American Water Resources Association
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Monday, Nov. 9
3:30 PM – 5:00 PM
SESSION 13: Stormwater

Design of Regional Urban Watershed Dry-Weather Flow Treatment System – Talbert Lake Diversion Project - Bruce Phillips, PACE, Fountain Valley, CA

Collection and treatment of dry weather flows from large urbanized watersheds present a unique and difficult challenge. An innovative treatment system was developed specifically for a 22 square mile Orange County watershed tributary to the East Garden Grove-Wintersburg Channel in Huntington Beach, CA. This watershed generates up to an estimated three MGD of highly degraded dry-weather flow that discharges to the Outer Bolsa Chica Bay. The project will divert the flows from the channel to the existing City Central Park. The system relies on interconnected key components which include: (1) a flexible in-channel collection system, (2) conveyance system to the treatment train, (3) primary wetland treatment train system, (4) manmade lake polishing treatment system, and (5) groundwater recharge and reuse. An inflatable rubber dam will be installed in the existing concrete channel that will capture and temporarily store the dry-weather flows while avoiding impacts to the flood control capacity. A forebay and pump station will be constructed underneath the channel access road which will pump the flows to Central Park located approximately one mile away. The dry-weather flow delivered to Central Park will be distributed to three independent wetland treatment cells which are composed of several interconnected shallow wetlands and wetland ponds. The wetland cells include surface and specialized subsurface wetlands treatment elements that will utilize surface area for the growth of bacterial biofilters. The outflow from the wetland treatment system will discharge for final polishing into the existing manmade Talbert Lake which will be reconstructed and restored for stormwater treatment, groundwater recharge, park irrigation and maintaining a year-round permanent water body. The restored manmade lake system will be specifically designed for stormwater treatment utilizing (1) submerged media biofilters, (2) lake aeration, (3) in-lake pumped circulation, and (3) water quality filters and wetland planters. The water quality of the restored engineered lake is designed to recreate the natural biological processes and develop a managed ecosystem that provides water quality treatment. A comprehensive review of the unique project planning and design process, include water quality treatment design guidelines and modeling techniques are discussed.

Characteristics of Stormwater Flow and Quality From Five Urban, Karst Watersheds - Katherine Blansett, Department of Ag & Bio Engr, Penn State University, University Park, PA (co-author: James Hamlett)

The quantity and quality of urban stormwater is an increasing water resources problem, particularly in the Chesapeake Bay watershed. The increase of impervious surfaces associated with urban development impacts the magnitude and quality characteristics of stormwater runoff. Hydrologists and practitioners in the field of stormwater management know that the characteristics of surface stormwater runoff in karst watersheds are different than in nonkarst regions but there is little research on quantifying these differences. This study will attempt to further the science of urban hydrology by investigating the water quality and quantity response of five small urban watersheds with different levels and types of urbanization in a karst region (i.e. an area that is underlain by limestone and fractured bedrock) of the Ridge and Valley physiographic province of Central Pennsylvania. Continuous flow data are being collected at eight locations with the watersheds including each watershed outlet, and water quality data are being collected periodically during selected storm events at seven of the locations. The flow and water quality data from different types of precipitation events from different seasons will be analyzed. The magnitude and character of the stormwater runoff will be compared to the amount of impervious surfaces, the connectedness of the impervious surfaces, and the preservation of natural drainageways and recharge areas. The types and distribution of water quality constituents (such as nutrients, metals, and sediment) will be compared between watersheds and between events. Event mean concentrations from the karst watersheds will be compared to those from the EPA NURP studies, updates to the NURP data and other reported observations.

Watershed Health Index Based on Biological Potential - Michael Milne, Brown and Caldwell, Seattle, WA (co-authors: Bob Storer, Carol Murdock, Bob Ellis)

Water Environment Services (WES) provides surface water management services for several urban service districts in portions of unincorporated Clackamas County. WES' Surface Water Management Program requires the development of performance metrics for all functional program areas as it transitions from a utility-based, regulatory driven program to a watershed health focus and integrated watershed management approach. To support this effort, WES developed a Watershed Health Index (WHI) to track overall watershed health conditions and trends, serve as a communication tool for customers, stakeholders and regulators, and support adaptive management decision-making. Some of the watersheds in Clackamas County have been affected by urban development. Urban development generally entails an array of landscape changes and instream stressors that can adversely affect watershed health. It is rarely feasible to completely eliminate these stressors from existing urban areas, especially areas that developed prior to current land use codes and stormwater management regulations. Consequently, urban streams generally have lower “biological potential” than streams in undeveloped watersheds. With this in mind, WES decided to express the benthic element of the WHI as the percentage of the estimated “biological potential” for each stream reach. The biological potential for each reach was estimated based on the percentage of urban land use/land cover, road density, and population density in the catchment area, using the bioassessment tool and developed by the Water Environment Research Foundation (Barbour et al, 2007). The benthic index value for each reach was then compared to the estimated biological potential for that reach. WES' ongoing benthic monitoring programs and GIS database should provide the data needed to discern watershed health trends over time. The WHI concept is straightforward and expressed in terms (% of site potential) that are easy to communicate to customers, stakeholders and regulators. In addition, the WHI can provide a useful basis for project and program prioritization, assisting in levels of service and setting performance metrics. Stream reaches with benthic WHI values well below their biological potential may be appropriate candidates for restoration, while reaches with WHI values close to their biological potential may be candidates for preservation.

Effects of Urbanization on Water Quality in the Lower Kaskaskia Watershed in Southern Illinois - Charnsmorn Hwang, Southern Illinois University Carbondale, Carbondale, IL (co-authors: Julia Friedmann, Karl Williard, Jon Schoonover)

The Kaskaskia River is a large river system located in central and southwestern Illinois that serves as a tributary to the Mississippi River. In the lower portion of the watershed, an expanding urbanization front exists in the Metro East area of St. Louis. For example, population growth of small cities, like O'Fallon, IL, has increased 36% from 1990 to 2000 (US Census Bureau 2007). Such areas of urbanization are especially vulnerable to stream degradation. Our study focuses on the effects of land cover, particularly urbanization, upon water quality parameters such as total suspended solids, nitrate, ammonium, orthophosphate, and Escherichia coli within the Lower Kaskaskia watershed. Forty-four catchments in the Lower Kaskaskia ranging from 12 km2 to 50 km2 were identified as study catchments. Based on the percent urban land cover present, catchments were categorized as urban (>10% urban), village (2-10%), and agricultural (<2%). Stream water was collected every two weeks in the dormant season and monthly in the growing season from January 2008 to present. Current results demonstrate that catchments had higher levels of total suspended solids (206.7 ± 28.7 g/L) and E. coli populations (520.4 ± 57.5 MPN) during stormflow conditions than baseflow (37.8 ± 3.5 g/L; 4730.5 ± 1805.4 MPN), as expected. Orthophosphate levels in urban watersheds were relatively high at baseflow (2.23 ± 0.18) and stormflow (1.25 ± 0.14 mg/L). Surprisingly, both nitrate and orthophosphate levels in urban watersheds were significantly greater than in agriculture watersheds ($p = 0.102$ and $p = 0.019$, respectively). The significant nutrient levels in urban streams may be due to nutrient inputs via stormwater runoff, wastewater treatment effluent, and home septic systems. In the second phase of the study, efforts will focus on source characterization of nutrient inputs. Stream water samples will be analyzed for caffeine concentrations, which is an accepted index of the degree of anthropogenic impact on water quality in a watershed.