Triangulation: Taking a bearing to a monument from two different locations.

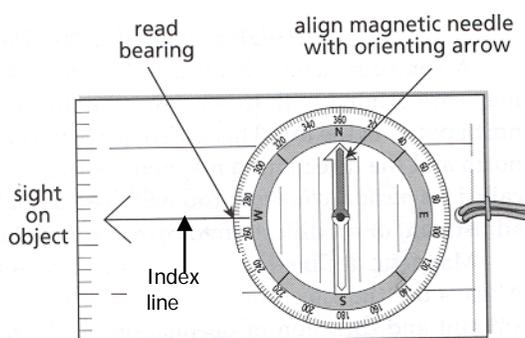


USING THE COMPASS

FROM TERRAIN TO MAP—To take a compass bearing from the terrain for your stream map by measuring the direction from one point to another on the terrain:

Let's say you need to determine the compass bearing of your baseline (see Reach Map protocol).

1. Stand at your "zero point" with your tape stretched along your baseline, and orient the body of your compass in exactly the same direction. There are several ways to do this:
 - a) "Lay-along" method (preferred): If you have a tape or string lined up exactly along the line you want to measure, you can lay the compass directly on top of it or next to it, thus assuring that it is pointing in the same direction.
 - b) "Sight-through" method (slow, accurate): open the compass cover to about a 50-degree angle so that you can see the compass dial in the mirror when held to the eye, as well as the tape measure through the slit.
 - c) "Sight-down" method (quick, not accurate): Hold the compass about waist level with the lid away from you. Aim the sighting slit/sighting line on the compass cover down the baseline.
2. To read the compass, "box the needle" by rotating the compass housing so the orienting arrow aligns with the red magnetic needle (see diagram). Read and record the bearing at the index line.



"Boxing the needle" to take a bearing from a line

FROM MAP TO TERRAIN—To follow a bearing written on your stream reach map to establish a point or line in the field, by setting the bearing on your compass:

This method is used to reestablish the baseline or transects in the field, or to find the "zero point" or other landmark based on triangulation from other points. You'll use the reverse of the procedures described in "From Terrain to Map."

Quick Accuracy Reading: Suppose, for example, that you can't find a rebar monument you put in the year before. Your map notes that the monument is "20 feet at 270 degrees from the corner fence post." Simply stand at the fence post and turn the compass dial to set 270 degrees at the index pointer. Holding the compass flat open at waist level, box the needle by ROTATING YOUR ENTIRE BODY until the red needle aligns with the orienting arrow. The sighting line will be pointing toward the monument, and you should be able to zero in on it now in the brush.

Extreme accuracy reading: Let's suppose you still can't find your monument and will have to install a new one. You'll need to be very accurate in order to get the monument in the same exact place. To do this:

- Use the "sight-through" method to find your bearings (see previous section).
- Use triangulation to get as accurate a location as you possibly can. This involves locating your spot from two different reference points. Your reach map should have two different reference points for each important monument (see Reach Map protocol), and if you mark the spots indicated by both of these reference points, they should agree with each other. If they don't, you'll have to use your best judgment as to where to locate the replacement monument. IF YOU HAVE TO RE-INSTALL A MONUMENT, BE SURE TO NOTE WHICH MONUMENT AND EXACTLY HOW YOU DECIDED WHERE TO PLACE IT.

WATER CHEMISTRY—GENERAL GUIDELINES

Overview

Our water chemistry data are submitted to the State under the federal Clean Water Act, so our procedures evolve in line with the State's updated quality-assurance (QA) standards. For a general discussion of the role of data in implementing water cleanup, see

<https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d/Assessment-policy-1-11>

Where to Sample

When first arriving at a site, you need to think carefully about where and when to perform each monitoring procedure. **For water chemistry measurements, you must sample an area upstream of any disturbance by your team.** Pick an area where the stream is flowing and appears to be well mixed. Sample 8-12" below the surface or at mid-depth, whichever is shallower.

Sampler's Initials

For each test that you perform in this protocol, there is a "Sampler's Initials" box to the right of the data boxes. Be sure to put all the initials of one sampler taking responsibility for the data; this should be someone who has been properly trained (see "Quality Assurance" protocol).

Common Sense and Expected Ranges

Please compare your readings with the expected ranges on the datasheet. If you're outside the expected range, consider re-sampling or troubleshooting with your fellow samplers.

Field Replicates

Our quality assurance plan requires that at one of your team's sites (or $\geq 10\%$ of your sites if you have >10 sites), you take a second set of readings for all tests. Such field replicates give an indication of how much variability there is in the equipment, sampling techniques, and environment. To do this:

1. Assign a number to each of your team's sites that you're sure you'll get to.
2. Roll the die in your field kit "Treasure Box" until one of those numbers comes up.
3. At that reach, perform each test a second time, as soon as possible after the first, re-dipping the sample bottle if you took a sample from the stream. You do NOT need to recalibrate between tests.
4. Record and initial results on the replicate section of the data sheet.

Replicate deviation & QA: Field replicates help to check the precision (consistency) of our data. If your replicate for a given parameter differs widely enough from the original sample, we have to flag ALL the data for that parameter for your team for that season as "Estimated" or "Rejected". Here are the allowable differences between sample and replicate:

<i>Parameter</i>	<i>Acceptable difference</i>
Turbidity	± 1 FNU (NTU), or Sum \geq Difference x 30
Water temperature	$\pm 0.2^\circ\text{C}$
DO concentration	± 0.3 mg/L
Conductivity	Sum \geq Difference x 30
pH	± 0.2 pH units

If any of your sample/rep differences are beyond the acceptable limits, take further replicates until you have a pair of readings within the limits. Then label the first of the pair your "sample" and the second your "replicate." On your data sheet, note these extended replicates, as well as any explanations you may have as to why multiple replicates were needed. Depending on the circumstances, we might still have to flag the data.

Repeating measurements exceeding water-quality standards thresholds: If your measurements at any site are near or beyond the exceedance threshold for state water-quality standards, it's a good idea to do a replicate to confirm the possible "red-flag"

reading. These replicates should agree with the samples within the “acceptable differences” in the table above, but the closer the better. Below is a table listing generalized water-quality standards for parameters that have been set by the state (*ignoring a variety of exceptions and conditions*):

Parameters & Water-Quality Exceedances

Temperature: > 16° C

pH: > 8.5 or < 6.5 pH

Turbidity: >5 NTU higher than any upstream site on the same stream, or 10% higher if the upstream turbidity is >50.

(As a general rule, take a turbidity replicate if you're at a downstream site, the turbidity is ≥ 10 , and you'll be visiting an upstream site on the same day. Take a replicate at the upstream too.)

Dissolved Oxygen: < 9.5 mg/L

If the sample and replicate straddle the threshold, take a third reading and a mean will be calculated.

Minimizing exposure in poor conditions: If the weather is severe and you wish to minimize your time on the creek:

- Warm up the multimeter before deploying it in the water.
- If you've saved the readings on the multimeter, you can retrieve and record them back at the car.
- DO calibration post-checks can be done back at the car.
- Note deviations from standard procedures on your data sheet.

AIR TEMPERATURE

EQUIPMENT NEEDED

1. pocket stick thermometer
2. data sheet, clipboard, pencil

PROCEDURE

One person can perform this test.

HANGING THE THERMOMETER

If the protective tube doesn't have a window, unscrew it and put it in your pocket. The thermometer will still be attached to its "hat" in which a string is looped. Make sure the thermometer is dry, and then hang it in a shady spot on the bank with good air circulation, preferably at about eye height, for several minutes to let it stabilize. We suggest you hang the thermometer as soon as you get to your site and then read it later while you're waiting for some of the other equipment to warm up or stabilize; just don't leave it hanging in the woods!

MEASURING AIR-TEMPERATURE

After the thermometer has been hanging for a few minutes, first make sure the sun hasn't been shining on it. Estimate the reading to the nearest whole degree Celsius (°C) or to more decimals if you can. Wait 30 seconds and estimate again. If the reading hasn't changed, record it and sampler's initials on your data sheet. If the reading has changed, jot down the second reading, leave the thermometer hanging, and read it again a few minutes later. Record the temperature once readings have stabilized.

Record the time and sampler's initials.

This should be someone who has been properly trained.

Screw the protective tube back on, if needed, and put the thermometer back in its box in the field kit. Replicates are not needed for air temperature readings.

COMMON SENSE AND EXPECTED RANGES:

Before packing up, make sure that your air temperature reading conforms to your common sense. As a guide, here's a chart comparing Celsius degrees (the ones on your thermometer) with Fahrenheit degrees (with which Americans are more familiar).

Celsius degrees	Fahrenheit degrees
0	32
4	40
10	50
16	60
21	70
27	80

MULTIMETER: YSI-ProDSS**EQUIPMENT NEEDED**

- YSI-ProDSS multimeter
- (Sampling wand, float, tub, scoop)
- Data sheet, clipboard, pencil

Storage notes:

- *The battery may be damaged if kept in an environment outside the range of 0 - 45 °C (32 - 113 °F).*
- *When taking the ProDSS out into the field, travel with a small amount of tap water in the calibration cup to keep it moist inside.*
- *When storing the ProDSS for longer than one week, if possible, store in expired pH4 buffer solution, with the cup upright and the probes submerged in the buffer.*

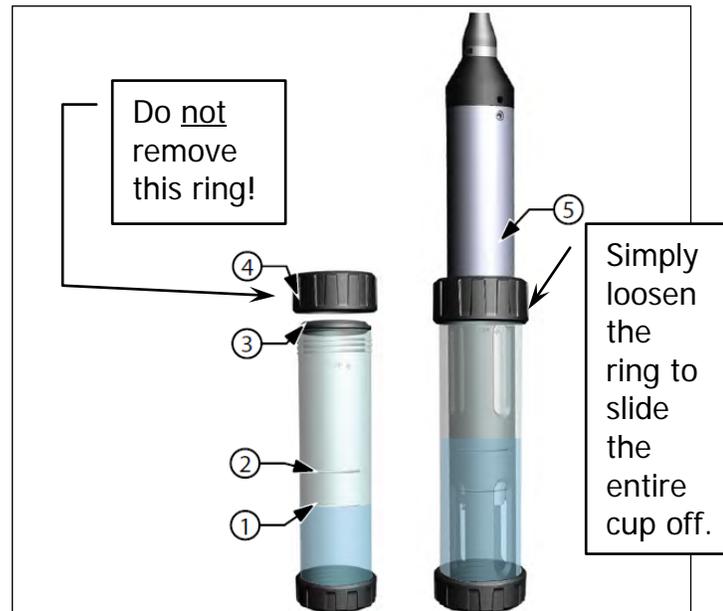
INITIAL INSTRUMENT PREPARATION:**1. CABLE CONNECTION**

Inspect the cable connection between the handheld meter and the cable. If cable is not connected to the meter, ***make sure the connectors are clean and dry before connecting!*** If connectors are clean and dry, align the keys on the cable assembly connector with the slots on the instrument connector. Push together firmly, and then twist the outer ring clockwise until it locks into place. The metal pin should “snap” into place and be visible through small hole in the outer ring (see image).

**2. SENSORS AND GUARD CHECK**

If any of the individual sensors are not connected or are loose, refer to “Settings and Troubleshooting” section for sensor installation. If there is an empty “slot” with no sensor installed, ***a port plug or sensor must be installed or the bulkhead will be damaged!***

1. Remove calibration cup by backing off a bit on the retaining nut in a counterclockwise direction (see diagram). DO NOT REMOVE

**Figure 44** Calibration cup standard volume

1 Fill line one (used for Turbidity, pH, and ORP calibration solution)	4 Retaining nut
2 Fill line two (used for conductivity calibration solution)	5 Calibration cup installed
3 Gasket	

THE RETAINING NUT; JUST LOOSEN IT!

(For a 4-second video, see <https://youtu.be/Z6b7YF1ONo0>.)

2. Slide the cup off and set it aside on its pack, slightly angled to hold the water inside.
3. Firmly hold the bulkhead with one hand and turn the sensor guard counter-clockwise until completely unthreaded. Set aside the sensor guard in a clean dry place. **Use caution once the sensors are exposed!**
4. Conduct a quick visual inspection of the sensors; clean any debris on the sensor tips with a lint-free cloth and rinse with water. Carefully “test” the connection of each sensor by grasping the sensor near the bulkhead between your thumb and finger, and try to turn the sensor to determine if it is loose. If the sensor moves or twists **at all** (sensors should **firmly** be in place), reconnect the sensor guard and inform the team leader. (See “Settings and Troubleshooting,” below, under “Sensor Installation”.) If sensors are firmly in place, proceed to next step.
5. Carefully slide the sensor guard over the sensors and push it toward the bulkhead

until the sensor guard threads align with the bulkhead threads. Carefully finger-tighten the sensor guard clockwise.

NOTE: If any resistance is felt, loosen the sensor guard completely to prevent cross-threading. Incorrect installation may cause damage to the sensor guard or bulkhead.

PREPARING FOR MEASUREMENT:

1. Turn on the meter by pushing the power key . (To turn off the meter, hold down the power key for 1.5 seconds.) If the meter does not turn on, inform the team leader and see the "Settings and Troubleshooting" section under "Battery Troubleshooting".

Charging the Internal Li-Ion Battery Pack

Use YSI designated charging equipment only!

If the battery is not charged, the meter must be charged from the AC power adapter (*strongest charge source*), or from a computer USB connection, or from an external, portable USB battery pack. When using the AC adapter, turn the unit on first so it recognizes the AC adapter. Once the charging signal appears on the screen, it can be turned off. It takes approximately 14 hours to charge the ProDSS battery with the unit turned off. For maximum battery life, if practical, don't charge until the battery is $\leq 40\%$, and bring the battery back up to $\geq 80\%$.

Expected battery life:

- 20 hours at 25% (default) LCD brightness
- 14 hours at 100% LCD brightness

2. Study the main "Run" screen (see picture). Confirm the following:
 - The battery charge is $>10\%$. If not, inform your team leader.
 - The date and time are correct:
The date and time should be displayed at the top of the screen; if not, refer to the "Settings and Troubleshooting" section under "Date/Time".
 - Logging is correct:

At the top of the screen in the green bar, it should read "Log One Sample"; if not, refer to the "Settings and Troubleshooting" section under "Logging Data".

- Individual parameter units are correct:
 - Temperature - °C
 - Barometric pressure – inHg
 - DO (dissolved oxygen) saturation – DO %L (local)
 - DO concentration – DO mg/L
 - SPC (Specific conductivity at 25 °C) – SPC $\mu\text{S}/\text{cm}$
 - Salinity – SAL-PSU (similar to ppt)
 - pH
 - turbidity – FNU (similar to NTU)

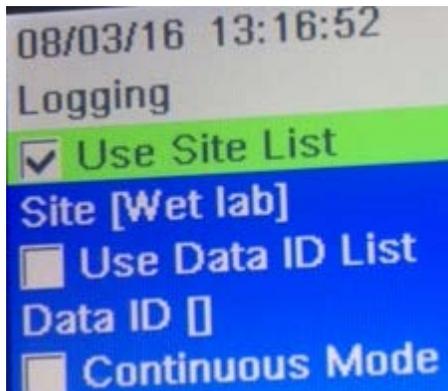
If any parameters shown above are not displayed or do not match the units on the photo below, notify your team leader and refer to the "Settings and Troubleshooting" section under "Sensor Display Details".



Select your Site:

- a) Select the *System* button , then highlight *Logging [single]* by using the down arrow. (Note: the green band indicates which feature is highlighted.) Select this feature by hitting Enter.

- b) Before selecting a site, make sure the *Use Site List* check box has been selected and *Use Data ID List* and *Continuous Mode* are not selected. If not, highlight rows and hit Enter as needed for the screen to look like this:



- c) Highlight the line with *Site[ABCXYZ]*. Hit Enter.
- d) You will see a list of sites. Scroll down until you find your site name, and hit Enter. If you can't find your site, select "test" and note on your field sheet the site and time.
- e) The green bar should read *Select [your site]*. Hit Enter, then hit Escape twice. This will return you to the Run screen.

MEASUREMENT:

1. ***Let the unit soak in the stream for 5-10 minutes***, in a place where it's safe and won't get fouled by bottom sediment. If you can put it at the measurement point, all the better—see below.
2. ***Place the probe at the measurement point:***
Standing downstream or to the side of the probe, place it in the main current, in a place with steady flow, adequate depth, good mixing, and no surface turbulence. ***Do not sample downstream of where your team has disturbed the bottom.*** Sample at mid-depth, or 8-12" below the surface if the water is deep. You may dangle the probe or place it on clean rocks at the bottom if the stream is shallow. ***You must immerse the probe at least halfway up the guard.*** Agitate the probe under water

to dislodge any bubbles at the probe tips. The goal is always to get a representative, well-mixed portion of the stream. Here are some alternative sampling methods:

- Hold the probe out in the stream with a wand and a float of some kind (an empty bottle or piece of wood), at mid-column or 8-12" under (whichever is shallower).
- If there's too much current to hold the probe at the end of the wand out in the fast water, you can wade out into the faster part of the water column (if it's safe) and hold the probe pointing straight down into the water with the wand.
- In extremely low water, here are a few possibilities:
 - Pull some of the rocks out of the middle of the creek, or build up rocks on the sides, to create a little chute to deploy the probe in.
 - Build a little rock dam and deploy the probe in the pool it creates. Leave enough time to let the disturbed sediment settle out.
 - Collect water in the tub included in the field kit's dirty bag (you might have to use something as a scoop) and do the measurements in there. If possible, sit the bucket down in the stream to keep it cool. Change out the water after you've let the probe pre-soak in the first batch for a few minutes.

3. ***Stabilize and log readings:***

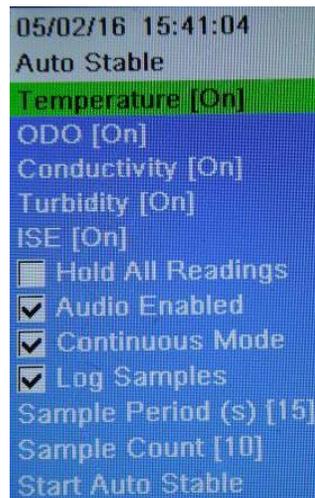
Turn on the Auto Stable feature:

- a) Hit the *Probe button* , then select **Auto Stable**.
- b) Confirm settings:

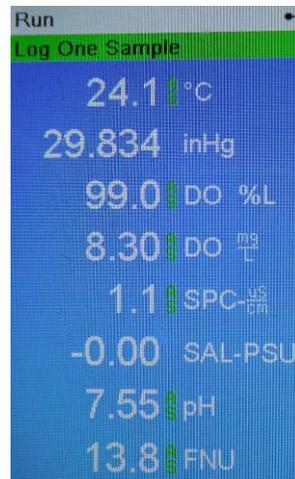
Parameters are all set to [On]

(ISE=pH)

- *Audio Enabled, Continuous Mode* and *Log Samples* boxes are checked
- *Sample Period(s)* is set to a number
- *Sample Count* is set to a number.



- c) **Stabilize:** Hit the up arrow and select **Start Auto Stable**. You'll return to the Run screen. On the Run screen, there will be a flashing red symbol **A** next to each parameter. Wait until all of these flashing red symbols become green and **stay green for at least two minutes** (use the on-screen clock). Also observe the readings (particularly temperature, DO, and pH) to look for drift.



If Auto Stable readings won't stabilize:

Try cleaning vegetation from the sensors or restarting the meter. If that doesn't work, you'll need to estimate values for the non-stable parameters. **Always notify staff!**

--If turbidity values oscillate, watch them for several minutes and estimate the average, to the nearest whole number, considering both the extremes and most frequent numbers. If needed, you could try taking multiple readings, and we might be able to calculate an average at the office.

--If DO readings stabilize overly slowly or not at all, the DO Sensor Cap might be failing. Check if more than a third of the black paint is missing from the face of the sensor.

- d) **Log a reading:** Once you're sure that all parameters have stabilized, press Enter to log a reading. *The first time you hit Enter, it will probably just light up the darkened screen; you have to hit Enter again before it will say "Sample Logged" at the bottom.* Anytime the screen is dark, hitting any button just brightens it.

3. **Record the data:** If possible, record the data directly off the Run Screen right after you've logged your measurement. It is also possible to retrieve the data either directly from the meter or by linking the meter to a computer—see instructions at end of protocol.

Record the readings on your data sheet, in the following order, using our rounding convention (see Quality Assurance protocol):

- Temperature:** to nearest 0.1°C
- Pressure:** to nearest 0.01 inHg
- DO Saturation (local):** to nearest %
- DO Concentration:** to nearest 0.1 mg/L
- Specific Conductivity:** to nearest whole µS (microSiemens)
- Salinity:** to nearest 0.1 PSU (Practical Salinity Units—similar to parts per thousand)
- pH:** to nearest 0.1
- Turbidity:** to nearest whole FNU

4. Record the meter number.

5. **If you're taking replicates at this site:** Remove meter from stream, shake off water, and replace in stream. Then stabilize and record a second reading; you may have to press Enter twice.

