UCLA Sustainability Action Research

Water Resiliency/ Rainwater Capture Team
2017 Midterm Report

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Abstract

This past quarter, the resilience team (now the "Water Resiliency / Rainwater Capture Team") made great progress towards achieving its number one goal: implementing a rainwater capture system on UCLA's campus. The purpose of the capture system is threefold: 1) to capture rainwater for irrigation reuse purposes to contribution to water conservation on UCLA's campus, 2) to provide a template for future similar projects on campus, and 3) to educate staff, students, and other visitors to UCLA's campus about water conservation. The biggest achievement for the team this past quarter was the selection and approval of a location for the cistern system. At the beginning of the quarter, several locations were evaluated. Due to the ease of implementation, stakeholder support, and potential for water capture, Parking Structure 9 was selected as the location for our system. More details regarding the selection process are discussed below. Other accomplishments this quarter included drafting up plans for the system location, including the style, size, and number of tanks tanks to be implemented. Research was also done into the potentials for reuse of the captured water and the water quality standards that must be met. Contact was made with the company RainHarvest Systems to discuss the best practices, and to establish a relationship in order to work with them in the future (especially for the implementation of the system). Starting next quarter, the team will be working on completing a comprehensive project proposal to submit to The Green Initiative Fund in order to receive funding for the project. Our proposal will include a detailed budget, engineering plans, and educational outreach ideas.

Introduction

Taking inspiration from UCLA's history of acting as a leader in sustainability – both in the UC system wide regard in community interactions— we hope to contribute to the legacy as UCLA as a leader in resource management, sustainable design, and forerunner in environmental planning. As resilience becomes an increasingly hot topic as climate change discussions begin to shape the 21st century, we hope to contribute to UCLA's commitment to promoting a sustainable and resilient future; our water cistern project promises to set the standards for both student project developmental aspects and implementation of resiliency plans at UCLA. Our main inspiration comes from the Rockefeller Foundation Resilient Cities Planning guidelines, which we have analyzed from a university perspective. As UCLA can be viewed as a "city" in a sense, the Rockefeller guidelines of developing resilient cities can be applied to UCLA and have aided last year's Resilience Team and the relevant stakeholder and task force in exploring resilience pertaining to campus-wide importance.

Our project aims to implement a rainwater capture system project at UCLA, with the goal of leading the way in sustainable resilience development in order to promote resilience awareness at UCLA. The continuation of last year's Resilience Team's project, we've learned that the implementation of projects requires dedication to implication and success in resource obtainment. The 2015-2016 Resilience Team's motivation for the water cistern project came as inspiration to develop systems for UCLA that incorporated both sustainable design and resilience, providing resources to aid in both everyday campus functions and a back-up resource in the case of disaster preparedness. Their goal was – and remains, as carried through by the 2016-2017 Resilience Team– to provide local irrigation and potential backup water sources in

the case of a natural disaster, thereby highlighting aspects of both sustainable campus projects and implementations supporting resilience planning at UCLA.

This year, we hope to accomplish the ideals set forth by last year's Resilience Team, in addition to adding our own creativity and project management applications to the project. As last year's team secured an $18,000 grant from The Green Initiative Fund, we hope to obtain more funding from TGIF in order to see the project to completion. We have worked hard at developing upon the previous Resilience Team's ideas to incorporate finalized design plans, budgeting, and future plans. Focusing on site specificity and design components this year, we have narrowed our focus in order to support a water cistern project that can be implemented on a feasible time scale. Our efforts continuing into spring will include application to TGIF, working with our stakeholder and relevant personnel, and spending of funds on project implementation.

Methodology

As described in the introduction, last year's Resilience Team launched a rainwater capture system project into motion. The team received $18,000 in funding after proposing the idea, but due to the short time frame, the project was not able to really get underway. Therefore, coming into this year, the Resilience Team was excited and willing to continue where last year's team left off. In choosing our goals, first and foremost we wanted to implement the cistern and leave a tangible impact on UCLA's campus. While this may seem like a relatively simple project, you will see later on in the report that it has entailed lots of effort, time, and a mobilizing of amazing resources and support. The implementation of the rainwater capture system is our primary goal due to three main reasons, and those reasons can be considered our secondary goals

that fall under the umbrella of the rainwater capture system. These three goals are: water conservation, educational outreach, and resiliency planning. The system notably includes water conservation as its chief purpose. Water is a free and highly crucial resource that should not be taken for granted and should not be wasted. The second tenant of the cistern includes educational outreach. This entails an incorporation of signage near the location of the cistern in Parking Structure 9, detailing how the capture system works, how much water it is saving, where that water is going, and why it is important. We collectively value and want to strive to execute the educational component of our project because we see this as a way to make the rain harvest system meaningful. Change only occurs after awareness does, and by reaching out to the UCLA community, we endeavor to open the minds of many about the benefits of water conservation and management. Lastly, the rainwater capture system connects with resiliency planning because it can serve as an emergency water source if UCLA was ever in a dire situation. We aim to complete some resiliency planning for UCLA's campus beyond water management and conservation. This third goal will likely be carried out during Spring Quarter with help from our stakeholder, Nurit Katz.

