## **EDUCATION ACTIVITES**

for

A Green Residential Stormwater Management Demonstration: An Integrated Stormwater Management and Graywater System to Reduce the Quantity and Improve the Quality of Residential Water Discharges





Report #2 FDEP #S0366 By

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#### Disclaimer

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#### **EXECUTIVE SUMMARY**

Information in this report provides motivation to build a home with stormwater management, gray water and wastewater treatment methods and devices that reduce the amount of pollution and volume of runoff from a residential site. Also the educational materials will assist in an understanding of building green with stormwater management in mind. Within this publication is teaching information that demonstrates and promotes an integrated stormwater and gray water system. The information can be used to promote and educate builders, individuals, city officials, and students on the benefits of an integration of residential stormwater management and gray water technologies. The information provides valuable consumer and market information to encourage green stormwater management building practices. It is anticipated that this work will improve our quality of life through home ownership which demonstrates water efficiency, environmental awareness, cost savings, and lifestyle choices.

In collaboration with the Florida Department of Environmental Protection (FDEP: <u>www.dep.state.fl.us/water/waters/stormwater</u>), UCF Stormwater Management Academy, (<u>www.stormwater.ucf.edu</u>) and Florida's Showcase Green Envirohome (FSGE: <u>www.fsge.net/</u>) all parties demonstrate the expertise needed to develop the "Greenest Residential Home" to date. FSGE is located on a coastal barrier island as a home site for demonstration and educational information to promote stormwater management. This home is a green residential stormwater management harvesting and gray water reuse design. The home is used to educate visitors about the methods and strategies for stormwater management as related to building green and building strong. FSGE is also

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available for use as a builder training and education facility. Additional specific publications and presentation materials can be obtained from the stormwater management academy at the University of Central Florida in Orlando, Florida and by accessing their web site at <u>www.stormwater.ucf.edu</u>.

It is recommended that the information in this report be used as a learning tool for stormwater management methods and devices in a residential setting. The integration of stormwater harvesting and gray water reuse at the FSGE should be promoted. Also the methods to remove nutrients from wastewater using on-site treatment should be promoted. Interested persons should sign up for tours of the FSGE home. FSGE will be "open to the public" and serve as a demonstration and learning experience for water saving methods and devices. Attendees will participate and see monitored "proof of performance" data from a live test site with tenants. Participants will learn how to save valuable water resources and lower the operating cost by building green

#### ACKNOWLEDGMENT

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#### **CHAPTER 1: INTRODUCTION**

#### **Introduction**

Educational activities to promote on-site stormwater management are important if we are to reduce runoff volume and mass of pollutants generated from a variety of land use activities, and as noted in this work from a residential location. A building site that has options to add stormwater and wastewater treatment without additional land for treatment was located for a demonstration of the latest stormwater and wastewater treatment building technologies. The site is located in Indialantic, Florida and is called Florida's Showcase Green Envirohome (FSGE).

In 2004, Hurricanes Frances and Jeanne destroyed the original structure of FSGE displacing Mark Baker's mother Betty Baker Farley. Eleven months later Hurricane Katrina destroyed Mark's wife, Nonnie Chrystal, mother's and sister's homes in New Orleans, Louisiana. After these experiences and with Betty's blessing, Mark and Nonnie decided to build FSGE where Betty's home once stood (FSGE, 2008).

FSGE is built to meet or exceed 12 green building guidelines (refer to appendix #) and obtain 8 green building certificates. The two-story 3292 ft<sup>2</sup> home is a "Near Zero-Loss Home<sup>TM</sup>", "Near Zero-Energy Home<sup>TM</sup>", "Near Zero-Runoff Home<sup>TM</sup>", and "Near Zero-Maintenance Home<sup>TM</sup>". It is spawned from the consumer-driven necessity to build a home resistant to hurricanes, tornadoes, floods, fire, mold, termites, impacts, and even earthquakes given up to 500% increase in insurance premiums in natural disaster zones, the dwindling flexibility and coverage of insurance policies, and rising energy, water and maintenance costs (FSGE 2008).



**Figure 1: Original Home & Construction Time Line** 

FSGE has green roofs, pervious pavements, cisterns, bioswales and native vegetation that are used for stormwater management (reference Appendix for pictures of each). Florida friendly plants are used for the landscaping and for a bio swale that retains stormwaters on site(Figure 7 in the Appendix). Irrigation water and water for toilet flushing are provided by a water cistern. The cistern contains the stormwater runoff from 5 different green roof areas (Figure 6 in the Appendix), the traditional roof area, decking areas, graywater, AC condensate and supplemental water from an artesian well. The supplemental water from the artesian well is used to maintain a minimum volume in the

cistern in times of water shortage. The overflow from the cistern is routed to a 100 ft<sup>2</sup> bio-swale (Figures 3-4). Water stored in the cistern is used for irrigating the ground level landscaping and green roof areas, toilet flushing, and connected for laundry water in the future. The graywater from the home is disinfected using ozone prior to being routed to the water cistern (refer to Figure 16: for house water management).

