COMPARISON OF PHOSPHORUS FORMS AT DIFFERENT SPATIAL SCALES AND ASSESSMENT OF AN AREA-WEIGHTED P-INDEX TO MULTI-FIELD WATERSHEDS

by

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ABSTRACT

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Phosphorus from agricultural runoff is a major concern to the quality of our water resources. Phosphorus in runoff is made up of sediment bound P and soluble P. In many watershed studies, particulate phosphorus (PP) is the dominate form of P. However, past monitoring of rural streams in the Lower Fox River sub-basin in northeastern Wisconsin has found mean concentrations of dissolved phosphorus (DP) representing from 45% to 75% of the total P (TP) concentration. This study was conducted to better understand P forms in tributaries of the Lower Fox River, to determine how the DP fraction changes along a flow path at different scales, and to assess the Wisconsin Phosphorus-Index (WI-PI) on multi-field watersheds in the Apple Creek watershed.

Automated monitoring stations were installed on four Lower Fox River tributaries in September of 2003. Three water years of event and low-flow samples were collected and analyzed for total suspended solids, TP, and DP. In conjunction with the automated monitoring station, event grab samples were collected near peak flow at 11 multi-field (0.25 to 2.5 km^2) and four integrator (12 to 87 km^2) sites in the Apple Creek Watershed.

Across the four sites, the TP concentration during event flows was made up of approximately equal portions of PP and DP (36% to 66% DP fraction). DP loads ranged from 36% to 52% of the TP load in 2004 and from 46% to 61% in the following 2 years. Duck Creek had the consistently lowest concentrations and yields of P and suspended solids among the four tributaries.

For five runoff events in Apple Creek during 2004, median TP was 0.46 mg/L from multi-field sub-watershed sites, 0.48 mg/L from integrator sites, and 0.43 mg/L from the main stem. Median DP percentage was 39% from source areas, 41% from integrator sites, and 44% at the main stem. The median DP percentage for the five events at each source area site, varied greatly (13% to 83%). The portion of DP in a snowmelt and a low intensity event in 2006 were twice the median from earlier events. Area-weighted WI-PI (SnapPlus) values were compared to P concentrations from event monitoring at multi-field sub-watersheds. Field management data, including crop rotation, nutrient applications, and tillage practices were collected from nutrient management plans. The WI-PI was unable to predict the TP and PP losses. However, a strong relationship was found between DP concentration in surface water and soluble P-Index values. It appears that the factors affecting variability in DP export between source areas are reasonably described by the WI-PI.