Front of Card

(name with color banner for parameter type Chemical (yellow), Biological (green) or physical (blue)

Definition:

Water Quality Impacts:

(A brief description of its affects on water quality)

Sources:

(A list of common sources or causes)

Back of Card

(name with color banner for parameter type Chemical (yellow), Biological (green) or physical (blue)

Source Examples:

Common examples

Targets:

Typical targets for Indiana waters or "ideal /detrimental" assessment of waterbody

Limits:

Indiana or US EPA requirements or guidance limits or "N/A" for not applicable

Non-point source symbol

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

point source symbol

Cut lines

This is the "example / explanation" card

Front of Card

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WATER QUALITY QUICK-CARDS

Overview

These cards provide a basic understanding of the main parameters that scientists collect to gain an understanding of the health of a water body and its biota. Some of the parameters require laboratory analysis while others can be directly measured in the waterbody.

For all of these parameters, it is important to collect *numerous* measurements and track the results over time. Multiple readings on any waterbody using the same locations and methods will better allow for the identification of adverse impacts or changes in the water body.

WATER QUALITY QUICK-CARDS

Overview Continued

Each of the cards have been designed in a standard layout in order to provide identicle key details for each of the water quality parameters. The color banner across the top of each card is used to indicate if the parameter is a biological (green), chemical (yellow) or physical (blue) reading.

For additional information please reference the document: *https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf*

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<u>Glossary of Terms:</u>

Biome – a community of organisms that together create the "biology" in and near the water
Biota – The characteristic set of organisms within a region or waterbody
Blooms – A distinct rapid growth in plant or bacteria (e.g. algae)
DNR – Indiana Department of Natural Resources
Eutrophication – an increase in nitrogen and phosphorus develops an imbalance in the water thereby creating large blooms and creating an environment that limits or alters the biome
IDEM – Indiana Department of Environmental Management
IN - Indiana
MCL – Maximum Contaminant Level
NP – (Non-point source) A source of material that results in environmental impacts or contamination of a waterbody and enters the water over a large diffuse area as opposed to a Point Source (PS)

(continued on back)

<u>Glossary of Terms (continued):</u>

OEPA – Ohio Environmental Protection Agency
Photosynthetic – The ability of an organism to utilize sunlight as a source of energy
ppb – parts per billion (1 in 1,000,000,000)
ppm – parts per million (1 in 1,000,000)
PS – (Point Source) A source of material that results in an environmental impact and can be attributed to a know location(s) as apposed to a Non-Point Source.
Secchi Disk – An engineered viewing disk that measures the depth of light traveling through the water and used to measure the clarity of the water
US EPA – United States Environmental Protection Agency
WQS – Water Quality Standard
WWTP – Waste Water Treatment Plant

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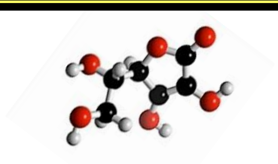
Chemical Parameters

Chemical parameters are collected to understand some of the key compounds that may indicate contamination or changing conditions of the water body. There are numerous chemical measurements that can be measured, however the following six parameters are the most common measurements that indicate water quality conditions.

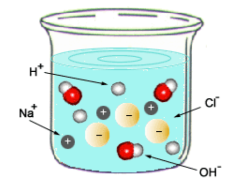
As with all other parameters it is important to collect numerous measurements and track the results over time.



Chemical Parameters

There is a Quick Card for each of the following chemical parameters:

1. Total Phosphorus,
2. Ammonia,
3. Biochemical Oxygen Demand,
4. Nitrate + Nitrite,
5. Total Nitrogen, and
6. Total Kjeldahl Nitrogen



Total Phosphorus

Definition:

The total concentration of the most common phosphorus containing molecules in our environment. This includes: organic phosphorus, orthophosphate, and polyphosphates (least common). Phosphorus is usually a limiting nutrient in natural aquatic biome.

