GLO River Basin Flood Study East Region

TIFF Brown Bag Seminar – 10/2/2025

Commissioner Dawn Buckingham, M.D.

Agenda

East Region Overview

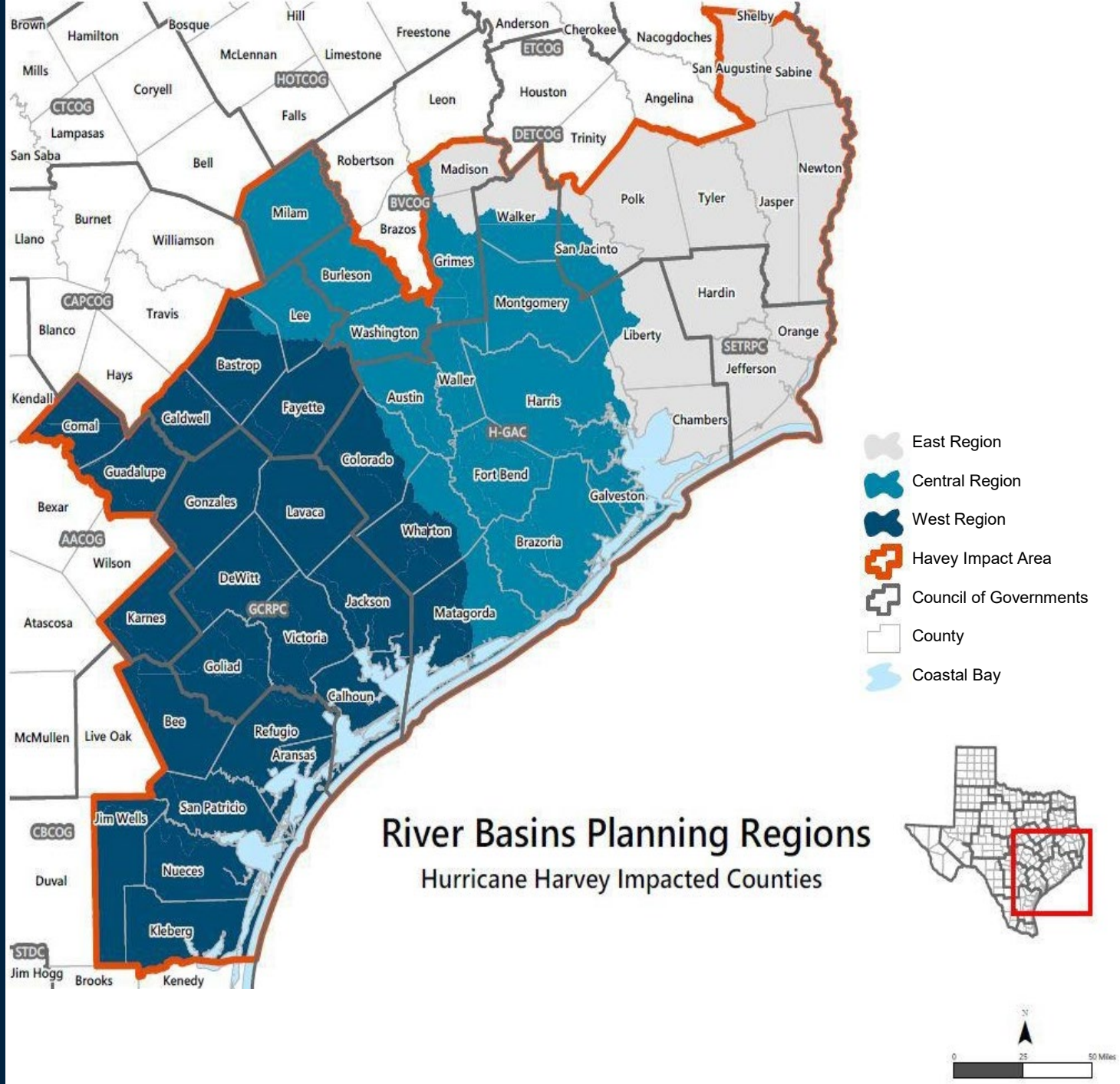
- RBFS Phases and Overview
- Phase 2 Analysis
- Phase 3 Modeling Methodologies
- Hot Spot Analysis
- Strengths and weaknesses
- Phase 4 Alternatives Analysis
- DMQT

River Basin Flood Study
Program Overview

In September 2020, the Texas General Land Office (GLO) initiated the Combined River Basin Flood Studies planning process to collect, analyze, and communicate flood risk information to help decision makers with protecting Texans from future floods. The goals for the flood study are to:

- Evaluate flood risks to our communities
- Identify flood projects that strengthen the resilience of our communities
- Identify possible funding sources for community flood projects

Texas General Land Office
Commissioner Dawn Buckingham, M.D.



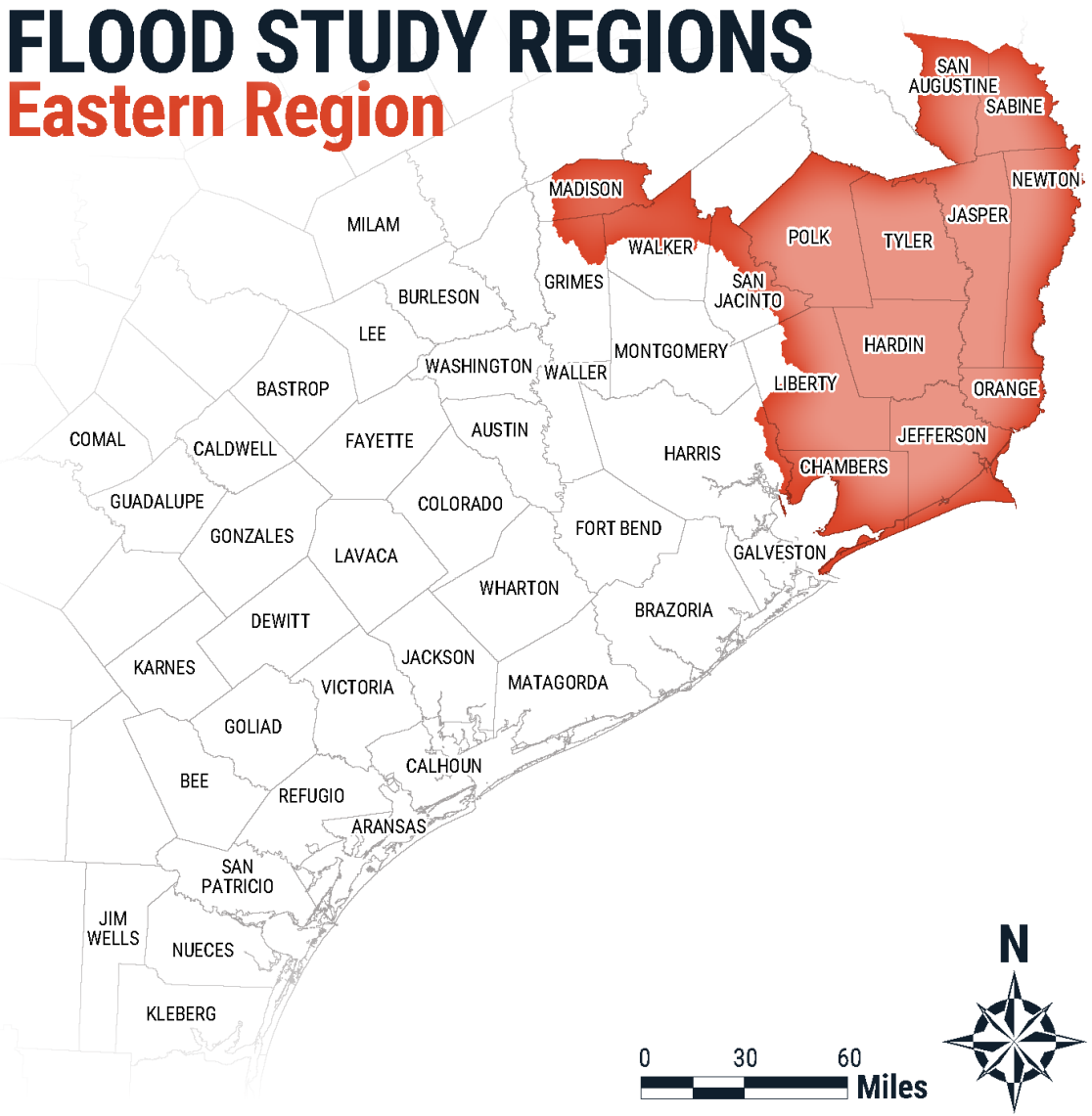
Phases and Timeline

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase Overview

Phase / Task	Outreach	Data Collection	SOP Development	Major Scope Item	Pilot Testing	Prioritization	Scoping
Phases 1&2: Outreach and Engagement & Data Collection	Engagement Plan and Outreach for General Data Collection and SWOT Analysis	Data Collection Plan and General Data Collection	Baseline Modeling SOP	Data Collection	Baseline Modeling Pilots	HUC Watershed Prioritization and Stream Level Risk Evaluation	Phase 3 Scope and Technical Action Plans
Phase 3: Evaluation of Flood Risk (Development of Baseline Models)	Outreach supporting modeling and MATCH Tool	Data Collection supporting modeling	Hot Spot Analysis SOP and Alternatives Analysis SOP	Development of Baseline Models	Alternatives Analysis Pilots	Hot Spot Analysis following 75% baseline modeling completion	Phase 4 Scope and Technical Action Plans
Phase 4: Identification of Mitigation Projects (Alternatives Analysis)	Outreach supporting alternatives and regionwide coordination	Data Collection supporting alternatives analysis		Alternatives Analysis		Regionwide prioritization of alternatives to move to Phase 5	Phase 5 Scope and Technical Action Plans
Phase 5: Determination of Funding Sources & Technical Assistance	Outreach supporting funding and regionwide coordination	Data Collection supporting funding assistance		Funding Technical Assistance	NA	NA	NA

East Region Overview



The East Region of the Combined River Basin Flood Studies includes:

- **16** Counties
- **3** Major Rivers (Trinity, Neches, Sabine)
- **3** TWDB Regional Flood Planning Groups (Regions 3, 4, and 5)
- **7** TWDB Flood Infrastructure Fund Committed Projects
  - Chambers County
  - City of Port Arthur
  - City of Silsbee
  - Jefferson County Drainage District No. 6
  - Orange County Drainage District
  - Sabine River Authority (x2)

Regular coordination is occurring with the TWDB to share data and avoid redundancy

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 2 Risk Analysis

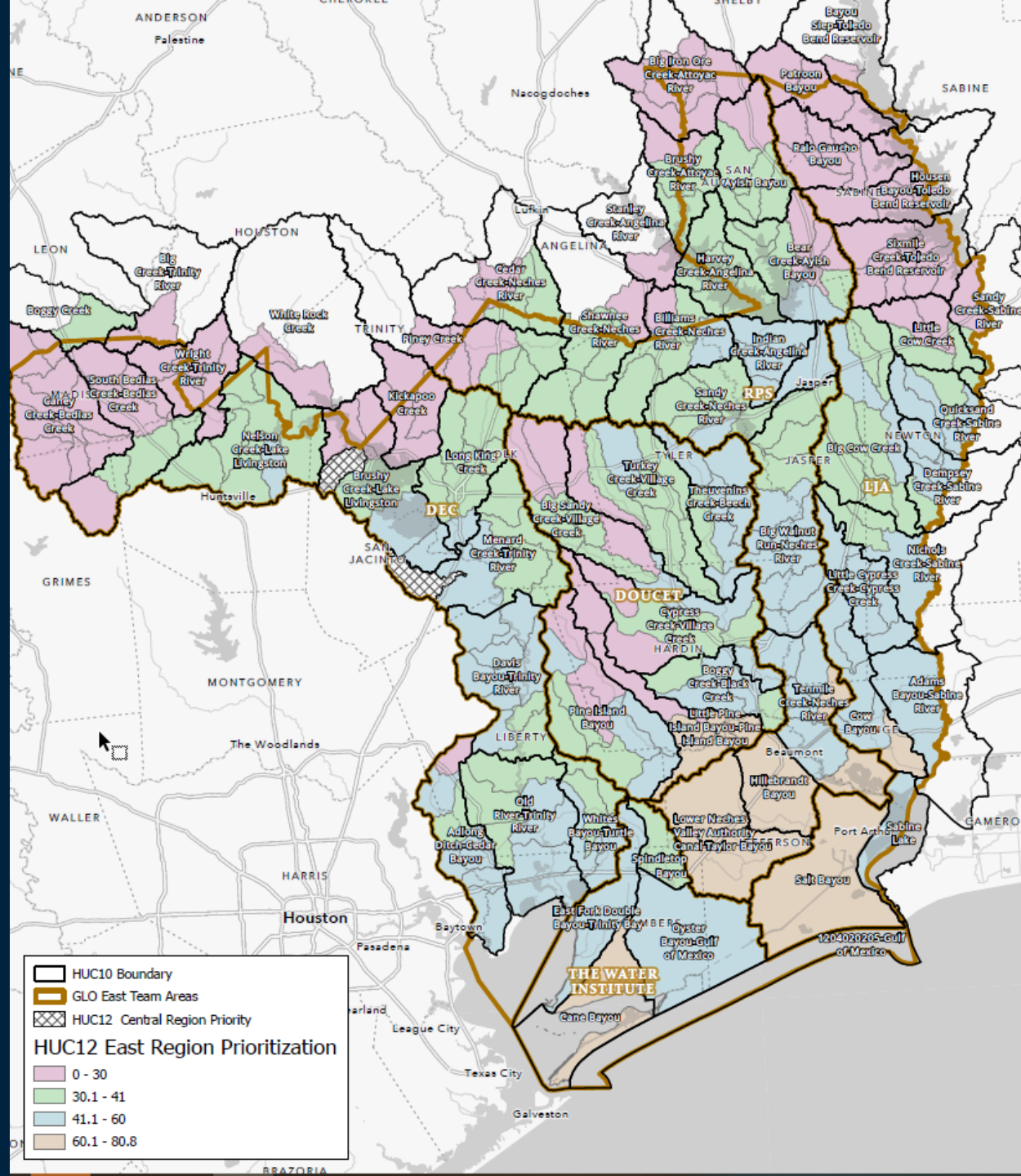
The analysis on a HUC 12 basis gave a normalized prioritization score that was applied to every USGS stream in the Region

