

**Title: Storm Water Detention Practices Reduce Phosphorus and Sediment Loads to Arcadia Creek**

Waterbody Improved: Arcadia Creek, a small tributary to the Kalamazoo River in the city of Kalamazoo, Kalamazoo County, Michigan (AUID 040500030606-04; HUC 040500030606).

GRTS Numbers: 97547403-10, 97547408-14, and 97547411-08.

Problem: Lake Allegan in the Kalamazoo River watershed is on the Clean Water Act section 303(d) list of impaired waters for excessive phosphorus loadings. Arcadia Creek is a significant contributor to the phosphorus load to Lake Allegan, ranking 5<sup>th</sup> of 75 subwatersheds for the highest total phosphorus loading per unit area. To address phosphorus loads, multiple storm water best management practices have been implemented in the subwatershed since the mid-2000s, especially on the campus of Western Michigan University.

Project Highlights: Multiple storm water BMPs were installed in the Arcadia Creek subwatershed between 2007 and 2011, especially on the Western Michigan University campus. To assess BMP performance, post-BMP wet weather and dry weather water sampling for total phosphorus and total suspended solids was conducted in 2013-2014, and data were compared to similar pre-BMP data collected in 2002-2003.

Results: Two Clean Michigan Initiative grants and a Section 319 grant funded the following BMPs:

- Three storm water detention basins totaling 141 acres in size
- A 395 foot grassed waterway
- A 6.5 acre infiltration/retention basin
- A 0.8 acre infiltration trench
- 3,115 feet of stream bank stabilization (Figure 1)
- 6 acres of vegetated buffers
- 1.6 acres of reconnected floodplain
- 5,900 native vegetation plugs

Additional storm water BMPs were installed in the subwatershed using other grants and local funds.

Post-BMP monitoring results demonstrated substantial improvements in phosphorus and suspended solids loadings, and stream hydrology:

- Average wet weather event mean concentrations (EMCs) for total phosphorus declined from 0.414 mg/L in 2002-2003 to 0.254 mg/L in 2013-2014 (39 percent decline; Table 1).

- Annual loadings of total phosphorus declined from 2,023 pounds in 2002 to 1,234 pounds in 2013-2014 (39 percent decline; Table 1).
- Average wet weather EMCs for total suspended solids declined from 137.7 mg/L in 2002-2003 to 89.6 mg/L in 2013-2014 (35 percent decline; Table 1).
- Annual loadings of total suspended solids declined from 403 tons in 2002 to 262 tons in 2013-2014 (35 percent decline; Table 1).
- Average wet weather flows and peak flows were substantially reduced after BMPs were installed, despite larger rain events in 2013-2014 (Figure 2).
- BMP performance studies of two storm water detention BMPs demonstrated 85 percent to 99 percent removals of total phosphorus and total suspended solids.
- There were anecdotal reports of reduced flooding throughout the Arcadia Creek watershed after the BMPs were installed.

In addition, Western Michigan University reduced its annual total phosphorus load to Arcadia Creek by 50 percent, and has committed to infiltrating 100 percent of the storm water from any redevelopment or new development.

Partners, Funding, and Congressional District: Two Clean Michigan Initiative implementation grants to The FORUM of Greater Kalamazoo and a Section 319 implementation grant to Western Michigan University totaled \$1,200,405 in grant funds and \$536,958 in match funds, for a total of \$1,737,363. Post-BMP monitoring was funded by a Clean Michigan Initiative grant to Western Michigan University. The monitoring grant amount was \$54,400 and the match was \$19,154, for a total of \$73,554. Partners in the implementation grants were Kalamazoo Christian High School, Western Michigan University, Wildtype Nursery, Geum Services, WildOnes Natural Landscapers, Kalamazoo River Watershed Council, the Gun Lake Tribe, Quantum Construction, and the City of Kalamazoo. Partners in the post-BMP monitoring project were the Portage/Arcadia Watershed Steering Committee, the Kalamazoo Water Reclamation Plant, City of Allegan Wastewater Treatment Plant, and Kieser & Associates. This project is located in Michigan's 6<sup>th</sup> Congressional District.

Photographs:

