WATERSHED P INDEX INVENTORIES: AN EXAMPLE OF RUNOFF P LOSS RISK DISTRIBUTION IN TWO DRIFTLESS AREA AGRICULTURAL WATERSHEDS

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There are a number of projects underway in Wisconsin to investigate the relationship between field management and runoff phosphorus (P) losses and P loads from agricultural watersheds. This paper focuses on the field runoff P loss risk distribution found in one of those projects located in two similar watersheds within the Pecatonica River Basin.

The Pecatonica River pilot project is testing Wisconsin Buffer Initiative recommendations for using targeted strategies in small agricultural watersheds (5,000 to 25,000 acres) to achieve water-quality improvement goals (http://www.nelson.wisc.edu/people/nowak/wbi/). This small watershed scale was chosen as optimal for identifying nonpoint pollution sources, implementing strategies, and measuring success.

This is a paired watershed project with an experimental treatment and reference watershed. Both watersheds are approximately 19 mi^2 and have similar soils and topography. Within the treatment watershed, changes in management are being applied to a small percentage of area that is identified as contributing comparatively high levels of sediment or phosphorus to the stream. A second nearby agricultural watershed with similar soils and topography is being monitored as a reference. Although P losses from these two watersheds are not exactly the same, they are close enough to have similar weather and they have a similar pattern of P load response to rainfall and snowmelt. By comparing P losses at the watershed outlet over time, we will be able to determine whether field-level management changes on targeted areas produce significant changes in P loading in the treatment watershed. Monitoring is complemented with multi-disciplinary measurements and modeling to better quantify overland flow and in-stream delivery processes between fields and watershed outlets (http://wi.water.usgs.gov/surface-water/9ko46/) .

The first step in the project was to identify fields and pastures contributing high levels of dissolved or sediment-bound nutrients via runoff to streams using the Wisconsin Phosphorus Index (WPI, http://wpindex.soils.wisc.edu). The WPI uses routine soil test and field management information to estimate runoff phosphorus delivery from a field to a stream or lake under average weather conditions. It is calculated with software developed by the UW-Madison Soil Science Dept. (SNAP-Plus, http://www.snapplus.net) that also computes field erosion using the Natural Resources Conservation Service RUSLE2 model. To get the information needed to calculate the WPI required collecting soil samples on all fields and interviewing farmers to document field management. In the treatment watershed, a full inventory was completed and the WPI calculated on approximately 80% of the agricultural land in the watershed. A similar coverage was obtained for the reference watershed.

Wisconsin PI calculations of runoff P loss risk uses soil P, manure and fertilizer P application rates and timing, and estimated runoff and erosion. In these Driftless Area watersheds, most of the high runoff P loss risk areas resulted from a combination of comparatively high comparatively high soil test P and erosion. A broad range of soil test P values were found in both watersheds, with the highest values associated with cropland with a history of manure applications, continuously grazed pastures, and dry lots or night pastures (Tables 1). Erosion rates calculated with RUSLE2 also varied widely (Table 2). Many of the fields in these watersheds are on highly erodible land and the highest erosion rates were on tilled fields with rotations that included

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multiple continuous years of low residue crops such as corn silage. Many of the continuously grazed areas show evidence of erosion, but erosion estimates for these areas are not included in Table 2 because RUSLE2 calculations are not currently as accurate for them as for cropland.

Table 1. Average and range of soil test P by land use for two agricultural watersheds in southwestern Wisconsin.

	Treatment watershed		Reference watershed	
Land use	Acres soil sampled	Average soil test P (Range)	Acres soil sampled	Average soil test P (Range)
		ppm		ppm
Cropland	3368	37 (5 - 384)	2623	36 (4 - 236)
Managed rotational grazing	57	42 (25 -72)	523	27 (8 - 97)
Continuous grazing	609	39 (7 - 348)	524	77 (9 -247)
Dry lots, night pastures	20	155 (32 – 348)	-	-
Grasslands	1048	23 (6 – 83)	191	23 (5 - 87)
Woods (may include grazed areas)	94	31 (13 – 59)	112	22 (18 -23)

Table 2. Average and range of estimated annual erosion rates for inventoried cropland and grasslands in two agricultural watersheds in southwestern Wisconsin.