The GIS process of the score was binned into three categories:

Tier 1 – High Risk

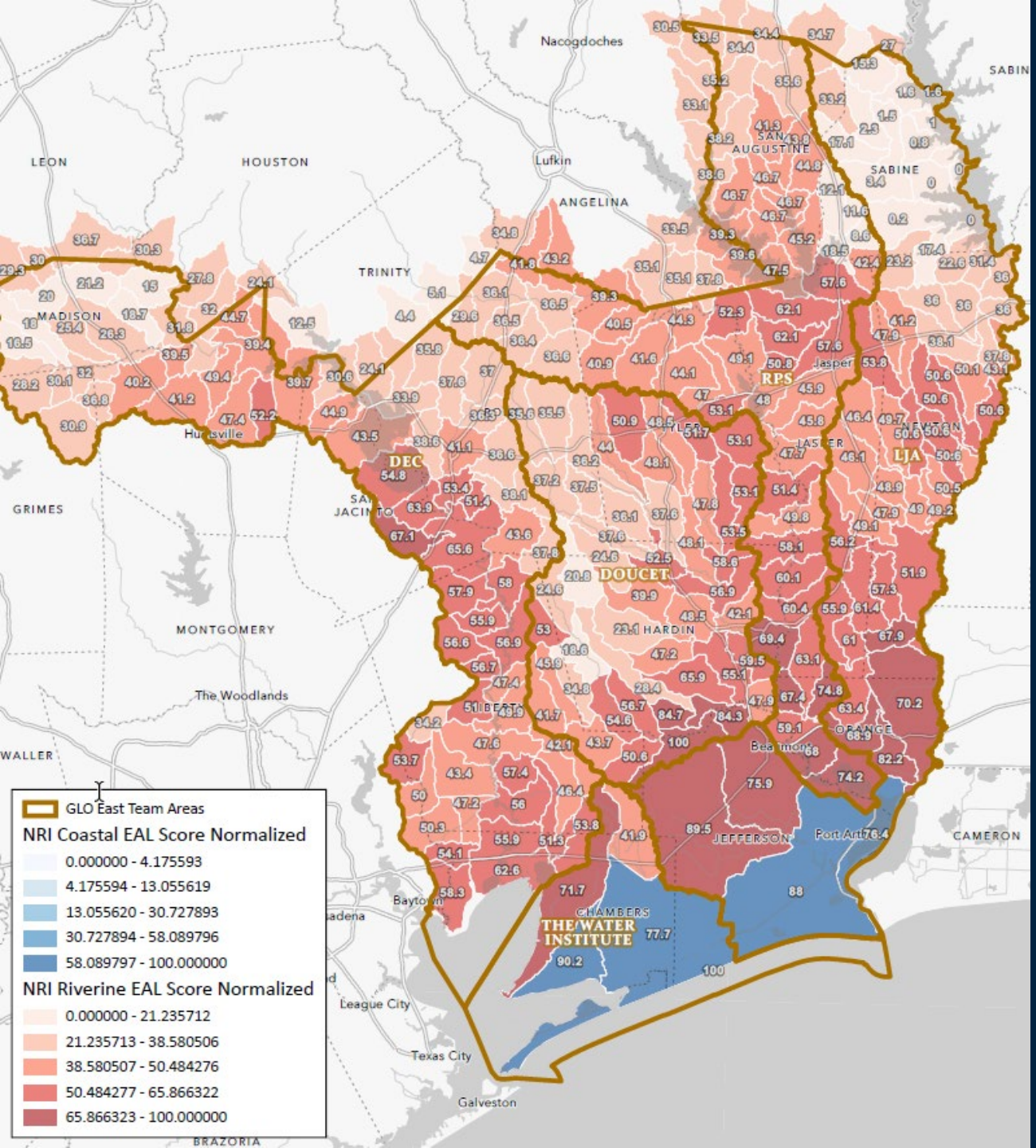
Tier 2 – Medium Risk

Tier 3 – Low Risk



Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 2 Coastal Analysis



The Determination of Coastal vs Non-Coastal was also determined with an evaluation process.

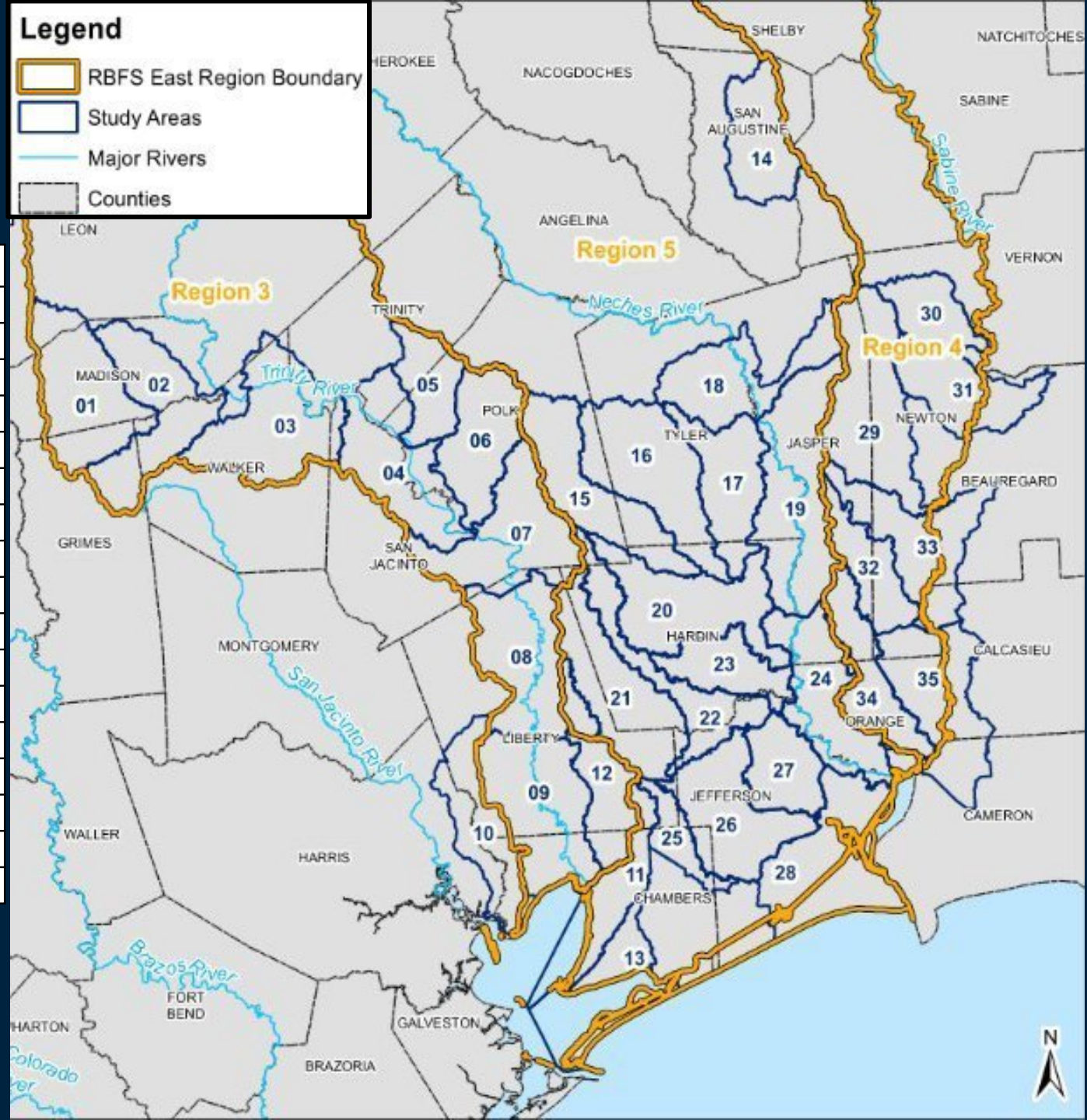
- Existing Risk of the HUC streams
- Conflict with existing projects (GCPD)
- GIS analysis

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 3 Study Areas

ID	Study Name
1	Caney Creek-Bedias Creek
2	South Bedias Creek-Bedias Creek
3	Nelson Creek-Lake Livingston
4	Brushy Creek-Lake Livingston
5	Kickapoo Creek
6	Long King Creek
7	Menard Creek-Trinity River
8	Davis Bayou-Trinity River
9	Old River-Trinity River
10	Adlong Ditch-Cedar Bayou
11	East Fork Double Bayou-Trinity Bay
12	Whites Bayou-Turtle Bayou
13	Cane Bayou
14	Ayish Bayou
15	Big Sandy Creek-Village Creek
16	Turkey Creek-Village Creek
17	Theuvenins Creek-Beech Creek
18	Sandy Creek-Neches River

ID	Study Name
19	Big Walnut Run-Neches River
20	Cypress Creek-Village Creek
21	Pine Island Bayou
22	Little Pine Island Bayou-Pine Island Bayou
23	Boggy Creek-Black Creek
24	Tenmile Creek-Neches River
25	Spindletop Bayou
26	Lower Neches Valley Authority Canal-Taylor Bayou
27	Hillebrandt Bayou
28	Salt Bayou
29	Big Cow Creek
30	Little Cow Creek
31	Quicksand Creek-Sabine River
32	Little Cypress Creek-Cypress Creek
33	Nichols Creek-Sabine River
34	Cow Bayou
35	Adams Bayou-Sabine River



Texas General Land Office | CDR
Commissioner Dawn Buckingham, M.D.

Model Level of Detail

The Phase 2 analysis guided the determination of the Phase 3 LOD

"Models will be built to varying levels of detail based on the **degree of existing flood risk** in a watershed and the **potential for flood risk mitigation projects**"

–RBFS Baseline SOP

Low	Low – Medium	Medium	Medium – High	High
• Little to no information • Lower overall risk and project potential • 2D BLE	• Some information • Some overall risk and project potential • 2D BLE+	• Contains information • Has overall risk and project potential • HMS and RAS	• Potential risk information • Regional risk/potential • HMS+ and RAS	• Measurable risk • Measurable project potential • All SOP components
	Coastal inclusions depending on location			

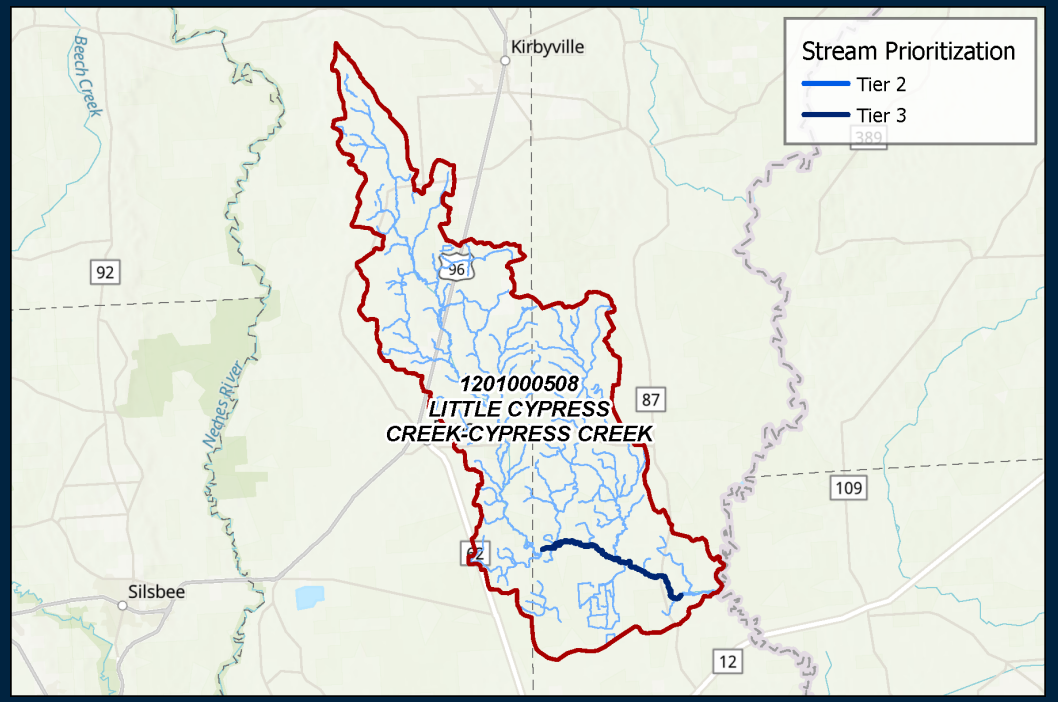
Model LOD Examples

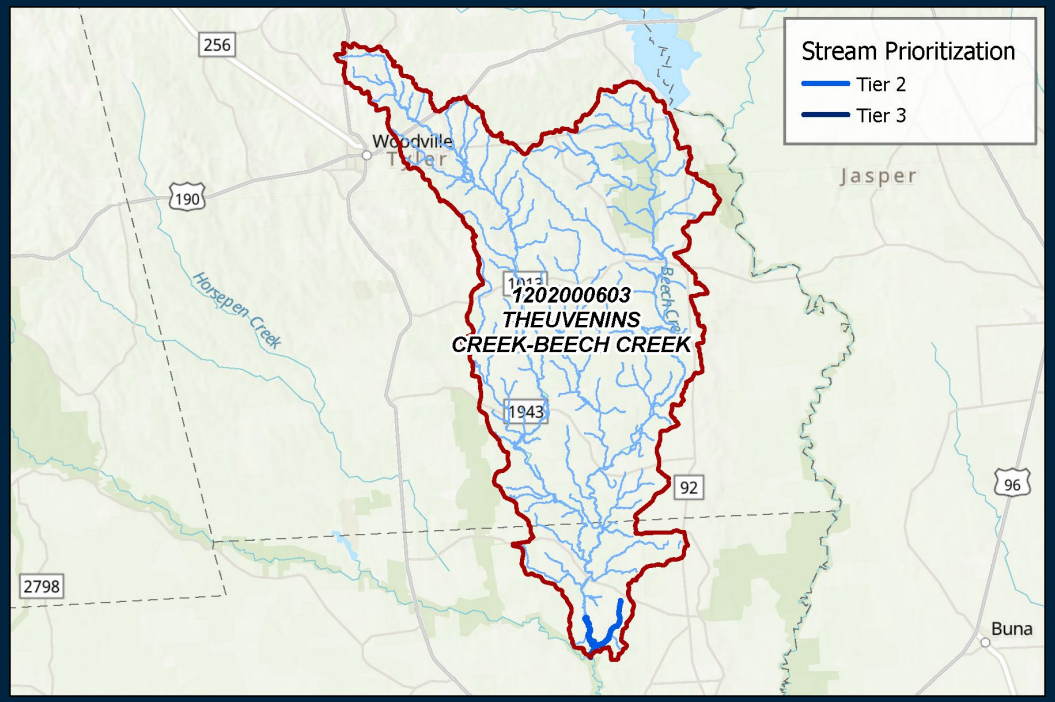
Given the population density most of the region was low or low – medium detail in terms of models produced for the phase.

