Water Quality Monitoring Methods
New Mexico Watershed Watch

How to test 6 water measurements for Healthy Watersheds, Fisheries & Resilient Communities.

1. Streamflow
2. Temperature
3. pH
4. Total Dissolved Solids
5. Turbidity
6. Dissolved oxygen

For more information visit www.RiverSource.net
and
http://www.wildlife.state.nm.us/education

Los Alamos National
Laboratory Foundation

Streamflow or Discharge

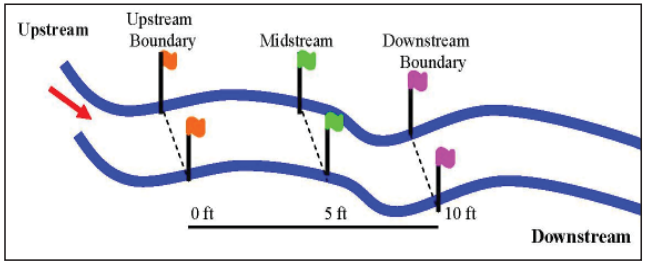
Streamflow is a measure of how much volume of water is passing by a point every second. Your results are recorded in cubic feet per second (CFS).

Streamflow or discharge of a river can fluctuate depending on:

- Season ≈ extra runoff with snowmelt during the spring, less during the summer with increased evaporation and plant use
- Weather ≈ streamflow increases during rainstorms, decreases during drought
- Irrigation ≈ less streamflow during irrigation season for crops or fields
- Disturbances to the landscape ≈ parking lots, roads, and other impervious surfaces create more peak runoff

Materials needed to measure streamflow include:

1. Tape measure
2. Yard stick
3. Stopwatch
4. Orange or piece of citrus (preferred) or a small but easy to identify floating object
5. 6 flags or sticks to mark channel banks
6. Calculator



To estimate streamflow (make sure to use a Watershed Watch field form):

1. Measure a 10ft straight section of stream with flags placed at the upstream (0ft), middle (5ft), and downstream end (10ft). The length can be adjusted for smaller or larger streams.
2. Measure the stream width (W) perpendicular the flags (upstream, middle, and bottom) and average your 3 measurements.
3. Measure the depth (D) at equal intervals across the channel along the width transects that appears the most typical of the 10 foot length of stream. Take a minimum of 9 measurements of depth and then average your results.
4. Multiply average stream width (W) times the average stream depth (D) to get a cross-sectional area in ft^2 (A=WxD).
5. Measure velocity by droppng your floating object upstream of the top flag and timing how long it takes to float 10 feet (or the distance from upstream to the downstream boundaries). Take the measurement a minimum of 3 times in the middle and on the sides of the stream. Average your results. Divide 10 feet (or the distance from upstream to the downstream boundaries) by your average time in seconds to get a measurement of velocity (V in feet per second).
6. Multiply your cross-sectional area (A) times your average velocity (V) to get streamflow in CFS

If the stream channel bottom is rough (e.g. lots of cobble or gravel) multiply your answer by 0.8. If the channel bottom is smooth (e.g. sandy or bedrock), multiply your answer by 0.9. These factors reduce your initial streamflow measurement to compensate for the velocity of the stream running slower than on the top of the stream where you took your veleocity measurements.

Standards and Methods for Interpreting Streamflow:

For mountain streams Barbour and Stribling (1991) consider that 2 cfs are necessary to support a high-quality, coldwater fishery.

Temperature

Temperature is a measure of water warmth or coldness. We record our results in degrees Celsius. Fish and other aquatic organisms have trouble getting enough oxygen at very warm temperatures.

Causes of increased temperature in water:

- Removal of riparian shade provided by trees, shrubs and grasses (such as a willow canopy)
- Urban runoff from hot streets and sidewalks
- Increased turbidity (particles in water absorb sunlight and heats water)
- Warmer seasons (summer vs. winter) or lower elevations where it tends to be warmer
- Increased water surface area (e.g. wide and flat stream channel)
- Industries discharging warm water used to cool machinery

Why do we care about water temperature of our streams?

