

# RAINWATER HARVESTING IN CHAMPAIGN-URBANA



A Study on the Summer 2017 Rain Barrel Sale  
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The City of Urbana and City of Champaign partnered with Faith in Place to organize a Rain Barrel & Compost Bin Truckload Sale in May of 2017. The sale was open to all, and residents of Urbana and Champaign could purchase rain barrels at a discounted rate with proof of residency in accordance with each city's stormwater utility fee rebate scheme. Online pre-ordering was available, and the sale was held in downtown Urbana.

While certain metrics were known immediately after the sale - total number of purchases, number of people who received discounts from Urbana or Champaign, number of pre-orders v. walk-ups, etc. - other pieces of information were unknown. Once rain barrels leave the sale, where and how are they used? Do all purchasers complete installation of the rain barrel, or do some barrels sit unused? What motivates people to engage in rainwater harvesting, and who made purchases at this sale?

An online survey was created to gather this additional information from purchasers. The survey was distributed to all purchasers who agreed to share their e-mail address. Out of 129 people who made a purchase at the sale, 118 people were contacted and invited to complete the survey. 49 total survey responses were received (42% response rate) (Figure 1).

This report details the results of the survey, and brings in additional data sets as needed to provide further context and insight. The results of this study can inform the work of Faith in Place and other stakeholders, each with unique reasons for encouraging the adoption of rain barrels. Specific recommendations are made at the end of the report (p. 16).

As the title suggests, the report's geographical emphasis is on the cities of Champaign and Urbana. Three survey respondents lived outside of Champaign County, and three lived within Champaign County but outside of Champaign or Urbana, leaving 43 total responses from Champaign and Urbana. Responses from those outside of C-U are tabulated with responses from C-U throughout the report, but users outside of C-U are also considered separately on page 5.



# CONTENTS + SUMMARY OF RESULTS

PAGE	TOPIC	SUMMARY
<b>6</b>	How did survey respondents hear about the sale?	Online (website or e-mail, 66%). The City of Champaign and City of Urbana accounted for 13 of the of the 33 online message delivery instances.
	How many barrels did they purchase?	25 people - 1 barrel / 24 people - more than 1 barrel / 78 total barrels sold
	New rain barrel users	45% were first-time rain barrel users. New users accounted for 5 of 7 instances where barrel installation was not started or complete.
<b>7</b>	Who purchased rain barrels?	94% White, 61% > 46 yrs, 55% Female, 90% completed 4 year degree
<b>8</b>	Barrel Locations, Home Value, and Household Income	Most rain barrels are located in block groups with median home values between \$96,001 and \$186,600 and median household incomes between \$33,287 and \$136,625 (Figure 3).
<b>11</b>	Why did respondents purchase barrels?	Provides an extra water source (86%), Part of a sustainable lifestyle (84%)
<b>12</b>	How are people using the barrels?	Outdoor irrigation, 2-5 gallons/day on average
<b>13</b>	Barrel Locations and Stormwater Management	12 people listed stormwater issues as a reason for using the barrel.
<b>15</b>	What has their experience been like?	Common issues included problems with overflow hose (4), water pressure (3), and barrel stability (3). 10 people observed mosquitos.
<b>16</b>	Recommendations	Provide online resources on installing, using, and maintaining the rain barrel / Explain the importance of emptying the barrel prior to the next precipitation event for best results / Organize workshop on installing, using, and maintaining the rain barrel / Inform buyers of common problems and ways to deal with them / Address barriers to reaching populations outside of the current demographic and in neighborhoods where barrels might help with flooding

