



2021 Annual Groundwater Report

Public Hearing
April 28, 2022



FORT BEND
SUBSIDENCE DISTRICT

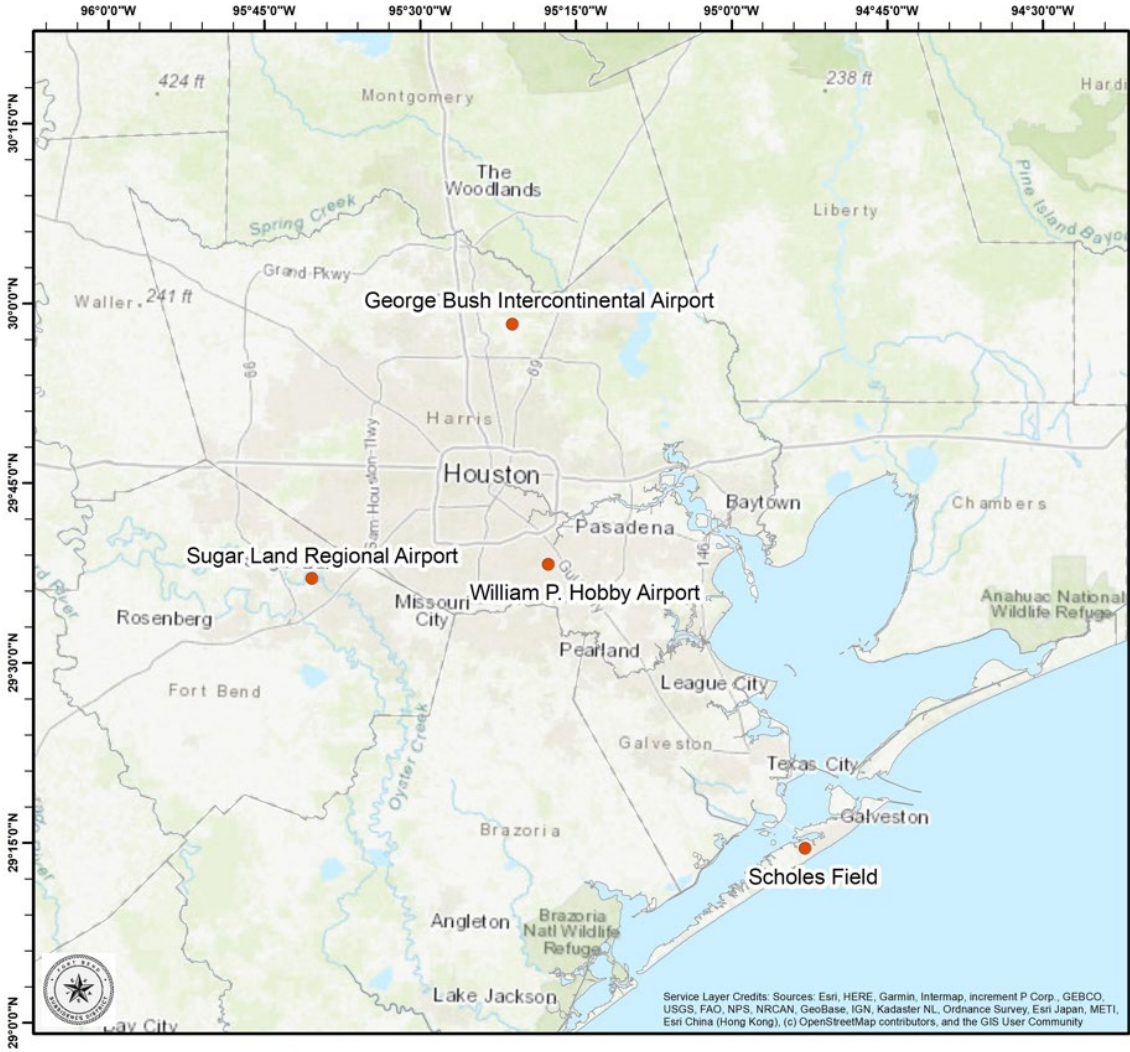
Table of Contents

- **Weather**
- Pumpage
- Water Levels
- Subsidence

Location Map

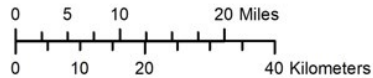


FORT BEND
SUBSIDENCE DISTRICT



EXPLANATION

- National Weather Service (NWS) Climate Stations



Weather

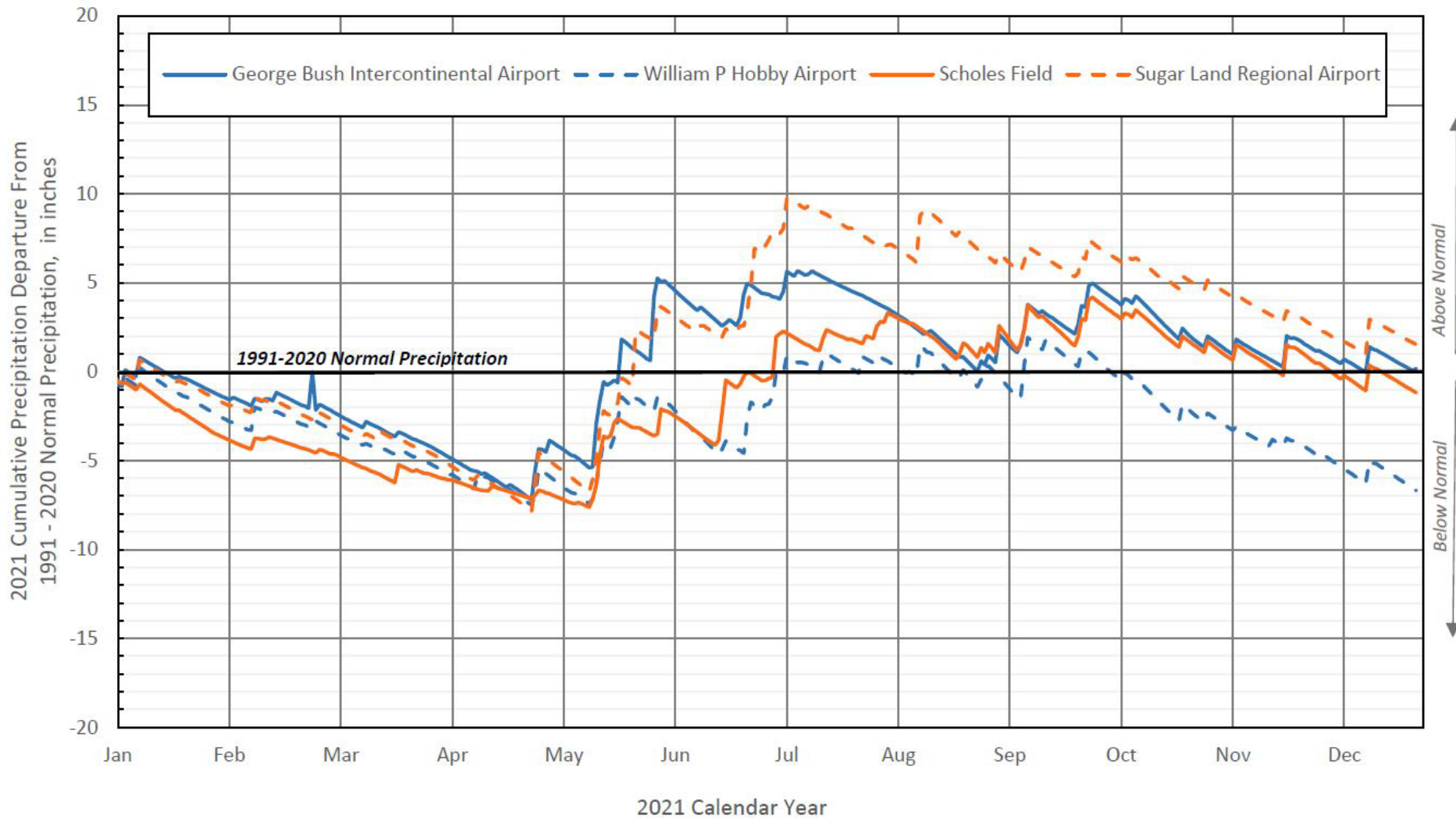


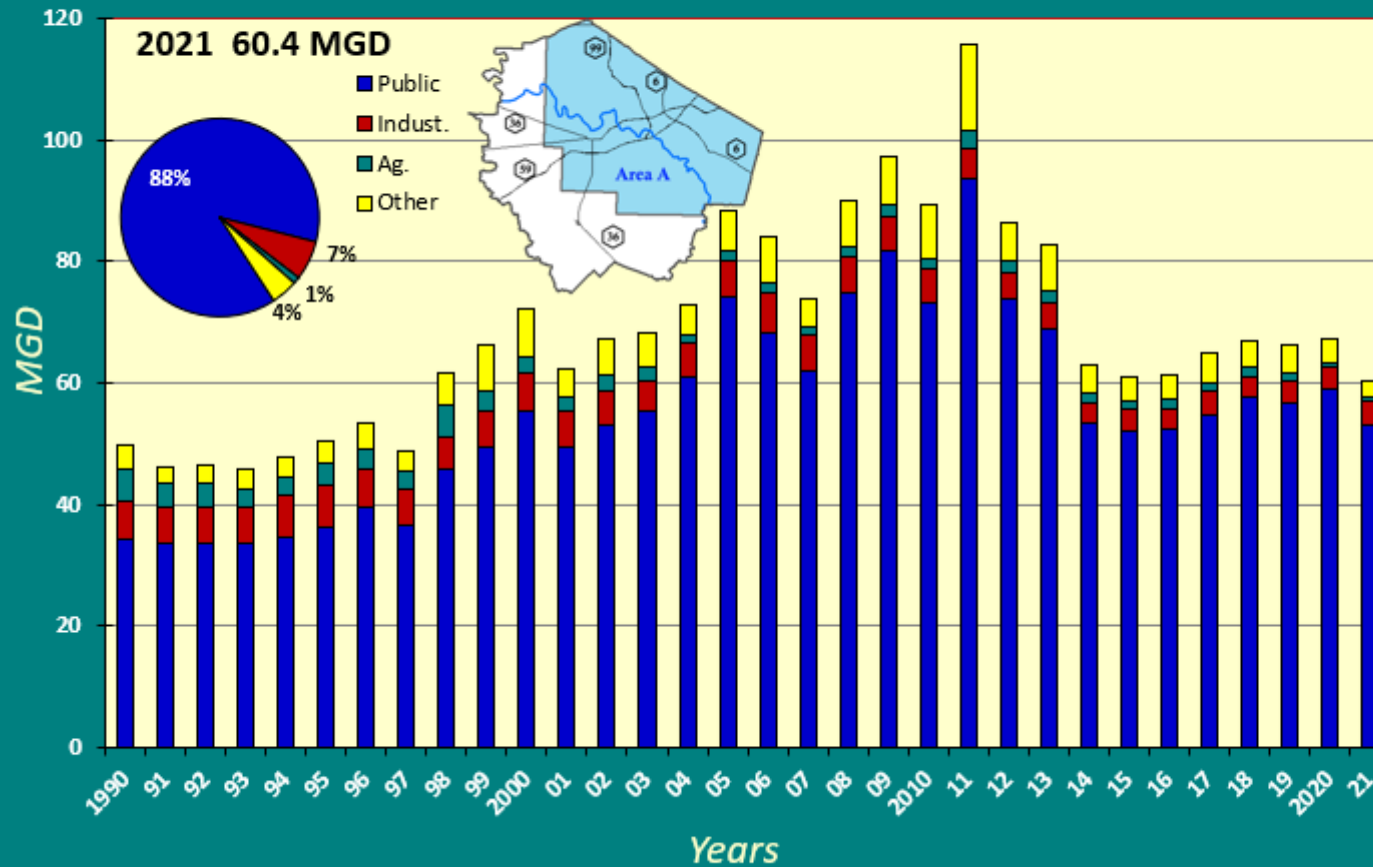
Table of Contents

