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Monday, Nov. 9

1:30 PM – 3:00 PM

SESSION 10: Controlling Nutrients

A Review of Approaches Used to Establish Regional and Site-Specific Numeric Nutrient Criteria - Douglas McLaughlin, NCASI, Kalamazoo, MI

EPA is requiring states to adopt numeric nutrient criteria to supplement or replace their existing narrative criteria. Beginning in 2000, EPA published a series of guidance documents to assist states in the development of nutrient criteria for rivers and streams, lakes and reservoirs, estuaries, and wetlands. In 2001, EPA announced a set of specific criteria recommendations derived using data from frequency distributions of total phosphorus, total nitrogen, chlorophyll a, and transparency data from waterbodies categorized by EPA Level III nutrient ecoregions. EPA indicated that these recommendations were to serve as starting points, and encouraged states to develop more refined nutrient criteria using methods outlined in the EPA technical guidance manuals or other scientifically defensible approaches. Since then, many states have been working to develop numeric nutrient criteria, and several approaches have been explored or used to provide statewide criteria. Many of these seek to account for within-state variability in waterbody types, and ecosystem-specific attributes and responses. In addition, there is interest in approaches that could be used to establish site-specific numeric criteria. This paper synthesizes information from a number of numeric nutrient criteria development efforts since publication of the EPA guidance documents and presents a summary of various approaches being used or considered for deriving regional and site-specific criteria. The general attributes of each approach, as well as their strengths and weaknesses, are discussed.

Developing Nutrient Cap Load Allocations for the Chesapeake Bay Restoration - Jing Wu, University of Maryland Center for Environmental Science, Annapolis, MD (co-authors: Gary Shenk, Ping Wang, Lewis Linker)

Excessive nutrients in the Chesapeake Bay and its tidal tributaries promote undesirable water quality conditions such as excessive algal growth, low dissolved oxygen and reduced water clarity. The effects of nutrient loads on water quality and living resources tend to vary considerably by season and region. In addressing this problem, the science-based nutrient cap load allocations by major tributary basins to the jurisdictions need to be developed to guide the Chesapeake Bay Program partners in their combined efforts to restore and protect the water quality of the Chesapeake Bay. In developing cap load allocations, it was key to understand which major basins affect which areas of the Bay and by how much. A series of geographic isolation runs with the Chesapeake Bay Water Quality Model, in which management controls were set at the maximum theoretical level for the isolated basin but held at existing levels for the rest of the watershed, was performed to determine the 'relative impact' of each basin on the Bay. The 'relative impact' is calculated as changes in mean dissolved oxygen concentration in the mainstem Chesapeake Bay normalized by the combined nitrogen and phosphorus loads reduced from that basin, thereby measuring the impact from each basin from each unit of nutrient load delivered to the Bay. Combining the 'relative impact' of each basin and riverine transport factors that measure how much nutrient loads traveled to the Bay from different locations within the watershed, the relative effectiveness of the nutrient load reductions from each major basin can be determined. The estimated relative effectiveness was then used to allocate nutrient loads among major basins based on a linear curve, with the principal that basins with the greatest impact must achieve the highest load reductions toward achieving final water quality goals.

Nitrogen-Fixing Diatoms and Cyanobacteria as Valuable Indicators of Stream Nitrogen Availability - A. Elizabeth Fetscher, Southern California Coastal Water Research Project (SCCWRP), Costa Mesa,

CA (co-authors: Rosalina Stancheva, Berengere Laslandes, Robert Sheath, Patrick Kocielek, Martha Sutula)

Nutrients are a common cause of stream impairment and are therefore a high-priority water-quality concern. High nutrient loads can lead to nuisance algal blooms, which can adversely affect a number of stream beneficial uses. Traditional monitoring for nutrients involves discrete sampling of ambient concentrations, but these data are rarely wholly indicative of the potential for aquatic life impacts. A more meaningful indicator would be based directly on biotic assemblages themselves, as they may integrate the sum total of effects of nutrient loads over time and space. The ultimate goal of our study is to develop an Index of Biotic Integrity for Southern California streams based on periphyton (benthic algae and cyanobacteria) assemblages. Through an extensive periphyton survey across gradients of anthropogenic disturbance, we found that the relative abundances of nitrogen-fixing diatoms and common free-living filamentous cyanobacteria bearing nitrogen-fixing heterocysts (heterocytes) were both positively associated with low-nitrate environments. In addition, a morphometric study of the cyanobacterial endosymbionts from several nitrogen-fixing diatom species revealed that total endosymbiont biovolume per diatom cell was significantly negatively correlated to nitrate levels. This suggests that endosymbiont production may be up-regulated in environments where the capacity to fix nitrogen confers a competitive advantage, a characteristic that may be useful for monitoring stream nitrogen availability. The results of this study show that nitrogen-fixing diatoms and cyanobacteria can be powerful bioindicators. Furthermore, sub-cellular analysis of diatom cyanobacterial endosymbionts shows promise as an additional layer of monitoring resolution and responsiveness, providing information beyond that attainable through assessment of periphyton assemblage alone.

Phosphorus Treatment - Advanced Removal Mechanisms and Amended Design for Stormwater BMPs - Joel Garbon, Imbrium Systems, Portland, OR (co-authors: Scott Perry, Brian Lee)

It has been well-documented that continued land development through urbanization is deteriorating surface water quality. One significant concern with our limited global freshwater resources is the onset of toxic algae blooms and reduced dissolved oxygen levels due to continued, uncontrolled phosphorus loading. This is leading to negative ecologic, economic, and human health impacts. As a result, regulators are beginning to acknowledge the impairment of freshwater bodies, and have begun implementation of Total Maximum Daily Loads (TMDLs). However, applying phosphorus-related TMDLs specifically to stormwater runoff may not be effective without first understanding the available mechanisms and limitations involved in phosphorus treatment for stormwater applications. To understand how to achieve continued high levels of permanent phosphorus removal, this presentation reviews the transport and fate of Total Phosphorus, including both particulate-bound and dissolved phosphorus, in urban stormwater runoff. The advantages and disadvantages of removal mechanisms employed in both conventional Best Management Practices (BMPs) and newer Low Impact Development (LID) applications are discussed. Advances in phosphorus treatment technology have recently become available, providing the ability to capture high levels of both particulate-bound and dissolved phosphorus. Understanding the functional removal mechanisms and how to sustain high treatment levels are critical to protecting our water bodies. Amending both conventional BMPs and LID applications with new advanced phosphorus treatment provides a solution to achieve existing and future TMDLs. These concepts and amendments are discussed as a potential means to raise the performance bar for phosphorus treatment and implement practices that protect our freshwater resources.