

## **Appendix I. Glossary of Important Terms**

**Anoxic** - condition in which the water column is characterized by a complete absence of oxygen. Anoxic conditions typically result from excessive decomposition of organic material by bacteria, high respiration by phytoplankton, stratification of the water column due to salinity or temperature effects or a combination of these factors. Anoxic conditions can result in fish kills or localized extinction of benthic communities.

**Anthropogenic** - resulting from or generated by human activities.

**Benthos** - refers to organisms that dwell on or within the bottom. Includes both hard substratum habitats (e.g. oyster reefs) and sedimentary habitats (sand and mud bottoms).

**B-IBI** - the benthic index of biotic integrity of Weisberg et al. (1997). The B-IBI is a multi-metric index that compares the condition of a benthic community to reference conditions.

**Biological Nutrient Removal (BNR)** - A temperature dependent process in which the ammonia nitrogen present in wastewater is converted by bacteria first to nitrate nitrogen and then to nitrogen gas. This technique is used to reduce the concentration of nitrogen in sewage treatment plant effluents.

**Biomass** - a quantitative estimate of the total mass of organisms for a particular population or community within a given area at a given time. Biomass for phytoplankton is measured as the total carbon within a liter of water. Biomass for the benthos is measured as the total ash-free dry weight per square meter of sediment habitat.

**Chlorophyll *a*** - a green pigment found in plant cells that functions as the receptor for energy in the form of sunlight. This energy is used in the production of cellular materials for growth and reproduction in plants. Chlorophyll *a* concentrations are measured in µg/L and are used as estimate of the total biomass of phytoplankton cells in the water column. In general, high levels of chlorophyll *a* concentrations are believed to be indicative of excessive growth of phytoplankton resulting from excess nutrients such as nitrogen and phosphorus in the water column.

**Chlorophytes** - algae belonging to the division Chlorophyta often referred to as true “green algae.” Chlorophytes occur in unicellular, colonial and filamentous forms and are generally more common in tidal freshwater and oligohaline portions of estuaries.

**Cryptomonads** -algae belonging to the division Cryptophyta that have accessory pigments in addition to chlorophyll *a* which give these small flagellated cells a red, brown or yellow color.

**Cyanophytes** - algae belonging to the division Cyanophyceae that are procaryotic and that occur in single-celled , filamentous and colonial forms. In general, high concentrations of cyanobacteria are considered to be indicative of poor water quality.

**Diatoms** - algae belonging to the division Bacillariophyta that have a cell wall that is composed primarily of silica and that consists of two separate halves. Most diatoms are single-celled but some are colonial and filamentous forms. Diatoms are generally considered to be indicative of good water quality and are considered to be appropriate food for many zooplankton.

**Dinoflagellates** - biflagellated, predominately unicellular protists which are capable of performing photosynthesis. Many dinoflagellates are covered with cellulose plates or with a series of membranes. Some dinoflagellates periodically reproduce in large numbers causing blooms that are often referred to as "red tides." Certain species produce toxins and blooms of these forms have been implicated in fish kills. High concentrations of dinoflagellates are generally considered to be indicative of poor water quality.

**Dissolved oxygen (DO)** - the concentration of oxygen in solution in the water column, measured in mg/L. Most organisms rely on oxygen for cellular metabolism and as a result low levels of dissolved oxygen adversely affect important living resources such as fish and the benthos. In general, dissolved oxygen levels decrease with increasing pollution.

**Dissolved inorganic nitrogen (DIN)** - the concentration of inorganic nitrogen compounds including ammonia ( $\text{NH}_4$ ), nitrates ( $\text{NO}_3$ ) and nitrites ( $\text{NO}_2$ ) in the water column measured in mg/L. These dissolved inorganic forms of nitrogen are directly available for uptake by phytoplankton by diffusion without first undergoing the process of decomposition. High concentrations of dissolved inorganic nitrogen can result in excessive growth of phytoplankton which in turn can adversely effect other living resources.

**Dissolved inorganic phosphorus (PO<sub>4</sub>F)** - the concentration of inorganic phosphorus compounds consisting primarily of orthophosphates ( $\text{PO}_4$ ). The dissolved inorganic forms of phosphorus are directly available for uptake by phytoplankton by diffusion without first undergoing the process of decomposition. High concentrations of dissolved inorganic phosphorus can result in excessive growth of phytoplankton which in turn can adversely effect other living resources.

**Estuary** - A semi-enclosed body of water that has a free connection with the open sea and within which seawater is diluted measurably with freshwater derived from land drainage.

**Eucaryote** - organisms the cells of which have discrete organelles and a nucleus separated from the cytoplasm by a membrane.

