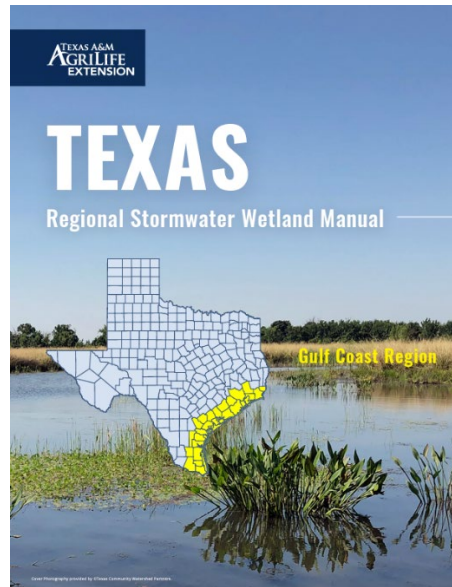


Texas Regional Stormwater Wetland Manual: Empowering communities to develop wetlands for resiliency.

Contract: 22-045-011-D108

Final Report
September 2023



Prepared by: Christie Taylor, Wetland Program Specialist
Texas Community Watershed Partners, Disaster Assessment Recovery Unit
Texas A&M AgriLife Extension Service
1335 Regents Park Drive, Suite 260
Houston, Texas 77058
christina.taylor@ag.tamu.edu

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Acknowledgements

Texas A&M AgriLife Extension would like to thank all the members of the project steering committee for their valuable input and assistance with content, knowledge, creation, and distribution of this publication:

Christina Taylor, AgriLife Extension/Texas Community Watershed Partners, Stormwater Wetlands Program Specialist

Brian Garcia, AgriLife Extension/Texas Community Watershed Partners, Graphic Designer III

Dr. Dean McCorkle, Texas A&M University/AgriLife Extension, Ag Economist Ph.D.

Daniel D. Hanselka, Texas A&M University/AgriLife Extension, Ag Economics Program Specialist

Dr. Fouad Jaber, Texas A&M University/AgriLife Extension, P.E.; Ph.D.

Charriss York, AgriLife Extension/Texas Community Watershed Partners, Green Infrastructure Program Director

Mary Carol Edwards, Green Star Farms, Green Star Farms

Brent Moon, Houston Botanic Garden, Houston Botanic Garden Horticulturalist

Jessica Henry, Houston Botanic Garden, Houston Botanic Garden Horticulturalist

John Branch, Clear Lake City Water Authority, Clear Lake City Water Authority Board

Jennifer Morrow, Clear Lake City Water Authority, Clear Lake City Water Authority General Manager

Matt Forster, Clear Lake City Water Authority, EG Land Steward

James Powers, MD Anderson, MD Anderson Facilities

Iris Clawson-Davis, formerly with MD Anderson, MD Anderson Facilities

Frank Weary, Exploration Green Conservancy Advisory Board, Exploration Green Board

David Sharp, Exploration Green Conservancy Executive Board, Exploration Green Board



Introduction

Constructed stormwater wetlands are a nature-based, engineered, management technique designed to work in conjunction with traditional grey infrastructure to protect communities from flooding and improve water quality. Stormwater wetlands can mitigate localized flood risks for developed or developing communities, protecting both homes and businesses, and re-connect the public to natural areas by providing community green space and recreational opportunities close to their homes. A green infrastructure practice implemented at the community-level, stormwater wetlands proved their value on the Texas Gulf Coast by protecting homes and businesses during recent floods caused by Hurricane Harvey. More and more jurisdictions are embracing stormwater wetlands because of their demonstrated benefit. However, communities lack the knowledge and resources to undertake stormwater wetland projects.

Texas A&M AgriLife Extension Service (AgriLife) used CMP Cycle 26 funds to develop a regional stormwater wetland manual for the Gulf Coast Region. With input from our existing project partners in and around the Houston area, we gathered information to guide communities through designing and constructing a stormwater wetland installation project. The manual contains information such as finding the best location, types of outfall structures, soil and vegetation considerations, sourcing wetland plants, opportunities to integrate green space and public recreation, how to talk to the public about the project, and funding options. The manual includes general sections applicable across Texas, with examples and sections specific to the Texas Gulf Coast. AgriLife also created an outreach and distribution plan for the wetland manual. This project empowers leaders with knowledge and vocabulary to interface with professionals to produce the best possible stormwater wetland project for their community.

