DEVELOPING A METHODOLOGY FOR COMMUNITY ENGAGEMENT WITH AN EMPHASIS ON STORMWATER MANAGEMENT PREFERENCES

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To Kathy and Saul

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ABSTRACT

The purpose of this project was to develop a methodology for effective community engagement with an emphasis on stormwater management. This methodology would assist landscape architects and city planners in communicating the benefits of modern stormwater practices while simultaneously gaining community input on the visual and ecological needs of stormwater management strategies at the local scale. Through qualitative research, I analyzed and synthesized: 1.) historical perspectives on stormwater; 2.) stormwater management concerns; 3.) management needs and trends; 4.) community planning and design theories; 5.) visual preference models; and 6.) design guideline approaches. This literature review created the groundwork for the development of a stormwater visual preference survey which served as a tool for initiating a dialogue between professionals and local residents.

During the Alachua Harvest Festival, a stormwater booth invited Alachua County residents to participate in taking the visual preference survey in addition to discussing their thoughts and concerns with stormwater management. The survey consisted of 8 different stormwater scenarios, each containing 3 alternatives with varied degrees of water treatment. Participants were instructed to choose their preferred alternative based on aesthetic preference and what they believe to be the most ecologically friendly. Then, participants were educated about each alternative to see if their opinions would change following their understanding of how the water was being treated on-site. Participants were asked to re-select a stormwater alternative for each scenario, this time based on aesthetics, ecology, and maintenance. A series of demographic and knowledge-based questions were also asked to evaluate significant differences in the results.

From the 78 participants, the survey results revealed: 1.) a strong desire to see more creative stormwater design solutions in their community; 2.) an interest in landscapes that showcase the technology of stormwater management; and 3.) landscapes that are more ecologically sensitive. A preference for weir systems, green roofs, rain barrels, bioswales and sidewalk planters in conjunction with a diverse selection of plants was desired over traditional stormwater management techniques of piping

water offsite. However, the survey also presented an even greater opportunity for participants to vocalize thoughts about local water quality, the cost and benefits of stormwater management, and the effects such designs could have on a growing community.

As a result, a methodology that highlights using a stormwater visual preference survey as part of a community engagement effort not only creates a foundation for communities to explore stormwater design options, but it allows a water-sensitive conversation to begin within communities. With this methodology, professionals will better understand how to create visual, interactive, socially friendly gatherings that will better involve and engage community members on stormwater design in their area. From this information, communities can then consider the formation of design guidelines that incorporate the community engagement findings in a way that best suits the needs of that community. Understanding and communicating stormwater management within a community will hopefully lead to more sustainable, functional, and aesthetically pleasing designs.

CHAPTER SUMMARY

"Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land."
- Luna B. Leopold, Former USGS Chief Hydrologist

INTENDED VALUE

This research attempts to understand the visual preferences for various stormwater solutions in the built environment, and how these preferences can influence future development plans for communities. My research is intended to provoke stormwater awareness at the community scale. Stormwater management often deals with pollutants such as sediments, nutrients, and pathogens; often undesirable and misunderstood components of daily life. My research asks the question, "In what way can landscape architects and city planners turn stormwater management into a participatory community effort that utilizes local resources in an attempt to protect quality of local watersheds?" By merging the findings of two separate sources: 1.) qualitative research and 2.) community input from my home town of Alachua, a methodology could be created that includes a series of guideline examples that follow the framework of Christopher Alexander and Joan Nassauer's recognition of patterns in the landscape.

The value of this methodology would be to initiate a dialogue within communities on stormwater management, and hopefully begin to reintegrate the technology of management strategies into the aesthetic of the land. It would not be enough to suggest guidelines for developing stormwater management designs in community public spaces without first addressing a community's environmental awareness and visual preferences.

In considering how to best communicate stormwater management techniques in *your* community, you may want to use this publication as a starting point for figuring out how to merge local opinions with the unique design character of stormwater management. Together, the opinions and concerns of a community can produce a clearer idea of how water is integrated into the public realm.

It is my hope that you develop a curiosity about how we as growing societies can influence and equally *be* influenced by the water around us... in particular, stormwater. I now encourage you to read through the following outline which briefly explains what you will find in each chapter of this publication.

FIVE MAIN CHAPTERS TO THIS PUBLICATION:

1. **The Introduction -**

   This chapter creates the ground plane for understanding the concerns with stormwater design as well as how its historical applications have evolved to how we manage water today. In addition to a historical perspective, this chapter also aims to look at concerns associated with water in the urban environment. Present day stormwater techniques and the relationship of these techniques to the health, safety, and welfare of humans is a major concern when interacting with potentially polluted water sources. So understanding what dictates the design of stormwater systems and how they are managed is critical for implementing management strategies. As concerns with stormwater affect how people react to local water the aesthetic and emotional appeal of stormwater is also examined. Together, these topics provide valuable information that lead into the communication of stormwater in Chapter Two.

2. **Background -**

   This chapter explores some of the current needs and trends of stormwater usage in the urban environment, the rhetoric of stormwater in our communities, theories of planning and ecology, visual preference models and the basics of design guidelines. This chapter addresses specific works by Christopher Alexander, Joan Nassauer, Robert Thayer, and Kaplan and Kaplan which explain patterns, theories, ecological awareness, and communication. Together, these works can be applicable toward creating spaces that encourage the protection of local water resources.

3. **Methods and Approach -**

   Chapter Three of this thesis addresses the methodology and approach of this project. A variety of qualitative and exploratory research approaches are used. These approaches involve research and public involvement as necessary factors in developing a methodology for community engagement. This chapter also delves into the 'meat and potatoes' of a stormwater visual preference survey that was conducted in the City of Alachua, as well as how community guidelines benefit from such research. This chapter concludes with the *results* of the survey and the community engagement process as a whole.

4. **Findings -**

   In this chapter, I discuss the *findings* of my research's visual preference survey and community interactions. In addition, I attempt to create local level advocacy for the preservation, conservation, enhancement, and management of water by formulating introductory guidelines for stormwater management in areas becoming urbanized. My overarching vision is that communities utilize the results from their community engagement to formulate their own forms of guidelines, with this chapter acting as a base for inspiration.

5. **Discussion and Conclusions -**

   In this final chapter, I discuss the practicalities of public input in the design of stormwater systems within growing communities, and the future research implications and recommendations for this subject area.

CHAPTER ONE: INTRODUCTION

"The need to improve water resources management relates to the more general issues of how conscious social choice can or should be used to direct the development and adoption of technological innovation and of how to improve the probability that the social choices will turn out to be truly in the best long-run interest of mankind."

- L. Douglas James, Man and Water, 1974

HISTORICAL PERSPECTIVE OF URBAN WATER MANAGEMENT

The purpose of this section is to give a brief perspective on the origin of urban water management design practices as well as significant events that have shaped how we experience water in our communities today. An emphasis on image and how people 'think' about wastewater is also addressed in relation to the historic design responses societies have had on their surroundings.

"Since the first successful efforts to control the flow of water... a very rich history of hydraulics has evolved"
- Mays, 2001

Ancient Water Management

Water management has been an essential practice to the survival of societies throughout the course of history. Spawning from a need to collect drinking water, irrigate crops, prevent flooding, and dispose of human waste, early Mesopotamians were among the first to recognize and respect the limited supply of water that was available to them (Barlow, 2002). As their cities grew in size, they became masters of the "hydraulic arts of controlling water (Solomon, 2010)." This art was a careful

FIGURE 1.1
Knossos drainage system.
(Source: Mays, 2013)

balance between sustaining life and understanding the importance of water within a city (Barlow, 2002).

However, it wasn't until the second millennium B.C. where the Minoan civilization of Crete learned to collect rain water and used extensive drainage systems to transport the water over various topographic terrain (Mays, 2001). Knossos, the modern capitol of Crete, was known for these early forms of drainage and began experimenting with various design forms (See Figs. 1.1 and 1.2). These designs were created for efficiency and served a strictly functional purpose of conveying water throughout their built structures. In many cases, rainwater desilting basins were places in walkways to allow debris and soil particles to settle out. The aesthetics of these systems were often linear in form and were not typically thought of as 'unique' until drains were incorporated into the design of drainage systems. Only Minoan palaces were known to have had drains at this time, which enabled storm water to be less visible in their living environments (Mays, 2001). Non-visible water systems was a 'design luxury' for those who could afford it.

FIGURE 1.2
Knossos rainwater channel and desilting basin.
(Source: Mays, 2013)

Drains were rediscovered by the Greeks around 700 B.C. and were no longer simply a luxury, but were modified to be a part of urban design (Mays, 2001). Still designed to be more functional than aesthetic, "components of the drainage systems included eavetroughs for individual buildings, drain pipes through walls or foundation of individual houses, collector channels in neighborhoods, and drains in public areas (Mays, 2001)." Having these systems as public commodities made these communities more efficient in design. In addition, water quality and living standards in these communities significantly improved.

The Roman Empire eventually took control of many of the Greek cities but were less educated about drainage systems when constructing new ones. Earlier cities such as Pompeii did not have a full network of storm drains, nor did they have a sense of effective urban planning (Mayes, 2001). As time progressed, newer parts of the cities branched away from having no city planning strategy and began following a square grid street pattern instead. Stone storm drains, manholes, and sidewalk curb and gutter systems were applied in logical gradient situations. Simple design strategies such as stepping stones across streets began to show signs of public safety as people interacted with the stormwater around them. Cisterns were another revelation during this time, as rain gutters collected much of the runoff from roofs and other built structures (Mayes, 2001) (See Fig. 1.3). Even well designed drainage channels were incorporated into large structures such as The

FIGURE 1.3
Early cistern design
and rain gutters.
(Source: Mayes, 2013)

Great Theater at Ephesus (Mayes, 2001) (See Fig. 1.4). The aesthetics of such a design was unique in its curvilinear form as it spanned across the floor of this theater which could hold 24,000 spectators (Mayes, 2001). The drainage channels became an amenity to the theater, molding to the form of its surroundings. The Romans marked a exceptional time of stormwater innovation and design.

FIGURE 1.4
Curvilinear form of drainage at The Great Theater at Ephesus (Source: Mays, 2001)

Unfortunately, water management declined during the Dark Ages of the Roman Empire (Mayes, 2001). After the fall of the Romans, sanitation and hygiene became serious concerns. The design of stormwater systems began to fail as human and animal waste mixed with local water supplies. Europe suffered greatly from this lack of water management, and polluted water was the cause of many disease outbreaks. It took roughly a millennium to reestablish a fully functional hydrologic system within the urban environment. (Mayes, 2001)

American Water Management and Regulation

Centuries after ancient stormwater drainage systems were developed, the Industrial Revolution marked a time where water became a tool, as well as a disposable commodity. Controlling water for the good of development was something that especially played a key role in both Europe and the United

States from 1760 to the mid 1800's (Solomon, 2010). Sewers and municipal water-supply systems were created, and around this same time, "people recognized that community health could be improved by discharging human waste into the storm sewers for rapid removal (Kemp, 2009)." Not knowing the implications of these actions, 25,000 miles of sewer lines were constructed by 1910 and directed to the closest water body as a means of "disposal by dilution" (Kemp, 2009).

During the 18th and 19th century, canals were another technological advancement that drastically altered water flow. They were constructed to further expand the travel and trade options (Solomon, 2010). In addition, they also served as a means of water conveyance, delivering potable water to cities and for agricultural irrigation; similarly to how ancient societies used water for power and city use. The modern industrial society had emerged with new frontiers in water supply, energy, and production. With this plentiful supply of water, also came unforeseen consequences. "Industrial steam power and large manufactory production had promoted rapid urban concentration (Solomon, 2010)" resulting in concerns around sewage disposal, sanitary drinking water, runoff pollution, and dropping aquifer levels.

FIGURE 1.5
Canal built during Industrial Revolution. (Source: http://socialstudiesmms.wikispaces.com/Industrial+Revolution)

Runoff pollution as well as wastewater pollution was the product of "non-existent regulations, little scientific knowledge of negative ecological and health-related effects, and lack of construction funding (Kemp, 2009)." However, water pollution began raising governmental concerns as the necessity for water treatment became apparent. Organizations and new government laws were established to protect the country's degrading water supply. Degrading water quality was "an environmental byproduct of the urbanization that accompanied early industrialization (Solomon, 2010)." Bodies of water began receiving more runoff from urban expansion, which affected much of the surroundings landscapes. Wetlands were especially affected as their numbers rapidly decreased.

Wetland ecosystems were often viewed as disease-ridden wastelands of horror, instead of indispensable kidneys of the landscape (Giblett, 1996). With this kind of perception, wetland ecosystems merely became obstacles that could easily be drained and turned into rich agricultural land. Acting as ecotones, the wetland acted as a "transition between two diverse communities (Outwater, 1996)," water and land. Without that transition, the biodiversity and productivity of life in and around those areas decrease, water is not as thoroughly cleansed, and erosion is more likely. Both natural and manmade wetlands served as essential systems for cleansing stormwater runoff, but were not often desired in the urban setting.

"In 1948, the Federal Water Pollution Control Act was instituted...the first major U.S. law to address water pollution" - EPA

By 1937, wetland and water quality issues had gained national recognition. From these issues, Ducks Unlimited was founded, which became "the leading waterfowl and wetlands conservation entity in North America (Cech, 2010)." Protecting waterfowl meant protecting their habitats, the natural wetland. By this time, over fifty percent of wetlands in America were "destroyed or degraded with continued loss estimated at over 55,000 acres per year (Cech, 2010)." However, through the Duck Unlimited organization, wetlands began making a significant comeback.

"The environment, however, paid a price, bringing about the greatest public outcry on water quality -- and corresponding legislative and executive response -- in U.S. history" - Kemp

By 1948, The Federal Water Pollution Control Act was instituted. This act was the "first major U.S. law to address water pollution (EPA, 2013)," as it enabled states to more effectively regulate pollution causing sources and protect their water resources. During the 1950s and 1960s, the U.S. government supplied funds for "constructing municipal waste treatment plants, water pollution research, and technical training and assistance (Kemp, 2009)." However, the population was booming and despite those efforts, pollution and environmental health concerns increased. This environmental degradation brought about the "greatest public outcry on water quality - and corresponding legislative and executive response - in U.S. history (Kemp, 2009)."

In 1967, several organizations were well established to protect America's wildlife and water resources. Some of these organizations included the National Audubon Society, the

National Wildlife Fund, the Nature Conservancy, the Natural Resources Defense Council, the Sierra Club, Trout Unlimited, and the Wilderness Society. The Sierra Club, known for it's mission of "exploration, enjoyment, and protection of wild places on Earth (Cech, 2010)," was founded by John Muir in order to promote "responsible use of ecosystems and resources, education , and the use of all lawful means to carry out these objectives (Cech, 2010). In 1970, Earth Day was recognized for the first time, followed by the establishment of the Environmental Protection Agency (EPA). Muir's message of responsibility and knowledge is vital to how stormwater *should* be treated in society.

In 1972, the Federal Water Pollution Control Act was amended to what is commonly known as the Clean Water Act (CWA) (Kemp, 2009). This act had six defining amendments:

> "1.) Established the basic structure for regulating pollutants discharges into the water of the United States, 2.) Gave the EPA the authority to implement pollution control programs such as setting wastewater standards for industry, 3.) Maintained existing requirements to set water quality standards for all contaminants in surface waters, 4.) Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions, 5.) Funded the construction of sewage treatment plants under the construction grants program, and 6.) Recognized the need for planning to address the critical problems posed by nonpoint source pollution (EPA, 2013)."

These amendments were major breakthroughs for America as far as how urban water was managed. Stormwater was more heavily regulated from a point source standpoint, but non-point source pollution still remained an issue. Planning for reduced amounts of non-point source pollution was difficult, and even more difficult to control.

In 1974, The Safe Drinking Water Act (SDWA) was enacted, which became one of the most "aggressive attempts at managing land use at the local level of government (Kemp, 2009)." This local level of government regulation helped establish the Source Water Assessment Program (SWAP), which required each state to provide information regarding the identification of potential water contamination sources, strategies for delineation, groundwater susceptibility, and public awareness (Kemp, 2009). This local level of government regulation more easily allows for in depth analysis of water management strategies, and public involvement. The more the public knows, the more active people will become within their communities in protecting water resources.

Summary

From the engineering feats that history has produced from water management, there has been minimal attempts at incorporating functional yet visually pleasing water management systems that become integrated into the landscape. Image was a major influence on design decisions of both wastewater and stormwater. Historically, people have put a strong emphasis on the power of image, from drain systems to wetlands. As a result, the landscape changed.

In many cases, water has been channeled and piped in ways that separate the water from its natural environment. "Through the centuries, societies have struggled politically, militarily, and economically to control the world's water wealth: to erect cities around it, to transport good upon it, to harness its latent energy in various forms, to utilize it as a vital input of agriculture and industry, and to extract political advantage from it.... today, there is hardly an accessible freshwater resource on the planet that is not being engineered, often monumentally, by man (Solomon, 2010)." Societies have found ways to be efficient in the management of water in and around the urban setting. This is a product of necessity. Population grows, urban environments expand, and we must quickly adapt to our surroundings. Unfortunately, the water resources in and around us become manipulated, and often times polluted.

"Today, there is hardly an accessible freshwater resource on the planet that is not being engineered, often monumentally, by man."
- Solomon

Organizations, laws, and regulations have helped in the management of water resources, yet we are still on the cutting edge of sustainable, water management design. Through this efficiency and sustainable design era, there are still quality and quantity concerns, image concerns, and emotional concerns that repeatedly find themselves apparent. To understand what is needed from stormwater management, one must first understand the present day concerns.

CONCERNS ASSOCIATED WITH STORMWATER

The purpose of this section is to highlight some of the contemporary issues and concerns associated with stormwater at the community scale. Historically, the design of water systems within societies were driven by need, necessity, and image. Today, water also tends to connect with the public realm on an environmental, physical, social, and emotional level. This section will therefore look specifically at the relationship between cities and nature, the health, safety and welfare of the public, and finally the aesthetic and emotional appeal of stormwater in general.

Environmental and Urban Interface

The interface between the natural environment and an urban environment greatly differ in hydrologic characteristics, presenting a series of concerns associated with water quantity, quality, and infrastructure. The human influence over stormwater design has changed the way water moves throughout its environment. This is why growing societies must understand the hydrology of the watersheds in their area and plan for effective stormwater networks. Hydrology, as defined by the U.S. National Research Council (1991), is

> "The science that treats waters of the earth, their occurrence, circulation, and distribution, their chemical and physical properties, and their reaction with the environment, including the relation to living things. The domain of hydrology embraces the full life history of water on Earth (Mays, 2001)."

This life history of water becomes more and more complex as urbanization occurs and as the relationship with living things shifts to include more human interaction. Hydrology functions within the hydrologic cycle. This hydrologic cycle is a relatively complex system of water that is often taught in its most basic form; condensation, precipitation, surface runoff, and evaporation or transpiration (See Fig. 1.6). The cycle is continuous and stormwater is a key component that is associated with surface runoff. If runoff is altered, the entire cycle is altered.

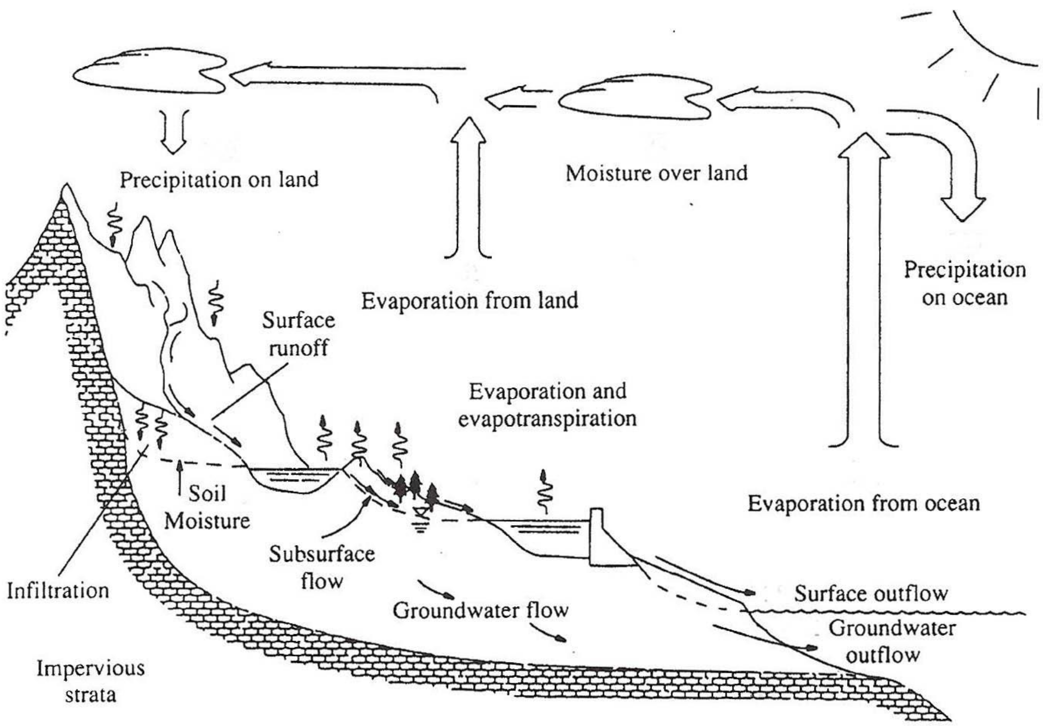


FIGURE 1.6
Environmental Water Cycle
(Source: Mays, 2001)

The environmental water cycle contains a wide variety of inputs and outputs from groundwater infiltration to surface water evaporation. Within this cycle are also multiple hydrologic systems. A hydrologic system is defined by Chow, Maidment and Mays (1988) as "a structure or volume in space, surrounded by a boundary, that accepts water and other inputs, operates on them internally, and produces them as outputs (Chow, 1988)." These hydrologic systems work to cleanse the water as it moves through the various stages. This natural purification process is what sustains life on this planet. However, the number of inputs and outputs increase from a pre-urbanized environment to a post-urbanized environment.

The distinction between a pre-urbanized hydrologic system and an urbanized hydrologic system is centered on each part of the definition of hydrology; the physical, chemical, and environmental relationships. The complexities of a pre-urban hydrologic system (See Fig. 1.7) are represented below, highlighting a direct connection between the land surface, bodies of water and how the water infiltrates into the ground. In this naturalistic environment, water precipitates on land or is intercepted by tree canopies. Tree canopies are essential for

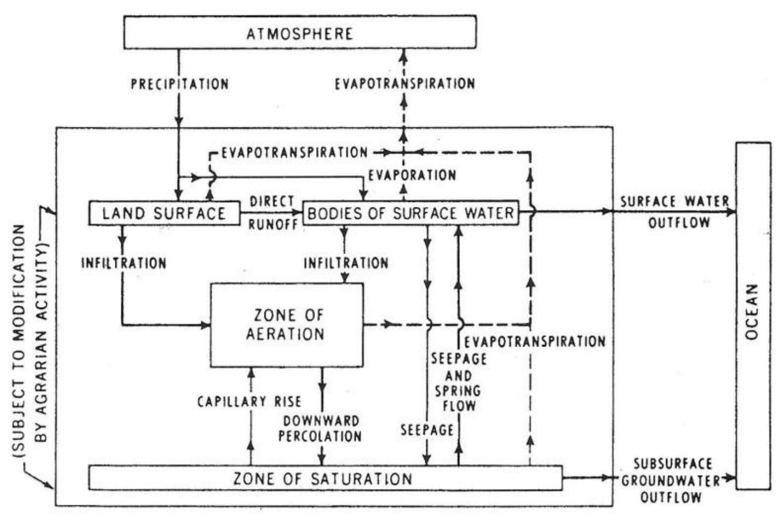


FIGURE 1.7
Pre-urban hydrologic system. (Source: Mays, 2001)

slowing runoff, as a mature tree with a 30 foot crown can intercept over 700 gallons of rainfall annually (City of Portland, 2013). The water that makes its way past the vegetation turns into surface runoff or infiltrates into the ground, becoming part of a subsurface flow (interflow) or groundwater flow (baseflow) (Davis and McCuen, 2005). Natural buffers, topographic treatment trains, and underground water tables allow water to make a journey across the land and runoff into larger bodies of water for evaporation (Mays, 2001). A cyclic balance of water movement allows water to complete the natural hydrologic system.

In a post-urbanized, developed environment, stormwater patterns, flow rates, and infiltration rates drastically change (See Fig. 1.8). The web-like matrix of water becomes even more

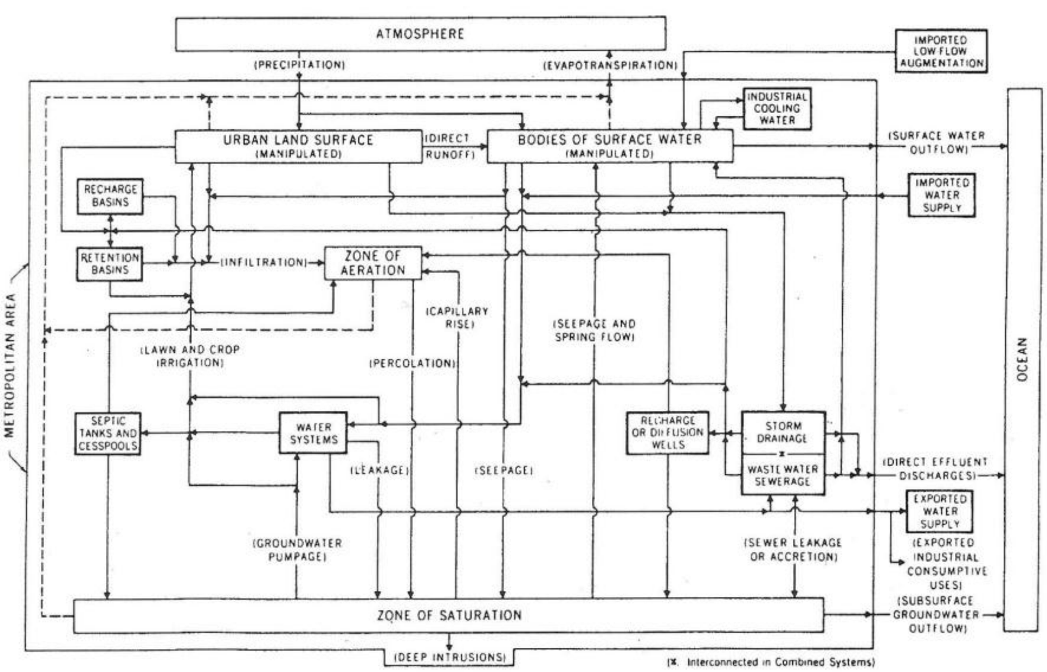


FIGURE 1.8
Post-urban hydrologic system. (Source: Mays, 2001)

complex, disrupting the natural flow of water in cities. Direct runoff still travels to bodies of surface water. However, this stage is manipulated, forcing runoff to take a variety of other man-directed paths such as storm drainage, wells, and retention basins. Development also reduces tree canopy coverage and changes the topography of the land to accommodate man-made structures such as buildings, roads, and parking lots. As a result, the quantity of surface water runoff increases, and the loss of topography eliminates effective water-holding depressions such as wetlands. Infiltration rates and subsurface interflow rates also decrease (Davis and McCuen, 2005).

According to discussions from the Emergent Urban Stormwater Conference held in 2001, the following hydrologic changes are some of the specific quantity and quality issues associated with urbanization (Urbonas, 2002):

1. Changes in Stormwater Runoff Quantity
    1. Increased runoff rates and volumes
    2. Increased frequency of runoff
    3. Changes in dry weather flow rates
    4. Changes in groundwater levels and hydrology
    5. Increased wet weather flow rates
    6. Increased "flashiness" of flows
2. Changes in Stormwater Runoff Quality
    1. Constituent concentrations and loads
    2. Water toxicity
    3. Temperature

4. Suspended solids concentrations and loads
5. Litter, debris and floatables
6. Pathogens
7. Oxygen demand and availability during dry and wet weather periods
8. Impacts on attainment of designated uses under state and federal water quality classifications and standards

(Urbonas, 2002)

Together, these issues create serious concerns for communities wanting to protect their water resources. Both quantity and quality issues directly affect the surface water runoff as well as the water that infiltrates into the ground. The graphic below illustrates the changes in the flow of surface and ground water by increasing or reducing the sizes of arrows from the pre to post landscapes (See Fig. 1.9). In a pre-development scenario, 70% to 90% of the rainfall is able to infiltrate naturally

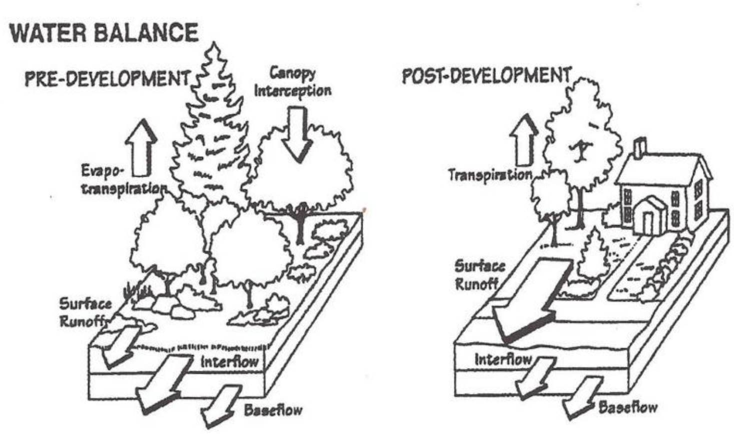


FIGURE 1.9
Effects on water runoff pre and post development. (Source: Davis and McCuen, 2005)

into the ground (Davis and McCuen, 2005). In a post-development scenario, anywhere from 10-95% of rainfall becomes impermeable runoff, meaning it is unable to infiltrate into the ground (Davis and McCuen, 2005). Therefore, post-development scenarios not only have to address increased runoff rates, but must address how to keep from reducing the amount of water that reaches the subsurface water systems.

The subsurface water includes interflow, baseflows, and groundwater. The interflow and baseflow are the two zones above the groundwater table that serve as a direct linkage to surface water. Interflow is the lateral movement of shallow subsurface water that feeds directly into surface bodies of water (Linsley, et.al, 1964). Baseflow is a deeper lateral movement of water, before reaching the groundwater (Wikipedia, 2011). The following graphic illustrates the amount of water that can

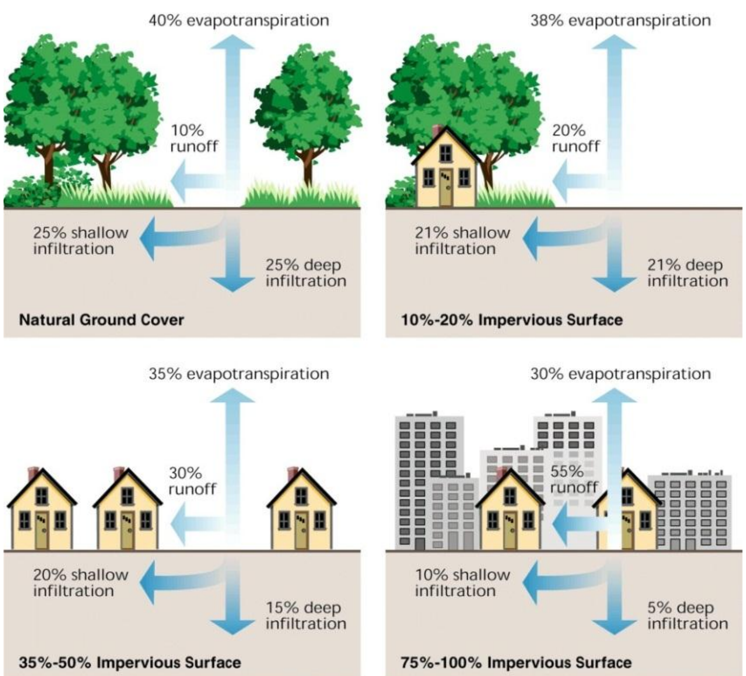


FIGURE 1.10
Effects on runoff and infiltrations rates with development.
(Source: NRCS, USDA)

actually infiltrate into these shallow and deeper flow zones (See Fig. 1.10). The heavier the development, the less water is able to infiltrate, which in turn affects the natural hydrology of a settlement.

Infrastructure

Another major stormwater concern, and perhaps one that is not often discussed, is infrastructure. Water and wastewater systems are aging, causing man-made stormwater networks to slowly become inadequate. These systems mainly include pipes, canals, sewer systems, and water treatment facilities. Water and wastewater utilities in the United States alone make up more than 800,000 miles of water pipe and more than 600,000 miles of sewer line, according to the U.S. Government Accountability Office (Kemp, 2009). The problem is somewhat a hidden issue, but will surface in time... both literally and figuratively, as one-third of utilities and one in five pipelines are reaching the end of their structural life (Kemp, 2009).

Professional and advocacy groups have identified America's aging water and wastewater infrastructure as a top concern (Kemp, 2009). However, the funds to repair such an elaborate system of pipes, culverts and water treatment facilities are extensive. Federal funds reach deep into the pockets of local communities (Kemp, 2009). Communities that cherish their local water resources, yet are often unaware of stormwater alternatives. Robert McMillion, former assistant water director of Fort Worth, Texas and former president of WEF stated,

> "There is no doubt that water and wastewater services help protect public health and the environment, but the water quality community is in an unsustainable position. We are faced with a mandate to protect water resources with aging, capacity-limited or nonexistent infrastructure assets, and diminishing financial resources and commitments. Locally, and across the nation, we need to determine where the funding will be found (Kemp, 2009)."

McMillion highlights a very key issue of how the water quality community is in an 'unsustainable position.' He bases this assumption off of the growing demand of new infrastructure and the dwindling resources needed to produce them (Kemp, 2009). Communities are presented with a financial burden when wanting to adopt more sustainable water practices, even after more than 8 in 10 Americans believe that clean water is a national issue that deserves federal investment (Kemp, 2009). The development of a strategy for infrastructure sustainability is growing interest among local and federal level interest groups, and will continue to be a headlining issue as more and more infrastructure failures occur (Kemp, 2009). Tim Williams, director of government affairs at the Alexandria, Va.-based Water Environment Federation (WEF) stated that,

> "Overall, there appears to be a general understanding of the infrastructure issue... however, considering the magnitude of this problem, [water quality professionals] need to be more proactive in educating public policy makers, local legislators and the general public about the implications of not making investment a priority (Kemp, 2009)."

Public education of stormwater concerns leads to more elections of policy makers that care about local water issues. Are stormwater concerns being properly educated to the public? Is the communication of stormwater the bigger issue? "The answer to storm water management does not include creating bigger and more expensive storm water management systems. Rather, it means changing our philosophy and methods to implement true water management systems that actually prevent and treat storm water pollutants (Kemp, 2009)." Changing the philosophy and methods of stormwater management requires a closer look at how communities interact with their local water supply.

Health, Safety, and Welfare of the Public

Stormwater management is more than just a quantity, quality, and infrastructure concern. The health, safety, and welfare of the public is equally a concern worth taking into account. With a variety of impervious surfaces throughout urban environments, the general public is more closely exposed to contaminants in stormwater and groundwater (See Fig. 1.11). The quantity and quality of our nation's fresh water supply is not just a pollution and treatment concern, it presents growing concerns with the health of communities as a whole.

Pollutants are mainly considered to be a water quality concern, however, the relationship people have to these chemicals could potentially affect people in ways that are

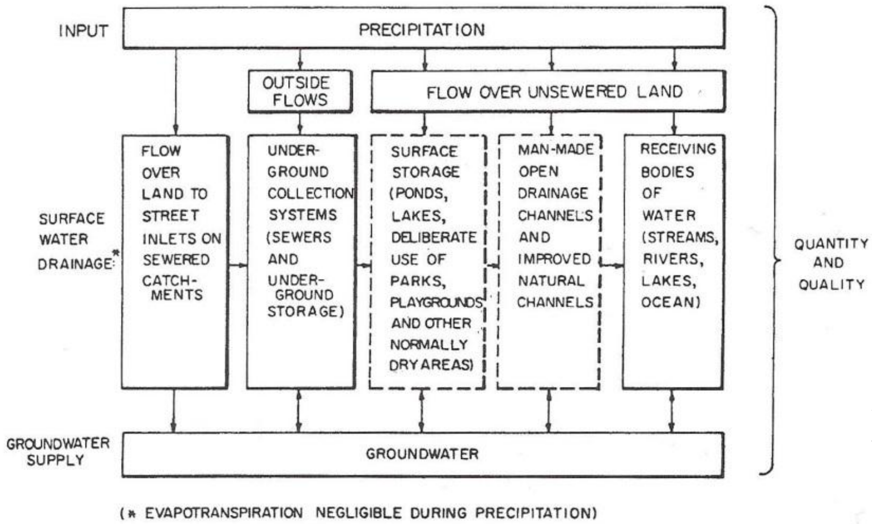


FIGURE 1.11
Urban stormwater flow chart.
(Source: Mays, 2001)

difficult to regulate. Meeting the current national, local, city and watershed rules and regulations pose the greatest challenge in stormwater management practices and nitrates and phosphates are at the forefront of concern (Kemp, 2009)." Nitrates are soluble in water, can travel great distances through soil and groundwater supplies, and are often due to fertilizer leaching or automobile byproducts (Kemp, 2009). Phosphates are known to bind to soil particles and are often a key component in agricultural soil (Kemp, 2009). Heavy rain events and erosion can cause rapid spread for both nitrates and phosphates across the landscape and inadvertently into the groundwater supply.

The health of the public heavily relies on water quality and a clean aquifer, which often falls victim to nitrate and phosphate pollution. This is often the case in the state of Florida where groundwater is clearly becoming compromised. As one article from the Gainesville Sun phrases it, "We're at a crossroads. It's time for us to command Florida's best future. Let's use inspiration and creativity as our springboards of choice to create a paradigm shift in how we live and make a living," as it refers specifically to the dropping levels in the Florida aquifer, the loss of natural springs, and the dangerous rise of nutrient levels (Pais, 2012). The article concludes by stating that "without the valiant and responsible effort of elected officials, citizens and the business community, we may lose this priceless legacy [Floridan Aquifer] that we love and depend on for our livelihood (Dame, 2012)."

"Let's use imagination and creativity as our springboards of choice to create a paradigm shift in how we live"
- Pais, The Gainesville Sun

The close interconnectivity of people to our water bodies goes beyond pollution and runoff rates. The very welfare of our landscapes depends on how we manage our water. From proper management comes healthier ecosystems, safer drinking water, and stormwater that is no longer a hazard, but a natural amenity to the public.

Water Management Strategies

We owe it to ourselves, our communities, our state and our country to protect our water resources, from how it moves across urban environments to how it infiltrates into the ground. Stormwater practices directly affect the groundwater and surrounding water resources, so Best Management Practices (BMPs) were developed to help regulate water management practices.

BMPs work to correct some of the management issues surrounding water, yet stormwater is still often treated as a constantly moving waste product (Kemp, 2009). This means that water is transported across rooftops, roadways, parking lots, curb-and-gutter systems, drains, and sewers, collecting and redistributing pollutants across the landscape. One answer to stormwater management "does not include creating bigger and more expensive stormwater management systems... rather, it means changing our philosophy and methods to implement true water management systems that actually prevent and treat stormwater pollutants (Kemp, 2009)." The welfare of the public not only centers on clean water, but maintaining healthy practices that encourage active stormwater management. In reference to Florida's water management, Paul Owens of the Orlando Sentinel stated,

> "Environmental groups and state officials have been sparring for more than a decade over whether Florida is doing enough to protect the state's waterways from pollution. The stakes are huge: The quality of Florida's rivers and springs is critical to the state's environment, economy and water supply... but environmental groups contend that the state rules aren't stringent enough to restore Florida waterways degraded by pollution, especially from nutrients in run-off from streets, storm drains and septic tanks (Owens, 2012)."

Many states across the country are experiencing similar water issues, and it's a concern that affects the public. Former Senator Ed Muskie of Maine made this statement regarding water and our need to restore it:

> *"Can we afford clean water? Can we afford rivers and lakes and streams and oceans which continue to make possible life on this planet? Can we afford life itself? Those questions were never asked as we destroyed the waters of our nation, and they deserve no answers as we finally move to restore and renew them. These questions answer themselves."*

Senator Ed Muskie of Maine, arguing for the passage of the Clean Water Act in 1972

The EPA's approach to stormwater management is driven by "internal goals and federal requirements," and they have "developed strategies that guide the stormwater-related actions EPA takes and help produce results such as reductions in site runoff volumes and improved stormwater quality." (EPA, 2012). However, the positive effects of such strategies are just beginning to show. Are there more local and proactive approaches to implementing stormwater management strategies that engage community members to the efffects of BMPs?

Today, Low Impact Development (LID) strategies have been added to the list of approaches to stormwater management and design, as a way to better the health, safety and welfare of the public in a way that is both functional and beneficial to the environment. The aesthetic component of such strategies is still being addressed, as there are more and more innovative designs that are beginning to surface.

Aesthetic and Emotional Appeal

Stormwater is a component of both natural and urban environments that we recognized and experience on a daily basis. Yet, the question of how stormwater contributes to the aesthetics of the landscape is something that is given little thought. History has dictated that stormwater is a byproduct of urban growth. The more we build, the more stormwater runoff becomes a nuisance.

