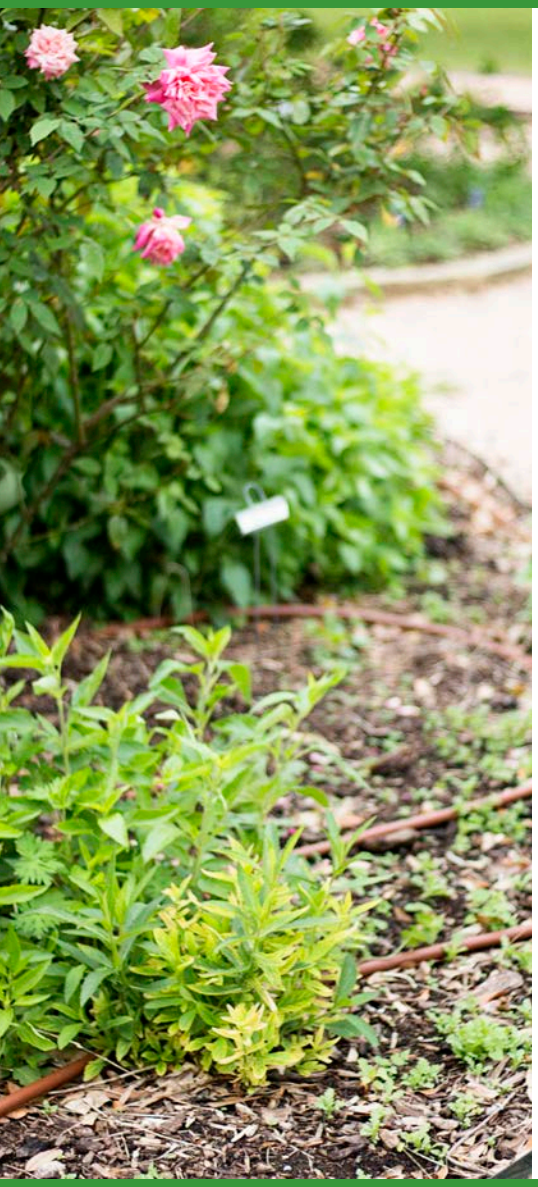
Healthy Lawns and Healthy Waters Education Program

Texas Water Resources Institute TR-525
August 2020



Texas Water Resources Institute
make every drop count

Diane Boellstorff, John W. Smith, Emily Monroe,
Rebecca Bowling, Reagan Hejl and Joel Pigg
Texas Water Resources Institute

Cypress Creek, Upper Cibolo Creek, Plum Creek, Geronimo Creek,
and Upper San Antonio River Watershed Protection Plan Implementation –

Healthy Lawns and Healthy Waters (HLHW) Education Program

Final Report

TCEQ Contract No. 582-17-70356

Prepared by:

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Texas Water Resources Institute Technical Report #525

August 2020

PREPARED IN COOPERATION WITH THE

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND

U.S. ENVIRONMENTAL PROTECTION AGENCY

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Abbreviations List

BMPs	Best Management Practices
CFUs	Colony Forming Units
HLHW	Healthy Lawns and Healthy Waters
TCEQ	Texas Commission on Environmental Quality
TWRI	Texas Water Resources Institute
SCSC	Department of Soil and Crop Sciences at Texas A&M University
RWH	Rainwater Harvesting

Executive Summary

Beginning in 2017, the Healthy Lawns and Healthy Waters (HLHW) program has delivered science-based, community-responsive education programing to 398 Texans at 14 events across the state. Through the Texas Water Resources Institute and the Department of Soil and Crop Sciences within Texas A&M AgriLife Extension Service, Texans have received free education focusing on turf management, soil testing, proper fertilization and pesticide application, efficient irrigation, and water resource management. The goal for this program has been to provide residents with a connection between home lawn care practices and the quality of water in their watershed. Through this awareness and knowledge of best management practices (BMPs), Texas residents are able to improve and protect surface water quality.

According to pre- and post-tests given before and immediately following each HLHW program, participants' test scores increased an average of 70.5% in healthy lawn care knowledge throughout the life of the project. In the six-month period following participation in a HLHW event, participants had implemented or planned to implement rainwater harvesting, Smart Watering techniques and shared HLHW resources and materials with others. Many indicated they had reduced the amount of fertilizer applied to their lawns, and those not currently testing their soils planned to do so to make better, more informed fertilizer application decisions. The HLHW project team also provided online resources and publications (Appendix A) covering turfgrass identification, selection, weeds and insects, as well as general weed, insect and disease control information. The website also provides extensive information and instructions for implementing rainwater harvesting at a residence. Since the beginning of the project, the website has received over 7,600 views with more than 2,300 unique visitors.

Figure 1 - Attendees at the HLHW program learned about different fertilizer types and proper application

Introduction

The Healthy Lawns and Healthy Waters (HLHW) program is an educational training program that aims to improve and protect surface water quality by enhancing Texas residents' awareness and knowledge of best management practices (BMPs) for residential landscapes. The program is offered by the Texas A&M AgriLife Extension Service in cooperation with the Texas Commission on Environmental Quality (TCEQ) and other partner agencies and organizations.

