



UPDATES

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TURNING STANDARD SUMPS INTO A POLLUTION PREVENTION DEVICE WITH THE SAFL BAFFLE

Contributed by Adam Howard

(Contact: John Gulliver at gulli003@umn.edu)

Funded by Minnesota Department of Transportation

There are many standard sumps that may qualify as a best management practice to remove suspended sediment from the water column. However, no data on the effectiveness of sediment removal and maintenance schedule of the sumps exist. Such data could justify providing pollution prevention credit for the use of standard sumps for transportation departments, municipalities, counties and other local governments.

To determine whether the standard sumps remove suspended sediment from stormwater runoff, two standard sumps were tested in a laboratory setting. The removal efficiencies under flow conditions up to design flow as well as the effluent concentrations under greater flow conditions were determined for all configurations. The sumps did remove suspended sediment at the lower flows, but at greater flows the sediment exhibited substantial scour. This scour would negate the sumps as a sediment capture device.

A flow-through baffle was designed and tested as a possible retrofit to the sump. The idea is to use the head loss provided by the flow-through baffle to distribute the jet flowing from the inlet more evenly across the sump, and reduce the maximum velocity. Multiple configurations with varying percent open area and different angles of attack were evaluated in a scale model. An optimum configuration was then constructed at the prototype scale and evaluated for both capture efficiency and sediment retention (i.e., scour prevention). The final design (Figure 1) of the St. Anthony Falls Laboratory (SAFL) Baffle consists of a flow-through baffle which is oriented perpendicular to the flow and extends a distance above to a distance below the inlet pipe crown and invert. (cont'd on page 4)

FIGURE 1: SAFL BAFFLE inside a standard sump manhole (flow inlet shown). (Photo courtesy A. Howard)



WELCOME

Thank you for reading our newsletter! Our purpose is to create opportunities for partnerships which are crucial to our quest for improving the methods for assessment and maintenance of stormwater treatment practices.

UPDATES is a quarterly newsletter designed to share news, current stormwater research efforts, and contact information related to the development of assessment methods and maintenance education for stormwater treatment practices. It is an outreach effort of a project sponsored by the Minnesota Pollution Control Agency (MPCA) and in cooperation with other agencies and organizations. For information, contact Andy Erickson (eric0706@umn.edu).

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SHSAM: A TOOL FOR SIZING HYDRODYNAMIC SEPARATORS AND MANHOLES AS STORMWATER TREATMENT BMPS

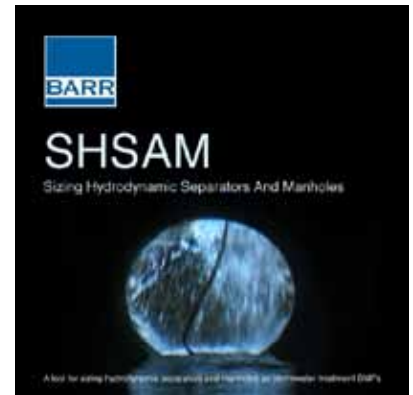
Contributed by Omid Mohseni (omm@barr.com)

Funded by Barr Engineering Company, Inc.

Hydrodynamic separators are stormwater treatment devices with small footprints used for removing suspended sediments and floatables from stormwater runoff in urban areas. Numerous data have been published by research institutes as well as manufacturers regarding the performance of these devices in removing suspended sediments from stormwater runoff. Often the published results are site dependent or only address the specific type of tests conducted on these devices. The questions ahead of the primary users of these devices, (i.e., cities, counties and other local government agencies and large retailers) are: “How well do these devices remove suspended sediment from our stormwater runoff? How can we size them for our site?”

To address this question, Barr Engineering Company has developed a tool (SHSAM: Sizing Hydrodynamic Separators And Manholes) to simulate runoff and the removal of suspended sediments from stormwater runoff using the results of the studies conducted at St. Anthony Falls Laboratory. The runoff component is a continuous hydrologic model

for small drainage basins in urban areas. The hydrologic model utilizes the SCS curve number method to simulate excess rainfall, and the SCS unit hydrograph to simulate the runoff hydrograph. The suspended sediment removal is estimated using the performance functions developed by the St. Anthony Falls Laboratory for 6 hydrodynamic separators and also standard sumps. The input data into the model are 15-minute precipitation data, daily air temperature data to mimic stormwater temperature, the drainage basin characteristics, the particle size distribution in stormwater runoff, the specific weight of sediment particles, and the concentration of suspended sediments in stormwater runoff. The output is the removal efficiency of these devices over a period of time, (e.g., 15 years) and the total amount of sediments removed as well as the number of times a device has to be cleaned every year.



In the November of 2009, SHSAM will be posted on the Barr web site and will be available to the public at no charge. For more information, please contact Omid Mohseni at omm@barr.com.

