Stream Team Monthly Monitoring Manual

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WATER QUALITY MONITORING MANUAL

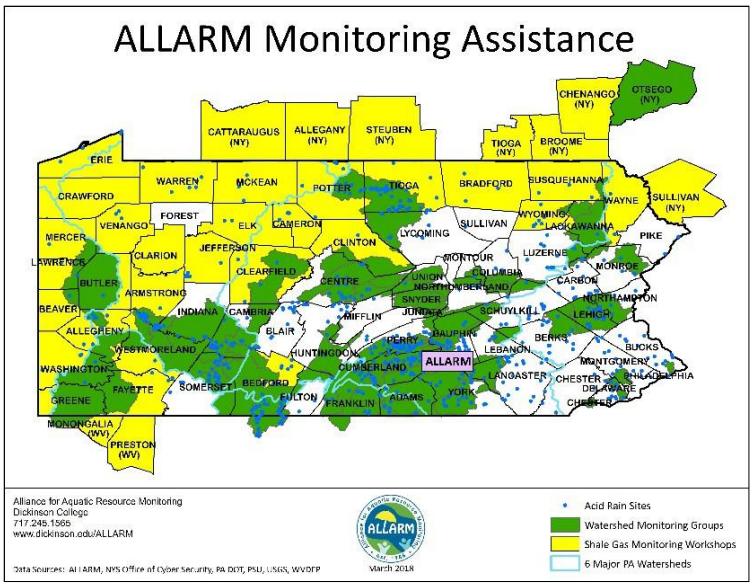
This Water Quality Monitoring Manual outlines Dickinson College's Alliance for Aquatic Resource Monitoring's (ALLARM) Stream Team volunteer monitoring program. The goal of this manual is to describe, in full detail, the directions and steps necessary for Stream Team volunteers to collect credible water temperature, water clarity, stage, conductivity, pH, and nitrate-nitrogen data. In order for data to be in compliance with ALLARM's federally approved QAPP, we ask that Stream Teams follow testing instructions carefully during each testing weekend.

ALLIANCE FOR AQUATIC RESOURCE MONITORING

The Alliance for Aquatic Resource Monitoring is a nationally recognized technical and programmatic support center for community organizations interested in watershed assessment, protection, and restoration. ALLARM was founded in 1986 and is a project of Dickinson College in Carlisle, PA. ALLARM's mission is to empower communities with scientific tools to understand the health of their streams and participate in local decision-making.

ALLARM provides customized assistance to community groups through skill-building workshops, trainings, and outreach on topics such as:

- Study design
- Water quality
- Macroinvertebrate monitoring
- Visual assessment
- Quality assurance/quality control
- Data analysis and interpretation



Through the work of four full-time staff, a science advisor, and 10-12 Dickinson College students, ALLARM offers comprehensive services to enable groups to use critical scientific tools that can enhance the quality of their local environment and allow them to fully participate in community decision-making. For more information on ALLARM, please visit: [www.dickinson.edu/ALLARM.](www.dickinson.edu/ALLARM)

STREAM TEAM

The Susquehanna River is the largest tributary to the Chesapeake Bay, providing 50% of fresh water and draining close to 28,000 mi^2 of land. Improving the health of the Susquehanna River watershed is key to Pennsylvania and New York achieving Bay pollution reduction goals. Stream monitoring is a tool for assessing the health of the Susquehanna watershed and determining the effectiveness of the Bay pollution blueprint. To this end, ALLARM developed a protocol for chemical and biological stream monitoring to collect baseline data on Susquehanna tributaries. These data can be used for community decision making and local purposes, as well as contribute to regional data collection efforts through the Chesapeake Data Explorer.

The chart below summarizes the Stream Team monitoring components.

<table>
<tr><td>1a. Monthly Chemical Monitoring
Water temperature
Water clarity
Stage
Conductivity
pH
Nitrate-nitrogen
Visual site characteristics assessment</td><td>1b. Biennial Macroinvertebrate Monitoring (spring or fall)
EPA Volunteer Monitoring MacroinvertebrateProtocol</td></tr>
<tr><td colspan="2">1c. Data Management:
Volunteers will record data in data sheets and upload data to the Chesapeake Data Explorer.</td></tr>
<tr><td colspan="2">1d. Data Interpretation (after 12 months)
Annually volunteers will receive a site packet with data, summarized statistics, and watershed information.
Volunteers will learn to interpret results and find the story in their data.
Develop written water quality reports that communicate the volunteers' findings.</td></tr>
<tr><td colspan="2">2. Additional Monitoring Parameters (if the baseline data indicate additional information is needed):
Dissolved oxygen
Orthophosphate</td></tr>
<tr><td colspan="2">Note: All volunteers will be trained in accordance with federally approved Quality Assurance Project Plans.</td></tr>
</table>

QUALITY ASSURANCE & QUALITY CONTROL

Quality assurance and quality control (QA/QC) are the backbone of any successful stream monitoring program. The ALLARM Stream Team volunteer monitoring program implements a variety of QA/QC practices to ensure that the data collected are of known quality. A summary of these practices is listed in the table below:

Practice	Component(s)
Training requirements	Attend ALLARM training workshops and follow-up meetings.
Documented procedures	Follow procedures in the Stream Team Monitoring Manual.
Equipment care	Care for equipment following the guidelines outlined in this manual, including: • calibrate and use equipment according to manufacturer's directions • inspect, clean, and store equipment properly • contact ALLARM with questions
Internal QA/QC	Measure parameters in replicate.
External QA/QC	Duplicate sample analysis, run by ALLARM. Performed twice in the first year.

SAFETY

The number one rule for stream monitoring is safety first! Please check the weather and stream conditions before going out to the field. Always monitor in a team of at least 2 people. Take caution when entering and exiting the stream and wear waders or closed-toe shoes. It is good practice to have a first aid kit available to attend to cuts and scrapes. Be aware of hazards in the area. You may be exposed to hazards such as insects, poisonous plants or animals, uneven terrain, and strenuous activity. It is not possible to

list each risk associated with participation in this program. Refer to Appendix C (page 21) for recommendations around choosing a monitoring site and instructions for obtaining GPS coordinates.

SAFETY TIPS!

- Monitor in a team and bring a cell phone
- Do NOT monitor if:
  - You feel ill
  - Weather is bad (icy conditions, storming)
  - High flow conditions -do not enter the creek if the water is above your knees
- Be careful entering/exiting the stream (could be steep or slippery)
- Wear a personal floatation device, appropriate wading boots or water shoes
- No trespassing
- Be mindful of the hazards in your surroundings

ACKNOWLEDGEMENTS

ALLARM's Stream Team program is not possible without collaboration with a number of partners, including County Conservation Districts, Penn State Master Watershed Steward program, the Lower Susquehanna Riverkeeper Association, the Middle Susquehanna Riverkeeper Association, and the incredible volunteers. Funding support is also provided by the Campbell Foundation; the Chesapeake Monitoring Cooperative, a cooperative agreement with the Environmental Protection Agency's Chesapeake Bay Program CB96387101-0 Capacity Expansion and Integration of Citizen-based Monitoring and Nontraditional Monitoring Partners into the Chesapeake Bay Program Partnership; and the PA Department of Environmental Protection funded Consortium for Scientific Assistance to Watersheds (C-SAW). ALLARM appreciates all of its funders and partners in this project. Thank you for your collaboration.

THE CAMPBELL FOUNDATION

CMC Chesapeake Monitoring Cooperative

C-SAW Consortium for Scientific Assistance to Watersheds

PART 1: PRE-STREAM

Quick Overview

- Gather the equipment and supplies you will need for the pre-stream monitoring section.
- Calibrate LaMotte Tracer PockeTester meter for conductivity testing.