At FSGE a new on-site sewage treatment and disposal system (OSTDS), which is a septic tank followed by a sorption filter and drain field is also evaluated to remove nitrogen (Reference Figures 9-10) The sorption media selected for this study is the Bold & Gold<sup>TM</sup> filtration media. The Bold & Gold<sup>TM</sup> filtration media is a mixture of tire crumb, sand and wood by products along with a top layer of sand and limestone which adds alkalinity to the filter tank. This media has been used for its nutrient removal efficiency in other pollution control applications. The Bold & Gold<sup>TM</sup> medium is also applied under the porous pavement (Reference Figure 11) and on the greenroofs (Figures 5-7).

#### **Objectives**

The objectives of this research are to:

- (1) Design a green integrated stormwater management and gray water harvesting system for a residential property in an urban area.
- (2) Provide monitoring data as to the effectiveness of green stormwater management and gray water reuse practices and to also include wastewater flow reduction data.

- (3) Make recommendations for the design of green stormwater management and gray water harvesting systems and to also include the effects on wastewater flows.
- (4) Educate the technical community as well as the general public.

#### **Limitations**

The information available uses data from FSGE, a two story home located on the east central coast of Florida as seen in Figure 1. This household has a total area of 3292 ft<sup>2</sup>. The water cistern has a capacity of 4500 gallons while OSTDS sorption filter addition has a design load of 300 gallons per day.

#### **Roadmap for Report**

Chapter one is an introduction to the design elements for FSGE. The chapter includes the objectives and an overview of the limitations of this study. Also, a roadmap to the report is presented. In Chapter two, a Green building process is presented with focus on residential stormwater management and gray water harvesting systems. Waste water management in a green onsite sewage treatment and disposal system (OSTDS) is presented. Chapter 3 covers three of the Big C's of watershed management, namely Community Involvement, Communication & Commitment along with educational outreach materials, and science, technology, engineering and math (STEM) focus. A discussion of why watershed management is presented to demonstrate the need for providing a venue for children outside the classroom to experience STEM as used for stormwater management in a residential home setting. A summary with conclusions and recommendations are presented in Chapter 4.

#### **Scope**

This research focused on the use of integrated stormwater management and gray water harvesting systems for residential buildings. The data obtained assist in the formation of green stormwater management rules and regulations for residential buildings in the State. There are three major activities of the research, namely the documentation of the integrated stormwater management with gray water as a harvesting system both within and outside of the home, documentation of the wastewater volume and concentration, and education of the public. This publication presents the results of education efforts.

#### **CHAPTER 2: Green Building Process**

#### **Introduction**

The Green building process in general, encompasses the entire movement to become environmentally conscious. You can go green in several ways, from stormwater management, gray water harvesting, water conservation, greenroofs, landscaping, bioswales, powering your home with green energy or by changing small things in your everyday life like using a cistern to water your garden. Green can apply to the way you drive, the way you build, the way you cook, the way you garden and more. You can choose to embrace a green way of life and do everything you can to be environmentally conscious. An important tool in the effort to build greener buildings and live greener lives is the selection of products that were made using environmentally friendly processes and are used in environmentally friendly ways. Green Products and design techniques are available for just about any daily need, and the ways they are green are many and varied: They are energy or water efficient; they use healthy non-toxic materials; they are made from recycled or renewable resources; they make current products you use more efficient or more durable; and they are recyclable or biodegradable, among many other things. Extensive research has gone into all the products and design techniques selected for use at FSGE. This section will highlight several of the innovative green technologies such as residential stormwater management & gray water harvesting systems, cisterns, greenroofs, bioswales, and porous pavement to name a few. Reference Appendix Table 1:Green Building Terminology for definitions and terminology summary.

#### **Building Green:**

For the purposes of this study building green is defined by any building that has most of the following:

#### **Table 1: Building Green Contents**

Stormwater Harvesting & Watershed Management	Near Zero Water Loss & Discharge
Low Impact Development	Natural Resource Efficiency
Energy Efficiency, Water Efficiency	Greenroofs, Bio-Swales,
(Graywater Systems, Cisterns), Indoor Air Quality, Durability	Native Landscaping
Minimal Global Impact, Climate Change	Ability to withstand natural disasters
Pervious paving systems	Ease of Maintenance

Green buildings are healthier, more environmentally sound, and more economical. Studies show that a person can retrofit or build new without sacrificing quality or breaking the bank. Green Building is not a fad – it is a life style! There is an estimated \$15 billion worth of green buildings currently in design or under construction in the US, representing 12 – 15% of total public construction and 2% of private sector construction. Although the \$15 billion is less than 5% of the total \$315 billion US annual construction for commercial, industrial and institutional buildings, this category is growing at a rate of about 75% annually.