In 1869, Frederick Law Olmsted became a "pioneer of stormwater conveyance, when he implemented it in the new community of Riverside, Illinois (Ferguson and Debo, 1990)." Riverside is a 1600 acre community known for its early design innovations of successful suburbs (“Riverside,” 2011). Scenic views, open space for recreation, curvilinear streets and slopes made for an exceptional living area (“Riverside,” 2011). At the time of Riverside’s construction, cars were not yet invented, and horse manure and mud created difficulties for people walking (Ferguson and Debo, 1990). Olmsted stated "there was a nuisance problem, an *aesthetic* problem, a public health problem" and that the "better alternative was to drop the stormwater and all the filth it carried off the streets, into a system of buried pipes (Ferguson and Debo, 1990)." This water management technique of buried pipes was a state of the art solution to large areas of development. Unfortunately, these pipes discharged into the Des Plaines River (Ferguson and Debo, 1990).

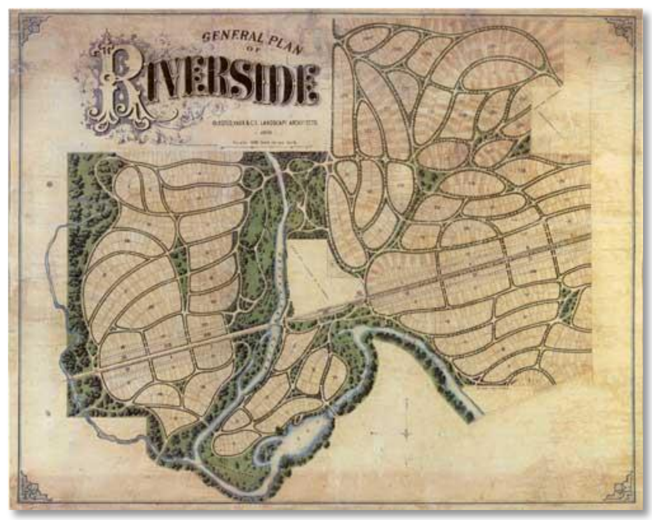


FIGURE 1.12
Master plan of Riverside. (Source: http://www.riverside.il.us/)

From the historical overview section, it was learned that many developments across the country began mimicking the ‘disposal by dilution’ practice by directing pipes to the closest water body (Kemp, 2009). The effects of these actions temporarily solved the aesthetic nuisance of standing water in new developments, yet merely redirected the nuisance of pollution to another location. Riverside, as well as other nearby establishments, eventually contributed to The Des Plaines River becoming listed under the Clean Water Act as an impaired water due to urban runoff (EPA, Illinois, 2012).

The appeal of piping the stormwater away was a type of management that is still regularly taught in design more than a century later (Ferguson and Debo, 1990). Although our methods of piping stormwater have drastically improved due to our understanding of pollutants and the regulations that support clean water, there still seems to be a greater appeal of piping water rather than exposing it. Designs of stormwater control systems are mainly based on high flow rain events and have been "inadequate for mitigating" urban runoff (Davis and McCuen, 2005). Overall, these systems have the purpose of removing and conveying runoff from the site as quickly as possible (Davis and McCuen, 2005).

In the case of the Des Plaines River and other similar sites across the country, BMPs were later enacted, which significantly changed how runoff was managed before discharging into rivers (EPA, Illinois, 2012). BMPs have evolved toward crafting devices that filter and capture floating debris or gross visible pollutants with additions such as catch basin inserts, traps, filters, vortex cyclone flow devices, in-line diversion screens, manhole baffles, capture screens and floating barriers (Kemp, 2009) (See Fig. 1.13).

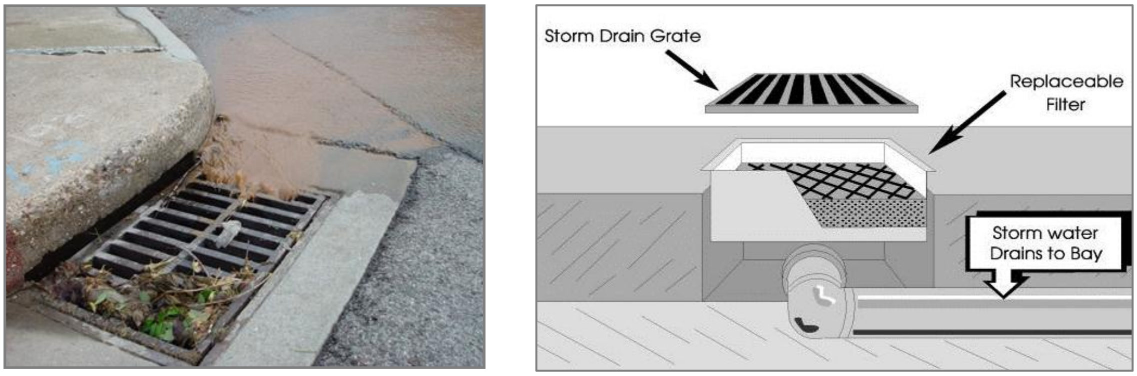


FIGURE 1.13
BMP catch basin filter before (left) and after (right). (Source: WBjournal, 2012) and (Source: Stormwater BMP Decision Support Tool, 2013)

As effective as these systems are with small rain events, they often produce maintenance issues during heavier rain events, which in turn produces a visually unappealing overflow of debris. Filters also have to be checked, cleaned, and often replaced over time. Detention and retention basins are larger structures that attempt to compensate for larger storm events. A detention basin is an area where excess stormwater is stored or held temporarily and then slowly drains when water levels in the receiving channel recede (Brayes, 2010). A retention basin also stores stormwater, but the storage of the stormwater would be on a more permanent basis. This differs greatly from a detention basin, which typically drains after the peak of the storm flow has passed, sometimes while it is still raining (Brayes, 2010).

Retention and detention basins are useful in storing water, yet can often produce concerns to the public. They are often "expensive to build and to maintain, they tend to control real estate, stir up material during construction, pose liability hazards, are aesthetically unappealing, create mosquito-breeding habitat, provide minimal recharge to groundwater, and they promote the re-suspension of pollutants (Kemp, 2009)." The unappealing aesthetics of the basins often come from the nature in which they are designed. Often designed to meet the minimum design requirements, much of the aesthetic and ecological needs of these systems get overlooked. Stormwater basins that are designed within the National Urban Runoff Program (NURP) are better suited to BMP standards, yet "fail to attempt to address, much less change, the foundational philosophy of such systems (Kemp, 2009)." Adapting the aesthetics of BMP standards requires more than just an understanding of the technical and physical changes, it also requires a closer look at the relationships we have with ourselves and the surrounding environment.

Aesthetics and Life Essentials

The philosophy of stormwater BMP systems directly relates to what Thayer describes as being a part of "a human life essentials triangle (Thayer, 1994)." This triangle outlines three essentials of the context, means, and reasons for living (See Fig. 1.14). All of the essential elements within our lives that contribute to why, how, and where we live are key to understanding the basic needs of a fulfilling environment. By applying stormwater to this triangle, we begin to see and understand an aesthetic and emotional disconnect between our lives and the water that we interact with.

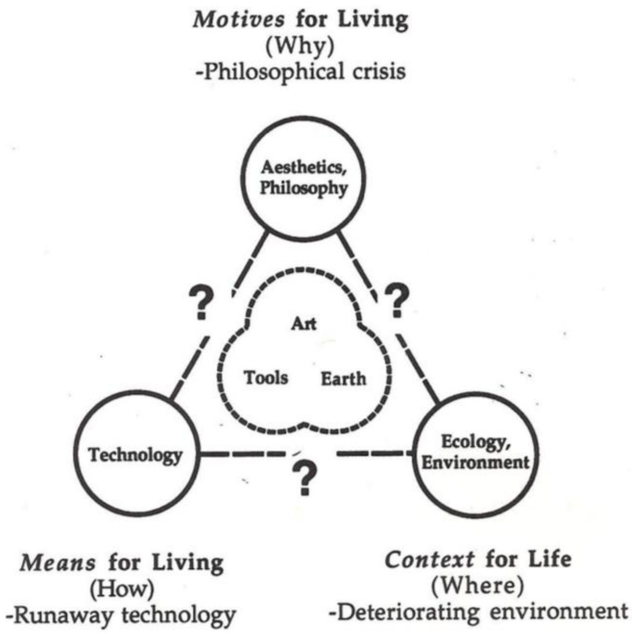


FIGURE 1.14
Thayer's Context, Means, and Reasons for Living. (Source: Thayer, 1994)

One corner of Thayer's human life essentials triangle is the "means for living and survival, first encompassing utilitarian tool use and ultimately, all of technology (Thayer, 1994)." The technology that stormwater uses is centered around function; function and conveyance. Stormwater is indeed a piece of how we live, yet is not a *means* for living with water. Hidden and misunderstood, "the landscape we now inhabit betrays the migration of technology and nature away from each other, and away from the center of our collective being (Thayer, 1994). Water within nature, and the technology used to manage it coincide. Visually, this connection is not always effective, but "at the root of technology may lie a hard-wired human predisposition to invent tools and use them creatively to solve problems (Thayer, 1994)." Problems, such as water pollution and management.

Another corner of the triangle is the "context for life, encompassing our relationship to the earth, atmosphere, artifactual environment, and other living things and beings (ecology in the broadest sense) (Thayer, 1994)." Water sustains life and is a key ingredient in the natural environment. The ecology of our urban environment is fragile, as we as societies work to design environments that refrain from deterioration. How stormwater fits within the urban ecological network has proved to be difficult. Increased knowledge of stormwater management has allowed more of an understanding of the relationship between cities and the natural environment (Davis and McCuen, 2005). However, "costs, current regulations, and public acceptance can discourage these ‘green’ designs from being implemented (Davis and McCuen, 2005)." Connecting how the technology of stormwater management relates with the context of the urban ecology is a possible reason why public acceptance is not occurring. The means for living and the context for life are some of the more prevalent issues when discussing the success of an urban society; however these factors are often so far stretched from each other that the *motive* for living is lost (Thayer, 1994). It's this motive that innately drives the public to appreciate their environment.

"At the root of technology may lie a hard-wired human predisposition to invent tools and use them creatively to solve problems"
- Thayer

The final corner of the human life essentials triangle encompasses the "reasons, or motivations for living, including aesthetic experience, art, and other affective states relating to the quality of our existence (Thayer, 1994)." It is this aesthetic appreciation for stormwater management that fails to answer *why*. We understand what stormwater does, where it goes, and how it becomes polluted, but do we truly understand why it's not a more omnipresent characteristic in the urban landscape? Could an aesthetic, artistic, and slightly more philosophical design approach to stormwater management change how societies view water in the landscape? Thayer particularly addresses our connection in the natural landscape by stating, "The American landscape simultaneously reflects our deep reverence for our natural context, our ingrained tendency to solve problems creatively to survive, as well as our discomfort with and apparent inability to tolerate living in a physical world comprised largely of the products of our own creation (Thayer, 1994)." Solving problems with stormwater management in creative, visually pleasing ways could indivertibly reconnect Thayer's triangle of life essentials.

"There may be no such similarly innate human mechanism for living in a world of our own creation."
- Thayer

CHAPTER SUMMARY

The historical applications of stormwater management as well as the health, quality, and aesthetic concerns with water management helps to further understand how we as a society address environmental issues in our communities. Our past shows that there have been great technological and governmental strides that push towards a better future for water management. From basic water storage and conveyance through pipes, to the use of BMPs to help regulate some of the stormwater systems, water management is viewed as a necessity for the health, safety and welfare of the public. Water quality and quantity continue to raise their own sets of concerns as societies increase in size, yet the aesthetic and emotional appeal of our environments also play a significant role in how we make water-related decisions. Cities are growing, yet our understanding of stormwater grows with them, leading to more technological advancements, environmental awareness, and ecological benefits.

Yet, how do these changes relate to current needs and trends of stormwater in our urban environments? Are cities integrating stormwater management into the planning and ecology of the public domain? The following chapter will explore some of the trends, theories, and methods that encompass the planning of stormwater management at the community scale.

CHAPTER TWO: BACKGROUND

"In the end we will conserve only what we love; we will love only what we understand and we will understand only what we are taught." - Babe Dioum, Environmentalist,1968

STORMWATER MANAGEMENT NEEDS AND TRENDS

The purpose of this section is to give a brief overview on the some of the current needs and trends of stormwater usage and management in the urban environment. How the public responds to these trends, as well as how societies are predicted to adapt to the needs of stormwater is also addressed.

Urban Effects

Stormwater management is regularly impacted by population and urban growth, creating a number of different management needs and trends. According to the U.S. Bureau of the Census, the world population is expected to increase from its currently estimated 7 billion to over 9 billion by 2050 (U.S. Bureau of the Census, 2013). With this increase in population, Earth's resources are to become more and more strained, driving societies to reexamine their management strategies.

In addition to population, "several trends are putting increasing pressure on water supplies: income growth, spatial concentrations of people, the widening range of uses to which water is put, and the need to disperse and to transport waste products of all kinds (Chrisholm, 2013)." With all of these population-influenced trends combined, "the management of water resources will become increasingly complex, especially in regions where precipitation is low, highly seasonal and/or variable (Chrisholm, 2013)." These regional water resource concerns are mainly centered around the unpredictability of rain

"...the management of water resources will become increasingly complex..." - Humanity Development Library

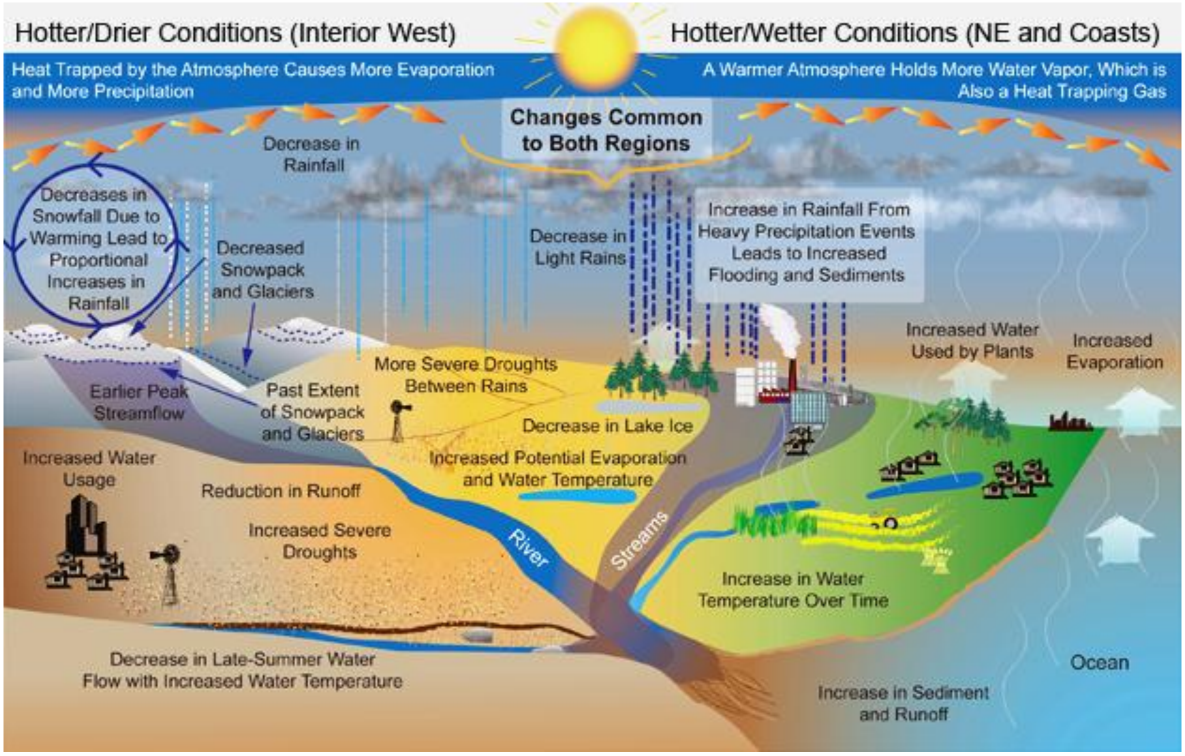


FIGURE 2.1
Projected water cycle changes in the United States. (Source: U.S. Global Change Research Program, 2009)

and weather events, which makes the design of effective water management more difficult. The National Oceanic and Atmospheric Administration (NOAA) and the National Climatic Data Center (NCDC) recreated the water cycle based on these predicted changes in the United States and produced a graphic that demonstrates some of these hydrologic changes (See Fig 2.1). Depending on the region, rain events and atmospheric changes greatly impact the amount of sediment and runoff that travels across the landscape. It is difficult to predict exactly when these changes will occur, although understanding the trends of water management will help dictate how we as growing societies will address some of these concerns. In addition, understanding the values of societies, and how much they understand these changes is equally as critical.

Public Awareness and Values

Forty years ago, the focus of what people wanted from resources management shifted. Societies began to move away from "the physical performance that engineers [had] been trained to provide (James, 1974)." Instead of this traditional approach, there was "a new emphasis on social and environmental values" that was introduced, creating an "interdisciplinary flavor into the water planning efforts in the federal agencies (James, 1974)." Today, this stands true as the management of water resources is requiring more creative design solutions within urban planning. In order to maintain healthy ecosystems, the needs of both urban and rural water requirements "will require hard thought about the priorities for water use (Chrisholm, 2013)." Having an interdisciplinary design team of engineers, landscape architects, soil scientists, hydrologists, and other water specialists all focused on these priorities for water is developing into a more common practice.

The needs of urban communities require "safety of life and property from floods, flowing streams for amenity and the environment, and secure quality and quantity of water supplies. It is not enough to dispose surface waters into streams during storms... on-site stormwater must be managed (Ferguson and Debo, 1990)." As a means to protect the quality of local water resources, stormwater is becoming more integrated into the public realm. Stormwater in public parks is becoming a key design element, in addition to being an amenity. This trend is a unique way of handling stormwater management, and "there is no question that the marriage of stormwater retention and parks will become more common in the coming decades, for both ecological and economic reasons (Harnik, 2010)." Stormwater parks as a management solution and recreational location is a relatively new concept that is gaining recognition throughout communities.

Public awareness of stormwater is one of the main drivers for successful stormwater designs. As this awareness increases, "potentially even more could be done... in some cases boardwalks, benches, and interpretive signage could be added to these natural and manmade marshy areas to put them to double use for walking running, and cycling (Harnik, 2010)." Simple design additions like these attract the interests of growing communities concerned with local water resources. New trends in multipurpose stormwater parks are just recently exploring new approaches such as using these areas for “dry-weather playing fields or skateboard parks if they are fitted with proper warning signage, fencing, and a commitment to hosing down residue following each high-water incident (Harnik, 2010)." Other design enhancements are following the "green movement," which includes green roof design, green streets, water storage, and more permeable surfaces. Especially in America, "cities are today on an upward trajectory... [cities] are enormous and intricate economic engines, but ultimately they are creatures of human free will and respond to people's desires for livable environments (Harnik, 2010)." Growing cities are to be better designed with stormwater in mind and are following a "path toward making modern cities, softer, more beautiful, more sociable, more fun, more ecologically sound, and more successful (Harnik, 2010)."

"there is no question that the marriage of stormwater retention and parks will become more common in the coming decades...
- Harnik

Public amenities with a focus on stormwater are a great benefit, as "several writers stress greater citizen awareness and participation as critical to efficient water resource use (James, 1974)." One particular study of the Delaware Basin listed four keys to "maintaining effective public participation in the development of water resources as 1) real problems, 2) concerned citizenry, 3) dynamic leadership, and 4) cooperative agencies (James, 1974, pg.169)." Public participation is a common practice when creating local awareness on water quality and resource concerns, however, including the public in the design and management of stormwater specifically is not as apparent.

PLANNING OF STORMWATER IN OUR COMMUNITIES

The purpose of this section is to give a brief overview on how societies ethically relate to water concerns, the communication process of engaging the public, and various perspectives on planning communities and environments. Several successful community engagement studies are discussed that deal with planning stormwater strategies. In addition, several literary dialogues on the pattern language of design, environmental ecology, bioregional thought, and visual communication are related back to methods of effective stormwater design at the community scale.

A Water Relationship

There is a strong disconnect between water and the human understanding of how we impact water-based systems. On global, provincial, and community scales, water-related issues often have similar problems of pollution, management, regulation, usage, communication, and awareness. Stormwater management is particularly important because it is heavily, if not completely, governed by the practices of humans. Well-designed stormwater spaces and water-based community programs that are directly connected to stormwater systems can act as frameworks for connecting people to their watersheds. While communities are becoming more urbanized, it is the responsibility of planners and designers to not only focus on stormwater management design, but to involve and engage community members to the effects of such a design. Author Cynthia Barnett references local awareness by stating:

> "Local water leads to wiser, more ethical use, and makes us good neighbors. But it is also key to the blue revolution for closing the distance between Americans and their water. It reconnects us to water and watersheds --- the land that drains to streams and rivers --- in the same way Saturday morning farmers' markets have reconnected us to local produce and the men and women who grow it. (Barnett, 2011, pg. 223).

Being able to create wiser, more ethical uses of stormwater in a community through design is not a new procedure. However, being able to do so in a manner that promotes interactive and current technologies, is ecologically effective, and is aesthetically pleasing, is.

Understanding different societies and how they manage their stormwater within populated areas while integrating community involvement could provide some interesting conclusions. The following passage is taken from the book *Man and Water*, and it introduces this section to our relationship as people to our management of water:

> "Water resources management suffers as alternatives are overlooked, consequences are unforeseen, the wishes of the people are misunderstood, formulated policy is ineffectively implemented, or the consequences of installed projects are not recognized. Social scientists need to determine how to do a better job of defining alternatives, predicting consequences, remaining responsive to current objectives, implementing policy, and monitoring effects of implemented policy. The need to express their findings in a manner that effectively communicates with practicing planners and to train working technicians to make the day-to-day applications. The planners need to digest the findings, abstract the implications to their work, and change policy as appropriate.
>
> The need to improve water resources management relates to the more general issues of how conscious social choice can or should be used to direct the development and adoption of technological innovation and of how to improve the probability that the social choices will turn out to be truly in the best long-run interest of mankind. Blending the contributions into practical applications will be required, but the most difficult task of all may be getting people from diverse backgrounds to work together. No exercise such as this can hope to do more than provide a pause to reflect and then a little help for doing a few things better (James, 1974, pg. 30)."

Improving our water resources comes with the idea that we need to understand the importance of management and incorporate public opinion. in the design process. Understanding various means of community engagement, as well as the philosophies of planning communities and natural environments can begin to shape how to apply better stormwater management guidelines.

Community Engagement Studies - Water Management

Study 1: Malmö, Sweden

The City of Malmö, Sweden is known for its unique, co-operation strategies of stormwater BMPs. Since the late 1980's, this community has been actively using BMPs, but it wasn't until the late 1990's where inhabitants in the Augustenborg started playing a very active role in the planning and the design of new stormwater systems (Urbonas, 2002). Stemming from a concern for surface water quality, all new developments in Malmö are currently planned with special consideration of the drainage of stormwater (Urbonas, 2002). Stormwater is viewed as a 'positive resource' in the urban environment, rather than a hinder. However, what makes this notion so successful are the consideration of aesthetics, multiple use, and public acceptance of the technical solutions (Urbonas, 2002).

FIGURE 2.2
Malmö, Sweden
(Source: Courtesy of Google maps)

"Sustainable stormwater management" is a phrase that is commonly used throughout Europe as an aesthetic solution to water quantity and quality concerns (Urbonas, 2002). Malmö was able to carry this concept further by incorporating public participation in the policy, design, planning, and management of stormwater. They developed an official policy document that outlined strategies that supported their stormwater goals. Based on this document, they invented a new process "from vision to realization of a typical sustainable stormwater project in the city (Urbonas, 2002)," which differs from the more traditional planning approach that was previously used by the city (See Figure 2.3 and 2.4). Various branches of the Swedish city governments, including city planning, parks, water and

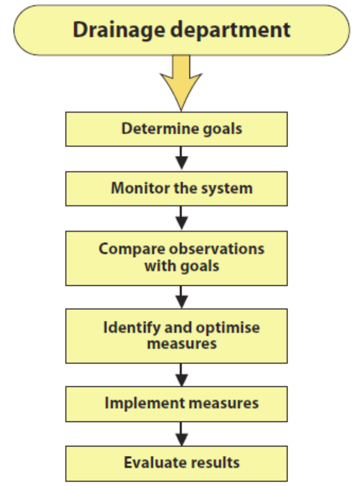


FIGURE 2.3
Traditional Planning Approach, Sweden. (Source: Stahre and Geldof, 2003)

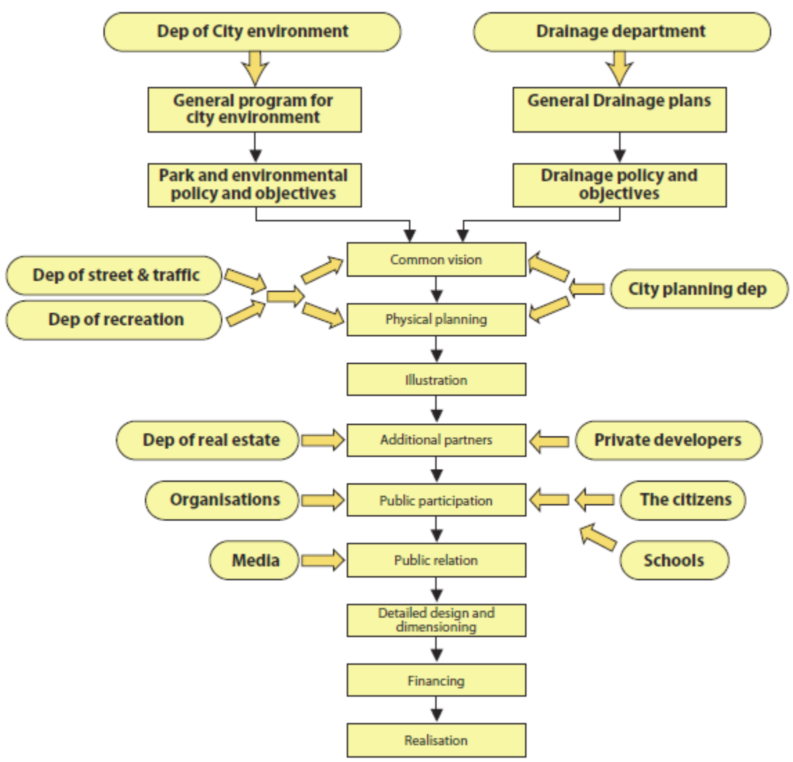


FIGURE 2.4
Vision to Realization Process - sustainable stormwater project, Sweden. (Source: Stahre and Geldof, 2003)

wastewater branches, all work together to create site-specific objectives. Once these objectives are fully integrated in an initial master plan phase, public participation is then integrated into the early stages of design.

During the design and implementation phase, Malmö prioritizes public participation as an important factor to the success of the projects. They seek support from "citizens, schools, and other pressure groups in the area" in addition to "a humble attitude to public demands and requests that will facilitate the public acceptance" of a design (Urbonas, 2002). Additionally, Malmö extends public awareness of their projects by incorporating local media in the promotion of the sustainable stormwater management ideas (Urbonas, 2002). Using the local media, Malmö is able to properly promote city meetings, public exhibits, and events (See Fig. 2.5). This ensures that families, students, public officials, and local organizations are fully aware of the developments that happen in and around their community.

FIGURE 2.5
Swedish public exhibit on community sustainability.
(Source: Lund University, 2013)

Together, these strategies formulate an integrated planning approached to sustainable stormwater design within Malmö (See Fig. 2.4). Malmö prides itself for recognizing that “real integration is only possible when science and practice interact intensively [and] science from a distance is not sufficient

(Stahre and Geldof, 2003)." All of these values that contribute to planning process, and are key elements to communicate to the public. Formulating a vision from these values is what "makes people enthusiastic, like citizens, politicians, and people from other municipality departments (Stahre and Geldof, 2003)." This integration initiates collaborative discussion, a collective sense of value, a clear understanding of local ecology and aesthetic preferences, and in turn, a successful, sustainable, stormwater management design (See Fig. 2.6).

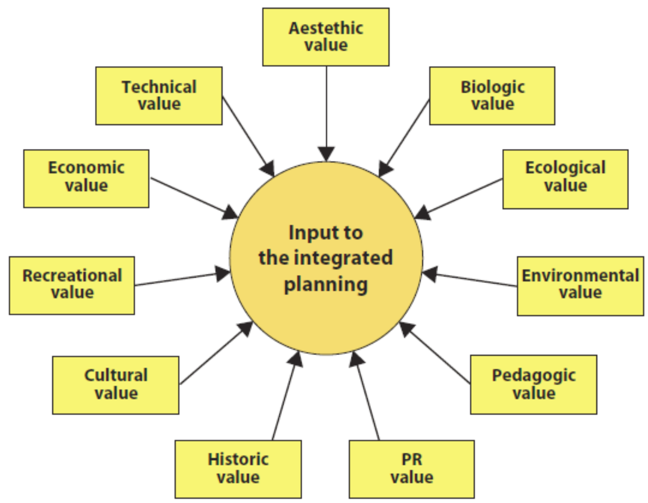


FIGURE 2.6
Swedish values associated with sustainable stormwater drainage systems.
(Source: Stahre and Geldof, 2003)

By incorporating aesthetic values into the integrated planning process, Malmö is able unite the city planning departments, city environmental departments, the park departments, and the recreation departments on a common visual vision for the community before confronting the public (See Fig. 2.7). The public involvement in the 'aesthetic value' of the community is something that effectively creates city spaces that are ecologically functional, profitable, technologically advance, recreational, and aesthetically pleasing (See Fig. 2.8).

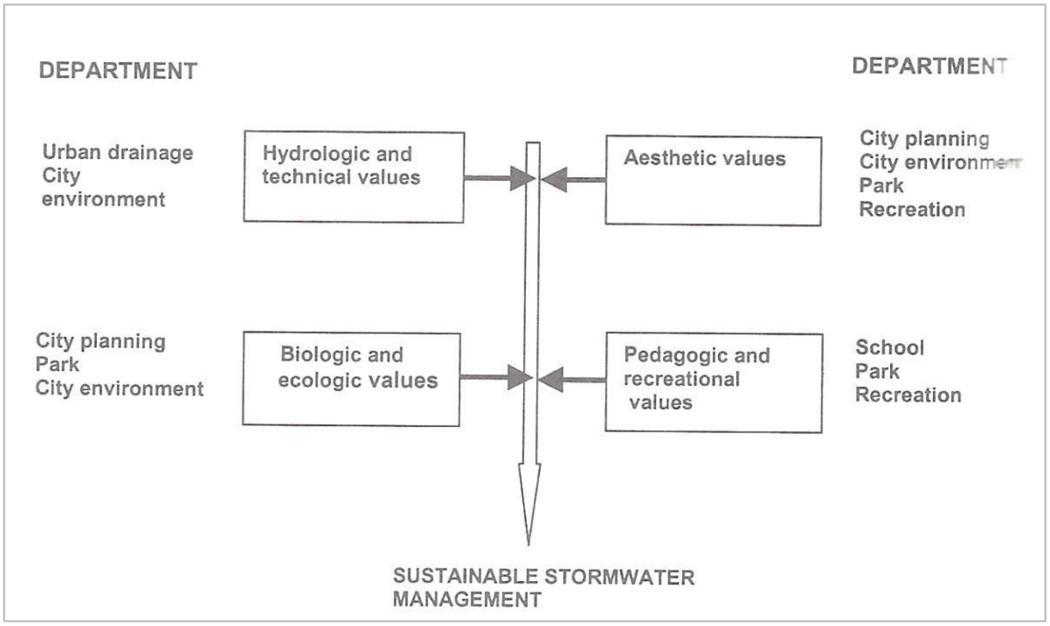


FIGURE 2.7
Stormwater management values in Malmö, Sweden. (Source: Urbonas, 2002)

FIGURE 2.8
Housing complex designed to manage stormwater in Malmö, Sweden. (Source: Courtesy of International Sustainable Solutions. <http://www.djc.com/news/ae/11165761.html>)

Study 2: Australian Water Research Facility

The International Water Center conducted a study in 2008 on public participation and community engagement for water resource management in the Pacific. This report specifically addresses community engagement as a key element in *collaborative* water management for government agencies and non-government organizations for cities. As a result, this study sheds light on how to have an effective participation process.

Public participation and community engagement are two phrases that are often used interchangeably. However, there are some slight differences worth noting. According to the International Water Centre, 'public participation' is the original phrase of involving the public, and referred mainly to "government, or sometimes private companies, sharing their decision-making roles with the public (Ross, Powel, and Hoverman, 2008)." 'Community Engagement' is similar, but "also extends to situations in which government (or industry) might not be the sole decision-maker or manager (Ross, Powel, and Hoverman, 2008)." The public has a much larger voice in community engagement situations, where there is a stronger focus on process and practices (Aslin and Brown, 2005). There are more people working together "to achieve a shared goal guided by a commitment to a common set of values, principles and criteria, and particularly on motivating the public to take action, thus motivating people to do more than just share a decision [and] government is not the sole decisionmaker (Aslin and Brown, 2005)." Community engagement, in turn, has a strong influence of the success of water management plans due to its ability to involve people at the community scale.

Involving people in the design and management of water allows for: the opportunity to make better decisions, better public acceptance and compliance with the decisions made, and social justice (Ross, Powel, and Hoverman, 2008). These reasons for public participation expand upon the *process* by which communities grow. With a range of public opinions and expertise, community engagement "enables the public to go beyond participation in a decision to be made by government, to become motivated to support a new perspective or issue and take action themselves (Ross, Powel, and Hoverman, 2008)." People tend to take ownership of their own creations or contributions. It also brings about a strong sense of community pride that otherwise would have been more difficult to achieve. However, a question of how much public participation is needed with decisions is often a concern when trying to make well planned results.

"Community engagement enables the public to go beyond participation in a decision… to become motivated to support a new perspective…" - Ross, Powel, and Hoverman

The ladder of public participation is a concept developed by American Planner, Sherry Arnstein. (See Fig. 2.9). Arnstein attempted to create a scale that shows the level of citizen power. This concept explores a range from "no participation, or government consulting to the public but not necessarily heeding their advice," to "complete and equal sharing of decisions or community control (Ross, Powel, and Hoverman, 2008)." The problem exists in the extremity of such an outline of shared power and roles. The idea of manipulation to citizen control, suggests that there is less of a balance of participatory cooperation. Instead, "the types and degree of sharing between government and public should vary according to the issue and circumstances (Ross, Powel, and Hoverman, 2008)."

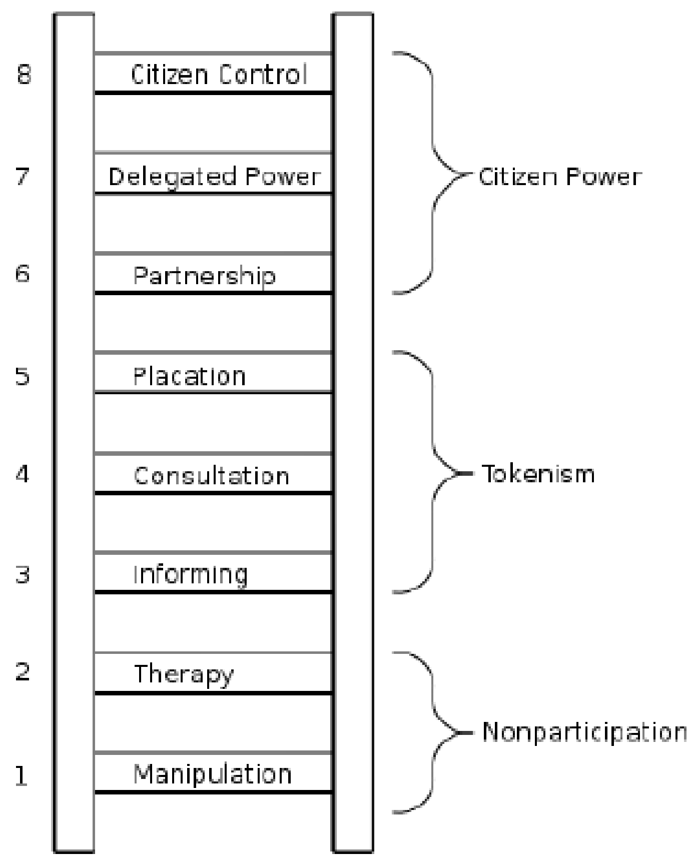


FIGURE 2.9
Arnstein's Ladder of Public Participation. (Source: Ross, Powel and Hoverman, 2008)

Another approach, created by the International Association for Public Participation (IAP2), presents a unique "spectrum of public participation, with increasing levels of public impact as the processes move from informing through consulting, involving, to collaborating and empowering. (See Fig. 2.10)." From inform to empower, this approach more

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Participation goal				
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives, opportunities and/or solutions	To obtain public feedback on analysis, alternatives and/or decisions	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution	To place final decision-making in the hands of the public
Promise to the public				
We will keep you informed	We will keep you informed, listen to and acknowledge concerns and aspirations, provide feedback on how public input influenced the decision	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision	We will look to you for direct advice and Innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible	We will implement what you decide

FIGURE 2.10
IAP2 Spectrum of Public Participation. (Source: Ross, Powel and Hoverman, 2008)

effectively addresses the possible levels of involvement, in addition to how the public should be treated during each. As previously mentioned, the level of public participation may depend on the project, but it is also important to know *how* to properly engage the public. Organization, clear goals, and genuine interest in public opinions will drive the engagement process. However, other key considerations when engaging the public include the following:

1. Be inclusive – all members of society should be open to participate, no matter the age, race, social or cultural differences. The engagement process should be held in locations where they feel at ease to speak freely.

2. Balance out differences in power – facilitate discussions to encourage the less advantaged to speak out.
3. Allow enough time – give people time, or extra time if needed, to understand what is asked of them. This allows more opinions to be heard.
4. Facilitation – place a neutral facilitator, or team of facilitators, with skills and knowledge of the issue, at the location of engagement to assist the process.
5. Capacity building – provide briefing and discussion to all parties involved. This allows for more effective participation.
6. Identifying benefits for participants – consider all perspectives; why should they participate, how can they gain from having a say.
7. Sufficient resourcing – enable people to participate. This may include travel costs, replaced wages if taking off work, child care, etc.

(Ross, Powel, and Hoverman, 2008)

These considerations are some of the basic requirements needed for a successful public participation event; however "there is no single recipe for a good participation process: it is best to customize according to the circumstances… it is particularly useful to seek and accept local advice while designing the process." In the case of seeking public participation and community engagement for stormwater management, it would be best to figure out exactly what kind of information is being sought and keeping it clear and simplified for a range of people to effectively voice their opinions. The amount of public involvement of an issue may depend on the situation, but the participation considerations that Ross, Powel, and Hoverman's provide would prove to be useful when attempting to get the most amount of information out of participants in a given timeframe.

Study 3: Albury,-Wodonga, Australia

According to the Water Sensitive Urban Design Program, Water Sensitive Urban Design (WSUD) is about "working with communities to ensure the planning, design, construction and retrofitting of urbanized landscapes are more sensitive to the natural water cycle (WSUD, 2013)." Similar to the United States Low-Impact Development (LID) design approach, or the Sustainable Urban Drainage Systems (SUDS) of the United Kingdom, WSUD is specific to Australia.

In Albury-Wodonga, Australia, community engagement is beginning to play an important role in the success of WSUD. The technologies that expand the success of water sensitive cities are becoming more apparent, however, "it appears that very little research on how to engage with and support our communities in the area of WSUD at a [small scale] has been done to date

(Dahlenburg and Morison, 2009)." The mentality that community engagement is an 'educational process' of teaching citizens about what's best for them, is not an approach that solves complex problems. In fact, "interactions by organizations and professionals with our communities need to be broadened and started earlier (rather than when a 'solution' has been found), made more collaborative, and allow the community to influence and participate in deriving locally appropriate solutions (Dahlenburg and Morison, 2009)." Growing communities have a range of complex, water issues. No matter the geographic location, communities are facing the need for more community interaction.

Whether it's WSUD, LID, or SUDS, community engagement in the realm of water management is a necessity across the world. Transitioning to a water sensitive city is a process, and is graphically represented in the following diagram (See Fig. 2.11). If communities can work toward the integration of public ideas to achieve community goals of better water management, there would be a greater outcome of cities successfully managing water resources.

