Permeable Curb and Gutters for Storm Water Control

Developing a proof of concept for new linear LID-SCM permeable materials

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21PUTSA01

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Lead Institution:

University of Texas at San Antonio

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Tran-SET

University of Texas at San Antonio

Total Project Cost:

$ 90,000

Storm water pollution is a pressing problem and a variety of Low Impact Development- Stormwater Control Measures (LID-SCMs) have been studied for reducing pollutant loadings to receiving waters. However, no measures have been widely adopted at levels necessary to fully mitigate storm water pollution in high density urban environments. The research goal of this project is to develop a proof of concept for how new linear LID-SCM permeable materials could be installed along curb and gutters to treat non-point source pollution for regular streets. The configuration will entail hollow core permeable curbs that collect filtered water to be conveyed as storm drainage. Pollutants are removed prior to entering receiving waters. Required permeability, porosity and associated material pollutant removal efficiencies and cleaning options need to be characterized for this storm water collection configuration to identify best form and function when utilized in urban environments. An experimental test apparatus will be constructed to simulate a typical street profile and water depths expected to occur during typical storm events. This apparatus will be used to determine: (1) The fraction of water that can be treated by the permeable curb, for a typical design rain event. (2) The amount of solids that may be removed from the water treated. (3) The potential for clogging and fouling of the permeable curb. (4) The ability to recover lost performance through vacuum cleaning of the porous curb, and (5) training of students, outreach to the public, and dissemination of research findings to the broader scientific community.

Problem Statement

Storm water pollution is a pressing problem and a variety of LID-SCMs have been studied for reducing pollutant loadings to receiving waters. To date, no measures have been widely adopted at levels necessary to fully mitigate storm water pollution in high density urban environments. Pollutants of concern include suspended solids, nutrients, and metals. Thermal pollution is also of concern since it leads to reduced dissolved oxygen levels in sensitive receiving waters. Existing LID-SCMs include bioretention ponds (also known as rain gardens), sand filters, permeable pavements, green roofs, rainwater harvesting systems, bioswales, infiltration trenches, retention basins, extended detention basins, grassy swales, vegetative filter strips, and constructed wetlands. While all these runoff treating measures have been shown successful to some extent, none have reached widespread adoption. The cause of inadequate adoption of LID-SCMs is their large footprint required to meet treatment goals. Most LID-SCMs require, on average, 200 square feet of area to treat one acre of drainage area. Hence, there is an urgent need for either (1) reducing the footprint needed for LID-SCMs or (2) reconfiguring of LID-SCMs such they can be incorporated into existing urban infrastructure as retrofits to facilitate adoption at levels necessary for mitigating pollution. This study proposes to achieve both goals by modifying how permeable materials are used.

Objectives

The research goal of this project is to develop a proof of concept for how new linear LID-SCM permeable materials could be installed along curb and gutters to treat non-point source pollution for regular streets. The specific objectives of this study are:

- Determine the proportioning of flow which can be filtered by entering through the permeable curb structure; to that flow which travels along the surface of the curb and remains unfiltered.
- Determine overall removal efficiencies of solids for the combined flow and ascertain the efficacy of the permeable curb and gutter technological approach.
- Evaluate clogging potential, and cleaning recoveries.
- Training of students in transportation related storm water management practices, enhancement of public awareness of storm water treatment technologies, and dissemination of findings from the study to the broader scientific community.

Figure 1. Rendering of testing Apparatus

Intended Implementation of Research

Students will be involved and trained in all aspects of the research project. One graduate MS student will be supported on the project and responsible for running the testing configuration and making determinations of flow proportions and solids removals possible for permeable curbs and gutters. Undergraduate students may also assist as volunteers (or paid if additional funding is found through our undergraduate RA program) with testing configuration and construction fabrication of the porous curb. To enhance public awareness of storm water treatment technologies, we will run the experimental apparatus in a demonstration mode during the Fall 2021 Roadrunner days (COVID-19-Permitting) where high school students from around Texas visit UTSA to explore possible studies. Finally, a peer review research publication will serve to dissemination findings to the broader scientific community. A summary of important results will be provided in a journal publication submitted to the ASCE Journal of Environment Engineering.

Anticipated Impacts/Benefits of Implementation

The research proposed in this study is a proof-of-concept approach with limited variables explored due to funding constraints. It will however provide the basis for future proposal development where funding sources can be approached to explore optimization of the approach and hopefully field scale demonstrations.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.