

Physical Properties of Natural Waters

Inherent properties of water that do not rely on chemical reaction

- temperature, density
- colour, taste/odour
- turbidity, conductivity
- solids (dissolved and suspended) TDS and TSS
- oxidation-reduction potential

Alkalinity and Hardness also included as ‘physical properties’, however these are actually measures of chemical concentrations.

alkalinity (total, aka: methyl orange vs phenothalein)
→ related to *Acid Neutralizing Capacity* (ANC)

hardness (total vs calcium)

COLOUR – due to the presence of a complex array of large organic molecules (humic and fulvic acids from the degradation of vegetative matter) complexed to certain metallic species particularly Fe^{3+} and Mn^{2+} .

World Health Organization (WHO) sets aesthetic limit of 15 CU
European Union (EU) has aesthetic limit of 20 CU

Most surface waters has colour < 1 – 5 CU

Colour may be due to natural and anthropogenic sources.

TURBIDITY – A measure of the light scattering ability of a water sample due to the presence of suspended particles. Roughly correlated with *Total Suspended Solids* (TSS)

Units:

Drinking waters	< 1 NTU
Rivers streams	~ 1 -10 NTUs
Storm events and erosion	> 500 NTUs

Lakes – wide range depending on ‘productivity’

CONDUCTIVITY – ability of a sample to allow the passage of an electrical current. It depends on the concentration of all ions, the temperature, the configuration of the conductivity cell (probe) and the inherent mobility of each ion (size, charge etc).

Units

Correlated with *Total Dissolved Solids* (TDS). Therefore, conductivity is used as a surrogate for TDS. Conversion factors to convert $\mu\text{S cm}^{-1}$ to mg/L NaCl are specific to water source. Typically use $0.65 \text{ mg L}^{-1} \text{ NaCl}$ per $\mu\text{S cm}^{-1}$.

TDS meters are actually conductivity meters in disguise.

High conductivity can be indicative of

- coastal inflow in groundwater sources
- effluent contamination
- increased mineral leaching

Conductivity often used as crude monitor of efficiencies of water treatment systems
Canadian Drinking Water Guidelines (CDWG) are aesthetic 500 mg/L as **NaCl**

OXIDATION – REDUCTION POTENTIAL: a measure of the oxidizing ability of a sample. Affects the speciation of many chemical constituents. Different ORP meters are constructed using different reference electrodes, therefore corrections may need to be incorporated to compare values to those recorded versus a Standard Hydrogen Electrode (SHE).

General ORP ranges:

ORP < -200 mV anaerobic environment (reduced oxidation states) – low pe

ORP > 0 mV aerobic environment (high oxidation states) – high pe

ORP between -200 and 0 mV transitional environment