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Evaluation and Improvement of the Design 4 Every Drop Course

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EVALUATION AND IMPROVEMENT OF THE DESIGN 4 EVERY DROP COURSE

A Water-wise Landscape Design Community Workshop Provided by Utah State University Extension

by

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A thesis submitted in partial fulfillment of the requirements for the degree

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MASTER OF LANDSCAPE ARCHITECTURE

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ABSTRACT

EVALUATION OF DESIGN 4 EVERYDROP

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Utah and the greater Intermountain West are experiencing a water crisis. Many factors are contributing to this situation, including an arid climate exacerbated by climate change, rapid population growth, and a high-water-demanding landscape typology. Landscapes currently consume an estimated 60-80% of Utah's potable water, representing a significant opportunity for water savings. However, changing the traditional water-dependent landscape typology requires educating the public regarding water-wise landscape design processes, best practices, and implementation approaches. Utah State University is the land grant university for Utah and home to one of the oldest Landscape Architecture departments in the Intermountain West. Utah State University's community outreach program is carried out by Utah State University Extension. This organization provides high-quality education for the community's benefit and use. Utah State University, in conjunction with the USU Landscape Architecture and Environmental Planning Department, created a course to teach community members about water-wise landscape design. The course was made available in Spring 2023 and delivered to 65 participants. The resulting study used participant feedback and course observations to evaluate student learning and help identify areas where the course could be improved. Based on this evaluation, suggestions were provided, and supplemental course content was created for incorporation into future course revisions.

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I would like to thank my committee chair, Professor Jake Powell, for helping me design and create this study. I will be forever grateful for his skilled mentorship and encouragement, time, kind feedback, friendship, and persistent belief that I could complete this work.

I am also very grateful to my committee, Professors Dave Anderson and Shital Poudyal, who graciously volunteered to help in this study. Their friendship, expertise, and insight brought this work to a higher level of quality.

Thank you to the participants in the course, some of whom I had a chance to meet and work beside . It is exciting to see their designs and inspiring ideas, and I wish them the best in making those designs a reality. I am grateful for their feedback, as it provided helpful information to guide this project and improve future courses.

I am thankful to my little family, and especially my wife, for their patience. They were with me every step of the way,ever encouraging me and believing in me. A special thanks to my wife for helping with the kids and providing great support to them and me. Perhaps, one day, we will be able to go on a date again. Huge thanks to my kids for being patient while I wrapped this up. I'll be doing a lot of playtimes, playing armies, rocking babies, and dance parties to make it up to you.

"All things denote there is a God; yea, even the earth, and all things that are upon the face of it, yea, and its motion, yea, and also all the planets which move in their regular form do witness that there is a Supreme Creator." Alma 30:44

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Utah's population is among one of the fastest-growing in the country (Bureau, 2021), and current, traditional landscape typologies are not conducive to Utah's arid environment (Keane, 1995). Current landscape design trends, accompanied by the growing population, threaten Utah's water supply, capacity for future growth, and overall environmental health (Jackson, 2003). Utah's rapid growth has followed a sprawl model, with hundreds of landscapes installed and updated annually. In 2021-2022 alone, Utah issued over 30,000 building permits. This staggering figure means that a similar number of new landscapes were installed in association with these permits (Bureau, 2022). As a high-desert state with cold, dry winters and hot, dry summers, Utah receives an average of 11 inches of precipitation each year, making it the second driest state in the United States (Division of Water Resources, 2023). Although Utah has a dry, arid climate, trending landscape design styles require a greater amount of water than climate-adaptive landscapes (Sovocool, 2006).

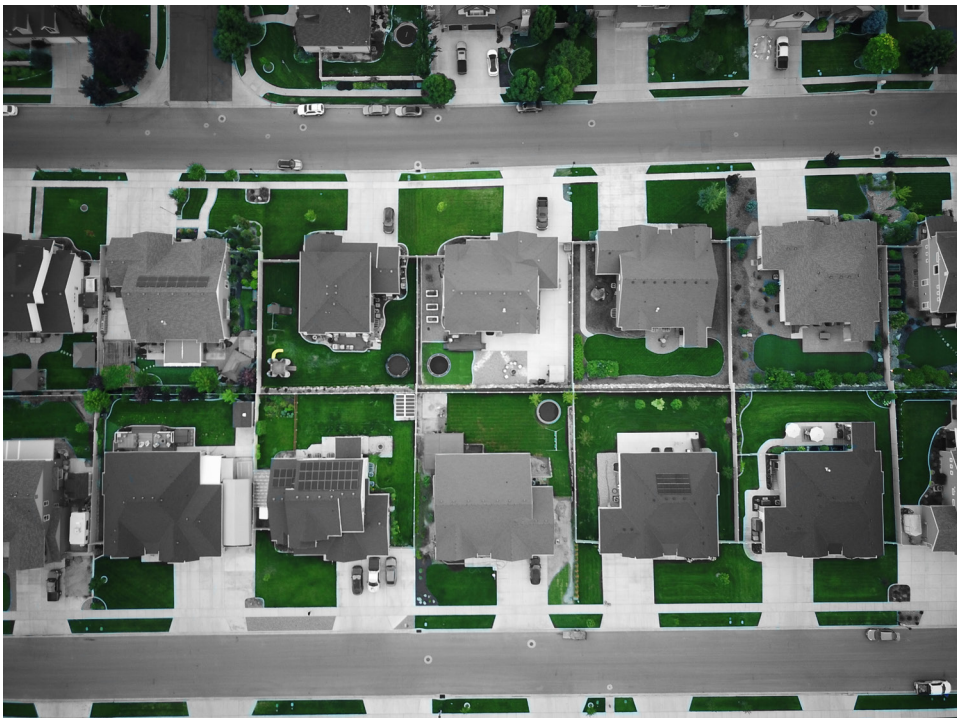


Figure 1.0 Typical Utah landscape typology dominated by lawn

In the face of limited water supplies and explosive growth, external landscape water conservation is becoming an important focus of statewide water conservation efforts (Li, 2017). Changing the traditional landscape vernacular, however, is proving to be difficult. While residential landscapes often reflect the values of the residents, they also highlight the values of the surrounding neighborhood and community. Yards with more lawns in Utah are preferred over more water-wise yards (McCammon, 2009). As shown in Figure 1.0, the lawn-dominated landscape is thirsty, making it the main target for water conservation in the region (Sovocool, 2006).

These lawn-dominated landscapes strain the water supply and the greater environment in Utah. The rate of expansion coupled with traditional landscape typology is not sustainable. Some developed areas will eventually be unable to water their landscapes or will be forced to adopt low-water landscape techniques. For example, Saratoga Springs, a recently developed community in Utah, has been forced to restrict irrigation water use and, in drought years, has completely turned off irrigation water as early as September. Yet high temperatures and dry air can occur even into November, further complicating water supply management, as landscape irrigation continues to be used late into the year. Some winters do not provide enough moisture to keep many newly planted landscapes alive. Though snow still falls during winter months, increasing cold temperatures without precipitation do not provide enough water for the plants, causing them to be stressed or die. This increases both financial strain on homeowners by risking the landscape health, and environmental strain as development increases the ambient temperature throughout developed areas, otherwise known as the heat island effect.. Furthermore, if not addressed, water strain could not only threaten landscapes, but could ultimately affect drinking water, creating a state of emergency for Utah residents.

Despite these challenges, several books, videos, and websites exist to assist people with the tactical elements of a xeric landscape. These resources cover topics such as irrigation upgrades, soil amendments, and plant selection; however, far less attention and available resources are devoted to the design of xeric, water-wise, or climate-adaptive residential

landscapes.

As a new homeowner in a newly developed neighborhood, I witness first-hand the excitement of new homeowners receiving a completed yard. Most developers include the front landscape in the purchase of a home. Typically planted on marginal soil, each home receives a few shrubs and a fresh blanket of sod to cover the rest of the landscape. Similar sod/lawn will ultimately dominate the landscape of the neighborhood as backyards are eventually developed and installed. Many Utah residents understand and want to implement water-wise principles but lack the understanding of how to execute these principles in an attractive and cohesive design. Utah residents with a desire to landscape their yards often install what is available and consistent with neighboring lots, unaware of simple measures that can be taken to reduce the amount of water their landscape consumes.

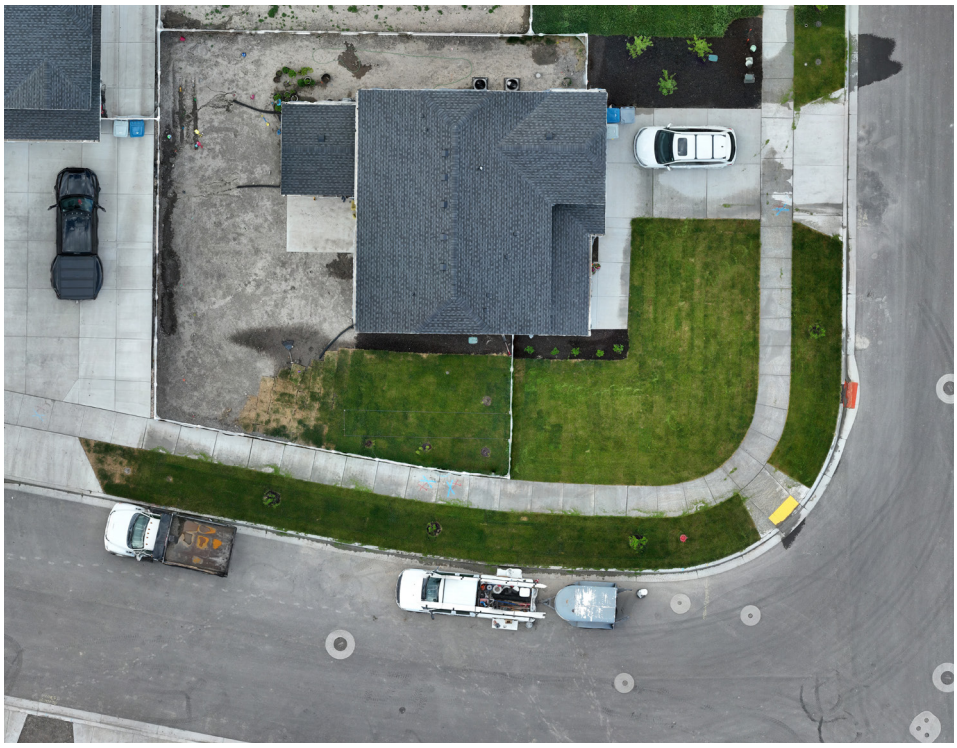


Figure 1.1 Example of newly developed home landscape

Community courses have become a popular way to share principles and elements of water-wise landscaping. Design 4 Every Drop is a Utah State Extension-sponsored community workshop that was created to train and educate Utah community members about water-wise

landscape design principles. The Design 4 Every Drop course was launched in February 2023. To date, 65 Utah residents have participated in the class.

The purpose of this study is to evaluate the Design 4 Every Drop course, to gauge its effectiveness in teaching participants fundamental water-wise techniques associated with landscape design, and to assess the course's ability to improve participants' knowledge, attitudes, and behavior regarding implementing water-wise landscape principles on their properties. This study will then utilize participant feedback and published academic literature to propose and implement adjustments in course deliverables and course material. Improvements and innovations to this course will have a positive impact on Utah communities and improve the overall acceptance and implementation of water-wise landscape designs.

A critical but often overlooked aspect of online course development is the cyclical process of evaluation, feedback, and revision. While Utah State Extension and many other online programs prioritize course creation, evaluating a course's effectiveness after implementation is a less common practice. Courses are typically designed with good intentions and the instructor's expertise in mind, yet a crucial question often remains unanswered: does the course truly achieve its intended learning objectives? This evaluation gap hinders continuous improvement and can leave knowledge gaps unaddressed. My examination of Design 4 Every Drop serves as a valuable case study, providing a template for future Utah State Extension courses and other online programs to implement. Following a thorough evaluation, I aim to identify areas for improvement and ensure the course effectively delivers the designed curriculum.

Design 4 Every Drop Course Structure

Through funding provided by Utah State University Extension and the work of several extension faculty members, the Design 4 Every Drop course provides a hybrid learning environment, teaching landscape design by combining functional layout and design in conjunction with water-wise principles.

Each student reviews core course content through an online course powered by Canvas, an online learning platform. In this preliminary Canvas-based course, students prepare for an

in-person workshop by reviewing course material online. This material includes informational videos, graphics, and texts teaching about site inventory and analysis, base map creation, and functional diagrams. An introduction to the landscape design process is also included, detailing principles and elements of design, water flow, water harvesting, mulch, irrigation, and planting design. Students are provided with a workbook to accompany the online module with material tasks that can be recorded in the workbook. The workbook helps participants collect information for their site: base maps, site images, city ordinances, water meter information, hydrozones, and drainage maps. This information is vital to create a successful landscape design. Thus, it is preferred that the online segment be completed before the in-person workshop.

Two different models of online interaction were employed to assess the validity of various ways of interacting with students during the online portion of the course. With the exception of the cohort registered for the Bluff in-person workshop, all other cohorts engaged in the online portion in a self-paced, individual manner with only occasional email prompts and reminders provided by Extension staff to inspire participants to complete the required tasks. The Bluff cohort, however, met weekly, at four different times during the online module, to share progress, ask questions, and stay accountable for the tasks associated with the online portion of the course.

Course participants then meet in person for a 1.5-day workshop. Although students were encouraged to complete all aspects of the course, no requirement was put in place to complete the online portion of the course in order to participate in the in-person workshop. The in-person workshop was offered during the spring of 2023 in five locations throughout Utah, in order to make the course more accessible for Utah residents. These locations were Hurricane, Bluff, Vernal, Murray, and Logan.

During the in-person course, participants begin by making functional diagrams, designing form studies, and creating schematic plans. They then learn how to create water studies and use basic hand graphics. They also learn planting plan strategies and irrigation basics. Between each section of the workshop, students are given time to work on their specific project and are

provided with one–on–one time with an instructor. Instructors provide students with feedback and design criticism. This helps deepen the learning experience, as students are encouraged to shift their thinking and apply innovative ideas to their projects.

ii. Significance of the Study

The study will make a significant contribution to the field of landscape architecture by providing evidence-based recommendations for improving the effectiveness of community landscape design workshops. The study will enhance the impact of the Design 4 Every Drop course, as participant concerns will be targeted and resolved. As participants from this workshop implement the principles taught, the environmental impact of traditional high-water landscapes will be reduced, creating a gradual cultural shift in Utah landscaping design.

Once a student completes the updated Design 4 Every Drop course, they will be exposed to the landscape design process as taught through Utah State's Landscape Architecture and Environmental Planning program, which includes site inventory and analysis, functional diagram, concept design, form studies, and schematic plans. This gives students confidence in their pursuits to implement and install their own water-wise landscapes. Students are also exposed to basic techniques and strategies surrounding grading, drainage, rainwater harvesting,

Figure 1.2 Example of water-wise front yard courtesy of Big Rock Landscape

planting, mulch, soil amendments, solid structure, and irrigation. Each topic is geared to educate participants about the many steps they can take to reduce the amount of water applied to their landscape.

The Design 4 Every Drop course improvements and innovations will deepen its impact on Utah communities and perpetuate the acceptance of water-wise landscape designs. This will help to better conserve Utah water and resources.

This research will help the Design 4 Every Drop and future Utah water-wise landscape design courses improve their effectiveness in improving the attitudes, knowledge, and behavior of Utah community members. Furthermore, by educating Utah community members through this workshop and future workshops, community members will better understand water-wise landscape design principles, helping them make the shift towards more sustainable landscape practices.

iii. Research Hypothesis, Questions, and Objectives

Research Hypothesis:

The primary question of this study is: How effective is the current Design 4 Every Drop course at teaching participants about water-wise landscape design? A successful Design 4 Every Drop course aims to educate participants about the importance of water-wise landscaping and provide them with essential steps to create functional, attractive, and water-efficient designs. The ultimate objective of the course is to empower students with a thorough comprehension of water-wise landscape design, enabling them to confidently implement their understanding. Additionally, this study will address supplementary questions that arise in relation to the topic. Such questions include:

- How is the current Design 4 Every Drop course structured, administered, taught, and evaluated, and what are ways these aspects could be improved?
- What course content is available, and does it need to be updated or refined?
- How do students learn about water-wise landscape design?

- Does good landscape design save water?
- What successes are similar courses experiencing, and how can they be applied to this course?
- How do participants rate or value the current Design 4 Every Drop course?
- Are participants satisfied with the course, and what improvements to the course are needed to satisfy participant feedback?

Research Objectives:

This research will critically analyze an existing extension program and improve the course based on course participant feedback, existing literature, and best practices from similar courses. By evaluating this course and exploring other similar courses, it is anticipated that new techniques and deliverables will emerge, thereby improving the course objective to teach Utah community members about water-wise landscape design while meeting student expectations and achieving overall course satisfaction.

Limitations:

Some study limitations include limited course sizes and resultant sample sizes for feedback. Due to venue size, the average number of participants enrolled in each course was limited for the in-person portion of the participants' learning experience. In the course's inaugural year, five workshops were offered throughout the state in five separate locations, with an average of 13 participants registered per workshop. Actual attendees were fewer than those who registered.

CHAPTER 2: REVIEW OF THE LITERATURE

Drought/ Xeriscape

In 1981, the city of Denver, Colorado developed the term "Xeriscape" as a fusion of the Greek word "xeros," meaning dry and arid, and the word "landscape." Due to steady population growth, Denver and the surrounding municipalities needed a way to adjust the 60-70% of annual household water being used to irrigate landscapes (Sovocool, 2006, p. 1). Utah and most major southwestern regions are currently experiencing a similar event. The population is increasing at a rapid rate, as data shows an increase of 31% in the last 20 years (Bureau, 2022). As a result, the demand for water is also increasing. In 1995, Terry Keane, a member of Utah State's Extension program, published an article titled "Water-wise Landscaping," which outlined the benefits of water-wise design and provided a step-by-step guide to creating a water-wise landscape. Keane attempted to curb the strain on water by educating Utah residents about the need and value of water-wise landscaping. "Much of the success of water conserving landscapes will come from sensitivity to and appreciation for the environment," he wrote (Keane, 1995, p. 98) "The more a person works with the landscape, the more enjoyment there will be in seeing and trying to understand the interactions of complex elements" (Keane, 1995, p. 98).

Utah Water Conservation

Water conservation is critical in the Western United States, due to the arid environment in many regions. In Utah, drought conditions are already threatening the water supply and environment, and Utah landscapes are one of the most water-consuming outlets in the state (Wilkowske, 2003, Kjelgren, 2000). Despite dire statistics regarding drought and water conservation in the state, there exists little information about water–wise landscape design. There are, however, many websites and articles that suggest ways to conserve water. Utah State University Center for Water-efficient Landscaping's website, https://extension.usu.edu/cwel, includes links to online articles and peer-reviewed literature prepared by university and extension members. These articles cover diverse topics, such as water-wise plants , irrigation maintenance,

mulch, turf grass care, and demonstration gardens (Mee, 2003). There are also articles about how to incorporate water-wise information into a functional and beautiful landscape design. In two of these articles, Keane (1995) and Wade (2010) describe the design process for water-wise landscapes by explaining site inventory and analysis, design principles (balance, unity, emphasis, etc.), hydro zoning, plant options, and basic installation techniques. The Design 4 Every Drop course covers these topics while also including information and instruction about functional diagrams, concept plans, form compositions, plant characteristics, water studies, simple grading, and basic hand graphics. The application of water-wise principles is manifest through design, and form compositions are the backbone of design and style— as significant to a landscape as architectural style is to a building or home. “Consequently, one should choose a design theme (i.e., style of forms) that will work and appear best for the situation” (Booth, 1989). Booth (1989) adds that ”one of the major considerations of this step of the design process is the visual relationship between a building” . The landscape compliments the home and home compliments the landscape. They work together to create an inspiring space. Form composition unifies a landscape, providing a cohesive system wherein water-wise tactics, such as planting, hydro zoning, and soil amendments, can be implemented.

Figure 2.0 Example of a water-wise yard

Utah's Landscape Vernacular – History and Context

The earliest known Utah residents were Native American tribes. The land uses of Native American tribes were designed with consciousness to all living species within that ecosystem (Anderson, 1996). Hunting and agricultural techniques were simple, as native people relied on the land for survival and did little to alter or adjust ecosystems. During this time, large populations did not reside in one location. Instead, smaller tribes and groups lived throughout Utah, including the Navajo tribes to the south and the Ute Tribes to the north (Worley-Hood, 2013). The resultant impact on the land was minimal compared to today's impact. These early residents continued their land use habits until explorers and settlers began to head west in the 1800s.

In 1847, immigrants, primarily from European countries, traveled to Utah for religious freedom as members of the Church of Jesus Christ of Latter-day Saints. These immigrants settled in the Salt Lake Valley and in many parts of the West. As a result, Utah's landscape palette is rich with European-inspired landscapes and habits. However, unlike the fertile, damp climates of Europe and the Eastern United States, Utah's arid climate cannot sustain such landscape typologies.

Historically, agriculture has been Utah's highest water-consuming practice (Criddle, 1962). But because populations throughout early pioneer settlements were small, water demand remained minimal. However, after World War II, tract-styled neighborhoods exploded across the United States. This popular movement required that each new home typically include a large yard and home. However, tract-styled development paid little to no regard to the existing desert landscape and its fragile ecosystems. For over 175 years, Utah's population and land uses have continued to grow and change. As trade and shipping became more available, it was no longer necessary to reserve land for the growing vital crops. This led to the transformation of Utah's land uses and demand for water. The globalization of agriculture means that localized farms have been removed, and agricultural land has become available for development. The contained nature of Utah's settled valleys has resulted in increased land costs, along with increased housing

demand. And within the last decade, Utah has become one of the fastest growing states in the country, leading to a rapid demand for water in an already water-strained environment.

Alternative Adopted Landscape Typologies

Many Western cities share a similar history, but some have adopted more water-wise landscape typologies. St. George, located in Southern Utah, is a unique township with an annual average temperature of 63.9 °F and an average annual precipitation rate of 11.1” (St. George Climate: Weather St. George & Temperature by Month, n.d.). In comparison, Salt Lake City, experiences an annual average temperature of 49.5 °F and an annual precipitation average of 20.9” (Climate Utah: Temperature, Climate Graph, Climate Table for Utah, n.d.). However, St. George has successfully adopted a more drought-tolerant landscape typology. For example, in Figure 2.1, a simple aerial image of neighborhoods shows collected lawn formations with large planting beds reducing non-functional turf. Because lawn requires more water than other climate-adaptive shrubs and perennials, this simple change effectively reduces the amount of water

Figure 2.1 St. George neighborhood Google Earth image

needed to maintain a landscape (Sovocool, 2006). Other cities across the Southwest, such as Phoenix, Tucson, and Santa Fe, are known for their desert-type landscape typologies. Although these desert-friendly landscapes may not be the correct answer for all of Utah, a shift in the current typology is nonetheless necessary.

Kentucky Bluegrass dominates the landscape throughout North and Central Utah. Kentucky Bluegrass requires large amounts of water during the hot arid summer to stay green. Lawn requires more water than perennials, shrubs and trees. While lawn is an easy, unifying plant, it is most often planted out of habit and tradition, rather than functionality. With the recent drought and concurrent increase in development and growth, water pressures are more apparent than ever. Thus, a shift in the current landscape typologies is vital to sustain growth and better represent the high desert environment throughout the state of Utah. Necessary adjustments need not be as drastic as the desert landscapes of St. George or Phoenix, but even a small shift away from turf, such as Kentucky Bluegrass, combined with more meaningful plant selection, could make a significant impact on limiting landscape water use.

Irrigation Practices in Utah

Irrigation is required to sustain Utah's current landscape typology. Throughout the state, the current industry standard for landscape irrigation is rotors and sprays for lawn and drip tubing/point source drip for landscape beds,trees, shrubs, and perennials. Some homes may not have an irrigation system, relying instead on hoses and sprinklers to irrigate and often over-water as a result. Updating or retrofitting these systems is a great way to save water. As faulty or broken systems are repaired or replaced with updated systems, watering efficiency improves. Irrigation systems are also typically controlled by a timer or controller, with the oldest systems relying on programmable clocks and timers to signal irrigation systems. Such a system simply controls the frequency and length of watering, and some articles suggest that traditional controllers are leading to over watering (Endter-Wada, 2008). However, understanding the landscape or plants' actual water needs can reduce the amount of water used in the landscape by allowing homeowners to program irrigation systems in such a way as to give plants only the amount of

water they actually need. Smart irrigation controllers do this very thing, and are becoming more affordable and available. These irrigation controllers factor in weather and seasons to set the watering schedule. Some smart controllers even adjust watering timing/duration with the help of probes and instruments that measure the amount of water in the soil with multiple other factors to determine the watering schedule. There are many ways in which smart controllers contribute to water conservation, with some studies claiming that landscape water use can potentially be reduced by 40-70% with their use (Dukes, 2012). And grants and rebates are becoming increasingly available to those who upgrade from an older controller to a smart controller. Still, while smart controllers can conserve water, the amount continues to depend on watering habits prior to use.