(http://www.stormwater.ucf.edu/research/presentations/USGBC\_UCF\_Green.ppt#279,20 Slide 20). The value of green building construction starts exceeds \$12 billion in 2008 & is projected to increase to \$60 billion by 2010. (McGraw Hill Construction Analytics, Smart Market Trends Report 2008). One recent study published by CoStar March 26, 2008 showed: LEED<sup>®</sup> and Energy Star<sup>®</sup> buildings respectively command premiums of \$11.33/sf and \$2.40/sf over their non-LEED and non-Energy Star peers with 4.1% and 3.6% higher occupancies. Energy Star® buildings are selling for an average \$61/sf more than their peers with LEED® at an amazing \$171/sf more. Green buildings have lower operating costs and overall the impressive data indicates that non-green buildings will become obsolete. In addition another study shows consumers will pay 11-25% more for green homes. Green roofs, cost about twice as much to install, says Seattle's King County government in a 2004 study. The cost of green roofs is about \$14 to \$25 square foot. The higher cost and longer membrane life, appear to offset each other. The King-County study estimates that, over a 40-year life span, the "total costs of ownership for the green roof" is only about 10% higher than for a conventional roof design.

#### **Residential Stormwater Management and Gray Water Harvesting Systems:**

The stormwater management system at FSGE consists of five green roof areas (Figure 6), porous paving in the form of Flexipave<sup>TM</sup> and pavers from Hanson<sup>TM</sup> (Figure 11), a bio-swale (Figures 3-4), and an irrigation cistern to capture, reuse, and harvest in the average year, over 95% of the stormwater on the property. The gray water system will take water from the shower, bathtub and washing machine and use this water to flush

toilets. This gray water will be stored in an 85 gallon cistern on the second floor. The overflow water from this gray water cistern will be diverted to the irrigation cistern from which the water will be used to irrigate the greenroof and parts of the ground level landscaping. The greenroof irrigation will be scheduled and will occur year round, while the ground level landscaping and the vegetation within the bio-swale will be used as a way to dispose of water in times of excess (Figures 3-4, 12). The overflow from the irrigation cistern to the city storm sewer will be minimized. The result of the integrated stormwater and gray water treatment system will be a drastic reduction of both the stormwater runoff and the water treated by the onsite septic tank and drain field.

A greenroof stormwater treatment system is a vegetated roof with a cistern, and is used for pollution control, volume reduction, and peak flow reduction. The greenroof has plants, a selected growth media and pollution-control media like Bold & Gold Greenroof Media<sup>™</sup>. Water which falls on a greenroof filters through the media to the roof drainage system. The filtrate from the greenroof discharges to a cistern or water storage pond that stores water. The water from the cistern is either used to irrigate the greenroof or nearby landscaping. FSGE has five greenroofs. Greenroofs reduce energy costs by keeping the roof warmer during winter & cooler during the summer (refer to Appendix Figures 5-7). Shows the temperature variance on a traditional roof vs. greenroof. Data collected from UCF SWMA first greenroof in Florida showed a max temp. during an avg. summer day 2005 on the Greenroof 91 F vs. Conventional roof surface130 F. In January & February 2006, when the outside air temperature dropped below 55 degrees, the avg. surface temp. of the greenroof was 60 degrees which was 11 degrees warmer than the avg. temp. of adjacent conventional roof.

There are two types of Greenroofs:

<u>Intensive</u> – depth  $\geq$ 6 inches, need added structural support, higher maintenance, less

commonly used.

Extensive – shallower typically 3-4 in., planted with hardy plants like Florida natives

Greenroofs provide many benefits including:

- Reducing stormwater pollution and flooding
- Cleaning the air, reducing global warming, and controlling local climate by reducing the heat island effect.
- Reducing heat transfer through the roof thereby reducing energy use and costs.
- C Local food supply source
- Improved habitat and biodiversity
- Improved physical and mental health
- Improved aesthetics
- Can last 50 100 years opposed to a 15yr roof

The greenroofs are designed to be lightweight and aesthetically pleasing. FSGE has five greenroof areas on the house. See Figures 8-10. Each greenroof has installed the water proof membrane, drainage fabric, separation media, pollution control media and growth media. The growth media is approximately four inches and houses Florida native plants. Refer to Figure 7 for a list and quantity of plants used. The plants listed in Figure 7 are considered to be native to this building area or existed before human occupation in this area. Coral Honeysuckle, Muhly Grass have been used on green roofs before. The plant selections will ensure diverse and healthy green roof habitat for song birds and pollinating insects as well as provide data on additional plants for greenroofs in Florida. Native Enviroscaping, removing invasive plants & composting at FSGE had the following outcomes. A reduction of 60% in outdoor irrigation due to an advanced drip irrigation system has been recorded. A reduction of 40% in outdoor irrigation due to a smart sensor irrigation.