Note! You must perform a dual calibration of the LaMotte Tracer PockeTester before every sampling event to ensure consistent data quality.

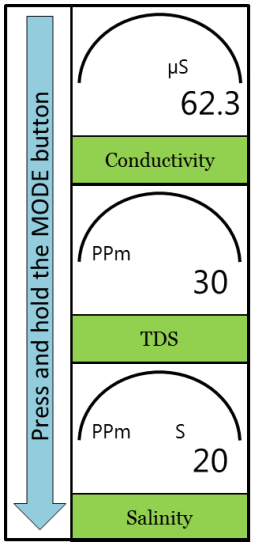
Pre-Stream Equipment Checklist:

- ☐ Data sheet
- ☐ LaMotte Tracer PockeTester
- ☐ 84 µS/cm conductivity standard
- ☐ 84 µS/cm calibration vial
- ☐ 1,413 µS/cm conductivity standard
- ☐ 1,413 µS/cm calibration vial
- ☐ Distilled water wash bottle
- ☐ Waste container

Calibrate the LaMotte Tracer PockeTester

Step #1: Start your data sheet & gather and prepare the equipment

1. Record monitoring start time on data sheet.
2. Gather the following supplies:
    a. LaMotte Tracer PockeTester
    b. 84 µS/cm conductivity standard
    c. 84 µS/cm calibration vial
    d. 1,413 µS/cm conductivity standard
    e. 1,413 µS/cm calibration vial
    f. Distilled water wash bottle
    g. Waste container
3. Remove the cap covering the electrode. Rinse the electrode with distilled water over the waste bucket and shake it dry. Rinse the 84 and 1,413 µS/cm calibration vials three times with distilled water and shake dry.
4. Turn the meter on by pressing the **ON/OFF** button and confirm that the meter is in conductivity mode – **µS** will be displayed above the reading (see diagram).



*Note! To change modes, press and hold the **MODE** button for ~3 seconds to cycle through the other two modes (total dissolved solids and salinity) until **µS** displays above the reading and **CON** displays below it.*

Step #2: Calibrate the meter with 84 µS/cm calibration solution

1. Invert the bottle of 84 µS/cm conductivity standard and pour ~20 mL of conductivity standard into the vial (about halfway).
2. Place the electrode into the solution (do not let the meter rest on the bottom) and allow the reading to stabilize. This may take up to 2 minutes. Once the reading is stable, press and hold the **CAL** button for ~2 seconds, until **CAL** appears on the bottom of the screen and **84** flashes. When the meter is

finished calibrating, **SA** and **End** will briefly flash and the meter will return to the conductivity measurement mode.

Note! SA will not flash if the calibration fails. Repeat and try again. See meter troubleshooting section if the issue persists (page 23).

3. Rinse the electrode with distilled water over the waste container and shake dry.

Step #3: Calibrate the meter with 1,413 µS/cm calibration solution

1. Repeat step #2 using the 1,413 µS/cm conductivity standard and vial.
2. After completing the second calibration, record on your data sheet that you calibrated the meter using both 84 and 1413 µS/cm conductivity calibration standards.

Step #4: Clean Up

1. When you have finished calibrating your meter, rinse it again and shake dry before putting the cap back on, turn it off, and note on your data sheet that you calibrated your meter.
2. Pour the 84 and 1,413 µS/cm conductivity standards into your waste container or sink and rinse the calibration vials with distilled water.

End of Part 1: Pre-Stream Section.

PART 2: AT-STREAM

Quick Overview

- Gather the equipment and supplies you will need for the at-stream monitoring section.
- Fill out your data sheet at the stream.
- Measure air temperature with the LaMotte Tracer PockeTester.
- Measure water temperature, stage, and water clarity in the stream.
- Collect a water sample for conductivity, pH, and nitrate-nitrogen testing.

At-Stream Equipment Checklist:

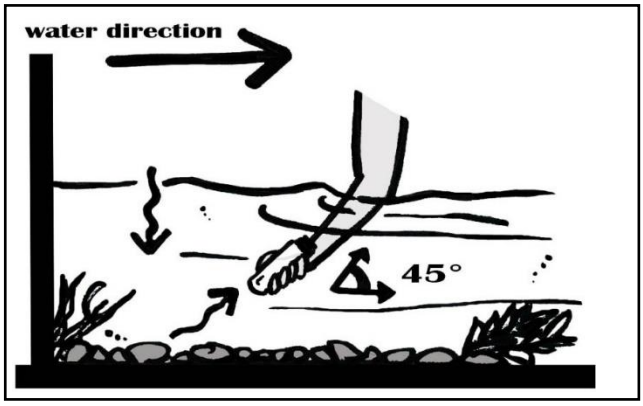
- ☐ Sample bottle
- ☐ LaMotte Tracer PockeTester
- ☐ Gage stick
- ☐ Turbidity tube
- ☐ Distilled water wash bottle
- ☐ Optional: sample collection pole, sampling bucket and rope
- ☐ Monitoring Manual (with data sheet)
- ☐ Waders or closed-toe shoes suitable for entering the stream
- ☐ Cooler with ice/freezer packs
- ☐ Pen
- ☐ Cell phone

Note! If you are not testing your sample for all parameters at the stream, the water must be transported in a cooler to the post-stream testing location.

Collecting a Water Sample

- Each time you visit your monitoring site, collect a water sample from the same location using the same collection method. Record on your data sheet if you change locations.
- Samples should be collected from the middle of the stream where the water is flowing steadily, using a clean sample bottle. Do not touch the inside of the bottle or cap with your hands.

Method #1: Wade into the stream:



1. Enter the stream.
    a. Enter the stream **downstream** of your monitoring site to avoid disturbing the streambed.
    b. Move to the center of the stream, if possible, and face upstream.
2. Rinse the sample bottle and cap.
    a. Fill the sample bottle with stream water and capit. Shake the bottle and pour the rinse water outdownstream from where you are standing.
    b. Repeat two more times.
3. Collect a water sample.
    a. Tilt the mouth of the bottle downstream and lower it into the stream. Sample the entire depth of the stream, but do not let the bottle touch the streambed.
    b. When the bottle is full, remove it from the stream and cap it.
    c. Exit the stream and store your sample for post-stream testing.

Note! If stream level is >6 inches, follow the above instructions. If stream level is <6 inches, tilt the bottleupstream, and collect as much water as possible without disturbing the streambed.

Method #2: Use a sample collection pole:

1. Rinse the sample bottle and cap.
    a. Stand along the stream bank or at a bridge at your monitoring site and secure the sample bottle to the sample collection pole. Remove the cap from the bottle.
    b. Fill the sample bottle with stream water. Swirl the water in the bottle, then pour out the rinse water downstream from where you are standing.
    c. Repeat two more times. During the final rinse, rinse the cap with stream water three times.
2. Collect a water sample.
    a. Extend the collection pole to the middle of the stream (or as close to the middle as possible). Tilt the mouth of the bottle downstream and lower it into the stream. Sample the entire depth of the stream, but do not let the bottle touch the streambed.
    b. When the bottle is full, remove it from the stream and cap it.

Method #3: Use a sampling bucket:

If you choose to sample from a bridge, there needs to be enough room on the shoulder of the road to stand and move safely without worrying about traffic. Also, be aware that a bucket full of water can be heavy and difficult to lift to the top of a bridge.

1. Rinse the sampling bucket, sample bottle, and cap.
    a. Stand on the bridge at the mid-point of the stream (or where the water is flowing swiftly), preferably on the upstream side, and lower the sample bucket (securely attached to a rope) over the side of the bridge and into the stream. Do not touch the streambed with the sample bucket.
    b. Raise the bucket back up to the bridge. Swirl the water in the bucket, then pour out the rinse water downstream from where you are standing.
    c. Repeat two more times. During the final rinse, rinse the sample bottle and cap with stream water three times.
2. Collect a water sample.
    a. Lower the sample bucket into the stream again. Sample the entire depth of the stream, but do not let the bucket touch the streambed.
    b. Raise the bucket back up to the bridge. Fill the sample bottle with water and cap it.
    c. Pour out the remaining water in the bucket.