# STUDY TIMELINE AND SAMPLING FRAME

May 6th, 2017  
Rain Barrel Sale

September 9th, 2017  
Online Survey Distributed

October 19th, 2017  
Online Survey Closed

## Survey Sampling Frame

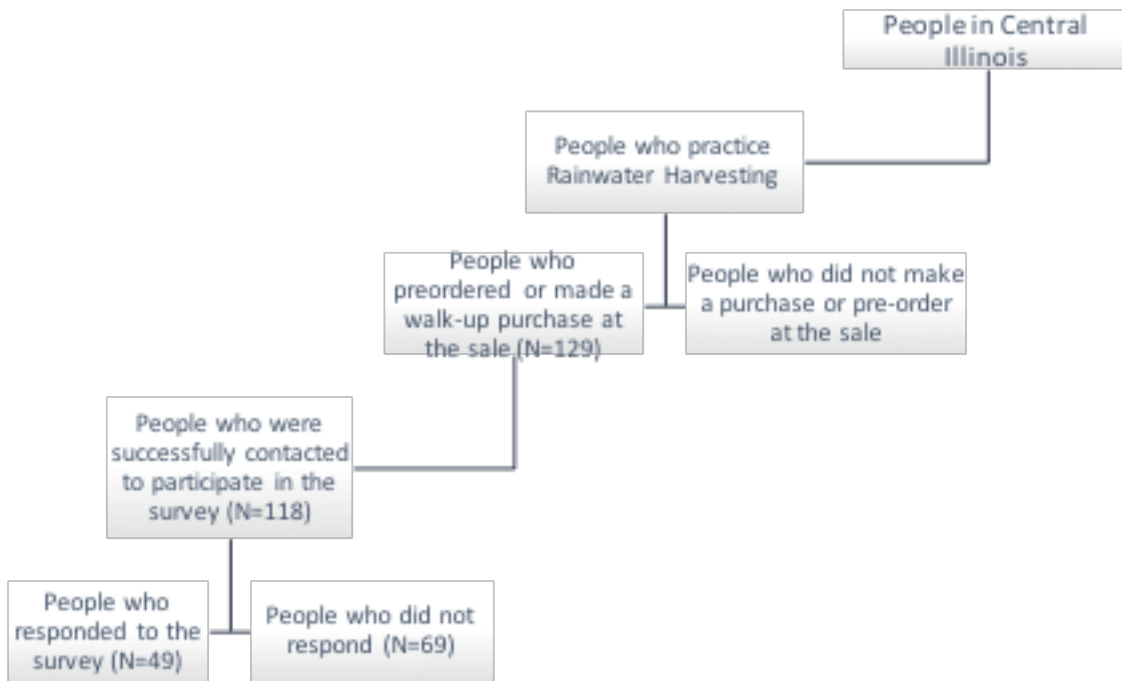


Figure 1. Sampling Frame.

42%  
response  
rate

49  
total  
responses

43  
from  
C-U

# LIMITATIONS

## Are survey respondents representative of all people who made a purchase or pre-order at the sale?

The results of this survey do not necessarily apply to groups from which the respondent group is derived (see Figure 1). If respondents possess significantly different traits than non-respondents, the survey results are non-representative of the larger population.

A lack of information on the non-respondents limits analysis of non-response bias in this study. The only piece of demographic information known about both the respondents and the non-respondents is the city they were receiving the rain barrel rebate from – Urbana or Champaign. City of residence for purchasers from outside Urbana or Champaign and people who placed walk-up orders is not known. A Chi-squared test was completed with the available data to assess if the respondents were significantly different from the non-respondents in terms of the city they come from (see Table 1).

Statistically, the differences in city of residence between respondents and non-respondents is not significant. While this is one positive indication, it still does not prove that the survey is representative of the study population, and this limitation should be kept in mind when interpreting and applying results.

## Are survey respondents representative of all people who practice rainwater harvesting in Central Illinois or the C-U area?

Extending survey results to draw conclusions about all people who practice rainwater harvesting in Central Illinois and the C-U area cannot be supported with statistical measures, as there is no data available on demographics for this group. Previous studies have suggested that areas with high property values and small minority populations have more Green Stormwater Infrastructure (GSI) such as rain barrels, and more stormwater managed by GSI than areas with lower property values and larger minority populations [1]. Demographics of survey respondents match this pattern with respect to race – 94% of respondents identified as White (Table 4). ACS block group data for respondents in C-U shows that rain barrels are primarily located in block groups in the second and third quintiles for median home value (Figure 2), though this is a rough estimation and exact home values are unknown.

	NON-RESPONDENTS	RESPONDENTS	TOTAL
URBANA	35	21	56
CHAMPAIGN	22	18	40
OUTSIDE CU OR UNKNOWN (DID NOT PRE-ORDER)	12	10	22
SUM	69	49	118

Table 1. City of Residence Data for Chi-squared Test. Outside of C-U (6 people) is combined with Unknown (16 people) to meet the size threshold for the chi-squared test (expected values must be at least 5). The critical value of  $\chi^2$  with two degrees of freedom at the 5% level of significance is 5.99, and  $\chi^2$  here is 0.73 which is less than 5.99.

## Users outside of C-U

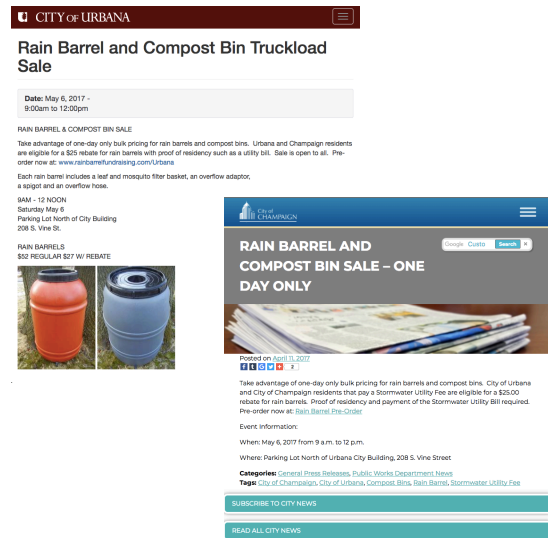
Of the six users outside of C-U, three heard of the sale by word of mouth, one through Faith in Place, one through the newspaper, and one through e-mail and TV. Four noted that the barrels they purchased were installed and operational, one had started but not completed installation, and one had not started the installation. No users observed mosquitoes, and their reasons for using barrels were: part of sustainable lifestyle (6), extra water source (5), helping the community in general (3), and community and site-level stormwater issues (1). Five people were interested in online resources, two were interested in in-person workshops, and one was interested in a question hotline. Two were in the 36-45 age range, three were in the 46-55 age range, and one was in the 56-65 age range. No one marked that they had implemented other stormwater management practices at the property.

# How did survey respondents hear about the sale?

Most respondents heard about the sale online, via a website or e-mail (66% combined) (Table 2). The City of Champaign and City of Urbana accounted for 13 of the of the 33 online message delivery instances, possibly more as the exact page or source of the Facebook shares was not collected.

HEARD ABOUT SALE FROM...		
Website	17	35%
City of Champaign	3	
City of Urbana	5	
Facebook	6	
Smile Politely	1	
Email	15	31%
City of Champaign	3	
Faith in Place	4	
City of Urbana	2	
Word of Mouth	8	16%
Unsure	4	8%
Print	3	6%
Newspaper	2	
Flyer	1	
Prior Event	3	6%
TV/WCIA	2	4%

Table 2. Sale Announcement Sources.