All the stormwater management pollution control components will be treated with the Bold & Gold<sup>TM</sup> pollution control media. This includes the green roof areas, the bioswale, and the porous pavement (such as Flexipave<sup>TM</sup>) areas. In addition, the area beyond the septic tank drain field will be treated with Bold & Gold<sup>TM</sup> pollution control media (reference Figures 12-13). A detailed cross section is shown in Figure 12. It is believed that the use of the pollution control media and the volume reduction into the septic tank system will reduce the maintenance requirements of the septic system as well as improve the quality of the effluent.

Porous pavement such as Flexipave<sup>™</sup> and Hanson Pavers are planned for several aspects of this system and can be seen in Figure 14. The two green roof areas on the second story deck will be drained via gutters with screen as shown in Figure 8. The use of Flexipave<sup>™</sup> and Hanson Pavers drain water through a pollution control media and eventually into the ground. Hanson Pavers are also used around the grounds in the rear of the house to illustrate water management as well as to guide visitors among the various native plants(refer to Figure 11). Flexipave<sup>™</sup> is also utilized in the driveway to provide

an infiltration zone for stormwater runoff and minimizing the water from going to the city stormwater system. A Flexipave<sup>TM</sup> strip will also be installed on the pool deck by the back door to prevent flooding during large storm events and convey water away from the house to the irrigation cistern for later reuse.

#### **Green Integrated Residential Wastewater Reduction:**

A conventional wastewater system transports wastewater from all water fixtures within a home (see Figure 16). Waters from household sinks, showers, and washers are not expected to have fecal contamination. Thus, the flow from these fixtures can be separated from the toilet and kitchen sink waste. The kitchen sink waste may be high in organics and thus is usually separated from gray water line. If minor amounts of fecal contamination are effluent from household sinks, showers, and washers, an on-site disinfection process is planned, before these waters are used for toilet flushing or irrigation. This gray water reduction in wastewater flow from a home can be as much as 60-75%.

The expected reduction in volume and water quality of the wastewater must be documented. A septic tank system is planned and flows to the septic system will be monitored and documented. It should be noted that this system of separation of gray water from wastewater has already been approved by the local building department. Also the drain field and septic tank has been approved, designed, and constructed.

#### Whole House Leak Detection System

- Whether moisture sensors are installed inside the home or not, FSGE's system can detect any leak in the home, including water leaks from broken pipes underground or inside the walls.
- Other leak detection systems rely on moisture sensors only at the location of each toilet, washer, sink, etc.
- A proprietary flow sensor-timing function shuts off the main valve if leaks are detected which can be adjusted for when the home is vacant during vacation.
- A leaky toilet can waste up to 200 gallons/day
- Toilets, Clothes Washers, Water Heaters, Dishwashers, Ice Makers, Refrigerator Water Dispensers, Bathtubs, Showers, Sinks, Underground Pipes, Pipes inside the walls, etc. can burst and cause tens, even hundreds, of thousands of dollars in damage.
- Homes making 2 or more water damage claims can become uninsurable rendering a house difficult to sell!
- Armored/metal hoses from service to all appliances will mitigate leaks

#### CHAPTER 3: Three C's of Watershed Management: Community Involvement, Communication, Commitment with STEM

#### **Introduction**

The 3 C's of Watershed Management: Community Involvement, Communication & Commitment are required for individuals from government, businesses and communities to create water management with a green culture. FSGE provides a venue to host, promote, educate, and train others. UCF & FSGE has made a positive impact on Florida's economy, environment, and quality of life. Individuals touring FSGE are provided with the knowledge to change our future. Data collected at FSGE is used for education and research useful for watershed management at the residential level. Implementing workshops and engaging the community bring an educational awareness that is required to embrace and move green technologies forward. FSGE is an excellent site to gain this exposure. Many challenges have been overcome in order to allow these new innovative materials and techniques. Guidelines have been established, building codes have been modified, data is being collected, and hours of litigation and research have been spent to incorporate green technologies in a residential neighborhood. Applying STEM (Science, Technology, Engineering, & Math) principles is crucial to developing the infrastructure necessary to incorporate green building practices. STEM education is necessary to change the face of our future.

#### Science Technology Engineering Math (STEM) Outreach

Infrastructure for development established through presentations to Space Coast Society of Women Engineers (SWE) and American Association of University Women (AAUW). AAUW has agreed to support the program from a State level and plans to promote it state wide. Both SWE and AAUW provide female STEM role models that will help get more girls excited, engaged and ready for a STEM career. A mini grant was received from a National Science Foundation (NSF) program through the National Girls Collaborative Project (NGCP) to demonstrate collaboration and provide a hands-on STEM experience for young ladies and gentlemen at FSGE. To understand watershed management and attract a dedicated technical talent pool requires exposure to STEM principles at an early age. One can reach all generations when a "hands-on" approach is used. FSGE provides the proper STEM environment and watershed management.