HLHW workshop participants learn how to design and install residential rainwater capture devices that support rainwater storage and landscape irrigation; the importance of choosing climate- and soil-appropriate turf and landscaping species for local growing conditions; the key importance of soil testing and how to determine nutrient application amounts; how to improve irrigation water use efficiency through better understanding of evapotranspiration, smart meters, deficit irrigation and cycle-soak methods for reducing runoff; and about water delivery equipment and measuring water distribution.

The Texas Water Resources Institute (TWRI) along with the Texas A&M AgriLife Extension Service's Department of Soil and Crop Sciences (SCSC) developed HLHW to deliver a science-based, community-responsive education curriculum to Texas residents. The goal of the HLHW program is to train Texans regarding reduced runoff, water quality and BMPs for protecting their home landscape, watershed and surface waters. The program focuses on protecting water quality by reducing runoff through rainwater capture and providing information on ecologically appropriate quantities and timing of inputs to residential lawns in the watersheds. The program offers free soil sample analysis with program attendance. As a result of participation, Texans have a better understanding of the relationships between practices in or near their residence and the quantity and quality of the water in the watershed.

HLHW Education Curriculum Development and Materials

Each program included three information sessions using curriculum developed by the project team and approved by TCEQ. Participants receive printed copies of the agenda and PowerPoint presentations described below. A wide variety of AgriLife Extension fact sheets on rainwater harvesting (RWH) and BMPs for turf management are also made available to those participants interested in additional information. A few of those publications are included in the Appendix.

The sessions and topics presented are:

I. Session 1 – Watershed Protection Plan-Watershed Coordinator
   - What is the Watershed Protection Plan (WPP) all about?
   - What is being done in the watershed?
   - How you can participate?

II. Session 2 – Rainwater Harvesting
- Conservation and reduced stormwater
- Collection capacity
- Components of a RWH system
- Gutters and filters
- Aesthetics
- Pumps and pressure tanks
- Preparing the RWH system for a freeze

III. Session 3 – Healthy Lawns
- Appropriate turf and landscaping selections for local conditions
- Soil testing and determining nutrient application amounts
- Improving irrigation water use efficiency
- Texas evapotranspiration, Smart meters, deficit irrigation and cycle-soak methods for reducing runoff
- Water delivery equipment and measuring water distribution

The HLHW team developed and adapted education resources to create a science-based, community-responsive HLHW education curriculum that was presented at the events aiming to train homeowners in RWH and lawn management concepts. In addition to receiving printed handouts of the presented materials for all sessions, participants also received the Texas Lawn Companion appropriate for the season of the year in which the program was delivered.

Additionally, printed handouts of available AgriLife publications relating to RWH and turfgrass management were brought to each program. To increase delivery of these educational materials to a greater audience, the educational materials were also transformed into an online format that is more readily available to the public. These materials are on the HLHW website (Appendix A). Since the beginning of the project, the HLHW website has received over 7,600 views with more than 2,300 unique visitors.

Figure 2 - Attendees at the HLHW program received information on how to properly design and install rainwater capture systems

Coordinating, Scheduling and Marketing HLHW Programs

On a quarterly basis, the HLHW facilitators contacted watershed coordinators, county extension agents, and other key stakeholders in the priority watersheds and watersheds with U.S. Environmental Protection Agency-approved WPPs to discuss scheduling a HLHW event in their counties. After scheduling, the program was advertised through TCEQ approved TWRI publications, press releases in *AgriLife Today* and local media outlets, as listed in Table 1. A HLHW website (hlhw.tamu.edu) was created to host an event calendar, registration and additional educational materials.

Table 1. HLHW Media Mentions and Press Releases

Media Source	Title	Date
AgriLife Today	Rainwater harvesting, turf management training set Aug. 29 in Seguin	8/10/2017
AgriLife Today	Rainwater harvesting turf management training rescheduled to Oct. 5 in Seguin	9/17/2017
AgriLife Today	Rainwater harvesting, turf management training set for Oct. 12-13 in Hill County	10/6/2017
Cypress Creek Project	Texas A&M's The Healthy Lawns and Healthy Waters Program	10/13/2017
TWRI News	Healthy lawns make for healthy waters	12/4/2017
AgriLife Today	Rainwater harvesting, turf management training set for Feb. 22-23 in Kyle and San Antonio	1/12/2018
AgriLife Today	Rainwater harvesting, turf management training Feb. 7 in Wimberly	1/12/2018