Screenshots of City of Urbana and City of Champaign Announcements of the Sale.

# How many barrels did they purchase?

All survey respondents purchased at least one rain barrel from the truckload sale. 25 respondents purchased one barrel, and 24 respondents purchased more than one barrel (Table 3). The total number of barrels purchased by survey respondents (78) represents 27.6% of all barrels sold (283).

NUMBER OF BARRELS PURCHASED		
1	25	51%
2	21	43%
3	2	4%
5	1	2%
CUSTOMER HAS USED BARRELS BEFORE		
Yes	27	55%
No	22	45%

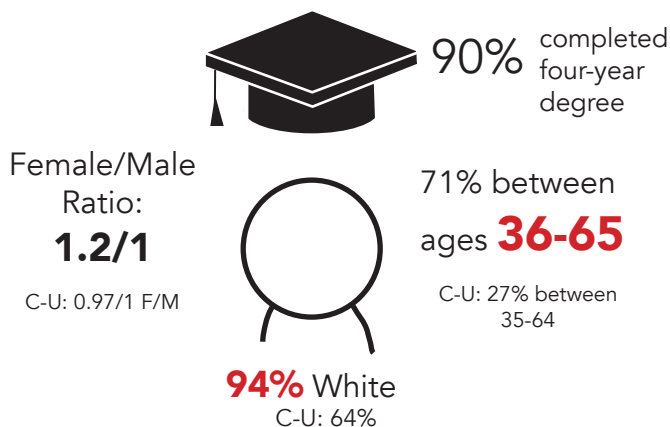
Table 3. Barrels Purchased and Prior Experience

## New rain barrel users

22 respondents had never used rain barrels before, but half (11) of these respondents purchased two barrels. New barrel users comprise the majority of respondents who reported that their barrels were not installed (4 of 5 total), and that installation was started but not complete (1 of 2 total). Correspondingly, they also made up most of the respondents who were not satisfied with the rain barrel, answering 'no' (1 out of 2 total) and 'don't know yet' (4 out of 5). New users' reasons for using barrels were similar to previous users - five of the new users marked that the stormwater rebate was a reason for using the rain barrels (5 out of 9 total), and three mentioned solving a specific stormwater issue (3 out of 6 total).

# Who purchased rain barrels?

The vast majority of respondents were White, and more than half were over the age of 46 (Table 4). Slightly over half of respondents were female, though it is unknown if respondents pursued rainwater harvesting as a solitary activity or shared responsibility for it with other members of their household. All respondents had completed some college, with close to half completing graduate or post-graduate studies. Information is compared with demographic information for all people in Champaign and Urbana in the figure below [9].



GENDER		
Female	27	55%
Male	22	45%
AGE		
18-25	2	4%
26-35	6	12%
36-45	11	22%
46-55	13	27%
56-65	11	22%
66+	6	12%
RACE		
White	46	94%
Did not say	3	6%
American Indian or Alaskan Native	1	2%
Black	1	2%
Asian	1	2%
HIGHEST EDUCATION LEVEL COMPLETED		
Bachelor's Degree	21	43%
Master's Degree	12	24%
Advanced graduate work or Ph.D.	11	22%
Some college	5	10%

Table 4. Respondent Demographics



# Barrel Locations, Home Value, and Household Income

Barrel locations were collected from respondents and geocoded to produce the maps below (barrels outside of Champaign, Urbana, and Savoy are not shown). 44 (90% of) respondents were collecting rainwater from the roof of a detached single-family house, and all but two of these houses were owned by the respondent or someone else in the household. 2015 5-year Estimate ACS data of Median Home Value for owner occupied homes (Figure 2) and median household income (Figure 3) are also shown at the block group level.