Choosing the proper demographic area is critical for success. With Brevard County exposed and open to new technology as seen in our space program and high tech industries in the surrounding communities makes FSGE location ideal. Research shows an active SWE organization that just completed two outreach programs for girls in the third to sixth grades where 507 attended and another one for seventh to ninth graders where 200 attended. They have the database and interest in the Space Coast area and are willing to share that connection with this project. In addition the Viera County office Science Director Ginger Davis has been contacted about scheduling schools to participate. A program called "Going Green" for the Space coast League of Cities was well attended and put on by Marsha Segal-George, General Administration Department Director and David Dunn, Orlando facilities Project Manager. Modules, patches (as shown in Figure 1), hands – on activities, and hand out materials have been created (presented in Reference Appendix B). Figure 1 illustrates a sample of a patch created for FSGE, DEP & UCF. Additional patches may be purchased as necessary.

![](_page_25_Picture_3.jpeg)

### Figure 2: Patch created for promotional distribution and educational awareness

Demographic census data April 1, 2000 for Brevard County (provided 321-633-2002)

Table 2: Demographics for Girls Go Green a	and Stormwater	Management &
Harvesting		

Total Number people in Area	476,230
(April 1, 2000)	
White, not of Hispanic origin	413,411
Black, not of Hispanic origin 40,000	
Hispanic, Latino, Spanish 21,970	
Multiracial	8,429
American Indian or Alaska Native	1,765

Asian or Pacific Islander	7,457
Other	5,168

#### STEM (Science Technology Engineering & Math) - FSGE has it all!

Touring FSGE will create an opportunity to teach people of all ages about stormwater management, science, technology, engineering, and math (STEM). This interactive hands-on experience will provide valuable information about our global environmental challenges. A study, "Green at 15?" performed by sociologist David Baker and colleagues at Pennsylvania State University found that students who are best informed about environmental science and geosciences are also the most realistic about the environmental challenges facing the world in the next 20 years. Students who are least informed in these areas are the most wildly optimistic that things will improve. Education is key to improve our economic, social, and governance challenges of a globalize economy. The study "Green at 15?", showed that the vast majority of students were familiar with issues including air pollution, energy shortages and extinction of plants and animals. For most countries, there was no strong association between the students' sense of responsibility for environmental issues and their proficiency in environmental science. Getting a firsthand experience at FSGE will demonstrate the value of stormwater management, water conservation, building green, greenroofs, and one's personal impact on our global environment. (Reference: STEM Trends, CPST (Commission on Professionals in Science & Technology) May/June 2009 Volume 46,

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#### Number 3 or

http://www.oecd.org/document/22/0,3343,en\_32252351\_32236191\_42466966\_1\_1\_1\_1, 00.html ) FSGE is the perfect site for additional Global Environmental studies.

There is less interest in STEM among girls than boys so the emphasis will be on encouraging and exciting girls in STEM. From a young age, girls express a preference for work that helps people and is intrinsically rewarding (Konrad et al, in Kimberlee Shauman, 2005). Creating a connection among stormwater management, STEM, helping people, and reducing impacts to our environment should excite and encourage a young child to pursue stormwater management or other closely related technical field of study. Connection between science, math, engineering, and helping people is not as clear and at times not as direct as it is for other fields, so young folks may not see the enormous contribution they can make in science and engineering. Studies have shown a continual decline in enrollment in STEM areas. It is critical that we engage both girls and boys in science and math at an early age so they take the proper course work necessary to prepare them for a technical interest and degree in college. After all, our future is based on water supply, the environment, and our children. It is up to us to educate the children. Using workshops and tours of the home, children are exposed to residential green building concepts, stormwater management, decision making, design, engineering, and technology. Engaging students in return will excite and influence their parents in stormwater and gray water harvesting.

The first educational outreach event was held at FSGE on July 31, 2010. There were over 55 people reached during this event. An excellent range of demographics and ages from  $2^{nd}$  grade to  $10^{th}$  grade participated with close to 17 parents and volunteers.

	<u>Ages</u>	
	(years)	<u>% Present</u>
2nd Grade	7	7%
4th Grade	8 to 9	20%
5th Grade	10	13%
6th Grade	11	13%
7th Grade	12	20%
8th Grade	13	7%
10th Grade	15	20%

#### Table 3: Statistics for FSGE first educational outreach event

![](_page_29_Figure_2.jpeg)

Table 4: Demographics data for first STEM event

A post survey was performed and results from both girls and adults responded. It was clear that none of the participants have a cistern at their home. After attending the event several adults are heading to local hardware stores like Home Depot and Lowe's to purchase a cistern. Making their own cistern and touring FSGE opened their eyes to why and how to integrate a cistern in their home.

