

International Low Impact Development Conference 2016

MAINSTREAMING GREEN INFRASTRUCTURE

Proceedings of the International
Low Impact Development Conference 2016

Portland, Maine ■ August 29–31, 2016



EDITED BY Robert Roseen, Ph.D., P.E., D.WRE
Virginia Roach, P.E.
James Houle, Ph.D.



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DEVELOPMENT CONFERENCE 2016

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New England Water Environment Association

Environmental and Water Resources Institute
of the American Society of Civil Engineers

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Preface

The International Low Impact Development Conference was held in Portland, Maine in August of 2016. The Proceedings presented here represent a slice of the interesting and timely content that was presented at the conference. The conference this past year highlighted the mainstreaming of Green Infrastructure and Low Impact Development in municipal programming as well as new and existing work and research in the United States and internationally. We are excited to announce that the 2016 LID conference led to a spin-off conference entitled Operations and Maintenance of Stormwater Control Measures that will be coming to Denver, Colorado in November 2016. We hope that these proceedings provide the in-depth information that you are looking for and we look forward to seeing you at the next LID conference in 2018!

Acknowledgments

Preparation and planning are the key to a successfully executed conference so we would like to recognize the hard work of the Conference Steering Committee and also others that are not mentioned here.

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Finally, we acknowledge and thank the staff of the EWRI of ASCE, who, in the end, make it all happen.

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Contents

Cistern Performance for Stormwater Management in Camden, NJ	1
Farzana Ahmed, Michael Borst, and Thomas O'Connor	
Low Impact Development for Controlling Highway Stormwater Runoff—Performance Evaluation and Linkage to Cost Analysis	9
Azadeh Akhavan Bloorchian, Jianpeng Zhou, Abdolreza Osouli, Laurent Ahiablame, and Mark Grinter	
How the Implementation of Green City, Clean Waters in Philadelphia Advances Modeling Capabilities across the Program.....	16
Eileen Althouse, Edward Lennon Jr., and Julie Midgette	
Addressing Water Scarcity in South Africa through the Use of LID	20
L. N. Fisher-Jeffes, N. P. Armitage, K. Carden, K. Winter, and J. Okedi	
Development of a Low Impact Development and Urban Water Balance Modeling Tool.....	29
Steve Auger, Yuestas David, Wilfred Ho, Sakshi Sani, Amanjot Singh, Tim Van Seters, Chris Davidson, Melanie Kennedy, and Kevin MacKenzie	
Simulation of the Cumulative Hydrological Response to Green Infrastructure	43
Pedro M. Avellaneda, Anne J. Jefferson, and Jennifer M. Grieser	
Dual Opportunity for Education and Outreach to Evaluate Benefits of GI Implementation	52
Leslie Brunell and Elizabeth Fassman-Beck	
Examination of Empirical Evidence and Refining Maintenance Techniques for GI.....	65
Amirhossein Ehsaei and Thomas D. Rockaway	
Comprehensive Benefits Assessment with as a Step toward Economic Valuations of Ancillary Benefits of Green Storm Water Infrastructure and Non-Structural Storm Water Quality Strategies in San Diego, California	78
Clem Brown, Richard Haimann, and Chris Behr	
A New Method for Sizing Flow-Based Treatment Systems to Meet Volume-Based Standards	89
Kelly L. Havens, Zachary J. Kent, and Aaron Poresky	
Evaluating the Real Estate Development and Financial Impacts of the San Diego Region's Post-Construction Standards and Alternative Compliance Program: A Multi-Disciplinary Effort	98
Juli Beth Hinds	

Estimating Monetized Benefits of Groundwater Recharge from Stormwater Retention Practices	106
John Kosco, Lisa Hair, Jonathan Smith, and Heather Fisher	
Design Parameters for Manufactured Soils Used in Storm Water Treatment, Wetland Restorations, and LID Projects.....	114
Geoffrey Kuter, David Harding, and Mike Carignan	
Performance Optimization of a Green Infrastructure Treatment Train Using Real-Time Controls.....	123
C. Lewellyn, B. M. Wadzuk, and R. G. Traver	
Greening Indiana—One Training at a Time.....	131
Sheila McKinley	
Update to Permeable Pavement Research at the Edison Environmental Center	135
Thomas P. O’Connor and Michael Borst	
Full-Scale Structural Testing of Permeable Interlocking Concrete Pavement to Develop Design Guidelines.....	143
David J. Jones, Hui Li, Rongzong Wu, John T. Harvey, and David R. Smith	
Developing Low Impact Development (LID)-Based District Planning (DP) Techniques and Simulating Effects of LID-DP	155
C. H. Son, J. I. Baek, D. H. Kim, and Y. U. Ban	
Green Infrastructure Performance Model in the Real World: Modeling Natural and Simulated Runoff Events	163
Stephen White, Tyler Krechmer, Taylor Heffernan, Nicholas Manna, Elizabeth Mannarino, Chris Bergerson, Mira Olson, and Jason Cruz	
Winter Road Salting in Parking Lots: Permeable Pavements vs. Conventional Asphalt Pavements.....	173
H. Zhu, J. Drake, and K. Sehgal	