TAMU AgriLife Extension Ag News and Views	Rainwater Harvesting and Turf Management Training	1/29/2018
Pines and Prairies Land Trust	Healthy Lawns and Healthy Waters Workshop for Homeowners	2/22/2018
AgriLife Today	Rainwater harvesting, turf management training July 12 in Seguin	6/21/2018
AgriLife Today	Rainwater harvesting, turf management training Sept. 20-21 in Boerne, San Antonio	8/18/2018
TownTalk Media Productions	Turf Management and Rainwater Harvesting Training	1/19/2019
Cypress Creek Project	Texas A&M's The Healthy Lawns and Healthy Waters Program	2/7/2019
AgriLife Today	Rainwater harvesting, turf management training set for April 18 in Lockhart	3/28/2019
AgriLife Today	Rainwater harvesting, turf management training set for May 7 in Boerne	4/11/2019
Texas Master Gardener	Healthy Lawns and Healthy Waters Program	5/7/2019
AgriLife Today	Rainwater harvesting, turf management training June 20 in Kyle	5/31/2019
AgriLife Today	Rainwater harvesting, turf management training Aug. 11	7/20/2020
AgriLife Today	Health Lawns and Healthy Waters program helps Texans save water, money	8/11/2020

Delivering and Evaluating HLHW Programs

As shown in Table 2, there were 14 HLHW programs held during the project, with 398 attendees total. The programs were delivered by the HLHW program coordinators, extension specialists and watershed coordinators, as appropriate and educational material was provided to all attendees. Each program began with a pre-test, collecting soil samples from participants and introductions. After session 1 and 2, participants had a break before resuming with session 3 and an open discussion time for additional questions. Participants then took a post-test and evaluation to measure knowledge gained during the program and to review the event. A sample agenda is provided in Appendix B.

Participants were encouraged to bring soil samples from their residence to the program they were attending; 146 soil samples were analyzed, and results were provided to participants free of charge. An example report that was provided to participants is provided in Appendix C.

Due to the COVID-19 pandemic of 2020, the final program in Cypress Creek was delayed until August and was held online via a Zoom meeting. Participants were able to drop off their soil samples to their county extension office and the agent mailed the samples to the HLHW program coordinators for analysis. Participants received their soil sample analysis via e-mail.

Table 2. Healthy Lawns and Healthy Waters Programs

Date	Watershed	City	County	Attendees
5-Oct-17	Geronimo & Alligator Creeks	Seguin	Guadalupe/Comal	55
12-Oct-17	Upper Cibolo Creek	Boerne	Kendall	23
13-Oct-17	Cypress Creek	Wimberley	Hays/Blanco	42
22-Feb-18	Plum Creek	Kyle	Calhoun/Hays	22
23-Feb-18	Upper San Antonio River	San Antonio	Bexar	46
12-Jul-18	Geronimo & Alligator Creeks	Seguin	Guadalupe/Comal	33
20-Sep-19	Upper Cibolo Creek	Boerne	Kendall	6
21-Sep-18	Upper San Antonio River	San Antonio	Bexar	5
7-Feb-19	Cypress Creek	Wimberley	Hays/Blanco	44
18-Apr-19	Plum Creek	Lockhart	Hays	14
7-May-19	Upper Cibolo Creek	Boerne	Kendall	22
20-Jun-19	Plum Creek	Kyle	Hays	13
25-Jun-19	Geronimo & Alligator Creeks	Seguin	Guadalupe/Comal	30
6-Aug-20	Cypress Creek	Boerne	Hays/Blanco	43

Program Evaluation and BMP Adoption

To measure both knowledge gained and behavioral changes of program participants, pre- and post-tests and evaluations were administered during each training session to evaluate

increased knowledge of training principles, appropriate BMPs and other water or turf management skills learned at the HLHW trainings. Furthermore, evaluations included participant satisfaction with the program and participant intention to change behavior because of attending the HLHW training.

The pre-test can be found in Appendix I and the post-test can be found in Appendix J. Pre-test scores averaged 45% correct answers, while post-test scores averaged 78% correct. Evaluations as measured by the post-training evaluation found in Appendix K are as follows:

- Post-training evaluation:
  - 96% of participants were satisfied with the HLHW training.
  - The value of participating in the program as estimated by attendees was an average of $796.68 or a total of $317,079 for all 398 participants.
- Intentions to adopt behavior change:
  - 96% of participants will fertilize based on recommendations from a soil test.
  - 95% of participants will install a RWH system.
  - 95% of participants will improve management of their home irrigation system.
  - 98% of participants will select plants/grass species based on water conservation.

In addition, a six-month follow-up survey was developed and delivered online to assess behavior changes adopted and other activities, such as the percentage sharing educational resources, by HLHW training participants. The survey can be found in Appendix L. An online survey link is emailed to past participants six months after attending the training. SCSC analyzes the results using descriptive statistical procedures. Of total participants, 20% responded to the six-month follow up and outcomes from the follow-up are as follows:

- 83% of participants indicated they have implemented or plan to implement Smart Watering techniques presented at the HLHW training.
- 83% of participants indicated they have implemented or planned to implement some time of RWH system, with the average size tank being 651 gallons.
- 73% of participants not already soil testing made changes or plan to make changes to their lawn fertilizer program based on soil test recommendations or information provided at HLHW.
- 100% of participants have applied resources/materials provided at the training
- 75% of participants have shared HLHW resources/materials with others.

