MS Thesis
Department of Environmental Science and Policy
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Title: Urban stream-floodplains increase soil carbon and nutrient retention along a chronosequence of restored streams in Fairfax County, VA, USA

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ABSTRACT

Streams and their floodplains can store or transport excess quantities of sediment and nutrients influencing downstream harmful algal blooms, hypoxic or anoxic dead zones, and fish kills in estuarine environments. Stream restoration is a common management practice to meet regulatory or voluntary efforts to improve water quality via carbon and nutrient retention, including in the Chesapeake Bay watershed. However, many restoration projects do not have quantifiable measures of project success and rarely collect pre-restoration data. Storage of nutrients, such as phosphorus (P), and carbon (C), in floodplain soils of restored streams can act as an easily quantifiable indicator of restoration success, particularly when the project goals include improved water quality. To determine how floodplains of restored streams change in their phosphorus and carbon storage as time since restoration increases, floodplain surficial soil samples (10 cm depth) were collected from 18 streams in the urbanized Piedmont region of northern Virginia, representing a chronosequence of time (<3 – 10+ years) since restoration as well as unrestored and reference streams. The samples were analyzed for total carbon (TC), total nitrogen (TN) and total phosphorus (TP), whereas C efflux and equilibrium phosphorus concentration (EPC0) were measured as metrics of nutrient loss. Linear models were developed to determine whether time since restoration had any impact on carbon and nutrient dynamics. These metrics were compared to potential environmental drivers, including soil moisture, pH, particle size, organic matter content, and degree phosphorus saturation. Overall, stream restorations demonstrated increasing nutrient storage for TC, TN, and TP along the chronosequence, as well as decreasing relative loss of carbon from efflux and no significant influence of EPC0. Soil wetness, a key driver in nutrient retention, also increased as restoration projects aged. These findings suggest restoration has successfully advanced water quality goals, and results can help practitioners assess restoration effectiveness.