Low Detail

Generally little measured prioritized streams or primarily Tier 3 streams if present

Models generally similar to BLE:
2D ROM HEC-RAS models





Texas General Land Office
Commissioner Dawn Buckingham, M.D.

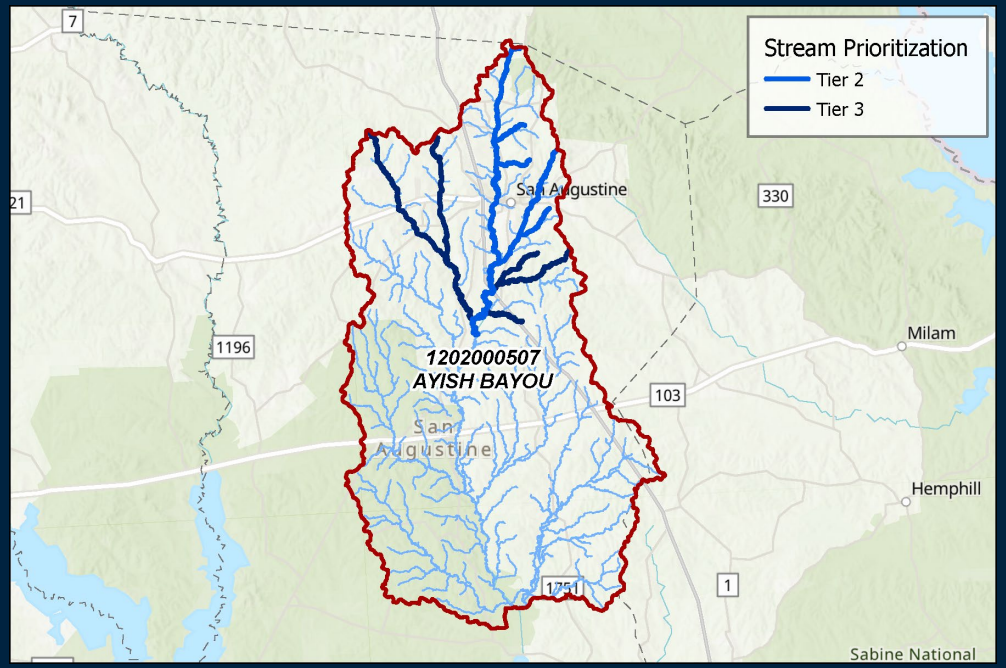
Model LOD Examples

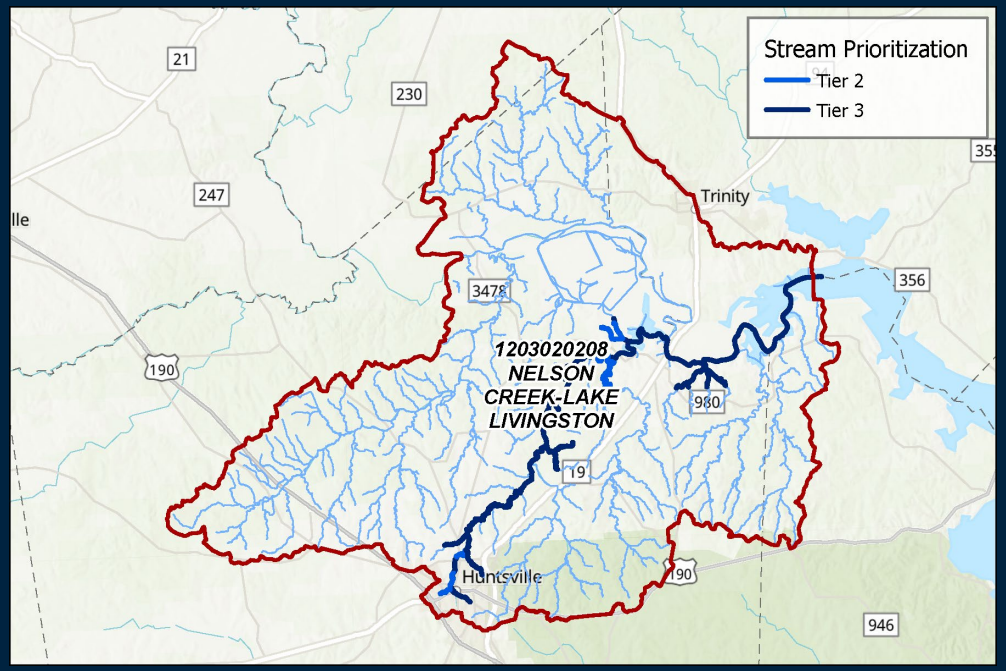
Low - Medium Detail

Mixed Tier 3 and Tier 2 streams and some Tier 2 streams with low expected project viability

Models include some survey structures on key streams and were built as either:
2D ROM HEC-RAS

2D HEC-RAS with HMS flow injections





Texas General Land Office
Commissioner Dawn Buckingham, M.D.

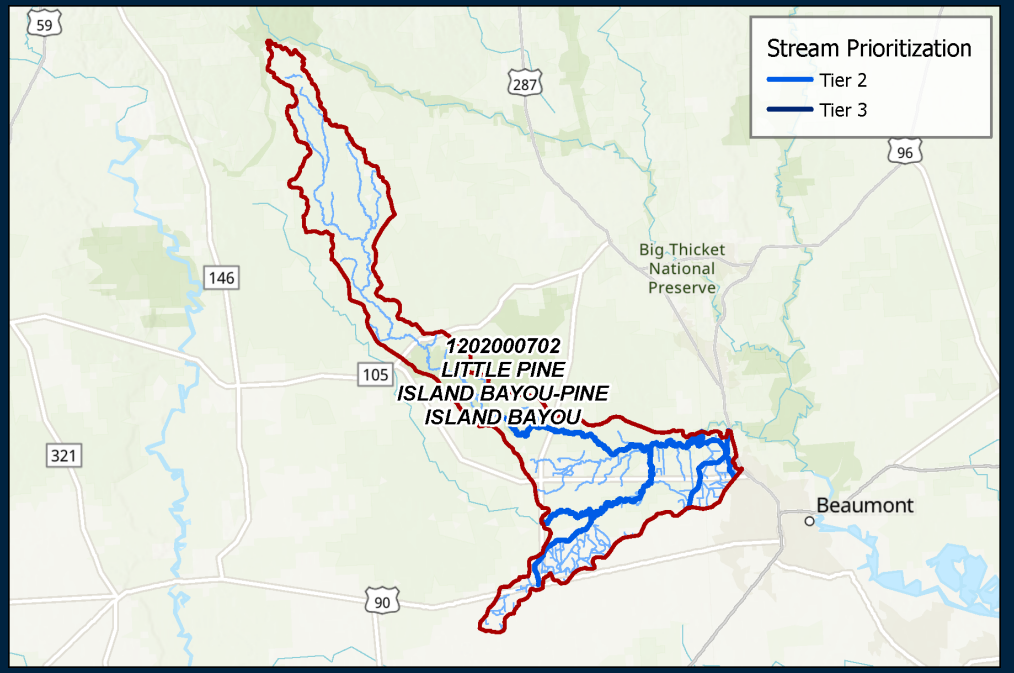
Model LOD Examples

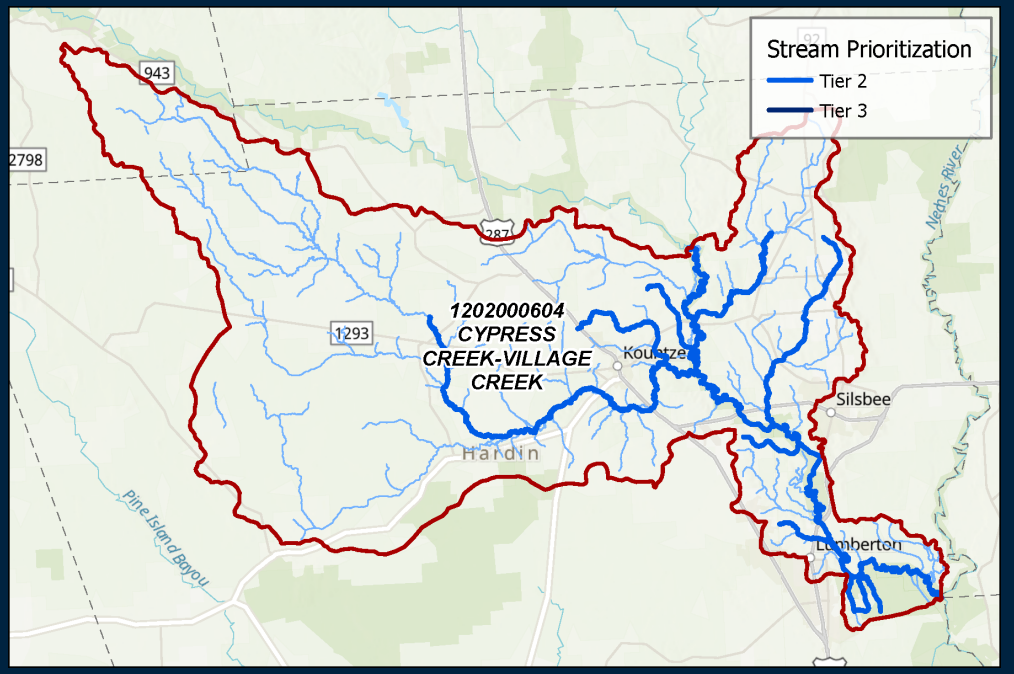
Medium Detail

Tier 2 streams or mixed Tier 2 and 3 with high project potential

Models included major structures and some survey structures:

2D HEC-RAS with HMS flow injections



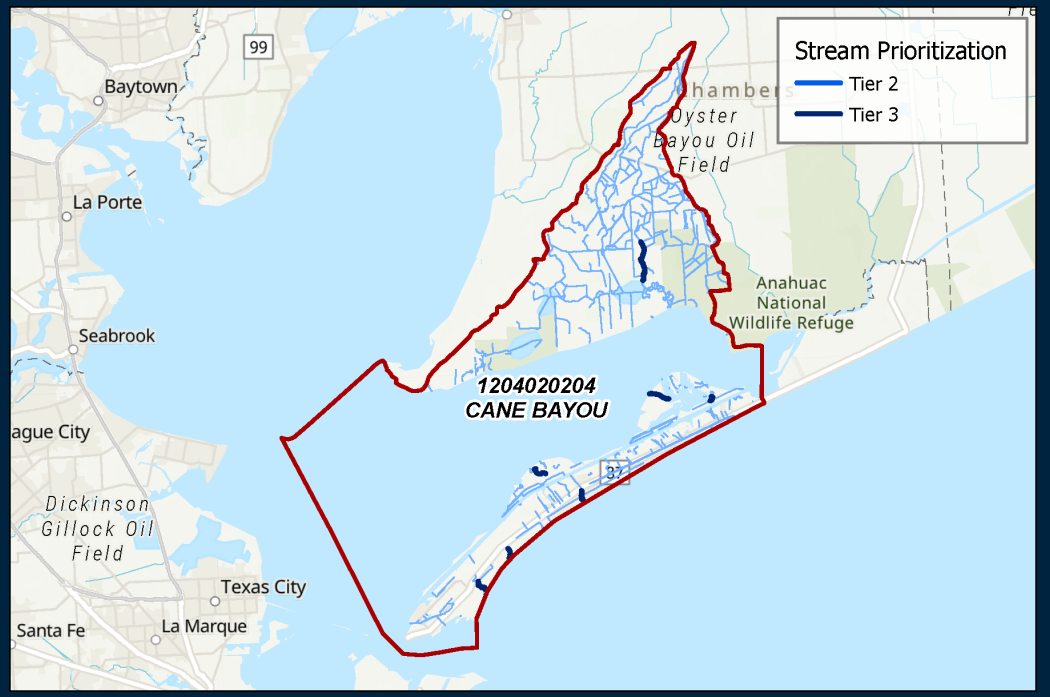


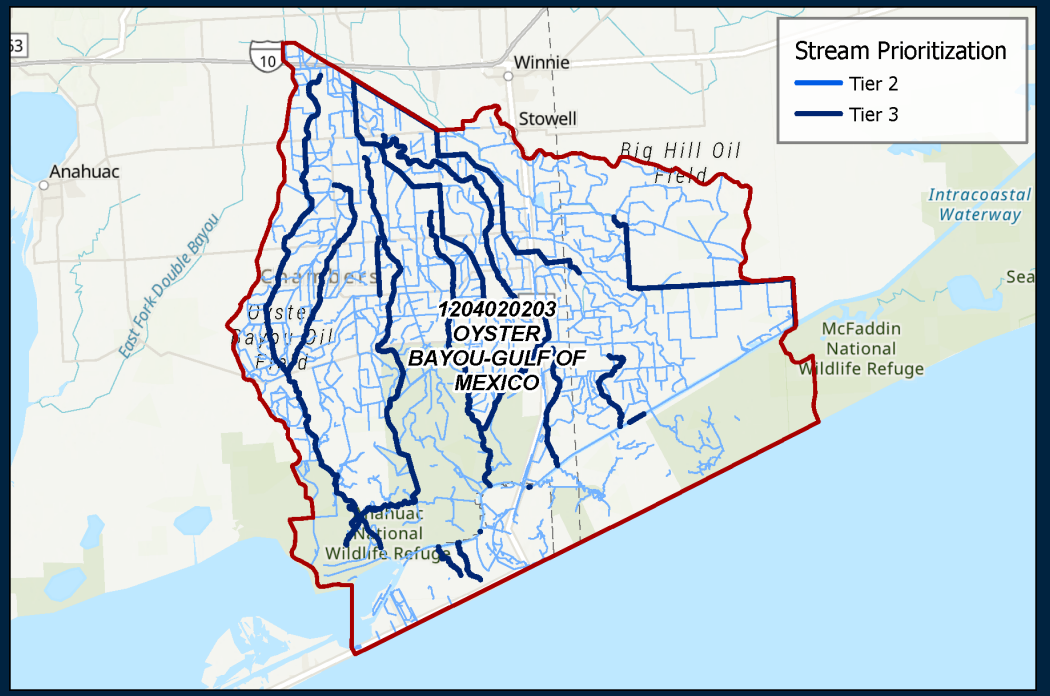
Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Model LOD Examples

Low – Med Coastal Model

Bivariate Analysis performed to scale existing ADCIRC results to model frequency flows on a most likely basis. The costal Region was combined into a single large HUC 8 2D ROM model with surge BCs to preform this effort.





Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Model Standards

Software	HEC-RAS 6.4.1
Land use	NLCD 2021 Aerial Imagery Building footprints or manual overrides if needed
2D Mesh	100ft – 300ft base cell size • Breakline enforcements • Terrain modifications • Cell size refinements • minimal manual edits so mesh could be remade
Structures	Survey and as-builts SA/2D Connections
Boundary Conditions	Flow Hydrograph (for injections) Normal Depth Stage Hydrograph (for costal and other zones)

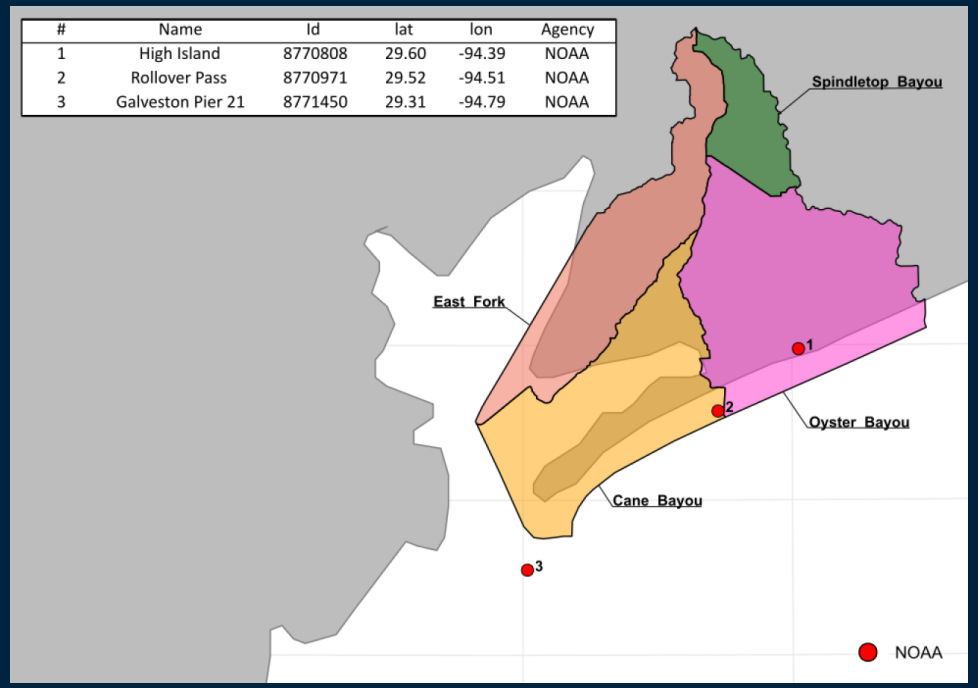
Following the SOP, individual modelling decisions were made based on engineering judgment depending on the level of effort and streams being impacted.

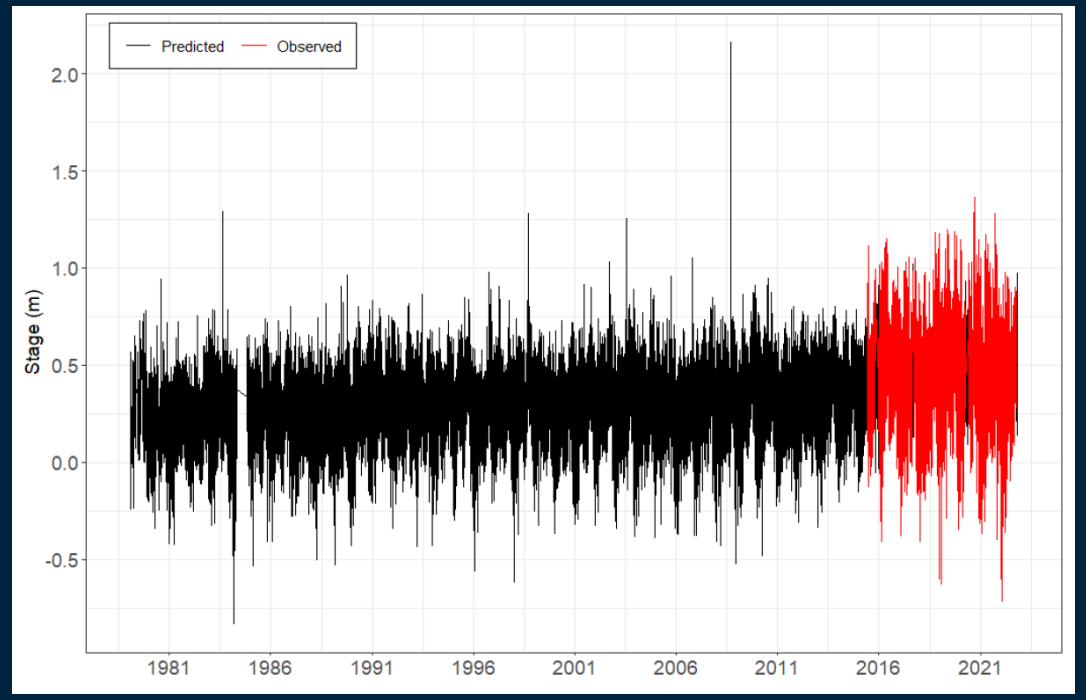
Examples such as including structures without survey or as-builts being added, or LiDAR edits to have bathymetry burned in. The engineers performing the work made countless decisions across the 35 HUC 10s modeled and are detailed in their individual reports.

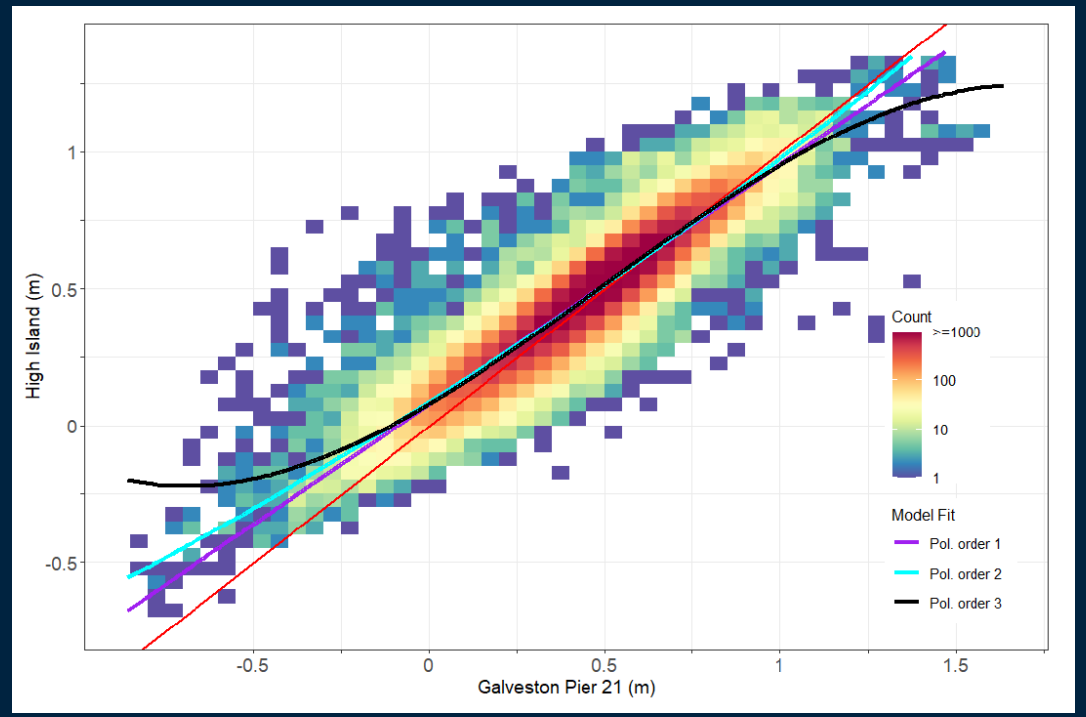
Bivariate Analysis

High Island and Rollover Pass gages were analyzed and extrapolated to create a period of record using Galveston Pier 21

#	Name	Id	lat	lon	Agency
1	High Island	8770808	29.60	-94.39	NOAA
2	Rollover Pass	8770971	29.52	-94.51	NOAA
3	Galveston Pier 21	8771450	29.31	-94.79	NOAA







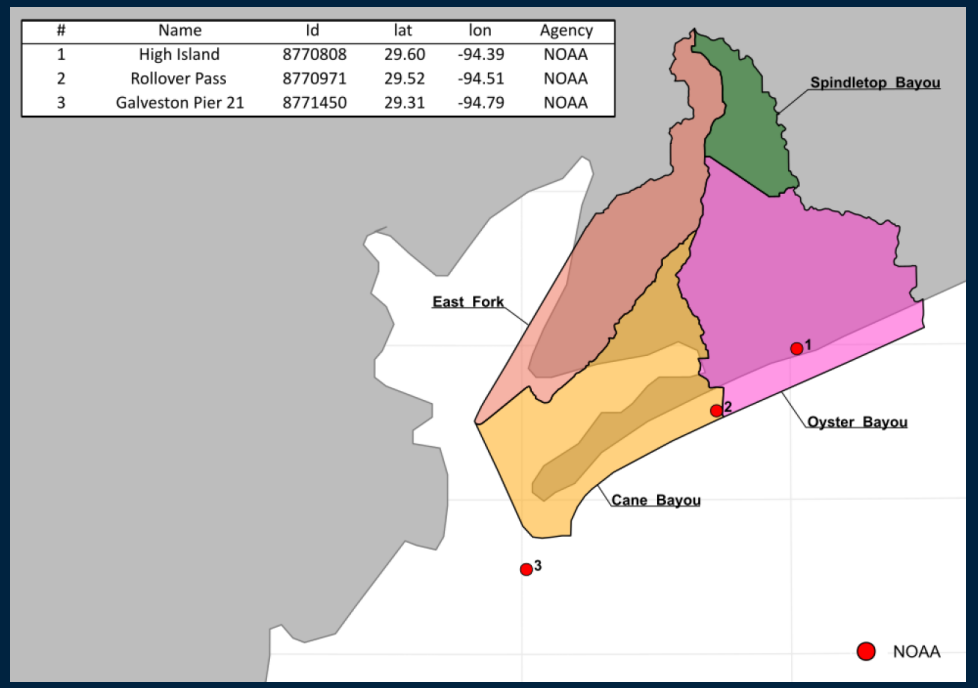
Texas General Land Office
Commissioner Dawn Buckingham, M.D.

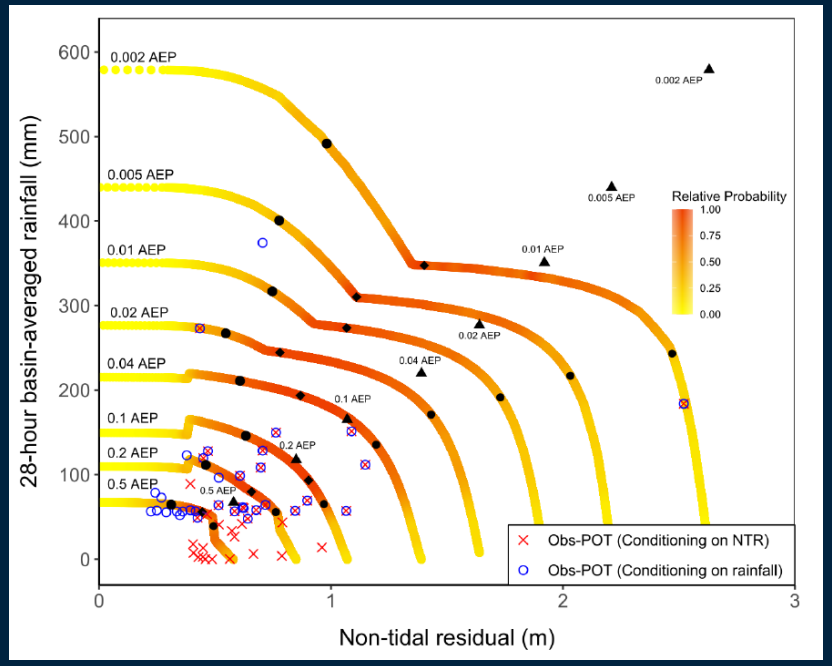
Bivariate Analysis

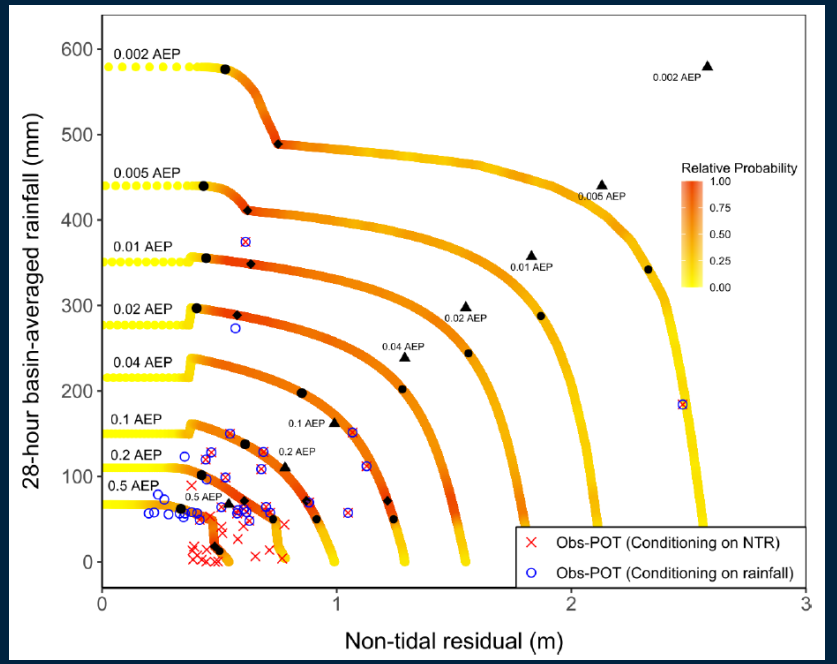
Each gage with an extended period of record was each then analyzed to determine the most likely scenarios of combined surge and rainfall events.