6. **Perform a Dissolved Oxygen drift check:** Remove meter from stream. Rinse thoroughly with purified water if the stream was dirty. Then shake off any water droplets from the DO sensor tip and temperature sensor; you can also insert a lint-free cloth through the open slots in the sensor guard. The temperature sensor does not need to be completely dry at its base. Then:

- a) Pour a small amount of clean water (1/8th inch) gently down the side of the calibration cup.
 - b) Gently insert the sensor and guard into the calibration cup and partially tighten the calibration cup to the bulkhead.
NOTE: Do not fully tighten the cup; atmospheric venting is required for accurate calibration. Make sure the DO and temperature sensors are not submerged in water.
 - c) Set the unit aside in the shade with the cup down and wait 5 to 15 minutes for complete air saturation.
 - d) Wait for the unit to stabilize to these criteria: **During a period of 2 minutes, both DO % Local and Temp (°C) stay within ± 0.1 of their initial readings.**
 - e) In Local DO% mode, **the meter should read 100% ±2%.** (If it does not, try unscrewing the sensor guard and carefully dabbing the DO sensor tip with a Kimwipe, then test again.)
 - f) Record the reading.
 - g) Re-tighten the calibration cup.
7. *If you are not submitting the data to Clallam County, record the latest calibration dates for all parameters. Select the *File* button, *View GLP*, and scroll to see when the instrument was last calibrated for each parameter.*
- COMMON SENSE AND EXPECTED RANGES:**
Please compare your readings with the expected ranges on the datasheet. If you're outside the expected range, consider re-measuring or troubleshooting with your fellow samplers. A couple of common problems:

Conductivity readings <25 µS: You might not have held the probe completely underwater. Try taking another set of readings.

Turbidity readings <0: This is probably a sign of contamination during zero calibration at the office; report the problem to staff, who can re-run the zero calibration without having to re-run the other turbidity calibration settings.
8. If you performed replicates, check the "Water Chemistry—General" protocol to see if your pairs of readings are within the acceptable precision limits; resample as needed.
9. **Record time and full initials** of the sampler; this should be someone who has been properly trained (see "Quality Assurance" protocol).
 10. **Turn off the meter** (hold the Power button), make sure the calibration cup is on tight, and place the unit in the field bag.
- When returning the meter:** Remove the calibration cup and take off both ends; remove the probe guard and unscrew the probe-guard end; clean everything thoroughly (with a brush if necessary), and put it all back together. Plug the unit in to recharge if it is below 40%. *If you don't have time to do these things, let staff know!*
- Storage for >1 week:** Pour enough expired pH 4 buffer into the calibration cup so the ends of the sensor modules are all submerged when the sensor assembly is oriented with the sensor ends down.
- Retrieving from the meter's data files:** Select the *File* button and select View Data and Show Data. (If no data is displayed, make sure you have the right date and time entered at the bottom.) Find the bottom row for the site you want, which should be the last set of data recorded when you hit Enter to log your reading at that site. (If you took a field replicate at this site, this last row will be those replicate readings; you'll have to scroll back up a bit to find your primary measurement readings.) To see the data readings for each parameter, hit the Right Arrow key to scroll.
- Retrieving from computer upload:** Connect the meter via its USB cable to a computer with KorDSS software loaded, and open KorDSS. Wait for the data in the meter to upload automatically. Then, on the Home Screen, choose "View Logged Data" and "Search." Choose your search criteria, then in the Results screen, select the datasets you want to view, and hit "Accept." Go to "Dashboard" tab and view and record your readings. You can Print these data sets or upload them to a .csv file. To find other data sets, choose "Search" again.

ProDSS Settings & Troubleshooting

Sensor, port plug, guard installation

Perform sensor/port plug installation in a clean, dry environment; **do not install in the field!** The ports on the ProDSS bulkhead are universal; therefore, you can install any sensor into any port. For highest accuracy, always install a conductivity/temperature sensor to compensate all measurement data for temperature and dissolved oxygen data for conductivity.

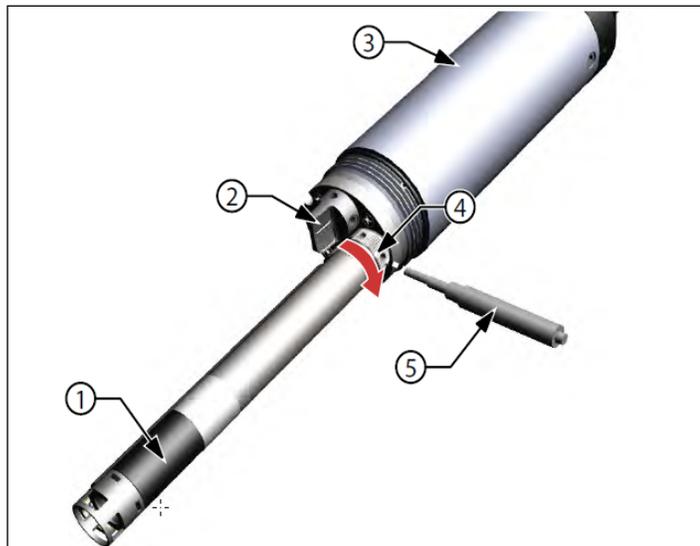


Figure 4 Sensor installation

1 Sensor	4 Sensor retaining nut
2 Port plug	5 Sensor installation/removal tool
3 Bulkhead	

Before installing a sensor or port plug, make sure that the sensor and bulkhead connectors are clean and dry. If there is an empty "slot" with no sensor or port plug installed, **a port plug or sensor must be installed or the bulkhead will be damaged!**

Equipment needed for sensor/port plug installation:

- Sensor(s) and or port plug(s)
- Bulkhead
- Krytox or silicone o-ring lubricant
- Sensor installation/removal tool
- Lint-free cloth

Sensor Installation

1. Inspect the bulkhead port for contamination. If the port is wet, carefully dry with a lint-free cloth.
2. Apply a thin coat of lubricant to the sensor o-rings. Wipe off any excess lubricant with a lint-free cloth.
3. Carefully align the sensor and bulkhead connectors by inserting the sensor into the port and then gently rotating the sensor until the connectors align. Once aligned, push the sensor toward the bulkhead until the sensor seats in the port.
4. Carefully finger-tighten the retaining nut clockwise. **NOTE:** If any resistance is felt, loosen the retaining nut completely to prevent cross-threading. Incorrect installation may cause damage to the sensor or bulkhead that is not covered by the warranty.
5. Use the sensor installation/removal tool to tighten the retaining nut clockwise until snug, about a $\frac{1}{4}$ to $\frac{1}{2}$ additional turn of the retaining nut. **NOTE:** Do not over-

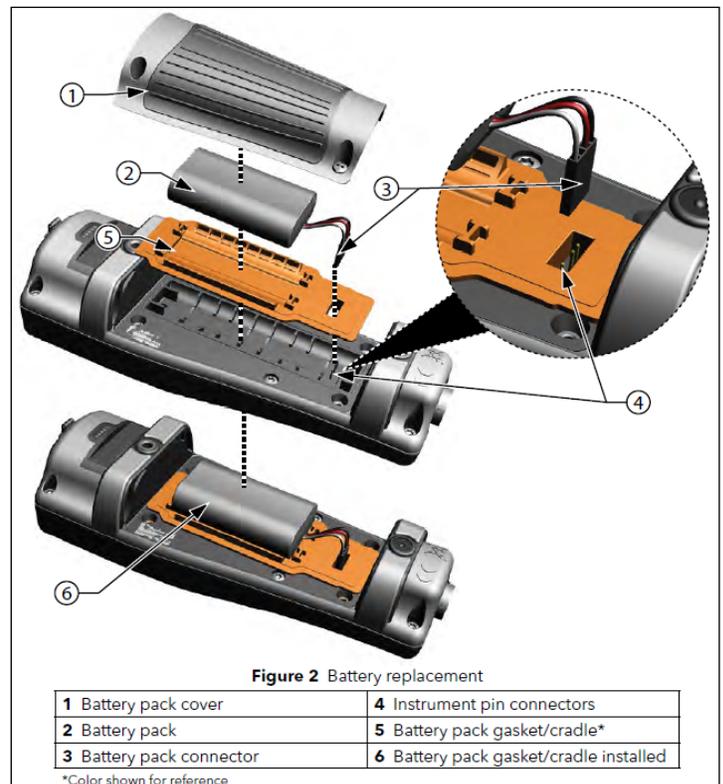


Figure 2 Battery replacement

1 Battery pack cover	4 Instrument pin connectors
2 Battery pack	5 Battery pack gasket/cradle*
3 Battery pack connector	6 Battery pack gasket/cradle installed

*Color shown for reference

tighten the retaining nut. Over-tightening can cause damage to the sensor or bulkhead not covered by the warranty.

Port Plug Installation

If there is an empty slot in the bulkhead, install a port plug. ***Never submerge the bulkhead without a sensor or port plug installed in all ports!***

1. Apply a thin coat of lubricant to the o-rings on the plug port. Wipe off any excess lubricant with a lint-free cloth.
2. Insert the port plug into the empty port and press until firmly seated.
3. Finger-tighten the port plug clockwise to install. If necessary, use the sensor installation tool to make sure that the plug is fully seated into the port.

NOTE: The o-rings will not be visible if a port plug is correctly installed. Do not over-tighten the port plug; over-tightening can cause damage to the port plug or bulkhead not covered by the warranty.

Sensor Guard Installation

Without the sensor guard, the sensors are extremely vulnerable to environmental damage.

1. Carefully slide the sensor guard over the sensors and bulkhead. Push the sensor guard toward the bulkhead until the sensor guard threads align with the bulkhead threads.
2. Carefully finger-tighten the sensor guard clockwise.

NOTE: If any resistance is felt, loosen the sensor guard completely to prevent cross-threading. Incorrect installation may cause damage to the sensor guard or bulkhead that is not covered by the warranty.

USB port cleaning

If the USB port cover gets dislodged, dirt can get into the port area. However, the port entry is waterproof even when the port is exposed. To clean dirt from the port area:

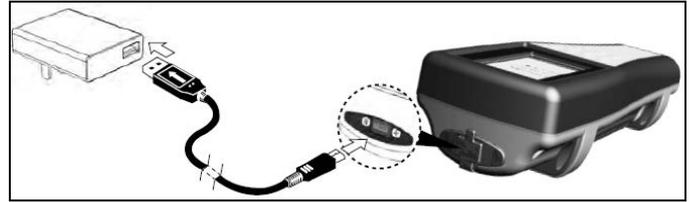
- Flush the port area out with water.
- Pour isopropyl alcohol into the port area and let it sit for 30 seconds.
- Pour out the alcohol and let dry before replacing the port cover.



Battery pack troubleshooting

If the instrument is not turning on, do the following:

1. Attempt to charge the unit: Using YSI charging equipment only, plug unit into the AC adapter with the USB connector (see figure on next page).



2. If this does not power on the unit, remove battery pack cover and examine battery pack (see figure on previous page).

NOTE: Do not remove the battery pack if it is hot to the touch, is producing an odd odor, or is leaking a fluid.

Removing and examining the battery pack needs to be done with **extreme** care by a team leader and in a dry, clean place, **preferably not in the field!**

- a) Remove the battery pack cover by unscrewing (counter-clockwise) the four screws with a flat or Phillips head screwdriver (the retaining screws are captured into the cover and are not removable).
- b) Inspect the battery pack; make sure the battery pack connector is properly connected to the instrument.
- c) If the connectors do not appear to be properly connected, grasp the battery pack connector with two fingers and pull the connector straight up to disconnect and remove. Inspect the connector and instrument pin connectors for any debris or damage. If the connectors look OK, align the battery pack connector wire terminals with the three instrument pins and connect the battery pack.

- d) If connectors look properly connected, reinstall the battery cover and attempt to charge the unit again. If the unit still will not turn on, the battery pack may need to be replaced. (Before ordering a new battery pack, call YSI at 800.765.4974 and troubleshoot problems with a ProDSS tech.)
- e) If a new battery pack has been ordered, refer to the YSI manual for battery removal/disposal and replacement.

System settings

Date/Time

If the date and time are inaccurate, press the *system button* , go to the **Date/Time** submenu option, scroll down to **Date** and hit Enter. In the numeric entry screen, use the arrow keys to maneuver around. If entire date needs to be corrected, click the *delete entire entry key* . If not, use the *backspace key*  to partially correct the date. After correcting the date, hit Enter. Scroll down to Time and hit Enter, then follow similar instructions as for date correction to correct the time. When finished, hit the Esc. or left arrow button until you are back to the Run screen.

Logging Data

If the logging settings are inaccurate, press the *system button* , scroll down to the logging submenu option, go to the Continuous Mode, and uncheck the box by pressing Enter. The box should become unchecked . Press the Esc button to return the Run Screen. In the green bar at the top of the screen it should now read "Log One Sample".

Sensor Display Details

If there is a parameter not displayed on the Run Screen, either the sensor is not installed correctly, or it is not working properly. To check if the sensor is installed properly, refer to the above section on **Sensor, Port Plug, Guard Installation** and carefully examine the sensors.

If the units do not match on the Run Screen, go

to the *probe button*  and scroll down to **Display** submenu and hit Enter. Scroll down and select the desired parameter. A submenu will appear with multiple parameter unit options; select the proper unit (see protocol above) and return to the Run Screen.

Cleaning the bulkhead & probes

The bulkhead, probe guard, and calibration cup can all be cleaned with a mild detergent. A bottle brush works well for cleaning the calibration cup; remove the locking ring and gasket and scrub the inside of the chamber well. Remove the bottom of the cup to clean it as well, particularly the threads, which can get full of grit. Use a bottle brush to clean the probe guard, removing it from the bulkhead and unscrewing the bottom of the guard to clean it. Clean any dirt off of the bulkhead and sides of the probes using a toothbrush. Don't scrub the faces of the probes with a brush, as this could cause damage. Be sure to rinse everything well with tap water after you've cleaned it.

FLOW

The main procedure described here primarily follows the discharge measurement procedure described in the 1994 TFW Ambient Monitoring Program (Schuett-Hames et al., 1994), which estimates flow by modeling a series of rectangular cells (see diagram on last page of this protocol). Some modifications were suggested by the Washington State Department of Ecology or based on Ecology's protocol (Kardouni 2011). The later 1999 TFW protocol calls for more cells and longer velocity averages, but Streamkeepers' technical advisors consider the 1994 TFW protocols to have adequate accuracy for our program purposes.

NOTE: Zero flows are important data that should be recorded; see "Basic Information" #2 below for how to do that.

EQUIPMENT NEEDED

- Velocity meter and peripherals (main instructions are for Swoffer 2100; special instructions for Marsh-McBirney 2000 are at the end of this section)
- flexible measuring tape in 0.1' increments
- 2 stakes
- pocket calculator
- timepiece
- sand-bags and ties, small shovel
- extra batteries (Swoffer: 9V; M-M: 2 D's)
- data sheet, clipboard, pencil

In this procedure, you will measure depth and velocity at 15-20 points across your stream. Back at the office, we will use your measurements to calculate the amount of water that the stream is discharging, recorded in cubic feet per second ("cfs"). For informational purposes, to better understand how discharge is calculated, see the illustration on the last page of this protocol. This procedure is best performed by two people: one taking measurements and the other recording.

When to measure: Generally, you'll measure flow each time you monitor each reach. If possible, wait until a day or two after major storms, to give the stream time to return to its baseflow. Also keep safety in mind—think twice about going into water above your knees.

Where to measure: Streamkeepers has established permanent flow monitoring markers at some of its monitoring reaches. In many cases they are the cross-section monuments, but in other cases they are separate monuments. (Check your reach maps, team

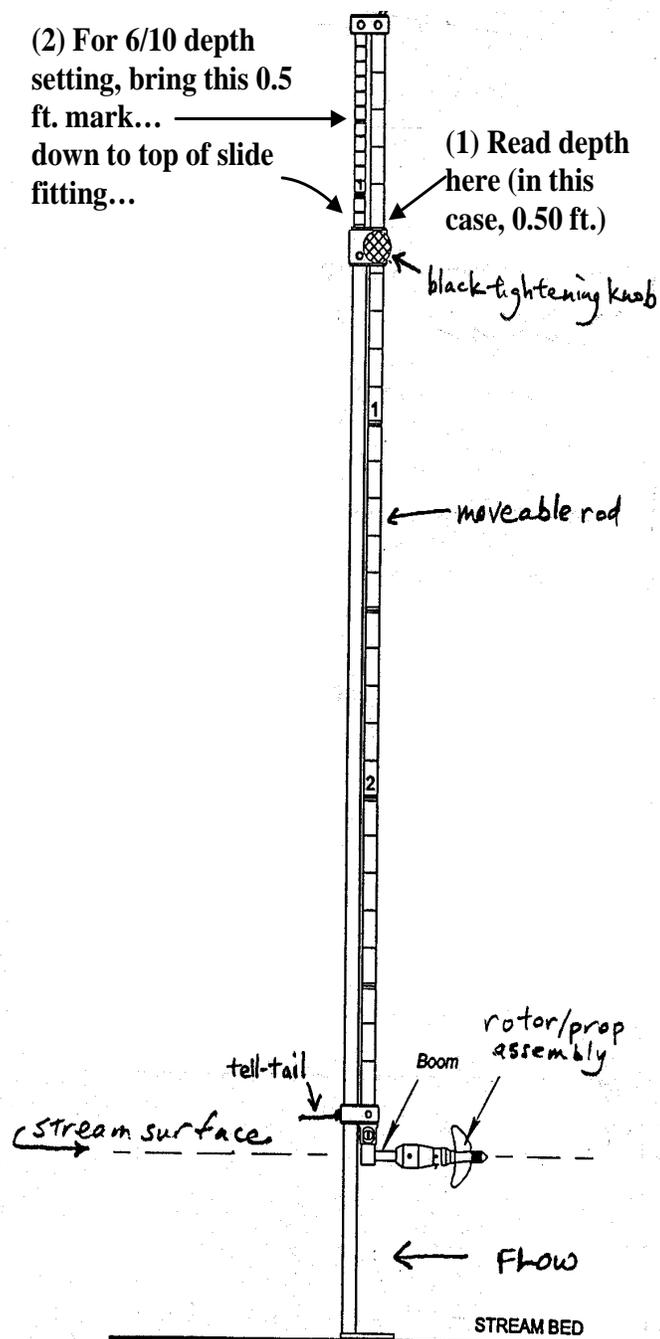
leader, or program staff for more information.) If your site has such monuments, use them. If it does not, you should pick the best spot on that day:

- The ideal site would be at least 5' across, at least 3" deep, and have water that is flowing straight and not turbulently at ≥ 1 ft/sec.
- If you can't find an ideal site (as is likely to happen with smaller streams in the summer), find or create a site where the water is at least 3" deep and moving at ≥ 0.5 ft/sec. (I.e., compromise on width if you have to.) You can "create" such a site by making temporary "peninsulas" on the sides of the creek to concentrate the flow, using rocks/gravel/sand, or the sandbags in your field kit.
- Look for variations in the amount of water you see flowing along the length of your reach, and measure at a spot where the flow is maximized and not running underground.
- A suitable site should not have side-channels, undercut banks, or flow obstructions such as boulders, logs, or aquatic vegetation. If a few large rocks are in the way, you can move them about six feet downstream.
- You may walk outside your reach IF no water leaves or enters the stream in between.

Propeller sizes: For the Swoffer meter, we normally use the 3" props because they perform best in our normal range of velocities (0-4 ft/sec), even if the prop can't be submerged completely. However, the 2" props

perform best at higher velocities (4-8 ft/sec). Consult with staff if you want to use 2" props.

SWOFFER 2100 STAFF:



BASIC INFORMATION

1. On your data sheet, indicate if you'll be using a Streamkeepers protocol or some other protocol, what method you'll be following (wade-across, bucket, etc.), and whether this is a primary

sample or a replicate, taken simultaneously with or immediately after a primary sample.

2. If there is no water flowing, indicate "Floating Object" method and describe:
 - a) No water visible.
 - b) Water in pockets only.
 - c) Water in channel, but no apparent flow.
3. Proceed to directions for the method you'll be using.

WADE-ACROSS METHOD—SWOFFER METER

PREPARING THE METER AND STAFF

1. While still on dry land, remove the velocity meter staff from its plastic-pipe case (see picture). Move the moveable rod up slightly. (Loosen or tighten the black knob on the slide fitting at the top, so that the sliding rod moves snugly.) At the bottom of the moveable rod is a boom that swivels. Swivel the boom to the 90° position. Take the orange protective cap from the boom and put it in your pocket.
2. Take the "PRIMARY" rotor/propeller bag from the "treasure box" in your kit. **Record the rotor number, calibration number, and calibration date on your data sheet.**
 - If you're using the alternate 2" prop, it's best to reset the calibration number on the meter to match the rotor/prop unit you'll be using (probably the Primary). Remove the black plastic screw on the base of the meter beneath the label "FT cal adjust" on the front. Switch meter on to CALIBRATE position. Use a small flat-bladed screwdriver to turn the screw inside and adjust the calibration number. Replace the cover screw.
 - It's not necessary to reset the calibration number in the meter; if you don't, the database will account for the discrepancy between the calibration number in the meter and the one for the rotor/prop, as long as you write both down correctly on your data sheet. However, as you wade across the stream, the velocity readings you'll be seeing will be incorrect because of the discrepancy (that's what the database will be correcting).
 - If you do reset the calibration number in the meter, please set it back to what it was (generally, the calibration number on the primary 3" rotor/prop unit) when finished.

