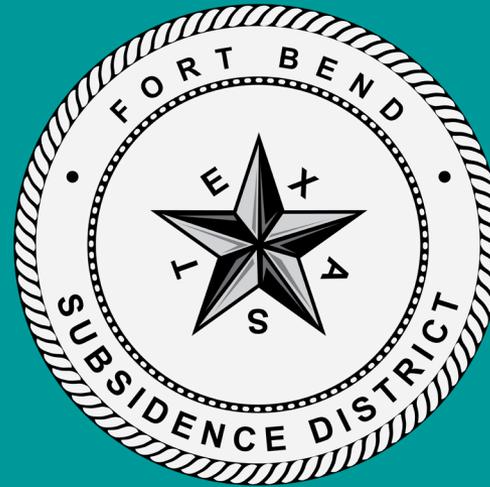


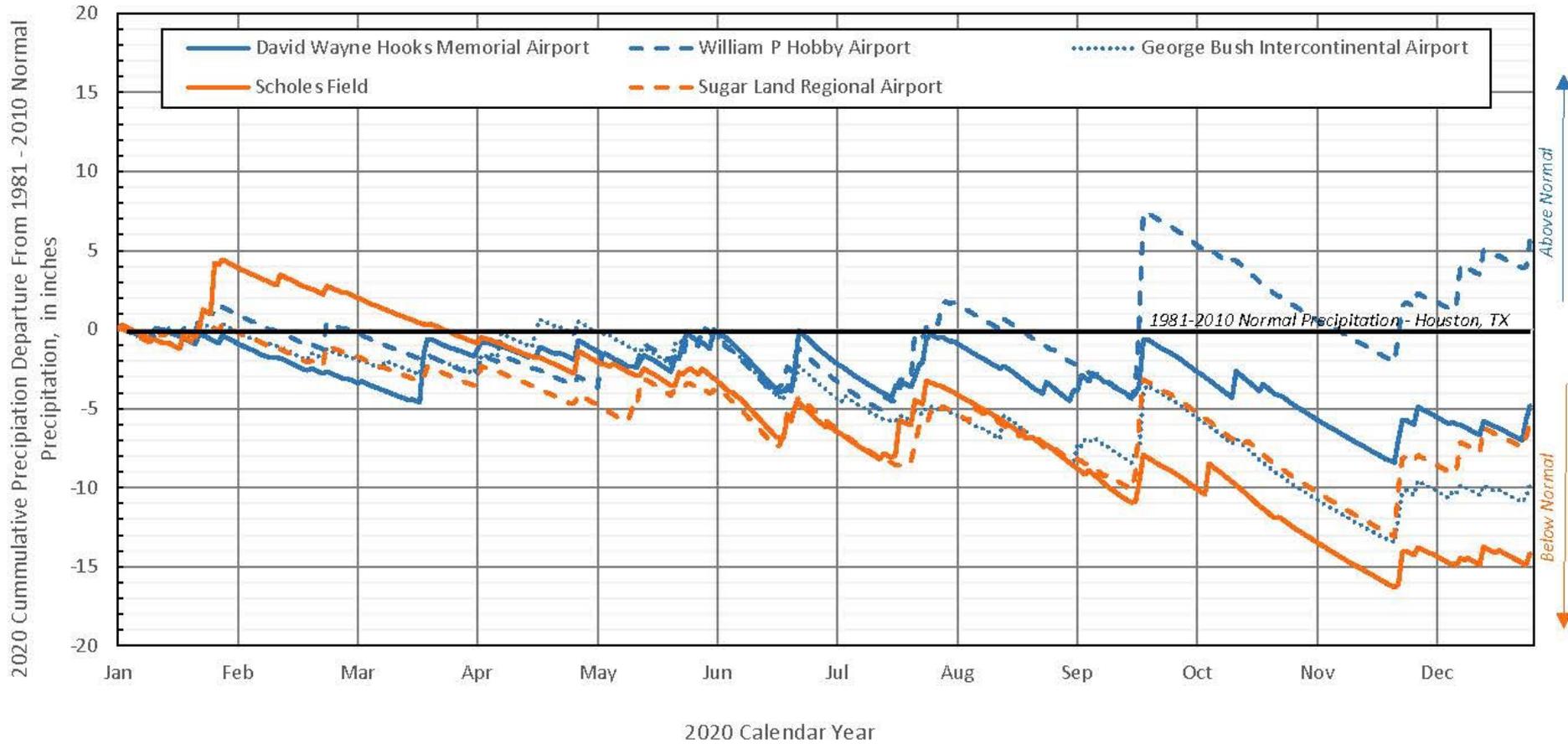
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