Sampling

Overview and Checklist

This list is an overview of everything involved with a sampling event. You can use it as a check list to make sure all is covered. Specific instructions for each follow in this section as well as datasheets and instructions. **SAFETY IS ALWAYS THE # 1 CONSIDERATION.**

Sample Prep (in the lab)

- ☐ Decide what you will be sampling today, water quality, macroinvertebrates, physical habitat, optional (though recommended) velocity / discharge and or photograph
- ☐ Decide how many stations will be sampled today
- ☐ Soak your pH probe in KCl solution before you head to the field if possible.
- ☐ Determine if QA/QC samples will be collected today
  - ☐ Metals = blank/duplicate every 5th trip
  - ☐ Nutrient duplicate (if instructed by us to do so)
  - ☐ Macroinvertebrate QA sample (if instructed by us to do so)
- ☐ Label your bottles
  - ☐ Metals (every time)
  - ☐ Nutrients (hi/low flow biannually)
  - ☐ Macroinvertebrate (inside/outside labels)
- ☐ Preserve all metal samples (**follow nitric acid protocols**)
- ☐ If time allows and it's a metal QA/QC sample, collect blank sample in your lab
- ☐ Make sure caddy is stocked, don't forget waders, Dei-water, filters, bottles, thermometer, waste container, and safety plan, gloves, etc.
- ☐ If macroinvertebrate collection, check macroinvertebrate equipment list*
- ☐ If physical habitat collection, check physical habitat equipment list
- ☐ If velocity / discharge, photo, check for: data sheets, float object, timer, distance measuring device, depth measuring device, camera

*whenever collect macroinvertebrates collect water quality if can, field, metals and nutrients so we can measure the quality of habitat the bugs resided

In the Field

- ☐ Order of collection function (walking composite, bucket composite or grab). If collecting everything always collect water quality first, macroinvertebrate collection second, physical habitat third, velocity/discharge fourth
- ☐ Collect dissolved oxygen, 300 mL BOD
- ☐ Collect filtered and not filtered metals with syringe (blank and dup if necessary)
- ☐ Take and record temperature
- ☐ Collect 16 ounce sample for alkalinity/hardness/pH
- ☐ Collect nutrient (if required)
- ☐ Collect macroinvertebrates (if requested and collect WQ and physical habitat too!)
- ☐ Assess physical habitat if possible
- ☐ Measure velocity/discharge if desire
- ☐ Take annual photo if time permits
- ☐ Complete field data sheet for field
- ☐ Check site for litter

Back in the Lab

- ☐ Put nutrients in refrigerator until it's time to ship
- ☐ If sampled at real time USGS/State Engineer Gauge, go online and get flow, record on field datasheet
- ☐ Titrate DO within 8 hours (keep cold/dark place), complete data sheet
- ☐ Titrate alkalinity/hardness/pH within 24 hours (keep refrigerated), complete data sheet (pH needs to be tested at room temperature!)
- ☐ Complete all data sheets and bring alkalinity, hardness and dissolved oxygen results forward to the field data sheet
- ☐ If collected macroinvertebrates, that evening decant alcohol in sample jar and refresh with remaining alcohol
- ☐ Enter data in www.coloradoriverwatch.org database
- ☐ Copy original data sheets or just field datasheets, file copy in your records
- ☐ With original data sheets (all) and chain of custody, ship metals at least every 3 months, nutrients within 48 hours, not on a Thursday or Friday, on ice and by 15th of each month, macroinvertebrates within two weeks of collection
- ☐ Before shipping, check supplies for refills, include sample bottles in the shipment for appropriate chemicals.
- ☐ Properly fill out chain of custody for shipping samples.
- ☐ Send velocity / discharge, take photo, conduct optional macroinvertebrate, physical habitat analysis
- ☐ Clean and store all field and lab equipment properly

Note: Deionized water is filtered to remove all ions. The deionized water provided to River Watch volunteers is of a known and consistent quality from the Colorado Department of Public Health and Environment Laboratory. River Watch provides a 5 gallon carboy full of deionized water to all volunteers. Use ONLY this deionized water, never use deionized or distilled water from your own filtration system or from a store, it varies in quality. This is a quality assurance and control program element.

Container, Preservation, Holding, Shipping & Turn-around Time Summary

Indicator	Container	Preservation	Units	Sample Frequency	Holding Time	Shipping Frequency	Turn Around Time[3]
Temperature	None	None	Degrees C	12/year (monthly)	None	Send Data Sheets w/ Bi-monthly	Within 3 months
Dissolved Oxygen	BOD Bottle	1st three chemicals	mg/L	12/year (monthly)	8 hours if cold dark refrigerated[1]	Send Data Sheets w/ Bi-monthly	Within 3 months
pH, Phenol/Total Alkalinity, Total Hardness	16 ounce Bottle reuse	None	mg/L	12/year (monthly)	24 hours if kept refrigerated[1]	Send Data Sheets w/ Bi-monthly	Within 3 months
13 Metals, total and dissolved	2 ounce HDPE new bottle	Pure Nitric Acid	ug/L	12/year (monthly)	6 months	Bi-monthly	Within 7 months
Nitrogen Species and Phosphorus	8 ounce Cylinder	Sulfuric Acid	mg/L	2/year (high/low flow)	28 days	W/in 48 Hr, on ice, M-T	Within 4 months
Bugs[2]	32 ounce bottle	High Grade Ethanol Alcohol		1/year	3 Years	W/in 2 weeks	Within 8 months
Physical Habitat[4]	None	none		1/year	None	Quarterly	Within 8 months

[1] 7 day exception

[2] Collect field, metals and nutrients AND physical habitat when collect bugs if at all possible equals a better story

[3] All times from when RW receives samples not from collection date

[4] Can and do collect reach physical habitat once a year!

Holding Time is the time between when a sample is collected and analyzed before results are no longer valid. Most parameters have a standard holding time based on an accepted collection and analyses method for a desired level of data quality, including the type of container that will maintain sample integrity until analyses.

Preservation of samples occurs for two primary reasons, first some parameters will change formation, concentration or in some way that is different than their amount, concentration or form in the river and preserving the sample ‘freezes’ that parameter as it was in the river at collection time for analyses at another time. The second reason is similar, but to allow for more time to analyze the sample.

Shipping Time is when a sample needs to be shipped to the laboratory for analyses before it expires. These times depend on sample location relative to analyses location, parameter holding time and other logistics and considerations. Shipping time is a program specific element but a necessary element to define.

Turnaround Time is the time it takes for River Watch (or a program) to receive a sample, analyze it, verify the results, analyze results and provide results for public or data users. The price for volunteer monitoring data is time, as we cannot match commercial laboratory result turnaround times. These turnaround times are benchmarks for River Watch to provide results in our database application for volunteers, data users and public to access. These will be program specific.

Sampling Instructions

Identifying a Sampling Event and Event ID

Each time you go to the river and collect or assess something, it is a sampling event. For example if you only measure temperature, that is a sampling event. If you collect and assess everything, metals, nutrients, bugs and physical habitat that is an event. If you measure dissolved oxygen every hour for 24 hours, each hour is one sampling event. A sampling event is its own unique occurrence. River Watch needs to be able to identify each sample event as unique occurrence. RW uses the following three pieces of information to create a unique Event ID for each sampling event:

- station number
- sample date
- sample time (military time or 24 hour clock so see difference between 12PM/12AM)

All three items are required. If one bottle or 14 sample bottles are collected at one time and analyzed for one or dozens of parameters, this is **one** sampling event, and gets only the above listed unique combination of identifiers. You can collect two samples in one day, but each of the sampling events would occur at a separate time, thus have two unique combinations of station number, sample date and sample time. If a nutrient sample or a macroinvertebrate sample is taken at the same time as metal sample, the sample identifiers would be the same.

River Watch uses the combination of station number, sample date and time as a unique Event Identifier. There should never be two different sampling events that have the same combination of event identifiers.

Prioritization of what constitutes a sampling event. For River Watch data objectives this is what is recommended:

- when collecting a metals sample always collect pH, temperature, alkalinity and hardness, dissolved oxygen (field parameters)
- when collecting dissolved oxygen always collect temperature
- when collecting nutrients, collect metals and other field parameters (field data)
- when collecting macroinvertebrates, collect water quality samples (metals and field parameters at a minimum, nutrients if possible - it tells us the water quality for the bugs when you sampled)
- if collecting macroinvertebrates, **ALWAYS** complete physical habitat analyses and take a photo if possible
- if not collecting macroinvertebrates conduct a stream reach physical habitat analyses and photo if possible, annually
- keep an annual photo log of site (via our instructions)

Each station should use a **sample tracking sheet** to track what is been collected or assessed when at that location. The sample date and time will be recorded along with a note of what parameters are collected, metals, blank or duplicate metals, nutrients, macroinvertebrates and physical habitat. **The sample tracking sheet is for your records only**. Below is an example of how to use the tracking sheet. This is similar to, but not the same as a chain of custody form. This sheet is used for your QA/QC purposes only.

SAMPLE TRACKING SHEET

Station Name Below Treatment Plant Sheet 1 of 2

River Plum Creek Station Number 123

Volunteer Group Happy HS RW

***Remember every 5th metal sample event should include a duplicate and blank sample.**

SAMPLE DATE	SAMPLE TIME	**DESCRIPTION** Metals	Nutrients	Macroinvertebrates
07-06-16	1726	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
8-10-16	0930	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
9-12-16	1505	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
10-10-16	0820	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
11-11-16	0930	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☒ NF Blank ☒ F Duplicate ☒ NF Duplicate ☒	TSS / CS ☒ NP ☒ Duplicate TSS / CS ☐ NP ☐	Yes ☒ QA sample ☐
12-09-16	1000	Filtered (F) ☒ Non-Filtered(NF) ☒ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐
		Filtered (F) ☐ Non-Filtered(NF) ☐ F Blank ☐ NF Blank ☐ F Duplicate ☐ NF Duplicate ☐	TSS / CS ☐ NP ☐ Duplicate TSS / CS ☐ NP ☐	Yes ☐ QA sample ☐

Sample Collection Preparation

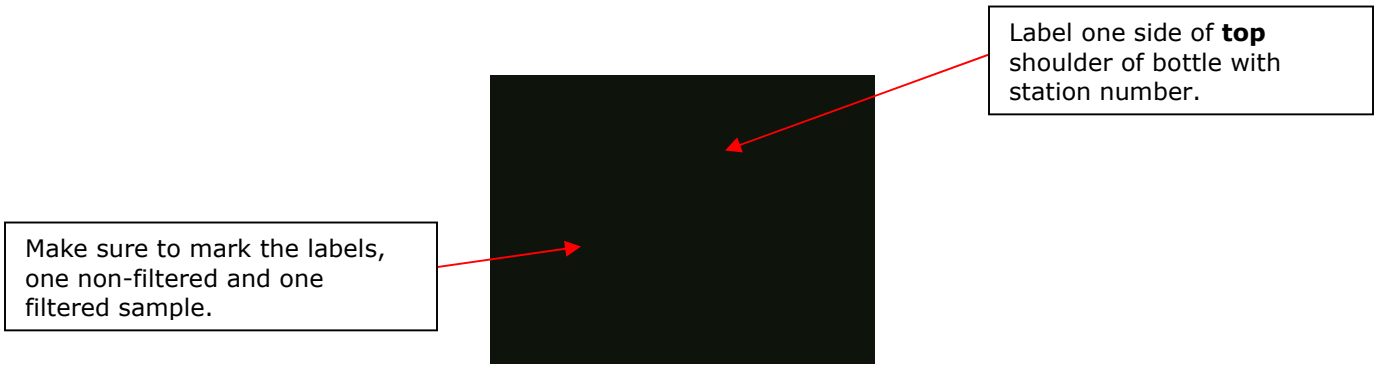
In the Lab/Labeling

Determine what you will be collecting or assessing this sampling event, field parameters (metals and baseline parameters), quality control samples such as metal blanks and duplicates, nutrients, macroinvertebrates, physical habitat or discharge (optional). Record on the sample tracking sheet this sampling event for each station.

Prepare datasheets for each station: Field Data Sheet, Alkalinity, Hardness, and Dissolved Oxygen. Also, prepare data sheets for macroinvertebrate collection and physical habitat, if appropriate, and Discharge (optional). Complete the top portions including date, station name, station number, organization and river name. *All datasheets for the sampling event should have same information on each separate datasheets: Station name, Station number, river name, date, time (military), volunteer group.*

Metals:

For metal samples prepare (label and preserve) 2, two-ounce bottles for filtered and not-filtered samples.



If you run out of labels and you are planning on sampling before you request more, please use a sharpie (or another non leaking marker) to label the bottles. Please make sure your organization name, station, date, time and what kind of sample it is (filtered, non-filtered etc.) is clearly marked on each bottle.

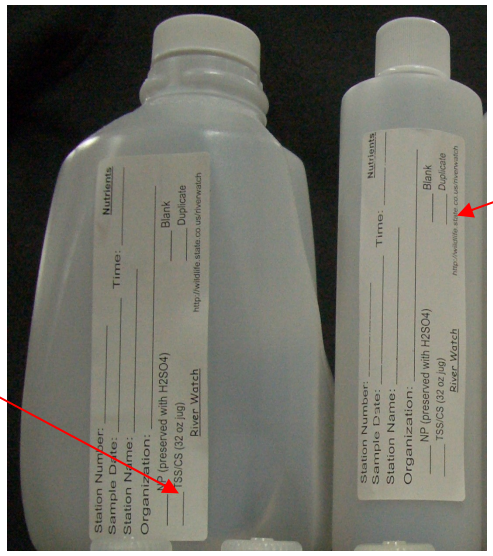
All metal collection samples are preserved with nitric acid. The acid lowers the sample pH<2 where metals will stay in the form they are in the river for later analyses. **Please use caution!** Using the proper safety gear, goggles and gloves provided, place 12 drops of HNO_3 (nitric acid) in each of your metal collection sample bottles. This applies to normal, duplicate and blank samples!