3. Take the rotor/prop unit out of the bag. Make sure the number etched into the side of the unit is the same as that on the bag. If not, check the other bag, or write down the numbers on both the bag and the unit. *Make sure the knurled nut holding the prop on the shaft is tight.* Then perform a **hand-spin test**: Hold the unit vertically by the steel rotor shaft with the prop facing up, and give a super-fast spin to the nut on top of the prop by “snapping” your fingers. If you hear a buzz, the rotor needs to be replaced—switch to the “SPARE” and return to Step 2. IF ANY ROTOR FAILS THE HAND-SPIN TEST, NOTE IT ON THE DATA SHEET AND INFORM THE PROGRAM MANAGERS UPON RETURNING THE EQUIPMENT. On your data sheet, mark the results of the test for the rotor you used.
4. Insert the rotor/prop assembly into the sensor boom on the staff. Use the 1/16” Allen wrench from the same bag as the rotor/prop to tighten the tiny set screw at the tip of the boom, fairly firmly. The prop should still spin freely. Put the Allen wrench in your pocket.
5. Connect the cables on the meter and staff. The connector is “keyed” and only mates one way, so be *very careful that you are aligning the connector ends properly.* Push the connector ends together, and then twist clockwise until the connector clicks into the lock position.
6. Switch to the “CALIBRATE” position. The display should read the same calibration number as that given for the primary rotor/prop assembly. If the number is not the same but is within 10%, proceed—the computer will compensate for the difference. If the difference is >10%, try a fresh battery (see “Meter Troubleshooting” at the end of this section), and if that doesn’t work, start over with the spare rotor/prop. Record the meter calibration number on your data sheet.
7. Perform a **count test**: Rotate the switch to the “COUNT” position. Turn the prop slowly and confirm that the count increases by one for every quarter-turn of the prop. If not, try a fresh battery. On your data sheet, mark the results of the count test.
8. Perform a **blow-spin test**: Hold the rotor/prop assembly with the prop facing up, and blow a strong, steady, sustained breath of air to give the 3” prop a chance to overcome inertia. (If you are using a 2” prop, use a short hard puff.) Right after you stop blowing, hit the “RESET” button on the meter and allow the rotor to coast to a stop. If the count is less than 300 consistently or if the prop stops abruptly instead of coasting slowly to a halt, try to:
 - Back off slightly on the set-screw, or
 - Take apart the rotor, rinse it in clean water and try again, or
 - Switch to the “SPARE” and return to Step 2.
 On your data sheet, record the results of the blow-spin test for the rotor you use. IF ANY ROTOR FAILS THE BLOW-SPIN TEST, INFORM THE PROGRAM MANAGERS UPON RETURNING THE EQUIPMENT.
9. When satisfied that the flow meter is operating correctly, turn the switch “OFF”.

MEASURING FLOW

1. Determine the *nominal interval for your measurements*:
 - a) At the point where you have decided to measure flow, stretch a tape across and above the wetted portion of the stream channel perpendicular to the direction of flow. (This may not be exactly perpendicular to the stream banks.) Use spring clamps to secure the tape around vegetation, large rocks, or stakes.
 - b) On your data sheet, note the tape readings for the wetted edges to the nearest 0.1’. Calculate and record the wetted width of the stream by subtracting one wetted edge from the other. Divide the wetted width by 10 to find the MAXIMUM INTERVAL and record it on the data sheet. Do not exceed the MAXIMUM INTERVAL between measurements even outside of the “prop-turning” portion (see below).
 - c) Determine the area along this line where the prop turns—i.e., don’t include portions where the stream is too shallow or the water isn’t moving. (This must be at least 0.1 inch inside of the wetted edges you have recorded.) On your data sheet, note the distances on the tape corresponding to the edges of the “prop-turning” portion. Calculate and record the “prop-turning” width on the data sheet by subtracting one from the other.
 - d) On your data sheet, divide this “prop-turning distance” by 20, then round UP any decimals to the nearest tenth of a foot. This will give

you an average interval that will yield 15-20 measuring-point cells across the “prop-turning” area.

(For example, if the area is 12.2' wide, $12.2'/20 = 0.61'$. If you round UP to 0.7', you will have about $12.2/0.7$ or 17 cells.)

NOTE: The MINIMUM INTERVAL distance is 0.3', regardless of what you rounded up to. So in a creek smaller than 4.5' across, you'll have fewer than 15 cells.

2. **Zero readings at wetted edges:** At both wetted edges (see above), you'll need to record the tape reading in the first and last blank in the flow data table; the depth and velocity (both zero) have already been recorded on the data sheet for you. If the bank is undercut (try to avoid this!), you'll have to estimate how far back the water goes. (You can do this by putting a stick into the undercut and then measuring this distance on the stick.)

3. **Proper stance:** Put the velocity meter's strap around your neck and enter the stream downstream of the tape. When taking measurements, stand with the wading rod at arm's length and your feet upstream and downstream of each other, off to the side of where the water flows past the rod. You will be facing upstream at about a 45° angle. Hold the rod so the propeller faces into the flow.

4. **Varying intervals :** Your nominal interval will be the one you calculated on your data sheet. However, your actual intervals should be:

- larger in non-prop-turning areas or places where water depth or velocity are relatively small or uniform
- smaller where water depth or velocity are relatively large or are changing rapidly

Intervals should be:

- no greater than 1/10 the wetted width of the stream (MAXIMUM INTERVAL)
- no smaller than 0.3' (MINIMUM INTERVAL)

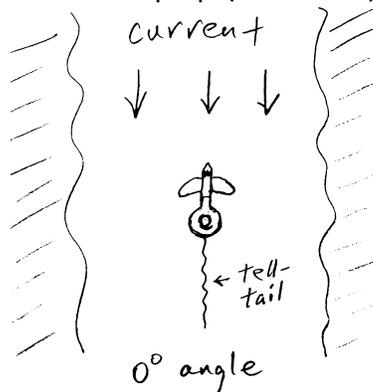
You need to take readings even in non-prop-turning areas, where you'll just record distance, depth, and in the velocity field either: “insf/d” for insufficient depth, “insf/v” for insufficient velocity or “insf/dv” for both (see “Low-Velocity Conditions” below).

BE SURE TO TAKE READINGS 0.3' TO EITHER SIDE OF “PROP-TURNING” EDGES,

unless those edges are right next to the wetted edges.

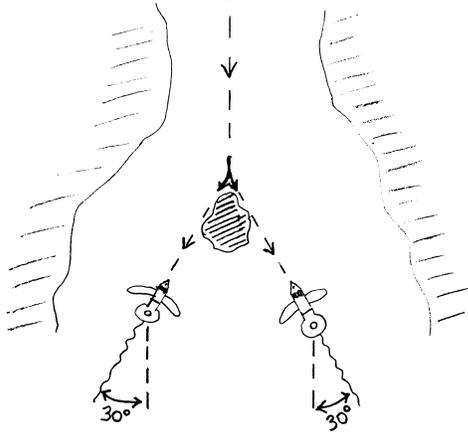
5. **Taking readings—general procedure for water between 0.3 and 2 feet deep:**

- Record on your data sheet the start time and the bank you're starting at.
- Set the rod on the stream bottom and record the tape reading on your data sheet, to the nearest tenth of a foot.
- Adjust the moveable rod as needed to set the tip of the prop at water level. The staff should be vertical, which you can determine by briefly letting go of it. Read the stream depth from the large scale on the moveable rod, at the point where it enters the top of the slide fitting. (See picture earlier in this section.) Note that the scale reads downward, intervals are in tenths of a foot, and foot-marks are triple lines. Record the water depth from the staff, to the nearest hundredth of a foot. (You will have to estimate between the 0.1' markings on the staff.)
- Place the prop at 6/10 the distance from the water surface to the stream bottom. You can do this easily by lowering the moveable rod until the top of the slide fitting matches the marking for your stream depth on the smaller rod. (Exception: do not go so far that the prop hits the stream bottom.)
- The tell-tail (piece of colored twine attached to the back of the prop/rotor fitting) will ordinarily point downstream in line with the axis of the prop (see sketch).



If it does not, then rotate the rod to one side or the other, until the prop faces directly into

the current with the tell-tail straight out behind it (see sketch below). Take your measurement with the prop turned into the current at this angle.



Estimate, to the nearest 10°, the angle you rotated the rod, and record it on the data sheet. (It doesn't matter whether you rotated the rod left or right—just record the number of degrees you had to rotate it.) If you did not need to rotate it at all, write 0. (If the stream flow were completely reversed at your point of measurement, i.e. flowing back upstream, and you had to turn the rod completely around, you would record an angle of 180°.)

NOTE: *If the water is turbid and you can't see the tell-tail, you should be able to feel the "sweet spot" where the current isn't trying to push the rod to either the left or right. Then compare the angle you see on the double-rod to the angle of the overall current.*

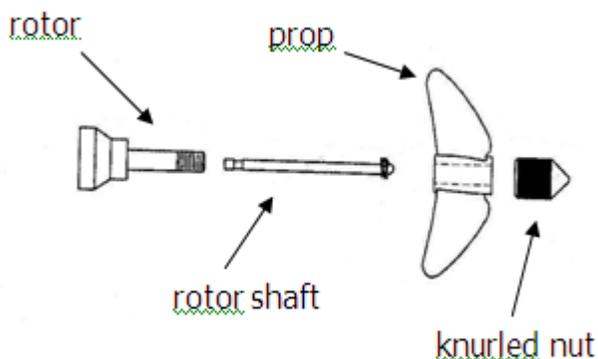
- f. Turn the meter switch to "DISPLAY AVERAGING" (between the Min and Max settings). Press and release the RESET button to zero the display. After approximately 25 seconds, the meter will display a velocity. Record this reading in the "velocity" column on your data sheet.
 - g. Proceed across the stream, taking your readings, ending at the far wetted edge.
 - h. If any velocity reading is different by a factor of 2 than the previous one, the recorder should ask the sampler to confirm that reading.
 - i. **COMMON SENSE & FLOW READINGS:** Use your common sense to consider whether the velocity on the meter jibes with how fast the water seems to be moving. Certain conditions can cause the meter to mis-read. If you doubt a reading, take another, then a third to confirm. If possible, record all of these data points along with an explanation of which ones you think should be ignored, and why. If problems persist, see the "Troubleshooting" section later in this protocol.
 - j. Indicate the end time for the sampling, next to the start time on the data sheet.
 - k. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data, which will generally be the person with the most experience or knowledge.
 - l. Recheck the meter calibration number (switch to "CALIBRATE"). If the number has changed, record the new number alongside the first number on your data sheet.
 - m. Turn the meter off when finished taking readings, and see storage and transport instructions at the end of this section.
7. **Procedure for water > 2 feet deep:** First, seriously consider whether it's safe for you to be in the stream! If you're sure it is (you'll need chest waders), you will need to take two velocity and angle measurements, at 2/10 & 8/10 of total depth. To do this:
- a. Put slashes across the velocity and angle boxes, to make room for the two readings you will take.
 - b. Instead of moving the smaller top rod to the equivalent mark as your depth, you'll take one reading with that rod at half of what your depth was, and another with that rod at twice what your depth was, along with the angles at each depth. This will give you 2/10 & 8/10 readings, which data-entry folks will average at the office.
8. **High velocity interference:** If the water is very fast, you may begin to feel the propeller vibrating in the water. If so, note this on your data sheet, because the readings will be under-reporting the actual velocities. If you're in a position to change to a calibrated 2" prop and start over again, do so.
9. **Procedures for low-velocity conditions:**
- a. If at a given measuring point, the water isn't moving fast enough to turn the prop, write

"insf/v" ("insufficient velocity") on the data sheet.

- b. If the prop turns, but erratically, measure the velocity a second time. If the difference is <20%, keep the first reading. If the difference is >20%, take a third reading, and record the average of all three.

10. **Procedure for water <0.3 feet deep:** For very shallow water, don't worry about the depth at which you set the prop—put it at any depth where the prop will turn. Record distance, water depth, and velocity as usual. (Note if the prop is partway out of the water.) However, if the shallowness is clearly impacting your velocity measurements, try one of the alternative low flow methods on the next page suggested by the U.S. Bureau of Reclamation (Perry, 2003).

11. **Gunk on the prop:** If there is a lot of organic matter in the stream (particularly filamentous algae and particulates), you may find the prop becoming impeded and turning erratically or not at all. The rotor/prop unit may have become dirty inside. Shake the rotor/prop unit in the water, or take it off using the 1/16" Allen wrench and try rinsing it in clean water or squirting clean water up the rotor shaft. If that doesn't help, unscrew the knurled knob, remove the rotor shaft, and **gently clean both it and the bore hole** in clean water. (See following diagram.) You may have to do this several times in certain conditions.



ALTERNATE LOW-FLOW PROCEDURES

BUCKET METHOD: If you can capture the flow (from a culvert or waterfall) in a bucket or other container, simply time how many seconds it takes to fill it. Record 3 reps, and then record the average. Measure the volume of the container and convert to cu. ft. (128 oz. = 1 gal. = 0.134 cu. ft.). Record the results with every step labeled clearly so office staff can verify the results.

ONE-POINT "HYDRAULIC" METHOD: If the water level is so low that you can't deploy the flow-meter prop in it, you might be able to confine the water into a small ditch or "canyon" that confines the water, using rocks or sandbags, creating a section as rectangular in cross-section as possible, a few feet long if possible, and deep enough to submerge the prop of the meter. (Also ensure you're measuring at a spot where significant amounts of water aren't flowing under the gravel; you may have to walk several hundred yards to determine this.) Then:

1. Find one good spot for a velocity reading:
 - a) halfway between the upstream and downstream ends of your ditch;
 - b) at a place where the tell-tail points straight back; and
 - c) at halfway depth.
 If the prop does not turn freely at this point, try to find a spot at which it does.
2. Take a velocity measurement at that point: set the meter to "Velocity/Max," take 3 readings, record and average them.
3. If you still can't get the prop to work, estimate the velocity by marking off the length of your ditch and floating a small twig down its length ten times. Divide the number of feet by the average number of seconds to get the velocity (all to the nearest tenth). Mark as an Estimate; this "Pooh-stick" method does not account for friction and may result in an overstated flow value.
4. Measure and record the channel depth and width at the spot you measured, to calculate the channel cross-sectional area to the nearest 0.1 ft². If it's not rectangular, draw it out and use geometry to calculate. If it's a culvert pipe, all you need is the pipe diameter and deepest depth, and the cross-section can be calculated at the office.
5. Multiply Velocity x Depth x Width and round to the nearest tenth or else to the first digit with an actual number (e.g., .04 or .003). This is your flow measure.
6. Provide all relevant information so a determination can be made in the office as whether to apply a qualifier or correction factor.

FLOATING-OBJECT METHOD: This method (based on Murdoch et al. 1996) will produce an estimate of flow when other methods aren't available, for example, when the water level is

extremely low and you can't use the one-point method. There should be a data sheet for this method in your forms folder, as well as in the Data Sheets section of the Handbook.

1. Find a place with the most even flow and flat bottom.
2. Mark off a course of as long a length as possible with uniform channel and flow.
3. Throw twigs in above the starting line, then time them from start to finish. Throw them in at multiple places across the creek to get an average time. Even if you can only throw in at one point, do at least 3 trials.
4. Divide the length by the average time to get the average velocity in ft/sec.
5. Estimate average depth & width to get a cross-sectional area.
6. Multiply the above by a 0.9 friction coefficient for a smooth-bottomed stream, 0.8 for bottoms with rocks or plants, or 0.7 or less if there's a lot of vegetation.
7. Round to two significant figures (probably one decimal place). The data will automatically be labeled as an Estimate due to the method used.

STREAM GAGES: Your stream may have a water-level gage installed on it, or we may be able to install one if you see a need and are willing to help with the reconnaissance and installation. Over the course of time, dual readings from both the flow meter and gage yield a calibration formula that enables us to estimate discharge simply by reading the gage. (We also have to calibrate the gage by periodically making dual readings and measuring the channel cross section.)

If you have a gage at your site, simply record the water height and units on your flow field sheet. Read the gage both before and after measuring flow, if possible, particularly if the water level might have changed during the course of the flow sampling.

In some cases, stage is measured by simply measuring the water level at some monumented point, or by measuring top-down from a set point (such as the top inside diameter of a culvert), in which case the value would be a negative number. Check the site description to see how to measure stage there. Indicate the method used on the data sheet.

MONITORING FLOW BETWEEN SESSIONS

You might want to measure flow between quarterly monitoring sessions, to learn more about extreme high and low flows in a stream, or about how flow changes during a storm. Therefore, if...

- you want to perform additional flow sampling,
 - a field kit is available,
 - it is **SAFE** to monitor, and
 - you have a team of at least two,
- ...you are welcome to borrow a field kit and data sheets at any time.

METER TROUBLESHOOTING

1. If the meter falls in the water, open the battery compartment on the back as soon as possible by twisting the set screws loose by hand. Dry the battery terminals and cable connections, and let the compartment air dry as much as possible before replacing the cover. Hand-tighten the set screws.
2. If the prop isn't spinning freely:
 - a) You may be at a spot in the stream with no current (or almost none). A sign of this would be that the tell-tail is drooping. If the tell-tail is pointing to the side, you may need to rotate the staff to face into the current.
 - b) If the tell-tail indicates current and the prop isn't spinning, try the "Gunk on the prop" cleaning procedure described earlier.
 - c) Try the hand-spin and blow-spin tests again. If a test fails, switch to the spare prop and start the flow measurement procedure over again from the beginning. Note problems and how you dealt with them on your data sheet.
3. If the velocity readings appear inconsistent or illogical as you're proceeding across the stream, try the following fixes and test them by turning the meter to "Count" and letting the prop turn in the stream; the numbers shouldn't skip or stop (unless the current is very slow).
 - a) Try turning the meter on and off again. Sometimes this will reset the circuits.
 - b) Examine the cords and connectors for wetness, bad connections, or any other obvious problems, taking corrective action where possible.
 - c) Try taking the battery out from the back panel, checking for wetness or corrosion,

and putting it back in if it looks okay. Sometimes this simple step can reset the circuits. If this doesn't work, try replacing the battery.

- d) Try the blow test again. If it fails, you can either take apart the rotor and rinse all the parts, or switch to the spare rotor.
- e) IF YOU CONTINUE TO EXPERIENCE DIFFICULTIES, NOTE THE NATURE OF THE PROBLEMS ON THE DATA SHEET AND DISCONTINUE FLOW MONITORING. INFORM PROGRAM STAFF UPON RETURNING THE EQUIPMENT.

top and the tell-tail tucked under so it does not get frayed.

- 4. At the end of each monitoring day, always be sure to remove the rotor/prop assembly and store staff, meter, rotor/prop assembly, protective cap and Allen wrench in their proper places. If possible, dry these parts with the rags in your field kit before storing.

TIPS FOR DATA RECORDING

1. Write legibly and be sure to record the data in the units and number of decimal places called for on the data sheet.
2. The data recorder should repeat measurements back out loud to the flow sampler to avoid mistakes.
3. The data recorder should be alert for inconsistencies in the progression of the numbers and bring any suspect sudden changes to the attention of the flow sampler for verification and resampling if necessary.
4. Use common sense when recording readings. If the water appears to be moving faster or slower than the meter is reading, consider going over the METER TROUBLESHOOTING steps in the prior section.
5. Zero flow – describe conditions carefully; see first page of protocol.

METER STORAGE AND TRANSPORT

1. When swiveling the boom mechanism, always hold it by its base and not by the rotor assembly.
2. NEVER transport the staff with the rotor/prop attached. Take off the rotor assembly, and replace the orange protective cap between sites. Return rotor/prop unit and Allen wrench to the treasure box. If you are going to another monitoring reach that day, you can keep the rotor/prop and Allen wrench in your pocket.
3. DO NOT wrap the cord around the wand before storing in the plastic tube to avoid causing shorts in the electrical cables. The preferred method of storage is to place the wand in the tube "head" first and drop the cord down inside when the wand is about halfway in, then insert the rest of the wand with the "foot" part at the

Marsh-McBirney® Model 2000

(adapted from WA Dept. of Ecology—Kardouni 2011)

NOTE: Ecology's Stream Hydrology Unit (SHU) does not use Marsh-McBirney meters nor recommend their use. Ferrous metals can corrupt the electromagnetic field within which the meter measures velocity, and it is extremely difficult if not impossible to determine when, where, and to what extent the field is altered. (Casey Clishe, SHU, personal communication May 2013). Given this situation, it might be particularly problematic using the M-M meter to measure the flow in or near a steel culvert.

The Marsh-McBirney® 2000 consists of a transducer probe, cable, and signal processor. The probe emits an electromagnetic frequency used to measure velocity. The Marsh-McBirney® wading rod has an adapter capable of holding the transducer probe.

Factory calibration: The meter should be sent to the factory for calibration at least once a year. The factory calibration report will indicate meter bias prior to calibration, which can be used to qualify data as needed.

Zeroing the meter: To ensure accurate measurements, zero the meter at least once a week during use; however, it is preferable to zero it at the beginning and end of each day of use. First clean the sensor, because a thin film of oil on the electrodes can cause noisy readings. Then place the sensor in a five gallon plastic bucket of water, keeping it at least three inches away from the sides and bottom of the bucket. To make sure the water is not moving, wait 10 or 15 minutes after you have positioned the sensor before taking any zero readings. Use a filter value of 5 seconds. Zero stability is ± 0.05 ft/sec.

