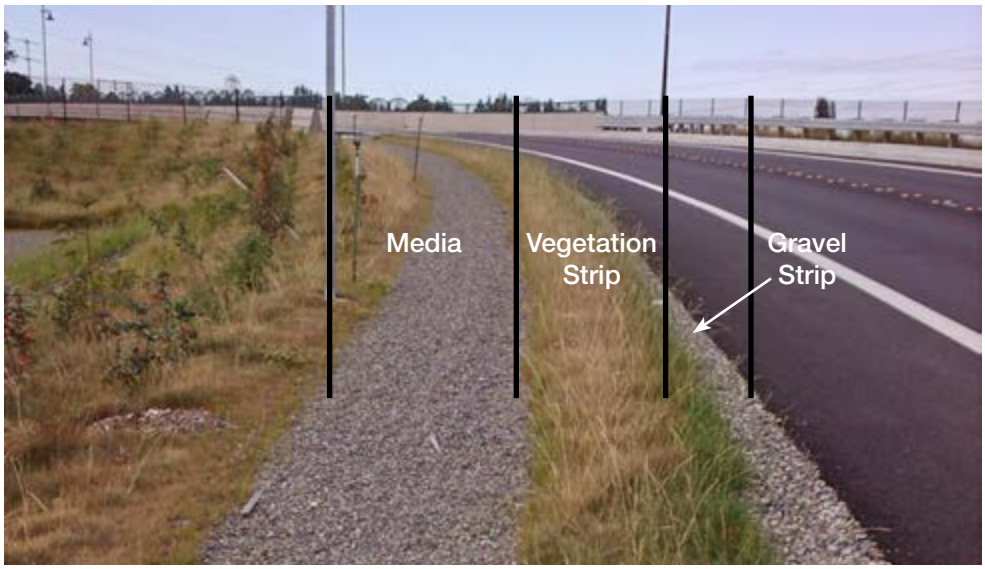
Research Note

Media Filter Drain: Modified Design Evaluation and Existing Design Longevity Evaluation

From the WSDOT Research Office
February 2014



Media filter drain sections.

Background

A media filter drain (MFD) is a stormwater best management practice with gravel, vegetated, and media sections. The media section is made up of crushed aggregate, perlite, gypsum and dolomite and has either a free draining toe or an underdrain. One of the many benefits of MFDs is the effective removal of dissolved zinc and copper from roadway runoff.

The Problem

Many MFDs are in use today, but the initial research on MFDs did not evaluate its potential life past ten years. One portion of this project (Existing Design Longevity Evaluation) determined if media from *existing* MFDs remain effective beyond 10 years to avoid costly, premature replacements. Currently, WSDOT has over 40 linear miles of MFDs in use. At an estimated cost of $50.00 per foot, the cost to replace them is about $10.5 million dollars. WSDOT estimates that if the replacement time for the existing media filter drains are extended from 10 years to 25 years, then the anticipated cost savings is at least $15 million over a 25 year period.

The *existing* design includes use of an aggregate gradation that is no longer readily available (*old* design). A more readily available and economical aggregate gradation has a slightly lower percent of finer material (*new* design). The other part of the project was to evaluate the effectiveness of the *new* design with respect to the *old* design (Modified Design Evaluation).

What we did

Existing Design Longevity Evaluation

For this part, we obtained *existing* media filter mix from two field applications. Site A has been in operation for 12 years and Site B had been in operation for five years. We placed the existing media in columns in the laboratory and accelerated aging by consecutively infiltrating into the columns simulated stormwater solutions adding very high dissolved zinc and copper concentrations. Periodically the columns were

tested for performance with simulated stormwater applications with concentrations more typical of roadway runoff. We also placed some of the existing media from both sites in other columns and added a thin layer of supercharged media (additional perlite, gypsum and dolomite), and then performed a series of accelerated aging tests on these columns to preliminarily look into possible rejuvenation techniques. In all cases, the influent and effluent were tested for dissolved zinc and copper.

Modified Design Evaluation

We placed freshly prepared *new* design media in columns and freshly prepared *old* design media in other columns and infiltrated these columns with simulated stormwater with metal concentrations in the ranges found in roadway runoff. In addition, we also prepared columns with *new* design media and accelerated metals aging with periodic performance testing similar to the methods used on the *existing* media in the first part. In all cases, the influent and effluent were tested for dissolved zinc and copper.