If you spill your sample in the field, rinse the sample collection bottle twice with sample water and repeat steps for filling. Once back in the lab, put 12 drops of HNO_3 in the collected sample.

If you are on your fifth metals sample since the last blank and duplicate sample was taken, you need to prepare duplicate and blank sample bottles. Please review instructions for duplicates before sampling. **Remember, all blank and duplicate samples need the 12 drops of HNO_3 too.**

Nutrients:
If you are collecting a nutrient sample, gather those two bottles and prepare label. Nutrient samples are generally collected twice per year, once during high flow in the spring, and once during low flow in the fall.

Fill out labels completely. 8 ounce cylinder is preserved with acid. **Please use caution!**



Fill out labels completely. 32 ounce jug is used for TSS, Chloride and Sulfate.

If you run out of labels and you are planning on sampling before you request more, please use a sharpie (or another non leaking marker) to label the bottles. Please make sure group name, station, date, time is clearly marked on each bottle.

Macroinvertebrates and physical habitat assessment:
If you are collecting a macroinvertebrate sample and conducting a physical habitat assessment, prepare the bug sample bottle. Macroinvertebrates are sampled once per year in the fall. A physical habitat assessment should always be conducted with a bug sample but can be conducted independently. A water sample should be collected with each bug collection to tell a more complete story. You can collect a physical habitat sample even if you are not collecting a macroinvertebrate sample.

The 16 oz sample bottle, syringe and glass BOD dissolved oxygen bottle:
You should have individual sample bottles, syringes and BOD bottles for each sampling site. Label each sample bottle, syringe and BOD bottle with the station name and/or station number to avoid confusion. All three could be used for other stations if follow thorough cleaning procedures.

Filling out Metal Bottle Labels

It is important the datasheets, metals, nutrients and macroinvertebrate sampling bottles are labeled correctly. Also, it is important to mark/label the filter you will be using to collect the metal sample. **Filters must only be used once**; marking them helps remind you that this filter has been "used".

Be sure and fill out your sample labels completely. Be sure to check if metal is filtered, non-filtered, and if the sample is a blank or duplicate. **For example:**

Metal Label:

Station Number _____6000__
Sample Date __7/17/05_____ Time: 0900
Station Name Sample Bridge_____
Organization _River Watch_____
__X__Non-Filtered _____Blank
_____Filtered _____Duplicate

Metal Label (for duplicate):

Station Number _____6000__
Sample Date __7/17/05_____ Time: 0900
Station Name Sample Bridge_____
Organization _River Watch_____
__X__Non-Filtered _____ Blank
_____Filtered _X___Duplicate

Nutrient Sample:

Station Number _____
Sample Date _____ Time: _____
Station Name _____
Organization _____
____NP (250 mL H2SO4 preserved)____Blank
____TSS/CS (500 mL jug) ____Duplicate

Macroinvertebrate Sample (one label for outside bottle and one label inside bottle – in pencil):

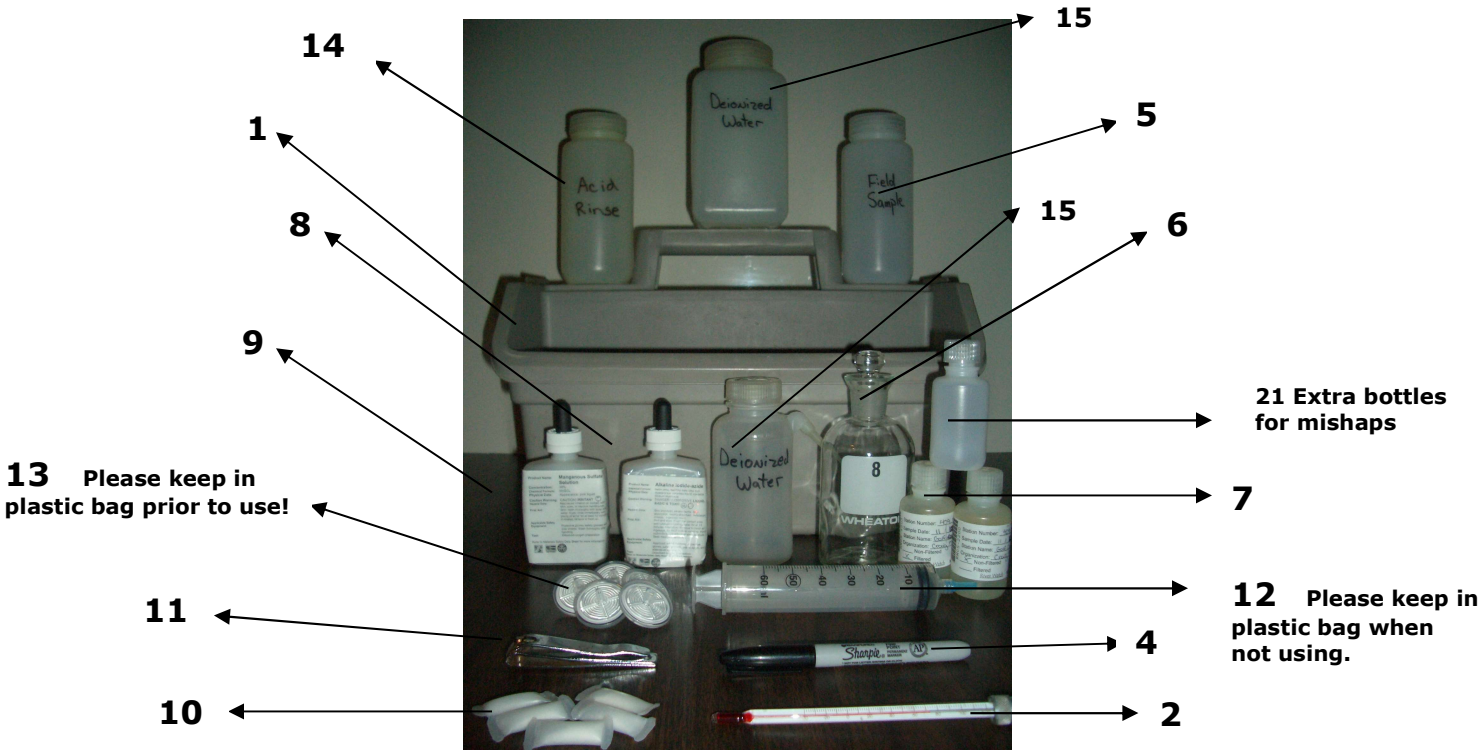
Station Number _____
Sample Date _____ Time: _____
Station Name _____
Organization _____ ____QA sample

See macroinvertebrate label for inside the bottle in macroinvertebrate section.

Checklist of "Take to Field" supplies:

Gather the equipment, supplies, and sample bottles to take in the field. Here is a checklist of what you will need:

1. Caddy
2. Thermometer
3. Field datasheet, Alkalinity, Hardness and DO datasheets, a set per station
4. Sharpie
5. 16 ounce sample bottle for sample collection **(one per station)**
6. 300 mL BOD bottle **(one per station)**
7. 2, 2 ounce pre-labeled and preserved metal bottles (N and NF - per station)
8. alkaline iodide
9. manganous sulfate
10. sulfamic pillows
11. clippers/scissors
12. syringe **(one per station)**
13. 2 filters (two per station) – (plus extras for mishaps)
14. 16 ounce bottle of nitric acid rinse
15. Large container of Deionized water and a DI squirt bottle
16. 4, 2 ounce pre-labeled and preserved metal bottles **IF** collecting blank and duplicate (per station)
17. CS/TSS 500 mL pre-labeled NP 250 mL pre-labeled nutrient bottle (per station) **IF** collecting nutrient sample
18. Macroinvertebrate and/or physical habitat equipment, labeled sample jar and macro/physical habitat datasheet **IF** collecting
19. Waders
20. Safety plan and appropriate materials (goggles, gloves, bug spray, etc.)
21. Extra unpreserved 2 oz metal sample bottle (for mishaps)



Sample Collection – Grab or Composite

There are two ways of to collect a sample:

- A composite sample is collected by taking several small sub-samples and combining them.
- A grab sample is collected at one point in the stream.

A composite is always preferred to provide a more representative sample than a grab. The priority of collection method should follow this order after access and safety issues are addressed: first a walking (or wading) composite, next an upstream bridge composite, then a downstream composite and last choice a grab sample. The grab sample is taken only if the sampler cannot access the entire stream either from a bridge or by crossing it because of high flows or other unsafe conditions.

Walking (wading) Composite Sample

If access and safety permits, for all collection containers, wade across the stream (facing upstream) following an imagined transect line, collecting a sub-sample of water at appropriate frequencies, based upon stream width. Wade and collect in such a manner that you do not disturb the substrate and water column where you dip the collection container.

The exception to this is method is the dissolved oxygen BOD sample bottle. Find a representative flow, not too fast or too slow and stagnant to hold the BOD bottle under water for 2-3 minutes. See specific sections for detailed sample instructions, metals, field and nutrient.

Remember:

It is important that the sampler and the other field crew never walk in the stream above where the sample is collected.

Composite Bucket Sample

For sample stations located at a bridge and on a river that is too deep and/or dangerous to wade across, a bridge composite sample should be taken. An upstream sample is preferred, however, if it is safer to sample downstream that is okay.

1. Use the two buckets provided. Use these buckets for sampling **ONLY**, otherwise we risk contamination. Use one bucket to collect water and the other to hold or “composite” the sample. The composite bucket holds the water you will collect your samples from.
2. Dip one bucket into a representative flow. This water will be used for rinsing the sample buckets, the syringe, the 16 ounce sample bottle and BOD bottle. Rinse each bucket, discard water downstream.
3. Flush 60 mL of DI water through the syringe twice by opening the syringe and pouring the DI into it, (120 mL total).
4. Rinse the syringe three times with sample water; the 16 ounce sample bottle, and the BOD bottle (if you plan on collecting the DO sample from the composite bucket) and rinse the other bucket. Empty the rinse water bucket. Keep the rinsed sample syringe and containers in a clean place.

5. With the sample bucket, go to the upstream left bank and fill the bucket with a representative sample of water. Gently pour the sample into the composite bucket, filling it 1/3 full. Remember to always toss the extra water downstream behind you.
6. Go to the middle of the bridge. Lower the sample bucket down to the river and fill the bucket with a representative sample of river water. Gently pour the sample into the composite bucket, filling it 2/3 full.
7. Go to the upstream right bank and repeat this procedure. Gently pour sample into the composite bucket. The composite bucket should be close to full with river water from three areas.

Remember, **do not** let your bucket touch the bottom or the sides of the bridge, you want to test the water column, not the stream sediment.

The composite bucket now holds the water you will collect for analysis and perform the chemical tests on. The order of the collection is important due to possible contamination.

Because you do not want to contaminate your samples, if you are going to take dissolved oxygen using the composite bucket, take this sample first. Very carefully submerge your BOD bottle into the bucket at an angle. You **MUST** do this slowly as you do not want to introduce any more oxygen into the sample. Make sure to overflow the bottle a little and have no air bubbles in the bottle that might falsely increase oxygen results. Pull the bottle out, cap it and make sure there are no air bubbles in the bottle. Once the bottle is full, continue to “fix” the sample.

Next, if you are collecting a nutrient sample, pour the sample from the bucket into the 32 ounce jug and from the jug, fill the 8 ounce preserved nutrient container. Be careful not to overflow the bottle as it contains a preset amount of sulfuric acid to preserve the sample. Refill the 32 ounce jug from the composite bucket.

Next, pour water from the bucket and fill the 16 ounce sample bottle. This will be used for field parameter tests.

Next collect your metals samples, both filtered and non-filtered. You have taken everything from the composite bucket, so you can go ahead and put the syringe in the bucket for these samples.

Finally, take the temperature from the bucket.

Finish preserving the BOD sample by adding liquid 1: manganous sulfate, then liquid 2: alkalide iodide. Shake the bottle, let it settle, shake again, settle again, add power pillow (sulfamic acid), see full instructions below on Dissolved Oxygen preservation and titration.

Grab Bottle Sample

Use a grab sample when collecting a composite sample will not work. For instance, if flows are too high, river too wide/deep to wade across or if a bridge is not available. When collecting a grab sample:

1. Select a site you can safely reach into the water where the water is flowing and not stagnant.
2. Flush 60 mL of DI water through the syringe twice by opening the syringe and pouring the DI water into it, (120 mL total). Assemble the syringe.
3. Rinse the syringe three times with sample water then fill metals bottles (see instructions).
4. Rinse 16 ounce sample bottle twice with sample water, disposing the water downstream, then fill sample bottle.
5. Fill BOD bottle for dissolved oxygen test and take temperature.

Remember:
It is important that the sampler and the other field crew never walk in the stream above where the sample is collected.

Frozen Sample Site

1. **Proceed only if your teacher or team leader has ascertained the ice will support your weight and movements.**

   If possible, obtain an ice auger and auger through the ice at your station. Use the auger with care and periodically assess the stability of the ice around you. Note that you augured a hole in the Field Data Sheet “Comments” section.

OR:

2. Walk up or down stream to the first open water and collect a sample there. On the Data Entry Form “Comments” section, note where you collected the sample. In either case make sure the ice and snow has thoroughly melted in the stream before sampling.

3 If neither above option is possible, **DO NOT** collect a sample, and note the reason in the Field Data Sheet and/or Data Entry Form “Comments” section and file. **SAFETY FIRST!**

If you can’t sample for any reason, construction, weather, injury, conflict, etc. contact River Watch staff and they will note in your performance report in the hardship section.

Metal Sample Collection

Metals are generally collected monthly with basic River Watch. When collecting a metal sample a filtered (dissolved) and non-filtered (total) collection is required. In addition, River Watch requests that when a metal sample is collected, data for hardness, alkalinity, temperature and pH measurement and discharge if possible are also collected. This data provides information for interpretation about mitigating factors and factors that influence the toxicity of metals to aquatic life.