The most likely scenario for each gage as well as the surge dominated and rainfall dominated most likely events are show with the black diamonds and circles

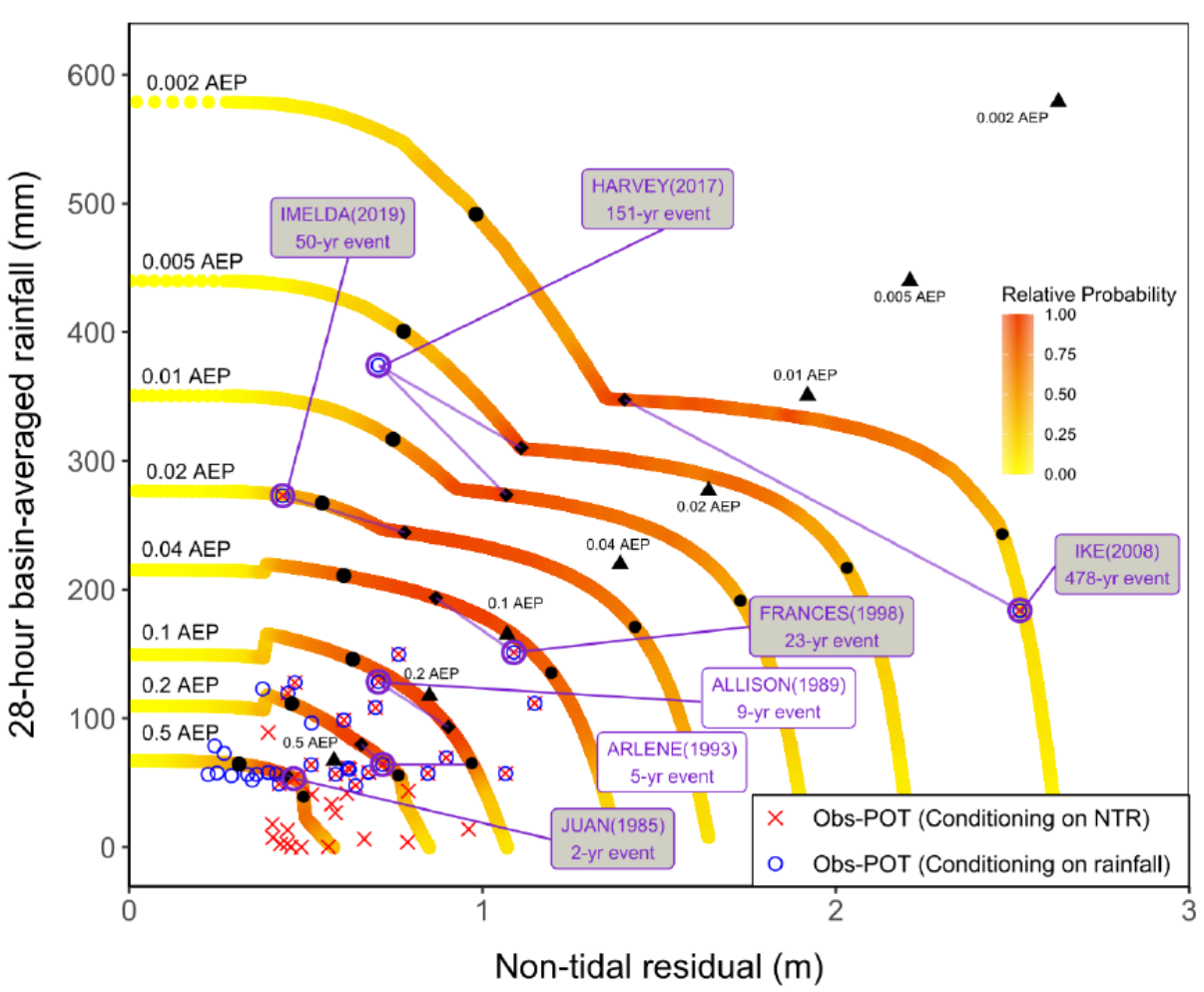
#	Name	Id	lat	lon	Agency
1	High Island	8770808	29.60	-94.39	NOAA
2	Rollover Pass	8770971	29.52	-94.51	NOAA
3	Galveston Pier 21	8771450	29.31	-94.79	NOAA

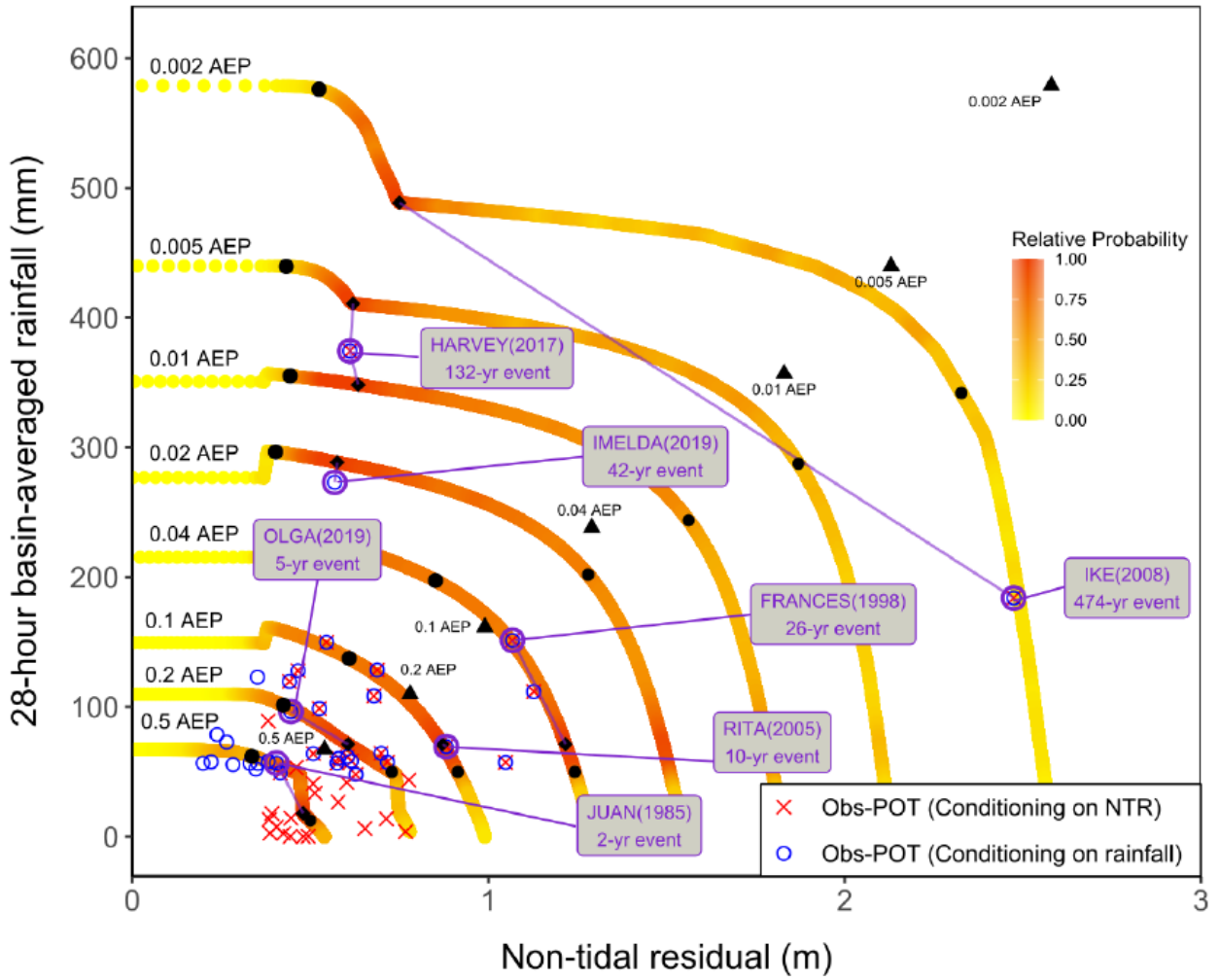






Texas General Land Office
Commissioner Dawn Buckingham, M.D.





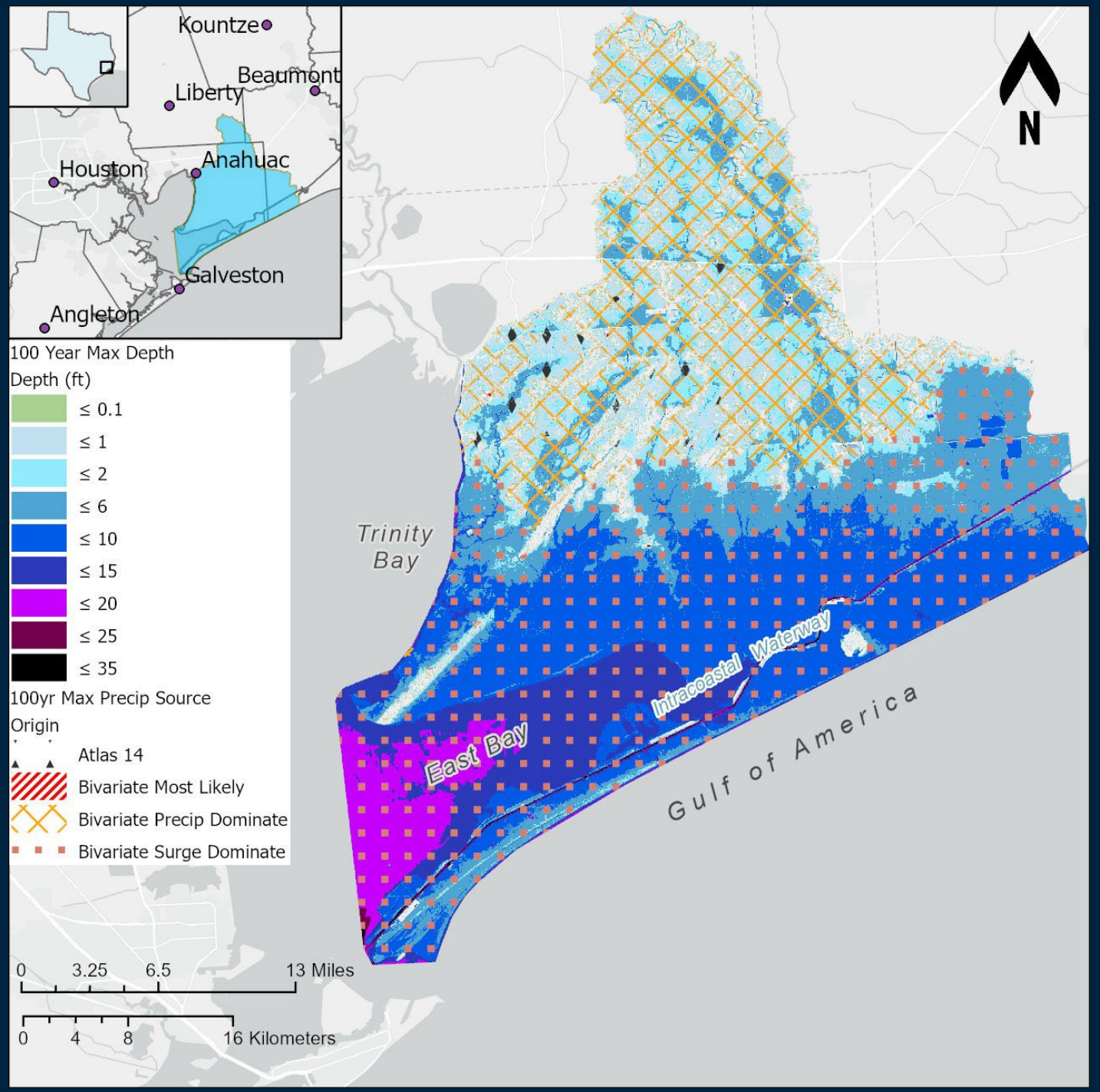
Recorded events shown for each gage on the resulting probability space graphics

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Costal Model

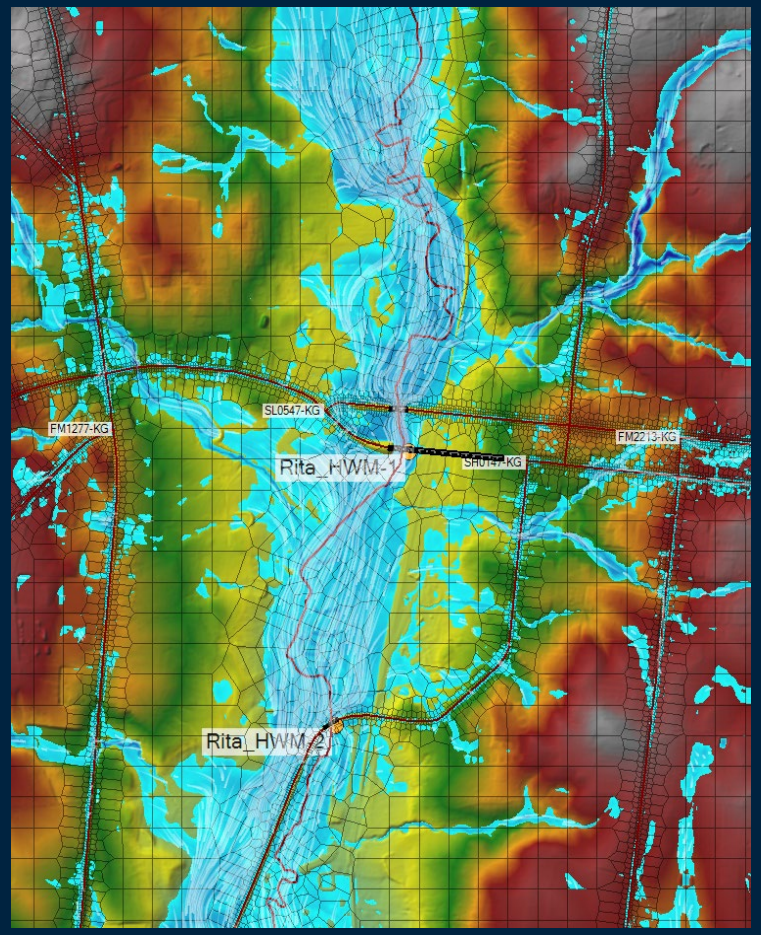
The outcome of that analysis was AEP precipitation events for what have been called a most likely (ML), surge dominated (SD), and precipitation dominated (PD) gridded inputs. Additionally, the AEP precipitation events were paired with historical storm surge pairings for use in the downstream boundary conditions. The surge data was taken from ADCIRC+SWAN model runs and processed/scaled for use in the downstream boundary condition.