An accepted approach in Texas has been for WPPs to estimate bacteria concentrations using a runoff curve number that shows areas with less impervious surface (such as residential lawns) are estimated to discharge about 10,000 colony forming units (CFUs) per 100 milliliters of water

(PBS&J 2000, Ling et al. 2012). Using publicly available monthly rainfall amounts and assuming 40% utilization of captured water for winter months and 70% utilization during warmer months, an estimated 3,485,981 gallons of water was captured via RWH and retained on site and thus an *E. coli* reduction of 4.27713E+12 CFUs occurred.

Load Reduction Estimates

Six-month follow ups indicated that 42% of participants reduced the amount of total fertilization product applied to their lawns as a function of the knowledge gained from the program they attended. Assuming a 42% reduction from standard recommendation rates, we estimate that the total annual nitrogen applied by all 398 participants was effectively reduced by between 18,977 and 113,865 total pounds (lbs.) and total annual applied phosphorus was reduced by between 6,326 and 37,955 lbs. This reduction saves participants between $7,220.26 and $45,545.88 in nitrogen costs.

Conclusion

The implementation of the HLHW program has been very successful. Participants continue to share information with others and the materials continue to be used for trainings and education on how to protect and manage Texas' water resources. Also, the programs continue to be widely requested by watershed coordinators.

Over 350 Texans have been given the opportunity to learn how their lawns impact their local water quality and quantity and have made decisions to stop over-fertilizing and adopt efficient irrigation strategies based on what they learned at HLHW events. As a result of the complimentary soil test provided to participants, 146 soil samples were analyzed, and results provided to participants to use in making lawn fertilization decisions.

In addition, six-month follow-up surveys showed that reductions in fertilizer application are a direct result of knowledge gained from the program. Surveys also indicate adoption of Smart Watering techniques and increased implementation of some type of rainwater harvesting system.

The HLHW efforts will continue under the TCEQ contract, Health Lawns/Healthy Waters (contract #582-20-10154).

Works Cited

Ling, W., McFarland, M., Magin, D., Warrick, L., and Wendt, A. 2012. Geronimo and Alligator Creeks Watershed Protection Plan. Geronimo and Alligator Creeks Partnership. http://www.geronimocreek.org/documents/wpp/FinalDraftGACWPP.pdf

PBS&J. 2000. Predicting Effects of Urban Development on Water Quality in the Cities of New Braunfels, San Marcos, Seguin and Victoria. Austin, TX: Guadalupe-Blanco River Authority and the Texas Natural Resources Conservation Commission. Document No. 000126. https://www.gbra.org/documents/crp/studies/urbandevelopmentstudy.pdf

Appendix

Appendix A: Additional Materials

Fact sheets are made available online through the links shown below. Paper copies of some of the fact sheets are also made available at the trainings.

Healthy Lawns Factsheets	https://hlhw.tamu.edu/healthy-lawns/
Rainwater Harvesting Factsheets	https://hlhw.tamu.edu/rainwater-harvesting/

Appendix B: Example Agenda

TEXAS A&M AGRILIFE EXTENSION

Healthy Lawns Healthy Waters

Agenda

June 25, 2019, Seguin, TX
1:00 p.m. – 5:00 p.m.

Sign-In/Pre-test/Soil Samples

Introduction

Geronimo and Alligator Creek Watershed Protection Plan (WPP) Update: Ward Ling, Watershed Coordinator
What is the Watershed Protection Plan all about?
What is being done
How you can participate

Rainwater Harvesting Design and Installation
Conservation and reduced storm water
Collection capacity
Components
Aesthetics
Pumps and pressure tanks
Preparing the RWH system for a freeze

BREAK

Locally Successful Turf and Landscaping Species and Management Practices
Appropriate turf and landscaping species for local conditions
Soil testing and determining nutrient application amounts
Improving irrigation water use efficiency
Texas Evapotranspiration, smart meters, deficit irrigation and cycle-soak methods for reducing runoff
Water delivery equipment and measuring water distribution

Questions, Discussions, Post-Test and Evaluations

Appendix C: Soil Sample Analysis

TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

Report generated for:
[redacted]

Sample received on: 7/11/2019
Printed on: 7/19/2019
Area Represented: 2077 sqft

Guadalupe County
Laboratory Number: [redacted]
Customer Sample ID: Front Yard
Crop Grown: LAWN

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Exoegs.	
pH	7.7	(6.2)	-	Mod. Alkaline	
Conductivity	314	(-)	umho/cm	None CL*	Fertilizer Recommended
Nitrate-N	28	(-)	ppm**		0 lbs N/1000sqft
Phosphorus	193	(50)	ppm		0 lbs P2O5/1000sqft
Potassium	598	(175)	ppm		0 lbs K20/1000sqft
Calcium	9,920	(180)	ppm		0 lbs Ca/1000sqft
Magnesium	354	(50)	ppm		0 lbs Mg/1000sgft
Sulfur	22	(13)	ppm		0 lbs S/1000sqft
Sodium	12	(-)	ppm		
Iron	2.92	(4.25)	ppm		
Zinc	8.40	(0.27)	ppm		
Manganese	12.35	(1.00)	ppm		
Copper	0.70	(0.16)	ppm		
Boron					
Limestone Requirement					0.00 lbs/1000sqft

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Nitrogen: Apply an additional 1 lb N/1000 sqft during late summer (St. Augustine grass), mid-summer and early fall (common bermuda grass and zoysia grass) and every 6-8 weeks for hybrid bermuda grass.