Steering Committee Meetings

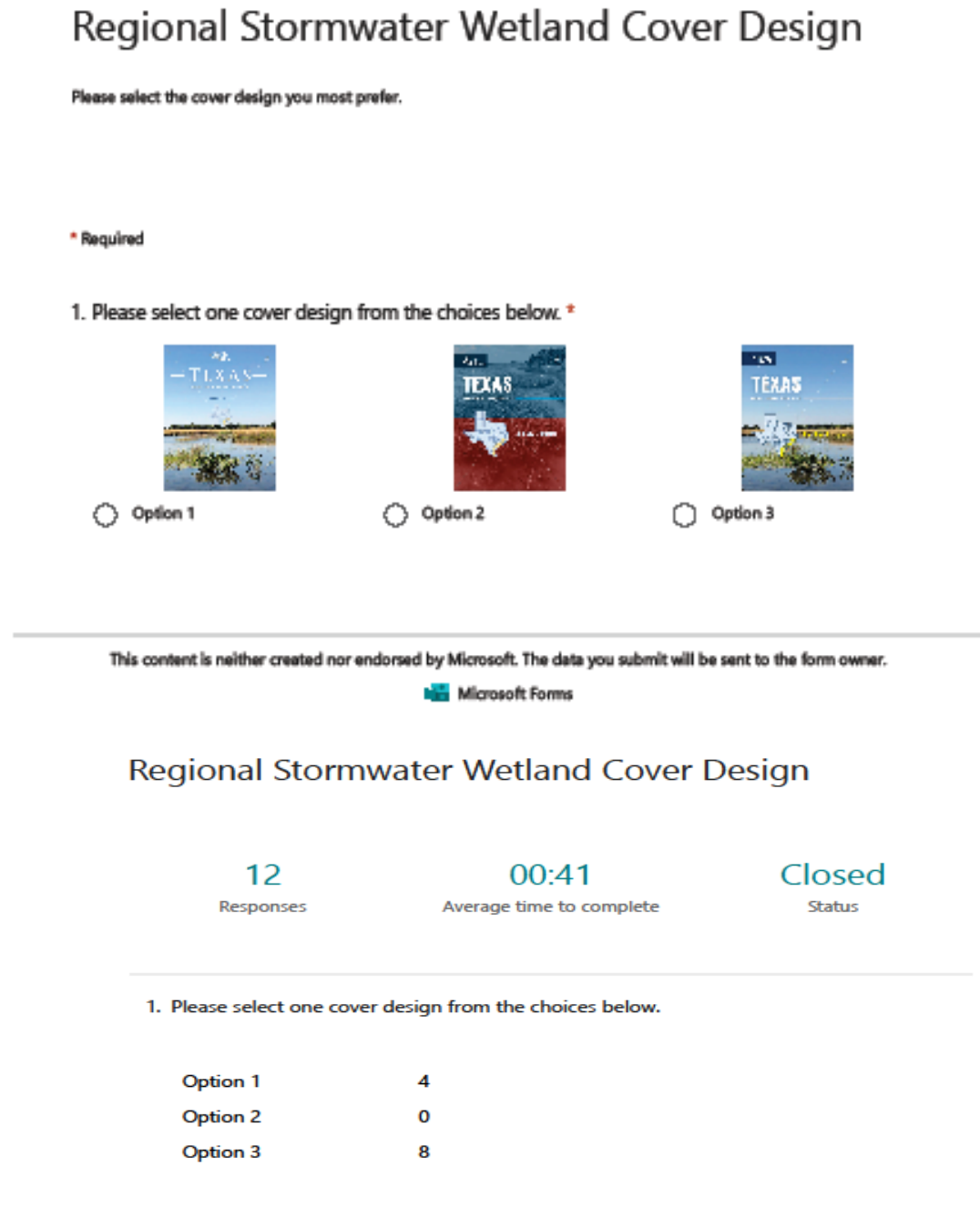
AgriLife convened a committee of subject matter experts to oversee the manual design and content and ensure the most comprehensive, accurate, and reliable information and scientific data available are used for this guide. The committee members were invited to participate on the steering committee based on their participation in and knowledge gained from installing local stormwater wetland projects. The committee met in the early planning stages via TEAMS or Zoom meetings. AgriLife will submit meeting notes at the end of the quarter in which the meetings are held beginning in January 2022.