Filtered and Non-filtered sample collection

****Remember, before leaving the lab, all METAL collection bottles should have been preserved with 12 drops of nitric acid. Please follow instructions on HNO_3^- use!!! Be careful not to spill bottles!**

Filling the sample bottles, remember the chant for the syringe is: "rinse-rinse-collect-rinse-rinse" (RRCRR) no matter what the sample medium:

Non- Filtered:

1. Completely flush (fill and squirt) syringe twice with deionized water.
2. Fill, shake and rinse syringe twice with 10 mL sample water.
3. Fill syringe with sample water, from walking composite, composite bucket or grab location.
4. Open cap to non-filtered bottle and set aside.
5. Gently squirt into non-filtered sample bottle without touching, fill to the neck of the bottle. Do not overfill (if you do, you must dump, rinse, fill again, preserve sample back at lab and note on field datasheet). Syringe holds 60 mL; sample bottle is 60 mL, fill to neck/shoulder of bottle; refill syringe if necessary.
6. Recap non-filtered bottle and set aside.

Filtered:

1. Remove cap from filtered bottle and set aside.
2. Fill syringe with sample water.
3. Mark the filter with sharpie and place marked filter on syringe tip (screw filter to syringe).
4. Seed (empty) up to 10 mL of sample through filter, **NOT** over the open sample bottle.
5. Gently squirt sample through the filter into the filtered bottle. If filter becomes clogged, use second filter; remember to seed this filter too. Syringe holds 60 mL. Sample bottle is 60 mL, fill to neck/shoulder of bottle. Refill syringe if necessary.
6. Recap the bottle and set aside.
7. Remove filter from syringe and dispose in a trash receptacle, pocket or different container. Remember, filters can only be used once.
8. Check the boxes on the field data sheet to match your collection, non-filtered and filtered.

Now it's time to clean. Back in the lab or in the field (within high water mark):

1. Do the dishes: "wash" the syringe with acid rinse. Pour 10 mL or so of acid rinse into the syringe and swirl. Push the acid rinse down the sink or within the high water mark.
2. Rinse syringe with deionized water. Shake excess water from syringe and store syringe in a clean Ziploc bag.

Metal Blank Sample

Collect a metal blank and duplicate every 5th event. A blank sample is a quality control sample where the sample water is deionized water not river water. From preparation to collection to analysis, a blank metal sample is treated just like a normal sample; the difference is the actual water in the bottle and the fact that the "sample" is poured into the syringe. A blank sample serves as a quality control sample by testing for contamination in the method that is used to "collect" normal river water for metals analyses. That is why it is easy to remember how to collect a blank, same way you collect a normal river filtered and a non-filtered metal sample, only your sample water is deionized water (R-R-C-R-R and toss filter).

In theory, there are no metals in deionized water. Therefore, if you are not introducing metals to the sample via the collection procedure, when we analyze the blank metal sample for metals we should get zero. What does it mean if we get a result? It is an indication that metals have been introduced to the blank sample and thus possible the river sample as well. We cannot validate your metals samples without blank checks. Please collect a blank metal filtered and non-filtered metal sample every fifth trip to a station.

River Watch prefers you collect a blank before you leave for the sample event, but can be collected at the site or when you return.

1. Label two (2) additional metals bottles, one filtered and one non-filtered, as you normally would for one of your stations. Remember to check the "Blank" line on the label for both samples.
2. **Using the same syringe chant for any metals collection: "rinse-rinse-collect-rinse-rinse"**

   R- First syringe rinse, is flush the syringe twice with deionized water. **DO NOT STICK THE SYRINGE IN THE CONTAINER.** Pop the syringe open and flush by pouring about 10 mL deionized water into the syringe. Put the plunger back into the syringe and shake. Empty the syringe into the sink (or high water mark if you're in the field). Never stick your syringe into anything but the river. This is the first step of collecting a "normal" sample too. If you think your finger is contaminating the sample let about 10 mL drain.
3. **R-Second syringe rinse,** rinse the syringe twice with sample (deionized) water, again by pouring about 10 mL into the syringe, shaking and squirting. This is the second step in a normal sample collection.
4. **C-Collect,** now you are ready to collect the blank sample. Fill the syringe with deionized water from your deionized water container.

5. Find the bottle labeled with “non-filtered” and “blank” and fill it to the neck/shoulder, do not over fill-or start over.
6. Refill the syringe with deionized water.
7. Grab a filter, mark it as used. Place it on the syringe and seed 10 mL through it.
8. Find the bottled labeled with “filtered” and ”blank” and fill it to the neck/shoulder, do not over fill. **Dispose of the filter, do not use for any other sample.**
9. Check the boxes on the field data sheet that match your collection for blank collection.

Back in the lab or in the field (within high water mark)

1. **R - Second to last syringe rinse,** do the dishes; “wash” the syringe with acid rinse. Pour 10mLs or so of acid rinse into the syringe and swirl. Push the acid rinse down the sink or within the high water mark.
2. **R - Last syringe rinse,** rinse syringe with deionized water. Shake excess water from syringe and store syringe in a clean Ziploc bag.

Metal Duplicate Sample

Collect a metal blank and duplicate every 5th event. A duplicate metal sample is a quality control sample that is a “second” sample containing the same “slug” of water as the normal metal sample. A duplicate metal sample serves as a quality control sample by checking for the reproducibility of the sample crew collection method. If collection methods are adequate and followed, and the ICP is working properly, metal analyses results should be very similar between the metal duplicate and normal sample.

You will take both the normal sample and the duplicate sample at the same time.

1. Label two (2) additional metals bottles as you normally would for one of your stations. Check the “Duplicate” line on the label. Be sure to have your normal bottles on hand too.
2. **Using the same syringe chant for any metals collection: “rinse-rinse-collect-rinse-rinse”**

   R- First syringe rinse, is flush the syringe twice with deionized water. **DO NOT STICK THE SYRINGE IN THE CONTAINER.** Pop the syringe open and flush by pouring about 10 mL deionized water into the syringe. Put the plunger back into the syringe and shake. Empty the syringe into the sink (or high water mark if you’re in the field). Never stick your syringe into anything but the river.
3. **R-Second syringe rinse,** Rinse the syringe twice with sample water. Fill the syringe with sample water. Fill the syringe by sucking up water from the river. Grab sample at one location, composite from across the river.
4. **C-Collect,** open both normal and duplicate “non-filtered” bottles. Gently squirt some into each bottle, alternating bottles until both are full to the neck/shoulder. You will need to refill your syringe at least once to fill both bottles.
5. Collect another syringe full of sample water.
6. Grab a filter, mark it as used. Place it on the syringe and seed 10 mL through it.

7. Open both normal and duplicate “filtered” bottles. Gently squirt some sample water into each bottle, alternating bottles until both are full to the neck/shoulder. You will need to refill your syringe. Remove the filter before refilling syringe, minimize handling and place in a clean dry place. Replace filter before continuing to fill the bottles. If need to replace actual filter, seed second filter with 10 mL of sample water first.
8. Check the boxes on the field data sheet that match your collection for duplicate collections.

Back in the lab or in the field (within high water mark)

9. **R-Second to last syringe rinse**, do the dishes; “wash” the syringe with acid rinse. Pour 10-20 mL or so of acid rinse into the syringe and swirl. Push the acid rinse down the sink or within the high water mark.
10. **R-Last syringe rinse,** rinse syringe with deionized water by disassembling the syringe and pouring DI water into it. Shake excess water from syringe and store syringe in a clean Ziploc bag.

Instructions for Making Acid Rinse

Cleaning our syringe and equipment is a quality assurance activity. Metals tend to accumulate onto plastic. Acid rinse is a “soap” that prevents buildup on the sample bottle sides and bottom from each sampling event of unwanted material, especially metals. This helps reduce sources of contamination.

1. Use proper nitric acid handling procedures and personnel protective equipment.
2. Fill the acid rinse bottle with deionized water.
3. Place 36 drops (approximately 1 mL) of nitric acid into the acid rinse bottle.
4. Shake well.
5. When you run out of acid rinse, make more. This is a weak solution and should not be irritating to most individuals upon touch.

Nutrient Sample Collection

Nutrient samples will be collected twice a year, once in the fall during a low flow period and once in the spring during a high flow period. The annual River Watch Calendar provides the nutrient sampling schedule for participants. For special projects, additional samples may be collected.

You will receive two nutrient sample bottles for each sample event per each site. One container is a 32 ounce juice jug; the second container is an 8 ounce cylindrical bottle and already contains 0.65 mL of **concentrated sulfuric acid** preservative. Be careful to not spill any of the sulfuric acid. Please store these bottles in a clean, dry, cool place in an upright manner.

Again, River Watch requests that you try and coordinate your nutrient sampling event with a regular (metal and field parameter collection) scheduled sampling event. Having all the data from the same sample event tells a deeper broader story about your river.

Label each bottle prior to sampling as per instructions. Place containers in carrying caddy to take to the field.

1. Take the juice jug and either:

   A. Collect a walking composite from a cross section.
   B. Pour sample into jug from the composite bucket.
   C. Collect a grab sample from the bank if a composite is not possible.

2. Pour a portion of jug contents into the 8 ounce cylindrical bottle. **Do not put the cylindrical bottle in the stream. BE CAREFUL to not splash, spill or overfill the bottle with the sulfuric acid preservative.**
3. Once your cylinder is full of sample, recap the bottle and set aside.
4. Refill the jug in the same manner and set aside.
5. Check the boxes on the Field Data Sheet that refer to collecting a nutrient sample. If you are only collecting a nutrient sample and no other sample, still complete all relevant information on the Field Data Sheet.

Back in the lab, refrigerate samples as soon as possible.

Ship nutrient samples on ice, within 48 hours of collection and only on a Monday, Tuesday or Wednesday. That means you will need to plan collection accordingly. Complete chain of custody and you can send metals or bug samples in the same shipment. The cooler should contain enough blue ice to keep the sample chilled for two days. Holding time of 28 days means you have the samples the first week, they are processed in Denver the second week and the lab needs the last 14 days to analyze the samples.

Please do not ship you nutrient samples on a Thursday or Friday as they will sit over the weekend or longer in a warehouse prior to reaching River Watch. If you need to hold your nutrient samples till Monday, do that. We prefer your nutrient samples do not sit in a warm warehouse over the weekend.

NUTRIENT QUALITY CONTROL SAMPLE

Approximately 10-20% of the volunteer groups will receive an extra set of nutrient bottles labeled "**DUPLICATE**." These serve as a field quality control and assurance sample. You collect these identically to the regular sample, alternating pouring from the jug into the cylinder till both cylinder bottles are full. Fill both jugs from the composite sample bucket.

1. You collect these identically to the regular sample, alternating pouring from the juice jug into the 8 ounce preserved cylinder till both cylinder bottles are full. Check the label on the bottle "NP" and "duplicate". Mark the Field data sheet box to indicate a nutrient duplicate.
2. Fill both jugs from a walking composite, the composite bridge sample from the bucket or at the grab/bank location. You want the same slug of water in both bottles. Check the label on the bottle "CS/TSS" and "duplicate". Mark the Field data sheet box to indicate a nutrient duplicate.
3. Follow the same storage and shipping instructions as a normal nutrient sample.

Temperature

How

1. Using your thermometer, take the temperature directly in the river in representative location or in the composite bucket if access to the river is not possible or safe.
2. Allow a couple of minutes for the thermometer to equilibrate.
3. After a few minutes, lift the thermometer out of the river and read the measurement immediately.
4. Measure and record to the nearest whole degree Celsius.
5. Record the temperature on the Field Data Sheet.

Hint: you might want to tie a string to the thermometer for easier retrieval and to reduce opportunities for losing thermometer.

Back in the lab

1. Store all samples in the refrigerator or where appropriate until you're ready to perform the analyses.
2. Clean all equipment. Store all your equipment clean.
3. If possible conduct all titrations and pH tests when you return. If not, do so within the following holding times:
    - **pH** within 24 hours at room temperature. If the temperature of the water is below 20^{o}C, you should let the sample warm up to room temperature for a better reading (20-25 ^{o}C is optimal). This should only take a half hour or so. **DO NOT** artificially heat the sample. Tuck sample bottle in pocket or under armpit for warming.
    - **Alkalinity and hardness** within 24 hours if sample bottle kept in cold place.
    - **Dissolved oxygen** within 8 hours, once fixed (first three chemicals), if capped and stored in cold dark place.
4. Complete all datasheets completely and check or completeness and accuracy. (See following pages.)
5. Enter data via website.
6. Copy data sheets and file.
7. Prepare chain of custody and ship when ready.

NOTES

Field Data Sheet Instructions

A Field Data Sheet should be completed and submitted along with your other data sheets and samples *for each* sampling event. The Field Data sheet serves as the official "record" of what happened on that particular sampling event. The Field Data Sheet also serves as the pH worksheet.

1. Complete station name, station number, volunteer group (school or organization), river name, **date and time**. (Use 24-hour time method. For instance if you collected a sample at 3:05pm in the afternoon, the time would be 15:05). Time and date are very important – **they are how we track your sample**.
2. Note **any comments** regarding weather anything that could affect the results of your collection. For example, note in the comments if you sampled after a big storm or if there is construction/drilling near your sampling location.
3. In the boxed area titled: "Samples Collection Method" these should be filled out in the field during collection. Make sure to fill out the box detailing what kind of samples you have collected. **It's important that your collections marked here match your chain of custody**. We check this box against your samples when processing, so completing this section will help to processing the sample faster. Make sure to note is this was a grab or composite sample.
4. If you can access flow from a gauge proximate to your sample site from the USGS or State Engineers office, check gauge box and provide the flow. If you conducted a float test or the flow is any other kind of estimate check estimate and provide data. If no flow data is available leave boxes unchecked and line blank or null.
5. Record results from the field and your laboratory on the appropriate line. If an analysis was not conducted, then fill in the result area with a -9 (we use -9 to indicate that the information is not available). Every line should have some piece of information in it for a complete Field Data Sheet.
6. Use this sheet for recording the results of the pH value and river temperature measurement.
7. The Field Data sheet is used to consolidate the field analytical results from the other field data sheets:
    - Alkalinity
    - Hardness
    - Dissolved Oxygen
    - Flow
8. Make sure to sign and date ALL data sheets and keep a copy for your records and send River Watch the originals along with your samples.
9. In order to better capture our volunteer's efforts, we have added the volunteer timesheet to the field data sheet.

