# Join the Clean Water Team
# for the Annual Snapshot Day

---

## Volunteer Monitoring Code of Ethics

We carry Out Our Monitoring with Integrity

We use proper scientific methodology.
We fully document our technical observations.
We accept the responsibility to report our data, our interpretations, and our conclusions so they can be reviewed.
We truthfully answer questions about sampling techniques, frequency and location.
We make a good faith effort to include as many different interests and perspectives in our monitoring programs as possible.

---

# Team Leader Handbook

Sponsored by the Nevada Division of Environmental Protection (www.ndep.nv.gov)

--Excerpted from: Clean Water Team Citizen Monitoring Program, California State Water Resource Control Board
Citizens' Volunteer Monitoring Program, Bureau of Watershed Conservation, Pennsylvania Department of Environmental Protection,
EPA Volunteer Monitoring, and Streamkeeper's Field Guide, Adopt-a-Stream Foundation

## What is Volunteer Water Monitoring?

Across the country, volunteers monitor the condition of streams, rivers, lakes, reservoirs, estuaries, coastal waters, wetlands, and wells. They do this because they want to help protect a stream, lake, bay or wetland near where they live, work, or play. Their efforts are of particular value in providing quality data and building stewardship of local waters.

Volunteers make visual observations of habitat, land uses, and the impacts of storms; measure the physical and chemical characteristics of waters; and assess the abundance and diversity of living creatures--aquatic insects, plants, fish, birds, and other wildlife. Volunteers also clean up garbage-strewn waters, count and catalog beach debris, and become involved in restoring degraded habitats. The number, variety, and complexity of these projects are continually on the rise.

Many volunteer groups collect data that supplements the information collected by state and local resource management or planning agencies. These agencies might use the data to:

- screen water for potential problems, for further study or for restoration efforts
- establish baseline conditions or trends for waters that would otherwise go unmonitored
- evaluate the success of best management practices (BMPs) designed to mitigate problems

*(Excerpted from EPA Volunteer Monitoring)*

## What is Snapshot Day?

Snapshot Day is a one-day, volunteer-based event designed to collect watershed information during one moment in time. Volunteer leaders are trained, and these leaders accompany teams of volunteers to various pre-determined sites to collect information relative to the health of our watersheds. The purpose of this effort is two-fold:

- to promote environmental education and stewardship, and
- to collect valuable water quality information.

While there is a great deal of high quality agency and research monitoring taking place in the region, there is still insufficient information to adequately assess the status of some of the aquatic resources in the Truckee River and Lake Tahoe Basin watersheds.  With proper training and quality assurance, community volunteers can help fill this void by providing valuable information for watershed management and pollution prevention.

## Citizen Monitoring: The Clean Water Team

The mission of the Clean Water Team citizen monitors is to produce environmental information that is needed to protect this hydrographic basin, local (sub)watersheds, and aquatic resources. Citizen monitoring will inform and engage the community in effective watershed stewardship.

## Team Leaders Needed

For safety and logistical purposes, there should always be a minimum of two people performing monitoring tasks. One person on the team must be trained as a team leader. The duties of the team are as follows:

- Note-taker
- Observer
- Observer/Photographer

**Equipment (What to bring with you)**

Required

- Data sheets and clipboard
- Pencil/pen
- Camera & Film
- Road map and/or Topographic Map
- Measuring tape or Ruler (for scale)
- Ice chest
- Watch
- Cell phone (if available)
- Garbage bags & recycling bags
- Access letter (only necessary when attempting to access private property sites)

Optional

- Waterproof boots or waders
- Plant communities guide for your region
- Additional water testing equipment
- Transparent cup for evaluating the color of the water
- GPS unit (use coordinate system UTM 11, NAD 27)

**Safety Concerns**

Stream and shore walk volunteers should ALWAYS put safety first. For safety reasons, always have at least two volunteers for the survey. Either make sure that the area you are surveying is accessible to the public or that you have obtained permission from the landowner prior to the survey. We recommend that the volunteer coordinator or leader discuss the potential hazards with all volunteers prior to any fieldwork.

Safety concerns that may be encountered during the survey include, but are not limited to:

- inclement weather
- flood conditions, fast flowing water, or very cold water
- poisonous plants
- dangerous insects and animals (e.g. bees, bears, etc.)
- harmful or hazardous trash (e.g. broken glass, hypodermic needles, human feces)

## Data Entry and Equipment Return

Return to your identified staging location for data entry and equipment return:

Make sure that all sample bottles and whirl-packs are labeled with stream/location ID (i.e. SLT-STRM-01), time, date, etc.

Return all forms, equipment, camera, samples and complete "check out" form. Enter data using web forms if available (we are in the process of making the data entry and data storage available over the internet).

## Report Released in Fall – Party

We strive to hold a Volunteer Appreciation Party in the fall with the release of the annual Snapshot Day report. Data is available also by contacting Tahoe Regional Planning Agency or by visiting the Tahoe Integrated Information Managements System website at www.tiims.org.

## STEP 1: Snapshot Day Basics

**Snapshot Day Forms**
**The most important thing you can do is fill out each form as completely as possible.**

- Field Data – Represents observations, measurements and samples taken from a specific **point** on the stream. *See details in Appendix A for details on the following parameters:*
  - Temperature
  - pH
  - Dissolved Oxygen
  - Electrical Conductivity
  - Turbidity

- Visual Assessment –Observations made of a stream **reach** of a minimum of 100 meters. *See details on the Visual Assessment (Stream and Shore Walk), page 5.*
- Mapping
- Photo Log – *See details on Photo Documentation, page 8.*

**Remember: The most important thing you can do is fill out each form as completely as possible.**

**Site Location ID**

Each stream or shoreline location has been given a unique 7- or 9-digit alphanumerical code. The first three digits represent the major watershed (i.e. NLT=North Lake Tahoe, SLT=South Lake Tahoe, MTR=Middle Truckee River, and LTR=Lower Truckee River). The next four digits represent the stream or location. If there are two additional numbers, these represent the location of the point on the stream with –00 at the mouth, -01 upstream, and 02 further upstream, and so on.

For example:

Incline Creek at mouth, North Lake Tahoe = NLT-INCL-00
Edgewood Creek just upstream from mouth, South Lake Tahoe = SLT-EDGE-01
Squaw Creek, Middle Truckee River Watershed = MTR-SQUA-02
Hunter Creek, Lower Truckee River Watershed = LTR-HUNT

*Always* use this code to represent your site **and** *always* identify the site (i.e. full stream name).

## STEP 2. Field Data Sheet for Water Quality Monitoring (green sheet).

The datasheet has placeholders for observations, measurements, and sampling conducted at a station. Some parameters and associated units have been provided. Although blank cells are acceptable, please try to fill out all cells in all fields. Enter "nap" if the cell is Not Applicable to your situation. Enter "not tested" if you could not do the measurement or observation (and please remember that no data is better than bad data). The data sheet offers some clarification and instructions; *these are printed in italics*.

**Identifiers and Other Information**

WRITE the Station ID, Creek Name, Site Description in the placeholders at the top of the page.