Photo of the laboratory column setup.

What we learned

Existing Design Longevity Evaluation

Accelerated aging tested on *existing* media from sites in Washington state indicated that the media may have extended lives past 25 and 18 years for the media from Sites A and B, respectively. Site factors such as prior filtration might impact the media's life expectancy and further research may hone in on maintenance requirements and the media's life expectancy. The parallel study using a thin layer of supercharged media on Site B *existing* media appears promising for rejuvenation.

Modified Design Evaluation

Findings from laboratory research performed on columns filled with new media versus columns filled with old media indicate that the new media initially has similar removal efficiencies as the old media for large storm events. Accelerated aging of the new media indicates that removal efficiency for dissolved zinc and copper of the new media remained viable for at least 15 years. Figures 1 and 2 present the percent concentration decrease of copper and zinc respectively for various influent concentrations over the course of the accelerated aging experiments on the new columns.

What the researcher's recommend

Based on the results of this research, we recommend that WSDOT use either the *old* or the *new* media mix for MFDs depending on availability and favorable cost. Additional pretreatment via filtration prior to infiltration into the MFD may also prove useful. In addition, we propose that the replacement time be extended well past the initial ten year evaluation.

We propose that research continue in two phases. The next phase (Phase II) would extend the laboratory work, and the subsequent phase (Phase III) would provide for field evaluations. For the Phase II project, it would be beneficial to continue the accelerated aging event sequences on both the *new* and the *existing* media in order to determine how long media filter drains remain viable. This Phase II project might also include further evaluation of simple rehabilitation techniques as originally proposed in Phase I once a failure point has been reached. The Phase III project might include developing simple field inspection protocols and tests for evaluating efficacy of existing MFDs and field test would enable WSDOT to verify the functionality of MFDs over time and also include evaluating the surrounding conditions of the MFD, determining whether there is adequate filtration prior to infiltration or if enhancements might increase the life of the MFD.

Figure 1: Percent Concentration decrease of dissolved copper for the accelerated aging tests on the *new* media columns.