Most of Utah's urban and suburban landscapes are watered with culinary water or secondary irrigation metered by the city. Depending on the jurisdiction, this water may or may not be expensive to use, although culinary water costs more than secondary irrigation water. Although Utah tends to have cheap water prices (Utah Division Water Resources, 2010), water remains a valuable resource to all Utahns, and using secondary water helps alleviate some of the pressure on Utah's potable water supply. Understanding the dynamics of irrigation within most of Utah's landscape will help guide decision-making when designing and installing a landscape. A simple adjustment to irrigation systems can save gallons of water each year. Using water checks, Jacksonet al. (2003) calculated that if the 4,552 participants in their study reduced watering by 20%, they would save a total of 737 acre feet of water (240,188,300 gallons) in one year.

Typical Landscape Irrigation Rates

To help illustrate the amount of water a typical lawn requires in comparison to a landscape bed irrigated with drip, simple yet typical landscape precipitation rates were calculated. These calculations were based on average precipitation rates for irrigation through specific systems.

Kentucky Bluegrass

On average, Kentucky Bluegrass requires 1 to 2 inches of water per week in the spring and 2.5-3 inches of water per week in the summer (Gross, 2008). For one square foot (SF) of lawn, 0.62 gallons of water is required per every one inch of water (Mitchell). For a sample area of lawn that is 10' x 10' (100 SF), achieving an optimal 3" of water would require 186.9 gallons of water per week.

(3" of water) x (100 ft 2 planting area) x (0.623 conversion factor) = (186.9 gallons)

Spray Nozzles

Figure 2.2 shows Hunter's™ product catalog. If this 10' x 10' (100 SF) area were watered by (4) 90° 10 Hunter™ fixed spray heads, each releasing .42 gallons per minute (GPM), this zone would need to run for a total of 37 minutes a week to release 1 inch of water.

PRO FIXED NOZZLES PERFORMANCE DATA



			5 — 5' radius, Fixed: ¼, ½, Full, Trajectory: 0° — ● Blue				8 — 8' radius, Fixed: ¼, ⅓, ½, Full, Trajectory: 15° — ● Brown				10 — 10' radius, Fixed: ¼, ⅓, ½, Full, Trajectory: 15° — ● Red			
Arc	Position	Pressure PSI	Radius ft	Flow GPM	Precip in/hr ■	Precip in/hr ▲	Radius ft	Flow GPM	Precip in/hr ■	Precip in/hr ▲	Radius ft	Flow GPM	Precip in/hr ■	Precip in/hr ▲
90°	Q	20	4	0.09	2.25	2.60	7	0.20	1.54	1.78	9	0.34	1.63	1.88
		25	4	0.11	2.54	2.94	8	0.22	1.33	1.53	10	0.39	1.48	1.71
		30	**5**	**0.12**	**1.80**	**2.08**	**8**	**0.24**	**1.46**	**1.69**	**10**	**0.42**	**1.63**	**1.89**
		35	6	0.13	1.36	1.57	9	0.26	1.25	1.45	11	0.46	1.47	1.69
		40	6	0.14	1.46	1.69	9	0.28	1.34	1.55	11	0.49	1.57	1.82

Figure 2.2 Hunter product catalog - spray nozzles

To achieve the 3 inches required during summer, the same zone would need to run for a total of 111.25 minutes a week. Note that the system would not need to run 111.25 minutes consecutively, but rather periodically throughout the week, in order to achieve the needed precipitation amount. In this scenario, the lawn requires 1.87 gal/ SF of water per week (Figure 2.3).

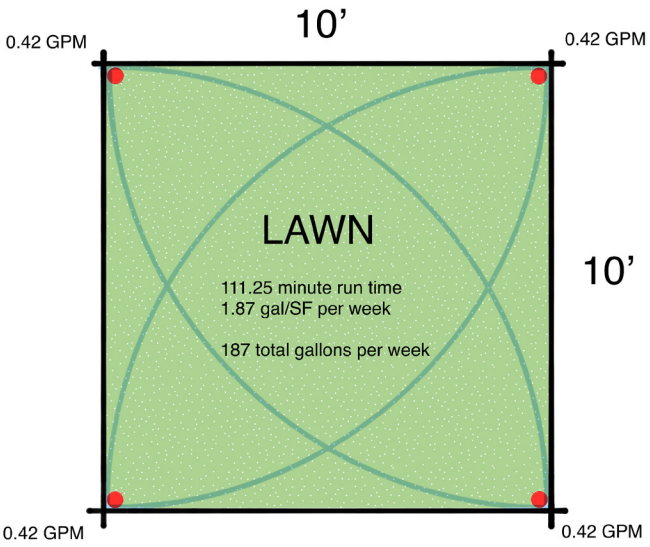


Figure 2.3 Lawn irrigation diagram

Drip Irrigation

A landscape bed or garden is typically irrigated with some type of drip product. Though there are a number of products available, the most common are currently drip tubing and point source emitters. Drip tubing has engineered orifices, called emitters, which control a certain precipitation rate, regardless of its location along the tubing and pressure of the system. Point source emitters are connected to simple irrigation tubing, as emitters are engineered to a specific gallons per hour (GPH) rate and can be placed at the base of each individual plant.

Shrubs and perennials need 0.5-1” of water per week (Utah State University, 2021). Based on 1” of water per week, a Hunter™ HDL-PC 12” drip tube engineered to 0.6 GPH and set on a 24” tube spacing will provide 0.96” per hour to 1 SF (0.01 gallons per minute). If each plant consumes a 2’ x 2’ area (4 SF), this system will yield 1.2 gallons per hour (0.3 gallons per SF or 0.48 inches per SF). The total runtime to achieve 1” is 125 minutes (Figure 2.4).

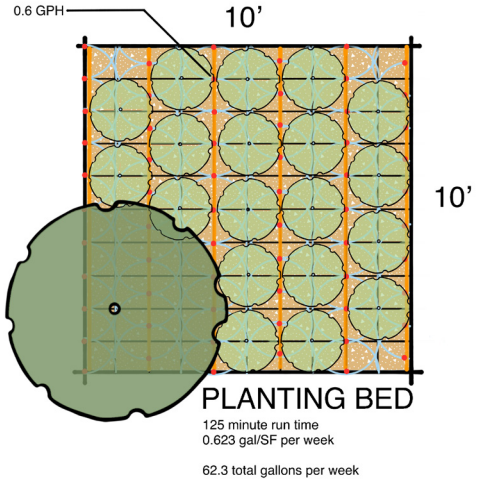


Figure 2.4 Drip irrigation diagram

Landscape Area	Irrigation Type	in./week	gal./week	gal./SF/week	time/week
Lawn	Spray	3"	1.86 gal.	186.9 gal.	111.25 min.
Planting Bed	Drip Point Source	1"	62.3 gal.	62.3 gal.	75 min.
Planting Bed		1"	62.3 gal.	62.3 gal.	125 min.

Figure 2.5 Hypothetical irrigation rate table

A Rainbird™ XB20PC point source emitter is engineered to 2 GPH. In the 4 SF scenario, this equals 0.5 gallons per SF. This system would need to run for 75 minutes to adequately water the plant. Although several factors contribute to irrigation rates, including evapotranspiration, soil conditions, weather, and plant density (Rupp, 1992), a shrub and perennial bed theoretically require roughly 0.623 gal/SF per week, while Kentucky Bluegrass requires 1.86 gal/SF per week. A landscape bed offers roughly 3 times the water savings (Figure 2.5).

This exercise illustrates the potential water savings that can occur by adjusting the design of a landscape to include more planting beds, rather than lawns. Although there are areas of lawn that may be needed, useful, preferred, and even required in a landscape, in most Utah landscapes, the amount of lawn serves as the primary culprit for the large amounts of water being distributed each year. In reality, there are several locations wherein a lawn may only be stepped on for its weekly mowing. The design process taught at Utah State University and through the Design 4 Every Drop Utah State Extension course is based on functional needs and preferences. Through this design process, unnecessary lawn locations and non-functional turf are identified and better utilized, thus saving water. Water-wise design can also help identify better program elements throughout the landscape, potentially reducing the amount of water required for that landscape by eliminating areas of nonfunctional lawn.

Through landscape design, water efficiencies can be achieved by selecting other land uses. Consider a yard that has been covered completely in Kentucky Bluegrass. Such a yard includes little to no design characteristics. Yet when a designer integrates landscape programs by replacing non-functional turf areas with gardens, patios, fire pits, planting beds with trees and shrubs, pools, play areas, and/or water features, not only are water demands reduced, but

the landscape also becomes more dynamic and species rich, due to the variety of plant materials. Landscape design can strategically reduce the amount of water needed to preserve the landscape by reprogramming the land uses.

Existing Landscape Design Courses

The natural spaces that surround us are critical to our mental health and overall well-being and as such, serve as important aspects of our personal lives and identities. However, many people lack either the funds to hire a professional designer or consultant, or the technical skills and/or equipment to install a landscape. In these instances, community workshops are an affordable and convenient option to learn about landscaping and water-wise principles, thereby dispelling community misunderstandings about unfamiliar topics, such as xeriscaping.

Landscape and garden courses attract hundreds of participants each year. More and more of these courses are being offered online to make them more accessible and increase community participation. The most active organizations in Utah offering courses to promote water-wise landscapes are the Utah State University Extension and the Jordan Valley Water Conservation Park's "Localscapes" program. But while these organizations offer many courses covering a wide range of gardening topics, only two or three of the courses offer information regarding landscape design.

Jordan Valley Water Conservation District and Localscapes

The Jordan Valley Water Conservation District initially developed the Localscapes program to provide landscape recommendations and a water conservation incentive program, offering participants with a plethora of resources, graphics, videos, programs, and even a series of courses at no cost. These self-paced courses teach students the basics of Localscapes, such as irrigation, plant reference, and rebate qualifications. Through the online platform Teachable™, participants can register for an introduction course, a workshop/hands-on course, an irrigation course, and a park strip conversion course, known colloquially as "flip the strip." These programs

are easily accessible and systematically break down the landscape design process into 5 simple steps. The steps are:

1. Central Open Space
2. Gathering Areas
3. Activity Zones
4. Paths
5. Planting Beds

Each of these elements is to be drawn in order on a base map, beginning with the central open space, which is often the lawn. In some instances, this space may also be designed as a hardscape surface to help limit the amount of lawn and eliminate any awkward or hard-to-water areas. To meet the qualification of "flip the strip," the lawn must fit certain parameters (no less than 8' wide, no more than 35% of the landscape, and no less than 10% of the landscape). Subsequent gathering areas are recommended to be scattered throughout the property, followed by activity zones that invite a wide variety of uses, and paths to connect all these spaces. Any unused space in the landscape becomes a planter bed.

This model helps to simplify the design process, as it offers a structure that can be applied to any landscape situation and that can be utilized by both professional and nonprofessional landscapers. Localscapes shares content through social media, websites, classes, videos, demonstration gardens, and incentive programs.

Utah State University Extension

In 1862, President Abraham Lincoln signed the Morrill Act, whereby land grant universities were created for the purpose of providing quality education to each state. Thanks to this legislation, a university was established in each state, and eventually, 106 land-grant institutions were created throughout the United States, United States territories, and Native American reservations.

As Utah's land-grant university, Utah State University, carries a special responsibility: to serve the state's citizens by disseminating research-based knowledge in a number of subjects

including agriculture and horticulture. Utah State fulfills this mission in several ways.

One key way Utah State serves the state of Utah is via its robust Cooperative Extension Service, often referred to simply as "Extension." Extension bridges the gap between the university and local communities by offering educational programs, workshops, and community resources. Delivered through local offices across the state, these programs address a wide range of topics, from agriculture and natural resources to family and consumer sciences. Extension empowers communities by equipping residents with the knowledge and skills they need to address local challenges and improve their everyday lives.

In addition to Extension, Utah State leverages technology by providing accessible digital resources, such as websites, fact sheets, and online courses. These resources ensure that research-based information reaches a wide audience, regardless of location. "While one-on-one consultation still occurs, Extension personnel have expanded their delivery of information by creating active websites and electronic delivery. The emphasis of Extension continues to be on unbiased information to inform, rather than endorsement of products or policies," explains Noelle Cockett (2014), former president of Utah State University. She continues, "Around 140 USU faculty members with Extension assignments are housed in 13 academic departments and in 31 offices located across Utah" (2014). For more than 120 years, Utah State Extension has been committed to improving the attitudes, knowledge, and behavior of Utahns in a wide array of subjects. These topics include agriculture and natural resources, business and community, food, health, and wellness, gardening, home, finance, and relationships (Utah State University Extension, 2023). The information is delivered in the form of research-driven classes, seminars, websites, fact sheets, certifications, emails, and videos.

Utah State University Extension is the primary resource across the state for agriculturally and horticulturally based information. For years, Utah State University has been committed to preserving water throughout the state. Utah State University also boasts the 13th oldest landscape architecture program in the United States. Utah State continues to help landscape architects better understand the necessity for saving water throughout the landscape.

Landscape Design – Intentional Landscape Design Saves Water

There are several ways to save water in the landscape, including choice of plant material, irrigation products, irrigation timing, and quantity/type of landscape areas. A "good" landscape design can be measured via various metrics, such as functionality, aesthetics, and sustainability. However, labels such as "good" or "bad" are often ineffective when measuring the quality of a design. What one considers a "good" design can vary in style and impact based on the unique goals of each client and designer partnership.

For the Design 4 Every Drop course, a "good" design is a landscape design that meets the participant's individual goals, respects the constraints of a given site, employs water-wise landscape design principles, and meets the goal of the course. The course uses a design process adapted from the process taught by the Utah State University Landscape Architecture Department, a process which is widely accepted within landscape architecture pedagogy. This process helps to create a design driven by objective site considerations, which preserves functionality and allows for designer input and flare.

Design 4 Every Drop Course

The Design 4 Every Drop course was adapted from its pilot version, Design 4 Everyone. The course was created by Extension specialists with years of experience and compiled data. At the time, the course filled a void in the agricultural and gardening course offerings. While Extension offers a wide variety of courses in all kinds of agricultural topics, including native and drought tolerant plants, soil and lawn care, pest management, vegetable gardening, flower gardening, urban farming, and even backyard chicken care, the only topic that compared to Design 4 Every Drop was How to Have a Water-Efficient Landscape, an intro course covering "a wealth of water conservation topics including water sources, landscape irrigation, plant materials, soils, and more" (How to Have a Water-Efficient Landscape – USU Extension Online Courses, n.d.). Although the pre-existing course offered to educate the homeowner on water-saving strategies, it did not teach design. Design 4 Every Drop was developed to fill this void by

applying water-wise strategies and information to landscape design principles. In the Design 4 Every Drop course, the design process is taught as follows:

Site Inventory and Analysis

Step One of the design process is the creation of a site inventory and analysis by collecting information about what currently exists on site. This step includes creating a 2D base map of the site to document information spatially. The base map then becomes the foundational graphic for the rest of the design process. It provides a framework of opportunity for future landscape programs, despite any immediate design interventions or opinions. This map is an unbiased collection of site characteristics and site dynamics. Factors such as wind, sun, shade, ice, moisture, soil, topography, noise, privacy, and smell are all documented and recorded spatially on a base map. Water use is also recorded in the workbook by collecting information from the controller. Any initial first impressions are recorded, studied, and recorded on the base map. Course participants learn strategies for taking accurate measurements of their site. Google Earth images are also introduced as a helpful way to acquire site measurements and feature locations.

Establishing Vision and Goals

Once the site parameters and information are collected, site inputs are received and reviewed through the lens of the participant's unique vision and goals. This is accomplished through the development of a vision statement in Step Two. In crafting a vision statement, the following questions must be answered and recorded in order to ensure that the design process remains true to the overarching role and purpose of the landscape: "What do you want to do in this space? What do you want this space to accomplish? How do you plan to use the space?

Developing a Design Program

In Step Three, a collection of precedent images and inspirational images are collected, followed by preparation of a prioritized list of desired programs or landscape elements . This

includes any desired site features, activity uses, or other uses intended for the landscape area. Examples of such elements include fire pits, pergolas, patios, BBQ's, pools, spas, play areas, and gardens.. The number of people expected to carry out these activities at any time is also considered, in order to ensure that each feature will be successful and functional.

Functional Diagrams

Step Four hones in on functionality. Designers identify desired elements for their landscape, and then organize these elements based on their compatibility and uses. This is accomplished through the use of the matrix, which allows both designer and client to leave behind bias and/or preconceived notions in order to view the landscape objectively . To create a functional diagram, information is then arranged spatially. Landscape elements or uses are represented by simple shapes, bubbles, arrows, labels, and hatching. Functional diagrams are meant to be an exploratory process, in that multiple renditions can be created quickly, allowing the designer and client to visualize an effective functional arrangement of the landscape elements.

Concept Plan

In Step Five, the functional diagram is manipulated into the concept plan. Because the concept plan is a visually simple design, when informed by the functional diagram, the landscape elements develop a more defined location and form, though they retain the same relationships as discovered in the functional diagram.

There are six primary form compositions: curvilinear, rectilinear, angular, diagonal, circular, and radial. Each form includes a series of rules and parameters that, if kept, keep the design style and aesthetics intentional. Landscape form compositions can be combined and manipulated to create more dynamic spaces, but this will not be discussed in this study. For the purposes of this study, the core form compositions are sufficient to generate a high-quality design. Through the formation of a concept plan, the designer is able to input some water-saving measures, such as collected lawn areas, hydrozones, planting bed sizes, and locations.

Schematic Plan

Once the desired concept plan is selected, it becomes more refined into a schematic plan. The schematic plan allows opportunities to interject designer style and homeowner preference. In the instance of this course, the schematic plan becomes a refined design that is backed by both logic and creativity.

Planting Plan

The final step, the planting plan, is built upon the schematic plan. The schematic plan is populated with generic plant symbols that hold little information but may have specific desired plant characteristics, such as size, texture, color, smell, water needs, etc. Thus, in the planting plan stage of the design process, specific plants are selected.

This course encourages students to identify acceptable plant traits before searching for plants with those traits or an acceptable number of them. Often a specific plant may be specified from an internet search but is not readily available. Rather than discouraging the designer/client, potential substitutes are welcomed. This keeps the planting design flexible, depending upon plant availability. As the client prepares for installation, other water saving measures may be possible through proper mulch depths, grading, drainage, and irrigation applications.

CHAPTER 3: RESEARCH METHODS

This research project was broken into five phases and completed on the following timeline:

Phase 1: Observe and Analyze the Current Course (December 2022 to May 2023)

In this phase, I observed and analyzed the current Design 4 Every Drop landscape workshop. I was given access to the course material through Canvas and thoroughly reviewed the existing content. I attended two in-person workshops and took notes on the curriculum, materials, and teaching methods. I observed classroom settings, general teaching practices, course presentation material, schedule, and participant work/ projects. The goal of this phase was to gain a better understanding of the current workshop and identify potential areas of improvement.

Phase 2: Assess Participant Feedback and Identify Trends and Possible Adjustments (February 2023 to July 2023)

In this phase, I gathered previously provided feedback from the Design 4 Every Drop participant to evaluate the participants' assessment of the effectiveness of the workshop. I used this feedback to identify participants' improvement in knowledge and attitudes by analyzing participants' pre- and post-course knowledge, as derived from course surveys. I also assessed participants' intentions to implement the water-wise landscape design strategies discussed during the course. Finally, I analyzed participant feedback to identify trends and patterns that identified possible adjustments to the workshop.

Phase 3: Research Other Landscape Design Workshops to Identify Best Practices (June to August 2023)

In this phase, I researched other landscape design workshops with the goal of identifying best practices. I searched for workshops similar in topic, audience, and teaching platform to the Design 4 Every Drop workshop (i.e., hybrid/ online/ in-person). I then analyzed the curriculum, materials, and teaching methods of these workshops to identify course strengths. Best practices were identified based on popular courses/number of participants, course length, course format,

cost, and content. The goal of this phase was to create an updated workshop that is more effective in teaching participants about water-wise landscape design techniques.

Phase 4: Update the Existing Design 4 Every Drop Course (August 2023-December 2023)

In this phase, I utilized the synthesized and organized participant feedback and best practices gleaned from similar landscape design courses to inform adjustments to the existing Design 4 Every Drop course. In so doing, I developed improved graphics, evaluation tools, and presentations to align with my newly updated curriculum. The goal of this phase was to ensure that the updated workshop would be effective in teaching participants about water-wise landscape design techniques. The updated workshop content was then published into a new version of the course.

Phase 5: Publish and Present the Results (December 2023)

In this phase, I published the results of my findings to the Landscape Architecture Department and Utah State University. This gave me the chance to share my findings with a community of landscape designers and educators via a published thesis.

CHAPTER 4: RESULTS

Course Feedback

Course feedback was collected via a pre- and post-survey. The pre-survey was provided to all participants through a required quiz embedded in the online course. Paper post-course surveys were provided to each participant at the end of the in-person course. Though the survey was anonymous, the last four digits of each participant's phone number were used to connect the results of the pre- and post-surveys. Sixty-five pre-surveys were completed, and 41 post-surveys were completed. Fewer post-surveys were completed, as 24 participants registered for the course and started the online portion of the course, but either did not attend or did not stay for the duration of the in-person course. Additionally, 13 of the phone numbers did not correlate with the post-surveys. This information was recorded, but it could not be used to compare pre-and post surveys. The number of participants' feedback is not enough to be statistically significant; however, it does represent the feedback of the 2023 course participants. Course feedback information was organized per question through a spreadsheet, thereby making the information available for analysis.

Workshop Location

The workshop was held in five different locations around the state: 13 survey participants attended the workshop in Murray, UT; 12 in Logan, UT; 4 in Vernal, UT; 4 in Hurricane, UT; and 8 in Bluff, UT (Figure 4.0).

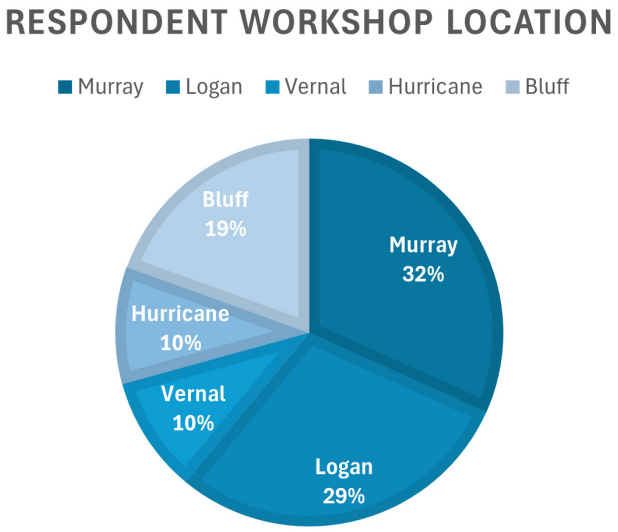


Figure 4.0 Respondent workshop location

Pre-Survey

The pre-survey asked participants "How would you rate your CURRENT KNOWLEDGE on the following topics?" This question identifies each participant's current knowledge, as related to water-wise landscape design. Topics are listed below:

- The need for landscape water conservation in Utah
- Conducting a site inventory of my property
- Establishing landscape design goals for my property
- Assessing the functionality of my landscape
- Creating multiple landscape design alternatives
- Selecting plants to include in a landscape design
- The principles and elements of design
- Utilizing hydrozones
- On-site water harvesting
- Using landform to facilitate water movement
- Water-efficient irrigation strategies
- Using hydrozones on my property
- Using a smart irrigation controller
- Water-efficient irrigation strategies

To identify what participants were already implementing prior to the course, the survey asked the following questions: "To what degree are you CURRENTLY DOING any of the following?" Topics are listed below:

- Using hydrozones on my property
- Using a smart irrigation controller
- Using mulch to retain soil moisture in my landscape.
- Evaluating my landscape for non-functional turf
- Eliminating non-functional turf

- Harvesting rainwater
- Using water-wise plant varieties
- Using a water budget for my landscape
- Using climate data to adjust my irrigation schedule.

Other supplemental questions were included to help gauge the needs of the course participants. The questions are listed below:

- How much of your landscape is currently irrigated by drip irrigation?
- Do you currently have a landscape design for your property?
- What barriers or limitations currently prevent you from a landscape design for your property?
- Please let us know why you are taking this workshop.
- Please let us know what you would like to learn or accomplish through this workshop.