WRITE the Date and Page Number on each sheet in the sequence you used them.

WRITE the name of the monitoring team leader and the names of the other team members; use the back of the sheet for more names if needed. It is important to have at least one phone number to contact with questions.

**Observations**

WRITE the Time that you begin taking observations at the monitoring site.

CIRCLE the word or phrase that best describes what you see at the monitoring station. Add descriptors if relevant.

- Record any **applicable weather information** including:
  - Cloud Cover: No clouds, partly cloudy, cloudy
  - Precipitation: none, foggy, misty, drizzle, rain, snow
  - Wind: calm, breezy, windy

- **Rain in past 24-Hours**: If any rainfall has occurred within the last 24 hours, circle yes. If no rain has occurred during the last 24 hours, circle no. If you know how much precipitation occurred during the last 24 hours, please record the amount in inches.

- **Water Clarity** can be described in 3 ways:
  - Clear – the water is clear and the observer can easily see the bottom.
  - Cloudy – the water is somewhat cloudy but the observer can see greater than 4 inches below the surface of the water, or the bottom of the waterway can be seen in greater than 4 inches of water.
  - Murky – the water is very turbid and the observer cannot see any more than 4 inches below the surface of the water, or the observer cannot see the bottom of the waterway in 4 inches or less of water.

  *If your group has sampled and measured for turbidity, then please give the measured turbidity result along with its units (e.g., 5.5 NTU). Turbidity is most commonly associated with rainfall events but can also be associated with excessive algal growth or point source pollution.*

- **In-Stream Flow:** Estimate the amount of water present in the channel, or the flow status. The flow categories for streams are described below:
  - **Dry Creekbed (none) –** dry (no water is present in the channel.)
  - **Isolated Pools** or **Trickle (low) –** water fills 25-50% of the channel
  - **Slow/Smooth** or **Moderate/Rippling (medium) –** water fills 50-75% of the channel and surface of water appears smooth or slightly rippled
  - **Rapid/Turbulent (high) –** water fills 75-100% of the channel and reaches the base of both lower banks, surface of the water is turbulent (i.e. white water)
  - **Flooding –** water level exceeds channel and bankfull

  *If you are aware of a measured flow rate (e.g. provided by an agency), or if your group has measured the flow at the time of your survey, then in addition to the narrative flow observation, also give the measured flow rate along with its units (e.g. 10 cubic feet per second). If agency flow data is used, give its source (e.g. USGS, DWR, etc.). If a USGS Gauge is located near your reach, include the gauge number on your form. You may need to use the comment section if the information does not fit in the flow box. If you are surveying the shoreline of a lake or reservoir then mark the flow box **NA**.*

- **Color:** Color can be assessed for both flowing water (e.g. in streams) or in lakes, reservoirs, estuaries or bays. Poor watercolor (e.g. brown or yellowish) can indicate turbidity caused by sediment, excessive algal growth and/or a point source pollution problem. To determine watercolor in flowing streams where little canopy cover is present, determine the color by just looking at the stream. If it is difficult to determine the water color due to extensive canopy cover, shallow water (substrate visible) or light reflection, use the "cup method:"

  a) Use a transparent plastic cup to collect a sample of water from the stream. Be sure to minimize the bottom sediments in the sample.
  b) Place a piece of white paper behind the cup and with the sun at your back observe the color of the water.

- **Odor:** An odor, of natural or human-induced origin, may be present at a specific point of your survey reach that you can detect. CIRCLE the odor type from the list provided. If "other" is chosen, describe the type of smell present.

- **Other:** Indicates the presence of algae, oil, foam, litter or other observed. Please describe and document with a photo.
  - **Algae or Water Plants:** Any type of algal growth present in the stream or waterway should be classified and documented. *In a stream, or flowing waterbody, excessive algal growth may be an indication of insufficient flow, high $H_2O$ temperatures, lack of riparian cover, excessive nutrients or other factors. The presence of algae in a lake is important because algae converts inorganic material to organic material; oxygenates the water; provides the base for the food chain; and affects the amount of light penetrating the water column. An imbalance in the amount of algae in a lake can decrease water clarity and alter the color of the water. Too much algal growth can be a sign of excessive nutrients.*

- **Oily Sheen:** The visual presence of petroleum or other oily substances can be described. Make note if this oily sheen is reddish (e.g. iron oxidizing bacteria).

- **Foam or Suds:** Indicate if foam is present at a particular site. *The presence of foam may be an indication of detergents, excessive nutrients or other unnatural inputs to the waterway. While foam may be an undesirable result of water pollution, it sometimes can result from natural causes (for example, kelp and other natural organic matter whipped into a frothy foam due to wave action along a beach).*

- **Litter or Trash:** Include all litter observed within the waterway, along the banks or shore within a 20 meter diameter area (10 meter radius of your position.) Banks or shoreline should be surveyed away from the water for 10 meters. *Please, take the time to pick up this trash.*

**Field Measurements - WRITE the Time that you begin taking field measurements**

If you measure one parameter with more than one instrument (e.g. using both pH strip and a pH electrode), fill in a new row at the bottom for that additional Instrument and measurement Result.

- Instrument ID – fill in the unique Instrument ID as it is written on your instrument (for example "NDEP-STB3a").

- Parameter – The sheet already has various selections; you can add parameters at the bottom of that table if needed. You may not be collecting all parameters at your monitoring station.

- Result – Write the result of each measurement in the appropriate row in the Result cell. Check your instrument specific operating procedures for the number of "significant digits," i.e., how many digits in the Result have a number that is meaningful.

- Units – Make sure the units are correct (change if needed).

- Bracket – If you think that the true value of your measurement clearly falls in between two marks on your instrument, you may report that value as your perceive it and enter the values of the marks it fell between. For example, use the Bracket cell to write "7 – 8" if the pH was between the marks of 7 and 8 on your pH strip and you reported 7.5 in the Result cell.

- 2$^{nd}$/Rep/Dep/Dil – While the "Result" field is for the result of the first measurement with a given instrument, this field is for additional results obtained with the same Instrument for the same station at the same time or immediately after the first. Write the new results in that cell and add a code of what it represents, as follows:

    - "2$^{nd}$" is for repeated measurement if you are not sure the first measurement was done right or if the Result did not make sense (always repeat the measurement in these cases). If the second result confirms the first, leave both results in their boxes. If you feel that the first measurement was not valid, cross out the first Result and write “invalid” near it in the Result box, and only the new (second) Result will be used.

- “Rep” is for replicate samples. You can also use this cell to record the perception by a second pair of eyes if different from the first “looker.”
- “Dup” is for a duplicate sample collected from the creek side by side along the first sample and at the same time, in two separate containers or sampling devices. Such “Field Duplicates” are taken routinely as part of field QA/QC and are used to assess the precision of your measurements.

**Creek Width and Depth**

WRITE the Width of the creek based on a measurement from “wetted edge” to “wetted edge.” Do not forget to include units. If there is no way to measure the width of the creek, leave this blank.

WRITE the Depth of the creek at the center point. Do not forget to include units. If you cannot reach to the middle of the creek, leave this blank.