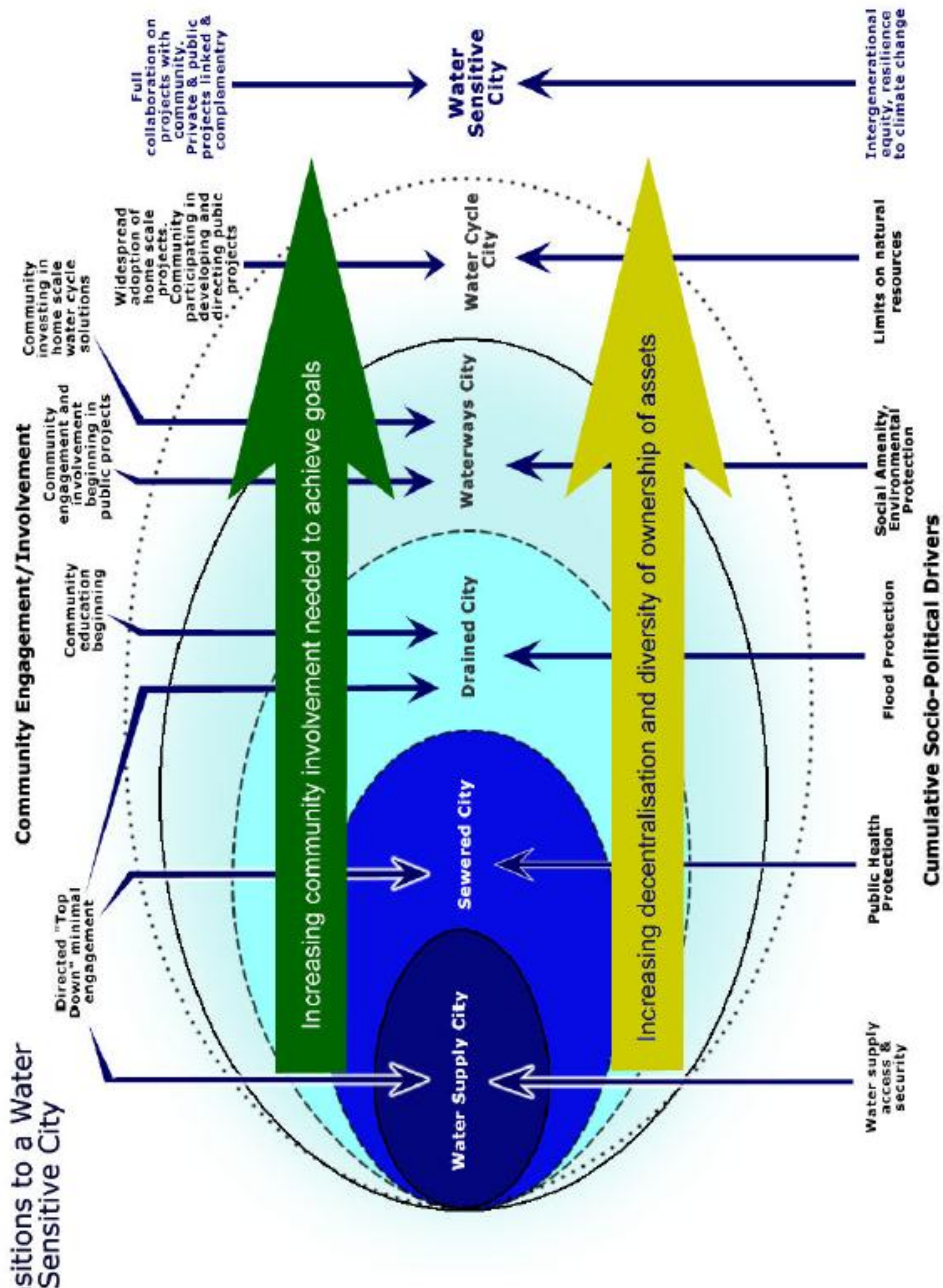


FIGURE 2.11
Transition to a Water Sensitive City.
(Source: Dahlenburg and Morison, 2009)

Planning Communities and Environments

From the previous case studies, one learns that there are several effective means for cities to utilize cooperative approaches of community stormwater design. Yet, to understand what prompts these cooperative efforts, the following perspectives give a bit of insight into the collective understanding of why people relate so passionately to a place, how patterns emerge from a place, and the relationship of ecology and visual preference to a place.

Christopher Alexander – A Pattern Language

Communities consist of a wide variety of design elements. These elements contribute to social, environmental, or physical needs of society, and in turn can begin to create a series of design patterns. According to architect and professor, Christopher Alexander, together these patterns can create a language for design. Alexander is most known for his architectural accomplishments, literature philosophies, and viewpoints on design. He recognized the need for a pattern language and emphasized how nature-based relations and solutions are found within individual patterns (Alexander, 1977). The language, as he described it, is a common pattern language that all people in society share when making towns and buildings become alive (Alexander, 1977). The elements in this language are entities or patterns that describe problems that occurs repeatedly throughout society. Combined, all of the entities have corresponding design solutions that intertwine with each other in a dynamic that communicates an entire language (Alexander, 1977). This common pattern language is a singular suggestion of an ever-evolving language that society can manipulate accordingly.

This method of creating patterns that can combine together to make an entire language of design patterns is an extremely beneficial tool to have in design, especially when designing guidelines for communities. Alexander makes a significant emphasis that his book, "A Pattern Language" is titled with "A" to have people recognize that this is *one* suggestion of a language. From research and observation, this was the most complete basic set of a pattern language he could produce for towns, buildings, and other public spaces. However, it is his hope that people who use this language "will try to improve these patterns – will put their energy to work, in this task of finding more true, more profound invariants – and hope that gradually these more true patterns, which are slowly discovered, as time goes on, will enter a common language, which all of us can share (Alexander, 1977)." Much like a framework, these patterns are the foundation for what environments are evolving to become. The ability for these patterns to change can not only challenge communities, but inspire them to mold a new "dialect" of the pattern language. Since the creation of Alexander's pattern language, others have indeed built upon this language, generally for a specific focus.

"...when you build a thing you cannot merely build that think in isolation, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole..."
- Christopher Alexander

When building spaces, one must merge patterns in combinations that make an environment functional. Alexander expands upon this branching effect by stating "when you build a thing you cannot merely build that thing in isolation, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole; and the thing which you make takes its place in the web of nature, as you make it (Alexander, 1977)." Designs are not meant to be separate entities within communities. Communities are spaces to live and interact with society, which designs that merge from one environment to another.

Alexander's method of presenting these patterns allows for a natural building of ideas as he breaks down various scales of design patterns from regional, to community, and down to individual elements. Depending on what the user is looking for, one could easily flip through these patterns and begin to formulate a language that is specific to the design challenge at hand. A series of loosely created graphic drawings accompany each pattern to help illustrate Alexander's written guidelines (See Fig. 2.12-15). Stormwater is an integral part of design at every scale, from regional runoff to residential runoff. Stormwater is a part of communities and has a unique set of patterns of its own when integrated in society. Alexander briefly covers various water pattern within the language of building and planning. Some of these patterns include access to water, green streets, pools and streams, still water, and roof gardens (See Fig.

2.15). However, this portion of his language could be expanded further to relate directly to some of the present day concerns with stormwater. The potential to improve upon these patterns gives a crucial angle to a pattern language of community water management.

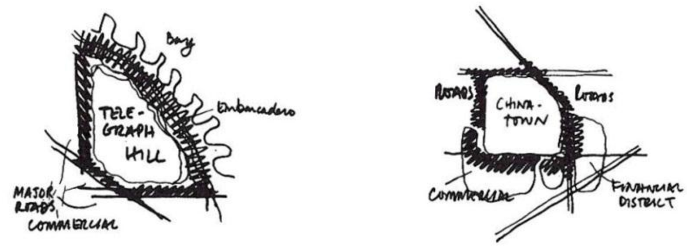


FIGURE 2.12
Pattern Language Graphic Example:
Subculture Boundaries
(Source: Alexander, 1977)

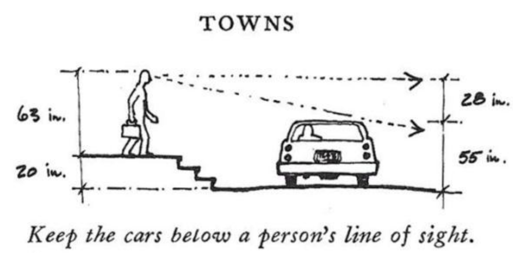


FIGURE 2.13
Pattern Language Graphic Example:
Raised Walk
(Source: Alexander, 1977)

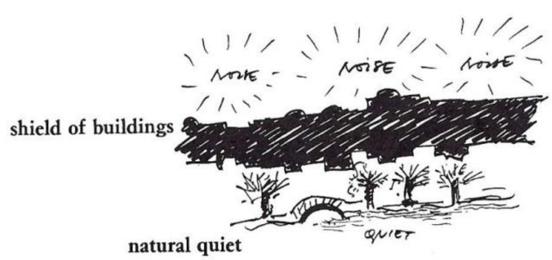


FIGURE 2.14
Pattern Language Graphic Example:
Quiet Backs
(Source: Alexander, 1977)

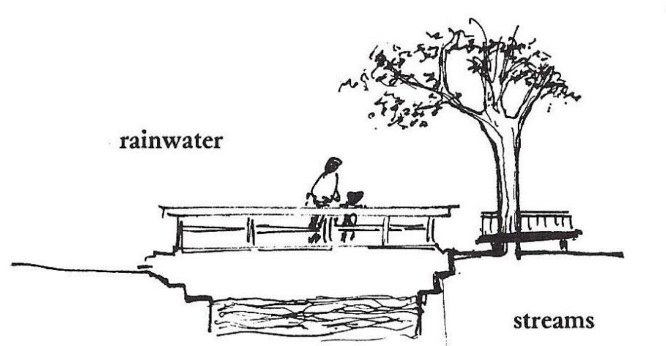


FIGURE 2.15
Pattern Language Graphic Example:
Pools and Streams
(Source: Alexander, 1977)

Joan Nassauer- Landscape Ecology

Ecology and aesthetics are closely interrelated within environments. Joan Nassauer, a professor and expert in Landscape Architecture and landscape ecology, explores unique linkages between communities and how aesthetics play a role in design. Nassauer makes the connection that "because aesthetic experience has so deeply and persistently influenced nearly every culture's conception of nature, thinking about aesthetic experience can provide penetrating insights into why people make certain landscape patterns (Nassauer, 1997)." The evolution of these landscape patterns through the course of history has indeed changed how our present day society treats our water within the landscape. As Christopher Alexander has mentioned, these patterns build the language of the land which can be expressed at different scales. At the community scale, "we see aesthetic tradition as the embodiment of community values and, consequently, the basis for a language that can be used to provoke change and sustain ecological quality (Nassauer, 1997)." Both Alexander and Nassauer acknowledge a pattern language in our societies. However, it is Nassauer that expands upon this concept by associating aesthetics with being "a strategic lever for changing landscape patterns (Nassauer, 1997)" in our landscape's ecological networks.

"We see aesthetic tradition as the embodiment of community values and, consequently, the basis for a language that can be used to provoke change and sustain ecological quality."
- Joan Nassauer

The maintenance and care of our landscapes is part of our aesthetic-based culture. Our scenic landscapes can often be described as being ecologically healthy, when they are instead the product of society's neat and tidy ideals. The aesthetic of care and landscape maintenance is "laden with good intentions and social meaning: stewardship, a work ethic, personal pride, contributing to the community (Nassauer, 1997)," but without the ecological knowledge to support care-related decisions, our landscape ecology suffers. There are benefits in knowledge that greatly enhances the aesthetic experience of landscapes, whether in the urban or natural setting. The more people understand their environment and the degree of care that it needs, the greater the success of cultural sustainability will occur.

Cultural sustainability stems from "survival that depends on human attention (Nassauer, 1997)." So how do the impacts of stormwater contribute to the ecology of water in an urban environment? Can cultural sustainability guide runoff innovations that not only attract human attention, but maintain the care and interest of people in their everyday lives? Nassauer recognizes that "landscapes that are ecologically sound, and that also evoke enjoyment and approval, are more likely to be sustained by appropriate human care over the long term…. the health of the landscape requires that humans enjoy and take care of it (Nassauer, 1997)." By these standards, society has the potential to take ownership of their landscapes by appreciating the ecological contributions that stormwater could have, and the aesthetic qualities that give life to these otherwise 'hidden systems.' A sense of ownership over our land, streets, neighborhoods, parks, and towns equally prompt landscape aesthetics to go beyond the *acceptable* to evoking "intelligent tending of the land so that aesthetic decisions can become intrinsically ecological decisions (Nassauer, 1997)."

People care about the land and want good ecological health for their communities. There is nobody who would want the opposite. Yet, ecological decisions are difficult. When attempting to align aesthetics and ecology in landscape design, the two most significant intrinsic properties of landscapes are landscape scale and landscape change (Nassauer, 1997). According to Nassauer, landscape scale "requires that our concept of landscape be large enough to accommodate flow of energy, materials, or species among heterogeneous ecosystems (Nassauer, 1997)." She uses the example of wetlands to explain how a wetland does little good by itself, but connected to the surrounding water bodies and uplands, it is one of the most important elements to most small and larger scale natural processes (Nassauer, 1997). A connective landscape is critical for the entire ecology of a region.

Landscape change, in turn, "refers to the results of flows from one ecosystem to another and to the growth and inevitable deaths of some individuals and communities and their replacement by others (Nassauer, 1997)." Ecosystems are evolving lifecycles, full of natural changes. This presents an aesthetic challenge for those wanting an unobstructed, scenic landscape. Nature is normally perceived as messy, while community aesthetic values tend to encourage green lawns, minimal weeds, raked open spaces and no standing water. So what modifies this community aesthetic?

Nassauer highlights care and management of the landscape as the key to an evolving community aesthetic. Intelligent care requires knowledge of ecological health, but vivid care signifies the *existence* of ecological health by its attractiveness (Nassauer, 1997). So, in order to align aesthetics and ecology, we must incorporate care into the design strategies, landscapes, and policy with "an awareness of what people enjoy and value in the appearance of the landscape now (Nassauer, 1997)." People care fort what they love. If water is an essential aesthetic and ecological benefit to a community, people will do more to care for it.

"…a new genre of art has aimed to reveal ecological function, and the landscape architects have emphasized ecological revelation in their work as well..."
- Joan Nassauer

To recognize the awareness of what people enjoy and value takes understanding the human connection to water. This awareness can be accomplished by designing "landscapes that protect or reveal ecological function (Nassauer, 1997)." If stormwater was more effectively revealed in the landscape as an ecological benefit and protected from methods of conveyance that add to pollution, perhaps the aesthetic of stormwater innovations will evolve to be a *part* of the community aesthetic. In recent years, "a new genre of art has aimed to reveal ecological function, and the landscape architects have emphasized ecological revelation in their work as well… each of these actions toward ecological function – to protect it or to reveal it – advances the evolution of new aesthetic conventions for the landscape (Nassauer, 1997)." The effectiveness of this new genre is spurring ecological changes across the country.

A successful case of evolving community aesthetics occurred in the regions surrounding the Phalen Chain of Lakes in Minnesota. The need for better water quality created both vivid and intelligent care changes in the urban landscapes from a new watershed ecosystem-management plan developed by six different municipalities (Nassauer, 1997). Stormwater was designed to be reintegrated into the urban landscape through gardens that demonstrate the cleaning of water before entering wetlands (Nassauer, 1997). The public was able to visually see and understand the processes being used to change the water quality issues of the area, giving knowledge to ecological effects. Wetland parks were also designed to further build connections to the landscapes at a larger scale (See Fig. 2.16). Landscape architects worked with residents to have stormwater infiltrate into the ground at smaller scales, thus empowering people to take ownership of water on their own properties (Nassauer, 1997). Schools, families, and

FIGURE 2.16
Phalen Wetland Park Master Plan
(Source: Nassauer, 1997)

children are all benefitting from the cultural aesthetic that is evolving around a water quality cause in this area.

Socially, people are compelled to follow the trends set by ecological significance and aesthetic expectations (Nassauer, 1997). This same practice can develop in communities everywhere, adding to a continuous evolution of an ecological pattern language. Especially in rural communities, maintaining an ecological and cultural resource system can be accomplished through "(1) application of sound planning and design principles, (2) education of the general public toward understanding the rural landscape, and (3) visionary legislation and effective local land-use guidelines with innovative implementation (Coen, Nassauer, and Tuttle, 1987)." Therefore, growing communities can benefit from guidelines that address the knowledge of local ecology, the innovative approaches to design, and the evolving patterns of stormwater.

Robert Thayer – Bioregional Culture, Technology, and Nature

The challenges with water at the local scale is that people should know more about it, where it comes from, where it's going and our place and role in helping it get there. Landscape Architect Robert Thayer talked about bioregional thinking in his book *Life Place*, and addressed the idea of bioregional culture, celebrating the spirit of place, spreading local wisdom, and taking personal responsibility for our surroundings (Thayer, 2003). Thayer overlaps upon a strong message that Nassauer stressed, by affirming how "people who care about a place tend to take better care of it… and people who take care of places, one place at a time, are key to the future of humanity and all living creatures (Thayer, 2003)." Thayer elaborates on Putah Creek country, California and his personal connection to the land there, something in which many people have to areas that mean the most to them. For Thayer, his life-place was in Putah Creek country.

Thayer defines a life-place or bioregion as a place that "connects natural place, awareness, knowledge, wisdom, affection, stewardship, sustainability, and, most important, *action*, as a 'fuzzy set' of nested and covariant concepts (Thayer, 2003)." Another reoccurring theme is the connection from caring about a place and the *action* of managing the land. Every region has an obligation to their place and the water within that place. Sustainable water management is only the first step for a urban environments. Having people play a role in the design and management of their local stormwater is a way of merging participation and place. "Embedded in the bioregional idea, therefore, is a very general hypothesis: that a mutually sustainable future for humans, other life-forms, and earthly systems can best be achieved by means of a spatial framework in which people live as rooted, active, participating members of a reasonably scaled, naturally bounded, ecologically defined territory, or *life-place* (Thayer, 2003)." Are there factors that are preventing humans from achieving this kind of connection to the land?

In Thayer's earlier book, *Grey World, Green Heart*, landscape image is addressed in terms of the human love of the land, our "hopes, dreams, frustrations, actions, and reactions to technology as it molds and influences (Thayer, 1994)" our everyday surroundings. The 'Life Essentials Triangle,' as mentioned in the previous chapter, integrates technology as a means for living with our environment's ecology and the aesthetics of that environment (Thayer, 1994). Technology alters landscapes and has become a part of our lives, either in positive or negative ways. The terms, 'technophobia, technophilia, and topophilia' are three extremes of how technology is associated with our technological connections to or away from nature (See Fig. 2.17).

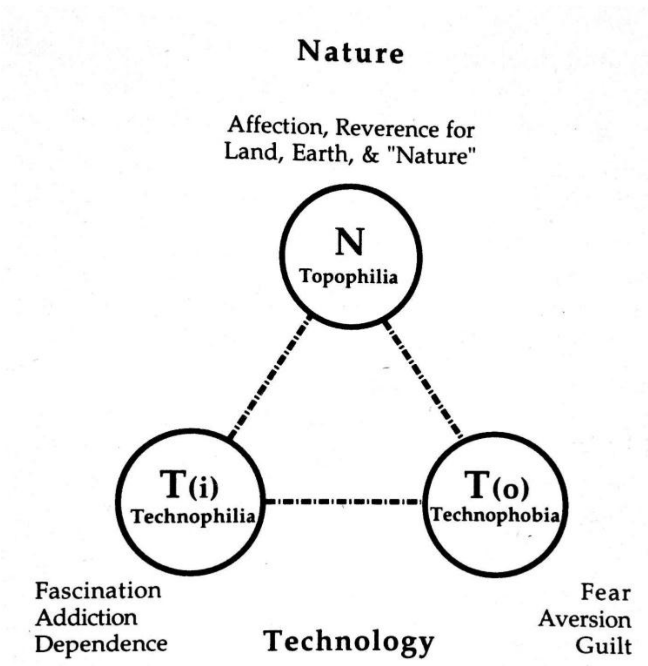


FIGURE 2.17
Triangle of Conflict in the American landscape.
(Source: Thayer, 1994)

The evolution of this Triangle of Conflict is a product of our own evolution from nature to technology, as expressed in the following timeline (See Fig. 2.18). As this timeline explains, our relationship to technology is often times disconnected from earlier views of technology being a part of design. Reestablishing the post-modern triangle into effective design practices requires a further breakdown of possibilities.

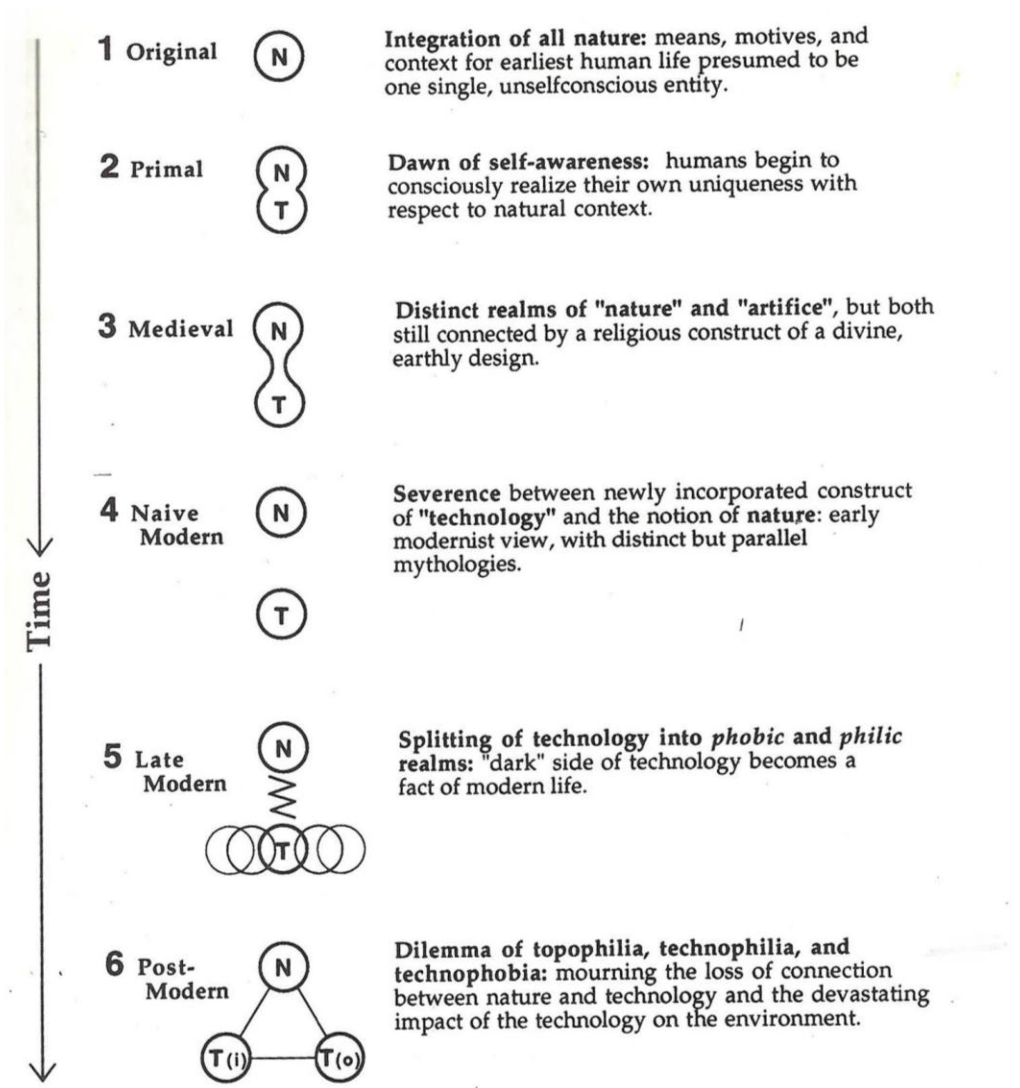


FIGURE 2.18
A "Water Droplet" model of nature and technology. (Source: Thayer, 1994)

The human response to the post-modern triangle dilemma of nature and technology has three possible outcomes according to Thayer: denial, acceptance, and action (See Fig. 2.19). The outcome of *action* is the preferred choice when wanting to incorporate technology into a means of sustainable landscape design through transparent means (Thayer, 1994). In other words, technology could be used to enhance the nature of stormwater in a way that encourages people to conserve runoff water and avoid the continual pollution of water. Designing for stormwater would then require a clear understanding of how technology is viewed.

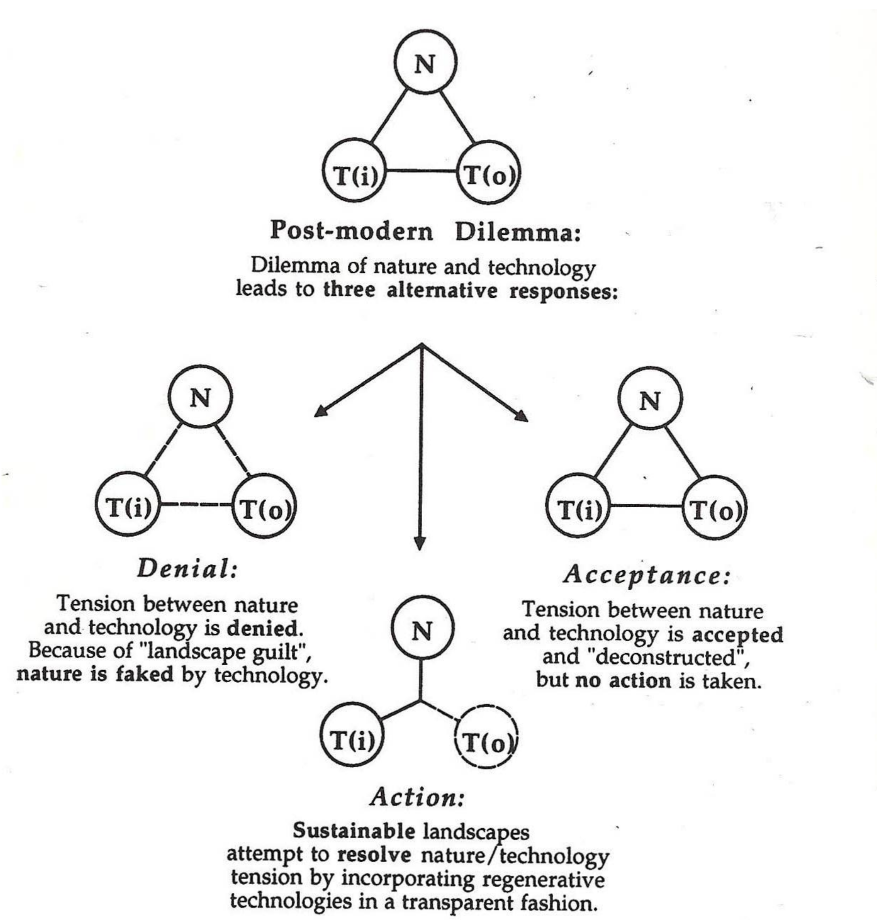


FIGURE 2.19
Responses to current state of dissonance between nature and technology in the landscape.
(Source: Thayer, 1994)

There are two main values of 'viewing a landscape' that Thayer discusses: surface and core. Surface values are "those that one can readily see and sense – the interaction by which one engages the landscape at its most immediate level (Thayer, 1994)." Core values are "the functional, technological, and ecological properties of the landscape, or the way in which the landscape operatively connects with the larger ecological context, including that of humans (Thayer, 1994)." (See Fig. 2.20 and 2.21). The core values are what drive us to stay connected to the landscape, and enable a life-place to form. However, if core properties are visible but inaccessible, landscapes become transparent (Thayer, 1994). This would be the same as seeing the ecological benefits of low impact design

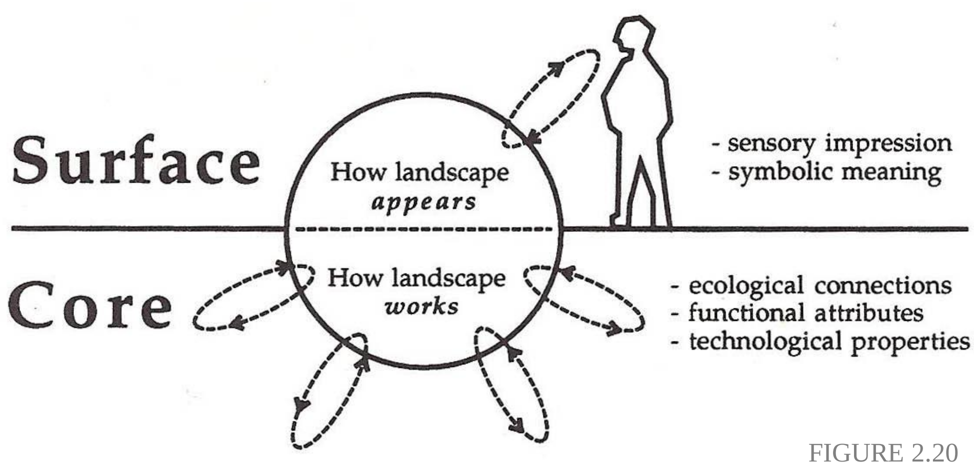


FIGURE 2.20
Surface and core properties of landscapes. (Source: Thayer, 1994)

in an urban setting, yet not being able to enact the practices. Opaque landscapes are different in that they occur when the ecological and technological functions are both inaccessible (Thayer, 1994). An example of this would be seeing a fence that separates you from an enhanced wetland. You could see the wetland through the fence, but know nothing about its benefits. Congruent landscapes are where the surface and core values intertwine, and what is seen does not contradict with what one gets from it (Thayer, 1994). In terms of effective stormwater design, this kind of landscape actually involves the viewer in understanding the small scale and large scale benefits. A green roof, for instance would visibly become part of a roof and lowers the temperature of the building from the inside, but reaches the core understanding of water collection and ecological connectivity. The final type of landscape is incongruent landscapes, where surface and core properties are incompatible

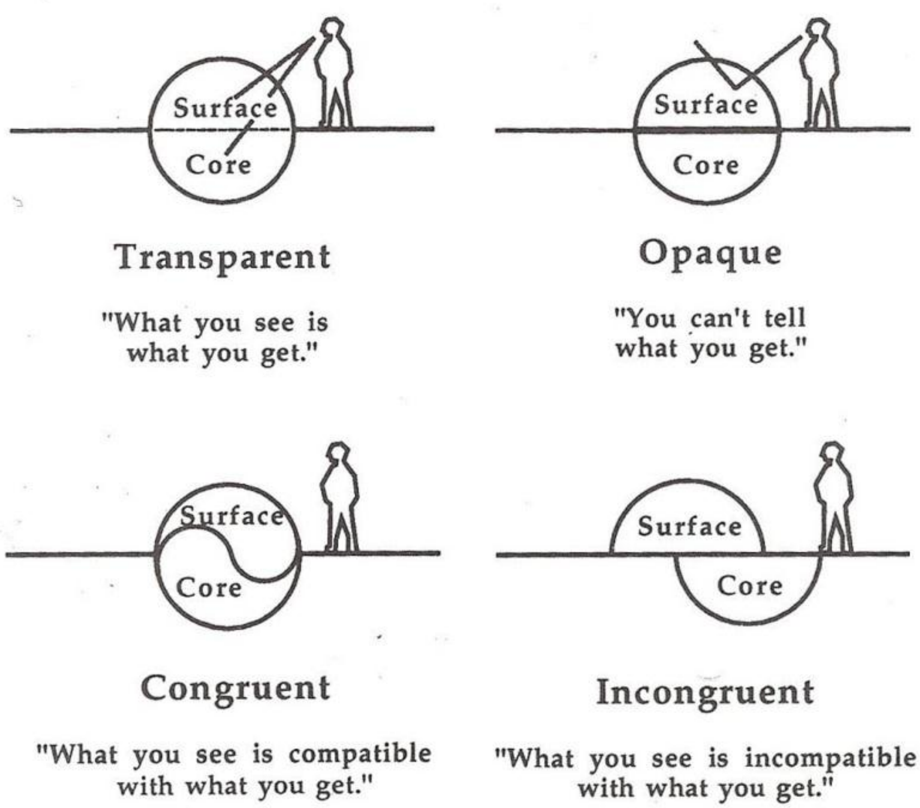


FIGURE 2.21
Surface and core relationships.
(Source: Thayer, 1994)

and contradictory to each other. This could be explained with the design of a weir system in which people do not understand the benefits of such technology.

Stormwater management and design should work to create congruent landscapes that engage the public in aesthetic and sensory values while simultaneously allowing ecological and technological properties to be apparent. The historic increase in complexity of core, as described from the water droplet model (Fig. 2.18, Thayer, 1994), as well as an increase in the incongruity of modern landscapes is creating visual and knowledge-based crisis (Thayer, 1994). It is the core values that keep our society moving in a sustainable living lifestyle, yet there is a growing demand for more surface values (Thayer, 1994). Communities must therefore strive to maintain a balance of these two values in order for our natural environment to flourish with our built environments.

Kaplan and Kaplan – Design with People

The works of Kaplan and Kaplan focus on the relationships of people to nature, design and management opportunities to bridge the gap between these two, and the process by which designers can engage the public (Kaplan, Kaplan, and Ryan, 1998). Christopher Alexander's recognition of patterns in the landscape was revisited by Kaplan, Kaplan and Ryan in an attempt to suggest "a relationship between aspects of the environment and how people experience or react to them

(Kaplan, Kaplan, and Ryan, 1998)." Kaplan, Kaplan, and Ryan explored possible design solutions that are appropriate to locally based themes and problems. Similarly to Alexander, the language of patterns are intended to be combined together to produce solutions that are specific to any given scenario (Kaplan, Kaplan, and Ryan, 1998). In addition to the varieties of patterns, Kaplan, Kaplan and Ryan elaborate on preferences and the importance of understanding the needs of the public.

One design and management approach that Kaplan, Kaplan, and Ryan developed is using preference to evaluate environmental scenes and natural settings. A preference matrix, shown in the following graphic, is used in their approach to understand and explore the information that can be extracted from a scene with two-dimensional and three-dimensional qualities (See Fig. 2.22). In a two-dimensional plane, people can view a particular image and quickly assess the basics of

Preference Matrix

	UNDERSTANDING	EXPLORATION
2-D	Coherence	Complexity
3-D	Legibility	Mystery

FIGURE 2.22
2-D and 3-D Preference Matrix. (Source: Kaplan, Kaplan, and Ryan, 1998)

grouping, numbers, and placement (Kaplan, Kaplan, and Ryan, 1998). In a three-dimensional plane, people look deeper into an image to allow themselves to imagine what it would be like to be part of that scene (Kaplan, Kaplan, and Ryan, 1998). Coherence and legibility are used to understand an environment in terms of organization and distinctiveness (Kaplan, Kaplan, and Ryan, 1998). Complexity and mystery contains information in the image that provokes further exploration, either by the variety of elements or the cues that are visible (Kaplan, Kaplan, and Ryan, 1998). This preference matrix begins to suggest the complexity of analyzing images. However, it also highlights images as being tools for understanding how people think and feel about a scene. Images are a power resources for collecting public preferences, but familiarity is another factor that residents of a particular space must also recognize.

When it comes to building spaces based off of preferred scenes, it is important to understanding the relationship between the different levels of preference and familiarity (See Fig. 2.23). When a particular scene is highly preferred, it can either attract a

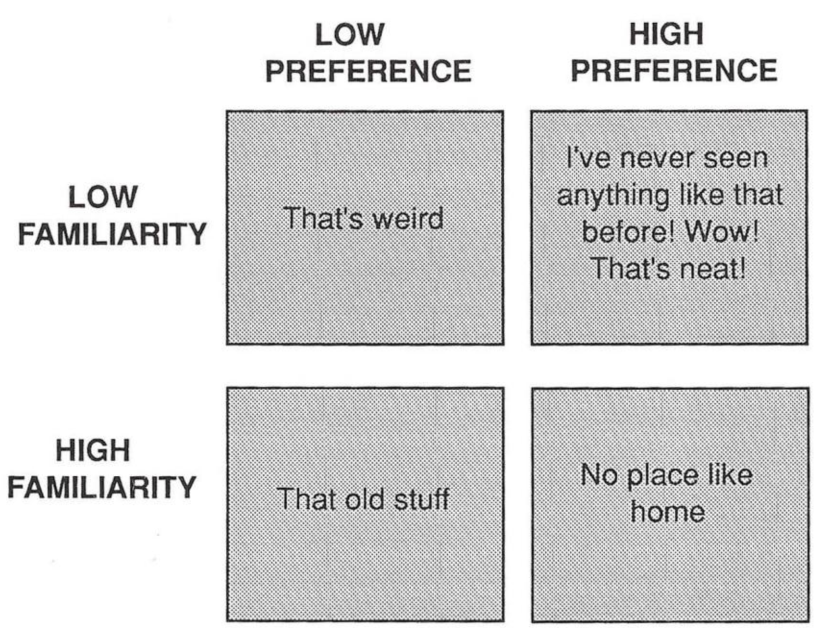


FIGURE 2.23
Familiarity and Preference matrix. (Source: Kaplan, Kaplan, and Ryan, 1982)

sense of amazement and intrigue or a sense of comfort and identity. Much like how Robert Thayer described a life-place as being an area you physically and emotionally identify with, it is the combination of high preference and high familiarity that begins to create that sense. Otherwise, spaces either become foreign and strange or boring and unattractive. Kaplan and Kaplan elaborate on familiarity and preference by stating,

> "Familiarity, the outcome of exploration, is also the starting point for play. In play the focus is not "what is this?" but "what can I do with this?"… With increasing familiarity, the mental entities become increasingly compact, increasingly discrete, and increasingly responsive t activation in the absence of what they represent… Thus familiarity is essential to the playful rearrangement and recombination of the elements of thought that we tend to associate with insight and creativity (Kaplan and Kaplan, 1982)."

By creating environments that are highly preferred and familiar from the act of exploration, play can be introduced as one of the most beneficial outcomes for public spaces. Knowing how to collect preferences for various environments is something Kaplan, Kaplan, and Ryan also thought to be equally as important as analyzing the results.

Designing and managing environments "depend on the the exchange of information [which includes] finding out about people's concerns as well as providing information to make their outdoor experiences satisfying (Kaplan, Kaplan, and Ryan, 1998)." The exchange of information is key to collecting the opinions of the public, educating the public on current issues, and relating the information learned from the public back to those who make design decisions. Challenges to recognize in this process include: 1.) relation of information to what the individual already knows; 2.) dealing with information that may be upsetting; and 3.) quantity and quality of information (Kaplan, Kaplan, and Ryan, 1998). Communication works in all forms of interactions. If you are telling a story, the listener is most intrigued if they haven't heard the story before, if it's a story that is of interest to them, and if you keep it fairly short and to the point.

When engaging the public, gaining feedback should be an enjoyable process for the participant. The method must be "friendly and appropriate… and one must find ways to obtain public input that are compatible with the public's strengths and concerns (Kaplan, Kaplan, and Ryan, 1998)." One example of eliciting feedback is "going to where the people are (Kaplan, Kaplan, and Ryan, 1998)." Attending a "community festival" and asking residents to

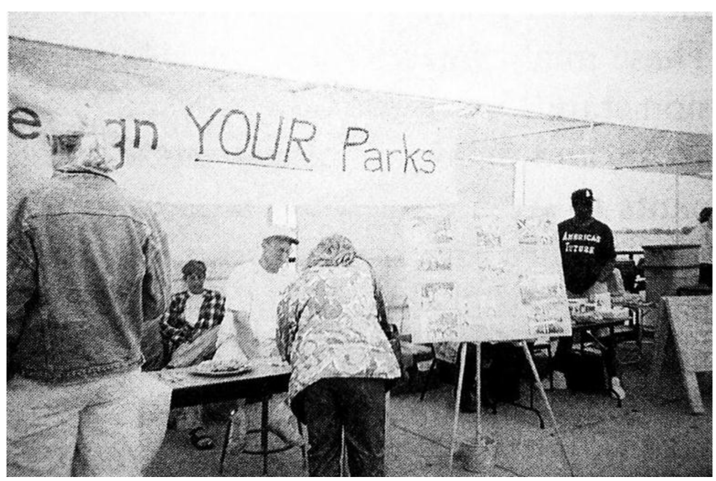


FIGURE 2.24
Community festival with photo boards. (Source: Kaplan, Kaplan, and Ryan, 1998)

"choose park elements from examples shown on photo boards (Kaplan, Kaplan, and Ryan, 1998)" is a great way to encourage participation. (See Fig. 2.24). Visual forms of information not only support the verbal forms communication, but they attract interest.

Photographs present various solutions and options to citizens, when desiring public preference (Kaplan, Kaplan, and Ryan, 1998). Through this "manageable and enjoyable process…citizens can learn about the range of possibilities and can contribute their concerns (Kaplan, Kaplan, and Ryan, 1998)." This range of possibilities can be expressed with photo questionnaires or visual alternatives of the same scene. Visual alternatives help communicate design issues and scenarios instead of demanding "a winner" of a design (Kaplan, Kaplan, and Ryan, 1998). (See Fig. 2.25). By having these alternatives, "both local input and the designer's creative reactions… give [the design] shape (Kaplan, Kaplan, and Ryan, 1998)." Visual preference surveys can differ in style, but are often used effectively to have citizens rank photographs based on a preference scale from a high preference to a low preference.

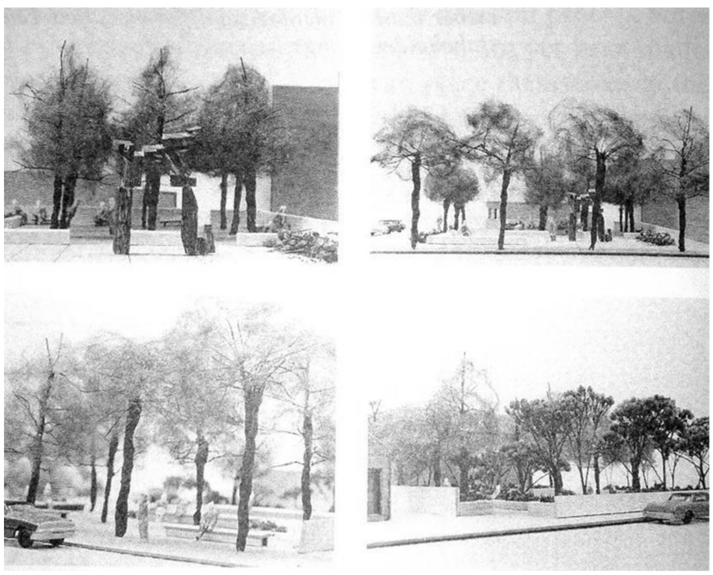


FIGURE 2.25
Alternative plaza designs with and without a proposed sculpture. (Source: Kaplan, Kaplan, and Ryan, 1998)

In the case of stormwater management, it is an important step to gauge the community preference of various stormwater techniques. Feedback from residents can not only reveal design patterns that emerge from visual preference surveys and visual alternative scenarios, but it can simultaneously educate the public on possibilities within their community.