Meeting Notes and Correspondence

The first meeting schedule was decided by a Doodle poll to be held on 2/25/2022. The second meeting was decided similarly to be held two months later to finalize the outline. The second meeting was held on 4/22/2022. The final meeting of the committee was held on 6/23/2022 to select topic sections to assist with content support, photos, and editing. Each member selected 1-2 sections to help provide content and editing support. Some members provided photos and details, and others just provided editorial support. It was before this final meeting that the first committee member informed AgriLife that he was stepping away from the committee due to a position change at his employer. After the third meeting of the full committee, it was decided that future correspondence would be through emails to those specific section members as needed. The manual sections were each sent to the respective

committee members for review as sections were completed. In August 2022, the draft manual was circulated to the committee for a progress update and review. In October 2022, a draft of the outreach plan was circulated among the committee members for input. In August 2023, another committee member retired from his position and stepped away from the committee. Then, the final manual was sent to the entire committee for review. At this time, the committee was polled through Microsoft Forms to decide on the cover design. See Appendix 1 for meeting agendas. See Appendix 2 for full meeting notes and attendance.

Figure 1: Microsoft form question and poll results



Manual Development

AgriLife staff, with assistance from the steering committee, developed a manual that covers constructing a wetland from initial planning to long-term maintenance. The manual covers the following topics: introduction, project timelines, communication, funding sources, economics including cost-effective analysis, finding the best location, types of outfall structures, soil and vegetation considerations, plant sourcing and selection ideas, construction, opportunities to integrate green space and public recreation, construction and maintenance considerations and schedules. The manual includes sections applicable across Texas, with sections and topics specific to the Texas Gulf Coast. The manual is designed for web-based and printed distribution with original graphics and research-based, region-specific recommendations.

Steering Committee Guidance and Participation

The first step was to outline the manual. AgriLife staff took initial outline ideas to the steering committee, and as a group, we refined those sections, see Figure 2 for the post-meeting outline.

Figure 2: Manual Outline

- Contract 22-045-011-D108**
Texas Regional Stormwater Wetland Manual
Task 2.1 Manual Outline
- Texas Regional Stormwater Wetland Manual Draft Outline**
(40-50 page limit)
1. Acknowledgements
 - a. Steering Committee Recognition
 - b. Funding Statement and Logos
 2. Executive Summary (2 pages)
 3. Introduction
 - a. Definition of Stormwater Wetland
 - b. Statement about Jurisdictional Wetlands
 - c. Our target audience (municipal leadership/developers or clients of environmental engineers/general public) and purpose statement
 4. Communication
 - a. Forming Partnerships
 - b. Communicating with stakeholder groups
 - c. Education Opportunities
 1. Adult
 2. Youth
 5. Economic Cost/ Benefit Analysis
 - a. Cost Range of Projects (table)
 1. Land value
 2. Construction costs
 3. Maintenance costs
 - b. Benefits
 1. Flood mitigation
 2. Property values
 3. Recreation
 4. Habitat creation
 5. Water quality improvements
 6. Health benefits
 7. Carbon sequestration
 8. Volunteer Contributions/ Community Involvement
 - c. Funding Sources
 6. Site Selection
 - a. Hydrology
 - b. Soils
 - c. Size
 - d. Zoning/permits/local ordinances
 7. Design
 - a. New construction
 - b. Retrofitting in existing basins
 - c. Floating wetlands
 8. Construction

Then members selected sections to contribute text, photos, input, and edits. We established a shared folder for contributions. Once contributions started coming in AgriLife staff began to compile the text and create spaces, for example, photos, tables, and figures. The graphic designer began to work on cover designs with input from the committee. The graphic designer was also tasked with digitizing the hand-drawn cross-sections and planting plan figures. See sample graphics below.

Figure 3: Sample graphics



Once 75% of the text for a given section was complete, the text was given to the graphic designer to insert into the chosen layout. Once the section was laid out, it was sent to the corresponding committee members for review and initial edits.

Most of the sections were compiled by the PI with input from the steering committee, except for the Economic section. Dean McCorkle and Dan Hanselka wrote a ten-page economic benefit section reviewing existing literature. Then the PI edited it to be less technical and easier to use practical examples for the target audience, reducing the section by half to align with the rest of the manual style. Then the revisions were sent to Dean and Dan to make sure they approved of the changes before being given to the graphic team for layout. The full chapter review is linked to the online version.