Post-Survey

The post-survey asked 11 questions with the purpose of evaluating each participant's understanding of course topics and overall experience. The questions were provided to the students directly after the course. This information is helpful in evaluating whether or not participants' expectations were met. The 11 survey questions asked participants to answer on a scale from 1 to 5. Each question then listed a series of related topics to guide the participant's feedback and rate their experience. The questions are listed below:

How would you rate your current (post workshop) knowledge of the following topics? (1=Very Low, 2=Low, 3=Average, 4=High, 5=Very High)

- The need for landscape water conservation in Utah
- Conducting a site inventory of my property
- Establishing landscape design goals for my property
- Assessing the functionality of my landscape
- Creating multiple landscape design alternatives
- Selecting plants to include in a landscape design

- The principles and elements of design
- Utilizing hydrozones
- On-site water harvesting
- Using landform to facilitate water movement
- Water-efficient irrigation strategies

As a result of this workshop, to what degree do you intend to do any of the following on your landscape? (1=No, and I have not considered it, 2=No, but I have considered it, 3=Yes, somewhat, 4=Yes, extensively)

- Use hydrozones on my property
- Use a smart irrigation controller
- Use mulch to retain soil moisture in my landscape
- Evaluate my landscape for non-functional turf
- Eliminate non-functional turf
- Harvest rainwater
- Use water-wise plant varieties
- Use a water budget for my landscape
- Use climate data to adjust my irrigation controller

How satisfied are you with the landscape design you developed in this workshop for your property? (1= Very Dissatisfied, 2= Dissatisfied, 3= Neutral, 4=Satisfied, 5=Satisfied.

Instruction: Please indicate to what degree you agree with the statements below (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

Instructor A

- The instructor was well-prepared for class
- The instructor presented the subject matter clearly

Instructor B

- The instructor was well-prepared for class
- The instructor presented the subject matter clearly

To what degree did this workshop address (or not address) the barriers or limitations currently preventing you from a landscape design for your property? (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

- Cost for a landscape design
- Lack of experience with landscape design
- Lack of confidence in my creativity
- Lack of information about landscape design
- Lack of time to develop a landscape design.

Help us understand if/how the workshop met your expectations. (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

- This workshop met my expectations.
- I would recommend this workshop to others.
- This workshop was worth its cost to me.
- Registration for this workshop was easy for me.
- Location of this workshop was convenient for me.
- Meeting date(s) for the workshop were convenient for me.
- The length of the workshop worked well for me.
- The workshop covered the content it stated it would.

What was the most important thing you learned from this workshop?

What from this workshop do you intend to implement in the next 1-6 months?

What did you like the most about this workshop?

What did you like the least about this workshop?

How could this workshop be further improved?

Survey Results

Participant Demographics

Course participants' demographics were recorded to better understand the population participating in the course. Gender, race, and age information was requested anonymously but identified by the last four digits of a participant's phone number.

Gender: Among the 65 participants of the pre-survey, 43 (66%) were female, 20 (31%) were male, and 2 (3%) preferred not to say (Figure 4.1).

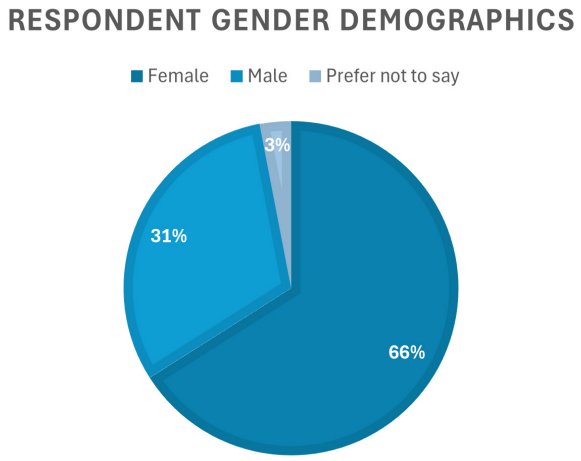


Figure 4.1 Respondent demographics - gender

Race: Among the 65 participants of the pre-survey, 60 (92%) of the participants identified as "White or Caucasian," 1 (1.54%) identified as Asian, 2 (3.08%) identified as a race/ethnicity that was not listed, and 2 (3.08%) preferred not to say (Figure 4.2).

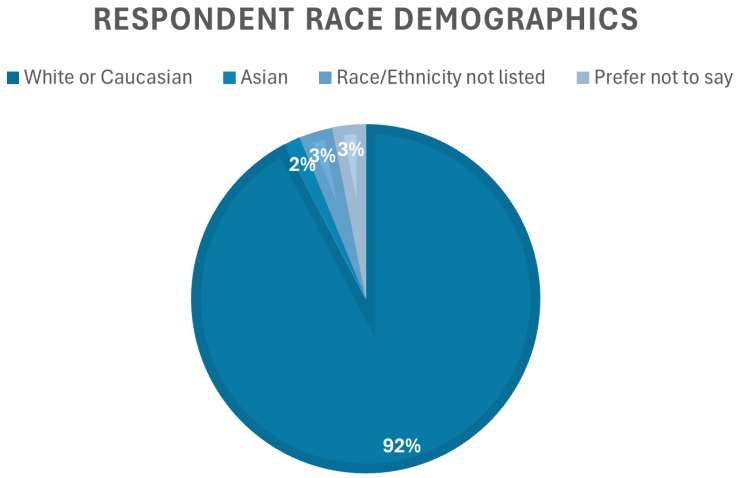


Figure 4.2 Respondent demographics - race

Age: The average participant age range was 45-64 years old. A detailed breakdown showed that 10 (16.39%) were aged between 25-34, 6 (9.23%) were aged between 35-44, 9 (13.85%) were aged between 45-54, 17 (26.15%) were aged between 55-64, 18 (27.69%) were aged between 65-74, and 3 (4.62%) were aged 75 or older (Figure 4.3).

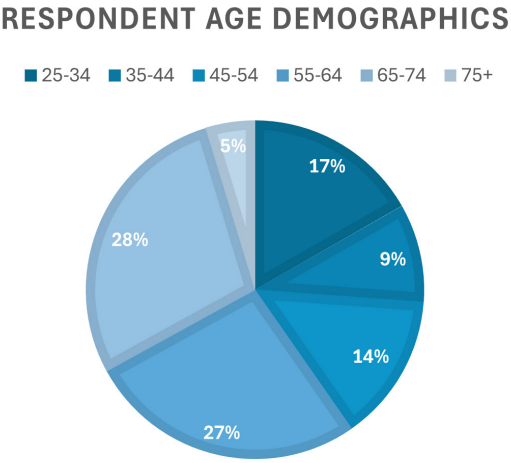


Figure 4.3 Respondent demographics - age

Pre-Survey and Post Survey Comparison

The pre-workshop survey asked: "How would you rate your CURRENT KNOWLEDGE on the following topics?" while the post survey followed up with: "How would you rate your current (post workshop) knowledge on the following topics?"

Most of the course participants already possessed knowledge or understanding of the need to implement water-wise landscapes in Utah: 30.8% scored high and 15.3% scored very high, with an overall average knowledge rating of 3.4 out of 5 (Figure 4.4). After the workshop, student knowledge of the provided topics increased an average of 2.2 points, or 110%. As a

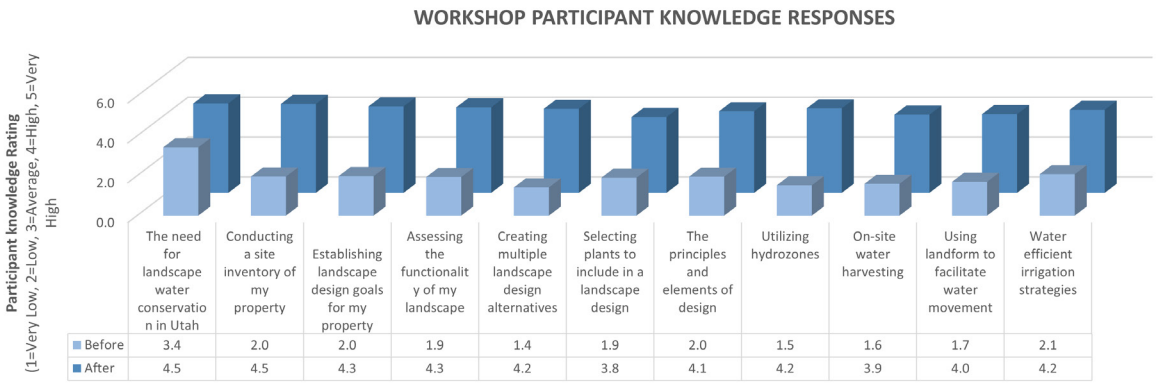
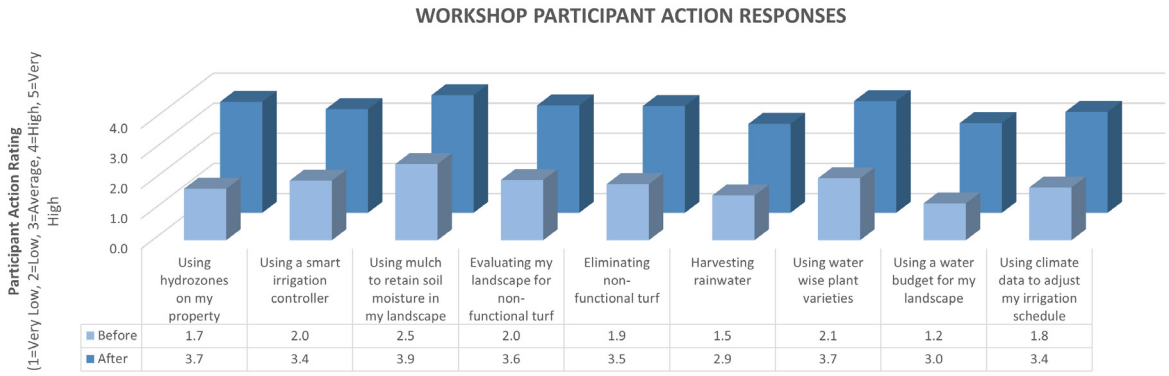


Figure 4.4 Respondent knowledge comparison

whole, pre-workshop average knowledge ratings grew from 2.0 points to 4.2 points in the post-workshop knowledge ratings.

Overall Course Satisfaction

Workshop participants felt that the course was all-around effective in promoting the topics provided. Figure 4.5 shows what participants were doing before taking the workshop, and what they intended to do afterwards. The average rating of participants' knowledge pre-workshop is 1.8 points, with an average increase of 1.7 points, making the post-workshop rating 3.5 points, or a 94% increase.



	Using hydrozones on my property	Using a smart irrigation controller	Using mulch to retain soil moisture in my landscape	Evaluating my landscape for non-functional turf	Eliminating non-functional turf	Harvesting rainwater	Using water wise plant varieties	Using a water budget for my landscape	Using climate data to adjust my irrigation schedule
Before	1.7	2.0	2.5	2.0	1.9	1.5	2.1	1.2	1.8
After	3.7	3.4	3.9	3.6	3.5	2.9	3.7	3.0	3.4

Figure 4.5 Respondent actions comparison

Landscape Design

The pre-survey shows that 61.02% of the participants did not have a design for their yard prior to participating in the workshop. The remaining 38.98% did have a design (Figure 4.6).

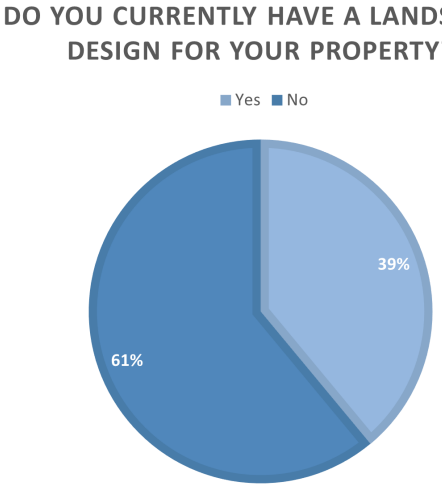


Figure 4.6 Design inquiry

These results may represent those who own an existing landscape but wish to modify it or add to it. The survey results do not report what participants with a design are seeking to accomplish. It is assumed they would like to make some type of adjustment or upgrade. That being said, the course is accessible with or without a design.

The pre-survey also shows that 64% of the participants used drip irrigation for a small amount (25%) of their existing yard, while 16% used drip irrigation for 50% or more of their landscape. (Figure 4.7). This is typical for the current Utah yard landscape typology. As mentioned prior, drip is more efficient and tends to use less water than a spray or rotor on the lawn. These figures suggest that the majority of participants' yards are dominated by lawn.

When it comes to program satisfaction, 60.98% of the participants were satisfied with their landscape plan following the workshop, 31.71% were very satisfied with their design, and 7.32% were neutral with their design (Figure 4.8).

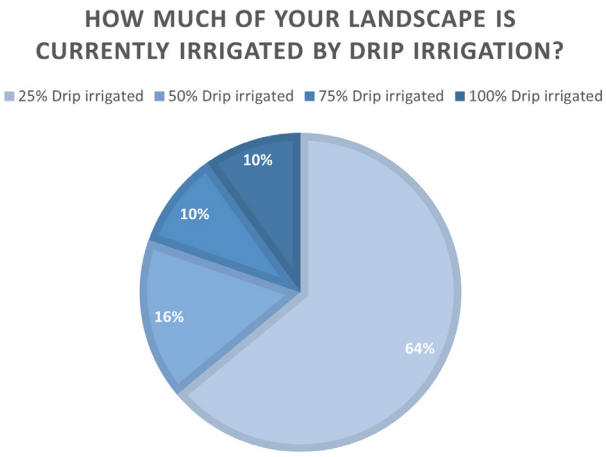


Figure 4.7 Respondent current drip irrigation

Figure 4.8 Post-workshop design satisfaction

One participant who reported neutral suggested, *"Maybe address people with existing landscapes to help them work through the processes in a little different way - like identify an area for tweaking, changing, or enhancing, and focus on that or something like that."* Another wrote, *"I would have liked to concentrate more on designing xeriscape: Specific plant (too many to choose) Design patterns (inexperienced)"*. A third mentioned that there was *"[T]oo little time to fully explore options and then redo."*

Course Expectations

The following graph (and similar graphs to follow) are populated with the survey results, but are categorized using "tags," since the questions prompted a written response. All responses to this question could be categorized into one of the following categories: Design, Conserve Water, Install (to install or build something in the yard), Maintenance, and Plants. Each time one of these topics was mentioned in a response, the response was given one of the tags. If one response mentioned multiple topics, that response would generate multiple tags.

Of the workshop participants, 90.3% came to the course with the expectation of learning first about landscape design, followed by water conservation. In other categories, 27.4% of respondents were interested in learning about installation techniques, 4.8% hoped to learn maintenance techniques, and 4.8% were interested in plant selection (Figure 4.9). Why participants took the course and what they wanted to learn followed a similar trend. See the following responses as a sample of participants' expectations: *"We just purchased a new home and want a design that conserves water, makes sense, and looks good."*

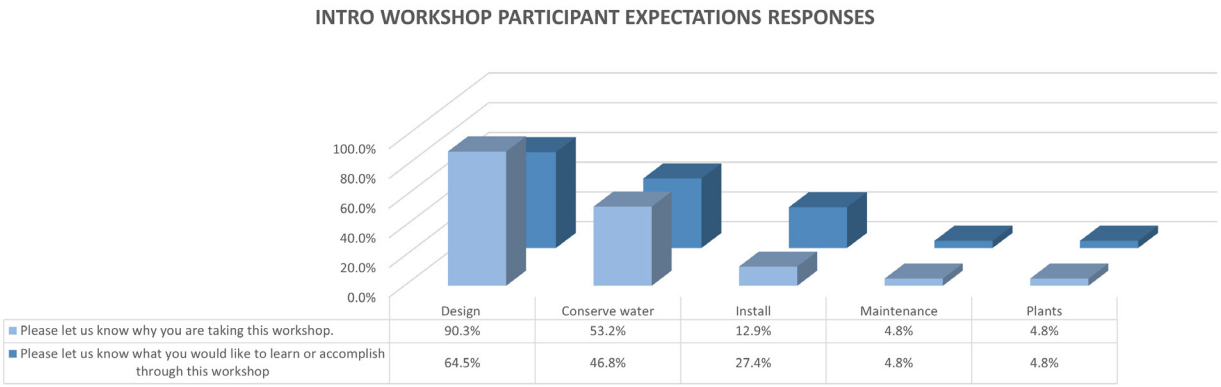


Figure 4.9 Pre-workshop expectations

"I have a large urban property on a hill that had dying trees on it when I bought the property. I want a peaceful, easy to maintain water-wise landscape that welcomes me home."

"We have a new home and need to install a landscape, beginning this spring and summer. We want to incorporate water-wise principles and practices. We want to make the landscape easy to maintain and meet the vision and goals we have for the outdoor spaces around

our home. We want to install our landscape intentionally."

"I have a half-acre lot on a corner and too much of the front yard is lawn. I want to remove about 1/2 of the existing lawn. I want to explore options."

"I would like to know which plants thrive in our environment, how to compose a visually appealing landscape, and when/how to water efficiently."

"Design, plant varieties, flow of yard, and we want it water-wise that looks great."

Overall, the workshop met expectations, and the participants who completed the course were satisfied with their experience. Most participants provided a high rating for the course, so much so, that the response "This workshop met my expectations" received the lowest rating (4.49 out of 5), only 0.16 pts. lower than the highest rating. All 65 participants of the course felt it was successful in meeting expectations (Figure 4.10). Considering the schedule, location, topic, and format, the course was a success.

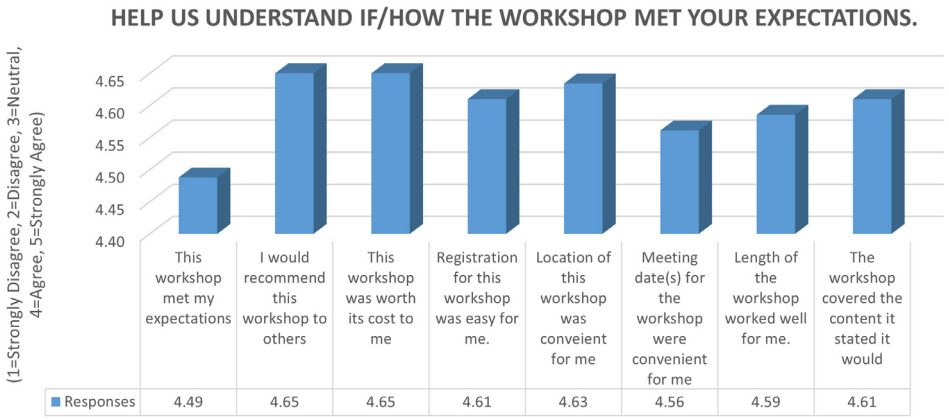


Figure 4.10 Post-workshop expectations

Instructors

Instructors are fundamental to any course. In the Design 4 Every Drop course, instructors provide lectures and facilitate online learning. Though online learning is self-paced and self-taught, participants can reach out to the instructors while participating in the online portion. Many responses referred to the value provided by the instructors through instruction and one-on-one feedback (Figure 4.11).

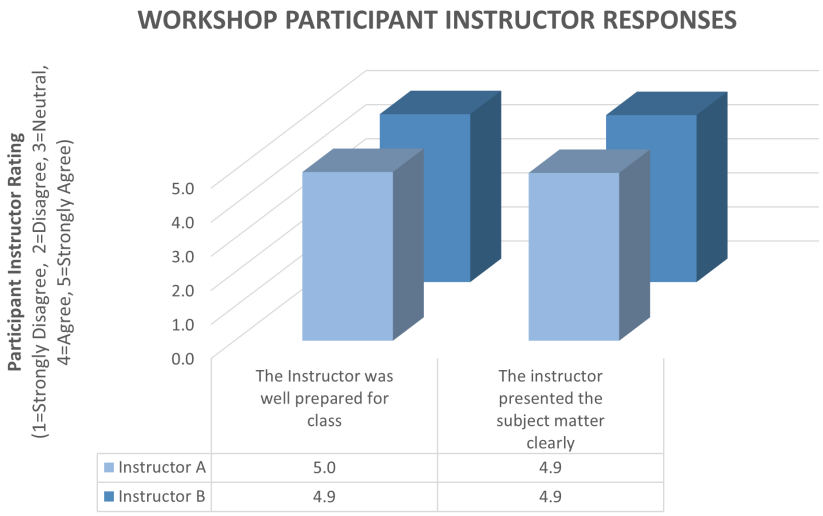


Figure 4.11 Course instructor rating

Participants gave instructors an average score of 4.9 out of 5. This rating was based on the instructors' preparedness and clarity teaching the subject. In addition, some comments in response to "What did you like the most about this workshop?" refer to the instructors:

"Knowledge and personality of instructors."

"Instruction between two instructors. Instructor sense of humor, the presentations were excellent."

"Hands-on - before and during, going through the steps one at a time, watching instructors design, having instructors or others critique my design."

Instructors for this course were Utah State University Extension faculty and Utah State University Landscape Architecture faculty.

Course Outcomes

In response to the question, "What was the most important thing you learned from the workshop?" participants responded that design (75.6%) and irrigation (29.3%) were the most important topics covered (Figure 4.12). Participants wrote:

"Forms. I am a master gardener, and I did Localscapes, but I didn't know how to make my landscape look cohesive. The concept of forms made that possible for me."

"Principles of design, creating outside rooms, using water-wise plants and irrigation."

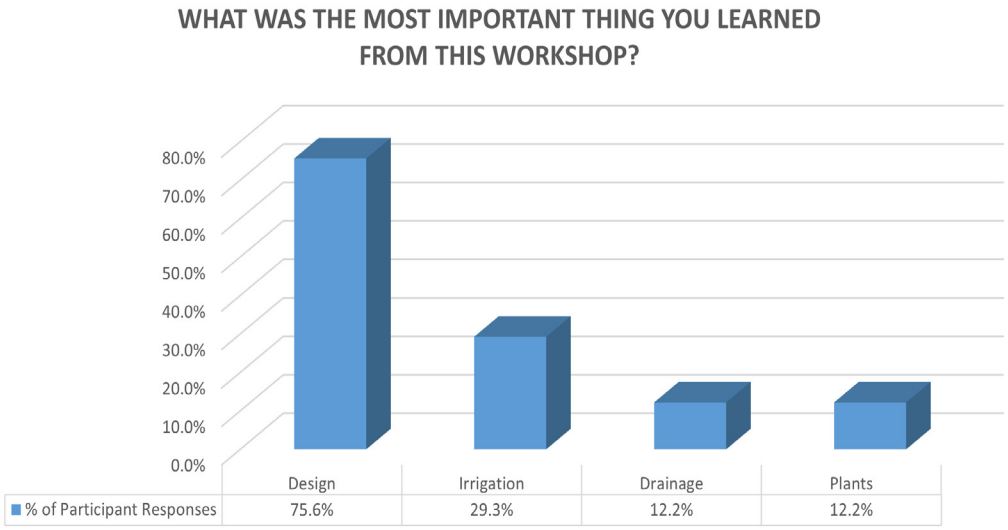


Figure 4.12 Workshop important takeaway

Eight of the 12 responses to irrigation questions specifically mentioned hydrozoning. Twelve percent of responses valued the principle of drainage with the intention of catching water in basins. One response reads: *"Prepping the landscape for planting and making dishes so you can get water to stay in specific places."* Twelve percent also referred to the value of water-wise plant suggestions and direction for plantings. One participant wrote: *"I began to look at my yard/ landscape in a new way - maybe a more unified way. I have lots of existing landscape, but I got some new design ideas, planting ideas, and irrigation ideas."*

Participants anticipated barriers and limitations prior to taking the course. Survey respondents expressed that the course was helpful in removing some of these barriers. However, when asked about the course's ability to remove barriers, participants gave the lowest rating to cost for a landscape design (Figure 4.13). This topic received a 3.4 average rating.

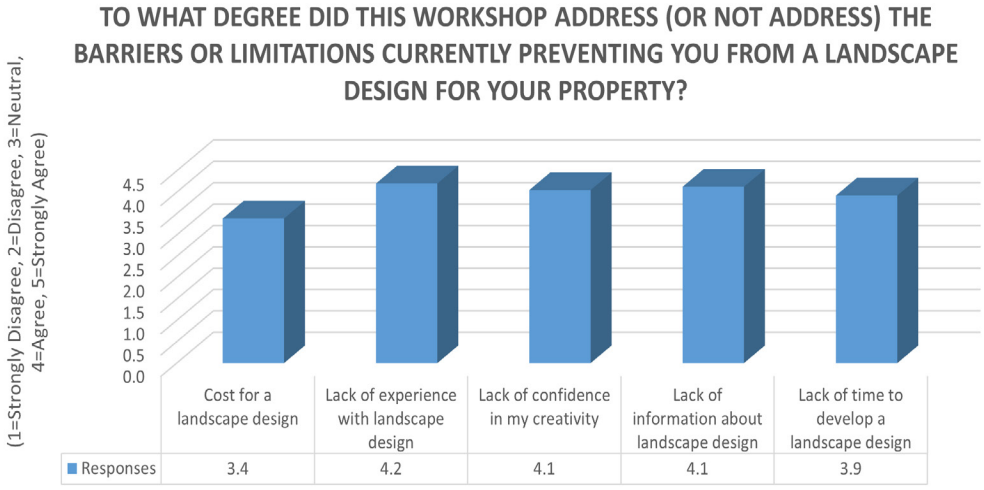


Figure 4.13 Address barriers or limitations

The course costs $150 for participants, and an average landscape design for a simple residence can cost anywhere from $500-$2000, depending on complexity and deliverables. The course averaged a rating of 3.94 for all the other topics. The pre-survey did not collect pre-course information regarding which barriers were preventing landscape design prior to the course. This information would be helpful to evaluate the success of the course in removing barriers.