Field Data Sheet

Station Name _____ Station Number _____

River/Stream _____ Date of sample ___/___/___

Volunteer Group _____ Time of sample ___ : ___ (military)

Air T°/Weather/Comments:_____

Sample Collection Method: □ Grab □ Composite

Samples collected for River Watch analysis: Check all that apply:

Metals	**Metals QA/QC**		**Nutrients**	**Biological**
□Filtered (F)	□ F Blank	□NF Blank	□ TSS/CS □ NP	□Macroinvertebrate
□Not Filtered (NF)	□ F Duplicate	□NF Duplicate	Duplicate□	□Macro QA sample
□No metals			□ TSS/CS □ NP	**Physical Habitat**
				□Physical Habitat

Flow

□ Gauge □ Estimate _____ ft^3/second

(If flow is estimate, please write in comment section when entering online vs in gauge field.)

River Temperature (Record Air Temperature in comment section above**)** _____ Celsius

Circle what buffers used in pH meter Calibrated 4 7 10

Are pH 7 And 10 standards showing up as accepted on your meter? **YES** **NO**

9126 pH probe condition (face of meter):
(Check probe condition after calibration)

pH sample \ ATC Temp Reading: _____S.U._____ °C
(pH measurement \ATC temp)

Phenolphthalein Alkalinity: _____ mg/L $CaCO_3$
(If pH is below 8.3, you should have "0" phenolphthalein alkalinity)

Total Alkalinity: _____ mg/L $CaCO_3$
(This includes phenolphthalein alkalinity)

Hardness: _____ mg/L $CaCO_3$

Dissolved Oxygen: _____/ mg/L _____ % Saturation

Other: _____ (unit)

Data recorded by _____ Date recorded _____

Volunteer Time Capture							
Name (use other side if necessary)	**Adult or Student**	**Hours**	**Mileage**	**Gas**	**Equipment**	**Mailing**	**Other**

✓ Please be sure to enter all of your volunteer info above as well as at the link below.
✓ Enter volunteer data here and into the CO Parks & Wildlife Database at: https://cpw.civicore.com/public
✓ **Attach all original data sheets to this form and submit to River Watch, keep a copy for your files.**
✓ If no data available, please leave blank.

pH Measurement Instructions (Hanna 9126 meter)

pH Supplies: The pH kit should have:

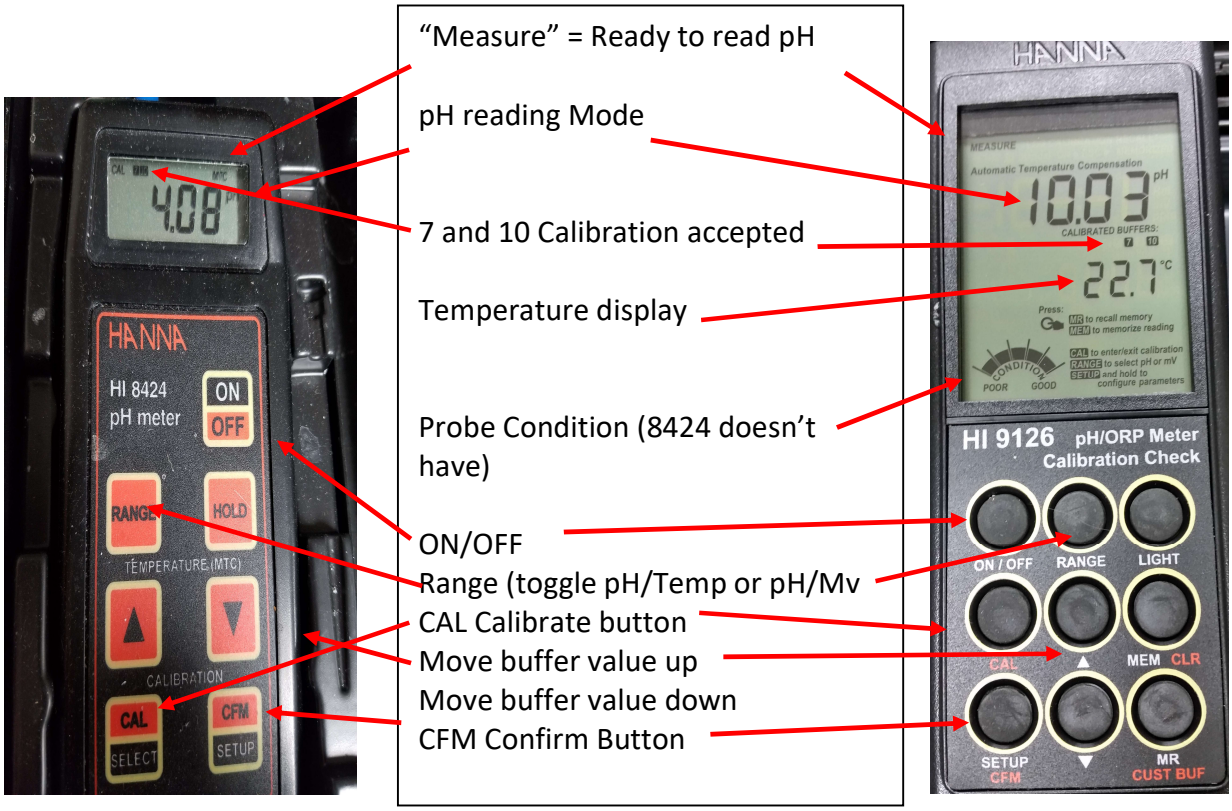
- 1 pH meter (two AAA batteries initially provided)
- 1 pH probe with a cap or Teflon tape (you provide as a substitute for cap) for pH probe (stored up right to minimize leaking)
- 1 ATC probe (Automatic temperature compensator = thermometer)
- 2 buffers solutions (pH 7.0, and 10.0) in small 60 mL bottles
- 2 large refill buffer bottles (7.0 and 10.0)
- 1 60 mL bottle with KCl solution
- 1 empty 60 mL bottle (for sample)
- pH probe rejuvenation or cleaning solution packet
- Instruction sheet

When testing, place a liquid waste container, paper towels and a squirt bottle of deionized water nearby.

Tips:

- Allow sample to be at room temperature or greater before testing (>= 20 ^{o}C), but do not put in microwave or boiling water, try a pocket, under arm or warm bath if pressed for time. Your pH reading will continue to rise if the sample is less than room temperature.
- If possible, soak the pH probe in KCl before you head to the field or at least 30 minutes before testing a sample.
- pH meter should be calibrated every month, once calibrated multiple samples can be analyzed in sequence.
- The ATC and pH probe go everywhere together except for the initial KCl soak for the pH probe.
- When reading pH, the level of liquid must be sufficient to cover the hole on the probe shaft that is just above the gel ball and the white material above gel ball. This includes the KCl solution in the storage cap, the hole is what needs covering at all times.
- At a minimum, rejuvenate or clean your probe at least twice a year; before each unknown test is a good reminder.
- If meter will not complete a two buffer calibration, takes a long time to calibrate or read your sample (> 5 minutes), try rejuvenating or cleaning pH probe.

Anatomy of the pH Meters Hannah 8424 and 9126



9126 pH Measurement Instructions (Hanna Meter)

1. Remove protective cap with KCl solution (or remove Teflon tape) from pH probe.
2. Soak the pH probe (not ATC probe) in KCl solution for half an hour prior to the first use of the day (if possible put probe in KCl before collecting the field sample or the morning before analyses).
3. Remove pH probe from KCl solution and rinse both the pH and ATC probes with deionized (DI) water. Recap KCl bottle
4. Prepare the pH meter, probes and calibration buffers: plug in both the pH and ATC probes into the meter; open each 500 mL buffer bottle and small 60 mL pH buffer bottles (refill from larger buffers if needed), have large buffers there to rinse the probes.
5. Prepare sample: Rinse small 60 mL pH sample bottle or clean beaker once with deionized water and twice with sample. Fill the bottle to just below shoulder (enough sample to cover hole on probe above gel ball). Allow temperature of sample to come to room temperature (at least 20 ^{o}C).
6. Rinse both probes with pH 7 buffer solution from the large pH 7 buffer squeeze bottle.
7. Place both the pH probe and the ATC probe into the small pH 7 buffer square bottle and lightly stir.

8. Turn the meter on and make sure the display shows the pH value not mV. Press [**RANGE**] to change the display until it shows pH *(see images).*
9. Note you will see the **#7/10** below pH display from last calibration, below that a temperature reading and in upper left "***MEASURE***" (meter is ready to measure a sample) *(see images).* *You will need to recalibrate the meter if this is the first time using it since last month.*
10. Press [**CAL**] to set the first **cal**ibration (far left middle button). "***CALIBRATION***" should appear in the middle at the top of the screen replacing "***MEASURE***". While the meter is calibrating to the known 7 pH buffer, "***WAIT NOT READY***" will flash and a flask symbol will appear with "***1st***" displayed next to it. This indicates you are calibrating the first buffer of 7 *(see images).*
11. When the calibration value is reached, the meter will beep, it is not a loud beep or long beep. Once you hear the beep, press **[CFM]** button, bottom left, to confirm the pH 7 buffer reading and to store this value. You will see a small "***7***" appear below the pH reading on the face of the meter. If probe/meter does not accept your pH 7 buffer solution you will see an "error" message on the face of the meter (if this happens, change out the buffer solution from the large buffer bottle and try again) *(see images).*
12. Quickly rinse both probes with pH 10 buffer solution from the large pH 10 buffer bottle, place both probes into the pH 10 square bottle and stir lightly. Select the ▲ ***UP ARROW***, (middle button), until meter displays 10.00 (there are ranges from 4.01 to 10.00). *Meter defaults to pH buffer 4.01 as second buffer, you need to tell it you are using a pH 10 buffer (see images).*
13. Once the 10.01 appears on screen and the meter will read 10.01 while waiting to match that known value to your pH 10 buffer solution, you will see "***WAIT NOT READY***" flashing on left and a flask symbol will appear with "***2nd***" displayed next to it. This indicates you are calibrating the second buffer of 10 *(see images).*
14. When the meter accepts your pH 10 buffer the meter will beep; press the same ***[CFM]*** button, bottom left, to confirm the pH 10 buffer reading and to store this value. If probe/meter does not accept your pH 10 buffer solution you will see an "error" message on the face of the meter (if this happens, change out the buffer solution from the large buffer bottle and try again) *(see images).*
15. The meter display tells you if the calibration curve you attempted with pH 7 and pH 10 was successful by displaying a small ***7*** and ***10*** under "***CALIBRATED BUFFERS"*** on the screen below the pH display. Also, you will see the pH meter mode is now "***MEASURE***" in the upper left of the display, indicating the meter is ready to measure pH in a sample. If you do not see this, or see any other message, please troubleshoot as it means the pH reading of your sample may not be accurate if you continue *(see images).*
16. The pH calibration is now complete. Answer the three questions on the Field Datasheet:
    a. Circle what buffers used to calibrate meter 4 7 or 10
    b. Color the *Poor to Good* graph indicating the condition on your probe from that same display on the face of the meter.

c. ***NOTE***: if the condition of your probe is only one or two bars, please rejuvenate or clean the probe (see instructions) and recalibrate.

d. ***NOTE***: if meter will not calibrate both buffers notify RW staff. You can take a pH reading form a one buffer calibration (7), noting on Field Datasheet as an interim solution.

17. Now measure your sample for pH: rinse both probes with sample water.

18. Place both probes in the sample bottle, ensuring the level of sample is ½" above the gel ball and gently stir for a couple of seconds. The hourglass on the left side of the display will flash until the meter determines a stable reading. Wait for the meter to stabilize. One stabilized, the hourglass on the left side of the screen will disappear. ***NOTE***: the first stable pH and temperature reading on Field Datasheet or a scratch sheet.

19. After it stabilizes once, gently stir the probes or agitate the sample to destabilize and initiate the hourglass again. The hourglass may appear again until the new reading has stabilized and hourglass disappears. Record this pH value and temperature. Repeat this again and as many times as necessary until the pH reading is the same or similar within the 10^{th} digit (the meter reads in 100ths digits).

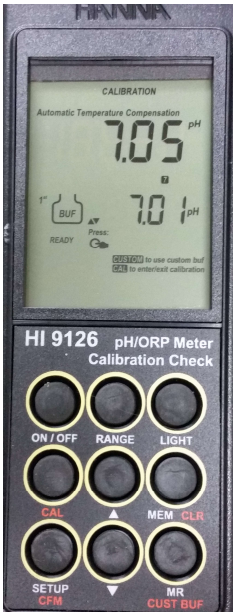
20. Once the meter displays a consistent reading (three times in a row or so), record the final pH and temperature of the pH sample on the Field Data Sheet and on the alkalinity datasheet.

21. If taking the pH of a different sample, rinse small sample bottle with sample water in the square pH bottle before filling it with different sample water. Rinse probes with sample water and repeat steps 17 and 19.

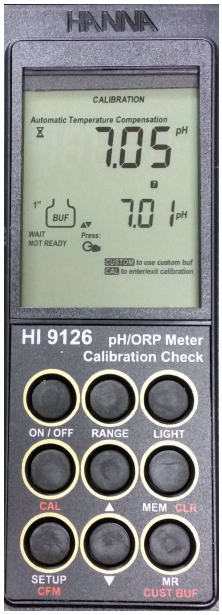
22. If done for the day, turn pH meter off. Rinse both probes with DI water and pat dry. Recap the pH probe for storage refilling KCl if needed, and store in upright position, in case if can.

9126 pH Measurement Meter Calibration Screen Capture

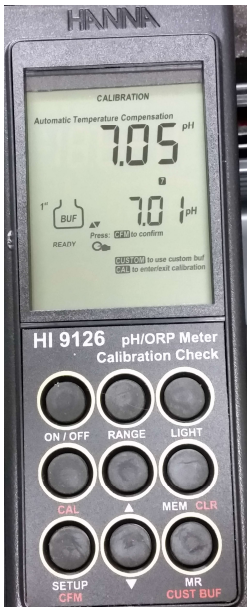
Initially turn on meter, it is not calibrated. No 7/10 buffer. Probe condition displayed but shows, “Measure” mode. You see a temperature.