Lessons Learned from Manual Creation and Steering Committee

Some lessons we learned from this manual creation process include timing, flexibility, more design time and or staff time is needed than anticipated and delegating early and often. We remembered that with most things, only 20% of the committee has the availability to be present and active at any given time. Some of our committee members left during the process, so we had to be flexible and shift who could edit and pick up the slack. Polls received the highest amount of participation. Be specific with request for

information from committee members. You get a much faster response when you ask for specific images or sections of the project and give clear timelines and due dates in your email request. Our graphic design took twice as long since our in-house designer was split between projects. In the future, we would contract out the graphic design to not overburden staff. We had an excess photography budget because we had a volunteer who took most of the photos we needed that we didn't already have in-house or from project partners. That budget was shifted to printing and outreach.

Outreach and Distribution

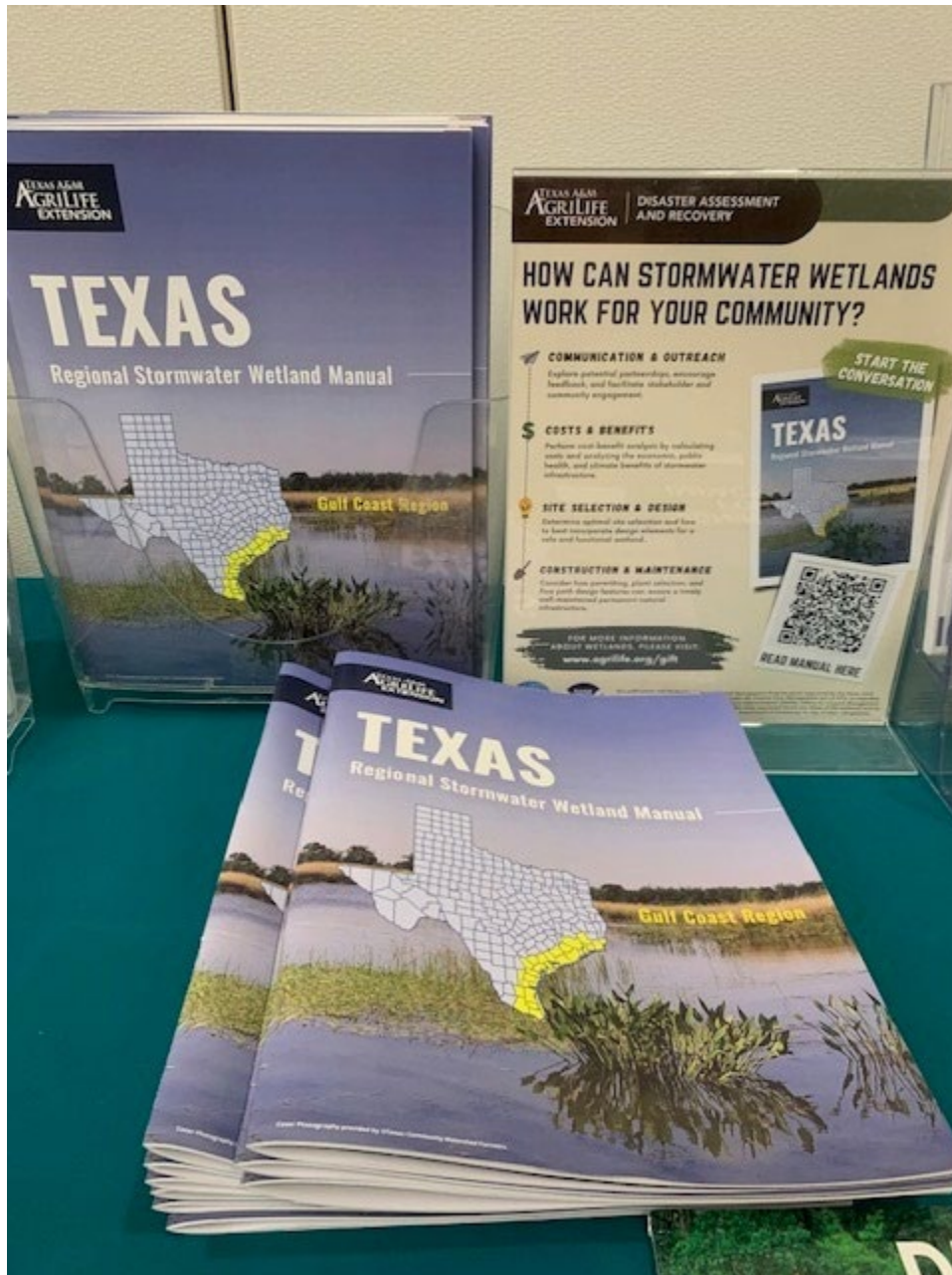
AgriLife staff, with input and approval from the Steering Committee (Task 1), developed and executed an outreach and distribution plan for the manual. The plan includes activities such as distribution at AgriLife and partner events, training AgriLife County Agents as a force multiplier for outreach within their region, online promotion, webinars, press releases, etc. For the full plan, see Appendix 3.

