Know What You're Monitoring!

Since not all of us are water chemists, here is a brief understanding of what your different tools measure

Extech EC400 meters

- Salinity (SAL)
- Total Dissolved Solids (TDS)
- Conductivity (CON)
- Water Temperature (°C)

Testing Strips

- 5-way water check: pH, Total Alkalinity, Total Hardness, Total Chlorine, Free Chlorine
- Nitrate/Nitrite strips

Tools and Units

Extech EC400	unit	5 way water check	unit	Nitrate/Nitrite	unit
Total Dissolved Solids (TDS)	ppm or mg/L	pH	S.U.	Nitrate	ppm
Conductivity	µS	Total Hardness	ppm	Nitrite	ppm
Salinity	ppm	Total Chlorine	ppm		
Water Temperature	°C	Free Chlorine	ppm		
		Total Alkalinity	ppm		

Measurement Unit Definitions

mg/L (milligrams per liter)	Measures concentration of grams in a liter of water (or other liquid or gas)
ppm (parts per million)	Measures very dilute concentrations: a part of something in a larger total amount
µS (micro siemens per cm.)	Measures electric conductance
S.U. (standard units)	pH is measured on a scale of 1-14; SU reflects that scale's values.

Extech EC400

TOTAL DISSOLVED SOLIDS (TDS)

Definition: TDS measures the combined amount of dissolved organic and inorganic substances in the water other than pure H20.
Unit: ppm or mg/L

Natural sources: leaves, plankton, weathering and dissolution of rocks and soils
Man-made sources: Agricultural, residential runoff, leaching of soil contamination, point-source water pollution from industrial sites or sewage treatment plants, runoff from de-icing salts

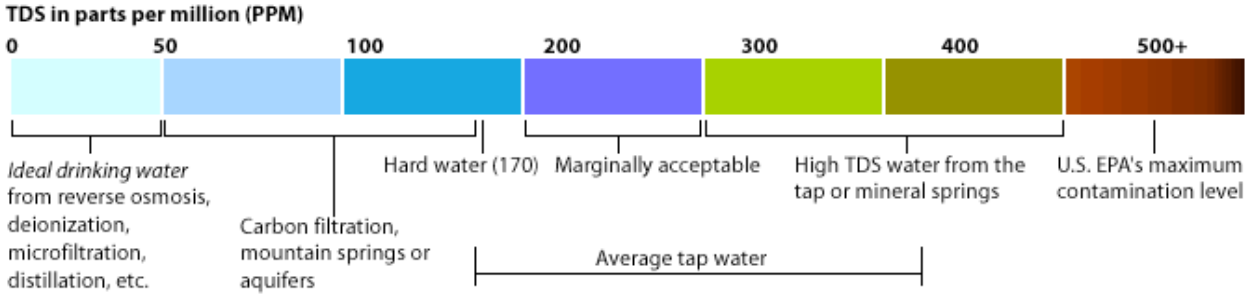
Most common chemicals: calcium, phosphorous, nitrates, sodium, potassium, chloride
High levels are often caused by high amounts of potassium, chlorides and sodium. However, they may also be caused by the presence of toxic ions: lead, arsenic, cadmium, nitrate

US EPA Levels for Drinking Water

Unsafe
> 500 (mg/L)

High levels can produce a laxative effect… Yikes!

Drinking Water TDS Standards



Surface Water TDS Standards

A certain level of TDS ions are necessary for aquatic life. Fluctuations in TDS concentrations, however, can be harmful as TDS levels affect the flow of water into and out of an organism's cells. Unsafe levels of TDS can degrade and diminish aquatic life.[1]

A few cases have shown spawning and juvenile fish to be very sensitive to TDS levels. Ex: In San Francisco Bay-Delta, areas with 350 mg/L of TDS showed reduced levels of spawning Striped Bass; concentrations below 200 mg/L promoted healthier spawning.[2]

US EPA Levels for Surface Water

Unsafe
Streams > 1500 mg/l
Lake Erie > 200 mg/l

Usually, freshwater aquatic ecosystems involving mixed fish fauna can tolerate TDS levels of 1000 mg/L.