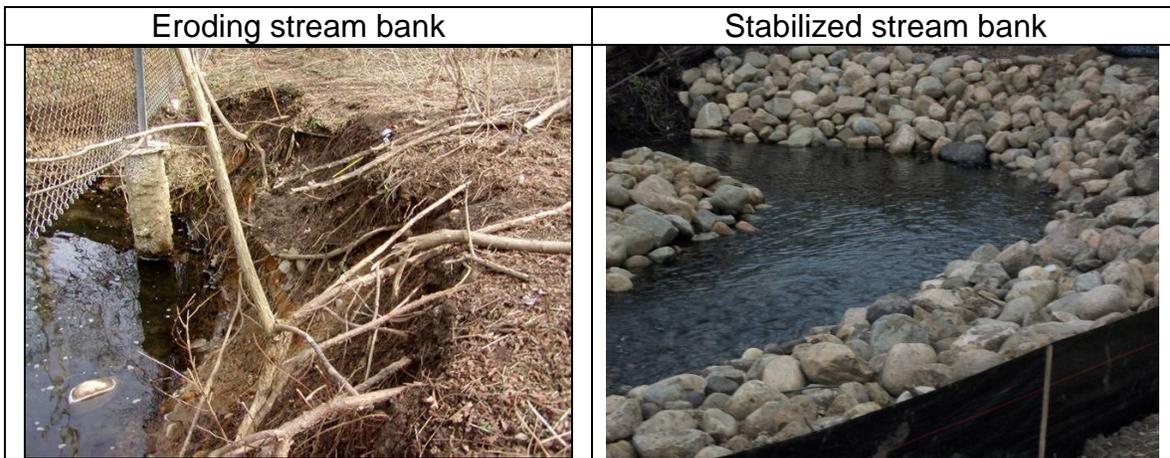


Figure 1. Arcadia Creek along Stadium Drive on the Western Michigan University campus.

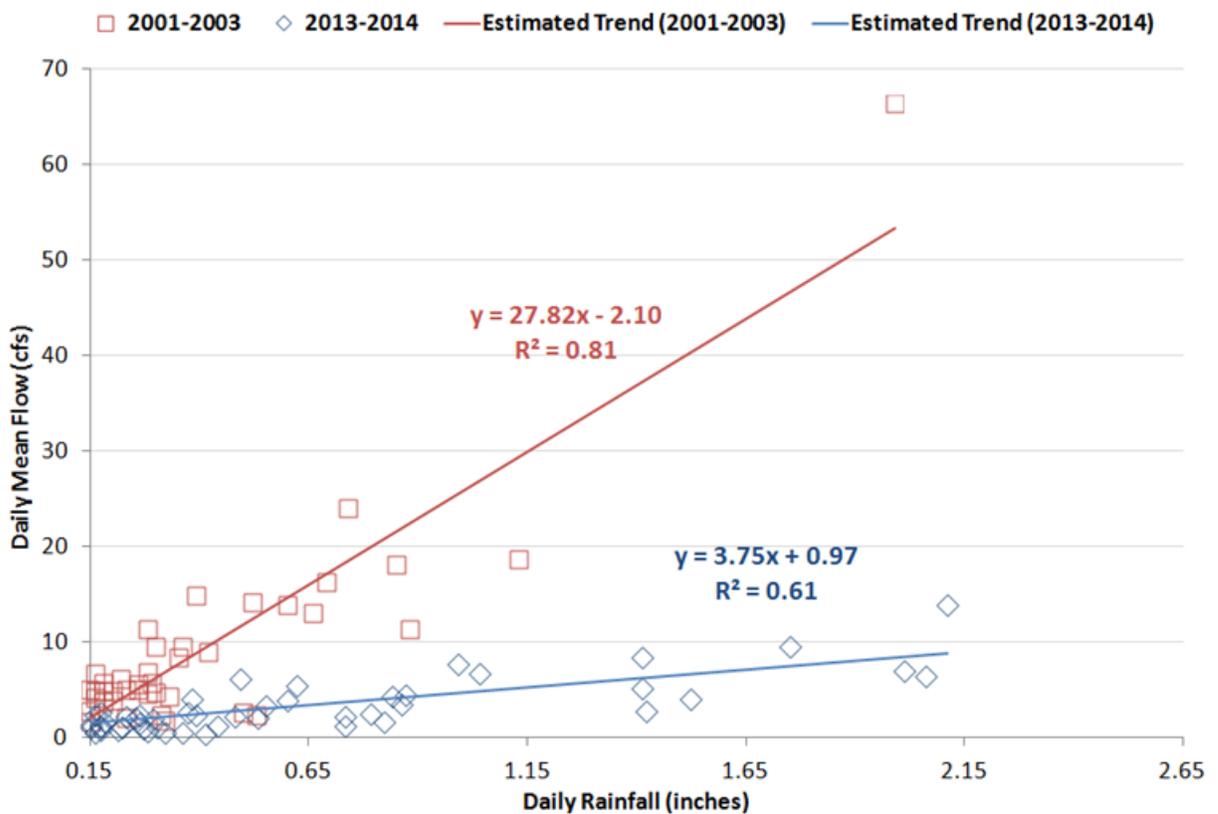


Figure 2. Relationship of rainfall and mean daily flow in Arcadia Creek.

Data table/graph/chart:

Table 1. Pre and post storm water BMP total phosphorus and total suspended solids annual loadings and event mean concentrations.

Years	Annual Loading		Event Mean Concentration	
	Total phosphorus (tons/year)	Total suspended solids (tons/year)	Total phosphorus (µg/L)	Total suspended solids (mg/L)
2002-2003 (Pre)	2,023	403	414	138
2013-2014 (Post)	1,234	262	254	90

Contact Information: Joe Rathbun, Michigan Department of Environmental Quality; 517-284-5517; rathbunj@michigan.gov.