## CU - Rain Barrel Locations and Median Home Value

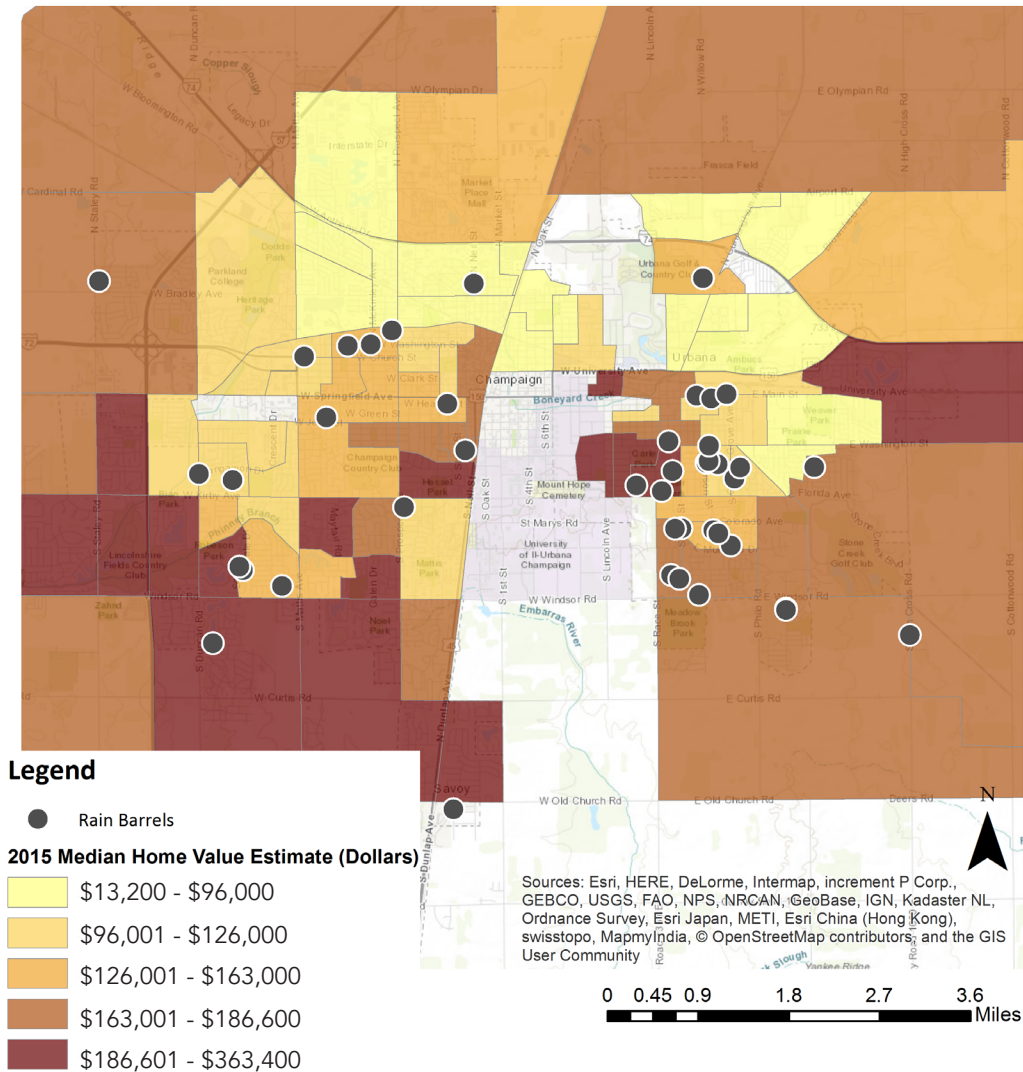


Figure 2. Rain Barrel Locations and Median Home Value.

Source: U.S. Census Bureau. Table B25077 - Median Value (Dollars). 2011-2015 American Community Survey 5-Year Estimates. Notes: Universe: Owner-occupied housing units. Displayed as quantiles (5) for block groups within Champaign and Urbana. Block groups with no color indicates that either there were no sample observations or too few sample observations were available to compute an estimate.



Most rain barrels fall within quintiles 3-5 for Median Household Income, and quintiles 2-4 for Median Home value (Figure 4). While the block group data provides an idea of the financial status of barrel owners, actual income and home values are unknown for households with rain barrels, and actual values may vary widely within each block group.