- Amount of dissolved oxygen in water (warm water holds less oxygen than cold water)
- The amount of energy used by (metabolism) of aquatic organisms
- Vulnerability of organisms to pollution, parasites, or disease
- The ability of fish and aquatic organisms to survive. Most fish, frogs, and macroinvertebrates are cold blooded. If the temperature changes rapidly their metabolism does not work well.

Measurement Method

1. Ensure thermometer is functional (i.e. no bubbles separating the color indicator)
2. Find a shady spot to measure (use your own shadow if there isn't any shade)
3. Place thermometer completely in the running water and wait for the temperature to stop changing (at least 1 minute)
4. Read temperature while thermometer is underwater or immediately after taking it out of the water and record on the data sheet. Record temperature in degrees Celsius.

Standards and Methods for Interpreting

The New Mexico Water Quality Standards says " the introduction of heat by other than natural causes shall not increase the temperature, as measured from above the point of introduction, by more than 2.7˚C (5˚F) in a stream, or more than 1.7˚C (3˚F) in a lake or reservoir."

Does the water temperature protect desirable fish? New Mexico Water Quality Standards for Fisheries say that the temperature needs to be lower than:

≤20˚C (68˚ F), max temp 23˚C	High Quality Cold Water Fishery
≤25˚C (77˚ F)	Marginal Cold Water Fishery
≤32.2˚C (90˚ F)	Warm Water Fishery

Rio Grande Cutthroat Trout

pH

pH is a measure of how **acidic** or **basic** the water is. pH is measured on a scale of 0 to 14. Distilled water which has no impurities is **neutral** with a pH of 7. Numbers less than 7 are acidic and above are basic.

Causes of altered pH values in water:

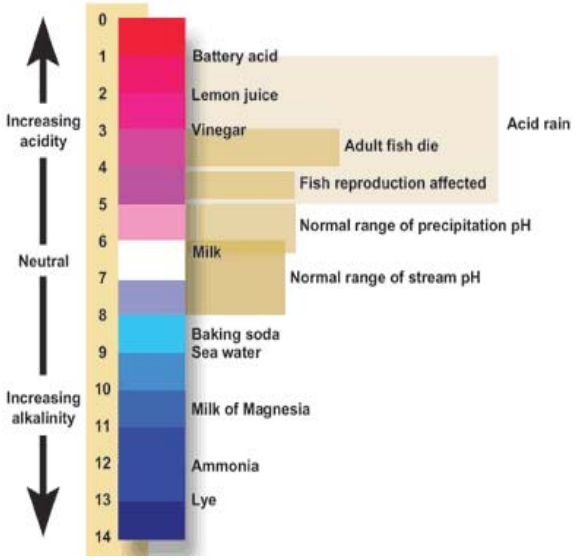
- Rainfall has pH value of around 5 to 6 due to carbonic acid picked up in the air.
- The pH of water in springs, streams, and lakes are influenced by the geology. In New Mexico limestone soils raise pH values of water - many New Mexico streams have basic pH (7 to 8.8).
- Plant photosynthesis removes carbon dioxide from water, raising pH of your stream. Expect the highest pH to occur in the early afternoon when the sun is highest.
- Mining exposes rocks to rain and produce a change in pH, often making the water more acidic.
- Dumping pollutants directly into streams can have intense and immediate changes in pH.
- "Acid rain" comes from sulfuric acid produced by coal burning. The basic soils of New Mexico help to decrease the effects of acid rain.

Why do we care about pH of our streams?

- Water with extremely high or low pH is deadly. A pH below 4 will kill most fish and very few animals can tolerate waters below pH of 3.
- Even moderately acidic waters (low pH) reduces the hatching success of fish eggs, irritate fish and aquatic insect gills and damage membranes.
- Amphibians are particularly vulnerable because their skin is so sensitive to pollution.