- Weather
- **Pumpage**
- Water Levels
- Subsidence

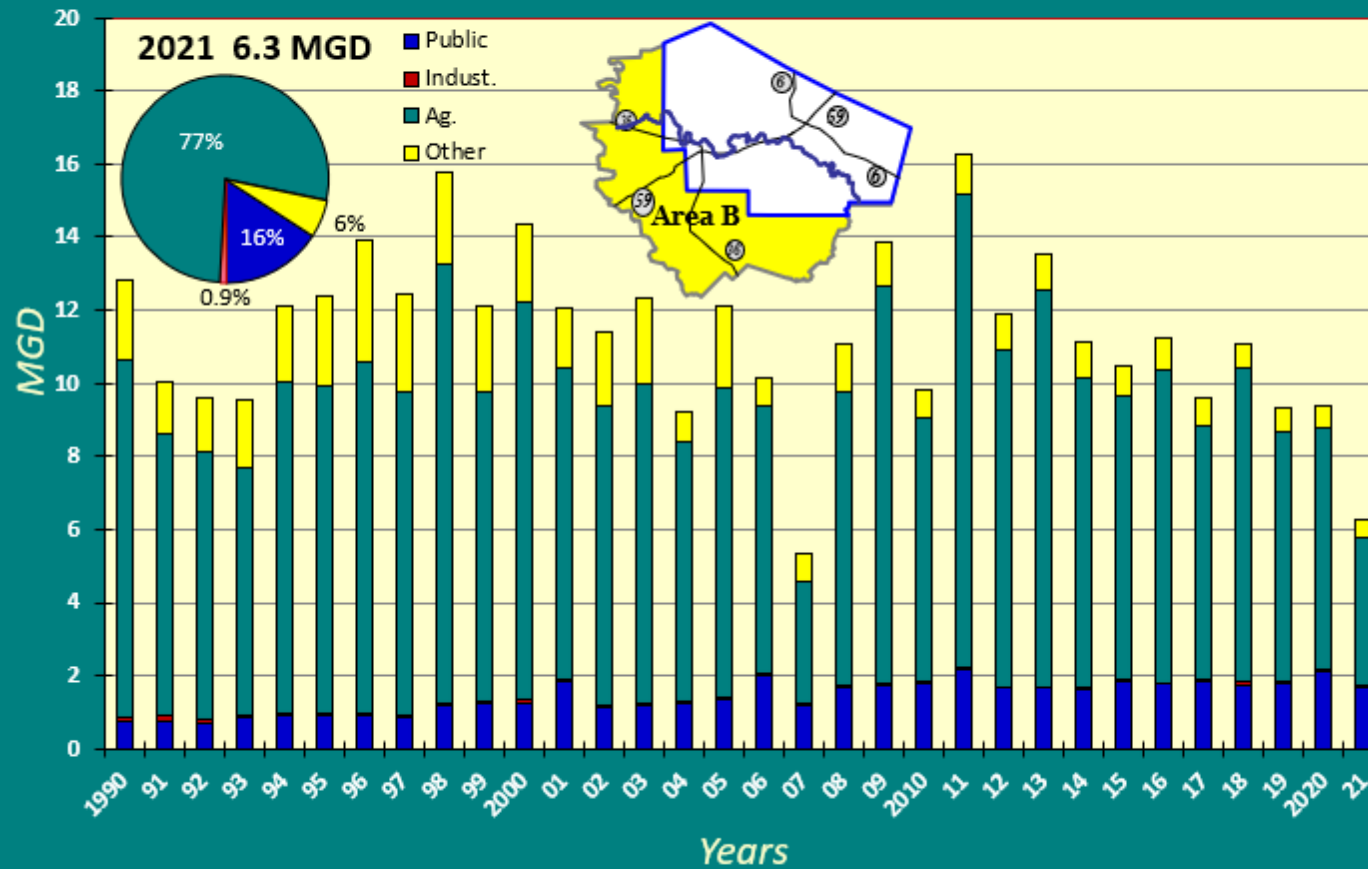
Groundwater Withdrawals | Grouped by Use – Regulatory Area A



Groundwater Withdrawals Grouped by Use - Regulatory Area A



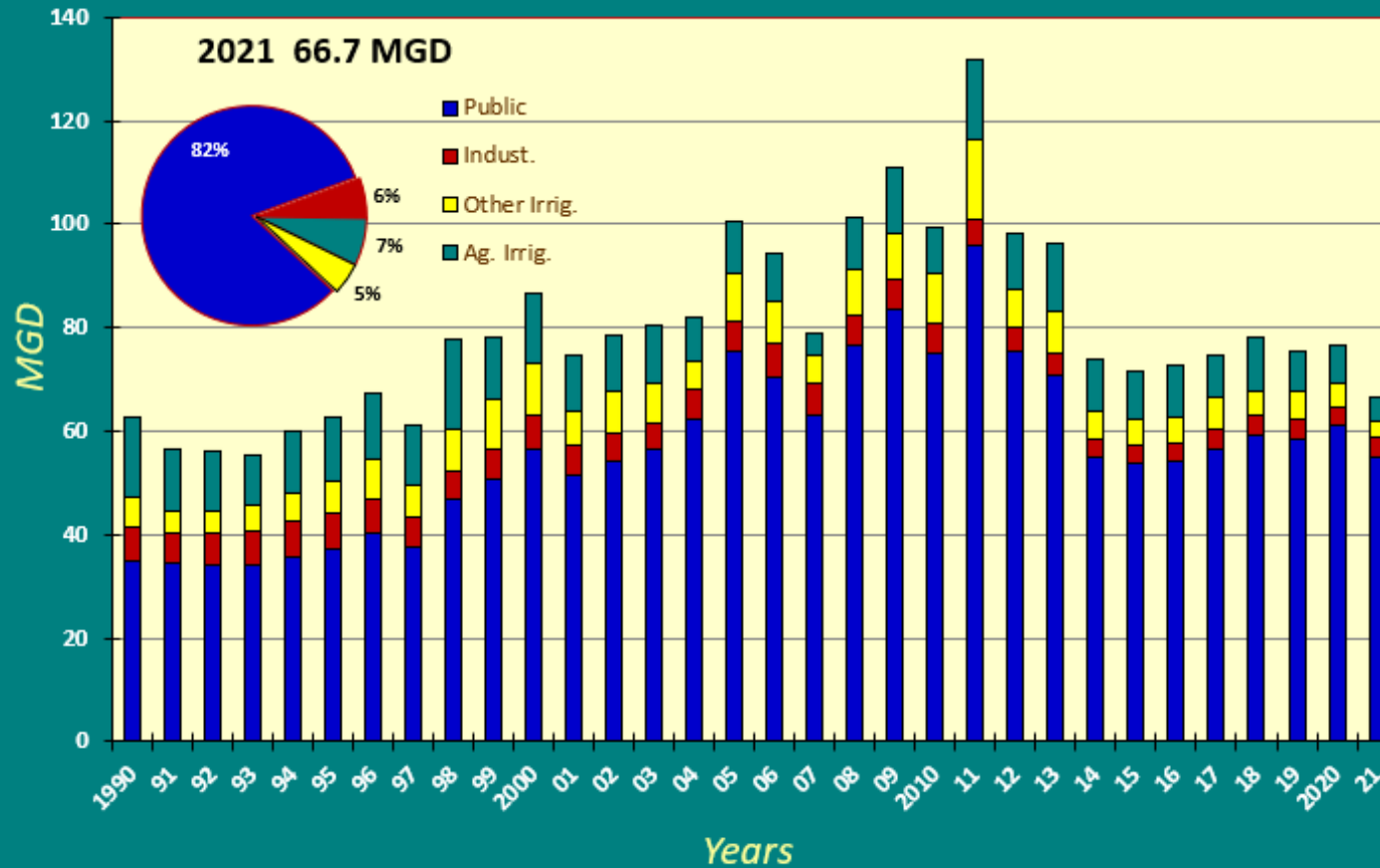
Groundwater Withdrawals Grouped by Use - Regulatory Area B



Groundwater Withdrawals | Grouped by Use – Entire District



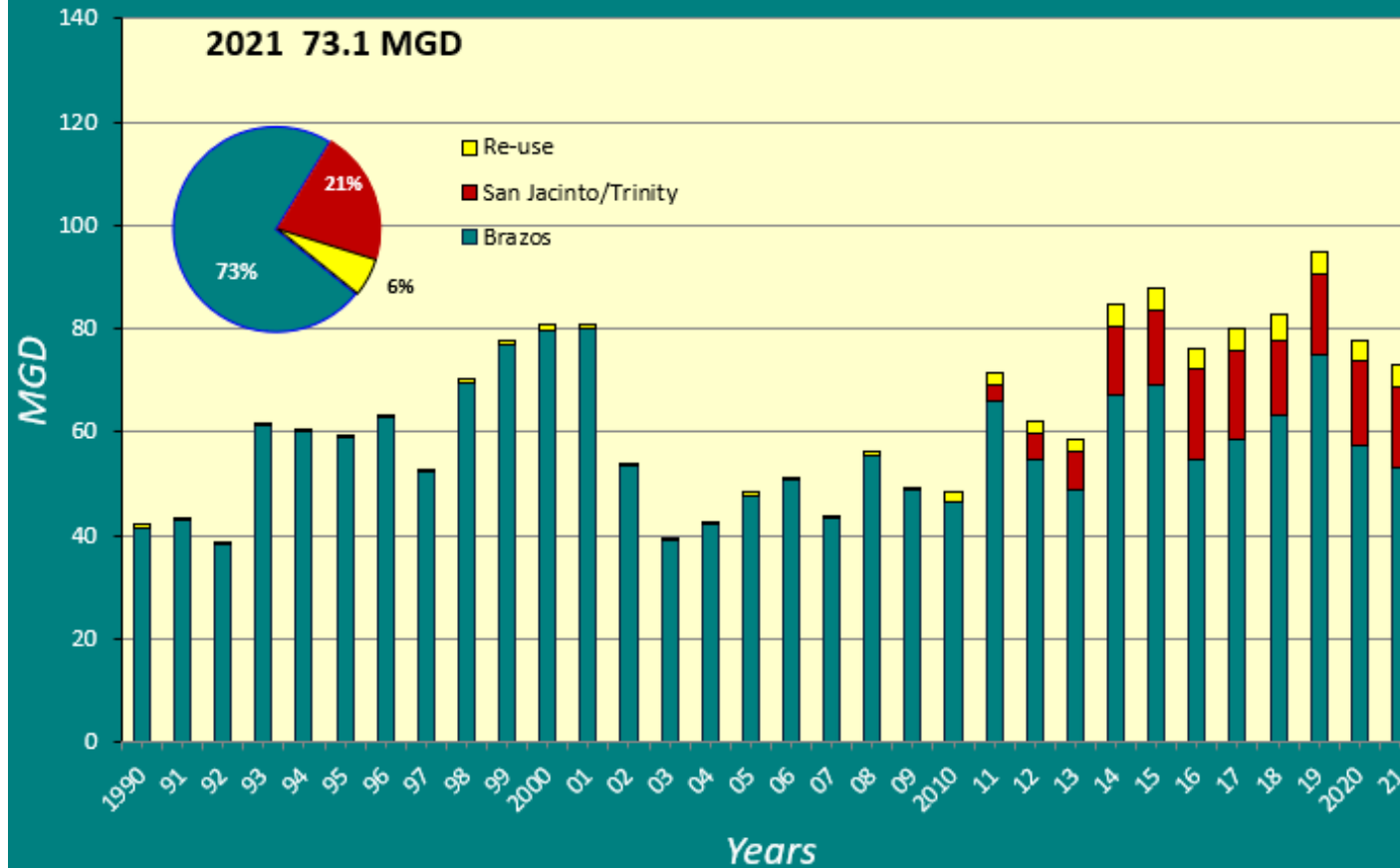
Groundwater Withdrawals Grouped By Use - Entire District