Outreach at in-person workshops and events began on September 7, 2023, at the Clean Coast Texas GIFT Workshop held in Portland, Texas. September 30, 2023, fliers were distributed at the Exploration Green Ribbon Cutting and Volunteer Appreciation Event hosted by our Exploration Green Partners at the Clear Lake City Water Authority and Exploration Green Conservancy. In October, our partners from the Houston Botanic Garden are presenting on stormwater wetlands at a conference in Ohio and have requested 100 fliers to distribute at their presentation.

Figure 4: Christie presenting the manual at the Clean Coast Texas GIFT Workshop in Portland, Texas, on September 7, 2023.



Figure 5: Manual display on the publication table at Portland Texas Gift close-up view including the outreach flyer.



All the steering committee partners have responded with the number of hard copies they need for their locations and have received electronic copies of the flier and QR link. Mail outs are ready for all the partners and are being mailed in September.

We have begun outreach to the county agents. So far, we have emailed electronic fliers and QR links to 6 of the coastal county AgriLife offices.

The manual has been circulated to at least 3 of our listserv contacts. HGAC included it in their newsletter, and Green Star Wetland Farms is including it in their newsletter. The manual was included for 5 weeks in the Weekly Wetland Newsletter to 380 subscribers.

Table 1: Table of outreach products distributed as of September 30, 2023

	Products Distributed	email w/ link	flyer w/QR	social media post	hard copy manual	
Steering Committee	Exploration Green	4		6	1	
	CLCWA	4	10		10	
	Houston Botanic Garden	2	109		9	
	MD Anderson Houston	1	1		1	
	Green Star Wetland Farm	1	1		1	
	AgriLife Ag Econ Dept.	2	5		5	
County Agents						
9/8/2023	Amy Nowlin	1	50		50	
9/1/2023	Phoenix	1				
9/1/2023	Greg Baker	1				
9/1/2023	Megan Carter	1				
9/1/2023	GRD Hyne	1				
9/1/2023	Jessica Chase	1				
9/1/2023	Corrie Bowen	1				
Presentations/Workshops						Attendance
9/7/2023	Portland GIFT Workshop		7		21	30
9/9/2023	MN Training Class Presentation		8			30
9/30/2023	Exploration Green Ribbon Cutting		20			77
Totals		21	211	6	98	137

Table 2: Table of social media and electronic newsletter outreach as of September 29, 2023.

Contact	Platform	Followers	Reactions	Comments	Repost/Share
Houston Botanic Garden	LinkedIn	953	13	3	2
Brent Moon	LinkedIn	453	2		
Nancy Falk	LinkedIn	9		1	
Houston Botanic Garden	Facebook		14		2

Houston Botanic Garden shared the manual link on their Linked In and Facebook Social Media accounts with 953 followers on September 6, 2023. That post was then shared by at least one follower, steering committee member Brent Moon. See photo below of Brent’s post.

Figure 6: Brent Moon shared the Houston Botanic Gardens post about the stormwater wetland manual.



Analytics from Monster Insights on WordPress show 70 views in August and 91 views for September. The manual is in the top ten most viewed pages on the GIFT website.

Outreach is ongoing. We have just begun outreach to coastal community leaders. I have created the slides for the webinar presentation of the manual to send in our outreach to local elected officials. See Appendix 4 for presentation slides. We purchased an additional 150 printed copies of the manual for upcoming workshops with Clean Coast Texas in La Marque, November 14, 2023, and Port Lavaca, February 7, 2023.