**Fall-line** - location of the maximum upstream extent of tidal influence in an estuary typically characterized by a waterfall.

**Fixed Point Stations** - stations for long-term trend analysis whose location is unchanged over time.

**Flow adjusted concentration (FAC)** - concentration value which has been recalculated to remove the variation caused by freshwater flow into a stream. By removing variation caused by flow, the effects of other factors such as nutrient management strategies can be assessed.

**Habitat** - a local environment that has a community distinct from other such habitat types. For the B-IBI of Chesapeake Bay, seven habitat types were defined as combinations of salinity and sedimentary types - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand and polyhaline mud.

**Hypoxic** - condition in which the water column is characterized by dissolved oxygen concentrations less than 2 mg/L but greater than 0 mg/L. Hypoxic conditions typically result from excessive decomposition of organic material by bacteria, high respiration by phytoplankton, stratification of the water column due to salinity or temperature effects or a combination of these factors. Hypoxic conditions can result in fish kills or localized extinction of benthic communities.

**Light attenuation (KD)** - Absorption, scattering, or reflection of light by dissolved or suspended material in the water column expressed as the change in light extinction per meter of depth. Light attenuation reduces the amount of light available to submerged aquatic vegetation.

**Loading** - the total mass of contaminant or nutrient added to a stream or river generally expressed in lbs/yr.

**Macrobenthos** - a size category of benthic organisms that are retained on a mesh of 0.5 mm.

**Mesohaline** - refers to waters with salinity values ranging between 0.5 and 18.0 ppt.

**Metric** - a parameter or measurement of community structure (e.g., abundance, biomass, species diversity).

**Non-point source** - a source of pollution that is distributed widely across the landscape surrounding a water body instead of being at a fixed location (e.g. run-off from residential and agricultural land).

**Oligohaline** - refers to waters with salinity values ranging between 0.5 and 5.0 ppt.

**Percent of light at the leaf surface (PLL)** - the percentage of light at the surface of the water column that reaches the surface of the leaves of submerged aquatic vegetation generally estimated for depths of 0.5 m and 1.0 m. Without sufficient light at the leaf surface, submerged aquatic plants cannot perform photosynthesis and hence cannot grow or reproduce.

**Phytoplankton** - that portion of the plankton capable of producing its own food by photosynthesis. Typical members of the phytoplankton include diatoms, dinoflagellates and chlorophytes.

**P-IBI** - the phytoplankton index of biotic integrity (Buchanan et al., 2005; Lacouture et al., 2006). The P-IBI is a multi-metric index that compares the condition of a phytoplankton community to reference conditions.

**Picoplankton** - phytoplankton with a diameter between 0.2 and 2.0  $\mu\text{m}$  in diameter. Picoplankton consists primarily of cyanobacteria and high concentrations of picoplankton are generally considered to be indicative of poor water quality conditions.

**Pielou's evenness** - an estimate of the distribution of proportional abundances of individual species within a community. Evenness ( $J$ ) is calculated as follows:  $J = H' / \ln S$  where  $H'$  is the Shannon - Weiner diversity index and  $S$  is the number of species.

**Plankton** - aquatic organisms that drift within and that are incapable of movement against water currents. Some plankton have limited locomotor ability that allows them to change their vertical position in the water column.

**Point source** - a source of pollution that is concentrated at a specific location such as the outfall of a sewage treatment plant or factory.

**Polyhaline** - refers to waters with salinity values ranging between 18.0 and 30 ppt.

**Primary productivity** - the rate of production of living material through the process of photosynthesis that for phytoplankton is typically expressed in grams of carbon per liter of water per hour. High rates of primary productivity are generally considered to be related to excessive concentrations of nutrients such as nitrogen and phosphorus in the water column.

**Probability based sampling** - all locations within a stratum have an equal chance of being sampled. Allows estimation of the percent of the stratum meeting or failing the benthic restoration goals.

**Prokaryote** - organisms the cells of which do not have discrete organelles or a nucleus (e.g. Cyanobacteria).

**Pycnocline** - a rapid change in salinity in the water column indicating stratification of water with depth resulting from either changes in salinity or water temperature.

**Random Station** - a station selected randomly within a stratum. In every succeeding sampling event new random locations are selected.

**Recruitment** - The successful dispersal settlement and development of larval forms of plants or animal to a reproducing adult.

**Reference condition** - the structure of benthic communities at reference sites.

**Reference sites** - sites determined to be minimally impacted by anthropogenic stress. Conditions at these sites are considered to represent goals for restoration of impacted benthic communities. Reference sites were selected by Weisberg et al. (1997) as those outside highly developed watersheds, distant from any point-source discharge, with no sediment contaminant effect, with no low dissolved oxygen effect and with a low level of organic matter in the sediment.

