

## APPENDIX D. Water Quality Parameters

### Dissolved Oxygen

Dissolved oxygen is oxygen that has been dissolved into water. It can come from the atmosphere or from plants through photosynthesis. Oxygen becomes dissolved in water until it reaches a saturation point. However, super saturation can occur – one source being excess oxygen being produced by vegetation through photosynthesis. Cool water can hold more oxygen than warm water. A standard value for DO is greater than 5mg/L and not less than 4mg/L. Typical ranges are from 5.4mg/L to 14.2mg/L, while the Indiana average is 9.8mg/L. When measured as parts per million (ppm), levels of 5-6ppm are considered healthy, levels around 3ppm are considered stressful, and levels ranging from 1-2ppm are when fish die. DO levels are most stressful on aquatic life during hot mornings when the water is less saturated, water flow is low, and aquatic plants haven't begun producing oxygen through photosynthesis since sunset of the previous day.

### Temperature

The temperature of the water plays a vital role in the natural processes of aquatic life. Animal metabolic rates are very sensitive to temperature. Animals in the early stages of life are very sensitive to temperature fluctuations. Temperature also affects the rate at which aquatic plants photosynthesize and produce oxygen. Cooler temperatures allow for the water to hold greater concentrations of oxygen which is better for the aquatic wildlife.

### pH

pH is a measure of the hydrogen ions in a substance. A lower value represents greater acidity, while higher values represent greater alkalinity. Seven is the middle of the 0 to 14 scale and is considered the most neutral of pH values. pH values from 6.5 to 8.2 are considered best for aquatic animals as they encourage wildlife diversity. Many natural waters can be found to have a pH value ranging from 5 to 8.5. Aquatic plants can impact pH levels during active periods of photosynthesis and respiration, resulting in a more alkaline or acidic environment respectively. As the pH in water decreases, the solubility of some heavy metals in the water increases, this can have detrimental effects on the wildlife.

### Phosphorus

Phosphorus is a necessary element for life. It occurs naturally in the environment. However, phosphorus levels can increase because of many reasons. Effluent from waste water treatment plants, fertilizer runoff, animal manure runoff, drained wetlands, different kinds of soils, commercial cleaning products and other sources are potential hazards to the phosphorus levels in natural surface waters. Phosphorus levels greater than 0.03 ppm can encourage excessive plant growth. As this plant matter begins to decompose, microorganisms use up the oxygen in the water leading to low dissolved oxygen levels. Due to the nature of the phosphorus cycle, phosphorus can only be removed from the aquatic system by physical removal. Orthophosphates are a specific form of phosphorus found in nature that is readily available to be taken up by vegetation. Measured orthophosphates can be used as a good indicator of total phosphorus levels.

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### Nitrogen

Nitrogen is another critical compound for all life. It is commonly found in water as the compounds Nitrate (NO<sub>3</sub>), Nitrite (NO<sub>2</sub>), and ammonia (NH<sub>3</sub>). Nitrogen can enter the water from human and animal wastes, decomposing organic matter, and from fertilizer runoff. Sewage is the greatest source of nitrates in the surface water of Indiana. Generally, waters with nitrate levels below 4 ppm are considered unpolluted. When nitrate levels increase to above 10 ppm and nitrite levels are over 3.3 ppm, the water is considered unsafe to drink. When measured in mg/L, a typical range for nitrates is 0 to 36.08. The average level for this in Indiana is 12.32 mg/L.

### Total Suspended Solids

Suspended solids are objects in the water that can be trapped by a filter. Generally, these solids refer to smaller particles that don't dissolve into the water. These suspended solids can block sunlight and keep it from reaching underwater vegetation. They can increase the temperature of the water as they absorb sunlight. They can decrease visibility in the water, reduce growth and decrease disease resistance in animals, clog the gills of fish, smother eggs of aquatic animals, suffocate larvae, and increase the amount of bacteria, nutrients, pesticides, and metals in the water. Waters with faster flows may increase the amount of suspended solids either from land sediment or by resuspending solids that had settled at the bottom of a waterway. These solids can come from a variety of places including runoff from urban areas, erosion, waste water treatment plants, septic systems, and decaying organic matter.

### E. Coli

Escherichia coli are a kind of fecal bacteria. Sources of *E. coli* in water include humans, livestock, and even waterfowl. It can enter the water via combined sewers, septic systems, or runoff from agricultural feedlots. It can enter the human body through the mouth, nose, eyes, ears, or cuts or abrasions in the skin. When testing for *E. coli*, it is only considered an indicator for fecal contamination as not all strains of *E. coli* are pathogenic. According to the U.S. Environmental Protection Agency (EPA), counts of *E. coli* colonies greater than 235/100mL indicate that more than 8 people of every 1,000 who come in contact with the water may become ill. Higher counts indicate a greater risk of illness. Factors that increase the chance of illness include duration of contact with the water, whether or not eyes and mouth come into contact, wounds on the skin, age, and overall health.

### Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a general assessment of the quality of a stream habitat. A total of seven metrics are measured and scored for a maximum total of 100 points (higher scores being better). The seven metrics (with subcategories) include:

1. Substrate (type and quality)
2. Instream Cover (type and amount)
3. Channel Morphology (sinuosity, development, channelization, and stability)
4. Riparian Zone (width, quality, and bank erosion)
5. Pool Quality (depth, current type, and morphology)
6. Riffle Quality (depth, substrate stability, and embeddedness)
7. Map Gradient

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### Macroinvertebrate Biotic Integrity Index (mBI)

This index indirectly measures the quality of the water by evaluating the number, types, and diversity of indicator aquatic invertebrate species in the water. Generally, the inclusion of certain species, a high number of certain species, and a great diversity of various species indicates healthier and more pollutant-free waters.