Participants were asked what intentions they have, over the next 6 months, with regards to implementing information and landscape designs after completion of the workshop. Using "tags," 37% of the respondents responded All, meaning they intend to implement all the items/ design elements created from the workshop.

Thirty-four percent reported that they would adjust their irrigation systems to save water. One participant planned to do so by "hopefully converting side yard to mulch and a drip irrigation planting flowerbed." Seventeen percent wanted to continue refining their design and ultimately design other portions of their yard.

Twelve percent wanted to implement some form of regrading, with the intent of intentionally directing and slowing the movement of water. One participant plans to implement this by *"Definitely grading and creating dishes for planting in certain areas of my landscape."* Twelve percent of participants intend to update plantings to more climate adaptive plants. Twelve percent also want to implement some form of edible garden or orchard into their landscape. Seven percent plan to start by converting the lawn park strip to a planting bed. Another 17% plan to start with a small area, such as a side yard or corner of the landscape. This was typically the case for participants with existing landscapes. Seven percent sought to implement a site feature, which refers to any type of structure, fire pit, patio, pool, spa, etc. Seven percent also mentioned specifically reducing the amount of lawn in their current landscape (Figure 4.14). In general, each participant intended to implement something they had learned or designed during the workshop.

The format, instructors, and design development of the course made for a positive response from the participants. Figure 4.15 shows 43.9% of participants reported that the format

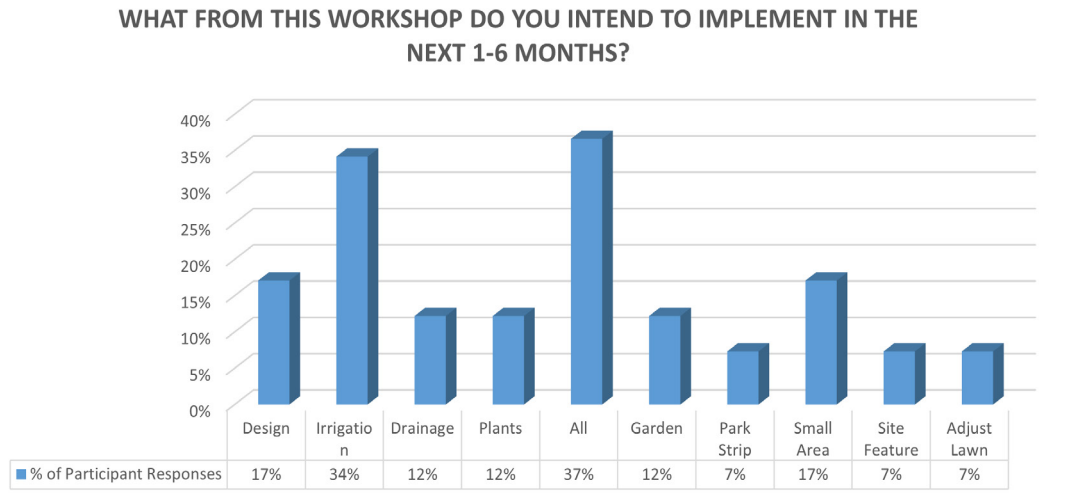


Figure 4.14 Post-workshop 1-6 month intentions

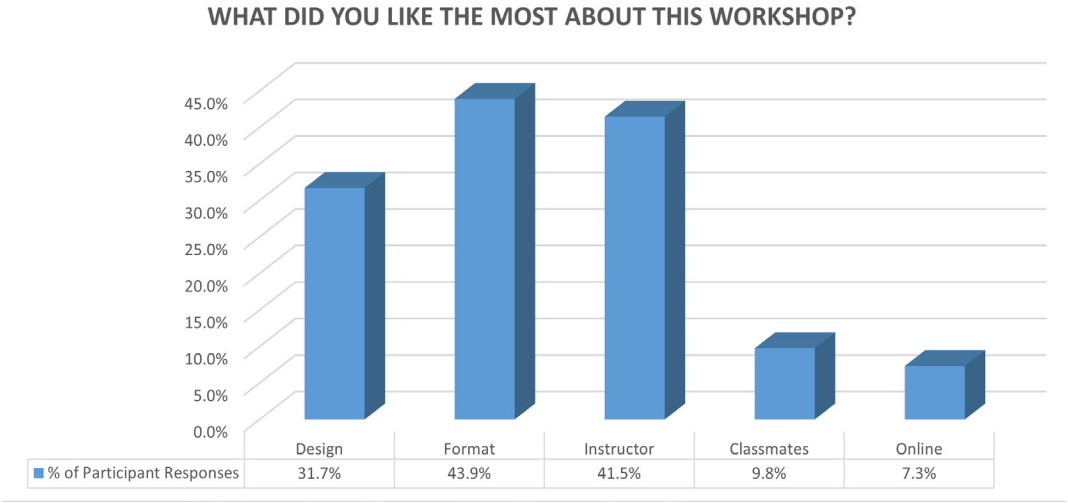


Figure 4.15 Post-workshop most-liked aspect

of the course is what they enjoyed the most, with special mention of the in-person, hands-on portion of the workshop.

Instructors were rated based on the following criteria: the instructor was well prepared for class and the instructor presented the subject matter clearly. Both instructors received high ratings. Instructor A received an average rating of 4.95, and Instructor B received an average rating of 4.9. Due to class size and time alloted, instructors were able to give each student constructive feedback and advice. Each participant received personal design help from both instructors multiple times, as the instructors would teach concepts before personally critiquing individual work. This model is often found in studio courses, as critiques are fundamental to developing designs. The Design 4 Every Drop course followed this model for the 1.5-day

workshop, which proved to be one of the most well-received aspects of the course.

Lack of time and the online portion of the course were the least-liked aspects of the course, with 36.6% of the responses mentioning time and 31.7% mentioning the other online content and format. Typical comments mentioned a dislike for the time required by the online portion and its accompanying homework (Figure 4.16).

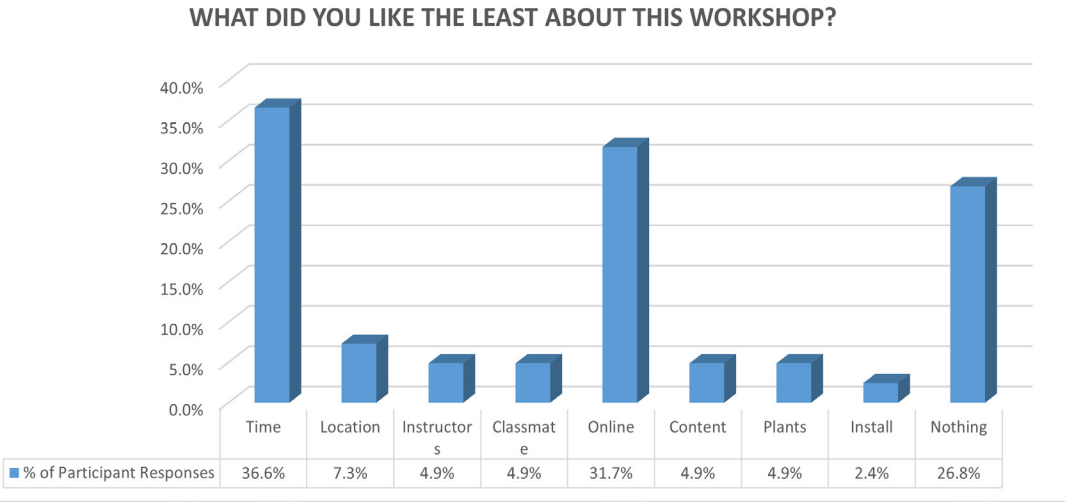


Figure 4.16 Post-workshop least-liked aspect

Respondents felt that they did not have enough time in the workshop to develop each topic, and/or that the course moved too quickly through the content. Common complaints included a desire for more time to work on various stages of design, more time with instructors, and more warning/understanding of the time commitment the online portion would take. When asked what they liked least about the course, one participant said, *"It felt pretty rushed. I wished more time would've been spent on things NOT covered in the homework. Many things felt a little redundant. I would emphasize more concrete examples of resources/principles instead of rehashing exactly what was in the homework…more time to complete the homework would be nice."* Another participant said they would have liked an *"email notification of the 10-20 hours of online work"* prior to the workshop.

A participant mentioned that they *"didn't realize how much of a time commitment the online modules and assignments would take until after signing up."* Some felt that the homework assigned through the online portion was redundant and unnecessary, but also helpful. One

participant said, *"All the homework, it is necessary, I guess. It took hours. We did not use the images of a proposed area - these pictures did get me thinking more about the spaces."* Although this participant felt that the homework was useless, they did find it helpful. Out of all the responses, 26.8% of respondents wrote that there was nothing they did not like about the course.

Course Deficiencies

Open responses providing suggestions on course improvement were summarized into the following categories: Time, Content, Nothing, Feedback, Online, and Plants. While these categories may be extremely simplified, the consensus of each was constructive and insightful (Figure 4.17).

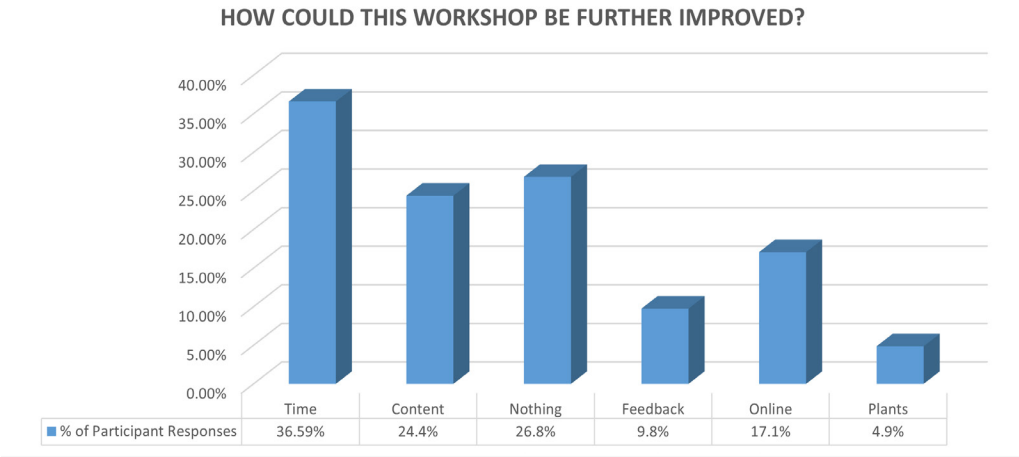


Figure 4.17 Post-workshop course improvements

Time: 36.59 % of respondents wished they had more time to work with the instructors during the workshop and more time to complete the online portion. Comments included:

"A little too rushed and would have liked one final feedback session w/instructors going over final design."

"Give more time for the homework that needs to be done before the workshop and also provide help to those of us who have no idea what we are supposed to do."

Content: 22.0% of responses mentioned multiple topics related to course content and requested more example images, project examples, and plant information, as well as less homework in the online portion. Comments included:

"I could see there being a bit more of a theoretical site plan at the beginning where everyone did the site in order to learn that process. Then we could move on to our own sites and focus."

"I think the functionality mapping and concept mapping could be merged. I wish I had more time to do concept mapping, and I think trying before coming to class would be helpful. Lots of good and bad examples of concepts and functions would be helpful."

Online: 17.1% of responses mentioned a desire for more time to work on the online portion; it seems that most of these responses came from the Murray group, which received its modules a little later than other groups. One participant wished they had another week to complete the online modules. Comments included:

"Maybe a little more time to do the pre-work (1 more week)."

"Better course description - more clearly describe time commitment and nature of assignments."

Plants: 4.9% of responses mentioned a need for adjustments to the planting information delivered. Comments included:

"Maybe spend a little more time on layering plantings."

"Spend more time on plant selection, spend more time on plant & soil science."

Though specific plants are not identified in the course, planting design is based on plant function, texture, and color. The online portion teaches about planting design and layout more than the workshop does.

Nothing: 26.8% of respondents felt that the course was satisfactory and did not require adjustment. Overall, course respondents seemed to enjoy the course and feel that it was effective in promoting and educating about water-wise landscape designs. The hybrid course model may be the greatest key to the course's success. While the online portion received some critique, in general, participants knew it was a necessary step in building a fundamental understanding of design and allowing the workshop to capitalize on its limited time frame by starting at an advanced level .

Bluff Workshop

The Bluff location workshop was executed with a different approach. Though the course content was the same, the course was delivered using a slightly different method. Bluff participants met together via Zoom four times prior to meeting in-person for the main workshop. The results and feedback from the group participating in the Bluff workshop will provide insight into the benefit of these added meetings and whether or not participants noticed a difference in course success. Other locations satisfied the online course portion but only met with instructors and classmates during the in-person workshop.

Bluff Workshop Demographics

Gender: Eight survey respondents participated in the Bluff workshop. Six of those participants responded to the demographics portion of the survey. 4 (66.66%) Female, 1 (16.66%) Male, and 1 (16.66%) preferred not to say (Figure 4.18).

Age: 2 (33.33%) aged 25-34, 3 (50%) aged 55-64, and 1 (16.66%) aged 75+ (Figure 4.19).

Race: 5 (83.33%) identified as White or Caucasian, 1 (16.66%) identified as a race not listed in the survey (Figure 4.20).

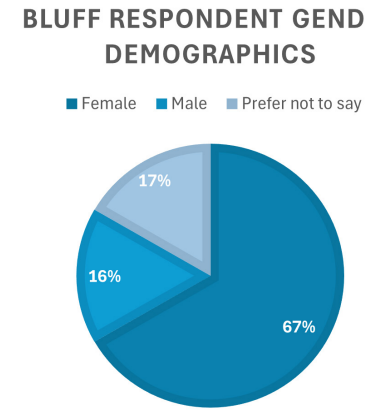


Figure 4.18 Bluff demographics - gender

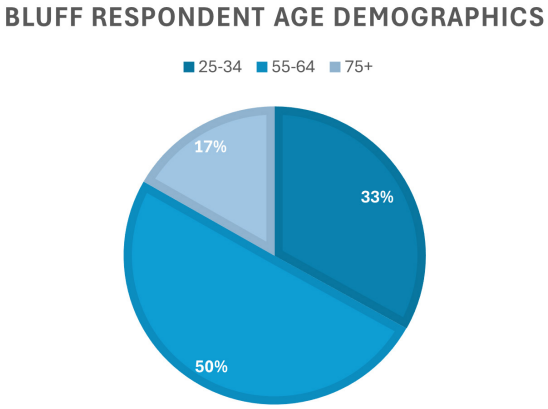


Figure 4.19 Bluff demographics - age

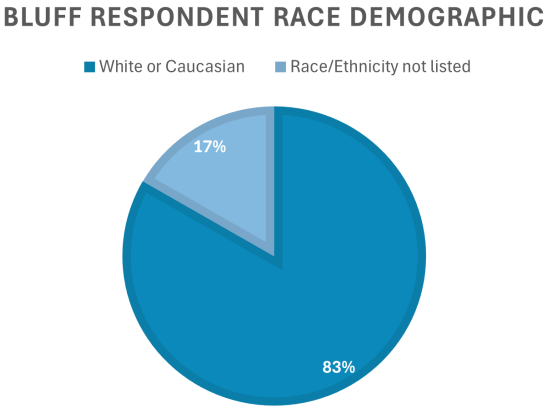


Figure 4.20 Bluff demographics - race

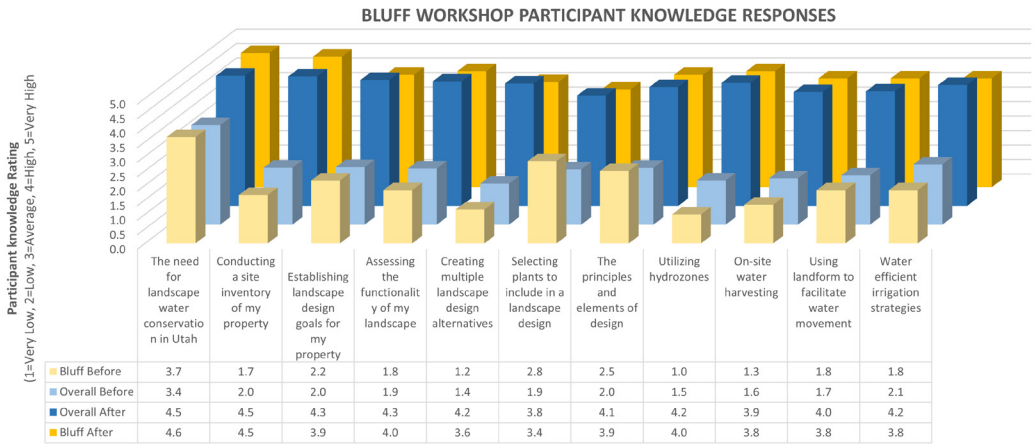
Bluff Results

The following charts and graphs were created to compare the Bluff cohort with the rest of the workshop participants. Since their experience was slightly different, these metrics may be helpful

in understanding the effect of the additional interactions.

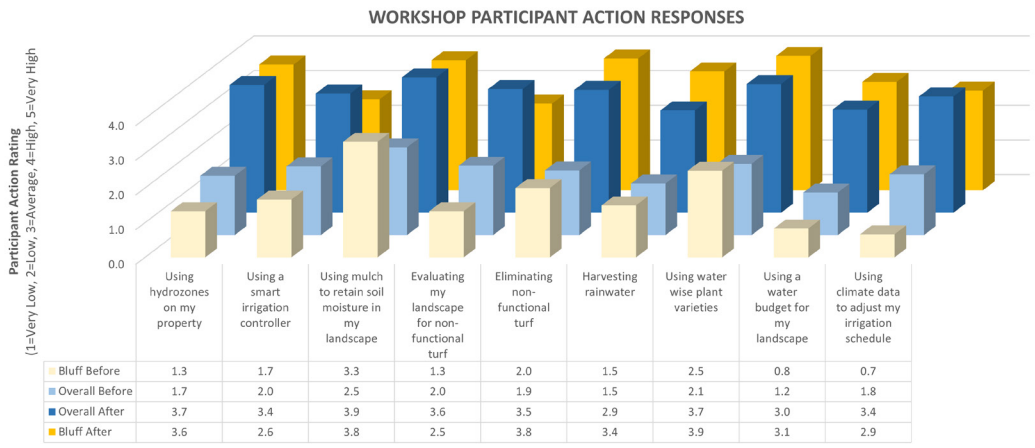
Bluff Pre-Survey and Post-Survey Comparison

Only slight differences emerge among the overall participant responses when compared to the Bluff group. Bluff respondents in the post-survey rated "Established landscape design goals for my property," -0.4 points lower than the course average post-survey responses, which was lower than the overall average. This group was also -0.6 pts lower than the overall average for "Creating multiple landscape design alternatives" and -0.4 pts lower than the overall average for "Water efficient irrigation strategies" (Figure 4.21). Like the rest of the participants, there was an increase in these areas after taking the workshop. Bluff participants did score a 0.9 points higher than the overall average in "Selecting plants to include in a landscape design.".



	The need for landscape water conservation in Utah	Conducting a site inventory of my property	Establishing landscape design goals for my property	Assessing the functionality of my landscape	Creating multiple landscape design alternatives	Selecting plants to include in a landscape design	The principles and elements of design	Utilizing hydrozones	On-site water harvesting	Using landform to facilitate water movement	Water efficient irrigation strategies
Bluff Before	3.7	1.7	2.2	1.8	1.2	2.8	2.5	1.0	1.3	1.8	1.8
Overall Before	3.4	2.0	2.0	1.9	1.4	1.9	2.0	1.5	1.6	1.7	2.1
Overall After	4.5	4.5	4.3	4.3	4.2	3.8	4.1	4.2	3.9	4.0	4.2
Bluff After	4.6	4.5	3.9	4.0	3.6	3.4	3.9	4.0	3.8	3.8	3.8

Figure 4.21 Bluff knowledge comparison



	Using hydrozones on my property	Using a smart irrigation controller	Using mulch to retain soil moisture in my landscape	Evaluating my landscape for non-functional turf	Eliminating non-functional turf	Harvesting rainwater	Using water wise plant varieties	Using a water budget for my landscape	Using climate data to adjust my irrigation schedule
Bluff Before	1.3	1.7	3.3	1.3	2.0	1.5	2.5	0.8	0.7
Overall Before	1.7	2.0	2.5	2.0	1.9	1.5	2.1	1.2	1.8
Overall After	3.7	3.4	3.9	3.6	3.5	2.9	3.7	3.0	3.4
Bluff After	3.6	2.6	3.8	2.5	3.8	3.4	3.9	3.1	2.9

Figure 4.22 Bluff action comparison

Overall, the Bluff cohort scored a lower rating for the topics provided in the chart (Figure 4.22), with the exception of "Eliminating non-functional turf" and "Using water-wise plant varieties." Bluff participants seemed more aware of "Using mulch to retain soil moisture in the landscape" prior to the workshop, as their pre-survey score for this topic was 0.8 pts higher than the other groups.

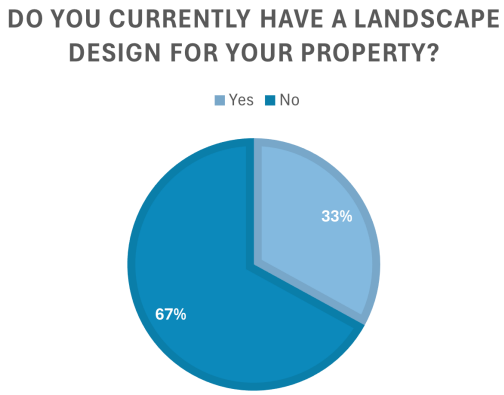


Figure 4.23 Bluff current landscape design

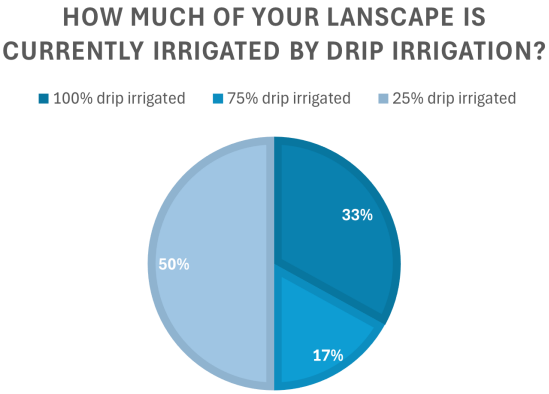


Figure 4.24 Bluff drip irrigation

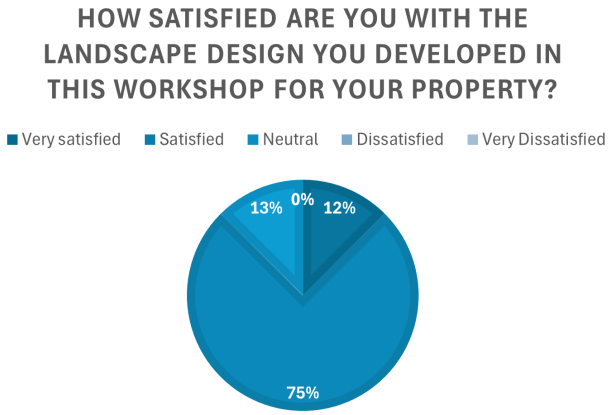


Figure 4.25 Bluff design satisfaction

Bluff Landscape Design

Out of all the Bluff participants, 67% did not have a landscape design for their yard before the workshop, while 33% did have a landscape plan (Figure 4.23). These are similar results to the other groups.

For landscape irrigation, 33% of the Bluff cohorts' landscapes were 100% drip irrigated, 17% were 75% covered with drip, and 50% were 25% irrigated with drip. As a group, the Bluff cohort has an increased percentage of lawn covered with drip irrigation in comparison to the other groups. The overall group averaged 41.5% drip coverage, while the Bluff group averaged 58.25% drip coverage (Figure 4.24).