Phosphorus: Phosphorus is highly elevated, avoid phosphorus containing fertilizers and organics for the next 5 years, retest annually.

Micro-nutrients: Apply a foliar iron solution every 4-6 weeks or more frequently if yellowing of new growth continues.

New online fertilizer calculators have been placed on the laboratory's website to determine appropriate fertilizers to purchase and determine their application rates.
http://soiltesting.tamu.edu/webpages/calculator.html

Methods: pH and conductivity/ 2:1; nitrate-N/Cd-red.; P, K, Ca, Mg, Na, and S/Mehlich 3 by ICP; Fe, Zn, Mn, and Cu/DTPA by ICP; and B/hot water by ICP.

Appendix D: Texas Lawn Companion

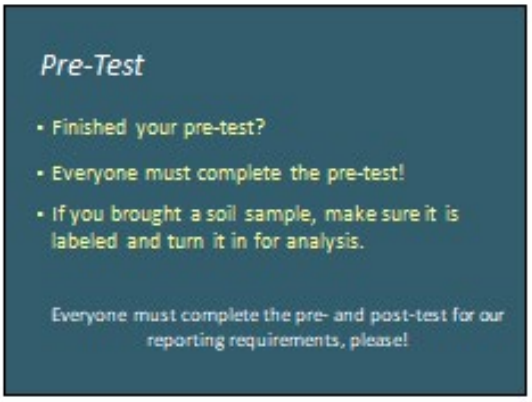
Here is what you'll find in this issue:

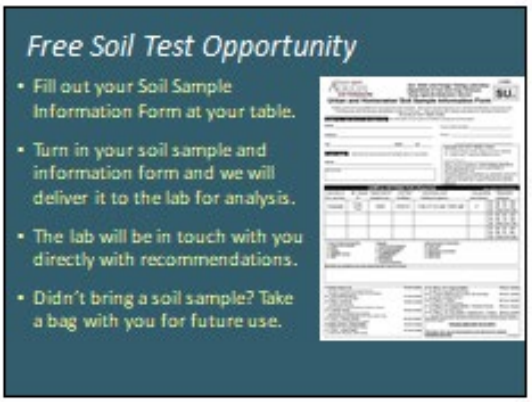
General Summer Management Recommendations and a Few New Publications to Help You
Dr. Becky Grubbs, Texas A&M AgriLife Extension - College Station

Bermudagrass Selection for Athletic Fields in the Transition Zone
Dr. Chrissie Segars, Texas A&M AgriLife Extension - Dallas

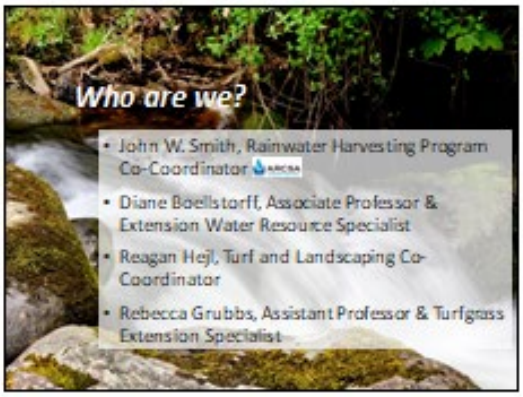
Summer Pest Considerations and New Herbicide Selection Guide for Homeowners
Dr. Becky Grubbs, Texas A&M AgriLife Extension - College Station

