Shingle Creek and West Mississippi Watershed Management Commissions
Iron- and Biochar-Enhanced Sand Filters Project

Urban stormwater conveys bacteria such as *E. coli* to receiving waters, where contact can be a human health risk. Shingle Creek, the Upper Mississippi River, and many other urban and rural streams in Minnesota have been designated as Impaired Waters for periodically exceeding the state water quality standard for bacteria, and must identify sources and strategies for reducing bacterial loading into those waters. In agricultural areas, bacteria sources may be readily apparent – concentrations of livestock or other animals, application of manure to fields, or septic systems. However, in urban areas bacteria sources are diffuse –pet and wildlife waste, sanitary overflows and leakages - and options for reducing loads are limited. The Shingle Creek and West Mississippi Watershed Management Commissions obtained a federal grant to fund a project to field-trial three applications of a new promising yet simple technology in various locations in these urban/suburban watersheds in Hennepin County, Minnesota.

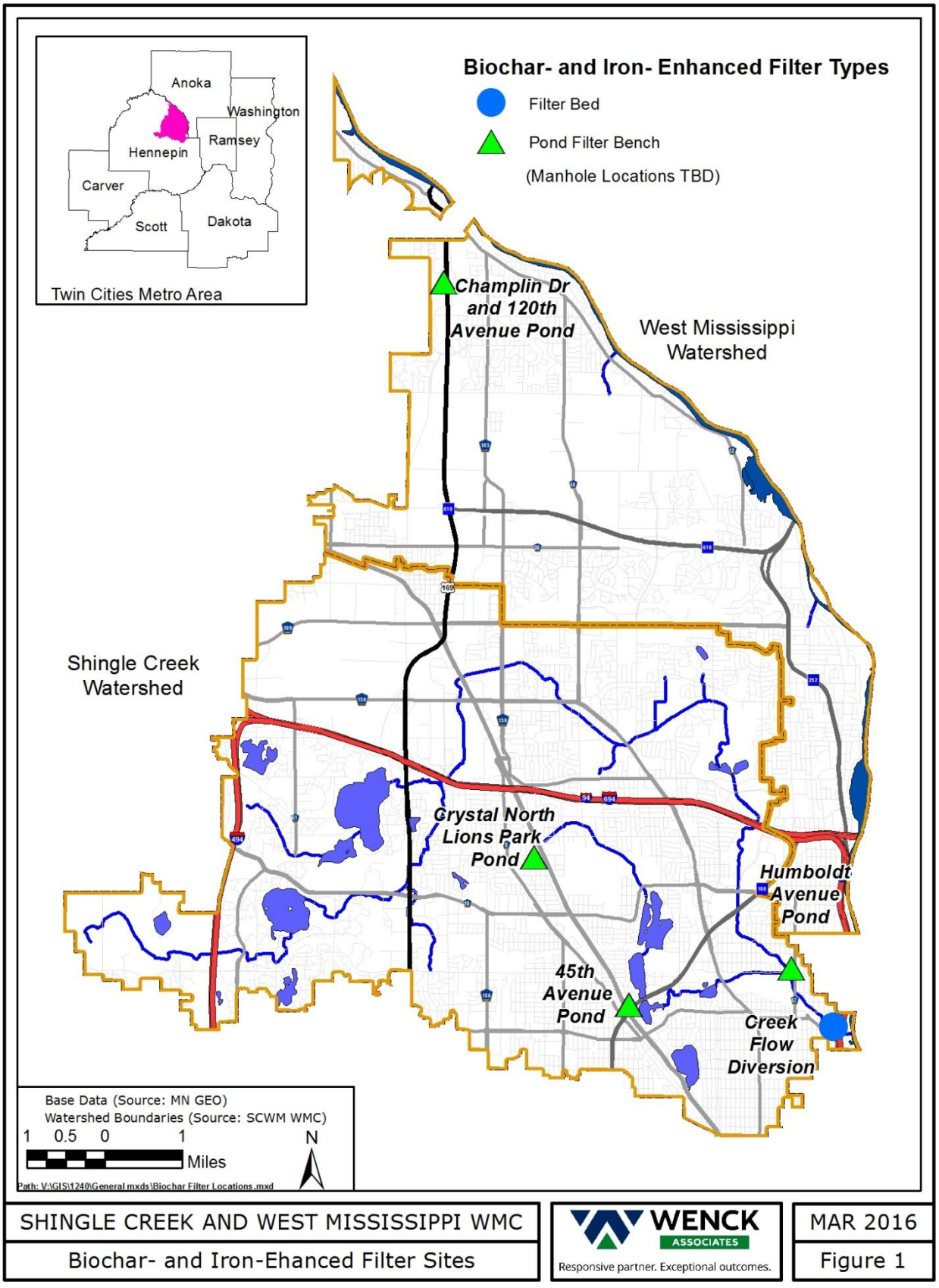
Technical assistance is being provided by the University of Minnesota's St. Anthony Falls Lab, which has developed and spurred the use of iron-enhanced sand filter benches on stormwater ponds to remove dissolved phosphorus from urban runoff. Biochar – a specially engineered type of charcoal –added to iron-enhanced sand filters has been effective in lab experiments at removing bacteria in synthetic stormwater. The three field trials will test the effectiveness of these filters at treating real-world stormwater runoff.