**Restoration Goal** - refers to obtaining an average B-IBI value of 3.0 for a benthic community indicating that values for metrics approximate the reference condition.

**Riparian Buffer** - An area of trees and shrubs a minimum of 100 feet wide located up gradient, adjacent, and parallel to the edge of a water feature which serves to: 1) reduce excess amounts of sediment, organic matter, nutrients, and other pollutants in surface runoff, 2) reduce soluble pollutants in shallow ground water flow, 3) create shade along water bodies to lower aquatic temperatures, 4) provide a source of detritus and large woody debris aquatic organisms, 5) provide riparian habitat and corridors for wildlife, and 6) reduce erosion of streambanks and shorelines.

**Salinity** - the concentration of dissolved salts in the water column measured in mg/L, ppt or psu. The composition and distribution of plant and animal communities is directly affected by salinity in estuarine systems. The effects of salinity on living resources must be taken into consideration when interpreting the potential effects of human activities on living resources.

**Secchi depth** - the depth of light penetration expressed in meters as measured using a secchi disk. Light penetration depth directly affects the growth and recruitment of submerge aquatic vegetation.

**Shannon Weiner diversity index** - a measure of the number of species within a community and the relative abundances of each species. The Shannon Weiner index is calculated as follows:

$$H' = - \sum_{i=1}^S p_i \log_2 p_i$$

where  $p_i$  is the proportion of the  $i$ th species and  $S$  is the number of species.

**Stratum** - a geographic region of unique ecological condition or managerial interest.

**Submerged aquatic vegetation (SAV)** - rooted vascular plants (e.g. eelgrass, widgeon grass, sago pondweed) that grow in shallow water areas. SAV are important in marine environments because they serve as major food source, provide refuge for juvenile crabs and fish, stabilize sediments preventing shoreline erosion and excessive suspended materials in the water column, and produce oxygen in the water column.

**Threshold** - a value of a metric that determines the B-IBI scoring. For all metrics except abundance and biomass, two thresholds are used - the lower 5<sup>th</sup> percentile and the 50<sup>th</sup> percentile (median) of the distribution of values at reference sites. Samples with metric values less than the lower 5<sup>th</sup> percentile are scored as a 1. Samples with values between the 5<sup>th</sup> and 50<sup>th</sup> metrics are scored as 3 and values greater than the 50<sup>th</sup> percentile are scored as 5. For abundance and biomass, values below the 5<sup>th</sup> and above the 95<sup>th</sup> percentile are scored as 1, values between the 5<sup>th</sup> and 25<sup>th</sup> and the 75<sup>th</sup> and 95<sup>th</sup> percentiles are scored as 3 and values between the 25<sup>th</sup> and 75<sup>th</sup> percentiles are scored as 5.

**Tidal freshwater** - refers to waters with salinity values ranging between 0 and 0.5 ppt which are located in the upper reaches of the estuary at or just below the maximum upstream extent of tidal influence.

**Total nitrogen (TN)** - the concentration of both inorganic and organic compounds in the water column which contain nitrogen measured in mg/L. Nitrogen is a required nutrient for protein synthesis. Inorganic forms of nitrogen are directly available for uptake by phytoplankton while organic compounds must first be decomposed by bacteria prior to being available for use for other organisms. High levels of total nitrogen are considered to be detrimental to living resources either as a source of nutrients for excessive phytoplankton growth or as a source of excessive bacterial decomposition that can increase the incidence and extent of anoxic or hypoxic events.

**Total phosphorus (TP)** - the concentration of both inorganic and organic compounds in the water column which contain phosphorus measured in mg/L. Phosphorus is a required nutrient for cellular metabolism and for the production of cell membranes. Inorganic forms of phosphorus are directly available for uptake by phytoplankton while organic compounds must first be decomposed by bacteria prior to being available for use for other organisms. High levels of total nitrogen are considered to be detrimental to living resources either as a source of nutrients for excessive phytoplankton growth or as a source of excessive bacterial decomposition that can increase the incidence and extent of anoxic or hypoxic events.

**Total suspended solids (TSS)** - the concentration of suspended particles in the water column, measured in mg/L. The composition of total suspended solids includes both inorganic (fixed) and organic (volatile) compounds. The fixed suspended solids component is comprised of sediment particles while the volatile suspended solids component is comprised of detrital particles and planktonic organisms. The concentration of total suspended solids directly affects water clarity which in turn affects the development and growth of submerged aquatic vegetation.