- To initiate the zero start sequence, press the **STO** and **RCL** keys at the same time. You will see the number 3 on the display.
- Decrement to zero with the 6 key.
- The number 32 will be displayed.
- The unit will decrement itself to zero and turn off. The unit is now zeroed.

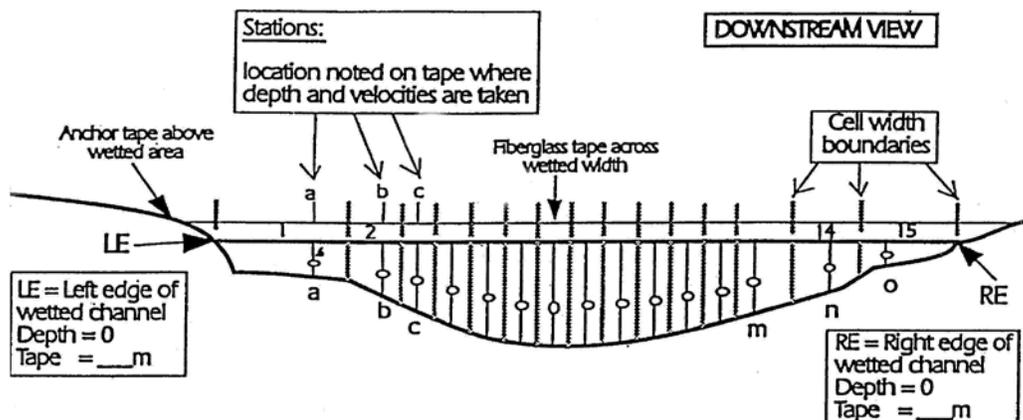
Measuring Velocity with the Marsh-McBirney:

- Attach transducer probe to wading rod.
- Turn meter on.
- If units indicated are not FT/S, toggle between to FT/S by pressing the **On** and **Off** keys simultaneously.
- Meter is already set to Fixed Point averaging (FPA) of 30 seconds.
- The wading rod should be set to the appropriate depth—see the “Taking Readings” section earlier in this protocol.
- Place the probe in the stream with the round end of the sensor facing upstream, perpendicular to your tape line.
- The time bar provides an indication as to the amount of time left until the display is updated. Wait for the appropriate time delay and then record the stream velocity.

Handling: The transducer probe's instrumentation is fragile; protect the probe from bumping.

Questions? Refer to the manual, in the same bag with the meter.

How Flow is Calculated using TFW protocols



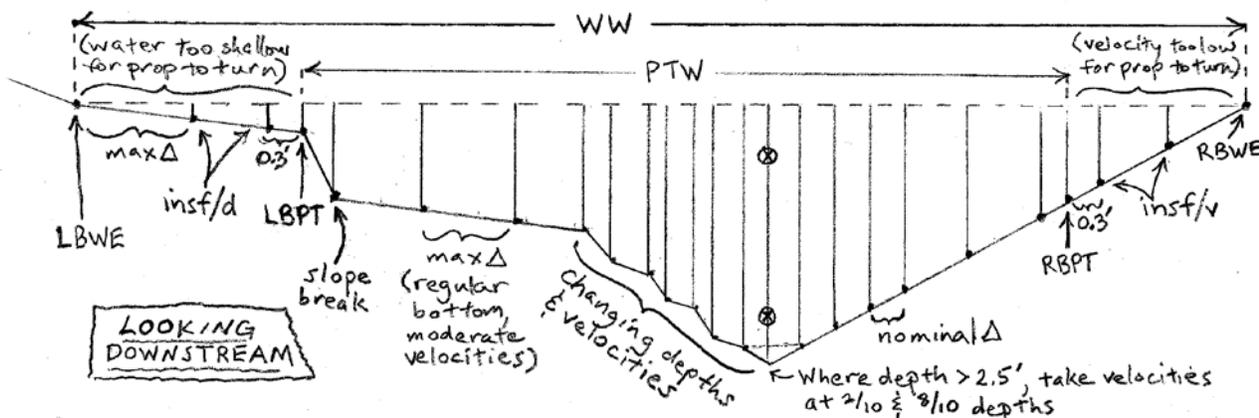
Cell width:
 Edge cells - distance from wetted edge to first station + 1/2 the distance to the next station
 for example: cell 1 = LE - a + 1/2 a - b
 cell 15 = 1/2 n - o + o - RE
 Middle cells - split the difference between stations
 for example: cell 2 = 1/2 a - b + 1/2 b - c
 cell 14 = 1/2 m - n + 1/2 n - o

Velocity:
 Station depth of water < 2.5 ft/.6m: take one velocity at .6 of depth (from surface) at stations
 Station depth ≥ 2.5 ft/.6m: take velocities at .2 and .8 of depth at stations and average together

NOTE: To capture high flow areas of stream, take smaller cell measurements in those locations.

Cell Discharge = Cell Width X Cell Depth X Cell Velocity
Stream Discharge = The sum of all cell discharges

Average cell depth:
 Depth at station from surface of substrate to stream's surface



Streamkeepers flow abbreviation definitions

- LBWE** = Left Bank wetted edge of dry land.
- RBWE** = Right Bank wetted edge of dry land.
- WW** = Wetted width; the difference between wetted edges.
- MaxΔ** = MAXIMUM INTERVAL; 1/10th the wetted width.
- LBPT** = Tape measurement at LB "prop-turning" edge.
- RBPT** = Tape measurement at RB "prop-turning" edge.
- PTW** = "Prop-turning" width; the difference between "prop-turning" edges.
- NomΔ** = NOMINAL INTERVAL; the "prop-turning" width divided by 20.
- Insf/d** = Insufficient depth, water too shallow for prop to turn.
- Insf/v** = Insufficient velocity, water too slow for prop to turn.

PHOTOS

EQUIPMENT NEEDED—BASIC

- camera with SD card and charged battery
- photo log on data sheet or in camera case
- knowledge of position of “zero-point” (central monitoring point) or cross-section transect for your reach, from your hand-drawn map, written description, or verbal instructions
- data sheet, clipboard, pencil

EXTRA EQUIPMENT NEEDED FOR PHYSICAL HABITAT SUITE

(Optional as of 2005):

- Cross Section tape and string still stretched across stream
- 2nd 100-foot tape, to stretch along baseline
- flagging tape, stakes
- Large Woody Debris and Erosion/Revetment protocols

Photos provide a visual record of stream and riparian features which are archived in the Clallam County Water Resources database. Streamkeepers' protocols call for different types of photos during the different quarterly monitoring sessions. Volunteers are also welcome to take additional photos at any time.

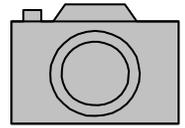
The camera is fully automatic, including exposure, focus, and fill-in flash. In rainy weather, keep the camera in your shirt pocket or close to your body to minimize fogging. For more camera instructions, see the “Camera Use” section.

Fill out the Photo Log on the data sheet and include all relevant information as you take photos (see samples below). Abbreviations that you can use are printed below.

Try to have a person or other familiar object in each photo as a size reference—but be sure not to block whatever the photo is supposed to show! Also, if possible, try to include a landmark—a culvert, bridge, fence, big rock, or other structure—that may help locate the photo's location.

SUMMER PHOTOS

(See sample photo log below)



1. Make sure the date is right on the camera—if not, fix it (see “Camera Use”).
2. If you aren't doing physical habitat measurements at this site, take photos upstream and downstream from your site's “zero point” (central monitoring point), from mid-channel.
3. If you are doing physical habitat measurements at the site, do the following:
 - a) Leave the Cross Section tape, string, and bankfull flagging still attached.
 - b) Stretch a tape along your baseline. Refer to your hand-drawn reach map or written description of zero-point location and compass bearing if necessary.
 - c) Photograph:
 - i) The entire width of the cross-section transect, with three pieces of flagging tape hanging from the string, taken from downstream at mid-channel (this may require more than one photo). On the photo log, indicate how many feet the photographer is standing down-stream of the cross-section line.
 - ii) Photos of where lbfll and rbfll were located, showing the entire bank with a flagged stake at the bankfull point.
 - iii) Views upstream and downstream from the cross-section line, from mid-channel.
 - iv) Photos of the string & tape where they attach to the lbm and rbm.

Also take photos of the following features. For each feature, indicate on your photo log the distance from your zero-point, and the direction (u/s or d/s).

- d) Each piece of large woody debris (LWD), with a large enough field of view to see the surrounding channel and riparian area. (If you aren't doing the Large Woody Debris protocol, take photos of any large wood that seems either to provide fish refuge or help shape the channel at some flow level.)
 - e) Any eroded or revetted areas, if you have not already photographed them during a recent Streamwalk (see separate chapter). Here you may need to pause and perform the Erosion/Revetment protocol (or at least read the definitions therein).
 - f) Any interesting or problem areas:
 - i) wildlife signs: redds, tracks, scat, etc.
 - ii) fish passage problems
 - iii) anything causing habitat problems
 - iv) new human-made structures
4. Also take shots of volunteers at work or play that we might be able to use as mementos or promotional materials. Be sure to record everyone's initials.
 5. Check "Yes" in the "Photos taken" box on your data sheet, and write the initials of the person who completed the photo log. If you didn't take photos at this site, check "No" in this box.

SPRING PHOTOS:

None required, but see 3c & 4 under "Summer Photos."

FALL PHOTOS:

These are described in the "Benthic Macroinvertebrate" protocol.

WINTER PHOTOS

1. Make sure the date is right on the camera—if not, fix it (see "Camera Use").
2. Take 4 photos from along the cross-section transect or zero-point of your site (see diagram on next page):

- a) Stand along the cross-section transect on one bank. Take a photo facing across the creek angling upstream, showing the opposite bank and riparian area.

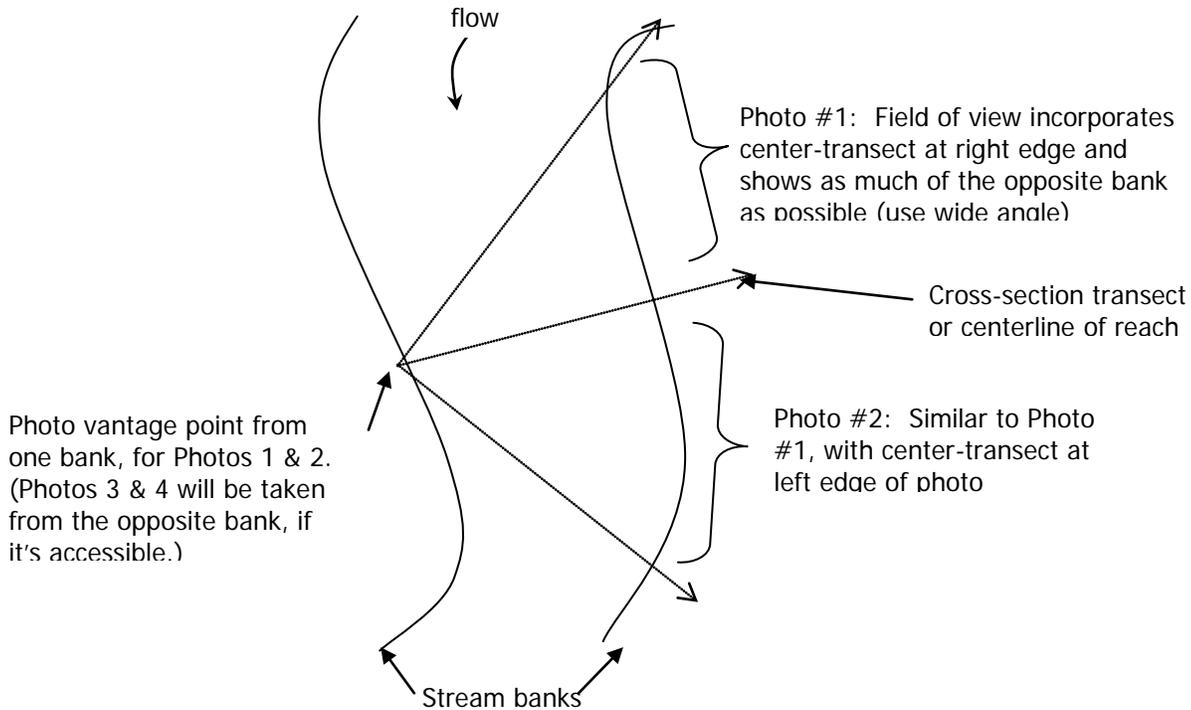
NOTE: Aim these shots so that the cross-section transect or centerline of the site is in the frame, but near the edge. (Either get the opposite-bank monument in view, or imagine where it would be.)

- b) From the same position, take a similar photo facing across the creek angling downstream.
- c) Now cross the creek if possible (in winter time this may not always be possible to do safely!), stand along the cross-section transect on the opposite bank, and take a photo across to the other side and angling upstream.
- d) From the same position, take a photo facing across the creek and angling downstream.

Take photos of anything else of interest, explaining the reason for the photo on your photo log. (See Summer Photos above for examples.)

3. Check "Yes" in the "Photos taken" box on your data sheet, and write the initials of the person who completed the photo log. If you didn't take photos at this site, check "No" in this box.

WINTER PHOTOS



ABBREVIATIONS TO USE WITH PHOTO LOG

u/s, d/s = upstream, downstream	X = cross, across
LB, RB = left bank, right bank (when facing downstream)	X-Sec = cross section
[#]' = number of feet (along baseline from zero-point, unless otherwise indicated)	trans = transect
@ = at	ch = channel
	pt = point

SAMPLE PHOTO LOG FROM DATASHEET

Photos taken? Yes No Sampler's initials: *KRM*

(Cut below after inputting data into database and recording Visit ID# below.)

Photo log:

Site Name: *Beaver 0.1* Date: *8/18/14* Camera #: *4*

Initials	Frame #	Subject	Vantage Point
<i>KRM</i>	<i>100-0023</i>	<i>Facing u/s</i>	<i>Zero-point</i>
<i>KRM</i>	<i>100-0024</i>	<i>Facing d/s</i>	<i>Zero-point</i>
<i>NSR</i>	<i>100-0025</i>	<i>LWD on LB 35' d/s of zero point</i>	<i>RB</i>
<i>NSR</i>	<i>100-0026</i>	<i>Erosion on LB 50-65' d/s of zero point</i>	<i>RB</i>
<i>NSR</i>	<i>100-0027</i>	<i>Poison Hemlock on LB 75' d/s of zero point</i>	<i>RB</i>

(enter in office) Visit ID#:

ANYTIME PHOTOS

1. Photos taken outside of regular monitoring when no data sheet is used must be recorded on the Photo Log inside the camera case. See example in camera case Photo Log below.
2. Whenever you change the date, location, or sampler, you need to make a "breakout" line in the log that makes this change absolutely clear (see example below).

**STREAMKEEPERS OF CLALLAM COUNTY
 *** LOG FOR PHOTOS ONLY IF NOT PART OF
 A REGULAR MONITORING VISIT *****

Camera #: 4**Date: 8/8/08****Location: Home****Initials: BDD**

Frame #	Subject
100-0030	Carol Dunlap calibrating pH
--Morse Creek ~30' d/s of Discovery Trail Bridge	
100-0031	Poison Hemlock on RB
--8/9/08	Ennis u/s of Ennis Creek Rd
100-0032	Unknown pipe input on LB

THE SCOOP ON YOUR PHOTO LOGS & PHOTO DATA SHEETS

A picture can be worth 1000 data points - that's why we include photos in our monitoring program. When you return your camera, the photos are down-loaded and then "processed" by lightening or darkening parts as needed, attaching information from your photo logs to the photos, organizing and storing the photos in a systematic way, and copying these files into the Clallam County Water Resources database, right along with the rest of your data.

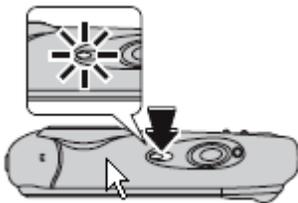
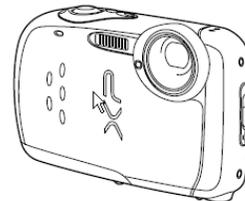
But to get this all right, we need your help! Please note the following:

- *All entries in the photo log need to clearly indicate who, what, when, & where.*
- *Correctly entering the camera # and frame # is essential for matching the photos to your photo log entries.*

CAMERA USE

Instructions for the Fuji XP10 Digital Camera

The Fuji XP10 is flexible and easy to use. The camera has been set for automatic operation which should provide good pictures in all field conditions. **Please do not change any of the settings other than those described below. Please insert your hand through the camera strap for safekeeping.**



Turning the Camera On and Off

Press the small button on top and hold it down until an image appears on the screen, and the blue light

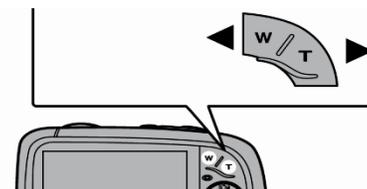
comes on. Press the small button again to turn the camera off.

Tip: Turning the camera on again

To enter shooting mode, press **ON/OFF**. To enter playback mode, press .

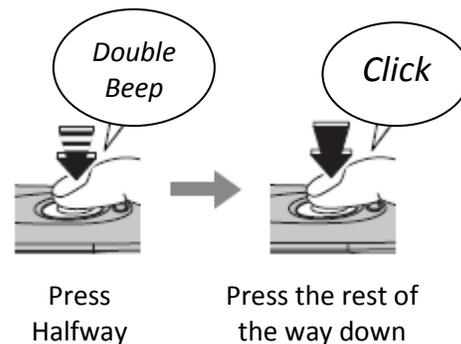
Framing the Picture

Position the main subject in the focus area and use the zoom buttons to frame the picture in the screen. Press **W** to zoom out or **T** to zoom in.



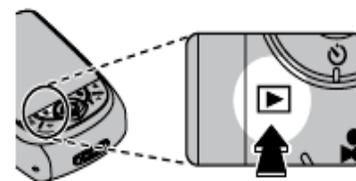
Focusing and Shooting

The camera will focus on whatever you see in the center of the screen. Press the shutter button (large button on top of the camera) halfway down to activate the auto-focus. When focus is obtained, two beeps will be heard. Press the button down the rest of the way to take the picture. Make sure you hold the button down until you hear the shutter click. In low light, the shutter will be slightly delayed while the scene is illuminated by the automatic flash. In the unlikely event focus is not obtained, a red message "AF!" will appear on the screen. In that case, find another object at the same distance from you, press the button half-way down to obtain a focus on that object, then, while keeping the button pressed half-way, move the camera to again view the picture you wish to take.



Checking the Picture

In order to check the picture, press the review arrow button on the back of the camera. If the picture is satisfactory, note all required information in the photo log sheet. If not, delete the picture and retake it.



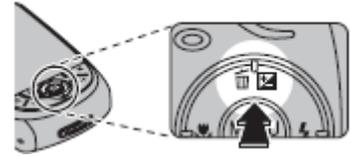
While in this mode, you can move back and forth between the stored pictures using the right and left sides of the Menu/OK button on the back of the camera. You can also zoom in on a picture you are viewing by using the zoom lever on the upper-right back of the camera.



Press the shutter button to return to shooting mode.

Deleting Pictures

To delete a picture being viewed, push the top of the Menu/OK button. A message will appear on the screen asking if you wish to erase the picture. To do so, again push the top of the Menu/OK button to select "OK" on the screen, then press the OK button. To exit without erasing, press the bottom of the Menu/OK button to select "Cancel" and press OK.



Entering Data on Log Sheet

When in the viewing mode, data for that picture is displayed on the screen. The frame number for that picture appears at the upper-right corner in the format XXX-XXXX. It is critical that this be entered on the log sheet, along with the descriptive information for the photo (see Photo protocol), the camera number, the site name, the date, and the initials of the photographer.

If you get lost in the Menus, don't start randomly hitting buttons! Get out by hitting the "DISP/BACK" button at the bottom of the back side.

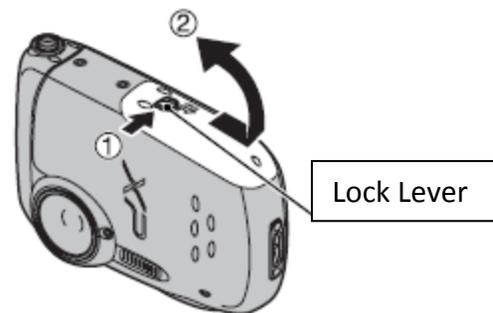
Charging the Battery

In viewing mode, a battery icon appears at the lower right side of the screen, showing the battery state. If this is blinking or solid red, the battery needs to be recharged. The charger is in the "treasure box" of the "clean bag" of the Streamkeeper field kit.

Turn camera off before removing the battery. With the camera in the position shown, locate a small slider button marked "OPEN" in the center of the bottom.

Slide this away from you and then to the right, and the cover will release. Raise it as shown in the figure. The battery is held in place by an orange tab. Push this to the left and the battery will pop up. Insert the battery into the charger with the orange stripe on the left and the terminals facing down. The charging indicator

will glow yellow when the battery is charging and green when it is fully charged. If it blinks yellow, remove the battery – there is a charging problem. Insert the battery with the orange stripe on the battery next to the orange tab on the camera. Push it in and it will snap into place. Lower the cover and push to the left to latch. Be sure that it is securely closed and snaps into place.