SAFETY TIPS!

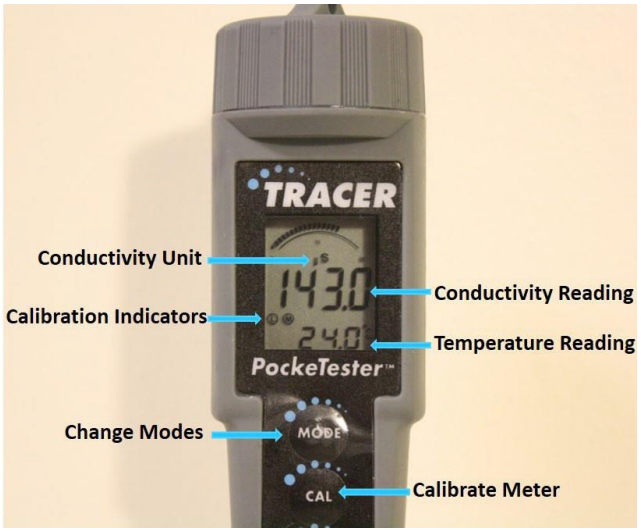
- Monitor in a team and bring a cell phone
- Do NOT monitor if:
    - You feel ill
    - Weather is bad (icy conditions, storming)
    - High flow conditions -do not enter the creek if the water is above your knees
- Be careful entering/exiting the stream (could be steep or slippery)
- Wear a personal floatation device
- Do not put yourself in a situation that could cause harm
- No trespassing
- Be mindful of the hazards in your surroundings

WATER TEMPERATURE: LaMotte PockeTester (1749)

The LaMotte Tracer PockeTester measures water temperature, the amount of heat present in water.The temperature will be recorded in degrees Celsius (°C).

Step #1: Measure the water temperature

1. Remove the electrode cap and turn the meter on – press the **ON/OFF** button.
2. Place the electrode in the stream (or water sample) andallow the water temperature reading to stabilize. The temperature reading is the smaller number at the bottom right of the screen (see diagram). The larger number is the conductivity reading, which will be measured during the post-stream section.



Note! Whenever possible, you should measure the water temperature in-stream. If you are not able to measure in-stream, you should note that on your data sheet.

3. Record the measurement on your data sheet as __°C.

Note! If your meter is reading in °F, follow the instructionson page 23 to change the unit.

Step #2: Measure the replicate(s)

1. Remove the electrode from the stream, wait 30 seconds, and then reinsert it into the water. Recordyour second value.
2. The values of the two replicates must be within the acceptable precision range of ± 0.5 °C for water temperature. If the values are outside of the range, measure additional replicates until two values are within the range.
3. Use the two replicate values within the acceptable range to calculate the average value. Record theresult on your data sheet.

EXAMPLE

Replicate #1	Replicate #2	Final Result
13.1 °C	13.3 °C	13.2 °C

Step #3: Clean Up

1. Exit the stream.
2. Turn the meter off. Rinse the electrode with distilled water and shake dry.
3. Replace the electrode cap

STAGE: Gage Stick

Since the amount of water in the stream can affect values like nitrate-nitrogen and conductivity (concentration or dilution of ions), it is necessary to establish the relationship between water level and the parameters. This can be done through stage measurements. This proxy measurement can only be used to compare values at a given site and cannot be used to compare stage between sites.
A gage stick is a measuring tool that is calibrated in tenths of feet.

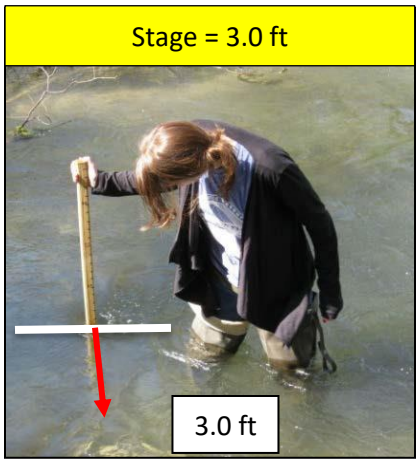
Methods and Steps of Collection:

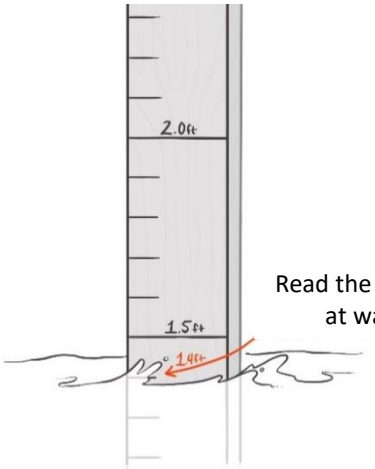
Method #1: Gage Stick

A gage stick is a measuring tool that is calibrated in tenths of feet.

1. Choose a site that is easy to access – you should be able to enter and exit the stream safely during different flow conditions and during all seasons.
2. Choose a spot in the stream that you can identify and return to. Be sure that the location is covered by water, even during low flow conditions. Find some reference points (e.g. rocks, trees, etc.) that will help you locate the spot, even under different flow conditions.

   Note! It is important to return to the same location each month when measuring stage.
3. Lower the gage stick into the water at the spot you selected. Turn the calibrated side of the stick downstream and read the stage of the water.
4. Record the value.
5. Repeat steps 3 and 4 for a second replicate. The values of the two replicates must be within the acceptable precision range of ± 0.2 ft. If the values are outside of the range, measure additional replicates until two values are within the range.
6. Return to that spot each time to measure stage.

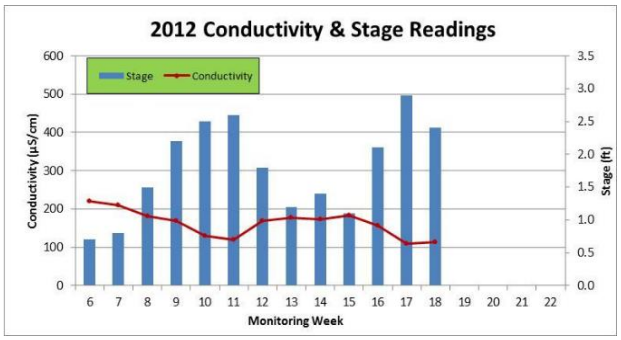




Read the value directly at water level

EXAMPLE

Replicate #1	Replicate #2	Final Result
2.4 ft	2.2 ft	2.3 ft



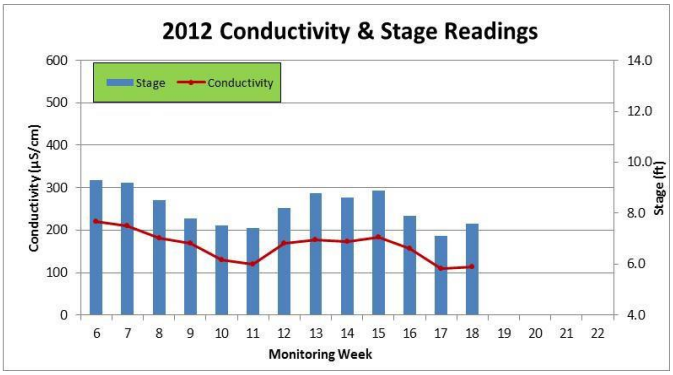
Example of data: Note that with this method, as stage increases, the conductivity will tend to *decrease.*

Method #2: Bridge

You can also measure stage from a bridge if you have a bridge cross the stream at/near your monitoring site. This method is easy to execute – you do not have to enter the water and will have easy access year-round and during all flow conditions. If you measure stage this way, it will have the opposite relationship to conductivity than if measuring stage with a gage stick. Because you will still be able to record changes in water depth accurately, this will make no difference in using the data to determine the relationship and identifying pollution events.