WRITE the USGS Gage Number if there is a USGS Gage at the sampling station.

CIRCLE the Sampling Depth that is appropriate. Where possible, attempt to collect water samples from 6 inches below the surface of the water. However, if the creek is not deep enough for a sample to be collected, make a note that your sample was collected at less than 6 inches below the surface.

CIRCLE the Sampling Device used for measurements and samples. Most teams will not have any sampling devices and will circle “none.”

**Sample ID**

Be sure the Site ID is WRITTEN on all of the Sample Containers taken.

- The 1-liter container is for
- The ½-gallon container is for
- Fecal Coliform Bacteria samples will be collected in a 100ml sampling container or in a plastic whirlpack.

Please try to fill in as much information as you can. The information you record on this Data Sheet will be entered into a SnapShot Day database, along with the calibration and accuracy checks recorded during equipment calibration. All of the information will be used to validate your data and evaluate its accuracy and precision.

## STEP 3. Collecting Water Quality Field Measurements

Not all teams will have the same equipment available on Snapshot Day. Relatively inexpensive and simple-to-use kits are generally given to volunteer monitors. Meters and sophisticated lab equipment may be more accurate, but they are also more expensive, less flexible, and will only be given to teams with more experience. Decisions about field measurements for each location are based upon available monitoring equipment, volunteer capability, and the types of water quality problems and pollution sources likely to be encountered.

### 1. Temperature

a) Obtain AIR TEMPERATURE FIRST with hand held thermometer in shaded location near stream.

b) Second, Obtain WATER TEMPERATURE with hand held thermometer in center of flow or on edge in flowing water. Read thermometer IN WATER. Place the thermometer in the water and keep it there for at least one minute. Read the temperature with the thermometer submerged, record the result, and remember to report the units (degrees C or F).

### 2. pH

Take out one pH strip and dip it in the water for about 5 seconds. Compare the strip to the color chart on the outside of the box. Record the result. If the strip's colors are anywhere in between two standards, then record the midpoint number; for example, if the colors are between 7.0 and 7.5, record it as 7.25. Place the spent pH strip in the dissolved oxygen kit for return to your coordinator.

### 3. Dissolved Oxygen

Fill the tube to the top with water and place an ampoule, sharp side down, in the tube. Snap the tip of the ampoule off and allow to fill (it will turn blue as it fills). Remove the ampoule and invert a few times making sure the air bubble travels the length of the ampoule while inverting. Compare the ampoule to the standards provided in the kit with your back to the sun (do not wear sunglasses when making your reading.) Record the result in ppm. If the ampoule's color is anywhere in between two standards, then record the midpoint number; for example, if the color is between 8 and 10, record it as 9. You may pour out the remaining water in the tube, as it is not contaminated in the testing process. Place the spent ampoule back in the kit for return to your coordinator.

### 4. Electrical Conductivity (used for determining total dissolved solids, TDS)

Standing down stream of your sampling site remove the cap and dip the cap in the water you are sampling. Dip and pour (down stream) three times, then dip one final time (up stream) and carefully place the cap containing sample water back on the probe. Be careful not to get water above the protective gasket. Turn the instrument on and record the result (in µS/cm). Shut off the instrument, remove the cap and empty it. Dry and replace the cap before storing.

## STEP 4. Collecting Water Samples ("Grab Samples")

Water samples are collected for analysis in the field or at the lab (specifically for analyzing conductivity, turbidity, nutrients and fecal coliform bacteria). *There is a time limit for getting certain samples analyzed (i.e. fecal coliform analysis must be started within hours of sample collection). There are predetermined times for "runners" to collect your samples, so be sure to deliver them to your staging area within the required time frame.*

Follow the following steps for collecting water samples:

**For Screw-Cap Bottles:**

In general, sample away from the streambank in the main current. The outside curve of the stream is often a good place to sample since the main current tends to hug this bank. To collect water samples using screw-cap bottles, us the following procedures:

1. Label the bottle with the Site Location ID, date and time.
2. Remove the cap from the bottle just before sampling. Avoid touching the inside of the bottle or the cap. If you accidentally touch the inside of the bottle, use another one.
3. Try to disturb as little bottom sediment as possible. Be careful not to collect water that has sediment from bottom disturbance. Stand facing upstream. Collect water sample on your upstream side, in front of you.
4. Hold the bottle near its base and plunge it (opening downward) below the water surface. Collect a water sample 8 to 12 inches beneath the surface or mid-way between the surface and the bottom if the stream reach is shallow.
5. Turn the bottle underwater into the current and away from you. In slow stream reaches, push the bottle underneath the surface and away from you in an upstream direction.
6. Leave a small air space (so that the sample can be shaken just before analysis). Recap the bottle carefully, remembering not to touch the inside.
7. IMPORTANT: Fill in the bottle number and/or site number on the appropriate field data sheet. This is the only way the lab analyzer will know which bottle goes with which site.
8. If the samples are to be analyzed in the lab, place them in the cooler. Take all samples to the drop-off location Take samples to the drop-off site (or lab if applicable).

**For BACTERIA Bottles:**

1. Label the bag with the Site Location ID, date and time.
2. Unscrew cap, breaking seal. Fill bottle up to (*or a tad past*) the 100ml mark. Don't dirty up the cap. **Very carefully**, Dip the bottle into your surface water body to collect the water sample. **Don't** lose your white powder that is in this bottle. **Don't** fill another bottle and transfer water into the bottle.

> Wading?? Try to disturb as little bottom sediment as possible. In any case, be careful not to collect water that contains bottom sediment. Stand facing upstream. Collect the water sample in front of you.

## STEP 5. Conducting Stream / Shore Walk - Visual Assessment

**Introduction**

The Lake Tahoe–Truckee Stream and Shore Walk Visual Assessment is based on the California SWRCB *Stream and Shore Walk Visual Assessment*. The form has been slightly modified to better suit our region. The data sheets are intended for volunteer monitoring groups to collect baseline data for gross problem identification within a watershed. The protocol is designed for use by volunteers with limited equipment and training. **.** Citizen volunteers should be able to survey a reach of stream or shore within 2-3 hours, depending on terrain and accessibility.

A minimum stream reach of 100 meters or approximately 300 feet should be observed in order to view a representative section of the stream, depending on the terrain and accessibility. Stream walks should be initiated from a downstream position, traveling upstream.

The frequency of the survey should be based on the monitoring goals. Two types of goals are provided below:

1. Gross problem identification. In this situation, it is assumed that, based on the results of an initial Stream or Shore Walk, a more in-depth monitoring program will be designed to evaluate specific non-point or point source pollution problems.

2. Baseline monitoring. For baseline monitoring, it is recommended that volunteers survey the same reach 2-3 times per year, specifically during early spring (before trees or shrubs are in full leaf and water levels are generally high), late summer (when water levels are low), or late fall (US EPA 1997).

## Instructions for Completing the Visual Assessment Form (yellow sheet)

**Identifiers and Clarification for Required Field Data:**
1. WRITE the **Date** and **Page Number** on each sheet in the sequence you used them.
2 – 4. WRITE the **Station ID**, **Creek Name**, **Site Description** in the placeholders at the top of the page.