Monopod Mount

A monopod is supplied in your kit, which can be used to steady the camera in very low light situations. This can be screwed into a socket on the bottom of the camera.

SETTING MENUS FOR THE FUJI XP10 DIGITAL CAMERA

Under normal circumstances, when the camera is turned on it will have already appropriate settings. However, should the settings be changed, the following instructions show how to go through the setting menus and select the proper options.

DATE/TIME will appear just for a few seconds when you first turn on the camera. Confirm that these are correct. If not, see instructions below.

INITIAL SCREEN: After the date disappears, the screen should show a view of whatever the lens is looking at, with various types of information on the screen and no grid. If there is no information on the screen, or there's a grid, double-click the DISP/BACK button until the grid is gone and the information shows. (There are three possible views: information with grid, information only, and no information.)

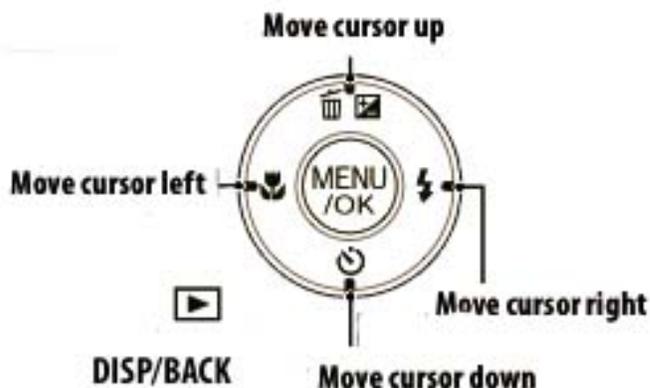
About the DISP/BACK button: This button, located at the bottom underneath MENU/OK button and the playback arrow, is easily pushed by mistake.

AVOID "SILENT" MODE: If the display shows the SILENT mode symbol at top center: , get out of it by pressing and holding the DISP/BACK button until that symbol goes away.

STREAMKEEPERS' PREFERRED MENU

CHOICES: This procedure makes use of selection buttons on the back of the camera as illustrated on the right.

(continued on next page)



Press **MENU/OK** to display the **Shooting Menu**.

1. The menu opens with "**SHOOTING MODE**" highlighted. Press the right selector button to show options. Press the up or down buttons until "**SR AUTO**" is highlighted. Press **OK**.
2. Press the down selector button to highlight **ISO**. Press the right selector button to display options. Press the up or down buttons to select **AUTO**. Press **OK**.
3. Continue in this way to access all the items in the shooting menu, changing the various items if needed to those in the following list:

Shooting Menu:

Shooting Mode	SR Auto
ISO	Auto
Image Size	12M
Image Quality	N
Fine Pix Color	STD
White Balance	N/A
Continuous	Off
Face Detection	On
AF Mode	N/A
Movie Quality	N/A

While viewing the Shooting Menu, press in sequence the left, down and right selector buttons to bring up the Setup Menu. As above, press the right button to access the options, and set the menu items. Press **OK** when done.

Setup Menu:

Date/Time	Use right, left, up, down buttons to set date and time.
Time Difference	Home
Language	English
Silent Mode	Off
Reset	DO NOT CHANGE. This resets all settings to factory defaults.
Format	DO NOT CHANGE. This erases all data from the memory card.
Image Display	3 SEC
Frame No.	Cont.

----Now skip down to the following items, and ignore the others:

LCD Mode	On
Auto Power Off	2 MIN
Digital IS	Off
Red Eye Removal	On
Save Org Image	Off

WHEN FINISHED, PRESS THE DISP/BACK BUTTON (below the small arrow) TO LEAVE THE MENUS.

FISH AND WILDLIFE SIGNS

EQUIPMENT NEEDED

- the five senses
- field guides if you have them & are inclined to use them
- data sheet, clipboard, pencil

Anytime you visit your reach, you will note any signs of fish or wildlife. You'll be most likely to observe animal signs when you first arrive at your site, but be open to observations that may occur at any time. How detailed and technical you wish to get is up to you, but even such information as "about six little brown birds," "a few fish fry about 2" long," or "tracks--raccoon?" can be useful to biologists. The UW Nature Mapping project will accept observations identified to species level only, so if you do know the specific or Latin name for the creature you observe, be sure to list it.

Note: Only write what you know—if you're taking a guess, indicate that it's a guess and why you've guessed it.

FISH

Your best bet is to quietly walk up to a pool, preferably not casting a shadow on it. If you're lucky, you may see some fish-like shapes holding still or darting around. Other possible sightings include spawners in riffles or pool tailouts, carcasses, or redds (salmon and trout nests), which are elongated oval mounds in the streambed that are algae-free, often with a depression on the upstream side.

There is a juvenile salmonid ID book in your field kit, but these are almost impossible to identify without catching them; "salmonid spp." would cover any salmon or trout that you might find. If you investigate your watershed and consult your local fisheries biologist or Streamkeeper staff, you will be able to make a pretty good guess as to what species of fish you might find in the stream at a given time of the year.

MAMMALS

WILDLIFE

The visual observation approach recommended below can yield valuable information on the presence and absence of wildlife and their relative abundances in different survey areas. For identification, there are many publications and keys available to help you. The animal-tracks key in your field kit will help since most wildlife do not appreciate human observers and hide from view. Or you may wish to bring a knowledgeable partner (such as an Audubon member) to help you.

BIRDS

Birds may be the easiest creatures to spot. Look and listen for them as you walk into your reach. Take into consideration that different species inhabit different layers of the vegetation, from the dense, shrubby undergrowth to the top of the canopy.

Note the locations where you see and hear birds both spatially and vertically. Record the species that you are able to identify by sight or sound. Also document any evidence you see that birds are present, such as nests, egg shells, feathers, or tracks.

HERPS

Herps (reptiles and amphibians) are more secretive than birds. The best places to look for them are under rocks and logs in damp spots, especially along the stream's wetted edges. Take care not to create too much disturbance on the fragile stream banks, and make sure you return all logs and rocks to their original positions.

In the spring, look for amphibian egg masses in slow-moving backwater areas, side channels, and other wetlands associated with the stream and in your reach area. If you can, take a trip to your stream reach on a spring evening to listen for breeding frogs.



Mammals may be the most challenging to spot, but they often leave behind evidence of their presence. Note any signs of mammals that you see in addition to actual sightings. Signs may be in the form of nibbled plant matter, scat, bones, fur, tracks, trails, nests, burrows or dens. You can use the scat and tracks keys here and in your field kit to help identify these signs. We also have a more detailed animal tracks guidebook in the Streamkeepers office that you can consult.

DOGS

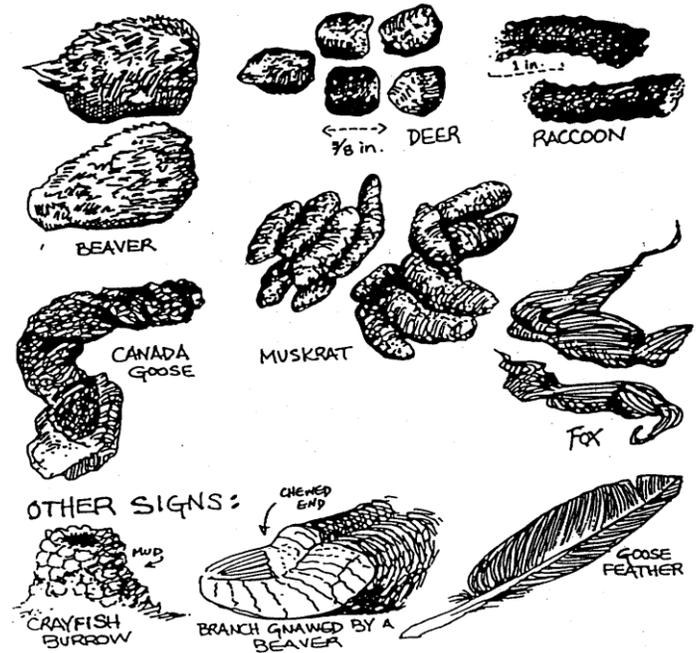
Note any sign of dogs in or near the creek, and take photos of them if you can. Dogs can eat spawning salmon and should not be left loose to do so. If notified, the Dept. of Fish & Wildlife can investigate and contact the appropriate landowner.

RECORDING WHAT YOU FIND

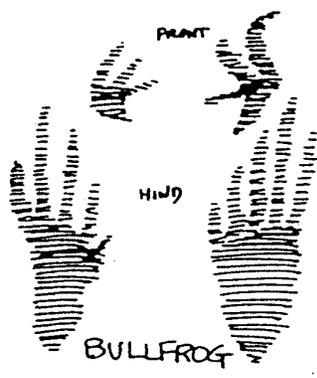
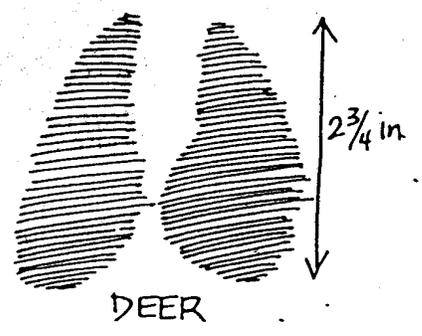
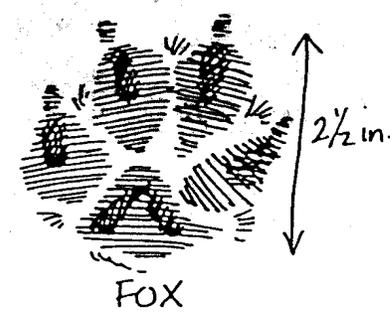
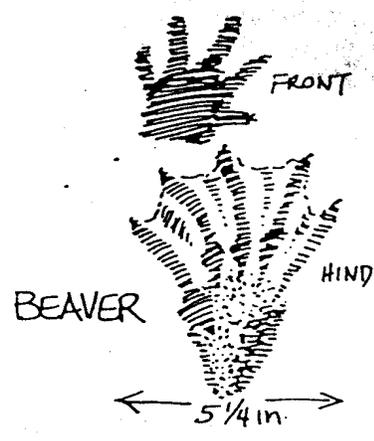
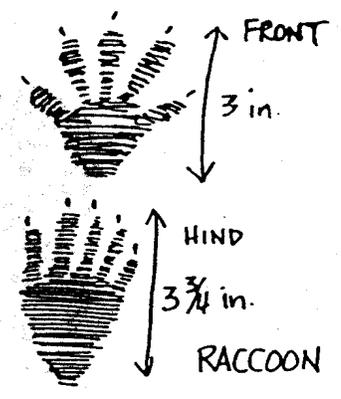
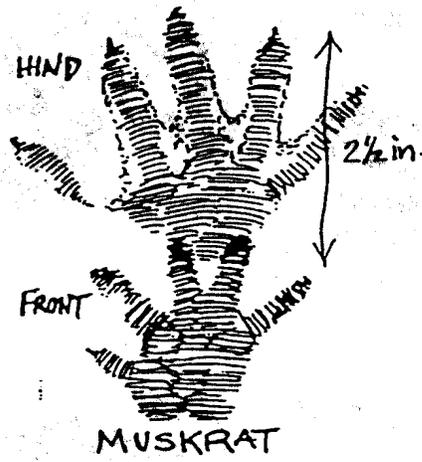
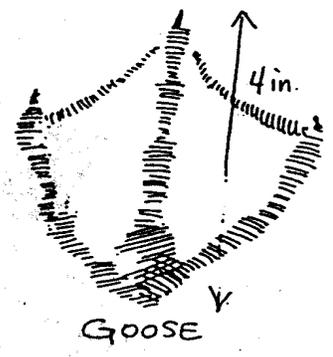
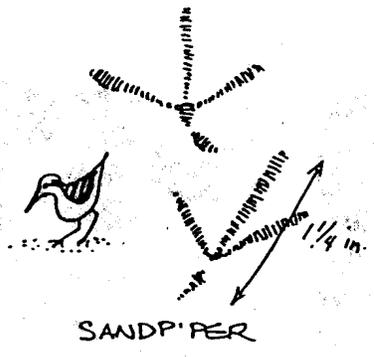
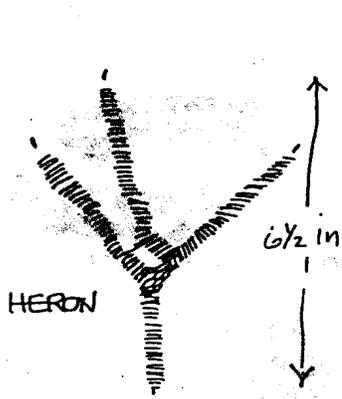
Record what you see in the space provided on your data sheet:

1. You can document the species you see, or use broad categories to record your wildlife sightings. For example, birds are categorized into types such as gulls, ducks, sandpipers, passerines (perching birds), raptors, etc. Herps can be easily distinguished as frogs, salamanders, snakes, turtles, etc.
2. Include information on number, size, and activity. Feel free to estimate, using the "~" symbol in front of a number to denote "approximately."
3. If no fish or wildlife are observed, write "None" in the data boxes.
4. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

ANIMAL SCAT:



FOOTPRINTS (TRACKS)—(note: no turtles on the Olympic Peninsula!)



From NEWS SPLASH, City of Bellevue
Salmon drawing Dog-Eared Publications

WHO'S THERE?

What kind of spawning salmon or trout is that?

1 Length
Chinook: 24-60"
Sockeye: 10-18"
Coho: 17-38"
Steelhead: up to 45"
Cutthroat: up to 30"
Chum: 30-42"

2 Dorsal Fin
Distinct dark spots: Chinook, Steelhead, Cutthroat
No spots: Sockeye, Coho, Chum

3 Back and sides
Green to brown, spots on back: Chinook
Bluish-green, lower sides red: Coho
Bright red to red-gray: Sockeye
Reddish stripe on sides: Steelhead
Silver or faint red: Cutthroat
Red-purple vertical markings: Chum

4 Caudal fin
Spots both upper & lower: Chinook, Steelhead, Cutthroat
Spots upper lobe only: Coho
No spots: Sockeye, Chum

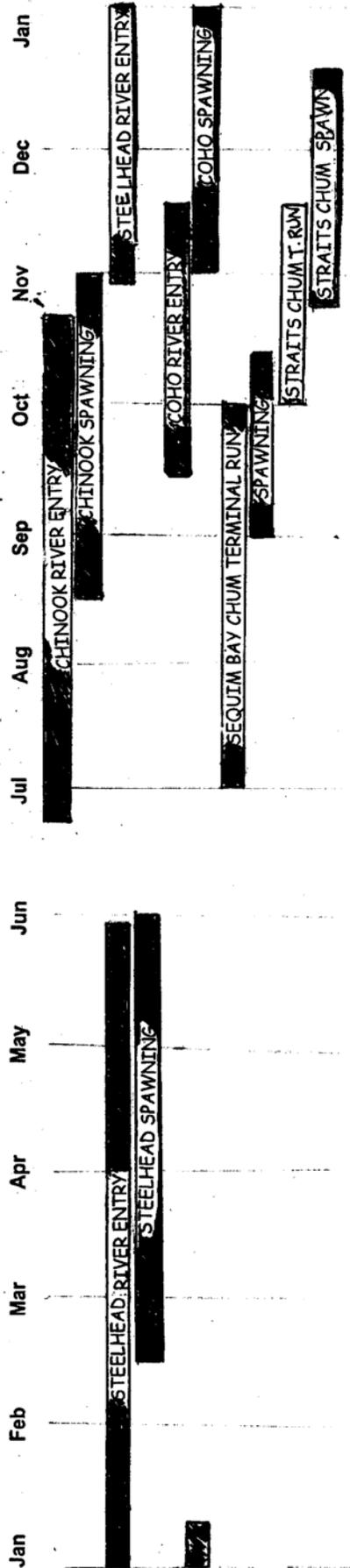
5 Head
Bright to olive green: Sockeye
Dark bluish-green: Coho
Hooked jaw: Chinook, Sockeye, Coho males
Blunt head: Steelhead, Cutthroat

6 Gumline (colors typical, but may vary)
Black on lower jaw: Chinook
Light color: Coho

7 Gill Covers
Green to brown: Chinook
Bright to olive green: Sockeye
Reddish: Coho, Steelhead

- 1st draft - Olympic Peninsula Salmon Timetable

These timing bars are estimates only. Information comes from SASSI report.



NOXIOUS WEEDS***EQUIPMENT NEEDED***

- Picture booklet: "Selected Noxious Weeds of Clallam County"
- Plant identification guidebook
- Ziplock bag, permanent marker
- Small shovel, pruners
- Camera, photo log
- Noxious Weed Report sheet, clipboard, pencil

Noxious weeds are introduced plant species that are aggressive, invasive, and once established, difficult to control. Noxious weeds tend to crowd out native plants, causing environmental damage, economic losses, and even public health and safety problems. State law mandates control of some species.

Complete a Noxious Weed Report at each site that you visit during summer quarterly monitoring, as well as whenever there are new data to report (new, advancing, or declining weeds). Turn in reports along with your other data sheets. This report will go to the Clallam County Noxious Weed Control Board Coordinator.

Feel free to turn in additional Noxious Weed Reports for any other infestations that you notice in your daily travels.

1. Survey your reach area for noxious weeds. It may help to review the identification booklet before going out in the field, or to ask the Noxious Weed Coordinator (as of June 2012, Cathy Lucero at 360-417-2442) what weeds you might find at your sites. If you don't find the plant in your Noxious Weed booklet, you may find it in the plant identification book.
2. On your Streamkeepers data sheet, indicate whether you're completing a Report, or if you didn't check for noxious weeds. Put your complete initials in the "Sampler's initials" box.
3. If your visit is part of summer quarterly monitoring, or if the weed situation has

changed since your last report (new, advancing, or declining weeds), fill out a Noxious Weed Report form (*in your team's forms folder*).

4. On the Noxious Weed Report, fill out the date, your name, and the site name and brief description. Circle a choice from 1-9 indicating property ownership. Fill in the landowner's name, when known.
5. Record the width of the reach area surveyed, including the stream area, and the length of reach surveyed along the stream.
6. Imagine you were looking down at your reach from the sky; how much of what you see is covered by noxious weeds? (These could be at ground, bush, or tree level.) Indicate category of weed cover: 0-5%; 6-50%; or 51-100%.
7. Check the box indicating whether noxious weeds were detected. If the answer is no, skip down to the comment section as desired.
8. If the answer is yes, complete the chart for each weed that you find. For each weed species, first imagine drawing a dotted line encompassing the entire infestation zone of that weed within your survey reach. Estimate the size of that infestation zone (width and length)—if the weed is ubiquitous, the infestation zone may be the same size as your survey reach.
9. Within that weed's infestation zone, group together all of that weed's plants in your mind, then decide on cover class based on the following categories of coverage within that zone:
 - 1 – 1-20%
 - 2 – 21-40%
 - 3 – 41-60%
 - 4 – 61-80%
 - 5 – 81-100%

Estimate as best you can without getting obsessed; if in doubt, consult with your fellow samplers. Remember, your main goal is to report the situation to the Noxious Weed Coordinator.

10. If you find a plant that you would like identified, use the "OTHER" line at the bottom of the survey sheet, and write "Sample #__." Use a marker to write the date, location, and Sample # on a ziplock bag. Place a **complete** sample of the unknown plant in the bag, and seal it. (Include leaves, flowers, and roots if

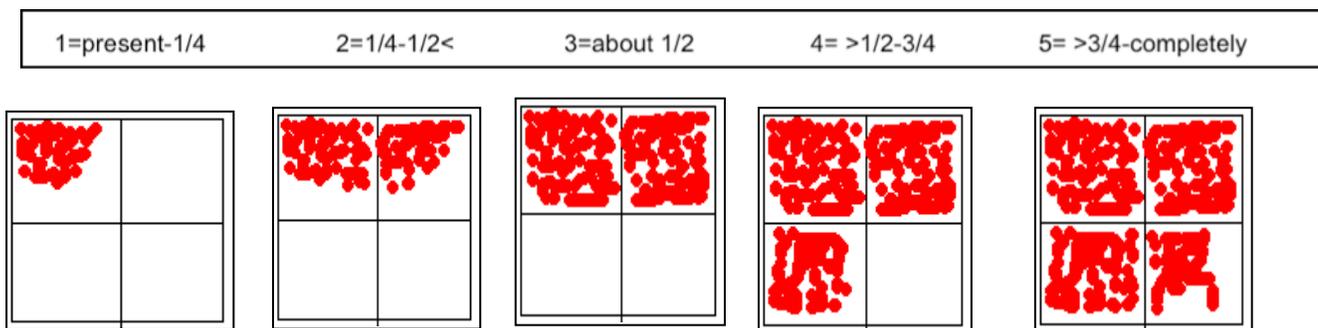
possible.) Keep the sample in as good a condition as possible (refrigerating it if you store it temporarily at home, or even putting it in water), and when you return your field kit, turn the bag in to the Noxious Weed Control Office or Cooperative Extension. ***If you would like to be notified of the results, include a note with your name and phone number.***

11. Take photos if possible, especially if the weeds have advanced or are in bloom. Complete the photo log for each picture.