Stage = 8.3 ft

1. Choose a bridge that is easy to access and safe to stand on when measuring stage. Do not choose a bridge where your safety may be in jeopardy.
2. Choose a spot on the bridge (as close to mid-stream as possible) that you can identify and return to every week. This could be a permanent fixture of the bridge, or you can create a reference point with a marker.
3. Attach a weight to the end of a tape measure and lower it from the bridge until it touches the surface of the water.
4. Record the distance from the marked spot to the top of the water.
5. Record the value.
6. Repeat steps 3-5 for a second replicate. The values of the two replicates must be within the acceptable precision range of ± 0.2 ft. If the values are outside of the range, measure additional replicates until two values are within the range.



Example of data: Note that with this method, as stage increases, the conductivity will tend to also *increase.*

EXAMPLE

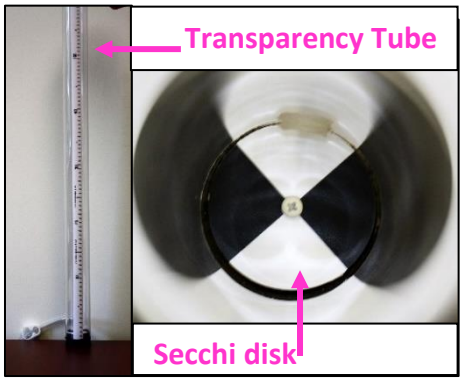
Replicate #1	Replicate #2	Final Result
8.4 ft	8.6 ft	8.5 ft

Note! Be sure to convert inches to feet when using a tape measure on a bridge.

Inches to feet conversion:

Inches	1	2	3	4	5	6	7	8	9	10	11
Feet	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.83	0.92

WATER CLARITY: Transparency Tube



Water clarity, or transparency, is a measure of how much light passes through the water column and the depth of penetration. To measure water clarity with a transparency tube, a water sample is collected in the tube, and then the water is drained to the point where the black and white pattern on the bottom of the tube (secchi disk) is **visible.** The cm value is recorded.

Step #1: Prepare the equipment

1. Return to your previous location in the stream.
2. Rinse the transparency tube 3 times with stream water: face upstream, hold the tube horizontally in the middle of the stream, mid-depth, and allow the tube to fill to the top.
3. Empty the rinse water downstream.

Step #2: Collect the sample

Hold the tube horizontally in the middle of the stream, mid-depth, and allow the tube to fill with water – ensure the clamp on the drain tube is closed by pinching tightly.

Step #3: Measure the water clarity

1. Stand with your back to the sun so that the tube is shaded.
2. Look straight down through the opening of the tube. If the secchi disk is visible (you can see two white and two black triangles), record the water level as the upper-most mark (Ex. 55 or 60cm) on your data sheet.
3. If you cannot see the secchi disk, partially open the drain clamp to drain the sample slowly until the secchi disk faintly appears, then close the clamp.
4. Read the scale on the side of the tube and record the water level on your data sheet as _____ cm.

Step #4: Measure the replicate(s)

1. Pour the water out of the transparency tube and repeat steps #2 – 3 for replicate #2.
2. The values of the two replicates must be within the acceptable precision range of ± 10 cm. If the values are outside of the range, measure additional replicates until two values are within the range.
3. Use the two replicate values within the acceptable range to calculate the average value. Record the final result on your data sheet.

Replicate #1	Replicate #2	Final Result
52 cm	56 cm	54 cm

Step #5: Clean up

1. Pour the water out of the transparency tube.

End of Part 2: At-Stream Section.

PART 3: POST-STREAM

Quick Overview

a. Gather the equipment and supplies you will need for the post-stream monitoring section.
b. Measure conductivity, nitrate-nitrogen, and pH.
c. Clean and store your monitoring equipment.
d. Record your results.

Post-Stream Equipment Checklist:

- ☐ LaMotte Nitrate Nitrogen Tablet Kit
- ☐ LaMotte Precision pH Kit
- ☐ Beaker
- ☐ Test tubes (4)
- ☐ Syringe
- ☐ Distilled water
- ☐ 5% Alconox soap
- ☐ Brush
- ☐ 10% Hydrochloric acid solution
- ☐ Waste container
- ☐ Nitrile gloves
- ☐ Safety glasses

Conductivity, pH, and nitrate-nitrogen may be measured at home using the water you collected in the sample bottle within the maximum holding time (see table below). Measure each parameter a minimum of two times (**replicates**), or until two values fall within the acceptable precision range, which is based on the precision and sensitivity of the equipment. These parameters may also be testing streamside, if there is an appropriate flat surface. The cleaning procedure must take place in a location with running water and a drain.

Parameter	Equipment	Acceptable Precision Range	Maximum Holding Time
Conductivity	LaMotte Tracer PockeTester	± 10 µS/cm	48 hours
Nitrate-nitrogen	LaMotte Nitrate Nitrogen Tablet Kit	0 – 2 mg/L = ± 1 mg/L 2 – 10 mg/L = ± 2 mg/L 10 – 15 mg/L = ± 5 mg/L	48 hours
pH	LaMotte Precision pH Kit	± 1 pH unit	24 hours

Prepare the Sample Water

Before testing any of the post-stream parameters, invert the sample bottle three times. Rinse the beaker three times with the sample water and pour rinse water into the waste container. Then fill the beaker no more than halfway with the sample water for conductivity testing. You will need to empty the beaker into the waste container after testing conductivity, then refill it with water to use for pH and nitrate-nitrogen testing.

CONDUCTIVITY: LaMotte PockeTester (1749)

The LaMotte Tracer PockeTester measures conductivity, or the ability of water to pass an electrical current due to the presence of ions (cations & anions) dissolved in water. The conductivity value (measured in "microSiemens per centimeter"; µS/cm) displayed on the meter will fluctuate until it stabilizes. The meter must be calibrated using 84 and 1,413 µS/cm solution before every sampling occasion.

Step #1: Gather and prepare the equipment

1. Gather the following supplies:
    a. Beaker of sample water
    b. LaMotte Tracer PockeTester
    c. Distilled water

Step #2: Measure the conductivity

1. Remove the electrode cap and turn the meter on – press the **ON/OFF** button.
2. Make sure that the meter is in the correct mode and **µS/cm** is displayed.
3. Place the electrode in beaker and allow the conductivity reading to stabilize.
4. Record the value on your data sheet as____µS/cm.

Note! Conductivity values ≥ 200 µS/cm will be displayed as a whole number (no decimal point). See Appendix B for equipment tips (page 23).

Step #3: Measure the replicate(s)

1. Remove the electrode from the water, wait 30 seconds, and insert into the sample again. Record the second value.
2. The values of the two replicates must be within the acceptable precision range of ± 10 µS/cm. If the values are outside of the range, measure additional replicates until two values are within the range.
3. Use the two replicate values within the acceptable range to calculate the average value. Record the final result on your data sheet.

Note! You must record an average that fits the equipment's precision capability. For example, the meter will not read a decimal point above 200 µS/cm, so if your replicate #1 is 256 and replicate #2 is 257, you cannot record 256.5, but must round up your average value to 257 µS/cm. You will do this for all tests so that your average values are always feasible.