Appendix 1 Steering Committee Meeting Agendas

Texas Regional Stormwater Wetland Manual Steering Committee

Agenda

Date: 6/24/2022

Call to Order/ Opening Remarks

Christie Taylor

Introductions

Charriss York	Brian Garcia
Fouad Jaber	Dean McCorkle
Jim Power	John Branch
Mary Carol Edwards	Tom Hegemier
Brent Moon	Matt Forester
Iris Clawson- Davis	Jennifer Morrow
Jessica Henry	Frank Weary
David Sharp	

New Business

1. Discussion of manual topics to be outlined
2. Brainstorm outline for manual sections (Whiteboard app)
3. Discuss groups for draft section follow up
4. Schedule deadlines for each outlined section draft to be submitted for review
5. Schedule draft review meeting in early June

Agenda for Next Meeting

List the items to be discussed at the next meeting.

Adjournment

Texas Regional Stormwater Wetland Manual Steering Committee

Agenda

Date: 6/24/2022

Call to Order/ Opening Remarks

Christie Taylor

The regular meeting of the Texas Regional Stormwater Wetland Manual Steering Committee was called to order at 11:00am.

Introductions

Charriss York	Brian Garcia
Fouad Jaber	Dean McCorkle
Jim Power	Dan Hanselka
Mary Carol Edwards	John Branch
Brent Moon	Tom Hegemier
Iris Clawson- Davis	Matt Forester
Jessica Henry	Jennifer Morrow
David Sharp	Frank Weary

Old Business

1. Update of manual topics outlined
2. Follow up on bullet point lists or draft sections

New Business

1. Discuss rough draft sections and table of contents order
2. Introduce cover design and rough draft template
3. Schedule deadlines for each outlined section draft to be submitted for review
4. Schedule draft review meeting June 24th
5. Submit rough draft for CMP review on July 15th

Agenda for Next Meeting

Review rough draft for deliverable submission

Texas Regional Stormwater Wetland Manual Steering Committee

Agenda

Date: 6/24/2022

Call to Order/ Opening Remarks

Christie Taylor

Introductions

Charriss York	Brian Garcia
Fouad Jaber	Dean McCorkle
Jim Power	Dan Hanselka
Mary Carol Edwards (not available)	John Branch
Brent Moon (not available)	Tom Hegemier (stepping down)
Iris Clawson- Davis	Matt Forester
Jessica Henry	Jennifer Morrow (not available)
David Sharp	Frank Weary

Old Business

1. Review minutes from 4-22-22
2. Update of manual draft progress
3. Follow up on draft sections completed to date
4. Follow up on cover design

New Business

1. Submit rough draft for CMP review on July 15th
2. Schedule final manual review meeting.
3. Address Outreach Plan

Appendix 2 Steering Committee Meeting Notes

CMP 22-045-011-D108

Texas Regional Stormwater Manual

Task 1.2

Meeting Summary

Total Number of Participants 13
Meeting Title Stormwater Manual Steering Committee Meeting
Meeting Start Time 2/25/2022, 8:56:07 AM
Meeting End Time 2/25/2022, 10:03:37 AM
Meeting Id 62f6a94e-5d66-4a7a-881d-8cd73a80ab8d

Full Name	Join Time	Leave Time	Duration
Brent Moon	2/25/2022, 8:56:07 AM	2/25/2022, 10:00:35 AM	1h 4m
Jessica Henry	2/25/2022, 8:56:24 AM	2/25/2022, 10:00:34 AM	1h 4m
Charriss R. York	2/25/2022, 8:56:25 AM	2/25/2022, 10:00:33 AM	1h 4m
Dean A. McCorkle	2/25/2022, 8:56:31 AM	2/25/2022, 10:00:51 AM	1h 4m
Brian Garcia	2/25/2022, 8:56:33 AM	2/25/2022, 10:03:37 AM	1h 7m
Christina C. Taylor	2/25/2022, 8:56:35 AM	2/25/2022, 10:00:32 AM	1h 3m
John Branch\" (Guest)	2/25/2022, 8:59:21 AM	2/25/2022, 10:00:34 AM	1h 1m
Frank Weary	2/25/2022, 8:59:57 AM	2/25/2022, 10:00:35 AM	1h
Tom Hegemier	2/25/2022, 9:00:20 AM	2/25/2022, 10:00:32 AM	1h
Matt Forster	2/25/2022, 9:00:34 AM	2/25/2022, 10:00:34 AM	59m 59s
Jennifer Morrow	2/25/2022, 9:00:43 AM	2/25/2022, 10:00:32 AM	59m 48s
Mary Carol Edwards (Guest)	2/25/2022, 9:01:35 AM	2/25/2022, 10:00:30 AM	58m 55s
Fouad H. Jaber	2/25/2022, 9:02:51 AM	2/25/2022, 9:47:58 AM	45m 7s

CMP Project: 22-045-011-D108
Title: Texas Regional Stormwater Manual
Task: 1.2

Texas Regional Stormwater Wetland Manual Steering Committee

Meeting Notes 2-25-2022

Opening

The regular meeting of the Texas Regional Stormwater Wetland Manual Steering Committee was called to order at 9:00am on 2-25-2022 on TEAMS by Christie Taylor.

