Abstracts

Tuesday, April 29

Session E6: Monitoring the Benefits of Green Infrastructure on Water Quality

3:30 – 5:00 pm | Room 232

Evaluation of Soil Media, Vegetative Diversity, and Projected Precipitation Effects on Bioretention Performance and Emission of Greenhouse Gases

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Abstract
Inflow and outflow water quality (nitrate, phosphate, total nitrogen, total phosphorus, total suspended solids), volumetric flow rate, soil moisture, temperature, conductivity and greenhouse gas emissions (nitrous oxide and methane) were monitored in eight newly constructed bioretention systems at the University of Vermont Bioretention Laboratory. Three treatments were employed to evaluate the response of the bioretention cells 1) under current ambient precipitation patterns compared with simulated climate change driven enhanced rainfall events in the Lake Champlain Basin by mid-late century 2) with two vegetative pallets, one being low in diversity having two salt tolerant species compared with high diversity pallet having seven species 3) with traditional soil media of gravel, pea stone, sand and compost compared with the traditional mix with the addition of a proprietary media called SorbtiveMedia from Imbrium Solutions, Inc. The water quality and volumetric flow rate were measured using an ISCO Model 6712, Teledyne Company automated water sampler equipped with a 720 pressure transducer, clipped into a customized 90° v-notch weir box and an in-pipe Thel-Mar weir four feet underground at the inflow and outflow respectively. The outflow probe was accessible via a water tight sump surrounding a t-pipe. Discrete water samples were taken every 2 minutes for 24 minutes to focus on the first flush of pollutant being mobilized during a storm event.

Greenhouse gas fluxes (N2O, and CH4) from soils were measured bi-weekly from October – December. These fluxes were measured in three locations per cell using the vented closed chamber method (Hutchinson and Mosier 1981), where gas concentration within the chamber is measured by withdrawing samples from the chamber by syringe at 3-4 time periods and analyzing gas concentrations by gas chromatography (Shimadzu GC-17A equipped with a Flame Ionization Detector for quantifying CH4 and with an Electron Capture Detector for quantifying N2O). Inorganic soil N was measured concurrently, as a covariate for N2O fluxes.

Multimetric Evaluation of Detention Basin Retrofit to Reduce Hydrologic Alteration of Urbanization and Restore Stream Stability

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Abstract
Conventional stormwater detention basins are ubiquitous in the developed portions of U.S., particularly those areas developed since the 1980s. Because most detention basins were designed exclusively for flood control, they are not being utilized to their fullest potential and do not include measures to mitigate erosive flows from small, but frequent storm events, that are often amplified by urbanization. These underutilized detention basins present

a retrofit opportunity to mitigate the erosive energy of small and intermediate storm events without adversely impacting flood control capacity.

The purpose of this research was to develop a cost-effective detention basin retrofit device that provides for a more controlled release of storm flows, ultimately mimicking a more natural flow regime. The benefits of this approach can include stream channel protection and water quality improvements (*e.g.*, TSS reductions), as well as stabilization of aquatic habitat in receiving channels. The device is designed to throttle stormwater flow, temporarily detain it, and gradually discharge it to the downstream channel at a more appropriate rate for the receiving stream. To monitor the effectiveness of the retrofit, the project measured an array of multidimensional parameters including:

1) time series rainfall data
2) time series flow data in the detention basin and receiving streams
3) hydrogeomorphic surveys in receiving streams pre- and post- retrofit installation
4) water quality grab samples

Preliminary modeling suggests that detention basin residence times will double during the typical year, and that the cumulative duration of flows that cause bed material disturbance in the receiving stream will be reduced by 50% relative to existing conditions. The simple retrofit technology is projected to fully restore the pre-developed disturbance regime, which should improve downstream channel stability and have cascading benefits for water quality, habitat, and ecosystem function.

This project is a collaborative partnership between multiple government agencies (Federal, regional, and local) and private businesses. Monitoring costs were contained by capitalizing on existing data collection efforts by project partners focused on documenting the impacts of urbanization on stream condition, as well as evaluating the performance of green infrastructure and other stormwater BMPs at improving stream health.

Application of Automatic Stormwater Monitoring Systems for Integrated Management of Urban Streams in Daejoen, Korea

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Abstract
An automatic monitoring station was developed for an urban stream to collect information on flow rate and water quality changes during storm events. Major objective of this study is to provide accurate information for urban watershed model (SWMM) calibration for the purpose of development of integrated urban river management plan. Rainfall gauge, water quality sensors, automatic water sampler and ultra-sonic water level meter were used to provide data on real time basis. The system was installed at the Donghwa Bridge in Gwanpyung Stream in Daejeon Korea that can be considered as the border between developed downstream areas and underdeveloped upstream area of the basin. Flow rates were estimated using water depth measured by ultra sound level meter attached to the bridge along with weir equation. Measured flow rate were verified with field measurements. While water quality sensors can provide real time data, automatic water sampler was used for laboratory analyses for more accurate measurements. The sampler can be programmed to start by using signal from rain gage, ultra sound water meter or manually from remote control. SWMM urban watershed model was applied and calibrated for single and continuous events. While flow modeling showed relatively good agreement for all events, water quality modeling results showed less accurate agreements. This suggests that pollutant build up and washoff effects of the study site need be investigated further. It is expected that his study can be used effectively to evaluate LID (Low Impact Developemnt) or GIS (Green Infra Structure) for sustainable management of basins and urban streams.

Tracking the Recovery of Onondaga Lake, NY: Monitoring the Effect of Gray and Green Infrastructure Improvements in Achieving Phosphorus TMDL Numerical Water Quality Targets

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Abstract
Onondaga Lake NY is a small urban lake with a long history of municipal and industrial pollution; since 1998, the lake has been at the top of state and federal priority lists of impaired waters due to nutrient enrichment, habitat degradation, and mercury contamination. Major investments in wastewater collection and treatment (gray infrastructure), coupled with an innovative focus on managing storm water (green infrastructure) and remediation of legacy industrial contamination, have brought about a remarkable recovery of the lake ecosystem. A suite of metrics were developed to help turn monitoring data into information that can support management decisions.

In 1998, New York State Department of Environmental Conservation (NYSDEC) promulgated a Phase I Phosphorus TMDL (Total Maximum Daily Load) for Onondaga Lake focusing primarily on load reductions from the Metropolitan Syracuse Wastewater Treatment Plant (Metro). An Amended Consent Judgment (ACJ), also issued in 1998, allowed NYSDEC to revise the phosphorus TMDL for Onondaga Lake based on monitoring and modeling. In 2012, EPA approved the final phosphorus TMDL for Onondaga Lake. The final allocation incorporates the use of Green Infrastructure (GI), in combination with other strategies, to meet water quality targets and assure that future growth does not increase nonpoint phosphorus loads to Onondaga Lake. The use of GI is a central component of reducing the inflow of untreated combined sewage into Onondaga Lake and its tributaries. To meet this new goal, the County initiated the “Save the Rain” program, designed to reduce stormwater inflows to the combined sewer system through a combination of gray infrastructure (such as storage) and multiple GI approaches distributed across the urban landscape of Syracuse.

This presentation highlights the monitoring program underway and the collaboration among the public sector, private engineering firms, and university and research institutions. With these efforts Onondaga County has developed effective ways to monitor and report progress toward ecosystem recovery.