Appendix E: Example of the Registration Slides

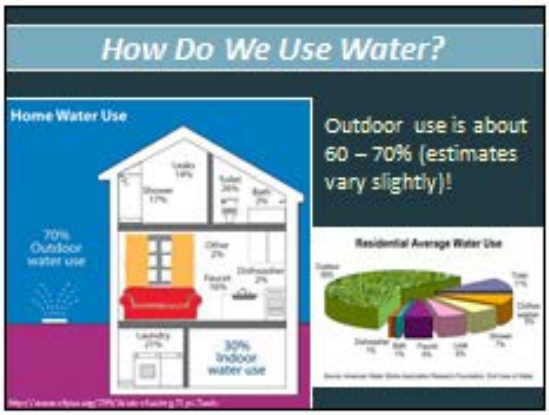


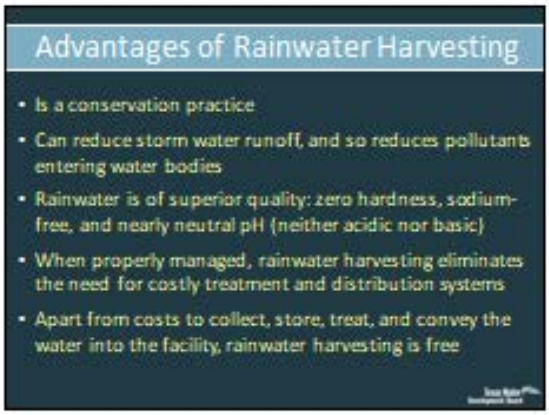


Appendix F: Examples of the Session 1 Presentation

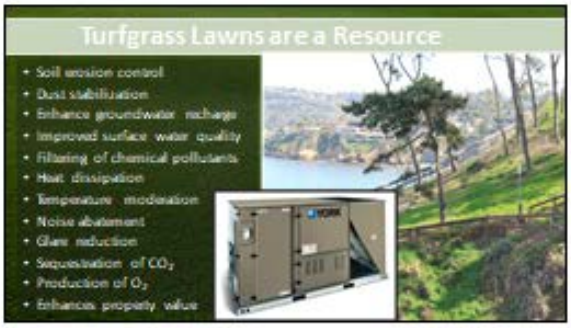


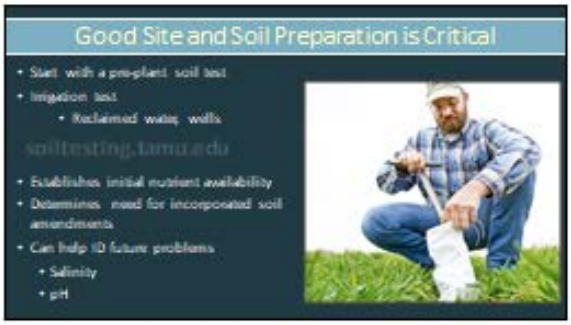
Appendix G: Examples of the Session 2 Presentation





Appendix H: Examples of the Session 3 Presentation





Appendix I: Pre-Test

TEXAS A&M AGRILIFE EXTENSION

MARKING INSTRUCTIONS
CORRECT: ● INCORRECT: ⊘ ⊘ ⊘ ⊘

Healthy Lawns and Healthy Waters-PreTest

Your views on the quality and effectiveness of Extension programs are extremely important. Please take a few minutes to tell us about your experience with this activity. Your answers to the following questions will help us better meet your needs. Please do not write your name on this form so that your responses are anonymous. Thank you!

1. Residents using rainwater harvesting are responsible for protection and maintenance of their own water systems.
   O True O False O Unsure

2. First flush devices are mandatory to wash accumulated debris from the collection surface before rainwater is allowed to enter the storage tank.
   O True O False O Unsure

3. The color for piping nonpotable (unsuitable for drinking) water should be:
   O White O Purple O Blue O Unsure

4. Painted roofs shall meet what standard if painted:
   O NSF 55 O NSF 61 O NSF 151 O Unsure

5. The average amount of water collectable per square foot of roof when one inch of rain falls:
   O 1.2 gallons O .335 gallons O .6 gallons O Unsure

6. The number of downspouts varies with size and surface area, but should be:
   O 1 per 100 square feet of roof surface O 1 per 1,000 square feet of roof surface
   O 1 per 500 square fee of roof surface O Unsure

7. The weight of water is:
   O 1.8 pounds per gallon O 5.8 pounds per gallon O 8.3 pounds per gallon O Unsure

8. If I have a 2,000 sq ft roof surface and 1 inch of rain falls, how much water will come off my roof?
   O 1,000 gallons O 1,200 gallons O 2,000 gallons O Unsure

9. An overflow pipe is critical to allow water out of the tank, and...
   O should be the same size or larger coming out of the tank than the inflow going into the tank
   O should be covered to prevent animal seeking water
   O will prevent rainwater backup up into the gutter
   O Unsure
   O A,B and C

10. Generally, all turfgrasses perform the same, it just depends on how they are managed.
    O True O False O Unsure

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Please continue on back

MARKING INSTRUCTIONS
CORRECT: ● INCORRECT: ⊘ ⊘ ⊘ ⊘

11. Which of the following turfgrass perform best under shade?
    - O Hybrid Bermudagrass O Bahiagrass O Zoysiagrass
    - O All turfgrasses perform the same under shade conditions

12. What is the yearly nitrogen requirement of a Zoysiagrass lawn?
    - O 0-1 lbs per 100 square feet O 2-4 lbs per 100 square feet
    - O 1-2 lbs per 100 square feet O 4+ lbs per 100 square feet

13. For a fertilizer with the analysis of 21-7-14, the "14" corresponds to which plant nutrient?
    - O Iron O Calcium O Nitrogen O Potassium