## CU - Rain Barrel Locations and Median Household Income

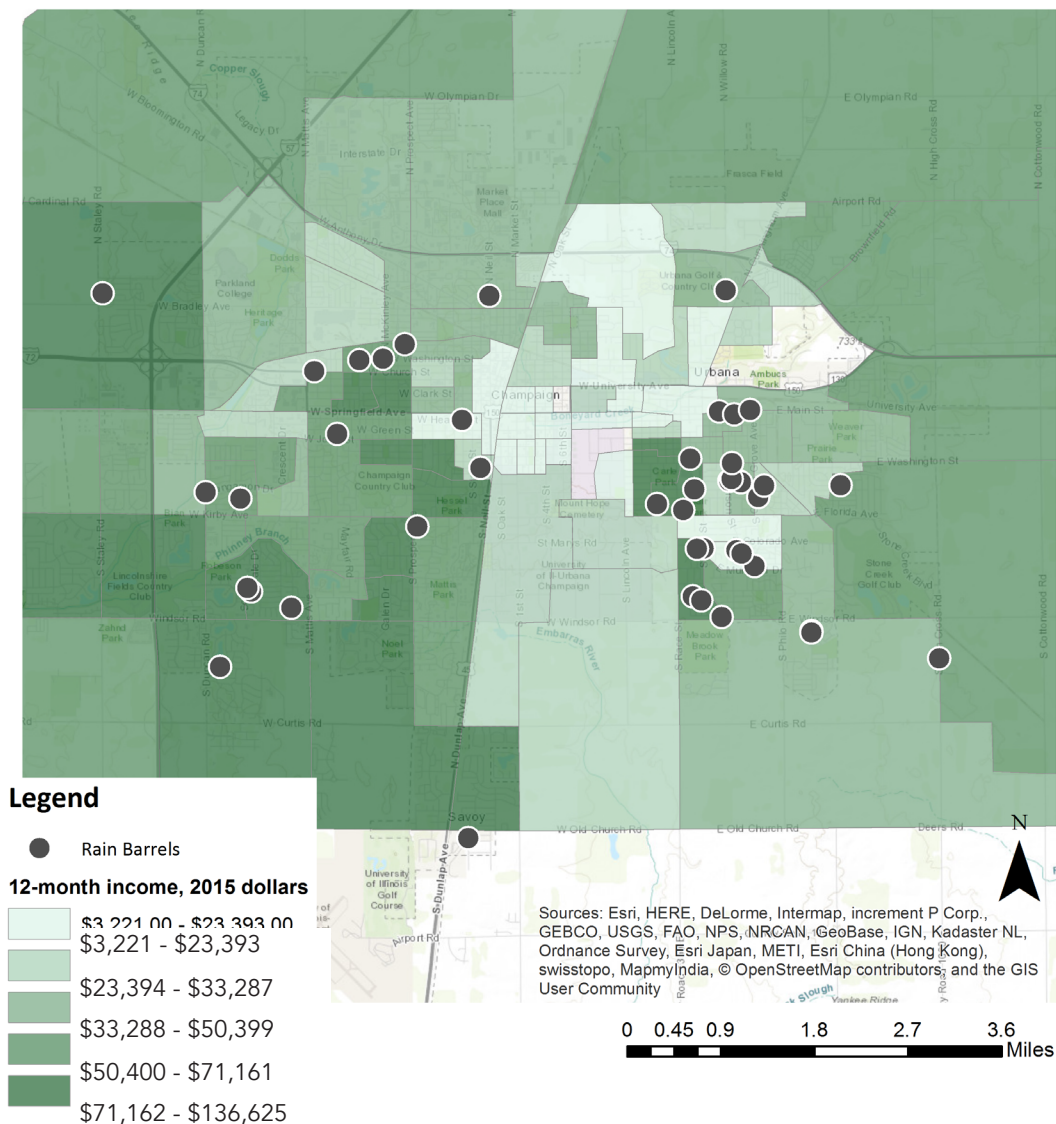


Figure 3. Rain Barrel Locations and Median Household Income.

Source: U.S. Census Bureau. Table B19013 - Median Household Income in the Past 12 Months (in 2015 Inflation-Adjusted Dollars). 2011-2015 American Community Survey 5-Year Estimates.  
 Notes: Universe: Households. Displayed as quintiles (5) for block groups in Champaign and Urbana. Block groups with a null value for median income were excluded.

# Barrel Locations, Home Value, and Household Income

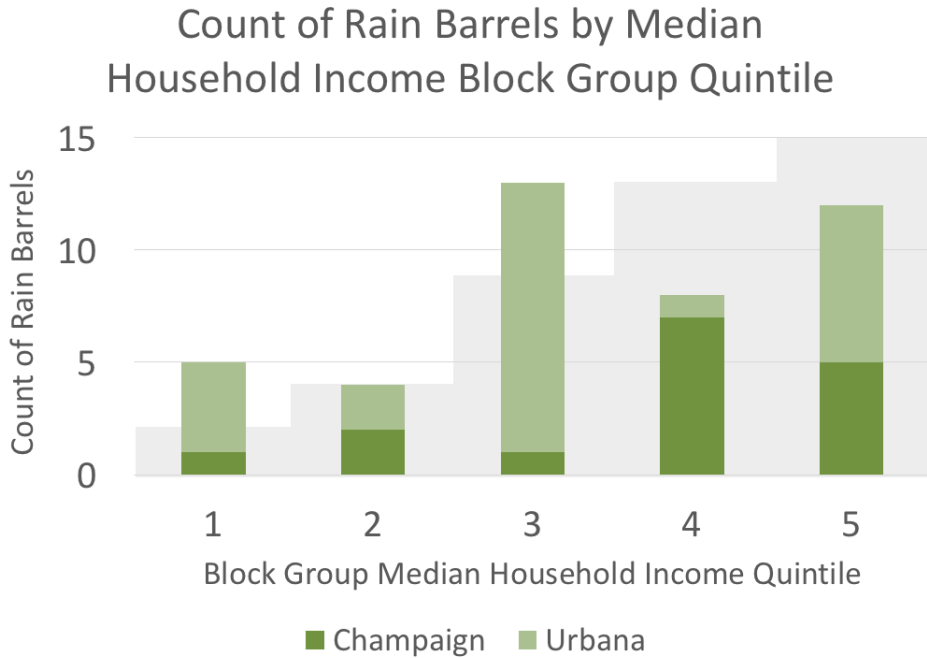
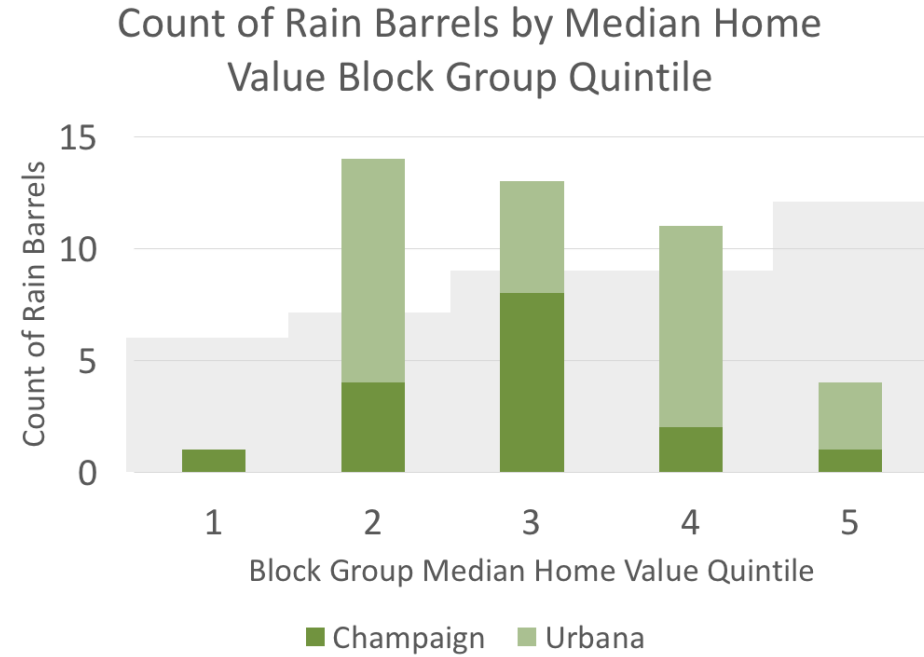


Figure 4. Counts of Rain Barrels by Quintile for Household Income and Median Home Value. The total number of owner-occupied households in each block group quintile were calculated, and these values were used to compute approximate expected values for the number of rain barrels within each quintile (shown in gray behind each bar).