Frankenstein Map Development:
Because 4 events were modeled per AEP event (ML< SD< PD and Atlas-14), the maximum WSE of each event was processed in GIS and mapped based on which model predicted the higher WSE.



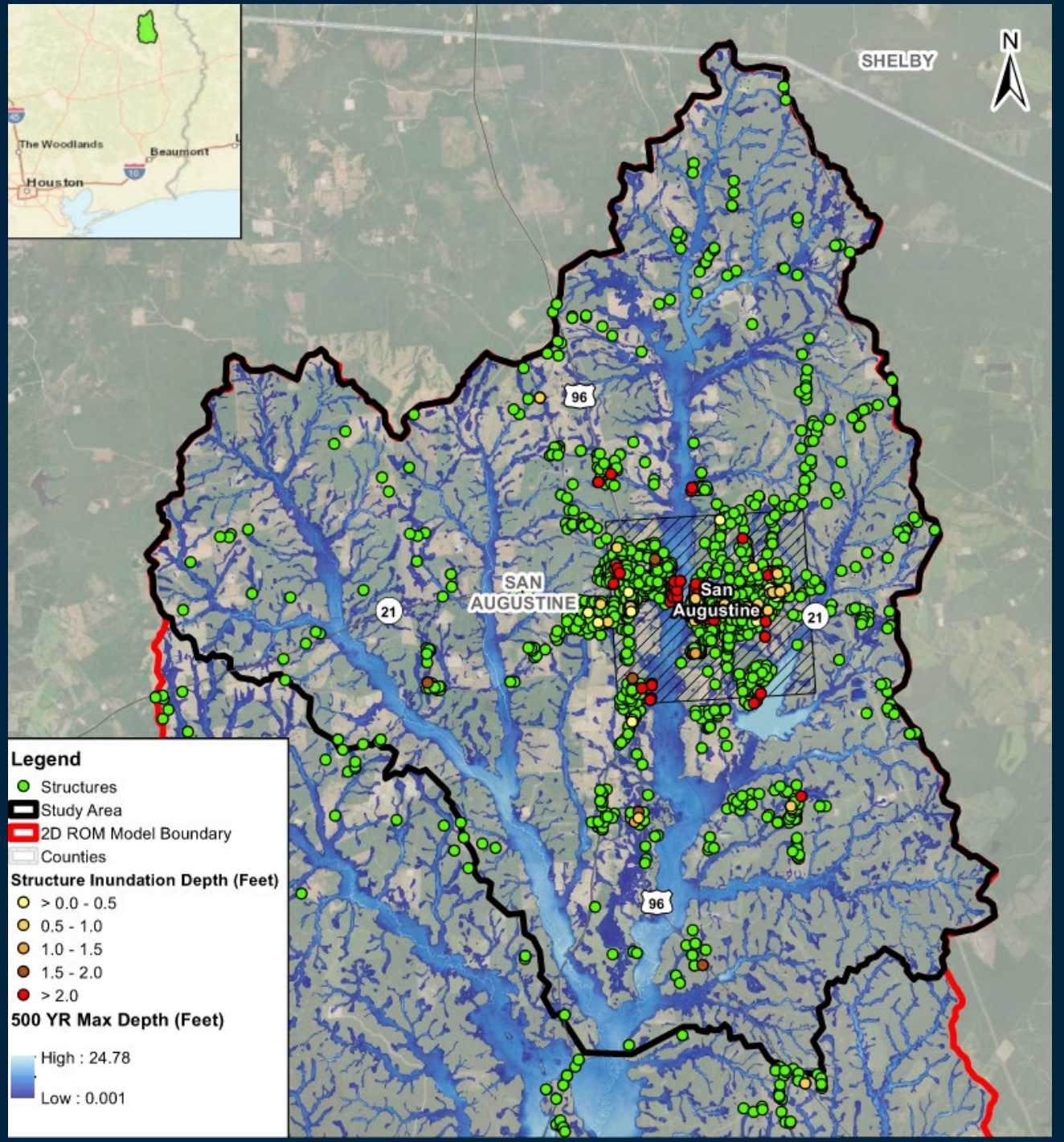
Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Inland Models



WSE maps produced by the 2D models were analyzed for surrounding risk to structures, roadways, and agricultural lands.

The maps had good correlation with FEMA effective, BLE, and InFRM results in the main channels but provide much more information in the overland areas



Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 3 Hotspots

Based on the results of the Phase 3 Baseline model results (for WSEL/Depth) a metric called annual expected instances of flooding (AIOF) was laid out in the Hotspot Analysis SOP.

This gave a quantitative metric to use as part of the assessment of locations for Phase 4 analysis.

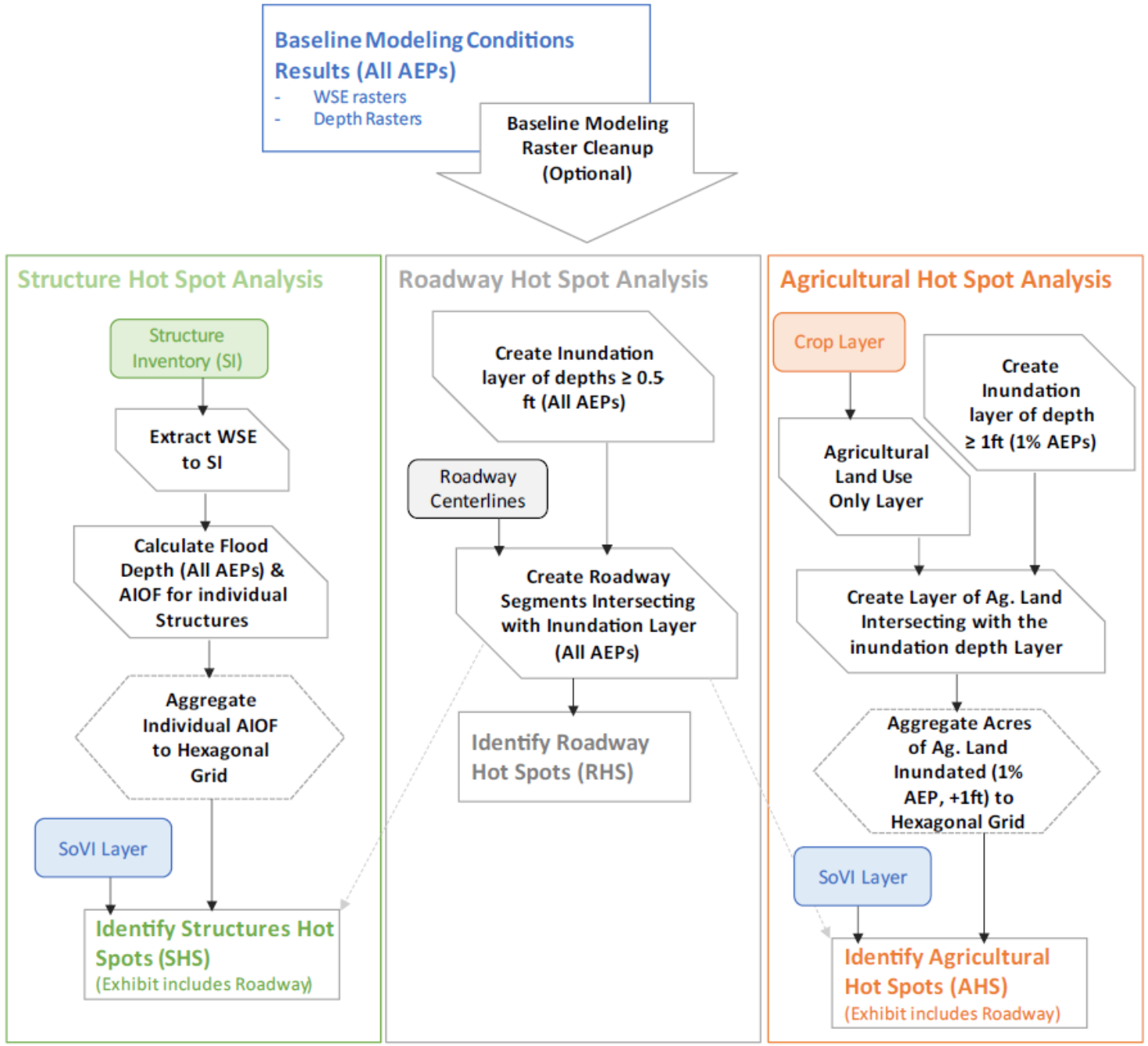


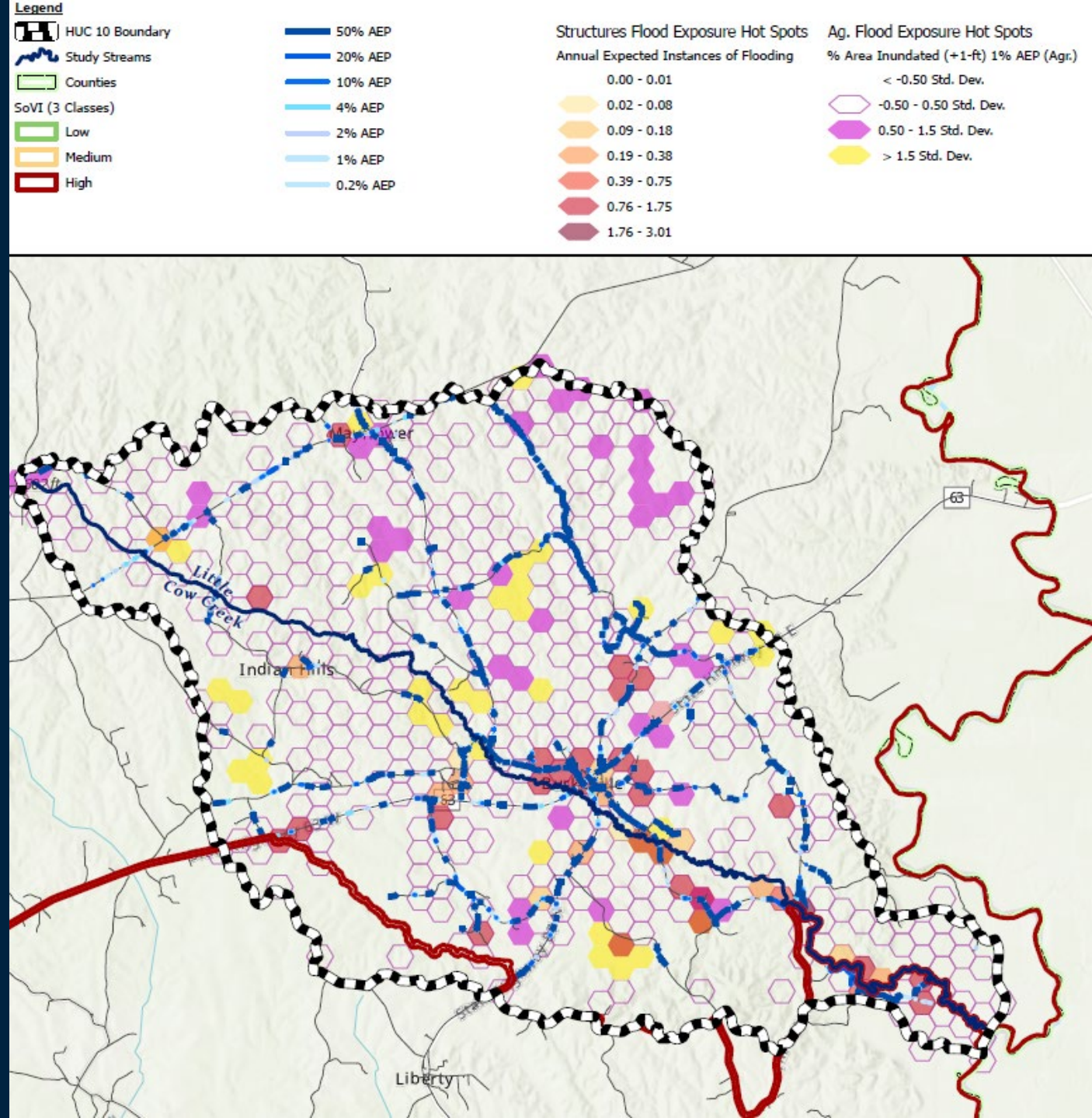
Figure 2. Regional Hot Spot Analysis Procedural Flow Chart