EXAMPLE

Replicate #1	Replicate #2	Final Result
414 µS/cm	419 µS/cm	417 µS/cm

Step #4: Clean Up

1. Turn the meter off. Rinse the electrode with distilled water and shake dry.
2. Replace the electrode cap.
3. Pour the sample water from the beaker into the waste container and refill the beaker for nitrate-nitrogen and pH testing.

The equipment directions have been modified by ALLARM for this specific audience. The manufacturer's directions can be found at: http://www.lamotte.com/en/browse/1749.html.

pH: LaMotte Precision pH Kit (5858)

The LaMotte Precision pH Kit measures the amount of hydrogen (H+) and hydroxide (OH-) ions which make up water (H_2O). pH is measured on a scale: 0 is the most acidic, 7 is neutral, 14 is the most basic. The difference of one pH unit is equal to a 10-fold increase in acidity.

Step #1: Prepare the water sample

1. Gather the following supplies:
    a. Beaker of sample water
    b. (2) Test tube and cap
    c. Wide Range pH Indicator
    d. Octa-Slide 2 Viewer
    e. (2) Octa-Slide 2 Bar
    f. Syringe
2. Rinse the (2) test tubes and caps with sample water from your beaker 3 times.
3. Rinse the syringe three times. Fill the syringe with about 5 mL of sample water. Pull the plunger to the 30 mL line and rotate the syringe to rinse all sides. Press the plunger to empty into the waste container.
4. Use the syringe <u>to fill both test tubes</u> with **10 mL** of sample water from the beaker. Set one test tube aside to test as replicate #2.

Syringe at 10 mL

Tip! Draw a little more than 10 mL of water into the syringe, point the tip into the waste container, and depress the plunger until the bottom of the black cone is level with the 10 mL line. See picture.

Step #2: Add Wide Range pH Indicator

1. Invert the bottle of Wide Range pH Indicator 3 times.
2. Remove the cap, **hold the bottle vertically**, and add 10 drops to the test tube.
3. Cap the test tube and invert it 3 times.

Step #3: Measure the pH

1. Insert the test tube and one Octa-Slide 2 Bar into the Octa-Slide 2 Viewer. If the color range on the Octa-Slide 2 Bar does not match the color in the test tube, insert the other Octa-Slide 2 Bar.
2. Hold the Viewer ~1 foot in front of a white-colored background (i.e. paper, wall, etc.) so indirect light can enter through the back of the Viewer. Match the color in the test tube to the color most similar on the Octa-Slide 2 Bar and record the result on your data sheet as_____pH units. If the color is between two values, record the average of the two values.

Step #4: Measure the replicate(s)

1. Repeat steps #2 & #3 using the second test tube and cap.
2. The values of the two replicates must be within the acceptable precision range of ± 1 pH unit. If the values are outside of the range, test additional replicates until two values are within the range.
3. Record the final result on your data sheet.

EXAMPLE

Replicate #1	Replicate #2	Final Result
8 pH units	7 pH units	7.5 pH units

Step #5: Clean Up

1. Pour the water from both test tubes into your waste container.

The equipment directions have been modified by ALLARM for this specific audience. The manufacturer's directions can be found at: http://www.lamotte.com/en/education/water-monitoring/education-kits/5858-01.html.

NITRATE-NITROGEN: LaMotte Nitrate Nitrogen Tablet Kit (3354)

Nitrogen is an essential plant nutrient, but excess amounts can cause problems, such as reduced oxygen levels, overabundance of aquatic plants, and eutrophication. The LaMotte Nitrate Nitrogen Tablet Kit measures the concentration of nitrate-nitrogen (NO_3-N) dissolved in water. Nitrate-nitrogen is measured in "milligrams per liter" or mg/L.

Step #1: Gather and prepare the equipment

1. Gather the following supplies:
    a. Beaker of sample water
    b. LaMotte Tracer PockeTester
    c. (2) Test tube and cap
    d. Syringe
    e. Nitrate #1 Tablet
    f. Nitrate #2/CTA Tablet
    g. Timer
    h. Octa-Slide 2 Viewer
    i. Octa-Slide 2 Bar
    j. Protective Sleeve (if testing outside)
2. Rinse the (2) test tubes and caps with sample water from the beaker 3 times.

Step #2: Prepare the water sample

1. Use the LaMotte Tracer PockeTester to measure the temperature of the water sample. **The sample must be at room temperature (20 – 23 °C) before testing it for nitrate-nitrogen.**

Tip! If your water sample is too cold, leave it out or place it in a bowl of warm water. If the temperature goes above the range, fill the beaker again with original sample water.

2. Use the syringe to fill both test tubes with **5 mL** of sample water. Set one test tube aside to test as replicate #2.

Step #3: Add Nitrate #1 Tablet to the test tube

1. Add one Nitrate #1 Tablet to the test tube and cap it. Shake the test tube until the tablet dissolves (nothing visible is settled on the bottom of the tube).

Step #4: Add Nitrate #2/CTA Tablet to the test tube

1. Add one Nitrate #2/CTA Tablet to the test tube and cap it. If testing outside, insert the test tube into the Protective Sleeve to shield the sample from UV light.
2. Set the timer for **two minutes** and shake the test tube to dissolve the tablet. Shake in a consistent manner for two minutes.
3. Set the timer for **five minutes** and wait for the reaction to finish.

Step #5: Measure the nitrate

1. After waiting for five minutes, insert the test tube into the Octa-Slide 2 Viewer. If testing outside, remove the test tube from the Protective Sleeve.
2. Hold the Viewer ~1 foot in front of a white-colored background (i.e. paper, wall, etc.) so indirect light can enter through the back of the Viewer. Match the color in the test tube to the color most similar on the Octa-Slide 2 Bar and record the result on your data sheet as_____mg/L NO_3-N. If the color is between two values, record the average of the two values.

Note! You must record an average that fits the equipment's precision capability. For example, you cannot record a value of 3.5 mg/L when reading the scale, it must be 2.0, 3.0, or 4.0 mg/L. Therefore, if your replicate #1 is 2.0 and replicate #2 is 3.0, you cannot record the average as 2.5 but must round it up to 3.0. You will do this for all tests so that your average values are always feasible.

Step #6: Measure the replicate(s)

1. Repeat steps #3 – 5 using the second tube and cap. If you do not have a clean test tube available, see cleaning instructions on page 16.
2. The values of the two replicates must be within the acceptable precision range (see table). If the values are outside of the range, run additional replicates until two values are within the range.
3. Use the two replicate values within the acceptable range to calculate the average value. Record the final result on your data sheet.

Nitrate Value	Acceptable Precision Range
0 – 2 mg/L	± 1 mg/L
2 – 10 mg/L	± 2 mg/L
10 – 15 mg/L	± 5 mg/L

Tip! If measuring both replicates at the same time, hold and shake both test tubes in the same hand.

EXAMPLE

Replicate #1	Replicate #2	Final Result
2 mg/L	4 mg/L	3 mg/L

Step #7: Clean Up

1. Pour the water from both test tubes into your waste container.
2. Turn the LaMotte Tracer PockeTester off, rinse the electrode with distilled water, and shake dry. Replace the gray electrode cap.

The equipment directions have been modified by ALLARM for this specific audience. The manufacturer's directions can be found at: http://www.lamotte.com/en/browse/3354-01.html.

