



Sedimentation ponds, photo by H. S. Garn

Water Quality of Agricultural Runoff in Pheasant Branch Tributary— How Effective Were Installed Conservation Practices?

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Pheasant Branch Conservancy users in the past complained about the barnyard smell of runoff in the tributary and poor water quality entering the marsh. In 2003 two sediment ponds were constructed in the ephemeral stream channel on the County portion of the Conservancy downstream from a dairy farm and cropland in order to remove nutrients and sediment that negatively impacted the marsh and Lake Mendota. Monitoring of the ephemeral stream water quality above and below the sediment ponds was conducted during 2003-06 under two previous DNR river grants obtained by the Friends of Pheasant Branch. The data documented the lack of and use of poor conservation practices on farmland draining into the Conservancy. Monitoring results then suggested that the sediment ponds were somewhat effective in reducing the nitrogen and phosphorus concentrations, but that overall, nutrients were still flowing into Pheasant Branch marsh at unusually high concentrations.

Installed Practices

The sediment ponds constructed in 2003 had greatly reduced capacity and trapping efficiency caused by the high sediment load, almost filling the ponds in about 6 years. Thus, the ponds were dredged and deepened in April 2009 by Dane County to improve their efficiency. The farm, in cooperation with Dane County Land Conservation Division, also made progress with improving farm management and installing runoff control and conservation practices during 2009. Practices that were installed included: not spreading manure when the ground is frozen or snow covered; installing a grassed waterway; diverting surface runoff around the farmstead and silage areas; downsizing the dairy herd; implementing nutrient management plans reducing the manure to be applied on this farm annually; planting more hay in the cropping rotation to provide soil cover.

With the installation of these new measures, the Friends were awarded a new River Planning Grant to continue efforts to evaluate the effectiveness of the recently dredged ponds and combined conservation practices. Upstream and downstream water monitoring was conducted by volunteers collecting grab samples at 5 sites on the tributary during 2010-2012 (fig. 1).

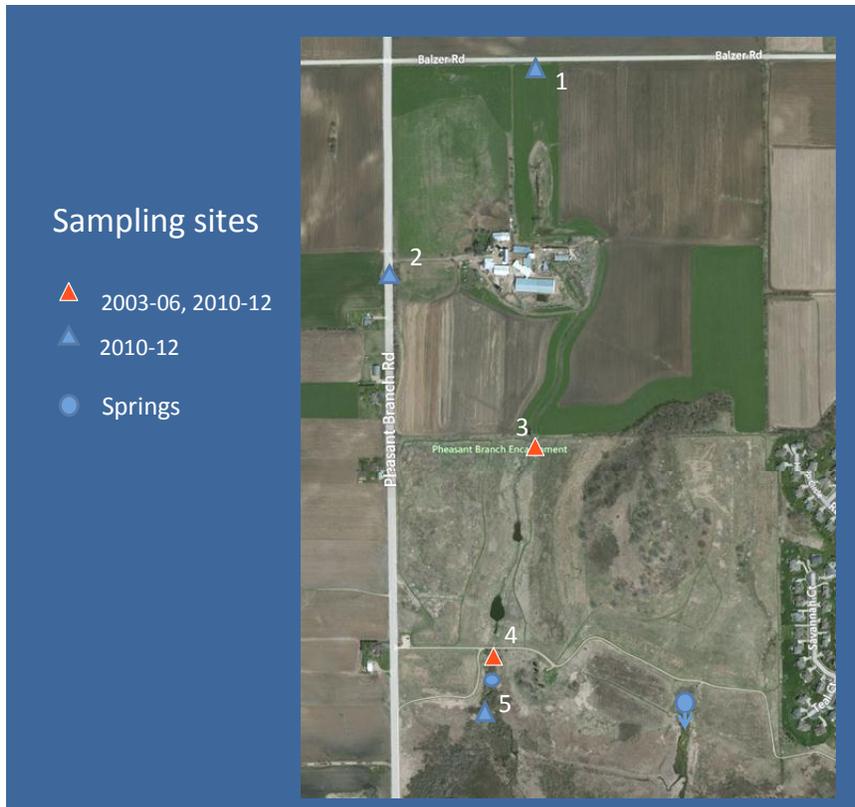


Figure 1. Location of sampling sites on ephemeral tributary to Pheasant Branch (2003-06 sites above and below ponds marked in red).