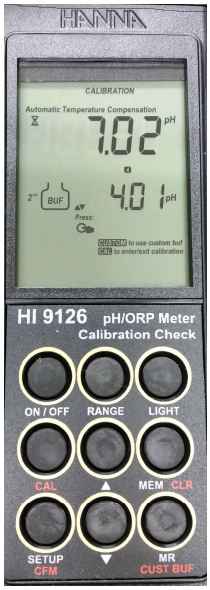
Probes in 7 buffer, hit CAL. Temp is replaced by 7.01 buffer, meter is calibrating to 7.01 buffer.



Hour glass upper left telling you probe is “reading” the solution.



“Beep”, meter accepted 7.01 buffer at value of 7.05 and to set that result. CFM selected, and you can see 7 below the 7.05.



Buffer 7 accepted. Probes rinsed and put in 10. Need to change 4.01 buffer to 10.01. Select up arrow, middle button above 3 times to get the 10.01 buffer.

Telling meter you want 10 buffer calibration. The hour glass is now ‘reading’ solution at 9.91

“Beep”, meter accepted 10.01 buffer at value of what appears 9.91. Select CFM to confirm the value of 9.91.

CFM selected and now see 7/10 below pH display. The condition of probe graphic completed and temperature showing. Top changed from CALIBRATION TO MEASURE.

pH Measurement Instructions (Hanna 8424 Meter)

1. Prepare sample. Rinse small 60 mL bottle or clean beaker once with deionized water and twice with sample. Then fill container with enough sample to cover hole on probe above gel ball. Allow temperature of sample to come to room temperature (at least 20 ^{o}C).
2. Prepare meter, probes and calibration buffers, plug in both pH and ATC probes, open each 60 mL buffer bottle, refill with larger buffers if need, have large buffer bottles there to rinse probes. Put caps in an upright safe place.
3. Remove protective cap with KCl solution (or remove Teflon tape) from pH probe.
4. Soak the pH probe (not ATC probe) in KCl solution for half an hour prior to the first use of the day (do before sample or morning before analyses).
5. Rinse the pH and ATC probes with deionized (DI) water.
6. Rinse both probes with pH 7 buffer solution from the large pH 7 buffer squeeze bottle.
7. Place both the pH probe and the ATC probe into the pH 7 buffer square bottle and lightly stir.
8. Turn the meter on and make sure the display shows the pH value. If not, press the [**RANGE]** button and toggle through temperature and mV mode (millivolt), until see pH displayed. Note you will see the **#7/10** in the upper left display from last calibration.
9. Press [**CAL**] to set the first **cal**ibration. "***CALIBRATION***" should appear on the display. While the meter is calibrating to the known 7 pH buffer.
10. When the calibration value is reached, the meter will beep, it is not a loud beep or long beep, once hear the beep and display 7.01. Press ***[CFM]*** button, bottom left, to confirm the pH 7 buffer reading and to store this value. **You have 12 seconds to finish the calibration or need to start over. This is plenty of time if move steady and focused**. You will see a small "***7***" appear on upper left of display. If probe/meter does not accept your pH 7 buffer solution you will see an "error" or dashed lines message on the face of the meter (change buffer solution with large buffer bottle and try again).
11. Quickly, rinse both probes with pH 10 buffer solution from the pH 10 buffer squeeze (large) bottle and place both probes into the pH 10 square bottle and stir lightly. **YOU MUST MANUALLY TELL METER YOU ARE USING THE 10 BUFFER STANDARD. Press ▲arrow up twice to move the buffer the meter is looking for from 4.01 to 10.01.**
12. Once the 10.01 appears on screen and the meter will read 10.01 while waiting to match that known value to your pH 10 buffer solution. Listen for that faint beep because when the meter accepts your pH 10 buffer the meter will beep, and press the same **[CFM*]*** button, bottom left, to confirm the pH 10 buffer reading and to store this value. If probe/meter does not accept your pH 10 buffer solution you will see an "error" message on the face of the meter (change buffer solution with large buffer bottle and try again).
13. The meter display tells you if the calibration curve you attempted with pH 7 and pH 10 was successful by displaying a small ***7*** and ***10*** in the upper left of the display. The

meter also shows on the right display both the ATC and pH probe are plugged in. If you do not see this, or see any other message, please trouble shoot as it means the pH reading of your sample may not be accurate if you continue.

NOTE: if you cannot "redo" the 10 if mess up, you have to start over with 7, then 10.

14. The pH calibration is now complete. Answer the three questions on the Field datasheet:
    a. Circle what buffers used to calibrate meter 4 7 or 10
    b. Is pH 7 and 10 Standards showing up as accepted on your meter YES NO
    c. *Ignore* the "Poor to Good" probe graph indicating the condition on your probe from that same display on the face of the meter.
    d. ***NOTE***: if meter will not calibrate both buffers notify RW staff, take a pH reading from a one buffer calibration (7), noting on Field Datasheet as an interim solution.
    e. ***NOTE***: if takes a while to calibrate or read a sample pH the condition of your probe is deteriorating, please rejuvenate or clean the probe (see instructions) and recalibrate.
    f. ***NOTE***: if you cannot "redo" the 10 if mess up, you have to start over with 7, then 10.
15. Now measuring your sample for pH and rinse both probes with sample water.
16. Place both probes in the sample bottle, ensuring the level of sample is ½" above the gel ball and gently stir for a couple of seconds. The hourglass on the left side of the display will flash until the meter determines a stable reading. Wait for the meter to stabilize. Once it has stabilized, the hourglass on the left side of the screen will disappear. Note the first stable pH and temperature reading on Field Datasheet or a scratch sheet.
17. After it stabilizes once, gently stir the probes or agitate the sample to destabilize and initiate the hourglass again. The hourglass may appear again until the new reading has stabilized and hourglass disappears. Record this pH value and temperature. Repeat this again and as many times as necessary until the pH reading is the same or similar within the 10^{th} digit (the meter reads in 100ths digits).
18. Once the meter displays a consistent reading (three times in a row or so), record the final pH and Temperature on the Field Data Sheet and one the alkalinity datasheet.
19. If taking the pH of a different sample, rinse small sample bottle with sample water in the square pH bottle before filling it with different sample water. Rinse probes with sample water and repeat steps 17 and 19.
20. If done for the day, turn pH meter off. Rinse both probes with DI water and pat dry. Recap the pH probe for storage refilling KCl if needed, and store in upright position, in case if can.

pH and mV (millivolts)

Many pH meters, including these two can measure millivolts if you had the correct probe. Every pH has an equivalent mV. What the meter is doing in its computer brain is taking an mV reading and translating it to a pH. For example, for pH 7 the mV equivalent is close to 0.0 mV. When the pH 7 buffer approaches an mV reading close to 0.0 mV, the meter will beep, telling you it accepted the pH 7 buffer, because it equates the mV reading of 0.0 mV to a pH of 7.01.

The more acidic the sample or solution, the higher the change in mV; the more basic the sample or solution, the lower the change in mV. The mV will change by 60 mV for each unit of measure.

- pH 4 mV should read +180mV
- pH 7 mV should read 0.0. + or -10 is still within a good range for probe.
- pH 10 mV should read -180mV

Possible Problems with pH Meter

If probe condition registers POOR or only one or two bars, meter will not take second pH buffer 10 calibration standard, calibration of either or both buffers takes a long time or reading pH of sample takes a long time (more than 5 minutes), and you have tried replacing buffer solutions then It is time to rejuvenate your probe.

- Get the cleaning packet from RW staff/your kit (a small foil like packet with liquid in it)
- Follow the instructions on the back which will direct you to soak the pH probe for a short period, 2-3 minutes
- Rinse probe with deionized water and try calibration again.
- If problem persist, contact RW Staff it may be time for a new probe

Not calibrated correctly or you cannot get successive pH readings:

- Soak the pH probe in KCl or pH 4.0 buffer for 10 or more minutes.
- Try a new batch of pH buffers. Empty the little bottles of old buffers. Rinse these three bottles with deionized water several times. Pour new buffers in the small bottles. Buffers can get contaminated. Now, recalibrate the meter and read your pH again.
- Make sure the pH probe is clean. Check the tip of the probe for white crystals. Make sure the hole near the top was open when you tried to read the buffers or pH. Check the condition of your pH probe.
- Check the condition of your probe on the face of the meter.

pH is below 8.3, but you have phenolphthalein alkalinity:

- Wash your alkalinity flask extremely well and titrate again.
- Test pH again (make sure your sample is at room temperature).
- Agitate the container to get a flow going over the probe.
- Time, it can take 30 minutes sometimes, agitate probe so meter doesn’t go to sleep.

pH is above 8.3, but you have no phenolphthalein alkalinity:

- Remove the pH probe and the ATC probe from the sample water. Change out the sample in the sample bottle. Rinse probes again with sample water and place into the bottle. Check the pH again.
- If you still have no phenolphthalein alkalinity, leave the probes soaking in the sample and check again after 20 minutes. Make sure it's at room temperature. Agitate the container to get a flow going over the probe.
- Time, it can take 30 minutes sometimes, agitate probe so meter doesn't go to sleep

Remember your pH meter is stupid. It will always give a reading regardless of if you perform the analysis correctly or not. You are the scientist, look at meter results and reality check them. If there appears to be a problem respond accordingly.

Check your pH reading and see if it makes sense, especially if you have seasonal data to compare. A good scientist ALWAYS checks his/her answer for plausibility.

Check the range of buffers during calibration. If the buffers do not calibrate within the acceptable ranges, change buffers and calibrate again. Make sure you have a 7 and a 10 showing on the screen after your calibration.

River Watch will replace KCl solution (and batteries if needed). The batteries are AAA and can be universally purchased. Please call or email if you are having difficulties with the pH meter.

Alkalinity Titration Instructions

Before testing, place the liquid waste bottle, paper towels and a squirt bottle of deionized water nearby.

1. Complete top portion of the Alkalinity Datasheet.
2. Rinse the graduated cylinder and the "A" labeled Erlenmeyer flask once with deionized water and twice with sample water.

Part I – Phenolphthalein Alkalinity

3. Fill graduated cylinder with 50 mLs of sample. If you go over 50 mL mark on flask, empty some out into waste bucket or sink. **Never pour back into sample bottle**.
4. Pour the sample from the graduated cylinder into the "A" Erlenmeyer flask. Record amount of sample used on line 1.
5. If known, record your pH value on line 2. Answer the question: Is pH greater than 8.3? Based on the pH value, what color do you predict your sample will be?
6. Add 15 drops of phenolphthalein indicator to Erlenmeyer flask. Answer question on line 3: Did the solution turn a faint pink? If answer is **YES**, go on to step 6 below.

   If your answer is **NO** and the sample did not turn pink, but instead turned a cloudy white or remained clear, record phenolphthalein alkalinity as 0.0 mg/L on line 5 and note this in the field data sheet comment section. It may mean the pH sample was too cold when pH was read, thus the pH reading is off slightly. Go on to Part II.
7. Self-zero the burette with H_2SO_4, (sulfuric acid). Be sure **NO** air bubbles are in the stem/arm of the burette by releasing a few drops and zero the burette again. If air bubbles resist moving, place burette over sink and tilt up and back with nozzle open. Also make sure the tip of the burette is not crusted with H_2SO_4. If the burette is crusted, place tip over sink and rinse with DI water and wipe with paper towel.
8. Place a white piece of paper under the flask. Place the flask under the tip of the burette and add H_2SO_4 **drop by drop**. Swirl the flask after each drop. Do this until the next drop turns the solution colorless. This is your endpoint for phenolphthalein alkalinity.

   Read the burette carefully. Record the reading on the data sheet on line 4. Starting point should have been "0".
9. Subtract starting point from endpoint. Multiply that difference by 40 (see line 5). This is the phenolphthalein alkalinity in mg/L of $CaCO_3$. Record phenolphthalein alkalinity value on line 5.

   For example: endpoint = 0.7 mL, start = 0.0 mL, 0.7 mL x 40 = **14.0 mg/L** phenolphthalein alkalinity as $CaCO_3$.

You are **NOT** through; continue to Part II for BGMR alkalinity. **DO NOT ZERO THE BURETTE!**

Part II – Total Alkalinity

10. Place 6 drops of BGMR indicator into the same "A" Erlenmeyer flask used above and swirl (color should be a turquoise). Answer the question on line 6.
    a. If your phenolphthalein alkalinity was **less than or equal to** zero (< 0), automatically zero your burette with the bulb. Make sure there is H_2SO_4 in the tip of the burette.
    b. If your phenolthalein alkalinity was **greater than** zero (> 0), **DO NOT** zero the burette.
11. Place the flask under the burette and add H_2SO_4 **drop by drop**. Swirl the flask after each drop. This reaction is relatively fast. The solution may turn pink, but return to blue. The color change proceeds from turquoise to blue-gray to a clear gray, then a pink-gray and finally a pink-peachy-pink. The color changes from blue-gray to pink-peachy-pink are usually a drop a part. **Your endpoint is the pink-gray color not the pink-peachy-pink**. Stop when you are at your endpoint (change should be gradual if you go drop by drop).

    Past the pink-gray endpoint, the solution will stay a pink-peachy-pink, regardless of any additional H_2SO_4 you add. Learn your river's color transition. A viable technique is to titrate through the endpoint color **if** you read the burette after every drop. Thus, you have a reading for every color change and can choose the best endpoint.
12. Read the burette carefully. Record the reading on the data sheet on line 7.
13. Subtract starting point from endpoint. Multiply that difference by 20. This is the Total Alkalinity in mg/L of $CaCO_3$. Record total alkalinity value on line 8.
14. For example: endpoint = 2.5 mL, start = 0.0 mL, 2.5 mL x 20 = **50 mg/L** Total alkalinity as $CaCO_3$.
15. Dispose the solution in the flask into a waste bucket or sink. Rinse out Erlenmeyer flask and graduated cylinder with deionized water and store UPSIDE DOWN.
16. Does this result make sense? You are the first point of validation, is it similar to last time, what you know, etc.? Provide any comments that help us understand what your experience was.
17. Sign and date for a complete datasheet. Copy the result to the Field Data Sheet.