Cover Class General Descriptions

<u>Cover Class</u>	<u>Definition</u>
	Imagine drawing a dotted line encompassing the entire infestation zone of that weed species within your survey reach. Within that infestation zone, group together all of that species in your mind, then decide on cover class based on the following categories.
1	1%-20% Present, but less than $\frac{1}{4}$ of infestation zone covered by that species
2	21%-40% More than $\frac{1}{4}$ but less than $\frac{1}{2}$ infestation zone covered by that species
3	41-60% About $\frac{1}{2}$ of the infestation zone covered by that species
4	61%-80% More than $\frac{1}{2}$ but less than $\frac{3}{4}$ of the infestation zone covered by that species
5	81%-100% Between $\frac{3}{4}$ and 100% of the infestation zone covered by that species

Rough Sketches of Cover Classes



BENTHIC MACROINVERTEBRATE SAMPLING

Benthic macroinvertebrates are animals without backbones, such as insects, worms, scuds, and mollusks, which live at the bottom of streams. Our stream teams collect them, and professional labs identify them. However, volunteers are welcome to examine the invertebrates before or after preserving them—see last part of this protocol—and can volunteer to help sort samples. (The June 2012 revision of this protocol is based on new protocols developed by collaboration between the WA Dept. of Ecology and local governments in the Puget Sound region—see Wilhelm, Lester, and Fore, 2011.)

EQUIPMENT NEEDED (Items with an * are in the regular bags rather than the “bug bag”):

- 95% denatured ethanol (*remember to get this from the storage cabinet outside the office before taking the field kit home*)
- 1 complete Surber sampler
- 2 buckets, marked “clean” and “dirty”
- 2 500-micron sieves, also “clean” and “dirty”
- 4 rubber dishpans
- strong weeding fork to disturb substrate
- “Clean water” decanter with handle
- 2 angled-spout wash bottles (one for water, one for alcohol)
- 2 spray bottles (one water, one alcohol)
- macroinvertebrate handling tools:
 - plastic spatula
 - flexible forceps (tweezers)
 - one rigid forceps
 - magnifying glasses
 - lighted magnifier
 - head magnifier
 - spoons
- wide-mouth sample jars with tight lids
- foam holder for sample jars
- electrical tape
- pre-printed labels—outer & inner
- ziplock bags—small and large
- 4 weights with flagging tape attached
- permanent marker
- macroinvertebrate ID field keys
- *stick thermometer
- *reach map or site sketch for each reach
- *100’ tape
- *timepiece with second hand
- *camera
- *rubber gloves
- *tarp
- *data sheet, clipboard, pencil
- OPTIONAL: extra buckets for sitting
- OPTIONAL: beach umbrella with stake & sledgehammer for rain

WHY SAMPLE MACROINVERTEBRATES?

The best way to assess the health of a watershed for living things is to look at those living things. Undisturbed watersheds in the Pacific Northwest contain a marvelous variety of benthic macroinvertebrates, representing a smorgasbord of shapes, sizes, survival strategies, and adaptations. Human activities that interfere with natural processes in a watershed have a definite and predictable impact on the types and numbers of invertebrates that live there.

Many invertebrates are just as sensitive to changes in their environment as salmon. We tend to be more interested in fish than invertebrates, but there are several good reasons to sample invertebrates rather than or in addition to fish:

- It is easier and less intrusive to the environment to sample invertebrates.
- Whereas anadromous fish are impacted by a variety of factors such as ocean conditions and fishing pressure, stream invertebrates are primarily impacted by activities within their watershed.
- Invertebrates have a wide geographic distribution, making it fairly easy to predict which types should be present where.
- Since invertebrates are an important food source for fish (and other wildlife), sampling them measures an environmental component with a direct impact on fish.
- Undisturbed streams have such a great variety of invertebrates that sampling can reveal subtle disturbances over space and time.

NOTE: Please also measure gradient if it has never been measured at your site (see separate protocol).

HOW DO MACROINVERTEBRATES PROVIDE A "BLOOD TEST" OF A WATERSHED'S HEALTH?

We can assess the biological health of a stream by looking at the types of invertebrates that either thrive or do not thrive in it. If only a few types of invertebrates live there, or if the invertebrates are primarily ones that adapt well to disturbed streams, there is some kind of problem present.

A group of teachers and students at the University of Washington (later spun off as the nonprofit group SalmonWeb) developed a means to sample invertebrates in a uniform way, identify and count them, and then perform calculations to assess stream health. The calculations measure such things as:

- The total variety and balance of life forms present (a.k.a. biodiversity)
- The variety of types of mayflies, stoneflies, and caddisflies—invertebrates that form an important part of the diet of salmon and trout, and that respond in complex ways to different human disturbances
- The variety or number of invertebrates that are known to adapt very well or very poorly to streams that are unnaturally warm, cloudy, or de-oxygenated
- The variety of invertebrates that need clear spaces between rocks or stable habitat for a long time span.

By sampling at many sites, both disturbed and undisturbed, these scientists were able to develop a set of calculations that give a good indication of the biological health of streams and their surrounding watersheds. These metrics are known as the Benthic Index of Biological Integrity (B-IBI) for the Puget Sound Lowlands.

The macroinvertebrate samples you collect will be professionally identified, and the counts will be entered into a database that calculates the B-IBI for each sampled reach. The B-IBI yields a single number on a scale (much like a test score), along with a description of that number, ranging from Healthy to Critically Impaired (much like a grade on a report card). Thus, the B-IBI enables us to transform information about

invertebrate populations into a generalization about stream health. It is a powerful analytical tool.

A wealth of information about the B-IBI is available on the Streamkeepers web site at http://www.clallam.net/streamkeepers/html/biological_monitoring.html.

WHEN TO SAMPLE

The Puget Sound local governments have decided that the target sampling window can cover at least August-September. In some circumstances, it may be acceptable to sample a bit after the end of the sampling window if there hasn't been a big rainfall event; check with staff. Also, check weather reports beforehand: if riffles are more than a foot deep, you can't see under the water, or conditions are unsafe, don't collect bugs that day—but you might be able to do your regular water-quality monitoring instead. Generally, you're less likely to get rained out earlier in the sampling window, so try to schedule early if possible. If you do sample when water levels are up, avoid sampling a riffle that would have been dry before the rain.

WHERE TO SAMPLE

- The B-IBI we currently use is only calibrated for streams up to a certain size. Consult with staff if you intend to sample a site where bankfull width is >60'.
- Try to sample at least 165' upstream or 660' downstream of a bridge or other large human-made structure (unless you are trying to measure the structure's impacts).
- The sample reach will ideally include four distinct riffle habitats (fast, turbulent water moving over gravel or cobble substrate), with two digs from each riffle for a total of 8 digs. If you cannot find four riffles, you can distribute your digs evenly in the available riffles. If there are no riffles anywhere in the vicinity, sample in areas with fast-moving water where the stream is straight and fairly uniform, the water is 4-12" deep, and the substrate is appropriate (see below).
- The best substrate would be 2-4" rocks, with smaller pebbles underneath. Avoid

sampling in rocks larger than 12" on the surface-layer or larger than 4" below that.

- Look for the best overhead canopy and riparian vegetation.
- If possible, avoid sites with filamentous algae on the rocks.

To try to meet the above conditions, you can range fairly widely from your normal water-quality monitoring location, as long as you:

- Stay in an area that has similar gradient, valley shape, and riparian land-cover.
- Don't cross any inputs to or outflows from the stream.
- Document your location (explained below).

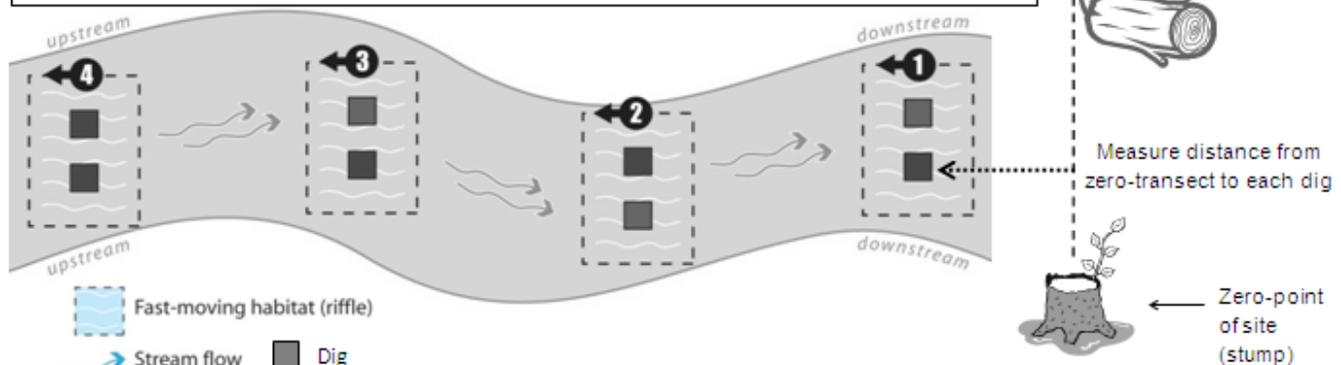
Note that in many cases, you are being asked to sample a site *because* of its disturbances, so there may, for example, be no true riffles or only fine sediment. In that case, your job is to find the best sampling spot you can there.

NOTE: If your site is less than ideal or simply not appropriate for collecting a sample, explain the situation in the "Comments" section of your data sheet, and take photos illustrating your points.

FIELD PROCEDURE

1. **Overview:** Beginning downstream and moving upstream, you will collect eight 1-ft² digs with the Surber sampler, ideally with two digs in each of four riffles—see diagram below. Sample within the stream's main flow and avoid the sides and downstream edges of riffles. Within a riffle, you may place the digs side-to-side or back-to-front.

SAMPLING SCHEMATIC FOR 8 FT² SAMPLE; TRY FOR 8 DIGS IN 4 RIFFLES



2. **Collect a sample:**

- a) Avoid disturbing vegetation overhead or upstream of your sampling site.
- b) Inspect the Surber sampler netting and collection cup for tears, holes, or critters. Apply duct tape if needed and note problems on data sheet.
- c) Once in the riffle, place the device quickly to avoid scaring bugs away. Frame out your Surber sampler, and place it on the selected spot with the opening of the nylon net facing upstream and the collection cup stretched out behind. Find a spot where the frame rests as flush as possible with the stream bottom. The current should move directly into the net. If the current is very slow or the water very shallow, take extra precautions to make sure the water is moving all the way down the net and into the cup. You may need to remove rocks or even excavate a little channel downstream of the frame.
- d) Larger rocks resting within or beneath the frame need to be brushed off carefully, with hands or a brush, to let any bugs on them wash into the net. **Only brush off the part of the rock resting within the sample frame.** Then set the rock aside in the stream, or if the entire rock was within the frame, you can put it in a dishpan for later examination. Once these rocks have been removed, the frame should be squarely on the stream bottom. If you

can't pry a big rock out, brush it off in place, concentrating on any cracks or

indentations, and move the frame as needed to get the back flush with the bottom. Note any problems on your data sheet. At this point, **note the water depth in inches** on your data sheet, using the marked notches in the Surber's frame.

- e) Once the larger rocks are removed, disturb the substrate vigorously with the weeding fork for 60 seconds, to a depth of about 4". (You should dig vigorously enough to be breathing hard). Organisms and detritus should wash into the net. As you dig, watch to keep material from going around the sides.
- f) If you hit more big rocks while digging, take a "time out" from the 60 seconds to pry them out. Brush off the portion that was within the sample frame and set aside in the stream, or if the entire rock was within the frame, you can put it in a dishpan for later examination. If you can't pry a big rock out, brush it off in place as above, and note it on your data sheet.
- g) At 60 seconds, lift the sampler out of the water, keeping the open end pointing upstream and tilting it up out of the water, to help wash organisms into the collection cup.
- h) ***Without emptying the cup***, repeat the sampling procedure at the next digging spot. Remember to record the water depth with each dig. When you finish digging in a riffle, mark the area of this riffle's digs with one of the flagged weights, near the center of the dig area.
- i) If you can collect all 8 digs without overflowing the Surber's collection cup, do so. Otherwise, when the collection cup gets nearly full, you'll need to take a break in sampling and empty it.

3. ***Transfer the sample to collection jars:***

- a) Put a little alcohol in a sample collection jar and put the jar in the foam holder, near the dishpan.
- b) Examine any large rocks collected in the dishpan, using a magnifying glass. Using a brush or forceps, gently move any organisms found into the sample jar. After examining each rock, spray it with alcohol over the pan or double-check it carefully, then set it on the bank. Clean water can also be used for rinsing rocks and hands.

TO MAKE "CLEAN" WATER FOR RINSING: Pour it from the "dirty" bucket, through the "dirty" sieve, into the "clean" bucket.

- c) When all rocks have been cleaned, pour the water from the dishpan through the clean sieve. Rinse the pan, agitate and pour again. This should filter out any invertebrates that washed off of the rocks. Then return the rocks to the stream in the area of the sampling site.

STRINGY ALGAE ON THE ROCKS? Scrape off as much as you can with something sharp and collect it all. You may have to get spaghetti jars from home—don't fill any jar over halfway.

- d) Meanwhile, the other samplers should attend to the Surber sampler. Wash all objects caught on the inside of the net into the collection cup:
 - ***With the opening out of the water***, rotate the net around in the water so that most of the objects inside wash into the cup.
 - Finish rinsing the contents of the net into the cup. You may use the "dirty" bucket to pour unfiltered water into the net from the outside, or you may pour filtered ("clean") water down the sides of the net from the inside.
- e) When the net is clean, empty the contents of the collection cup into the 2nd dishpan. Clean the neck and collar of the sampler over the dishpan to

collect any critters that may remain inside. Examine the net carefully and pick out any remaining invertebrates, then set it aside. Rinse the cup and empty again, continuing until you have emptied it completely. (To rinse, you may pour clean water inside the cup; or you may dip the cup into the stream, holding it upright, and let the stream water filter in through the mesh on the side of the cup.)

- f) **Large taxa:** *Pick out any bigger, predatory-looking insects* and put them in the sample jar to protect the other ones! *Freshwater mussels*, which look like ocean mussels with their oblong, fragile-looking shells and are usually of some size, should be pulled out of the sample, counted, noted, photographed, and returned to the stream. In contrast, little *“seed” clams* no bigger than a pea, *crayfish and snails* should be included in the sample.
- g) *Pick out non-decayed large debris* (sticks that you can't break easily and leaves that you can hold upright from the stem) from the material in the dishpan. Using a magnifying glass and squirt bottle or tools, remove any organisms to the dishpan or sample jar before discarding these debris pieces. Decayed debris should be collected in the sample because it might hide organisms inside (e.g., if a leaf is limp, damaged, or “skeletonized”).
- h) Pour some *clean* water into the dishpan and swirl the sample around in it. While the water is still agitated, pour it off into the *clean* sieve. Most of the organic matter should enter the sieve with the water, while the rocks stay at the bottom. Repeat this decanting procedure until the water is completely clear and there are no invertebrates still crawling around in the debris in the dishpan. If you've collected a mat of algae, shake this mat to loosen up any

mud stuck to it; the mud will later escape through the sieve.

- i) Put a bit of water back in the dishpan and comb over it with the lighted magnifier (which will get critters to move) and rigid forceps (which will pick them up efficiently). Keep a keen eye out for caddisflies, which in their cases look very much like small rocks, and chironomid tubes, which look like globs of dirt or sand. If you are sure that only rocks and sand are left in the dishpan, discard the contents; if not...

Critters still crawling in the sand? Try an “alcohol float”: Decant the water out of the dishpan, then put in enough alcohol to cover. Swirl and see if critters start releasing from the sand particles. If so, decant them into the sieve, catching the alcohol in another dishpan. If there are critters in that waste alcohol too, save that as well, marking it “Thru sieve from alcohol-float.” If this doesn't work, collect both sand and critters.

- j) Transfer the remaining contents of the clean sieve into the sample jar, which the rock-pickers should have finished with by now. Your job is to get ***everything*** that's now in the sieve into the sample jar, a.s.a.p. Get the contents down at one end to make them easier to remove, by agitating the sieve at an angle in shallow clean water in one of the dishpans (like panning for gold). Use gentle forceps, a spatula, and/or a squirt bottle to move the remaining contents of the clean sieve into the sample jar. (One technique is to squirt alcohol from the back, washing the material along with the alcohol into the cup.) Fill the jar no more than halfway with “stream stuff,” then fill to near the top with alcohol.
- k) Now turn the sieve over in a clean dishpan and spray with clean water from the backside to collect any bugs that remain on the sieve. Examine the sieve carefully to make sure there are no

critters left; any still hanging onto or wrapped around the mesh can be removed with a bit of alcohol and the rigid forceps.

- l) Use a pencil to fill out one of the pre-printed internal labels, with the agent, project, site, date, samplers' initials, jar ___ of ___, and # of SqFt. Place inside the jar, ideally so that the writing can be seen from the outside. Close the jar tightly (users of "pop-top" jars pay close attention here!) and wrap several times, starting on the lid and then working your way down, concentrating on closing the gap between the lid and the jar. Leave a 1/2" pull-tab at the end.
- m) Use a pencil to fill out one of the pre-printed external labels, with the agent, site, jar ___ of ___, date, # of SqFt, and chief sampler's initials. Tape to the outside of the jar.

- c) Indicate whether this "riffle" was turbulent or non-turbulent.
 - d) Record this riffle's width and length to the nearest foot.
 - e) Repeat this procedure for the other riffles.
6. With the flagging and measuring tape still in place, **photograph** each riffle. A set of photos consists of:
- The riffle area itself, ideally showing the measuring tape and some of the substrate. (Find the angle where the light gives the best view.)
 - The riparian corridor taken up- and downstream from the riffle.

Complete the photo log section of your datasheet (see sample below).

- n) Place all the jars from the site in a single sealed bag, using another external label, this time indicating the total number of jars. (Larger bags are included in the field kit.)

Site Name: <i>Morse 1.1</i>	Date: <i>8/8/08</i>	Camera: <i>3</i>
Photos taken at this site on this date? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Samplers Initials: <i>BDD</i>	
FOR SUMMER & WINTER PHOTOS: AT SITES WITHOUT ESTABLISHED CROSS-SECTION, USE CENTRAL SAMPLING POINT (A.K.A. "ZERO POINT") AS CENTRAL POINT FOR PHOTOS.		
Photo Log: fill in the log below completely for each picture including where it was taken from		
Frame #	Subject	Vantage Point
<i>101-0023</i>	<i>Macroinvert riffle #1</i>	<i>Directly above</i>
<i>101-0024</i>	<i>Riparian corridor looking w/s</i>	<i>Riffle #1</i>
<i>101-0025</i>	<i>" " " d/s</i>	<i>"</i>
<i>101-0026</i>	<i>Macroinvert riffle #2</i>	<i>Directly above</i>
<i>101-0027</i>	<i>Riparian corridor looking w/s</i>	<i>Riffle #2</i>
<i>101-0028</i>	<i>" " " d/s</i>	<i>"</i>
<i>101-0029</i>	<i>Arthur Frost examining the net</i>	
<i>101-0030</i>	<i>Etc.</i>	

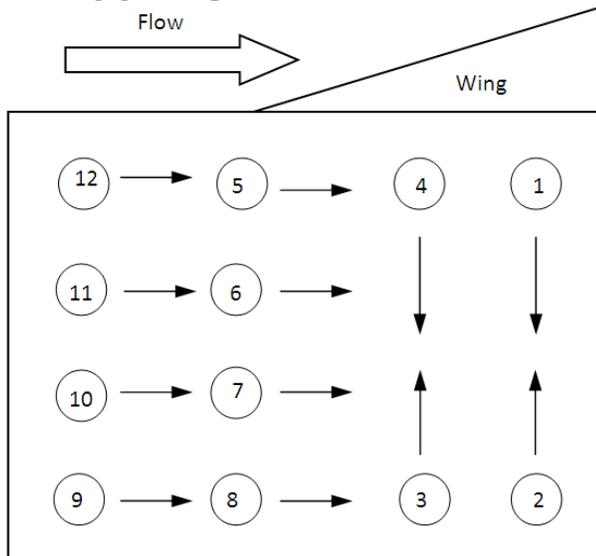
- 4. If you are not performing Water Chemistry monitoring during this visit, take the air and water temperature, following the protocols outlined in this Handbook.
- 5. You now have flagging at each of your riffles. Starting with Riffle #1:
 - a) Measure its direction (upstream or downstream) and distance from the zero-transect or reference point of your reach (see Reach Map or Sketch Map protocols), and record that on the data sheet under Dig #1.
 - b) On your data sheet, indicate which other digs were part of this riffle by recording the same Riffle # for them.
- 7. Collect your flagging & measuring tape.
- 8. In the "Sampler's Initials" box on the data sheet, put the full initials of the chief sampler taking responsibility for this sample.
- 9. If you have been asked to take a replicate sample at this site, take a lunch break first, and rest your eyes and back! Then move upstream in the same reach and repeat the above procedure, indicating "R" after the site name. If you were not given an extra data sheet, hand-write the data on the back of the original data sheet.
- 10. Clean and store the equipment. Make sure the net and sieves are clean—use the brush in the kit to clean them if needed.

BUG SAMPLING—ADDITIONAL THOUGHTS

Digging Patterns for Fast and Slow Water Scenarios

Slow Water Scenario

In slow-moving water (roughly, < 1 ft/sec), violent side-to-side motions at the front of the sampler could result in a loss of bugs around the wings of the sampler. You can minimize this problem by the way you dig.

