Summary of TWRI Scholarship 2017

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Topic: Evaluating LID applications in the urban area for flooding control using ArcSWAT and evaluating sand mixture for the bioretention use through laboratory test.

Summary: Flooding in the urban area is a severe issue in the State of Texas due to rapidly increasing urbanization land use type in recent years. To mitigate the flooding hazard, Low Impact Developments (LIDs) and Best Management Practices (BMPs) are commonly used to enhance infiltration rate and to reduce surface runoff. The present research focuses on two aspects to understand the efficiency of flooding control through LID applications: 1. Numerical study of surface runoff reduction rate for green roof & permeable pavement, detention pond and wetland using ArcSWAT model. 2. Laboratory column test of saturated hydraulic conductivity (K_{sat}) for five types of sand mixtures for the bioretention use. In the numerical study, the East Fork of Trinity River Watershed was selected for the ArcSWAT model, and the watershed was located near the City of Dallas. The simulation showed that 70% surface runoff reduction rate was predicted under the detention pond installation in the targeted downstream area; and 20% and 16% surface runoff reduction rate were simulated for green roof & permeable pavement and wetland, respectively. The result suggested that the detention pond for surface runoff control and infiltration enhancement is better than the combination of green roof and permeable pavement, and wetland. For laboratory test, raw materials of sand, compost, and biochar were selected and mixed with various ratio of composition to prepare sand mixture for the column test. The different ratio of sand mixture could exhibit multiple soil characteristics and hydraulic conductivity. The experimental results indicated that the sand mixture with 80% sand and 20% compost (% by volume) could reach K_{sat} up to 240 cm/hr. The high K_{sat} could result in fast infiltration rate. When surface runoff is produced during heavy storm events, the soil mixture with higher K_{sat} could provide more efficient mitigation of flooding hazard. However, the soil mixture with low K_{sat} might provide better water quality control. Besides, with compost in the sand mixture, the column test results showed more phosphorus release than the mixtures without compost.

The further study results are being submitted to a journal