**5. Reach Length:** Indicate the distance of stream or shore surveyed. The protocol recommends surveying 100 meters or 300 feet. If a different survey length was surveyed, please explain why in the notes section. To determine the length of the reach use your maps or the odometer of your car. There may be cases when physical landmarks such as bridges, roads, or tributaries will bracket the reach. In such cases, these starting and ending landmarks may dictate the length of the reach.

6. WRITE the name of the monitoring **team leader** and **phone number**. It is important to have at least one phone number to contact with questions.

**7. Starting Point:** Where possible, begin your survey at a prominent landmark (e.g. a bridge, or some other feature that will be easy to find again on subsequent surveys). If no prominent landmark is present, describe the starting point in detail. In some cases, you can use surveyor's flagging, stakes or some other type of reference mark for subsequent visits. Provide enough details and instructions so that someone who had never been to the site could locate it. On streams, if possible, try to plan your observations so that the starting point is downstream of the ending point (i.e., you then proceed upstream.)

**8. Latitude/Longitude:** Determine latitude and longitude from a topographic map, GPS unit, software program, or other means and record it in the box (optional). Use coordinate system UTM 11 and NAD 27, or write the coordinate system used by your equipment.

**9. Water Inputs or Discharges:** If you come across any obvious input or discharge points during the survey, fill out the "input/discharges" section with the input or discharge(s) observed. A discharge point may not necessarily be a pipe or drain but could also be a dumping location for trash, etc. *If no discharge points were observed, do not fill out this section.* You may also use the "Notes" section if you need additional room. For <u>each</u> Input or Discharge found along the stream reach, CIRCLE the words that best describe what you observe entering the stream reach from the Input or Discharge:

- **Input** or **Discharge –** circle one
- **Input or Discharge Point –** circle one (e.g., pipe, open concrete storm drains, earthen drains)
- **Input or Discharge Type –** circle one "discharge type" observed (if there are any)
- **Clarity –**refers to the water coming out of the discharge point, circle one
- **Flow –** refers to the water coming out of the discharge point, circle one
- **Color –** refers to the water coming out of the discharge point, circle one
- **Odor –** refers to the water coming out of the discharge point, circle one
- **Other –** refers to the water coming out of the discharge point, circle all items that you note the presence of algae, oily sheen, foam/suds, litter/trash, or other (please describe)

**10. Dominant stream- or shore-side vegetation*:** *(*Note: this section is for observers who have some knowledge of the local flora. If you do not know primary plant species or native vs. nonnative plants, put a slash through this section.)* Briefly describe the vegetation, including the following:

- **% Native**- Estimate the percentage of native vegetation present throughout the reach surveyed. Optional: If you can identify the primary species, list them or describe them (common names are acceptable).

- **% Non-native**- Estimate the percentage of non-native vegetation present throughout the reach. If you can identify the primary species, list them or describe them (common names are acceptable).

- **Natural vegetation zone width-** Estimate the overall width of the natural vegetation on both sides of the stream or along the shoreline. If there is little or no natural vegetation present, please describe what is present (e.g., golf course, cement path, etc.).

**11. List land uses and activities:** Based on your observations, record the primary land uses and/or activities occurring within ¼ mile of the waterway you are surveying. You may also be able to obtain a copy of a land use map for the area through your county or city planning department. Use the Land Use Observation Codes and list land use in order of dominance.

**12. Fish Barriers, Water Diversions, Modifications and Stream Channelization:** If you encounter any possible barriers to fish passage, stream/shore modifications, such as diversions, stream channelization, or armoring (e.g., rip rap); use this section to describe each location where a barrier, diversion, modification or channelization was observed. Make sure you include it in your map or site sketch on the back as well. With regard to possible fish barriers, take into consideration flow levels throughout the year, i.e., will an object or structure be a barrier to fish passage at the time of the year in which fish migration occurs.

- CIRCLE the underlined word that best describes what you see.
- WRITE a description of the location and include this location on the map on the back.
- PHOTO documentation – take a photo of the various barriers, diversions, modifications or channelization that you observe.

**13. Erosion, unstable banks, bed conditions (sedimentation):** If you encounter any areas of erosion, bank instability or excessive bed sedimentation during the survey, describe each location and the observed problem.

**14. Ending point:** Where possible, end your survey at a prominent landmark (e.g. a bridge), something that will be easy to find again on subsequent surveys. If no prominent landmark is present, describe the ending point in detail. In some cases, you can use surveyor's flagging, stakes or some other type of reference mark for subsequent visits. Provide enough details and instructions so that someone who had never been to the site could locate it. Record the Station ID, Latitude and Longitude in the same manner as described above for the Starting point.

**15. Draw a map of the reach or shoreline:** After you have walked the reach, draw a map or sketch of the reach that depicts the key features including: start and stop points; vegetation features; discharges; stream or shoreline modifications; stream diversions; possible fish barriers; erosion, photo point locations, direction of flow, and a "north arrow" (approximate direction of north).

**16. Notes, special problems, comments:** Use this section to describe any of the above parameters in further detail. This section can also be used to identify any special problems, illegal activities, or interesting observations (e.g. wildlife, fish, etc.).

## STEP 6. Photo Documentation

### Introduction

Use your photographs to provide a qualitative, and potentially semi-quantitative, record of conditions in a watershed or on a water body. Use your photographs to document general conditions on a reach of a stream during a stream walk; pollution events or other impacts; assess resource conditions over time; or to document temporal progress for restoration efforts or other projects designed to benefit water quality. Photos provide a visual portrait of water resources to those who never have the opportunity to actually visit a monitoring site.

Photos can be used in reports, presentations, or uploaded onto a computer website or GIS program. Briefly describe photo information on the stream and shore walk form so that any photos taken during the survey can be scripted.

**Complete the Photo Documentation of Visual Assessment**
Monitoring teams that receive a disposable camera to use for the Snapshot Day event usually have 27 exposures. Eight (8) specific photos are required:

1. Station ID Sheet – *see below*
2. Picture of Monitoring Team (show all members your team – if possible)
3. Start Point – Upstream
4. Start Point – Stream Bed
5. Start Point – Across Stream
6. End Point – Downstream
7. End Point – Stream Bed
8. End Point – Across Stream

Remaining photos may be used to document other observations such as Water Inputs or Discharge Points, Vegetation, or unusual conditions such as fish passage barriers, water diversions, stream/shore modification or stream channelization.
In addition, please take some photos of your team conducting the stream monitoring or just having fun. These photos are used in the Final Report and presentation, as well as for various publications and outreach efforts.


A Site ID Sign is included in your materials.

**Detailed Photo Documentation Instructions**

From the inception of any photo documentation project until it is completed, always take each photo from the same position (photo point), and at the same bearing and vertical angle at that photo point. Photo point positions should be thoroughly documented, including photographs taken of the photo point. Refer to copies of previous photos when arriving at the photo point. Try to maintain a level (horizontal) camera view unless the terrain is sloped. (If the photo cannot be horizontal due to the slope, then record the angle for that photo.) When photo points are first being selected, consider the type of project (meadow or stream restoration, vegetation management for fire control, ambient or event monitoring as part of a stream walk, etc.)