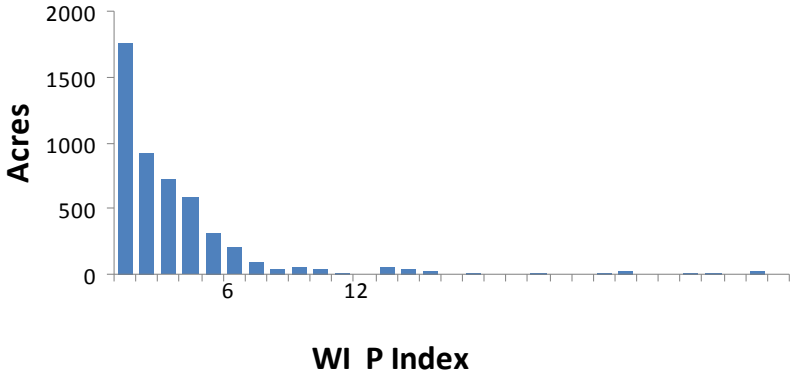
	Treatment watershed			Reference watershed		
		Erosion (T/a) †			Erosion (T/a) †	
Land use	Inventoried acres	Area weighted average	Range	Inventoried acres	Area weighted average	Range
Cropland	3400	2.4	0.1 – 19.9	2630	3.2	0.1 – 17.9
Grasslands-not grazed	1050	<0.1	0 – 0.2	190	<0.1	0 – 0.1

† Erosion was calculated on a field basis with the Natural Resource Conservation Service (NRCS) RUSLE2 program embedded in SNAP-Plus software (www.snapplus.net), following NRCS conservation planning guidelines.

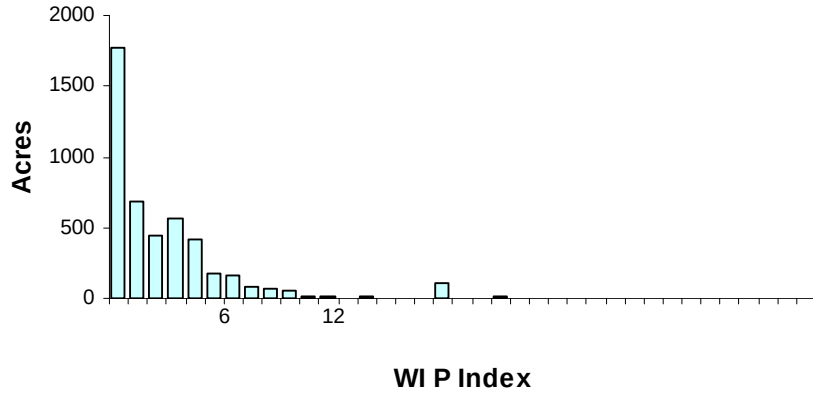
Only a comparatively small percentage of the inventoried lands in both watersheds had WPI values above the Wisconsin standard of 6, while the majority was below 3 (Fig. 1). This year, 2010, implementation of management practices to reduce erosion and P loss began on fields in the treatment watershed with WPI values above the standard.

Figure 1. Distribution of acres by baseline[1] rotational P Index values in the (a) treatment (5018 acres[2]) and (b) reference (4576 acres[2]) watersheds.

(a)



(b)



WI P Index category	Treatment watershed proportion of acres	Reference watershed proportion of acres
< 3	68 %	63%
3- 6	21 %	25%
> 6	10 %	12%

[1] Crop rotations in place for crop year 2007, the first year the watersheds were monitored.
[2] This includes all acres with complete inventories and soil sampling except for woods and continuously grazed (not rotational) pastures.