Cistern Performance for Stormwater Management in Camden, NJ

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ABSTRACT

The Camden County Municipal Utilities Authority installed cisterns at locations around the city of Camden, NJ. Cisterns provide a cost effective approach to reduce stormwater runoff volume and peak discharge. The collected water can be substituted for potable water in some applications reducing the demand. This presentation focuses on five cisterns that were monitored as part of a capture-and-use system at community gardens. The cisterns capture water from existing rooftops or shade structures installed by CCMUA as part of the project. Cistern volumes varied from 305 gallons to 1,100 gallons. The design volume was based on the available roof drainage area. Water level was monitored at 10-minute intervals using pressure transducers and rainfall was recorded using tipping bucket rain gauges. Cisterns were sampled at 6 to 8 week intervals through the growing season for determination of concentration of microorganisms, nutrients, and metals. The analyses detected antimony, arsenic, barium, copper, lead, manganese, nickel, vanadium, and zinc. Concentration of all these metals were below recommended water quality criteria for irrigation by EPA guidelines for water reuse. The total nitrogen, phosphate, and total organic carbon concentrations varied from 0.23 to 2.26 mg/L, 0.025 to 1.11 mg/L, and 0.55 to 4.06 mg/L, respectively. Large total coliform concentrations were observed in some samples. The presentation will summarize the data for first growing season giving the results from monitoring the water use and water quality of cisterns.

INTRODUCTION

The Camden County Municipal Utilities Authority (CCMUA) has installed several green infrastructure stormwater control measures (SCMs) throughout the City of Camden to reduce the volume of Combined Sewer Overflows. This presentation focuses on five cisterns installed at community gardens. The Rutgers Cooperative Extension Water Resources Program developed engineering plans and specifications for each of the sites. US EPA is monitoring these five installed cisterns for three consecutive growing seasons. This paper summarizes the findings from monitored cisterns for the first year growing season.

Cisterns collect and store rainwater that can be used for household and other uses. A gutter and downspout system directs the collected rainwater to the storage cistern. Cisterns can be installed above or below ground. Roof harvested rain water has been considered to be one of the most cost effective sources for various non potable uses like irrigation, toilet flushing, and car washing (Ahmed, et al. 2011)). Cisterns can reduce stormwater runoff volume and peak discharge rates, and provide an alternative water supply during times of water restriction. Factors that influence the quality and quantity of captured rainwater include: roof geometry (size,

exposure, and inclination), roof material (chemical characteristics, roughness, surface coating, age, and weatherability), location of the roof (proximity of pollution sources), maintenance history of the roof, rainfall events (wind speed, intensity, and pollutant concentration), other meteorological factors (seasons, weather characteristics, and antecedent dry period), and concentration of substances in the atmosphere (transport, emission, half-life, and phase distribution) (Abbasi and Abbasi 2011).

The objectives of this study are to: 1) demonstrate the performance of cisterns, 2) determine how the performance of cistern changes during the first three years of operation, and 3) collect and analyze aqueous samples from cistern for presence of bacteria and other analytes. This paper only presents the quantity and quality analysis from the first growing season.

SITE DESCRIPTION AND INSTRUMENTATION

Camden is located in southwestern New Jersey, United States. The city is highly urbanized with an aging and overburdened combined sewer system which discharges to the Delaware River. As part of the effort to control combined sewer overflows, CCMUA installed the cisterns in 2014 and 2015, with capacities ranging from 300 to 1,100 gallons to provide capture-and-use for irrigating community gardens and existing landscaped areas. Since May 2015, US EPA monitored water collection-and-use at five cistern sites: the Vietnamese Community Garden, Kaighns Avenue Neighborhood Community Center, Respond Inc., Cooper Sprouts Community Garden, and St. Joan of Arc Church. Level loggers (Solinst 3001 LT Levellogger) placed at the bottom of each cistern record water level at 10-minute intervals. At five sites, standalone tipping bucket rain gauges (Onset model RGD-04) were installed. A layout of the location of the installed sensors are shown in Figure 1.