When taking photographs, try to include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. Lighting is, of course, a key ingredient so consider the angle of light, cloud cover, background, shadows, and contrasts. Close view photographs taken from the north (i.e., facing south) will minimize shadows. Medium and long view photos are best shot with the sun at the photographer’s back. Some artistic expression is encouraged as some photos may be used on websites and in slide shows (early morning and late evening shots may be useful for this purpose). Seasonal changes can be used to advantage as foliage, stream flow, cloud cover, and site access fluctuate. It is often important to include a ruler, stadia rod, person, farm animal, or automobile in photos to convey the scale of the image. Of particular concern is the angle from which the photo is taken. Oftentimes an overhead or elevated shot from a bridge, cliff, peak, tree, etc. will be instrumental in conveying the full dimensions of the project.

If possible, include the Site ID sign in the view, marked at a minimum with the location, subject, time and date of the photograph.

When monitoring the implementation of restoration or Best Management Practices (BMP), include or attach to the photo-log a narrative description of observable progress in achieving the goals of the project. Provide supplementary information along with the photo, such as noticeable changes in habitat, wildlife, and water quality and quantity.

## STEP 7: Complete the Invasive Weed Mapping Sheet

While you are conducting the visual assessment, look around the area to see if you can identify any invasive weeds. Invasive weeds are non-native plants that are prolific, highly competitive, and hard to control. They:

- Displace native plants,
- Decrease wildlife habitat,
- Reduce recreational values and uses,
- Damage water quality and clarity, and
- Cost millions of dollars each year in treatment and losses in productivity.

If you see anything that looks like any of the species provided in the pictures, please fill out this form as completely as possible. If you're not sure of the identification, collect a sample and make a note on the form. Also, make sure to take a few pictures of the plant, (one close-up and one with the landmarks that will help us find the location).

## STEP 8: Return to Your Staging Area Location:

At check-out:

- **Make sure that all of your forms are complete**
- **Make sure that all sample bottles are labeled with the following:**
    1. **Station ID**
    2. **Team Leader Name**
    3. **Date**
    4. **Time**
- **Complete "check out" form: return all forms, equipment, camera, and samples.**
- **Complete "chain of custody" form for all lab samples.**
- **Please complete the Snapshot Day Evaluation.**

## STEP 9: Utilize the Information That You Have Shared and Learned

Your inventory and monitoring data can serve as the basis for protecting your stream and potentially harmful land use decisions, or restoring your stream if it is already degraded.

You, your family friends and neighbors, and the people you elect to government offices at the local level are the real resource managers. By learning more and helping to promote environmental stewardship, you will in turn help to create an informed public voice that collectively can influence decisions that affect our environment, and subsequently our water resources.

## THANK YOU FOR PARTICIPATING IN SNAPSHOT DAY!!!

# Temperature

## What is Water Temperature?

Temperature is a measure of the average energy (kinetic) of water molecules.
It is measured on a linear scale of °C or °F.

## Why is it Important?

It is one of the most important water quality parameters. Temperature affects water chemistry and the functions of aquatic organisms. It influences the:

- amount of oxygen that can be dissolved in water,
- rate of photosynthesis by algae and other aquatic plants,
- metabolic rates of organisms,
- sensitivity of organisms to toxic wastes, parasites and diseases, and
- timing of reproduction, migration, and aestivation of aquatic organisms.

## How is Stream Temperature Measured?

- Thermometers
- Temperature probes and meters

Conversion between Fahrenheit and Celsius is: ◦C = (◦F - 32) x 5/9.

## What Factors Affect Temperature?

**Natural Factors**

- Sunlight Energy: Seasonal and daily changes, shade (cover), air temperature
- Flow
- Depth of water
- Inflow of groundwater: Usually colder than stream
- Inflow of surface water into stream which is at a different temperature than the stream (e.g. A drainage ditch or another stream)
- Color and turbidity of water: suspended sediment absorbs heat

**Human Factors**

- Removal of riparian vegetation
- Soil erosion
- Stormwater runoff
- Alterations to stream morphology, substrate, flow
- Cooling water discharges from power plants

## What are Acceptable Ranges?

- Acceptable ranges cannot be assigned without understanding the aquatic ecosystem. The maximum temperature tolerated by organisms depends on the species.

Maximum weekly average temperature for growth and short-term maximum temperatures for selected fish (ºC or ºF). Adapted from *EPA's Draft Volunteer Stream Monitoring: A Methods Manual*.

| **Species** | **Growth** | **Maxima** | **Spawning**** | **Embryo Survival**** |
|---|---|---|---|---|
| Bluegill | 32°C (90 °F) | 35°C (95 °F) | 25°C (77 °F) | 34°C (93 °F) |
| Carp | | 21°C (70°F) | 33°C (91°F) | |
| Channel catfish | 32°C (90 °F) | 35°C (95 °F) | 27°C (81 °F) | 29°C (84 °F) |
| Largemouth bass | 32°C (90 °F) | 34°C (93 °F) | 21°C (70 F) | 27°C (81 °F) |
| Rainbow trout | 19°C (66 °F) | 24°C (75 °F) | 9°C (48 °F) | 13°C (55 °F) |
| Sockeye salmon | 18°C (64 °F) | 22°C (72 °F) | 10°C (50 °F) | 13°C (55 °F) |

* The optimum or mean of the range of spawning temperatures reported for the species.
** The upper temperature for successful incubation and hatching reported for the species.

## What are the Water Quality Objectives[1]?

- The water quality objectives for freshwater ecosystems protect coldwater ("COLD") or warmwater ("WARM") fishes. In general, the water quality objective does not allow temperature of any water supporting these fishes to be increased by more than 5◦ F above natural receiving water temperature. However, the water quality objectives vary from region to region in California. Therefore, you should check with the Regional Water Quality Control Board in your area. Water quality objectives are included in their Basin Plan.