Water Quality Impacts:

Any elevated concentrations nutrients, such as phosphorus, can dramatically increase microbial and algal growth, stress fish and aquatic insect communities and fluctuate dissolved oxygen (DO) levels.

Sources:

Elevated levels often occur during high flow conditions due to storm water runoff. Many WWTPs do not treat for phosphorus and therefore can elevate levels during low flow conditions.

Total Phosphorus

Source Examples:

grass clippings, leaves, lawn fertilizers, WWTPs, agricultural runoff, field tiles, industry, manure application on agricultural fields and its runoff

Targets:

<0.3 mg/L (IDEM Target)

Limits:

<0.08 mg/L OEPA criteria to protect aquatic communities
Levels >0.03 mg/L can produce nuisance algae blooms in lakes

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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Ammonia

Definition:

A colorless gas that is very soluble in water. It is one of the most common forms of nitrogen due to human activity related to biological-based waste in streams. Ammonia (NH_3) is a toxic form of nitrogen with a strong pungent odor, formed when organic matter breaks down in water. Ammonia levels are dependent on pH and Temp (>pH and temp = more toxic ammonia).

Water Quality Impacts:

Fish communities are extremely sensitive to ammonia. Fish can begin to die when ammonia reaches 0.2 mg/L.

Sources:

Natural break-down of plant material in the water (this can be dramatically increased due to human activity such as grass or lawn material dumping in or near a water body).

Ammonia

Source Examples:

grass clippings, leaves, agricultural nutrient application, WWTPs

Targets:

WQS dependent on pH and temperature but in general: max 0.0075 mg/L - 0.0294 mg/L; average 0.0005 mg/L - 0.0294 mg/L

Limits:

> 0.06 mg/L can impact fish; > 2.0 mg/L can kill tolerant fish

NP

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Biochemical Oxygen Demand (BOD)

Definition:

Biochemical oxygen demand (BOD) is the measure of oxygen used by aerobic (oxygen-consuming biota like fish and bacteria) as they break down organic wastes over a specific time period. The more biota the more demand it will have on the oxygen levels in the water.

Water Quality Impacts:

The greater the BOD the more oxygen is demanded by the biota. If there are a lot of plants using the oxygen it can reduce the amount of oxygen available to native biome such as fish and stress and kill them

Sources:

There is an unnatural demand on the available oxygen for other biota (such as fish) when there are large blooms of plant materials, such as algae. The plants outcompete other biota by using all the available oxygen.

Biochemical Oxygen Demand (BOD)

Source Examples:

grass clippings, leaves, large algal or plant blooms, stagnant water conditions

Targets:

1 - 2 mg/L (clean water); 3 - 5 mg/L (fairly clean); 6 - 9 mg/L (excess organic matter); 10+ mg/L (very poor water quality)

Limits:

there is no limit, this is based on site-specific aquatic ecology

NP

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Nitrate + Nitrite

Definition:

Nitrogen is the most abundant element in the Earth's atmosphere. The nitrogen cycle is one of the major chemical sequence to produce biological activity. Nitrate and Nitrite are the two basic molecules of inorganic nitrogen and therefore often measured together. Nitrate is much more stable and common in the earth's waters than Nitrite.

Water Quality Impacts:

Nitrates can be toxic at high concentrations and even limit oxygen in low concentrations. Elevated levels can cause eutrophication of lakes and areas of low dissolved oxygen in salt water (i.e. Gulf Of Mexico Hypoxia).

Sources:

Elevated levels often occur in the Spring as a result of tile drains in agricultural land use. Many WWTPs do not treat for nitrogen and therefore can elevate levels during low flow conditions.

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Nitrate + Nitrite

Source Examples:

Animal farms, agricultural runoff, fertilizers, industry, WWTPs

Targets:

< 10 mg/L (IDEM Drinking Water Standard)
<1 mg/L (OEPA criteria for warm water habitat)

Limits:

Levels > 1 mg/L indicate human influence

NP

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Orthophosphate

Definition:

Orthophosphate is an inorganic form of phosphorus, a nutrient required for the basic processes of life but, when it is highly concentrated can cause eutrophication.