Introduction of grant project. Set up that this manual is being designed as a high level introduction to Stormwater Wetlands. The target audience will be local elected officials, developers, municipalities, and other organizations or clients of engineering or design firms to give them a base understanding of the whole process and some things to expect or plan for when the begin/ construct/ maintenance a stormwater wetland.

Notes from Charriss: Target audience: Municipal leaders, governments, organizations, developers that may want to implement SW Wetlands, and how to go from concept to maintenance, how to get started and how to have the conversation with contractors, residents, etc.

NOT a Tech manual with design criteria

May use smaller groups in Teams or via email for individual sections

Timeline:

- Meeting in June for draft
- Meeting End of summer for outreach plan
- Outreach in the fall

Thank you everyone for participating in the steering committee. Your ideas really help to make this manual usable and accessible to our target audience.

Meeting Summary						
Total Number of Participants	19					
Meeting Title	RSWM Steering Committee					
Meeting Start Time	4/22/2022, 10:52:17 AM					
Meeting End Time	4/22/2022, 11:42:52 AM					
Meeting Id	ed1d73b4-8052-4edc-ad77-06a733d75fce					
Full Name	Join Time	Leave Time	Duration	Email	Role	Participant
Clawson-Davis, Iris - PRD	4/22/2022	4/22/2022	50m 20s	Iris.Clawson@prd.com	Presenter	Iris.Clawson@prd.com
Christina C. Taylor	4/22/2022	4/22/2022	49m 44s	christina.taylor@prd.com	Organizer	christina.taylor@prd.com
Daniel D. Hanselka	4/22/2022	4/22/2022	46m 51s	Daniel.Hanselka@prd.com	Presenter	Daniel.Hanselka@prd.com
Dean A. McCorkle	4/22/2022	4/22/2022	46m 51s	Dean.McCorkle@prd.com	Presenter	Dean.McCorkle@prd.com
Frank Weary (Guest)	4/22/2022	4/22/2022	3m 1s		Presenter	
Brian Garcia	4/22/2022	4/22/2022	45m 11s	brian.garcia@prd.com	Presenter	brian.garcia@prd.com
Frank Weary	4/22/2022	4/22/2022	44m 18s		Presenter	
John Branch\" (Guest)	4/22/2022	4/22/2022	7m 31s		Presenter	
Charriss R. York	4/22/2022	4/22/2022	44m	charriss.york@prd.com	Presenter	charriss.york@prd.com
Brent Moon	4/22/2022	4/22/2022	42m 30s	brent@hbg.com	Presenter	brent@hbg.com
Tom Hegemier	4/22/2022	4/22/2022	41m 52s	thegemier@prd.com	Presenter	thegemier@prd.com
Matt (Guest)	4/22/2022	4/22/2022	18m 48s		Presenter	
Matt (Guest)	4/22/2022	4/22/2022	2m 21s		Presenter	
Power,James	4/22/2022	4/22/2022	19m 10s	jepower@prd.com	Presenter	jepower@prd.com
Jennifer Morrow	4/22/2022	4/22/2022	40m 15s	j.morrow@prd.com	Presenter	j.morrow@prd.com
John Branch\" (Guest)	4/22/2022	4/22/2022	6m 37s		Presenter	
Fouad H. Jaber	4/22/2022	4/22/2022	34m 5s	Fouad.Jaber@prd.com	Presenter	Fouad.Jaber@prd.com
John Branch	4/22/2022	4/22/2022	29m 10s	John.Branch@prd.com	Presenter	John.Branch@prd.com
Jim Power, UT MD Anderson (Guest)	4/22/2022	4/22/2022	24m 42s		Presenter	
Matt Forster	4/22/2022	4/22/2022	16m 35s	m.forster@prd.com	Presenter	m.forster@prd.com

CMP Project: 22-045-011-D108
Title: Texas Regional Stormwater Manual
Task: 1.2

Texas Regional Stormwater Wetland Manual Steering Committee

Meeting Notes
4-22-2022

Opening

The regular meeting of the Texas Regional Stormwater Wetland Manual Steering Committee was called to order at 11:00am on 4-22-2022 on TEAMS by Christie Taylor.

Opening remarks and introduction of new committee member Dan Hanselka AgriLife Extension Program Specialist in Ag Economics working with Dean McCorkle on economic benefit section. Dean reported back that Dan's microphone was not working but he could hear the meeting. Welcome Dan.

CT submitted the outline to CMP for the deliverable – doesn't mean it's set in stone, edits can still happen (From Charriss's notes)

Timeline:

- Meeting June 24 for draft
- Draft due to CMP July 15
- Meeting End of summer for outreach plan
- Outreach in the fall

Thank you everyone for participating in the steering committee. Your ideas really help to make this manual usable and accessible to our target audience.

Attendance

Christie Taylor	AgriLife Extension Facilitator	Charriss York	AgriLife Extension GIFT Program Director
Brian Garcia	AgriLife Extension Graphic Designer	Fouad Jaber	AgriLife Extension Specialist Stormwater Engineer
Dean McCorkle	AgriLife Extension Specialist Ag Economics	Tom Hegemier	Doucet and Associates Engineering

Texas Regional Stormwater Wetland Manual Steering Committee

Meeting Notes
6-24-2022

Call to Order/ Opening Remarks 11:32am Christie Taylor

Introductions/Announcements

Charriss York present	Brian Garcia present
Fouad Jaber	Dean McCorkle present
Jim Power	Dan Hanselka present
Mary Carol Edwards (not available)	John Branch (not available)
Brent Moon (out of office)	Tom Hegemier (not available)
Iris Clawson- Davis present	Matt Forester
Jessica Henry present	Jennifer Morrow (not available)
David Sharp (not available)	Frank Weary present

Old Business

1. Review minutes from 4-22-22
2. Update of manual draft progress:
 - Christie has text of introduction and communication for review.
 - Christie has entered some notes into the design, construction, plants
 - Jennifer is working on draft sections and will send over when she can.
 - Call with Dean June 13 to update section preparing for 4-5 pages to include benefits, table, cost analysis, hypothetical example calculations, and link to reference article. (in my inbox)
 - Charriss work on glossary
 - Iris add to cost benefits combined with stormwater collection system in place at MDA.
 - Photos can still be added to shared folder. Iris drop some photos from MDA in folder. Follow up with Jim to add UTRP wetland photos.

Appendix 3: Outreach and Distribution Plan



Outreach and Distribution Plan

Regional Stormwater Wetland Manual

By the Texas Community Watershed Partners,
a program of Texas A&M AgriLife Extension Service



This publication was funded by a Texas Coastal Management Program grant approved by the Texas Land Commissioner, providing financial assistance under the Coastal Zone Management Act of 1972, as amended, awarded by the National Oceanic and Atmospheric Administration (NOAA), Office for Coastal Management, pursuant to NOAA Award No. NA21N054190136. The views expressed herein are those of the author[s] and do not necessarily reflect the views of NOAA, the U.S. Department of Commerce, or any of their subagencies.



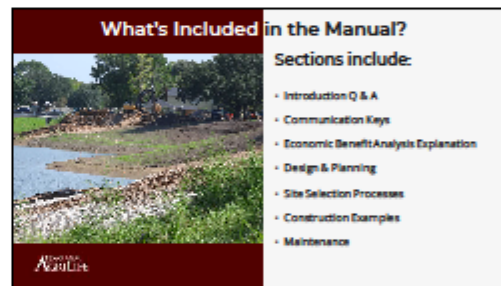
1



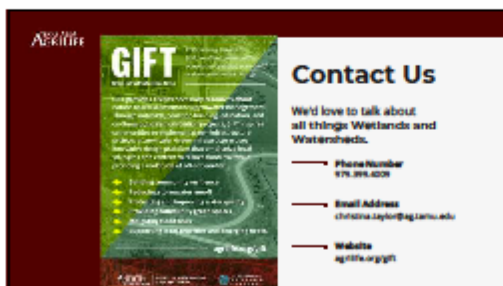
2



3



4



5