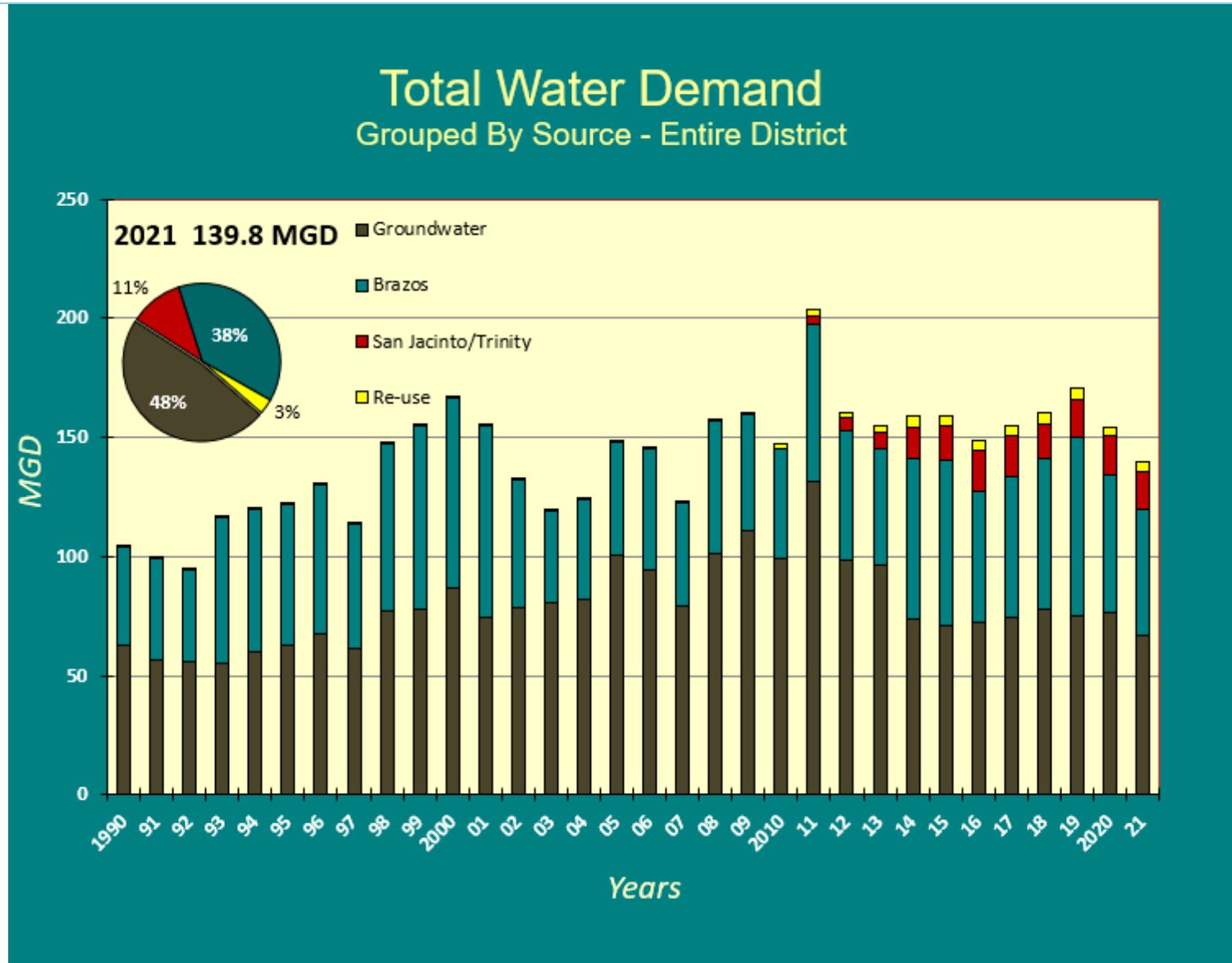
Surface & Re-Use Water Utilized | Grouped by Source – Entire District



Surface & Re-Use Water Utilized Grouped by Source - Entire District



Total Water Demands | Grouped by Source – Entire District



A stylized map of Texas is shown in the background, rendered in various shades of blue. A prominent white star is located in the center of the state, enclosed within a circular white outline. The map is partially obscured by a dark blue horizontal band that runs across the middle of the slide.

Table of Contents

- Weather
- Pumpage
- **Water Levels**
- Subsidence

Groundwater-level Altitudes
(2022) and Changes Over Time in
the Chicot and Evangeline
(Undifferentiated) and Jasper
Aquifers and Compaction in the
Chicot and Evangeline Portions
of the Undifferentiated Aquifer
(1973-2021)

April 28, 2022



Jason Ramage

Hydrologist
jkramage@usgs.gov

Christopher Braun

Hydrologist
Groundwater Specialist
clbraun@usgs.gov

John Ellis

Hydrologist
Studies Chief
jellis@usgs.gov



2022 Water-Level Altitude Map Series

- **Chicot and Evangeline Aquifers (undifferentiated)**

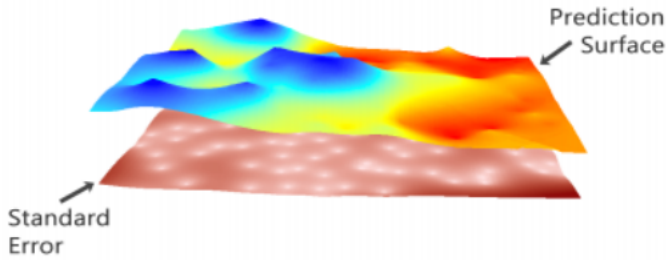
- *2022 Water-Level Altitude*
- *2021 to 2022 Water-Level Change*
- *2017 to 2022 Water-Level Change*
- *1990 to 2022 Water-Level Altitude Change*

- **Compaction 1973-2021**

- *Compaction Data from 14 Extensometers*

Geology and Hydrogeology

- Chicot and Evangeline aquifers (undifferentiated) have been combined into a “shallow” aquifer system
 - *GULF 2023 model - updated tops and bases*
 - *Chicot thickened significantly in much of the region, particularly in central and southeast Harris County*
 - *Many of the wells previously designated as Evangeline are now designated as Chicot*
- Altitude and long-term change maps are now represented by shaded grids (Kriging)



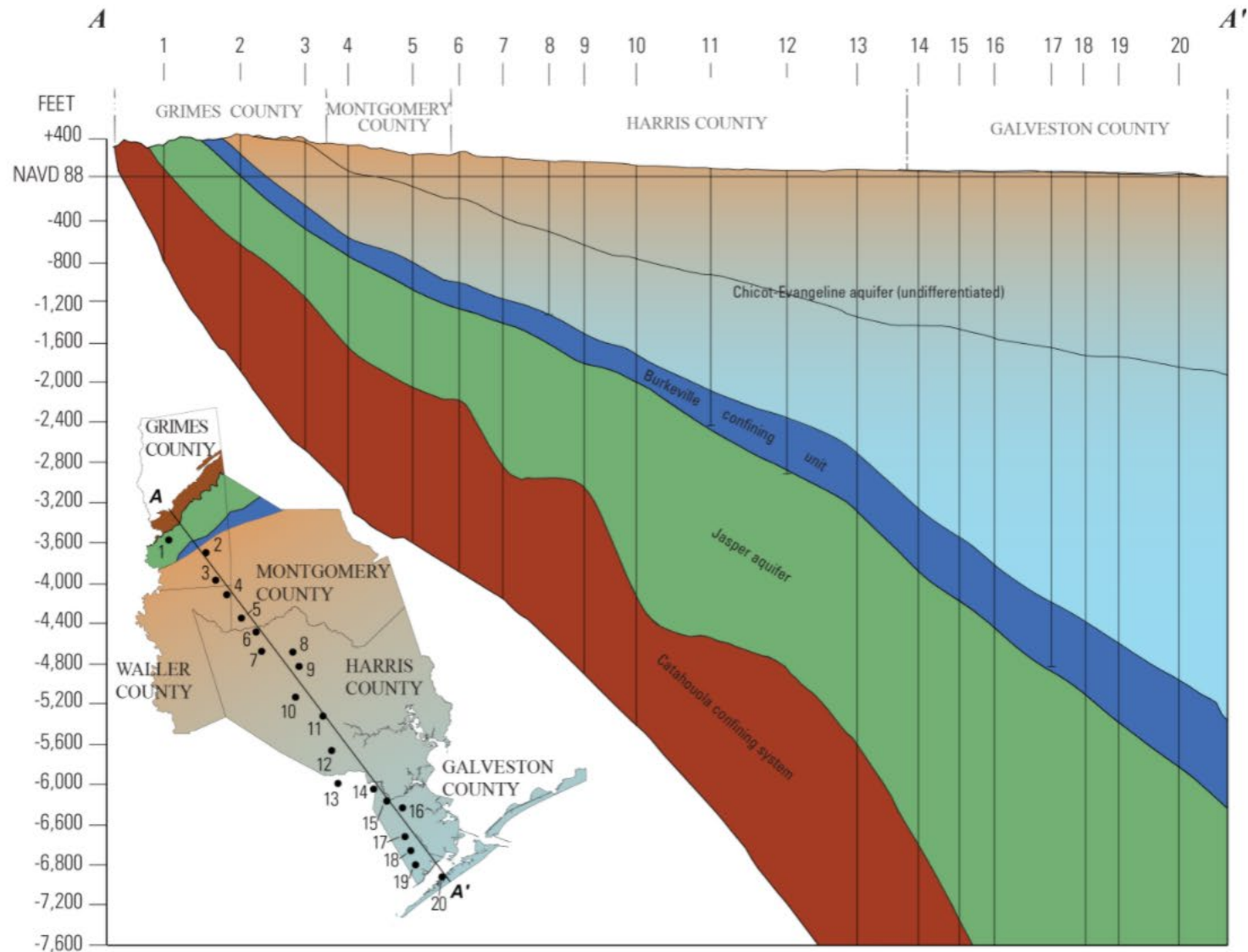
Geologic timescale		Prior to 2021		In 2021 and Moving Forward		
System	Series	Geologic units		Hydrogeologic units		
Quaternary	Holocene	Alluvium		Alluvial, terrace, and dune deposits		
	Pleistocene	Beaumont Formation		Beaumont Formation		
		Lissie Formation	Montgomery Formation	Chicot aquifer	Lissie Formation	Montgomery Formation
			Bentley Formation		Bentley Formation	
Willis Sand		Willis Sand		Chicot - Evangeline aquifer (undifferentiated)		
Pliocene	Goliad Sand		Evangeline aquifer		Goliad Sand (upper part)	
					Goliad Sand (lower part)	
Tertiary		Fleming Formation	Burkeville confining unit	Lagarto Clay (upper part)	Burkeville confining unit	
		Lagarto Clay		Lagarto Clay (middle part)		
	Miocene	Oakville Sandstone		Jasper aquifer	Lagarto Clay (lower part)	Jasper aquifer
					Oakville Sandstone	
Oligocene	Catahoula Sandstone	Upper part of Catahoula Sandstone	Catahoula Confining System	Catahoula Formation	Upper Catahoula Formation	
	Anahuac Formation	Anahuac Formation		Frio Formation	Catahoula Confining System	
		Frio Formation				