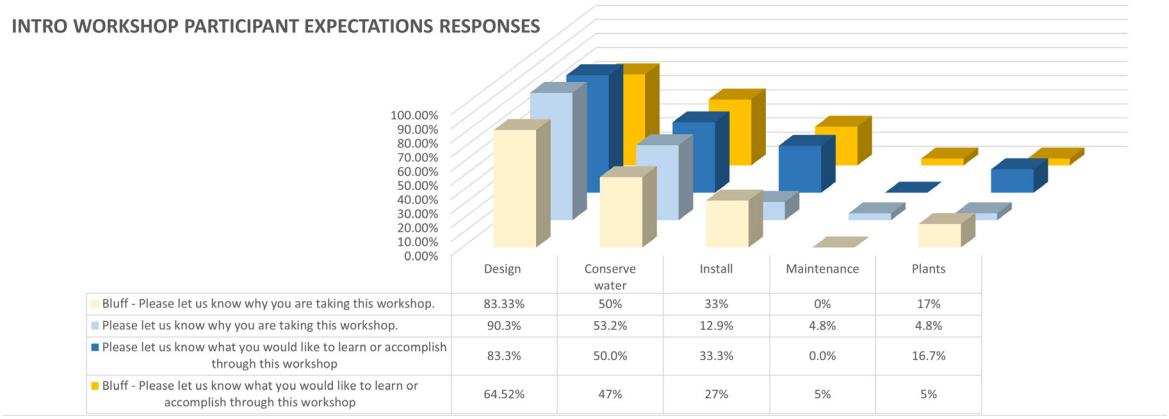
When it came to designs created in the workshop, 75% of Bluff participants were satisfied with their design, 12.5% very satisfied, and 12.5% were neutral (Figure 4.25). The one neutral respondent also expressed that they had an existing yard, commenting, *"Maybe address people with existing landscapes to help them work through the processes in a little different way - like*

identify an area for tweaking, changing, or enhancing, and focus on that or something like that."

Bluff Course Expectations

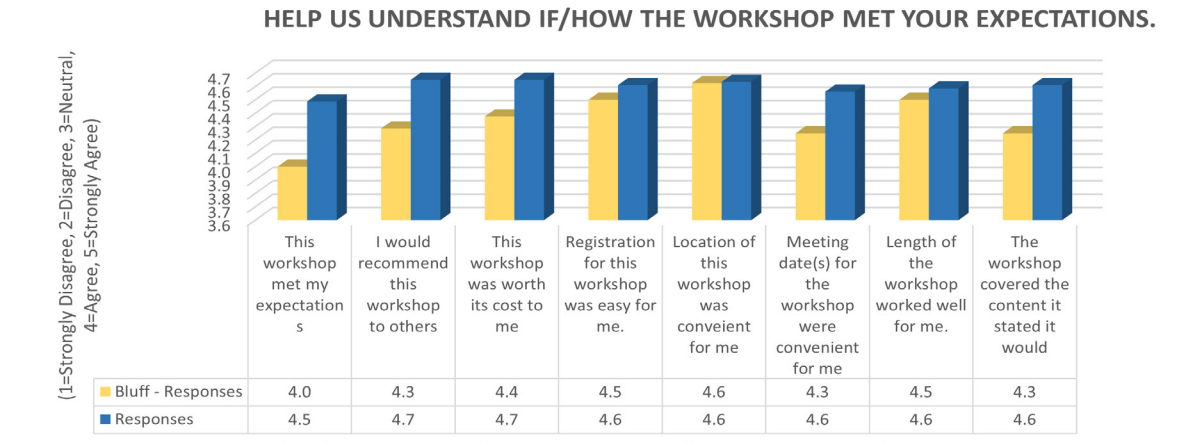
There was not a significant difference in participant expectation responses between Bluff and the other groups besides more interest from the Bluff group in taking the course to learn about installing landscape and plant material (Figure 4.26). For all groups, design remains the primary reason participants took the course, with water conservation as the second reason. In the Bluff cohort, 33% of the participants wanted to learn more about landscape installation, and 5% of responses expressed a desire to learn more about plants.

The Bluff group gave the course a lower rating than the overall course average, demonstrating that to some degree, the Bluff participants felt that the course was less effective in delivering and meeting participant expectations (Figure 4.27).



	Design	Conserve water	Install	Maintenance	Plants
Bluff - Please let us know why you are taking this workshop.	83.33%	50%	33%	0%	17%
Please let us know why you are taking this workshop.	90.3%	53.2%	12.9%	4.8%	4.8%
Please let us know what you would like to learn or accomplish through this workshop	83.3%	50.0%	33.3%	0.0%	16.7%
Bluff - Please let us know what you would like to learn or accomplish through this workshop	64.52%	47%	27%	5%	5%

Figure 4.26 Bluff expectations



	This workshop met my expectations	I would recommend this workshop to others	This workshop was worth its cost to me	Registration for this workshop was easy for me.	Location of this workshop was conveient for me	Meeting date(s) for the workshop were convenient for me	Length of the workshop worked well for me.	The workshop covered the content it stated it would
Bluff - Responses	4.0	4.3	4.4	4.5	4.6	4.3	4.5	4.3
Responses	4.5	4.7	4.7	4.6	4.6	4.6	4.6	4.6

Figure 4.27 Bluff met expectations

Bluff Instructors

The Bluff group, like the other groups, were satisfied with the instructors (Figure 4.28). Both instructors only received a 0.1 point lower rating amongst the Bluff group when compared to the rest of the participants. The Bluff group was the first group to receive the course, therefore, possibly exposing some gaps in the curriculum and workshop. The Bluff group also spent the most face-to-face interaction time with instructors, due to an additional four virtual meetings prior to the workshop.

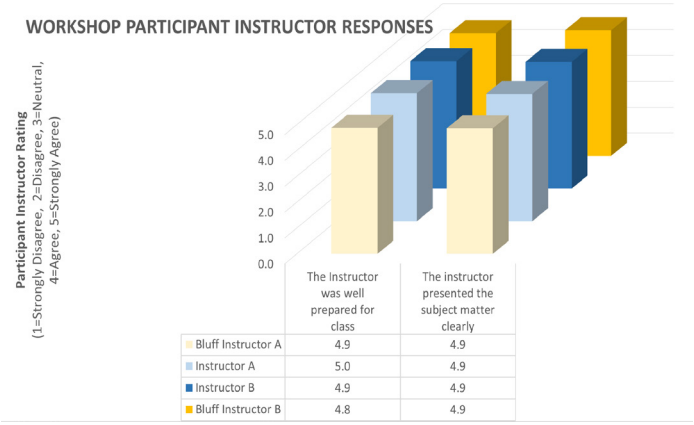


Figure 4.28 Bluff instructor rating

Course Outcomes

As discussed previously, survey data was categorized with the use of tags. Each participant's response was tagged with one or more of the following four categories: Design, Irrigation, Drainage, and Plants. The survey asked "what was the most important thing you learned in the workshop?" Between the Bluff group and total respondents, there was a 13.11% decrease in Design tags, when compared to the overall average. However, there was a 20% increase in Irrigation tags, a 12.8% increase in Drainage tags, and a 25.3% increase in Plants tags. Like the overall group, Design was still the most important topic for the Bluff participants. As design was the intent of the course, the data shows that the course was successful in delivering that information. Irrigation,

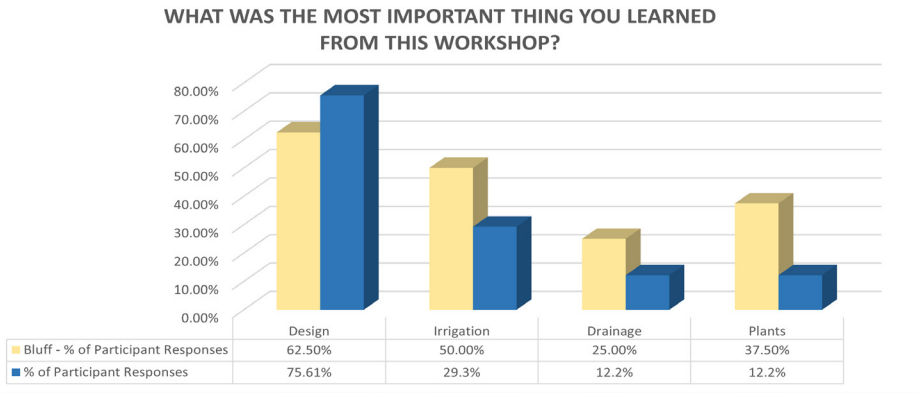


Figure 4.29 Bluff important takeaways comparison

Drainage, and Plants all received higher ratings from the Bluff group (Figure 4.29). Together, these topics make up the core of the course. This shows that participants successfully learned about the most vital parts of the program's overall goal.

In addressing the limitations of the course, the Bluff cohort suggested that the course could make improvements in removing barriers and limitations to landscape design. That being said, the Bluff group also felt that the course was 0.2 points more helpful in removing the cost of landscape design (Figure 4.30).

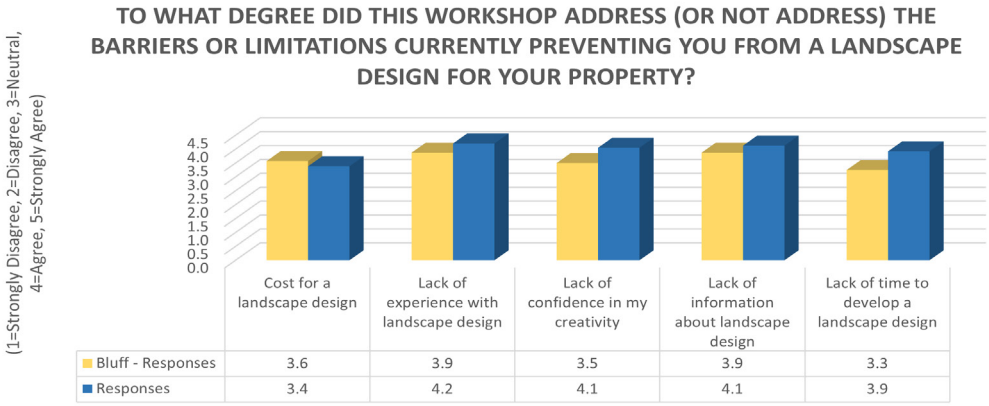


Figure 4.30 Bluff addressed barriers comparison

The Bluff group showed a strong desire to act on their designs and targeted similar areas as the whole group (Figure 4.31). The Bluff group did not mention any intentions for adjusting lawn spaces (areas of non-functional turf). Likewise, there was no mention of the park strip (lawn in the park strip is very common in Utah landscapes). The site feature, as mentioned in the survey (Figure 4.31) refers to any structure or feature the participant wishes to implement, such

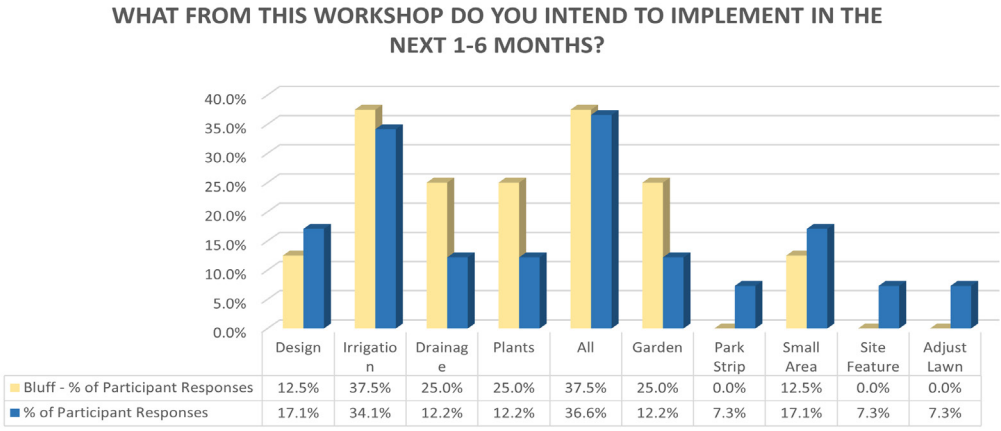


Figure 4.31 Bluff post-workshop 1-6 month intentions comparison

as a fire pit, water feature, pergola, patio, etc.

Like the other groups, design, format, and the instructor were all highly rated by the Bluff group (Figure 4.32). The instructor rating is consistent with the Bluff group's feedback about the instructors. Similarly, the Bluff group, like the other groups, expressed that the hybrid format was the most liked aspect of the course. Most of the participants mentioned that this was their favorite aspect of the course. One participant said, "The hands-on portion and doing an actual planting. Also, I really like the form studies in person, really allowed me to be fully engaged."

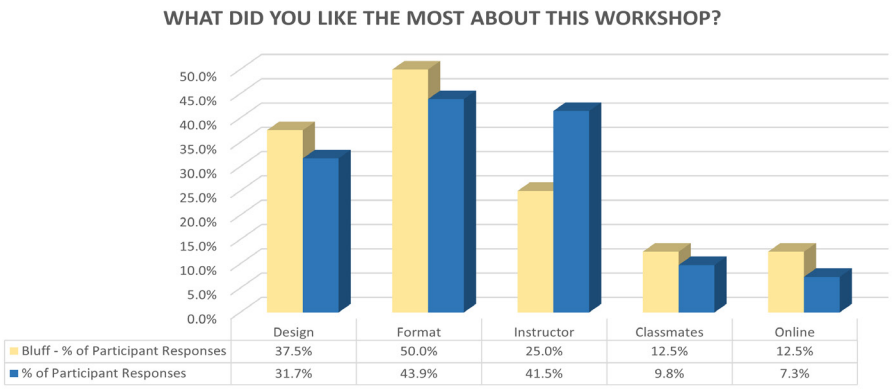


Figure 4.32 Bluff most-liked aspect comparison

Across all groups, time and online elements remain the two lowest-rated aspects of the course (Figure 4.33). Time refers to the lack of time devoted to various topics and the feeling of being rushed. Some participants mentioned that certain areas took too much time, time which could have been focused on other topics. Comments include:

"More time on plant selection for this particular location."

"I was frustrated by the online portion and all the technical design aspects - primarily from the standpoint of having an existing landscape and not knowing how to work on assignments within my existing landscape. I think if I had a little more understanding of how I

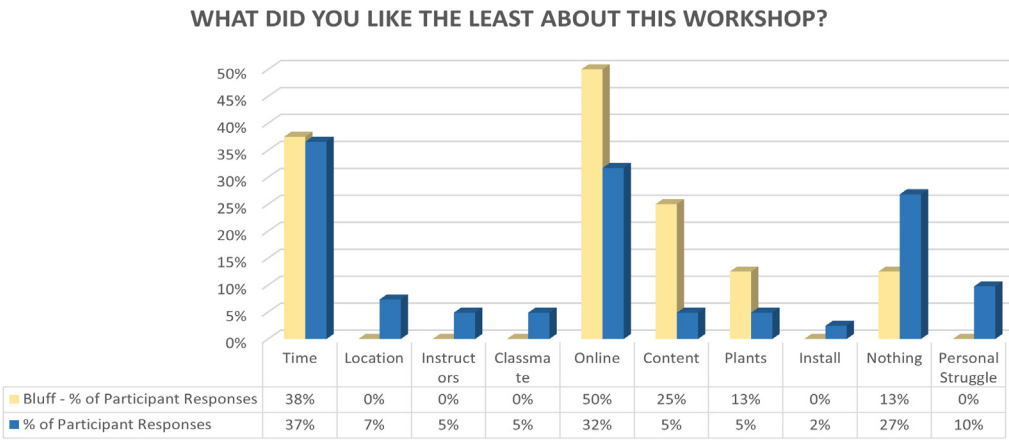


Figure 4.33 Bluff least-liked aspect comparison

could work within the framework, I could have jumped in with more comfort."

Finally, all groups expressed that they ran into technical difficulties while accessing the online material, which also led to frustration with the online portion of the course.

Bluff Course Deficiencies

Consistent with the rest of the groups, Time, Online, Content and Plants remain the top areas needing improvement for the Bluff group (Figure 4.34). Comments include:

"More time in the classroom"

"Spend two hours on plants - native, invasive, easy, drought-resistant. I really need to be educated in this area. More time on hydrozones and determining how much water plants need. What to look for??"

"I could see there being a bit more of a theoretical site plan at the beginning, where everyone did the site in order to learn that process. Then we could move on to our own sites and focus."

Overall, the information from the Bluff group proved consistent with responses from the other groups. Some variations in responses are helpful in testing the value of the Bluff group's' experience. Because the Bluff group met four times virtually prior to the in-person workshop, a comparison between the Bluff group and the overall group highlights the impact of these meetings and whether or not they added value to the course. This will be discussed further in Chapter 5.

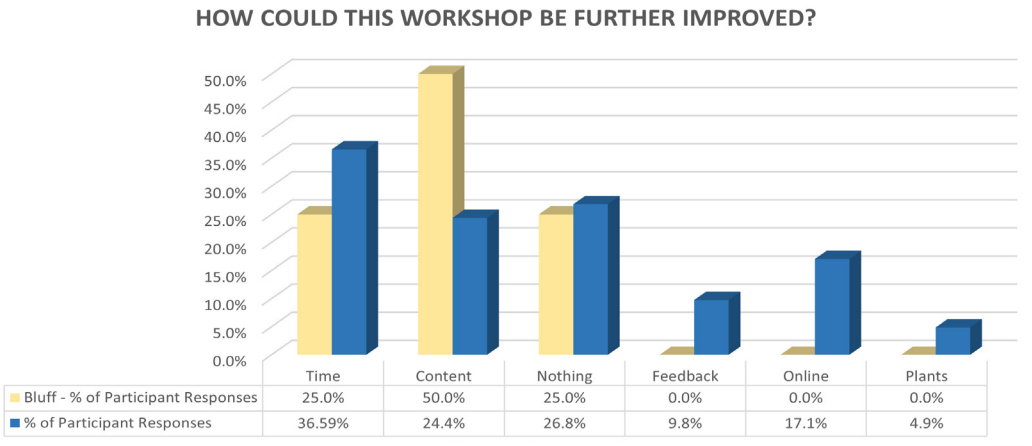


Figure 4.34 Bluff course improvement comparison

CHAPTER 5: DISCUSSION

Introduction: Purpose of Design 4 Every Drop

Throughout this chapter, the findings and implications of this research will be discussed. Data from survey responses will be used to extract participant observations and experiences. Personal observations and related course practices will be compared to evaluate the overall effectiveness of the Design for Every Drop course and workshop. The results will then be submitted and ultimately applied to the course by others, with the purpose of improving future participant use and experience.

This study set out to answer the following questions:

- How is the current Design 4 Every Drop course structured, administered, taught, and evaluated, and what are ways in which these aspects could be improved?
- What course content is available, and does it need to be updated or refined?
- How do students learn about water-wise landscape design?
- Can good landscape design save water?
- What successes are similar courses experiencing, and how can they be applied to this course?
- How do participants rate or value the current Design 4 Every Drop course?
- Are participants satisfied with the course? What improvements to the course are needed to satisfy participant feedback?

Throughout this section, these questions will be addressed and matched with data and observations collected through the research. The end goal will be to create and distribute an effective course for Utah State Extension, thereby improving the water situation in Utah and making the state a better place to live.

Traditionally, Utah State Extension has focused on course development and delivery, with limited formal evaluation practices. This study fills a critical gap by providing a comprehensive evaluation of the Design 4 Every Drop course. By analyzing participant feedback, course materials, and best practices, this research identifies areas for improvement that can significantly enhance the effectiveness of the program. This evaluation serves as a valuable model for future

Extension endeavors. Demonstrating the power of course review, this study provides a roadmap for Extension professionals to assess and refine existing educational programs, ultimately leading to improved learning outcomes and a stronger impact on the communities served by Extension.

The fundamental question of this research is whether or not the course is effective/successful. While success comes in many forms, our intention is to evaluate whether or not the course is successfully achieving its primary intention: to teach Utah residents about landscape design in conjunction with water-saving principles.

Why is Landscape Design Necessary?

After obtaining a property, it is the homeowner's responsibility to maintain that property. While some use landscape primarily for aesthetic reasons, others use landscapes to satisfy social demands, and still others use their landscape for recreation, food production, and/or livestock. In every case, landscape provides a function to the homeowner, making landscaping practices useful, convenient, and even luxurious. In any case, landscape earns its perceived value through its ability to uphold function in whatever fashion it may present itself. Thus, teaching Utah residents how to create a landscape that is functional is not only helpful to the user, it also provides value to the landscape by helping the user understand how to program the landscape to meet its demands. The user can then adjust landscaping elements as needed and make educated decisions when such adjustments are made. Participants will also be empowered to install structures and/or create a yard/space that increases the landscape's value, rather than wasting money, time, and energy. If a landscape can provide value to its user, then designing and installing a yard becomes more sustainable because it is enjoyable and worth maintaining.

A landscape driven by function alone is rarely the most attractive use of space. In Figure 5.0, a newly-built home sits on 2 acres and provides a good example of a functionally driven landscape. Large turf areas cover the ground. In addition, the driveway is not square with the house or property line and serves the sole purpose of accommodating high visitor car traffic. The current house landscape also lacks form and interest. With the help of landscape design principles, this landscape could become both beautiful and functional. With the current strain

Figure 5.0 Example of function a driven landscape

on Utah's water supply, such a design must also be water-wise. This overarching goal provides the foundation for this course: to give Utah residents the knowledge and tools to create beautiful, functional spaces that complement Utah's climate and protect the state's environment and people.

Intentions & Expectations

Figure 4.9 shows that 90.3% of participants expressed that they took the course with the intent of learning about design. Another 29% wanted to learn more about irrigation. The responses show an overall positive rating on the course meeting these expectations (Figure 4.10). Although the ratings were positive overall, the ranked statement "this workshop met my expectations" received a lower overall rating. As design was the primary reason participants took the course, did they feel that it under-delivered in teaching about design?

After observing the workshop firsthand, it seemed that many participants were very eager to receive detailed planting plans, despite this observation, participant responses did not reflect this in the survey responses as either a primary intent to take the course, or as the key takeaway from the course (Figure 4.9).

Across the board, participants expected to learn about design (Figure 4.9), and roughly 92% of respondents said they were satisfied, if not very satisfied, with their landscape design (Figure 4.8). If participants were unfamiliar with what a completed landscape design should

look like, the course provided the Olmstead residence as an example within the online modules.. Figure 4.13 shows that the course did serve to remove many of the barriers preventing a landscape design from reaching completion.

Still, respondents in the Bluff and Murray locations gave the lowest rating to whether the course met expectations. Murray's expectation rating was 0.07 points below the average rating, and Bluff rated 0.49 points below average. Murray hosted one of the largest groups, and Bluff hosted the smallest. Bluff held four virtual meetings prior to the workshop, allowing students to connect with instructors and ask questions prior to the workshop. In this scenario, course size and time with instructors did not seem to factor into course satisfaction. The Bluff cohort, on average, rated each category below the average (Figure 4.27). Bluff was also the first group to receive the course. Since Bluff was the first to experience the workshop, it was possible that the instructors were still working out some kinks. Figure 4.28 shows that the Bluff group rated the instructors slightly lower than the overall average. Instructor A and Instructor B both received a rating that was 0.1 points lower from the Bluff cohort for "The Instructor was well prepared for class" than the overall workshop average. This is not significant enough to be the cause for the lower rating in the other categories, but an interesting observation. Incorporating testimonials from past Design 4 Every One participants could further enhance the course's effectiveness. By sharing positive experiences and the knowledge gained from prior students, course designers can address potential anxieties new participants might have about their ability to grasp the water-wise design concepts. Testimonials could also establish realistic expectations about course content and workload. This approach can build confidence and encourage active participation among new learners, ultimately leading to a more positive learning environment and potentially greater knowledge retention.

Does the course need to be more malleable, and are there expectations/needs outside of the surveyed information that students would like to learn about? The course could provide an opportunity for participants to share and discuss their expectations and desires and thereby inform instructors to focus on those topics more heavily than planned. This would help students

feel like they have more control over course deliverables and help target expectations more effectively. Since the course has live instructors who can modify lectures as needed, such a modification could realistically be implemented.

The lower rating may not stem from any lack in the course itself, but rather, the time allotted to completing assignments. Survey participants were asked what they liked least and what they felt needed to change. Figure 4.27 shows that respondents disliked the time required to complete the online modules and the lack of time to complete the hands-on, in-person workshop. To address these concerns, additional time should be added to complete online and in-person assignments. Despite some of the course's lower ratings, Figure 4.10 shows that respondents were eager to refer this course to others and felt that it was worth the cost.

Location

The course is currently designed as a hybrid format, with both online and in-person segments. The online portion provides flexibility and convenience and is used to prepare participants for the in-person workshops.

The ability to provide this course throughout the state is fundamental to Utah State University's mission. During the spring of 2023, in-person workshops took place in five different locations: Bluff, Hurricane, Vernal, Murray, and Logan. Coming to the participants and meeting in their area improves the course acceptance and shows participants that instructors are invested in them and in their community. Bringing the course to the students is one aspect that improves the course's rating. Figure 4.10 shows the course location rating as 4.6. Therefore, students felt that the location of the course was convenient and helpful.