Common problems

- Phenolphthalein should generally be less than 60 mg/L. If higher than 60 mg/L, clean the flask and try again.
- Misreading the burette - check twice, or get a second opinion.
- Passing the endpoint because you:
  -did not allow enough time between drops for reaction to occur.
  -did not add one drop at a time.
- Zeroing the burette after phenolphthalein alkalinity before titrating for total alkalinity.
- Titrating only for phenolphthalein alkalinity and forgetting to titrate BGMR alkalinity.
- Final multiplication is wrong.

Alkalinity Data Sheet

Station Name _____ Station Number _____

River _____ Date of sample ___/___/___

Volunteer Group _____ Time of sample: ____:____

PART I - Phenolphthalein Alkalinity

1. Amount of sample used (should be 50mL): _____**mL**

2. pH _____ Is pH greater than 8.3? ☐**Yes** ☐**No**
(If pH is less than 8.3, phenolphthalein alkalinity should be 0 mg/L: **check your results!** Do you need to clean your flask? Clean flask and try again.)

3. Add phenolphthalein indicator. Did solution turn pink? ☐**Yes** ☐**No**
   If **YES** → continue with step 4.
   If **NO** → record phenolphthalein alkalinity as 0.0 mg/L, and then go to part II.

   Make sure your burette is zeroed and there is H_2SO_4 in tip of burette, but there are no air bubbles in arm/tip of burette. Your starting point on the burette should be 0.0.

4. Titrate from a pink to a clear, record mL of H_2SO_4 you added. _____ mL H_2SO_4 used

5. Multiply mL of H_2SO_4 used by 40. Record this as the phenolphthalein alkalinity.
   Example: 0.2 mL H_2SO_4 titrant used x 40 = 8.0 mg/L $CaCo_3$

Phenolphthalein Alkalinity Result _____ **mg/L $CaCo_3$**
(Phenolphthalein values should be equal to or less than 60 mg/L.)

(Note: If you have phenolphthalein alkalinity, DO NOT re-zero the burette before continuing.)

PART II - Total Alkalinity

6. Add BGMR indicator. Did solution turn blue? ☐**Yes** ☐**No**

7. Titrate from turquoise to pink-gray. Record mL of H_2SO_4 added. _____ mL H_2SO_4 used

8. Multiply mL of H_2SO_4 used by 20. This is the total alkalinity.

Example: 2.5 mL H_2SO_4 titrant used x 20 = 50.0 mg/L

Total Alkalinity result _____ **mg/L $CaCo_3$**

(Total alkalinity includes phenolphthalein value. Do not zero burette if you have phenolphthalein alkalinity.)
Your alkalinity SHOULD be lower than hardness. Do your results make sense?

Comments: _____

_____

Data Recorded by: _____ Date: _____

Hardness Titration Instructions

Before testing, place the liquid waste bottle, paper towels and a squirt bottle of deionized water nearby.

Complete the top portion of the "Hardness Data Sheet".

1. Rinse the graduated cylinder and "H" Erlenmeyer flask once with deionized water and twice with sample water.
2. Fill the graduated cylinder with 50 mL of sample, and then pour into the flask. If you go over 50 mL mark on flask, empty some out into waste bucket or sink. **Never pour back into sample bottle.**
3. Add 15 drops of ammonia buffer to flask and swirl.
4. Place a small amount of the EBT indicator into the flask and swirl.* Place sheet of white paper under flask.

   *Use the metal scoop and to add about 1/8 inch of EBT. Remember, more can be added if needed, but cannot be taken out of the sample. The sample should be purple (magenta), you should be able to just see through the solution. The key here is to produce a consistent purple.

Answer questions 1 and 2 on the hardness datasheet.

5. Self-zero the burette with EDTA. Be sure **NO** air bubbles are in the stem/arm of the burette by releasing a few drops and zero the burette again. If air bubbles resist moving, place burette over sink and tilt up and back with nozzle open. Also make sure the tip of the burette is not crusted with EDTA. If the burette is crusted, place tip over sink and rinse with DI water and wipe with paper towel.
6. Place flask under EDTA burette and add EDTA drop-by-drop. Swirl the flask after each drop. Be sure to give yourself plenty of time between drops to swirl the flask sufficiently. Keep adding a drop at a time until the next drop turns the solution from purple to a blue.

   This is a slower reaction than alkalinity, thus needs more time in between drops to react. This solution should stay blue, and if not add another drop of EDTA. The shade of "blue" will correlate to the purple. If your purple was dark, the blue will be dark blue. Likewise, if the purple was light, the blue will be light. The first blue you see is your endpoint.
7. Read the burette carefully. Subtract the starting point from the endpoint (the starting point should have been "0"), and record the milliliters of EDTA used on line 4.
8. Multiply the milliliters of EDTA used by 20. This is the total hardness in mg/L of C_aCO_3. Record the hardness result value in line 5.

   Example: if the endpoint = 7.4 mL and the start = 0.0 mL, so the difference is 7.4 mL. Now multiply 7.4 mL x 20 to get 148 mg/L hardness as C_aCO_3.
9. Dispose the solution in the flask into a waste bucket or the sink. Rinse out Erlenmeyer flask and graduated cylinder with deionized water and store UPSIDE DOWN.
10. Does this result make sense? You are the first point of validation, is it similar to last time, what you know, etc.? Provide any comments that help us understand what your experience was.
11. Sign/date for a complete datasheet. Copy the result to the Field Data Sheet.

Hardness Data Sheet

Station Name _____ Station Number _____

River _____ Date of sample ___/___/___

Volunteer Group _____ Time of sample: ____:____

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1. Amount of sample used (should be 50mL): **_____mL**

2. Add ammonia buffer and EBT indicator.
   Did solution turn purple? ☐**Yes** ☐**No**

   Make sure your burette is zeroed and there is EDTA in tip of burette, but there are no air bubbles in arm/tip of burette. Your starting point on the burette should be 0.0.

3. Titrate from purple to first drop changes solution to blue.

4. Record the mL of EDTA you added.

   end point ___ mL - start point ___mL = ___ mL EDTA used

   Example: 7.4 mL - 0 mL = 7.4 mL EDTA used _____ mL EDTA used

5. Multiply mL of EDTA used by 20 to get the Total Hardness result, and record below.

   Example: (7.4 mL EDTA titrant used) x 20 = 148.0 (mg/L) total hardness as $CaCO_3$

Total hardness **_____ (mg/L) $CaCO_3$**

Your hardness result SHOULD be equal to or higher than alkalinity. Check your work!

Comments: _____

_____

_____

Data recorded by _____ Date recorded _____

Common mistakes

- As a general rule, hardness should be higher than alkalinity. This is not always the case, but check your results. In some areas of the state the geology is different and results in alkalinities greater than hardness. Sometimes alkalinity and hardness are equal. How is you sample this month compared to usual?

- Misreading the burette - check twice, get a second opinion.

- Purple is too deep or dark making endpoint hard to see and reaction not accurate.

- Participant does not allow enough time between drops for reaction to occur.

- Participant forgets to use ammonia buffer, color changes will never occur.

- Final multiplication is wrong.

Dissolved Oxygen Winkler Titration Instructions

Safety

The Winkler titration test uses a number of potentially hazardous chemicals, please take care the chemicals **do not come into contact with eyes, skin,** or clothes - wear safety glasses and rubber gloves.

Before testing, place the liquid waste bucket, paper towels and a squirt bottle of deionized water nearby.

- Alkaline **iodide azide is a strong base and can cause severe burns.**
- The **azide is very poisonous**.
- **Sulfamic acid can cause eye burns** and can cause skin and respiratory tract irritation
- Manganous sulfate can irritate eyes and skin.

Standard Winkler Titration Method Dissolved Oxygen

In the Field

1. Record the temperature of the river on line 1 of datasheet. *This should match your field datasheet.*

2. Rinse 300 mL, BOD with sample water.
3. Collect a water sample in the BOD bottle: uncap the BOD bottle and submerge under water at a 30-45 degree angle. Hold bottle at angle for at least one minute. Overflow the bottle for two minutes to remove any trapped air bubbles.
4. Pull bottle up with a swooping motion to keep as much water in bottle as possible. Cap the bottle and hold while turning upside down to make sure no air bubbles are trapped inside. If there are bubbles, re-submerge bottle and lift again. Repeat until no air bubbles are present.
5. Remove cap and add 1 mL Manganese Sulfate Solution and then 1 mL Alkaline Iodide-Azide Reagent (wearing gloves and goggles).
6. Immediately insert the stopper so that no air is trapped in the bottle. Invert several times to mix. You've just added a liquid, so the bottle will be overflowed. Invert over safe area.
7. A flocculent precipitate will form. It will be orange-brown if oxygen is present or white/pale yellow if oxygen is absent.
8. Wait until the floc in the solution has settled at least half way down the bottle, invert and shake to mix again.
9. After inverting bottle, wait until floc has settled at least half way down again, invert one more time and wait for floc to settle at least half way down again.
10. Remove the stopper and add the contents of one Sulfamic Acid Powder Pillow. You are adding a solid to solution, so there will be overflow again. Be careful not to spill on yourself.

11. Replace the stopper without trapping air in the bottle and invert several times to mix prepared sample. Continue to invert/shake holding the stopper till the majority of "crystals" have dissolved.

    The floc will dissolve and leave a golden/yellow color if oxygen is present. The sample is now 'fixed" and needs to be titrated within 8 hours (kept in a cold dark place). Refrigerate if possible till titration. If you have to wait to titrate and 8 hours have passed, titrate the sample and note in the comments when titration took place. For example, "collected sample 24 hours before titration" or "titrated sample 36 hours after collection."

In the Lab

1. Rinse the 500 mL Erlenmeyer flask and 250 mL graduated cylinder with deionized water.
2. Measure 200 mL of the prepared sample using the graduated cylinder, then pour into the 500 mL Erlenmeyer flask.
3. Rinse and fill the 25 mL burette with 0.025 N Sodium Thiosulfate ($Na_2S_2O_3$), by filling the burette to the 5 mL mark. Let 3 mL out to the 8 mL mark. If you go past 8 mL, fill back to 8 mL with more $Na_2S_2O_3$. Make sure there are no air bubbles in tip of burette.

    a. Letting out 3 mL of $Na_2S_2O_3$ ensures there will be solution in the tip of the burette. This amount is included in the measurement. **Please always make sure there is solution in the tip before titrating.**

4. Record starting point on line 2 of Winkler Dissolved Oxygen datasheet.
5. Titrate with $Na_2S_2O_3$ into the prepared sample drop-by-drop, swirling the flask until the sample turns a pale, straw yellow color.
6. Compare color to the remaining sample in the BOD bottle. If solution in Erlenmeyer flask is more gold than yellow, continue to add sodium thiosulfate.
7. Once solution in flask is light yellow, add 5 - 20 drops of starch indicator solution. Enough drops to turn solution a dark blue, green or brown. You want to be a color that is dark enough to see when the solution turn colorless. If 5 drops work, stop. If 20 drops do not work, change the starch.
8. Continue to titrate with sodium thiosulfate from the dark color to colorless or clear endpoint. Watch out for floating particles that may stay colored when solution is clear.
9. Carefully, read the burette and record the endpoint on line 3 of Winkler Method Dissolved Oxygen datasheet.
10. Subtract endpoint from start point, and record mL dissolved oxygen on line 4 of Winkler Dissolved Oxygen datasheet. (For example: 16.2-8.0 = 8.2)
11. 1 mL titrant used equals 1 mg/L dissolved oxygen.

12. Determine the percent saturation of dissolved oxygen, using the chart on the datasheet:
    a. Find your water temperature on the top scale and dissolved oxygen value on the bottom scale.
    b. Draw a straight line between the water temperature and dissolved oxygen measurement (oxygen mg/liter).
    c. Read the saturation percentage at the intercept on the sloping scale.
13. Record the percent saturation on the percent saturation line.
14. Drain burette, Erlenmeyer flask, graduated cylinder. Then rinse with deionized water twice and store the burette upside down or store the burette upright with remaining $Na_2S_2O_3$ and a cork, foil or some other closable plastic to cover opening.
15. Provide any comments that help us understand what your experience was.
16. Sign and date for a complete datasheet. Copy the result to the Field Data Sheet.

Common mistakes

- As a general rule, dissolved oxygen should be between 6-12 mg/L. Do your results seem plausible? If you are unsure, double check your initial results:
  - Titrate the sample again from the initial collection using 100 mL from the bottle.
  - Double the results of the 100 mL test. Do they come close to initial reading?

- Spilling the sample (either knocking bottle over or spilling as pouring into flask):
  - Titrate the sample again from the initial collection using 100 mL from the bottle
  - Double the results of the 100 mL test.
  - Record your results for the 100 mL test and explain what happened in the comments section of the datasheet.

- Misreading the burette - check twice, get a second opinion.

- Participant does not allow enough time between drops for a reaction to occur.

- Final multiplication is wrong.