[1] Mitchell and Stapp, 1992 Field manual for water quality monitoring: An Environmental Education Program for Schools
[2] Kaiser Engineers, *Final Report to the State of California, San Francisco Bay-Delta Water Quality Control Program* (1969)

CONDUCTIVITY[3]

Definition: Conductivity measures the ability of an electrical current to pass through water. Levels of conductivity are affected by the presence of **inorganic** dissolved solids.
Unit: µS/cm

Natural sources: Geology of the area, water temperature, size of watershed
Man-made sources: Agricultural, residential runoff, leaching of soil contamination, point-source water pollution from industrial or sewage treatment plants, runoff from de-icing salts

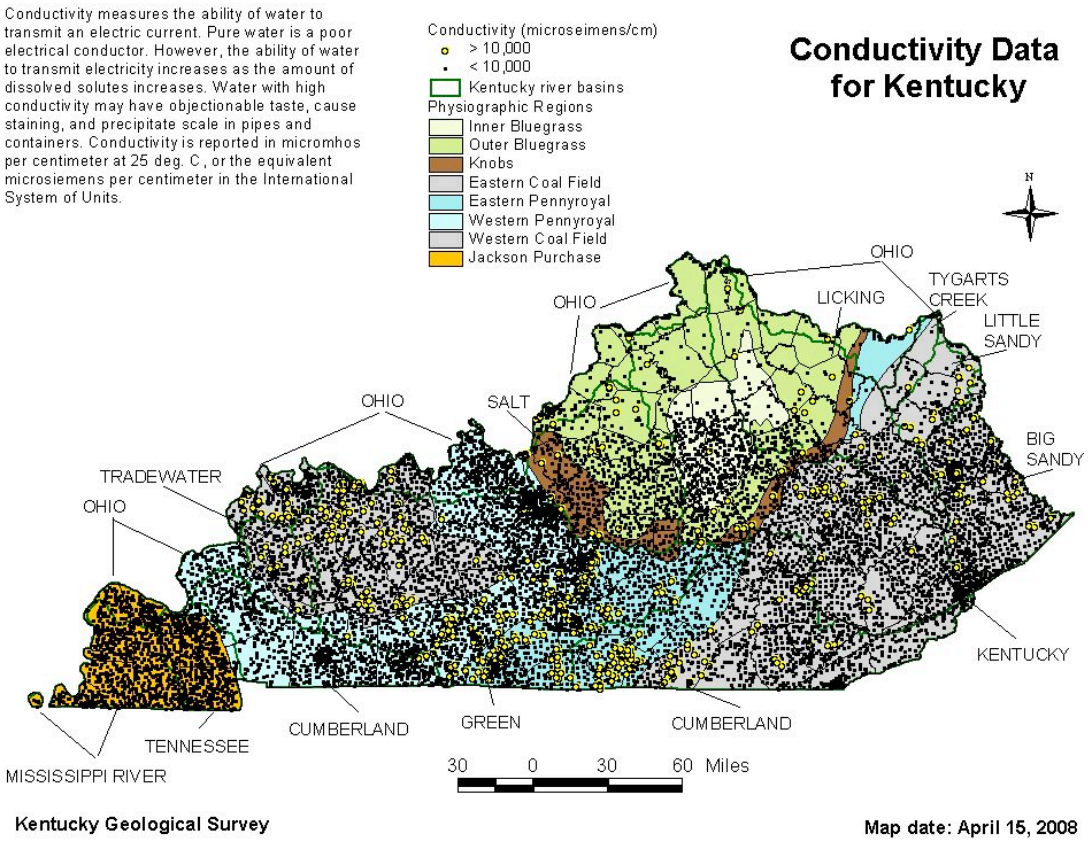
Most common chemicals: chloride, nitrate, sulfate, and phosphate negative ions (anions), sodium, magnesium, calcium, iron, aluminum positive ions (cations).

High levels of Conductivity may be caused by high water temperatures, presence of clay, metals
Low levels of Conductivity may be caused by organic compounds such as oil (oil spills), phenol, alcohol, sugar, and presence of granite

US EPA Levels for Drinking Water

Distilled water = **0.5 – 3 µS**
Drinking water **> 500 µS**
Historical Data Avg.: **641 µS**

Each stream tends to have a relatively constant range that can be used as a baseline; significant changes could indicate a discharge or other source of pollution has entered a stream.



US EPA Levels for Surface Water

Unsafe
Streams **> 500 µS**

Rivers **> 1500 µS**

Historical Range
50-1500 µS

Industrial Waters
Up to 10,000 µS

[3] US EPA, *Water Monitoring and Assessment,* "What is Conductivity and why is it important?" http://water.epa.gov/type/rsl/monitoring/vms59.cfm

SALINITY

Definition: The total of all non-carbonate salts dissolved in water; can often be detected by an increase in chloride.
Unit: ppm

Natural sources: River streambeds with salt-containing minerals
Man-made sources: Runoff from salted roads, impervious surface coverage/stormwater runoff, irrigation water returned to streams, chlorinated drinking water, water softener regeneration, fertilizers and pesticides
Most common chemicals: calcium, sodium, chloride, and carbonate.