SIMULATION OF STORMWATER TEMPERATURE AND HEAT LOADING FOR THE MILLER CREEK TEMPERATURE TMDL

Contributed by William Herb (herb0003@umn.edu)
Funded by Minnesota Pollution Control Agency

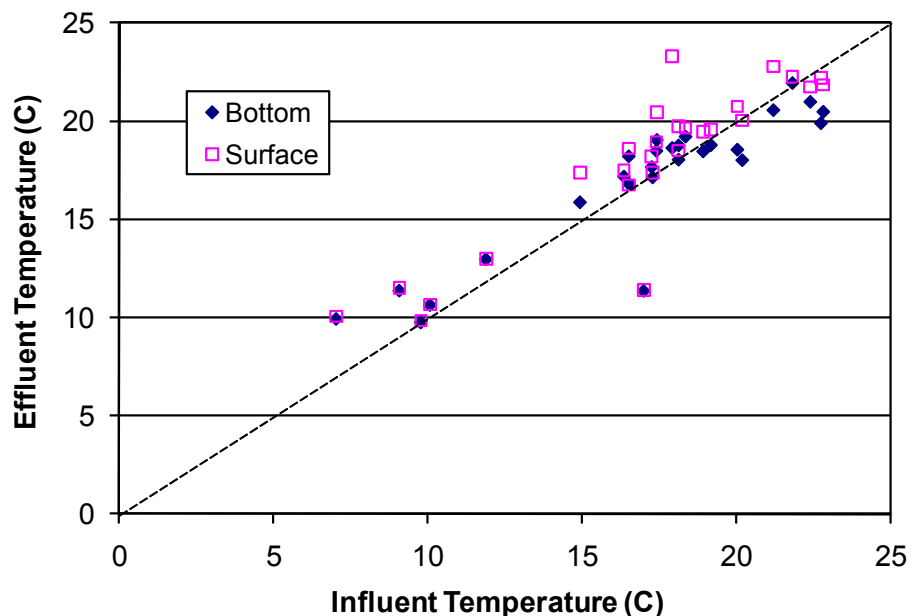
Miller Creek is a designated trout stream which originates near Duluth International Airport, flows through the cities of Hermantown and Duluth, MN and discharges into St. Louis Bay. Miller Creek was recently added to the list of impaired waters (for temperature) by the Minnesota Pollution Control Agency. The 9.4 square mile watershed is about 22% impervious, so that stormwater is a dominant source of flow for Miller Creek.

In support of the TMDL, the MINUHET surface runoff modeling tool was used to characterize stormwater runoff temperatures for typical residential and commercial sub-watersheds for June to September, 2008. Overall, runoff temperatures were simulated to an accuracy of 1.1 to 1.3 °C when compared to field observations. Runoff from the commercial site was, on average, 0.6 °C higher in temperature than the residential site due to higher fractions of impervious area and lower shading.

Models for wet detention ponds were then used to estimate changes in temperature and heat loading to Miller Creek from surface runoff, where heat loading depends on both runoff volume and temperature. A typical wet pond was found to increase, overall, water temperature (Figure 1) and total heat loading, but reduce peak heat loading rates by reducing flow rates. The use of a wet pond with a bottom withdrawal outlet structure gave some reductions in effluent temperature for smaller rainfall events (< 1 cm rainfall), but were of little benefit for larger events compared to standard surface outlets.

Underground stormwater vaults and infiltration practices are currently being studied as alternate practices to reduce heat loading. Further details on this study and the models used can be found in the reference section (Herb and Stefan 2009, Herb et al. 2009a and 2009b).

FIGURE 1: Simulated wet pond effluent temperature for surface and bottom outlets vs. influent temperature for 25 rainfall events in 2008. Points above the dashed line mean that the pond increased the water temperature. (Figure courtesy W. Herb)



EVENTS CALENDAR

NOTE: All travel paid for by the University of Minnesota

October 26-27, 2009: Minnesota Water Resources Conference (St. Paul, MN)

- *Iron-Enhanced Sand Filtration for Stormwater Phosphorus Removal*
- *Standard Sumps as A Stormwater Best Management Practice*
- *Particle Settling Velocity and the Impact on Stormwater BMP Performance*

December 3-4: Minnesota Association of Watershed Districts (Alexandria, MN)

- *Operation and Maintenance for Stormwater Management (December 3rd, 7 pm)*
- *Posters: Assessment and Maintenance of Stormwater Treatment Practices*

January 10-14, 2010: 89th Annual Transportation Research Board Meeting (Washington, D.C.)