The first application of this biochar-enhanced technology is modifying four existing stormwater treatment ponds with enhanced Minnesota Filter benches (see Figure 1). Inflow, outflow, and ambient water quality will be monitored in the four ponds to assess the effectiveness of the filters. There are thousands of stormwater ponds in the Twin Cities Metro Area and growing interest in retrofitting them with sand filter benches. Quantifying the impact of adding biochar to the sand will add a powerful new tool to the urban stormwater toolbox.

Bacteria in stormwater has also been found in storm sewer conveyances and manhole sumps. The second application of this technology will test whether a biochar-enhanced medium in a manhole can effectively remove bacteria. A standard manhole sediment control insert will be modified to incorporate an enhanced sand filter to treat stormwater flowing into the basin. Two devices will be installed and monitored, not only for removal effectiveness but also for maintenance and durability.

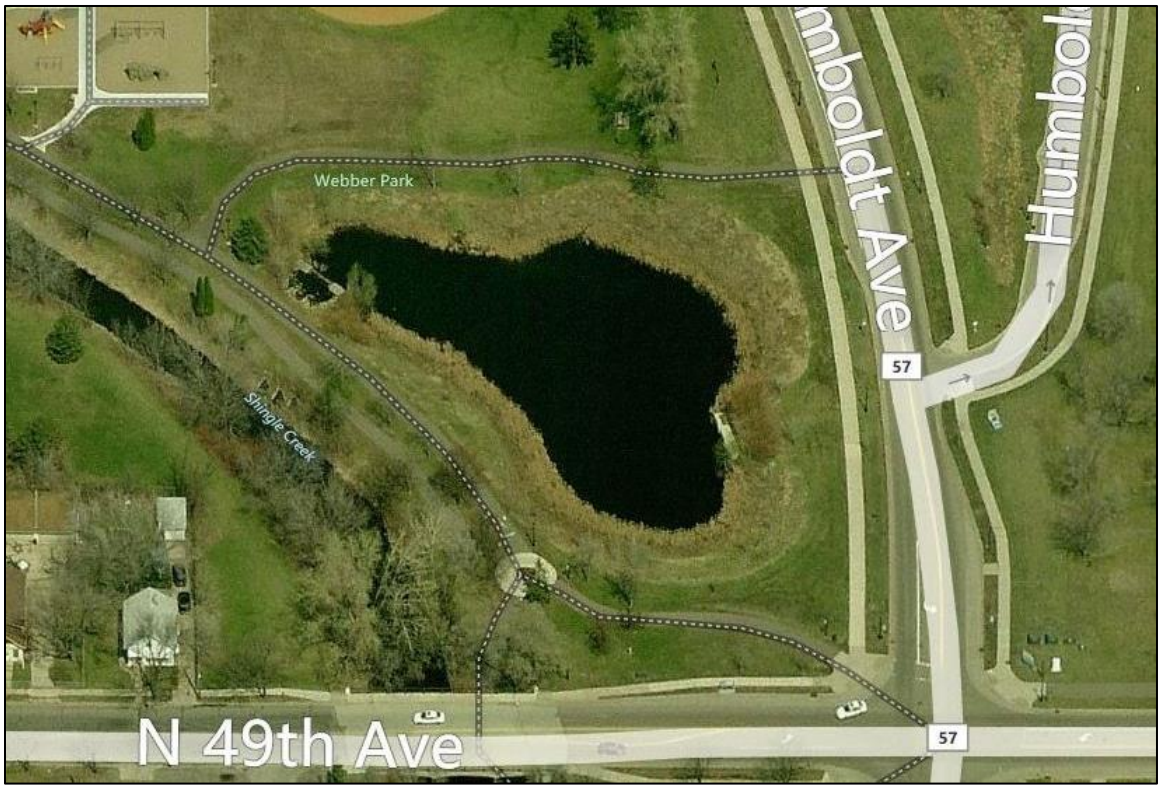
The final application of this technology is a filter to directly treat diverted flow from Shingle Creek. An iron- and biochar-enhanced filterbed will be constructed in a heavy duty steel chest similar to the boxes typically used to house creek monitoring equipment. A pipe will intercept flow from the creek and route it to the filter, where it will percolate to the bottom and then be piped back to the creek. Of interest is whether the removals from this type of direct treatment can be scaled up to make an impact on concentrations in the Creek.