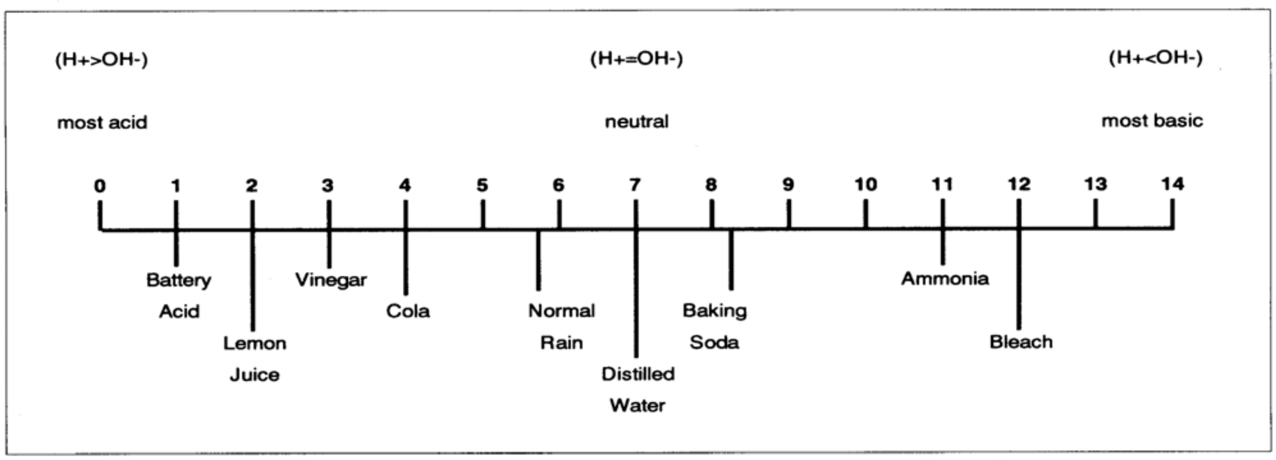
- For bays, estuaries, and ocean waters, elevated waste discharges cannot cause surface water temperatures to rise greater than 4º F above the natural temperature.

[1] A water quality objective is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the uses of that particular waterbody and an antidegradation statement.

# pH

## What is pH?

- pH is a measure of how acidic or basic (alkaline) the water is. It is defined as the negative log of the hydrogen ion concentration.
- The pH scale is logarithmic and goes from 0 to 14. For each whole number increase (i.e. 1 to 2), the hydrogen ion concentration decreases ten fold.
- As the pH decreases, water becomes more acidic. As water becomes more basic, the pH increases.




pH scale showing the values of some common substances. (Source: U.S. Fish and Wildlife Service.)

## Why is pH Important?

- Many chemical reactions inside aquatic organisms (cellular metabolism) necessary for survival and growth of organisms require a narrow pH range.
- At the extreme ends of the pH scale, (2 or 13) physical damage to gills, exoskeleton, fins, occurs.
- Changes in pH may alter the concentrations of other substances in water to a more toxic form. For example:
    - A decrease in pH may increase the amount of mercury soluble in water.
    - An increase in pH may cause the conversion of nontoxic ammonia to a toxic form of ammonia (un-ionized ammonia).

## How is pH Measured?

- pH paper. The famous litmus test is based on a vegetable dye that changes color. Other indicator dyes are more sensitive to changes in pH.
- pH meters and probes. A two-electrode system consisting of a glass electrode containing an acid solution and a reference electrode. When placed in water, an electrical force produced between the acid and the water can be measured. This force is a measure of pH.
- pH test kits. Colorimetric tests are based on indicator dyes that change color over a range of pH.

## What Affects it in Water?

Pure water (de-ionized) has a pH of 7.0. Two major factors can cause the pH to change:

- **Buffering capacity**
- **Input of basic or acidic substances (manmade or natural)**

**Buffering Capacity**

A buffer is like a chemical cushion that neutralizes acids or bases when added to the water. Examples of natural buffers:

- $CO_2$ from the air dissolves in water and forms a buffer (carbonic acid $H_2$CO3).
- Minerals (calcium, magnesium) which come from rocks, such as limestone, dissolve in water.

**Input of basic or acidic substances (manmade or natural)**

pH can change because of external inputs. You might measure a difference in pH along a stream due to:

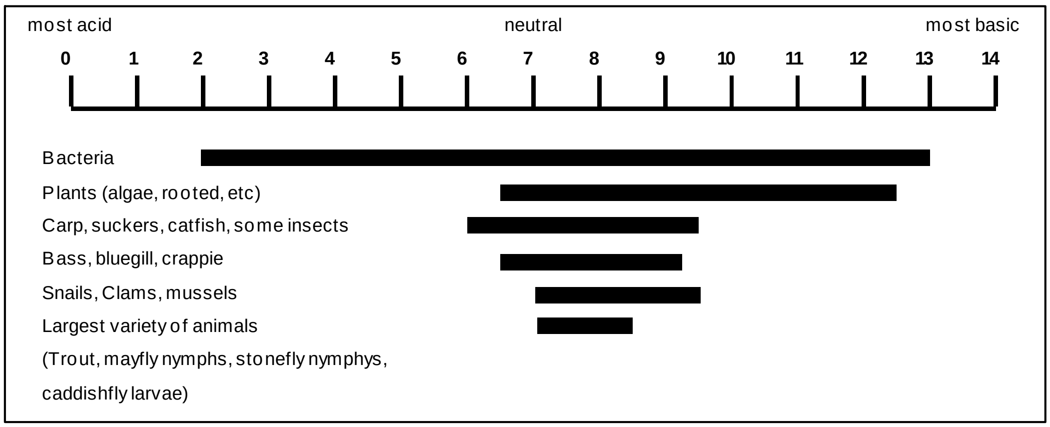
- A change in tree type, Conifer needles are acidic and maple leaves are basic
- A change in stream bottom material (gravel vs. silt vs. bedrock)
- A large change in temperature
- A change in human activity affecting the stream

**Other Factors**

- In fresh water, increasing temperature decreases pH.
- Waters with high algal growth can show a diurnal change in pH. When algae grow and reproduce, they use $CO_2$ . This reduction causes pH to increase. Therefore, if conditions are right for algal growth (sunlight, warm temperatures), the water will be more alkaline. Maximum pH usually occurs in late afternoon, pH will decline at night. Since algal growth is restricted to light penetrating zones, pH can vary with depth in lakes, estuaries, bays and ocean water.
- Manmade inputs that reduce pH include acid rain (from automobiles, industrial sources, and acid mine drainage). Nutrients can indirectly affect pH by stimulating algal growth.

## What are Acceptable Ranges?

Most natural environments have a pH between 4 and 9. The pH of seawater is usually between 7.5 and 8.4. In fresh water, pH in the range of 6.5 to 8.5 should protect most organisms. The range of pH tolerated by organisms varies, as seen in the chart below.




pH ranges that support aquatic life.

## What are the Water Quality Objectives[2]?

The water quality objectives for pH vary from region to region. Check with the Regional Water Quality Control Board in your area.

- **For the Lahontan Region: In fresh waters with designated beneficial uses of COLD or WARM, changes in normal ambient pH levels shall not exceed 0.5 pH units. For all other waters of the Region, the pH shall not be depressed below 6.5 nor raised above 8.5. However, some waters may have natural pH levels outside this range. Compliance for those waters will be determined on a case-by-case basis. There are pH objectives specific to certain waters (e.g. Eagle Lake, Lake Tahoe) in the Region.**

[2] A water quality objective is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the uses of that particular waterbody and an antidegradation statement.

# Dissolved Oxygen (DO)

## What is Dissolved Oxygen?

- It is the amount of oxygen dissolved in water.

## Why is it Important?

- Most aquatic organisms need oxygen to survive and grow
  - Some species require high DO such as trout and stoneflies.
  - Other species do not require high DO, like catfish, worms and dragonflies.

- If there is not enough oxygen in the water the following may happen:
  - Death of adults and juveniles,
  - Reduction in growth,
  - Failure of eggs/larvae to survive,
  - Change in species present.