Close to 100% responded that this event did change their mind about engineering in a positive way. One girl wrote "I love engineers and want to be one." Several girls added personal comments to the survey. One girl said, "I would like to learn more about green houses because someday I would like to make a house with green products. It was so interesting and makes me want to use my girl power to make a difference." One girl scout leader stated, "Please offer this program again! It's wonderful! Our girls learned so much! Program for house tour & Q&A session needs more time! Please do an energy (wind & sun) program with the house. It would be perfect for another STEM program for Girl Scouts!" from Jennifer Chan Co leader GS. Others said, "Terrific!!! THANK YOU!", and "Would love to come again - next time longer please," and "I would love to build green houses". There was a high percentage (87%) of girls that do not have parents that are engineers. It is critical for us to offer programs like this with female role models to reach and engage young girls in engineering in order to prepare them for an engineering career. The girls have an interest in math (80%) we just need to keep them engaged so they are ready for an engineering career.

# Table 5: Girls Go Green & SW Harvesting Survey

		Cirla Desmanas	Adult
		Girls Kesponse	Response
Did today change your mind about engineering?		87%	100%
Was this the first time you met a female engineer?	Yes	47%	
	No	53%	100%
Is one or more of your parents engineers?	Yes	13%	
	No	87%	100%
Are you planning on going to college?	Yes	87%	40%
	No	13%	
Which subjects do you like?	Math	80%	40%
	Science	47%	60%
	Tech	47%	20%
	Computers	47%	20%
Do you have a cistern at home?	Yes		
	No	100%	100%
What is your house irrigated with?	Lake	20%	
	Potable H2O	27%	40%
	Cistern	0%	
	Reclaim	20%	40%
	Well	7%	
	Do not know	27%	

The announcement reached women all across Florida. Many traveled for hours to attend. Ladies participated from the following communities. All attendees signed a photo consent form. Insurance documents were obtained.

Orlando	Merritt Island
New Port Richey	Mims
Palm Bay	Port St. John
Kissimmee	Satellite Beach
Haines City	Melbourne
Rockledge	Indialantic
Davenport	Eau Gallie
Winter Garden	Celebrations
Tampa	Belle Isle

![](_page_32_Picture_4.jpeg)

Figure 3: Attendees

#### Why Watershed Management?

Through immersion in the natural world, children can discover and experience nature's basic patterns. They experience events they would never see in the classroom. Instead of reading about science, the environment, and the flow of water and energy, they encounter it in the rich ways the environment changes and builders construct new buildings. Much like an engineer approaches and solves problems. Embracing green concepts allow children to understand nature's rhythms and time scales at which natural events occur. Much like planting, harvesting a garden enables them to see seasonal changes why not build a cistern and recycle the 'free' rainwater. Or build a greenroof where you extend the life of your roof, increase land area, reduce global warming, clean the air, control local climate, bring nature to your home, and insulate your building leading to lower energy costs. You will need to consult with a specialist to design the support structure, proper permeable fabric, drainage technique, and plant palette. Students who learn nature's principles in gardens and other natural settings have been shown to score better in creative thinking and problem solving, science and a variety of other academic subjects. They appreciate the importance of things like safe water and healthy soil, and work to conserve them.

Watershed management is rooted in a deep knowledge of place. Places known and loved deeply have the best chance to be protected and preserved, so that they will be cherished and cared for by future generations. Protecting our precious water supply by reducing stormwater runoff and harvesting stormwater in cisterns is a great start. Reducing energy costs with solar and wind power is another excellent alternative. Building green, using Florida natives, and building greenroofs will provide a more healthy and sustainable living environment. The first student education event was held July 31, 2010 at FSGE for the Girl Scouts. Curriculum is available for providing additional hands-on experiences. At FSGE students experience events they would never see in the traditional classroom. Instead of reading about science, the environment, and the flow of water and energy, they encounter it in the rich ways the environment changes

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and "true green" builders construct holistic buildings. By touring FSGE and engaging in hands-on activities, students are inspired by a much needed change for our environment and precious natural resources.

#### **CHAPTER 4: CONCLUSIONS AND RECOMENDATIONS**

#### Summary

Educational materials were produced for this study that shows greenroofs, cisterns, water harvesting, bio retention, and porous pavement can be designed and constructed to preserve, demonstrate, and showcase ways to conserve water for a residential development. It is anticipated that FSGE design can make an impact and difference in an individual's own home and community.