14. It is important to fertilize in the winter months to ensure warm-season turfgrasses have enough nutrients to break dormancy in the spring.
    - O True O False O Unsure

15. Improperly applied fertilizers have the potential to pollute what?
    - O Surface water O Ground water O Atmosphere O All of the above

16. Returning clippings when moving is beneficial to turfgrass lawns.
    - O True O False O Unsure

17. What is the recommended crop coefficient for warm season grasses?
    - O 0.25 O 0.4 O 0.6 O 0.9

18. Which of the following is a strategy to lessen irrigation runoff while promoting deep soil wetting?
    - O Cycle soak irrigation
    - O Only irrigate 1 day per week
    - O Irrigating during the heat of the day
    - O None of the above

19. Which of the following are important to consider when selecting a turfgrass for a specific site?
    - O Heat/drought tolerance
    - O Irrigation requirements
    - O Management capabilities
    - O All of the above

20. Bermudagrass will thrive in shade as long as fertilizer and water are not limited.
    - O True O False O Unsure

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Thank you!

Appendix J: Post-Test

TEXAS A&M AGRILIFE EXTENSION

MARKING INSTRUCTIONS
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   O should be covered to prevent animal seeking water
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   O A,B and C

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Please continue on back

MARKING INSTRUCTIONS
CORRECT: ● INCORRECT: ⊘ ⊘ ⊘ ⊘

11. Which of the following turfgrass perform best under shade?
    - ○ Hybrid Bermudagrass ○ Bahiagrass ○ Zoysiagrass
    - ○ All turfgrasses perform the same under shade conditions

12. What is the yearly nitrogen requirement of a Zoysiagrass lawn?
    - ○ 0-1 lbs per 100 square feet ○ 2-4 lbs per 100 square feet
    - ○ 1-2 lbs per 100 square feet ○ 4+ lbs per 100 square feet

13. For a fertilizer with the analysis of 21-7-14, the "14" corresponds to which plant nutrient?
    - ○ Iron ○ Calcium ○ Nitrogen ○ Potassium

14. It is important to fertilize in the winter months to ensure warm-season turfgrasses have enough nutrients to break dormancy in the spring.
    - ○ True ○ False ○ Unsure

15. Improperly applied fertilizers have the potential to pollute what?
    - ○ Surface water ○ Ground water ○ Atmosphere ○ All of the above

16. Returning clippings when moving is beneficial to turfgrass lawns.
    - ○ True ○ False ○ Unsure

17. What is the recommended crop coefficient for warm season grasses?
    - ○ 0.25 ○ 0.4 ○ 0.6 ○ 0.9

18. Which of the following is a strategy to lessen irrigation runoff while promoting deep soil wetting?
    - ○ Cycle soak irrigation
    - ○ Only irrigate 1 day per week
    - ○ Irrigating during the heat of the day
    - ○ None of the above

19. Which of the following are important to consider when selecting a turfgrass for a specific site?
    - ○ Heat/drought tolerance
    - ○ Irrigation requirements
    - ○ Management capabilities
    - ○ All of the above

20. Bermudagrass will thrive in shade as long as fertilizer and water are not limited.
    - ○ True ○ False ○ Unsure

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Thank you!

Appendix K: Evaluation

TEXAS A&M AGRILIFE EXTENSION

MARKING INSTRUCTIONS
CORRECT: ● INCORRECT: ⊘ ⊘ ⊘ ⊘

Healthy Lawns and Healthy Waters - Evaluation

1. Overall, how satisfied are you with this activity?
   ○ Not at all ○ Slightly ○ Somewhat ○ Mostly ○ Completely

   If not "completely satisfied," please tell us what we could have done better in order for you to be "completely satisfied?"

2. How satisfied are you with the following aspects of the activity?

	Not at all	Slightly	Somewhat	Mostly	Completely
a. Quality of course materials	○	○	○	○	○
b. Information being easy to understand..	○	○	○	○	○
c. Helpfulness of the information in decisions about your own situation	○	○	○	○	○

3. Based on the information and technical assistance you received today, what is the likelihood that you would recommend Texas A&M AgriLife Extension Service to your family and friends as a contact for information on water-related issues?

Not Likely *Fill in one number below where 0 = not likely and 10 = very likely.* **Very Likely**

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

4. Please indicate your intentions to do the following:

Practice that could be adopted . . .	Plan to Adopt	Undecided	Will not Adopt	Already Adopted	Not Applicable
a. Fertilize based on recommendations from soil test	○	○	○	○	○
b. Install some type of rainwater harvesting system	○	○	○	○	○
c. Improve management of home irrigation system	○	○	○	○	○
d. Select plants/grass based on water conservation	○	○	○	○	○

5. What is the most significant thing you learned during the program?

6. Are there any topics you would suggest we add to the training?

7. Estimate how valuable your participation in the water educational program has been to you:
   ○ $100 - $249 ○ $250 - $499 ○ $500 - $999 ○ $1,000 - $2,499 ○ $2,500 or more

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Please continue on the other side.