From the goals listed above, our progress was steady and consistent. The major tasks we completed as part of this progress are: conducting research, carrying out site evaluations, picking a site, and then developing plans for that site.

In the past ten weeks we have been confronted with several challenges, but have made and are continuing to make progress towards our goals. For our literature review, we focused on a comprehensive list of topics that we felt would help provide some direction. These topics included: UCLA water policy, resilience planning, and rainwater capture systems – how they

work, their implementation, and their sustainability potential. With regard to UCLA water policy, our main focus was on the UCLA Water Action plan released a few years ago. This plan was developed in response to recent mandates prescribed by the University of California to cut water consumption by 20% by the year 2020. We discovered that UCLA uses roughly about 900,000,000 gallons of water a year on average. In order to meet our goals, we would have to cut 143,000,000 gallons of water. It became clear that Resilience team's ambitions were aligned with those of the university's, and we felt validated. We researched resilience planning with the idea of pursuing a resilience related project in the future, likely during spring quarter after we finish our rainwater capture project. In short, we isolated three main components that are of particular importance to UCLA: continuity of critical services, integrated development planning, and safeguards to human health.

Researching rainwater capture systems definitely helped us move forward. It gave us both clarity and direction. The sheer potential that we discovered for these systems provided extra motivation. For example, "a one-inch storm, it is possible to collect 600 gallons of rainwater off of a 1,000 square foot roof" and ultimately, "rainwater capture systems have the potential to increase Southern California water supply by 420,000 – 630,000 acre-feet per year"(NRDC). Understanding exactly the potential involved in what we were pursuing contributed to our progress in a more indirect way, but nevertheless it still had a significant impact. Researching rainwater capture cisterns also helped us gather an understanding of what to look for and what to expect along the way, especially with regard to implementation. We focused our attention on the five main elements of rainwater capture systems; the catchment area, the

conveyance, roof washing, the storage tank, and the distribution system (Kinkade-Levario). This gave us a more effective and efficient way of evaluating our potential sites.

Our next big steps forward were our site evaluations and picking a location. Originally there were four sites under consideration: Boelter hall, the Botany building, Franz Courtyard, and Parking Structure 9. Each site had its pros and cons. Some had more space, easier access, condensate potential, and practicality. Picking a site was a major challenge that is detailed in the following section.

However, an additional factor for us that was not included in the research we did was an education component. It was important to us that the site we picked have the potential as an educational benefit as well. This, along with the likelihood of relatively intense water treatment, was the main reason we originally dismissed Parking Structure 9. Ironically, Parking Structure 9 would be the site to ultimately win us over. This was largely due to: the size/capturing potential of the space itself, its ease of access, its practicality (given the green belt around it), and the support of a key outside contributor to our project – Tom Lukas. The space can potentially hold seven cisterns, totaling to about 28,000 gallons of water capture, and the catchment area could easily supply that. The drawbacks are, as previously stated, water treatment – which is proving to be a bit of an issue – and the lacking of an educational component. Ultimately, though, we decided that this site was our best option in terms of moving forward and making a greater impact.

Lastly, we had to start developing plans for our site to convert our ambitions into reality. We needed to take measurements and draw up a preliminary plan for our vision of the site. To do this we used AutoCad. Luckily, we have Cayla. She took on the responsibility of drawing up the

plans herself using AutoCad – as she was the only person on the team who was familiar with the program. She was able to get solid plans drawn up and approved by Tom Lukas. This was marks the transition into the good stuff, as we are now preparing to have plans prepared and ready for an engineering study. We look to be ready for our TGIF proposal coming up in April.