#### **Conclusions**

FSGE home is a "Near Zero-Loss Home<sup>TM</sup>", "Near Zero-Energy Home<sup>TM</sup>", "Near Zero-Runoff Home<sup>TM</sup>", and "Near Zero-Maintenance Home<sup>TM</sup>". It is spawned from the consumer-driven necessity to build a home more resistant to hurricanes, tornadoes, floods, fire, mold, termites, impacts, and even earthquakes given up to 500% increase in insurance premiums in natural disaster zones, the dwindling flexibility and coverage of insurance policies, and rising energy, water and maintenance costs (FSGE 2008). FSGE provides an opportunity to demonstrate some significant Big C's of Watershed Management: Community Involvement, Communication & Commitment. These provide an opportunity for individuals from government, businesses and communities to come together to share their experiences and challenges related to creating watershed management with a green building culture. FSGE provides a venue to host, promote, educate, and train others. The educational materials show FSGE has made a positive impact on Florida's economy, environment, and quality of life. Individuals touring FSGE are provided with watershed management knowledge at the residential building

level to encourage the use of stormwater management and water saving methods and devices. Data collected at FSGE is used for education and research. An economic improvement for watershed management efficiency and effectiveness is demonstrated at FSGE. Protection and restoration for watershed management systems are presented at FSGE.

At FSGE, the community and students of stormwater management experience events they would never see in the traditional classroom. Instead of reading about stormwater management, the environment, and the flow of water and energy, they encounter it in rewarding ways using "hands on" experiences resulting from the "true green" builders of the FSGE. By touring FSGE and engaging in activities, students are inspired by a much needed movement to harvest stormwater and conserve waters in an effort to help preserve our environment and precious natural resources.

#### **Recommendations**

The information in this report can be used as a learning tool for methods and devices to educate consumers and contractors on the value of stormwater management in a residential setting. The integration of stormwater harvesting and gray water reuse at the FSGE should be promoted. Interested persons should sign up for tours of the FSGE home. FSGE will be "open to the public" and serve as a demonstration and learning experience for water saving methods and devices. Attendees will participate and see monitored "proof of performance" data from a live test site with tenants. Participants will learn how to save valuable resources and lower the operating cost by building green.

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## APPENDIX

## Table 6: Building Green Terminology

	Stormwater is generated from the "built environments" and in specific
Stormwater	from impervious surfaces where it picks up particles and dissolved
	materials in addition to gross solids before ending up in local surface
	waters.
Water	Reducing the use of water and is the most cost-effective and
Generation	environmentally sound way to reduce our demand for water within a
Conservation	building.
Watershed	To ensure availability for future generations, the withdrawal of fresh water
Managamant	from an ecosystem should not exceed its natural replacement rate. ESGE is a
Wanagement	Near Zero-Runoff Home <sup>TM</sup> ESGE's "water footprint" is neutral not only in
	quantity but also in quality. Watershed management with FSGE methods
	and devices does inherently improve the water quality of our water bodies.
	For an average 6-month rain event in Florida that yields about 1.6 inches of
	rain, a given homeowner with 2000 sq.ft. of "non-pervious" areas (roof,
	concrete driveways and walkways, etc.) is generating 2000 gallons of
	runoff. In that same rain event, FSGE is retaining all of the water from the
	1.6 inch rainfall on site using greenroofs, pervious pavements, and bio
	retention for the runoff. As a Near Zero-Runoff Home <sup>TM</sup> , FSGE contains
	about 99% of its stormwater onsite in the average year. Thanks to its
	"Greenroofs That Keep On Giving" and the pervious pavements That Keep
	On Taking, FSGE sets the bar for the rest of the world to be "water neutral".
LID	The process of watershed management that includes a hydrologic

Low Impact	balance and an objective of using existing land and structures to
Development	accomplish a balanced water quality and quantity.
Water	An action, behavioral change, device, technology, or improved design
Conservation	or process implemented to reduce water loss.
Gray water	Refers to any household wastewater excluding toilet wastes and
Harvesting	garbage disposal waste, which can be used for irrigation and other
System	water conservation applications. In FSGE's case potable water used in
	showers, bathroom sinks and clothes washers is routed to the gray
	water cistern where it is treated according to Florida Building Code.
Greenroof	A roof structure with plants, a selected growth media and pollution-
	control media like Bold & Gold Greenroof Media <sup>™</sup> . Water which
	falls on a greenroof filters through the media to the roof drainage
	system.
	Plants that occurred within the current state boundaries prior to
	European contact in the 1500's. When using Native plants you can
Florida Native	enjoy plants that require minimum water, fertilizer, and pesticides.
Plants	They generate a natural habitat promoting butterflies, birds and other
	wildlife. Native plants have adapted over thousands of years to
	Florida's soils, rainfall patterns, and an assortment of insects.
Bioswale	Landscaping plant selection & design that transports and infiltrates
	water using plants not just grass, reducing runoff & nutrients into our
	waterways.