This diagram shows salinity in parts per thousand (ppt). For parts per million (ppm), multiply by 1000. Example:
Freshwater = between 0 and 500 ppm,
Brine water =50,000 ppm

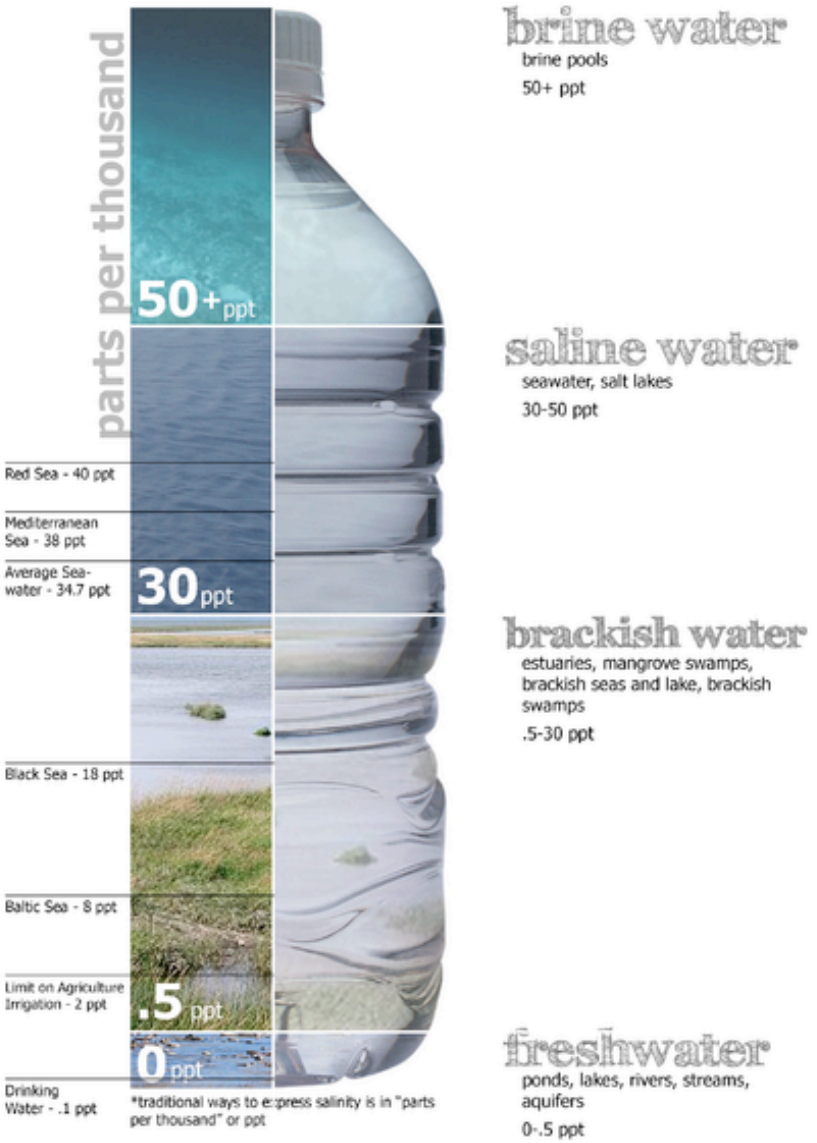
US EPA Levels for Drinking Water

Unsafe
> 250 ppm

US EPA Levels for Surface Water

250 ppm: harmful to freshwater life

1,000 ppm: lethal and sublethal effects on aquatic plants and invertebrates



5-way water check

pH[4,5]