Dissolved Oxygen Winkler Data Sheet

Station Name _____ Station Number _____

River _____ Date of sample __/___/____

Volunteer Group _____ Time of sample ___ : ___

---

1. River temperature _____ **º Celsius**

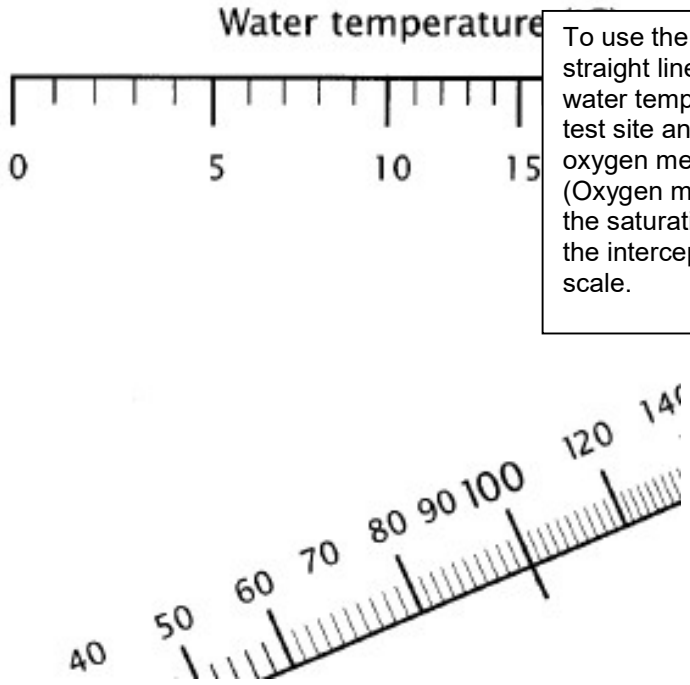
2. Titrate start point (yellow) _____ **mL**
   (Is there liquid in the tip of your burette with no air bubbles? Make sure to seed your burette first! Read your burette carefully!)

3. Titrate end point (clear) _____ **mL**

4. Subtract starting point from end point: # of mL at start point - # of mL at end point = milliliters of titrant used

   milliliters of titrant used = mg/L dissolved oxygen _____ **mg/L D.O.**

5. Determine the percent saturation of dissolved oxygen using the chart below.



To use the chart, draw a straight line between the water temperature at the test site and the dissolved oxygen measurement (Oxygen mg/L), and read the saturation percentage at the intercept on the sloping scale.

Percent Saturation_____%

Comments: _____

_____

Data recorded by_____ Date recorded _____

Stream Velocity and Discharge

River Watch cares about stream velocity and discharge as they are habitat features for aquatic life but also the amount of water in the stream that is diluting a particular pollutant concentration is an important piece of information to add to our story. This allows us to calculate a **pollution load**. The Clean Water Act standards are in **concentrations**, restoration strategies focus on reducing pollutant loads to achieve a certain in-stream concentration. Whenever possible we want to locate a station by a USGS or State Engineer Stream Gauge. Instructions to access this discharge or flow data are included below. For educational purposes the following activity is provided to help understand how velocity and flow is measured and how it might influence chemical, physical and biological components of a stream ecosystem.

Stream discharge or flow can be measured directly using the methods listed below. At some stations there are stream gauges. Using the methods described in the Retrieving Stream Flow Gauge Data from the Internet for River Watch Sampling section, the data can be downloaded from the internet.

To measure discharge you need to know the velocity of the cross sectional area of the stream. **Velocity** is the speed of water passing a point. The cross sectional area over a given distance is the volume of the stream area. By multiplying the stream velocity by the stream volume you get the amount of water that is moving past a given point at a given time or discharge. **Discharge** is the volume of water that passes a point; this is normally measured in cubic feet of water moving past a point in one second (cubic feet per second or CFS).

Stream Velocity

Ideally pick a 50-100 yard section of stream that is a free flowing riffle without any “hang-up” areas. Measure the exact length in feet and record.

On the surface of the water, gently place a floatable object (similar to an orange or tennis ball). There should be another participant downstream at the end of the station to catch the floatable object.

Another participant records the time between release and capture of the floatable object. Measure the time travel over the known distance at least three times, recording each time. Average the time of the three runs and record.

Divide the distance the object floated (in feet) by the average time (in seconds) to get stream velocity (feet/second).

Discharge

Pick a representative stream reach, preferably include the stretch used for velocity. At the beginning, middle, and end of the segment, measure and record the wet stream width.

At those same three locations, measure and record the depth, 1/4, 1/2, and 3/4 across the channel. You should have nine depth measurements. Average the nine depths and record.

Choose a bottom stream type.

Take the discharge formula and plug in the appropriate values. You will need a velocity value and average travel time from your velocity test.

Complete the math and you have discharge in cubic feet per seconds.

Stream Velocity Data Sheet

Station Name _____ Date of survey ___/___/___

River/Stream _____

Volunteer Group _____

---

1. Starting point description: _____
2. Ending point description: _____
3. Distance in between _____ feet
4. Seconds for orange to travel: First time _____ seconds

   Second time _____ seconds

   Third time _____ seconds

   Average _____ seconds
5. Distance in between stations

   Average number of seconds equals _____ feet/second

Continue to the Stream Discharge Data Sheet

Comments:

_____

_____

Data recorded by_____ Date recorded _____

Stream Discharge Data Sheet

Station Name_____ Station Number _____ Date of survey ___/___/___

River_____ Volunteer Group_____

1. Travel distance of floatable object _____ feet
2. Travel time of floatable object: First time _____ seconds
   Second time _____ seconds
   Third time _____ seconds
   Average _____ seconds
3. Velocity (divide travel distance by travel time) **(v) _____ feet/sec**
4. Channel width: at beginning of segment _____feet
   at middle of segment _____feet
   at end of segment _____feet
   Average (w) _____feet
5. Channel depths:

	beginning of segment	middle of segment	End of segment
1/4 across	feet	feet	feet
½ across	feet	feet	feet
3/4 across	feet	feet	feet

Average of average depths (d) _____feet

6. Stream bottom type (choose one) **(a)**

   a. (0.8) rough, loose rocks, coarse gravel

   b. (0.9) smooth, mud, sand, hardpan rock

7. Discharge calculation:

   r = v*w*d*a

   r = discharge in cubic feet per second.
   v = velocity of stream in feet per second**.**
   w = average width of channel section tested (average of three measurements above).
   d = average depth in feet (use average from nine measurements)
   a = constant whose value depends on the nature of the stream bottom:

8. Stream Discharge _____feet^3/second

Data recorded by_____ Date recorded _____

Retrieving Stream Flow Gage Data from the Internet

The Colorado Water Resource Division and the U.S. Geologic Survey Water Resource Division maintain hundreds of stream gauge stations throughout Colorado. To access all the active stream flow gage data go to http://www.dwr.state.co.us.

The first step is to determine if there is a stream flow gage in the vicinity of your River Watch monitoring station. For most of the stream flow gauge stations, there is only a name given to indicate which stations are gauged. You can view the list on the list on the Water Resource website. Contact the River Watch office if you are unable to determine whether a stream flow gauge station is near your monitoring site (303-291-7322).

There are many River Watch monitoring stations that do not have stream flow gauge monitoring stations near them. If there is a flow gauge at your station, the flow data can be used to calculate load rates in pounds per day (concentration X flow rate = load). Load is used extensively in managing pollutant discharges to streams.

Steps to downloading flow data

Go to the website http://www.dwr.state.co.us and locate the appropriate stream flow station from the list. You can narrow your search by the selecting only the stream flow stations in the county or water division your monitoring station is located in. Bookmark your stream flow station site.

If the stream flow station is operated by the Colorado Water Resource Division, follow the steps below. If they station is operated by U.S. Geologic Survey follow the second set of directions.

Colorado Water Resource Division (link here)

1. Select your station from the list of stations, and click on the retrieve button. The screen will show an instantaneous flow and a graph of flows over the last 10 days.
2. Select the “Retrieve self-timed tabular data” hotlink.
3. Data is available on 15 minute time increments for the last three days. Find the stream flow under the “DISCHRG” column closest in time to when you sample was collected. This is the stream discharge in cubic feet per second (cfs).
4. Record result on Field Data Sheet, and check the “gage” box.
5. Data older than three days is not available online.

U.S. Geologic Survey, Water Resource Division (link here)

1. Review the tutorial for all the kinds of surface water flow data available. You can go to the current conditions tab or daily data tab and follow the instructions on that tab to get a flow that is closest to the time of sample collection. Record that time on datasheet and in the gauge field when entering data on-line.

Look for the flow data for the sample collection date under the “dv_cd” column. Record the result on the Field Data Sheet and check the “gauge” box. This is the stream discharge in cubic feet per second (cfs).

Chain of Custody

A chain of custody is a quality control measure. It is a form that tracks the custody of a sample from its birth (collection) to its death (analysis) and helps ensure that no tampering or contamination occurred along that pathway. **A chain of custody is required for samples shipped or delivered to Denver.**

THE CHAIN OF CUSTODY AND THE SAMPLE TRACKING SHEET LOOK VERY SIMILAR.

The Sample Tracking sheet is a tool to help you track what samples have been collected from each station, field, metals, nutrients, bugs or physical habitat and quality assurance samples. It is a good practice to highlight every fifth entry line to remind you to collect a metals blank and duplicate quality assurance sample**.** The Sample Tracking sheet is for your use only.

The chain of custody is for River Watch to be able document and prove sample handling is conducted such a way to retain sample integrity from collection, transport and analyses.

PLEASE ONLY SUBMIT THE CHAIN OF CUSTODY BACK TO RIVER WATCH WITH YOUR SAMPLES.

Shipping Containers:

Field datasheets: If shipped alone can place in an envelope. If shipping with any sample bottle(s) place originals in a Ziploc bag or equivalent protection to keep dry during shipment.

Metal Samples: Place in a Ziploc bag with absorbent material in case of a leak; paper or paper towels. Place bags in a box if only shipping metals, along with paperwork. You can also send in a cooler shipment with nutrients, it is okay for them to be kept cold.

Nutrient Samples: Nutrients have to be kept on ice and cold after collection and during shipment so these must be shipped in a cooler. Pack the cooler with ice using an ice system that will not leak (blue ice, frozen water jugs or actual ice in a sealed bag). USPS has been known to return leaky coolers.

Macroinvertebrate Samples: Place sample bottles and alcohol containers in Ziploc bags with an absorbent material and ship in a box or in your cooler with nutrient samples if that is efficient.

Physical Habitat datasheets: If shipped alone can place in an envelope. You can also include these with other samples in a box or cooler enclosed in a Ziploc bag or equivalent protection to keep dry during shipment.

How to Complete the Chain of Custody Form (Please complete from the BOTTLES not datasheets to ensure accuracy)

1. Gather all sample bottles to be shipped (metals, nutrients or bugs) and place in order by date for each station.
2. Gather and organize all associated datasheets (field, alkalinity, hardness, dissolved oxygen, macroinvertebrate and/or physical habitat), compiled together for each station and ordered by date. This is contrast to compiling all alkalinity datasheets for example from all stations and dates.
3. For each bottle, check each cap that it is tightly sealed and each label is complete including a time.
4. For each bottle, find corresponding datasheet set. Check that the date and time on the bottle matches the datasheet, if not rectify (pick one but make them the same). Check that each datasheet has Event ID information (river, station and organization name, station number, date, time) and make sure the datasheet is signed.
5. Check that the field datasheet is complete. All Event ID information on top, all relevant boxes checked, if a bottle exists and is being shipped, the results for all parameters analyzed (like temperature, pH, phenol and total alkalinity, hardness, dissolved oxygen), any comments, sheets are signed and dated. **Make a copy of either all the datasheets or the Field datasheet if complete for YOUR RECORDS, the originals will be included in the shipment.**
6. Now you are ready to complete the chain of custody. You can use one chain of custody for multiple stations and sample events. Use one “entry line” on the form per event.
   a) For each station/date or event, fill in the station name, number, date and time of collection (time should match bottle labels and corresponding datasheets).
   b) Check the correct boxes for metal sample (filtered, not filtered, filtered blank or duplicate) if they exist.
   c) Check the correct boxes for nutrient sample bottles (TSS/CS or NP, Duplicate TSS/CS or NP) if the exist.
   d) Check the correct boxes for macroinvertebrate sample or quality assurance sample if either exist.
   e) If you have no bottles, only field datasheets, you can list the Event ID information and leave boxes to the right unchecked.
7. Repeat for another event from the same station OR move on to the next station.
   a) Note if you have more events than one form will allow, grab another form and complete. Write on the top right corner ***Page 1 of 2***, and ***Page 2 of 2*** on the corresponding forms.
8. When events for all stations are entered complete the “TALLY TOTAL” summary section in this way:
   a) Count all the metals bottles you have. Count all the check marks for metals bottles on the chain of custody form. Do the numbers match? If they do, record that number in the metals box. If they do not match RECTIFY until they do.
   b) Count all field datasheets you have, with or without bottles and how many are associated with samples on the chain. If the number matches record, if not RECTIFY until they do.

c) Count all the nutrient bottles you have. Count all the check marks for nutrient bottles on the chain of custody form. Do the numbers match? If they do, record that number in the metals box. If they do not match RECTIFY until they do.
d) Count all the macroinvertebrate bottles you have. Count all the check marks for bug bottles on the chain of custody form. Do the numbers match? If they do, record that number in the metals box. If they do not match RECTIFY until they do.
e) If you are using two sheets, you can record X of Y on each sheet. For example, 20 of 48 metal samples on Form 1 and 28 of 48 on Form 2.
f) Print your name and sign it on the top, check the boxes if the field data in this shipment has been entered and those sheet are included.

Place Chain of Custody, Equipment Request Form and all **ORIGINAL** datasheets in a plastic bag in the box or cooler (you keep the copies of datasheets). Samples are not valid without a chain of custody form and will not be processed without completed datasheets. Refer to shipping instructions to complete shipping tasks.

Chain of Custody

Volunteer Group ______________________ Date Shipped ______ /______ /______

Shipped by __________________________ Signature ____________________________

Field Data Sheets included - ☐Yes ☐ No Field Data entered via web - ☐ Yes ☐ No

Station Name	Station Number	Date	Time	Metal Samples	Nutrients	Macroinvertebrate Sample
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___
				Filtered (F) _____ Non-Filtered(NF)_____ F Blank _____ NF Blank _____ F Duplicate _____ NF Duplicate _____	TSS / CS___ NP___ Duplicate TSS / CS___ NP___	Yes ___ QA sample___

TALLY TOTAL #'s	
Sample Container	**Total #**
Metal Bottles	
Field Datasheets	
Nutrient Bottles	
Macro / Phys Hab	/

Metal Abbreviations	Nutrient Abbreviations
F=Filtered	**TSS**=Total Suspended Solids, in 32 oz jug
NF=Non Filtered	**CS**= Chloride, Sulfate, in 32 oz jug
NFB= Non Filtered Blank	**NP**=Nitrate+Nitrite, Ammonia, Total Nitrogen & Phosphorus
FD = Filtered Duplicated	All in 8oz H_2SO_4 preserved
NFD =Non Filtered Duplicate	**QA** = Quality Assurance Macro Sample check Yes

Ship samples to River Watch, 6060 Broadway, Denver Colorado 80216.