# Why did respondents purchase barrels?

Most (86% of) respondents use the rain barrel because it provides an extra water source, and see using the barrel as “part of a sustainable lifestyle” (84%). Only 9 respondents marked the stormwater rebate as one of their reasons, and 14 referred to specific stormwater issues in their community or property. Two of these people referred to stormwater issues in both their community and property. Out of the 12 unique people with stormwater management issues, 6 of them had implemented other stormwater management techniques at their site.

REASONS FOR USING RAIN BARRELS	
Extra water source	42
Part of a sustainable lifestyle	41
Helping my community in general	17
Stormwater rebate	9
Helping my community with known stormwater issues	8
Solving a specific stormwater issue on my property	6
Other: save money	3
Other: beneficial properties of rainwater	3
Convinced/prompted by someone else	0

Table 5. Reasons for Using Rain Barrels

## Note on Incentive Programs

The City of Urbana began collecting a stormwater utility fee in September of 2013 that is “charged to each property based on the potential runoff that would result from that property in a storm event.” Incentives are available for installing rain barrels. The rain barrel incentive is limited to two rain barrels per property once every 10 years. The City will subsidize a purchase of up to two rain barrels per household at \$25/barrel. As the guide states, “the rain barrels must be purchased from a pre-approved supplier located in Urbana, and the rebate is applied at the time of purchase.” [2]

The City of Champaign passed an ordinance in April 2012 that established a stormwater utility fee. All properties within the City that have 500 square feet or more of impervious area pay the fee. The City provides an incentive for rain barrels at \$25 per barrel with no maximum limit. The incentive payment is made after the property owner provides proof of rain barrel purchase to the City. The city is considering a \$2 increase to this rebate to correspond with stormwater utility fee rate increases for 2019. [3]

# How are people using the barrels?

Forty-one respondents reported that the rain barrels they had purchased were installed and operational at the time of the survey. Most respondents (5 out of 8) who marked that barrels were not operational or installation was not complete cited a specific, temporary circumstance (new house, need approval, need help, ongoing home modification), while the other three respondents gave general, ongoing reasons (no time, no specific reason).

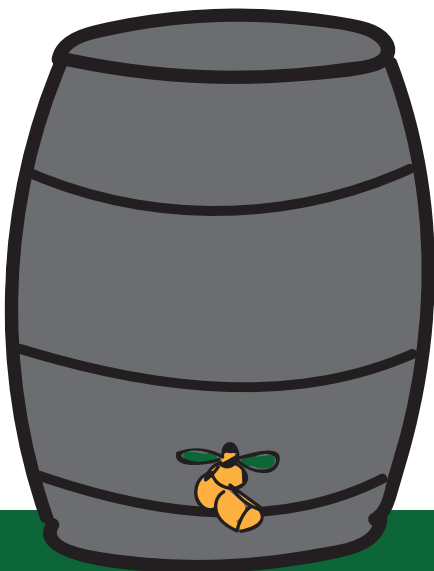
Respondents primarily used harvested rainwater for irrigation. Irrigated areas included gardens with and without edible plants, lawns, and other landscaped areas. The reported harvested water usage schedule varied from 2-5 gallons per day. Most respondents did not report a specific number, but a general frequency of usage (1-2 times per week, monthly, etc.). Only one respondent specifically mentioned trying to drain the barrel before the next rainfall. When respondents were asked roughly how many times the barrel had emptied and filled in the past month, 17 indicated that the barrel had been filled and emptied the same amount of times, 12 indicated it had been filled more times than emptied, and 4 indicated that it had been filled fewer times than it was emptied.

RAIN BARREL STATUS		
Installed and operational	40	82%
Not installed	5	10%
Installation started but not complete	2	4%
Installed and not operational	1	2%
Installed but not used for rainwater	1	2%

Table 6. Rain Barrel Status

WHAT IS WATER USED FOR	
Irrigation: Garden without edible plants.	29
Irrigation: Garden with edible plants.	28
Irrigation: Other landscaped area.	12
Irrigation: Lawn.	6
Other outdoor use.	4
Indoor non-potable use.	1
Indoor potable use.	1
Nothing/not used.	0

Table 7. Harvested Water Uses



# Barrel Locations and Stormwater Management

Urbanization and the corresponding increase in impermeable surface area typically affects the hydrology of a site through increasing runoff rate and volume and decreasing infiltration, groundwater recharge, interception, and evapotranspiration. These effects can be minimized through the use of low impact development (LID) technology. LID practices are, “micro-scale control practices used to bring the natural hydrology of a site close to that of its pre-development condition” [4]. Rainwater harvesting is one LID practice that reduces runoff volume, which can reduce the burden on city stormwater systems during precipitation events and alleviate yard and street flooding. Rain barrels can also reduce the risk of basement flooding by directing water away from a home’s foundation.

**0.62** gallons of runoff collected per sq. ft. of catchment surface per inch of rain

The efficacy of rain barrels as a stormwater management tool is highly dependent on the size of the barrel, the amount of roof area it is draining, and usage habits (i.e. whether the user fully empties the barrel before the next precipitation event). Most respondents used the water for gardens or landscaping, and used from 2-5 gallons per day on average. 12 of 33 total respondents indicated they did not empty the rain barrel each time it filled. While this is a rough measure and it relies on respondents’ memories and estimations, it gives some indication of the range of barrel draining schedules.

