Green Infrastructure Impact on Stormwater-Control and Water Quality
Ashley Rolon-Marlowe1, Dr. Jennifer Cherrier2, Dr. Brianne Smith3
1UWIN URP 2017 student at Brooklyn College – City University of New York (ashley ролино65@myhunter.cuny.edu), 2,3 Brooklyn College – City University of New York

INTRODUCTION

New York City is home to 8,537,673 people (US Census data), 14 wastewater treatment plants and is working to reduce water pollution caused by Combined Sewer Overflows (CSO) and flooding influenced by storm surge. CSOs can contain sewage, suspended solids, litter, and excess nutrients among other potentially harmful substances. Increased urbanization and stormwater discharge into waterways can lead to more frequent flooding, increased temperature, habitat degradation and erosion.

According to the New York City Panel on Climate Change annual precipitation is expected to increase by 5-10% for middle range predictions or by 15% for high range predictions by the year 2050. Sea level is expected to rise 11 to 24 inches for middle range predictions or by 11 inches for high range estimates (Horton et al. 2015).

The NYC Department of Environmental Protection CSO Consent Order modified in 2012 called for an investment of over $600 million for at least 10 years in the use of green infrastructure (GI) to capture 10% of storm water from each sewershed.

RESEARCH QUESTIONS

This project studies the impact of green infrastructure (GI) design on water control and quality.

• What percent of the input volume will outflow through the mesocosms systems?
• What concentration of phosphate and ammonium will remain in the system outflow?
• Which green infrastructure design provides more efficient stormwater control?
• Which design is more effective at reducing nutrients in the water that filters through the system?

STUDY SITE

Red Hook, Brooklyn

METHODS

When a rain event occurred the benefits of green infrastructure (GI) can be observed in the reduction of stormwater outflow. As a result, less rainfall is transmitted to water controls, water delayed and contolled. GI systems can provide a control of water: CSO and NYC mesocosms were created in duplicate. Six simulated rain events occurred over a 14-day period using historical precipitation data (May – Sept., 2011) and trends from Red Hook, Brooklyn. Prior to each rain event start, water inflow samples were collected into 500 ml vials, starting 10 minutes after the start of the rain event. Each rain event sample was collected from the bottom to the surface. The samples were then 20 ml vials. GI mesocosms showed a control with open vials. GI mesocosms reduced water inflow volumes and collection were sampled at least 24 hours following the end of the rain event.

RESULTS

Hydrology

Figure 4. Ammonium Concentration. Approximate 2.6 mg/L. N in ammonium was added to tap water prior to the start of each rain event. NYC and ECO systems showed a dramatic decrease in ammonium concentration. Outflow samples for all systems and rain events showed a concentration of 2 mg/L, NO₃, which were too dilute to acquire a result.

CONCLUSIONS

• ECO systems released 81% to 105% of volume input after 24 hours, with some overflow once maximum storage capacity was reached. NYC systems released 7% to 10% of volume input, with most of the volume released within the first 10 hours of a rain event.
• The ecoWIR mesocosms are more effective and consistent at controlling water.
• The NYC passive system provides more efficient phosphorus removal. The ECO mesocosm system may be more efficient at ammonium removal. More research is needed on the total nitrogen (TN) concentration of system inflow and outflow for greater accuracy.
• Holding water for a period of at least 24 hours encourages Phosphorus to desorb from the system and flow out.
• Results from this experiment can inform the optimized design and implementation of GI in urban areas, such as New York City.

ACKNOWLEDGEMENTS

I thank Dr. Jennifer Cherrier and Dr. Brianne Smith of Brooklyn College for their tireless mentorship throughout this project, Michael Griinroth for his assistance, Alan Berkowitz and Audre Locher for their guidance, and UWIN for their support of the URP program. This work was funded by NYS Sustainability Research Network (SRN) Cooperative Agreement 1444758 through the Urban Water Innovation Network.

REFERENCES

J. Murphy, J.P. Ray, A modified single solution method for the determination of phosphates in natural waters, Analytica Chimica Acta, Volume 27, 1962, Pages 31-36, ISSN 0003-2670