1. Title of Proposal

Design and evaluation of Best Management Practices (BMPs) for urban stormwater quality improvement in South Texas

2. Focus Category:

SURFACE WATER; WATER QUALITY; WETLANDS

3. Keywords

Stormwater quantity and qualify, Continuous flow monitoring, Best Management Practices, Performance evaluation

4. Duration:

March 1, 2010 through February 28, 2011

5. Federal Funds Requested.

$5,000

6. Non-Federal (matching) Funds Pledged.

$16,177. Please see associated matching funding letter.

7. Principal Investigator (graduate student).

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9. Congressional District(s) where project will occur

Congressional District 28 (McAllen City, TX)

10. Abstract.

The increase in population and rapid development at the border of US and Mexico imposes a serious stormwater quality problem and potential flooding risk in the Arroyo Colorado Basin area. In order to improve urban stormwater quality, some Best Management Practices (baffle box and treatment wetlands) are being designed for City of McAllen, TX. Continuous flow monitoring will be used to survey the critical water quantity and quality parameters including flows, dissolved oxygen, nutrients, bacteria, and others. Then water quantity and quality can be evaluated after comparing the volume and concentration at the inlet and outlet of the BMP designs. A

mathematical descriptive model of each BMP will be developed and validated using these data.

11. Statement of Critical Regional Water Problems

Urban stormwater runoff water quality is increasingly becoming a major contributor to non point source water pollution for 21st century development. It can not only become a cause of flooding if not properly managed during storm events, but also cause water pollution through runoff containing sediment and materials [1] Thus, it is very important to accurately characterize the frequency, volume and sediment load of storm water during rainfall events for urban landscape development, drainage patterns and water quality prediction especially in semiarid coastal areas.

At the border of the US and Mexico, the population is growing and urbanization progressing at a significant rate. In addition, the rapid development of industrial and municipal sectors also imposes a heavy environmental and ecological burden, which causes serious air, water and solid waste pollution, and can impact human health. The Arroyo Colorado and Rio Grande are important environmental and economic resources in South Texas. However, both were listed as impaired, identified in the 2008 Texas Water Quality Inventory and 303(d) listed for depressed dissolved oxygen, bacteria, mercury in edible tissue and PCBs in edible tissue [2]. Thus, as part of a prudent watershed protective plan, it is essential to implement some best management practices (BMPs) for urban water quality improvement in South Texas to mitigate the impact of non-point pollution such as urban stormwater on watershed quality.

12. Nature, Scope, and Objectives of the Research.

The proposed research outlined here is part of a larger project (funded by the Texas Commission on Environmental Quality and the City of McAllen).

Urban stormwater runoff can not only become a cause of flooding if not properly managed during storm events, but also a cause of water pollution through runoff containing sediment and materials.

The acquisition of adequate data for stormwater and runoff for BMP mitigation designs and models is still a challenge. Over the past several years, some interesting phenomenon identified concerning storm water, such as first flush, has been discovered and discussed in the literature [3-4]. The complex relationship among land use, storm events and urban water quality is still poorly understood. New approaches to develop the most complete and useful datasets for stormwater quality description and data analysis are needed [5].

Thus, it is very important to accurately characterize the frequency, volume, sediment and materials loading of storm water during rainfall events for project design and policy making. In an effort to improve our understanding of these events, we propose

to use continuous flow monitoring to survey the critical parameters including flows (flow rate, temperature, turbidity), nitrate and periodic measurements for nutrients (nitrogen, phosphorus, chlorine, sulfate), bacteria (E.coli, Enterococci), and others (pH, Dissolved Oxygen, TDS and TSS) for the best management practices designs and model calibrations, and collect the data to make the time-flow, time-concentration and time-mass loading curves.

Based on these results, we will design some innovative best management practices for urban water quality improvement in South Texas, such as sediment baffle boxes, free water surface wetlands, bioretention cells, treatment swales and others. Modeling of small scale urban BMPs presents challenges in the development of accurate models including fundamental water quality treatment processes. Thus, water quantity and quality will be monitored and evaluated after comparing the volume and concentration at the inlet and outlet of the BMP designs. A mathematical descriptive model of each BMP will be developed and validated using these data.

In addition, in the background of global climate change, proper management of urban stormwater also can decrease the risk of flood and increase the infiltration to groundwater. Thus, our project may provide some pioneer work on the sustainable management and planning of urban stormwater in a semi-arid area like South Texas.

13. Results Expected from this Project

Some Best Management Practices (baffle boxes and wetland) would be designed and installed in the City of McAllen. Descriptive models of each BMP would be developed and validated using continuous flow monitoring data and periodic measurements.

The BMP designs and performance evaluation will be presented to stakeholders and recommended for incorporation into the South Texas Arroyo Colorado Watershed Protection Plan to improve regional water quality. The results will also be submitted as a manuscript(s) to a peer-reviewed journal.

Literature Cited

[1]Wong T.H.F. Introduction. In: Wong, T.H.F. (Ed.), Australian Runoff Quality. Institute of Engineers, Australia, 2006.
[2] Texas Commission on Environmental Quality (TCEQ). 2008 Texas Water Quality Inventory and 303(d) List, 2008.
[3] Deletic A. The First Flush Load of Urban Surface Runoff. Water Research 1998, 32(8): 2462-2470.
[4] Stenstrom M.K., Kayhanian M. First Flush Phenomenon Characterization. Final report prepared for the California Department of Transportation, Report No. CTSW-RT-05-73-02.6, Sacramento, CA, 2005.
[5] Leecaster M. K., Schiff K., Tiefenthaler L. L. Assessment of efficient sampling designs for urban stormwater monitoring. Water Research 2002, 36(6):1556-1564.