POST-STREAM EQUIPMENT CLEAN UP

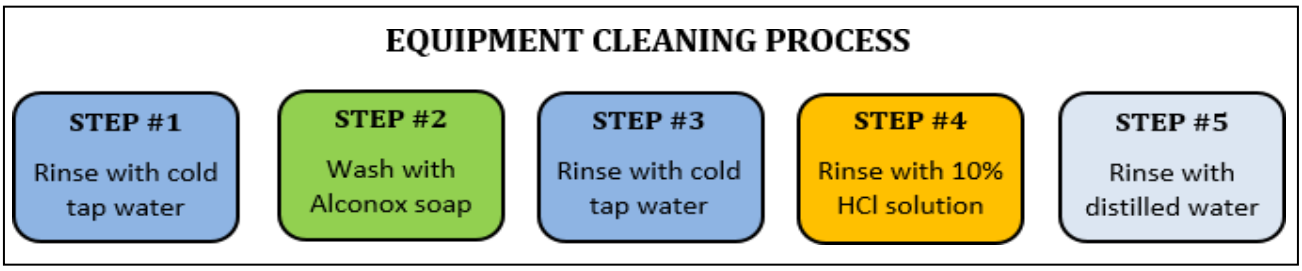
Cleaning your equipment **after each use** is very important. Using dirty equipment can affect the results significantly, which defeats the quality assurance measures built into your monitoring program and can question the credibility of your data. Equipment should be cleaned at a sink using a combination of tap water, Alconox soap (5%, phosphate-free detergent), Hydrochloric Acid (10%, HCl), and distilled water, using the following methods:

Note! Do not acid-wash the conductivity calibration vials. Rinse with DI water after use.

1. Pour the wastewater from your waste container into your sink while flushing with cold tap water.
2. Clean your syringe:
    a. Separate the plunger from the body of the syringe and rinse both parts with tap water.
    b. Wash both parts with a small amount of 5% Alconox soap using the brush.
    c. Rinse 3 times with cold tap water.
    d. Pour a very small amount of 10% Hydrochloric acid solution into the body of the syringe. Carefully reattach the plunger and rotate the syringe so that all inside surfaces come in contact with the 10% HCl. Depress the plunger to empty the used HCl solution down the sink while flushing with cold tap water.
    e. Separate the plunger again and rinse both parts 3 times with distilled water.
    f. Let both halves dry completely before reattaching.
3. Clean your remaining supplies.
    a. Rinse with tap water.
    b. Wash with a small amount of 5% Alconox soap. Use a brush to remove any particles.
    c. Rinse 3 times with cold tap water.
    d. Rinse with a small amount of 10% Hydrochloric acid solution. Pour the used HCl solution down the sink while flushing with cold tap water.
    e. Rinse 3 times with distilled water.

Note! Rinse transparency tube with tap water three times. Do not wash with soap or acid.

BEWARE!
10% HCl can stain your stainless-steel sink!



When your equipment is completely dry, return it to your monitoring bin. Use the following best practices to store your monitoring equipment and supplies:

- Keep reagent containers tightly closed.
- Store in a dry, cool, well-ventilated place away from combustible materials.
- Keep out of reach from children and pets.

DATA MANAGEMENT

Review your data sheet and confirm that you have completed all the tests and filled it out completely. Note the time it took to complete all sections of the monitoring process on the bottom of your data sheet. Store your data sheets in your binder until the data upload training. The data will be regularly integrated into the Chesapeake Data Explorer.

End of Part 3: Post-Stream Section.

APPENDIX A: EFFECTS, PRECAUTIONS, FIRST AID, CLEAN-UP

Some of the reagents and cleaning solutions included in your monitoring bin are slightly hazardous materials. Use caution and follow these safety practices:

- Avoid contact with your skin, eyes, nose, and mouth.
- Wear safety glasses and nitrile gloves for extra protection.
- Wash your hands immediately after testing your water sample and cleaning your equipment.

Nitrate #1 Tablet

Contact	Effect	Precautions to Take	First Aid Measures
Eye	May cause irritation.	Wear safety glasses.	• Rinse thoroughly with plenty of water, also under the eyelids. • If irritation persists or develops, contact a physician.
Skin	May cause irritation.	Wear protective gloves and clothing.	• Wash off with warm water and soap. • If irritation persists, call a physician.
Swallowed	May cause gastrointestinal irritation, nausea, vomiting, and diarrhea.	Do not eat, drink, or smoke when using this product.	• Drink plenty of water. • If more than a few tablets have been swallowed, or if symptoms persist or develop, contact a physician.
Inhaled	May cause irritation of respiratory tract.		• Seek fresh air. • If symptoms persist, call a physician.
Spill Clean-up Procedure: Avoid dust formation. Containerize spill material and hold for later disposal. If permitted, dissolve with a large volume of water, neutralize with alkaline material (sodium bicarbonate), then rinse down drain with extra water.			

Nitrate #2/CTA Tablet

Contact	Effect	Precautions to Take	First Aid Measures
Eye	May cause irritation.	Wear safety glasses.	• Rinse thoroughly with plenty of water, also under the eyelids. • If irritation persists or develops, contact a physician.
Skin	May cause irritation.	Wear protective gloves and clothing.	• Wash off with warm water and soap. • If irritation persists, call a physician.
Swallowed	May cause gastrointestinal discomfort if consumed in large amounts.	Do not eat, drink, or smoke when using this product.	• Drink plenty of water. • Clean mouth with water. • Consult a physician.
Inhaled	May cause irritation of respiratory tract.		• Seek fresh air. • If breathing is difficult, give oxygen. • If not breathing, give artificial respiration and contact emergency personnel.

			• Call a physician immediately.
Spill Clean-up Procedure: Avoid dust formation. Containerize spill material and hold for later disposal. If permitted, dissolve with a large volume of water, neutralize with alkaline material (sodium bicarbonate), then rinse down drain with extra water.			

10% Hydrochloric Acid (HCl)

Contact	Effect	Precautions to Take	First Aid Measures
Eye	Irritation and may include inflammation, redness, watering, itching, and possible burns.	Wear safety glasses.	• Call a physician immediately. • Remove contact lenses. • Flush with water for at least 15 minutes.
Skin	Irritation and may include inflammation, itching, scaling, reddening, or occasionally produce blistering or burns.	Wear protective gloves and clothing.	• Call a physician immediately. • Flush with plenty of water for at least 15 minutes, while removing contaminated clothing and shoes. • If serious, wash with a disinfectant soap and cover with an anti-bacterial cream. • Cover the irritated skin with an emollient. • Washing clothing and shoes before wearing again.
Swallowed	Irritation to gastrointestinal tract and may include nausea, vomiting, abdominal cramps, and diarrhea.		• DO NOT INDUCE VOMITTING unless directly by emergency personnel. • If large quantities are swallowed, call a physician immediately. • Never give anything by mouth to an unconscious person. • Loosen tight clothing.
Inhaled	Severe irritation of respiratory tract and may include coughing, choking, sneezing, hoarseness, or shortness of breath.	Use in a well-ventilated area.	• Call a physician immediately. • Seek fresh air. • If not breathing, give artificial respiration. • If breathing is difficult, give oxygen. • If serious, loosen tight clothing (collar, tie, belt, waistband, etc.).
Other Effects: May be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, and teeth. May cause adverse reproductive effects and affect genetic material and behavior. Repeated or prolonged exposure can produce target organs damage. Repeated or prolonged exposure to spray mist may produce chronic eye irritation, severe skin irritation, and respiratory tract irritation leading to frequent attacks of bronchial infection.			
Spill Clean-up Procedure: Dilute the liquid with water and mop up or absorb with an inert dry material and place in an appropriate waste container.			

84 and 1,413 µS/cm Calibration Solution

Contact	Effect	Precautions to Take	First Aid Measures
Eye	N/A	Wear safety glasses.	• Rinse/flush gently with water for 15-20 minutes. • Remove contact lenses if present and easy to do. Continue rinsing.
Skin	N/A	Wear protective gloves and clothing.	• Rinse affected area with water and soap. • If irritation persists, call a physician.
Swallowed	N/A	Do not eat, drink, or smoke when using this product.	• Rinse mouth and drink plenty of water. • Do not induce vomiting. • If symptoms develop, call a physician.
Inhaled	N/A		• Seek fresh air. • If symptoms develop, call a physician.
Spill Clean-up Procedure: Absorb with non-combustible, liquid-binding material.			