VISUAL PREFERENCE MODELS OF MANAGEMENT STRATEGIES

Based on the community engagement studies and perspectives of pattern language, ecology, bioregionalism , and designs with people in mind, a curiosity of visual preference models might emerge. Kaplan and Kaplan spoke specifically about engaging the public to understand a collective community preference on a subject. Therefore, this section evaluates some successful examples of cities that used a visual preference survey with their community engagement efforts in hopes of better understanding the thoughts and opinions of their citizens.

Study 1: Peachtree City, Georgia

In an effort to update the city's Comprehensive Plan, Peachtree City, Georgia decided to use a Visual Preference Survey as one of the tools for the public to supply feedback on city planning and design alternatives (Peachtree Comp. Plan, 2007). This approach was highly successful and proved to be an excellent model for developing design guidelines for the city.

However, what made this approach so successful was their methodology of collecting information from kick-off meetings, to the use of a Visual Preference Survey, and finally with Comment Boards.

On seven separate occasions during 2007, public forums were held in each of the Peachtree's villages which allowed the community to understand the need for updating the Comprehensive Plan. At these public forums, community members gathered together and were able to voice their opinions at a kick-off meeting , then take a the Visual Preference Survey designed by urban designers and landscape architects in Virginia. (See Fig. 2.26). The survey consisted of a series of images used to illustrate various options for "development, infrastructure, streetscapes, screening, landscape features, and other elements which might be found in the villages of Aberdeen, Glenloch, Braelinn, Kedron, West, and Industrial Park (Peachtree Comp. Plan, 2007)." The city recognized the value of this kind of survey as being able to gather a range of opinions, a shared common ground of interests, and community desires with the objective of defining a vision for the future (Peachtree Comp. Plan, 2007).

The Visual Preference Survey presented a total of 26 questions, with the last 20 questions asking participants to "rank each of a series of photos in a common category, on a scale of -3 to +3, with 0 being neutral (Peachtree Comp. Plan, 2007)." The images that were used for this portion of the survey effectively demonstrated a range of design possibilities ranging from subtle designs to more prominent ones (Peachtree Comp. Plan, 2007). An online version of the survey was also available to citizens via the city website, resulting in a total of 137 participant responses. The following data demonstrates how the photos were ranked:

1. Photo rankings were shown using three figures. The *sum* simply adds (or subtracts) each participant's selected ranking. With 137 completed surveys, the highest sum possible would be 411 (+3*137), the lowest -411 (-3*137).
2. When a neutral value of 0 is entered, it neither adds to nor subtracts from the sum.
3. The *mode* is the numerical ranking (-3, -2, -1, 0, +1, +2, or +3) selected the most number of times. While this is helpful in seeing a majority preference it does not show the second or third most common ranking, which may be an opposing preference.
4. The *mean*, or average, divides the sum by the total number of responses, giving an accurate reading of overall preference on the scale -3 to +3. Some results show clear or negative or positive responses (as demonstrated by a mean closer to -3 or +3),

while others show either a neutral or polarized response (as demonstrated by a mean closer to zero)
(Peachtree Comp. Plan, 2007)

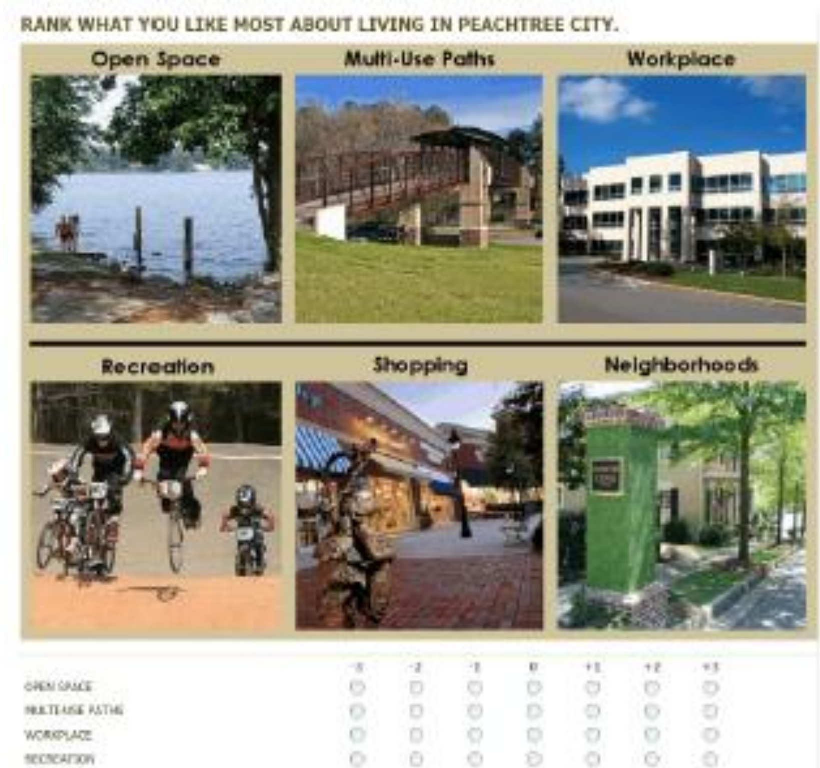


FIGURE 2.26
Peachtree Visual Preference Survey Sample (Source: Peachtree Comp. Plan, 2007)

This particular method of photo rankings seemed to be one of the most effective ways of analyzing the response. In the survey results, multi-use paths, open spaces, and neighborhoods ranked the highest following recreation, shopping, and the workplace. Other visual preference rankings revealed pedestrian-scaled environments that encourage social and environmental interactions, as well as promote small-town character. This survey did more than just acquire visual preferences for the community; it brought attention to some of the design considerations that were happening locally. By doing so, the city also wanted to collect any additional concerns citizens had regarding certain images or topics pertaining to these images.

One of the unique characteristics of this particular means of public participation includes the use of a Comment Board. At each public meeting, community members were able to add additional comments to a 4 x 8 foot Comment Board with 26 different topic blocks. Some of these topics included natural resource management, streetscapes, redevelopment, recreational facilities, and buffers and landscaping. Based on these topics, the survey, and the kickoff meeting presentations, participants were encouraged to comment on any concerns or thoughts they may have. These written comments provided useful feedback which reflected the majority of public opinions. Some of the feedback that was provided on this board included additional places citizens liked or dislike, thoughts on future development, requirements that developers and builders should or should not do, as well as proposed themes for the city. Due to the range of comments, both positive and negative, this comment board added an extremely useful means of collecting

FIGURE 2.27
Public Comment Board
(Source: Peachtree Comp. Plan, 2007)

community preference information. (Peachtree Comp. Plan, 2007)

Overall, the visual preference survey and the comment board enabled Peachtree City to have a thorough understanding of the community needs and concerns, in additional to a better Comprehensive Plan.

<u>*Study 2: Somerville, Massachusetts*</u>

In Somerville, Massachusetts, a closer look was given to local planning and building development appearances. In an attempt to get more community input, the city initiated a kick-off meeting on October 17th, 2012, with the title of *Somerville-by-Design*. At this meeting, a visual preference survey was conducted in order to “generate ideas on what community members want or don’t want (Somerville, 2012).” The survey generated over seventy responses from community members.

The way this visual preference survey was structured was unique in its execution. While sitting at tables, participants were asked to sort through sixty photographs of urban buildings and streetscapes and evaluate the images based on preference (Somerville, 2012). (See Fig. 2.28). The photos were arranged in a series of categories based on building type: 1-story commercial, 2-story mixed use, 3-story mixed use, commercial house, and infill housing (Somerville, 2012). The sorting of the photos required participants to group the images into two piles of preferred and not preferred for their neighborhood. In addition,

	For	Against
Overall	5	5
Gilman Square	2	1
Lowell St./Magoun Square	1	2
Ball Square	2	2

Comments

Gilman Square
- Mix response
- Too modern, Negative = recesses

Lowell St./Magoun Square
- A+
- Doesn't fit style
- Bad fake balconies

Ball Square
- Trees are good, building too stark
- Positive = trees, buildings

FIGURE 2.28
Example of one image used in the visual preference survey, comments included. (Source: Somerville, 2012)

they were asked to write comments about *why* those images worked or didn't work. (See Fig. 2.29).

Engaging the community in a way that was comfortable, fun and above all, simple in approach, allowed the city to begin a better urban design framework for each neighborhood. The question of *why* was key to understanding trends in preferences and clarified any misconceptions as to the decisions the participants made. In designing a visual preference survey that caters to the design needs of stormwater management, answering the questions of *why* people prefer one image over another is a useful element to then creating effective management guidelines. Also, by allowing people to have a limited number of choices to classify the images, cuts down on confusion and allows for more time to leave thoughtful comments.

FIGURE 2.29
Visual Preference Survey with Group Discussion. (Source: Somerville, 2012)

<u>Study 3: Lick Run: Cincinnati, Ohio</u>

Protection of the Lick Run watershed around Cincinnati, Ohio required input from the use of a visual preference survey and several written surveys to "gauge community preferences and priorities for proposed solutions in the watershed (Cincinnati, 2011). Currently, about 1.7 billion gallons of raw sewage and stormwater overflow into local creek systems in the Lick Run watershed. The opinions of community members needed to be heard in order to move forward with new water management strategies. Thanks to new regulations, community outreach, and design changes, a new master plan for Lick Run is now implemented.

The community outreach was overwhelmingly successful for the project, especially with the use of display boards that visually explained issues with the watershed and an additional visual preference survey. (See Fig. 2.30). Over 300 participants were able to voice their opinions and multiple workshops over a year's worth of time. The results of the survey showed trends of desired natural ecology and stormwater-specific designs. (See Fig. 2.31). Overall, this survey's presentation was one of the most awe-inspiring in terms of collecting community input.

FIGURE 2.30
Visual Preference Survey display boards. (Source: Cincinnati, 2011)

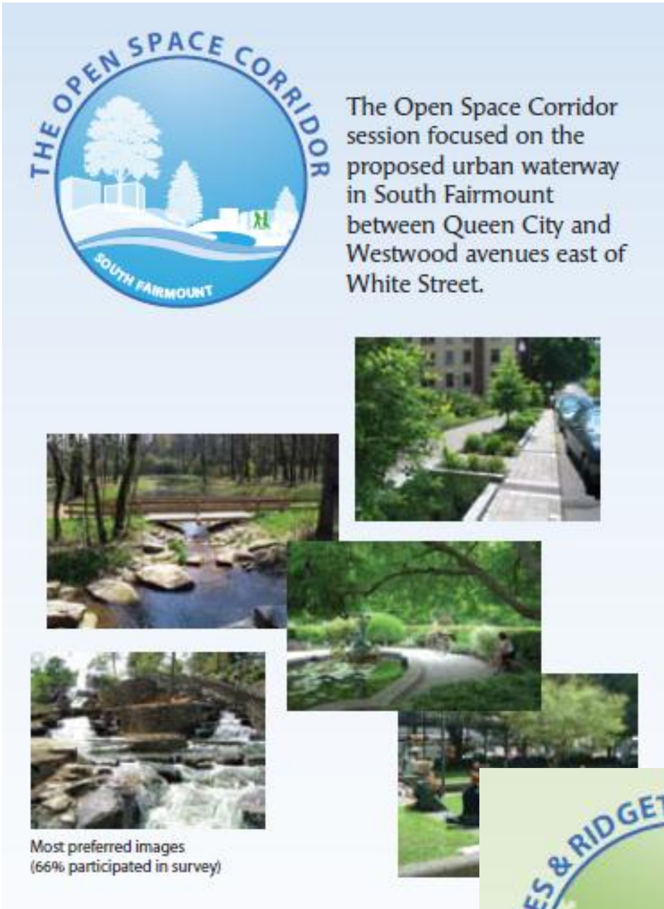
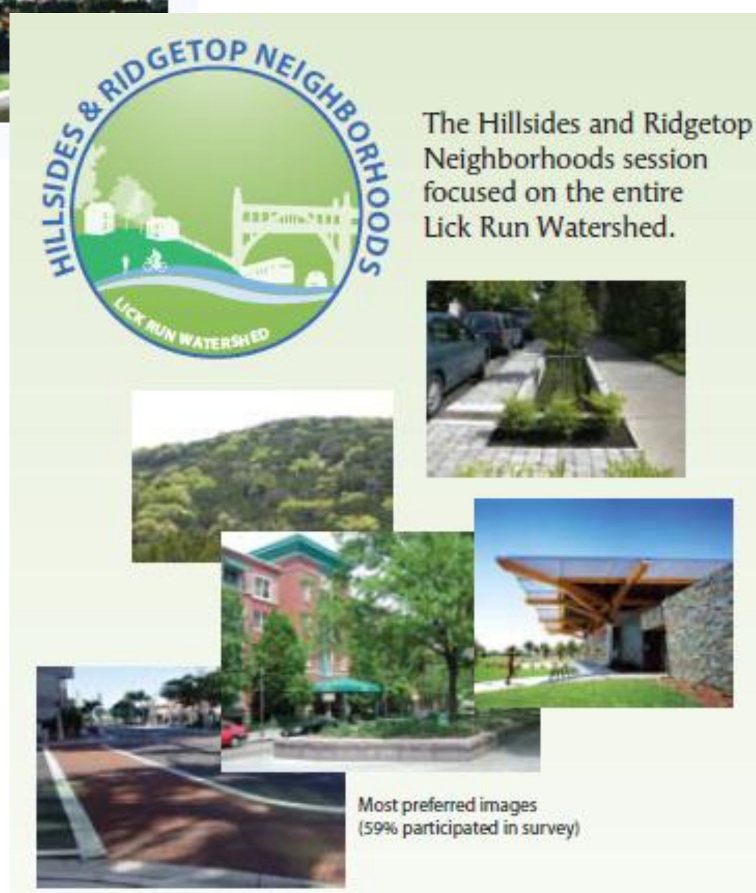


FIGURE 2.31
Examples of photos ranked as 'high preference.' (Source: Cincinnati, 2011)



DESIGN GUIDELINES

Visual preference surveys have the ability to reveal patterns and design preferences that can lead to the creation of better design guidelines for communities. This section will give an overview of the purpose and function of guidelines, how to develop and distribute them, as well as a summary from an interview conducted with author and stormwater specialist Larry W. Mays.

Purpose and Function

According to Peachtree City, design guidelines "provide a consistent framework for high quality development and redevelopment (Peachtree Comp. Plan, 2007)" within the urban environment. However, the purpose of stormwater guidelines is more specific. These guidelines are normally made to educate the user on the design possibilities that surround the implementation of drainage systems, either in urban or non-urban environments. Stormwater design guidelines can function as anything from highly technical hydraulic calculations to simple 'suggestions' based on a pattern language of water.

Interview – Stormwater Specialist, Larry W. Mays

In hopes of gaining more insight on the process of developing stormwater guidelines, a telephone interview was conducted with author and stormwater specialist, Larry W.

Mays, on February 13, 2013. Mays is the author of *Stormwater Collection Systems Design Handbook* and *Urban Stormwater Management Tools*, as well as several other research publications. (See Appendix C for Interview Questions).

In speaking with Mays, it was clear that the main function of design guidelines caters to the needs of the user, whether it's city planners, landscape architects, city residents, or students (Mays Interview, 2013). Mays wrote his stormwater books with engineers in mind, covering as many technical aspects of stormwater design as possible. However, after learning the specifics of my research, he recognized that an audience of government officials and landscape architects would need a different set of tools. For my research, it was recommended to first answer 'what am I trying to achieve?' and what does the user need from the guidelines? (Mays Interview, 2013). Do I want to inspire new stormwater designs with graphic illustrations or direct the users to the next step of technical information elsewhere? Mays suggested that a slight combination of the two would be interesting to explore: an informative set of guidelines that walk city planners through approaches of stormwater (both historically and currently) as well as a graphic source of ideas that somewhat inspire landscape architects and planners to want to look further into how it could be done (Mays Interview, 2013).

When asked *how* to begin the guideline-writing process, he mentioned that tailoring the information in guidelines or in handbooks to a specific audience is extremely beneficial, not only for the user, but to the writer as well (Mays Interview, 2013). Once you have your user clearly defined, it's up to the writer for the most part as how to proceed. There is no right or wrong way to create guidelines, it just depends on what works best for obtaining the information you need and reformatting that information into a usable tool (Mays Interview, 2013).

In captivating an audience, Mays mentioned that more so than often, stormwater handbooks are all pretty much the same… mundane and dry (Mays Interview, 2013). If the function is to provide engineers with detailed guidelines that meet city regulations, you need it to be this way (Mays Interview, 2013). However, for wanting to better communicate the possibilities of stormwater, guidelines can equally function as more graphic sources of stimulus to provoke ideas (Mays Interview, 2013). It just depends on the goals and objectives of a particular handbook of guidelines.

In reference to visual preference surveys, Mays found the process to be a creative approach to not only developing guidelines, but also as a means to educate the users in a creative fashion. By this, Mays imagined the possibilities of introducing guidelines with a historical outlook on stormwater management, followed by guidelines that encompass some of the strategies found in the visual preference survey.

Overall, Mays was a useful source in understanding how stormwater guidelines could be created and used with an audience. The 'no right or wrong way' to write guidelines approach that caters to the needs of the user was an interesting basis to continue with. Not only does this approach keep the user in mind, but it does not restrict the writer to a pre-developed notion of the guideline-writing process.

Development Methods

Developing stormwater guidelines for communities can be a flexible process. In fact, "the bottom line is, you learn by doing (Mays Interview, 2013)." Guidelines can result from a combination of different sources, including already existing guidelines or literature, community surveys, master plans, or handbooks. In the case of stormwater design guidelines for the City of San Francisco, these guidelines emerged from the city's Better Streets Plan and the Sewer System Master Plan. (San Francisco, 2009). (See Fig. 2.32). Local storm drainage manuals don't need to be as technical as hydraulic manuals can sometimes be, however, looking through existing urban drainage documents can kick start some of the design basics needed when presenting stormwater innovations to the public (Mays Interview, 2013).

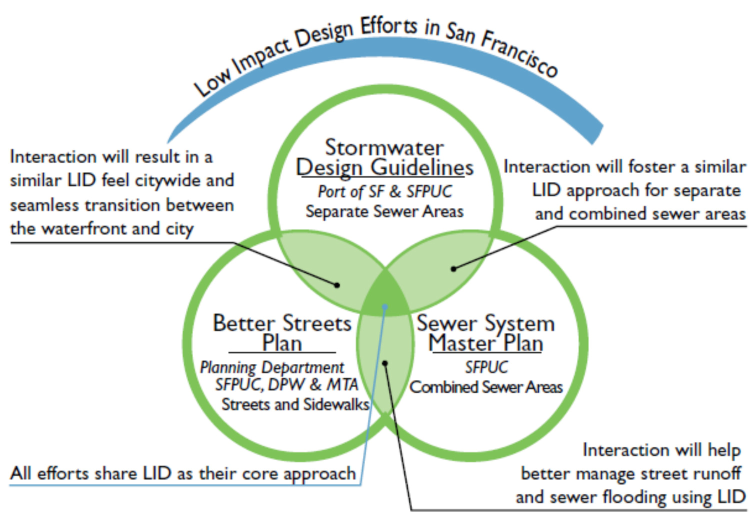


FIGURE 2.32
Stormwater design guidelines for LID.
(Source: San Francisco, 2009)

Distribution and Use

Stormwater design handbooks are not often used by city planners or landscape architects as a means to understand how to incorporate public opinion in the design of stormwater systems. Highly technical guidelines dominate the market of stormwater handbooks simply due to their effectiveness in allowing engineers and designers to design safe, functional systems in and around city structures. However, the distribution of a graphic stormwater handbook that specifically recognizes patterns from a visual preference standpoint is something that is much less common, and somewhat more practical for communities wanting ideas that not only benefit the ecology of an area but also contributing to the overall aesthetic.

A Methodology Guidebook

A handbook of this nature could recognize a unique methodology for city planners and landscape architects to use when engaging the public, as well as provide source material that can be regularly updated with new and innovative stormwater management techniques. Beginning the dialogue of stormwater management within communities, through the initial use of a visual preference survey, could begin to formulate guidelines that merely 'start the conversation' rather than be definite guidelines that apply to every situation. Much like Alexander's desire for people to expand upon a pattern language, guidelines could be developed that are meant to encourage additions. To better assist the user, a methodology guidebook could be distributed on city websites, for community officials, landscape architects, and residents to view and comment on. The book could be printed as a hardcopy to regularly reference as well.

In the case of San Francisco's Stormwater Design Guidelines, these guidelines elaborate on the requirements for stormwater management within the city and give developers the tools to achieve compliance (San Francisco, 2011). The guidelines were "adopted by the San Francisco Public Utilities Commission (San Francisco, 2011)" and heavily used in the structural design of stormwater systems. Yet, if these guidelines were formatted to encompass community engagement suggestions and design ideas, city planners and landscape architects alike could benefit from this material in a completely different way than typical stormwater guidebooks.

CHAPTER SUMMARY

The human relationship with stormwater can often be complex. Creating a means to better educate the public, city officials, and landscape architects on the design potentials of stormwater management can even be more complex. This chapter evaluated some of the needs and trends of stormwater management, literary perspectives on various planning and ecological theories, cases studies on community engagement and visual preference models, as well as the creation of stormwater guidelines as they pertain to different audiences. From this information, a research question evolved: "In what way can landscape architects and city planners turn stormwater management into a participatory community effort that utilizes local resources in an attempt to protect quality of local watersheds?" Using the information collected in both Chapter 1 and Chapter 2, I begin to explore the answer by merging the findings of two separate sources: 1.) qualitative research and 2.) community input from my home town of Alachua. From this research, I hope to create a methodology that includes a series of guideline examples that follow the framework of Christopher Alexander and Joan Nassauer’s recognition of patterns in the landscape.

CHAPTER THREE: METHODS AND APPROACH

"The crisis of our diminishing water resources is just as severe (if less obviously immediate) as any wartime crisis we have ever faced. Our survival is just as much at stake as it was at the time of Pearl Harbor, or Argonne, or Gettysburg, or Saratoga."

- Jim Wright, Former Democratic U.S. Congressman from Texas, The Coming Famine, 1966

PURPOSE AND INTENDED RESULT

This section begins to formulate the purpose of my research project as it pertains to the City of Alachua. A variety of qualitative and exploratory research approaches are used, involving research and public involvement as necessary factors in developing a methodology for community engagement.

City of Alachua Overview

This terminal project was inspired by the City of Alachua, a small community with a population over 9,000 people according the 2010 U.S. Census. After living within this community for over twenty years, Alachua has become my personal 'life-place.' (See Fig. 3.1). I have developed a strong connection to the culture, ecology, and public spaces that are integrated within the landscape of this area. Water has also been an integral part of this community, with several creeks, lakes, and sinkholes that provide clean sources of water for the surrounding ecosystems. Growing up here, I have explored most of these water resources, not knowing whether or not they needed protecting or water management could be improved.

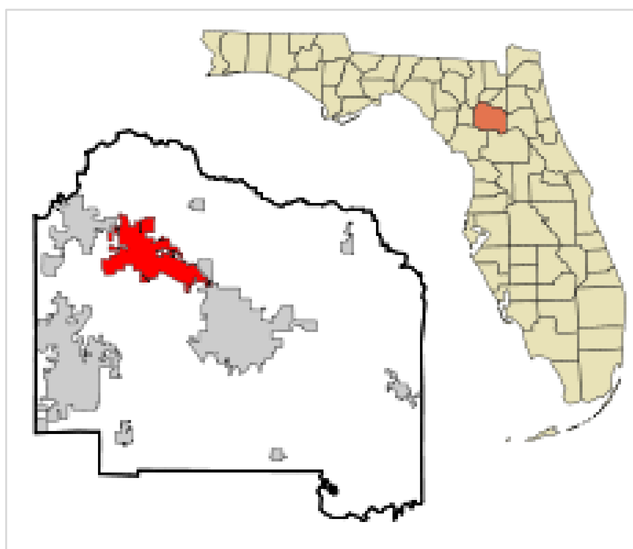


FIGURE 3.1
City of Alachua, Florida. (Source: http://en.wikipedia.org/wiki/Gainesville,_Florida)

With Florida's harsh weather changes, I have watched how stormwater has affected Alachua. Heavy rain events have caused massive amounts of flooding in streets and neighborhoods. Impermeable surfaces transport water swiftly to the nearest retention basin or low point, and there is little design emphasis to slow this process down or to cleanse the stormwater along the way.

Mill Creek is one example of a water body that directly feeds into Mill Creek Sink, previously known as Alachua Sink. The water that flows into Mill Creek Sink travels through a series of underground cave systems, and partially connects to the Santa Fe River. Dye tests have proven this six mile long trek, which further brings up concerns on water quality connectivity. Due to the sensitivity of the land around this area, I began my

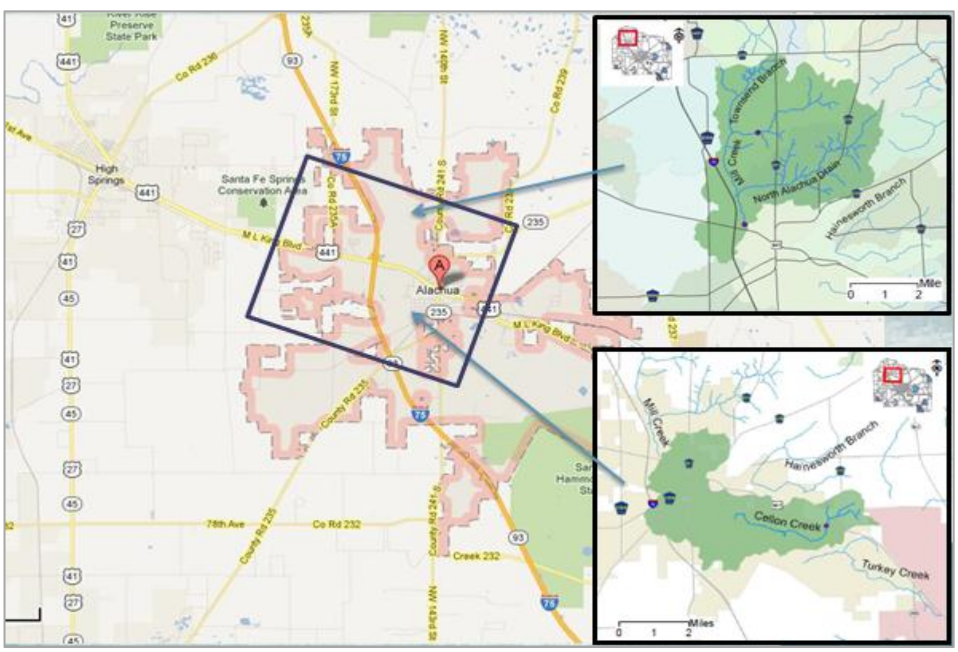


FIGURE 3.2
Mill Creek Watershed (Top Right) and Cellon Creek Watershed (Bottom Right).
(Source: Base map courtesy of Google Maps) (Source of Top Right: Mill Creek, 2013)
(Source of Bottom Right: Cellon Creek, 2013)

research with the intended purpose of understanding the relationship local residents had with the water in their own community. I was especially curious if people understood their local watersheds and how stormwater design could affect the health of water and bring about community awareness. The community of Alachua is growing, and the watersheds around the Mill Creek Watershed and Cellon Creek Watershed could be drastically affected. (See Fig. 3.2)

Alachua is planning for more urban development near its commercial intensive district. The plan includes residential housing, a Walmart Supercenter and retail outparcel, and a stormwater park at the southeast corner of I-75 and U.S. 441 (See Fig. 3.3). Stormwater management is an extremely important component for this plan in order to maintain a healthy watershed for the area. However, after speaking with the Mayor, Gib Coerper, there was a clear interest in learning what a 'stormwater park' actually meant and how stormwater could be

FIGURE 3.3
Alachua Florida Mill Creek Sink (Top Star) and it's connection to the Santa Fe River (Blue Arrow), Future Stormwater Park (Bottom Star), Future Walmart location (Left Square), and Future Residential Housing (Right Square)

(Source: Adapted from base map provided by Google Maps) better integrated within the entire community. The City of Alachua is a prime example of rapidly growing communities that want to protect their local water resources, as well as maintain a visually pleasing lifestyle. I realized that there may be of potential for innovative stormwater management approaches that fit within the pattern language of community water.

RESEARCH METHODOLOGY

Mixed Methods Approach

The purpose of this thesis project is to develop guidelines that assist landscape architects, planners, designers, and residents of rural communities in creating functional and aesthetic spaces for stormwater management. A mixed methods approach was used to develop these guidelines, which included 1.) qualitative research and 2.) community input. Through qualitative research, I analyzed and synthesized: 1.) historical perspectives on stormwater; 2.) stormwater management concerns; 3.) management needs and trends; 4.) community planning and design theories; 5.) visual preference models; and 6.) design guidelines. This literature review created the groundwork for the development of a stormwater visual preference survey that assessed the aesthetic and ecological needs of communities facing rapid urbanization. (See Fig. 3.4).

Visual Preference Survey Approach

A visual preference survey was developed in order to collect valuable community input on the aesthetics of stormwater management. Specifically, I was interested in finding out if community members in the City of Alachua were interested in seeing more creative and ecologically viable stormwater design solutions, compared to more standard stormwater design approaches that involve piping water offsite. The framework of the survey was developed to allow community members to easily analyze the visual and ecological benefits of different stormwater scenarios. The survey was modeled after Kaplan and Kaplan's combined methods for engaging the public, creating visual alternatives, and providing a preference survey.

The visual preference survey and the methods for engaging the public were submitted for approval by the University of Florida's Institutional Review Board. In compliance with the IRB, each survey contained an Informed Consent document, which provided an overview of the survey's purpose, brief methodology, researchers contact information and affiliation, and the rights of the participant (See Appendix B). Participants were asked to give their consent by signing the document and dating it. These forms were given separately in order to protect the anonymity of the participants. IRB also approved permission to have audio and visual records of the visual preference survey community interaction process.

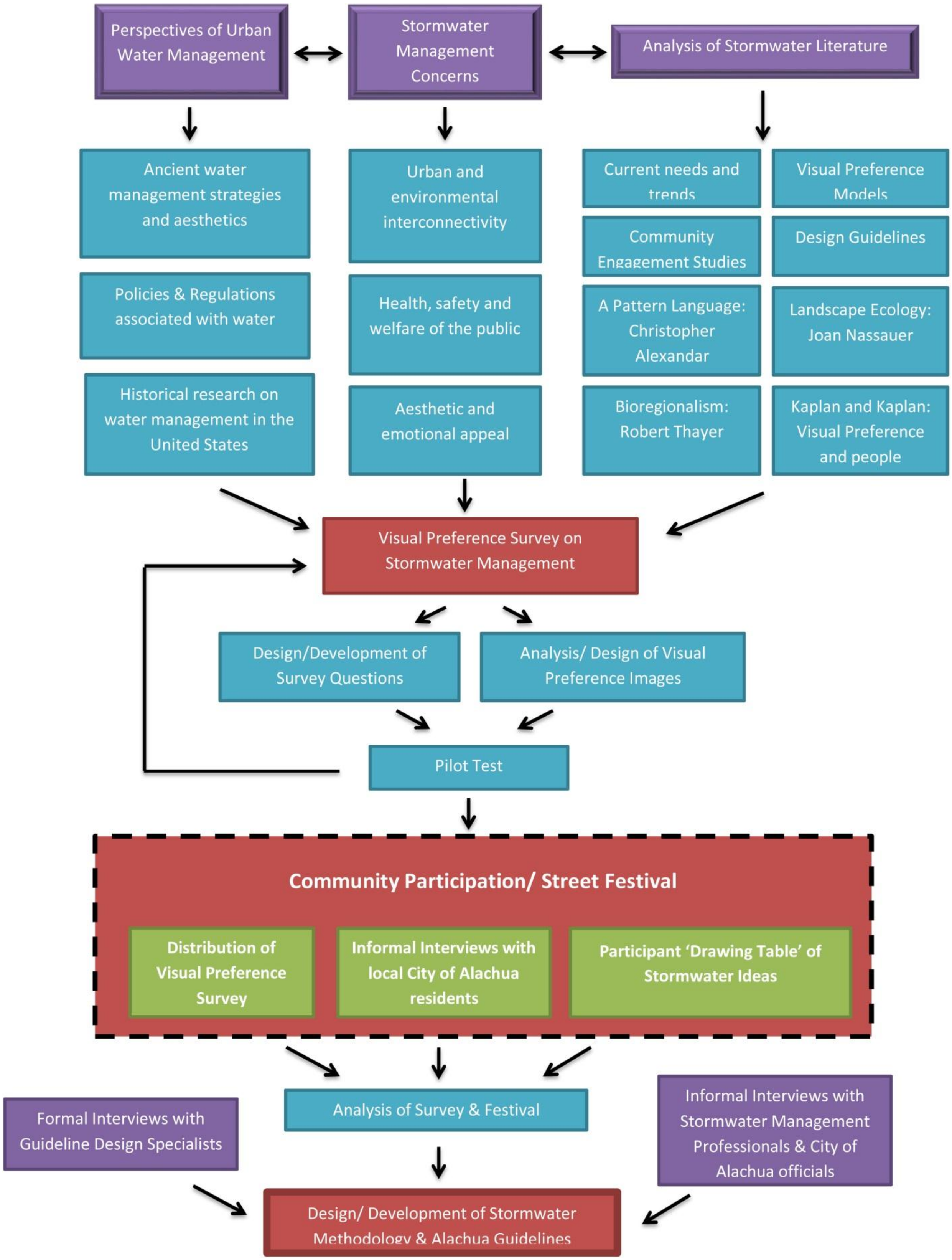


FIGURE 3.4
Research Methodology Diagram
(Source: M. Requesens)

COMMUNITY ENGAGEMENT/ SURVEY

Qualitative Research

Engaging the community and distributing a visual preference survey is a part of the qualitative research process that enabled me to effectively create initial community guidelines specific to the City of Alachua. According to the Department of Public Policy and Administration the term 'qualitative research' is defined as,

> "… gaining a deep understanding of a specific organization or event, rather a than surface description of a large sample of a population. It aims to provide an explicit rendering of the structure, order, and broad patterns found among a group of participants. It is also called ethnomethodology or field research. It generates data about human groups in social settings. [It] does not introduce treatments or manipulate variables, or impose the researcher's operational definitions of variables on the participants. Rather, it lets the meaning emerge from the participants. It is more flexible in that it can adjust to the setting. Concepts, data collection tools, and data collection methods can be adjusted as the research progresses… [It] aims to understand how the participants derive meaning from their surroundings, and how their meaning influences their behavior (PPA, 2012)."

It is through qualitative research that allows a unique insight into the meaning behind decisions made about stormwater management. By understanding the thought process of the general public, research can reveal patterns needed to further better our environments.

Visual Preference Survey Procedure

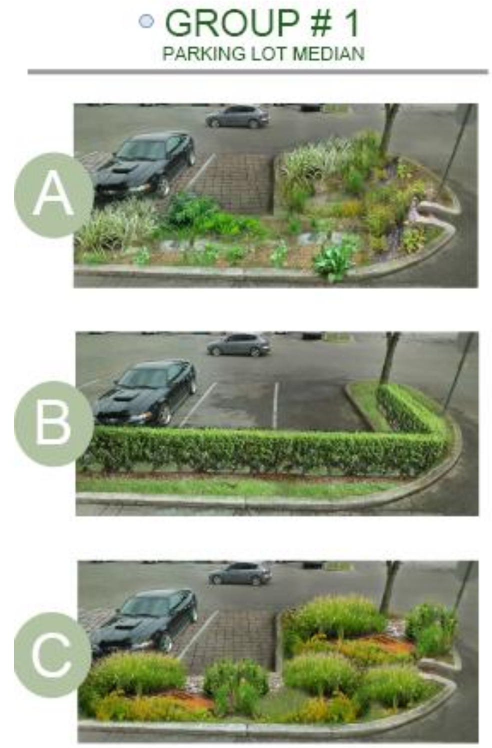
Method

In an effort to simultaneously engage the public in a comfortable surrounding while collecting valuable visual preference data, I developed a visual preference survey that would be suited for a street festival (See Appendix A). This survey would aim to engage residents of the City of Alachua in a method that involved 1.) the selection of a visual stormwater alternative based on ecological and aesthetic properties, 2.) an educational review of the alternatives, and 3.) a reselection of an alternative with the consideration of maintenance included. By recognizing Kaplan and Kaplan's approach to engaging the public, I decided to administer an interactive version of a standard visual preference survey to community members of all ages during the Alachua Harvest Festival within the City of Alachua. This festival occurred on November 11, 2012 from 11 a.m. to 5 p.m, and consisted of 10' x 20' booth that allowed community members to enter and participate in the survey.

Design

The visual preference survey was designed to reference a series of different stormwater scenarios. The process by which these scenarios were created involved extensive research of modern and innovative stormwater management approaches. A selection process then began in order to narrow down the choices to a number that effectively gave a range of options without overwhelming the participant. The selection process reduced the number of design choices to 10 management options that ranged in complexity and location. After closer analysis, the 10 scenarios were further narrowed to 8, eliminating repeating ideas and overly simple solutions.

The visual preference survey therefore referenced 8 different stormwater scenarios, each containing 3 alternatives with varied degrees of water treatment. Each stormwater scenario and alternative was a digitally created using Adobe Photoshop CS5 Extended, and represented an effective range of stormwater management techniques.

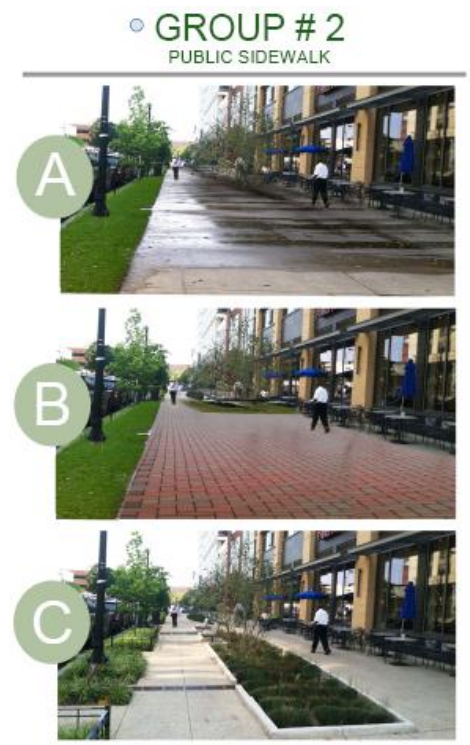


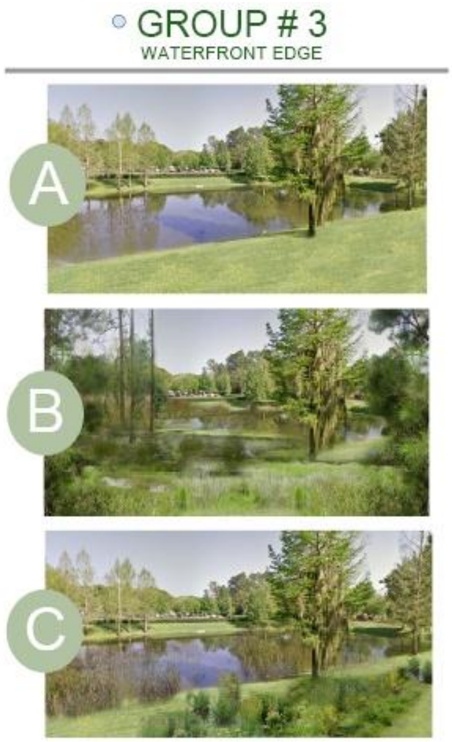
Each scenario contained 3 stormwater solution options (labeled A, B, or C) based on management:

- Minimal impact to stormwater management
- Partial impact to stormwater management
- Most effective impact to stormwater management

Each scenario also focused on a singular urban environment, whether it was:

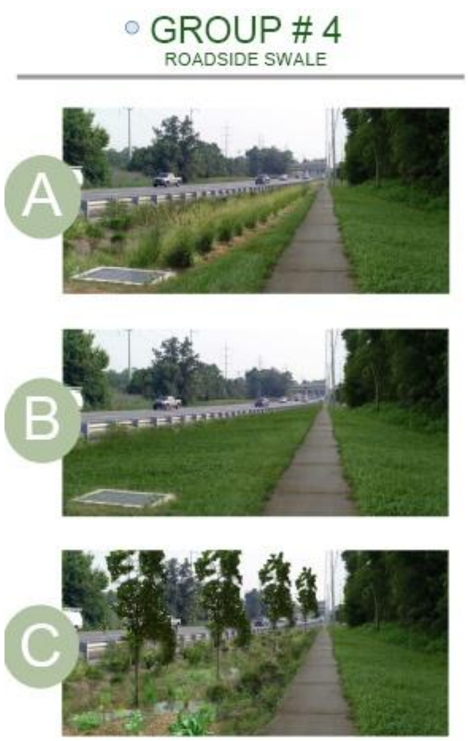
- Commercial and Industrial
- Residential (Single Family or Multifamily)
- Stormwater Ponds





Together, the following 8 stormwater scenarios were created (See Fig. 3.5):

1. Parking Lot Median
2. Public Sidewalk
3. Waterfront/ Stormwater Pond Edge
4. Roadside Swale
5. Roofwater Collection / Greenroof
6. Rainwater at Home / Rainbarrel
7. Public Green Space
8. Residential Lawn

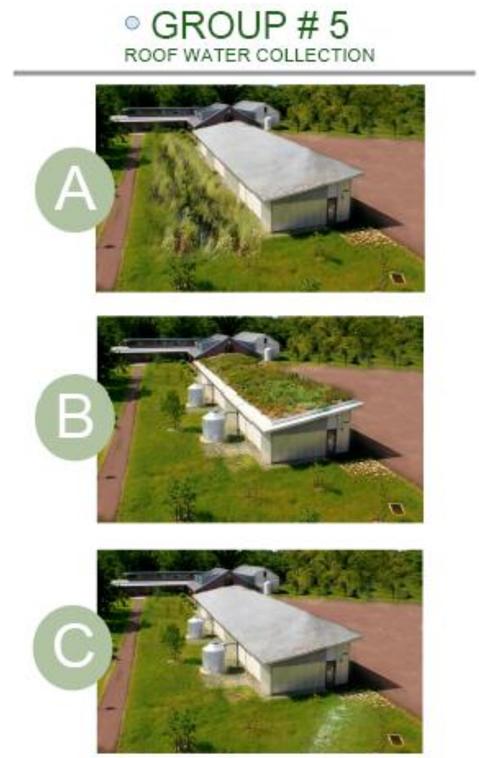


During the Alachua Harvest Festival, 8 separate 24” x 36” poster boards displayed the scenarios with the 3 stormwater solution alternatives per board. A corresponding visual preference survey handout was designed to be given to participants in reference to the poster boards. This survey would act as a catalyst for participants to begin discussing the stormwater scenarios with volunteers.