## How it is Measured?

- **In the lab**
  - Usually by wet chemistry using the Winkler titration method. This method is valid for ocean water and fresh water, but not highly alkaline water.

- **In the field**
  - DO Meter: electrical conductance based on a chemical reaction.
  - DO chemical test kit: the micro-Winkler method.

- **Reporting DO**
  - Dissolved oxygen can be reported as the actual concentration (mg/l)[3] or as the amount of oxygen that the water can hold at any given temperature. This is the percent saturation.

[3] mg/l is milligrams per liter. mg/l is sometimes referred to as parts per million (ppm) because a liter is 1000 grams of fresh water.

## What Affects the Concentration in Water?

- **Temperature**
- **DO Sources (inputs)**
- **DO Sinks (outputs)**
- **Other Factors**

**Temperature**

As temperature increases, less oxygen can be dissolved in water. When water holds all the DO it can at a given temperature, it is said to be 100 percent saturated with oxygen. Water can be supersaturated with oxygen under certain conditions (e.g. "whitewater rapids," or when algae are growing rapidly and producing oxygen more quickly than it can be used up or released to the atmosphere). The table below shows the concentration of dissolved oxygen that is equivalent to the 100 percent saturation for the noted temperature (and normal barometric pressure). For fresh water only.*

| Temperature ºC | DO (mg/l) | Temperature ºC | DO (mg/l) |
|---|---|---|---|
| 0 | 14.6 | 16 | 9.9 |
| 1 | 14.2 | 17 | 9.7 |
| 2 | 13.8 | 18 | 9.6 |
| 3 | 13.5 | 19 | 9.3 |
| 4 | 13.1 | 20 | 9.1 |
| 5 | 12.8 | 21 | 8.9 |
| 6 | 12.5 | 22 | 8.7 |
| 7 | 12.1 | 23 | 8.6 |
| 8 | 11.8 | 24 | 8.4 |
| 9 | 11.6 | 25 | 8.3 |
| 10 | 11.3 | 26 | 8.1 |
| 11 | 11.0 | 27 | 8.0 |
| 12 | 10.8 | 28 | 7.8 |
| 13 | 10.5 | 29 | 7.7 |
| 14 | 10.3 | 30 | 7.6 |
| 15 | 10.1 | 31 | 7.5 |

## DO Sources

Oxygen is added to water by:

- **Re-aeration:** Oxygen from air is dissolved in water at its surface, mostly through turbulence. Examples:
  - Water tumbling over rocks (rapids, waterfalls, riffles)
  - Wave action
- **Photosynthesis** (during daylight): Plants produce oxygen when they photosynthesize. DO is generally highest in the late afternoon, and lowest in the early morning hours before sunrise.

## DO Sinks

Dissolved oxygen is consumed in two major ways:

- Respiration
  - Aquatic organisms breathe and use oxygen.
  - Large amounts of $O_2$ are consumed by algae and aquatic plants at night (when large masses of plants are present).
  - Large amounts are consumed by decomposing bacteria (when there are large amounts of dead material to be decomposed, there will be significant numbers of bacteria).
- Substances breakdown and use oxygen in the breakdown process (and are generally biodegradable). Examples:
  - Dead organic matter (i.e. Algae)
  - Sewage
  - Yard Clippings - yard waste
  - Oil and grease

### Other Factors

- Altitude: Water holds less oxygen at higher altitudes.
- Salinity: As salinity increases, dissolved oxygen decreases.
- Mineral content: As the mineral content increases, dissolved oxygen decreases.

## What are generally the biggest causes of low DO?

- Increases in water temperature
- Algal blooms
- Human waste
- Animal waste from feedlots, dairies etc.

## What are Acceptable Ranges?

This table gives specific DO values for the survival of different species:

| Biologic effects of decreasing dissolved oxygen (DO) Levels on salmonids, non-salmonids fish, and aquatic invertebrates | | |
|---|---|---|
| | Dissolved Oxygen (mg $L^{-1}$) | |
| | Instream | Intergravel |
| I. Salmonid waters | | |
| A. Embryo and larval stages | | |
| No production impairment | 11 | 8 |
| Slight production impairment | 9 | 6 |
| Moderate production impairment | 8 | 5 |
| Severe production impairment | 7 | 4 |
| Limit to avoid acute mortality | 6 | 3 |
| B. Other life stages | | |
| No production impairment | 8 | |
| Slight production impairment | 6 | |
| Moderate production impairment | 5 | |
| Severe production impairment | 4 | |
| Limit to avoid acute mortality | 3 | |
| II. Non-Salmonid waters | | |
| A. Early Life stages | | |
| No production impairment | 6.5 | |
| Slight production impairment | 5.5 | |
| Moderate production impairment | 5 | |
| Severe production impairment | 4.5 | |
| Limit to avoid acute mortality | 4 | |
| B. Other life stages | | |
| No production impairment | 6 | |
| Slight production impairment | 5 | |
| Moderate production impairment | 4 | |
| Severe production impairment | 3.5 | |
| Limit to avoid acute mortality | 3 | |
| III. Invertebrates | | |
| No production impairment | 8 | |
| Some production impairment | 5 | |
| Limit | 4 | |

## What are the Water Quality Objectives[4]?

- Water quality objectives for dissolved oxygen vary from region to region. Check with the Regional Water Quality Control Board in your area. Water quality objectives are included in their Basin Plan. For waters that support coldwater fishes, the objective requires that the dissolved oxygen concentration shall not fall below 6 to 8 mg/l (depending on the region in California). For waters that support warmwater fishes, the objective requires that the dissolved oxygen concentration shall not fall below 5 to 6 mg/l (depending on the region in California). Some Regional Water Boards describe objectives in terms of percent saturation (i.e. the dissolved oxygen shall not fall below 80% saturation).

- For ocean waters, the dissolved oxygen concentration shall not be depressed more than 10 percent from that which occurs naturally.

[4] A water quality objective is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the uses of that particular waterbody and an antidegradation statement.

# Electrical Conductivity/Salinity

## What is Electrical Conductivity/Salinity?

Conductivity is the ability of water to conduct an electrical current. Dissolved ions in the water are conductors. The major positively charged ions are sodium, ($Na^{+}$) calcium ($Ca^{+2}$), potassium ($K^{+}$) and magnesium ($Mg^{+2}$). The major negatively charged ions are chloride ($Cl^{-}$), sulfate ($SO_4^{-2}$), carbonate ($CO_3^{-2}$), and bicarbonate ($HCO_3^{-}$). Nitrates ($NO_3^{-2}$) and phosphates ($PO_4^{-3}$) are minor contributors to conductivity, although very important biologically.

Salinity is a measure of the amount of salts in the water. Because dissolved ions increase salinity as well as conductivity, the two measures are related. The salts in seawater are primarily sodium chloride (NaCl). However, other saline waters, such as Mono Lake, owe their high salinity to a combination of dissolved ions including sodium, chloride, carbonate and sulfate.