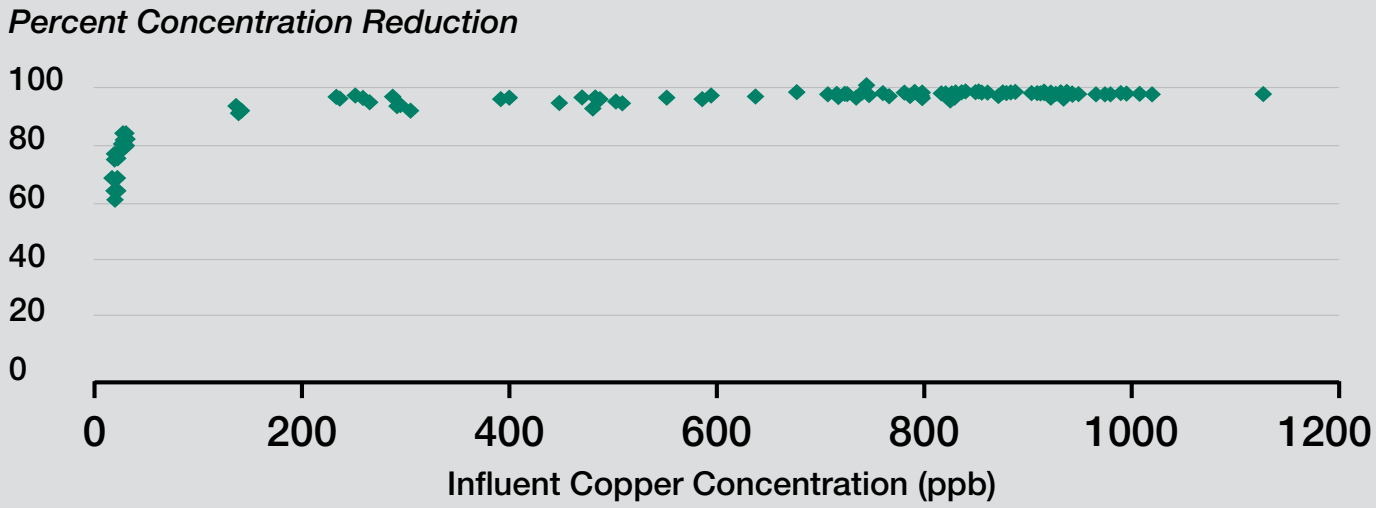
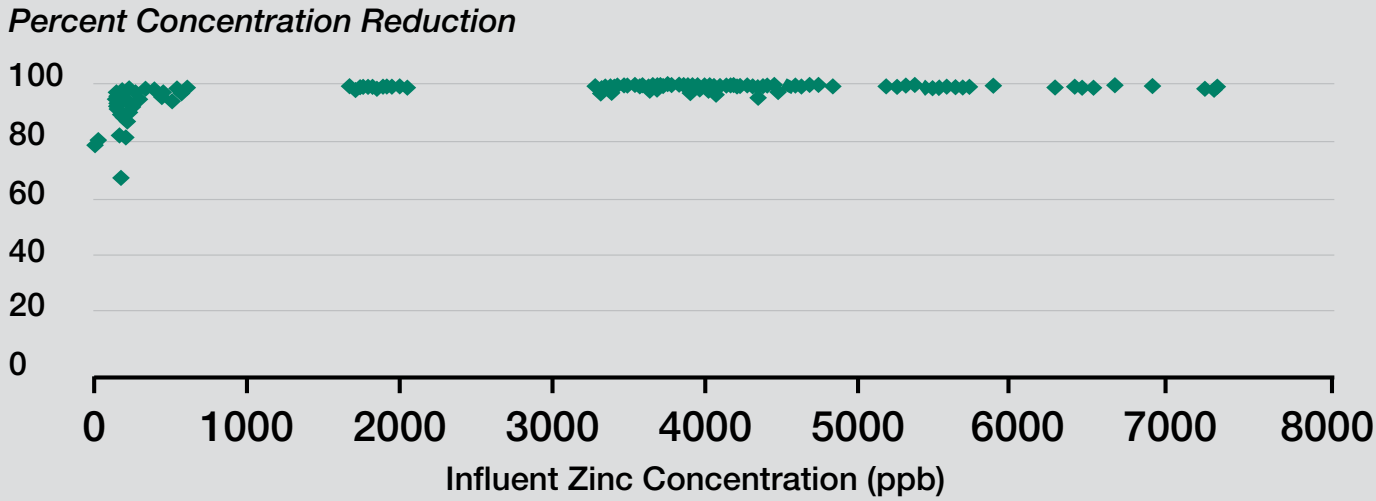


Figure 2: Percent Concentration decrease of dissolved zinc for the accelerated aging tests on the *new* media columns.



Summary of Implementation

MFD designs which have a range of applicable aggregate gradations will be useful and economical for WSDOT based on the local or regional availability of aggregate in the area. This research expands both the applicable design criteria and the anticipated life expectancies of the media filter drain, particularly for applications where dissolved zinc or copper are metals of concern. In addition, there would also be cost savings for all new MFDs installed if the replacement times are extended to 25 years or more. MDFs are currently in use by other states, counties and cites.

Media filter drain at Site A.

Modified filter drain at Site B.

Contact Information

Report Number and Title
WA-RD 822.1 Media Filter Drain: Modified Design Evaluation and Existing Design Longevity Evaluation

Researchers
Cara Poor and Liv Haselbach
Washington State University
Civil & Environmental Engineering Department
Box 642910
Pullman, WA 99164-2910
cpoor@wsu.edu, (509) 335-4547
haselbach@wsu.edu, (509) 335-4874

Research Manager
Rhonda Brooks
WSDOT Office of Research
and Library Services
Transportation Building
Box 47372
Olympia, Washington 98504
BrookRh@wsdot.wa.gov, 360-705-7945

Technical Monitors
Mark Maurer, PLA, PE, and Larry Schaffner
WSDOT Project Development Division
Transportation Building
Olympia, WA 98504
MaurerM@wsdot.wa.gov, 360-705-7260
SchaffL@wsdot.wa.gov, 360-570-6657

Funding
$40,000 State
$20,000 Federal
$60,000 Pactrans

14-04-0002473