Measurement Method

- Make sure the pH meter been rinsed with distilled/demineralized water
- Uncap and turn on pH meter and dip meter in moving water
- Wait for reading to stabilize (wait at least one minute)
- Read and record pH measurement while meter is held in water
- Rinse the pH meter in distilled/demineralized water before capping



Standards and Methods for Interpreting

- The allowable range of pH is 6.6 to 8.8 in most streams in New Mexico. Some streams are allowed to range as high as 9.0.

- Water becomes unsuitable for most organisms at extremes less than 4.1 or greater than 9.5

Total Dissolved Solids (TDS)

TDS is a measure of dissolved (molecular, ionized, or micro-granular) inorganic and organic substances contained in a liquid. We use conductivity to estimate TDS, using an electrical current since the higher the concentration of dissolved ionized solids, the more electricity is conducted.

Causes of altered TDS values in water:

- Naturally occurring minerals such as calcium, magnesium, sodium, and other salts,
- Higher concentrations of TDS may come from runoff from agriculture or residential areas. Flood irrigation can flush salts from farm fields. Stormwater from city roads can wash salts into rivers.
- Nutrients from fertilizers can add excessive nitrate and phosphates to streams from runoff.

Why do we care about TDS in our streams?

- Rapid increases in TDS levels can be toxic for some aquatic organisms.
- Spawning fishes and juveniles appear to be more sensitive to high TDS levels.
- People prefer to drink and bathe in water with TDS levels lower than 500 mg/L.

Measurement Methods

- Ensure the TDS meter is calibrated and has been rinsed with distilled/ demineralized water.
- Uncap and turn on the TDS meter.
- Dip the meter in moving or non-stagnant water.
- Wait for reading to stabilize (wait at least one minute).
- Read the TDS measurement while meter is held in water and record the result in mg/L.
- Rinse the conductivity meter in distilled/demineralized water before capping and storing in it's box.

Standards and Methods for Interpreting

- The standard for human drinking water is 500 mg/l which is an aesthetic standard (based on how salty the water tastes).
- There are standards for specific river segments in New Mexico based on the state water quality standards.
- Some species of fish have been shown to have impaired spawning at levels as low as 350 mg/L.

Turbidity

Turbidity is a measure of water transparency (i.e. water clarity or cloudiness).

Causes of Turbidity:

- Sediment from soil erosion that enters the stream and creates suspended particles.
- Algae growth, particularly in larger rivers that are wider, slower and more exposed to the sun.
- Forest fires, roads, or anything that removes plants that can help keep soil out of the stream.
- Good vegetation cover in the riparian areas near streams generally decreases turbidity.
- Pollutants from urban runoff such as oil and grease or nutrients (plant food) that increase algae.

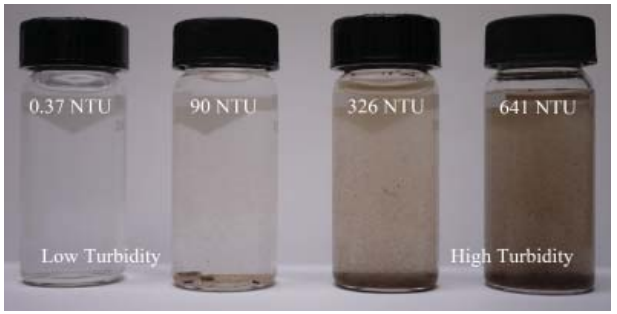
Why do we care about turbidity in our streams?

- Turbidity can raise the water temperature because suspended sediment absorbs heat.
- Suspended particles absorb sunlight which prevents aquatic plants from growing on the stream bottom.
- Sediments can clog fish gills and reduce visibility for fish to see prey and predators.
- Settling of sediment can bury organisms and spawning beds (areas where fish lay eggs).