The visual preference survey handout was divided into three parts: 1.) Initial Preference Questions, 2.) Educated Preference Questions, and 3.) Demographic and Knowledge Based Questions.

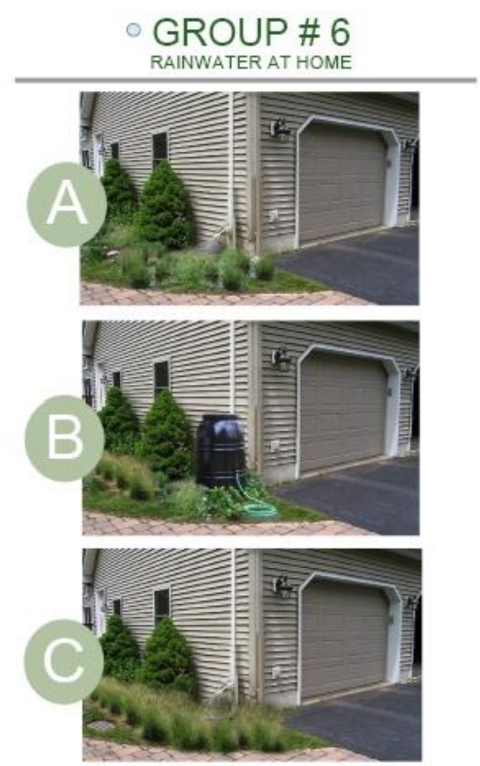
In Part 1 of the survey, participants were asked to observe the scenarios and choose the images that best answer the following questions:

1. Which image is the most *Visually Appealing*?
2. Which image seems to be the most *Ecologically Friendly*?



For this portion of the survey, participants were not informed as to which stormwater category or which stormwater solution option they were observing.

In Part 2 of the survey, participants were asked to read additional information provided on the various stormwater management scenarios and then choose the image that they would want to have at their home, business, or community based on the following considerations: 1.) aesthetic preference, 2.) ecological benefits, and 3.) maintenance.



In Part 3 of the survey, participants were asked to answer a series of 10 demographic and knowledge based questions. The first four questions were demographic questions about gender, age, residency, and ethnicity. The next five questions attempted to better understand the audience's knowledge about: 1.) stormwater management,

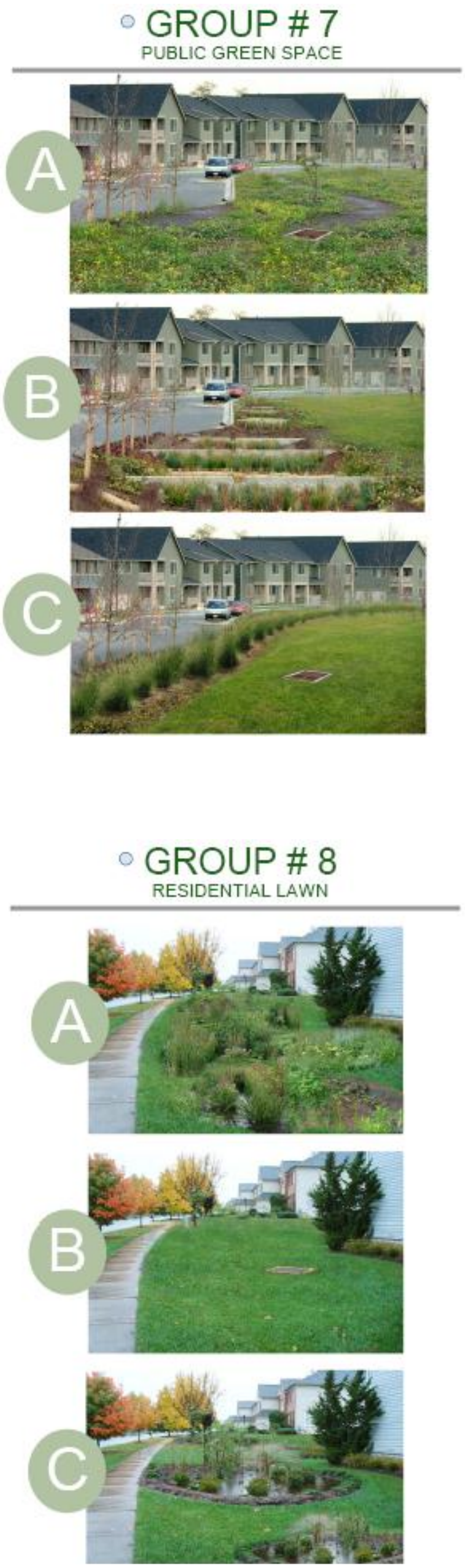


FIGURE 3.5
Groups 1-8 of the Visual Preference Stormwater Posters.
(Source: M. Requesens)

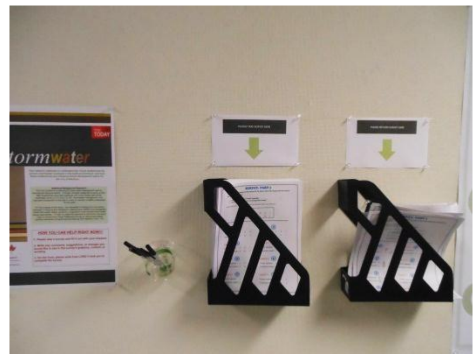
2.) personal water conservation practices, 3.) concerns people may have about water quality in their community, 4.) the Floridan Aquifer, and 5.) the roles of community members in protecting watersheds from pollution. The final question asked whether or not participants would like to be added to an email list for research progress updates and an invitation to the public presentation.

Pilot Test

Before engaging the community of Alachua during the Alachua Harvest Festival, I conducted a Pilot Test with students and professors at the University of Florida. (See Fig. 3.6). For one week I displayed the 8 stormwater scenario poster boards and the corresponding surveys in the 4^{th} Floor hallway of the UF Architecture Building. A total of 11 surveys were filled out, each with answers and comments pertaining to the design of the survey. On average participants noted that the survey took roughly 8 minutes to complete. Two of the main graphic suggestions that participants commented on were the following:

1. Group #2 – It is likely that nobody will prefer choice A due to its excessive flooding on the sidewalk. Perhaps this alternative could simply represent traditional drainage and green lawn, rather than flooding.

2. Group #6 – The concept of a rain barrel is highly attractive from a water conservation standpoint, but this particular rain barrel looks more like a trashcan. Could there be another rain barrel design?
3. Group #8 – Rain gardens don't have to look so messy, perhaps use a better rain garden example?



Based on these comments, Group #2 and Group #6 were adjusted to allow for a clear depiction of the various forms of stormwater management. As it was not my intention to manipulate responses based solely on appeal, changing the visual appeal of the rain barrel simply allowed this feature to be more apparent as to its function. I did not change the visual appeal of the rain garden on the residential lawn due to the fact that I was more curious about how people would respond to the connectivity or isolation of individual gardens rather than the design of the garden itself. (See Fig. 3.7).

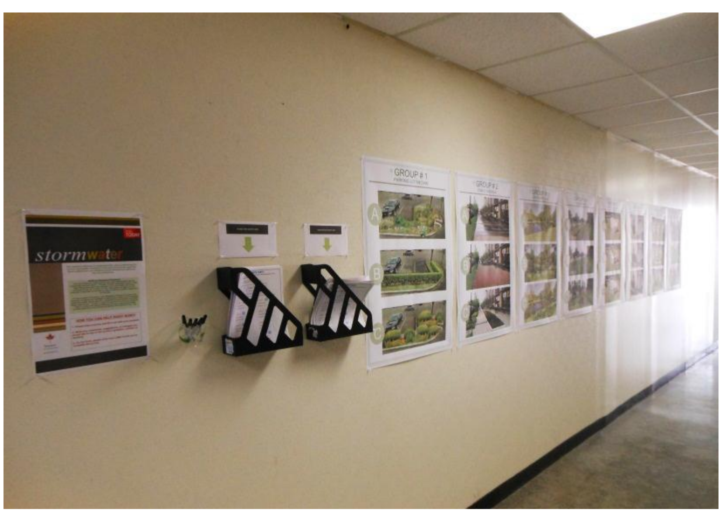


FIGURE 3.6
Pilot Test of Visual Preference Survey – 3 Images from UF Architecture Hallway
(Source: Kay Williams)

FIGURE 3.7
Edits to Group 2 and 6 of the Visual Preference Stormwater Posters
(Source: M. Requesens)

Distribution

On the day of the Alachua Harvest Festival, City of Alachua participants were invited to enter a covered booth, greeted by myself and trained volunteers, to participate in a stormwater visual preference survey. Several posters describing the purpose of my research as well as images and aerial photographs of future development sites in Alachua were key elements in attracting the interest of residents. After signing a an informed consent document, participants were able to take a clipboard containing the survey, and walk through the booth to view the posters as they filled out their answers.

A separate area of the booth was designated the "Coloring Table" for children to "Draw what they like to see in a

Landscape" on a mural of paper. This table allowed parents to comfortably take a survey while their kids were occupied with markers. This was a creative management approach to the design of the booth..

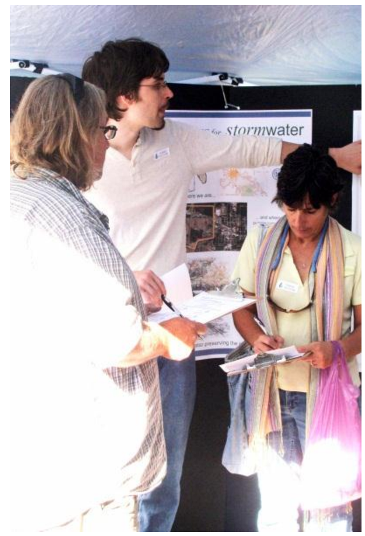


FIGURE 3.8
Images from the Alachua Harvest Festival – Distribution of the Stormwater Visual Preference Survey

(Source: M. Requesens)

Quantitative Analysis

In total, 78 participants completed visual preference surveys. Using Qualtrics, an online survey software, I recreated the survey that was distributed to participants during the Alachua Harvest Festival on November 11, 2012. Then, I entered the answers from each of the 78 surveys. A combination of analysis techniques from Qualtrics Survey Statistics, and Excel Graphs express the results in a series of sections (See Appendix D).

The first section of the results shows a brief breakdown of the answers for Part # 1 of the Survey. Numbers 1, 2, and 3 in the pie charts refer to Answers A, B, and C for each question. For example, 69% of the total responses chose “C” for the most visually appealing, and 58% of the total responses chose “C” for most ecologically friendly as well.

The second section of the results further breaks down each image. There are a series of statistics for A, B, and C for each group. Please take note of the number of responses for each of the bar graphs for this section; otherwise the results may seem misleading.

The third section analyzes the results from when participants were asked to read information about the various stormwater management techniques and then answer which they preferred based on this new information. For the purpose of recreating this survey through Qualtrics, these questions were simplified in order to efficiently acquire the data.

The last section consists of the statistical results for the demographic questions and knowledge-based questions of the visual preference survey. The following section illustrations a simplified version of these results.

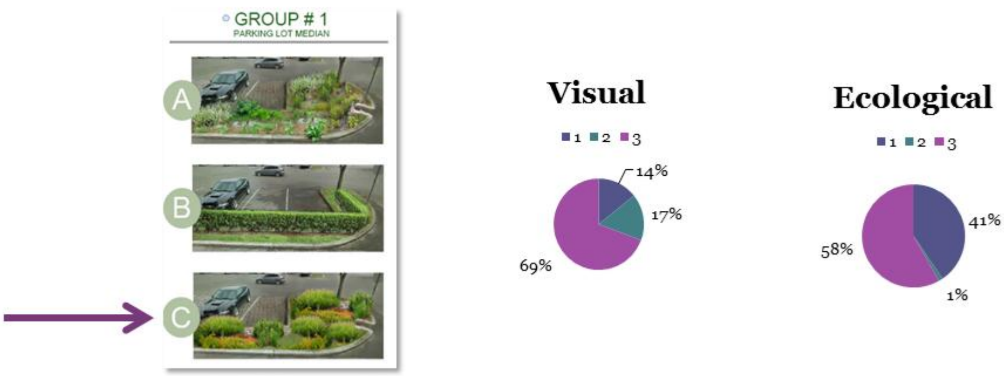
QUANTITATIVE RESULTS (GROUPS #1-8)

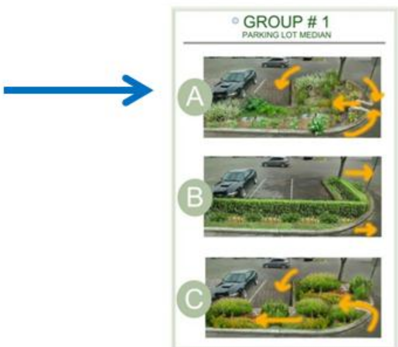
In this section, a brief summary the quantitative results of Parts 1 and 2 of stormwater visual preference survey will be assessed. As previously mentioned, a more detailed version of this section can be found in Appendix D.

In each scenario of this section, the top image demonstrates the image found in Part 1 of the Survey, with corresponding pie charts indicating the overall visual and ecological preferences. The purple arrow points to the image that received the highest preference for both. If two purple arrows are present, this indicates that there were two different preferences, one with the highest visual preference and one with the highest ecological preference.

The bottom image demonstrates the image found in Part 2 of the Survey, with the corresponding information that each participant was instructed to read, and a bar chart showing the overall preference basic on aesthetics, ecology, and maintenance. The blue arrow points to the image that received the highest preference for this part.

GROUP # 1 RESULTS





- *Water from the parking lot flows into a planted median to slow and filter pollutants out of the water*
- *Water from the parking lot flows into a drain and taken off site*
- *Water from the parking lot flows into a planted median and some of that water goes into a drain and taken off site*

#	Answer		Response	%
1	A		36	60%
2	B		2	3%
3	C		22	37%
	Total		60	100%

In this scenario, respondents had an overwhelming visual preference for Choice C, with Choice A and B being fairly even second choices. However, Choices A and C were found to be more ecologically friendly, while Choice B was drastically lessened to 1%. There was a greater preference for plant diversity and water management.

After reading about each stormwater alternative, this particular scenario showed an overall preference for Choice A, when Choice C had originally had the highest visual and ecological preference.

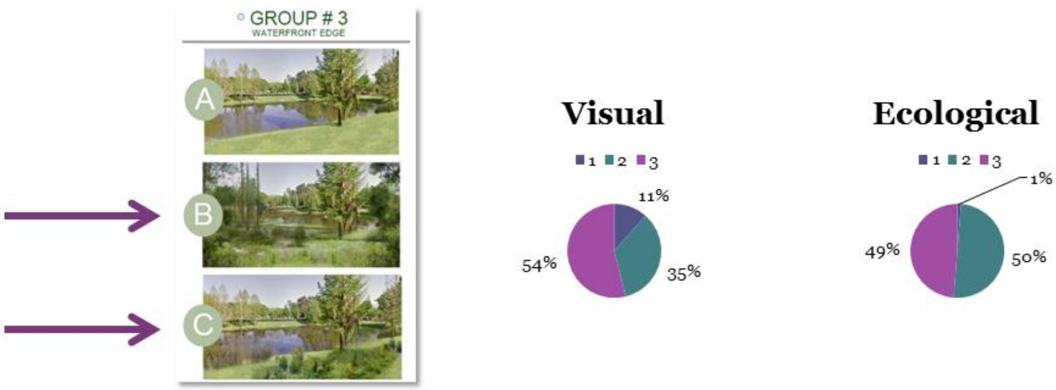
GROUP # 2 RESULTS

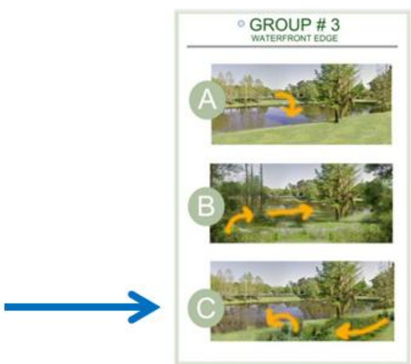
#	Answer		Response	%
1	A		1	2%
2	B		24	40%
3	C		35	58%
	Total		60	100%

In this scenario, respondents had a fairly equal visual preference for Choice B and C, with very little preference for Choice A. However, Choice C was found to be significantly more ecologically friendly, while Choice B was lessened. Choice A remained the same in both visual and ecological preference.

After reading about each stormwater alternative, this particular scenario showed an overall preference for Choice C, when Choice B and C were similar in visual preference and Choice C was the most ecologically preferred.

GROUP # 3 RESULTS





- *Water from surrounding streets are piped into this pond to slowly soak back into the ground*

- *Vegetation at the pond edge slows and filters pollutants out of the water before entering the pond*

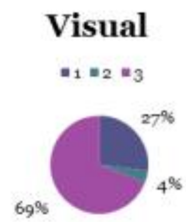
- *Water flows into vegetated depressions, where it slows and filters pollutants before entering the pond*
- *Grass separates pond edge and vegetated depression*

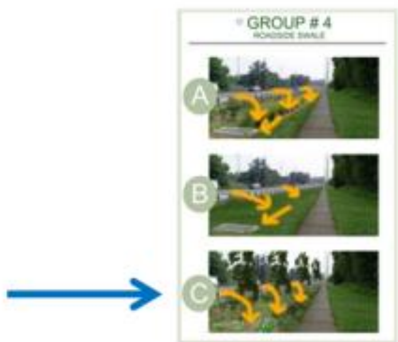
#	Answer		Response	%
1	A		1	2%
2	B		27	44%
3	C		33	54%
	Total		61	100%

In this scenario, respondents had a high visual preference for Choice C, with a close secondary preference for Choice B. However, Choice B increased to have a relatively equal ecological preference to Choice C. Choice A significantly decreased from a visual preference of 11% to an ecological preference of 1%.

After reading about each stormwater alternative, his particular scenario showed an overall preference for Choice C, when there was a high visual preference for Choice C and a relatively equal ecological preference between B and C.

GROUP #4 RESULTS





- Water from the street flows into the planting bed where grasses and shrubs are used to filter pollutants before it's piped off site

- Water from the street flows into the grassy depression and then piped to a nearby pond
- Mowing is the only maintenance needed

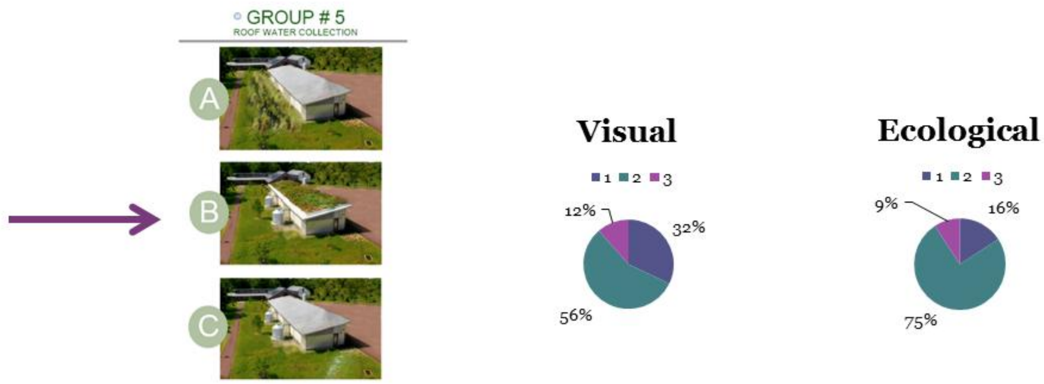
- Water from the street flows into the planting bed where it remains until it is filtered and soaks back into the ground
- No mowing needed

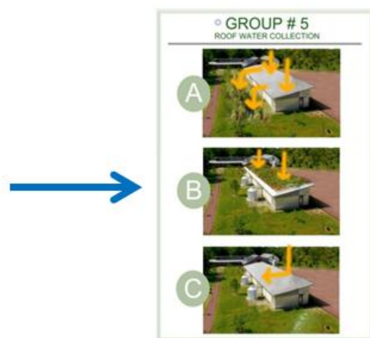
#	Answer		Response	%
1	A		11	18%
2	B		0	0%
3	C		49	82%
	Total		60	100%

In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice A. There was not a drastic change in responses to ecological friendliness, but Choice C increased by 12% while Choice A decreased by 13%. Choice B stayed at relatively the same low percentage.

After reading about each stormwater alternative, this particular scenario showed an overwhelming preference for Choice C, when Choice C had both a high visual and ecological preference as well.

GROUP # 5 RESULTS





- *Water from the roof flows directly into the vegetated depression to allow it to soak back into the ground*
- *No gutters allows a sheet flow of water to evenly enter the depression*

- *Rain water irrigates the vegetated Eco-roof*
- *Any excess water flows into cisterns and reused for the landscape and amenities such as toilets*

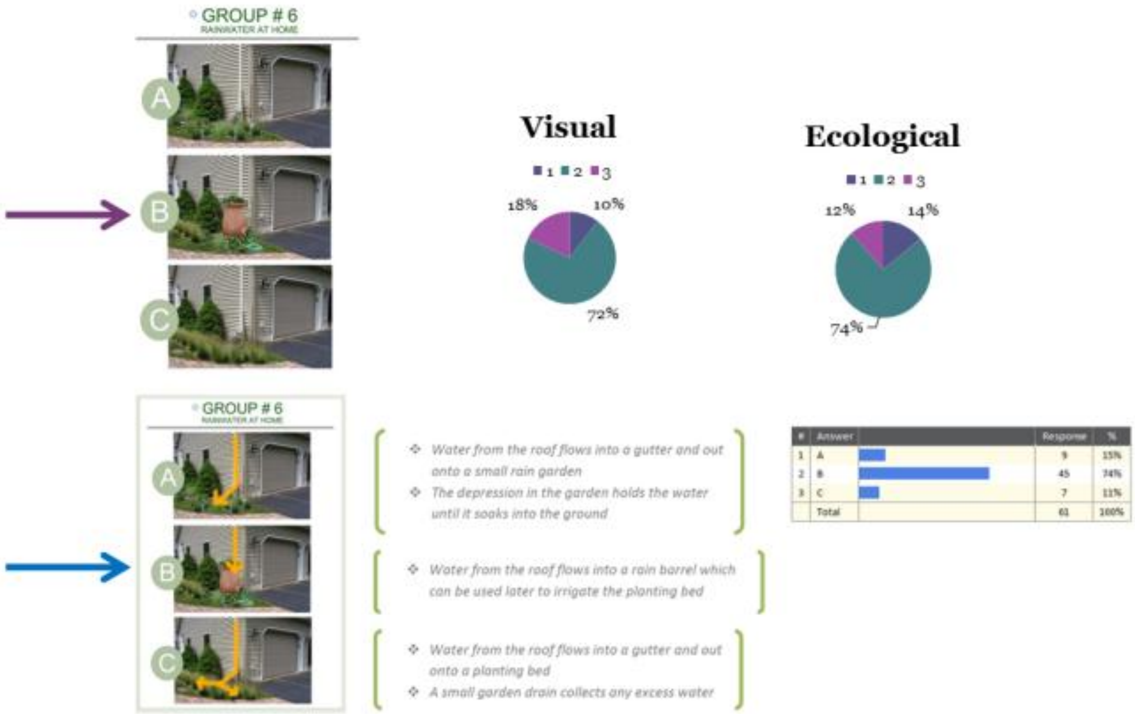
- *Cisterns capture most of the rain water*
- *Any excess water flows onto the grassy landscape and piped off site*

#	Answer		Response	%
1	A		5	8%
2	B		49	83%
3	C		5	8%
	Total		59	100%

In this scenario, respondents had a high visual preference for Choice B, with a secondary preference for Choice A. However, the ecological preference for Choice B increased by 19%, while Choice A decreased by 16%. Choice C stayed relatively low in both visual and ecological preference.

After reading about each stormwater alternative, this particular scenario showed an overwhelming preference for Choice B, when Choice B had both a high visual and ecological preference as well.

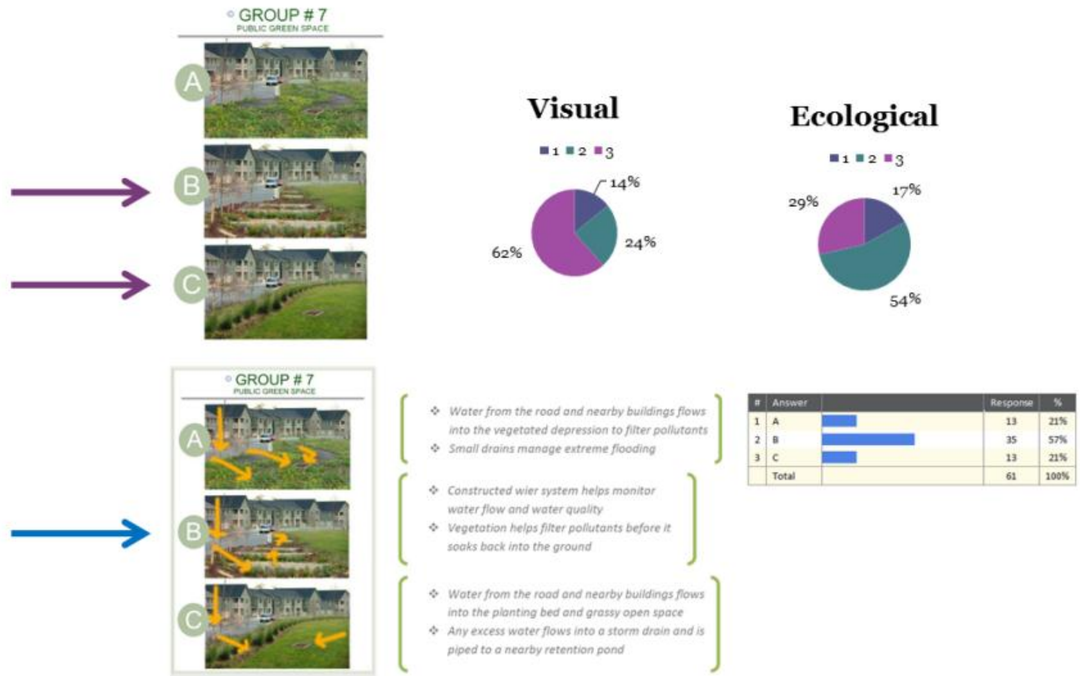
GROUP # 6 RESULTS



In this scenario, respondents had both a very high visual and ecological preference for Choice B. Choice C had a slightly higher visual preference as a second choice, which Choice A had a slightly higher ecological preference as a second choice.

After reading about each stormwater alternative, this particular scenario showed an overall preference for Choice B, when Choice B had both a high visual and ecological preference as well.

GROUP # 7 RESULTS

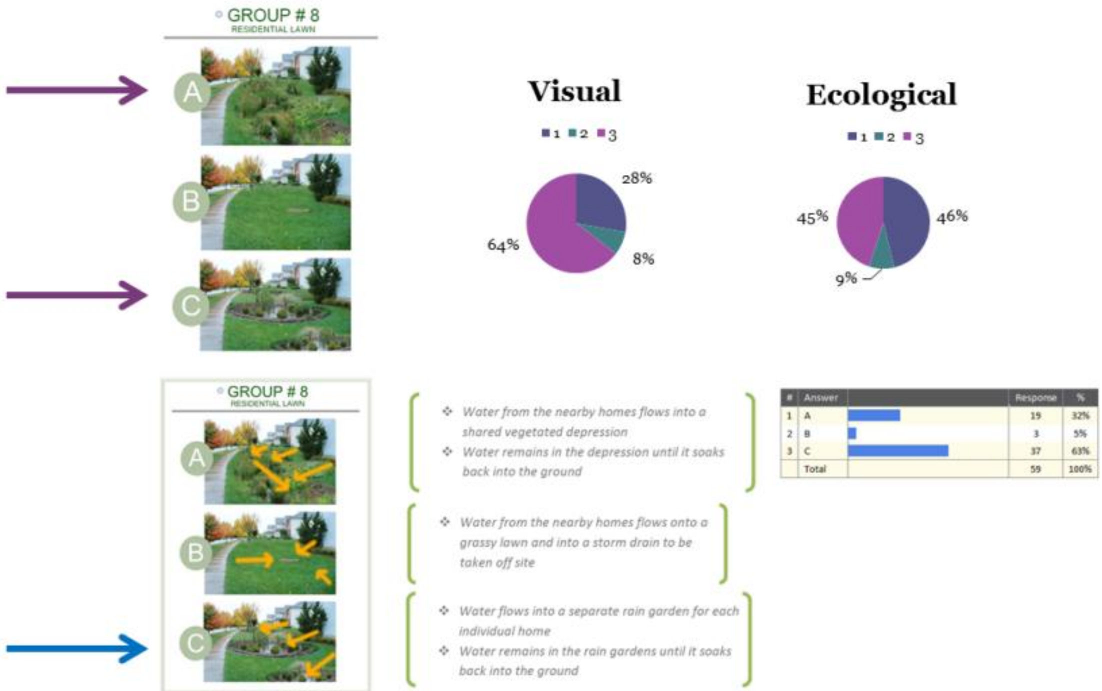


#	Answer		Response	%
1	A		13	21%
2	B		35	57%
3	C		13	21%
	Total		61	100%

In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice B. However, Choice B had a significantly high ecological preference, increasing by 30%. The ecological preference of Choice C decreased by 33% from its high visual preference. Choice A remained about the same for both preferences.

After reading about each stormwater alternative, this particular scenario showed an overwhelming preference for Choice B, when Choice C had a high visual preference and Choice B had a high ecological preference.

GROUP # 8 RESULTS



#	Answer		Response	%
1	A		19	32%
2	B		3	5%
3	C		37	63%
	Total		59	100%

In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice A. However, Choice A and Choice C had almost identical ecological preference. Choice B remained about the same for both preferences.

After reading about each stormwater alternative, this particular scenario showed an overall preference for Choice C, when there was a high visual preference for Choice C and an almost identical ecological preference for both Choice A and Choice C.

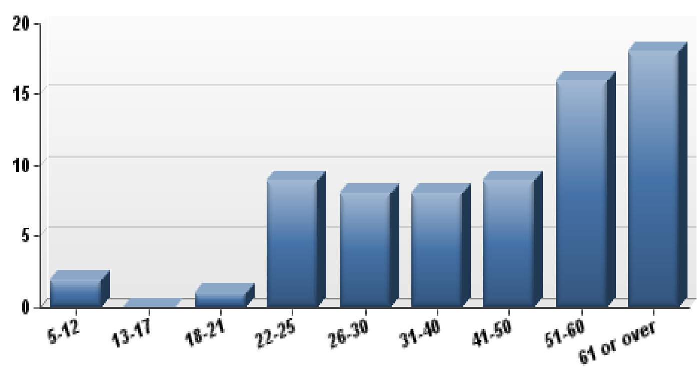
DEMOGRAPHICS & KNOWLEDGE BASED QUESTIONS

Part 1 and 2 of the survey indicated higher preferences for stormwater alternatives that contained more plant diversity, more on-site water management, and more visible technology. In this section, Part 3 of the visual preference survey is graphically represented with bar charts created from Qualtrics. These answers make up the demographic and knowledge based questions of the survey.

What is your gender?

#	Answer		Response	%
1	Male		33	46%
2	Female		38	54%
	Total		71	100%

What is your age?



Do you live in the CITY of Alachua?

#	Answer		Response	%
1	Yes		23	33%
2	No		46	67%
	Total		69	100%

What is your ethnicity?

#	Answer		Response	%
1	White, non-Hispanic		59	86%
2	African-American		1	1%
3	Hispanic		4	6%
4	Asian-Pacific Islander		2	3%
5	Native American		1	1%
6	Other		2	3%
	Total		69	100%

How much do you know about stormwater management?

#	Answer		Response	%
1	I have never heard of stormwater management		3	4%
2	I have heard of it, but don't know very much about it		23	32%
3	I know some information about it		34	48%
4	I know a lot about it		11	15%
	Total		71	100%

How often do you consciously try to conserve water in your home?

#	Answer		Response	%
1	Not often		6	8%
2	Sometimes		20	28%
3	Often		45	63%
	Total		71	100%

How concerned are you about water quality in your COMMUNITY?

#	Answer		Response	%
1	Not concerned		4	6%
2	Somewhat concerned		21	30%
3	Very concerned		44	62%
4	I don't know if there are any water quality issues in my community		2	3%
	Total		71	100%

How much do you know about the Floridan Aquifer?

#	Answer		Response	%
1	I have never heard of the Floridan Aquifer		7	10%
2	I have heard of it, but don't know very much about it		15	21%
3	I know some information about it		35	49%
4	I know a lot about it		14	20%
	Total		71	100%

How important is it for community members to play active roles in protecting local watersheds from pollution?

#	Answer		Response	%
1	Not important		0	0%
2	Sometimes important, depending on what's causing the pollution		7	10%
3	Very important		63	90%
4	It is not the community member's role		0	0%
	Total		70	100%

Would you like to be added to the email list to receive updates on the progress of this research and an invitation to the public presentation?

#	Answer		Response	%
1	Yes		33	46%
2	No		38	54%
	Total		71	100%

Observations and Participant Reactions

Introduction

Assessing the visual preferences of various stormwater solutions in a festival setting proved to be a valuable experience, both written and verbally. The following sections will describe a series of anecdotes, observations, and opinions regarding the interactions that occurred during the festival.

The Booth Design

The design of the two booths were planned in order to give participants the ability to freely move throughout the space; to view the posters in order from left to right but also giving everyone enough room to walk back through them in any order. A table for greeting participants with surveys was placed on the left, and a table for drawing was placed on the right. The middle was open to invite people in, and to efficiently monitor who was ready to take surveys and then hand them back in.

All trained volunteers were instructed to keep their introduction of the project friendly, engaging, and to the point. This approach attracted immediate interest and opened up discussion for more questions. Residents were immediately interested in *where* stormwater concerns were happening in Alachua, and *what* the posters had to do with my research.

Having the posters as a backdrop was incredibly useful. They caught the attention of several people at once, even when volunteers were preoccupied giving instructions to others. With so many people stopping by the booth at once, I noticed on several occasions that people “followed the leader” by overhearing the introductory talks, signed a release form, and walked themselves through the survey.

The Survey and Posters

One of the best parts of this festival event was being able to talk with people about what they were thinking as they were taking the survey. It seemed as though the quantitative research that supported the survey sparked a much greater qualitative discussion. I found that these discussions were one of *the most* beneficial aspects to my research. Hearing people's opinions and thought processes was very exciting, and created a lot of great discussion. I believe these discussions are key to truly understanding what people want to see in their communities.

The Walmart

Once community members realized that the research booths were interactive and involved their opinion, people were very interested and engaged. After the first hour of having the booths, I quickly realized that the construction of the local Walmart was a very hot topic of interest for community members. From this observation, I started using the Walmart as part of my opening dialogue, which increased my participation rate exponentially.

- Water – Some people were interested about water quality and the cookie cutter retention ponds that come with big box stores. Most of their concerns involved *where* these were going to be placed, and *how* they were going to look. Many were already aware of the purpose and function of retention ponds and assumed most of these ponds are designed the same way. This was interesting because the retention pond scenarios from Poster #3 were from a photographed pond in

Gainesville. However; I had several comments from residents saying "Well, that looks familiar." They were referring to the retention pond in front of the Hitchcock's Foodway in Alachua. I did not deliberately choose this image to look like the one in Alachua, but it interesting seeing how remarkable the similarities were.

- Immediate Reactions – There was almost an even amount of negative and positive opinions on the Walmart being beneficial to the community. Those who had positive comments couldn't wait for it to get here. Their reasoning was that it would not only provide jobs, but allow them to shop for more of the necessities they need locally rather than driving to Gainesville. Those who had negative comments were content with the new Walmart that is being built further South on 13th Street, and were willing to travel that extra distance to keep Walmart out of their community. There were another handful of community members that had no idea that a Walmart was being proposed for Alachua, and thought I was talking about a different one. Showing them the map and the proposed location was shocking to most people and led them to have an overwhelming support for my research. I received a lot of "Thank you for what you're doing," and "Please present your findings to the city" comments.

- Pollution - People seemed genuinely concerned about the pollution from cars in parking lots and the impact that has on surrounding water systems. I had several comments about the scale of the Walmart parking lot and what happens to the runoff. Permeable pavers came up a lot in these discussions with concerns of whether or not pollutants soak directly into the ground.

- Look and Feel of a Big Box Store – Those who had negative comments about the Walmart mentioned how Walmart would not be characteristic of Alachua and how they worried it would take away from the historic nature and the ‘small town’ feel that they loved.

- Traffic – worried that Walmart would significantly cause more traffic and pollution.

- Local Business/ Economy – There were positive comments on jobs; however, there were some concerns that Walmart would be the “beginning of the end” for smaller, local businesses.

- Parking Lots – Locals know the proposed site for the Walmart as agricultural land. It is one of the few areas in Alachua that has a relatively good amount of topography as well. So naturally, there were many comments on the unsightly design of Walmart parking lots and how that would destroy the natural feel of the area. People described the Walmart parking lots as being “unappealing and lacking trees.”

- Location – People were concerned about the location as far as the proposed entrance, and especially the ***view*** of the existing single family and multi-family residential housing nearby. This was particularly important to those who were living there currently. I had one family mentioned that they lived in the multi-family residential complex “One 51 Place” and they love the views of the open and natural land around them and often take walks down to these natural areas. They were very concerned about how this natural area would look if a Walmart was placed there.

Discussions from Poster 1: Parking Lot Median

- Permeable Pavers – what are they and are they good for parking lots when pollutants of cars can soak through them?
- Drains – where do they go, and are they necessary?

- Plants – there are a lot of differences in plant selection, is this important? Are they native? (It was encouraging to hear people recognize that native plants are a good thing).
- Plant Health – Image C typically received more recognition because the plants 'looked' healthier and more full compared to Image A
- Flooding – more people preferred to see some drainage in case of flooding
- Visibility – parking lot & streetscape concerns

Discussions from Poster 2: Public Sidewalk

- Color – Many people found Image B to be very appealing in color. In many instances, people commented that they'd love to see a combination of B and C, which had a combination of the red permeable pavers with the sidewalk planters. I was surprised by the larger number of people that commented on this same detail. One woman even began combining design elements from different posters. She mentioned that it would be perfect if had the red pavers, with the plant selection of Board 1 (option C) and Board 4 (option C).
- Open Space – Fluidity for people to move about was important, which allows for better walkability and bike-ability, as well as safety.

- Character – Many noted that C seemed to be more ecologically friendly, but still chose B due to the combination of color and permeability.
- Slipping – a concern, especially for images with no on-site drains *and* for permeable pavers. Those who did not choose Image B in many instances thought that the cracks might be hard to walk on and maintain / algae and water in cracks.
- Combinations – as mentioned above, people made many comments on their wanting to combine two or more different choices to get the perfect combination of what they like to see. After viewing all the boards, I received several questions on whether or not certain elements could apply to all or most cases, such as permeable pavers, green roofs, and weirs in a single site.

Discussions from Poster 3: Waterfront Edge

- Plants – People seemed to like the more natural look for both visually appeal and ecological friendliness, but wondered how much grass is too much grass.
- Water flow – Common questions of how long does the water sit, and where does it go?
- Maintenance – Option B looked "messy" to some and difficult to maintain, but they often liked that option if there was a way to keep it looking nice. A couple

people commented on algae growing with standing water and how to keep the water clean.

Discussions from Poster 4: Roadside Swale

- **Visibility-** This was a significant point of consideration for people. It seemed as though those who were having difficulty choosing between A and C were addressing the visibility concerns.
- Flooding/Drainage – As with most posters, people liked to see more natural landscapes with some drainage. Concerns with flooding and mosquitoes were also a concern.
- Plants – which plants would do well with little maintenance and which look the healthiest. Again, people seemed to like a combination of options.