Jennings et al.’s modeling study on barrels in Cleveland Heights concluded that for 50 gallon rain barrels servicing a roof area of 500 ft<sup>2</sup> and the irrigation needs of a 150 ft<sup>2</sup> garden, the total annual whole roof runoff reduction irrigating every 2 days would have been 2.1%. As they state, “the primary reasons for modest annual performance are that it is difficult to send drainage from a large fraction of the roof area to a single rain barrel, and many rainfall events produce runoff that exceeds barrel capacity and overflows into the storm sewer.” Indeed, for a roof area of 500 ft<sup>2</sup>, a precipitation event over 0.17 inches will cause the barrel to overflow [5].<sup>1</sup>

Barrels can still have a positive effect on city-wide stormwater management if installing them results in disconnecting downspouts [6]. In this study, only two respondents reported that prior to rain barrel installation the rain would go directly to the storm

Over **600,000** gallons of storm water diverted from the sewer systems annually from rain barrels sold by Faith in Place [10]

sewer. Eight people said it would go to a paved area. Installing a rain barrel in these situations slows the flow of runoff to the sewer and decreases the peak discharge the sewer system must deal with, and reduces the total volume through diverting water from the sewer system into the lawn or garden. Even for locations where rain was already released onto the lawn or garden, the barrel can hold water that previously would have run over saturated ground and release it after the ground is unsaturated.

<sup>1</sup> In Champaign and Urbana from 1 June - 30 September 2017, there were 29 days with recorded precipitation. 17 of these occasions were for rainfall events less than 0.17 inches, and 12 were equal to or greater than 0.17 inches. These months were drier than normal - June, July, August, and September were 2.29, 1.90, 1.71, and 2.29 inches below the 1981-2010 average, respectively [7]. The lack of rainfall was something several of the respondents noted in the survey.

# Barrel Locations and Stormwater Management

As Jennings et. al. state, “a few residences successfully employing [rain barrels or other stormwater management options] will have little effect on watershed-level problems” ([5] p. 758). Rain barrels become more effective when implemented broadly, or when used along with other LID techniques and stormwater management tools. As previously mentioned, of the people that mentioned using the rain barrels because of stormwater issues, half of them also implemented other techniques as described in Table 8.

Users who reported that they used the rain barrels because of site or community level stormwater issues are distinguished in Figure 5. These users are roughly distributed near each side of Vine Street in Urbana, and near the West Washington and East John Street watersheds in Champaign. Data on flood complaints was gathered for Urbana and the density of complaints is also displayed in the Figure 5. This dataset is limited by the fact that not all residents report flooding when it occurs, and certain neighborhoods may disproportionately report or under-report flooding.