River Watch Staff Section

Total # metals bottles received: __________ Date Samples Received _________________

Total # of field datasheets received: _______

Total # of nutrient bottles received: _______

Total # of macro samples received: _______ Received by ____________________________

Shipping Metals, Nutrient or Macroinvertebrate Samples

- Follow the **How to Complete a Chain of Custody Form** instructions above that include copying all datasheets and all bottle labels and checking them for completeness and that they have the same **DATE/TIME**. Remember all originals must be shipped with your samples.
- After copying your datasheets, please enter data online if possible before shipping.
- Check supplies, if need any that require shipping a sample bottle, now is a good time to include it, include a bottle and a request for equipment form. **Place this form on the top of your chain of custody and datasheets! We need this to be the first item we see when unpacking your samples.**
- Place completed Chain of Custody form, with **ORIGINAL** data sheets and Equipment Request form in a Ziploc bag.
- Select the appropriate shipping container (see above). Ensure all bottles being shipped are tightly closed.
- Check the samples are labeled correctly and place samples in a sealable bag. Place enough absorbent material in the sealable bag (newspaper, etc.) to absorb the contents of the largest container.
- Seal the bag and place in the shipping container (box or cooler).
- For nutrients put frozen blue ice or enough ice to last 48 hours in the cooler. For metals and macroinvertebrates blue ice is not needed.
- Surround the samples and fill the empty space with packing paper or newspaper so the samples do not roll around.
- If sending nutrients, secure the cooler closed with packing tape. This will inhibit tampering during shipment. **Nutrients must be shipped on a Monday, Tuesday or Wednesday to arrive by Thursday or Friday so samples will stay cold.**
- Use the mailing labels provided and label the shipping container.
- If a problem arises with shipping, please notify River Watch. Whenever asked by anyone “What are you shipping?” reply with “water samples.”

When to Ship

Each volunteer group is asked to ship their metals samples **at least once every other month**. The holding time for metal samples is 6 months. Shipping metal samples on a quarterly basis allows maximum time for River Watch to process and analyze the data.

Nutrients should be shipped within 48 hours of collection, with enough ice to last for 48 hours. Do not ship on Thursday or Friday or on a day when the sample would arrive on a Saturday or Sunday. The holding time for the nutrients is 28 days. If you collect on a Thursday or Friday, please hold your nutrient samples and ship on Monday.

Macroinvertebrate samples should be shipped within two weeks of collection. Enclose any alcohol that was not used, and bottles not used.

Mailing Labels

FROM: **Name:**____
Organization:______________________________ **Kit#**_______
Address:______________________________________
City, State, Zip:__________________________________

To: Colorado Parks and Wildlife
River Watch
6060 Broadway
Denver, CO 80216

FROM: **Name:**____
Organization:______________________________ **Kit#**_______
Address:______________________________________
City, State, Zip:__________________________________

To: Colorado Parks and Wildlife
River Watch
6060 Broadway
Denver, CO 80216

FROM: **Name:**____
Organization:______________________________ **Kit#**_______
Address:______________________________________
City, State, Zip:__________________________________

To: Colorado Parks and Wildlife
River Watch
6060 Broadway
Denver, CO 80216

Web Enabled Field and Unknown Data Entry

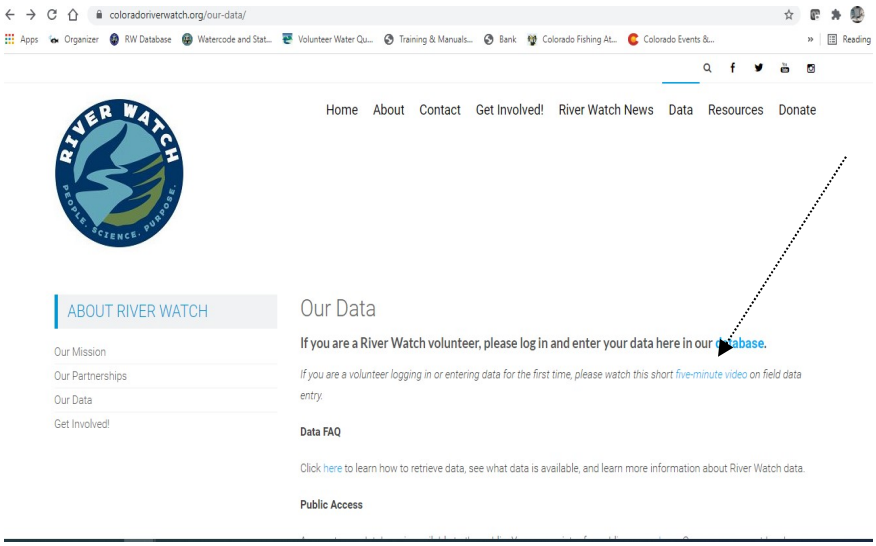
River Watch needs to **validate or verify** your results, both for precision and to make sure they are entered accurately entered into the database. This step is part of QA/QC. Multiple steps and individuals are involved in validation. The volunteer is the first point of validation, checking the results and asking if they make sense, noting in comments where they don't or that you did the test several times and got same answer, etc. Staff check all data entry fields from your original datasheets for accuracy. The industry standard is to check 10%. Staff also check every analytical result and check field QA/QC results against normal samples. The River Watch database application has numerous functions, including data entry suggestions for volunteers, such as a warning when you enter a pH value <0 or >14. Only data that passes all field, laboratory and data management QA/QC checks is moved to the final data repository, which is only accessible by River Watch staff as part of **data security**. CPW RW Program Manager is responsible for all final data validation.

Data management includes managing metadata, or data about the data. For example, **Metadata** such as volunteer information, station, QA/QC data. Metadata is very important to help document the quality of the data, why it was collected, units and information that helps other users determine if the data is useable for their uses but also to interpret the data for the intended you. Exports and reports are provided for metadata and results and in specific formats for different data hub and data user's needs.

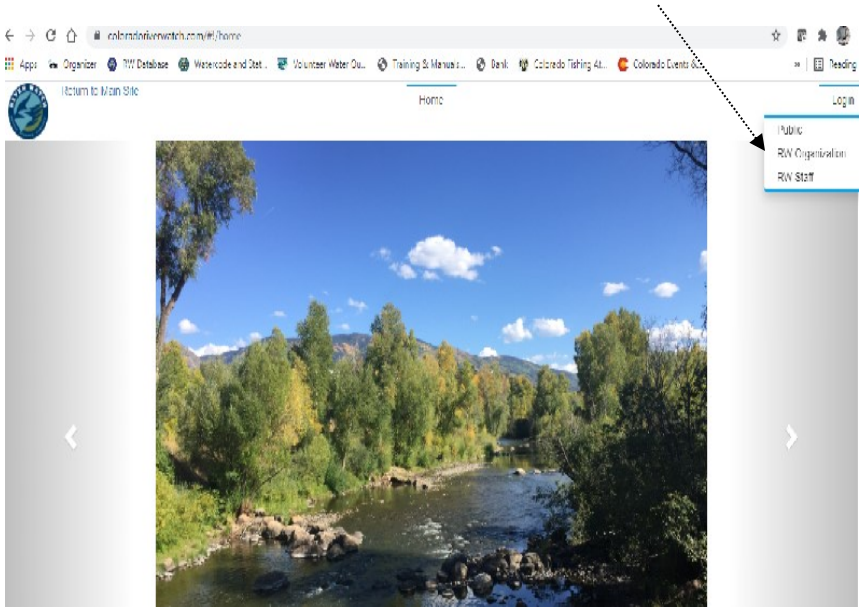
As part of your performance criteria we ask you enter and submit your field data **at least** once per quarter in a contract year. Entering after every event is recommended. Data entry by you allows our staff to focus scarce resources on more sample analyses, reporting, site visits and the like. Data entry includes monthly **field data** and the quality control **unknown samples** two times per year.

Along with electronic entry of your field data, you are required to keep a copy of the hard data and send us the original copies. We validate your data entry from the original copies.

1. Once you have completed filling out your Field Data Sheet, prior to shipping samples, go the River Watch website and enter your data into the electronic data forms.
2. To enter field data, you will need your organization name or kit number, and your organization password. If you do not know your kit number and password, please contact a River Watch staff person via phone or by email (front cover of this manual).
3. To enter your data from the coloradoriverwatch.org website, go to the "Data" tab and click on the "database". This will take you to the homepage of the River Watch database. There is a video link also how to enter data.



4. Once you are on the landing page of the River Watch database, you will need to login to enter data. In the upper right hand corner is a login, select RW Organization.



5. A drop down menu appears asking for your organization-kit#. Type in your org name (or your kit number) and groups will begin to appear with a kit number associated. Find your organization and select. Never use another organizations name or kit #. Type in password, select Log In. If successfully logged in, your organization and kit number will show in upper right and you will see three options, Home, Organization and Reports.
6. Select Organization, and then Field data. The next screen should auto fill in your organization and you now select a station from the drop down on the right. Your choices will be list by river name first alphabetical then number, be careful to select the station you are entering field data for. You can also start to type station name in and that will narrow the choices to select.

7. Once you select a station, you will need to enter in the sample collection information. Enter the data and time (military time) for the sample collected and hit “submit”.
8. Proceed to enter data from your field datasheet. Zero’s will appear as default but are **NOT** the value in the field. If you have a zero result, say for temperature or phenol alkalinity you **must still ENTER a 0 in that field**, if you don’t it will come up null or blank. You can type in numbers or use the up/down arrows to get to your result.
    a. For flow data, if you have USGS, State Engineer or other **official** gauge flow measurement enter here and click gauge box to right.
    b. If only an estimate from an orange float test or a gauge that is too far away or other source, please leave this field blank and type “XX cfs flow estimate” in the comments. Other comments can be entered in comments section as well.
9. Check all boxes you have bottles for that should match what is checked on the Field data sheet. For nutrients, please check all three boxes, NP, CS and TSS if you have two bottles. For labeling purposes, NP=ammonia, nitrate/nitrite, total nitrogen and total phosphorus, CS=chloride and sulfate, TSS=total suspended solids.
10. Add comments and when finished, hit the “save” button and your data will be sent to our database. You will get at “**Save Successful**” message.
11. To enter another record, click the save message off, go back to organization, field data and repeat above steps.
12. Copy all data sheets. Mail all **original data sheets** with your samples.
13. If you do not have any samples to ship, (for example all you have is field data), no metals, nutrients or macroinvertebrates, you still need to enter the data electronically, copy the datasheets and send originals.

Unknown Data Entry

1. Part of our QA/QC is having volunteers sample “unknown” samples for alkalinity, hardness and pH. These are completed once at a site visit and once when RW staff mail them to the volunteer. The results of these samples are unknown to the volunteer but known to staff and are used test your equipment, chemicals and protocols. Unknown samples that are received in the mail are completed by volunteers and the results for these tests should be entered into the database. Once the tests are complete and the results entered, please send the original datasheets to Denver, just like field datasheets.
2. Data entry of unknowns follow steps 1-5 above but instead of selecting “field data” select “unknown data”.
3. You will be presented a data entry form that you can enter two alkalinity and hardness unknown results, up to six pH measurements (following the unknown test instructions), and submit.
4. Tutorial videos are available on the coloradoriverwatch.org website under **Data** Tab, then **Database Instructional Videos** tab. Both field data and unknown data entry is covered as well as how to access your unknown results, metals blank and duplicate results, your organization performance report and all RW chemical, macroinvertebrate and physical habitat results.

NOTES

Photographic Record of Your Stations (Optional)

Completing a photographic record of your River Watch station(s) could prove valuable in the future. The objective is to document change over time - geologic time. The beach erosion that has occurred on the Colorado River in the Grand Canyon is an excellent example that illustrates the invaluable importance of such documentation. The large beaches present in the canyon have been eroding away since the Glen Canyon Dam/Lake Powell was built. This was due to the extreme flow fluctuation due to dynamic releases from the reservoir. These extreme fluctuations are no longer allowed because old photographs documented the way the beaches used to be. A new water release plan, the result of extensive research, is in place now with the intent to restore old beaches and reduce erosion of existing beaches.

This photographic record will become part of history, as will your water quality data. When selecting a location to photograph your station, pick a camera position, angle, view and perspective that can be repeated year round. Sometimes it helps to mark the camera location and transect view with stakes or flags so every photo has this reference point. Pick a consistent direction/angle to take the picture and include large permanent structures if possible. The following information should be included with every photograph. Use the form on the following page.

- Station name and location
- Direction of photograph (upstream, downstream, etc.)
- Date of photograph
- Time of photograph
- Type of film/exposure or digital
- Time of year
- Relevant comments

Digital photographs are preferable, and pictures can be emailed to River Watch. You can view station photos in the website in the watershed report section.

Explore the Izaak Walton Leagues, Stream Selfie program and submit a photo to that site, logging your station in to a national database. https://www.iwla.org/water/stream-monitoring/stream-selfie or https://scistarter.org/stream-selfie

Photographic Record Data Sheet

Station Name_____ Date of picture ___/___/___

River_____ Station number:_____

Volunteer Group_____

Upper Terminus:
1. Location T_____ R_____ S_____

2. Elevation _____ feet

Lower Terminus:
Location T_____ R_____ S_____

Elevation _____ feet

Approximate flow: _____ Approximate width:_____

Station description

_____

_____

Photo: Film: _____ Exposure _____

Time picture taken: _____ Time of year (season) _____

Name of photographer: _____

Diagram of Angle

	Circle one: Flow Direction: Place a☆ to show where you stood when you took the picture.	

Attach photo here.

Comments: (comparison with other photos, weather conditions, etc.)

_____

_____