

“Rein in the runoff”

Increasing amounts of natural land in the United States are being converted to impervious (hardened) surfaces, such as roads, rooftops, sidewalks, and parking lots. Water that once largely percolated through the soil to recharge groundwater supplies is now conveyed from these hard surfaces by storm drains, pipes, and canals to nearby surface waters. This stormwater runoff carries pollutants such as nutrients and metals, as well as elevated water temperature as it flows over warm surfaces. These pollutants can have negative effects on fish and aquatic insects. In addition, stormwater runoff is often be “flashy”—that is, the runoff increases in intensity and volume very quickly once a precipitation event begins—as the natural features that once were present to detain the runoff have been converted to impervious surfaces; the energy associated with this increased water volume can result in more streambed and bank erosion, and flooding downstream.



Fig. 1. Map of Michigan's lower peninsula counties (right) and blow up of Ottawa County (left) with outline of Spring Lake watershed (in yellow) and locations of Spring Lake, Grand River, and Lake Michigan (entire left side).

We examined the effect of stormwater in a number of municipalities that border Spring Lake, the Grand River, and Lake Michigan in western Michigan, USA (Fig. 1).

These municipalities are located in one of the fastest-growing regions in the upper Midwest. Spring Lake has a history of high phosphorus levels and potentially-toxic harmful algal blooms, which motivated residents to fund a ~\$1,000,000 alum treatment of the lake in 2005 to control phosphorus entering the water from the lake sediment. Hence, the residents around Spring Lake and downstream water bodies were very interested in making sure new pollution from stormwater runoff didn't offset the water quality improvements that derived from their prior financial investments.

Our analysis showed that the amount of impervious cover in the Spring Lake watershed increased from an average of 8.9% in 1978 to an average of 15.1% in 2006. While this increase may not seem very large, most of the increase was directly adjacent to the lake (Fig. 2), which approximately doubled. Most of this increase was attributable to a doubling in the amount of residential land use, largely at the expense of agricultural land.

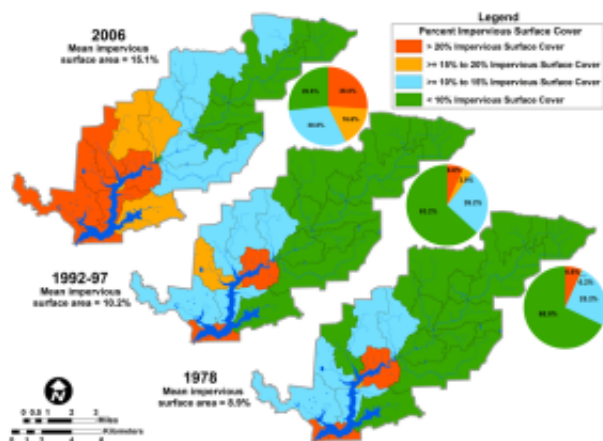


Fig. 2. Percent impervious surface by subbasin in the Spring Lake watershed in 1978, 1992-1997, and 2006. Note the substantial increase in percent impervious surface directly adjacent to the lake (dark blue) over time.

Based on these results, we identified a suite of “best management practices (BMPs)”, or more effective ways to manage stormwater, in the watershed, as well as their optimal locations in the watershed. Our BMP analysis targeted high priority areas in the watershed—those responsible for high amounts of phosphorus and those with the best chance to capture stormwater due to their soil characteristics.

Finally, we used a mathematical model to determine how much phosphorus would be captured in the watershed if all these BMPs were implemented. Our analysis showed that the total amount of phosphorus would be reduced by 15%, from 5.8 to 4.9 metric tons per year, if these BMPs were put into place, with the greatest benefit occurring in sub-basins directly adjacent to the lake.

The process by which we selected the BMPs for Spring Lake watershed, which is shown in a flow chart, is transferable to other watersheds. The schematic provides a framework that can be adapted by resource managers and decision makers in other municipalities.

Publication

[Stormwater runoff to an impaired lake: impacts and solutions.](#)

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