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 3 Hotspots

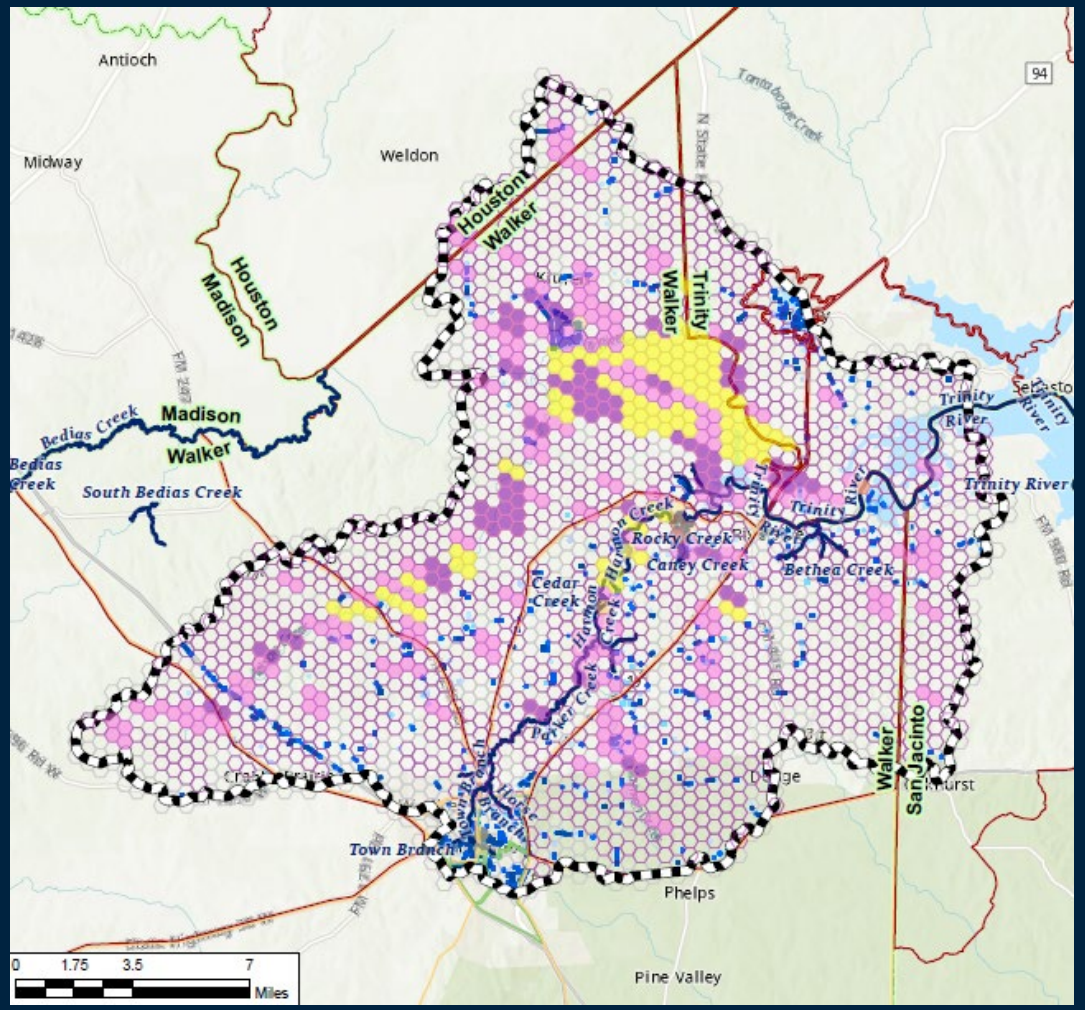
The AIOF and other analysis like roadway and Ag. were taken and filtered for the most significant damages.

Since so much of the region was modeled in Phase 3 many rounds of filtering and prioritization were needed to get to a viable number of locations for alternatives analysis.

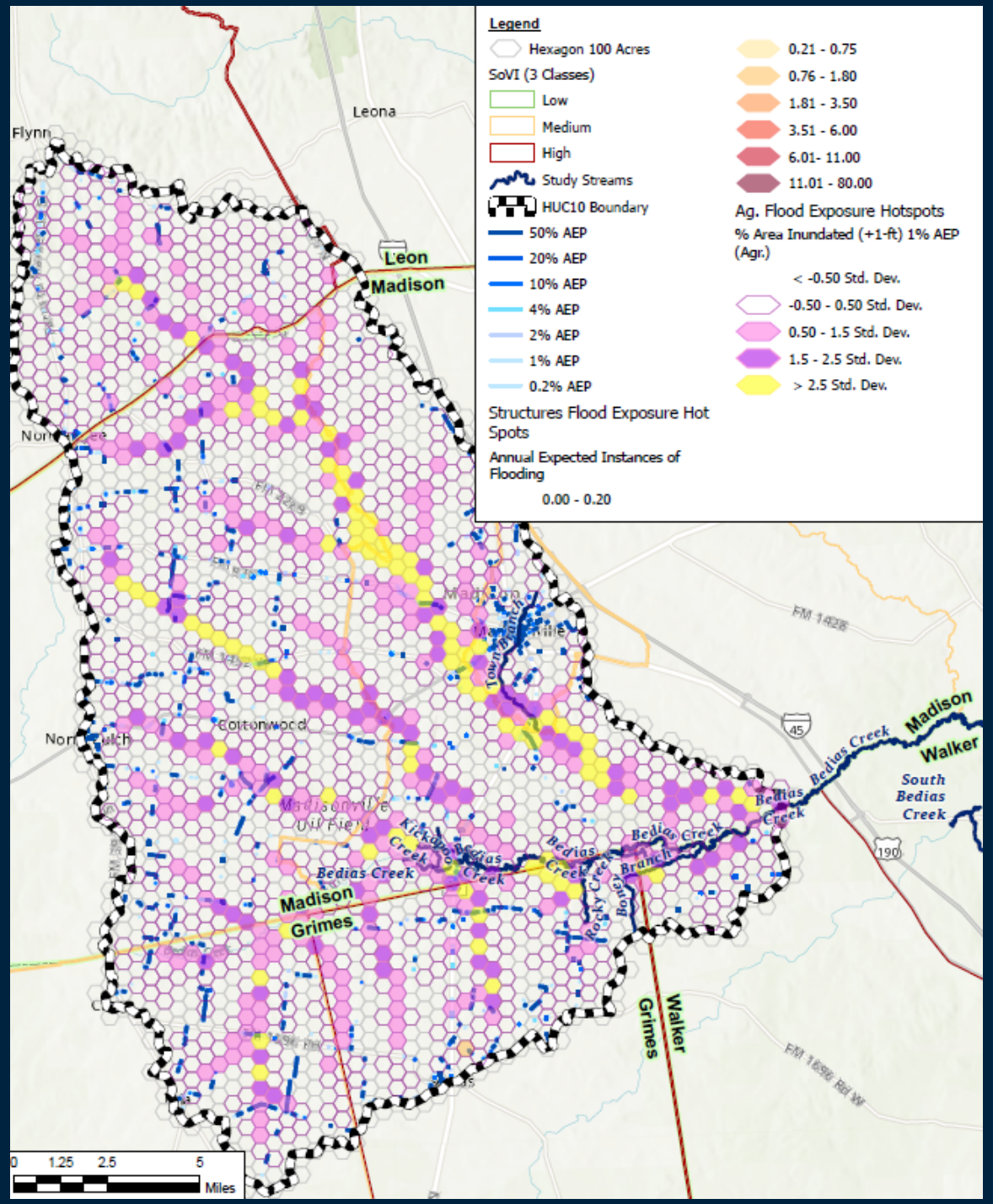


Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Phase 3 Hotspots



Ag flooding was generally combined with other forms of flooding to be considered for analysis in Phase 4.

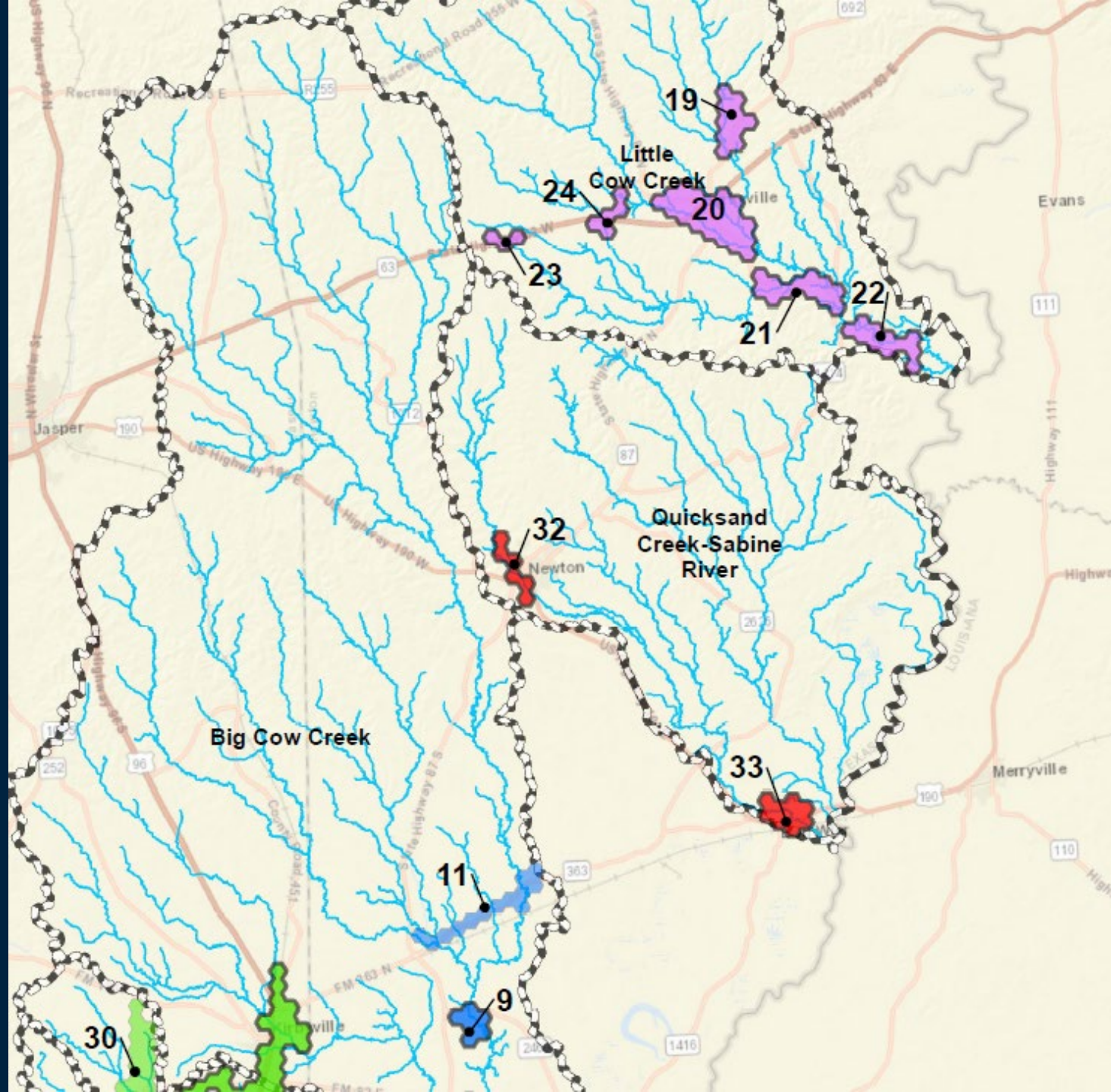


Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Hotspots to Mitigation Areas

The hotspot results were then clustered together into semi-contiguous groups based on engineering judgment and fooding source to form mitigation areas.

There areas are where the Phase 4 efforts will be located for smaller scale targeted alternatives analysis.



Texas General Land Office
Commissioner Dawn Buckingham, M.D.

Strengths and Weakness

Strengths of the Approach

1. Provided a BLE or better engineering model to all areas involved in the study. This is a large amount of the initial effort completed for any future projects or studies.

2. The continuum of model effort laid out in the SOP meant that the engineers could tailor the approach to maximize the efforts in any individual location while still covering all zones.

Weakness of the Approach

1. The inherent non-uniformity of models and level of detail makes it difficult for communication and requires a lot of documentation.

2. If the selections of Phase 3 prioritization (hotspots) did not fully align with the Phase 2 prioritization (Stream Tiers) then some efforts could be over done or need additional work in baseline refinements for Phase 4 Alternatives Analysis.

Phase 4 Alternatives Analysis

Analysis Framework

✓ Decision milestones

Step 1

Identify Problems and Opportunities

1. Define Risk and Need
2. ✓ Conceptualize Mitigation Ideas

Step 2

Collect Data and Define Mitigation Targets

1. Site Specific Data Collection for Alternatives Analysis
2. Performance Targets
3. Future Conditions and Resilience

Step 3

Formulate Alternatives

1. ✓ Screen Mitigation Concepts
2. Generate Alternatives
3. Develop Modeling Plan