Wide Range pH Indicator

Contact	Effect	Precautions to Take	First Aid Measures
Eye	May cause irritation.	Wear safety glasses.	• Flush thoroughly with water for 15 minutes, lifting lower and upper eyelids. • If irritation develops, call a physician.
Skin	Irritation.	Wear protective gloves and clothing.	• Flush with water for 15 minutes. • If irritation develops, call a physician.
Swallowed	May cause drowsiness and dizziness. May be fatal or cause blindness if swallowed. May cause central nervous system depression.		• Drink two glasses of water. • Do not induce vomiting without first consulting a physician. • Call a physician immediately.
Inhaled	May cause irritation of respiratory tract. May cause central nervous system depression with nausea, headache, dizziness, vomiting, and incoordination.	Use in an area with adequate ventilation.	• Seek fresh air. • If breathing is difficult, give oxygen. • If not breathing, give artificial respiration and contact emergency personnel. • Call a physician immediately.
Spill Clean-up Procedure: Absorb spill with inert material and place in a chemical waste container. After cleaning, flush away tracer with water.			

B: EQUIPMENT TROUBLESHOOTING & TIPS

LaMotte Tracer PockeTester (1749)

If you have trouble calibrating or using your meter, try the following options:

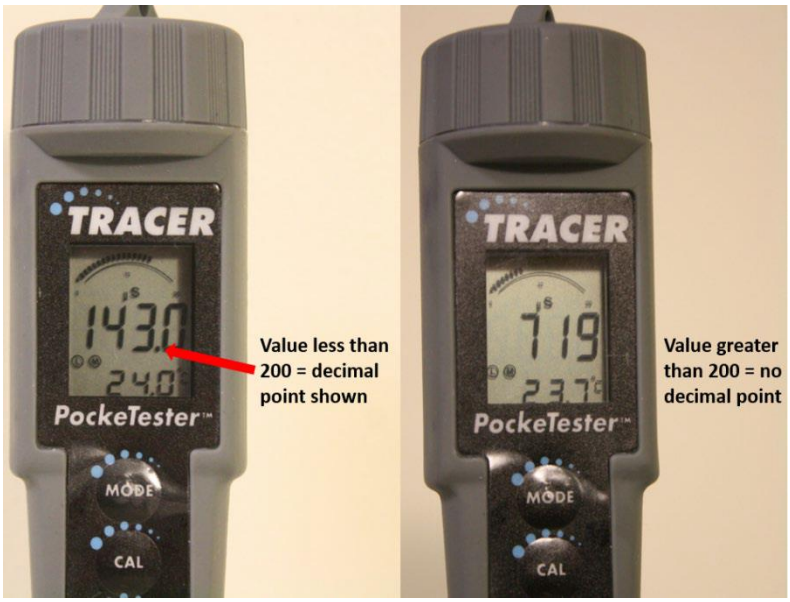
Remove the batteries	Replace the batteries	Reset the meter
Removing the batteries temporarily can be a way of "resetting" the meter. 1. Twist off the battery compartment cap. 2. Hold the battery housing in place with one finger. Remove the battery carrier by pulling on the small tabs. 3. Remove the four CR2032 batteries. 4. Insert the same four batteries (observe polarity). 5. Replace the battery compartment cap.	The batteries in the PockeTester will need to be replaced every 2-5 years, depending on use. There is a low battery indicator on the meter that displays "BAT" when the batteries become weak. You can find replacement batteries (CR2032) at any local box/grocery/home improvement store or online. Four new batteries cost ~$2. Replace the batteries following the instructions above.	1. Turn the meter off. 2. Simultaneously press the MODE, CAL, and ON/OFF buttons momentarily. "dFlt" will be displayed on the screen.

To change temperature measurement from °F to °C and vice versa:

1. Turn the meter off.
2. Simultaneously press the CAL and ON/OFF buttons momentarily.
3. SELF CAL will flash on the screen and the meter will turn back on with the newly changed unit of measurement.

Tips!

When you are outside, there could be glare from the sun on the screen. Slightly tip the meter up and down to make sure the glare is not showing a decimal point or any other symbol that should not be there. If you are inside, poor lighting could also make it harder to see the screen. It can be tricky to spot the decimal point on the conductivity value. A value **less than 200 µS/cm** will show a **decimal point** in the tenth's column. A value of 200 µS/cm or greater will not show a decimal point, and you will typically only see three numbers on your screen. See the picture.



For additional help troubleshooting your meter, please contact ALLARM.

C: Site Selection and GPS Coordinates

Selecting a Monitoring Site:

The Stream Team protocol assesses small streams for conductivity, nitrate-nitrogen, pH, and water temperature. There are several factors to consider when choosing a monitoring site but remember that safe access to the stream is the first priority!

1. Watershed Characteristics
    - What are the main uses of land in your stream drainage area?
    - Upstream or downstream?
        - When you start monitoring, choosing a downstream site of agricultural or development is recommended. Additional sites can be added later to collect upstream and downstream data of potential pollution sources.

2. Public Accessibility – choose a site that is safe and easy to access!
    - Is the site accessible through public property like a municipal park, state forest, or game lands?
    - If the site is on private property, you must obtain written permission from the landowner to access the stream (contact ALLARM for Landowner Permission Form).
    - Will you be able to park close to the site? Is it generally easy to access?
    - If not, is there a bridge crossing where you could safely access the stream?
        - With bridges, safety is the most important consideration:
            a) Is there safe and adequate room to pull off and park your car?
            b) Are you able to climb down the bank and access the water?
            c) Is there a pedestrian area on the bridge you could use to collect a water sample with a bucket?

3. General Safety
    - How steep is the bank? Is it going to be muddy? Slippery? Overgrown?
    - Will you be able to access this site all year round?
    - How deep is the water? Will you be able to wade in mid-stream to collect your sample?
    - Are there other natural or physical hazards in the area?
    - Will your site have cell phone reception?

General Considerations:

- How many people are in your monitoring team? ALLARM recommends a minimum of two people in a group.
- Do you have a back-up plan if you cannot monitor one of the months, or your site randomly becomes inaccessible?
- Do you have a sampling pole if you cannot wade into the stream?
- Do you have a bucket and rope if sampling from a bridge?
- Do you know what to say if someone asks what you are doing?

Find Site Location Coordinates:

A. Find GPS coordinates using Google Maps on a computer
    1. Go to “google.com/maps.”
    2. In the search bar, type the closest known location or landmark to your site.
    3. After you have located your site, click on that point. You will notice the GPS coordinates for latitude and longitude (Lat/Long) on the bottom of the page.

    Tip: You can click the ‘Menu’ option (the three horizontal lines next to the search bar) at the top left of the screen. You can then toggle between ‘Map’ and ‘Satellite’ if you are having trouble locating your site.

B. Find GPS coordinates using iPhone (at the site)
    1. The easiest way to find your coordinates when you are at your site is to use the built-in “Compass” app.
    2. Make sure you have ‘Location’ turned on in your iPhone. This can be done through going to ‘Settings’ and then clicking on ‘Privacy’ menu.
    3. The GPS on the ‘Compass’ app will be noted in the bottom of your screen.

C. Find GPS coordinates using Android phone (at the site)
    1. The built-in app: “Google Maps” will let you access the GPS location of your site.
    2. Make sure you have your ‘Location’ feature turned on. (Accessed through phone Setting and in the Location menu, make sure access to location services is switched on).
    3. Open ‘Google Maps’ and click on “My Location” button which is the ‘bulls-eye target’ icon. Tap and hold the site area on the screen. A red pin will pop up and the latitude and longitude coordinates will be displayed in the search bar at the top.

