XVII[th] World Congress of the International Commission of Agricultural and Biosystems Engineering (CIGR)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada June 13-17, 2010

MEANDER BEND REGULATION OF SURFACE-GROUND WATER EXCHANGE AND IMPACTS FOR RESTORATION DESIGN

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CSBE101528 – Presented at 10th American Ecological Engineering Society Annual Meeting (AEES) Symposium

ABSTRACT Meander bends in alluvial pool-riffle rivers experience cut-bank erosion and point bar deposition dynamics, and a river may contain various stages of meander cutoff, quantified by their relative curvature. Large values of curvature indicate morphologically young meanders with gentle bends, and small values of curvature indicate older meanders pinched and nearing cutoff. Modeling studies have shown as curvature adjusts toward meander cutoff, rates of surface-ground water exchange increase through the point bar. These hyporheic exchanges in the point bar set in place ecologically important nutrient flows and should be a functional target for stream restoration designs. Our field and laboratory work provide new data to support these otherwise mathematical predictions of steepened hydraulic gradients and increased hyporheic exchange through point bars of nearing cutoff, and suggest river restoration utilize a range of meander curvatures. Additional computational and river table analysis of meanders with in-channel structures, such as j-hooks common to natural channel design, showed structures can further influence hyporheic exchange across the point bar. Restoration structures create local steepening of the water surface, either in pools or riffles, and increase the gradients driving hyporheic exchange through the point bar. The results document a strong mixing of groundwater and surface water by downwelling and upwelling fluxes in both sides of the meanders near cutoff.

Keywords: River restoration, Structures, Hyporheic.