# Listing of FSGE's Green Building Guidelines:

#### Table 7: Green Building Guidelines

DOE Building America

- IBHS Fortified...for safer living
- USGBC LEED
- EPA Energy Star
- FPL BuildSmart Program
- SJRWMD Florida Water Star
- Florida Green Building Coalition
- NAHB
- American Lung Association Health House
- Federal Alliance for Safe Homes (FLASH) Blueprint for Safety
- EPA WaterSense New Homes Program
- Health Gems Home Environment Quality

![](_page_39_Picture_16.jpeg)

![](_page_39_Picture_17.jpeg)

October 2010

![](_page_40_Picture_2.jpeg)

Install 3 daisy-chained 1500 gal (total 4500gal)

![](_page_40_Picture_4.jpeg)

**Graywater Cistern Operation** 

![](_page_40_Picture_6.jpeg)

![](_page_40_Picture_7.jpeg)

![](_page_40_Picture_8.jpeg)

![](_page_40_Picture_9.jpeg)

Figure 4: Graywater Harvesting

![](_page_41_Picture_2.jpeg)

![](_page_41_Picture_3.jpeg)

# CISTERN SOLUTION GRAVITY OVERFLOW

![](_page_41_Picture_5.jpeg)

Figure 5: Cistern and Bio-swale Overflow

![](_page_42_Picture_2.jpeg)

Figure 6: Purge Overflow and Construction for Bioswale

![](_page_43_Picture_2.jpeg)

![](_page_43_Picture_3.jpeg)

![](_page_43_Picture_4.jpeg)

Figure 7: Bioswale Operation & Overview

![](_page_44_Picture_2.jpeg)

# FSGE'S GREEN ROOF-CONCRETE UNDERLAYMENT

![](_page_44_Picture_4.jpeg)

![](_page_44_Picture_5.jpeg)

**Figure 8: Greenroof Installation** 

![](_page_45_Picture_2.jpeg)

Figure 9: Five Greenroofs with Various Underlayment

# Plants on FSGE Greenroofs Small Roof East Side

<u>Crows Nest 200 sq ft</u>	
Blue Porterweed	15
Verbena	15
Horsemint	15
Muhly Grass	15
Dotted Horsemint	15
Goldenrod	15
Seaside Helietrope	15
East Side roof area	
Red Sage	24
Coral Honeysuckle	33
Coastal Verbena	23
Black eyed Susan	11
FL Elephants Foot	10
Railroad Vine	11
FL Gamma Grass	19
Muhly Grass	21
Porterweed (addition)	11
<ul> <li>Lemon Bacopa</li> </ul>	12
<ul> <li>Pineland Helietrope</li> </ul>	13
• Peperomia	15

![](_page_46_Picture_4.jpeg)

# Plants on FSGE Greenroofs Small Roof East Side

#### Pump House

Purple Lovegrass	12
Muhly Grass	11
Moon Vine	10
Railroad Vine	10

#### Small Roof East Side

Sunshine Mimosa 19	
Coral Honeysuckle	15
Elliotts Lovegrass 6	
Blanket Flower	19
<ul> <li>Lemon Bacopa</li> </ul>	19
<ul> <li>Pineland Helietrope</li> </ul>	15

![](_page_46_Picture_10.jpeg)

#### Figure 10: Greenroofs using Florida Native Plant Selection

![](_page_47_Picture_2.jpeg)

![](_page_47_Picture_3.jpeg)

![](_page_47_Picture_4.jpeg)

Green roofs reduce energy costs by keeping the roof warmer during winter & cooler during the summer

![](_page_47_Figure_6.jpeg)

Figure 11: Greenroof Heat Island Effect

# **Bold 'n Gold Cross Section**

![](_page_47_Picture_9.jpeg)

Recycled ground tire aggregate used in sep<sup>2</sup>
 green roof, under pool deck, bioswale

![](_page_47_Figure_11.jpeg)

Figure 12: Bold & Gold Cross Section

# FSGE Control Field Image: Signature of the state of the s

![](_page_48_Picture_3.jpeg)

Figure 13: Septic Drain Field Design, Construction, Test Site using Bold & Gold<sup>TM</sup>

![](_page_49_Figure_2.jpeg)

Figure 14: Porous Pavements: Flex-Pave & Hanson Pavers

# **FSGE Green Building Process**

![](_page_50_Picture_3.jpeg)

Figure 15: Florida's Showcase Green Envirohome Green Technology Demonstrated

![](_page_51_Figure_1.jpeg)

![](_page_51_Figure_2.jpeg)

Figure 16: Water Flow Diagram for Florida's Showcase Green Envirohome

October 2010

![](_page_52_Picture_2.jpeg)

Figure 17: Envirohome Tour

![](_page_53_Picture_2.jpeg)

**Figure 18: Tropical Storm Fay** 

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![](_page_56_Picture_0.jpeg)

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