	Option1	Option2	Option3	Option4	Option5	Option6
Dimensions						
Storage (gal)	3000	4100	1900	1700	1200	1300
Diameter (in)	102	102	64	76	72	60
Height(in)	93	130	154	95	82	114
Weight - tank(lbs)	405	714	300	250	210	194
Weight-water (8.34 lb/ga	25020	34194	15846	14178	10008	10842
SG		1.2				1.2
Storage						
Total Storage - 6 tanks	18000	24600				
Total Storage - 7 tanks	21000	28700				
Total Storage - 8 tanks				13600		
Total Storage - 9 tanks				15300	10800	
Total Storage - 10 tanks			19000		12000	13000
Total Storage - 11 tanks			20900			14300
Weight						
Total Weight - 6 tanks	152550	209448				
Total Weight - 7 tanks	177975	244356				
Total Weight - 8 tanks				115424		
Total Weight - 9 tanks				129852	91962	
Total Weight - 10 tanks			161460		102180	110360
Total Weight - 11 tanks			177606			121396
Cost						
Cost per tank	$1,095.95	$2,289.95	$1,359.95	$764.95	$799.95	$849.94
Cost - 6 tanks	$6,575.70	$13,739.70				
Cost - 7 tanks	$7,671.65	$16,029.65				
Cost - 8 tanks				$6,119.60		
Cost - 9 tanks				$6,884.55	$7,199.55	
Cost - 10 tanks			$13,599.50		$7,999.50	$8,499.40
Cost - 11 tanks			$14,959.45			$9,349.34
Cost/gallon	$0.37	$0.56	$0.72	$0.45	$0.67	$0.65

Total Catchment Area (in^2)	12,492,099.29	* Level 6
Total Catchment Area (ft^2)	86750.69	
1" precipitation (ft^3)	7229.224167	
Volume of runoff (ft^3)	6506.30175	**Assume runoff coef. =0.9,
Volume of runoff (gal)	48667.13709	
Perimeter (ft)	1446	
Level 1 Elevation (ft)	355	** all lower half of parking lot
Level 2 Elevation (ft)	366	* ground level
Level 6 Elevation (ft)	410	
Height of outer wall (ft)	15.25	370.5 ft
Height of cement overhang (ft)	21	376
Ground level (ft)	355	
Horizontal distance apart (ft)	4.25	
Vertical distance apart (ft)	5.75	
Diagonal (ft)	7.150174823	**limiting value
Length of area (in)	860	
Width of area (in)	162	
Stormdrain diameter (in)	18	

Figure 1. Calculations for cistern determination. We deduced that Option 2 would be the most feasible.

