Project Summary

Texas Department of Transportation

0-4611: Non-proprietary, Small Footprint Stormwater Quality Structures for Use in Urban Areas

Background

Phase II rules of the National Pollutant Discharge Elimination System (NPDES) require that all new construction projects, as well as reconstruction projects, address issues of stormwater quality. In many cases, retrofitting existing urban rights-of-way is necessary and requires acquisition of additional right-of-way that is cost prohibitive or would prove socially disruptive. In these situations, it may be necessary to use underground stormwater treatment structures.

The purpose of this Texas Department of Transportation (TxDOT) project was to develop simple, effective stormwater quality treatment structures that are simple in design and maintenance but effective in removing regulated stormwater pollutants. The proposed underground stormwater best management practice (BMP) is suited for ultra-urban conditions that require low head loss and highly efficient, low-maintenance and cost-effective stormwater quality treatment within limited rights-of-way.

What the Researchers Did

Researchers conducted a literature review of small-footprint and underground stormwater treatment devices and their cost, performance, and maintenance considerations. A conceptual model was developed and a physical model study, to test the principles to be employed, was conducted at the Center for Research in Water Resources of The University of Texas at Austin. The conceptual model study modeled a rectangular detention basin to characterize the hydraulic behavior of the basin and the settling of sediments within the basin. The physical model used a 1:5 scale model of the proposed BMP and examined the effects of factors such as sediment loading and inflow rate on sediment removal performance.

A full-scale prototype of the proposed BMP was constructed at the TTI/TxDOT Hydraulics, Sedimentation and Erosion Control Laboratory (HSECL) at the Riverside Campus of Texas A&M University to examine the concepts developed in the conceptual and physical studies. Researchers carried out experiments on the prototype to determine the sediment removal efficiency and event mean concentrations that could be achieved using the proposed BMP. Researchers tested the prototype with various sediment loadings, outlet types, outlet locations, and outlet flow conditions.

Research Performed by:

Texas Transportation Institute (TTI),
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What They Found

Results from the studies indicate that the proposed BMP can effectively lower the concentration of total suspended solids in stormwater. The model study and the prototype study exhibited sediment removal efficiencies greater than 80 percent. Measurements from a floating-type outlet exhibited significantly higher sediment removal efficiency compared to a fixed-type outlet.

Resuspension of sediment accumulated from previous storm events can lower the sediment removal efficiency. Detention of sediment-laden water for approximately 3 hours, and the use of a common inlet/outlet can effectively reduce the problem of resuspension and improve performance of the proposed BMP.

What This Means

The significance of this project can be summarized as follows:

- The model and prototype of the proposed underground stormwater BMP performed satisfactorily in removing sediments carried by storm runoff.
- A floating-type outlet displayed improved performance potential. However, researchers anticipate maintenance problems associated with use of such an outlet.
- Researchers developed a flow-control chamber that should be used in conjunction with the proposed small-footprint BMP to reduce problems related to cleaning and maintenance.
- Resuspension of settled sediment during subsequent storm events negatively affected the performance of the proposed BMP. To reduce the effect of resuspension and improve performance, researchers suggest detaining the sediment-laden water in the BMP for about 3 hours with no discharge and having a common chamber for water to enter and leave the BMP.

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