MARKING INSTRUCTIONS
CORRECT: ● INCORRECT: ⊘ ⊘ ⊘ ⊘

8. My lawn species is currently:

○ Bermudagrass ○ St. Augustine ○ Zoysia ○ Buffalo ○ Fescue ○ Bahia grass ○ Other

9. I have managed my residential lawn irrigation and fertilizer inputs to achieve maximum lawn appearance.

○ True ○ False

10. The average lawn size in Texas is 6,534 sq. feet (.15 acre). What is the size of your lawn?

If you know <u>your exact</u> sq. ft. or acres . . . **OR** *Select the lawn size below that's closest to yours*

☐☐☐☐☐ sq. ft.

☐☐.☐☐ acres

○ 1/10 acre (4,356 sq. ft.) ○ 1/3 acre (14,375 sq. ft.)
○ 0.15 acres (6,534 sq. ft.) ○ 1/2 acre (21,780 sq. ft.)
○ 1/5 acre (8,712 sq. ft.) ○ 3/5 acre (26,136 sq. ft.)
○ 1/4 acre (10,890 sq. ft.) ○ 3/4 acre (32,670 sq. ft.)
○ I don't know

11. What year did you last fertilize?

○ 2017
○ 2016
○ 2015
○ 2014 or earlier

OR ○ Have never fertilized (skip to question 14)

12. How many fertilizer applications do you typically make <u>annually</u>?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 or more ○ No regular number (varies every year)

13. What nitrogen rate did you apply the last time you fertilized?

☐.☐☐ lbs. per 1,000 sq. ft. **OR** ○ I don't know or recall

14. Which of the following information do you intend to utilize for making lawn <u>fertilization</u> decisions (timing and amounts) moving forward? Select all that apply.

○ Turf grass species
○ Appearance/growth rate of the lawn
○ Age of the Lawn
○ Local frost dates
○ Soil test recommendations
○ Cost
○ Other_____

15. Which of the following do you intend to utilize for making lawn <u>irrigation</u> decisions (timing and amounts) in the future? Select all that apply.

○ Appearance of the lawn (wilt)
○ Month/season of the year
○ Reference evapotranspiration data
○ Soil moisture data
○ Time of day
○ Soil texture

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Thank you!

Appendix L: Six-Month Follow-Up Questionnaire

HLHW 6 Month Follow-Up

Q1: In which city did you attend the Healthy Lawns and Healthy Waters training?

Q2: Please tell us if you adopted any of the following practices below based on what you learned at the Healthy Lawns and Healthy Waters training.

Submitted a soil test during or after the Healthy Lawns and Healthy Waters training?

- o Yes, I did.
- o No, but I still plan to.
- o No, and I don't plan to.
- o I don't fertilize my yard.

Q3: Made changes to your lawn fertilization program based on results of soil test recommendations or information provided at the Healthy Lawns and Healthy Waters training?

- o Yes, I did.
- o No, but I still plan to.
- o No change needed, I already follow the recommendations.
- o No, and I don't plan to.
- o I am still undecided.

Q4: Based on my soil test fertilizer recommendation and/or the information provided at the training, I plan to decrease the amount of fertilizer I apply by…

- o 10%
- o 25%
- o 50%
- o 75%
- o 100%

Q5: I implemented Smart Watering techniques presented at Healthy Lawns and Healthy Waters training.

- o Yes, I did.
- o No, but I still plan to.
- o No change needed, I already follow the recommendations.
- o No, and I don't plan to.
- o I am still undecided

Q6: Please estimate the amount of water you saved by implementing Smart Watering techniques presented at the Healthy Lawns and Healthy Waters training.

- o None
- o Under 10%

- o 10%-24%
- o 25%-49%
- o 50% or more
- o Does not apply

Q7: Have you implemented some type of rainwater harvesting after attending the Healthy Lawns and Healthy Waters training?

- o Yes, I did.
- o No, but I still plan to.
- o No change needed, I already collect rainwater.
- o No, and I don't plan to.
- o I am still undecided.

Q8: I have or plan to install a tank of the following size:

- o Less than 50 gallons
- o 51-100 gallons
- o 101-500 gallons
- o 501-1000 gallons
- o 1001-3000 gallons
- o Larger than 3,000 gallons
- o I do not plan to install a tank.

Q9: Have you applied the resources/materials provided at the training?

- o Yes
- o No

Q10: Have you shared with others the resources/materials provided at the training?

- o Yes
- o No

Q11: How satisfied were you with the resources/materials provided at the training?

- o Not at all
- o Slightly Somewhat
- o Mostly Completely

Q12: Did you feel like there were obstacles to adopting the techniques learned from the Healthy Lawns Healthy Waters program (e.g., time, cost, etc.)? If yes, please expand on that here.

Q13: Do you engage in other practices on your lawn that you feel help conserve water or reduce inputs that were not outlined in the HLHW program? If yes, please expand on that here.