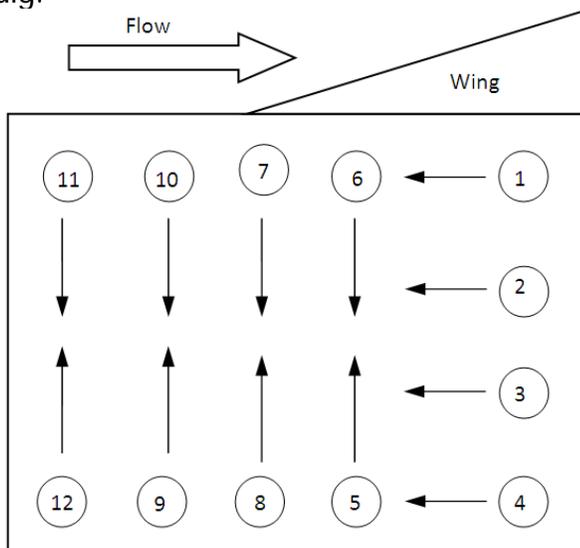


⊘ = general dig

NOTE: These drawings are schematic, to make a general point; your actual dig pattern will vary.

Fast Water Scenario

In a fast-water scenario (roughly, > 1.5 ft/sec), you don't need to worry about organic matter being lost around the wings of the sampler. But violent backwards motions could result in a large number of rocks being pushed into the net. Again, you can minimize this problem by the way you dig.



⊘ = dig

Notes about Digging and Rocks

- Before digging, remove any rocks that will get in the way. Usually you can just wash these with your hands and set them aside in the creek, but if they have crevices that might harbor bugs, you can put them in a dishpan for closer inspection.
- If a rock straddles under the sampler frame, *just wash the part of it that was inside the frame, and don't collect it in a dishpan.*
- When digging, your mantra should be “delve deep and pry within”—no need for violent stirring of the surface rocks. You've hit pay-dirt if you see a big cloudy plume wash into the net while prying.
- If after digging, you have a pile of rocks just within the Surber frame, you can have your partner lift both ends of the net out of the water, leaving you with a little “pond” in the black cloth section (not the netting), and take handfuls of those rocks, wash them, inspect them, and then set them aside in the creek. You can put any questionable ones in a dishpan. Keeping the rocks separate will make processing your samples easier.

How much rain is too much?

Don't collect bug samples if:

- It's unsafe or just too miserable to do a good job.
- The water level overtops the sampler frame.
- The water's too murky for to see what you're doing.
- The rain would dilute the alcohol in the jars too much or splash critters out.
 - You can protect the open jar with your body.
 - We have a beach umbrella with a hefty stake, which we can loan out.

If you do decide to collect a sample during a higher-water event:

- Be careful not to sample in a riffle that would have been dry earlier in the summer.
- Try to dig really deep if the water's moving fast, because critters might move down deeper for shelter.

Additional items available for your convenience:

- Extra buckets, to sit on and carry alcohol and sample jars.
- Hip chain in case you need to measure loong distances.

GRAB SAMPLING FOR LAB ANALYSIS (BACTERIA, NUTRIENTS, ETC.)

NOTE: Grab sampling is generally accomplished not by regular stream teams, but by a special team that collects a large number of samples in a single day, in what's known as a "tour" in the Clallam County Water Resources database. The following instructions are based on the WA Dept. Ecology's general sampling SOP (Joy 2006).

EQUIPMENT NEEDED--GENERAL

- Field manual
- Data sheets—see "Data Sheets" section
- Clipboard, pencils, waterproof marking pen
- Directions to collection sites
- Sterile bottles, one for each site & lab bottle, plus replicates/blanks/extras
- Timepiece
- Exam gloves
- Thermometer or multimeter
- Salinity meter (*optional—see below*)
- Sampling wand to attach bottles to
- Large cooler to keep in car
- Portable cooler to carry to sites
- Gel ice packs or ice—roughly equivalent to the volume of sample bottles you'll be collecting (more if it's hot!)
- Hand disinfectant
- Anti-contamination supplies (see separate protocol)

SPECIAL EQUIPMENT/INSTRUCTIONS:

The above equipment is standard for fecal coliform grab samples, the most common type collected by Streamkeepers. There are many other possible lab analytes; in addition to the instructions provided here, follow any special instructions provided by the lab or project manager. Some items often needed:

- Field collection bottle, used to fill the lab bottles. Acid-wash before sampling day: rinse with 1 N HCl, then rinse 3X with distilled water and let dry. This bottle can then be used at multiple sites simply by rinsing twice before sampling; however, if a site is particularly contaminated, the collection bottle should be "retired" for the day and a fresh bottle used.
- Face mask if caustic chemicals are used.

WHY GRAB SAMPLES?

Many types of water analysis are exclusively or optimally performed in a laboratory. This

protocol describes sampling for bacteria, but similar procedures can be used for many other types of lab analysis.

Microorganisms, nutrients, metals, etc. are naturally present in streams, but humans can change both the quantity and nature of these inputs in a way that upsets nature's balance:

Pathogenic (disease-causing) microorganisms that humans or domestic animals introduce to water—including varieties of bacteria, viruses, and protozoa—can cause diseases in humans and animals alike, including salmonella, hepatitis, and giardia.

One way to test for the presence of human-introduced pathogenic microorganisms is to focus on fecal coliform bacteria, which primarily live in the digestive systems of warm-blooded animals, aiding digestion. These bacteria, though not pathogenic themselves, are good indicators of human or animal waste contamination, which often carries other more harmful organisms that are harder to test for. Hence, Washington State water quality standards use fecal coliforms as the indicator of potential pathogenic conditions in streams.

Similarly, excessive inputs of nutrients (forms of nitrogen and phosphorus, delivered to water bodies through fertilizers, livestock, or leaking septic tanks) can lead to Blue Baby Syndrome, reduced livestock vitality, "brown blood disease" in fish, and eutrophication--a massive build-up and die-off of vegetative matter that takes up the available dissolved oxygen in the water and suffocates fish and the macroinvertebrates they depend on. Nutrient loading can be particularly devastating to nearshore marine areas.

When elevated levels of pathogens, nutrients, or other constituents are present, water quality may be at risk, and State Water Quality Standards recognize unacceptable levels of many of these constituents (Washington Administrative Code, Chapter 173-201A).

WHEN TO SAMPLEPeriodicity:

Each project will have its own schedule, such as quarterly, monthly, or storm-based sampling.

ANY proposed sampling date must be confirmed well in advance with the processing laboratory (in Streamkeepers' case, usually the Clallam County Environmental Health Lab, 360-417-2334. NOTE: The lab does not take samples on Fridays.) The lab will generally provide bottles and other required sampling equipment; be sure you also have access to the other equipment listed above.

Time of day: Ordinarily, bacterial samples must be delivered by 2 p.m. and within 6 hours of the first sample, but some projects may differ; for example, stormwater projects often accept a 24-hour holding time to increase the flexibility of sampling. Stay in close touch with lab managers about expected delivery dates/times.

Tidal sites: If you're supposed to be testing the freshwater runoff of a stream, you need to avoid tidal interference:

- Check tide tables (available online) before planning the collection day.
- Samples taken near the mouths of streams should be taken on an outgoing tide. In general, you can sample ½ hour after mean high tide, defined as the point halfway between the high-low tide and low-high tide for the day.
- If a salinity meter is available, take it along and sample salinity. Note the reading on the tracking sheet.
- Be sure that the water is flowing downstream when you sample. If the tide has turned and you notice upsurge effects, note that on the tracking sheet and plan your next sample day to avoid such situations!
- Sites that are well above the stream mouth should have no problem with tidal interference.

If there's no flow: Zero flows can be important data, so if no water is flowing, it's

important to record that fact on your data sheet. Indicate one of the following:

- Creek bed completely dry throughout reach.
- Water present in pools, but no apparent flow.
- Water present between rocks, but no apparent flow.
- Water present, but level and/or velocity are too low to measure with a meter.

FIELD REPLICATES:

Our quality control plan requires that for 10% of samples, a second sample be collected for a replicate test. Field replicates give an indication of how much variability there is in the equipment, sampling techniques, and environment.

To perform and record field replicates:

- Streamkeepers staff or the team leader will determine how many replicate samples need to be collected, select sites for replicates, and then notify team members where they'll need to collect replicates.
- At the replicate site(s), the team will grab a second sample, as soon as possible after the first, and in the same spot.
- On the Streamkeepers Sample Tracking Sheet, write "FR" in the "Field Rep?" column on the line for the replicate sample (see sample field sheet at the end of this section).

FIELD BLANKS may also be required: follow the same collection procedure as a regular sample, using distilled water instead of sample water.

FIELD PROCEDURE

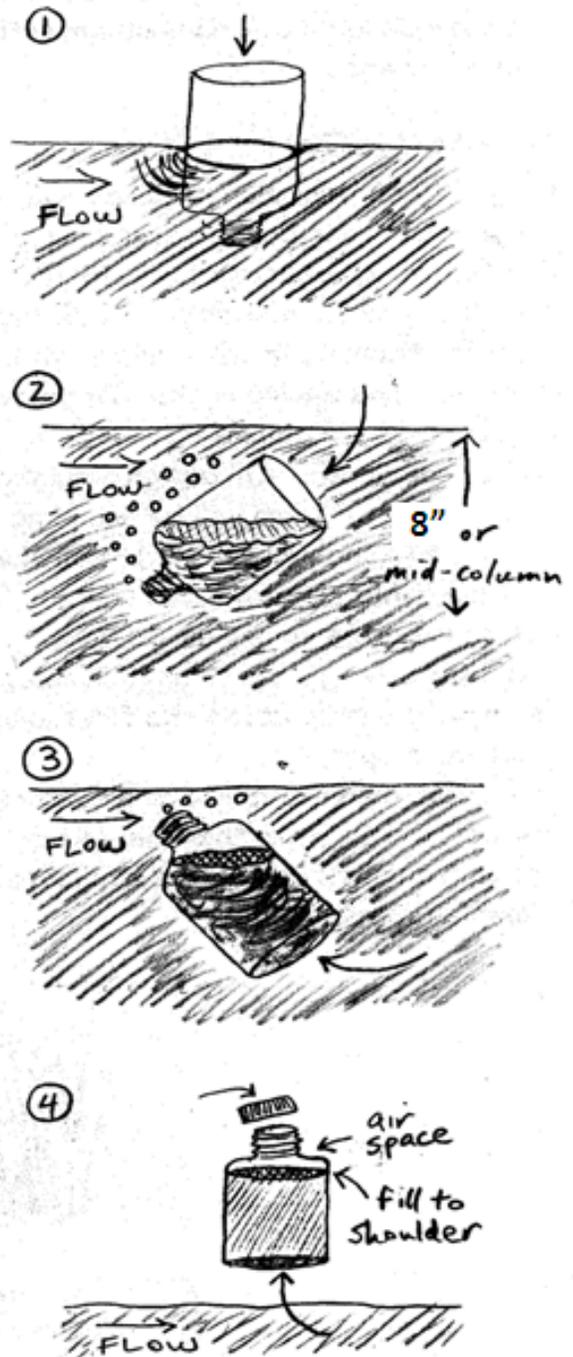
1. Fill the car cooler with ice or ice packs; the latter are less messy and keep colder longer.
2. Take the portable cooler with you to each site, with enough ice to chill the sample(s) until you get them back to the car cooler.

3. Bottles should be labeled before collecting samples. Fecal coliform collection bottles, if reusable, should be pre-numbered. If there is no number on the bottle, mark it per lab instructions. You may also have to affix tags to the bottles after sampling.

4. **Collecting the sample:**

- a. Enter the stream downstream of where you plan to sample, to avoid contaminating the sample from your boots or stirred-up sediment. Sample at a point where the stream is flowing, well mixed, and preferably at least 6" deep. (If there is no such place at your regular site, you may have to go outside it; if so, note your location on the tracking sheet.) Get as far away from the banks as you can. Choose a spot that appears undisturbed and has little or no sediment stirred up in the water, if possible. It is preferable to use a sampling wand, as this stirs up the bottom far less than walking in the creek, and also avoids decontamination problems; see Anti-Contamination Protocol.
- b. For a bacterial bottle: uncap the bottle¹ and do not let anything touch the inside of the cap. Do not rinse the bottle or cap. If the bottle becomes contaminated (e.g., if you touch the threads or hit it on the stream bottom), send it back to the lab uncapped for re-sterilization.
- c. For a field-grab bottle for other parameters such as nutrients: rinse it twice with stream water (as well as its cap) before sampling.
- d. If you're in water >6" deep, hold the bottle near its base and plunge it below the water surface with the opening pointing downward. Collect the sample 8-12" below the surface, or midway between the bottom and the surface if

the water is shallower. Turn the bottle underwater into the current, moving it slightly upstream as you turn it up, and take the bottle out of the water when it is filled up to the shoulder—see figure below.



- In still water, it's particularly important to keep a forward motion with the bottle through the water, to avoid contaminating the sample with whatever might be on the outside of the bottle.

¹ If the site has a noticeable layer of "gunk" on top, either take all samples at the site by removing the cap under water, or remark upon the surface layer at that site on the data sheet.

- If the bottle comes out with the water level below the shoulder, pour out the water and try again.
 - If the bottle comes out full, quickly flick the bottle until the water level decreases to the shoulder. If more than a few seconds have passed, cap and shake the bottle before flicking.
- e. If the water is <6" deep, you have a couple of options:
- Sample in shallow, fast-moving water, preferably at a point where the water is forced between a couple of larger rocks. Hold the bottle facing upstream so as to catch the moving water in it. Do not touch the bottom except for at the back of the bottle.
 - If there is a drop-off somewhere, as from a cascade or culvert, you can sample from this drop-off so long as the bottle touches nothing but the falling water.
- f. Note any deviations from protocol on the data sheet.
5. Recap the bottle carefully, without touching the inside.
 6. If there is a number on the bottle, record that number on the data sheet. Otherwise, follow instructions for that project.
 7. Put the bottle in the cooler, or, if you're using this bottle as a field-grab bottle to fill laboratory bottles, be sure that anytime you're pouring or extracting sample from the field-grab bottle, you cap and invert it several times to mix.
 8. Follow any additional instructions from the lab, such as filtering or adding fixatives. Gloves and mask may be needed.
 9. If this is a site where you are to take a **replicate** or **blank**, repeat the sampling procedure. Indicate R or B as instructed on the tracking sheet.
 10. At your first sampling site, fill out the headers on the Tracking Sheet (see example at end of section). The "Sampler in Charge" is the person ultimately responsible for the data at those sites on that day. Be sure to include all initials.
 11. At each site, enter on the tracking sheet:
 - a. The bottle number, if there is one.
 - b. The site name; if you do not know its name, describe it well enough that its location is clear.
 - c. "R" for field replicate or "B" for blank (see discussion above).
 - d. The time of sampling.
 - e. Sample collector's initials.
 - f. Other water-quality measures (e.g., temperature) as instructed.
 - g. Any noteworthy remarks—e.g., a flock of ducks on the water, abundant leaf litter, strange debris, high turbidity, unusual smells—or problems sampling.
 12. If using a field-grab bottle to fill other bottles, rinse this bottle & its cap with distilled water when finished at site.
 13. Transfer sample bottles to the car cooler. Be sure to get bottles well-mixed with the ice or ice packs to insure quick cooling.
 14. When finished sampling, bring all samples and forms to the laboratory or shipping site. On your data sheet, enter the time that you turned the samples in, and have someone from the laboratory or shipper initial the time that they've received the samples.
 15. Have the lab use their temperature gun to record holding temperatures of bottles from the first, last, and warmest of your sites; record these on your data sheet.
 16. Submit the data sheets that the lab requires, and make copies for the Streamkeepers office. Don't forget to turn in a Tour Cover sheet and Volunteer Hours sheet for your team.
 17. The lab will process the samples and submit results to Streamkeepers, who will enter the information into the Clallam County Water Resources database and then issue a report.

BANK STABILITY ASSESSMENT

To help evaluate the severity of the erosion and revetment you documented in the Erosion/Revetment protocol, this protocol provides a simple rating scale, based on some easily-recognizable factors. It was developed at the University of Washington [Henshaw and Booth, 2000], and has been found to provide reliable results when the assessments are performed by different observers ($R^2 = 0.71$ indicates a strong correlation between scores given by different observers [Sossa and Booth, 2004]).

FIELD PROCEDURE

1. Assess the entire vicinity of your reach, if possible, not just the part within the "official" reach boundaries. By "vicinity," we mean the entire stretch of stream that has similar characteristics (gradient, valley/channel shape, and riparian vegetation) to your "official" reach.
2. Use the scale below to assess the degree of stability/instability, and check it off on your data sheet.

Categories of bank stability, from Henshaw and Booth (2000), adapted by Sossa and Booth (2004), further adapted with assistance from Booth 2004.

Class	Description
4	<p>STABLE</p> <p>Herbaceous vegetation other than just grasses down to the ordinary low-water line (us. the bottom or "toe" of the bank slope)</p> <p>No raw or undercut banks</p> <p>No recently exposed roots</p> <p>No recent tree falls</p>
3	<p>SLIGHTLY UNSTABLE</p> <p>Vegetation to water line in most places</p> <p>Some scalloping of banks</p> <p>Minor erosion and/or bank undercutting</p> <p>Recently exposed tree roots rare but present</p>
2	<p>MODERATELY UNSTABLE</p> <p>Vegetation to water line sparse (mainly scoured or stripped by lateral erosion)</p> <p>Bank held mainly by hard points (trees & boulders), and eroded bank elsewhere</p> <p>Extensive erosion and bank undercutting</p> <p>Recently exposed tree roots and fine root hairs common</p>
1	<p>COMPLETELY UNSTABLE</p> <p>No vegetation (other than grasses) at water line</p> <p>Bank held only by hard points</p> <p>Severe erosion of banks on outside bends and both banks on straight stretches</p> <p>Recently exposed tree roots common</p> <p>Tree falls and/or severely undercut trees common</p>
1	<p>ARMORED BANKS</p> <p>Banks held by placed structures such as riprap, retaining walls, etc.</p>

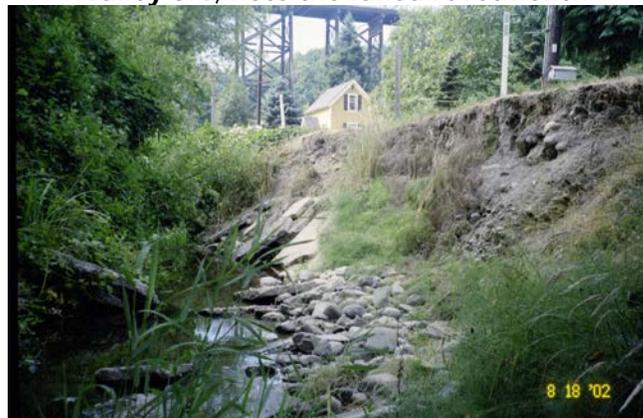
**A slightly unstable bank (Class 3):
Jimmycomelately 0.6**



**A moderately unstable bank (Class 2):
Jimmycomelately 0.2 prior to channel restoration**

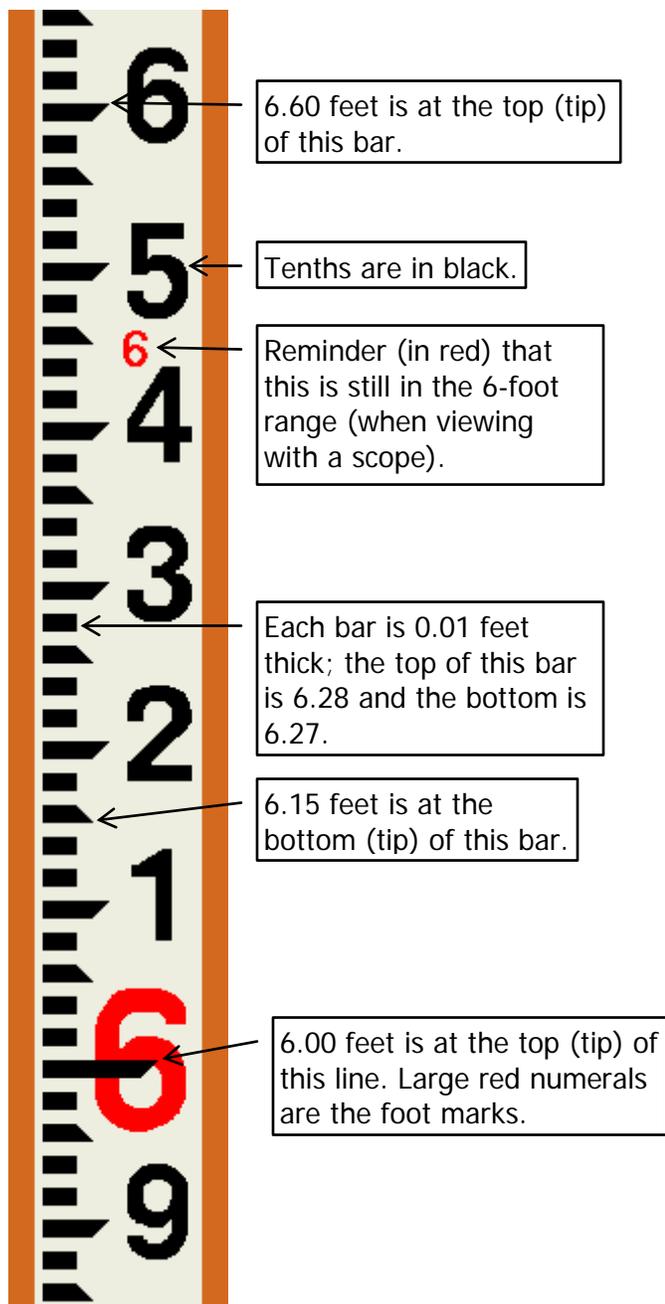


**A completely unstable bank (Class 1):
Valley 0.4; note the failed revetment.**



GRADIENT

STADIA ROD SCHEMATIC:



EQUIPMENT NEEDED

- Sight level (“peashooter”--in leather case)
- 100'+ tape, marked in .01-foot increments
- stadia rod, marked in .01-foot increments
- data sheet, clipboard, pencil

Using this procedure, known as the “peashooter” method, you will measure the downhill slope (gradient) of the water surface. Two people are required: a sighter and a rod-holder. The sighter should ideally be someone with a steady hand and a good eye. A tip: the sight level fogs up in rainy

weather, so carry it in your shirt pocket (close to your body) to minimize fogging.