From Braun and Ramage, 2022 (in press) to be published in June

Network

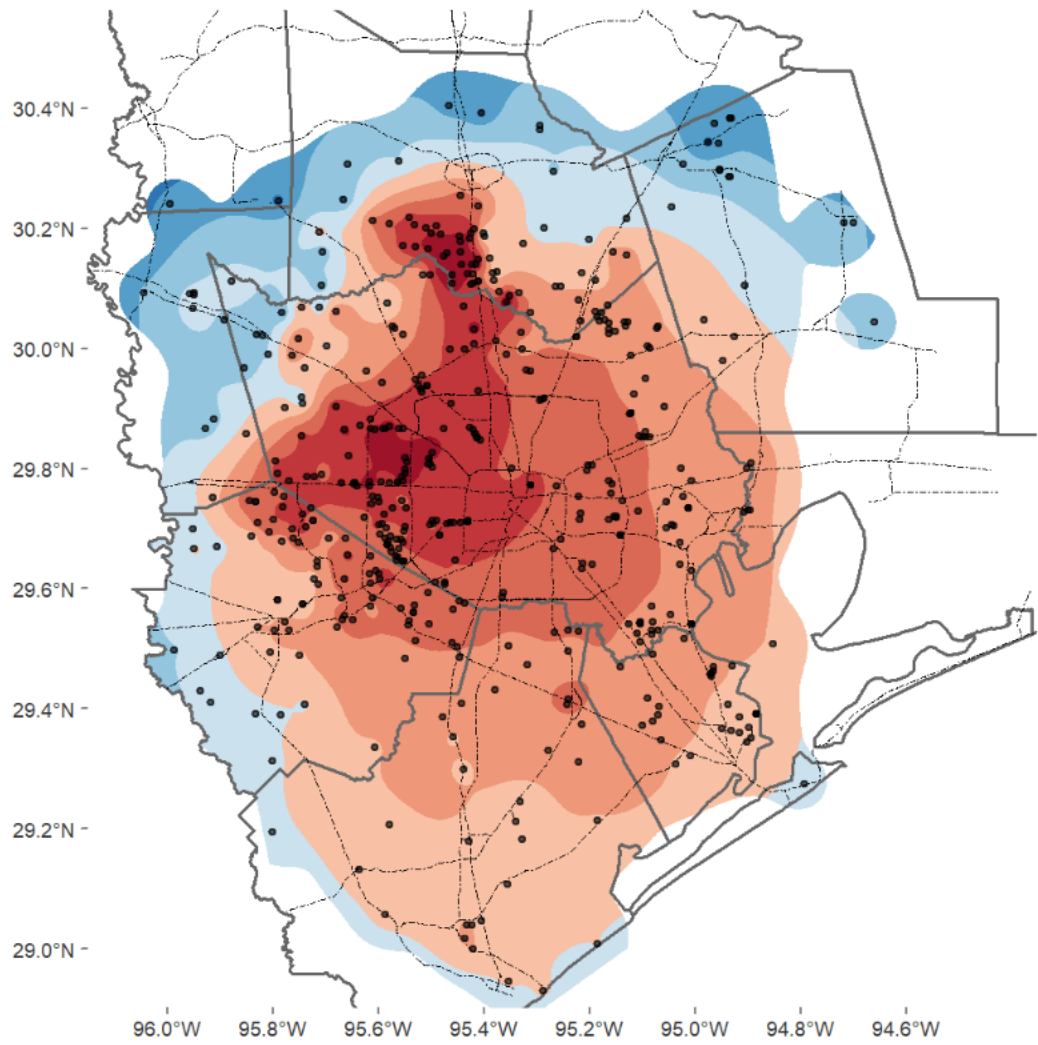
- Data were collected across 11 counties (Harris and surrounding) from 2021-11-29 to 2022-03-11
- Requires collaboration and agreements with well owners and operators (MUDs)
- Variety of well types including public supply, irrigation, industrial and observation
- Number of Chicot and Evangeline (undifferentiated) water-levels collected: **537**
- Number of wells used to create 2022 Altitude maps
 - *Chicot and Evangeline (undifferentiated): 498*

Stratigraphic cross section



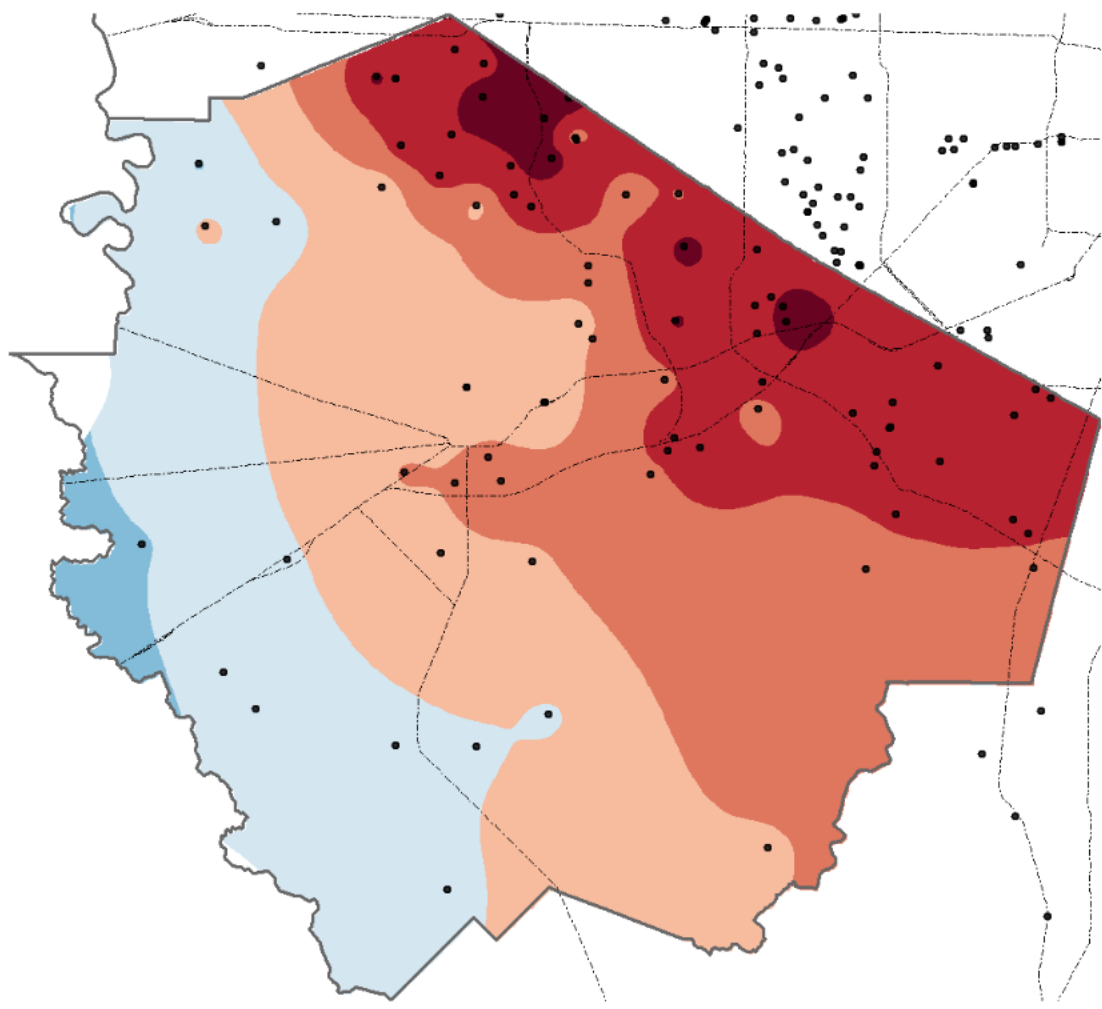
VERTICAL SCALE GREATLY EXAGGERATED
From Braun and Ramage, 2022 (in press) to be published in June

2022 Chicot and Evangeline (Undifferentiated) Water-level Altitude

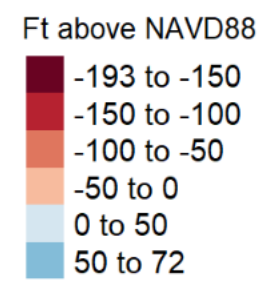


- Data Summary:
Min : **-270**
Mean : **-42**
Max : **195**
- Highest areas of usage in western Harris County, and the south-central portion of Montgomery County

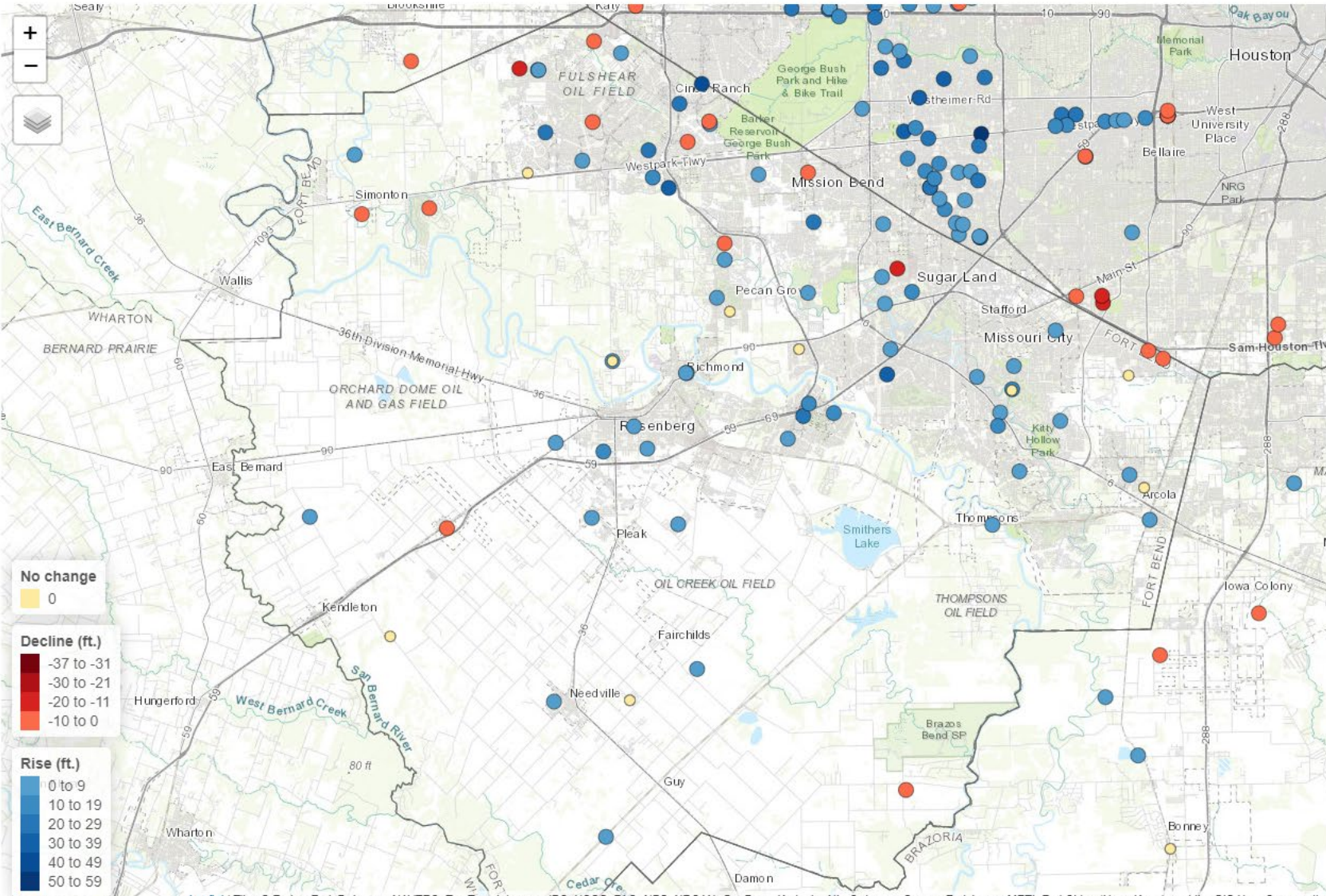
2022 Chicot and Evangeline (Undifferentiated) Water-level Altitude



- Data Summary:
Min : **-193**
Mean : **-46**
Max : **72**
- Highest areas of usage in western Harris County and some areas of northern Fort Bend County