- *Iron-Enhanced Sand Filtration for Stormwater Phosphorus Removal*

February 21-24, 2010: 17th Congress of the Asia and Pacific Division of the International Association of Hydraulic Engineering and Research (IAHR-APD 2010) (Auckland, NZ)

- *Dissolved Phosphorus Capture in Stormwater Filtration*
- *Settling Velocity Distribution in Urban Stormwater Runoff*

TURNING STANDARD SUMPS INTO A POLLUTION PREVENTION DEVICE WITH THE SAFL BAFFLE (cont'd)

(cont'd from page 1)

Tests were performed on sumps pre-loaded with sediment. The results shown in Figure 2 indicate that, with the right baffle dimensions and porosity, there can be nearly complete elimination of sediment scour for flows up to the 10-year design storm of 4.2 inches in 24 hours for the Minneapolis, MN area. A significant increase in removal efficiency at the low flows was also observed with the SAFL Baffle. The data collected show that standard sumps retrofitted with the flow-through SAFL Baffle can be successfully used as stormwater treatment BMPs.

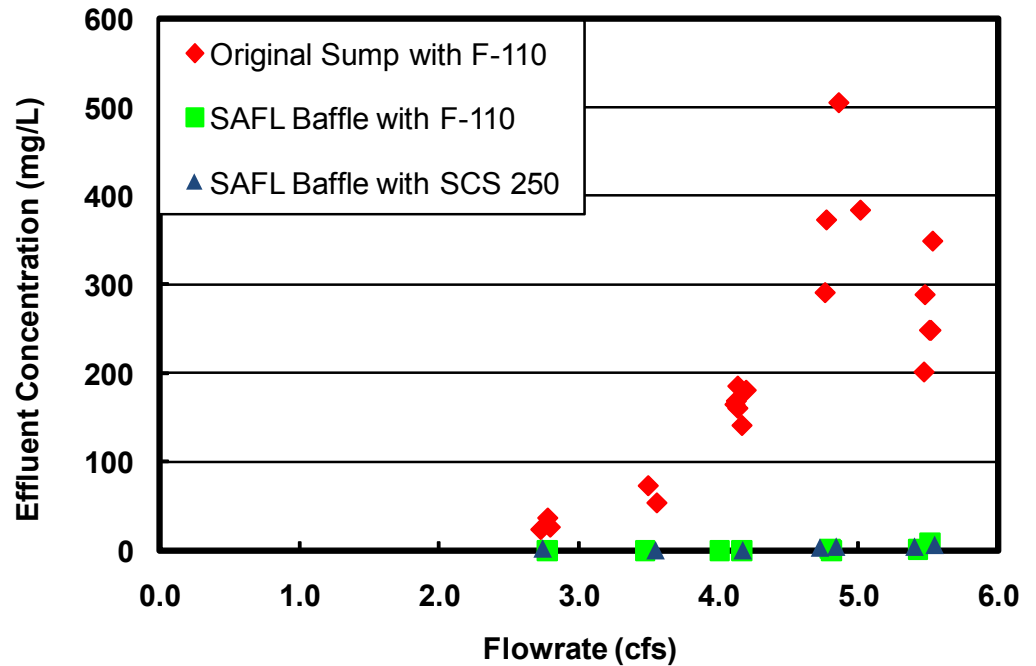


FIGURE 2. A large effluent concentration from the sump pre-loaded with sediment indicates substantial scour at flows above 4 cfs. Almost complete elimination of scour occurs with the SAFL Baffle for sediment loading with F-110 (median diameter of 110 microns) and SCS-250 (median diameter of 44 microns). (Figure courtesy A. Howard).

PUBLICATIONS

1. Erickson, A.J., Gulliver, J.S., Weiss, P.T., and B.J. Huser. (2010). Dissolved Phosphorus Capture in Stormwater Filtration. Proceedings of the 17th Congress of the Asia and Pacific Division of the International Association of Hydraulic Engineering and Research (IAHR-APD 2010). February 21-24, 2010, Auckland, NZ.
2. Erickson, A.J., Gulliver, J.S., Weiss, P.T., and B.J. Huser. (2010). Iron-Enhanced Sand Filtration for Stormwater Phosphorus Removal. Proceedings of the 89th Annual Transportation Research Board Meeting. January 10-14, 2010, Washington, D.C.
3. Herb, W.R., B. Janke, O. Mohseni and H.G. Stefan. (2009a). MINUHET (Minnesota Urban Heat Export Tool): A software tool for the analysis of stream thermal loading by urban stormwater runoff. St. Anthony Falls Project Report 526.
4. Herb, W.R., B. Janke, O. Mohseni and H.G. Stefan. (2009b). Simulation of temperature mitigation by a stormwater detention pond. *Journal of the American Water Resources Association*, 45(5): 1164-1178.
5. Herb, W.R. and H.G. Stefan. (2009). MINUHET (Minnesota Urban Heat Export Tool): Stream Temperature Modeling of Miller Creek, Duluth, MN. St. Anthony Falls Project Report 535.
6. Hettler, E. and J.S. Gulliver (2010). *Settling Velocity Distribution in Urban Stormwater Runoff*. Proceedings of the 17th Congress of the Asia and Pacific Division of the International Association of Hydraulic Engineering and Research (IAHR-APD 2010). February 21-24, 2010, Auckland, NZ.