



Region 11: Guadalupe Regional Flood Planning Group Meeting

Wednesday, May 5, 2021
2:00pm

Agenda Item 1

Call to Order

1. Attendance

Agenda Item 2

Welcome

Agenda Item 3

Public General Comments

Public Comments limited to 3 minutes per speaker

Agenda Item 4

Approval of Meeting Minutes

1. Approval of meeting minutes from
April 13, 2021 Region 11 RFPG Meeting

Meeting Minutes
Region 11 Guadalupe Regional Flood Planning Group Meeting
April 13, 2021
2:00 PM

Guadalupe-Blanco River Authority River Annex (905 Nolan Street, Seguin, TX 78155)
or
GoToWebinar Virtual Meeting

Roll Call:

<u>Voting Member</u>	<u>Interest Category</u>	<u>Present (x) / Absent () / Alternate Present (*)</u>
Doug Miller Melissa Reynolds*	<i>Agricultural interests</i>	X
John Johnston	<i>Counties</i>	X
Lon Shell	<i>Counties</i>	
Bobby Christmas	<i>Electric Generating Utilities</i>	X
Annalisa Peace Vanessa Puig-Williams*	<i>Environmental interests</i>	X
Beth Parker Doug Sethness*	<i>Flood districts</i>	
Kevin Stone	<i>Industries</i>	X
Joseph Pantalion Laurie Moyer*	<i>Municipalities</i>	*
Ken Gill	<i>Municipalities</i>	Joined at 2:10pm
Kimberly Meitzen	<i>Public</i>	X
R. Brian Perkins	<i>River authorities</i>	X
Ray Buck	<i>River authorities</i>	X
Gian Villarreal	<i>Small business</i>	X
Ronald Fieseler	<i>Water districts</i>	X
Joseph McDaniel	<i>Water utilities</i>	X

<u>Non-voting Member</u>	<u>Agency</u>	<u>Present(x)/Absent()/ Alternate Present (*)</u>
Sue Reilly	Texas Parks and Wildlife Department	X
Natalie Johnson	Texas Division of Emergency Management	X
Jami McCool	Texas Department of Agriculture	X
Allen Nash	Texas State Soil and Water Conservation Board	X
Kris Robles	General Land Office	X
Morgan White	Texas Water Development Board (TWDB)	X
Joel Klumpp Brittney Wortham-Teakell*	Texas Commission on Environmental Quality	X
Don Durden	Public	X
Suzanne Scott	Region 12 Liaison	X
Patrick Brzozowski	Region 10 Liaison	X

Quorum:

Quorum: **Yes**

Number of voting members or alternates representing voting members present: **13**

Number required for quorum per current voting positions of 15: **8**

Other Meeting Attendees:

Lauren Willis, GBRA (Facilitator)

Ramiro Mendoza, GBRA (IT)

Victor Castillo, GBRA (Purchasing Manager)

Other Meeting Attendees: **

Tiffany Cartwright

Adam Conner

Karen Ford

Natalie Johnson

Vamshi Konduru

Paula Jo Lemonds

Josh Logan

Krista Melnar

Tami Norton

Shelley Rappaport

Melissa Reynolds

Abe Salinas

Pratibha Sapkota

Jay Scanlon

Andrew Smith

Sam Vaugh

Christine Westerman

Daniel Zell

Matt Nelson

**Meeting attendee names were gathered from those who entered information for joining the GoToWebinar meeting.

All meeting materials are available for the public at: <http://www.quadalupeRFPG.org>

AGENDA ITEM NO. 1: Call to Order

Doug Miller called the meeting to order at 2:02 PM. Lauren Willis called roll of the planning group members to record attendance and a quorum was established.

AGENDA ITEM NO. 2: Welcome

Doug Miller welcomed members to the meeting.

AGENDA ITEM NO. 3: Public General comments (Public comments limited to 3 minutes per speaker)

Doug Miller provided instructions for public comments.

1. Shelly Rappaport with the General Land Office (GLO) outreach team for the West Region of GLO combined River basin flood studies. One time study to evaluate flood risks, identify flood mitigation projects that strengthen resiliency and identify possible funding sources for projects.

Twenty-five Counties received the Presidential disaster declaration due to Hurricane Harvey. Counties in the Guadalupe basin include Bastrop, Caldwell, Calhoun, Comal, Dewitt, Fayette, Goliad, Gonzales, Guadalupe, Karnes, Lavaca and Victoria. Three virtual information sessions will be held on Thursday, April 15th at 10am, Tuesday, April 20th and Wednesday, April 21st. For any questions, individuals may use GLOfloodstudies.west@recovery.texas.gov or reach out to Kris Robles.

AGENDA ITEM NO. 4: Approval of Minutes from the March 3, 2021 Region 11 RFPG Meeting

Doug Miller opened discussion on approving the minutes from the March 3, 2021 Region 11 RFPG Meeting.

A motion was made by Bobby Christmas to approve the March 3, 2021 Region 11 RFPG Meeting. Kimberly Meitzen seconded the motion. The meeting minutes were approved by consensus.

AGENDA ITEM NO. 5: Region 11 Guadalupe RFPG Chair Updates

Chairman Doug Miller did not have updates for the RFPG.

AGENDA ITEM NO. 6: TWDB Update/Presentation

Morgan White provided updates regarding the TWDB and the RFPG sponsor, GBRA.

1. The contract has been successfully executed between TWDB and GBRA.
2. GBRA to receive the initial 20% advance from TWDB.
3. The subcontract between the Technical consultant and GBRA will need to be reviewed by the TWDB.

AGENDA ITEM NO. 7: Other Presentations

Laurie Moyer, City of San Marcos presented on the Flood Protection Efforts of the City of San Marcos.

AGENDA ITEM NO. 8: Discussion, evaluation and action concerning the technical consultant procurement for Region 11 Guadalupe Regional Flood Planning Group.

a. Update and discussion of responses to the RFQ

Doug Miller stated that the Guadalupe RFPG received five proposals to the RFQ. Chairman Miller complemented the proposals, reviewed the scoring process and stated that four of the technical consultants were chosen to be interviewed.

b. Discuss a recommendation from the Executive Committee for the selection of a technical consultant

Doug Miller stated that the consulting firm that received the highest-ranking score is the one being recommended by the Executive Committee, Freese & Nichols. This consulting firm

has familiarity of the basin, ability to focus on Region 11, ability to manage RFPG expectations and to set a foundation for the future. Each Executive Committee team member (Ron Fieseler, Kimberly Meitzen, and Brian Perkins) gave their perspective on the decision of Freese & Nichols.

Doug Miller opened the floor for discussion or questions from RFPG members. Members asked questions about which consulting firm placed second and what consulting firms made up the full Freese & Nichols team. Members discussed the spread of the points between the consulting firms and mentioned that Freese & Nichols spent a lot of focus on collaborative efforts among different stakeholder groups.

- c. **Consider authorizing the Region 11 Sponsor to negotiate and execute a contract with the selected firm to provide technical consulting services with the development of a regional flood plan.**

A motion was made by Ron Fieseler to nominate Freese & Nichols as the Region 11 technical consultant and authorizes the Region 11 Sponsor, GBRA to negotiate a contract. Annalisa Peace seconded the motion. The vote passed by a vote of 12 Ayes, 0 Ayes and 1 Abstention.

AGENDA ITEM NO. 9: Update from RFPG Sponsor (GBRA)

Lauren Willis reiterated that GBRA and TWDB have a fully executed contract and the next steps are to develop the subcontract for the technical consultant (timeline 4-6 weeks). For the communication updated, GBRA has added the RFPG meetings to all social media accounts.

Doug Miller mentioned in June or July to go to an in person meeting.

AGENDA ITEM NO. 10: Public General comments (Public comments limited to 3 minutes per speaker)

Doug Miller provided instructions for public comments. A public comment was submitted through the guadalupeRFPG website from Hunter Warren.

Comment: In San Antonio, we have a range of flood control measures, from underground tunnels to preserved floodplain. The preserved floodplain approach offers a body of water and mostly undisturbed natural lands accompanying it. These offer nature and recreation and are immensely popular with the community, even making the surrounding neighborhoods much more desirable. But then, some creeks have been converted into massive concrete ditches. These offer no benefit other than flood control, and are an eyesore and can be dangerous. No one wants to live next to these, and generally property values near them will demonstrate that. Preserving floodplain land for flood control is cheap and offers an incredible return on investment for the community. Building expensive flood infrastructure on the other hand, allows more development at a massive cost to the public and eliminates a community natural asset.

AGENDA ITEM NO. 11: Consider date and agenda items for next meeting

Doug Miller opened discussion to consider the date and agenda items for the next meeting.

The RFGP discussed the possibility of the technical consultant's ability to discuss topics on schedule, data and outreach and the tentative presentation from Texas Living Waters was mentioned for the May meeting. The next meeting will be by May 5, 2021 at 2:00pm.

AGENDA ITEM NO. 12: Adjourn

Brian Perkins made a motion to adjourn. The motion was seconded by Bobby Christmas. The motion passed by unanimous consent.

The meeting adjourned at 3:31 PM by Doug Miller.

Approved by the Region 11 Guadalupe RFGP at a meeting held on 05/05/2021.

Brian Perkins, SECRETARY

Doug Miller, CHAIR

Region 11 Guadalupe RFPG Chair Updates

Agenda Item 5

Texas Water Development Board Update

Agenda Item 6

Agenda Item 7

Other

Presentations

Texas Living Waters Project: Nature-Based Solutions for Flood Mitigation

Arsum Pathak, Ph.D.

Adaptation & Coastal Resilience Specialist

National Wildlife Federation

Danielle Goshen

Water Policy & Outreach Specialist

Galveston Bay Foundation

Anna Farrell-Sherman

Clean Water Associate

Environment Texas

Nature-Based Solutions for Flood Mitigation

Overview for Region 11 RFPG



National Wildlife Federation



Presentation Outline

- Region 11 flooding concerns
- What are nature-based solutions?
- Examples of nature-based solutions
- Co-Benefits
- Case studies
- Funding for nature-based solutions
- Local recommendations
- Equity concerns
- Incorporating nature-based solutions in a flood plan



Nature-Based Flood Mitigation Infrastructure & RFPGs

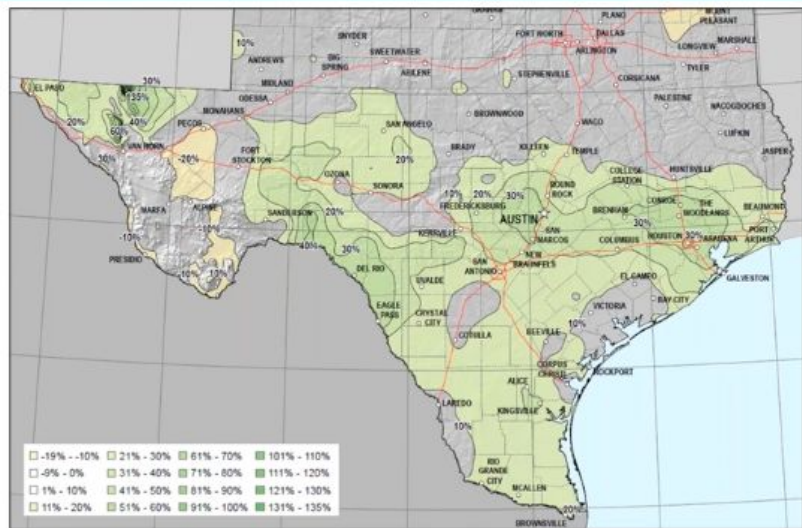


RFPGs are required to ***describe natural flood mitigation features*** in the RFP (TAC Rule 361.31) and ***shall identify and evaluate*** potential FME's and ***potentially feasible FMSs and FMPs, including nature-based solutions...***(TAC Rule 361.38).

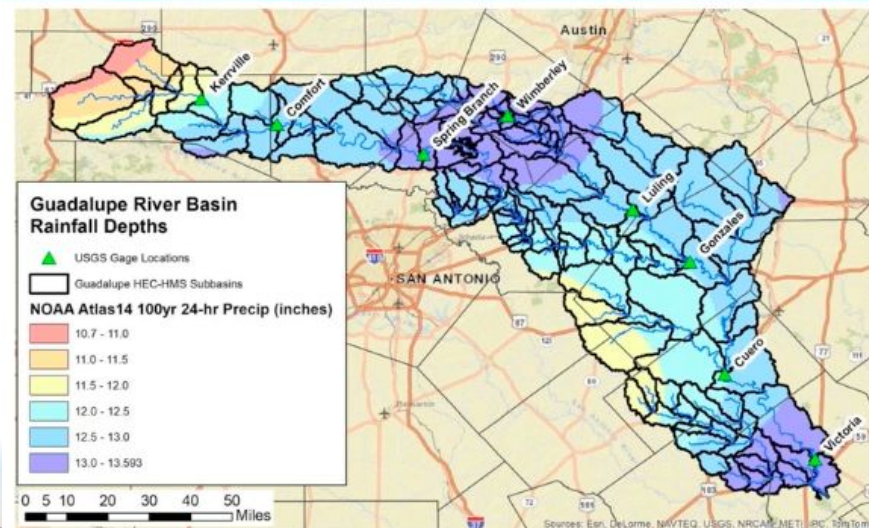


Region 11 Flooding Concerns

NOAA Atlas 14 vs. 2004 USGS Rainfall Atlas % Difference in 100-yr 24-hr Precip



NOAA Atlas 14 100-yr, 24 hour Rainfall Depths for the Guadalupe Basin



What are Nature-Based Solutions?

Nature-based flood mitigation includes “mitigation approaches involving the use of natural features, materials, and processes to reduce the risk and impacts of flooding” (TAC 361.10).

- **Mimic** or **support** historical hydrological patterns
- Allow for stabilization of streams and rivers to better **capture floodwater**
- Provide flood protection while **increasing resilience** and providing **additional co-benefits**



Types of Nature-Based Infrastructure

1. Stream Restoration

Re-establish structure, function and the **self-sustaining behavior** of stream system.

Preservation or restoration of **tributaries and their headwaters** is a priority to mitigate flooding and protect downstream floodplains.

Reedy Creek restoration

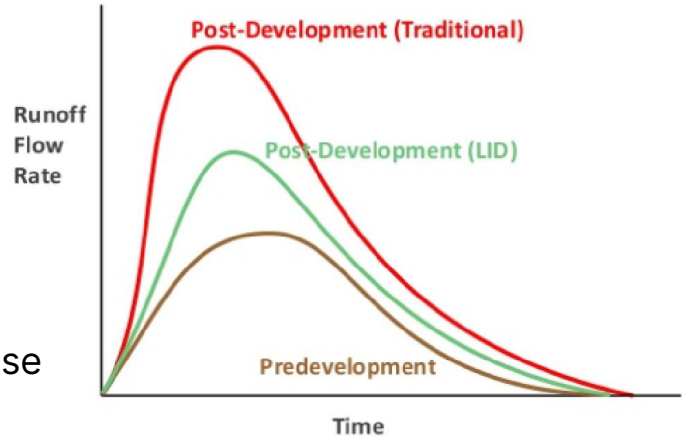


Types of Nature-Based Infrastructure

2. Low Impact Development (LID)

A variety of development practices that **use** or **mimic natural processes** that result in the infiltration and/or use of stormwater

Reduces floodwaters by storing stormwater allowing it to infiltrate



Source: Michael F. Bloom, P.E., 2017



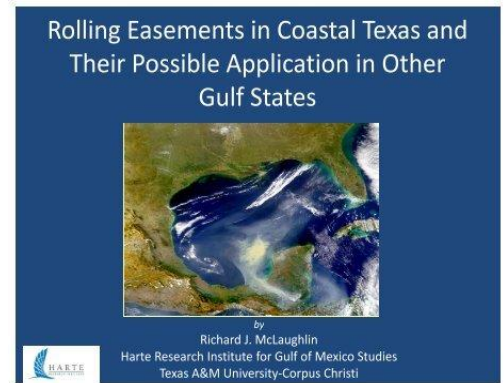
Types of Nature-Based Infrastructure

3. Conservation easements

Landowner voluntarily gives an easement holder certain rights to limit uses of the land in perpetuity to promote conservation.

4. Buyouts

Removes built structures from areas vulnerable to flooding typically through voluntary purchases.



Types of Nature-Based Infrastructure

5. Wetland Restoration and Constructed wetlands

Uses restored or built wetlands to store and filter up to 330,000 gallons of water per acre

INVISTA Wetland in Victoria, Texas



6. Living Shorelines

Range of shoreline stabilization techniques to reduce erosion through the use of ecological approaches

Bulkhead



Living Shoreline



Hybrid Infrastructure

Service

Potential Sources of Infrastructure Cost Reduction

Coastal flood management and erosion control

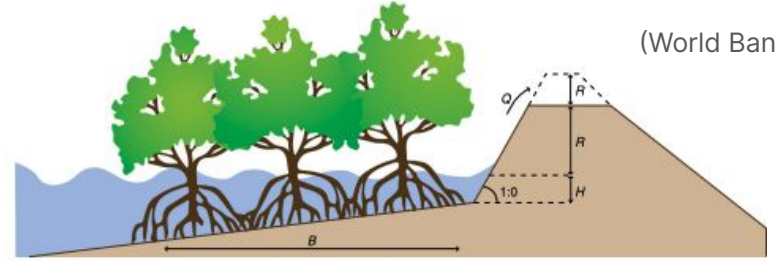
Natural coastal barriers such as wetlands and sandbars lower costs for gray infrastructure, such as seawalls, dikes, and groynes. These barriers can reduce wave energy and the height of a storm surge, which potentially lowers the cost and/or improves resilience of built solutions.

River flood management

Floodplains lower costs for gray infrastructure such as flood control embankments, sluice gates, and pumping stations. The floodplains store flood waters and lower flood levels, thus potentially lowering the cost and/or improving the resilience of the built solution.

Urban stormwater management

Stormwater retention areas lower costs for stormwater drains, pump stations, and treatment of wastewater discharges. They filter pollutants and can remove up to 90% of heavy metals from stormwater.

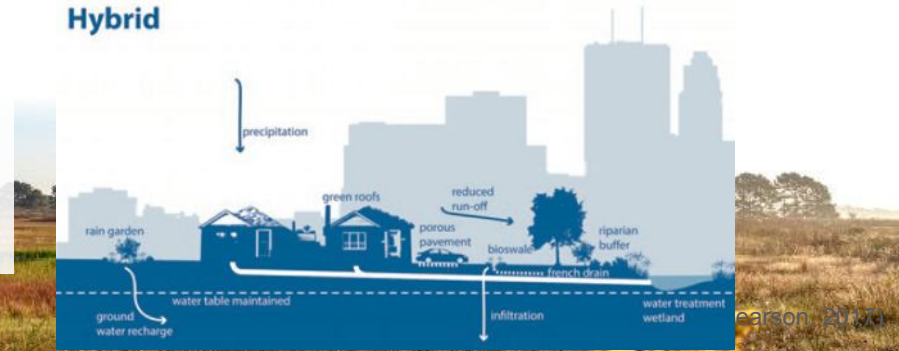


(World Bank, 2017)



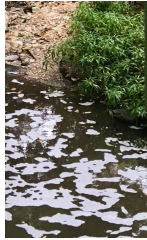
Yolo Bypass
(Browder et al., 2019)

Hybrid



Co-Benefits of Nature-Based Solutions

Under TAC 361.38, “evaluations of potentially feasible FMS and FMPs shall include. . . a ***description of potential . . . benefits*** from the FMS or FMP to the ***environment, agriculture, recreational resources, navigation, water quality, erosion, sedimentation***, and impacts to any other resources deemed relevant.”



Water Quality

Trap 45-99% of solid pollutants



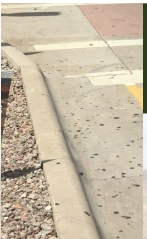
Flooding

Absorb 50-90% of rainfall



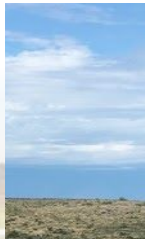
Water Supply

Water that soaks in replenishes aquifers



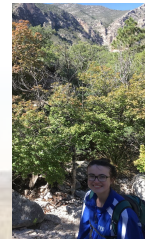
Urban Heat

Reduce summer temps by 10-15 degrees



Added Resilience

No catastrophic breaks and less maintenance



Mental health

Green spaces reduce stress and anxiety

Case Study: Exploration Green, City of Webster, TX

- Converted golf course into series of **detention** and **wetlands** projects designed to detain and slow floodwaters
- **Cleans runoff from 95% of storms** that occur in the community
- Phase 1 when 80% complete **detained 100 M gallons of Harvey Stormwater**
- Once complete it will have a storage capacity of **1,680 acre-feet**

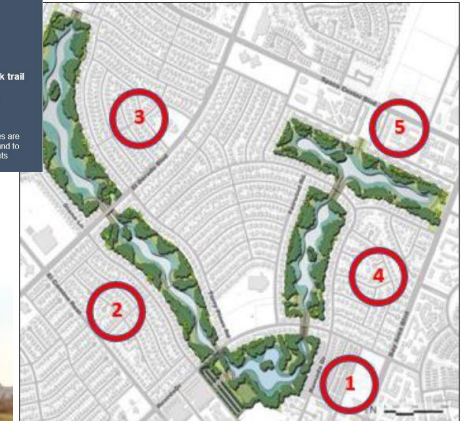
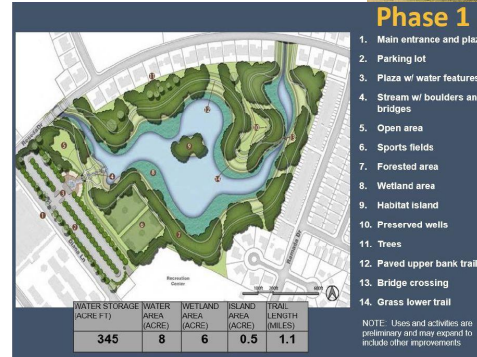


Figure 1: Aerial view of Exploration Green – artist's rendering

Case Study: The San Antonio River Improvements Project (SARIP)

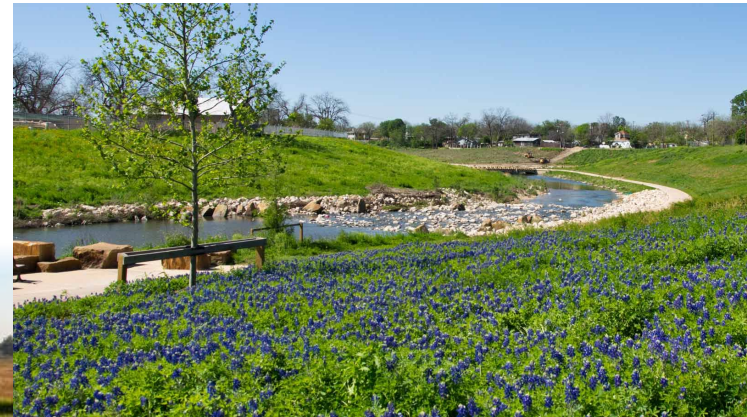
Stream restoration project supported by a **\$384.1 million public investment**

Included public **stakeholder meetings** to gather input and create a common community goal

Utilized environmentally sensitive methods **enhancing existing flood management** elements

Resulted in:

- Stronger connection between the river and the community
- Improved water quality and healthier ecosystems and increased recreational use



Case Study: Natural Waterway Conveyance Project, City of Helotes, TX

- Nonstructural and nature-based elements include **natural channel design** and **buyouts**
- Designed to remove residential properties from **100-year storm event** floodplain
- **Removed 30 homes** from 100-year floodplain



French Creek (LC-23): 2. Cross Vane + 2 years



16



★
Native
Vegetation



Funding Opportunities for Nature-Based Infrastructure

Under TAC 361.38, “evaluations of potentially feasible FMS and FMPs shall include. . . and be based on. . .an indication regarding the ***potential use of federal funds, or other sources of funding*** as a component of the total funding mechanism.”

Federal Funding Sources

- FEMA's Building Resilient Infrastructures and Communities (**BRIC**) Program
- HUD's Community Development Block Grant for Mitigation (**CDBG-MIT**) Funds
- National Resources Conservation Service's (NRCS) Emergency Watershed Protection Program (**EWPP**)*

*Note: This funding source allows the NRCS (not a local governmental entity or non profit) to purchase conservation easements

Funding Opportunities for Nature-Based Infrastructure

Under TAC 361.38, “evaluations of potentially feasible FMS and FMPs shall include. . . and be based on. . .an indication regarding the ***potential use of federal funds, or other sources of funding*** as a component of the total funding mechanism.”

State and Local Funding Sources

- Clean Water State Revolving (**CWSRF**) Funds
- Flood Infrastructure Fund (**FIF**)
- Harris County Flood Bond (2018)
- Hays County Parks and Open Spaces Bond (2020)

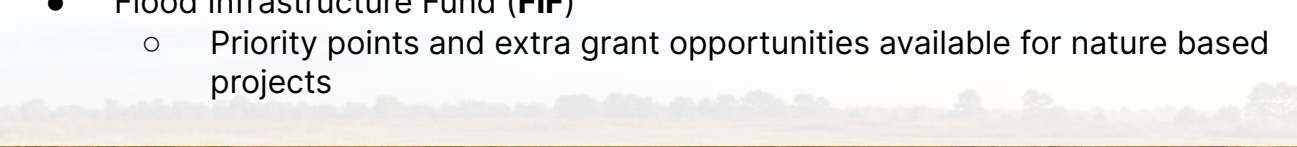


Funding Opportunities: Incentives for nature-based infrastructure

Under TAC 361.38, “evaluations of potentially feasible FMS and FMPs shall include. . . and be based on. . .an indication regarding the ***potential use of federal funds, or other sources of funding*** as a component of the total funding mechanism.”

State and Local Funding Sources

- Clean Water State Revolving (**CWSRF**) Funds
 - *Green Project Reserve* available for nonpoint source protection or estuary management projects
 - **HB 2350** if passed will make it easier to secure funding under the *Green Project Reserve*
- Flood Infrastructure Fund (**FIF**)
 - Priority points and extra grant opportunities available for nature based projects



Local Recommendations for Nature-Based Flood Mitigation

RFPGs are required to *describe natural flood mitigation features* in the RFP (TAC Rule 361.31) and *shall identify and evaluate* potential FME's and *potentially feasible FMSs and FMPs, including nature-based solutions, some of which may have already been identified by previous evaluations and analyses by others* (TAC Rule 361.38).

Design should include options for permeable pavement, rainwater harvesting, vegetative buffers and bioretention basins to mitigate drainage problems and flooding at low water crossings, parking areas and walkways.

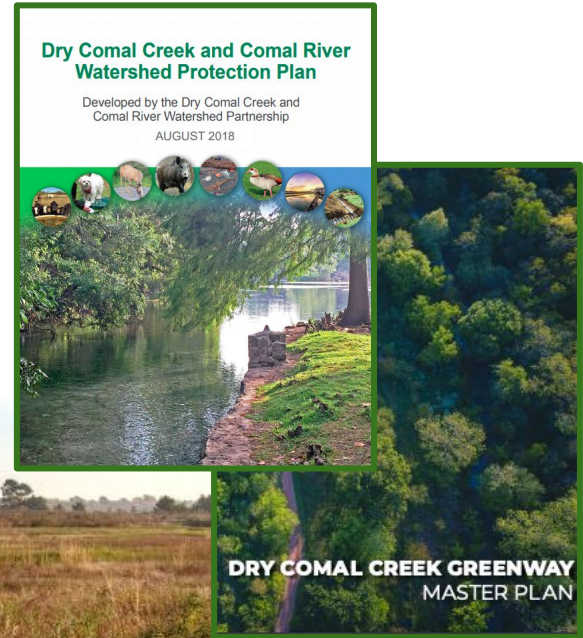
- ***Dry Comal Creek Greenway Master Plan***

Modification of riparian areas to restore or add vegetation to trap contaminants in runoff from reaching streams.

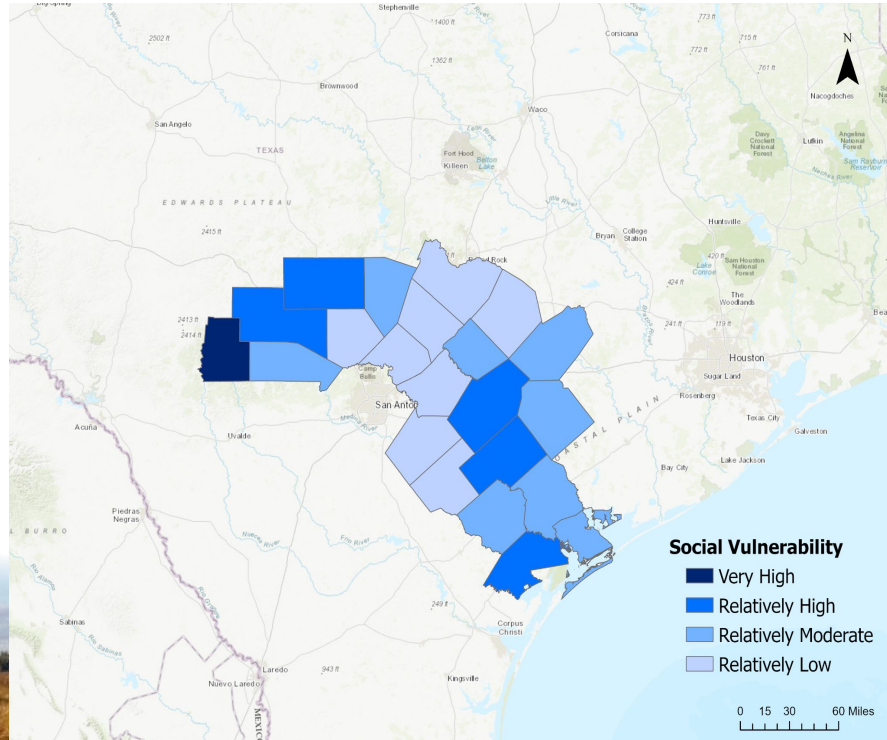
- ***Dry Comal Creek and Comal River Watershed Protection Plan***

Identification and implementation of up to \$500,000 in additional LID and reduced impervious cover infrastructure.

- ***Dry Comal Creek and Comal River Watershed Protection Plan***



Equity Considerations



Under TAC 361.38, “evaluations of potentially feasible FMS and FMPs shall include. . . and be based on. . . an **equitable comparison** between consistent assessment of all FMSs and FMPs that the RFPGs determine to be potentially feasible.”

Incorporating Nature-based Infrastructure in a Flood Plan

STEP 1: Consider “no action” or simple nature-based improvements.

STEP 2: In places where more protection is needed or simple nature-based improvements are not feasible, consider hybrid solutions.

STEP 3: If needed, compare infrastructure options through initial construction costs, long term maintenance cost, future replacements and negative environmental and community fabric impacts.

Source: World Bank



Thank you!

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National Wildlife Federation





Natural and Nature-Based Infrastructure

RESOURCE PACKET FOR REGIONAL FLOOD PLANNING GROUPS

Flood control projects in Texas have historically relied on conventional “gray infrastructure” solutions. While such projects may be essential in some circumstances to protect lives and mitigate property damage, they are also associated with negative environmental impacts and carry [residual risks](#) such as overtopping when capacity is exceeded. As climate variability continues to increase, it is more important than ever to build resilient systems that can adapt to ever changing circumstances.

A Note on Terminology:

Many terms are used to describe natural and nature-based flood mitigation strategies. TWDB rules defines nature based flood mitigation as “mitigation approaches involving the use of natural features, materials, and processes to reduce the risk and impact of flooding.” We believe that the goal of these types of projects should center around the conservation, restoration, or emulation of an existing natural ecosystem, which provides essential flood mitigation benefits.

In recent years natural and nature-based flood solutions for flood mitigation have [generated great interest](#) and have increasingly been deployed in Texas and across the nation. While gray infrastructure quickly drains stormwater to rivers and streams, increasing peak flows and downstream flood risk, natural and nature-based infrastructure works by allowing water to infiltrate where it lands, spreading it across the landscape, and slowing down peak flows.

Unlike gray infrastructure, these natural and nature-based infrastructure projects provide numerous [co-benefits](#) to surrounding communities such as improved air and water quality and recreational

benefits. Further, nature-based techniques can protect and extend the lifetime of structural investments by deploying a combined or “hybrid approach.” For example, [bioswales](#) can reduce and delay peak flood heights, which alleviates pressure on stormwater drainage systems during rainfall events, and can extend the lifetime of gray investments.

Below, we have provided an annotated bibliography compiling recent studies and reports on the performance of natural and nature-based infrastructure. These resources can be used to inform the Regional Flood Planning Groups on natural infrastructure techniques as they develop flood management evaluations (FMEs), flood management projects (FMPs), and flood management strategies (FMSs).

ANNOTATED BIBLIOGRAPHY

Internal Resources

Glick, P., E. Powell, S. Schlesinger, J. Ritter, B.A. Stein, and A. Fuller. (2020). [The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction](#). Washington, DC: National Wildlife Federation.

This report summarizes the latest science surrounding the effectiveness of a wide range of natural and nature-based infrastructure in lowering the risks to communities from floods and other climate-related hazards. The report also highlights key policy reforms needed to mainstream and increase the use of natural infrastructure in communities across the country.

Tags: Latest research; policy recommendations; risk analysis

Texas Living Waters Project. (2020). [Houston-Based Recommendations on Natural Infrastructure for Flood Mitigation](#).

Following catastrophic flooding caused by Hurricane Harvey and with three consecutive years with 500-year storms, a diverse set of stakeholders have published numerous reports in the Houston-area supporting natural and nature-based flood mitigation solutions. This brief report summarizes key green infrastructure techniques, local recommendations and policies to support natural and nature-based flood mitigation.

Tags: Houston area; literature review; recommendations

General Resources

Browder, G., Ozment, S., Rehberger-Bescos, I.; Gartner, T., Lange, G. (2019). [Integrating Green and Gray: Creating Next Generation Infrastructure](#). Washington, DC: World Bank and World Resources Institute.

This report calls for green infrastructure, such as mangroves and wetlands, to play a bigger role in traditional infrastructure planning. The authors argue that integrating nature into mainstream infrastructure systems can produce lower cost and more resilient services. Further, the report also reviews approaches and examples of how to integrate green infrastructure into mainstream project appraisal processes and investments.

Tags: Hybrid infrastructure

Depietri, Yaella & McPhearson, Timon. (2017). [Integrating the Grey, Green, and Blue in Cities: Nature-Based Solutions for Climate Change Adaptation and Risk Reduction](#). 10.1007/978-3-319-56091-5_6.

Through case studies and literature reviews, this chapter explores the role of grey, green, and blue infrastructure and in particular hybrid approaches for disaster risk reduction and climate change adaptation to shed light on available sustainable adaptation opportunities in cities and urban areas. At the same time, the chapter highlights the limitation and drawbacks in the adoption of merely grey or merely green infrastructures and suggests that an intermediate 'hybrid' approach, which combines both blue, green and grey approaches, may be the most effective strategy for reducing risk to hazards.

Tags: Hybrid infrastructure

Gunnell, K., Mulligan, M., Francis, R. A., & Hole, D. G. (2019). [Evaluating natural infrastructure for flood management within the watersheds of selected global cities](#). Science of The Total Environment, 670, 411–424.

This study uses metrics from the WaterWorld model to examine the flood management-relevant natural infrastructure of the upstream watersheds of selected global cities. These metrics enable the characterisation of different types, magnitudes and geographical distributions of potential natural flood storage. The storages are categorised as either green (forest canopy, wetland and soil) or blue (water body and floodplain) and the proportion of green to blue indicates how different city upstream basin contexts provide different types and levels of storage which may buffer flood risk. By mapping the magnitude and types of 'natural' storages in these basins, we have shown that most city upstream basins have a strong reliance on green natural storage which is driven primarily by canopy cover but also soil storage.

Tags: Green vs. blue storage; natural storage; risk exposure

Smith, C.S., B. Puckett, R.K. Gittman, and C.H. Peterson. (2016). [Living shorelines enhanced the resilience of saltmarshes to Hurricane Matthew](#). Ecological Applications 28: 871–877.

This study evaluated rock sill living shorelines as compared to natural marshes and hardened shorelines (i.e., bulkheads) in North Carolina, USA for changes in surface elevation, *Spartina alterniflora* stem density, and structural damage from 2015 to 2017, including before and after Hurricane Matthew (2016). The results show that living shorelines exhibited better resistance to landward erosion during Hurricane Matthew than bulkheads and natural marshes, were more resilient than hardened shorelines, and were able to enhance *S. alterniflora* stem densities over time when compared to natural marshes. These findings suggest that living shorelines have the potential to improve coastal resilience while supporting important coastal ecosystems.

Tags: Living shorelines; coastal flooding; coastal resilience

Stoner, A. & Hayhoe, K. (2020). [Climate Impact Assessment for the City of Houston](#). ATMOS Research & Consulting.

The Climate Impact Assessment was identified in 2019 as a critical component to creating a safer, more resilient and sustainable Houston. This Assessment links the City's first resilience strategy, Resilient Houston and the City's first climate action plan, Houston Climate Action Plan. The assessment provides downscaled climate trends and projections for Houston to inform the implementation of climate mitigation and adaptation action in the city.

Tags: Climate change; climate vulnerability; flood projections

Sutton-Grier, A. E., Gittman, R. K., Arkema, K. K., Bennett, R. O., Benoit, J., Blicht, S., ... & Grabowski, J. H. (2018). [Investing in natural and nature-based infrastructure: building better along our coasts](#). Sustainability, 10(2), 523.

This study highlights that the implementation of natural and nature-based infrastructure (NNBI) aimed at flood prevention and coastal erosion protection is lagging. However, the researchers argue that there's a present opportunity as the U.S. government reacts to the recent, unprecedented flooding and hurricane damage and considers greater infrastructure investments, to incorporate NNBI into coastal infrastructure projects. The study stresses that doing so will increase resilience and provide critical services to local communities in a cost-effective manner and thereby help to sustain a growing economy.

Tags: Coastal flooding; investments

World Bank. (2017). [Implementing nature-based flood protection: Principles and implementation guidance](#). Washington, DC: World Bank.

The objective of this document is to present five



principles and implementation guidance for planning, such as evaluation, design, and implementation of nature-based solutions for flood risk management as an alternative to or complementary to conventional engineering measures.

Tags: Principles; implementation

Gulf Coast Resources

Bousquin, J. & Hychka, K. (2019). [A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands—A Benefit Indicators Approach](#). *Front. Environ. Sci.* 7:54. doi: 10.3389/fenvs.2019.00054.

This paper details the development of a nationally consistent dataset and a set of high-resolution indicators characterizing where people benefit from reduced flood risk through existing wetlands. This dataset can be used at different scales (regional or local) to rapidly assess flood-reduction benefits. The authors used other national scale indicators (CRSI, SoVI) to gauge community resilience and recoverability in Harris County, Texas as a case study. Analysis of the Gulf Coast region and Harris County, Texas identifies communities with both wetland restoration potential and the greatest flood-prone population that could benefit from that restoration.

Tags: Wetlands; flood vulnerability; Harris County; Gulf Coast

Reguero, B.G., Beck, M.W., Bresch, D.N., Calil, J., Meliane, I. (2018). [Comparing the cost effectiveness of nature-based and coastal adaptation: A case study from the Gulf Coast of the United States](#). *PLoS ONE* 13(4): e0192132. <https://doi.org/10.1371/journal.pone.0192132>.

This study applies a quantitative risk assessment framework to assess coastal flood risk across the United States Gulf of Mexico coast to compare the cost

effectiveness of different adaptation measures. These include nature-based (e.g. oyster reef restoration), structural or grey (e.g., seawalls) and policy measures (e.g. home elevation). From the portfolio studied, this study shows that nature-based adaptation options could avert more than \$50 billion of costs, and can do so cost effectively with average benefit to cost ratios above 3.5. Wetland and oyster reef restoration are found to be particularly cost-effective. This study demonstrates that the cost effectiveness of nature-based, grey and policy measures can be compared quantitatively with one another, and that investments in nature-based adaptation could meet multiple objectives for environmental restoration, adaptation and flood risk reduction.

Tags: Coastal flooding; cost-benefit comparison; Gulf Coast

Summers, J. K., Harwell, L. C., Smith, L. M., & Buck, K. D. (2018). [Measuring community resilience to natural hazards: The Natural Hazard Resilience: Screening Index \(NaHRSI\)—Development and application to the United States](#). *GeoHealth*, 2, 372–394. <https://doi.org/10.1029/2018GH000160>.

NaHRSI (Natural Hazard Resilience Screening Index) is a tool for communities to evaluate their likely vulnerability and resilience to acute meteorological events like hurricanes, tornadoes, droughts, floods, etc. The index has been applied to all counties of the United States and consists of five major parts examining risk of events, governance to address events, societal, built environment and natural environment attributes that will enhance recoverability for these types of events. By evaluating the factors that influence vulnerability and recoverability, an estimation of resilience can quantify how changes in these characteristics will impact resilience given specific hazard profiles. This study highlights effects of increased development and loss of natural lands on flood risk exposure in the Houston area.

Tags: Vulnerability tool; risk exposure; Texas coast; Hurricane Harvey

Houston Area Resources

FEMA. (2018). [Exploration Green! A Case Study in Effective Floodplain Management](#).

Exploration Green is an ideal example of what is possible as a result of collaboration within a community to achieve long-term, sustainable mitigation of flood-related damage to residential, civic, and commercial structures, while improving quality of life for the people and businesses in the surrounding community. The project involves the conversion of the old public golf course into a public park with five large ponds that will serve as detention basins for excess water during flood events. This report developed by FEMA in 2018 discusses the project and impressive preliminary flood reduction benefits observed after Hurricane Harvey in 2017, when Phase I (out of 5) was just 80% complete.

Tags: Detention and retention; Hurricane Harvey; Houston-Area

Juan, A., A. Gori, and A. Sebastian. (2020). [Comparing floodplain evolution in channelized and unchannelized urban watersheds in Houston, Texas](#). *Journal of Flood Risk Management* 13: e12604.

This study compares the ability of two riverine flood control approaches: channelization and stream preservation/setbacks, to alleviate the adverse impacts of rapid urbanization. While the two watersheds studied (Brays and Buffalo Bayou) are similar in size, topography, and development level, they have contrasting riverine flood management approaches. Brays Bayou is channelized, whereas Buffalo Bayou remains mostly unchannelized. The study found that, while floodplain extent in both watersheds increases over time, the relative change in floodplain extent for Brays Bayou (channelized) is substantially larger than that for Buffalo Bayou (unchannelized).

Tags: Houston; floodplain; channelization; natural channel; urban flood mitigation

Co-Benefits Resources

Bureau of Economic Analysis (BEA). (2019). [Outdoor Recreation Satellite Account \(ORSA\) - Texas 2019](#).

U.S. Department of Commerce.

Green spaces are a vital socio-economic component to Texans. In 2019, the state ranked third in the country for GDP and employment contribution related to outdoor recreation. This document reflects the data collected by the Bureau of Economic Analysis, US Department of Commerce, to show economic output generated by outdoor recreational activities such as boating, hiking, etc. The data also highlights the need for protection and conservation of natural resources in the state.

Tags: Co-benefits; recreation; natural spaces; Texas

Guerrero, J., Mahmoud, A., Alam, T., Chowdhury, M. A., Adetayo, A., Ernest, A., & Jones, K. D. (2020). [Water Quality Improvement and Pollutant Removal by Two Regional Detention Facilities with Constructed Wetlands in South Texas](#). *Sustainability*, 12(7), 2844.

This study shows the role of constructed wetlands in improving water quality by reducing pollutants due to stormwater runoff. The researchers compared two regional detention facilities (RDF) with constructed wetlands in McAllen, Texas, through collecting and sampling water quality data for different pollutants over a period of 22 months. The findings revealed a reduction of suspended solids, pollutant concentration and load at both sites for different storm events. The site with larger constructed wetlands and wet detention ponds performed better emphasizing a need of incorporating such hybrid approaches in future detention basins and stormwater management structures in Texas.

Tags: Co-benefits; Water quality; wetland benefits; Texas



Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017). [Nature-based solutions to climate change adaptation in urban areas: Linkages between science, policy and practice](#). Springer Nature.

This book provides a wealth of resources on the effectiveness of nature-based solutions in addressing climate change adaptation (for instance, chapter 6, as discussed above). A special emphasis on the role of nature-based solutions in creating jobs and stimulating innovation for a green economy is employed throughout the chapters. Chapter 18 discusses different market-based instruments which can help financing nature-based solutions at the local and municipal level. The book also showcases other evidence-based examples to make the case for nature-based solutions in urban areas.

Tags: Co-benefits; green jobs; economy

Spano, G., Dadvand, P., & Sanesi, G. (2021). [The Benefits of Nature-Based Solutions to Psychological Health](#). *Frontiers in Psychology*, 12.

This article synthesizes recent literature on the association of nature-based solutions with psychological well-being and mental health from different perspectives. The authors provide examples of studies conducted across different disciplines and age groups to show the positive effects of green spaces in improving mood, cognition, and attention, among other benefits.

Tags: Co-benefits; human health

Willis, K. J., & Petrokofsky, G. (2017). [The natural capital of city trees](#). *Science*, 356(6336), 374-376.

This short article compiles recent research on the natural capital of trees for carbon sequestration, lowering heat island effect, and pollution reduction. It delves further into a focus on specific tree species for maximising these benefits. In addition to providing detailed context of the values provided by urban trees, studies like these are also important to showcase the depth of research on specific nature-based solutions.

Tags: Co-benefits; urban trees; pollution reduction



The Texas Living Waters Project is a collaboration of conservation groups working to ensure fresh water, healthy rivers, and flood resilience for all Texans.



Agenda Item 8

Discussion and potential action regarding Region 11
RFPG Technical Consultants work and schedule

Region 11 Flood Plan

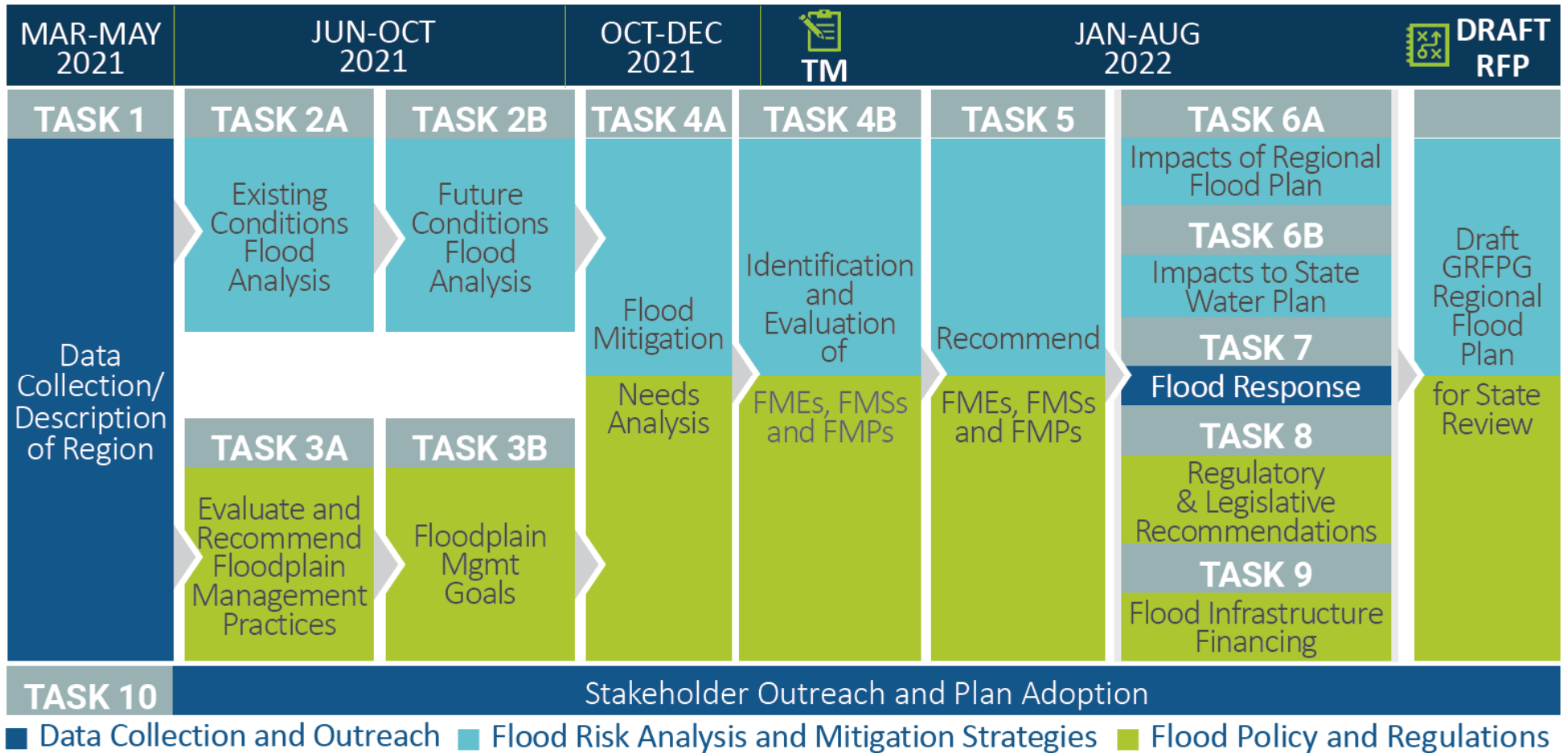
Guadalupe Regional Flood Planning Group

March 18, 2021





Driving the Schedule





Managing Expectations

Future Planning Cycles

- Update baseline flood risk
- Continue to improve policies
- Move to next tier of projects

- With each planning cycle, actions are implemented and the total flood risk in the basin decreases
- RFPG improves data and executes additional FMEs, FMSs, and FMPs. Funding is expanded



Second Planning Cycle

- Utilize improved data
- Refine baseline flood risk
- Enhance policies
- Identify new regional FMSs & FMPs

- TWDB prepares BLE Data
- Execute FMEs, FMSs, FMPs
- Integrate with Water Plan



First Planning Cycle

Establish Foundation

- Collect data
- Establish baseline flood risk
- Focus on policy & known projects

Agenda Item 9

Discussion of second Pre-Planning Public Input Meeting to solicit public input (as required per Texas Water Code §16.062 (d) and 31 Texas Administrative Code §361.12 (a)(4))

Agenda Item 10

Update from RFPG
Sponsor (GBRA)

Update from GBRA

Agenda Item 11

Public General Comments

Public Comments limited to 3 minutes per speaker

Agenda Item 12

Consider date and agenda items for next meeting

Agenda Item 13

Adjourn