## Why is it Important?

Conductivity can affect the quality of water used for irrigation or drinking. Most aquatic biota tolerate a range of conductivity. However, the ionic composition of the water can be critical. For example, cladocerans (water fleas) are far more sensitive to potassium chloride than sodium chloride at the same concentration.

Conductivity will vary with water source: ground water, water drained from agricultural fields, municipal wastewater, rainfall. Therefore, conductivity can indicate groundwater seepage or a sewage leak.

## How is it Measured?

Conductivity is measured by an electronic probe, which applies voltage between two electrodes. The drop in voltage is used to measure the resistance of the water, which is then converted to conductivity. Conductivity is the inverse of resistance and is measured in the amount of conductance over a certain distance. The units are "Φmhos/cm"[5].

---

[5] mhos is the reciprocal of ohms, the measure of resistance. For most natural waters, the units of mhos/cm are too large, so conductivity is reported as Φmhos/cm where $10^6$ x mhos is equal to one mho. Sometimes the units are expressed as microsiemens, µS (equal to Φmhos/cm).

Salinity can be measured using a hydrometer or a refractometer. The hydrometer measures specific gravity, which can then be converted to salinity. The refractometer measures the ability of the water to refract light. Scientists also measure salinity by determining the amount of chlorine in seawater. Salinity is measured in grams/liter (g/l) or parts per thousand (ppt) in seawater. In fresher waters, total dissolved solids are often measured instead of salinity. It is measured by filtering a sample, drying the water that has been filtered, and then weighing the remaining solids. TDS is the solid material left in the water after it has been dried and evaporated. The units of TDS are milligrams/liter (mg/l) or parts per million (ppm). Some conductivity probes will express the results in conductivity as well as TDS. These probes assume a constant relationship between conductivity and TDS.

## What Affects it in Water?

- Soil and rocks release ions into the waters that flow through or over them. The geology of a certain area will determine the amount and type of ions.
- The salinity and conductivity of coastal rivers is influenced by tides. Sea spray can carry salts into the air, which then fall back into the rivers with rainfall.
- The flow of rivers into estuaries can greatly affect salinity as well as the location of the estuarine mixing zone. This is very important to the survival of estuarine organisms.
- Fresh water lost by evaporation will increase the conductivity and salinity of the waterbody. Warm weather can increase ocean salinity.
- As temperature increases, conductivity increases. Salinity is the amount of salt actually present in the water; therefore, it is not dependent on temperature.

## What are Acceptable Ranges?

Here are some values of conductivity and salinity to give you an idea of possible ranges you might encounter. Waters that might have higher conductivity include:

- rivers or drainage ditches dominated by subsurface agricultural return flows
- ephemeral streams or pools late in the season
- tidally influenced coastal waters
- naturally saline lakes or ponds

**Conductivity of Water in Φmhos/cm**

| | |
|---|---|
| Distilled Water | 0.5 - 3.0 |
| Melted snow | 2 - 42 |
| Potable water in U.S. | 30 - 1500 |
| Irrigation Supply Water | < 750 |

## What are the Water Quality Objectives[6]?

The water quality objectives for conductivity vary from region to region. Check with the Regional Water Quality Control Board in your area. Water quality objectives are included in their Basin Plan. In some cases, there are no objectives for conductivity, but there are for total dissolved solids (TDS). Conductivity can be estimated from TDS values and vice versa. However, when monitoring to compare to water quality objectives you should monitor the appropriate parameter rather than a substitute. The following information is applicable to surface waters only (excluding the Pacific Ocean).

- **For the Lahontan Region: The mean annual electrical conductivity of Lake Tahoe shall not exceed 95 Φmhos/cm at 50 ºC at any location in the Lake. For other water bodies, there are objectives for total dissolved solids.**

[6] A water quality objective is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the uses of that particular waterbody and an antidegradation statement.

# Turbidity

## What is It?

Turbidity is a measure of suspended particles in the water. Algae, suspended sediment, organic matter and some pollutants, can cloud the water making it more turbid.

## Why is it Important?

Suspended particles diffuse sunlight and absorb heat. This increases temperature and reduces light available for algal photosynthesis. If the turbidity is caused by suspended sediment, it can be an indicator of erosion, either natural or man-made. High sediment loads can clog the gills of fish. Once sediment settles, it can foul gravel beds and smother fish eggs and benthic insects. Sediment can carry pathogens, pollutants and nutrients.

## How is It Measured?

- Turbidity meter - an observer measures how much light is scattered when directed at a water sample. Results are reported in nephelometric turbidity units (NTUs). The meters are also called nephelometers or turbidimeters. The expense of these meters (approximately $900) greatly limits their availability to volunteers.
- Turbidity tubes - an observer views an object through the water in a tube and visually compares it to a standard. Results can be converted to Jackson Turbidity units (JTUs).
- Secchi disc (for standing water only) - an observer measures the depth at which the secchi disc is no longer visible. Results are measured in feet or meters.

NTUs and JTUs should not be used interchangeably. JTUs are based on viewing an object through a tube of water. NTUs measure the light scattered at 90 degrees. While it is recommended that a nephelometer be used if you want to compare your results to water quality objectives expressed in NTUs, the turbidity tubes can be used to evaluate gross pollution problems or significant changes in turbidity.

## What Factors Affect It?

**Natural Factors**

- Algae and nutrient loading
- Seasonal weather, storm events
- Suspended sediment from erosion and transport
- Local stream morphology (where sediments are deposited or eroded)

**Human Factors**

- Erosion (i.e. removal of vegetation, changes in stream morphology or stream flow patterns)
- Excessive nutrient loading and algal growth

## What are Expected Turbidity Levels?

Since the rivers, lakes, bays and ocean waters are home to small, suspended plants and animals called plankton, turbid water is natural. The level of turbidity will vary from lake to lake and river to river depending on the nutrient loading, geology and stream dynamics. For example, Lake Tahoe is renowned for its clear water. On the other hand, the algae and nutrients in Clear Lake conspire to produce very turbid water.

Here are some typical turbidity values for different water bodies.

| Water Body | Turbidity Level |
|---|---|
| Water bodies with sparse plant and animal life | 0 JTU |
| Drinking water | <0.5 JTU |
| Typical groundwater | <1.0 JTU |
| Water bodies with moderate plant and animal life | 1 - 8 JTU |
| Water bodies with large plumes of planktonic life | 10 - 30 JTU |
| Muddy water or winter storm flows in rivers | 20 - 50 JTU |

Table is from *Water Quality Testing and Monitoring Program for Middle Schools and High Schools. San Diego County Water Authority.*

## What are the Water Quality Objectives[7]?

Water quality objectives are included in the Regional Water Quality Control Board's Basin Plans. Most of the nine Regions' water quality objectives for turbidity require that surface waters (except ocean waters) be free of changes in turbidity that cause nuisance or adversely affect the beneficial uses of water. In addition, most of the nine Regions' Basin Plans state that turbidity should not increase by a certain percent above naturally occurring levels. This information is summarized below.

- **In the Lahontan Region, turbidity shall not increase more than 10 percent above natural levels.**

[7] A water quality objective is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the uses of that particular waterbody and an antidegradation statement.