Turbidity from a storm event

Measurement Methods

- Ensure turbidimeter is turned on and reads "0.00 NTU" (Nephelometric Turbidity Units)
- Take a clean vial and submerge in the water in a location that is near the middle of the stream 2 times and empty the bottle. On the third time take the sample that you'll measure.
- Make sure you collect your sample upstream of where people are walking in the stream and do not disturb site around sample site as this leads to higher measurement than actually exists.
- Seal sample, hold it by the lid, and gently wipe off glass with a soft cloth (remove water, fingerprints, oils, dirt)
- Open turbidimeter lid and place vial in carriage with diamond on vial facing towards turbidimeter buttons
- Close lid, press "Read," and wait until turbidimeter provides a response
- Record number of NTUs, remove vial, pour out the sample, and repeat process 2 more times to get an average
- Rinse out the vial with distilled/demineralized water to remove sediment particles and make the vial ready for the next time it gets used



Standards and Methods for Interpreting

- Drinking water 0.5 NTU
- Activities shall not cause turbidity to increase more than 10 NTU over background turbidity (measured at a point immediately upstream of the activity) when the turbidity is 50 NTU or less.

Dissolved Oxygen

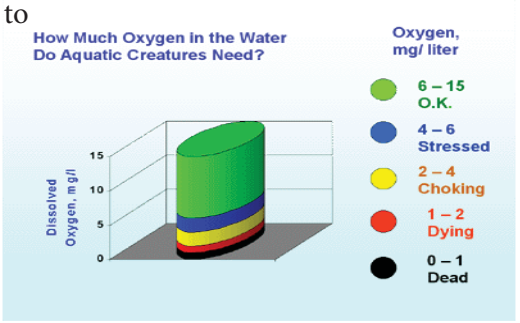
Dissolved Oxygen is a measure of gaseous oxygen in water that helps aquatic organisms survive.

Importance of Dissolved Oxygen (DO):

- Temperature Aquatic organisms require oxygen for survival. Changes in DO can impact organisms ability to grow and develop.

Factors Influencing Dissolved Oxygen

- Temperature--As temperature increases, the ability of water to hold oxygen is diminished (e.g. imagine a pot of boiling water, just before it starts to boil the tiny bubbles which form are oxygen coming out of solution). Vegetation shading a stream will help maintain healthy oxygen levels.
- Pressure--As air pressure increases the pressure of oxygen increases so water exposed to that air can absorb more oxygen. Thus water at high altitude can hold less oxygen than water of a similar temperature at sea level



Measurement Methods

- Fill water sampling bottle to allow no air bubbles as they will give incorrect results.
- Add eight drops each of Manganous Sulfate Solution and Alkaline Potassium Iodide Azide to sample bottle, cap and gently mix.
- Allow precipitate to settle then add eight drops of Sulfuric Acid or one level 1g spoonfull of Sulfamic Acid Powder depending on which kit type you have. At this point the sample has been fixed and exposure to air will not affect the results.
- Cap and mix until reagent and precipitate dissolve.
- Fill test tube with 20mL of sample.
- Add eight drops of Starch Indicator.
- Fill Titrator with Sodium Thiosulfate.
- Slowly add Sodium Thiosulfate to test tube one drop at a time while gently swirling until blue color just disappears (Care should be taken to prevent adding to much Sodium Thiosulfate)
- Read result on titrator as ppm of Dissolved Oxygen.
- Dispose of the water with reagents in a well-capped bottle labeled "waste water".

Standards and Methods for Interpreting

•DO <2 ppm is fatal to most fish
•DO <3 ppm is stressful to most fish
•DO above 6 ppm is sufficient for most species

Based on the temperatures and barometric pressures commonly found in New Mexico streams, the saturation point of DO in the water will rarely rise above 10ppm

Water Quality & Fisheries Monitoring Methods for New Mexico Watershed Watch

New Mexico Watershed Watch is supported by New Mexico Department of Game and Fish which is funded through the Sports Fish Restoration Act of the Federal Government (administered by US Fish Wildlife Service) which raises funding from a tax on fishing rods, reels, lures, fishing line, and related fishing equipment. New Mexico Watershed Watch gets youth involved in knowing their local watershed, going to their local river and going fishing.

River Source supports people living as good stewards of their watersheds with education, environmental monitoring, restoration design, and planning services.