Water Quality Impacts:

The amount of orthophosphate constitutes an index of the amount of phosphorus available for algal growth. Excessive algal growth can cause low DO, algal blooms, taste and odor problems and lower recreational value.

Sources:

Elevated levels often occur during high flow conditions due to storm water runoff. Other forms of phosphorus can be converted to orthophosphate and other acids.

Orthophosphate

Source Examples:

grass clippings, leaves, lawn fertilizers, WWTPs, agricultural runoff, field tile runoff, industry, manure application on agricultural fields

Targets:

NA

Limits:

>0.005 mg/L causes eutrophic or highly productive conditions in lake systems; Median concentration of 0.02 mg/L in IN lakes (2010)

NP

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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Total Nitrogen

Definition:

The total concentration of the most common nitrogen containing molecules in our environment. This includes: total kjeldahl nitrogen, ammonia nitrogen, nitrate, and nitrite.

Water Quality Impacts:

Elevated nutrient levels can impact algal growth, fish and aquatic insect communities and DO levels. Elevated levels lead to excess plant growth and decay, low DO and reductions in water quality.

Sources:

Elevated levels often occur in the Spring as a result of tile drains in agricultural land use. Many WWTPs do not treat for nitrogen and therefore can contribute to elevate levels during low flow conditions.

Total Nitrogen

Source Examples:

grass clippings, leaves, lawn fertilizers, WWTPs, agricultural runoff, field tiles, industry, manure application on agricultural fields

Targets:

< 10 mg/L (IDEM Target)

Limits:

Too much creates eutrophication of streams and lakes and decreases the resources values, for recreation, fishing, hunting and aesthetic enjoyment.

NP

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Total Kjeldahl Nitrogen (TKN)

Definition:

This is a summation of the two most common forms of nitrogen (ammonia + organic nitrogen) and are related to the discharge of biologically active waters.

Water Quality Impacts:

Elevated nutrient levels can impact algal growth, fish and aquatic insect communities and DO levels. High levels result from sewage and manure discharges to waters.

Sources:

Decaying organic material (plants, animal waste, urban and industrial disposal of sewage.

Total Kjeldahl Nitrogen (TKN)

Source Examples:

grass clippings, leaves, lawn fertilizers, WWTPs, agricultural runoff, field tiles, industry, manure application on agricultural fields

Targets:

US EPA Proposed Criteria:
Central Corn Belt Plains – <0.66 mg/L; Eastern Corn Belt Plains - <0.4 mg/L; S Michigan/N IN Drift Plains - <0.58 mg/L; Huron/Erie Lake Plain - <0.65 mg/L; Interior Plateau - <0.28 mg/L; Interior River Lowland - <0.54 mg/L

NP

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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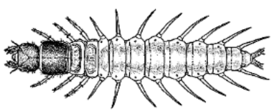
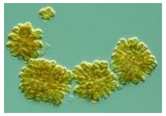
Biological Parameters

Biological information is collected to understand key characteristics about the overall condition of the waterbody based on the biota. Some parameters may lead to public health advisories while others indicate potential water quality problems. There are numerous chemical measurements that can be measured, however the following 4 parameters are common measurements that indicate water quality conditions.

As with all other parameters it is important to collect numerous measurements and track the results over time.