Workshop location is helpful and convenient, but the presence of instructors on-location sets this course above other local courses, such as Localscapes, which only offer online course material. As instructors meet in-person in each location, they build trust. This helps prepare participants for constructive feedback, whereby they receive critical feedback and encouragement through one-on-one time during the workshop. This was highly favored by the participants of the course, as seen in Figures 4.11 and 4.15.However, the need for on-location,

highly qualified instructors may also prove to be a limitation of the course, as this reduces the number of instructors that can successfully teach workshops .

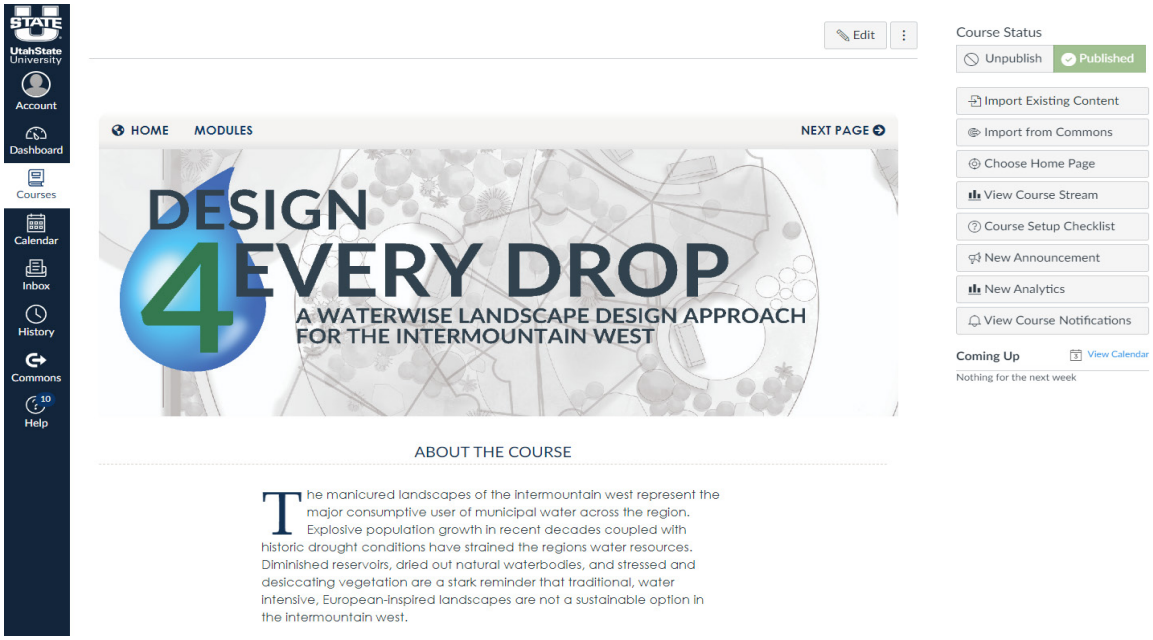


Figure 5.1 Screenshot of Design 4 Everydrop canvas homepage

Course Content

Design 4 Every Drop uses Canvas as the course platform. It is well-organized and divided into the following six modules:

Module 1: Learning the Principles of Water-Wise Design

This module helps participants learn how to build a base map and site plan. Students use a landscape lens to gather all the information they can about their site. Students are then equipped with a to-scale site plan that can be used as the template for upcoming concept plans and schematic plans.

Module 2: Knowing Your Site and Your Needs

In this module, students identify what they want to have in the landscape. They identify priorities and organize them with the use of a matrix or functional diagram. Multiple functional diagrams are encouraged, in order to help generate different ideas, spark creativity, and explore options.

Module 3: Creating a Water-Wise Landscape Design

In this module, students create a concept plan while learning about the elements and principles of design. Design elements include line, shape, form, color, and texture. Other design principles introduced in this module include symmetry, asymmetry, consistency, variety, emphasis, scale, repetition, alternation, inversion, gradation, and rhythm. Students are then given an opportunity to take the Localscapes course in tandem with the Design 4 Every Drop course. The online course reads "we encourage you to take advantage of the great design framework and resources presented in the Localscapes courses that will further build your concept development skills (Powell, 2023).

Module 4: Implementing Strategies, Techniques, and Technology to Support a Water-Wise Landscape

Module 4 introduces the differences between hiring a contractor and DIY landscaping, grading and drainage, plant classification, plant resources, and hydrozones. This is where students learn how to approach plants based on characteristics, rather than specific varieties.

Module 5: Final Details

The final module prompts students to take the intro survey in order to prepare for the workshop. After reviewing participant responses, Figures 4.4 and 4.5, show that the course succeeded in informing participants about the various topics. When asked, "How could this workshop be further improved?" comments primarily centered around a desire for more examples. Comments included:

"I would emphasize more concrete examples of resources/principles instead of rehashing exactly what was in the homework."

"Show more examples of landscape design."

"Show lots of plant pictures and pictures of actual landscapes."

"More pictures for examples."

"I could see there being a bit more of a theoretical site plan at the beginning, where

everyone did the site in order to learn that process. Then we could move on to our own sites."

"Possibly in the growing season, take actual "field trips" in person to either inspiring landscapes and designs."

After receiving this feedback and reviewing the course modules, there is a clear need for more examples in the digital portion of the class. When design was taught in person, participants mentioned that they enjoyed being able to learn from the instructors by *"going through the steps one at a time, watching instructors design, having instructors or others critique my design."* Another student commented that they enjoyed *"the in-person aspect, [and] seeing other people's designs."*

However, the online portion of the course only provides one project example of a landscape design process known as the Olmstead Residence. While the "Olmstead Residence" is used to walk participants through the design process, there are no other project examples to aid the instruction. Instead, the online course moves directly from concept plans to elements and principles of design without providing project examples. The course then introduces schematic plans. Before a schematic plan is created, the students need to learn about form compositions. Form compositions are critical as they help guide the overall style and form of the landscape.

The "Olmstead Residence" project does not include form composition examples. In order to provide a more comprehensive example of the design process the "Brigham Home" was introduced to the course. This additional site provided the base map for additional concept plans and form compositions.

In order to alleviate this issue, I created several functional diagrams, concept plans, and form compositions digitally, in the style of hand-drawn designs similar to what the students will produce. These examples show many variations of the same property to help demonstrate the process of design exploration. Other examples were created with the use of drone mapping software to create high quality plan view images of varying home styles and lot sizes. Such examples will help students connect the dots between the concept plan and schematic plan. Figures 6.3-6.8 are examples of study examples created specifically for this course.

Time

Many participants complained about the amount of time that the online course required, as well as the lack of time during the workshop. This is clear to see in Figure 4.16. Comments included:

"It felt pretty rushed. I wish more time would've been spent on things NOT covered in the homework. Many things felt a little redundant. I would emphasize more concrete examples of resources/principles, instead of rehashing exactly what was in the homework. I knew snow was hard this year, but more time to complete the homework would be nice."

"too much time spent on things we already covered online"

"too little time to fully explore options and then redo"

"email notification of 10-20 hours in advance work"

"More conceptual/ abstract work and prior to working and own site. More group projects. More hands-on! What were 10 copies of the site plan for? Could be longer with more independent work assigned without unnecessary instructor time."

For the workshop to be successful as a hybrid course, participants are expected to complete 10-20 hours of online-based learning before the workshop begins. Students are asked to prepare a site plan to use as a base map and to collect images of existing conditions. The Bluff group was the only group to meet prior to the workshop (in a series of four virtual meetings), and of the eight respondents in the Bluff group, none mentioned time as a burden during the online portion. They did, however, struggle with the online content. The only comment about time from the Bluff group referred to a desire for more time discussing specific plants. This indicates that the added virtual meetings allowed for participants to feel like they had more time. Based on this data, I recommend adding virtual meetings before the workshop to help students feel like they have more time with instructors and to complete assignments.

From the comments, it appears that the Logan group received their modules late. Three out of 11 respondents from Logan commented that the online portion required too much time or that they felt they needed more time to work on the online assignments. Two more participants

in this group felt that they needed more time in general to work on items and tasks during the workshop.

The following is an example of the Murray workshop schedule (held April 13-15, 2023). The other groups experienced a similar schedule.

Day 1 - Friday (4/14) 6:00 PM- 9:00 PM

6:00 PM - Welcome and Introductions

6:30 PM - Review of the design process

7:00 PM - Demonstration and studio time to develop your concept plans.

9:30 PM - Wrap up and prep for tomorrow

Day 2 - Saturday (4/15) 8:00 AM – 5:00 PM

8:00 AM - Working breakfast (light breakfast and graphic communication demonstration)

9:00 AM - Concept plans to form study exercises

9:30 AM - Break

9:45 AM - Form study development

12:00 PM - Working Lunch (Box lunch provided)

12:30 PM - Grading and drainage development

1:30 PM - Demonstration and studio time to develop schematic plans

2:45 PM - Planting Design

3:45 PM - Applying implementation to schematic designs

4:45 PM - Wrap up and conclusion

5:00 PM - Dismissal

The workshop runs a total of 12 hours: roughly 2.5 hours of lectures, 45 minutes for breaks, and 8.25 hours for design work. The students are expected to come prepared with information supporting their site characteristics and a preliminary concept plan. The workshop

picks up from there and provides the direction needed to create a schematic plan, simple drainage plan, and basic planting plan.

An email or announcement explaining the time required would be a simple solution to set time expectations for participants. The course requires that participants are hands-on, and designing is an active task that can require more time than may be expected. Giving each task or project some kind of time frame will help guide student expectations. For example:

- A base map can take 1-2 hours for site measurements and documentation.
- Functional diagram and use matrix: 1-2 hours.
- Concept plans: 2-4 hours.
- Schematic plan: 2-4 hours.
- Planting plan: 4-6 hours.
- Simple water drainage map: 1 hour.
- Grading plan: 1-2 hours.

According to this example, the total hours required come to 12-17 hours, not including time for instruction, which seems appropriate. As a professional landscape designer, I budget for about 10-15 hours to complete a landscape design for a home with roughly 1 acre or less. This includes taking site measurements and creating a base map, 2-3 concept plans, and a planting plan. Therefore, less experienced designers will likely need more time to complete their designs.

Canvas was used as the course platform. According to the Canvas report, students spent an average of 19 hours on the Canvas pages, which does not include time spent working off the computer on various assignments. Some possible solutions to help accommodate concerns with time are as follows:

- Set time expectations early in the course or before participants sign up for the course.
- Give anticipated time frames for each step in the design process.
- Highlight any assignment or task that students tend to spend more time on and give guidance to the students to help them avoid getting stuck.
- Give workshop time expectations prior to the workshop.

Though the workshop is prefaced with the schedule, the pace of the workshop can feel quick. In design, the term "charette" is relevant in this course, or "the intense final effort made by architectural students to complete their solutions to a given architectural problem in an allotted time or the period in which such an effort is made" ("Charette," n.d.). In essence, the workshop becomes a guided charette, focusing on each student's site. The instructors and classmates become interested parties, collectively working to explore design solutions in a quick, decisive manner. Approaching the workshop in this way helps to keep the process moving to avoid an "analysis paralysis," where decisions are not made, unnecessarily stretching out the design process. Communicating this to students before the workshop portion of the course would be helpful in managing student expectations.

Redundancy

Students expressed that elements of the course felt redundant between the online work and the in-person workshop. In a quick side-by-side comparison of the topics covered in both the online portion and the workshop, some of the redundancies become apparent. Although each section is helpful, adjustments could be made to the content to focus more intentionally on new topics, rather than repeating the same concepts in both sections of the course.

Figure 5.2 provides an outline of the topics covered in both the online portion and workshop. The yellow highlighted cells identify topics that are covered in both

Online	Workshop
Xeriscaping	Design Process
Base Map	Concept Plan
Site Inventory	Functional Diagrams
Programs/ Components	Graphic Communication
Mood Boards	Form Studies
Functional Diagrams	Schematic Plan
Concept Plan	Sections and Elevations
Localscapes	Outdoor Rooms
Elements and Principles of Design	Water Use/ Value
Outdoor Rooms	Rain Water Harvesting
Plants/ Requirements	Mulch/ Soil
Hydrozones	Planting Design
Rain Water Harvesting	Hydrozones
Mulch	Hardiness
Irrigation	Irrigation
Contractor vs DIY	

Figure 5.2 Topics comparison table between online content and the workshop

the online portion and the workshop. The red cells suggest topics that could be greatly condensed or removed from the workshop and included in the online material instead, leaving the workshop to focus only on those topics that are most relevant to the hands-on productions made during the workshop.

By moving some topics from the workshop material to the online module, students may have more time for participants to work on designs and receive needed feedback. For example, students are currently tasked with creating a functional diagram during the online portion and only introduced to concept plans, though they have the necessary tools and information to create the concept plans at this point. If concept plans could be created before the students attended the workshop,they could be submitted and reviewed by an instructor through Canvas prior to the workshop. This shift would free up the majority of the first evening of studio time, allowing for more time to focus on design development. With a little creativity, the workshop could provide more time for design development and reduce course redundancy.

Observations

As part of this project, the Murray and Logan workshops were observed in person. Attending the workshops was helpful and informative. I was able to help provide feedback and design suggestions to participants, and I was about to observe several things that the workshop did well. I also participated in the Localscapes online course to experience another way of approaching landscape design instruction.

The Design 4 Every Drop workshops were an enriching, organized, and fun environment—and even included snacks! The locations were clean and professional, with tables and chairs ready.

The instructors are the backbone to the workshop and the course overall. Because they were present in some of the online videos, participants were already familiar with them. They are very well trained and personable and successfully conveyed the information to the students, making it a point to talk to each participant, provide valuable constructive design feedback, and express enthusiasm in each property. As a result, participants were excited to share their

yards and sites and were willing to explore different design solutions. That being said, some respondents expressed frustration that they did not get enough time for feedback and critiques. With only two instructors, there was not enough time to give everyone all the time they hoped to receive. Because some participants required more time than others, the instructors even started setting timers to make sure they could effectively get to everyone during the workshop. Continuing this practice would be helpful to ensure that everyone participating in the workshop gets time with the instructors.

Other positive aspects of the workshop included a simple field trip around the building's landscape, which served as both a helpful break and real-world context for the information discussed. A simple hands-on irrigation demonstration was also provided, which was a great success, as Figure 4.14 shows that one of the biggest action items participants planned to take was to install or update their irrigation.

Though participants often needed significant guidance up front, by the end of the workshop, participants were creating very nice designs that they felt good about. While their final designs still needed some help and artistic touches, the foundational design plan was complete, and participants now had the tools to build upon it. The Design 4 Every Drop course teaches the same principles and fundamentals as the Localscapes course, but the courses arrive at a water-wise landscape design in different ways. While each approach is helpful and effective, they also have their limitations. The Localscapes course can be completed at a student's own convenience, as it is totally online and free to use after creating a profile. It's simple landscape design breakdown into five principles allows for an easy guide to follow, and helpful videos teach students how to draw and design effectively. The course also provides examples of yards that follow the same design pattern, and includes great resources about water-wise plants. It provides irrigation information and demonstrates a few hands-on applications. Although the course is accessible and helpful, its design process functions based on student reactions to each step in the process. As a result, while site characteristics, water, and hydrozones are factored in, the design aesthetics and function are lacking. Despite these shortcomings, the course is extremely valuable

to the Utah community and does well in promoting water-wise principles. These observations are merely for comparison and analysis purposes.

Conclusion

Overall, the Design 4 Every Drop course was a success. Yet while the course was successful in reaching many of its objectives, there is still room for improvement. The feedback provided in the surveys reflects a positive experience that was informative and useful to its participants. The course succeeds in teaching about water-wise principles in conjunction with landscape design. It also fills a gap in available community landscaping/gardening courses in Utah by teaching about landscape design. It fulfills the mission of Utah State University Extension, and it is making an impact, not only on the people who participate in the course, but also on the suitability of future Utah landscapes within the state's water-hungry climate The participant responses were crucial in improving the course. Although the course had a very positive rating, the following adjustments will help improve the experience for future participants:

- Keep promoting design and function.
- Keep teaching water-wise principles with design.
- Ask participants about their course expectations; allow the course to adjust to those expectations.
- Set time expectations for each task in the workshop and online module.
- Keep the hybrid format.
- Provide more real-world examples.
- Provide more time for the online module.
- Condense some workshop topics and expound upon them in the online module to reduce redundancy and potentially free up time for feedback in the workshop.
- Have participants prepare concept designs before the workshop.
- Share previous participant testimonials through videos, quotations, and/or example design images.

These suggestions will help improve the course experience, but future adjustments may be necessary as the course continues to develop. Participant survey responses were critical and provided valuable information to guide improvement. Continual use of a pre- and post-survey, such as those used in this study, would also help the course develop and continue to meet the needs of participants.

In conclusion, by critically evaluating the Design 4 Every Drop course, incorporating participant feedback, and drawing upon existing knowledge in water-wise design principles, this study has the potential to pave the way for a transformative educational experience. The recommendations presented here offer a roadmap for fostering a generation of Utah residents equipped with the knowledge and confidence to design landscapes that are not only beautiful and functional but also sustainable in the face of our arid climate. By integrating design principles with practical considerations and leveraging the power of community education, this enhanced course can empower Utahns to become active stewards of our precious water resources, ensuring a vibrant future for our communities and landscapes.

CHAPTER 6: IMPROVED COURSE CONTENT

Concept Plans and Form Study Design Examples

Course content was created to supplement areas in the course needing adjustment. Concept plans and form studies were created based on a new example home similar to the Olmstead residence utilized in the course. The goal is to develop the concept plan further by demonstrating the process of creating different form studies based on one concept plan. This information is lacking in the course and required much of the first workshop day to address. These examples will allow participants to trace a completed landscape plan from site analysis to schematic plan. Three concept plans and 6 form studies were created. The diagonal form studies demonstrate form study refinement.

Design Examples Existing and Proposed

Drone mapping software was used to capture 5 different properties demonstrating a variety of property size and function.

(Figure 6.9) Example of a newly constructed home, eliminating non-functional turf.

(Figure 6.10) Example of an existing landscape lacking form.

(Figure 6.11) Same property as Figure 6.10 with proposed adjustments to strengthen form.

(Figure 6.12) Existing landscape demonstrating good form and good water-wise design with reduced amounts of non-functional turf.

(Figure 6.13) Existing landscape with predominantly lawn over a two acre site. This is a challenging site, due to the amount of space and low program elements.

(Figure 6.14) Same home as Figure 6.13 with adjustments to preserve function, eliminate non-functional turf, and include additional programs and form.

(Figure 6.15) Existing landscape with predominantly lawn and little landscape style.

(Figure 6.16) Same home as Figure 6.15 with suggestions to reduce turf and improve function and form.

Proposed Workshop Schedule

The following is a proposed schedule for the workshop. This proposed schedule requires students to come to the workshop with a completed concept plan. With the concept plan in hand, participants will have more time to focus on their schematic plan and focus on planting design. Participants are expected to walk away with a design, this proposed scheduled is arranged to give the participants more time work on a design while still leaving time for some of the supplemental design information such as drainage, hand graphics, and irrigation.

Day 1 - Friday 6:00 PM - 9:00 PM

6:00 PM - Welcome and introductions

6:30 PM - Review of the design process (30 min.)

7:00 PM - Concept plans to form study exercises (2 hr. 30 min.)

9:30 PM - Wrap up and prep for tomorrow

Day 2 - Saturday 8:00 am – 5:00 pm

8:00 AM - Working breakfast (light breakfast and graphic communication demonstration) (1 hr.)

9:00 AM - Form study development (1 hr.)

10:00 AM - Break (15 min.)

10:15 AM - Grading and drainage development (45 min.)

11:00 AM - Demonstration and studio time to develop schematic plans (1 hr.)

12:00 PM - Working lunch (Box lunch provided) (30 min.)

12:30 PM - Schematic plans (1 hr. 30 min.)

2:00 PM - Planting design (1 hr. 45 min.)

3:45 PM - Applying implementation to schematic designs (1 hr. 15 min.)

4:45 PM - Wrap up and conclusion (15 min.)