Step 4

Analyze Alternatives

1. Without-Project Model
2. With-Project Model
3. Develop Preliminary Comparison

Step 5

Compare Alternatives

1. ✓ Evaluate Alternatives
2. Preliminary Rank/Prioritize Alternatives

Step 6

Recommend an Alternative

1. ✓ Select Recommended Alternative
2. Refine Recommended Alternative

Figure 1. Overview of Alternatives Analysis Process

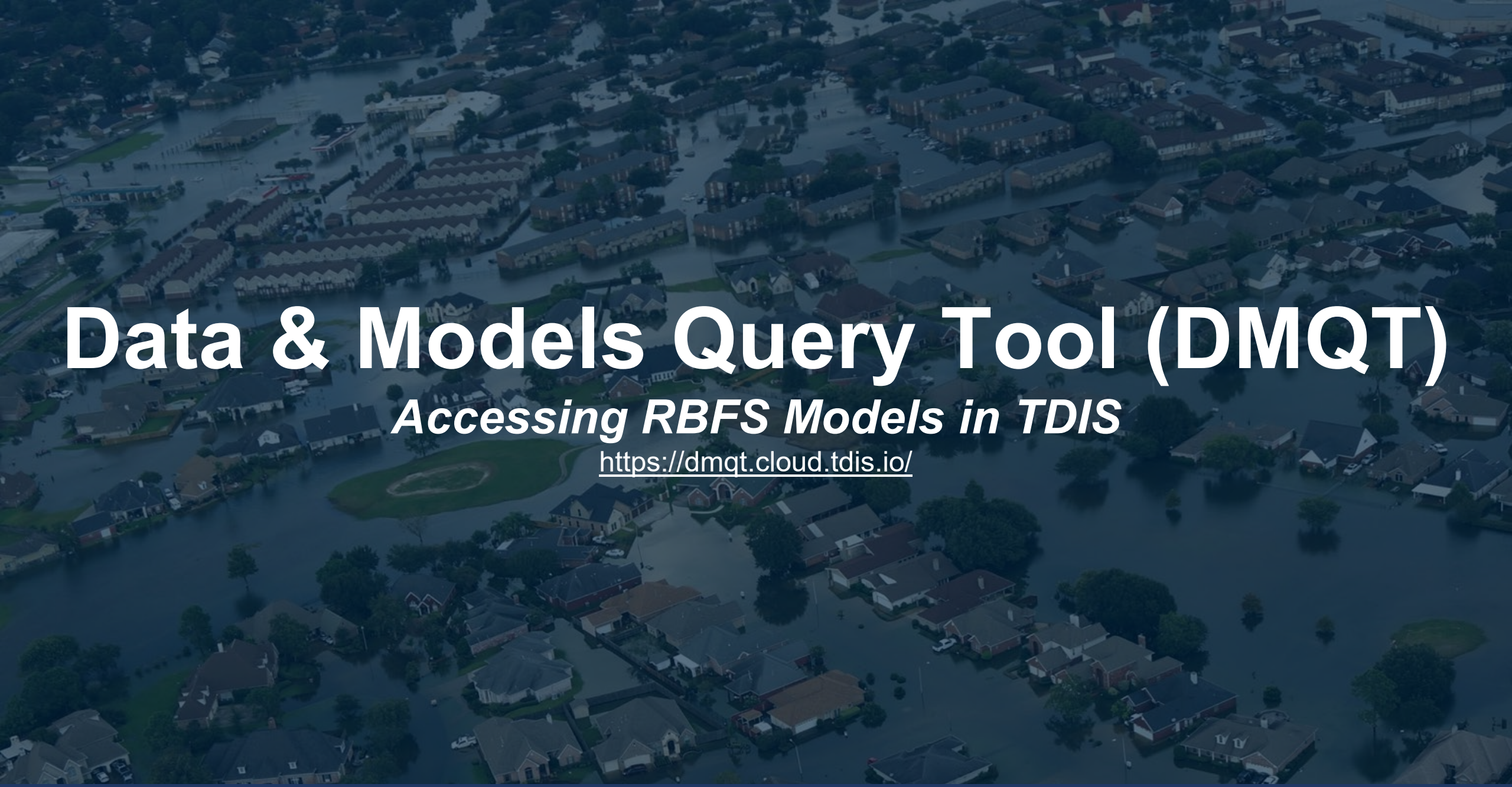
				Percent complete	70%	0%	0%	0%
Alternatives Analysis Step	**Alternatives Analysis Report Section**		**Description**	**25%**	**50%**	**75%**	**100%**
1	Identify Problems and Opportunities	1.1	Summarize RBFS Efforts to Date				
		1.2	Define Source, Risk, and Need				
		1.3	Define Objectives				
		1.4	Identify Mitigation Concepts that Could Meet Objectives				
2	Collect Site-Specific Data and Define Mitigation Targets	2.1	Collect Site-Specific Data				
		2.2	Establish Performance Targets				
		2.3	Identify Future Condition Data Sources				
3	Formulate Alternatives	3.1	Evaluate Mitigation Concepts Using Screening Criteria				
		3.2	Generate Alternatives				
		3.3	Develop Preliminary Modeling Plan				
4	Analyze Alternatives	4.1	Develop Without-Project Model				
		4.2	Develop With-Project Model				
		4.3	Compare Alternatives (Preliminary)				
5	Compare Alternatives	5.1	Evaluate Alternatives Using Evaluation Criteria				
		5.2	Rank/Prioritize Alternatives, Including Preliminary Recommendation				
6	Recommend an Alternative	6.1	Select Recommended Alternative				
		6.2	Refine Recommended (or Prioritized) Alternative(s)				
Model Package							
Benefit-Cost Analysis Data (Excel format)							

Phase 4 AA

Where we are as of this presentation:

Most of the initial assessments and models plans for the Mitigation Areas have been completed.

Most models will be cropped to less than the Baseline model and have further refinements and additional survey



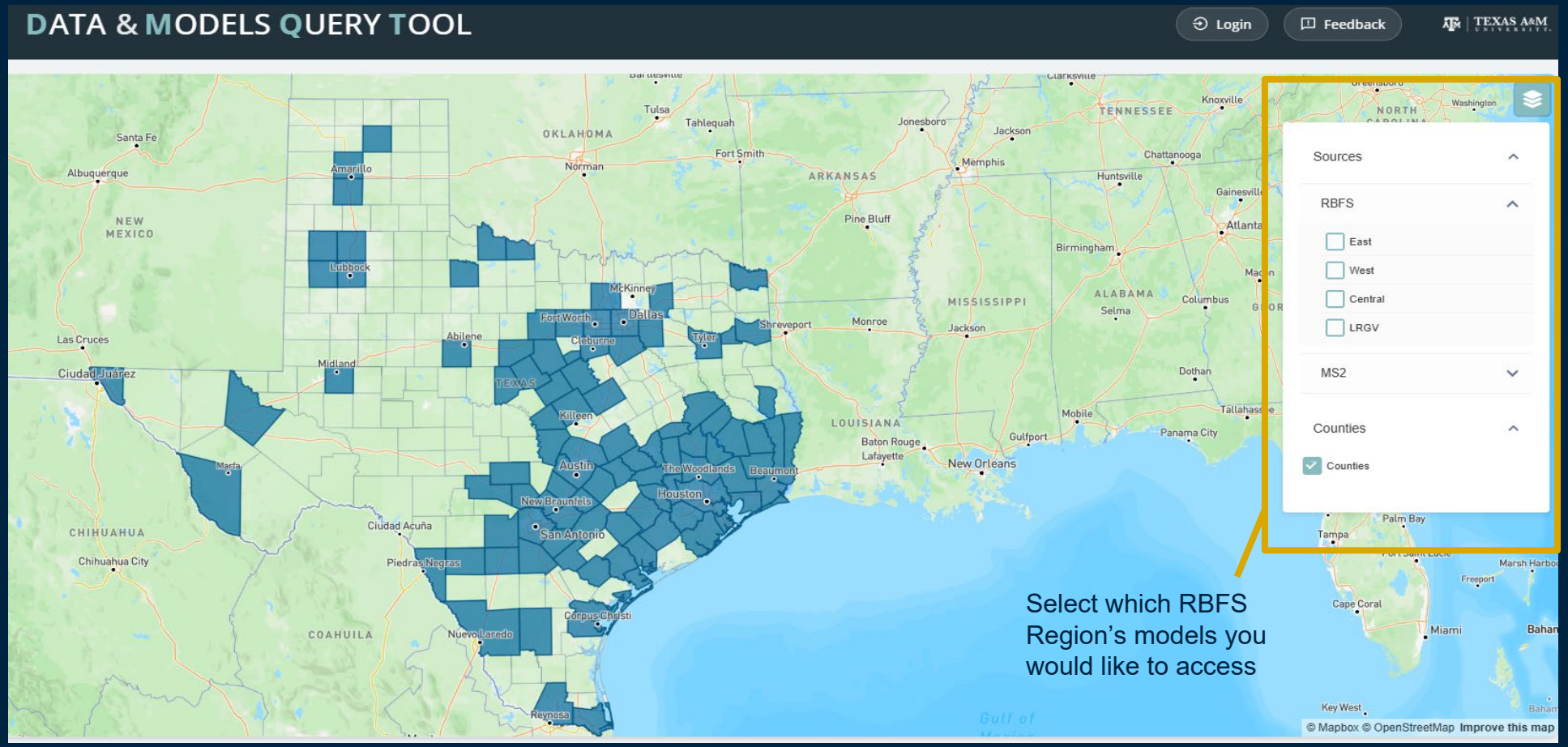
Data & Models Query Tool (DMQT)

Accessing RBFS Models in TDIS

https://dmqt.cloud.tdis.io/

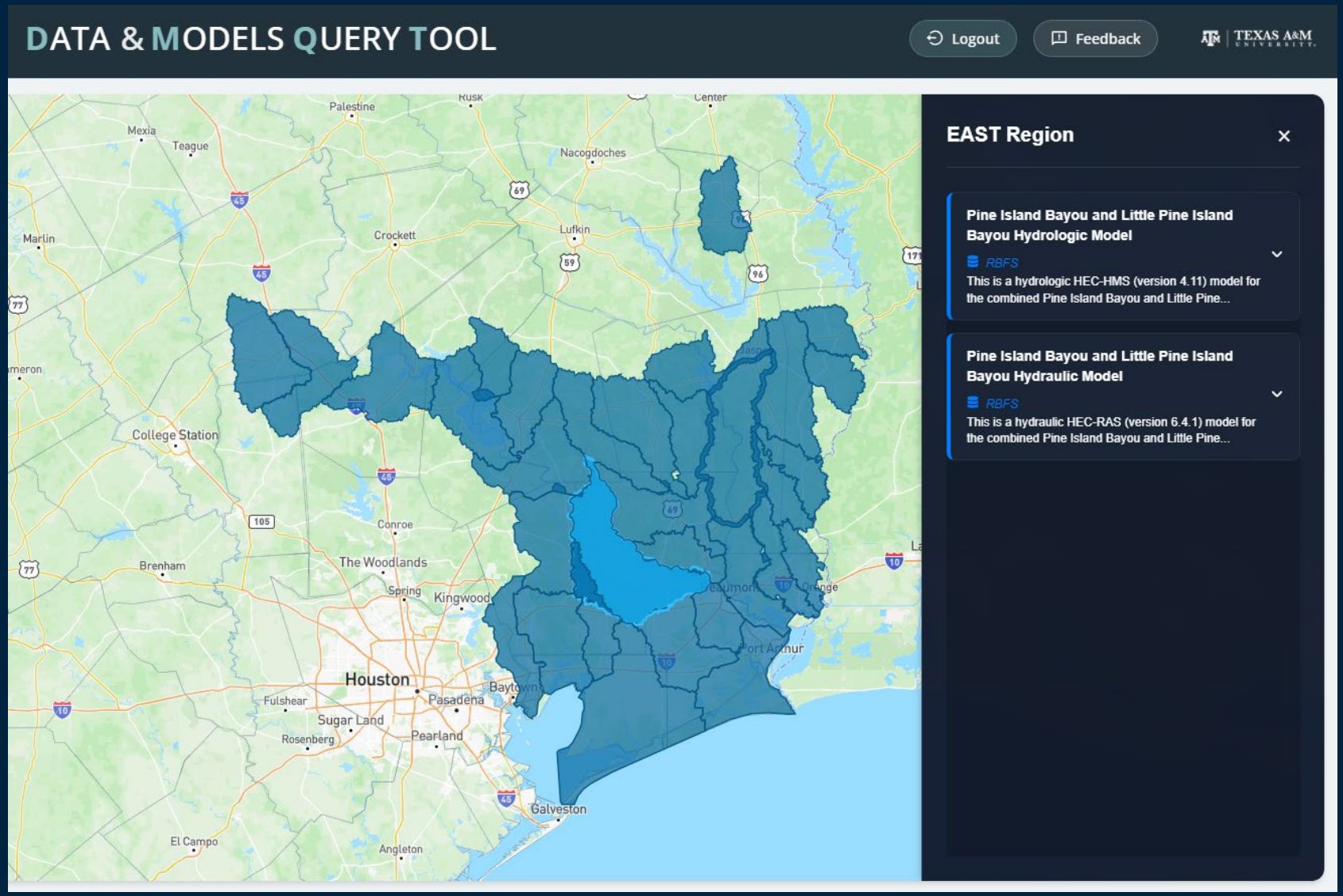
Commissioner Dawn Buckingham, M.D.

TDIS Data & Models Query Tool



Texas General Land Office
Commissioner Dawn Buckingham, M.D.

TDIS Data & Models Query Tool



Texas General Land Office
Commissioner Dawn Buckingham, M.D.

TDIS Data & Models Query Tool

Pine Island Bayou and Little Pine Island Bayou Hydraulic Model

X

General Information | Contact Information

HUC:

1202000701, 1202000702

County:

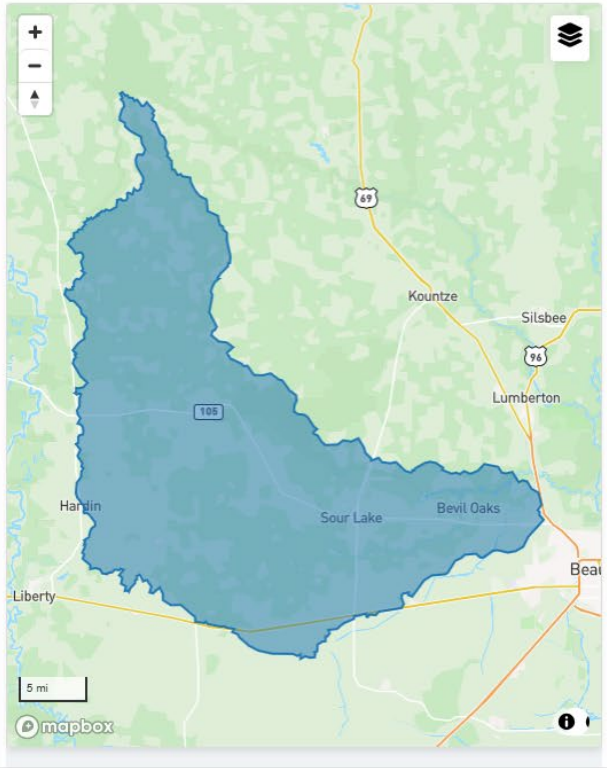
Polk, Liberty, Hardin, Jefferson

City:

Sour Lake, Nome, Daisetta, Bevil Oaks, Other

Model Description:

This is a hydraulic HEC-RAS (version 6.4.1) model for the combined Pine Island Bayou and Little Pine Island Bayou HUC10. This model was developed by East Region for the Texas General Land Office's River Basin Flood Study during Phase 3 of the study. This is a hydraulic model run to determine water surface elevations and inundation boundaries for calibration, validation, and hypothetical events. Modeled events include historical storms and frequency storms. This model was run for the August 2017, September 2019, May 2021, May 2015, and November 2015 historical events and the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 500-year hypothetical scenarios.



Model Files Listing | Available Files for Download

Search files and folders

1202000701 Pine Island Bayou 1

N/A* - Not Available/Not Applicable/Not Specified

Close

Texas General Land Office
Commissioner Dawn Buckingham, M.D.

QUESTIONS?

Contact by email at:

GLOfloodstudies.east@recovery.texas.gov