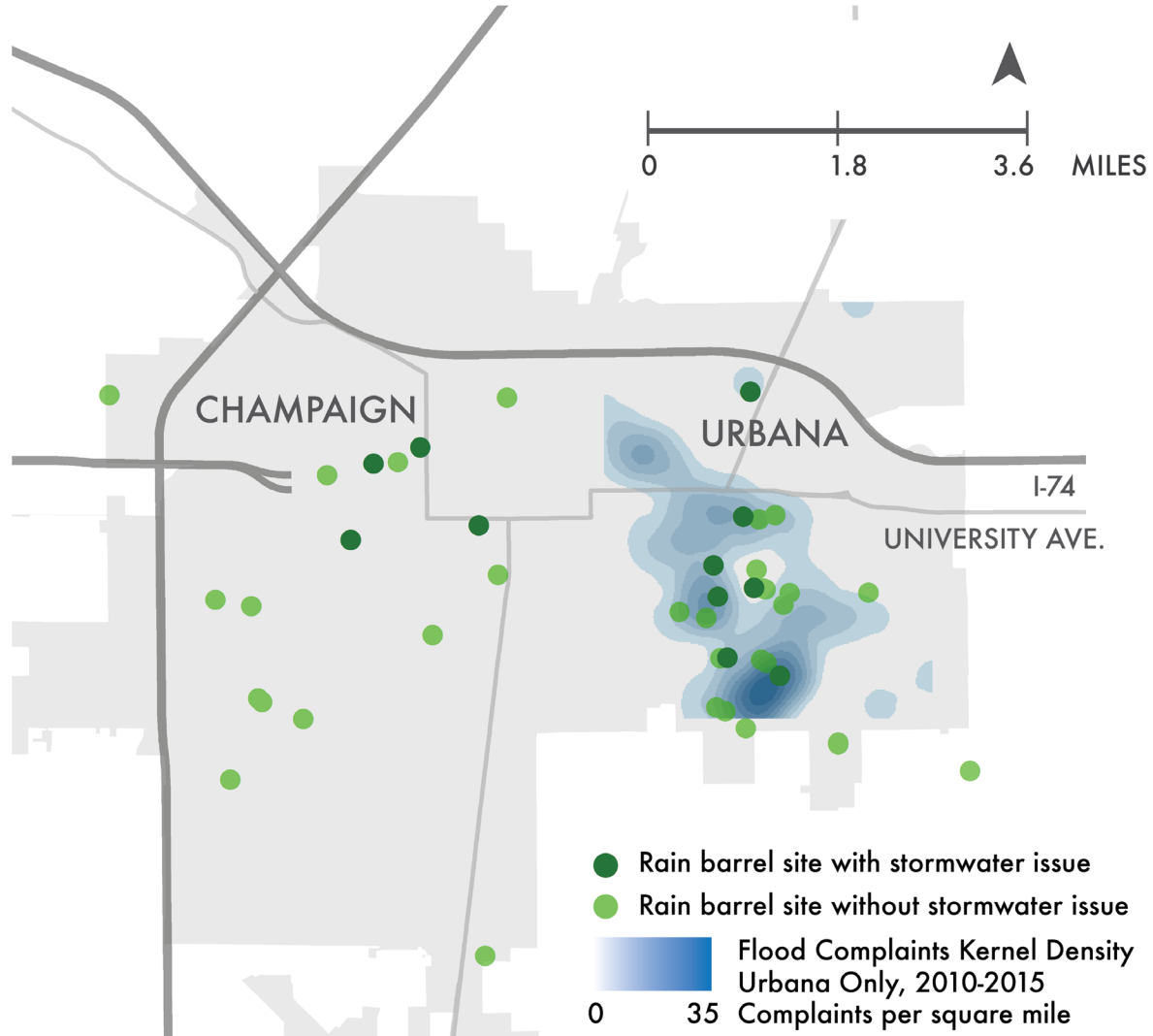


Figure 5. Rain Barrel Locations and Stormwater Issues



Have implemented other stormwater management practices on site		
No	18	38%
No response	16	33%
Diverting water away from house using pipe or grading	5	10%
Rain Garden	4	8%
Other Rain Barrel	3	6%
Drain Tiles	1	2%
Trying to minimize impervious surface area	1	2%

Table 8. Stormwater Management Practices

DESTINATION OF RAIN PRIOR TO BARREL	
Lawn	44
Garden/Landscaped area	12
Paved area	8
Previous Rainbarrel	3
Unpaved	2
Storm Sewer	2

Table 9. Destination of Rain Prior to Barrel

## Are respondents satisfied with barrels?

Common issues that users reported included problems with the overflow hose (4), water pressure (3), barrel stability (3), and mosquitos (2). Individual respondents reported issues with the amount of rainfall, the barrel appearing used/dirty, smell from the barrel, squirrels, and questions about using the water for edible plants and where to purchase parts for the rain barrel. Most respondents (32) had not observed any mosquitos in or around the barrel, 10 people had observed mosquitos. These users are shown in Figure 6.

CU - Rain Barrel Locations and Mosquitos

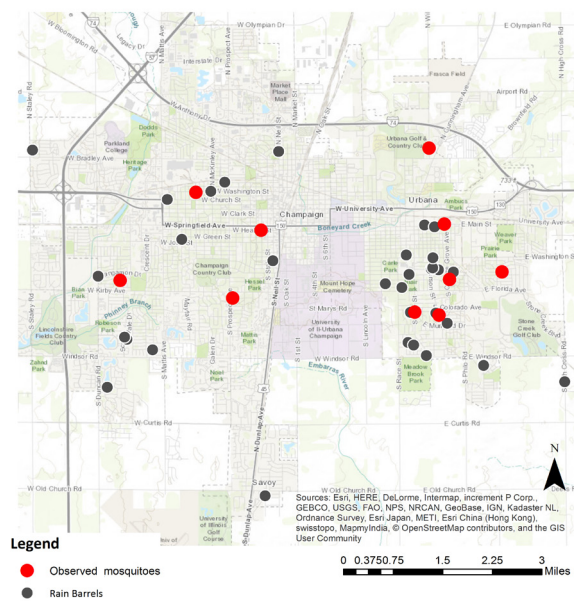


Figure 6. Rain Barrel Locations and Mosquito Observations

Interested in Educational Opportunities	
Yes - Online Resources	31
No	15
Yes – Workshops	11
Yes – Meetings	6
Yes – Phone number I can call with questions	3

Table 10. Educational Opportunities

Regarding education and community building opportunities, respondents were most interested in more online resources about rain barrels and rainwater harvesting (63%). Fewer were interested in workshops (22%), meetings (12%), and assistance via phone (6%).

# RECOMMENDATIONS

The following recommendations are based on the survey responses discussed throughout this report.

## Provide

Provide online resources or links to online resources on installing, using, and maintaining the rain barrel.

Provide accurate recommendations at the sale or online on where to find parts to complete barrel installation.

## Explain

Explain to buyers the importance of emptying the barrel prior to the next precipitation event for best results.

## Organize

Organize a workshop on installing, using, and maintaining the rain barrel for new and potential owners.

## Inform

Inform buyers of common problems and ways to deal with them (pressure, stability, overflow, mosquitoes, etc.).

## Address

Address barriers to reaching populations outside of the current demographic, particularly in neighborhoods where barrels might help with flooding such as Northwest Urbana, Garden Hills, East Washington Street, and John Street.

Remarking on the challenge of encouraging multiple stakeholders to adopt Green Infrastructure (GI) strategies, Montalto et. al. (2012) state,

“Although many of the non-stormwater benefits of GI are often viewed by planners as a means of rehabilitating blighted conditions (e.g. as a means of promoting environmental justice), the residents of these neighbourhoods sometimes look at externally planned GI projects with suspicion. Historically, the urban poor and many working-class minorities have felt alienated by government sponsored urban interventions, due principally to the top-down manner in which these projects were implemented, and the ultimate role they played in physical (e.g. urban renewal) and economic (e.g. gentrification) displacement of the economically disadvantaged, resident population.” ([8] p. 1190).

These historical patterns must be considered when developing plans to encourage adoption of GI strategies by groups within poor and working-class minority communities, as well as the time and money required for maintenance of GI elements.



# REFERENCES

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- [10] Faith in Place calculation, personal communication.