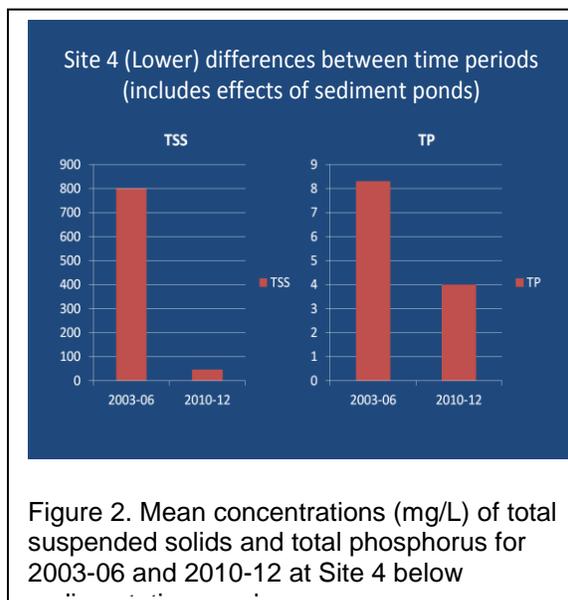
Quality of Agricultural Runoff

A comparison of the mean values between upstream incoming water quality and water quality below the sedimentation ponds (Site 4) entering the marsh during 2010-12 is presented in table 1. Sites 1 and 2 measuring inputs from upstream adjacent fields had smaller flows having the highest concentrations of TSS but comparatively low concentrations of nutrients. Concentrations of TSS decreased, but TKN and TP measured at Site 3 were still relatively high after the installation of all the management and conservation practices on the farm. However, large reductions in TSS, TKN and TP concentrations occurred at Site 4 due to the dredging and deepening of the sediment ponds, resulting in differences of over 60 and 50 percent between Sites 3 and 4. These reductions in concentration by the sediment ponds are larger than those found during 2003-06, indicating better trapping efficiency by the ponds. Site 5 in the marsh is downstream from a group of small springs and has perennial flow that dilutes the upstream concentrations.

Table 1. Mean concentration values in mg/L of water quality constituents at each of five sites on Tributary to Pheasant Branch, 2010-12 [TSS, total suspended solids; TKN, total Kjeldahl nitrogen; TP, total phosphorus; n, number of samples at each site].

Site number	TSS	TKN	NO ₂ +NO ₃ -N	TP
Site 1 n=2	1205	6.4	4.93	2.14
Site 2 n=2	460	4.3	3.62	1.18
Site 3 n=8	129	22.1	0.65	9.2
Site 4 n=8	47	8.6	0.88	4.0
Site 5 n=5	49	7.7	2.7	3.2
Site 3-Site 4	-64%	-61%	+35%	-56%

Figure 2 compares the mean concentrations between the two monitoring periods at Site 4, representing the combined effects of the management and conservation practices installed on the farm and effects of the improved sediment ponds completed in 2009. Mean TSS concentrations were reduced by over 90 percent, and TP was reduced by 52 percent. TKN decreased from 23.7 to 8.6 mg/L, a 64 percent decrease. The average concentration of 4 mg/L TP at Site 4 entering the marsh after treatment was still relatively high compared to other agricultural streams. Much of the total phosphorus in the runoff may be in the soluble, dissolved form which is readily available for plant uptake and growth of algae.



Conclusions

Key findings from the study include: (1) the farm practices and sedimentation ponds appear to have greatly decreased suspended solids concentrations; (2) total nitrogen and phosphorus concentrations decreased less, but progress was made on this small watershed toward achieving the goal of 50% reduction in TP load to Lake Mendota; (3) even with these improvements, agricultural runoff from this small watershed still has higher concentrations of nutrients than desired entering Pheasant Branch Marsh. The data illustrate how difficult it is to achieve reductions in non-point-source phosphorus pollution.

We demonstrated that relatively low-cost volunteer water sampling could be used to provide valuable information about water quality characteristics and effects of management practices.

This Fact Sheet summarizes methods and discussion of results presented in detail in the final report for River Planning Grant RP206-11 provided to Wisconsin Dept. of Natural Resources: Garn, H. S., 2012, Water Quality of Agricultural Runoff in an Ephemeral Tributary to Pheasant Branch Marsh and Lake Mendota, 2003-06 and 2010-12, Dane County, Wisconsin: Garn Hydrologic Services, 22p.