Chicot and Evangeline (Undifferentiated) 1 year change



Number of wells: **74**

Rises: **68.9%**

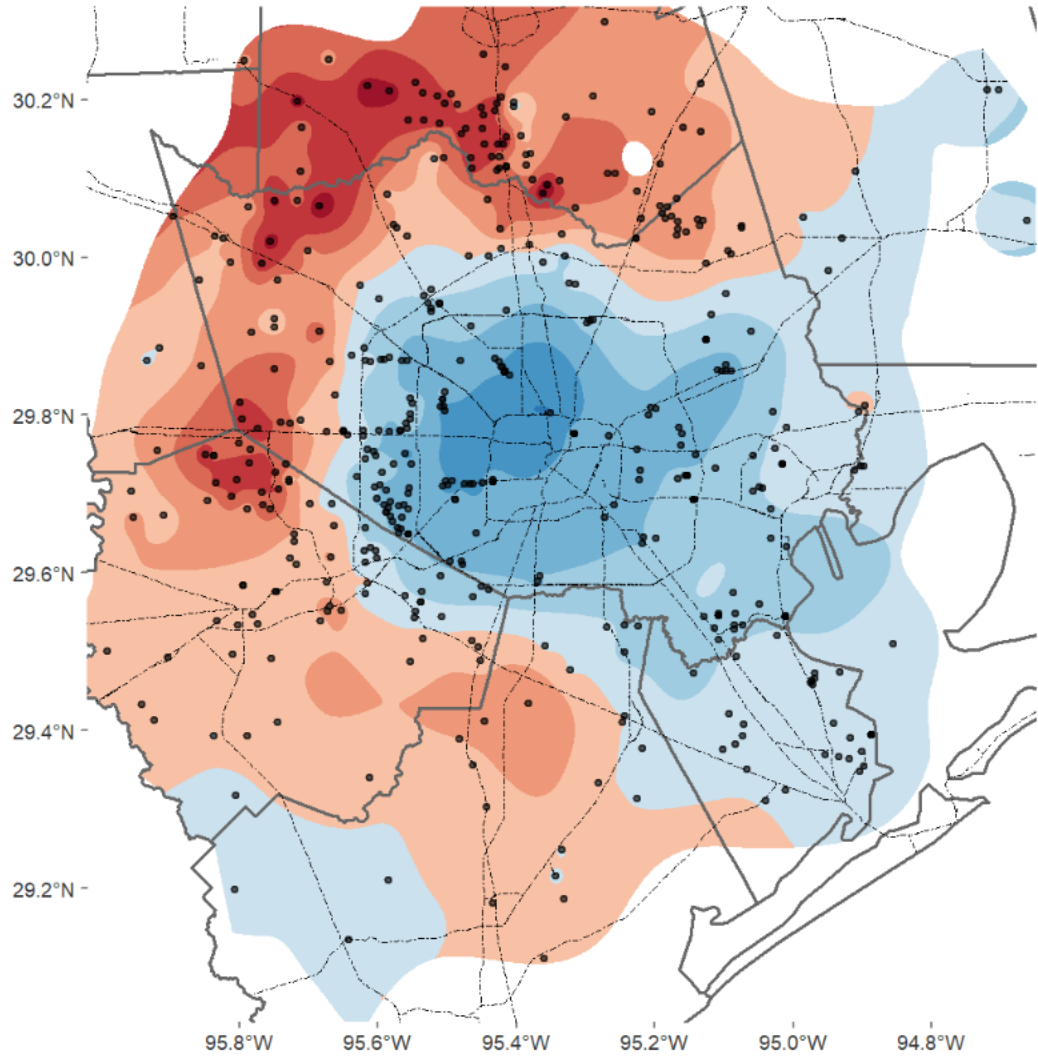
Declines: **18.9%**

No Change: **12.2%**

more than 20 ft. rise: **8**
more than 30 ft. rise: **3**

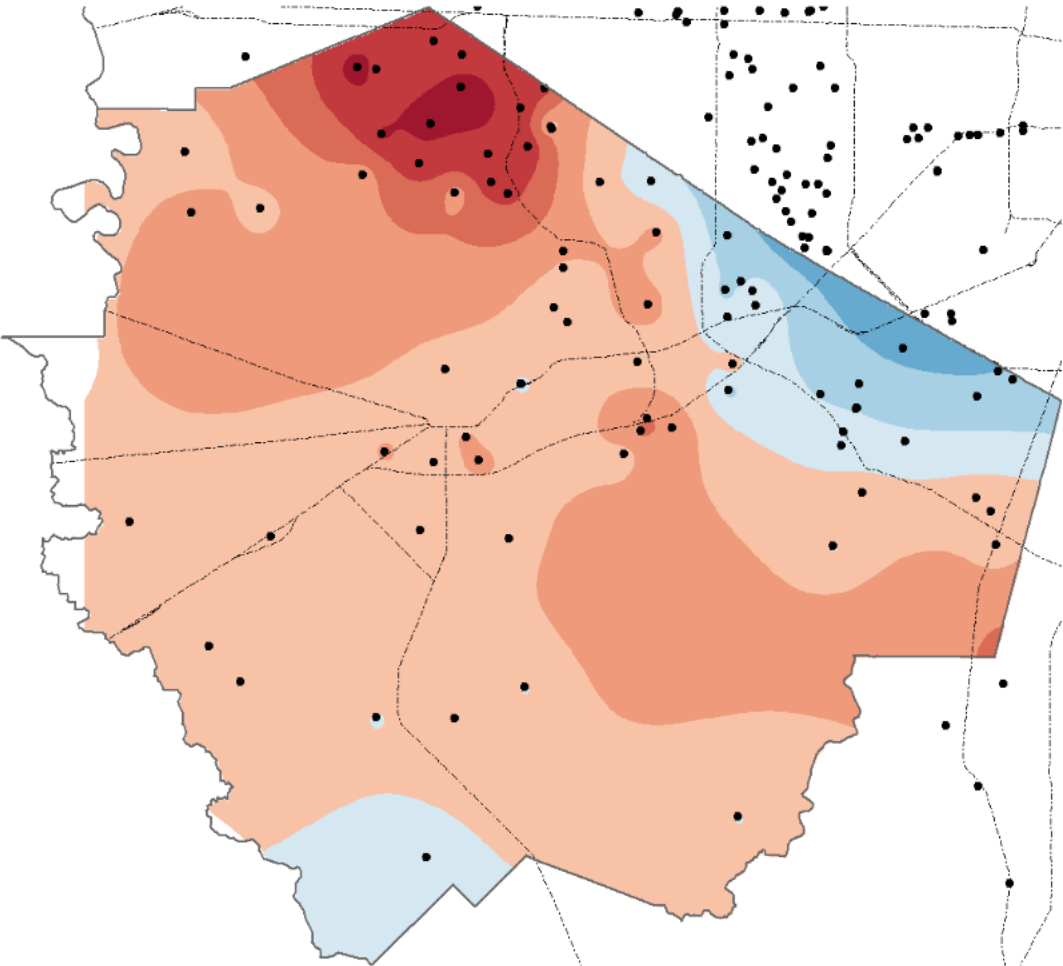
more than 20 ft. decline: **0**
more than 30 ft. decline: **0**

Chicot and Evangeline (Undifferentiated) water-level change since 1990

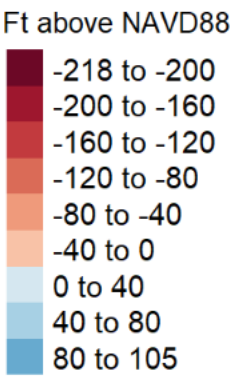


- Data Summary:
Min : **-292**
Mean : **-6**
Max : **209**
- Water-level rises across most of central and eastern Harris County as well as Galveston County
- Water-level declines in the Northern part of Fort Bend County, NW portions of Harris County, and Montgomery County

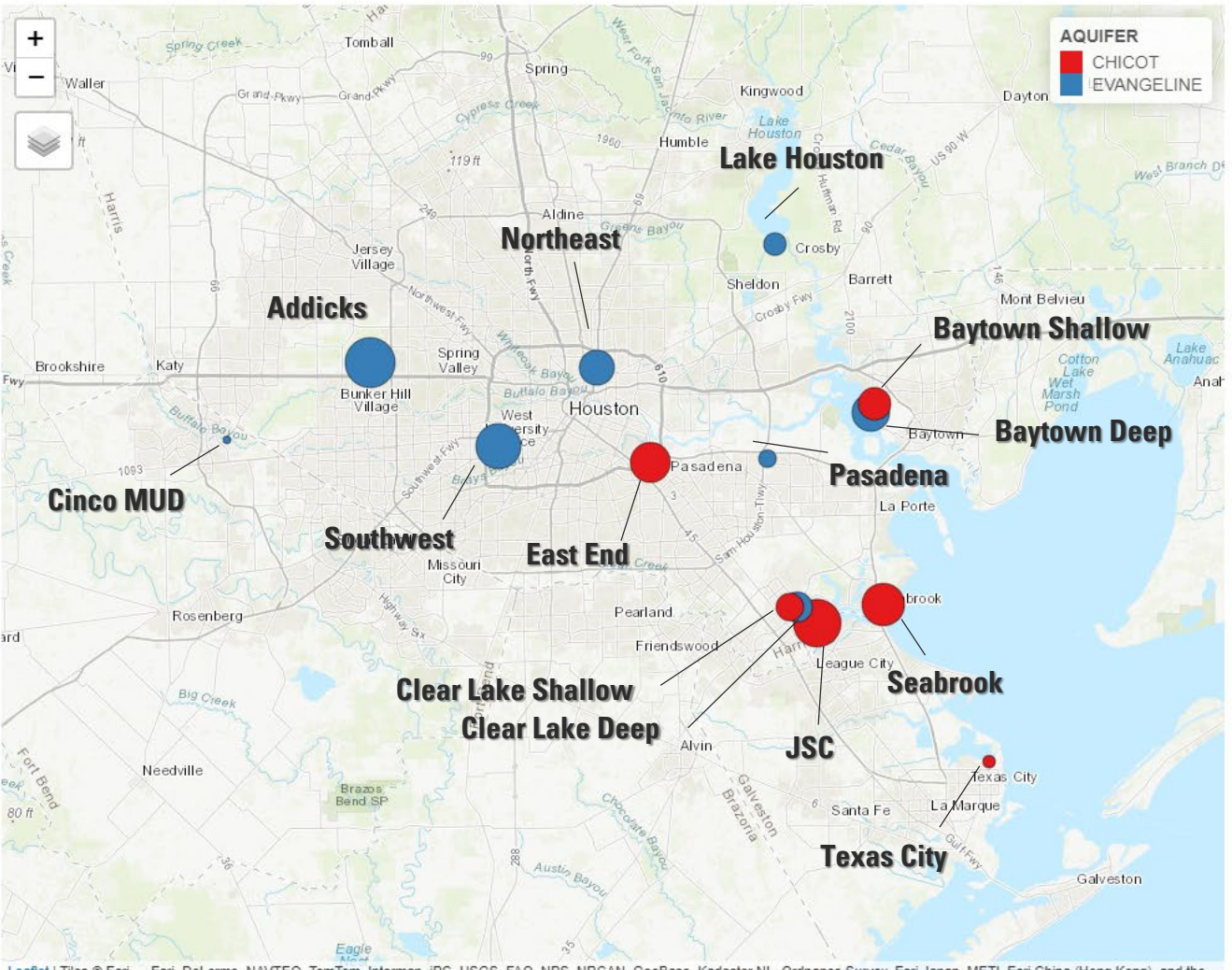
Chicot and Evangeline (Undifferentiated) water-level change since 1990



- Data Summary:
Min : -218
Mean : -29
Max : 105
- Water-level rises across most of central and eastern and central Harris County
- Largest water-level declines in the Northern part of Fort Bend County



Compaction



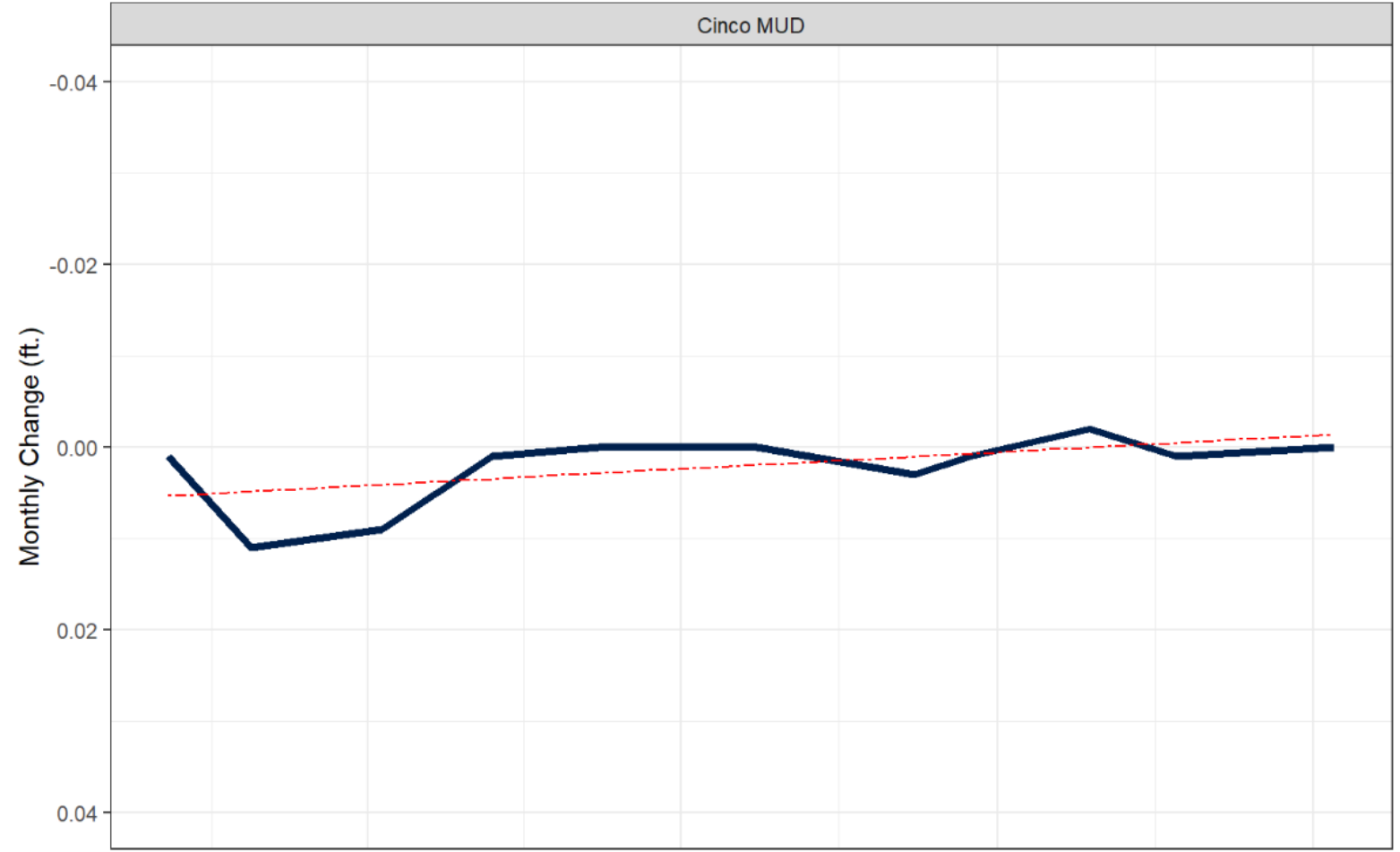
Size of symbol reflects amount of total cumulative compaction

- Cumulative compaction recorded at each location as of December 2021

- Chicot
 1. 1973 | Baytown Shallow - 0.874 ft.
 2. 1973 | East End - 1.350 ft.
 3. 1973 | Johnson Space Center - 2.580 ft.
 4. 1973 | Seabrook - 1.570 ft.
 5. 1973 | Texas City - 0.091 ft.
 6. 1976 | Clear Lake Shallow - 0.686 ft.
- Evangeline
 7. 1973 | Baytown Deep - 1.110 ft.
 8. 1974 | Addicks - 3.780 ft.
 9. 1975 | Pasadena - 0.458 ft.
 10. 1976 | Clear Lake Deep - 0.705 ft.
 11. 1980 | Lake Houston - 0.636 ft.
 12. 1980 | Northeast - 1.000 ft.
 13. 1980 | Southwest - 1.680 ft.
 14. 2017 | Cinco MUD - 0.014 ft.

Compaction 1 year monthly changes

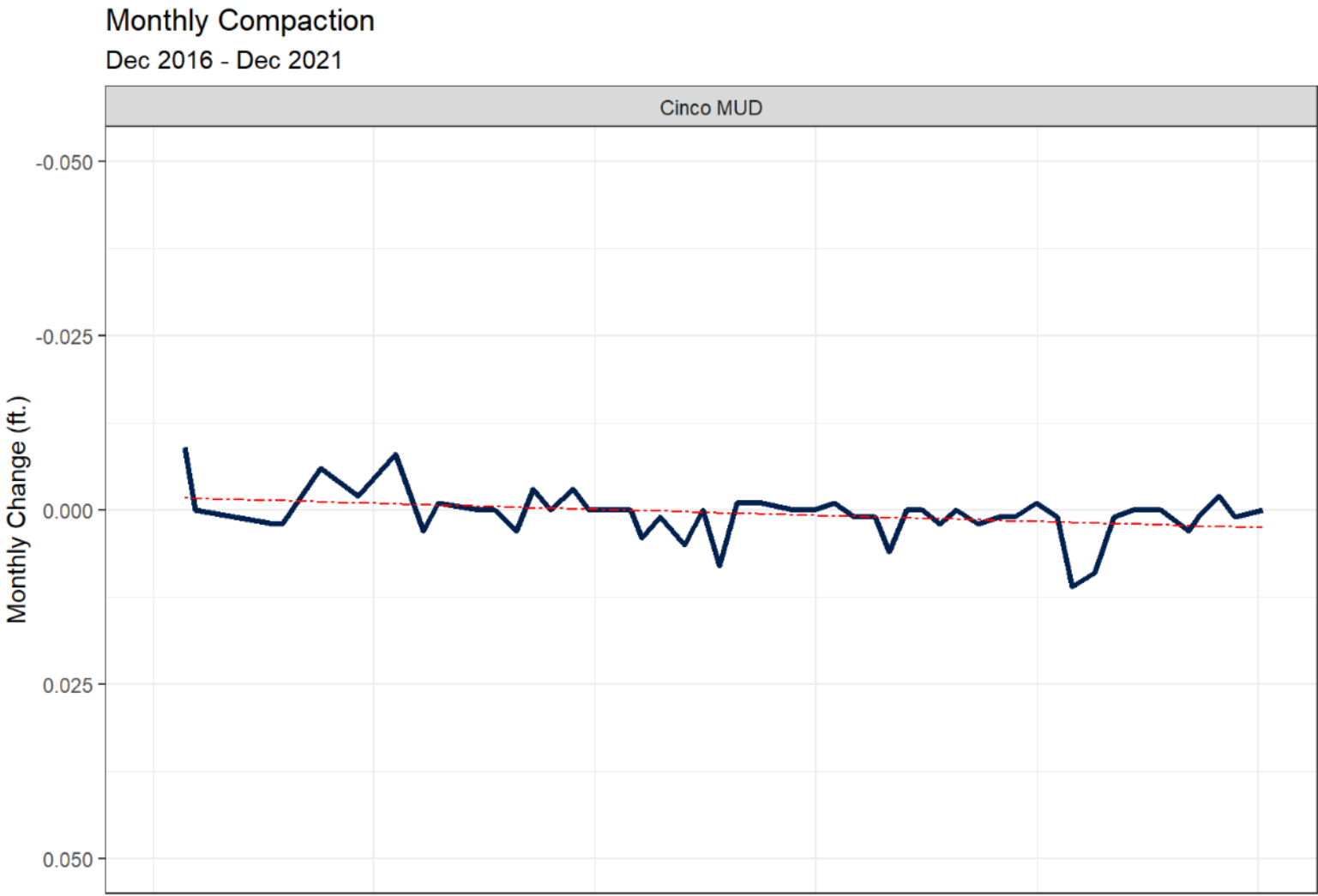
Monthly Compaction
Dec 2020 - Dec 2021



- Slight decrease in trend (expansion)

Monthly change in land surface elevation at each location
(-) expansion, (+) compaction

Compaction 5 year monthly changes



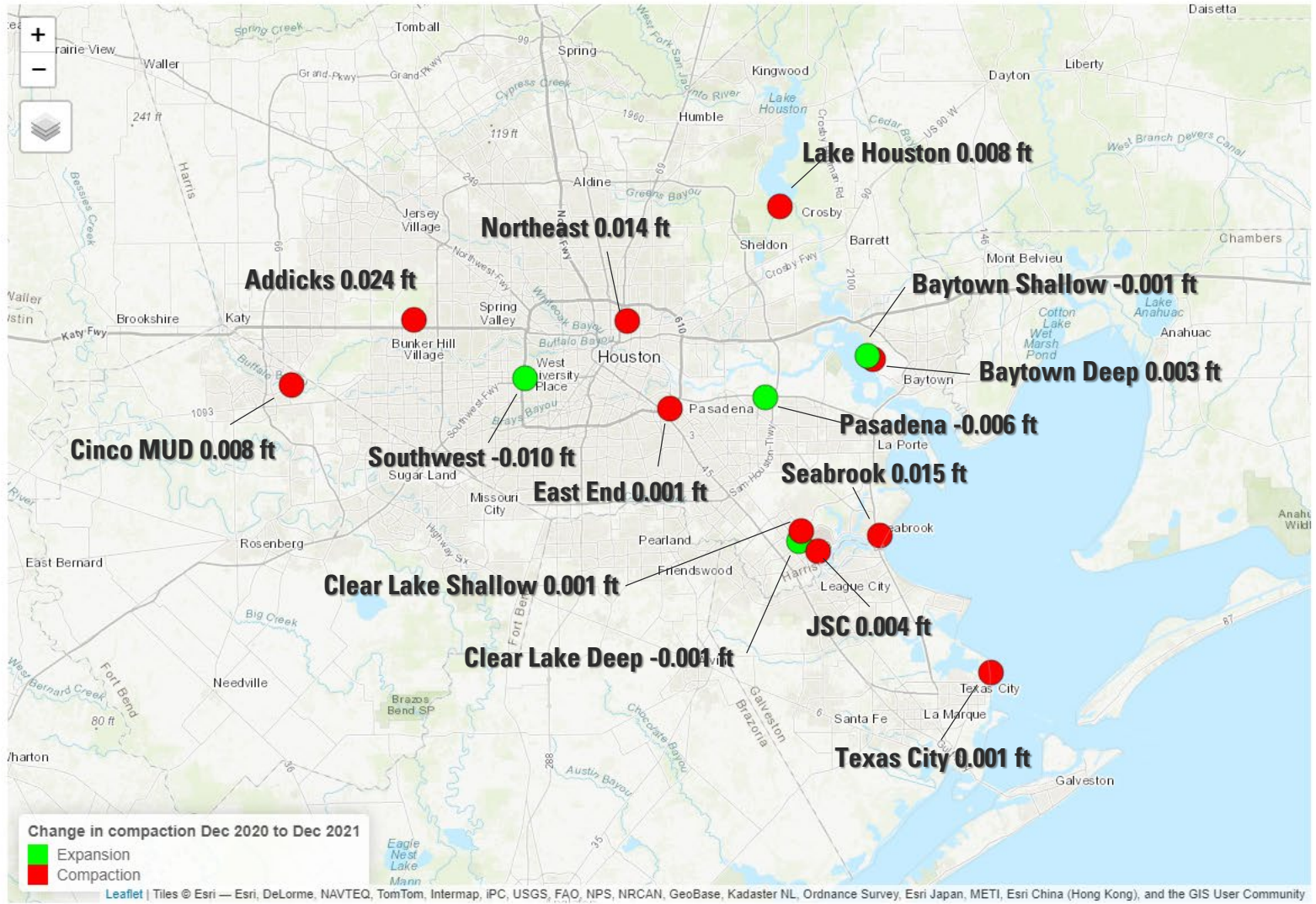
- Slight increase in trend (compaction)

Monthly change in land surface elevation at each location
(-) expansion, (+) compaction

Summary: Compaction

Absolute changes for the period December 2020 through December 2021, in ft.

- 4 sites recorded expansion ranging from 0.001 ft. to 0.01 ft.
- 10 sites recorded compaction ranging from 0.001 ft. to 0.024 ft.
- 0 sites recorded no change





Jason Ramage

Hydrologist
jkramage@usgs.gov

Christopher Braun

Hydrologist
Groundwater Specialist
clbraun@usgs.gov

John Ellis

Hydrologist
Studies Chief
jellis@usgs.gov

Table of Contents

- Weather
- Pumpage
- Water Levels
- **Subsidence**

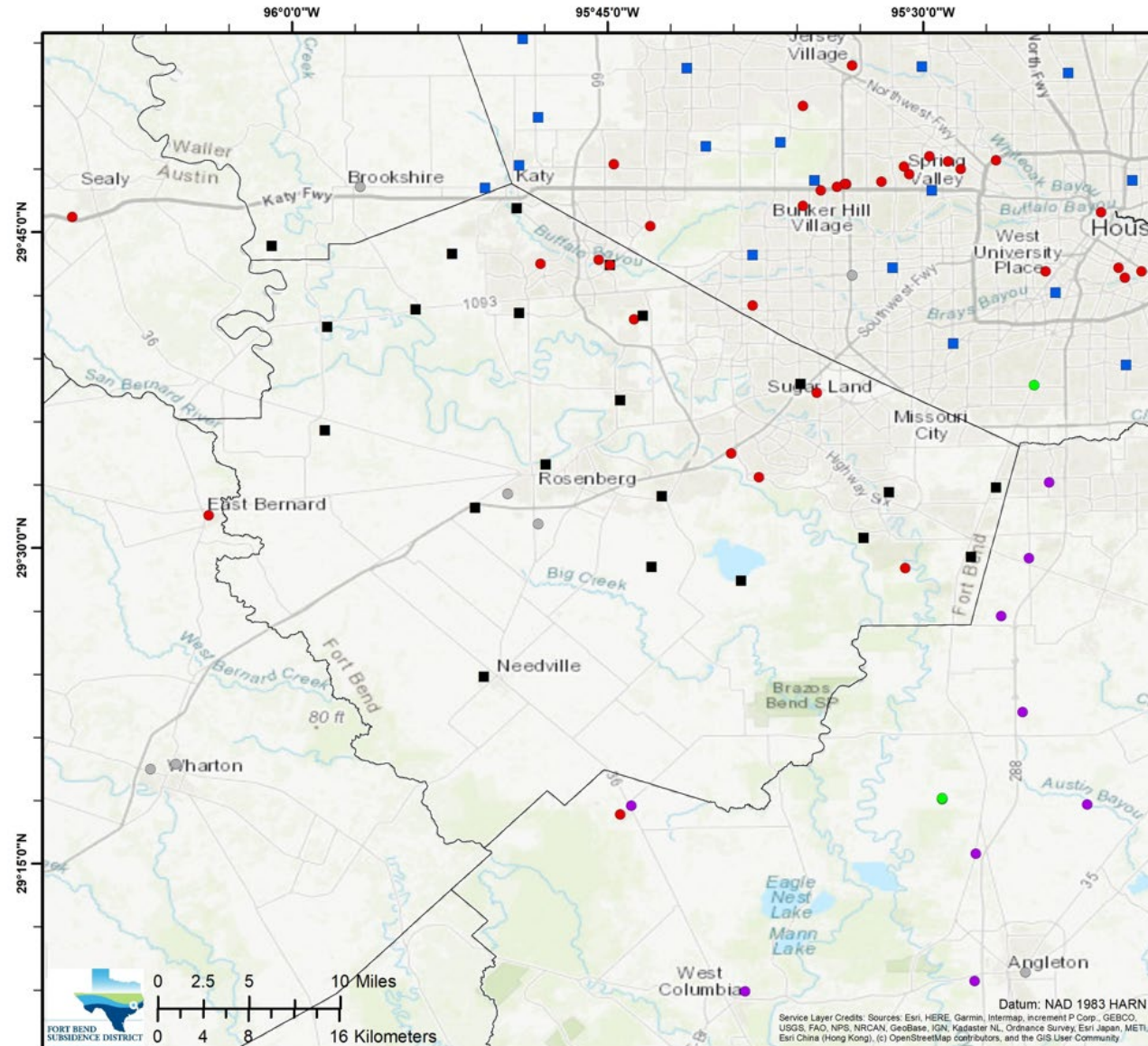
GPS Station Operators



EXPLANATION

GPS Station Operators

- Fort Bend Subsidence District
- Harris-Galveston Subsidence District
- Brazoria County Groundwater Conservation District
- Lone Star Groundwater Conservation District
- Texas Department of Transportation
- University of Houston
- Other Agencies



Subsidence Rates

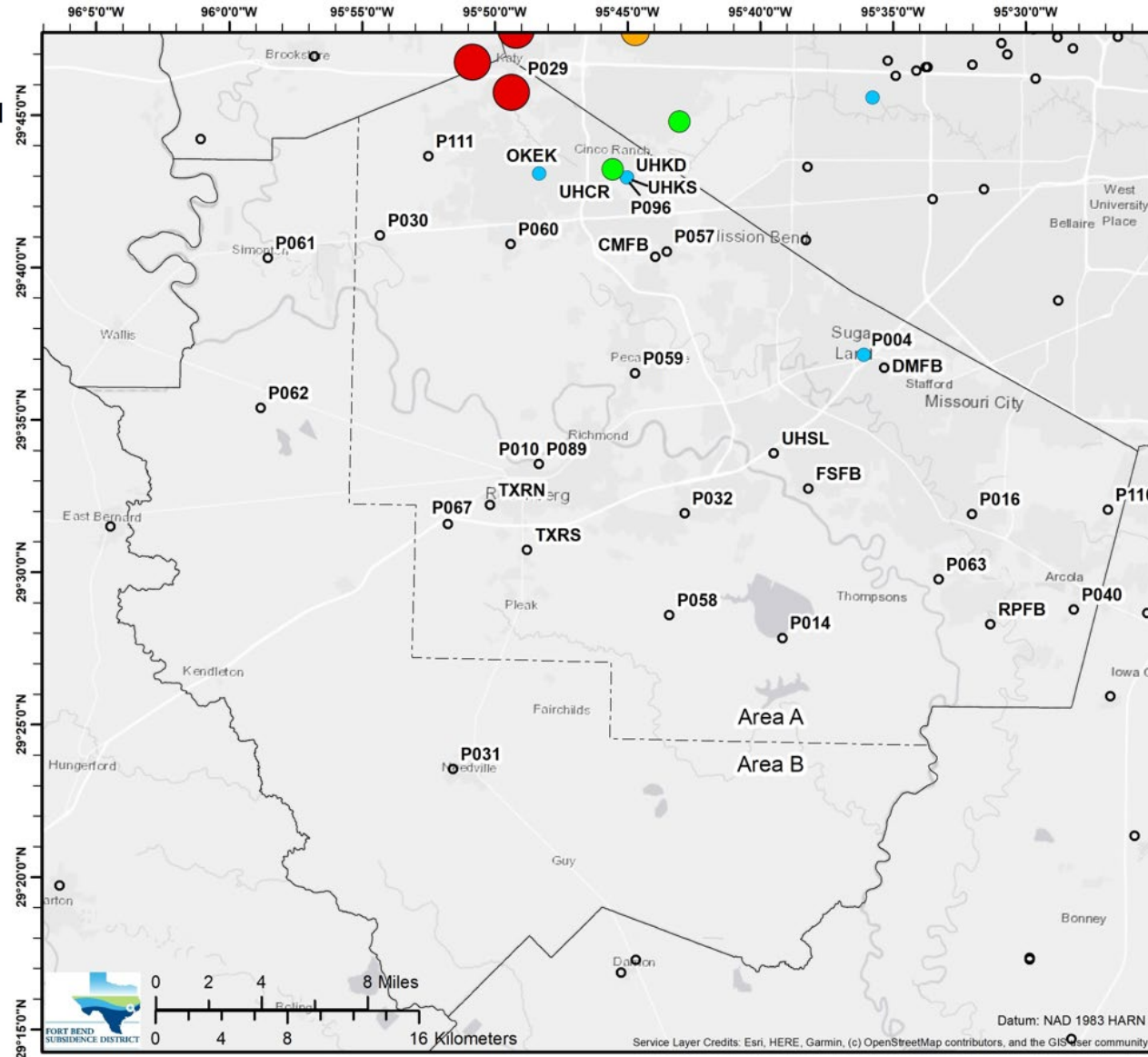


FORT BEND
SUBSIDENCE DISTRICT

EXPLANATION

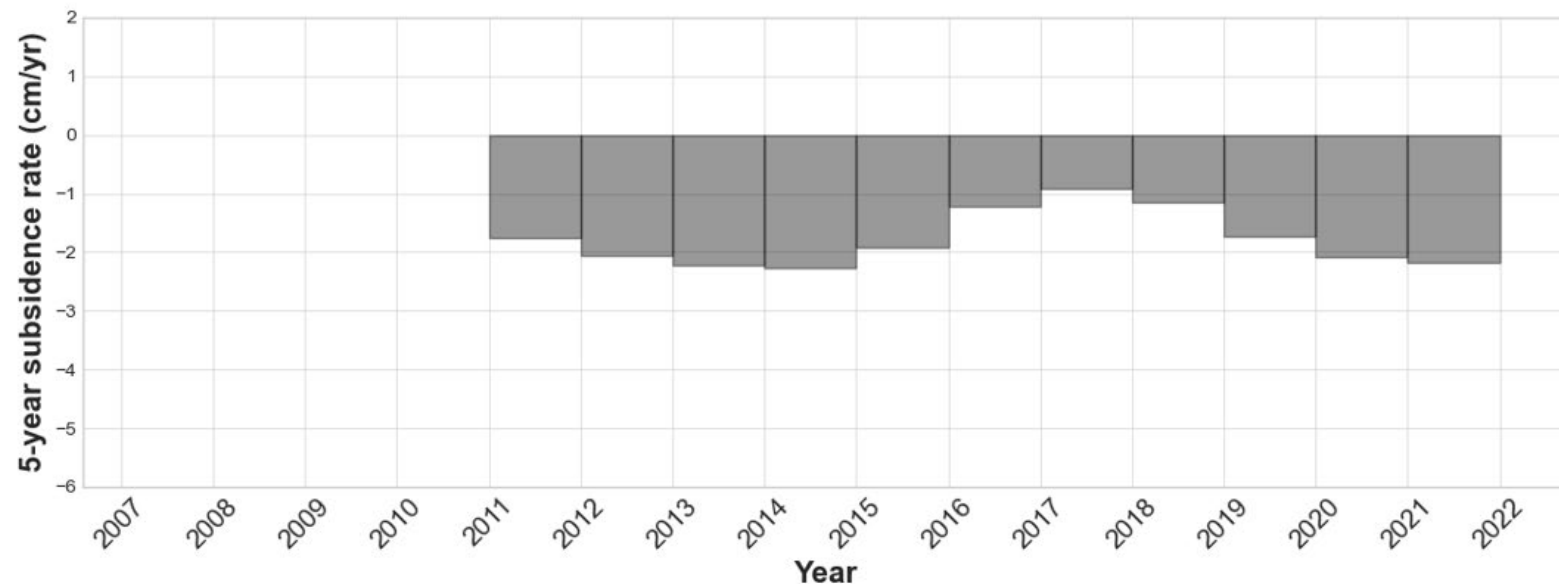
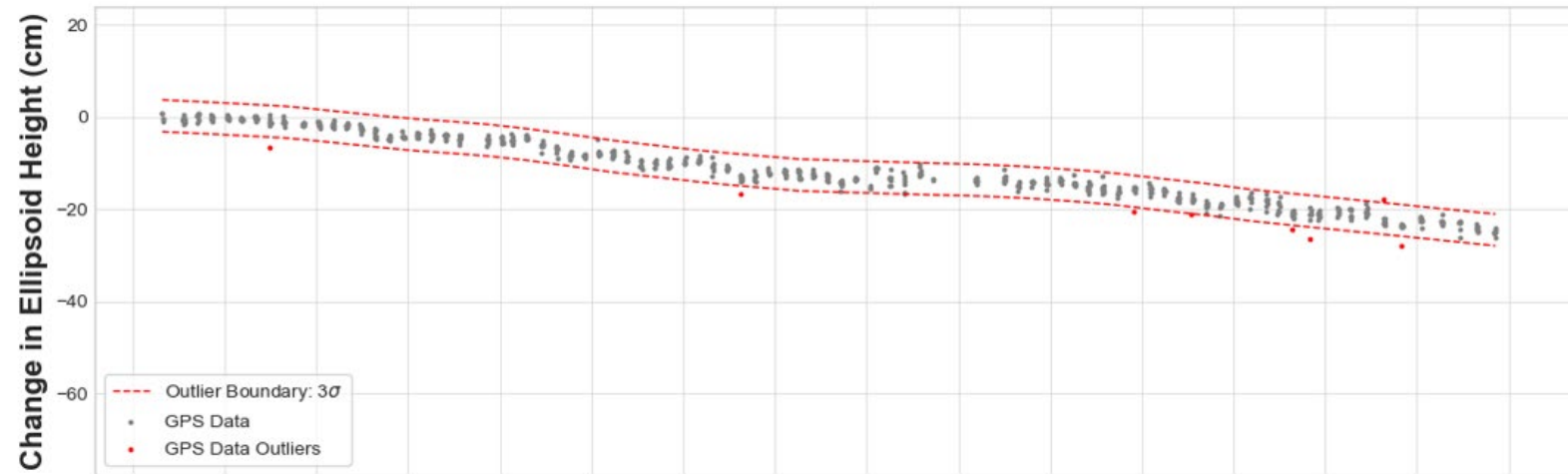
Annual Subsidence Rate (cm/yr) from 2017 to 2021

- Greater than 2.0
- <2.0 - 1.5
- <1.5 - 1.0
- <1.0 - 0.5
- Less than 0.5 or period of record less than 3 years



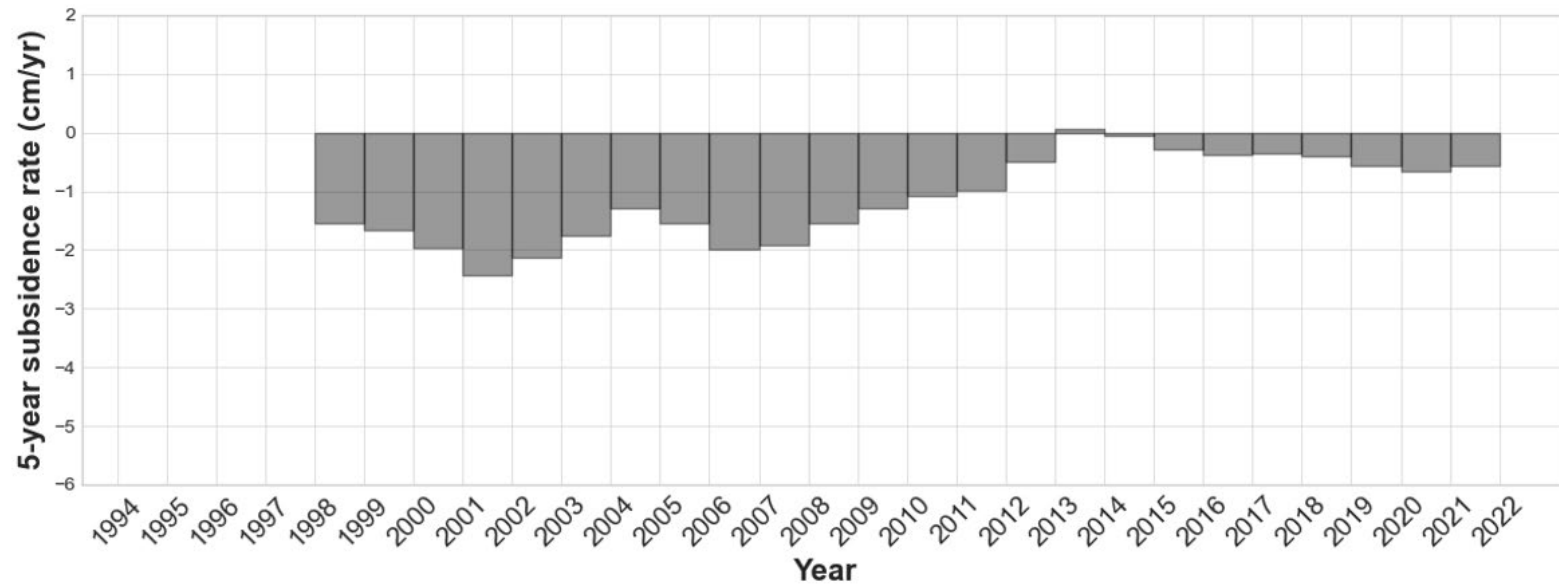
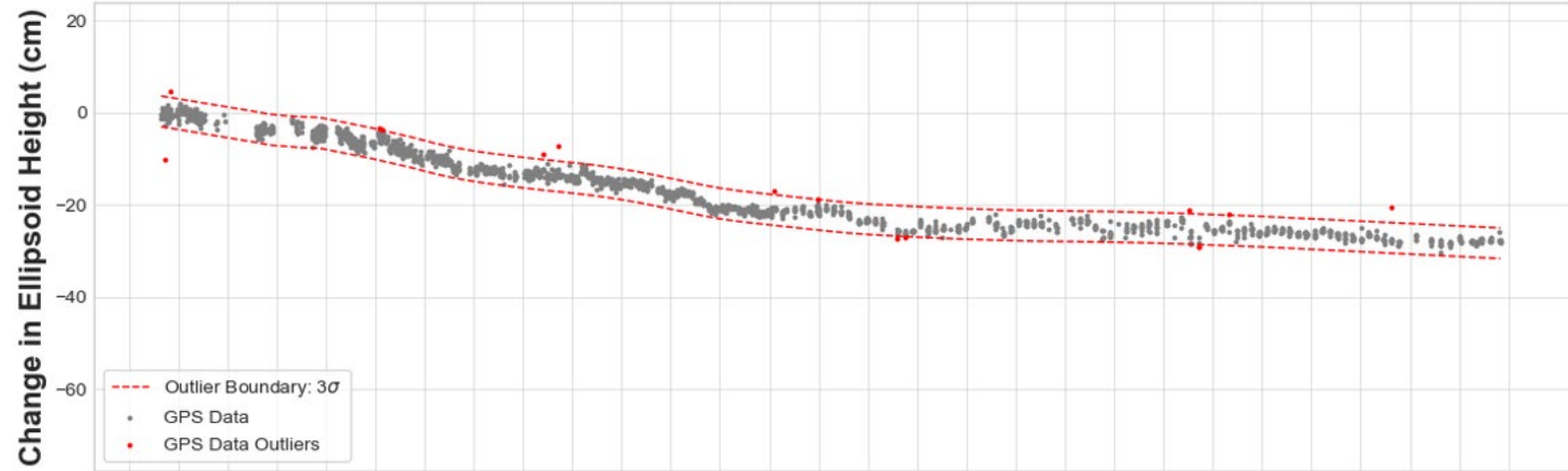
Period of Record Plot for P029 - Katy

- 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.



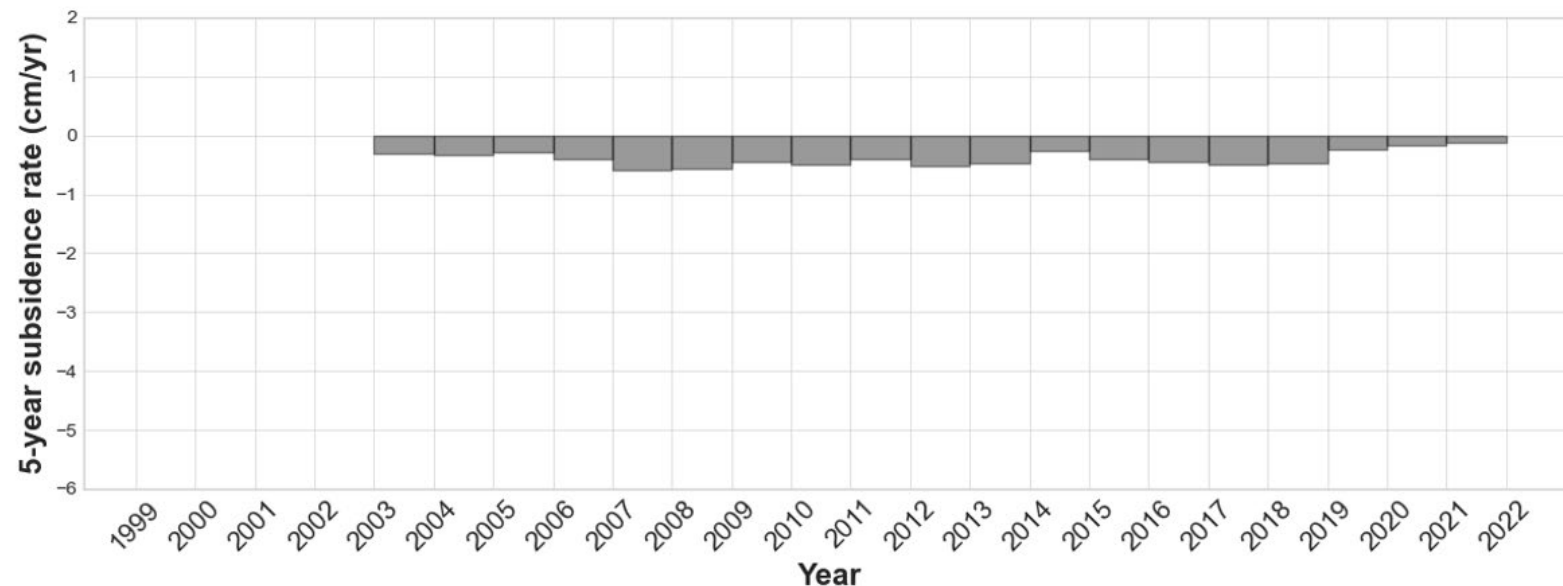
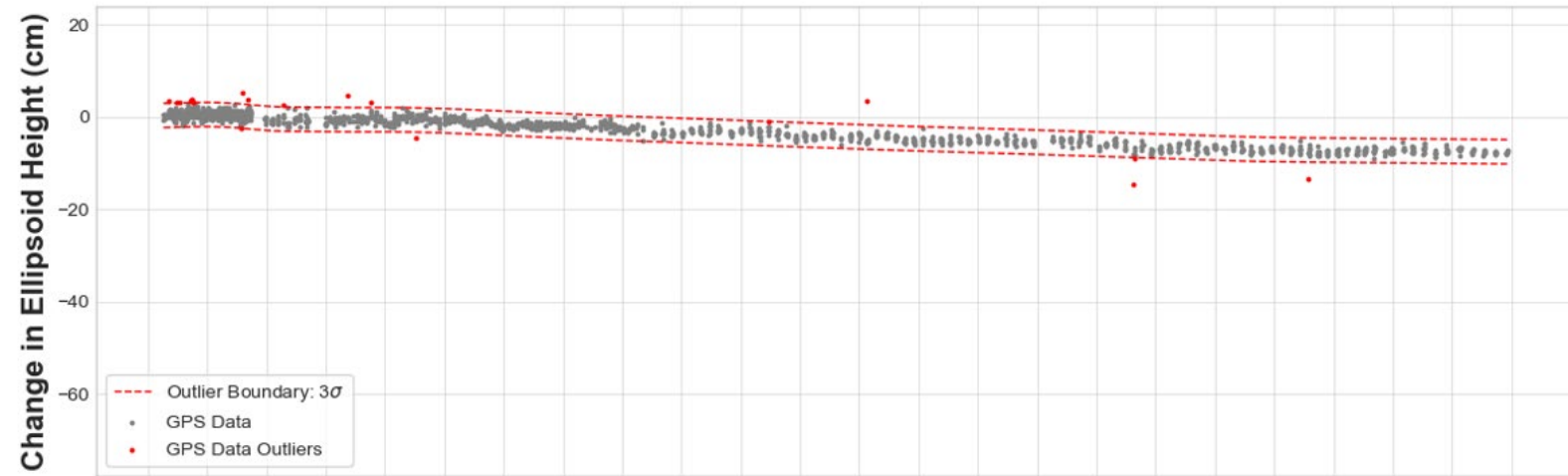
Period of Record Plot for P004 - Sugar Land

- 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.



Period of Record Plot for P010 - Richmond

- 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.



Thank you for attending the Public Hearing for FBSD's 2021 Annual Groundwater Report

- A draft copy of this presentation is available on the District's website (www.fbsubsidence.org).
- Record will be open until May 6, 2022. You may provide comments by sending an email to fbinfo@subsidence.org.
- The 2021 Annual Groundwater Report will be presented to the Fort Bend Subsidence District Board of Directors on May 25, 2022.
- The 2021 Annual Groundwater Report will be posted on the District's website upon approval of the District's Board of Directors.

Contact Information

301 Jackson St., Ste 639

Richmond, TX 77469

281-342-3273

fbinfo@subsidence.org

www.fbsubsidence.org



FORT BEND
SUBSIDENCE DISTRICT