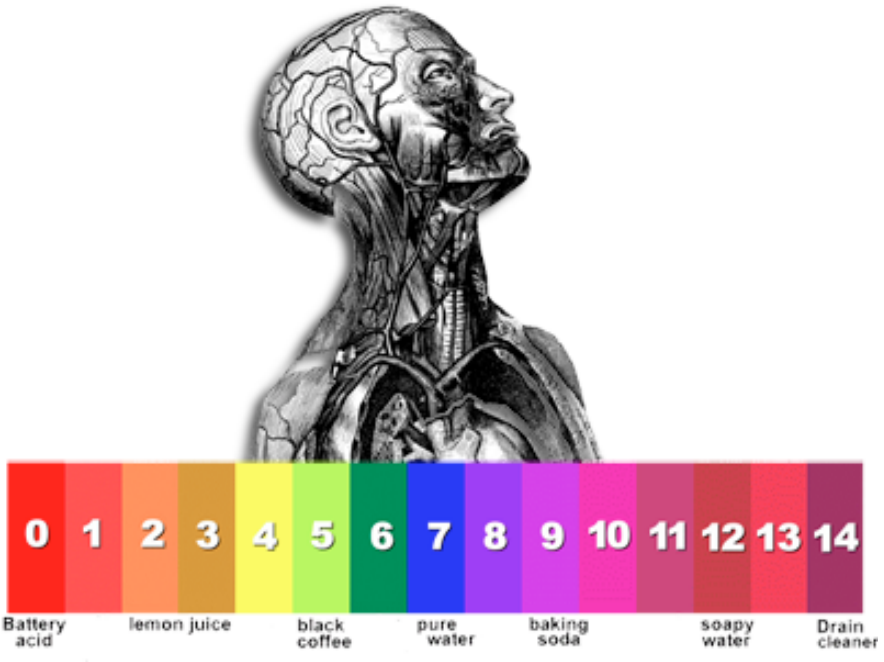
Definition: pH measures the acidity or alkalinity (base) of a solution.
Unit: S.U.

pH Scale: 0 to 14
Neutral water = **7**
Acidic **< 7**
Basic **> 7**

***** pH of 6 is 10x more acidic than a pH of 7 and 100x more acidic than pH of 8

Natural sources
Low pH values (acidic): Decomposing pine or fir needles; granite rock; snow melt, unpolluted rain; stormwater runoff that reaches stream before percolating through soil
Higher pH values (basic): Calcium carbonate present in soil or rock act as buffers to acid; aquatic plant photosynthesis: highest levels in the late afternoon

Man-made sources
Low pH values (acidic): Acid rain caused by pollution from industrial or large urban areas (sulfuric acid from coal, nitric acid from cars); point source pollution; mining: exposes rocks to rain water and produces acidic runoff.
Low pH levels can make already present ammonia increasingly toxic.
Heavy metals such as cadmium, lead, and chromium dissolve more easily in lower pH levels; many chemicals become more toxic when dissolved
High pH values (basic): fertilizer and sewage runoff. High pH, phosphorous, and water temperature are breeding grounds for algae



US EPA Levels for Drinking Water

pH Range: 6.5 – 8.5 S.U.

US EPA Levels for Surface Water

pH Range: 6.5 – 9 S.U.

[4] US EPA, National Recommended Water Quality Criteria, http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
[5] US EPA, Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals, http://water.epa.gov/drink/contaminants/secondarystandards.cfm

Total Hardness

Definition: Measure of mineral content in water.
Unit: ppm
Common Chemicals: Calcium: Calcite & Gypsum, Magnesium

Water hardness does not have an effect on human health but does cause problems in industrial settings with clogging.

Healthy range: Calcium (40-80 ppm) and Magnesium (20-30 ppm)

Total Chlorine

Definition: Measure of both free and combined forms of chlorine.
Unit: ppm

Combined chlorine is free chlorine that has reacted with other substances in water and has therefore made the free chlorine less toxic.

Free Chlorine

Free Chlorine (chlorine gas dissolved in water) is toxic to fish and other aquatic organisms, even in small amounts.

If water contains a lot of decaying materials, free chlorine can combine with them to form trihalomethanes (THMs). Some high concentrations of these are carcinogenic and persist in water for a long time.

Total Alkalinity

Total alkalinity is the amount of acid needed to bring a water sample to a pH of 4.2 S.U.
At this level, all of the alkaline compounds are used up.

Nitrate

Nitrates are mainly used in fertilizers because they are highly soluble and biodegradable. Other sources include raw sewage and livestock feedlots. Nitrates refer to ammonium, sodium, potassium, and calcium salts. In freshwater, nitrate levels over 30 ppm can impact aquatic species by inhibiting growth, impairing immune systems, and causing stress.

Nitrite

Once consumed, Nitrates turn to Nitrites. Other sources include runoff from fertilizer use; leaching from septic tanks, sewage; and erosion of natural deposits. The Maximum Contaminant Level Goal for Nitrites is 1 ppm. An effective treatment to remove nitrites from drinking water is reverse osmosis.