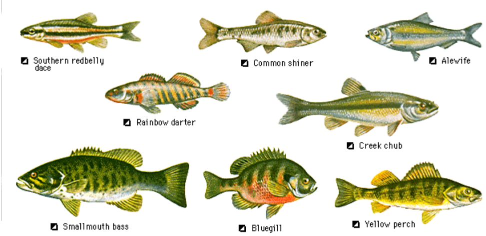


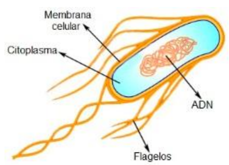


Biological Parameters

There is a Quick Card for each of the following biological parameters:

1. Chlorophyll a
2. *E. coli*
3. Fish and Macroinvertebrate Index of Biotic Integrity (IBI)
4. Blue – Green Algae





Chlorophyll a

Definition:

Chlorophyll a is one of the most important pigments used for photosynthesis. It is what causes the green coloring of algae and plants. Chlorophyll a is the most common pigment in algae so sampling for it allows for an indirect estimate of the amount of algal biomass in surface waters.

Water Quality Impacts:

Chlorophyll a sampling can indicate the amount of algae in the water. The right amount of algae is needed to maintain a balanced food web .

Sources:

Chlorophyll a can be used as a direct indicator of an overactive plant growth in the environment. Overproduction of plant growth (e.g. algae) can stress the rest of the biome.

Chlorophyll a

Source Examples:

grass clippings, leaves, agricultural nutrient application

Targets:

US EPA proposed criteria by ecoregion:

- Central Corn Belt Plain - 2 ug/L
- Eastern Corn Belt Plain - inconclusive
- S Michigan/IN Drift Plains - 3.5 ug/L
- Huron/Erie Lake Plain - 3.2 ug/L
- Interior Plateau - 3.9 ug/L
- Interior River Lowland - 1.5 ug/L

NP

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Escherichia coli (E. coli)

Definition:

E. coli is a bacteria found in the fecal waste of warm-blooded mammals (i.e. humans, cattle, wildlife). *E. coli* measurements are used only as an indicator of contamination by fecal waste materials.

Water Quality Impacts:

E. coli indicates there is likely fecal waste in streams and additional toxic microbes could also be present. These microbes can lead to illness or infections (i.e. nausea, diarrhea, dysentery, hepatitis) after swimming in polluted water.

Sources:

E. Coli is a direct result of contamination with warm-blooded fecal matter. Typically direct contamination or runoff or drainage from poorly managed waste streams flowing into the water.

Back of Card

Escherichia coli (E. coli)

Source Examples:

WWTPs, combined sewers, failed septic systems, dog poop, animal operations, manure application on agricultural land

Targets:

< 125 CFU/100 mL geometric mean (5 samples collected 5 consecutive weeks) or < 235 CFU/100 mL from a single sampling event

Limits:

NA

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Fish and Macroinvertebrate Index of Biotic Integrity (IBI)

Definition:

An index of Biotic Integrity (IBI) is a statistically based scientific tool used to identify and classify water pollution problems through the inventory of plainly visible fish and bugs in the water body. High scores indicate a good healthy biom and waterbody.

Water Quality Impacts:

The IBI is a standardized way to compare sites along a stream across geographic areas. Comparing scores over time can show water quality improvement or degradation.

Sources:

An IBI is calculated using 12 metrics, including # of individuals, species diversity, # of deformities, and other trophic and community characteristics. Scoring and metrics vary depending on the ecoregion and the drainage area.

Back of Card

Fish and Macroinvertebrate Index of Biotic Integrity (IBI)

Source Examples:

NA (This is a standardized classification of a the health of a waterbody)

Targets:

Excellent 53-60; Good 45-52; Fair 35-44; Poor 23-34; Very Poor < 22

Limits:

The scores range from 0-60 and a score < 36 is impaired

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Blue Green Algae

Definition:

A group of photosynthetic bacteria found in a wide range of water bodies. Periods of significant growth occur during the warm season (between May and October in Indiana).

Water Quality Impacts:

This algae can produce toxins which can cause skin irritation, sickness and death to livestock and dogs. The algae can create taste and odor problems and fish kills as the decaying algae consumes oxygen.

Sources:

Warm temperatures combined with elevated levels of nutrients in the water.