Discussions from Poster 5: Roof Water Collection

- **One of the largest amount of discussion was prompted on this poster.**
- **Green roofs**– many people were unfamiliar with the functionality of green roofs and weirs
    - maintenance and labor (lots of questions)
    - life-span and durability (some questions)
    - plant selection, specific to Florida and this region (lots of questions)

    - cost (minimal questions)
    - water – leaking problems into building? Basic design of a green roof?
    - insects (minimal questions)
    - for those who asked about the other benefits of green roofs, they really like the cooling, comparative cost of a conventional roof, etc.
- **Cisterns** – lots of interest
    - people loved the practicality of being able to reuse the water in the building
    - loved the water storage aspect of them
    - people overall didn't think they were unappealing.
    - once they learned more about them, they seemed very interested in seeing more of them.
    - people were curious about different ways cisterns could be placed in the landscape, such as the use of different materials
    - Seemed to like cisterns over the green roof
        - Can SEE the cistern and the reuse happening
        - Can NOT see the green roof as easily

<u>Discussions from Poster 6: Rainwater at Home</u>

- Rain barrel
    - visual appeal of barrel - positive
    - mosquitoes – possible breeding problem
    - maintenance – algae and upkeep
    - hose vs. drip irrigation options in Image B.
    - drainage – are drains necessary?
    - plant selection – water tolerant plants vs. others

<u>Discussions from Poster 7: Public Green Space</u>

- **One of the largest amounts of discussion was prompted on this poster.**
- **Weirs –** people were VERY fascinated by the mechanism of a weir system. I was surprised how much people liked the science behind them and even more surprised with how much they liked them visually.
- Curiosity – people had many questions on where they can go to see something like this, if this is being done in other places, how this would work here, etc.
- Water flow – is there enough water to keep this system going? How would it look if there is a drought?
- Maintenance – how difficult would it be to keep it looking nice?
- Plants – how many different plant species could be planted in this system?

- Types – are there different types and styles of weir systems?
- Art form – people seemed intrigued by the structural components of them.

Discussions from Poster 8: Residential Lawn

- Standing Water – there were several comments regarding standing water near residential areas and how this would be addressed in each of these scenarios; especially an issue in Image C? The concern about mosquitoes came up the most during this poster.
- Maintenance – Image A is hard to maintain, how would residents care for it?
- Snakes and other animals – People had some other concerns about hard-to-control animals in 'messier' landscapes.

CHAPTER SUMMARY

The City of Alachua is the reason why I was inspired to base my research on stormwater management. This community is not only my home and 'life-place,' but it envelopes several watersheds and ecological networks within the area. Stormwater management is going to play a bigger and bigger role in developing communities, such as Alachua, as development continuously increases. Therefore, communities need to be very conscious of the needs of the local residents, in terms of stormwater design.

The process of community engagement prompted thought-provoking results and discussions during the City of Alachua's Fall Festival. The visual preference scenarios that participants most preferred tended to have better on-site management techniques over the least preferred scenarios of traditional techniques (See Fig. 3.8). However, the discussions that arose from the survey was equally beneficial in that it allowed several concerns and questions to be discussed openly. Further findings will be discussed in the following chapter.

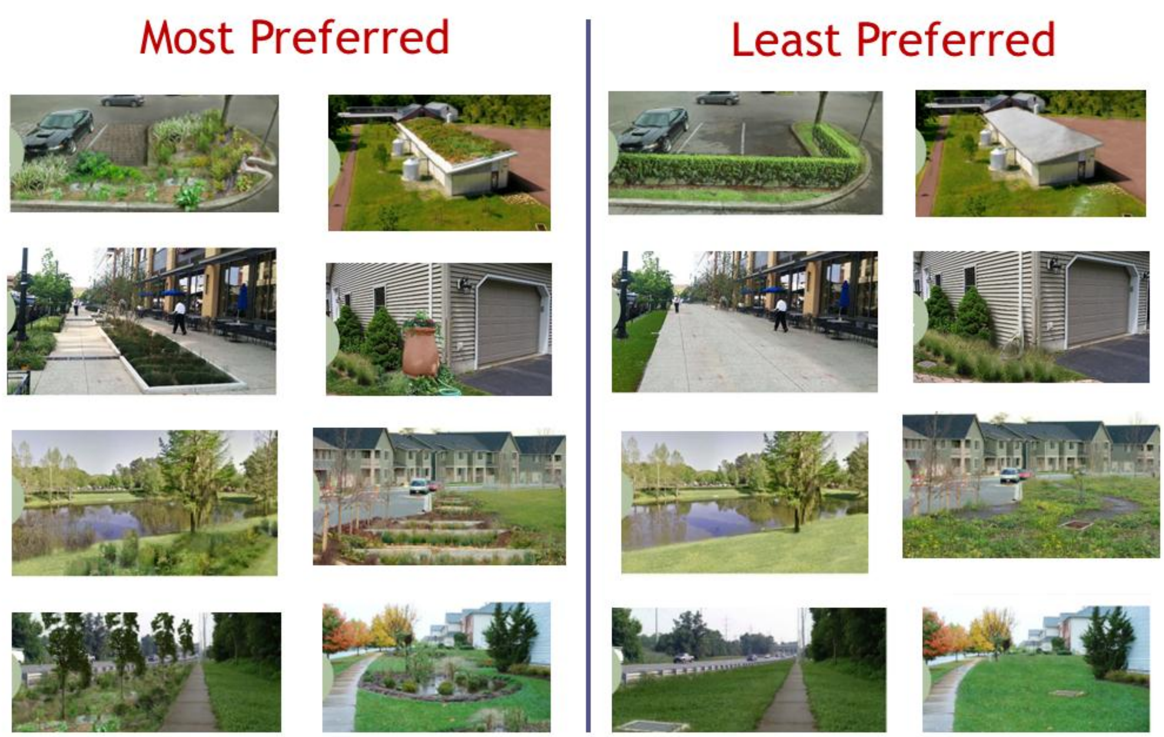


FIGURE 3.9
Most and Least Preferred Stormwater Management Scenarios
(Source: M. Requesens)

CHAPTER FOUR: FINDINGS

"When you take the time to actually listen, with humility, to what people have to say, it's amazing what you can learn. Especially if the people who are doing the talking also happen to be children." - Greg Mortenson, *Stones Into Schools: Promoting Peace With Books, Not Bombs, in Afghanistan and Pakistan 2009*

FINDINGS AND CONCERNS

Robert Thayer described a surface and core approach of how people view the landscape. By conducting a visual preference survey that mimics Kaplan and Kaplan's community engagement strategies and visual design alternatives, the community preferences and opinions on stormwater management began displaying a core approach to viewing stormwater.

Qualitatively, participants spoke openly about what they would like to see in their community and were eager for more information regarding various stormwater management techniques. The data that was produced from the written portion of the visual preference survey supported the qualitative discussions. The following findings summarized some of the key conclusions from both the community engagement and the visual preference survey:

Traditional stormwater management alternatives (top) vs. preferred stormwater management design solutions

<u>Positive Findings</u>

1. Local residents are interested in seeing more creative, stormwater design solutions in their community vs. the undesirable 'traditional' approach
2. Landscapes where they can visibly see the water were most desired
3. With education, people preferred the landscapes that were the most ecologically friendly

4. Diversity of vegetation was both a visually and ecologically desired design element in every stormwater scenario
5. Water management at eye level was preferred to better allow people to interact with and appreciate the landscape
6. People are not afraid of technology. The more interesting the design, the more curious people became about its function.
7. People often consciously conserve water in their homes and are genuinely concerned about water use, water quality, and water conservation.

<u>Concerns</u>

1. Maintenance was a concern in many cases, especially with upkeep of public stormwater designs and residential designs
2. Safety was a concern in terms of public access, visibility, and pests (mosquitoes, snakes, etc.)
3. Sustainability and durability of designs was a concern for many of the public spaces
4. Flooding was one of the biggest concerns with designs that had minimal drains

FIGURE 4.1
4 Sets of Images: Least preferred (top) vs. Most preferred (bottom).
(Source: M. Requesens)

5. Color was a preference concern in terms of how stormwater structures fit into the overall design aesthetic of small communities
6. Residents of growing communities were concerned about the impacts more development would have on local watersheds. In the case of the City of Alachua, people were most concerned about increasing commercial developments, a Walmart, and residential developments

The discussions that stemmed from the visual preference survey revealed that residents were most interested in seeing creative solutions for water storage, colorful yet functional public spaces where water is visible, and unique technologies that improve upon local water quality. While taking the survey, participants were able to also discuss their thoughts on water in their community. This dialogue proved to be one of the most beneficial methods of community interaction. However, due to this open dialogue, several surveys were not completed. In other instances, participants tended to merge Part 1 and Part 2 of the survey with an over anticipation for learning about each alternative. As a result, the visual preference survey became more of a tool for discussion and gave a broad perspective into the visual, ecological, and educated preferences for various stormwater scenarios.

The combination of literature and survey results can effectively begin a handbook of guidelines that assists planners, designers, and residents of rural communities in creating functional and aesthetic spaces for stormwater management.

COMMUNITY ENGAGEMENT METHODOLOGY

My research is intended to provoke stormwater awareness at the community scale. In doing so, a strong methodology of community engagement became one of the most beneficial tools for answering the research question, "In what way can landscape architects and city planners turn stormwater management into a participatory community effort that utilizes local resources in an attempt to protect quality of local watersheds?" Whether it's stormwater management, ecological enhancements, new construction, or public spaces, community engagement can initiate a solid dialogue between city representatives and the general public.

With stormwater management as the focal topic of discussion, I proved that properly planned community engagement 1.) excites participants to engage in local issues, 2.) collects vital thoughts, preferences, and concerns that could otherwise be lost in a non-engaging scenario, 3.) prompts a dialogues between professionals and locals as well as locals with other locals, and 4.) reveals patterns of community needs that city planners and landscape architects can then turn into guidelines that are specific to that community.

In the creation of a community engagement methodology, I wanted to highlight three of the main parts that played key roles in the engagement process: planning, development, and the engagement itself (See Fig. 4.2). Both city planners and landscape architects have the resources to effectively execute this process and develop community guidelines from the results.

Planning Stage

The planning stage is what initially determines the success of the entire engagement process. It is one of the most important, if not *the* most important, step that outlines why you want to engage the community and what basis of knowledge is needed to proceed. When planning, it is critical that you seek out as much knowledge as possible, from literature, professionals, and stakeholders that represent the audience you plan to engage. Researching the type of engagement that best suits the purpose and goals is beneficial, in addition to researching case studies that have successfully used that type.

As it pertained to stormwater management in the City of Alachua, a distinctive approach was made based on conversations with UF landscape architect professionals, Mayor Gib Coerper of the City of Alachua, other city officials, and UF wetland specialist Dr. Mark Clark. These conversations highlighted some of the initial stormwater needs of the community as it faces concerns with community growth.

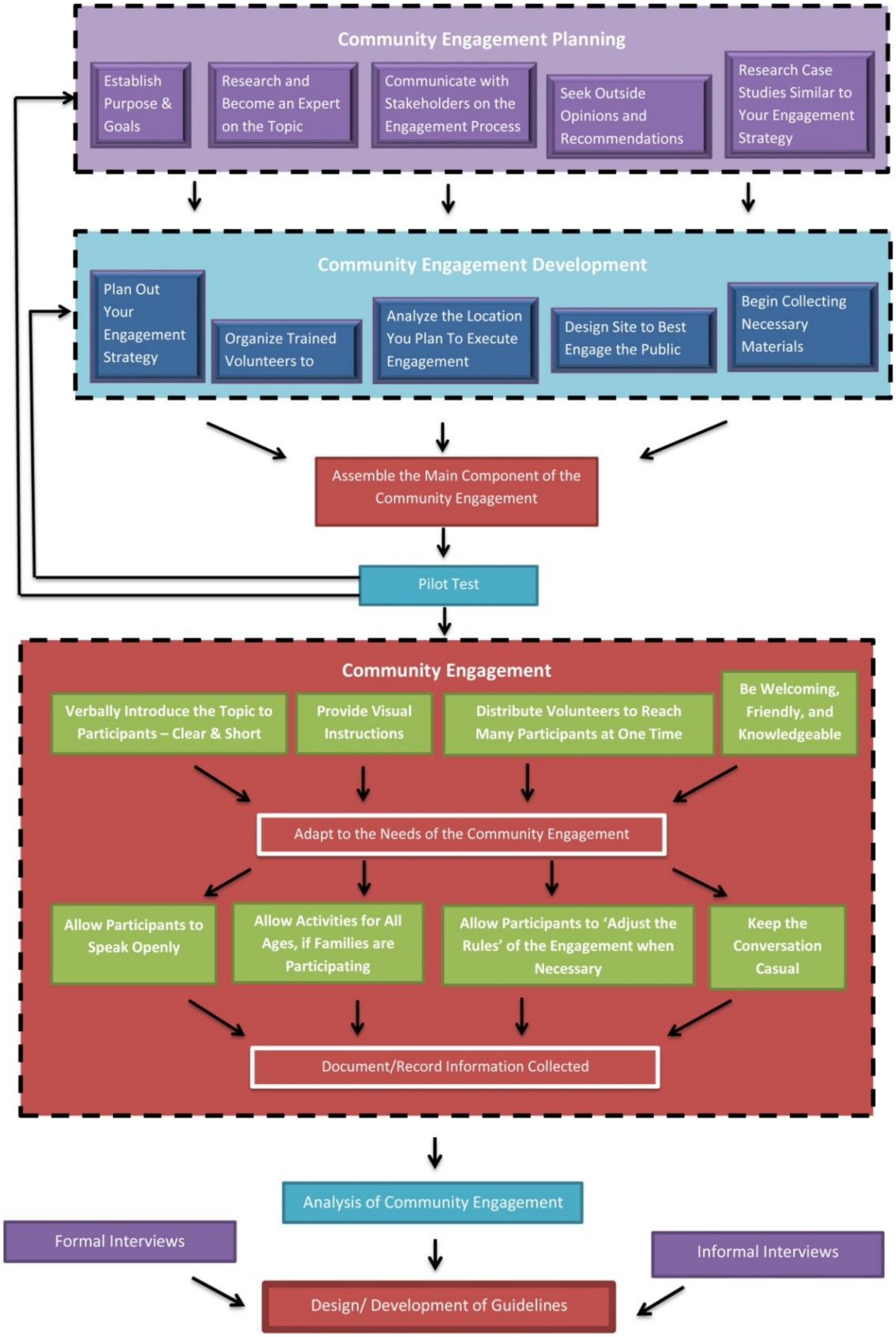


FIGURE 4.2
Community Engagement Methodology Diagram
(Source: M. Requesens)

The conversations also highlighted a need to creatively engage the public during a festival setting. in hopes of educating participants and collecting opinions on stormwater management.

The decision to lead the community engagement process with a visual preference survey occurred after researching the 1.) quantitative benefits of collecting large amounts of opinions with a survey, 2.) the visual component of an illustrative visual aid to the survey, and 3.) the approachability of this type of survey during a street festival scenario.

The type of community engagement should be based specifically on what works best for *your* community, and adapted to best obtain its goals and objectives.

Development Stage

The development stage is where you properly plan for the community engagement. After collecting all of the base knowledge about the type of community engagement you wish to proceed with, as well as plenty of background knowledge about the subject matter, you design your strategy. The design includes everything from planning out materials, the actual design of the site you will be confronting the public with, to training volunteers to assist you. You must never underestimate this stage, for it is what determines how smoothly the day of the community engagement will run.

As it pertained to development of a visual preference survey in the City of Alachua, lots of planning went into the design of survey as well as the design of the booth that local residents entered to participate in. However, to ensure that you are fully prepared for the day of the engagement, it is recommended that you assemble the main components of the event (assemble materials, volunteers, etc.) and either conduct a pilot test of the survey beforehand, or have a dry run-through before the day of the engagement.

Engagement Stage

The day of the community engagement will tend to run smoothly if you are fully prepared from the planning and development stages. However, when dealing with the public, there are several things to keep in mind:

- Introduction – talking with participants is important when communicating to them why they should participate in the first place. Keep this dialogue clear and concise. You don't want to overwhelm them with too much information the minute they walk up to you
- Visuals – a visual preference survey is a nice way to attract the attention of participants, especially if there are large graphics for people to see from afar. However, if not conducting a survey, it is still important to provide supporting visuals for people to reference to.

- Volunteers – space volunteers in different locations to allow participants to freely ask questions when needed
- Interaction – people don't like to feel intimidated. Be friendly and helpful, and also be knowledgeable of the subject matter.
- Be Flexible – if people begin to deviate from the task at hand, allow them to do so. The engagement tool should remain a *tool* in that it begins a conversation rather than aiming to retrieve
- Keep Audience in Mind – if there are families involved, be sure you accommodate the needs of all ages, whether it's through an activity or separate engagement strategy.

Result

The creation of community guidelines must first come from a clear methodology of community engagement. After completing the engagement process, it is useful to acquire even more outside opinions as to the directions the guidelines should take. It is essential that the guidelines mold to the needs of the community and issue at hand. As previously mentioned, there is no right or wrong way to create guidelines, but they should be a reflection of your research findings and the engagement goals.

STORMWATER DESIGN GUIDELINES

My research attempted to understand the visual preferences for various stormwater solutions in the built environment, and how these preferences can influence future development plans for communities. Based off the created methodology for community engagement, this section beings to create design guidelines specific only to the the City of Alachua's stormwater management preferences. These guideline examples aim to follow the framework of Christopher Alexander and Joan Nassauer's recognition of patterns in the landscape in a manner that is meant to be further adapted.

A Pattern Language of Stormwater

A pattern language of stormwater began to emerge from this research, similarly to Christopher Alexander's city-based pattern language in the landscape. Alexander encouraged people to take his guidelines as a singular example of a language, and improve upon it as the language evolves. The patterns that he saw for water included examples such as pools and streams, and green roofs. However, Alexander only scratched the surface of the amount of patterns that could pertain to community stormwater. The results from the City of Alachua stormwater visual preference survey and community discussions aimed to cover a variety of stormwater management techniques that in turn revealed some of these common patterns.

To organize these patterns, I placed stormwater management into four categories: 1.) Rooftop, 2.) Roof to Ground, 3.) Across the Ground, and 4.) Underground. The subcategories within these designations are as followed:

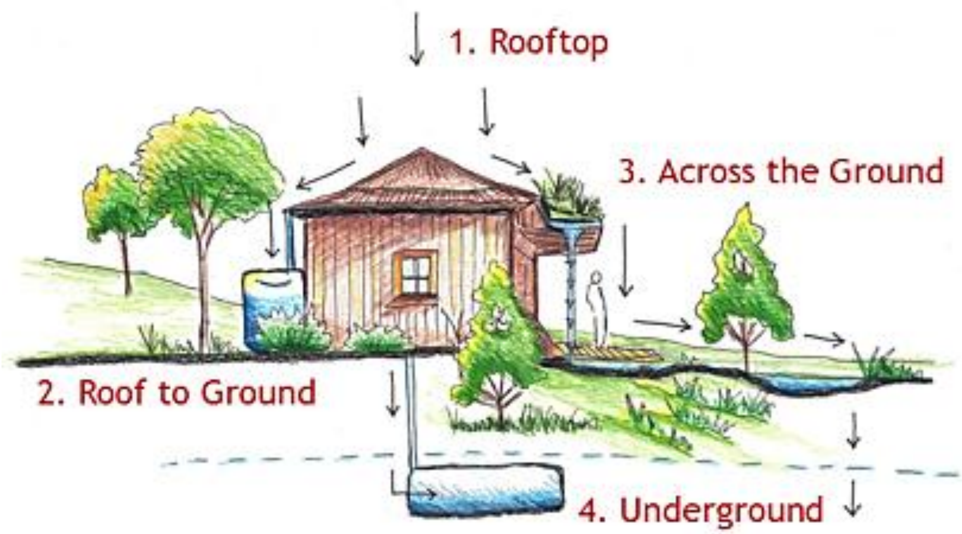


FIGURE 4.3
Stormwater Categories
(Source: M. Requesens)

1. Rooftop: roof garden (extensive, shallow), eco-roof (intensive, deep)
2. Roof to Ground: downspout disconnection, rain barrels, cisterns, rain chains, visual tiers, etc.
3. Across the Ground: vegetative swales, planters (flow-through, infiltration, contained), pavers/pavement (pervious, permeable, turf blocks), wetlands, stormwater ponds, weir systems, check dams, rain gardens
4. Underground: water storage tanks, dry wells, trenches

Within these categories, a common language of community water emerged. In an effort to identify with community needs, the following Do's and Don'ts signify some of the basic guideline goals that apply to every category:

DO

1. Integrate stormwater whenever possible into the ecology and language of the urban environment
2. Enhance the technology and visibility of stormwater management systems
3. Create functional stormwater systems that clean local water sources, stores water, and is easily maintained
4. Keep it simple

DON'T

1. Isolate or redirect stormwater away from its natural topography within the landscape
2. Hide technology
3. Design for the sake of design
4. Overdesign / Make it tacky

Introductory Guidelines – City of Alachua

By following these Do's and Don'ts, communities can begin to design more effective stormwater management systems. In reference to the results of the visual preference survey and comments that were collected, the City of Alachua found management techniques such as green roofs, stormwater collection devices, and weir systems to be the most interesting and desired design solutions.

The following guidelines act merely as an example of possible community stormwater guidelines that could be created following community engagement. With additional efforts to collect community thoughts and preferences that aim at reaching a wider range of community demographics and ages, a more collective community preference could be developed by city planners and landscape architects in and around the City of Alachua.

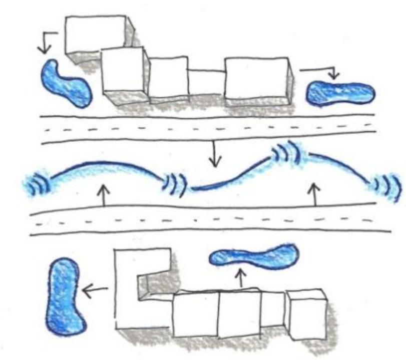


FIGURE 4.4
Integrated Stormwater Design (top) vs. Undesired Stormwater Design (bottom)
(Source: M. Requesens)

<u>Guideline #1: INTEGRATE</u>

- *Placement: when designing for new developments, create on-site runoff within the urban environment, rather than 'hiding' it behind buildings.*
- *At the street scale, avoid the use of static retention ponds.*
- *Mold the design to natural topography.*
- *Establish nodes for sediments to be collected.*

Integrating stormwater within cities is an important management effort to consider, especially with cities facing rapid urbanization. The results from the visual preference survey

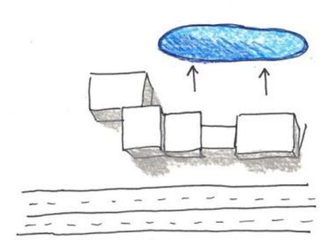
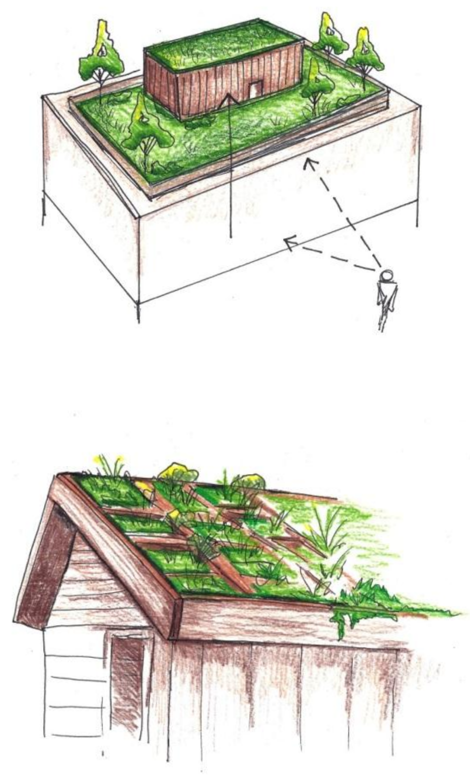


FIGURE 4.5
Green Roof Design Options for City of Alachua: Accessibility and Visibility (below)
(Source: M. Requesens)



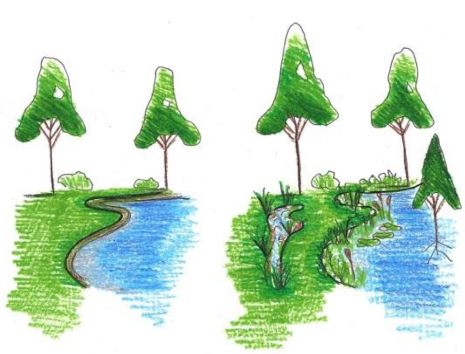
indicated that residents are open to seeing water at the forefront of design in their public spaces.

<u>Guideline #2: ENHANCE</u>

- *When designing systems that highlight a unique form of technology, make it accessible.*
- *Visibility is important* **-** *People like to see technology. If people cannot physically access a design, create angles that showcase it.*

In the case of green roof design, residents of the City of Alachua were extremely interested by their technology and aesthetic appeal. However, on larger buildings with flat rooftops, people were concerned that they would never get to see it. Therefore, it was concluded that designing for accessibility to the green roof itself or angling the roof to see from the ground would be most preferred.

FIGURE 4.6
Water Edge with Vegetated Depressions Before and After.
(Source: M. Requesens)



<u>Guideline #3: FUNCTION</u>

- *Intercept water before it reaches a major water body; bioswales, rain gardens, etc.*
- *People like to see colorful, lush vegetation: use a diverse selection of native plants to better suit local ecology.*
- *Use less lawns and hedges. People have an overwhelming affinity for natural ecosystems.*

- *Use a diverse selection of native plants to better suit local ecology.*

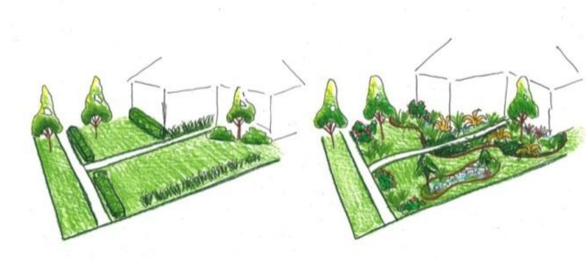


FIGURE 4.7
Residential Lawn with Rain Gardens and a Diverse Selection of Plants Before and After.
(Source: M. Requesens)

Whether it was a residential scenario, or a natural water body in the public realm, people preferred better on-site water management techniques that allowed for more catchment areas and more vegetation. The aesthetic, ecological, and maintenance of these designs were highly preferred.

Guideline #4: SIMPLICITY

- *People like to see simple, clean designs with tasteful creativity*
- *Do not overuse the same design element*
- *Color: use color choices that match the character of the local community. Only use a highlight of color when drawing attention to a specific element*
- *Use various shapes and forms to add interest to the flow of water*

FIGURE 4.8
Residential Rain Barrel Style Option 1 with Rain Chains (above)
(Source: M. Requesens)

The design of rain barrels was a good example of personal preference and how stormwater management designs should remain simple, but still fit within the aesthetic of the community. Function is important, but traditional styles can be enhanced with color and elements such as rain chains, for added interest.

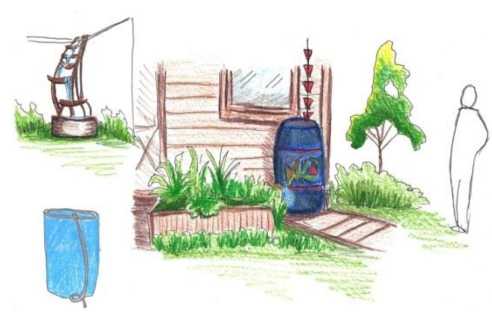


FIGURE 4.9
Residential Rain Barrel Style Option 2 (above), with Artistic Design Element (top left) and a Poor Barrel Design (bottom left).
(Source: M. Requesens)

Guideline #5: Weirs

- *One of the most highly discussed water management technique*
- *The "speed bumps" of stormwater management. They are designed and strategically placed within a stormwater facility to slow the flow of runoff.*
- *To integrate them into the urban environment, place them in areas where they can easily collect stormwater runoff*
- *If the weir is placed away from the building, water can either be diverted under the street into the weirs or diverted to rain gardens.*

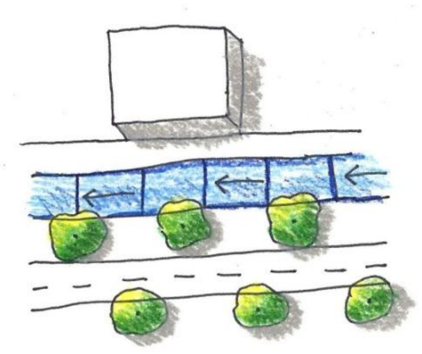


FIGURE 4.10
Weir System Placement between building and street
(Source: M. Requesens)

The one of the most interesting design scenarios that attracted the most visual and ecological preferences were the concepts of integrating weir systems and check dams into public spaces. By definition,

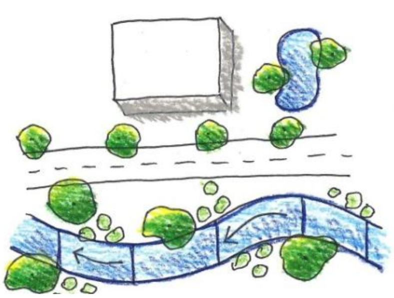


FIGURE 4.11
Weir System Placement next to street, away from building
(Source: M. Requesens)

> "Check dams and weirs are the "speed bumps" of stormwater management. They are designed and strategically placed within a stormwater facility to slow the flow of runoff. Check dams can be defined as structures in the landscape that retain stormwater. Weirs are a notch within a check dam with an adjustable height to allow for varied amounts of stormwater retention. Check dams should retain stormwater to relatively shallow depths, with a maximum ponding depth of 6 to 8 inches of runoff during storm events. Check dams and weirs can be made out of any durable material, including rock, concrete, metal, or wood. A check dam or weir should generally be placed in a rain garden facility for every 4 to 6 inches of elevation change. Check dams may also be used in swales and planters that have little or no slope to promote infiltration. This should be done only where soil conditions are conducive to infiltration

> (Class A or B soils) or if there is an underdrain system installed in the stormwater facility. Steep grade conditions (over 6 percent) may require hardscape check dams (i.e., concrete, stone, wood, metal) and weirs to terrace rain gardens down the steep slope. (EPA, Smart Growth, 2013)"

The technologies of weir systems are an especially rare commodity in the urban environment. When used, they are often set aside from the public eye and convey a strictly functional purpose of regulating water flow. However, when integrated into the urban environment, these structures can function as both an ecological amenity and a sculptural aesthetic. The following guidelines begin to introduce the pattern language of weir systems in residential, commercial and industrial areas of growing communities:

- *Plant site specific vegetation around the weir systems and add walkways that run parallel to the weirs.*

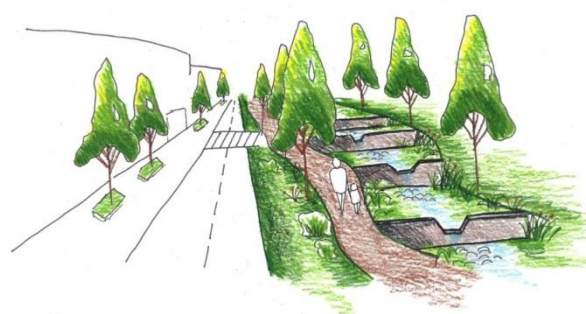


FIGURE 4.12
Weir System Commercial Design: Pedestrian Friendly Access with sidewalks, shade, and vegetation
(Source: M. Requesens)

The fascination with stormwater management technologies such as weir systems, draws people closer to them. Allowing safe access to these systems in a way that is visually pleasing and ecologically beneficial is preferred. In an urban setting, weir systems can act as structural stormwater solutions as well as public amenities.

- *If the weir is placed between the building and the street, the runoff from each of these locations can be diverted into the weir system.*
- *Place weir systems in front of residential homes and apartments. People prefer to see this technology.*

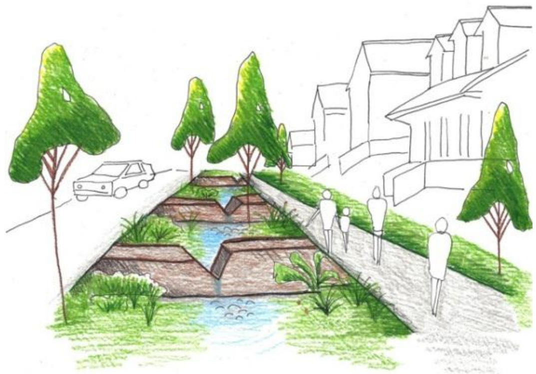


FIGURE 4.13
Weir System Residential Design: Pedestrian Friendly Access with sidewalks, shade, and vegetation (Source: M. Requesens)

In a residential scenario, stormwater management techniques that separate the public from the street is an added amenity. The community engagement results discovered an affinity for on-site stormwater management that is visible and well maintained.

- *Create crossing points across the weir systems*
- *Do not make the weirs too far out of the line of sight.*
- *Width and height of the weir system may depend on site specific stormwater flow rates. However, access to the system should be attainable.*
- *If there are walls containing the weir structure (more typical of commercial and industrial sites), they cannot extend too high for safety and maintenance reasons.*
- *On average, a comfortable weir system width is between 3' to 15' across. A comfortable weir system height is between 2' to 5' depending on the design.*

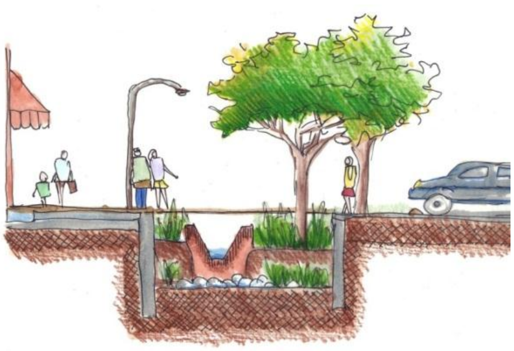


FIGURE 4.14
Weir System Crossing Points: Benefits to Visual Appeal, Safety, Visibility and Maintenance (Source: M. Requesens)

Crossing points for all stormwater management techniques allows visibility of the technology to increase. By allowing systems such as weirs to collect runoff from nearby structures and roadways, the general public is able to watch the cleansing process of the water from a safe distance.

- *When creating above ground weir systems (most desired in commercial areas), allow for easy public access.*
- *A comfortable height is between 3' to 6'.*
- *When possible, divert street runoff into these systems to allow pollutants to be filtered out in a controlled environment.*
- *Do not mask the function of the weir system.*

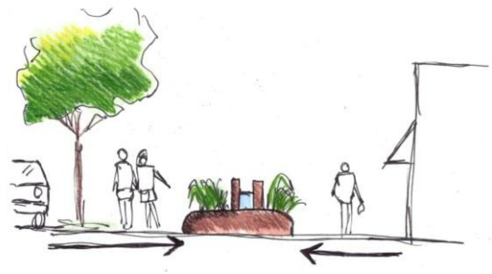


FIGURE 4.15
Above Ground Weir System Design: Accessibility and Function
(Source: M. Requesens)

Weir systems are not restricted to the same design, size or shape. Stormwater management can be an artful design form, as long as the function of the design is not masked with elements that take away from the aesthetic of the design itself, such as placing wood logs over weir surfaces. Safely managed systems can in fact be integrated into the public realm, adding interest and benefits to the surrounding environment.

FIGURE 4.16
Design Element that masks the function of the Weir System
(Source: M. Requesens)

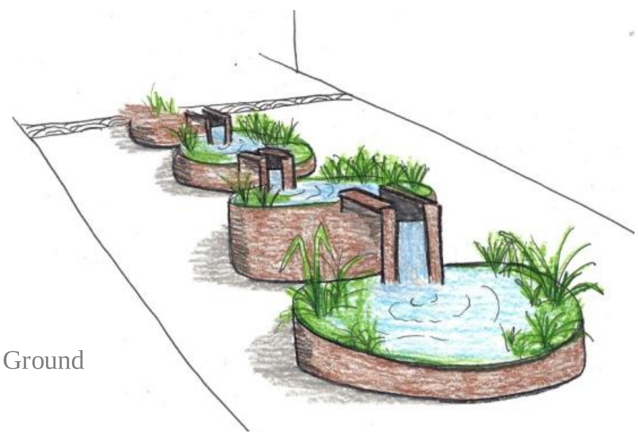


FIGURE 4.17
Design Option for Above Ground Weir System
(Source: M. Requesens)

CHAPTER SUMMARY

This chapter discussed the findings of my research's visual preference survey and community engagement. From these findings, a methodology was developed that helps guide city planners and landscape architects through the process of effectively engaging community residents. In an effort to demonstrate how this methodology could be used to develop guidelines, I also modeled an introductory set of guidelines after the stormwater visual preference survey conducted in the City of Alachua.

When designing any stormwater management system, it is important to recognize the community preference of those systems and understand how it may affect the surrounding public spaces. It is equally important knowing how to collect opinions and concerns of the public in an effort to create local level advocacy for the preservation, conservation, enhancement, and management of water.

From this research, communities can not only begin to benefit from a community engagement methodology locally, but the continual practice of reaching out to the general public for a continuous design discussion can benefit the management of water on regional and global scales as well.

CHAPTER FIVE:
DISCUSSION AND CONCLUSIONS

"A small group of thoughtful people could change the world. Indeed, it's the only thing that ever has."
- Margaret Mead, American Cultural Anthropologist

DISCUSSION ON STORMWATER DESIGN AND COMMUNITY ENGAGEMENT

This section discusses the overall research conclusion as it relates to the development of guidelines from community engagements, a series of conclusions as they pertain to various aspects of the community engagement that was conducted in the City of Alachua and a discussion on what this means for growing communities.

Research Conclusion

By creating a community engagement methodology, I helped to generate a means by which landscape architects and community planners communicate with the general public on community-related issues. Difficult issues to vocalize to local residents, such as stormwater management, can be easily turned into a fun, engaging activity that people of all ages can benefit from. The key benefit of this type of interaction is the dialogue that initiates from participants.

In the case of the City of Alachua, a stormwater visual preference survey and festival interaction were the sources of this dialogue, providing visual, written, and human references to relate to. The second part of the survey also did more than just briefly educate the public on each stormwater management alternative, it inspired people to ask questions. In fact, many participants couldn’t even wait until the second part of the survey before wanting to find out more. Many management techniques were discussed as participants were completing part one. Therefore, the visual preference survey did more than just collect visual preferences; it got the general public to ask questions, and left them with wanting to know more. This is precisely what the methodology of community engagement is meant to achieve: curiosity and a continual dialogue outside of the festival setting.

The community engagement was an extremely successful event due to the proper planning, development, and engagement stages of community engagement. Without these stages, the amount of information that was gathered could not have been achieved. The community engagement methodology itself was designed to be applied to any type of community engagement scenario, whether it uses a visual preference survey or not. It more acts a tool to lead community engagement to a successful outcome.

From the community engagement methodology and findings, examples of possible community stormwater guidelines were developed to demonstrate how guidelines could be started. These were by no means a complete set of guidelines, but rather a visual representation of how communities could begin to create their own set of guidelines that cater to the needs of a particular subject matter. Overall, it is my hope that communities use the methodology to adhere to the design needs of their own individual community residents.

Conclusions from Community Engagement

Some factors about the stormwater visual preference survey processes that are worth considering for future community engagements are as followed:

- Demographics : The main demographic of participants were mainly Caucasian women over the age of 40. Due to this demographic, there are still diverse groups of residents that were not reached. Attempting to reach all demographics through a public street festival, as well as attracting people to one booth in particular, proved to be a challenge. Since this demographic did not have many young people, Question 2 in Part 3 should have had more choices over the age of 61. There were a few instances where older participants openly commented on the lack of options over the age of 60. To acquire a wider range of ages and ethnicities, I may suggest for future studies to have other locations for this activity, such as a local grocery store, local business or high school. Providing an incentive for taking a survey, other than stickers, may also increase participation rates.

- Length: The length of the survey was probably one of the biggest factors that restricted some participants from fully finishing. It was simply too long. Many people were interested and spent an extended amount of time on Part 1. As a result, these were the same people that seemed overwhelmed to find out there there were two additional parts to the survey. Others seemed interested but didn't have the time to stop during their walk through the festival. The length also seemed to be a negative factor to younger adults and children who liked looking at the posters but didn't want to take the survey.

On the other hand, the length enabled more thought provoked answers followed by discussions of local stormwater. In many instances, participants asked questions throughout the entire survey process. In fact, the eagerness of wanting to know more about each stormwater scenario caused a lot of "cheating." This overarching curiosity allowed for people to not only ask lots of questions, but it sparked a lot of cross discussions with other participants. The mixture of dialogue was an unexpected result that turned out to not only educates people about stormwater, but allowed for a greater ease of stormwater discussions with the people around them. Nothing could be more valuable than initiating this kind of discussion. However, in most cases, Part 2 was not completed because many participants wanted more discussion on each posture during Part 1, therefore not needing to complete Part 2.

- Family: Engaging the public involved also engaging children. To allow a better ease of the survey taking process, a 'kids table' was set up in order to 1.) allow all ages, especially kids to draw what they like to see in the landscape, and 2.) to entertain children if their parents decide to take the visual preference survey. This method was highly effective.

- Hydrology: Roughly half of the participants seemed aware of the unique hydrology in the area and stormwater discharge points (large sinkhole, streams, ponds, caves, etc), and disappointed they could not access many of them. The other half either did not know they existed or knew little to none about where they were or what implications they had for the surrounding environment. The future of stormwater and water awareness in general has great potential within the city.