D. Find GPS coordinates from a picture taken with a smartphone
    1. Make sure you take a picture standing at or very close to your site.
    2. The GPS location of any picture is stored in your metadata of your picture.
    3. In order to access the metadata, you need to first transfer your pictures into your computer.
    4. After transferring your picture, right-click on your picture from your computer and select “Properties”. Then click on “Details” and your GPS location will listed there.

Tip: You can take this GPS location and put it in ‘Google Maps’ to see if your GPS location was recorded accurately.

Quality Control Instructions

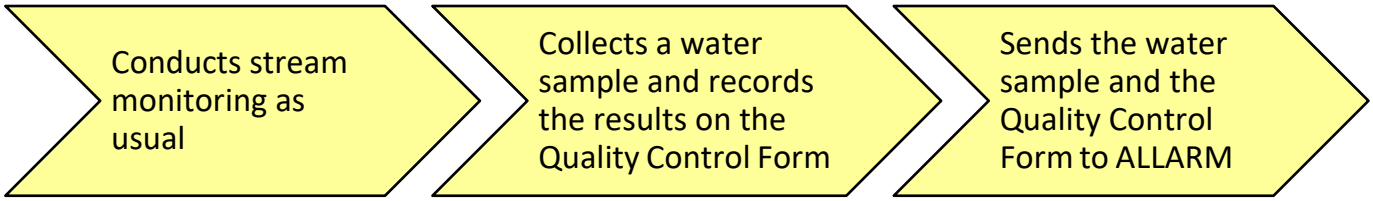
Stream Team

The Alliance for Aquatic Resource Monitoring (ALLARM) is pleased to provide quality control (QC) assistance to volunteers who monitor streams throughout Pennsylvania – a service funded by the Consortium for Scientific Assistance to Watersheds (C-SAW) and Dickinson College.

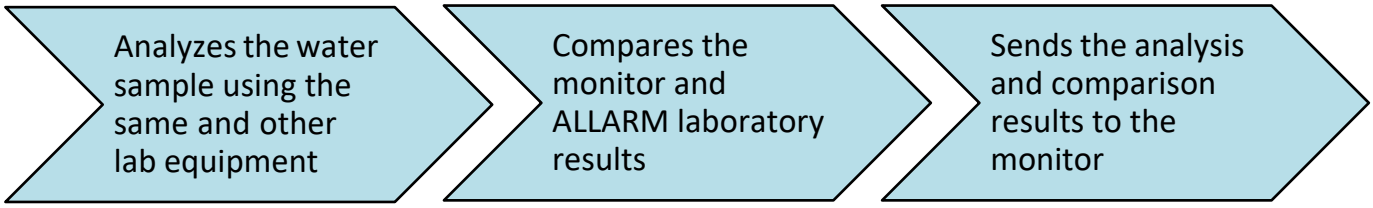
Quality assurance and quality control (QA/QC) procedures are an important part of a stream monitoring program and should be followed consistently to help ensure the credibility and quality of the data being collected. ALLARM helps volunteers implement QA/QC procedures in a variety of ways, including duplicate sample analysis, where volunteers collect and send a water sample to the ALLARM Community Aquatic Research Laboratory for analysis.

Here's how the ALLARM Quality Control Program works:

Monitor:



ALLARM:



For specific directions, please see the Quality Control Form on the back of this page. Remember to:

1. Label the QC bottle with your name, site name/ID, and the collection date and time.
2. Fill the QC bottle completely with stream water and close the lid tightly to avoid leaks.
3. Keep the sample cold.

If you have questions, please contact: streamteam@dickinson.edu , (717) 245-1565

ALLARM will send you the analysis and comparison results within one month of processing your water sample. Thank you for monitoring Pennsylvania streams and participating in ALLARM's Volunteer Monitoring Quality Control Program!

For more information on ALLARM, please visit www.dickinson.edu/ALLARM.

Quality Control Form

Stream Team

1. Fill out the label on your QC bottle.

2. Enter the stream and face upstream. Rinse your QC bottle and cap ③ times – fill the bottle with stream water, then pour the rinse water out downstream. Next, fill your QC bottle completely with stream water and close it tightly with the cap.

3. Record your results in the boxes below.

Parameter	Units	Replicate #1	Replicate #2	Average Result
Conductivity	µS/cm			
pH	pH units			
Nitrate-nitrogen	mg/L			
Water clarity	cm			

4. Fill out the information in the boxes below.

Monitor Information		Sample Information	
Monitor Name		Site ID	
Mailing Address		Stream Name	
		Latitude Coordinate	
Email Address		Longitude Coordinate	
County Monitored		Collection Date	
Affiliation		Collection Time	

5. If you are mailing your sample to ALLARM, pack a small box with your QC bottle and this QC Form and mail it to:

Dickinson College/ALLARM
28 N College Street
P.O. Box 1773
Carlisle, PA 17013

STREAM TEAM FIELD DATA SHEET

1. Record the time when you start the monitoring process (pre-stream section): _____

2. Check that equipment is prepared and calibrated:

☑	**Equipment Prep**
	Equipment gathered, inspected, and ready to use
	LaMotte Tracer PockeTester calibrated with 84 µS/cm calibration solution
	LaMotte Tracer PockeTester calibrated with 1,413 µS/cm calibration solution

3. Record the sampling and site information in the boxes below:

Sampling Information		**Site Information**	
Monitor Name		Stream Name	
Sample Collection Date		Site ID	

4. Record general observations in the boxes below:

Air Temperature (°C) (use PockeTester)	
Stream Flow (circle one)	Trickle (Negligible) Low Normal High
Water Color (circle one)	Normal Abnormal
Water Color Description (circle one)	Clear Brown Green
Weather Conditions Today (circle one)	Sun Partial Cloud Overcast Fog Drizzle Rain Snow
Weather Conditions Yesterday (circle one)	Sun Partial Cloud Overcast Fog Drizzle Rain Snow
Observations/Notes/Sketches:	

5. Record all parameter measurements in the boxes below:

Parameter	Order	Acceptable Range	Rep #1	Rep #2	Rep #3*	Average**
Water Temperature(°C)	At-Stream	± 0.5 °C				
Stage (feet)	At-Stream	± 0.2 feet				
Water Clarity (cm)	At-Stream	± 10 cm				
Conductivity (µS/cm)	Post-Stream	± 10 µS/cm				
pH (SU)	Post-stream	± 1 pH unit				
Nitrate-nitrogen(mg/L) Sample at room temperature? ☐ Yes ☐ No	Post-Stream	0 – 2 mg/L = ± 1 mg/L 2 – 10 mg/L = ± 2 mg/L 10 – 15 mg/L = ± 5 mg/L				
Observations/Notes:						

*If the second replicate value falls outside the acceptable range listed in the chart, retest the sample. Record the average of the two values that are within the acceptable range in the final column.
Ex. Nitrate Rep #1 = 2.0 mg/L; Rep #2 = 5.0 mg/L; Rep #3 = 3.0 mg/L, then record 3.0 mg/L average.

***Averages must fall within the equipment's precision capability. Round up to the nearest feasible value or whole number. Ex. Conductivity average 410.5 round to 411. pH average 7.875 round to 8. Please reference your data reminders guide in your binder!*

6. Was the water sample tested within the maximum holding time?

Parameter	Maximum Holding Time	☑ YES	☑ NO
Nitrate-nitrogen	48 hours		
pH	24 hours		
Conductivity	48 hours		
Temperature	Immediately at stream		

7. Record the time after you have finished the monitoring process, including:

a. Preparing monitoring equipment
b. Driving to/from collection site
c. Collecting a water sample and measuring all parameters
d. Cleaning monitoring equipment
e. Recording data

End Time:

_____

Total Minutes: