

## **Project Title: Understanding the Factors that Influence Outdoor Residential Water Conservation: A Case Study in Suburban Boston**

**Project Leader: Robert Ryan**

### **Project Overview**

In the face of recent droughts and climate change impacts, water conservation is critical for meeting water demands of humans and freshwater ecosystems. Since residential landscaping is a major component of domestic water use, efforts to promote outdoor residential water conservation are critical. Water harvesting using rain barrels, infiltrating stormwater using rain gardens, and landscaping with native plants have been promoted through outreach campaigns as a means to reduce water use and provide ecosystem benefits. There is a need to understand how these recent water conservation outreach efforts impact local residents' attitudes towards and behaviors incorporating these low-impact development (LID) strategies, and subsequently lead to measureable improvements in water conservation and ecosystem health. In addition, it is important to understand the formal and informal role the green industry plays in promoting residential landscape water conservation.

The Ipswich and Parker River watersheds north of Boston drain into the biologically rich Plum Island Estuary. The Ipswich is considered one of the most threatened rivers in the US, due to polluted stormwater runoff and overdraft of water by local communities. Water conservation and stormwater management are critical priorities for local government agencies faced with frequent water shortages and impaired water quality. This initiative will examine the influence of policy and outreach efforts on local residents' adoption of water conservation and stormwater strategies in the residential landscapes of the Ipswich and Parker River watersheds. The project team will assess the impacts of land use change on water use and the potential for green stormwater infrastructure to restore watersheds while creating a new line of research and outreach inquiry focused on linkages between local policies, outreach efforts, and household decisions related to water conservation.

### **Activity Summary - 2015**

- Graduate landscape studio in the Ipswich River watershed focusing on green infrastructure and open space planning. (1)
- Interviews with representatives from stakeholder groups (13)
- Monitoring residential landscape water use and creation of a data set (30)
- Presentations on residential water conservation for homeowners, municipal officials and community groups (3)
- Review of local conservation programs available at the state, watershed, and local levels. (12)
- Survey of local residents' conservation behavior, attitudes, and actions (270)

- Training/advising of Phd student in interviewing and data analysis. Training of master's level student on survey design. (3)
- Website/webpage on residential water conservation for homeowners (1)
- Stacy, Johanna, Ryan, Robert, Milman, Anita, and Roy, Allison H. (draft). Homeowner Willingness to Adopt Environmentally Beneficial Landscape Practices in an Urbanizing Watershed (working title). Draft article in preparation to submittal to *Landscape Journal* in late fall, 2016.
- Danford, Rachel, Milman, Anita, Roy, Allison, and Ryan, Robert (draft). The Role of Small Municipal Water Suppliers in Residential Demand-side Management (working title). Draft article in preparation for submission to *Cities and the Environment* in late fall, 2016.
- Training/advising of Phd student in interviewing and data analysis. Training of master's level student on survey design.

### ***Total educational contacts***

	Adult Contacts
In Person	268
Indirect Contacts (Print, Web, etc...)	98

### **Narrative Summary and Impact**

Our first goal is to identify local policy and outreach efforts across the watershed and to evaluate connections between those and the adoption of LID practices.

### **Studies and Results**

Residential water use is increasingly being viewed as an essential component of sustainable water management. Research has predominantly focused on the potential savings from specific residential demand-side management (DSM) tools, with scant attention to the processes by which decisions are made to implement these tools. Yet DSM the policies and programs selected by water suppliers to achieve residential water conservation will have a direct impact on water-use patterns. Our focus over the past year has been to investigate the external and internal factors that drive decision-making and DSM implementation by small residential water suppliers. Semi-structured interviews of state, local, and non-profit organizations were analyzed together with secondary data on water withdrawal permits and interbasin transfer agreements to characterize water conservation policies and programs within the Ipswich and Parker watershed. (Interview sample: 11 water supplier officials, two MA Department of Environmental Protection officials, and three employees from non-profit community groups.)

We find substantial heterogeneity in the DSM policies and programs implemented by water suppliers. While state mandated residential water efficiency requirements are similar across communities, the requirements allow flexibility in how suppliers may achieve residential water conservation. Consequently, suppliers vary in their level of engagement with DSM. Analysis of the interview data suggests decision-making at the supplier level is influenced by water supplier attitudes toward water conservation and perceptions of organizational capacity, and often ensues without information on the structural (device-saturation, lawn area, etc.) and non-structural (residential attitudes, community norms, etc.) factors that influence DSM tool effectiveness.

The original research results from this analysis were summarized in a research manuscript in which we developed of a conceptual model of water supplier decision-making. The manuscript was submitted to two international journals in December 2014 and then in May 2014. Although the manuscript was

reviewed favorably, in both cases it was ultimately rejected due to the small, regional nature of the sample. After reviewer and editor feedback, the manuscript is being re-written with an emphasis on DSM for submission to a journal with a regional focus.

Data collected for this goal was used for sample selection in goals 2 and 3, and may also be used in combination with data collected in the other goals to investigate how top-down policies influence decision-making at the residential level.

Our findings have provided significant insights about the role of water suppliers in shaping residential water conservation policy, as well as on the process by which water suppliers make DSM decisions. This work has provided necessary background information for goals 2 and 3 as well as served to establish relationships with stakeholders that will be useful for dissemination of overall findings. More broadly, findings from goal 1 indicate potential inefficiencies in the current support system for decision-making at the water supplier level that may be improved by tightening connections between residents and suppliers.

Our secondary goal is to conduct a Homeowner Attitudes Survey.

In order to address the second goal of our study, to explore the factors that influence local residents' decisions to engage in low impact development strategies to conserve domestic water and manage stormwater, we developed a survey instrument that was pre-tested, refined, and administered to 999 residents within 1000' of the river in four towns (Middleton, North Reading, Topsfield and Wilmington). The survey instrument included questions about willingness to adopt landscape water conservation practices. A link to the digital version of the survey was also shared on a Facebook page of a local watershed group. A total of 270 completed surveys were received to date. Subsequent survey mailing resulted in additional surveys being returned, so the final response rate will be determined in the new study year. Initial analysis indicates that generally, the survey population is representative of the homeowner population in the two counties where the survey was sent. Data analysis of the survey results will be completed in the coming year. Initial results suggest that homeowners are both aware of water shortages and of the potential for low-impact design strategies to conserve water. Yet, they are hesitant to implement low-impact design strategies.

Urbanizing watersheds often face water shortages due to increased water use for residential landscaping and decreased base flow as impervious land cover limits aquifer recharge. Low-impact development (LID) practices, specifically those that infiltrate runoff, have the potential to keep more water in the watershed, and increase base flows in the river. This study explored the barriers and motivations that exist to LID adoption by local residents in the Ipswich River watershed north of Boston, Massachusetts that experiences seasonal water shortages. The study used a postal and on-line survey with images of different low-impact development practices including rain gardens and native plantings and items about homeowners' watering practices, likelihood of adopting innovative residential landscape practices to save water, and attitudes towards environmental issues in the region. The results found that local residents (n=265) were aware of existing water shortages and supportive of water policies to restrict use. In addition, their willingness to adopt innovative landscape practices were influenced by their aesthetic response with more support for those practices that appeared neat and cared for rather than those that were more rough and unkempt appearing. Barriers to residential adoption of these landscape practices included concern about disease-carrying pests and the perceived cost of landscape change. Knowledge about the environment, as operationalized by membership in a local watershed association, as well as educational attainment and income were significant variables in predicting aesthetic preferences and willingness to adopt LID practices. While survey response rates were highest among watershed members, membership in a watershed association did not correlate with a stronger

willingness to adopt these landscape practices or an increase in the number of existing features on homeowners' property. Those with higher income and education were, however, more willing to adopt these practices. Some discrepancies exist among groups between stated willingness and aesthetic acceptance of these landscape, where respondents indicated they were less interested in adopting the practice, but when shown a photo, were much more interested. The findings emphasize alternate strategies for land use planners, landscape professionals and environmental organizations to promote behavioral changes in the way residential landscapes are managed, and policies municipalities could adopt to implement more widespread use of LID practices.

### Third Goal Residential Outdoor Water Use Behavior- Homeowner Water Monitoring Study

To fulfill this particular goal, this study was designed to help us understand the connection between adoption of water conservation practices and actual water quantity savings at the household level. In order to explore this question, we began recruiting local residents in the Ipswich Watershed to meter their residential landscape water use, using post-cards mailed in the surveys, as well as advertisements. A total of 22 residents participated during the late summer-fall growing season. With the data we have collected so far (Aug-Sept 2014) we have found that lawn watering uses the largest quantity on average and also has the broadest range (27-1010 gallons). Watering other garden areas was the second highest use with a range of 2.3-284 gallons. Other outdoor water uses include filling pools as well as washing cars and other equipment. We plan to expand our recruiting efforts in the coming year to increase this sample to our goal of 50 participants.

Outdoor water use accounts for the largest proportion of residential water use. Previous studies have found correlations between greater lawn size and higher total water use; however, these studies do not look at other outdoor uses of water and additional factors that may influence water use. This research seeks to quantify the amount of residential water used for different outdoor purposes, and to understand factors influencing residents' water use behavior.

In summer 2014, 22 water meters were placed on outdoor spigots at selected residences in the Ipswich River watershed from August to October 2014. Study participants were recruited through multiple methods (e.g., residential surveys, fliers) and residents recorded the date, time, and amount of water used for outdoor water use events. Outdoor water uses included filling the pool, filling the bird bath, pet care, and cleaning (lawn mowers, cars, etc.). Lawn watering had the greatest average water use (297 gallons per watering event); however the range (27-1010 gallons per watering event) was high suggesting that lawn watering is difficult to predict.

In summer 2015, we recruited additional water metering participants through a direct mailing (250 in each of the 4 towns), an insert in water utility bills in one town (1000 total), and fliers. These recruitment activities were a form of outreach as they informed the public about the project and water conservation issues in the watershed. There were 28 participants involved in the second season of data collection (Wilmington = 6, North Reading = 10, Middleton = 1, Topsfield = 11), 16 who also participated in the first season of data collection. In-person interviews are being conducted with each participant to better understand factors that influence water use. To date, 13 interviews have been conducted. Water meter data were collected through October 31, 2015. A follow-up survey was administered to participants at the end of October 2015. Results were presented at the Society for Freshwater Science in May 2016. This research is currently being written up in masters in environmental conservation thesis by Emily Argo that will be completed at the end of summer 2016 which will be followed by a journal article.

Information about water use and residents' motivations will be used to identify outreach approaches to encourage outdoor water conservation.

During the summer of 2016 we are engaged in preparing outreach materials for the watershed including brochures, a webpage, and display posters.

### **Project Collaborators**

- **Wayne Casontguay, Executive Director, Ipswich River Watershed Association**
- **Ed Himlan, Executive Director, Massachusetts Watershed Coalition**
- **Rena Sumner, Executive Director, Massachusetts Nursery and Landscape Association**
- **Virginia Wood, Executive Director, Massachusetts Association of Landscape Professionals**
- **Janet Nicosia, Martin's Pond Association**
- **Mark Clark, Town of North Reading Water Superintendent**
- **Danielle McKnight, Town of Reading Planning Administrator**