Blue Green Algae

Source Examples:

grass clippings, leaves, lawn fertilizers, sediment runoff, failing septic systems, agricultural nutrient application, WWTPs

Targets:

Health Advisory if algal cell counts > 100,000 cells/mL, microcystin toxin level > 6 ppb, cylindrospermopsin toxin > 5ppb or anatoxin-a toxin > 80 ppb

Limits:

Swimming beaches will close if microcystin toxin reaches 20 ppb

NP

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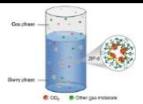
Physical Parameters

Physical characteristics of waterbodies are determined by senses of touch, sight, smell and taste. The information collected is used to understand some of the properties, functions, and landscape influences of the waterbody. There are numerous physical measurements that can be measured, however the following 12 parameters are common measurements that indicate physical stream characteristics and/or water quality conditions.

As with all other parameters it is important to collect numerous measurements and track the results over time.



Physical Parameters

There is a Quick Card for each of the following physical parameters:

1. Carlson's Trophic State Index (CTSI)
2. Citizens Qualitative Habitat Evaluation Index (CQHEI)
3. Dissolved Oxygen (DO)
4. Electrical Conductivity (EC)
5. Indian Trophic State Index
6. pH
7. Qualitative Habitat Evaluation Index (QHEI)
8. Richards-Baker Flashiness Index
9. Rosgen Stream Classification System
10. Suspended Sediment Concentration (SSC)
11. Temperature
12. Total Dissolved Solids (TDS)

Indiana Trophic State Index

Definition:

A standardized multi-metric index using physical, chemical and biological data from a lake. The index is used to classify lakes based on eutrophication using nutrient levels, DO levels, water clarity, and plankton cell counts.

Water Quality Impacts:

Eutrophication of lakes impact the fish by creating low DO zones, create problems for drinking water facilities, cause odor problems and decreases recreational value.

Sources:

This index requires few resources and little training. Understanding lake classification can help guide approaches to lake management. Trophic state data can be useful when repeated from year to year.

Indiana Trophic State Index

Source Examples:

N/A (This multifaceted indexing system used by the IN Clean Lakes Program.)

Targets:

0 - 15 is Oligotrophic (highest quality); 16 - 31 is Mesotrophic (intermediate); 32 – 46 Eutrophic (low quality); > 47 Hypereutrophic (lowest quality)

Limits:

Score ranges from 0 - 75

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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Carlson's Trophic State Index (CTSI)

Definition:

The Carlson TSI is a measure of the trophic status of a body of water using several measures of water quality including: transparency or turbidity (using a secchi disk), chlorophyll-a concentrations (algal biomass), and total phosphorus levels. This index is a simple and quick way to demonstrate the associations between water clarity, nutrients and overall algal biomass, to classify and rank lakes.

Water Quality Impacts:

This parameter does not have impacts it measures the overall health of the lake.

Sources:

High nutrient levels lead to Eutrophic and Hypereutrophic classification. Eutrophication of streams and lakes often decreases the resources value, hindering the recreation, fishing, hunting and aesthetic enjoyment.

Carlson's Trophic State Index (CTSI)

Source Examples:

N/A (This is a standard assessment tool. Often used in volunteer lake programs.)

Targets:

< 40 Oligotrophic (highest quality); 40 - 50 Mesotrophic (intermediate)
50 - 60 Eutrophic (low quality); > 60 Hypereutrophic (lowest quality)

Limits:

Scores from 0 - 100

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Electrical Conductivity (EC)

Definition:

Electrical conductivity is the measure of the ability of water to pass an electrical current. There are a variety of solids that can occur in the dissolved phase depending on the inherent capacity of the water body to maintain this suspended or dissolved load of solids.

Water Quality Impacts:

This measurement is typically a sign of a change in water chemistry and large variations could indicate contamination. However, its measurement alone will not be a direct impact to the waterbody.

Sources:

Dissolved and suspended solids can increase the electrical conductivity. Distilled water or deionized water will have no conductivity. All natural waters will always have some level of EC.