The results of this field testing and monitoring will be used to develop technical designs and specifications that can be used by stormwater managers as they undertake water resource protection and improvement projects in urban areas.



SHINGLE CREEK AND WEST MISSISSIPPI WMC	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	MAR 2016
Biochar- and Iron-Ehanced Filter Sites		Figure 1

45th Avenue N Pond, Robbinsdale

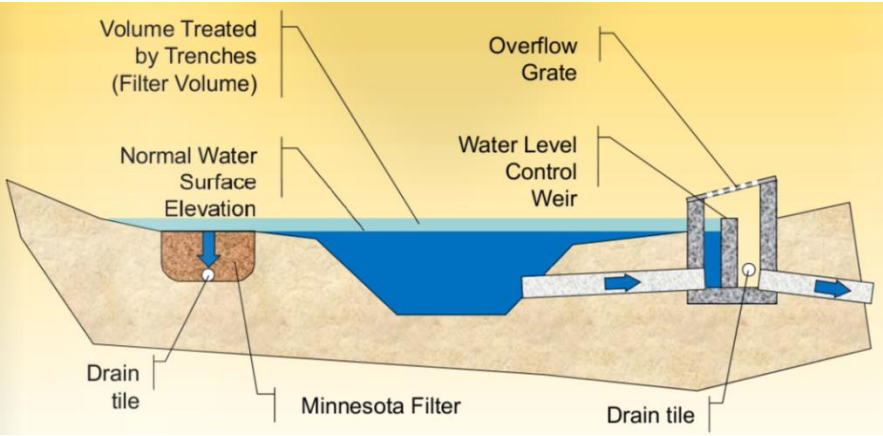


Humboldt Avenue N Pond, Minneapolis

120th Avenue N/Champlin Dr Pond, "City Hall Pond," Champlin

Crystal North Lions Park Pond, Crystal

MINNESOTA FILTER



Cross section of a Minnesota Filter in Prior Lake, Minnesota. (St. Anthony Falls Lab, University of Minnesota)

A Minnesota Filter rings this pond in Prior Lake, Minnesota. When the pond elevation rises, water percolates through the sand filter. The iron filings in the sand filter adsorb the dissolved phosphorus in the pond water. In this project four existing ponds will be retrofit with Minnesota Filters. Biochar will be added to the iron-enhanced sand filter medium to reduce bacteria in pond outflow. Water quality flowing into, out of and in the pond will be monitored to measure effectiveness.

CATCH BASIN INSERTS

The second application is a standard catch basin sediment-control insert such as the one shown at left, modified to incorporate an iron- and biochar-enhanced sand filter medium. The top "layer" of the insert will catch sediment, debris, and organic material. This layer can be easily lifted out and cleaned off. The bottom layer will contain the enhanced sand medium, which will filter out smaller particles, dissolved phosphorus, and bacteria.

CREEK DIVERSION

The proposed Shingle Creek off-line diversion will be located at Webber Park Falls in Minneapolis. The filterbed will be incorporated into a stainless steel chest, such as the one shown above, placed on a viewing area overlooking the falls (see below). A pipe will extend out to the creek to carry streamflow to the box. After percolating through the filter, flow will return to the creek via an outlet pipe. Measuring bacteria concentration in the inflow and outflow will help determine if a filter medium could make an appreciable direct reduction in streamflow concentration.