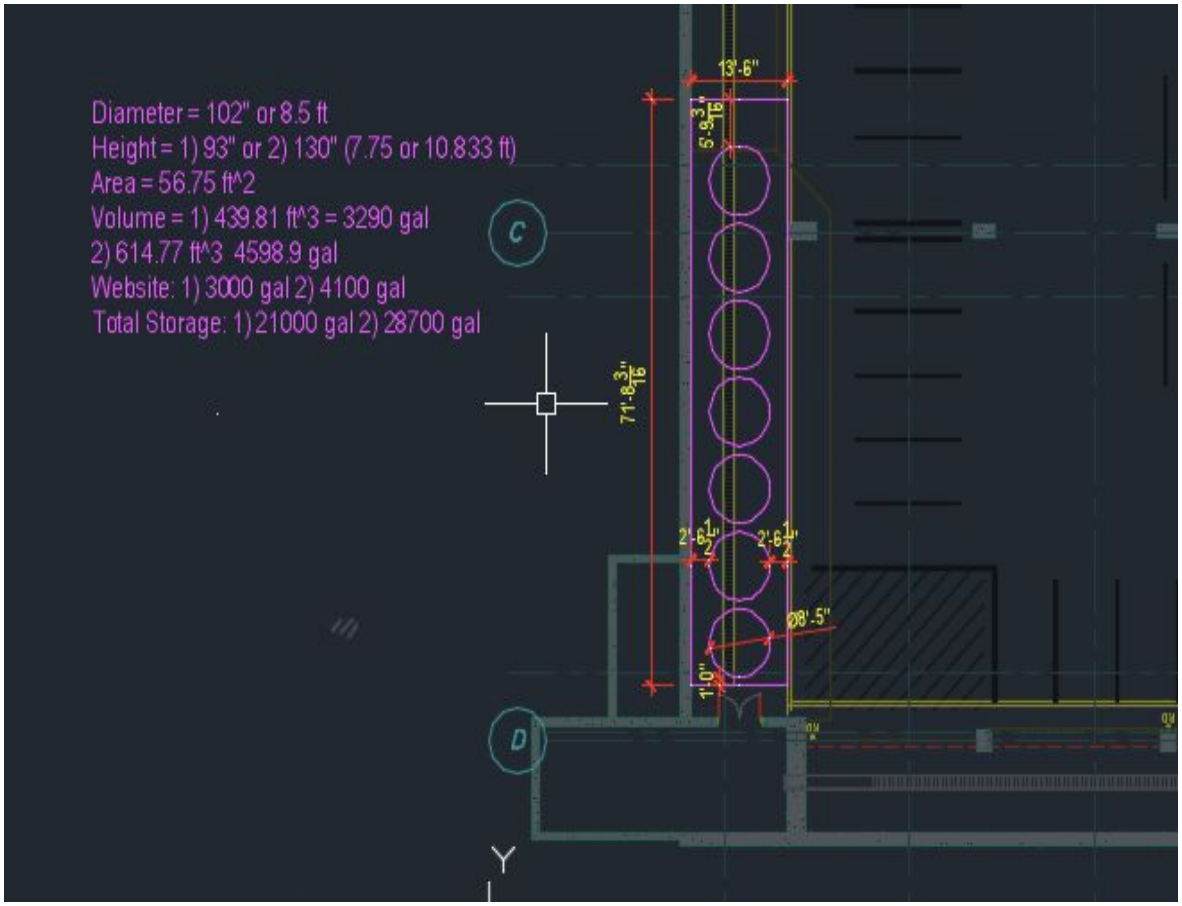

Figure 2a. AutoCad drawings of the cisterns in their proposed location (Parking Structure 9).

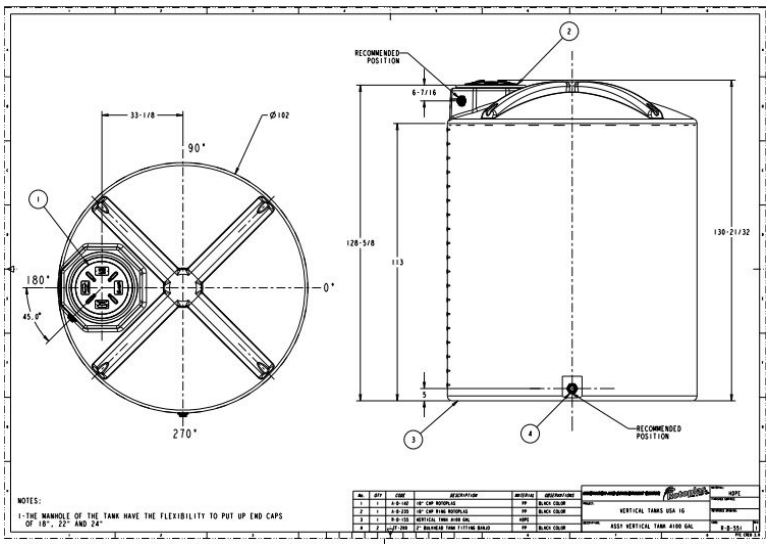

Figure 2b. Cistern measurements.

Challenges and Difficulties

Throughout this quarter, great difficulty was preceded by great progress. The team faced several challenges, the most notable being choosing a site for the cistern system, developing engineering plans for the system, choosing a cistern size/number of cisterns, and coordinating meetings and emails. At the beginning of this quarter, there were four sites to evaluate: Boelter courtyard, Franz/Geology walkway, Parking Structure 9, and behind the Botany building. Each site was evaluated for available space, slope size, disruption of plant life, jurisdiction, educational impact, and ease of implementation. There were additional factors that were taken into account for each site as well. A pros and cons list for each site was compiled, including photos of each site. After evaluation, the two most suitable site locations were Boelter courtyard and Parking Structure 9. While Boelter courtyard had more potential for educational impact and aesthetics, it lacked the spatial availability and presented future issues with project approval from the School of Engineering. Since implementing this cistern is our primary goal, we decided, along with support from Tom Lukas and Nurit Katz, to choose Parking Structure 9. However, there was some hesitation regarding the site, due to its limited educational impact, concerns over the quality of water collected, and debate over space ownership. These challenges were overcome through research addressing water filtration processes, alternative educational impact ideas, and discussion with our primary stakeholder.

Determining the number of cisterns and cistern size was also a difficulty since there are a myriad of options available on the internet. This problem was resolved through our introduction to the RainHarvest systems company. They were able to provide us with information regarding

the best cistern type and size for our location. We were able to use their recommendations to develop a preliminary budget for the size and number of tanks that would fit the space most efficiently.