Electrical Conductivity (EC)

Source Examples:

Excessive algae or plant growth or higher temperatures in the waterbody, industry, mining activities, limestone

Targets:

< 1,200 microhoms/cm (IDEM Standard)

Limits:

N/A

NP

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Dissolved Oxygen (DO)

Definition:

Dissolved oxygen measurements quantify the amount of oxygen that is dissolved in the water. DO is temperature and pressure sensitive.

Water Quality Impacts:

DO levels vary in natural waters, however it is most typical to speak about low DO readings due to contamination that then affects the waterbodies' ability to maintain biota.

Sources:

The following will lower DO:

- Stagnant water
- Influx of nutrients
- Excessive bio-activity
- High DO is an indicator excess nutrients or highly agitated water body (e.g. fast flowing river).

Dissolved Oxygen (DO)

Source Examples:

Stagnant water, excessive algae or plant growth or higher temperatures in the waterbody

Targets:

> 4 mg/L (IN WQS)
< 12 mg/L (IDEM Target)

Limits:

< 2 mg/L does not allow aerobic (oxygen-using) biological processes. Most surface water bodies should have > 4 mg/L to help with healthy aquatic life. Very high DO is an indicator of high nutrients

NP

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Total Dissolved Solids (TDS)

Definition:

Total dissolved solids (TDS) is the measure of amount of a broad array of molecules that are considered to be dissolved in the water. While TDS does not indicate contamination directly, and many natural waters have a very wide range of values (e.g. 1 ppm in rain water to >1,000 ppm in sea water) it is a good indicator measurement as it is quick, cheap and if done regularly can indicate the water is changes in chemistry over time.

Water Quality Impacts:

May give water a murky appearance and change the taste of drinking water. Levels are associated with water hardness and may increase corrosiveness.

Sources:

Essentially this is the measure of all minerals, metals, and salts dissolved in the water that are < 2 micrometers in size. Therefore the source could be any occurrence of added materials to the water body (e.g. excessive runnoff).

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Total Dissolved Solids (TDS)

Source Examples:

Bare soil, construction activities, stream bank erosion, storm water, pesticide use, road salt, agricultural land use, WWTPs

Targets:

< 500 mg/L (EPA drinking water recommendation)

Limits:

N/A

NP

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Turbidity

Definition:

Turbidity (also called transparency) is the measure of water clarity. This is the measure of the scattering of light through the water. The higher the turbidity the less light can travel through the water.

Water Quality Impacts:

Phosphorus and metals are attracted to sediment particles which increase nutrient levels and toxic metals in streams. High levels of sediment can stop light penetration reducing plant growth and when it settles can cover valuable habitat for aquatic animals

Sources:

Turbidity and transparency indicate visibility in water. High turbidity has often been linked to bacterial pollution. Increasing turbidity is correlated to storm events and stream flow. It is used as a good indicator of stresses to the aquatic system.

Turbidity

Source Examples:

Bare soil, construction activities, stream bank erosion, storm water, WWTPs

Targets:

< 25 NTU (MN Standard)
< 10.4 NTU (EPA recommendation)

Limits:

Lakes with water clarity less than 5 feet have poor water quality

NP

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Temperature

Definition:

Temperature is the measure of the degree of heat in a waterbody. Temperature above all other characteristics of a water body plays a major role in controlling chemical and biological activity.

Water Quality Impacts:

Increased water temperature decreases the amount of oxygen available to aquatic organisms. Also some chemicals are more toxic to aquatic life at higher temperatures.

Sources:

Air temperature, amount of light hitting the water, water depth, turbidity, groundwater contributions and land use all impact stream temperatures.

Temperature

Source Examples:

Stagnant water, isolated pools, lack of shaded areas along stream banks, industry, impervious surfaces all increase temperature of the water body

Targets:

Normal daily and seasonal temperature fluctuations shall be maintained.