- Photoshop Stormwater Scenarios: The method in which I created the digitally created Photoshop scenarios was by means of photo collaging a range of images into a cohesive alternative. However, due to restricting the alternatives to three, there was some difficulty in decided how different each should be. There needed to be enough variety between the choices, without having one dominate over the other. The similarities that were not the points of interests stayed the same, and the differences were aimed and stormwater aesthetics. In future attempts of this nature, there needs to be more visible clarification in some instances, and less visible clarification in others. For instance, the waterfront edge scenarios were confusing to a lot of survey takers in that they could not distinguish a clear preference between Choices B and C. Also, I would probably choose a different pond image that would not make people think of a specific place in their community. However, it did bring up a point that each of these ponds is in fact designed for the main purpose of efficiently storing water. In another instance, there may have too much of difference in the public green space scenarios as it tried to incorporate weir systems, manicured lawns, and a wild-form of native landscaping. Visual aesthetics were also sometimes swayed by color choices, specifically in the case of the red permeable pavers in conjunction with the street planters. Perhaps making all alternative images more similar in color will have the focus drawn to the stormwater management technique in particular.

- Need for Answers: – People almost expected there to be a right and a wrong answer to the alternatives. It was important to express to them that there was not right answer, so they wouldn't try and answer according to what they thought was best according to *my* standards vs. what they thought was best to *their* standards.

Concluding Discussion

Public engagement is reviewed as a way of understanding how people relate to water quality issues. People regularly utilize water; whether it's through recreation or consumption, people want healthy water systems. Public open spaces for stormwater should not only be visually exciting, but should provoke an emotional connection to the land, and prompt citizens to actively protect the quality of water around them. In turn, by engaging the public is a stormwater visual preference survey, designers and planners help redefine a water ethic for individuals within a community.

Annie Pais, executive director of Florida's Eden and The Blue Path project, published an article in the Gainesville Sun on June 21st, 2012, stating that there is a need for a new way of addressing water, treating it as a "treasure for a sustainable future" by direct means of how water is *managed* (Pais, 2012). However, through community engagement, an educated approach to water resources and a willingness to have innovative design solutions is what drives stormwater management to adapt the water crisis of the present.

The visual preference survey data as well as the qualitative data collected from engaging the public proved to give valuable insight into the preferences and perspectives of community members in the City of Alachua. Thus, suggesting a *new way* in how stormwater is designed and managed.

FUTURE RESEARCH IMPLICATIONS AND RECOMMENDATIONS

The profession of landscape architecture is often driven by the effective planning and sustainable approaches to landscape design. In the coming years, stormwater management in going to be a highly discussed topic of debate, especially with the aging of stormwater infrastructure. According to a March 19th, 2013 article from the Huffington post, the Congressional Progressive Caucus released *The Back to Work Budget*, “a proposal that offers long-term solutions to our challenges while capitalizing on opportunities to create good jobs and build strong, healthy communities (Ellis-Lamkins, 2013)." This proposal highlights *green solutions* with a "call for investments in infrastructure and community resilience... by modernizing our water and transportation systems using 21st century green technology, we can put American's to work and make vulnerable communities more resilient in the face of superstorms and other climate change disasters…. Fixing our broken stormwater infrastructure alone would create 2 million new jobs – and safer, healthier, more prosperous communities (Ellis-Lamkins, 2013)." With jobs as a driving force for many recent Congressional decisions, the recognition of failing infrastructure is a predominant concern for the country as a whole.

There is no better time to look at innovative design solutions in communities than right now. Infrastructure may be failing, but the opportunity for change is also at the forefront of community planning decisions. Future research implications include a closer look at the needs of communities, the visual preferences of *green solutions* for stormwater management, and the investments in 21st century technology as opposed to simply re-doing existing infrastructure.

I would recommend that more stormwater visual preference surveys be conducted not only to encourage further stormwater communication, but to encourage communities to take action in the design of local stormwater systems. Water is a resource we cannot afford to take for granted. The more residents prefer *green* stormwater designs, the more they will elect local government officials that support and invest in these designs.

In order to inspire both local residents and local government officials with effective design solutions, the creation of a stormwater handbook that contains design guidelines for each stormwater management technique would be highly useful. I encourage future research projects to pursue the pattern language of stormwater more in depth, and to effective test the useful of this tool as a means to jumpstart action at the community scale.

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SURVEY- PART 1

For each group of images on the posters (#1- 8), please choose the images that best answer the following questions:

- Which image is the most **Visually Appealing**?
- Which image seems to be the most **Ecologically Friendly**?

Circle your answer (A, B, or C). You may select the same answer more than once.

SAMPLE:

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 1

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 2

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 3

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 4

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 5

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 6

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 7

Visually Appealing? A B C

Ecologically Friendly? A B C

GROUP # 8

Visually Appealing? A B C

Ecologically Friendly? A B C

SURVEY- PART 2

Please read the additional information provided on the various stormwater management options. Then, please answer the following question for each group (#1-8):

Which image best demonstrates what you would want to have at your home, business, or community based on the following considerations:

- **aesthetic preference**
- **ecological benefits**
- **maintenance**

Circle your answer (A, B, or C).

SAMPLE:

Which do you prefer?

A B C

GROUP # 1

A

- *Water from the parking lot flows into a planted median to slow and filter pollutants out of the water*

B

- *Water from the parking lot flows into a drain and taken off site*

C

- *Water from the parking lot flows into a planted median and some of that water goes into a drain and taken off site*

Which do you prefer?

A B C

GROUP # 2

- *Rain water flows onto a concrete sidewalk where it goes into drains and taken off site*
- *Grasses and street trees allows for some infiltration*

- *Rain water flows onto a permeable walkway, which allows the water to soak directly into the ground*

- *Some of the rain water from the street flows into sidewalk planters to filter pollutants out before soaking into the ground*
- *Some extra maintenance is needed to keep the planters working properly*

Which do you prefer?

A B C

GROUP # 3

- *Water from surrounding streets are piped into this pond to slowly soak back into the ground*

- *Vegetation at the pond edge slows and filters pollutants out of the water before entering the pond*

- *Water flows into vegetated depressions, where it slows and filters pollutants before entering the pond*
- *Grass separates pond edge and vegetated depression*

Which do you prefer?

A B C

GROUP # 4

- *Water from the street flows into the planting bed where grasses and shrubs are used to filter pollutants before it's piped off site*

- *Water from the street flows into the grassy depression and then piped to a nearby pond*
- *Mowing is the only maintenance needed*

- *Water from the street flows into the planting bed where it remains until it is filtered and soaks back into the ground*
- *No mowing needed*

Which do you prefer?

A B C

GROUP # 5

- *Water from the roof flows directly into the vegetated depression to allow it to soak back into the ground*
- *No gutters allows a sheet flow of water to evenly enter the depression*

- *Rain water irrigates the vegetated Eco-roof*
- *Any excess water flows into cisterns and reused for the landscape and amenities such as toilets*

- *Cisterns capture most of the rain water*
- *Any excess water flows onto the grassy landscape and piped off site*

Which do you prefer?

A B C

GROUP # 6

A

- *Water from the roof flows into a gutter and out onto a small rain garden*
- *The depression in the garden holds the water until it soaks into the ground*

B

- *Water from the roof flows into a rain barrel which can be used later to irrigate the planting bed*

C

- *Water from the roof flows into a gutter and out onto a planting bed*
- *A small garden drain collects any excess water*

Which do you prefer?

A B C

GROUP # 7

A

- *Water from the road and nearby buildings flows into the vegetated depression to filter pollutants*
- *Small drains manage extreme flooding*

B

- *Constructed wier system helps monitor water flow and water quality*
- *Vegetation helps filter pollutants before it soaks back into the ground*

C

- *Water from the road and nearby buildings flows into the planting bed and grassy open space*
- *Any excess water flows into a storm drain and is piped to a nearby retention pond*

Which do you prefer?

A B C

GROUP # 8

- *Water from the nearby homes flows into a shared vegetated depression*
- *Water remains in the depression until it soaks back into the ground*

- *Water from the nearby homes flows onto a grassy lawn and into a storm drain to be taken off site*

- *Water flows into a separate rain garden for each individual home*
- *Water remains in the rain gardens until it soaks back into the ground*

Which do you prefer?

A **B** **C**

SURVEY- PART 3

For each question, please answer to the best of your ability.

Check the box next to your answer

1. What is your gender?

- ☐ Male
- ☐ Female

2. What is your age?

- ☐ 5-12
- ☐ 13-17
- ☐ 18-21
- ☐ 22-25
- ☐ 26-30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ 61 or over

3. Do you live in the CITY of Alachua?

- ☐ Yes
- ☐ No

4. **What is your ethnicity?**
   - ☐ White, non-Hispanic
   - ☐ African-American
   - ☐ Hispanic
   - ☐ Asian-Pacific Islander
   - ☐ Native American
   - ☐ Other _______________

5. **How much do you know about stormwater management?**
   - ☐ I have never heard of stormwater management
   - ☐ I have heard of it, but don't know very much about it
   - ☐ I know some information about it
   - ☐ I know a lot about it

6. **How often do you <u>consciously</u> try to conserve water in your home?**
   - ☐ Not often
   - ☐ Sometimes
   - ☐ Often

7. **How concerned are you about water quality in your <u>community</u>?**
   - ☐ Not concerned
   - ☐ Somewhat concerned
   - ☐ Very concerned
   - ☐ I don't know if there are water quality issues in my community

8. **How much do you know about the Floridan Aquifer?**
   - ☐ I have never heard of the Floridan Aquifer
   - ☐ I have heard of it, but don't know very much about it
   - ☐ I know some information about it
   - ☐ I know a lot about it

9. **How important is it for community members to play active roles in protecting local watersheds from pollution?**
   - ☐ Not important
   - ☐ Sometimes important, depending on what's causing the pollution
   - ☐ Very important
   - ☐ It is not the community member's role

10. **Would you like to be added to the email list to receive updates on the progress of this research and an invitation to the public presentation?**
    - ☐ Yes
    - ☐ No

    If yes, please write your email address below:

    ____

THANK YOU FOR YOUR PARTICIPATION!!

Informed Consent Document

My name is Mia Requesens and I am a graduate student in the Department of Landscape Architecture at the University of Florida. I am interested in researching the visual preferences for various stormwater solutions in our built environment, and what these preferences mean in terms of future development for the City of Alachua.

This survey has no anticipated benefits or risks and should take less than 10 minutes to complete. You will be asked to choose your favorite designs based on the following critieria: visual appeal, maintenance, and ecological effectiveness. You will then be asked to answer several short questions about stormwater. Although there is no direct compensation, your participation is important and very much appreciated. Thank you for your willingness to participate in this study.

Before beginning this survey, I would like to reassure you that as a participant of this study you have several very definite rights:

- There are no direct benefits, risks, or compensation to you for participating in this study.
- Your participation in this survey is entirely voluntary.
- You are free to refuse to answer any question at any time.
- You are free to withdraw from the survey at any time.
- Your identity will be kept confidential to the extent provided by law.
- This survey will be kept strictly confidential and will be available only to members of the research team.
- Excerpts of this survey may be made part of the final report, but under no circumstances will your name or any personally identifying characteristics, other than a subject number (for example 1, 2, or 3), be included in this report.
- Survey forms will not bear your name or any personally identifying characteristics other than a subject number (for example 1, 2, or 3).
- Photography or video recording may be used to present the final design project, but under no circumstances will your name be used.

If you have any questions regarding this survey please feel free to ask me at any point in time or to contact me at (352) 231-3027. You may also contact my faculty supervisor, Kevin Thompson at (352) 392-6098 (ext. 329) [University of Florida, College of Design Construction, and Planning, Department of Landscape Architecture, PO Box 115704, Gainesville, FL, 32611-5704]. For questions about your rights as a research participant, please contact the University of Florida Institutional Review Board at (352) 392-0433 [University of Florida, Psychology Building 98A, Gainesville, FL].

I have read the above description. I voluntarily agree to participate in this study and have received a copy of this description.

Signature ___________________________________ Date ________________________

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-1101
For Use Through 10-25-2013

Parent / Guardian Authorization

I voluntarily give my consent for my child, ___________________, to participate in taking the survey of stormwater solutions as described above, understanding that I and/or my child may withdraw consent at any time and discontinue participation without penalty. Any child under the age of 8 does not need to answer the survey questions following the visual preference survey. I further consent to having the activity photographed or digitally recorded, and understand that any of the material may be included in a documentary presentation. I have read, understand, and received a copy of this description and have received answers to any questions I asked.

__________________________________ ___________
Signature of Parent / Guardian Date

Signature of person obtaining consent ______________________________ Date ____________

Printed name of person obtaining consent ___________________________ Date ___________

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-1101
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Younger Children

Assent Script

Hi, my name is Mia Requesens, and I'm from the University. I'd like to show you some pictures and ask you pick your favorite. Your [mom/dad] said it was OK. It will take about 5 minutes. Would you like to do this?

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-1101
For Use Through 10-25-2013

Older Children

Assent Script

Hello *[child's name]*. My name is Mia Requesens and I am a student at the University of Florida. I am trying to learn what people like about stormwater and if you understand how stormwater management is important in your community.

I will be surveying several people during the Alachua Harvest Festival today. If you decide to participate, you will be asked to take a survey that lets you to choose your favorite stormwater designs, and answer some general questions about water. The survey should take less than 10 mintues to complete.

There are no known risks to participation, and many people actually enjoy this survey. You do not have to be in this study if you don't want to and you can quit the study at any time.

Other than the researchers, no one will know your answers. If you do not understand a question, please ask a volunteer for help. If you don't like a question, you don't have to answer it and, if you ask, your answers will not be used in the study.

Your [parent/guardian] said it would be OK for you participate. Would you be willing to participate in this study?

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2012-U-1101
For Use Through 10-25-2013

INTERVIEW QUESTIONS

Author Larry W. Mays. "Stormwater Collection Systems Design Handbook."
Department of Civil and Environmental Engineering
Arizona State University
Tempe, Arizona

My Introduction:
- Explain my research and intended purpose of creating stormwater guidelines for developing communities
- Describe my methodology and how I plan to transform the survey results into those guidelines

Questions to Ask:
1. How did you begin your process of developing a Stormwater Design Handbook?

2. In your book, you stated how you reflect upon your own experiences in the field of water resources, and how you are continually reminded of how handbooks have always been part of your learning. Can you elaborate on what made these handbooks so influential to your learning?

3. Are there any specific factors that you have found to be particularly critical for users to have in a handbook? Organization, tables/graphs, graphics, etc.?

4. In creating the handbook, did you encounter any unexpected challenges? If so, what were they and how did you overcome them?

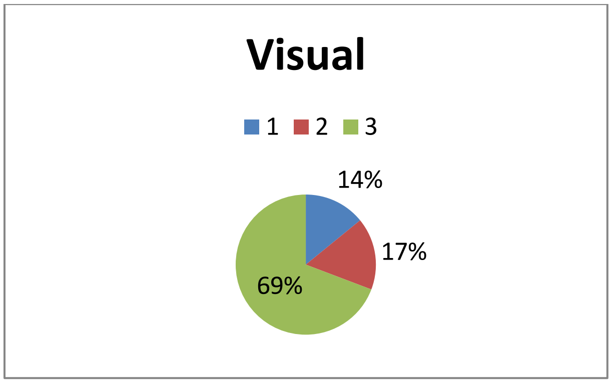
5. You designed this handbook to be a teaching tool mostly for undergraduate and graduate students learning stormwater design. How would you have designed your handbook differently to interest the general public?

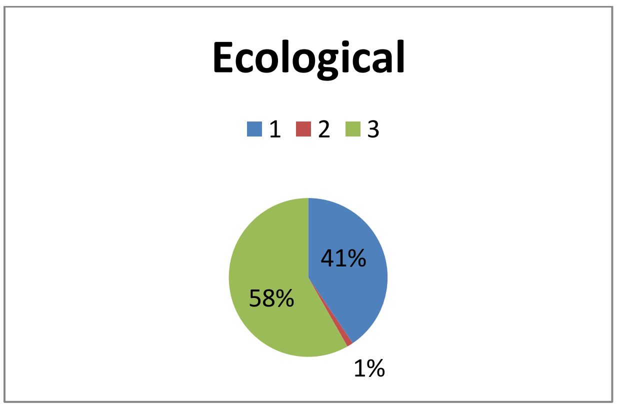
6. As a stormwater expert, do you think it is probable to design a handbook to accommodate the needs of landscape architects/city planners/designers AND the general public?

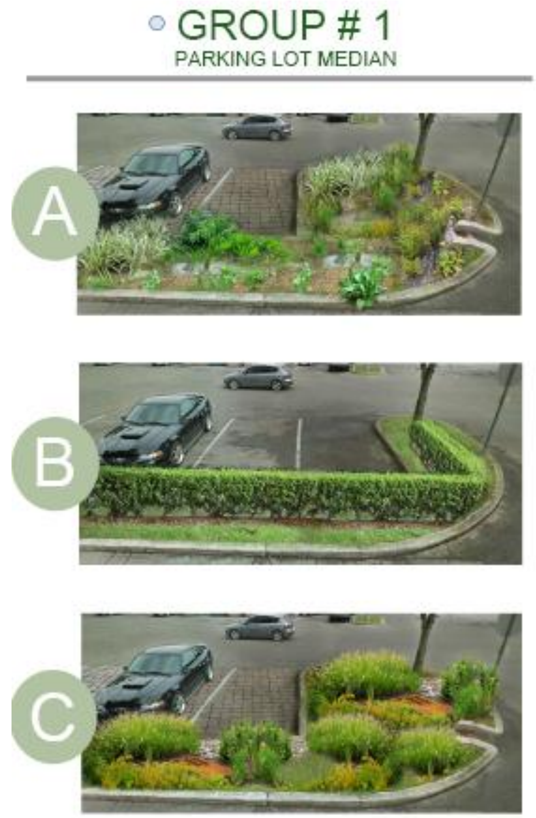
7. In your book, you mention three roles of the design of hydrologic systems: economics, optimization, and risk analysis. If you were to incorporate a fourth role of 'aesthetics' how would you go about including that?

8. If you were to create a pocket-sized book of stormwater ideas for growing communities, what sort of things would you include? What would you exclude?

PART 1: GROUP # 1

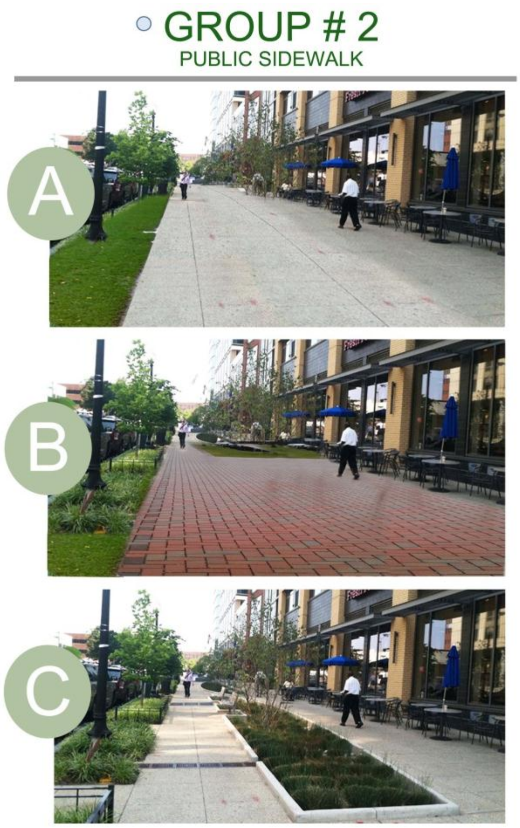


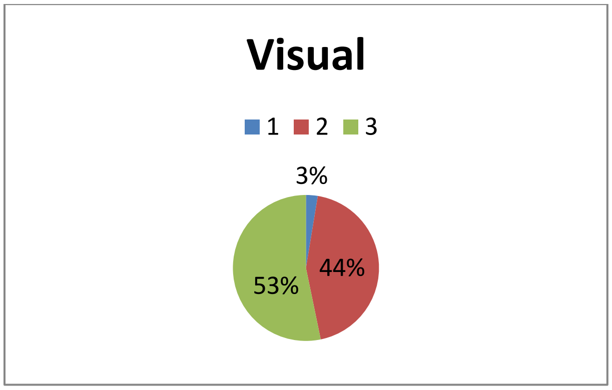


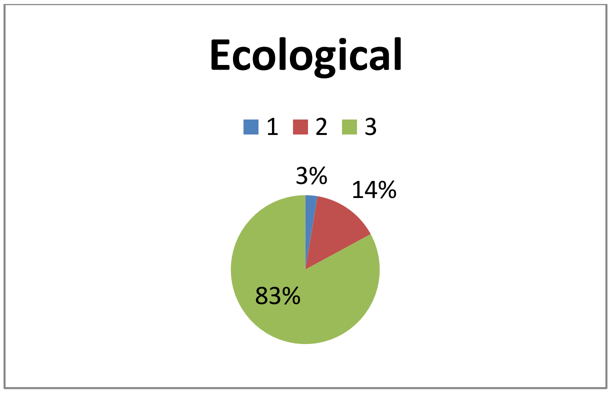


In this scenario, respondents had an overwhelming visual preference for Choice C, with Choice A and B being fairly even second choices. However, Choices A and C were found to be more ecologically friendly, while Choice B was drastically lessened to 1%. The greater the plant diversity and water management quality, the greater the preference.

PART 1: GROUP # 2

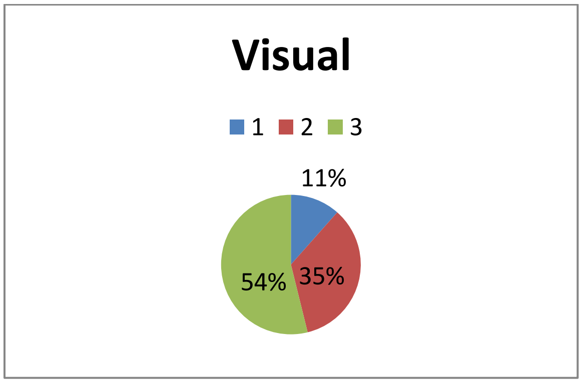


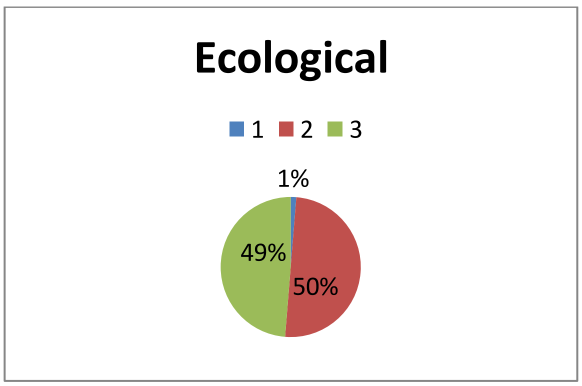


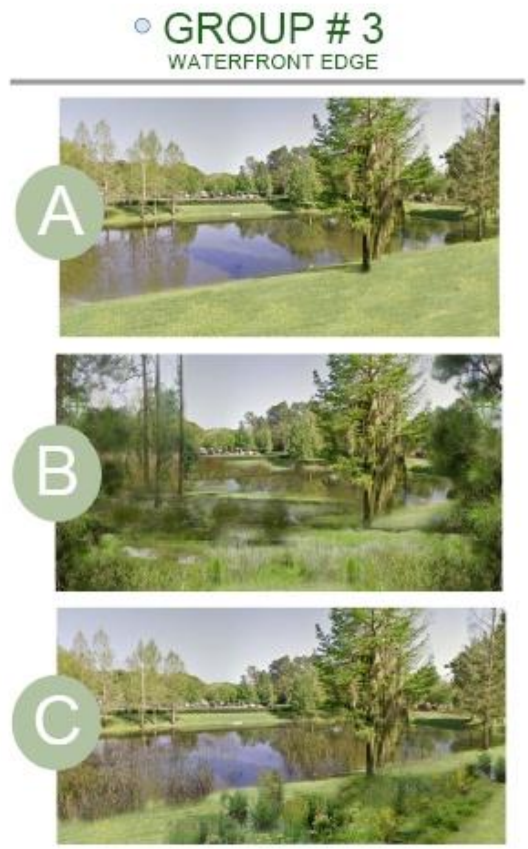


In this scenario, respondents had a fairly equal visual preference for Choice B and C, with very little preference for Choice A. However, Choice C was found to be significantly more ecologically friendly, while Choice B was lessened. Choice A remained the same in both visual and ecological preference.

PART 1: GROUP # 3

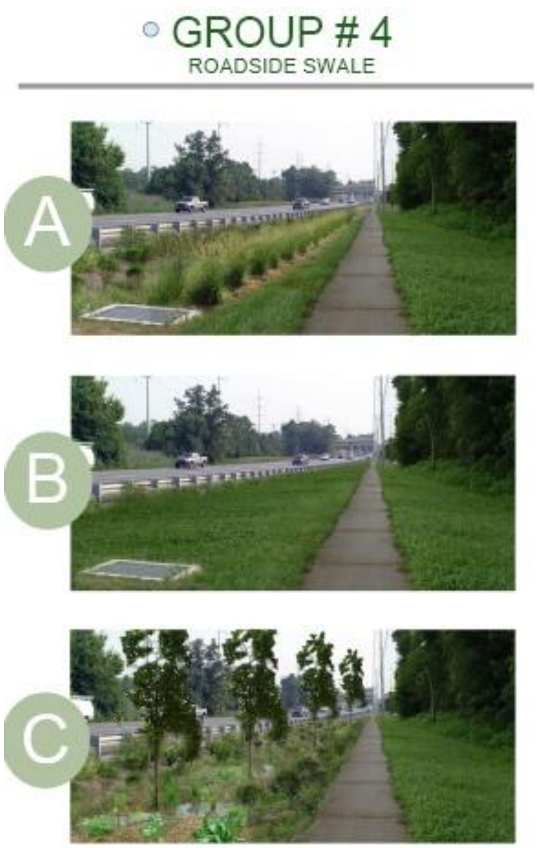


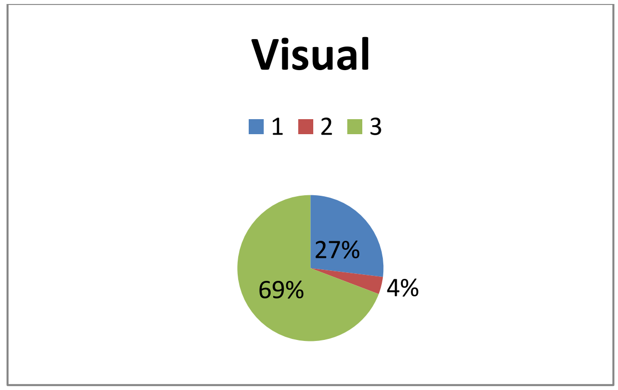


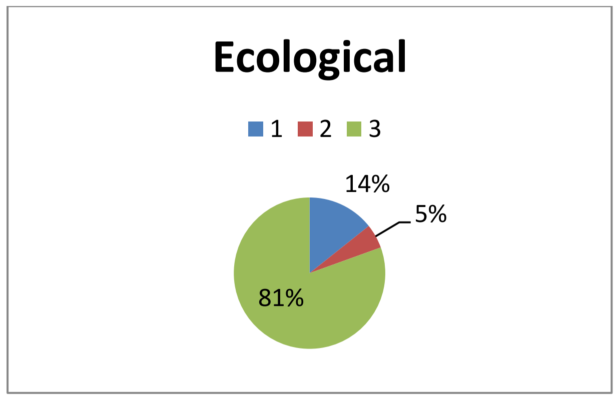


In this scenario, respondents had a high visual preference for Choice C, with a close secondary preference for Choice B. However, Choice B increased to have a relatively equal ecological preference to Choice C. Choice A significantly decreased from a visual preference of 11% to an ecological preference of 1%.

PART 1: GROUP #4

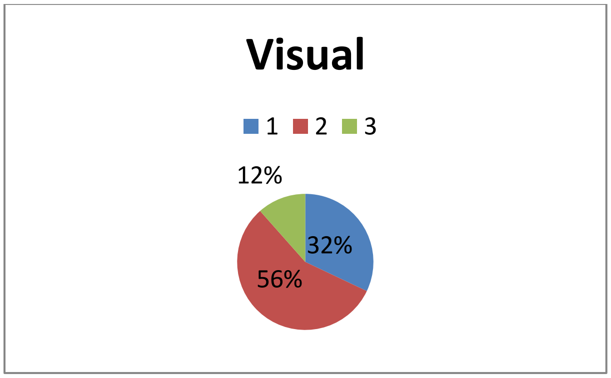


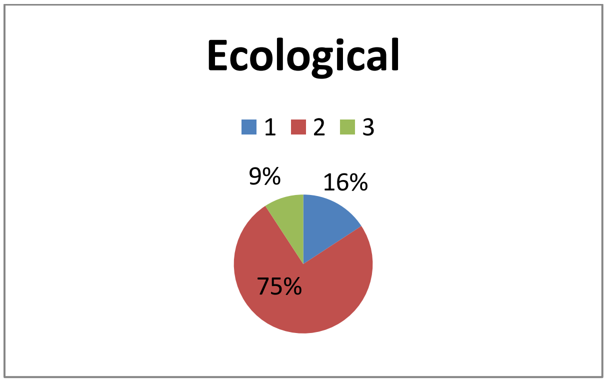


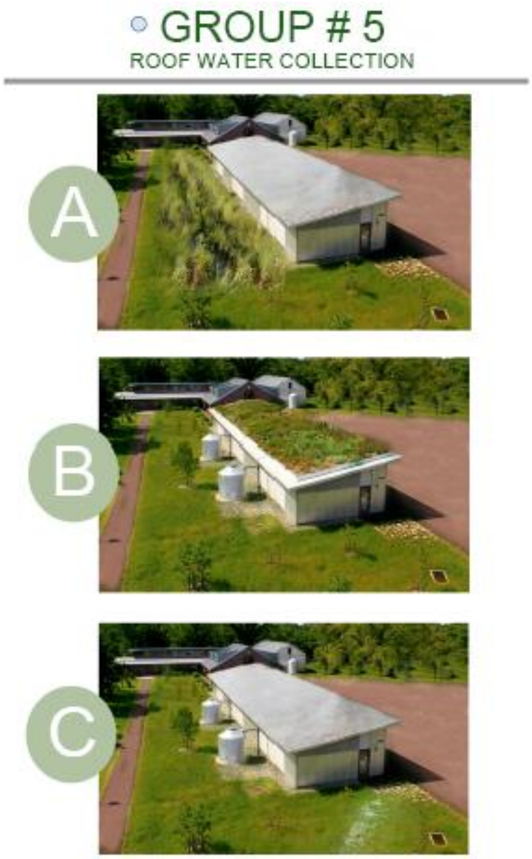


In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice A. There was not a drastic change in responses to ecological friendliness, but Choice C increased by 12% while Choice A decreased by 13%. Choice B stayed at relatively the same low percentage.

PART 1: GROUP # 5

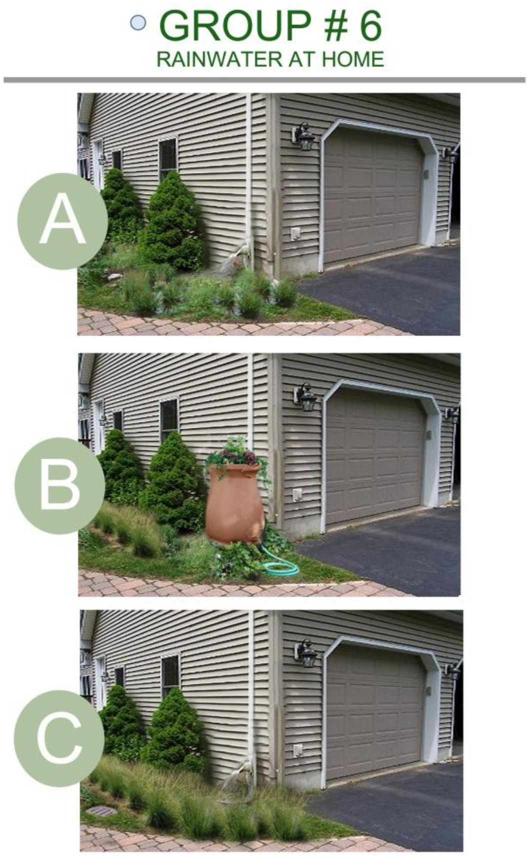


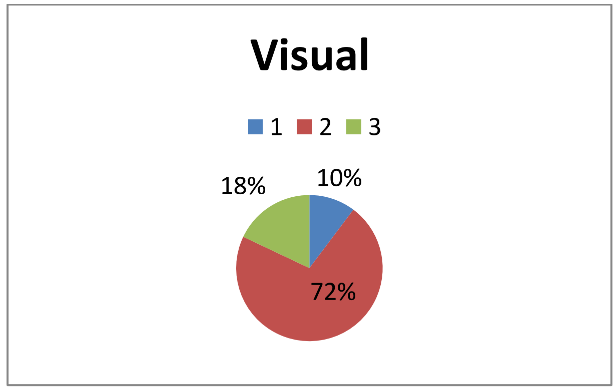


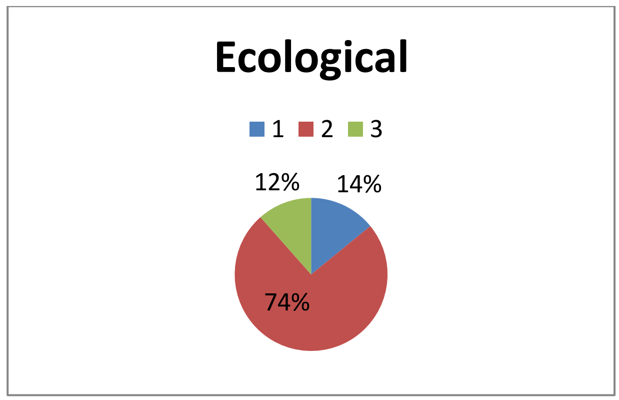


In this scenario, respondents had a high visual preference for Choice B, with a secondary preference for Choice A. However, the ecological preference for Choice B increased by 19%, while Choice A decreased by 16%. Choice C stayed relatively low in both visual and ecological preference.

PART 1: GROUP # 6

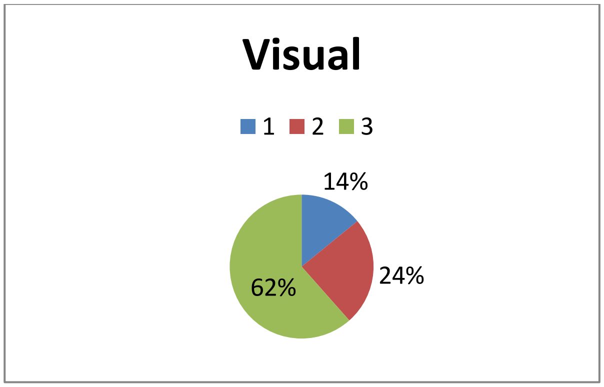


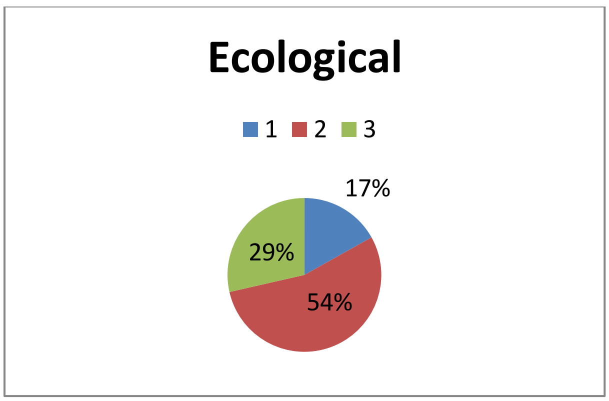




In this scenario, respondents had both a very high visual and ecological preference for Choice B. Choice C had a slightly higher visual preference as a second choice, which Choice A had a slightly higher ecological preference as a second choice.

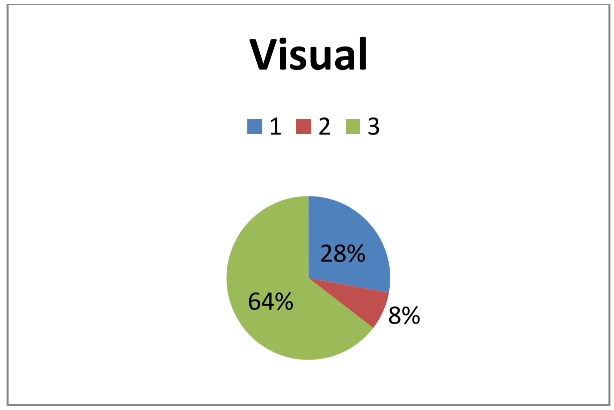
PART 1: GROUP # 7

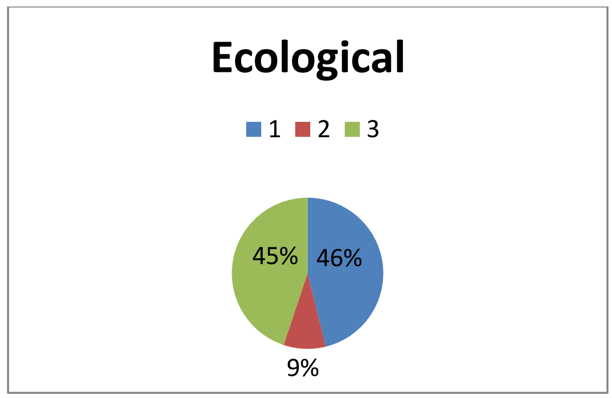




In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice B. However, Choice B had a significantly high ecological preference, increasing by 30%. The ecological preference of Choice C decreased by 33% from its high visual preference. Choice A remained about the same for both preferences.

PART 1: GROUP # 8

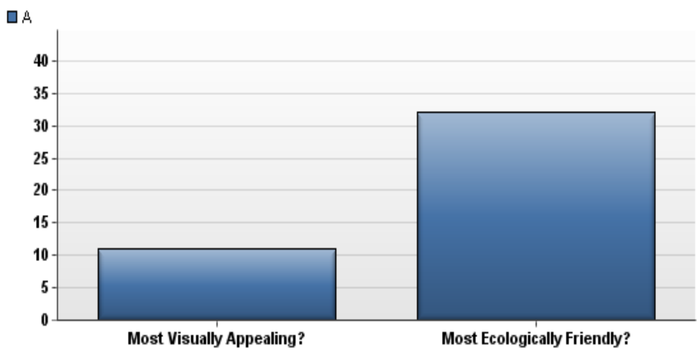




In this scenario, respondents had a high visual preference for Choice C, with a secondary preference for Choice A. However, Choice A and Choice C had almost identical ecological preference. Choice B remained about the same for both preferences.