After deciding on the number and sizing of the tanks for our system, an additional challenged we encountered was actually developing the engineering plans for the system. Tom Lukas was able to secure the AutoCAD files for the Parking Structure to develop initial plans for the space. However, as only one member of our team had experience using this program, it was difficult to work as a team regarding this aspect of the project. The plans were also relatively complex, and we needed to reach out to experts in the Facilities Management department to set up a meeting for plan assistance.

This leads to our final challenge, which was scheduling meetings and keeping up with emails. Our project is truly a collaborative effort - we have needed to reach out to a myriad of people, from the Parking Structure 9 manager who let us into the space on our first site visit, to the gardener of the green belt surrounding the structure, to the staff in the department of Environmental Health and Safety regarding water quality standards. This has resulted in a large amount of emails to keep track of. Often, we had difficulties in communication when people were not CC'ed on particular emails and therefore did not receive information. Also, sometimes people did not respond for several days which stalled our progress. Finally, when attempting to schedule meetings with various people, the available times that worked for everyone were often few and far between. Clear communication is key to the success of any project, and we learned from this quarter on the ways to improve our communication. From now on, weekly emails will

be sent to our team members and stakeholders, therefore, if someone misses a meeting, they are still caught up on the project.

Overall, complex projects will always present challenges - the most important idea is that these challenges can be seen as learning experiences for the future and help us improve, both as individuals and as a team.

Plans for Spring

One of our most important goals for the Spring quarter will be to apply for funding through TGIF. Since the proposal for funding is due Week 5, we will be preparing our application during the first half of the quarter. Similarly to the 2016 SAR Resilience Team, we will be creating several different plans. How much funding we get will determine the size and amount of cisterns we will be able to purchase. Hopefully, we will receive enough funding to fill the entirety of our space in Parking Structure 9, with the 7 cisterns we have determined will fit.

Before we apply to funding, our site location must be finalized. While parking structure 9 is currently what we have decided, Nurit Katz and Bonnie Bentzin raised some concerns over the cost of filtration system needed, and if we can even secure the spot. Tom Lukas, however, believes this is the ideal location for us and that we should continue pursuing it. Our first step will be to have the spot approved by Transportation Services, which is looking to go our way through Mr. Lukas's connections. Mr. Lukas has been crucial in getting our project going. After compiling the necessary information on the hydrologic separator, as suggested by Rainharvest Systems, and finalizing the size, type, and price of the cisterns, he will help develop our final budget. This will include cistern costs, filtration costs, and maintenance costs. The $18,000 from

last year's TGIF grant will go towards the installation of the system. We will be including this in our new TGIF application, to indicate what the previous funding allocation was used for. Another important aspect we will be working on is filtration and irrigation. We will be working to determine if the water will need treatment and how it will be irrigated. In total, we will be detailing our project goal, project schedule, budget, and drawings of the site in our application process for the first half of the quarter.

The Resilience Team will also be participating in the UCLA Earth Day fair this year. At our table, we hope to partner with Rainharvest Systems and create a mini rainwater cistern simulation. We also will be contacting Tree People about a rain barrel workshop and contacting DWP about giveaways for the fair. Lastly, we will be reaching out to Ecochella about potentially tabling the event. We are enthusiastically awaiting Spring Quarter!

Conclusion

Our one major goal — implementing a rain water capture system — has never changed. However, our route to getting there has definitely been altered. We never expected Parking Structure 9 to be the final location for the cistern. We also did not realize how many connections we needed to make in order to make this idea a reality. We owe so much to Tom Lukas and Nurit Katz!

By the end of spring quarter we hope to hand the design, plans, project specifics, and funding over to the UCLA Facilities department so they can begin the actual building of the water capture system. A huge highlight will be hopefully receiving major funding from TGIF to truly get the project off the ground. Other highlights will be completing our goals of educational

outreach and resiliency planning. We want this project to extend beyond SAR and impact the UCLA campus and community. We will work hard to achieve this by partnering with other companies and organizations to propose a comprehensive and informative water management presentation.

As UCLA's campus is populated by more than 80,000 people daily, both sustainability measures and preparation for the effects of climate change and increasing numbers of natural disasters should be considered a top priority by the university. A water cistern would serve to provide not only sustainable irrigation of UCLA's campus, but also could be used as an emergency water supply if Los Angeles were to experience a natural disaster or an unforeseen circumstance. An integrated water cistern would additionally serve to portray UCLA as a leader in sustainability both in California and in educational universities worldwide. We cannot and should not sit back and wait for our water to be depleted. The Resilience Team is excited and equipped to do our part in ensuring UCLA's water security.

Works Cited

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