Title: Centuries-old land-use changes influence contemporary biogeochemical groundwater behavior in headwater streams

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Abstract:
Before the era of fossil fuel use, water provided power for industrial processes in the USA through a ubiquitous network of dams and mills. This infrastructure was constructed concurrently with widespread deforestation and sedimentation during the 18th through 20th centuries causing wide-spread transformation of streams and buried floodplains with so-called legacy sediments. These centuries-old changes lead to stream incision and decoupled hydrological and biogeochemical processes causing excess transport of sediments and nutrients. In a pilot study, floodplain restoration involving legacy sediment removal was implemented at an intensively studied stream, Big Stream Run in Pennsylvania, USA. We sought to understand how restored hydrologic connection between floodplains and streams would influence biogeochemical processing of nitrogen and carbon in this landscape. Using variability in the oxygen isotope composition of catchment waters, we examined how groundwater contact times and flowpaths influenced seasonal nitrate and carbon concentrations in an 8-year, pre- and post-restoration study conducted at Big Spring Run. Denitrification potential was lowest in legacy sediments and significantly higher in the restored portion of the floodplain. Furthermore, greater nitrogen transformation occurred along more active paths of groundwater flow, especially where carbon concentrations were seasonally stable. Our study showed that even centuries-old extreme events can affect biogeochemistry of streams and that restoration can have a positive effect on sediment and nutrient fate and transport. (Disclaimer: The views expressed in this paper are those of the author and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency)