

Welcome to the Public Hearing for the 2022 Annual Groundwater Report



- Participants will be muted for the entire hearing.
- Public testimony will be available for participants at the end of the hearing. The hearing is presented virtually for viewing purposes only.
- The webinar is being recorded including all chat between participants.
- For any problems, please chat with the organizer.

HARRIS-GALVESTON



SUBSIDENCE
DISTRICT

2022 Annual Groundwater Report

Public Hearing – April 27, 2023

Harris-Galveston Subsidence District Mission

- The Harris-Galveston Subsidence District was created in 1975 to prevent land subsidence in Harris and Galveston counties through the regulation of groundwater.
- Land subsidence contributes to flooding, threatening the economic health of the area.
- Efforts to prevent subsidence by the District and the regulated community have required significant investment to create a more resilient infrastructure while securing reliable water sources for future needs.
- An annual groundwater hearing is required by enabling the act to receive testimony regarding the effects of groundwater withdrawals on subsidence.



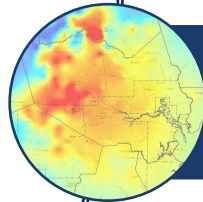
Agenda



Climate



Groundwater Use



Groundwater Levels



Subsidence Data

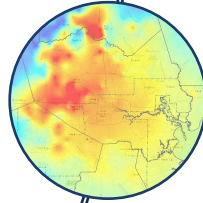
Agenda



Climate



Groundwater Use



Groundwater Levels



Subsidence Data

Exhibit 1

Location of National Weather Service (NWS) climate stations used for precipitation data for the 2022 calendar year.

(Provisional - Subject to Revision)

2022 Cumulative Precipitation and 1991-2020 Precipitation Normals from select NWS Climate Stations

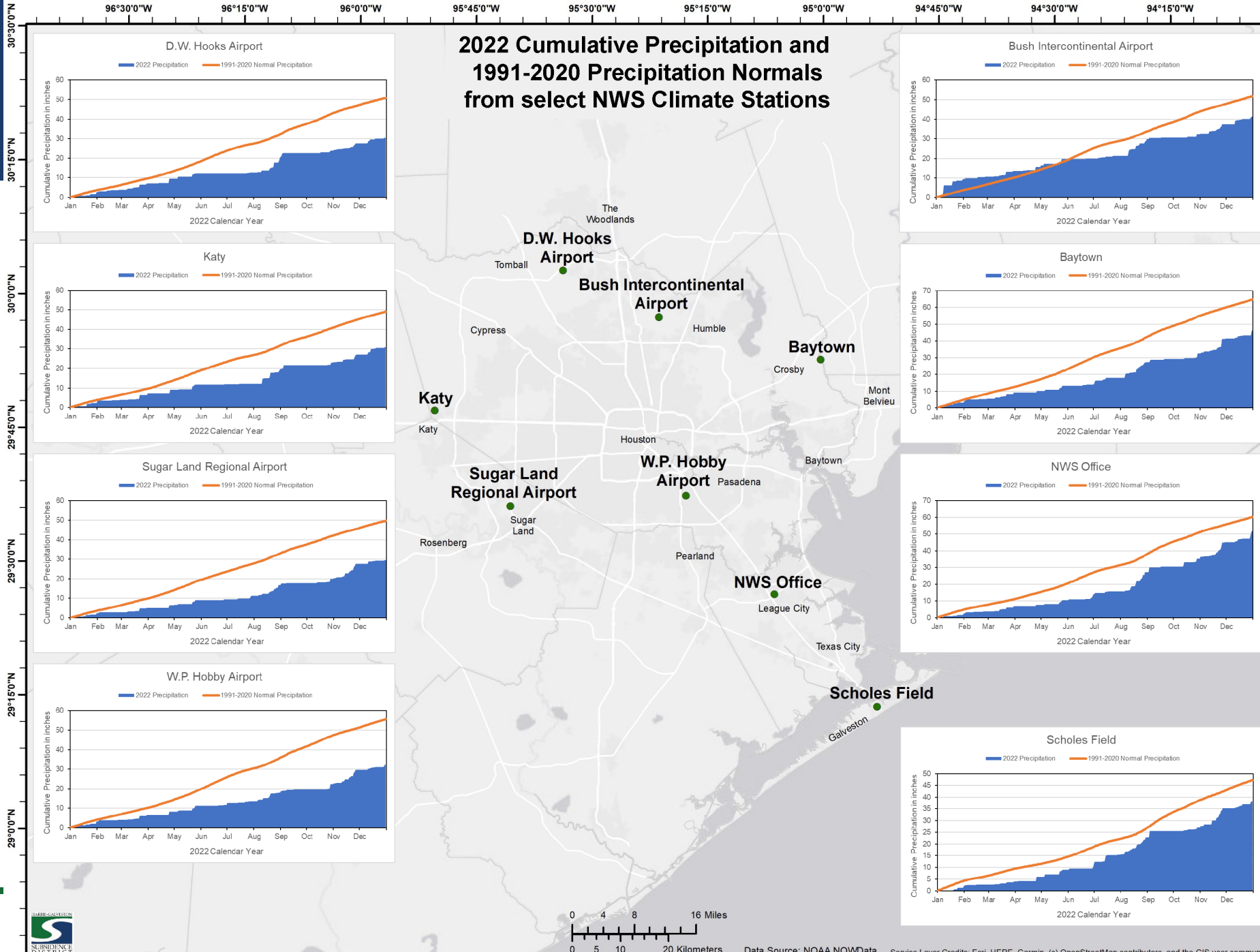
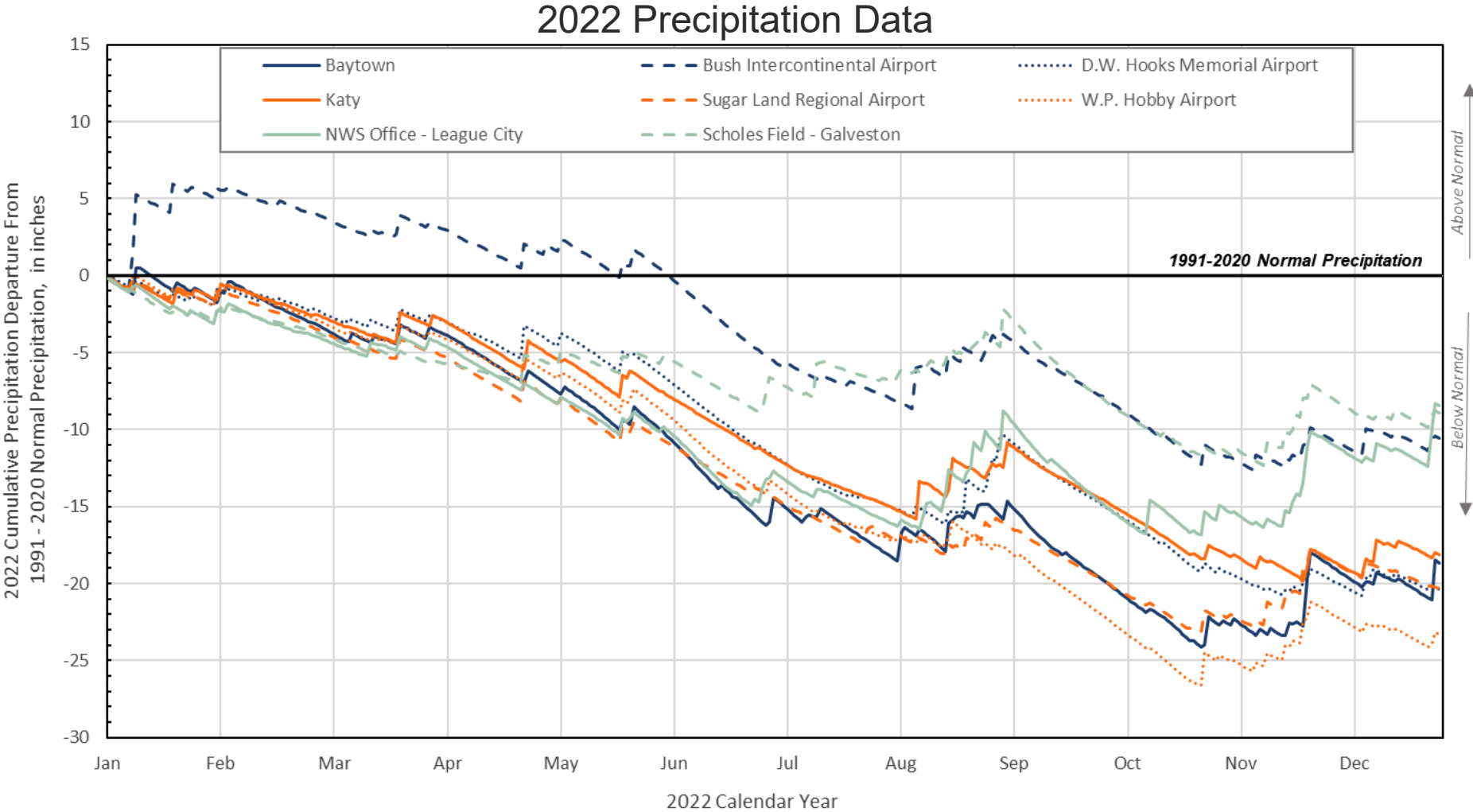


Exhibit 2



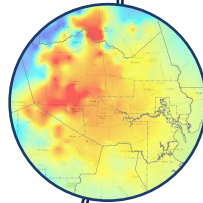
Agenda



Climate



Groundwater Use

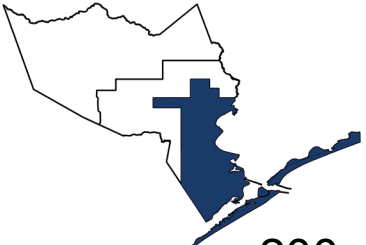


Groundwater Levels



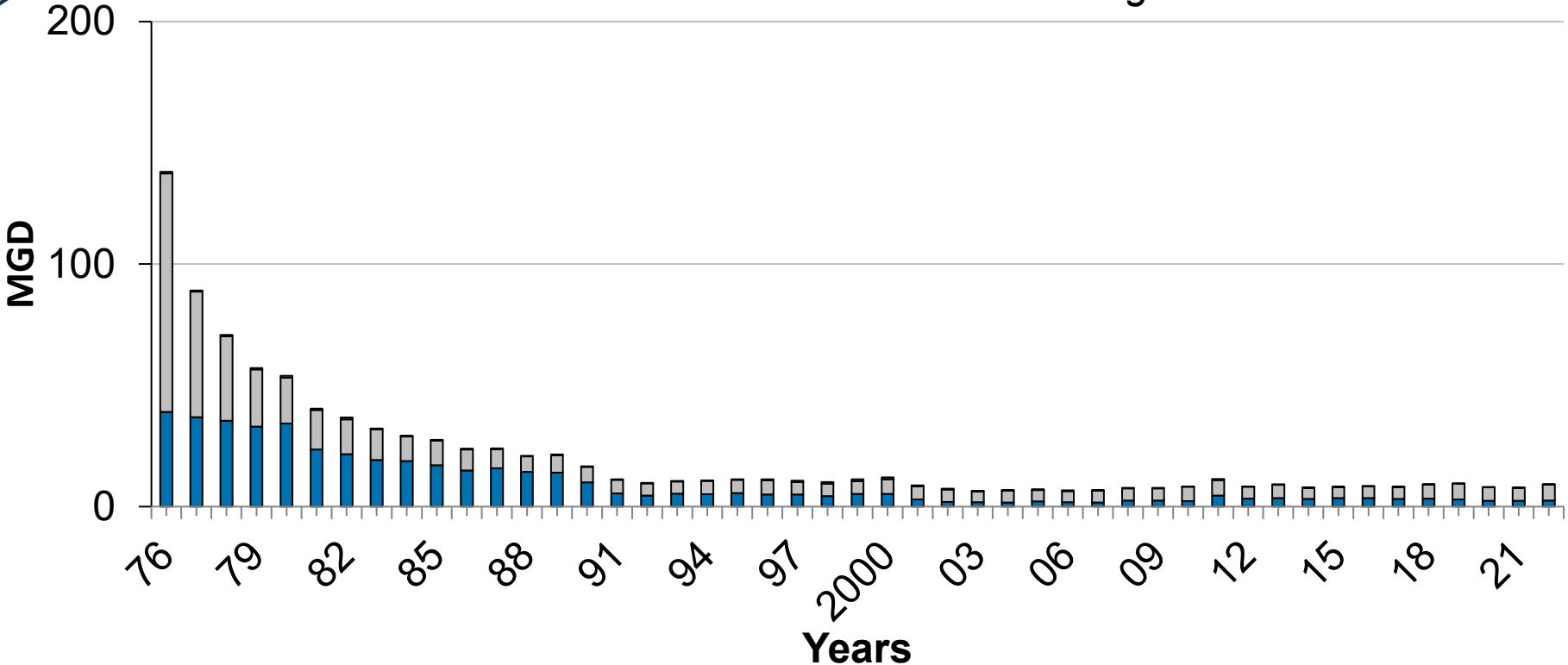
Subsidence Data

Exhibit 3



Regulatory Area One Groundwater Withdrawals Grouped by Use

■ *Public* ■ *Industrial* ■ *All Irrigation*



2022: 9.2 MGD

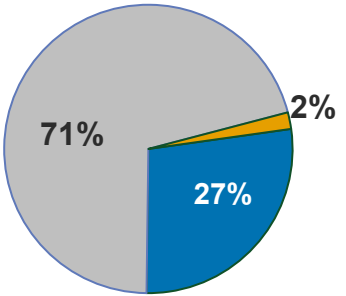
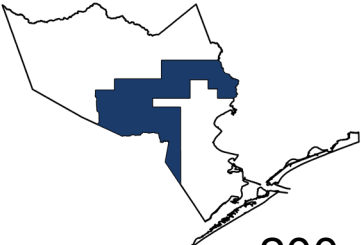
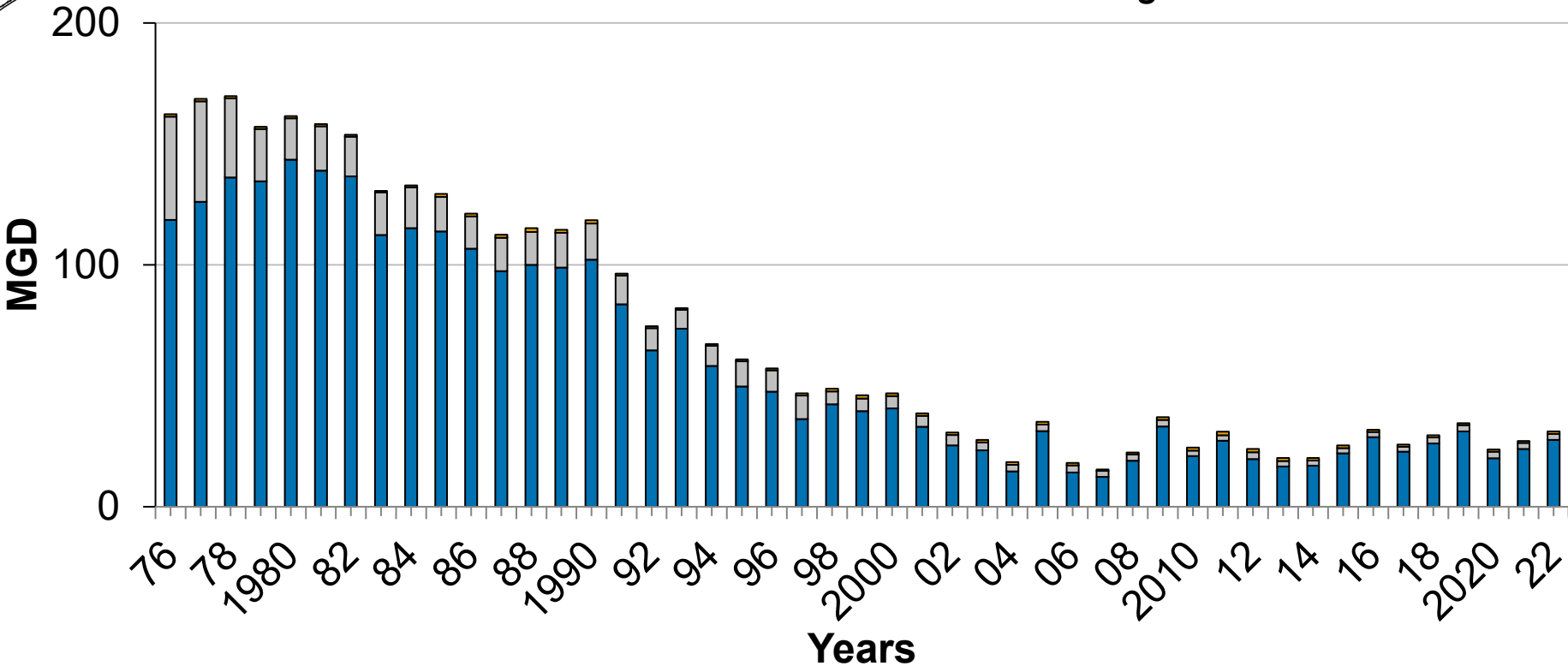


Exhibit 4



Regulatory Area Two Groundwater Withdrawals Grouped by Use

■ Public ■ Industrial ■ All Irrigation



2022: 31.1 MGD

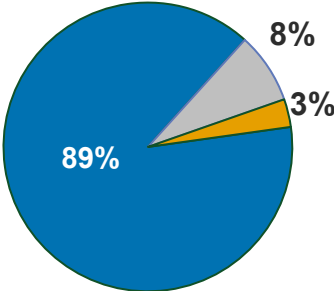
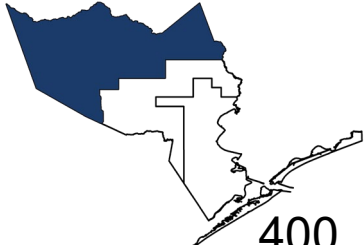


Exhibit 5



Regulatory Area Three

Groundwater Withdrawals Grouped by Use

Public Industrial All Irrigation

2022: 212.6 MGD

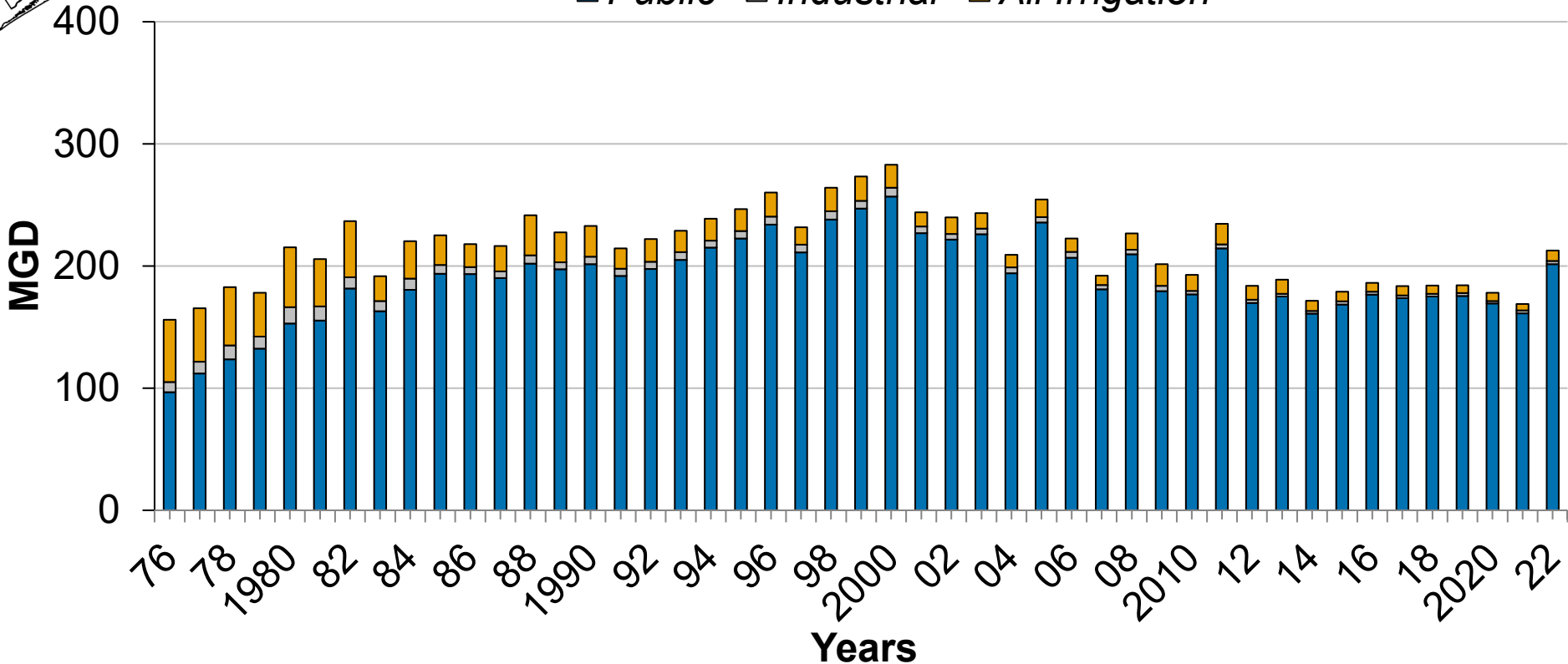
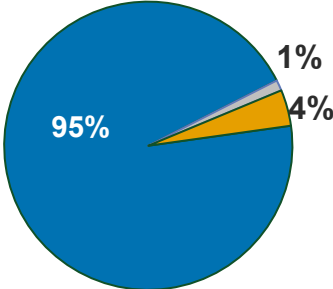
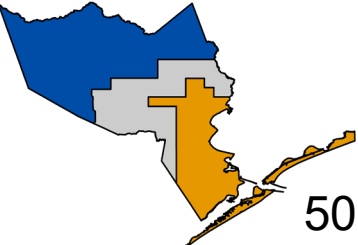


Exhibit 6



Entire District

Groundwater Withdrawals Grouped by Regulatory Area

Area 1 Area 2 Area 3

2022: 252.9 MGD

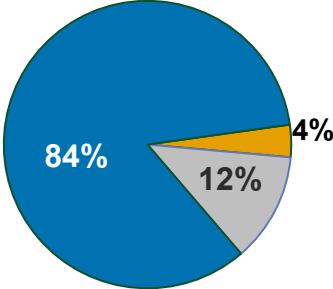
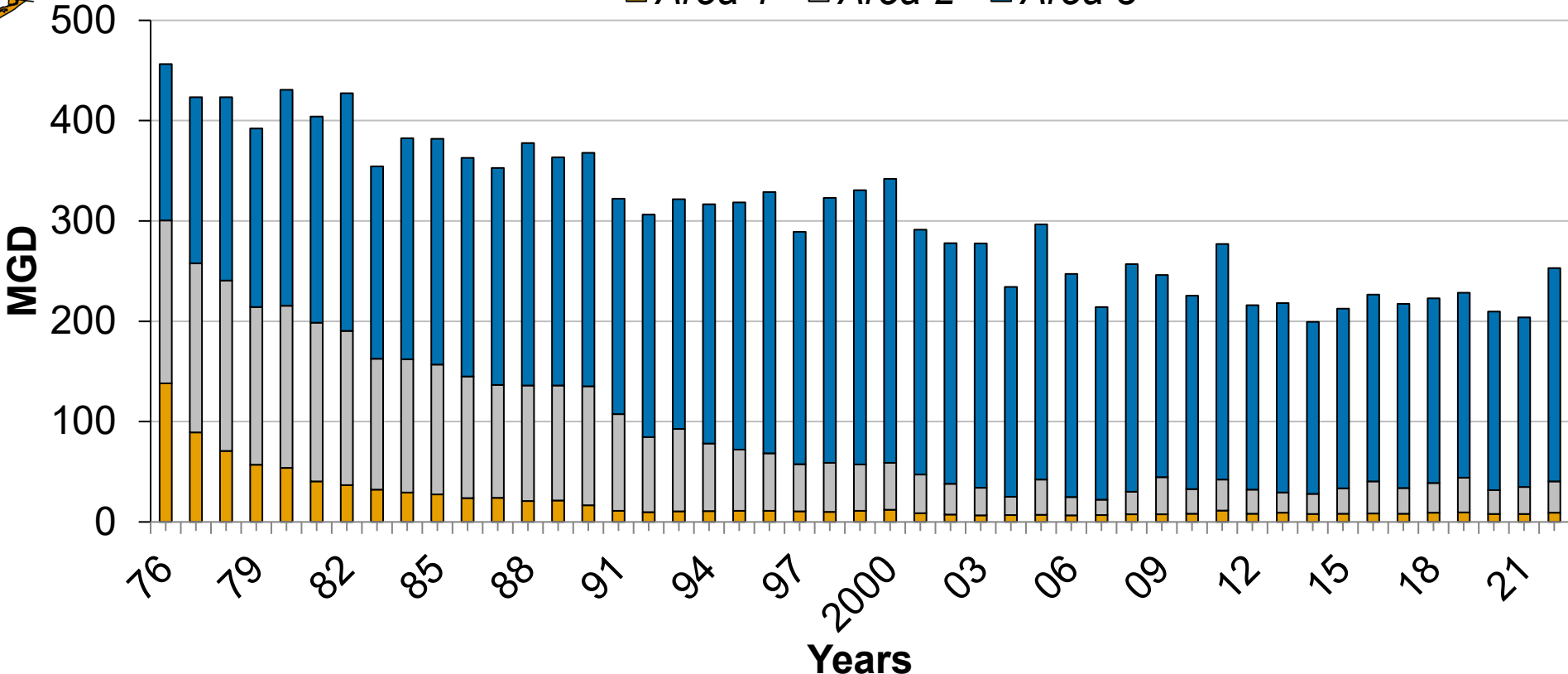
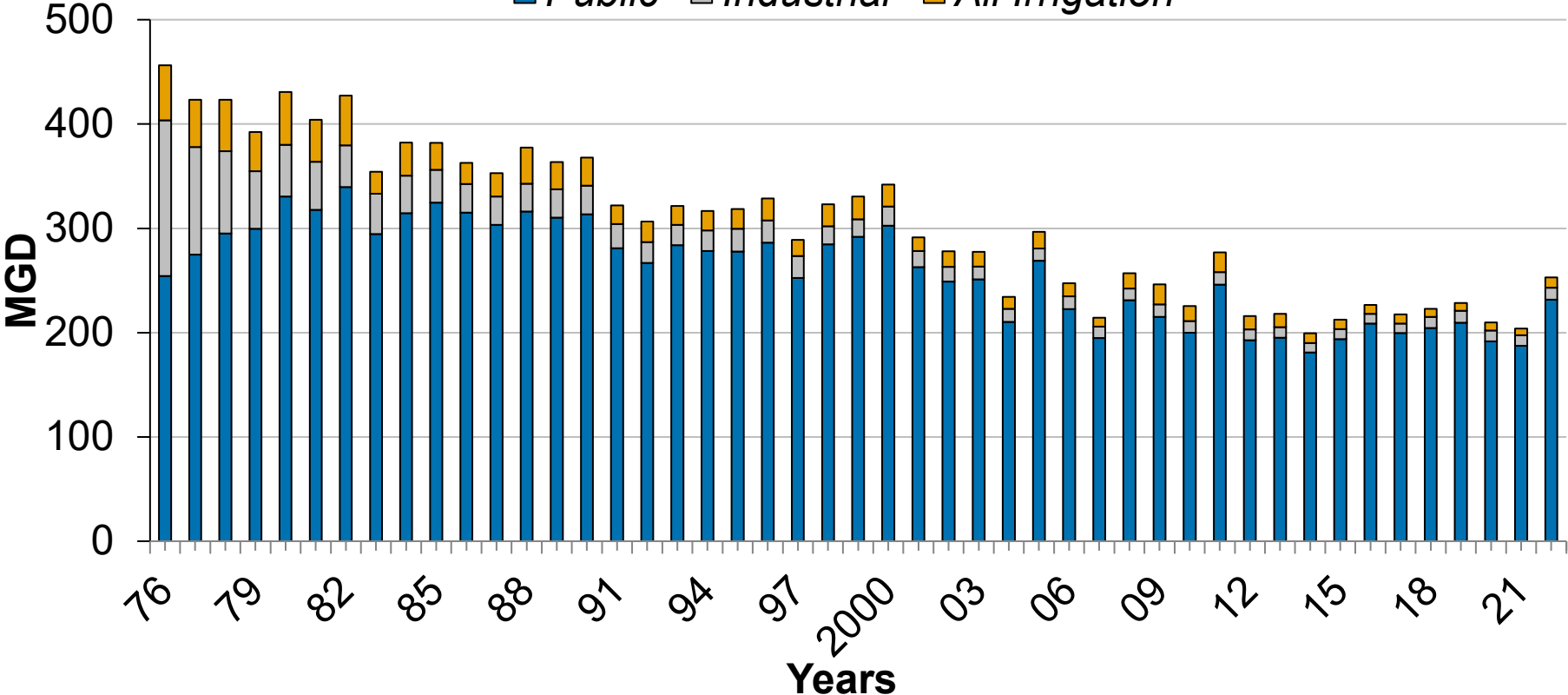


Exhibit 7

Entire District

Groundwater Withdrawals Grouped by Use

Public Industrial All Irrigation



2022: 252.9 MGD

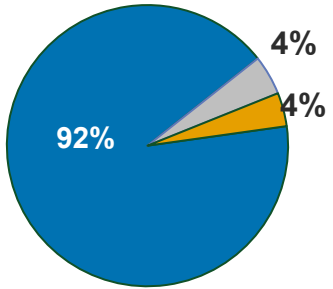


Exhibit 8

Location of surface water sources:

- Trinity River
- San Jacinto River
- Brazos River

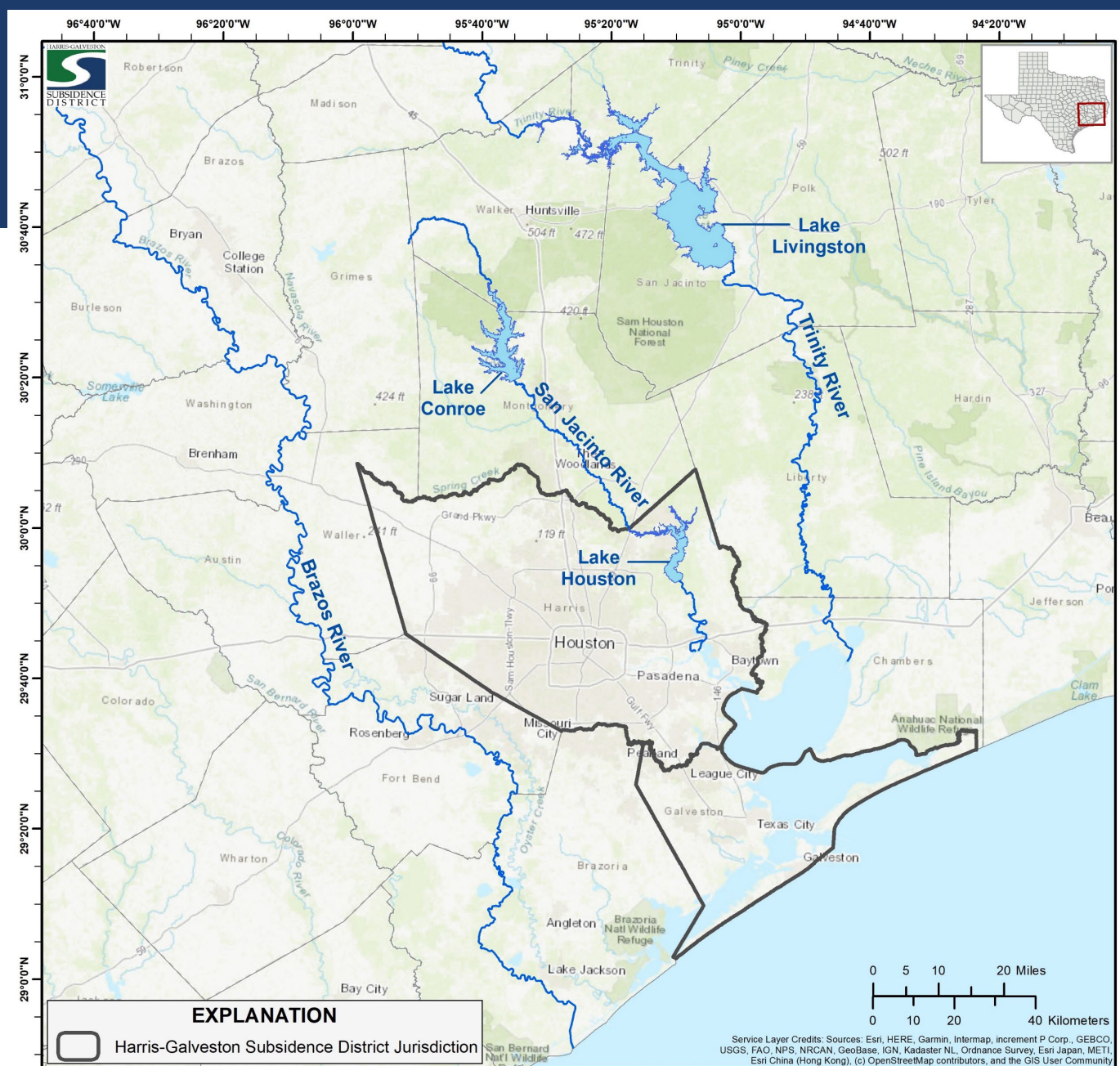
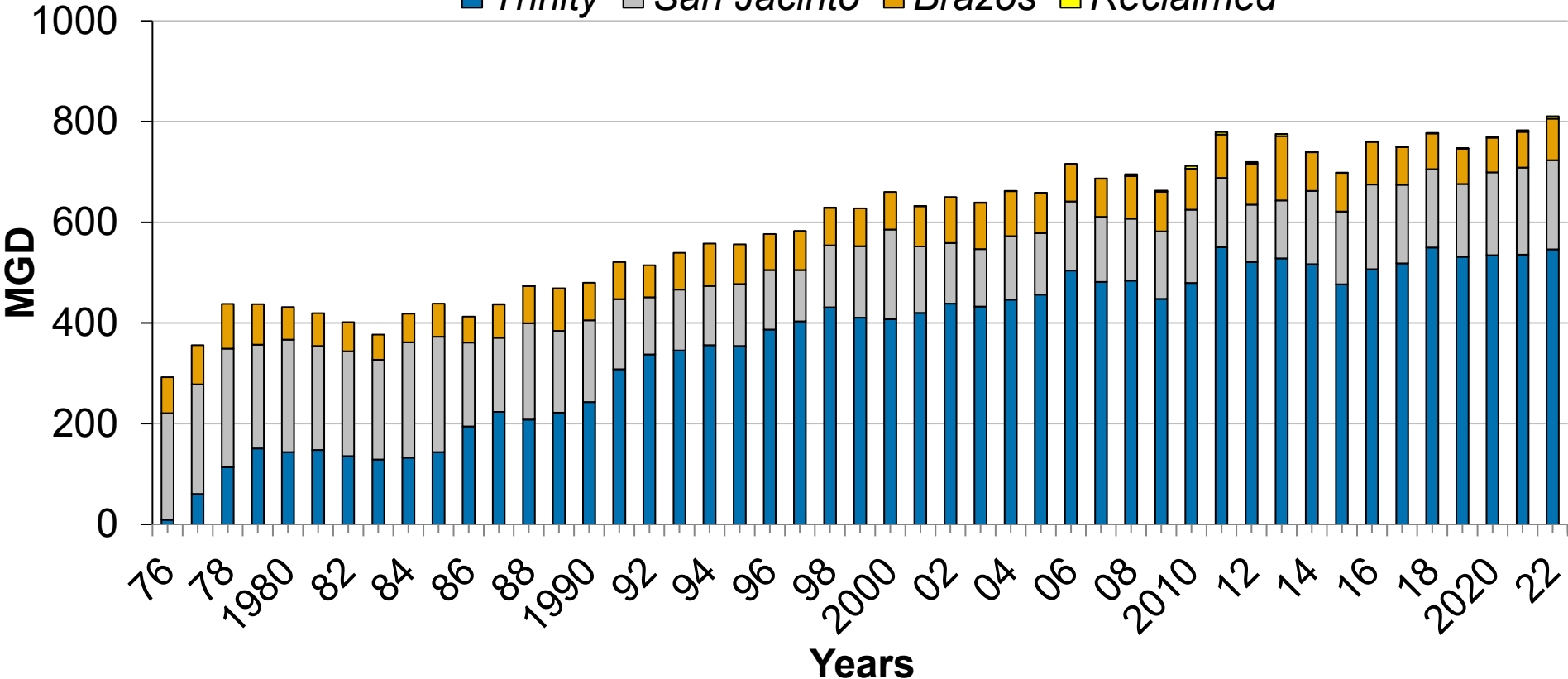


Exhibit 9

Alternative Water Used

Grouped by Source for Entire District

Trinity San Jacinto Brazos Reclaimed



2022: 806.1 MGD

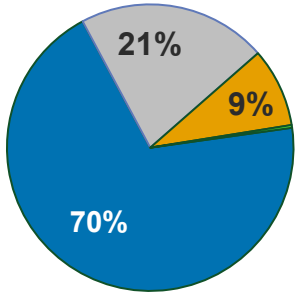
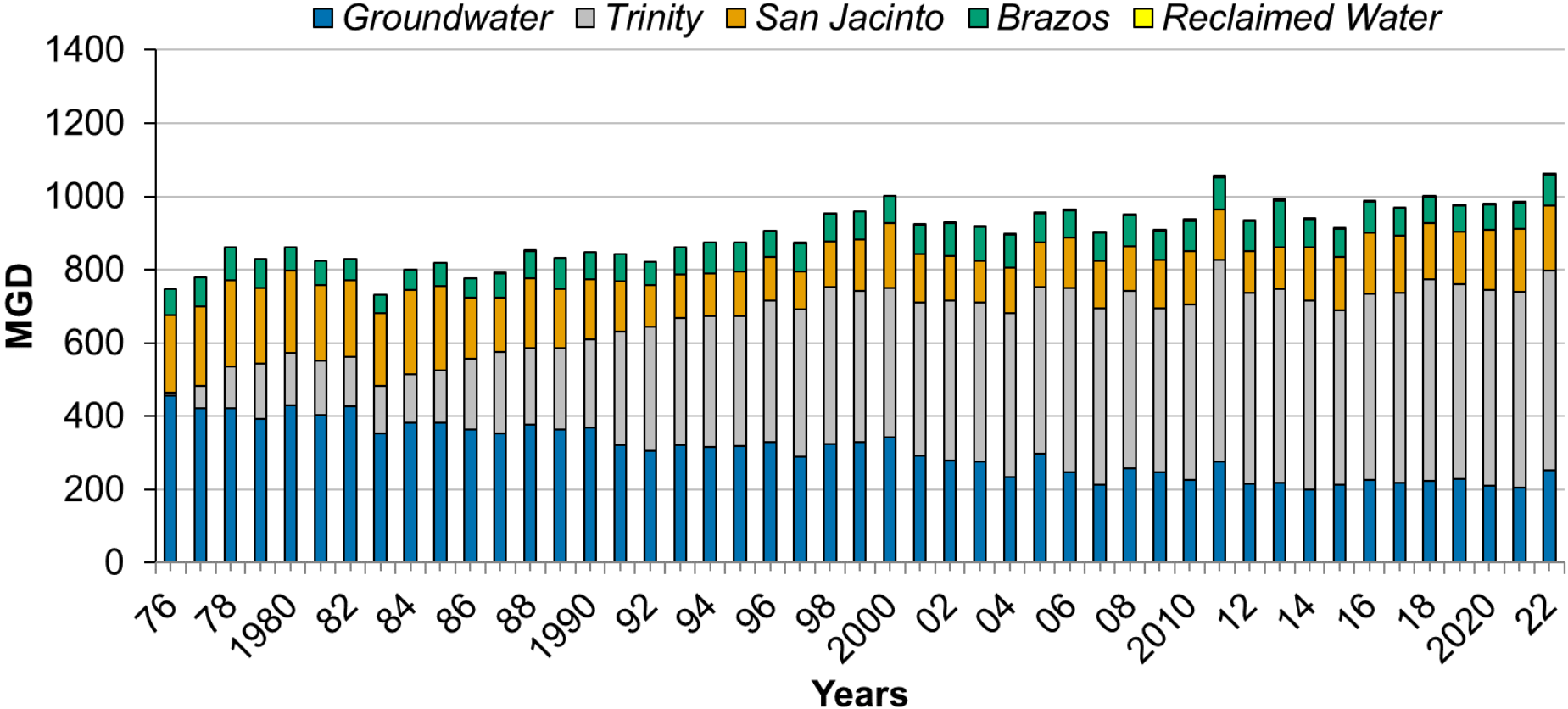


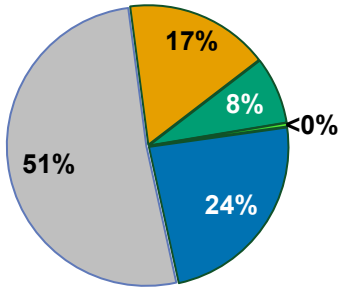
Exhibit 10

Total Water Demand

Grouped by Source for Entire District



2022: 1063.5 MGD



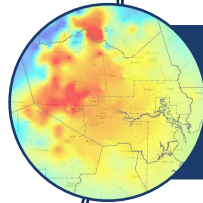
Agenda



Climate



Groundwater Use



Groundwater Levels



Subsidence Data

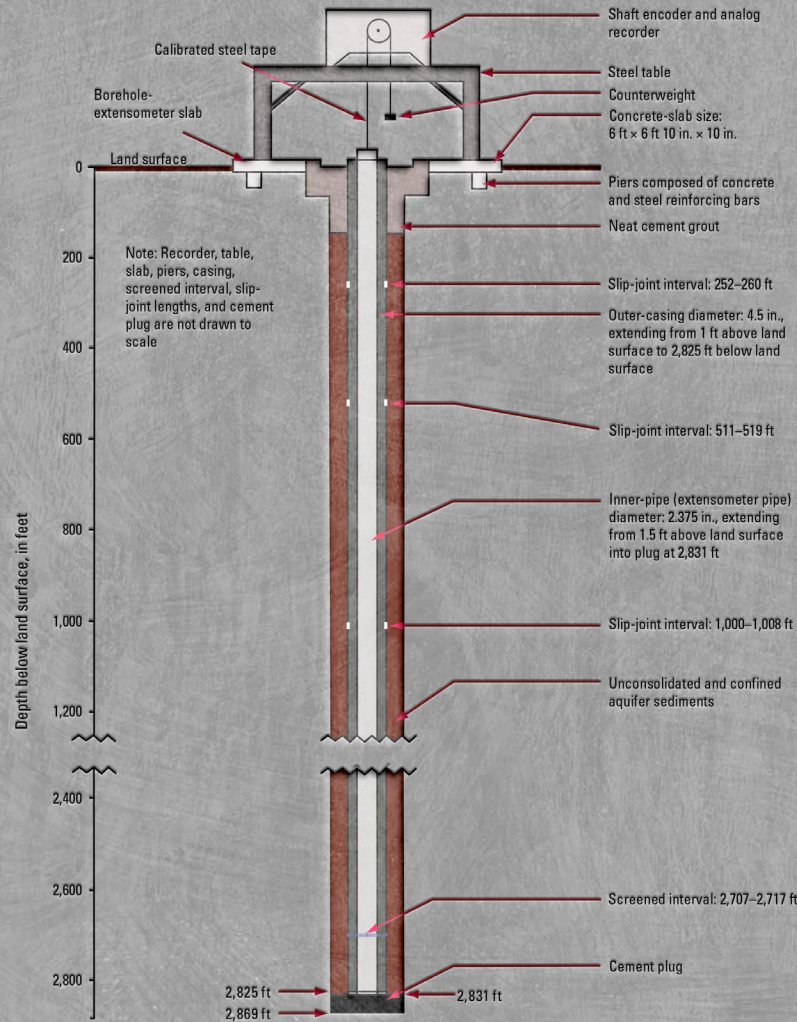


DIAGRAM OF A BOREHOLE EXTENSOMETER

Groundwater-level Altitudes, Long-Term Change & Compaction

CHICOT/ÉVANGELINE AND JASPER AQUIFERS

RESEARCH IN COOPERATION WITH THE HARRIS-GALVESTON & FORT BEND SUBSIDENCE DISTRICTS, BRAZORIA GROUNDWATER CONSERVATION DISTRICT, THE CITY OF HOUSTON AND LONE STAR GROUNDWATER CONSERVATION DISTRICT

2023 Water-Level Map Series

- Chicot and Evangeline Aquifers (undifferentiated)

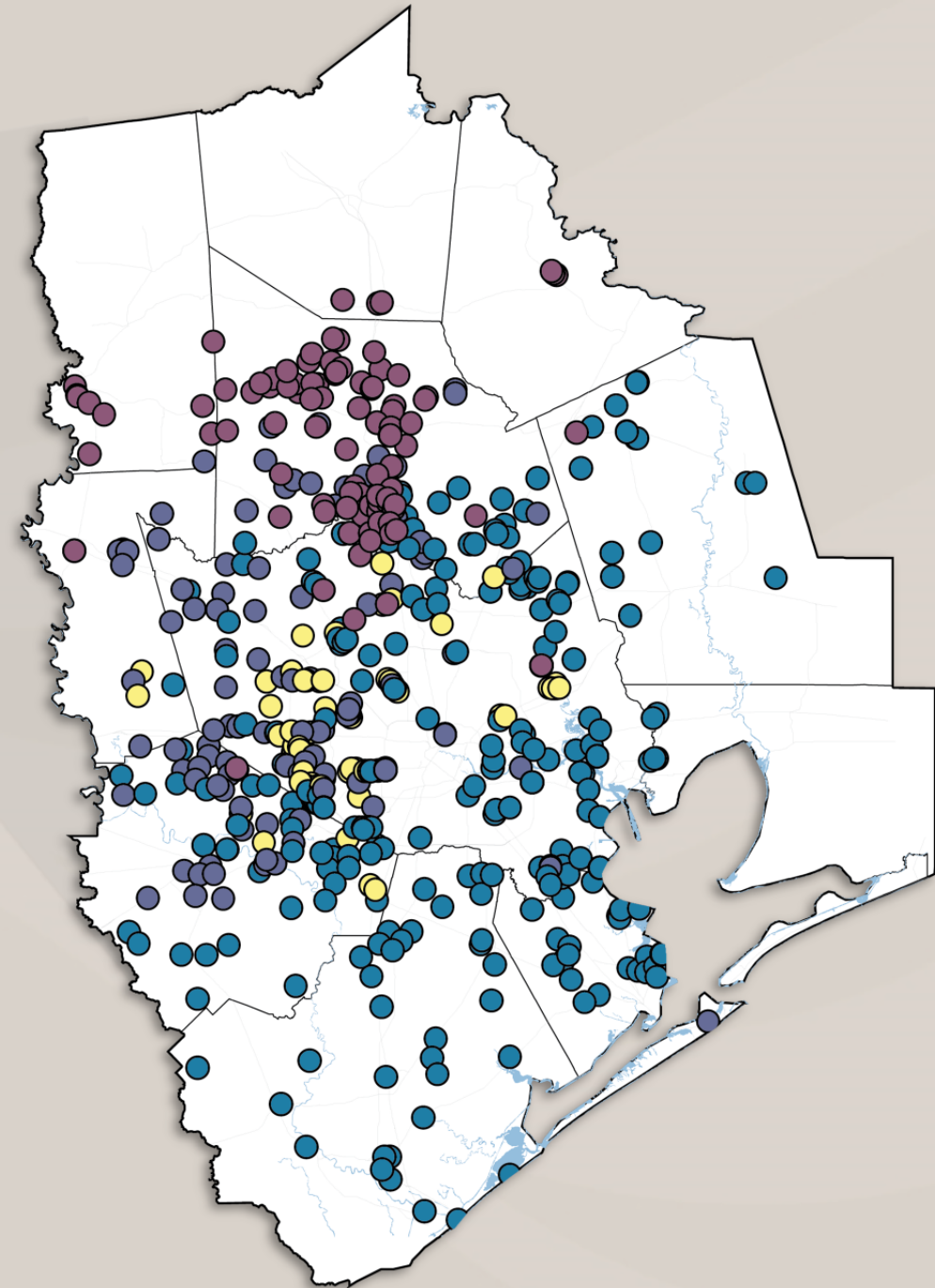
- 2023 Water-Level Altitude
- 2022 to 2023 Water-Level Change
- 2018 to 2023 Water-Level Change
- 1990 to 2023 Water-Level Change
- 1977 to 2023 Water-Level Change

- Jasper Aquifer

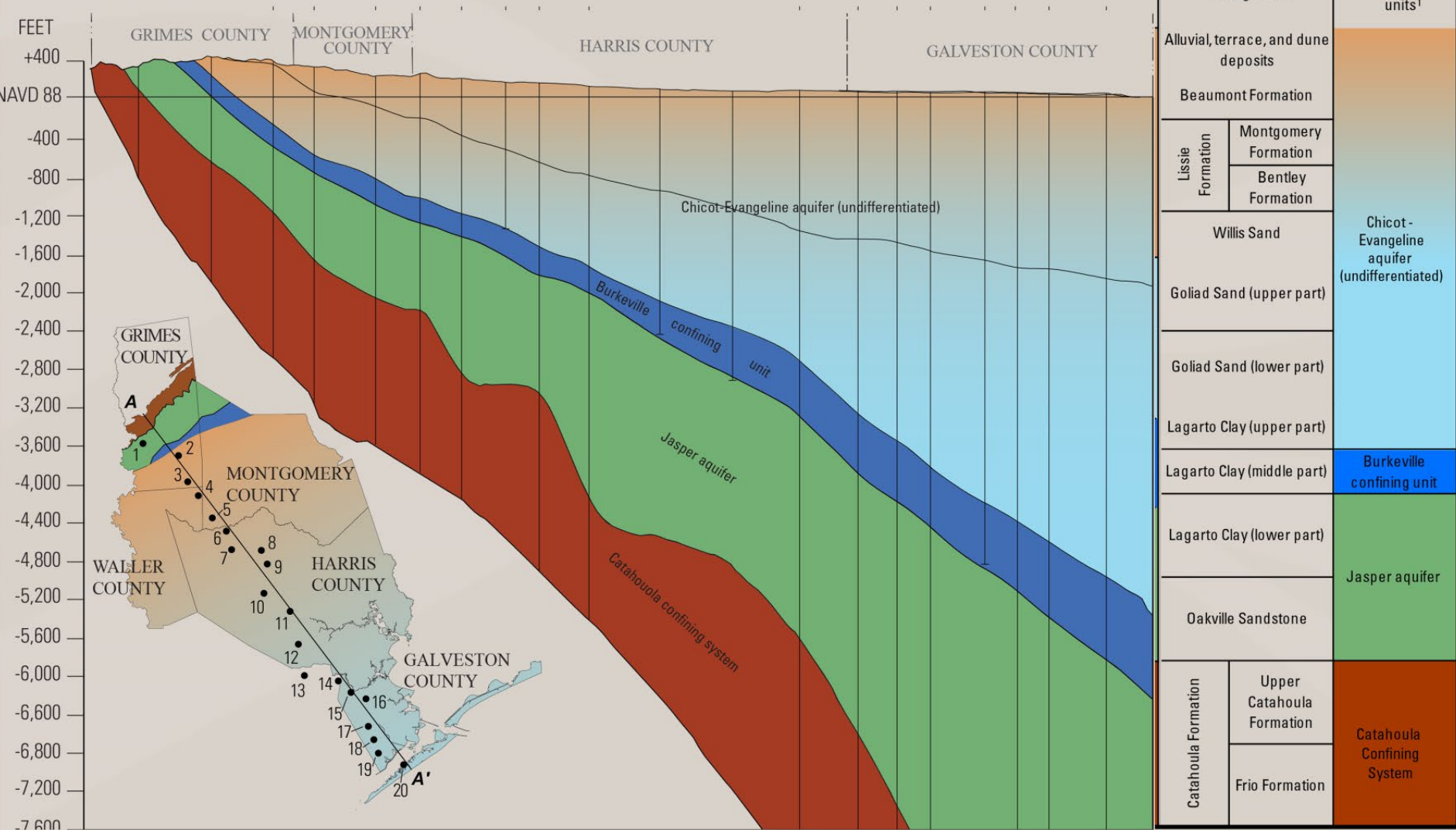
- 2023 Water-Level Altitude
- 2022 to 2023 Water-Level Change
- 2018 to 2023 Water-Level Change
- 2000 to 2023 Water-Level Change

- Compaction 1973 to 2022

- Compaction Data from 14 Extensometers



Geology and Hydrology



In 2021 and Moving Forward			
Geologic units ¹		Hydrogeologic units ¹	
Alluvial, terrace, and dune deposits		Chicot-Evangeline aquifer (undifferentiated)	
Beaumont Formation			
Lissie Formation	Montgomery Formation		
	Bentley Formation		
Willis Sand			
Goliad Sand (upper part)			
Goliad Sand (lower part)			
Lagarto Clay (upper part)			
Lagarto Clay (middle part)			Burkeville confining unit
Lagarto Clay (lower part)			Jasper aquifer
Oakville Sandstone		Catahoula Confining System	
Catahoula Formation	Upper Catahoula Formation		
	Frio Formation		

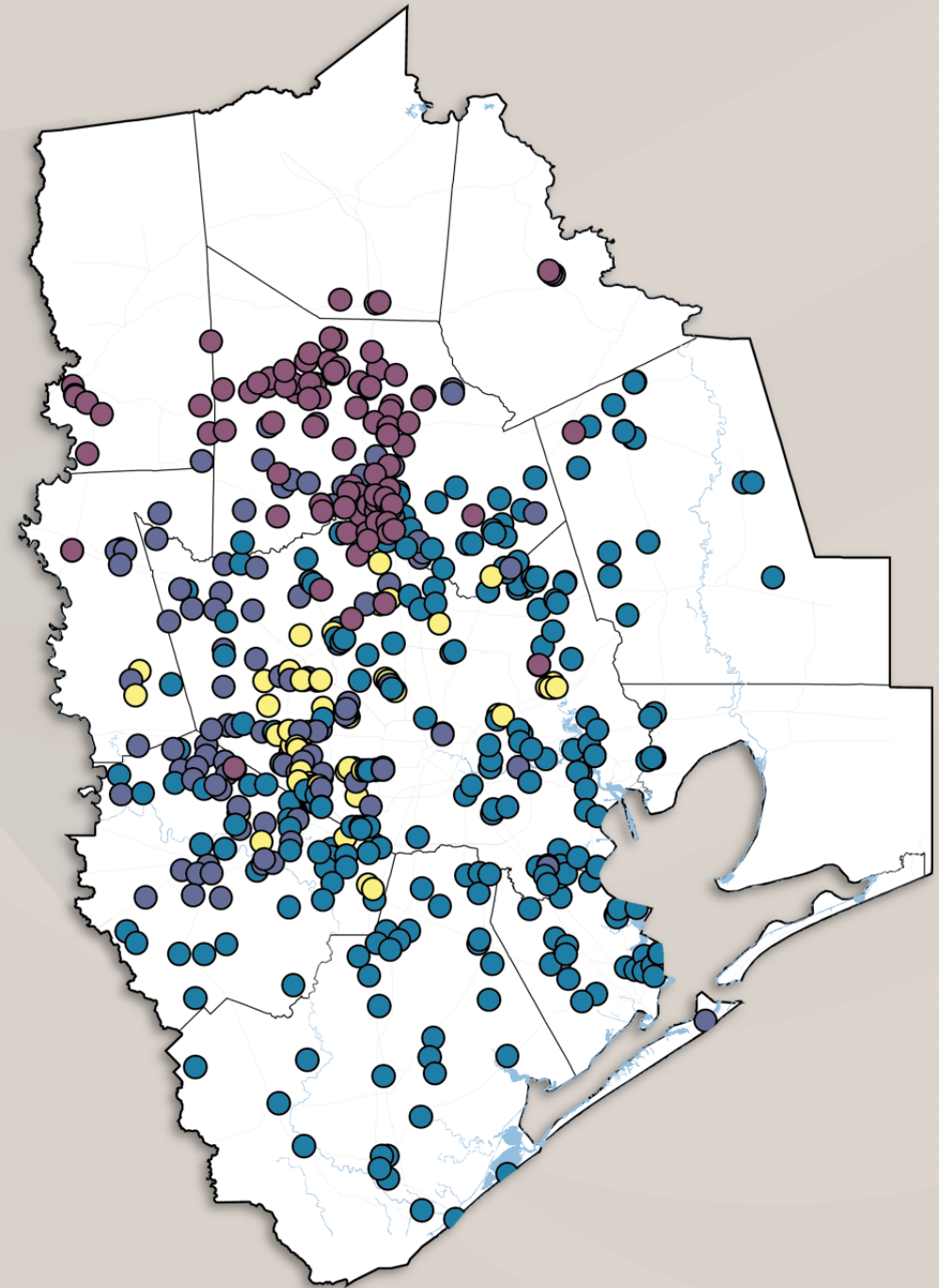
- Chicot and Evangeline aquifers (undifferentiated)
 - combined for annual regional-scale assessments
 - Updated aquifer tops and bases*
 - Chicot thickened across much of southeast Harris County
 - Distribution of Evangeline wells changed significantly

¹Young, S.C., Kelley, V.A., Deeds, N., Hudson, C., Piemonti, D., Ewing, T.E., Banerji, D., Seifert, J., and Lyman, P., 2017

*Young, S.C., and Draper, C., 2020

Network

- Data collected across 11 counties
- Data collection from 12-09-2022 to 3-14-2023
- Well Types:
 - Public Supply, Irrigation, Industrial, Observation
- Chicot and Evangeline (undifferentiated) water-levels: 512
- Jasper water-levels: 101
- Number of wells used to create the 2023 altitude maps
 - Chicot and Evangeline (undifferentiated): 479
 - Jasper: 98



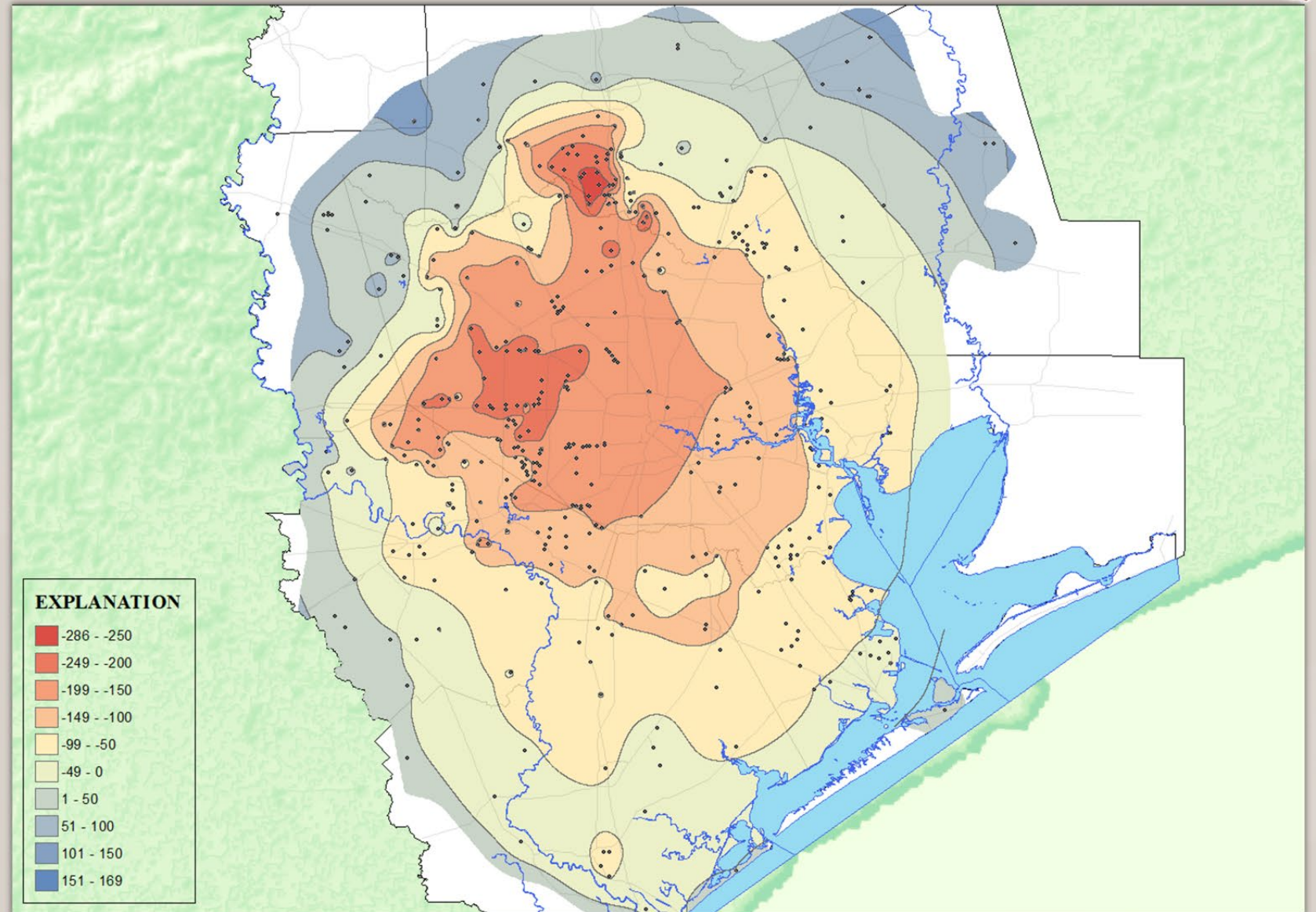
Water-Level Altitude

Chicot and Evangeline (undifferentiated)

Altitudes are referenced from NAVD 88

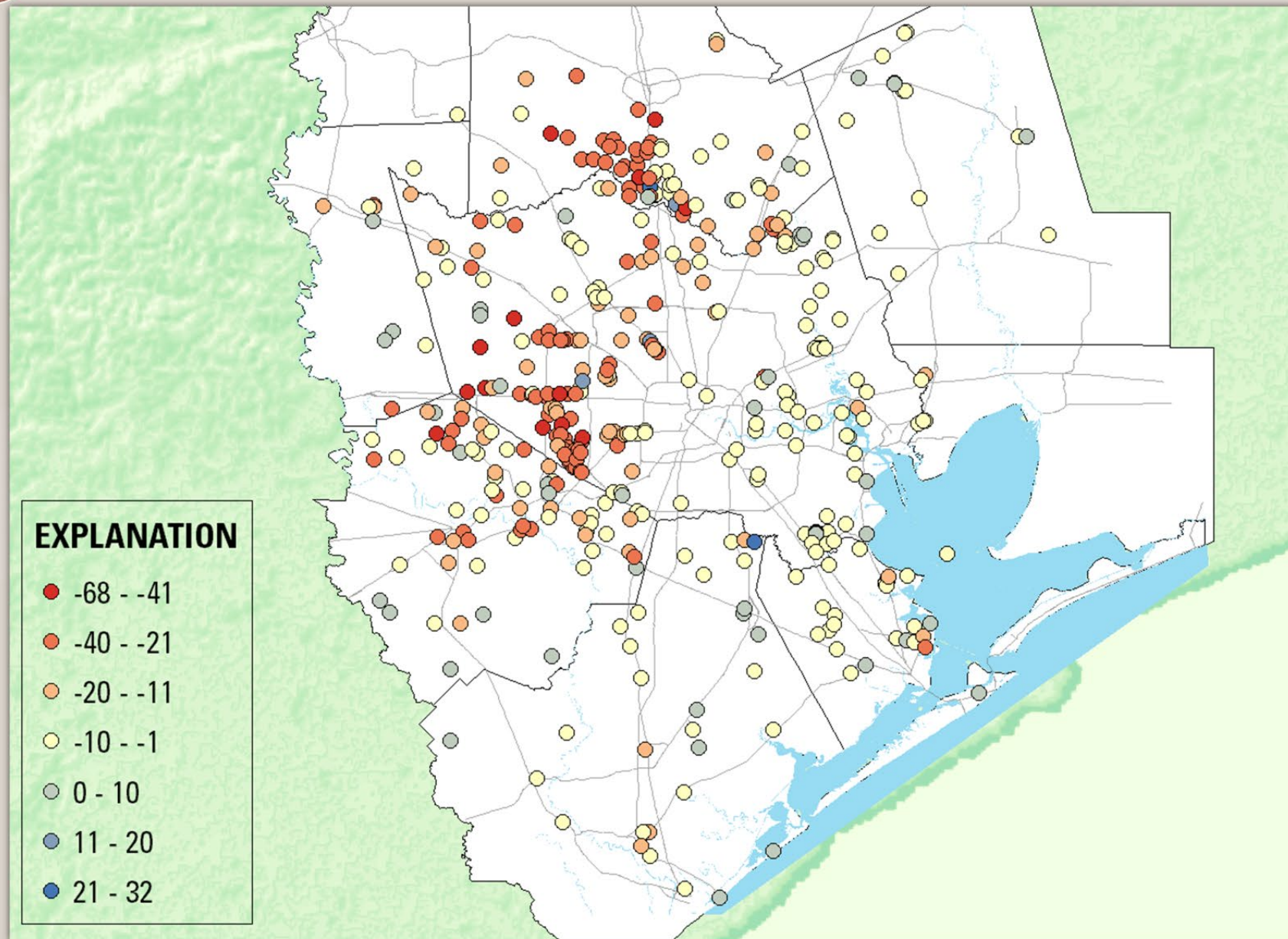
Lowest altitudes in south-central portion of Montgomery County and western Harris County

Highest altitudes in portions of south-eastern Grimes County, south-eastern San Jacinto County, and central Liberty County



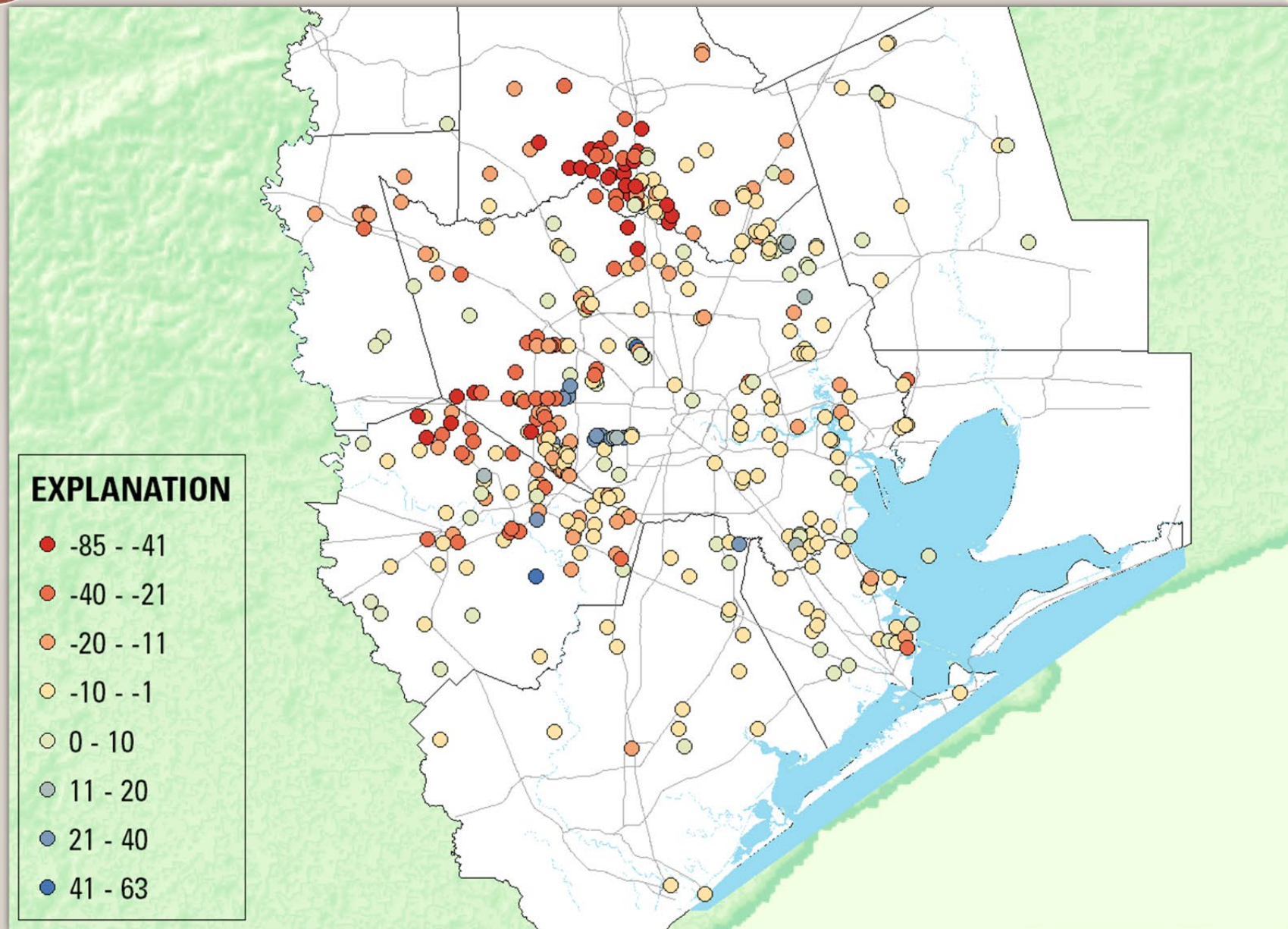
2022 to 2023 Water-Level Change

- 454 water-level pairs
 - Mostly declines
 - Largest declines (>40 ft):
 - portions of western Harris county and south-central Montgomery County
 - 1 in Fort Bend County
 - Largest rises (> 20 ft):
 - 1 in south-central Montgomery County
 - 1 in Brazoria County



2018 to 2023 Water-Level Change

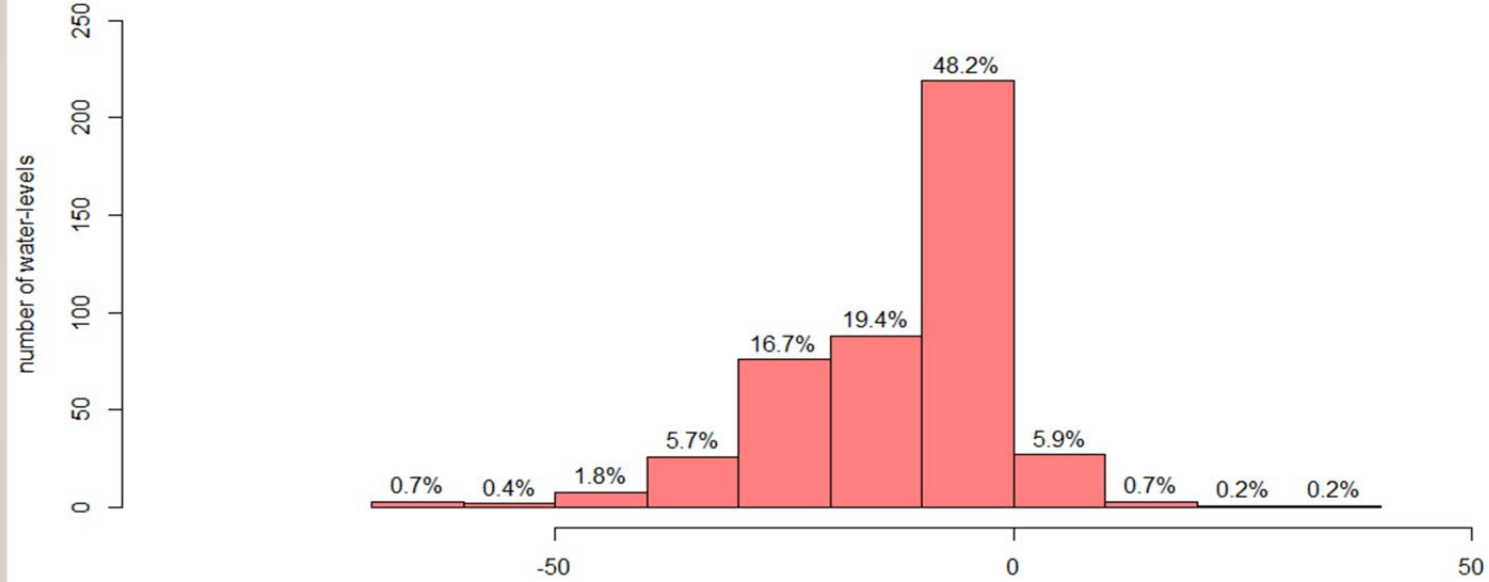
- 420 water-level pairs
 - Mostly declines
 - Largest declines (>40 ft):
 - portions of western Harris county, northern Fort Bend County and south-central Montgomery County
 - Largest rises (> 40 ft):
 - 1 in central Harris County
 - 1 in Fort Bend County



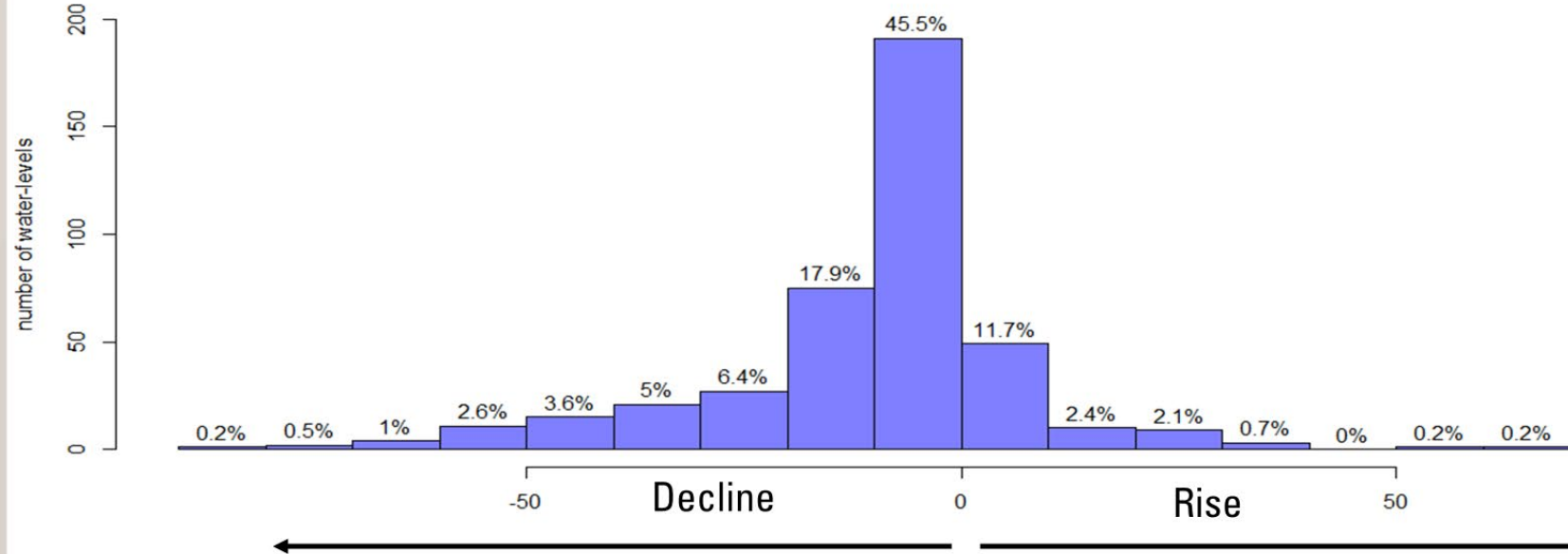
Change Comparison

Chicot and Evangeline (undifferentiated)

1 Year
2022 to 2023



5 Year
2018 to 2023

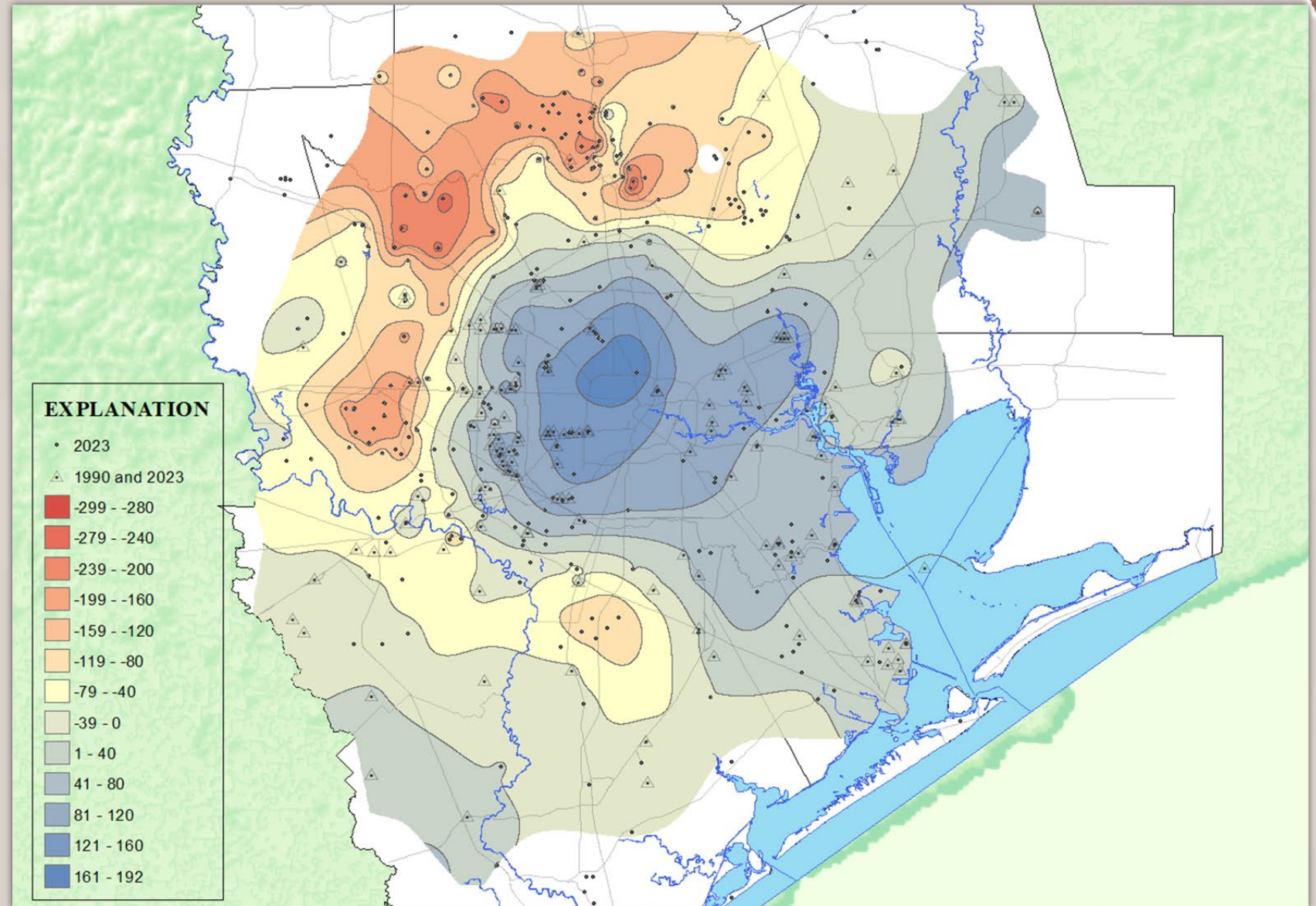


Long term change

Water level rises across most of central and eastern Harris County and Galveston County

Water-level declines from central Brazoria County, much of Fort Bend County, Western and NW Harris County, portions of Waller County, and portions of Montgomery County

Chicot and Evangeline (undifferentiated) Water-Level Change 1990 to 2023

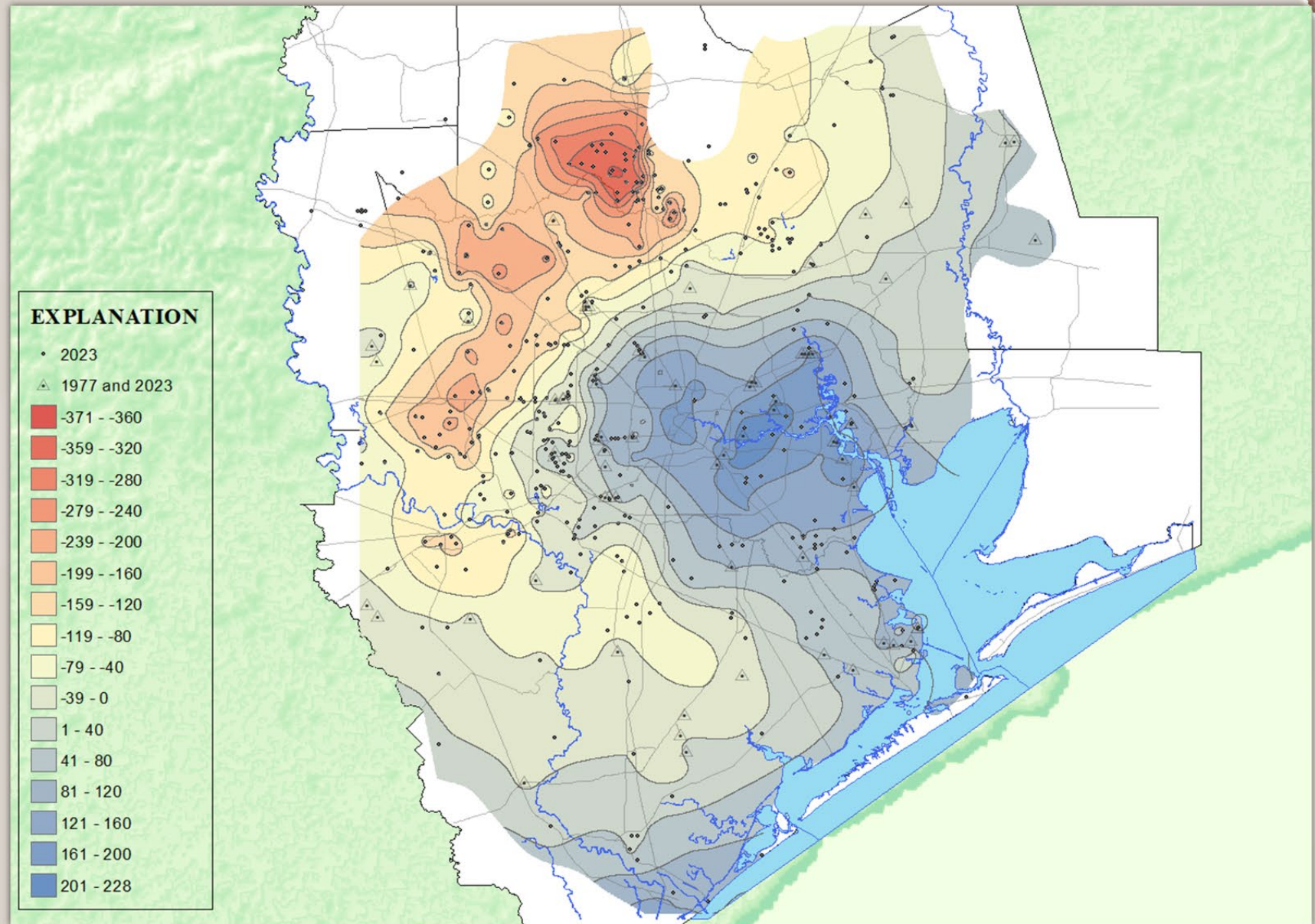


Long term change

Water level rises across most of central and eastern Harris County and Galveston County

Water-level declines from central Brazoria County, much of Fort Bend County, Western and NW Harris County, portions of Waller County, and portions of Montgomery County

Chicot and Evangeline (undifferentiated) Water-Level Change 1977 to 2023



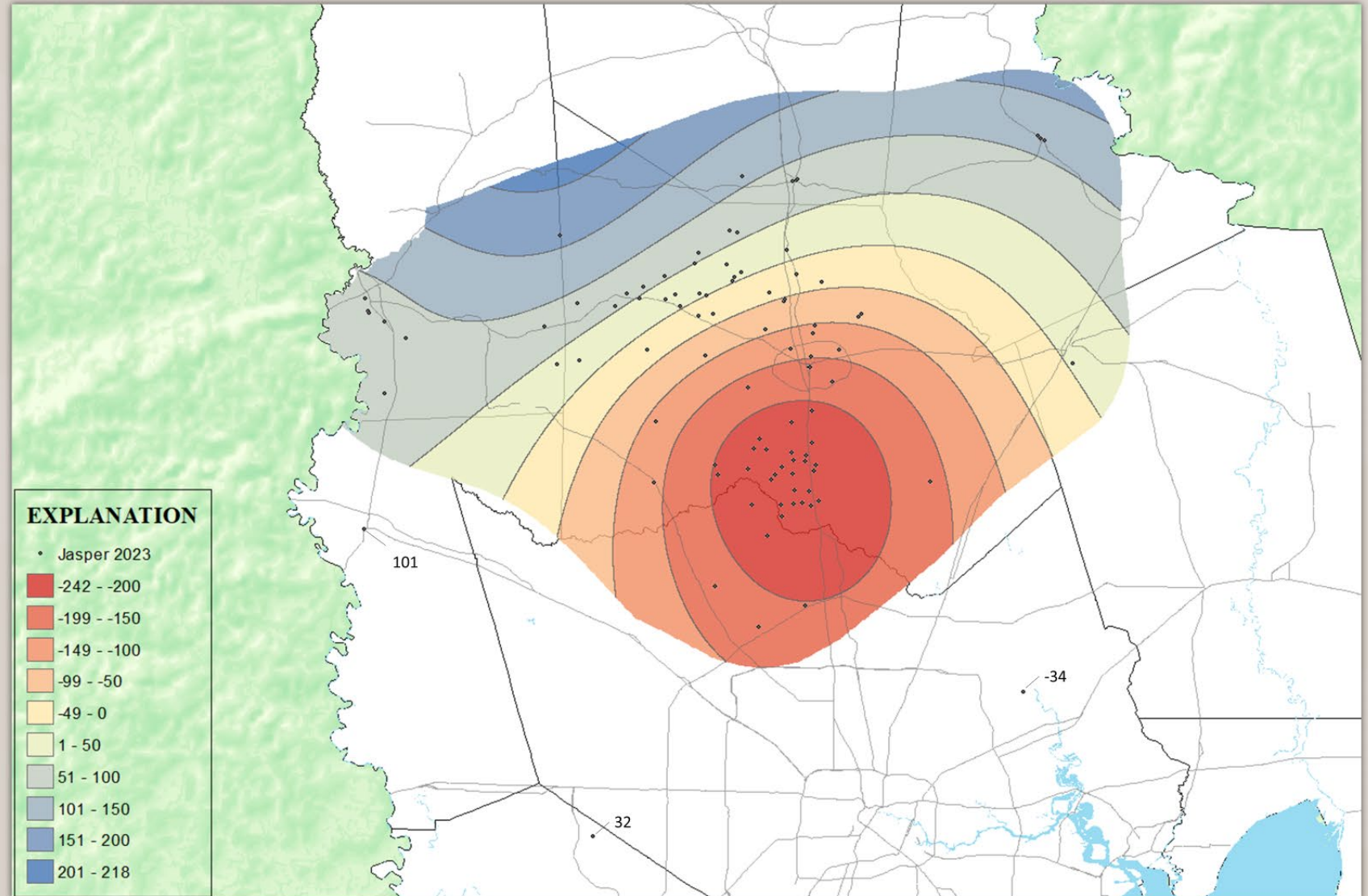
Water-Level Altitude

Jasper

Altitudes are referenced from NAVD 88

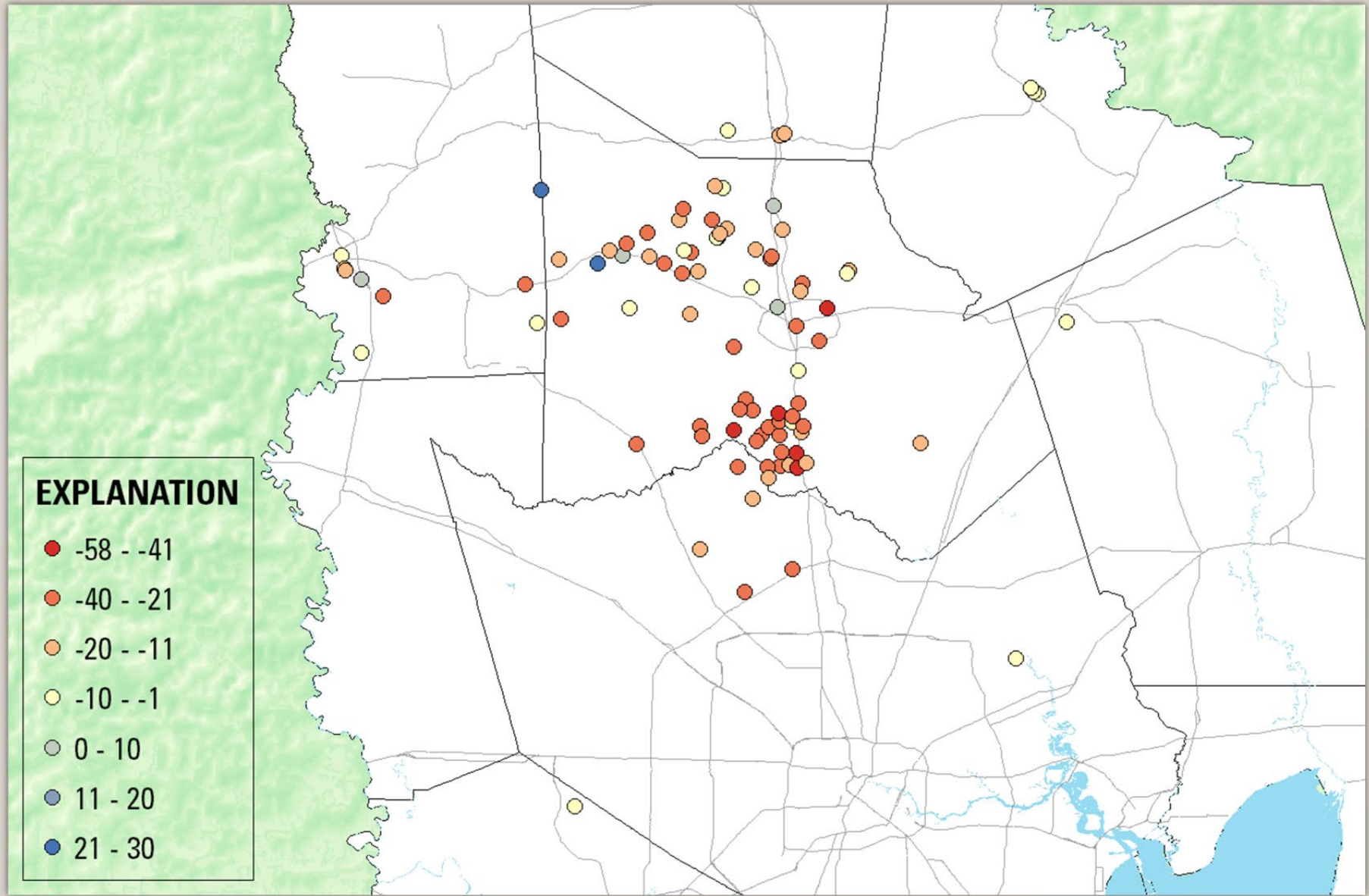
General trend of altitudes deepening in down-dip direction (NW-SE)

Lowest altitudes in south-central Montgomery County and north-central Harris County



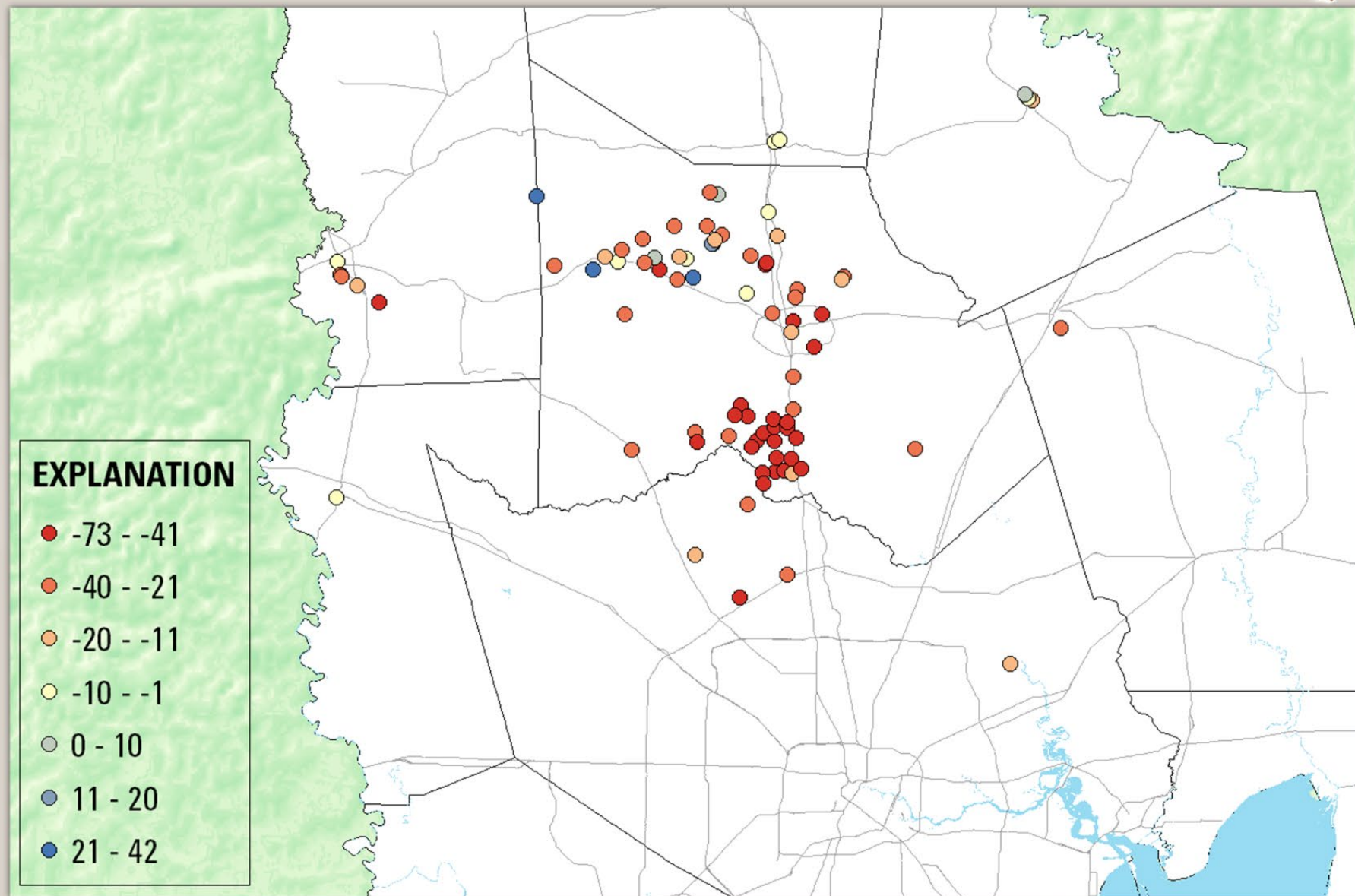
2022 to 2023 Water-Level Change

- 92 water-level pairs
 - Mostly declines (~93%)
 - Largest declines (>40 ft):
 - 4 in south-central Montgomery County
 - 1 in central Montgomery County
 - Largest rises (> 20 ft):
 - 2 in west-central Montgomery County



2018 to 2023 Water-Level Change

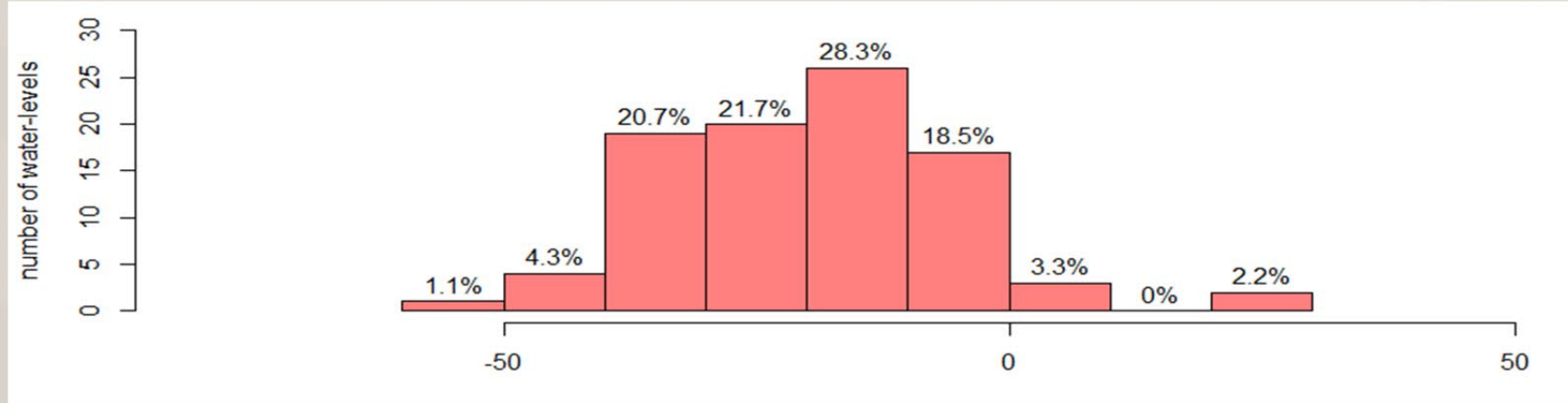
- 83 water-level pairs
 - Mostly declines (~92%)
 - Largest declines (>40 ft):
 - Central and south-central Montgomery County
 - 1 in Grimes County and 1 in west-central Harris County
 - Largest rises (> 20 ft):
 - West-central Montgomery County



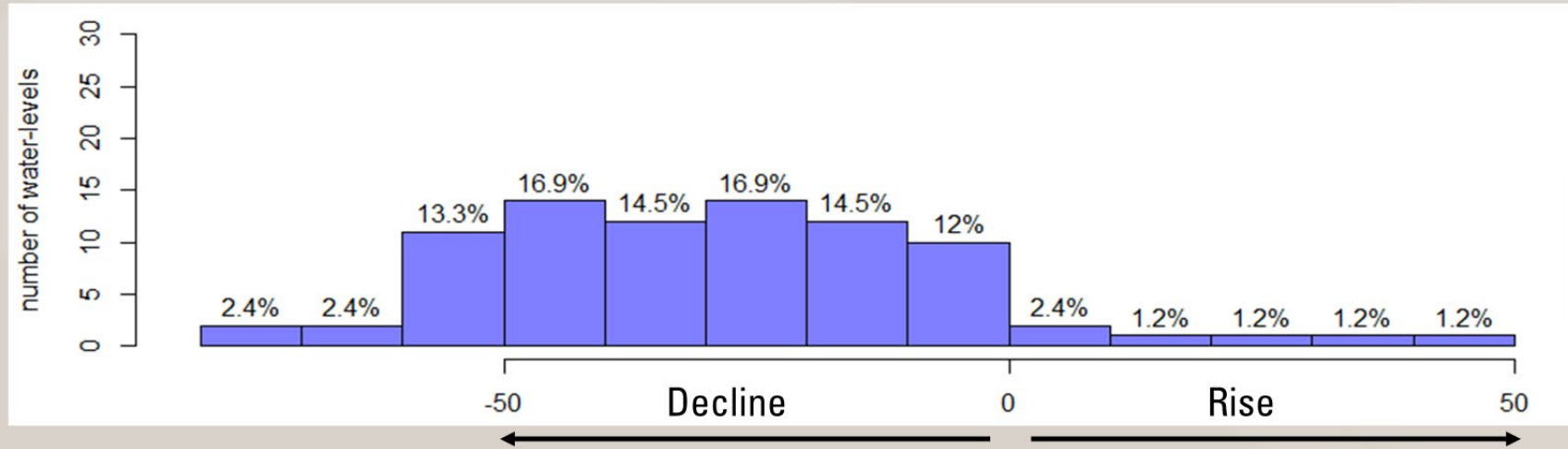
Change Comparison

Jasper

1 Year
2022 to 2023



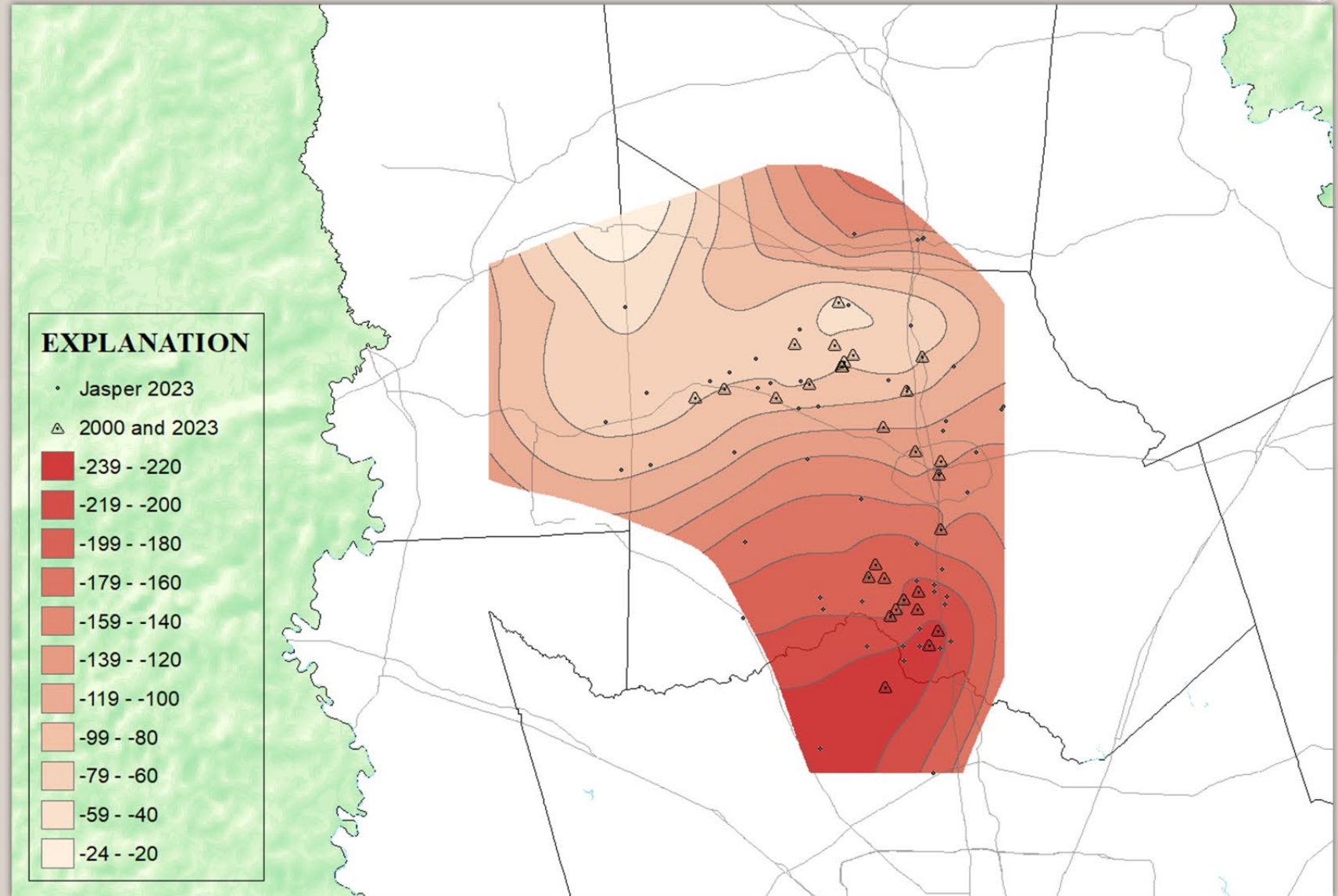
5 Year
2018 to 2023



Long term change

Water-level declines from north-west Montgomery and Grimes Counties down-dip into south-central Montgomery County and northern Harris County

Jasper Water-Level Change 2000 to 2023



Compaction 1973 - 2022

Compaction Interval:

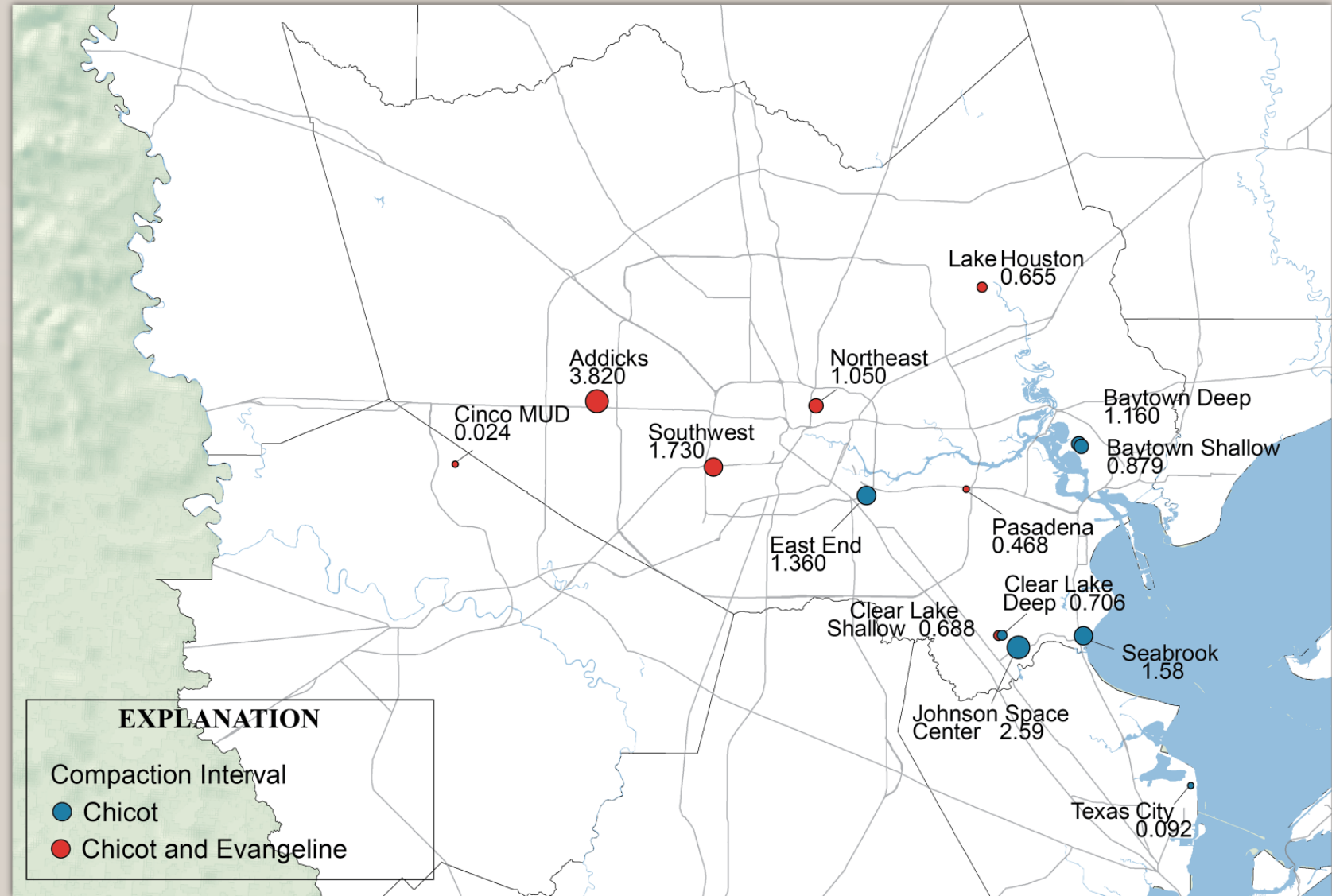
Chicot

1. 1973 | Baytown Shallow 0.879 ft.
2. 1973 | East End 1.360 ft.
3. 1973 | Johnson Space Center 2.590 ft.
4. 1973 | Seabrook 1.580 ft.
5. 1973 | Texas City 0.092 ft.
6. 1976 | Clear Lake Shallow 0.688 ft.

Compaction Interval:

Chicot and Evangeline

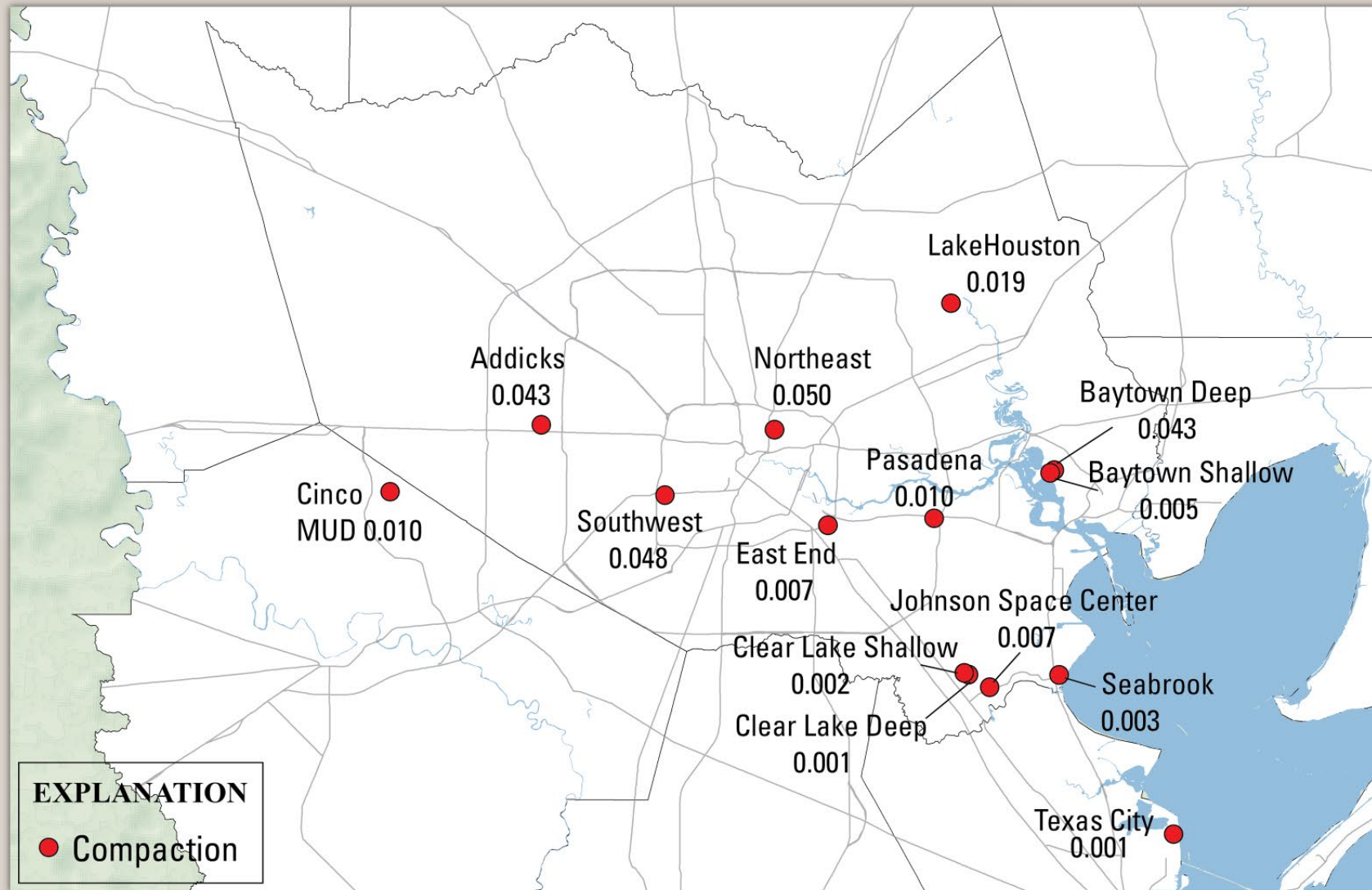
7. 1973 | Baytown Deep 1.160 ft.
8. 1974 | Addicks 3.820 ft.
9. 1974 | Pasadena 0.468 ft.
10. 1976 | Clear Lake Deep 0.706 ft.
11. 1980 | Lake Houston 0.655 ft.
12. 1980 | Northeast 1.050 ft.
13. 1980 | Southwest 1.730 ft.
14. 2017 | Cinco MUD 0.024 ft.



2022 Compaction Summary

- All sites recorded compaction for the period (no expansion)
- Compaction ranged from 0.001 ft to 0.050 ft

Compaction December 2021 to December 2022



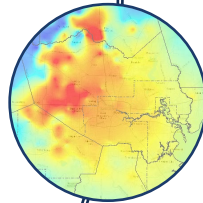
Agenda



Climate



Groundwater Use



Groundwater Levels



Subsidence Data

Exhibit 11

All District operated global positioning system (GPS) stations are constructed in a custom design.

GPS data are collected for approximately one week every two months (periodic monitoring).

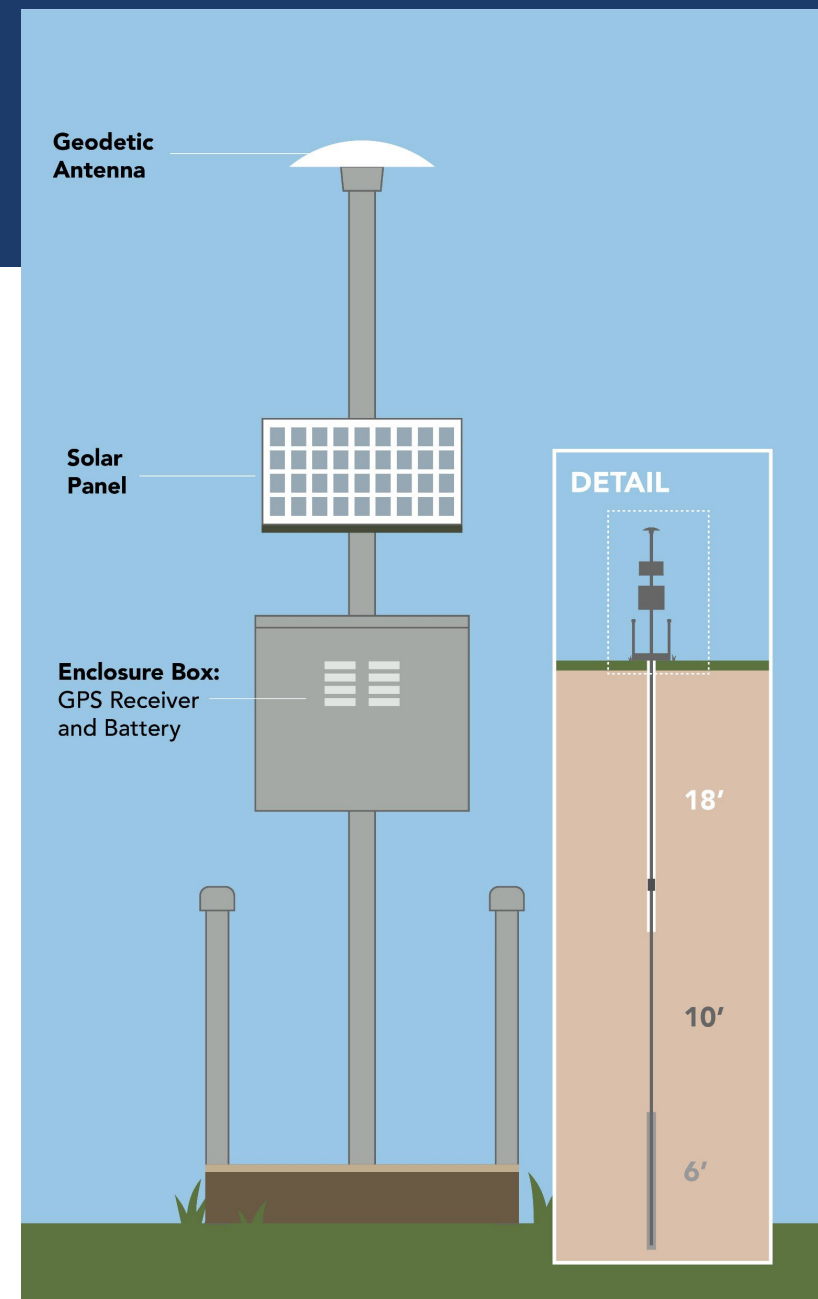


Exhibit 12

Location and operator of GPS stations that monitor land-surface deformation periodically or continuously within the greater Houston-Galveston region in 2022.

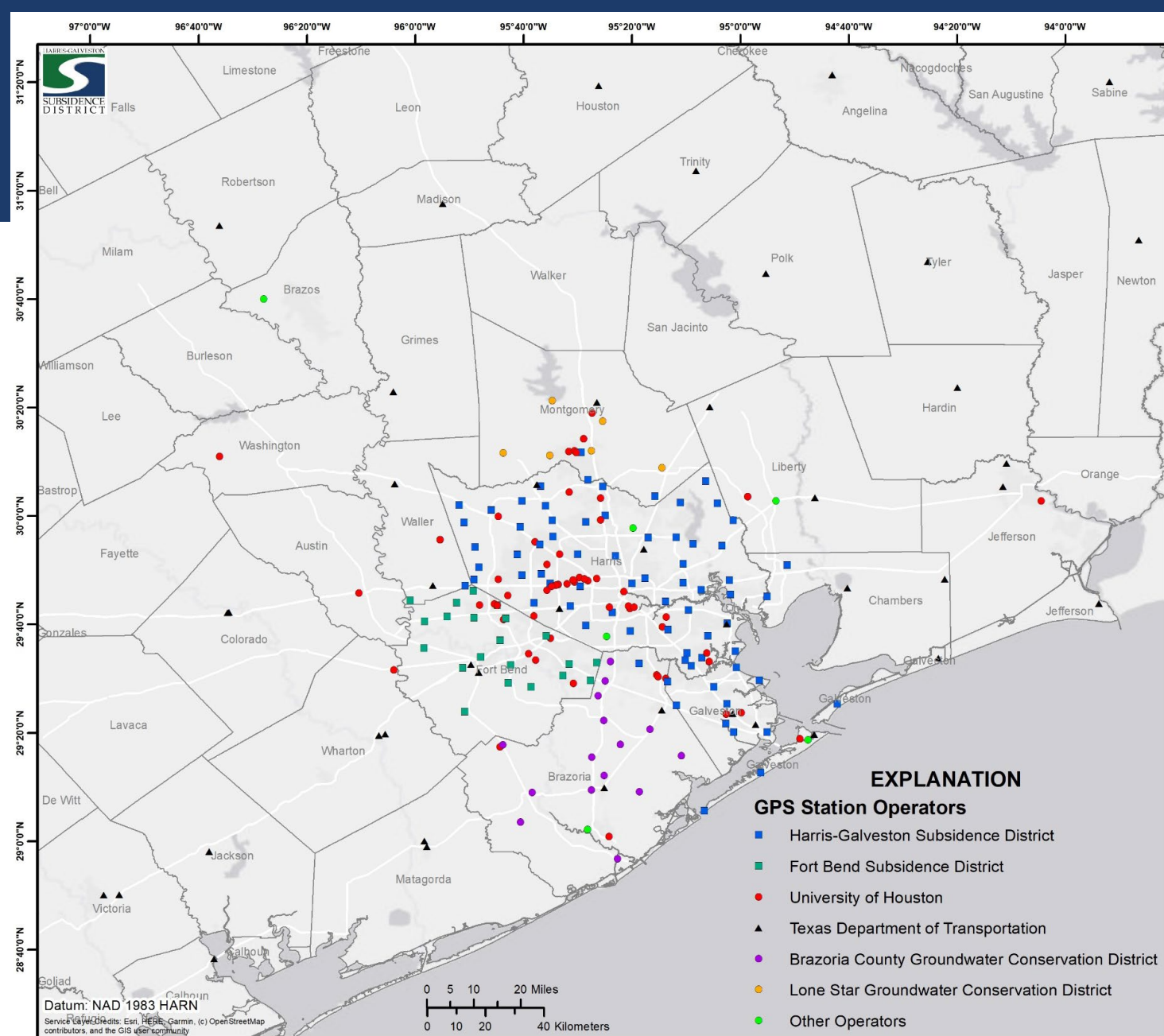


Exhibit 13

Annual subsidence rate, in centimeters per year (cm/yr.), measured at GPS stations with three or more years of GPS data in Harris, Galveston, and surrounding counties, averaged from 2018 to 2022.

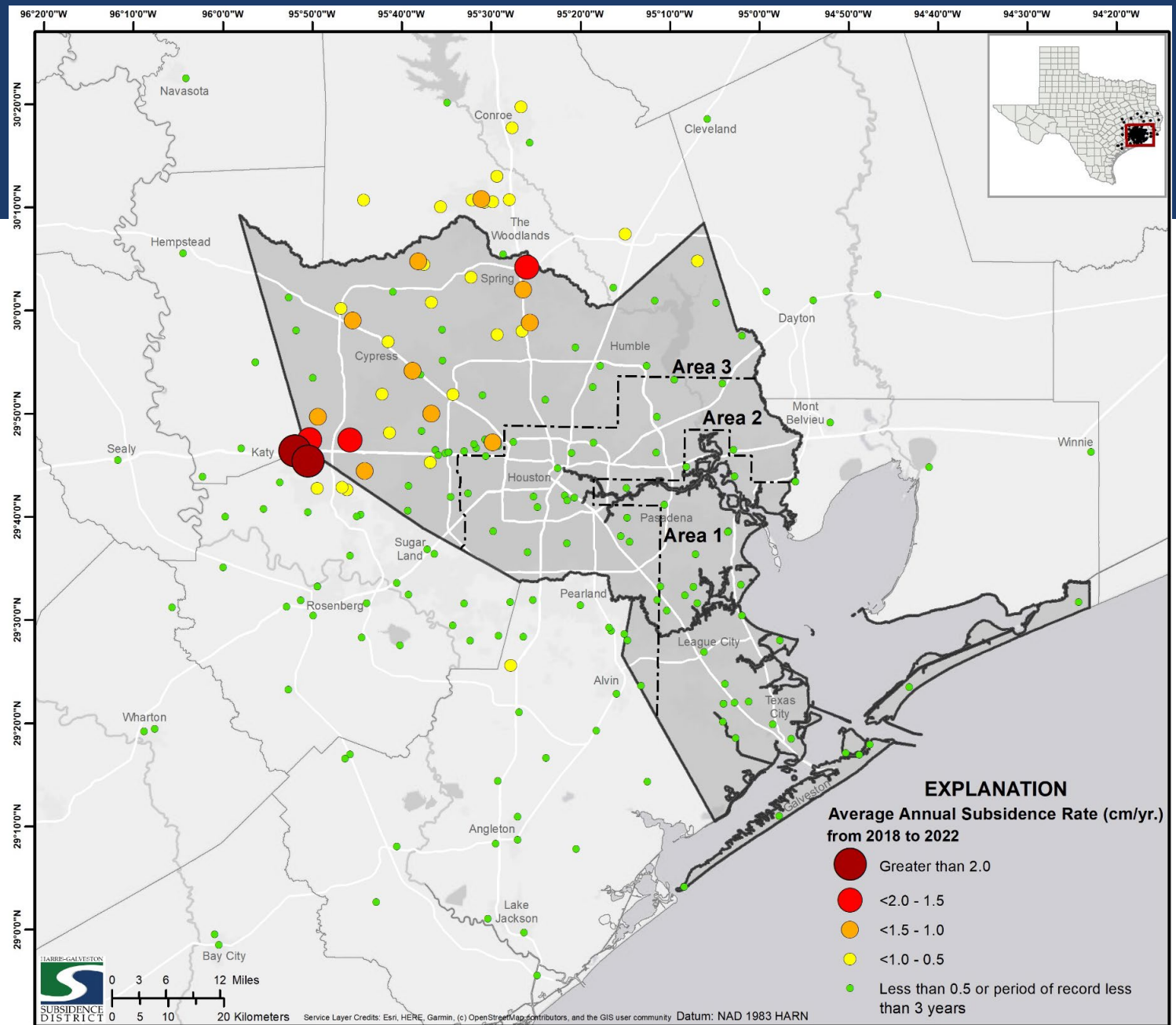
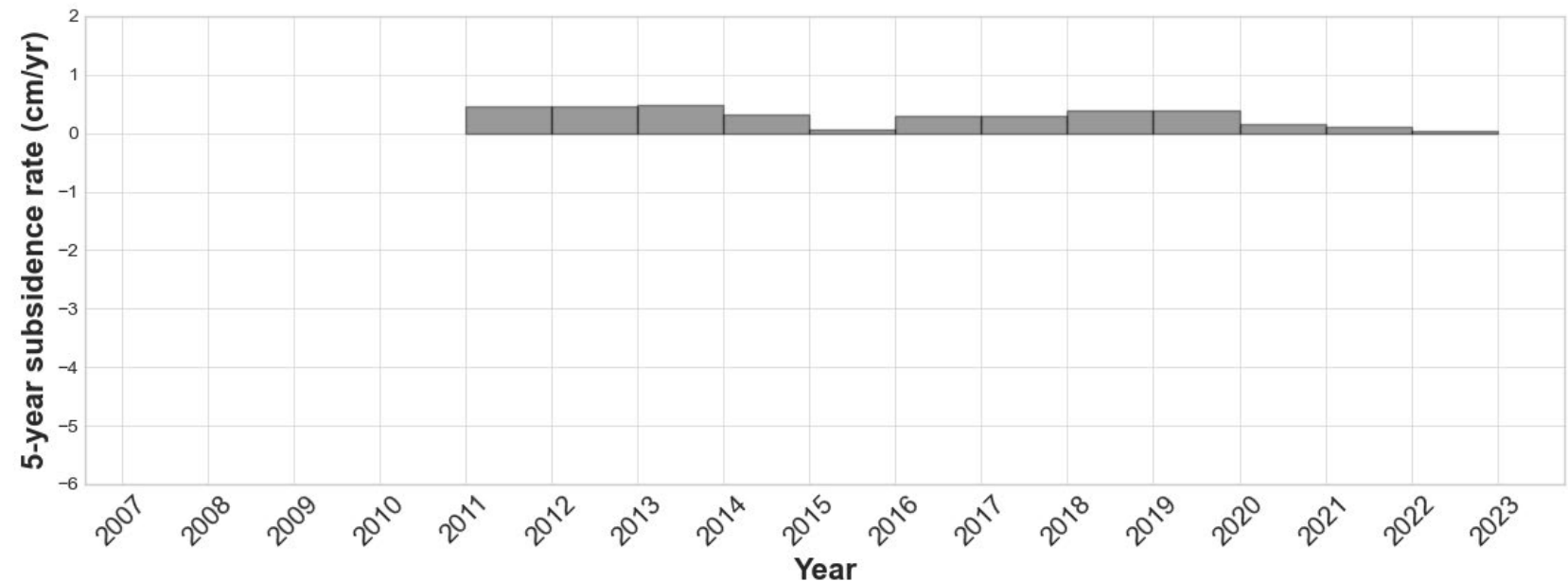
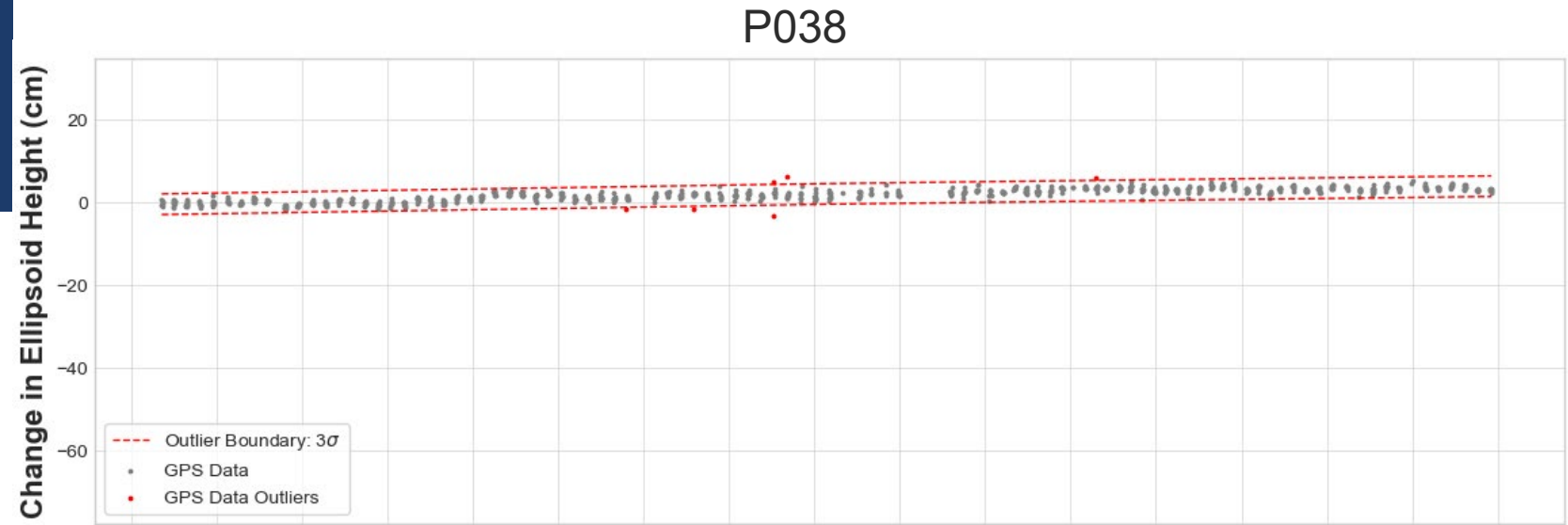


Exhibit 14

GPS station P038, located in Pasadena, has measured a total of approximately 3.3 cm of uplift since 2007.

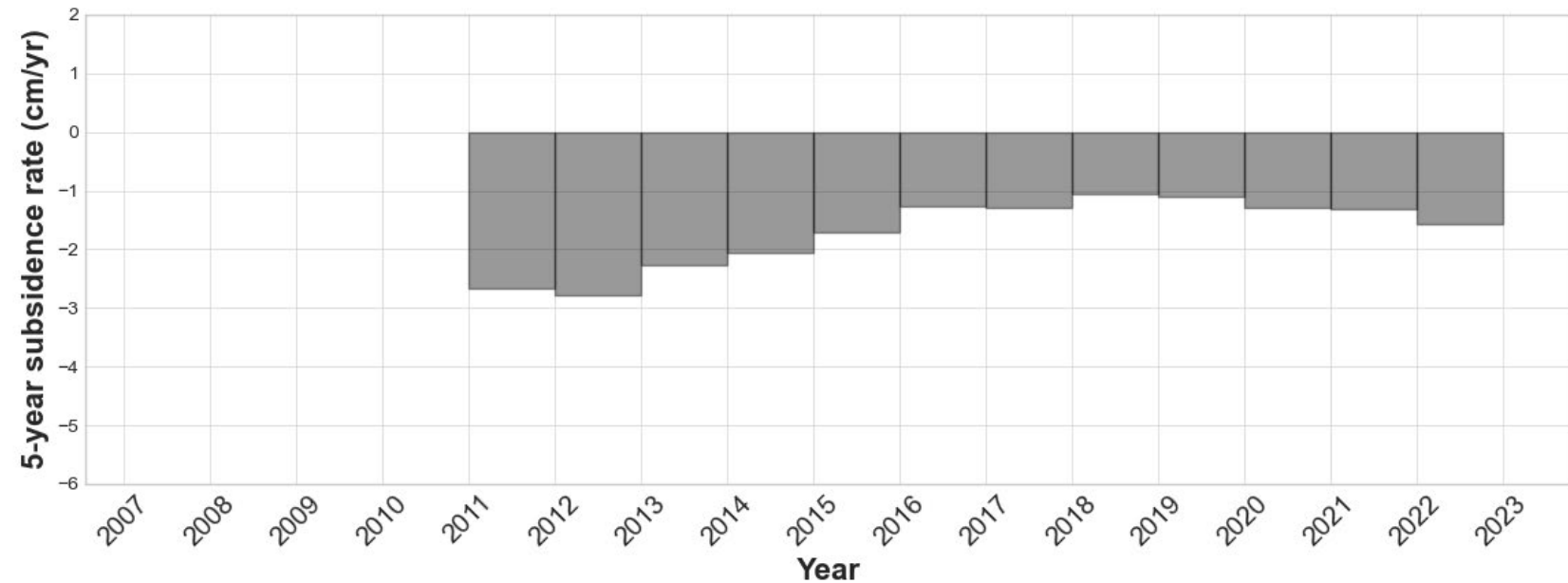
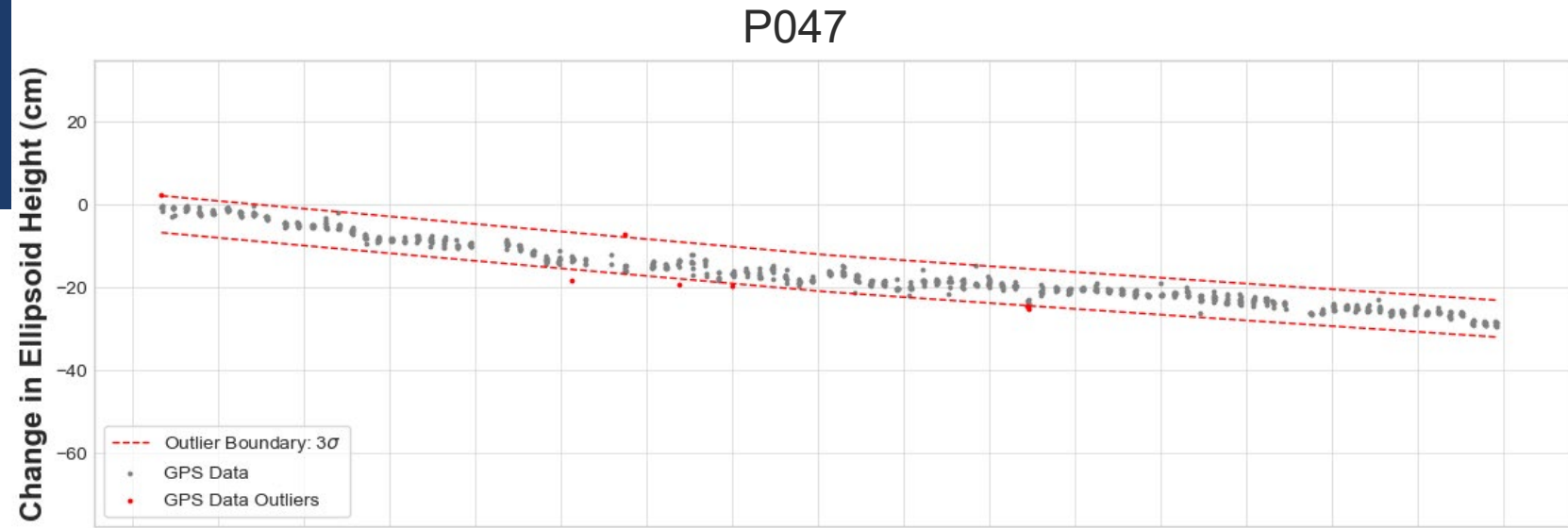


Processed GPS data (source: UH) over period of record. Processed data (grey circles) located inside the outlier boundary (red dashed lines) are used when calculating subsidence rates. Processed GPS data identified as outliers (red circles) are excluded from subsidence rate calculations and are shown for informational purposes only.

Exhibit 15

GPS station P047, located in Spring, has measured a total of approximately 27.5 cm of subsidence since 2007.

Processed GPS data (source: UH) over period of record. Processed data (grey circles) located inside the outlier boundary (red dashed lines) are used when calculating subsidence rates. Processed GPS data identified as outliers (red circles) are excluded from subsidence rate calculations and are shown for informational purposes only.



Testimony and Public Comment

Any person who wishes to appear at the hearing and present testimony, evidence, exhibits or other information may do so in person, by counsel, via email to info@subsidence.org or any combination of these options.

Thank you for attending the Public Hearing for the 2022 Annual Groundwater Report



- Record will be open until May 5, 2023. You may provide comments by sending an email to info@subsidence.org.
- The 2022 Annual Groundwater Report will be presented to the Harris-Galveston Subsidence District Board of Directors on May 10, 2023.
- The 2022 Annual Groundwater Report will be posted on the District's website (www.hgsubsidence.org) upon approval of the District's Board of Directors.



HARRIS - GALVESTON
SUBSIDENCE DISTRICT

Contact Information



Connect with us!



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