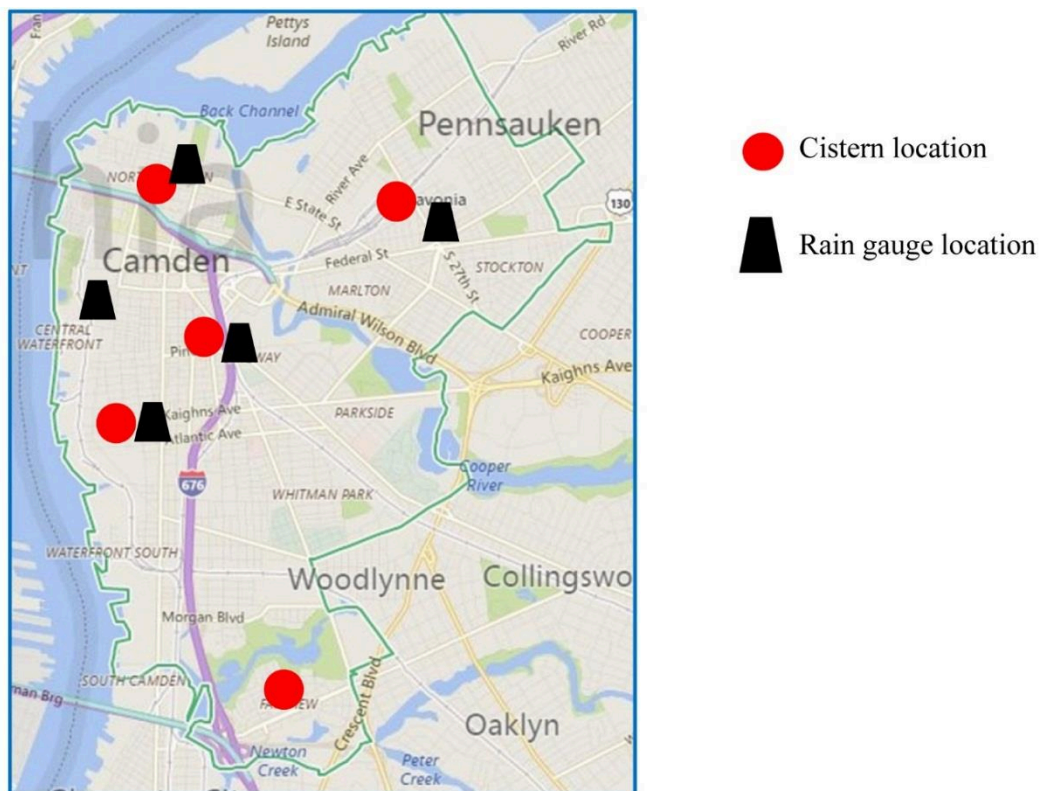


Figure 1. Location of cisterns and rain gauges



Figure 2. Cistern at St. Joan of Arc Church site

These cistern tanks as shown in Figure 2, are made of resins that meet FDA specification to ensure safe water storage. The black color limits light penetration to reduce the growth of water borne algae. The monitored cisterns are installed near vegetable gardens to provide irrigation water. These cisterns capture roof runoff through the downspout from adjacent buildings. At some sites no building existed, therefore, a shade structure was constructed to supply roof runoff to the cistern tank. If it rains while the cistern is full, the cistern overflows. Near the bottom of each tank a spigot and a hose was installed so that the water can be used. At two sites, a pump was installed with the spigot that helped to draw the water from the tank.

Pressure transducer and rain gauge data were used to calculate the fraction of available water used from each cistern. Water samples were collected every 6 to 8 weeks after the sensor installation. The samples were analyzed for microorganisms, metals, and nutrients.

AVAILABLE WATER USE

For each cistern, the relative use of available water was calculated. To calculate the relative volume used, the total water use between consecutive rain events is divided by the available water volume in the tank. For example, in Figure 3, the green line shows the water level depth inside the cistern tank monitored by pressure transducer at the Kaighns Avenue site. The red dots show the cumulative rain depth from 07/31 to 08/12. Precipitation was recorded on 07/30, 08/07, and 08/11. Between 07/30 and 08/07 rain events the available water was 1.04 m and no water was used, so the water use between 07/30 and 08/07 is 0%.

Between 08/07 and 08/11 rain event water use was 0.12m and available water was 1.04m. So the water use is $\frac{L_2}{L_1} * 100\% = \frac{0.12}{1.04} * 100\% = 11\%$. After calculating the water use between each consecutive rain event, the water use was averaged.

Table 1 shows the water use for each cistern site for first growing season. The water use ranged from 8 to 34%. At St. Joan of Arc Church site, the gardeners did not use any captured water. Discussions with one of the gardeners suggested that the reason might be lack of pressure to help to transfer water from the tank to the garden. Since no water was used, the roof runoff overflowed from the cistern after it was full and it did not reduce stormwater runoff volume. At