5:00 PM - Dismissal

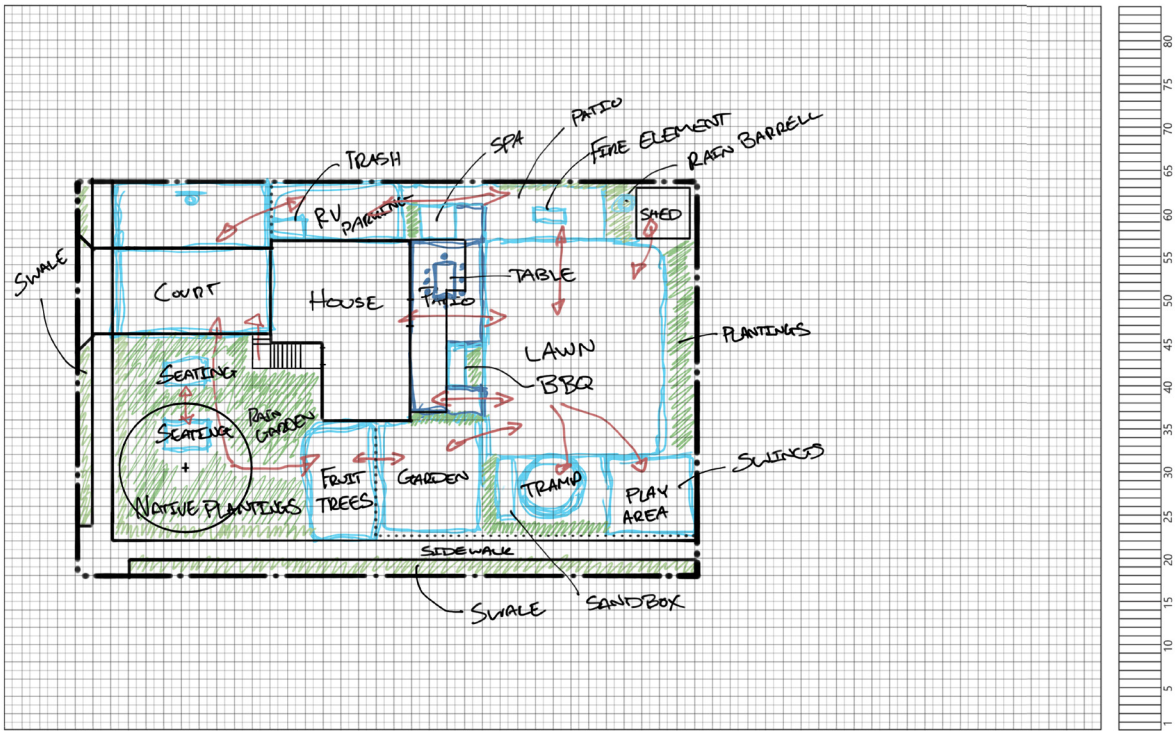


Figure 6.0 Example A hand rendered concept design

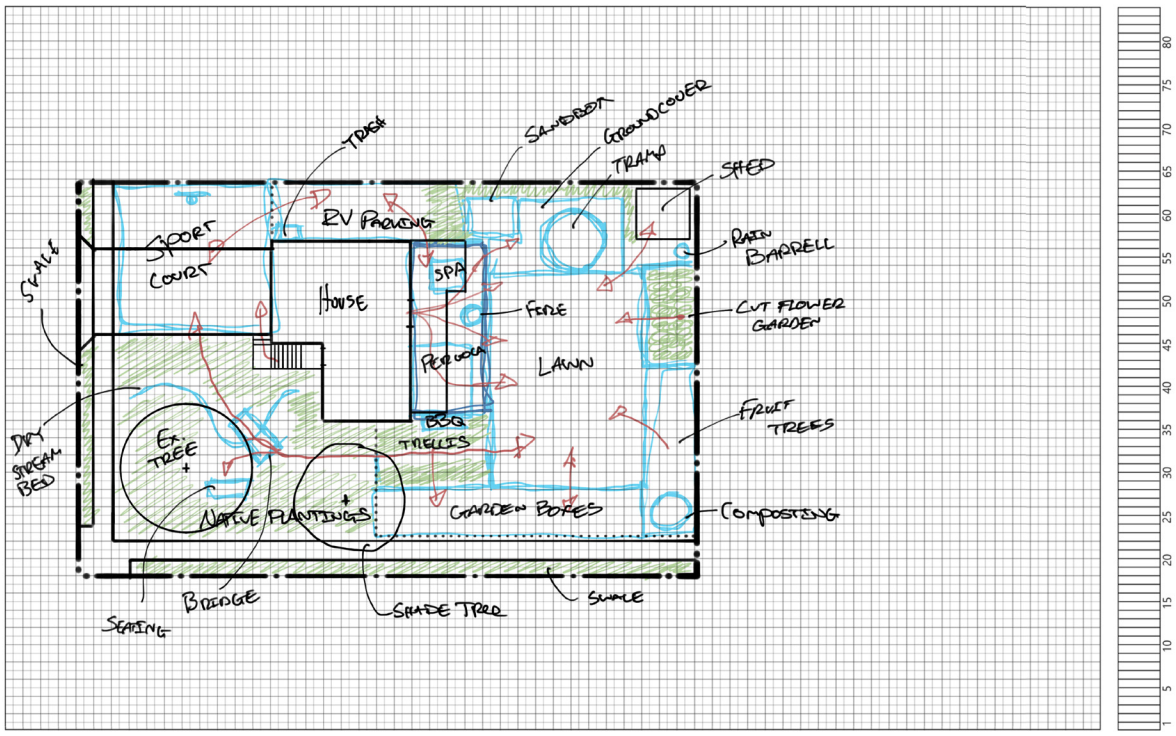


Figure 6.1 Example B hand rendered concept design

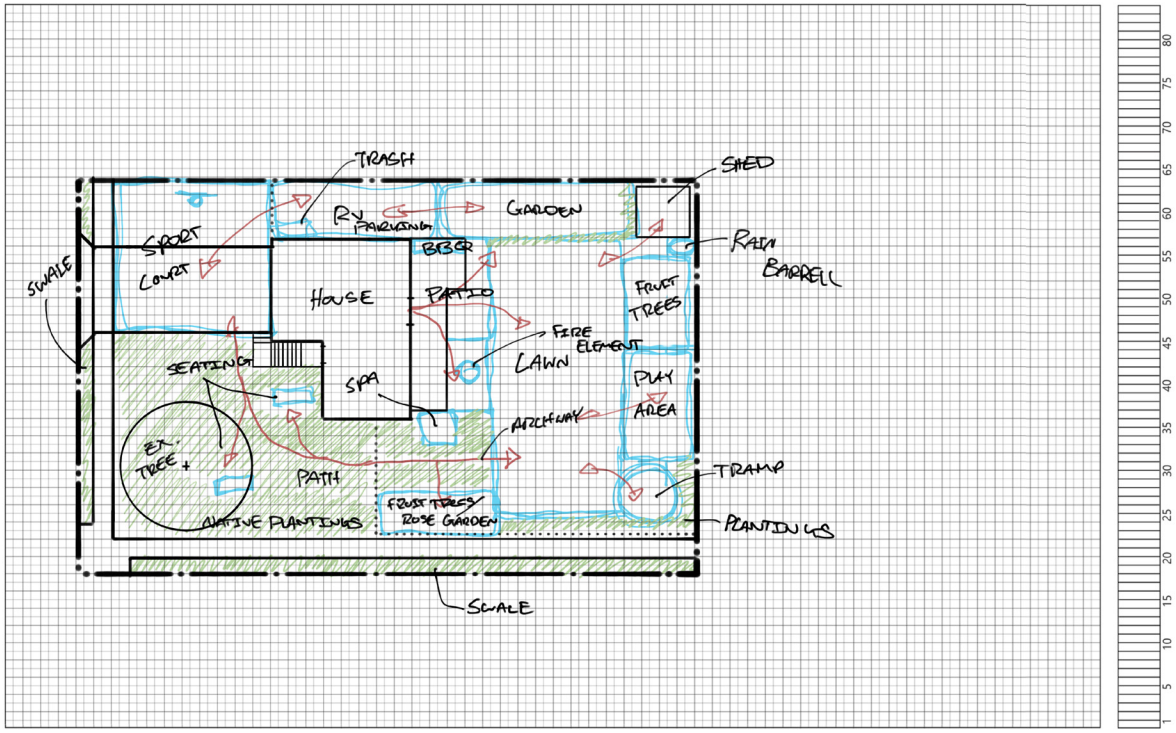


Figure 6.2 Example C hand rendered concept design

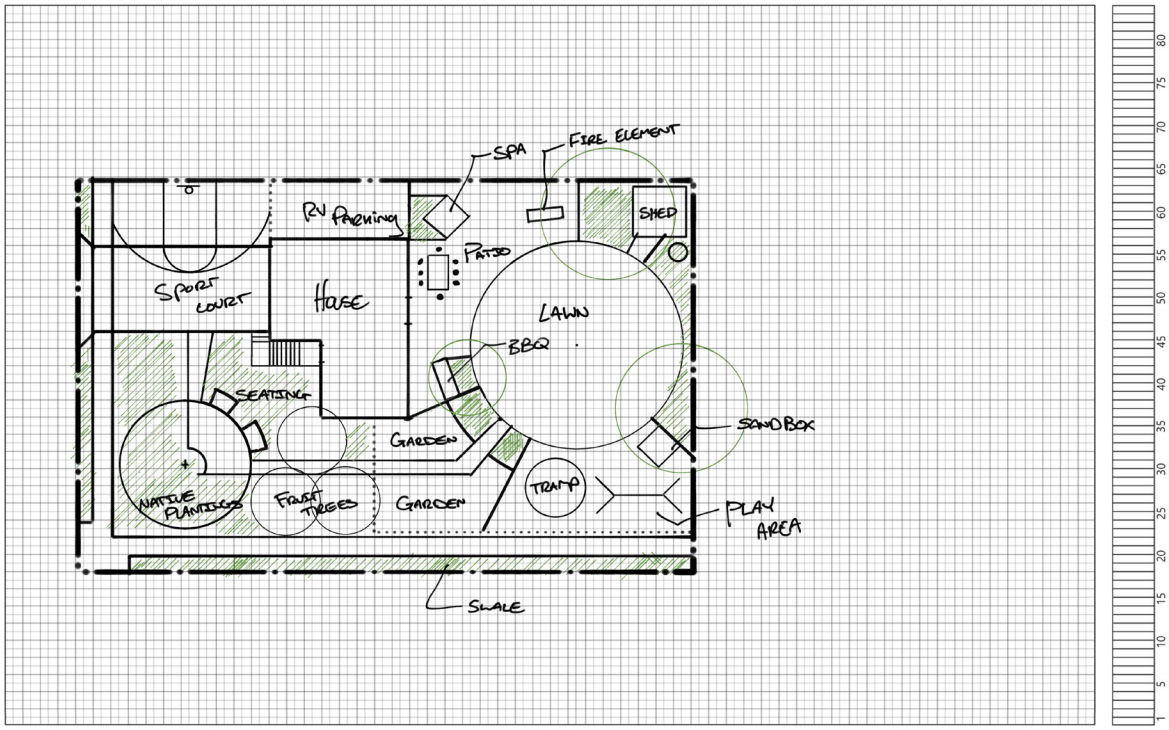


Figure 6.3 Circular form study example

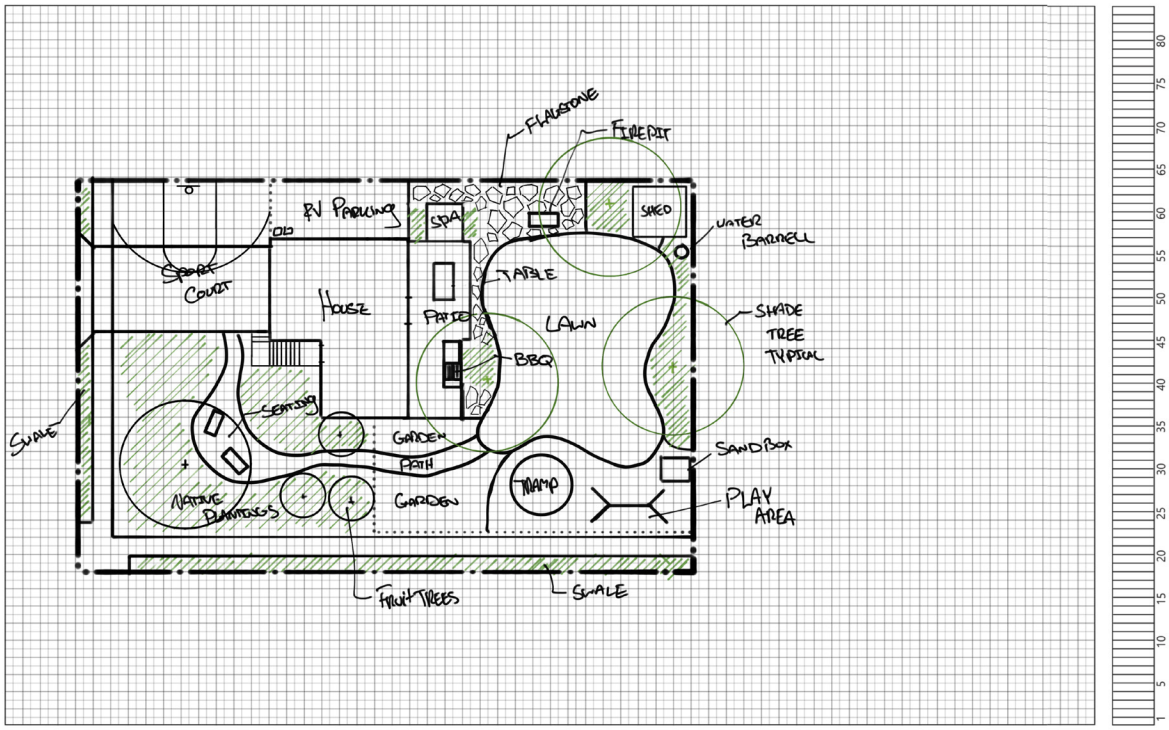


Figure 6.4 Curvilinear form study example

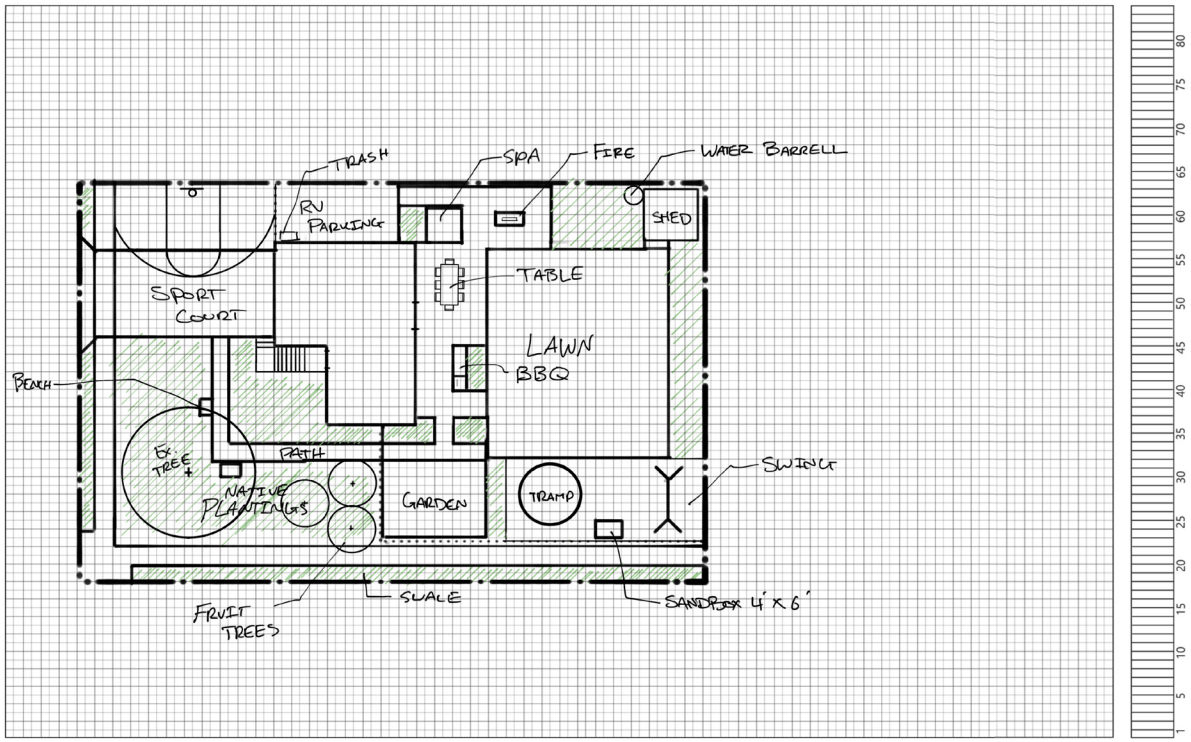


Figure 6.5 Rectilinear form study example

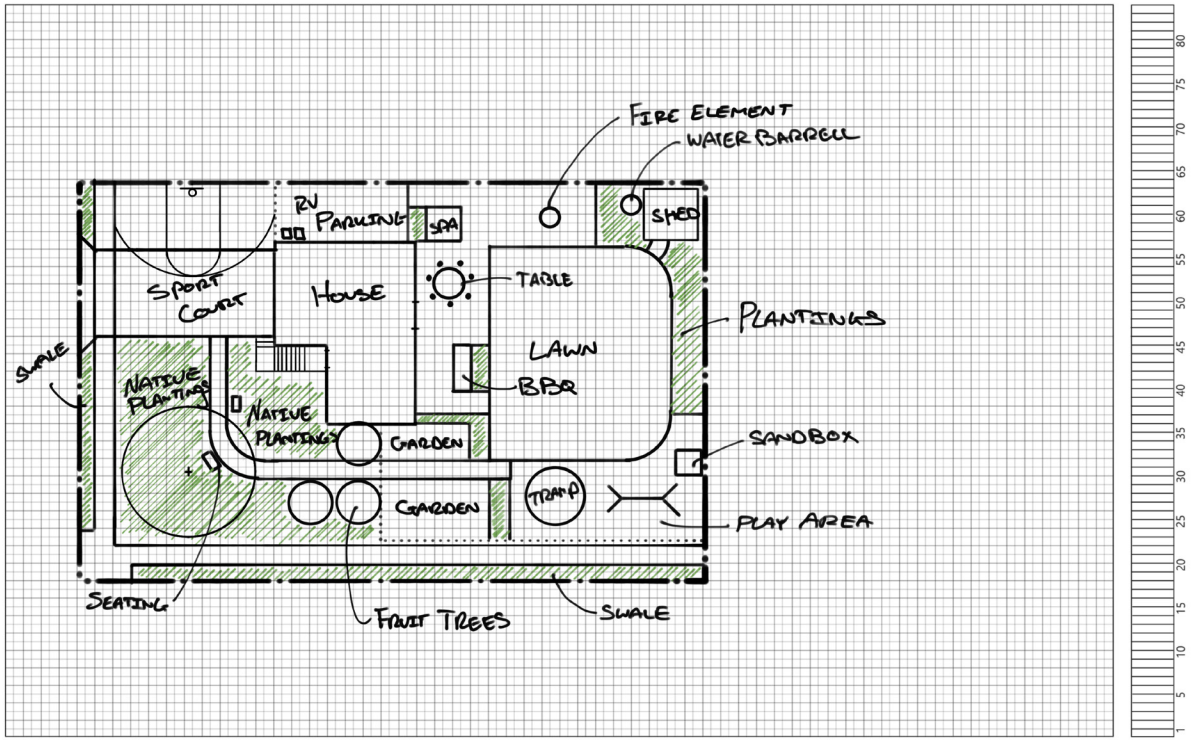


Figure 6.6 Arc & tangent form study example

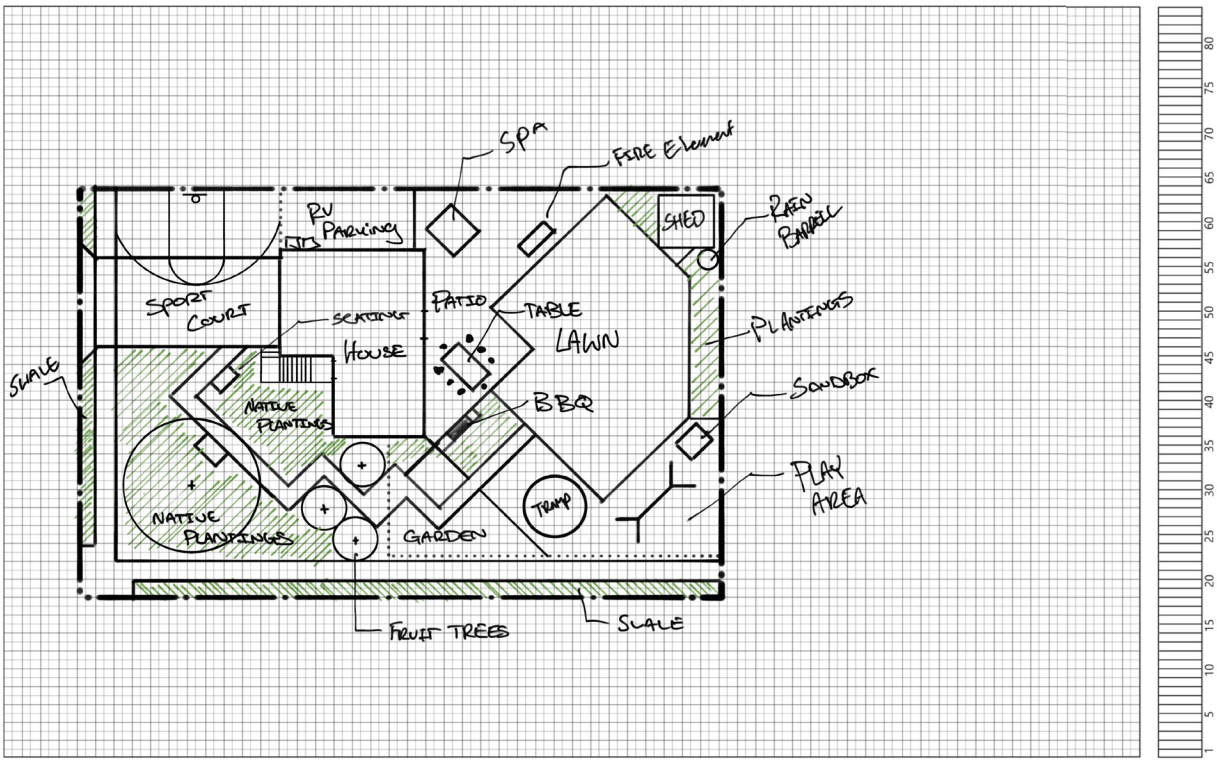


Figure 6.7 Diagonal form study example A

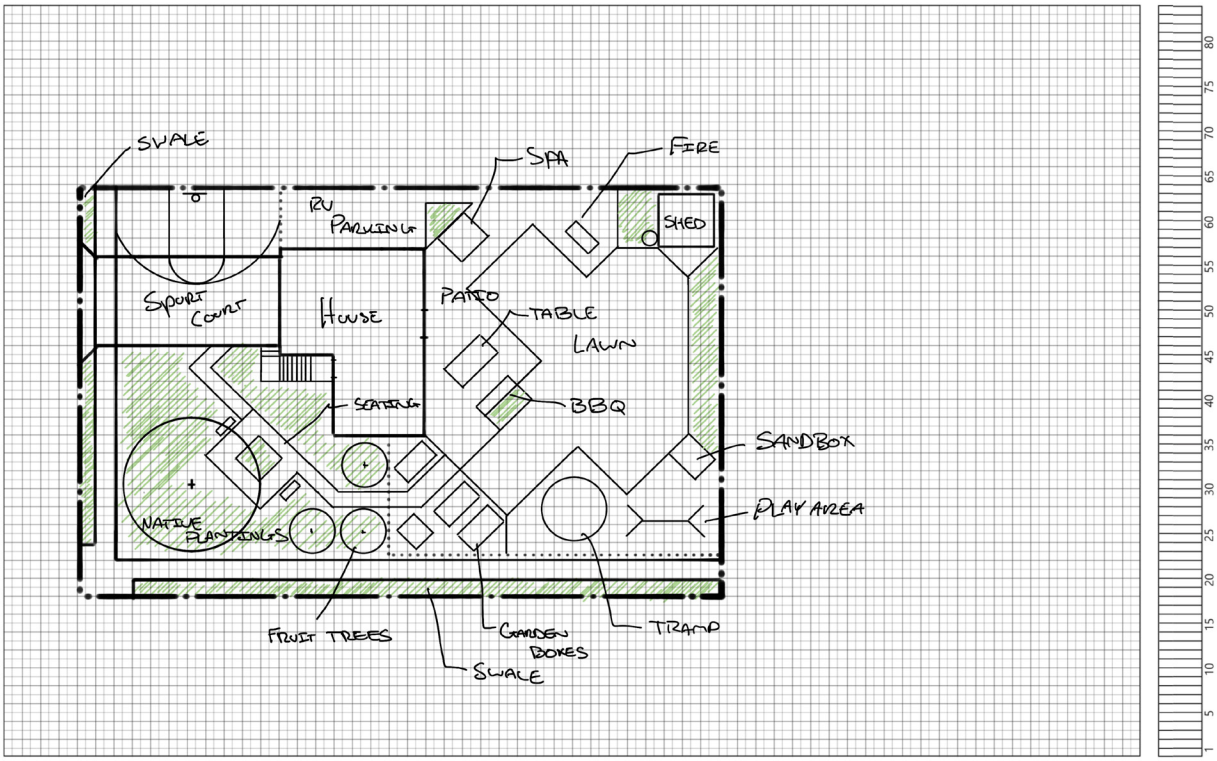


Figure 6.8 Diagonal form study example B

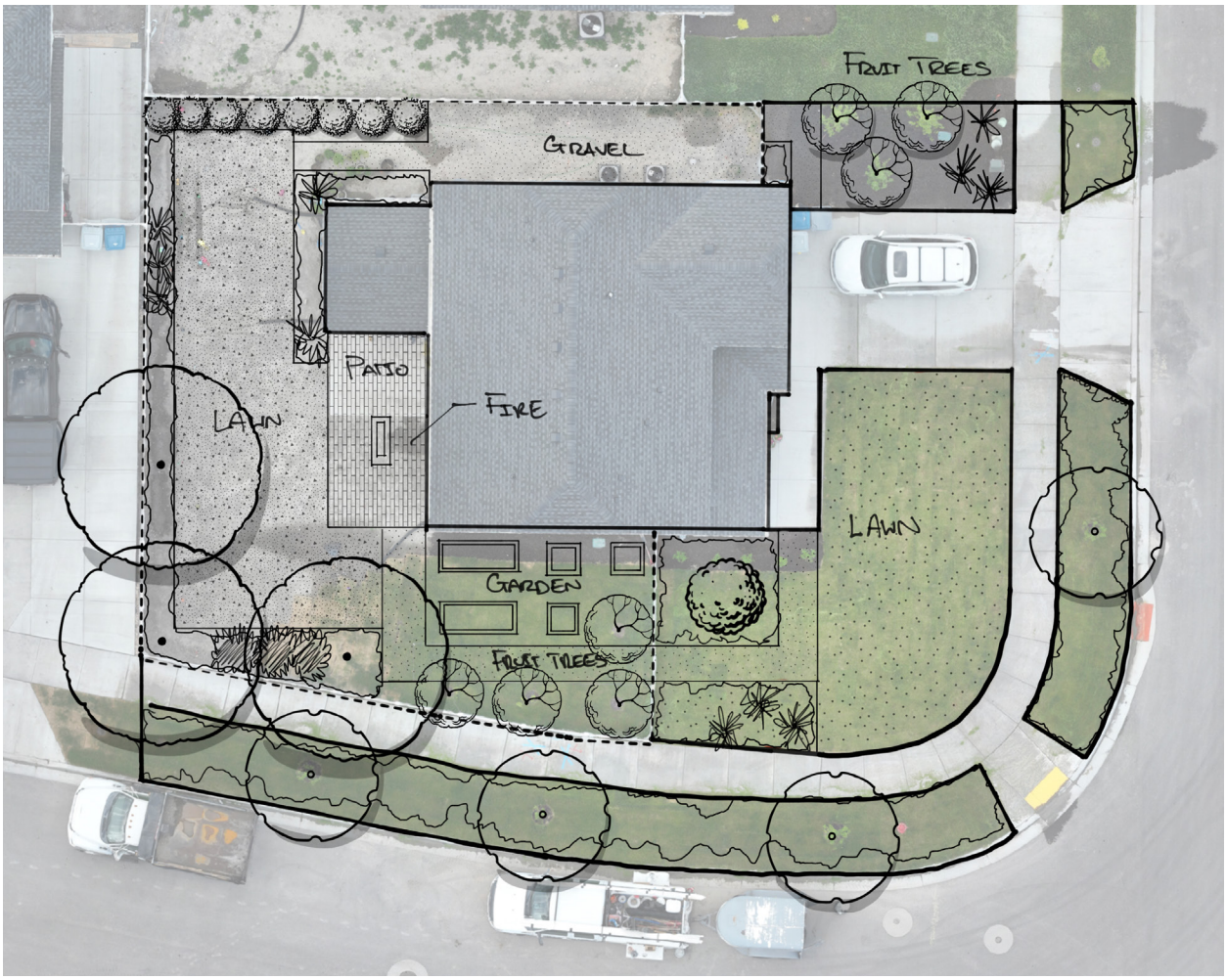


Figure 6.9 New build example design

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
1063	1988*	1516	114*	66	944	15*	72
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