WHERE TO MEASURE: The ideal place:

- is fairly straight and in a single channel, with a good sight line, and with no downstream constrictions that may cause backwater effects during high flows
- is representative of the section of the creek your reach is in
- has 2 identical habitat units (e.g., the tops or bottoms of 2 pools or riffles) for endpoints
- is at least 50-100 feet long
- is upstream of your cross-section line (if your reach has one)

Do the best you can to meet these conditions; you may go outside your reach if necessary.

(NOTE: Placement will be different if you are measuring gradient for a stream gage—consult with staff if this is the case.)

HOW TO MEASURE: Try to have more than one set of samplers perform this procedure (or switch roles) to increase your precision.

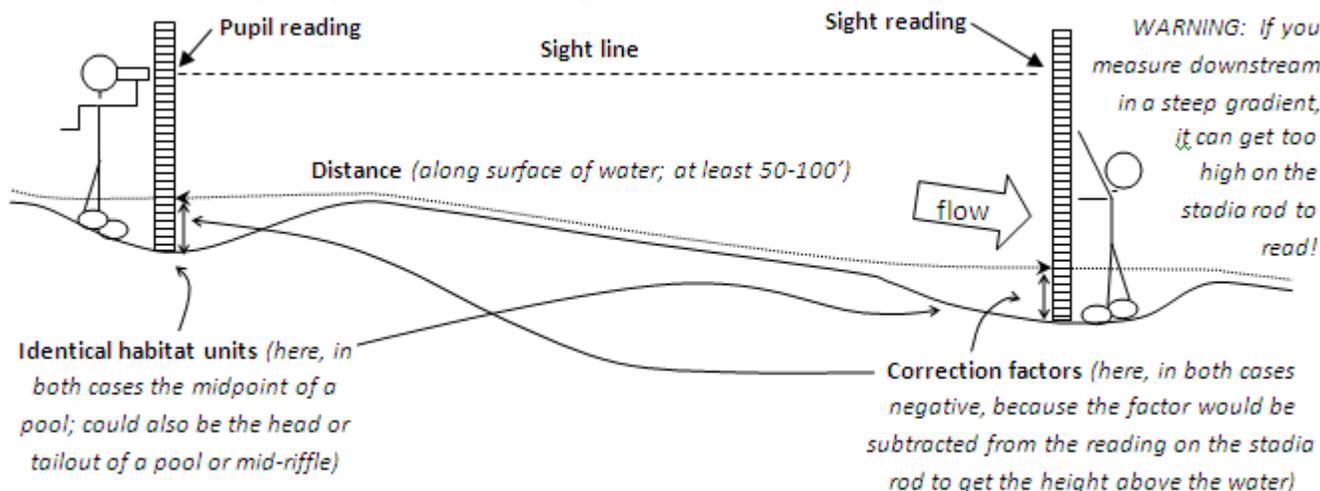
1. Decide where the sighter and rod holder will stand. (*Who stands u/s & who stands d/s is purely a matter of convenience of reading the height on the rod.*) The sighter then takes position in or alongside the stream and sights through the peashooter to where the rod-holder will eventually be, leveling it by getting the bubble in the middle of the 3 lines. Meanwhile, the rod-holder extends the stadia rod from the bottom section until the button clicks, so that the rod reads above 7', and sets it down next to the end of the peashooter, leveling it by holding it with two fingers from above like a plumb-bob. The rod-holder then measures the “Pupil Reading” on the rod to the middle of the leveled peashooter, to the nearest hundredth of a foot. (See stadia rod picture.)

- If you measure with the bottom of the rod right at water level, you can enter a zero for “Correction Factor.”
- If the rod is resting below or above the water level (e.g., in the water or on a rock), you need to record the Correction Factor that would need to get added to the Pupil Reading to get the height above the water:
 - If the rod is resting below the water level, this will be a negative number.

- If the rod is resting above the water level, this will be a positive number.
2. The sighter holds the tape reel while the rod-holder takes the rod, the clipboard and pencil, and the end of the tape, and walks to the pre-determined point. You may have to do some minor pruning of overhanging branches or walk outside of your reach to get a good sight-line. Run the tape between you along the water.
 3. The rod-holder holds the stadia rod at any convenient point (given the criteria stated above), making sure it is straight up by using the "plumb-bob" technique described earlier.
 4. The sighter, standing in the same position and posture as in step 1, sights through the sight level (with the label at the top) toward the stadia rod, and adjusts it so that the bubble is centered on the sight level's center mark. The sighter then determines where the center mark crosses the stadia rod, either by reading the numbers on the rod her/himself, or by giving signals or verbal directions to the rod-holder to move a dark, straight object (such as the sight-

level case) in front of the rod until its top aligns with the center mark. The rod-holder notes that "Sight Reading" to the nearest hundredth of a foot, then measures the Correction Factor if the rod is resting below or above the water level (see previous section), and enters both values on the data sheet.

5. The two then stretch the tape between them, along the contour of the water, and record the "Distance" on the data sheet, to the nearest tenth of a foot.
6. If there is no adequate straight stretch, you may have to take multiple straight-segment readings as you go around a bend at the deepest point of the water. If you take an "additive" gradient in this manner, record values for each segment separately and note that the values must be added together, which can be done in the office.
7. In the "Sampler's Initials" box, put the sighter's initials next to each set of measurements; record any comments relevant to the quality of each set.



Sample gradient data sheet

Pupil reading	Pupil height correction factor (- if below water level, + if above)	Sight reading	Sight height correction factor (- if below water level, + if above)	Distance
5.21	0	5.16	-0.24	91.4

Pupil/Sight heights above water = Pupil/Sight readings + correction factors

Gradient = "rise/run" = ABS[(pupil height above water)-(sight height above water)]/distance

SAMPLING PLAN DESIGN

HOW TO PROPOSE A NEW STREAM, REACH, OR PROJECT

Streamkeepers has a regular quarterly monitoring plan that has been devised in consultation with our technical advisors and volunteers. That plan provides a general framework for the ambient monitoring of a stream, meaning that it's designed to establish baseline conditions, compare conditions between sites and streams, and track trends. Beyond our regular quarterly monitoring, we also perform special projects at the request of partner agencies, volunteers, or other area residents. Each fall, Streamkeepers staff, volunteers and technical advisors work together to determine the streams, monitoring reaches, and projects to be monitored the following year. If you are interested in a stream, site, or project that is not on this year's work plan, we suggest you do the following:

1. Join an existing stream team for the time being. This way you will receive the training and learn our protocols. You can tell Streamkeepers staff which of the existing teams you'd like to join, or staff can assign you to a team.
2. Do the homework necessary to determine the value of monitoring the new stream or reaches, and to locate where the monitoring reaches should be (see "New Reach Establishment" section). You'll probably want to convene a meeting and/or field trip for local experts to advise you. We can help you get in touch with these experts.
3. Round up a team of volunteers, if possible. Recruit your friends and neighbors!
4. Write an informal proposal showing the results of the above efforts. This doesn't have to be formal or fancy, but it should include:
 - a. A description of your proposed stream/sites/projects and the benefits of carrying out your proposal;
 - b. List of prospective team members (name, address, phone);
 - c. If your proposal involves anything other than the regular Streamkeepers quarterly monitoring plan, you'll need to compose a more detailed sampling plan. We can provide you with reference materials for designing such a plan (e.g., Murdoch et al. 1996 and Yates 1988).
 - d. Contact information for any professionals with whom you've consulted (name, agency, address, e-mail and phone number);
 - e. Rationale for your choice of sites, and maps showing those sites.
5. Participate in the Volunteer Advisory Committee and Steering Committee in the fall, and advocate for your stream/reaches. You will advocate most effectively if you are prepared with the aforementioned proposal!

CRITERIA FOR SELECTING MONITORING SITES ALONG A STREAM

Streamkeepers generally monitors small- to medium-sized wadeable streams, most of which arise in the foothills and are of relatively short length—often just a few miles. In streams we monitor, we generally try to establish three or more reaches: ideally, one at or near the mouth, one or more in developed areas, and one above most/all of the developed areas. This arrangement allows some comparison between stream characteristics at different elevations and levels of human impact.

The exact location of a monitoring reach will depend on characteristics specific to each creek (including access, owner permission, creek history, etc.) Resources that can help you identify the most effective and accessible places to establish new reaches include USGS quad maps, driving/walking tours (but don't trespass), your personal knowledge of the area, and **especially** the suggestions of local natural resource specialists (Clallam County; Tribes; Clallam Conservation District; State Departments of Fish and Wildlife, Natural Resources, and Ecology; US Forest Service, National Park Service, Natural Resources Conservation Service; etc.).

Criteria for selecting reaches to monitor on a given creek include:

1. Reasonable and safe access by volunteers.
2. Publicly owned land or permission of landowner to access and mark sites.
3. A good spot to gather data, either because:
4. It provides a representative view of the stream at that point in its watershed, or
5. There's a particular land-use impact that you're trying to track, in which case you'll want sites both upstream and downstream of that land use.
6. At least 165' upstream or 660' downstream of bank alterations such as bridges, riprap, etc., if possible. (Unless your purpose is to measure the effects of these bank alterations!)
7. Containing both pools and riffles, if possible.
8. Above saltwater and tidal influence.
9. Generally located at least one half mile apart.
10. If you're trying to establish a "reference site" which approximates pristine conditions, find a site with little/no adjacent land use, good riparian cover and channel complexity (including pools and riffles), and that's neither totally incised nor a Devil's Club swamp!

Once you've determined where your sites should be and have gotten approval for the new project and sites, you'll need to establish the new sites by following our "New Site/Reach Establishment" protocol (next section in the Handbook).

NEW SITE/REACH ESTABLISHMENT

Here are some steps to go through if you're establishing a new monitoring site or reach. A "site" is a fairly-contained spot, whereas a "reach" is a specified length of stream; generally, a "site" will suffice unless you'll be doing physical-habitat measurements, in which case you'll need to establish a "reach." For the purposes of this section, we'll use the words interchangeably.

1. Identify prospective monitoring reaches

- a. Using the resources and criteria described in "Monitoring Program Design," select prospective monitoring reaches and mark them on a map. To do this, you may go into Google Earth and find the location, then create a pin at the location. In the header on the left, click 'place', highlight the location and click Properties. In the Properties dialog box, you can give the location a name. Copy the latitude and longitude from the dialog box and paste them into the name. Print the map for a record of the site location.
- b. Use the County Assessor's maps to identify the parcel number and look up the owner's name (either at the Assessor's office or online at <http://www.clallam.net/Maps>).
- c. Confirm accessibility of the site through a visit or a drive-by. If private property, contact the owner regarding access. Streamkeepers staff can supply you with a permission form for establishing a monitoring site and a standard letter asking for permission, which you can bring to the owner; or we can mail these items to them at your request.
- d. Write a brief text (1-2 paragraphs) describing the reach, its location, how to access it, and why you've chosen it. If you consulted with anyone, be sure to list his or her name, title and contact information. Also, if you want to do something other than monitor the regular suite of parameters (e.g. you think you should monitor only chemical water quality, or only riparian vegetation, etc.), list the parameters you want to monitor and (briefly) why you think it's a good idea to diverge from the standard suite.

2. Confirm selection of monitoring reach(es) with Streamkeepers staff

3. Document and mark the reach

- a. Complete as much of the "New Site Questionnaire" (see following pages) as you can prior to going into the field. You can get this form from our office or our website at <http://www.clallam.net/SK/doc/Newsitequestion.pdf>.
- b. Go to the site(s) and:
 - i) Finish the "New Site Questionnaire"
 - ii) Perform the "Sampling Site Sketch Map" or "Reach Map" protocol, depending on directions from program staff. A Google Earth printout may help you with this.
 - iii) Install monuments and flagging as needed at your reach(es), per the above protocols.
- c. Draw your map(s), per the above protocols.
- d. Determine the Washington Department of Fish & Wildlife stream number for each reach; you'll need the state Water Resources Inventory Area (WRIA) catalog, available from Streamkeepers staff.
- e. Have staff create a field-forms folder and hanging file for the stream-team, and an office binder for the stream if new. In the binder, include copies of maps with the monitoring site(s) clearly marked.

STREAMKEEPERS OF CLALLAM COUNTY—NEW SITE QUESTIONNAIRE

(This form is available at <http://www.clallam.net/SK/doc/Newsitequestion.pdf>.)

Dear Streamkeeper advisor/partner/volunteer: You have suggested a new Streamkeepers monitoring site. (For more information, see <http://www.clallam.net/streamkeepers/assets/applets/SamplingPlanDesign.pdf> & <http://www.clallam.net/streamkeepers/assets/applets/NewReachEst.pdf>.) In order to facilitate our addition of this site into our database system, please answer the following questions about each new site you wish to see monitored, using a separate form for each site. You may submit responses electronically or by hard-copy.

1. Your name (and agency if applicable):
2. Brief descriptive name of this site, and stream-mile to the nearest tenth if you can calculate it from a map:
3. How frequently would you like this site sampled? In what condition? For what parameters and duration?
4. Where, exactly, would you like this site to be? (Either locate on a map, preferably 1:3000 or larger scale, or provide coordinates, preferably to 9 decimals for latitude and 7 decimals for longitude; see next page.) *Please note: Streamkeepers' macroinvertebrate-sampling protocol specifies that collection sites are to be at least 660' downstream or at least 165' upstream of any human-made structure in the bankfull channel, such as a culvert or bridge, UNLESS your goal is to sample the impacts of the structure. So if you think macroinvertebrate samples will someday be taken at this location, follow the above guidelines.*
5. Supply good written directions as to how to access this site, both driving and walking to the site:
6. Every new site needs to be visited by SK staff or a technical advisor prior to any monitoring. Has this site been visited, and if so, by whom and when? If not, who will be visiting this site, and when?
7. The technical advisor should help decide if flow will be measured at this site, and if so, if it should be measured along a transect between permanent monuments. If so, have the monuments been installed, or is there a plan to install them? (If so, the installation should be indicated and referenced on the Site Sketch Map.) Also, is it safe to measure flow at or near that site in all conditions?
8. Who owns the site and the access route to it? What are the parcel numbers? (Get from County web maps.)
9. Have you obtained permission to access these parcels? If so, when, and who did you talk to (incl. phone #)? If not, can you help us make the necessary contacts?
10. Would there be any special access instructions, such as gated access points or the need to contact the landowner prior to each site visit?
11. Is past data available at that site? If so, who/what/when/where & how can we access it?
12. How soon would you ideally like Streamkeepers to start monitoring? (The quicker & better the information you provide, the sooner we can start.)

13. Location information—Please help us with the following information, to the best of your ability:

- a. Put a dot for this site on an attached map (preferably 1:3000 or larger scale; use interactive County maps or Google Earth), **OR** give a lat/long, preferably in decimal degrees (i.e., set your GPS to read out in this form) or determine the lat/lon from Google Earth.
- b. We also need to know how you placed your dot or took your GPS reading, so please answer the questions below. We need this information in order to share our data with the State and other agencies. Some of the notes in italics should help you with your answers.

Horizontal collection method (select one):

- Address match--unspecified #
- Survey--conventional
- Computer Map (GIS-based, including EIM, Google Earth)—specify imagery used
- GPS standard unit or unknown (code phase)
- GPS high end consumer unit (DGPS or WAAS enabled)
- GPS survey-grade unit (carrier phase)
- GPS *real time survey-grade (kinematic)*
- Paper map interpolation [*e.g., County road maps or USGS 7.5' quads*]. *Specify the map scale*
- Unknown

Horizontal datum (select one):

- N. American Datum 1927 (NAD27) [*e.g., USGS 7.5'quads or NOAA charts*]
- N. American Datum 1983 (NAD83 or 91 Adj.)[*e.g., Clallam County GIS*]
- N. American Datum 1983 HARN
- WGS84 (GPS NAVS88)
- Unknown

Horizontal accuracy (use your best judgment and select one):

- ± 0.01ft
- ± 1ft
- ± 3ft
- ± 10ft (3m)
- ± 20ft (6m)
- ± 40ft (12m)
- ± 100ft (35m)
- ± 180ft (55m)
- ± 250ft
- ± 500ft
- ± 1000ft
- Unknown

SAMPLING SITE SKETCH MAP

EQUIPMENT NEEDED

- pencils with erasers
- paper (pref. Rite-in-the-Rain; in a pinch, you can use the back of a data sheet)
- clipboard
- tape measure
- sighting compass
- flagging tape
- permanent marker
- If you're installing permanent monuments, you'll need the Reach Establishment Kit including: rebar & caps, spikes, sledgehammer, hacksaw, helmet, and goggles.

This procedure will guide you in drawing a simple sketch map which will help you document the location of a "point" sampling site (where, for instance, only water chemistry and flow are measured). This map will allow you and others to be consistent in sampling the same spot.

Once you've created this sketch, a copy will be filed in your stream's binder in the Streamkeepers office, and another copy will stay in your team's forms folder, so you'll be able to refer to it or make revisions as necessary each time you visit your reach. (If you do make revisions, please let staff know so they can change the copy in the office's stream binder.)

This sketch is easy!: Your goal here is just to get the information down, so straight lines, scale, and "compass trueness" are not important in the sketch, as long as you get the proper information across.

NOTE: In the instructions that follow, measurements follow the "lay of the land." So if you're measuring up a hill, you extend the tape going up the hill rather than on a level.

1. Decide roughly where your sampling site will be; see "Identify Prospective Monitoring Reaches" in the New Reach Establishment protocol. If possible, make the sampling site a place that will be easy for you and others to find and access.

2. Complete as much of the "New Site Questionnaire" as you can before going out in the field.
3. At your site, decide on a "zero-point," an easily identified point near where your monitoring will occur, and to which exact sampling locations can be referenced (such as when you collect macroinvertebrates). Ideally this will be a prominent landmark which you can flag and draw on your map, such as a big conifer, boulder, bridge, fence post, or end of a path. Otherwise, you can install a piece of capped rebar.
4. At the top of your sketch, include:
 - Site name, which in general is the name of the stream plus the stream-miles to the nearest tenth (but see staff regarding exceptions)
 - Date you surveyed for the map
 - First initials and last names of all map sketchers
 - An approximate North arrow
 - Approximate elevation in feet, which you should already have determined while completing the New Site Questionnaire (see New Reach Establishment protocol)
5. Draw a rough map or write directions explaining where to park, and then how to walk to the site from the parking place. Include approximate distances and compass directions as needed.
6. If not prohibited, place some kind of marker near the sampling site. Capped and flagged rebar is best (materials available at the office), or else flagging hanging from a nearby tree or bush. Mark the flagging with your site name and give instructions for getting from the flagging to the central sampling point, if it's not directly across from the flagging. Try to minimize the visual pollution from the flagging, and yet make sure it's visible. Usually you can find a branch nearby to hang it from.

7. On your sketch map, reference the sampling-point to two prominent nearby landmarks, as well as your monument/flagging. Distances and directions (even approximate) are helpful.
 8. Draw the stream on your sketch and indicate the direction of its flow.
 9. If all measurements (e.g., flow and water chemistry) are being taken within 50 feet of the identified sampling point, that's exact enough. If they're further apart than that (for instance, if the best spot to measure flow is more than 100 feet downstream of the best spot to measure water chemistry), mark each sampling point separately.
 10. Install permanent flow-monitoring monuments if you have been instructed to do so (see New Site Questionnaire and Flow protocol). These will be either rebar driven solidly into the ground above bankfull and sawed off as necessary, or spikes driven into trees. Label these monuments with flagging marked "flow
- lbm/rbm" to help distinguish them from the brush. If you can't put the flagging on the monument itself, hang it nearby and explain where the monument is in relation to the flagging. Include on your map:
 - a) The flow-monitoring monuments, indicated as "flow lbm" or "flow rbm", and as "rebar" or "nail in tree."
 - b) Distances and azimuths (see "Compass Use" protocol) to each monument from the landmarks described above in #6.
 11. Sketch any other information you deem useful about the stream and riparian areas. Include observations about such features as vegetation types and locations, pools and riffles, gravel bars, downed logs, and human alterations.

