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Title: Tidal Freshwater Potomac River Eutrophication: Patterns and Relations to Climate Change, Nutrient Management and *In Situ* Factors

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ABSTRACT

Eutrophication, the transition of an aquatic ecosystem from nutrient-scarce to nutrient enriched conditions, is a water quality concern for rivers and coastal zones globally. The tidal freshwater (TFW) Potomac River, in particular, was strongly impacted by anthropogenic eutrophication throughout the twentieth century. Hydrometeorological and in situ biogeochemical factors may contribute to the persistence of eutrophic conditions in the TFW Potomac River, despite advancing nutrient management initiatives. This study investigated the patterns of TFW Potomac River eutrophication and examined water quality relations to nutrient inputs, climate change, and in situ factors over the 1985-1997 period. Eutrophication indicators included total phosphorus (TP), total nitrogen (TN), and algal biomass as Chlorophyll a (Chl a). Nutrient inputs from the non-tidal river and nearby wastewater treatment plants (WWTPs) were examined separately and in aggregate. Climatic factors, such as solar energy, air temperature, wind, precipitation, and freshwater inflow, were also considered. In situ factors comprised both abiotic (e.g., pH) and biotic (e.g., the Asiatic clam, *Corbicula fluminea*) variables. Statistical parametric, non-parametric and graphical methods were used to analyze historical data from various federal, state, and local monitoring agencies, both before and after a basin-wide ban on phosphate in laundry detergents. A

field study over summer 1997 further clarified effects of partial effluent denitrification at Blue Plains, the region's largest WWTP. Data analysis examined patterns and relations longitudinally, across various temporal scales (multi-day, seasonal, annual, and inter-annual). Ambient nutrient concentrations were generally an attenuated function of upstream source nutrient concentrations. TP was longitudinally stable, while TN crested near the outfall pipes from the largest WWTPs. Below this area, Chl a increased substantially. Chl a varied directly with 14-day solar energy, 4-day temperature and, in upper segments, wind speed; and inversely to freshwater inflow and, in lower segments, 4-day wind speed. Chl a also increased with TP during warm, dry weather, consistent with pH-related sediment TP release. No clear relation was established between Corbicula and algal biomass, however. Both the phosphate detergent ban and Blue Plains denitrification were found to have limited impact on TFW Potomac eutrophication. Season-specific and year-to-year patterns and relations are also discussed.