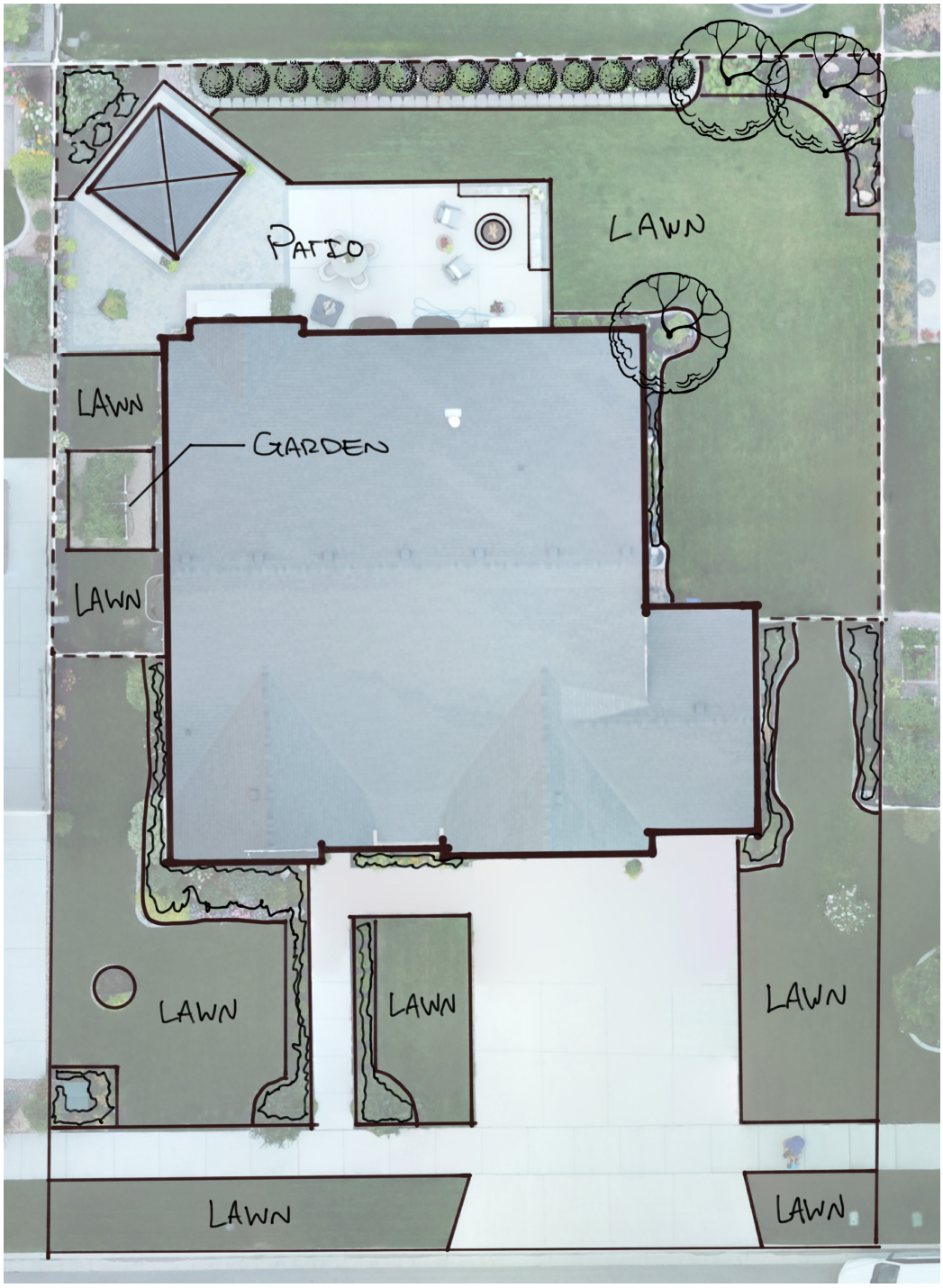


Figure 6.10 Existing landscape lacking form

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
2397	4482*	714	54*	31	445	5*	24

**Based on GPM rates from Fig. 2.2 & 2.3*

**Based on 70% shrubs/ 30% perennials ratio*
**16 SF per shrub*
**4 SF per perennials*

**16 SF per tree*
**6.4 GPH*

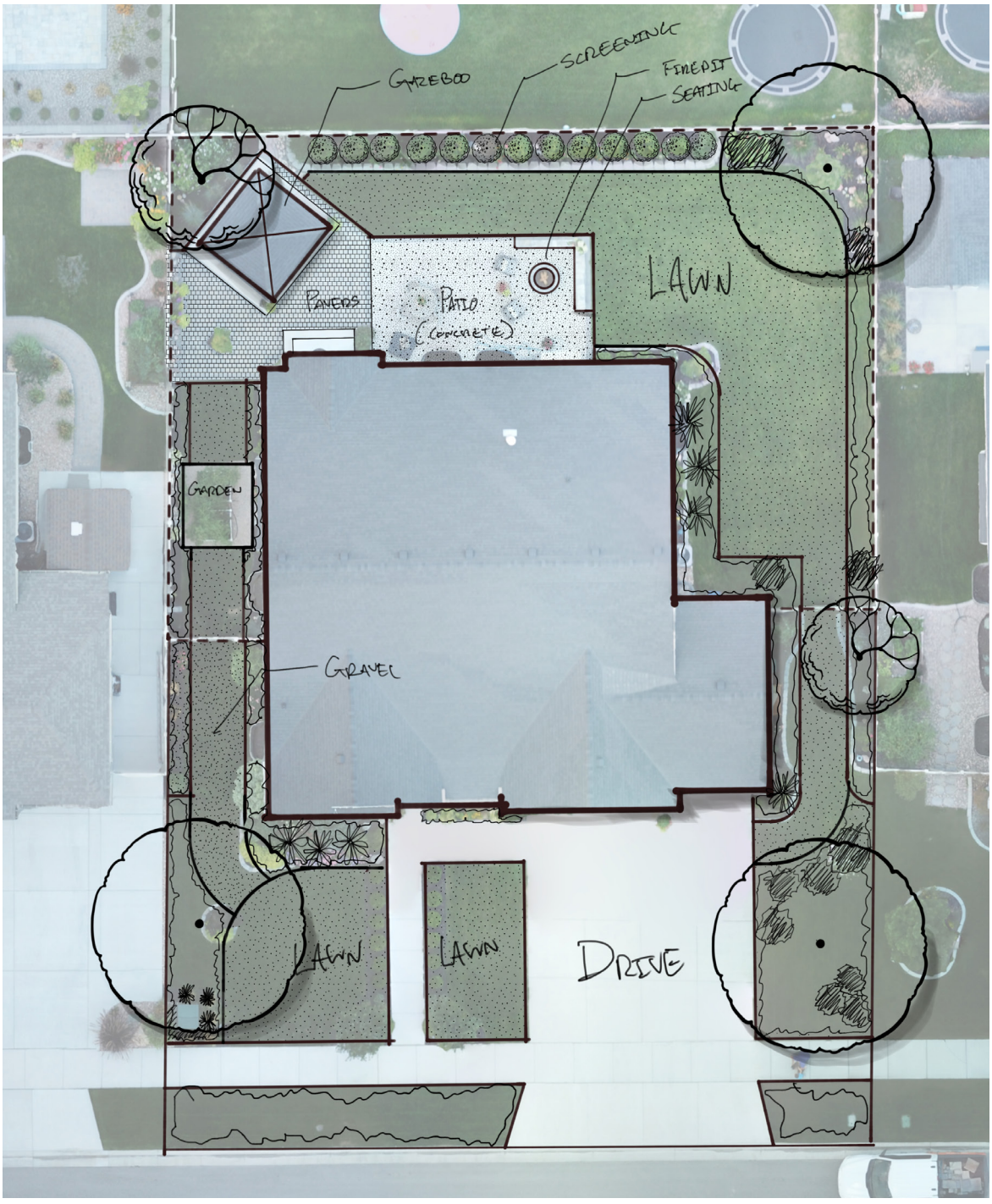


Figure 6.11 *Same property as Figure 6.10 with proposed adjustments to strengthen form*

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
1400	2618*	1616	121*	71	1007	5*	24
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

Figure 6.12 *Existing landscape design reducing non- functional turf*

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
3013	5634*	2068	155*	90	1288	18	86.4
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

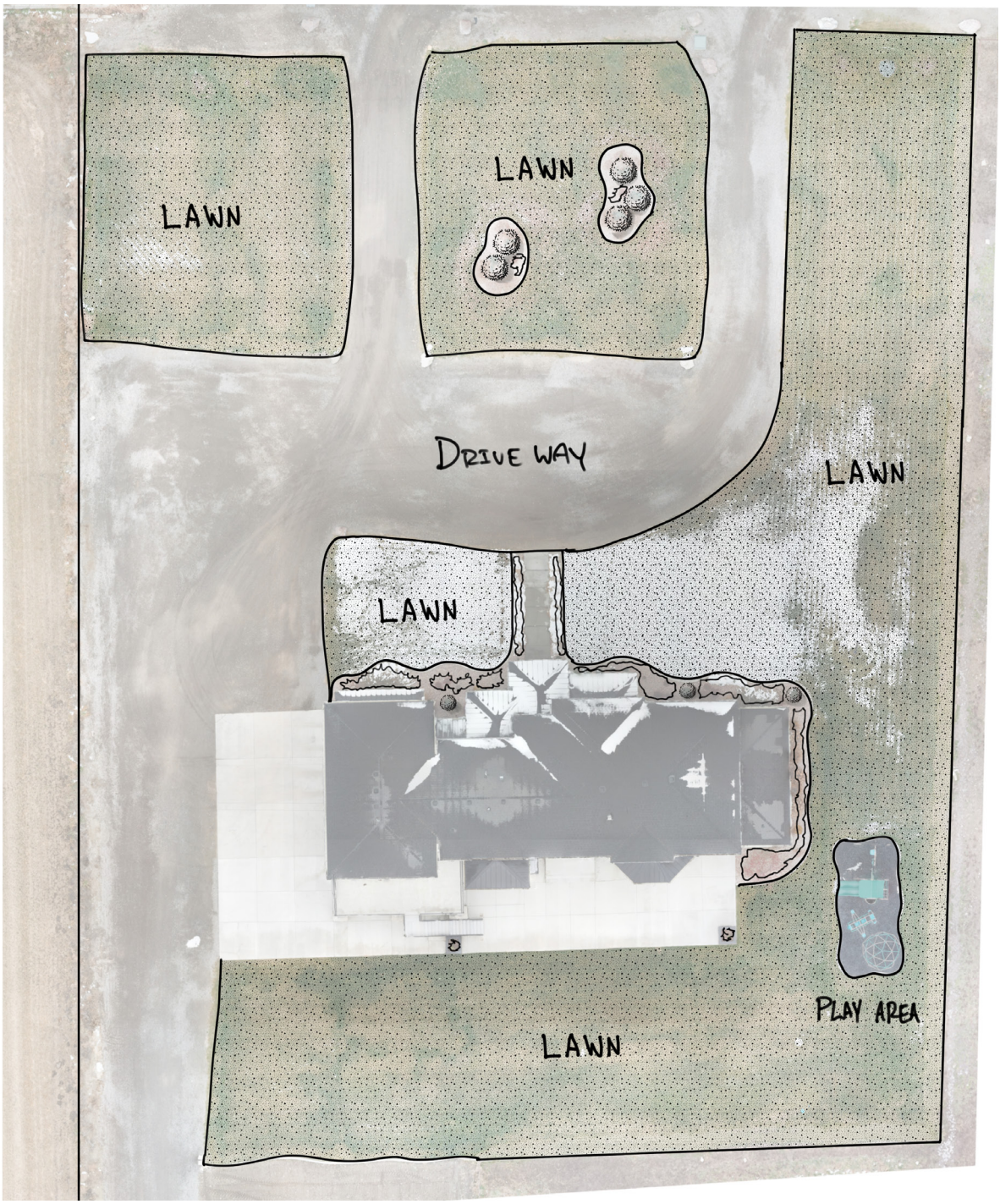


Figure 6.13 Existing landscape that's predominantly lawn over a 2 acre site

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
36871	68949*	1860	140*	81	1159	8*	38.4
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

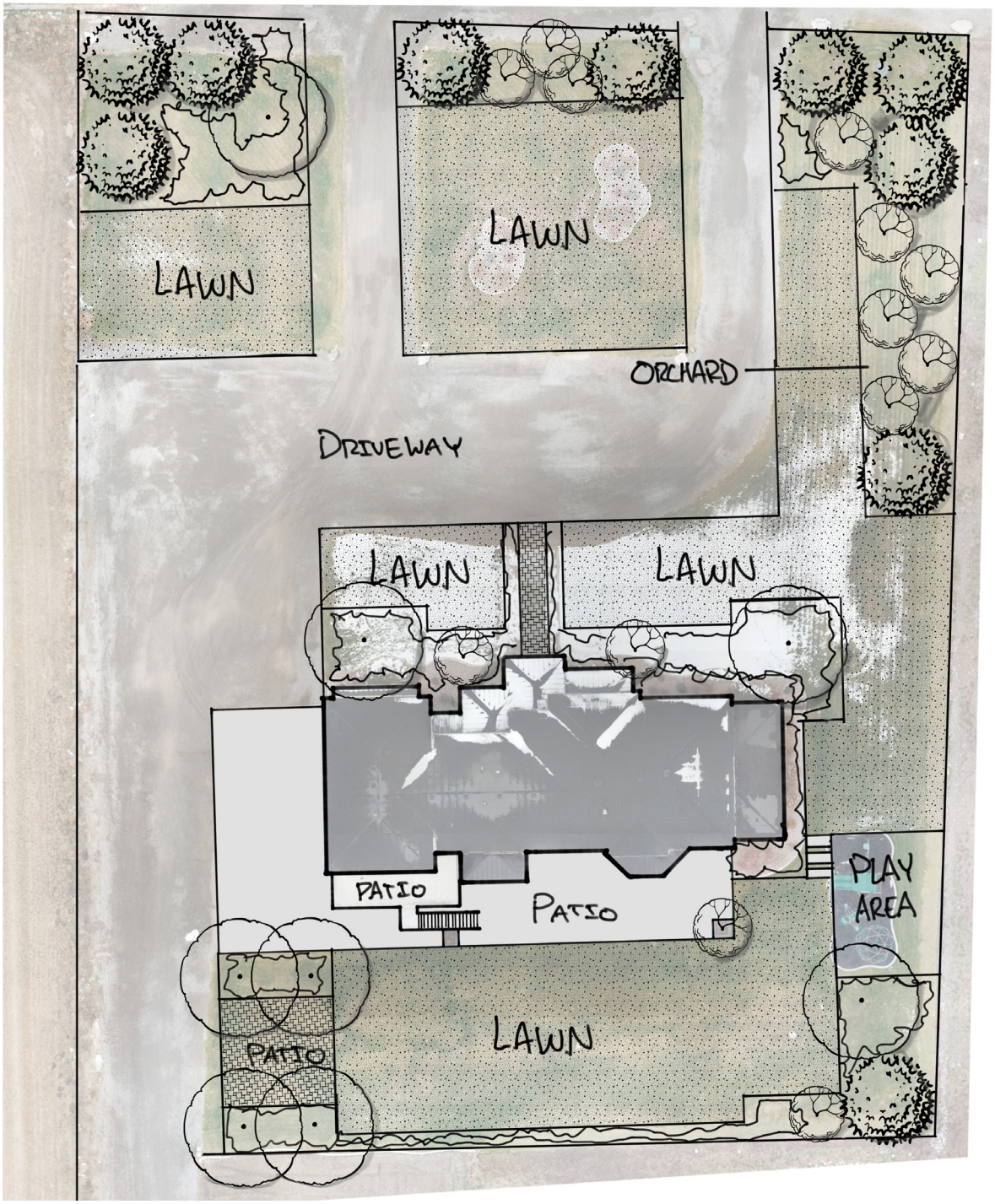


Figure 6.14 Same home as Figure 6.13 with adjustments eliminating non-functional turf

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
22490	42056*	15415	1156*	674	9604	32*	153.6

**Based on GPM rates from Fig. 2.2 & 2.3*

**Based on 70% shrubs/ 30% perennials ratio*
**16 SF per shrub*
**4 SF per perennials*

**16 SF per tree*
**6.4 GPH*

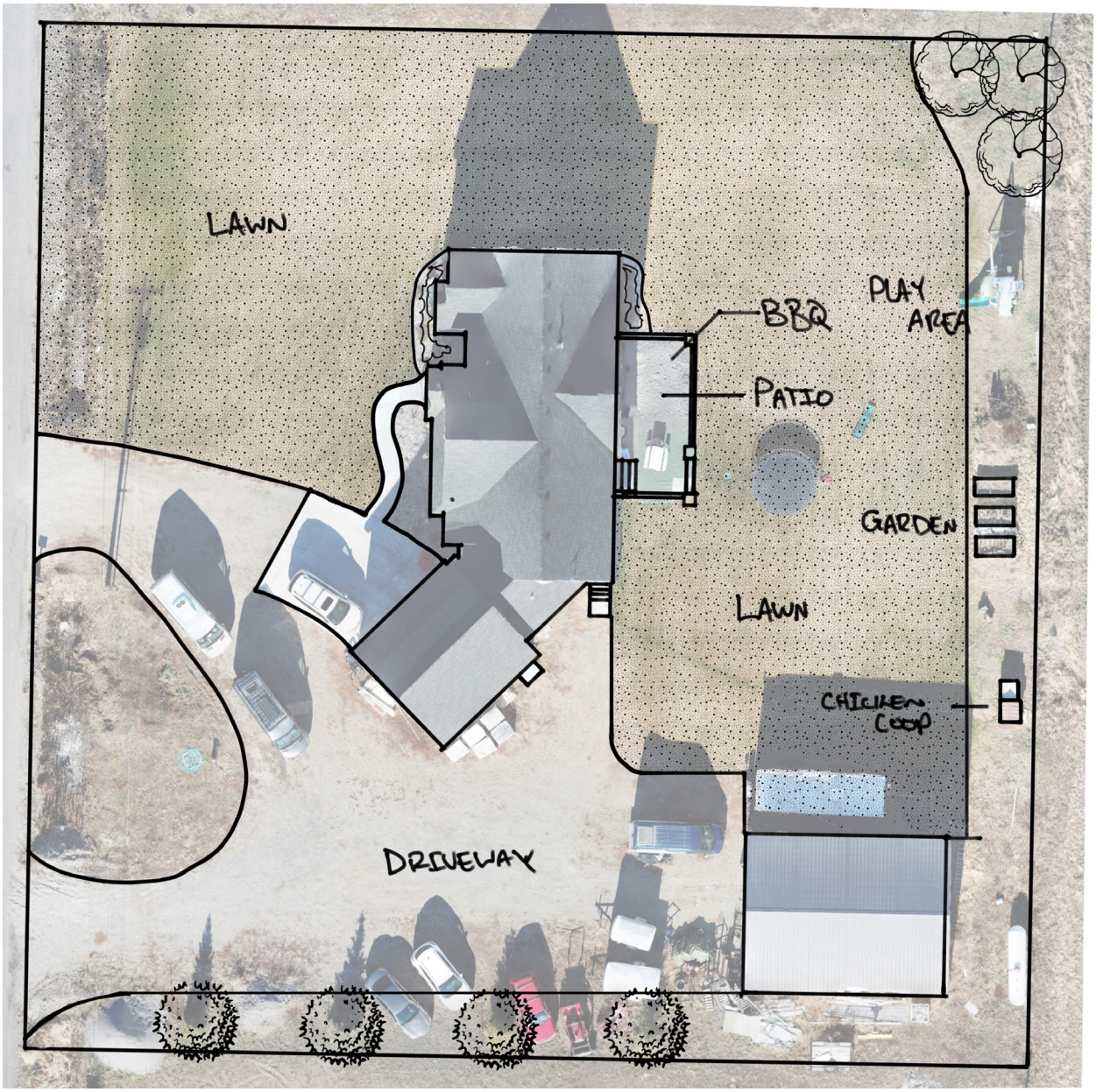


Figure 6.15 Existing landscape that's predominantly lawn with little landscape style

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
19012	35552*	6086	456*	266	3792	4*	19.2
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

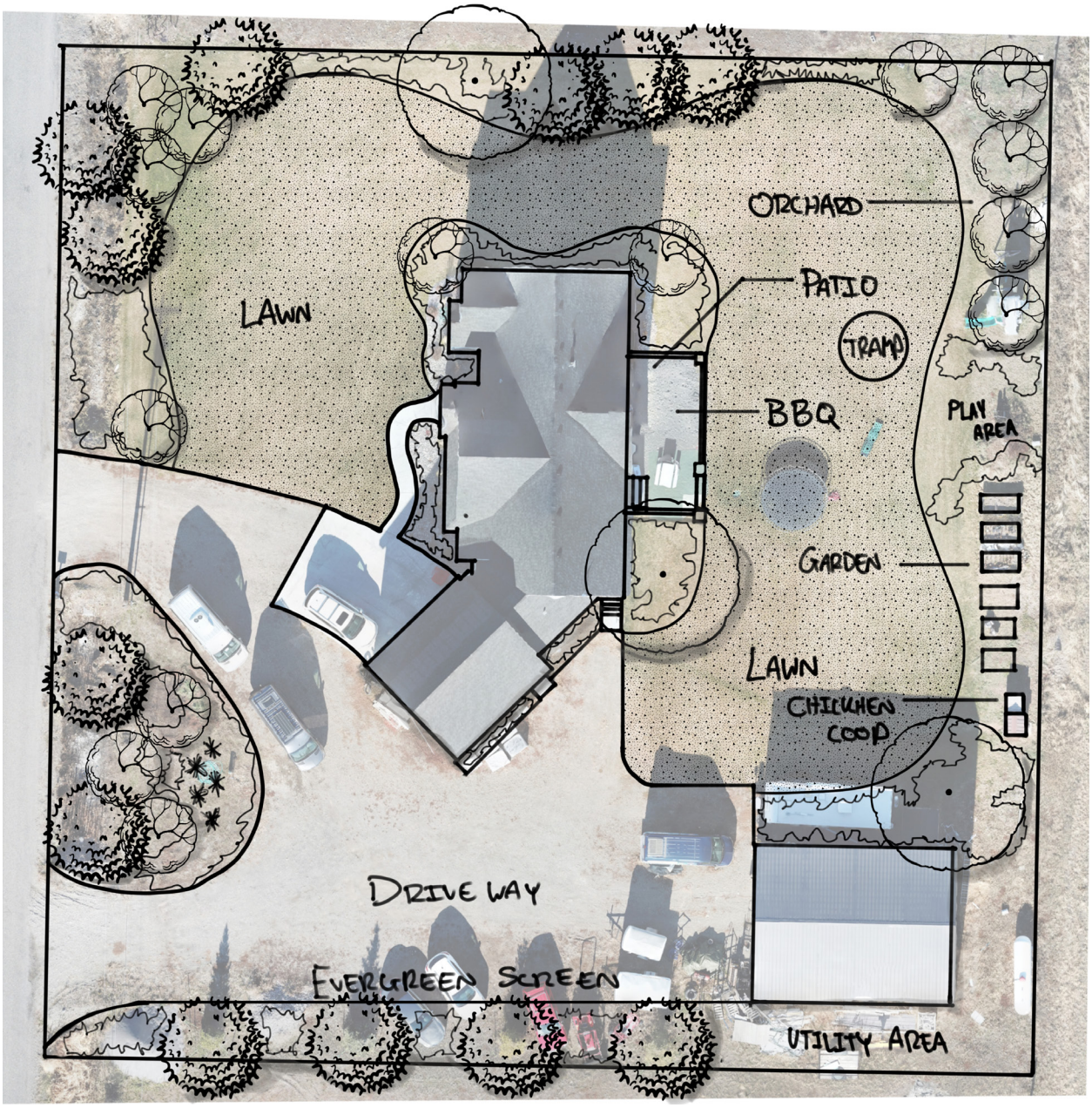


Fig. 6.16 Improved from Figure 6.15 reducing turf and improving function

Lawn SF	Gallons per week	Planter Beds SF	# of Perennial	# of Shrubs	Gallons per week	Trees	Gallons per week
13105	24506*	11912	893*	521	7421	29*	139.2
	**Based on GPM rates from Fig. 2.2 & 2.3*		**Based on 70% shrubs/ 30% perennials ratio *16 SF per shrub *4 SF per perennials*			**16 SF per tree *6.4 GPH*	

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