PART 1: GROUP # 1 STATISTICS

1. Group # 1: Choice A

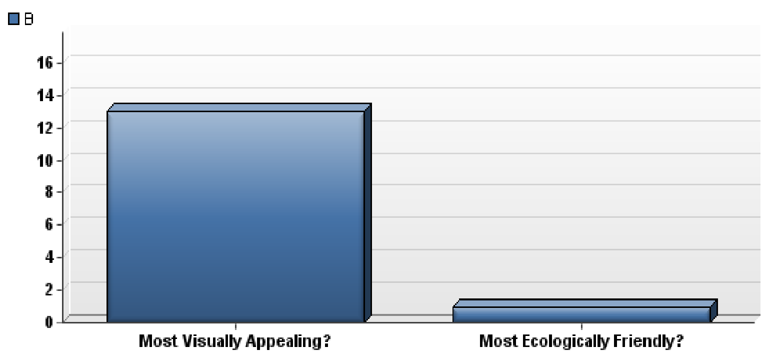


#	Question	A		Mean
1	Most Visually Appealing?	11	11	1.00
2	Most Ecologically Friendly?	32	32	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	11	32

PART 1: GROUP # 1 STATISTICS

2. Group # 1: Choice B

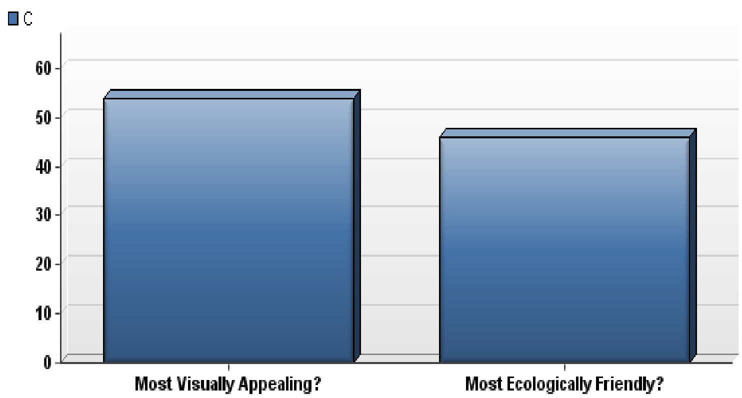


#	Question	B		Mean
1	Most Visually Appealing?	13	13	1.00
2	Most Ecologically Friendly?	1	1	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	13	1

PART 1: GROUP # 1 STATISTICS

3. Group # 1: Choice C

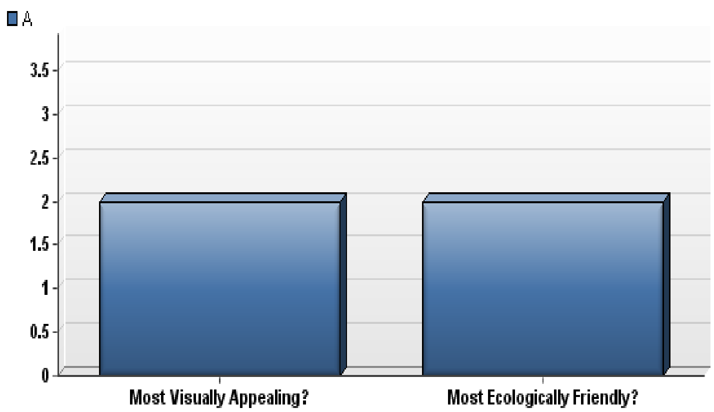


#	Question	C		Mean
1	Most Visually Appealing?	54	54	1.00
2	Most Ecologically Friendly?	46	46	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	54	46

PART 1: GROUP # 2 STATISTICS

4. Group # 2: Choice A

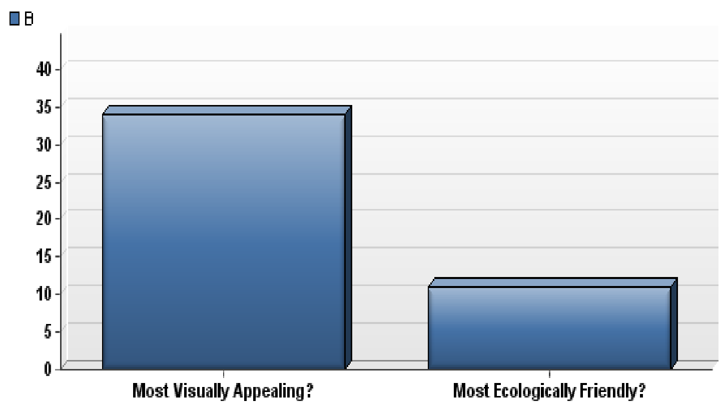


#	Question	A		Mean
1	Most Visually Appealing?	2	2	1.00
2	Most Ecologically Friendly?	2	2	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	2	2

PART 1: GROUP # 2 STATISTICS

5. Group # 2: Choice B

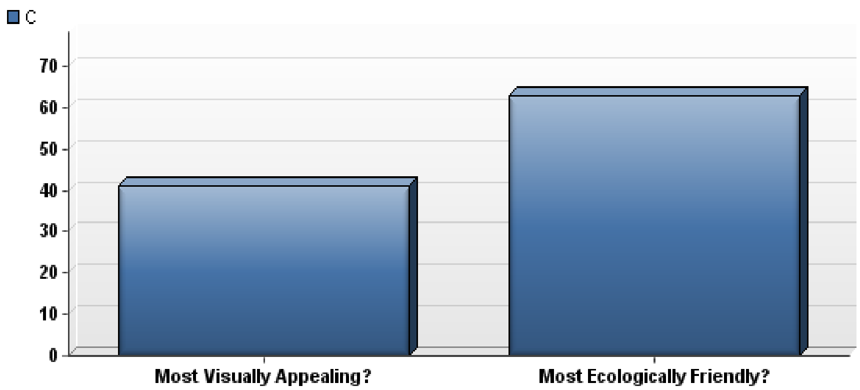


#	Question	B		Mean
1	Most Visually Appealing?	34	34	1.00
2	Most Ecologically Friendly?	11	11	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	34	11

PART 1: GROUP # 2 STATISTICS

6. Group # 2: Choice C

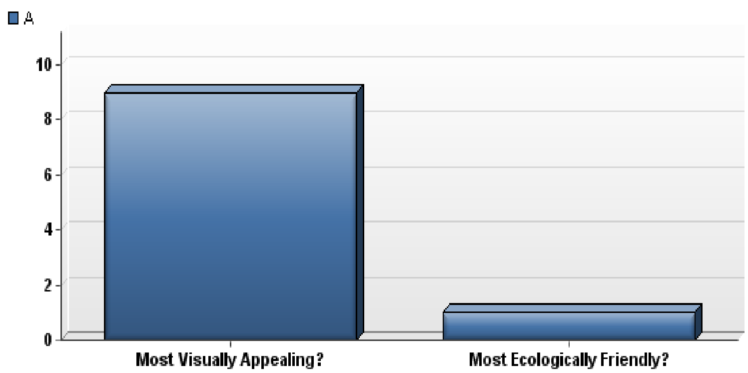


#	Question	C		Mean
1	Most Visually Appealing?	41	41	1.00
2	Most Ecologically Friendly?	63	63	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	41	63

PART 1: GROUP # 3 STATISTICS

7. Group # 3: Choice A

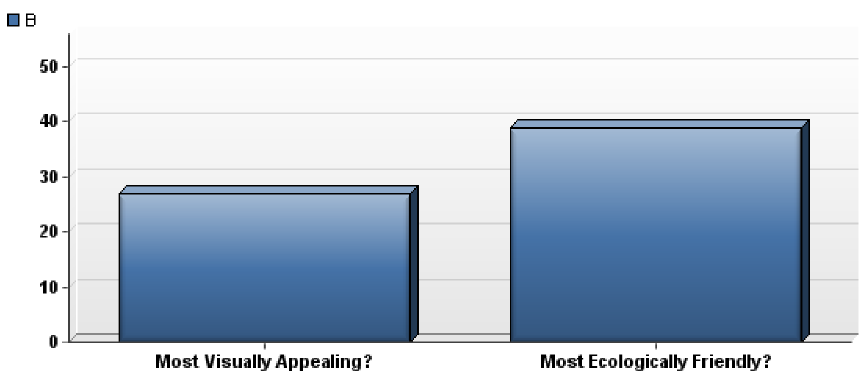


#	Question	A		Mean
1	Most Visually Appealing?	9	9	1.00
2	Most Ecologically Friendly?	1	1	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	9	1

PART 1: GROUP # 3 STATISTICS

8. Group # 3: Choice B

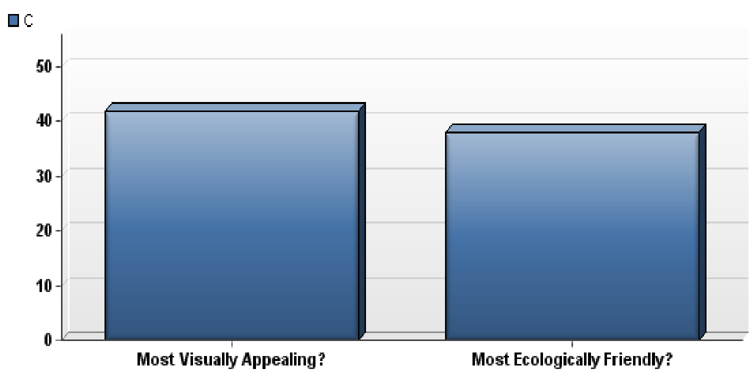


#	Question	B		Mean
1	Most Visually Appealing?	27	27	1.00
2	Most Ecologically Friendly?	39	39	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	27	39

PART 1: GROUP # 3 STATISTICS

9. Group # 3: Choice C

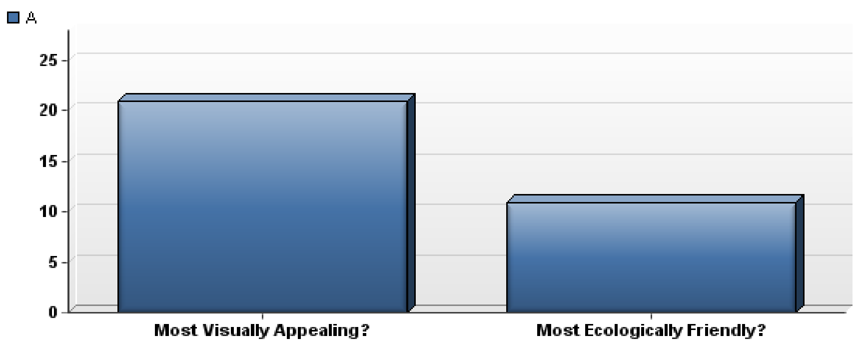


#	Question	C		Mean
1	Most Visually Appealing?	42	42	1.00
2	Most Ecologically Friendly?	38	38	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	42	38

PART 1: GROUP # 4 STATISTICS

10. Group # 4: Choice A

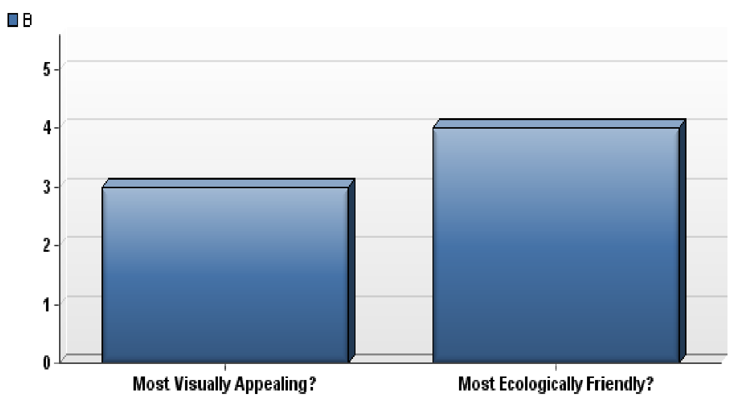


#	Question	A		Mean
1	Most Visually Appealing?	21	21	1.00
2	Most Ecologically Friendly?	11	11	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	21	11

PART 1: GROUP # 4 STATISTICS

11. Group # 4: Choice B

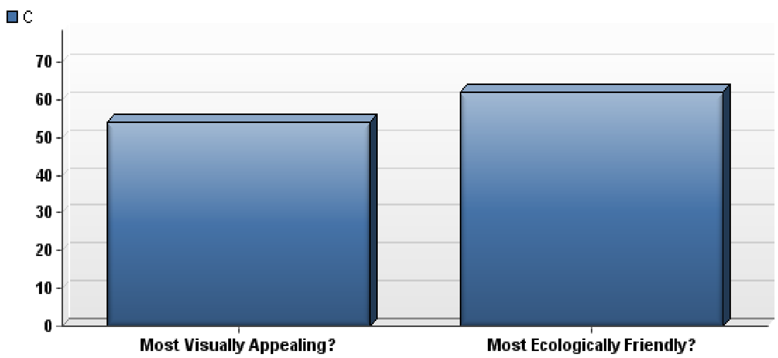


#	Question	B		Mean
1	Most Visually Appealing?	3	3	1.00
2	Most Ecologically Friendly?	4	4	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	3	4

PART 1: GROUP # 4 STATISTICS

12. Group # 4: Choice C

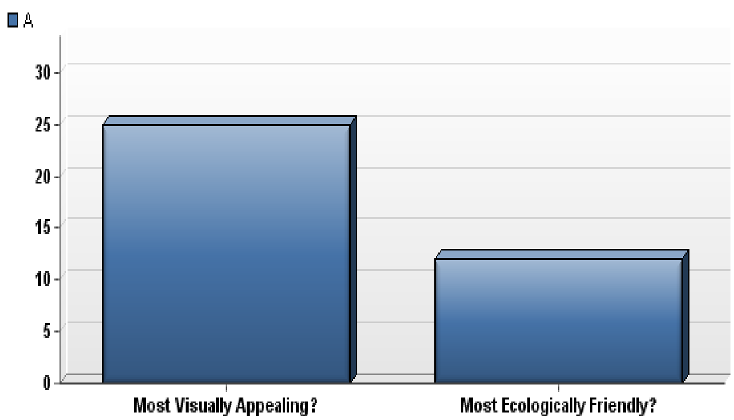


#	Question	C		Mean
1	Most Visually Appealing?	54	54	1.00
2	Most Ecologically Friendly?	62	62	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	54	62

PART 1: GROUP # 5 STATISTICS

13. Group # 5: Choice A

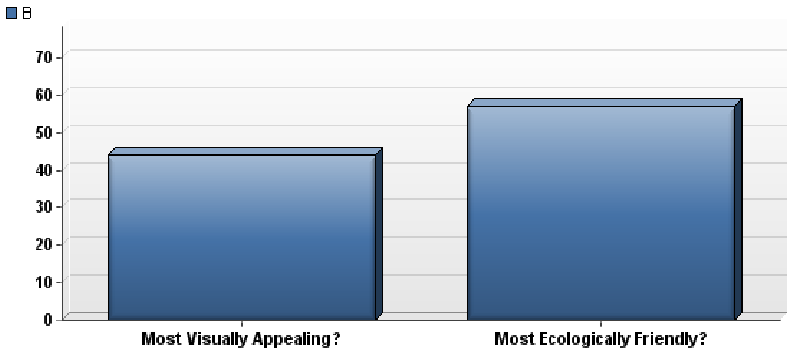


#	Question	A		Mean
1	Most Visually Appealing?	25	25	1.00
2	Most Ecologically Friendly?	12	12	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	25	12

PART 1: GROUP # 5 STATISTICS

14. Group # 5: Choice B

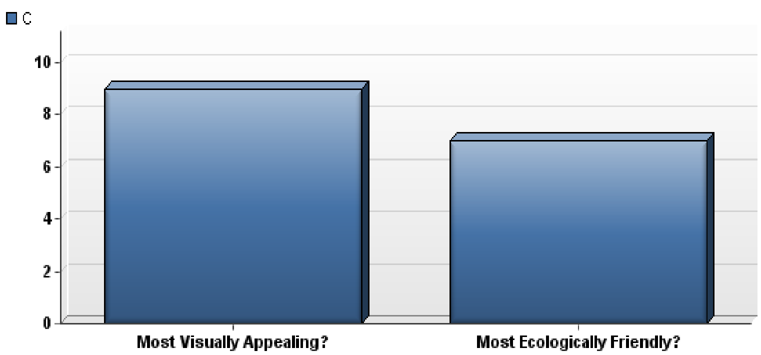


#	Question	B		Mean
1	Most Visually Appealing?	44	44	1.00
2	Most Ecologically Friendly?	57	57	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	44	57

PART 1: GROUP # 5 STATISTICS

15. Group # 5: Choice C

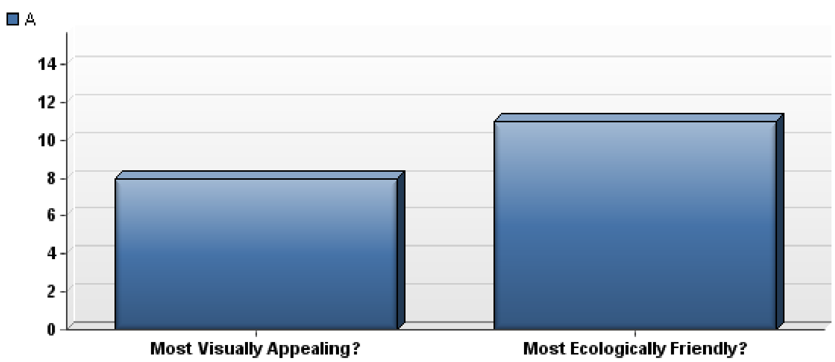


#	Question	C		Mean
1	Most Visually Appealing?	9	9	1.00
2	Most Ecologically Friendly?	7	7	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	9	7

PART 1: GROUP # 6 STATISTICS

16. Group # 6: Choice A

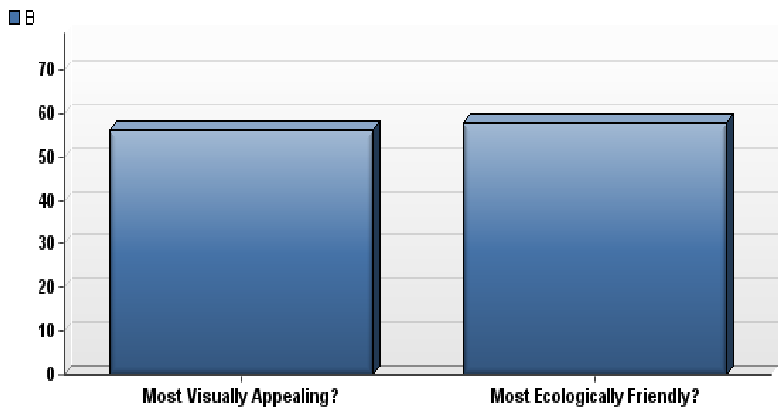


#	Question	A		Mean
1	Most Visually Appealing?	8	8	1.00
2	Most Ecologically Friendly?	11	11	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	8	11

PART 1: GROUP # 6 STATISTICS

17. Group # 6: Choice B

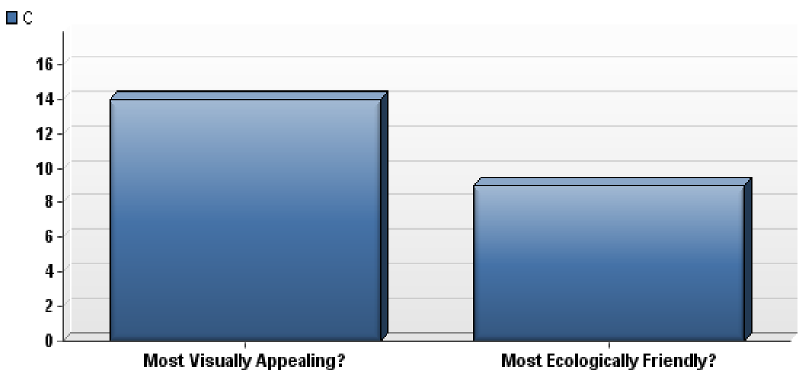


#	Question	B		Mean
1	Most Visually Appealing?	56	56	1.00
2	Most Ecologically Friendly?	58	58	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	56	58

PART 1: GROUP # 6 STATISTICS

18. Group # 6: Choice C

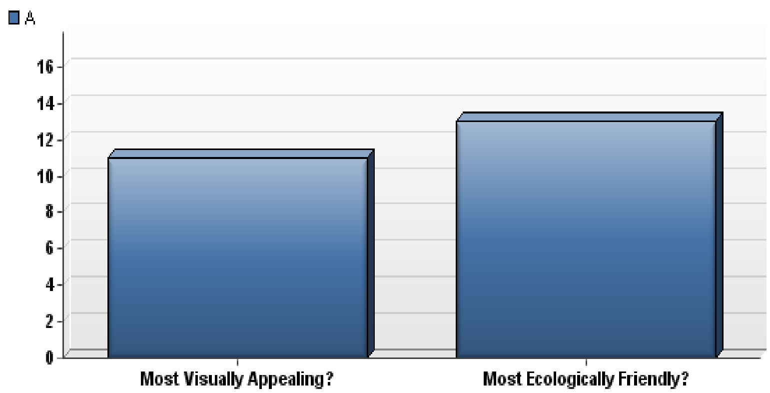


#	Question	C		Mean
1	Most Visually Appealing?	14	14	1.00
2	Most Ecologically Friendly?	9	9	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	14	9

PART 1: GROUP # 7 STATISTICS

19. Group # 7: Choice A

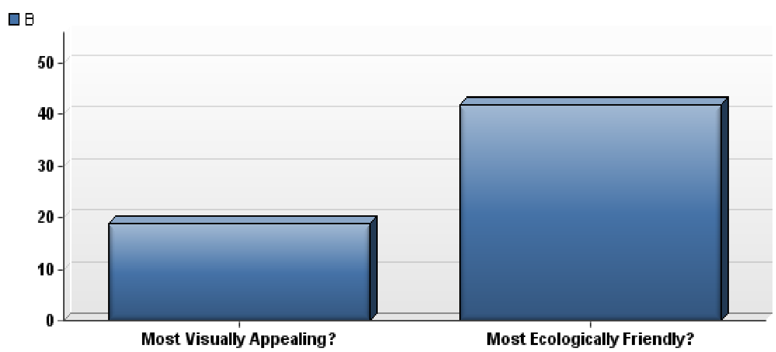


#	Question	A		Mean
1	Most Visually Appealing?	11	11	1.00
2	Most Ecologically Friendly?	13	13	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	11	13

PART 1: GROUP # 7 STATISTICS

20. Group # 7: Choice B

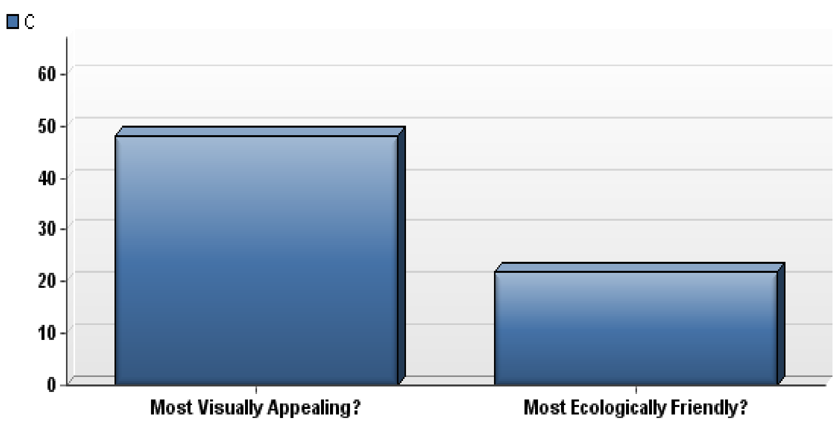


#	Question	B		Mean
1	Most Visually Appealing?	19	19	1.00
2	Most Ecologically Friendly?	42	42	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	19	42

PART 1: GROUP # 7 STATISTICS

21. Group # 7: Choice C

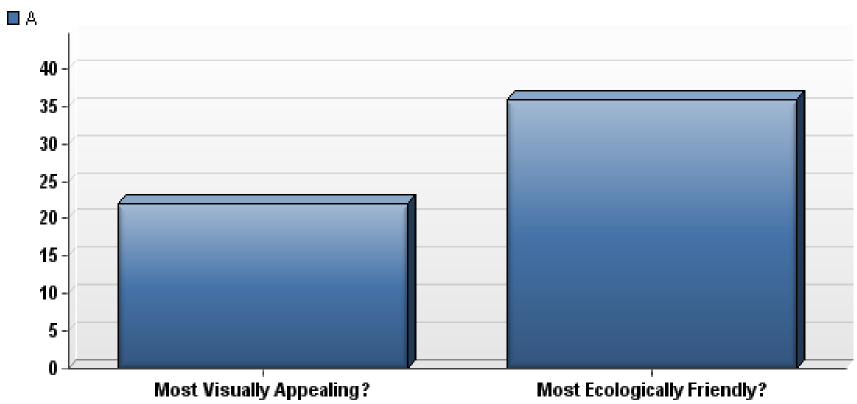


#	Question	C		Mean
1	Most Visually Appealing?	48	48	1.00
2	Most Ecologically Friendly?	22	22	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	48	22

PART 1: GROUP # 8 STATISTICS

22. Group # 8: Choice A

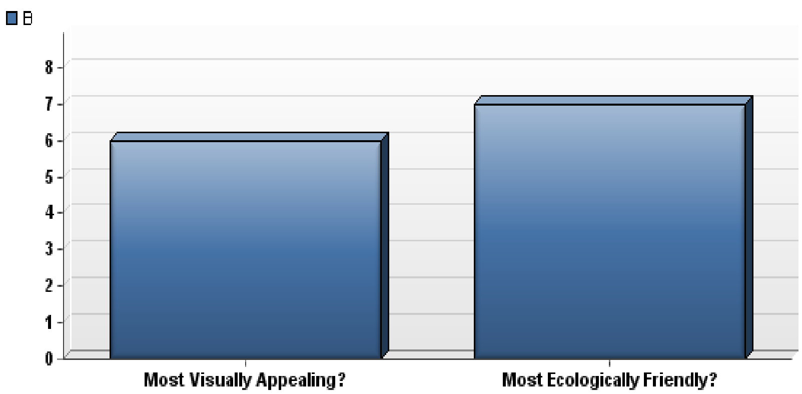


#	Question	A		Mean
1	Most Visually Appealing?	22	22	1.00
2	Most Ecologically Friendly?	36	36	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	22	36

PART 1: GROUP # 8 STATISTICS

23. Group # 8: Choice B

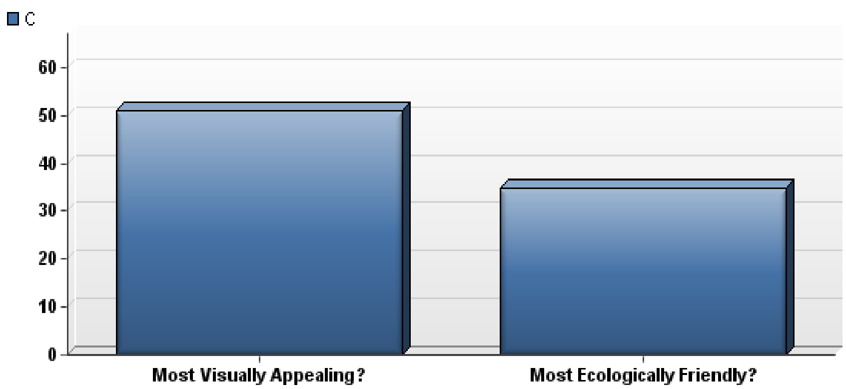


#	Question	B		Mean
1	Most Visually Appealing?	6	6	1.00
2	Most Ecologically Friendly?	7	7	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	6	7

PART 1: GROUP # 8 STATISTICS

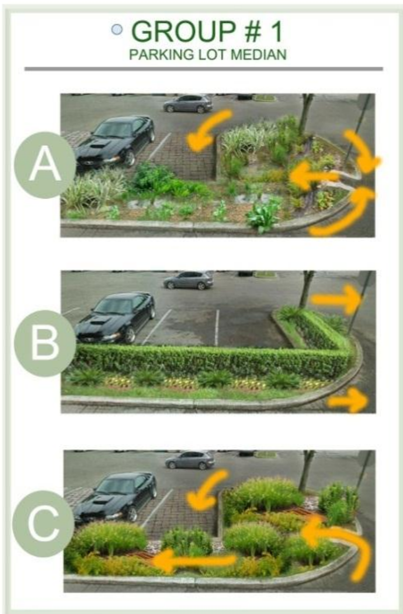
24. Group # 8: Choice C



#	Question	C		Mean
1	Most Visually Appealing?	51	51	1.00
2	Most Ecologically Friendly?	35	35	1.00

Statistic	Most Visually Appealing?	Most Ecologically Friendly?
Min Value	1	1
Max Value	1	1
Mean	1.00	1.00
Variance	0.00	0.00
Standard Deviation	0.00	0.00
Total Responses	51	35

PART 2: GROUP # 1 STATISTICS



- *Water from the parking lot flows into a planted median to slow and filter pollutants out of the water*

- *Water from the parking lot flows into a drain and taken off site*

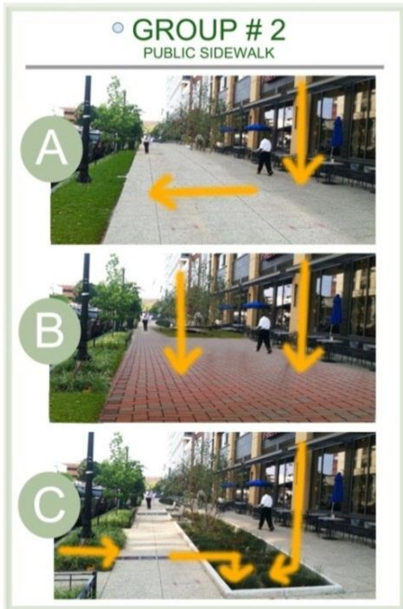
- *Water from the parking lot flows into a planted median and some of that water goes into a drain and taken off site*

#	Answer		Response	%
1	A		36	60%
2	B		2	3%
3	C		22	37%
	Total		60	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	1.77
Variance	0.93
Standard Deviation	0.96
Total Responses	60

After reading about each stormwater alternative, this particular scenario showed an overall preference for Choice A, when Choice C had originally had the highest visual and ecological preference.

PART 2: GROUP # 2 STATISTICS



- *Rain water flows onto a concrete sidewalk where it goes into drains and taken off site*
- *Grasses and street trees allows for some infiltration*

- *Rain water flows onto a permeable walkway, which allows the water to soak directly into the ground*

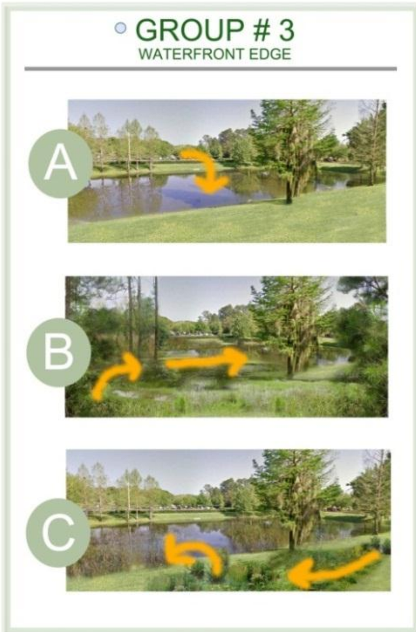
- *Some of the rain water from the street flows into sidewalk planters to filter pollutants out before soaking into the ground*
- *Some extra maintenance is needed to keep the planters working properly*

#	Answer		Response	%
1	A		1	2%
2	B		24	40%
3	C		35	58%
	Total		60	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.57
Variance	0.28
Standard Deviation	0.53
Total Responses	60

This particular scenario showed an overall preference for Choice C, when Choice B and C were similar in visual preference and Choice C was the most ecologically preferred.

PART 2: GROUP # 3 STATISTICS



- *Water from surrounding streets are piped into this pond to slowly soak back into the ground*

- *Vegetation at the pond edge slows and filters pollutants out of the water before entering the pond*

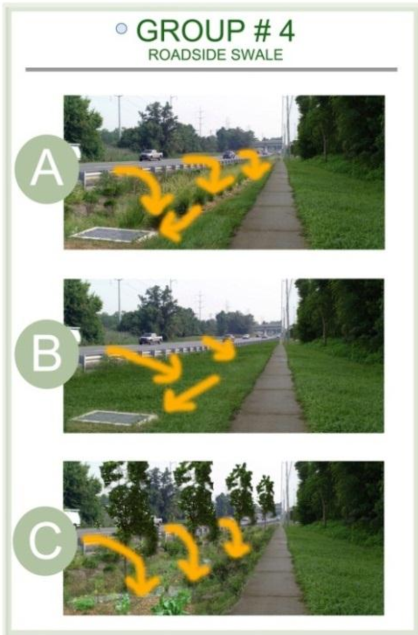
- *Water flows into vegetated depressions, where it slows and filters pollutants before entering the pond*
- *Grass separates pond edge and vegetated depression*

#	Answer		Response	%
1	A		1	2%
2	B		27	44%
3	C		33	54%
	Total		61	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.52
Variance	0.29
Standard Deviation	0.54
Total Responses	61

This particular scenario showed an overall preference for Choice C, when there was a high visual preference for Choice C and a relatively equal ecological preference between B and C.

PART 2: GROUP # 4 STATISTICS



- *Water from the street flows into the planting bed where grasses and shrubs are used to filter pollutants before it's piped off site*

- *Water from the street flows into the grassy depression and then piped to a nearby pond*
- *Mowing is the only maintenance needed*

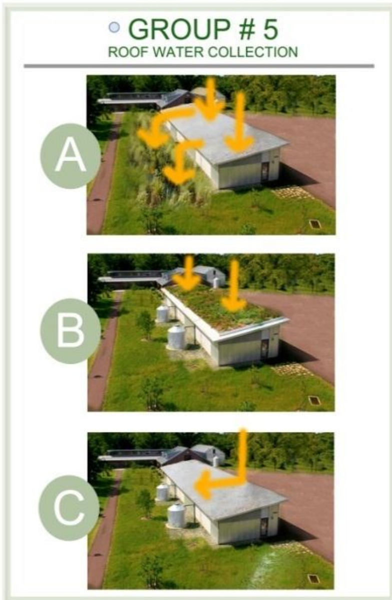
- *Water from the street flows into the planting bed where it remains until it is filtered and soaks back into the ground*
- *No mowing needed*

#	Answer		Response	%
1	A		11	18%
2	B		0	0%
3	C		49	82%
	Total		60	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.63
Variance	0.61
Standard Deviation	0.78
Total Responses	60

This particular scenario showed an overwhelming preference for Choice C, when Choice C had both a high visual and ecological preference as well.

PART 2: GROUP # 5 STATISTICS



- *Water from the roof flows directly into the vegetated depression to allow it to soak back into the ground*
- *No gutters allows a sheet flow of water to evenly enter the depression*

- *Rain water irrigates the vegetated Eco-roof*
- *Any excess water flows into cisterns and reused for the landscape and amenities such as toilets*

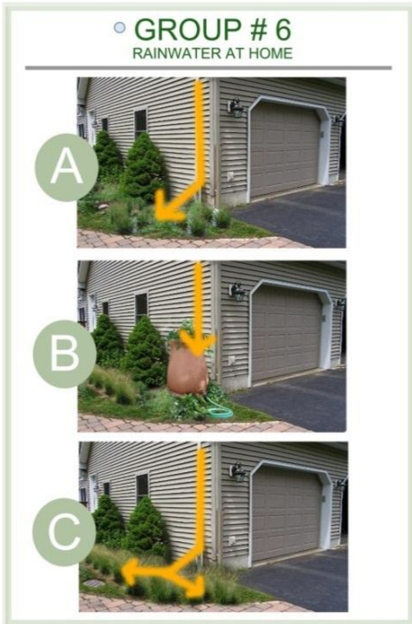
- *Cisterns capture most of the rain water*
- *Any excess water flows onto the grassy landscape and piped off site*

#	Answer		Response	%
1	A		5	8%
2	B		49	83%
3	C		5	8%
	Total		59	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.00
Variance	0.17
Standard Deviation	0.42
Total Responses	59

This particular scenario showed an overwhelming preference for Choice B, when Choice B had both a high visual and ecological preference as well.

PART 2: GROUP # 6 STATISTICS



- *Water from the roof flows into a gutter and out onto a small rain garden*
- *The depression in the garden holds the water until it soaks into the ground*

- *Water from the roof flows into a rain barrel which can be used later to irrigate the planting bed*

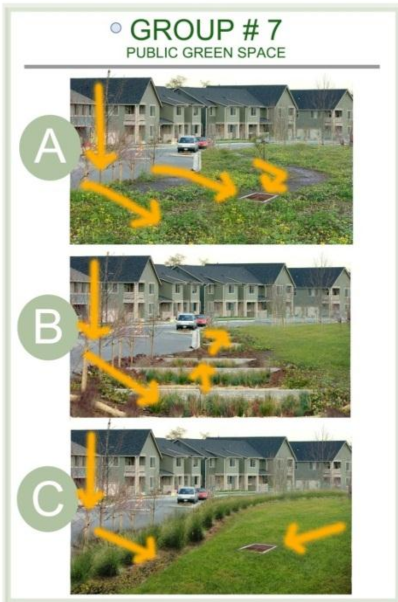
- *Water from the roof flows into a gutter and out onto a planting bed*
- *A small garden drain collects any excess water*

#	Answer		Response	%
1	A		9	15%
2	B		45	74%
3	C		7	11%
	Total		61	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	1.97
Variance	0.27
Standard Deviation	0.52
Total Responses	61

This particular scenario showed an overall preference for Choice B, when Choice B had both a high visual and ecological preference as well.

PART 2: GROUP # 7 STATISTICS



- *Water from the road and nearby buildings flows into the vegetated depression to filter pollutants*
- *Small drains manage extreme flooding*

- *Constructed wier system helps monitor water flow and water quality*
- *Vegetation helps filter pollutants before it soaks back into the ground*

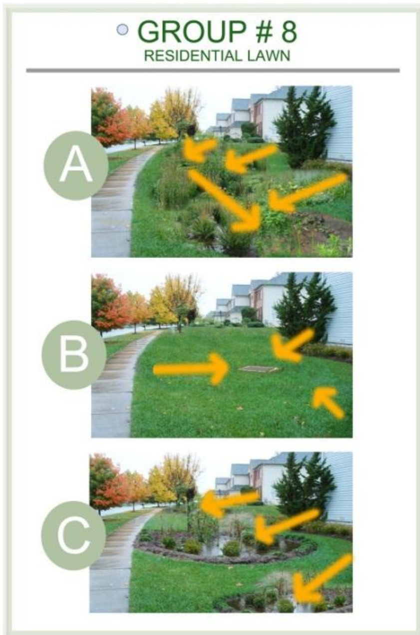
- *Water from the road and nearby buildings flows into the planting bed and grassy open space*
- *Any excess water flows into a storm drain and is piped to a nearby retention pond*

#	Answer		Response	%
1	A		13	21%
2	B		35	57%
3	C		13	21%
	Total		61	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.00
Variance	0.43
Standard Deviation	0.66
Total Responses	61

This particular scenario showed an overwhelming preference for Choice B, when Choice C had a high visual preference and Choice B had a high ecological preference.

PART 2: GROUP # 8 STATISTICS



- *Water from the nearby homes flows into a shared vegetated depression*
- *Water remains in the depression until it soaks back into the ground*

- *Water from the nearby homes flows onto a grassy lawn and into a storm drain to be taken off site*

- *Water flows into a separate rain garden for each individual home*
- *Water remains in the rain gardens until it soaks back into the ground*

#	Answer		Response	%
1	A		19	32%
2	B		3	5%
3	C		37	63%
	Total		59	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.31
Variance	0.87
Standard Deviation	0.93
Total Responses	59

This particular scenario showed an overall preference for Choice C, when there was a high visual preference for Choice C and an almost identical ecological preference for both Choice A and Choice C.

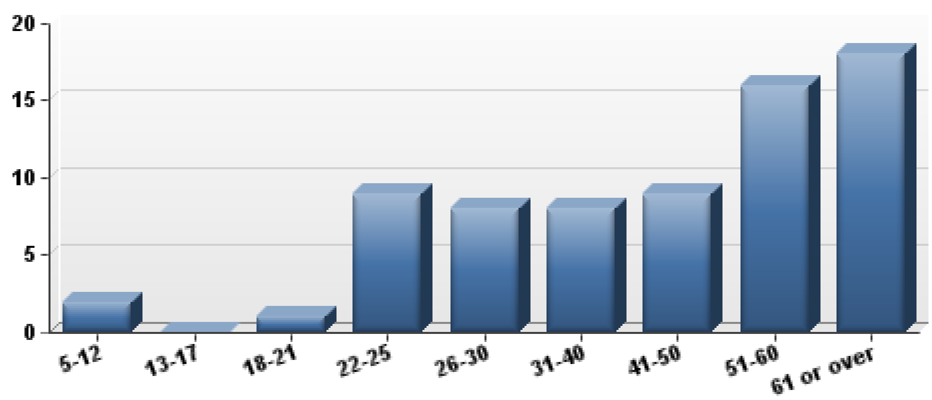
PART 3: DEMOGRAPHICS & KNOWLEDGE BASED QUESTIONS

What is your gender?

#	Answer		Response	%
1	Male		33	46%
2	Female		38	54%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.54
Variance	0.25
Standard Deviation	0.50
Total Responses	71

What is your age?



#	Answer		Response	%
1	5-12		2	3%
2	13-17		0	0%
3	18-21		1	1%
4	22-25		9	13%
5	26-30		8	11%
6	31-40		8	11%
7	41-50		9	13%
8	51-60		16	23%
9	61 or over		18	25%
	Total		71	100%

#	Answer		Response	%
1	5-12		2	3%
2	13-17		0	0%
3	18-21		1	1%
4	22-25		9	13%
5	26-30		8	11%
6	31-40		8	11%
7	41-50		9	13%
8	51-60		16	23%
9	61 or over		18	25%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	9
Mean	6.79
Variance	4.20
Standard Deviation	2.05
Total Responses	71

Do you live in the CITY of Alachua?

#	Answer		Response	%
1	Yes		23	33%
2	No		46	67%
	Total		69	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.67
Variance	0.23
Standard Deviation	0.47
Total Responses	69

What is your ethnicity?

#	Answer		Response	%
1	White, non-Hispanic		59	86%
2	African-American		1	1%
3	Hispanic		4	6%
4	Asian-Pacific Islander		2	3%
5	Native American		1	1%
6	Other		2	3%
	Total		69	100%

Statistic	Value
Min Value	1
Max Value	6
Mean	1.42
Variance	1.31
Standard Deviation	1.14
Total Responses	69

How much do you know about stormwater management?

#	Answer		Response	%
1	I have never heard of stormwater management		3	4%
2	I have heard of it, but don't know very much about it		23	32%
3	I know some information about it		34	48%
4	I know a lot about it		11	15%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	2.75
Variance	0.59
Standard Deviation	0.77
Total Responses	71

How often do you consciously try to conserve water in your home?

#	Answer		Response	%
1	Not often		6	8%
2	Sometimes		20	28%
3	Often		45	63%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.55
Variance	0.42
Standard Deviation	0.65
Total Responses	71

How concerned are you about water quality in your COMMUNITY?

#	Answer		Response	%
1	Not concerned		4	6%
2	Somewhat concerned		21	30%
3	Very concerned		44	62%
4	I don't know if there are any water quality issues in my community		2	3%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	2.62
Variance	0.41
Standard Deviation	0.64
Total Responses	71

How much do you know about the Floridan Aquifer?

#	Answer		Response	%
1	I have never heard of the Floridan Aquifer		7	10%
2	I have heard of it, but don't know very much about it		15	21%
3	I know some information about it		35	49%
4	I know a lot about it		14	20%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	2.79
Variance	0.77
Standard Deviation	0.88
Total Responses	71

How important is it for community members to play active roles in protecting local watersheds from pollution?

#	Answer		Response	%
1	Not important		0	0%
2	Sometimes important, depending on what's causing the pollution		7	10%
3	Very important		63	90%
4	It is not the community member's role		0	0%
	Total		70	100%

Statistic	Value
Min Value	2
Max Value	3
Mean	2.90
Variance	0.09
Standard Deviation	0.30
Total Responses	70

Would you like to be added to the email list to receive updates on the progress of this research and an invitation to the public presentation?

#	Answer		Response	%
1	Yes		33	46%
2	No		38	54%
	Total		71	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.54
Variance	0.25
Standard Deviation	0.50
Total Responses	71