Limits:

Fish, insects, zooplankton, algae and other species all prefer temperature ranges to varying degrees.

NP

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Total Suspended Solids (TSS)

Definition:

The total suspended solids (TSS) measurement quantifies all particles suspended and dissolved solids in water.

Water Quality Impacts:

Phosphorus and metals are attracted to sediment particles which increase nutrient levels and toxic metals in streams. High levels of sediment can stop light penetration reducing plant growth and when it settles can cover valuable habitat for aquatic animals

Sources:

Suspended materials include soil particles (clay, silt and sand), algae, plankton, microbes and other substances, which typically range in size from 0.004 mm (clay) to 1.0 mm (sand).

Total Suspended Solids (TSS)

Source Examples:

Bare soil, construction activities, stream bank erosion, storm water, WWTPs

Targets:

< 30 mg/L (IDEM Target)

Limits:

< 20 mg/L, water is clear
40 - 80 mg/L, water is cloudy
> 150 mg/L, water is dirty

NP

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Rosgen Stream Classification System

Definition:

A method for classifying streams and rivers based on common patterns of channel characteristics (i.e. river patterns, profiles, dimensions and substrate).

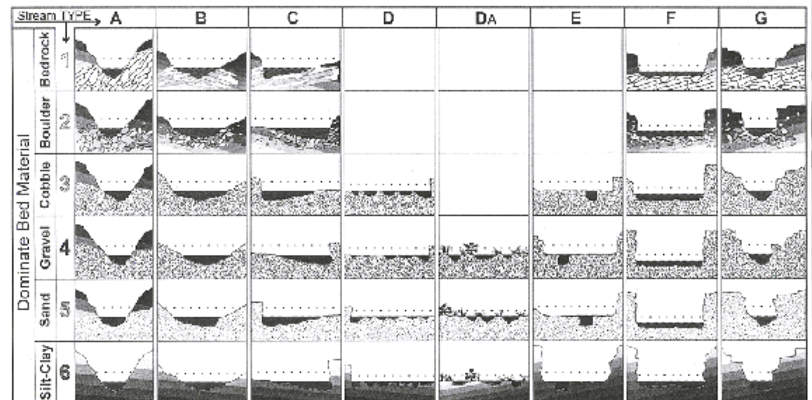
Water Quality Impacts:

The stream levels are classified using channel and land use characteristics to determine sediment supply, stream sensitivity to disturbance, potential for natural recovery, channel response to changes in flow regime and fish habitat potential.

Sources:

Not used to determine water quality but can be used for stream restoration studies.

Rosgen Stream Classification System



Stream TYPE	A	B	C	D	DA	E	F	G
Entrchmnt.	< 1.4	1.4 - 2.2	> 2.2	n/a	> 4.0	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 40	< 12	> 12	< 12
Sinuosity	1 - 1.2	> 1.2	> 1.4	n/a	variable	>1.5	> 1.4	>1.2
Slope	.04-.099	.02-.039	< .02	< .04	< .005	< .02	< .02	.02-.039

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

Suspended Sediment Concentration (SSC)

Definition:

Suspended sediment concentration (SSC) is a measure of the solid-phase material suspended in a water-sediment mixture and is usually expressed in mg/L.

Water Quality Impacts:

Phosphorus and metals are attracted to sediment particles which increase nutrient levels and toxic metals in streams. High levels of sediment can stop light penetration reducing plant growth and when it settles can cover valuable habitat for aquatic animals.

Sources:

Suspended materials include soil particles (clay, silt and sand) only. Regular monitoring of SSC can help detect trends that might indicate increasing erosion.

Suspended Sediment Concentration (SSC)

Source Examples:

Bare soil, construction activities, stream bank erosion, storm water, WWTPs

Targets:

< 25 mg/L (EPA recommendation for excellent fisheries)
25 – 80 mg/L (EPA recommendation for good to moderate fisheries)

Limits:

NA

NP

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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pH

Definition:

pH is the measure of the concentration of hydrogen ions in a solution (water or other). The measure is stated in a standard units from 0 to 14 with 7 being natural and typically ideal for municipal processes. If pH is < 7 it is considered “acidic” and > 7 it is “basic”. It is measured in standard units (SU).

Water Quality Impacts:

pH indicates whether the water can support aquatic life. pH also has effects on the toxicity of other substances (i.e. iron, aluminum, mercury).

Sources:

pH is sensitive to many water quality characteristics. Even temperature can change the pH level of a solution. pH can be affected by organic material, acid precipitation, bedrock and soil composition, and industry and mining activities.

pH

Source Examples:

Mining activities, industry, wetlands

Targets:

9 SU > pH > 6 SU

Limits:

Productivity of aquatic ecosystems is reduced considerable with pH < 5

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

Richards-Baker Flashiness Index

Definition:

An index used to quantify the frequency and rapidity of short-term changes in stream flow caused by storm events.

Water Quality Impacts:

The index is a tool for diagnosing the scale of a stream channel or stability problem and can be used in determining sites to install management practices.

Sources:

A tool used to reduce sediment loads entering a stream due to stream bank erosion.

Richards-Baker Flashiness Index

Source Examples:

Changes in land use will increase flashiness of a stream.

Targets:

The R-B index is influenced by the size of the watershed, percent of impervious surface area, and amount of tile drainage so target levels are not recommended. Instead index values can be analyzed over time to develop trends.)

Limits:

Daily flow is needed, so the index can only be calculated for sites and time periods where continuous flow data exists

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

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Citizens Qualitative Habitat Evaluation Index (CQHEI)

Definition:

The CQHEI is a physical habitat index that was developed by the Ohio Environmental Protection Agency to be used as a "citizens" companion to the QHEI used by State professionals. The purpose of the index is to provide a measure of the stream habitat and riparian health that generally corresponds to physical factors affecting aquatic life.

Water Quality Impacts:

Habitat is strongly correlated to the biological communities living in a stream. This index provides much more description of the habitat characteristics so that anyone can understand the terminology.

Sources:

The characteristics used to calculate the index include bottom type, hiding places, stream shape and human alterations, riparian areas and erosion, stream depth velocity, riffles and runs.

Citizens Qualitative Habitat Evaluation Index (CQHEI)

Targets:

(70-100) "Exceptional Warm Water Habitat"
(61-69) "Warm Water Habitat (WWH)
(50-60) "Warm Water Habitat," but some features are lacking
(0-49) "Modified Warm Water Habitat"

Limits:

Score ranges from 0 - 114

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf

Qualitative Habitat Evaluation Index (QHEI)

Definition:

The QHEI is a physical habitat index that was developed by the Ohio Environmental Protection Agency in 1989 to evaluate stream and river habitat characteristics important to biological communities. The purpose of the index is to provide a measure of the stream habitat and riparian health that corresponds to physical factors affecting aquatic life.

Water Quality Impacts:

Habitat is very strongly correlated to the biological communities a stream can support. Species of fish and aquatic bugs have different habitat requirements. A variety of habitat types supports a more diverse biological community.

Sources:

The characteristics used to calculate the index include substrate, riparian zone, streambank erosion, channel morphology, instream cover (i.e. woody debris, boulders), riffle, run and pool quality, and gradient.

Qualitative Habitat Evaluation Index (QHEI)

Source Examples:

Sunfish live in pools, darters live in riffles, some suckers require flowing. water

Targets:

Excellent ≥ 70; Good 55-69; Fair 43-54; Poor 30-42; Very Poor <30

Limits:

The scores range from 0 - 100 and < 50 is viewed as being impaired although not used to impair streams on the IN 303(d) list.

https://engineering.purdue.edu/watersheds/monitoring/MonitoringWaterinIndiana.2012.1.pdf