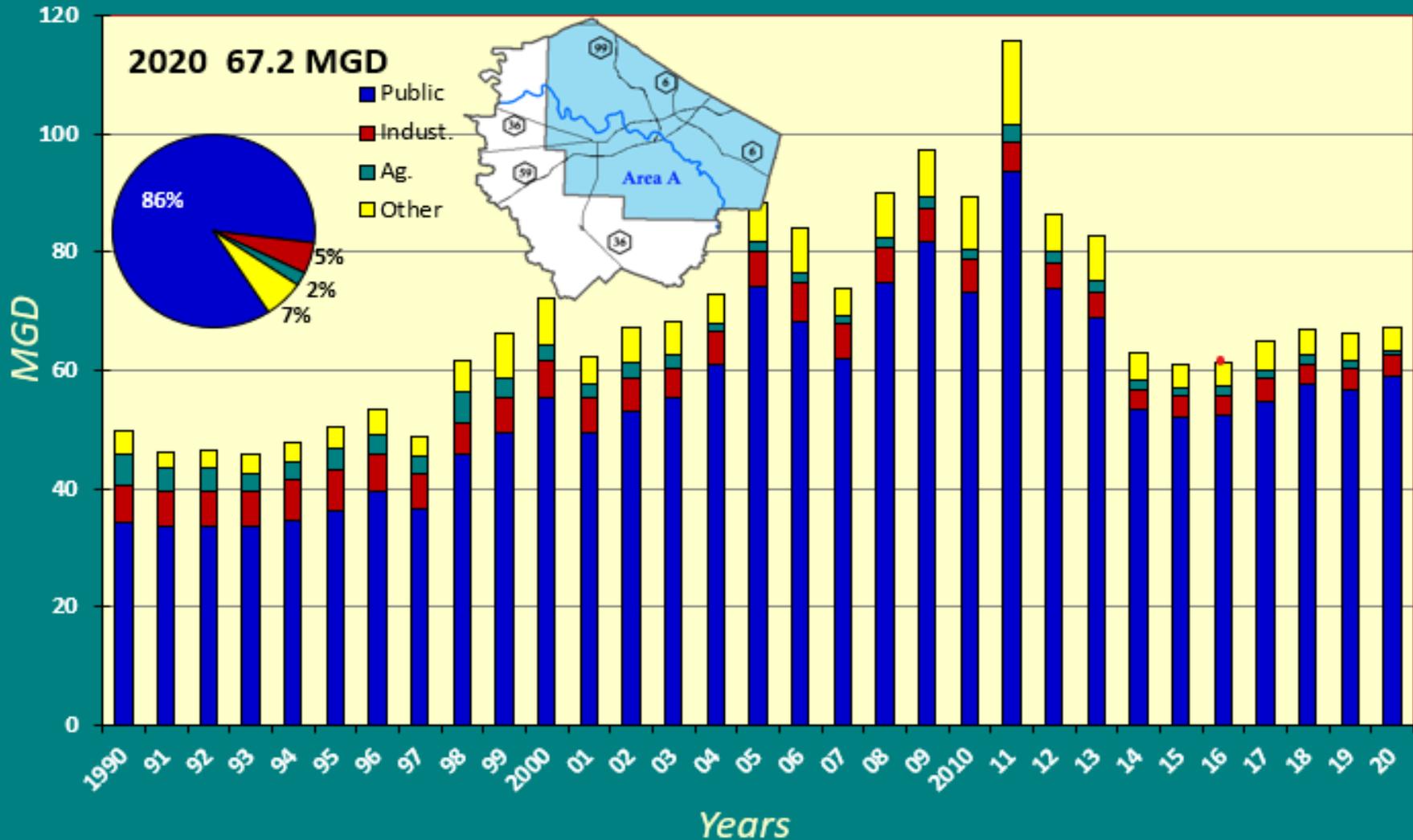


Weather
Pumpage
Water Levels
Subsidence



Groundwater Withdrawals

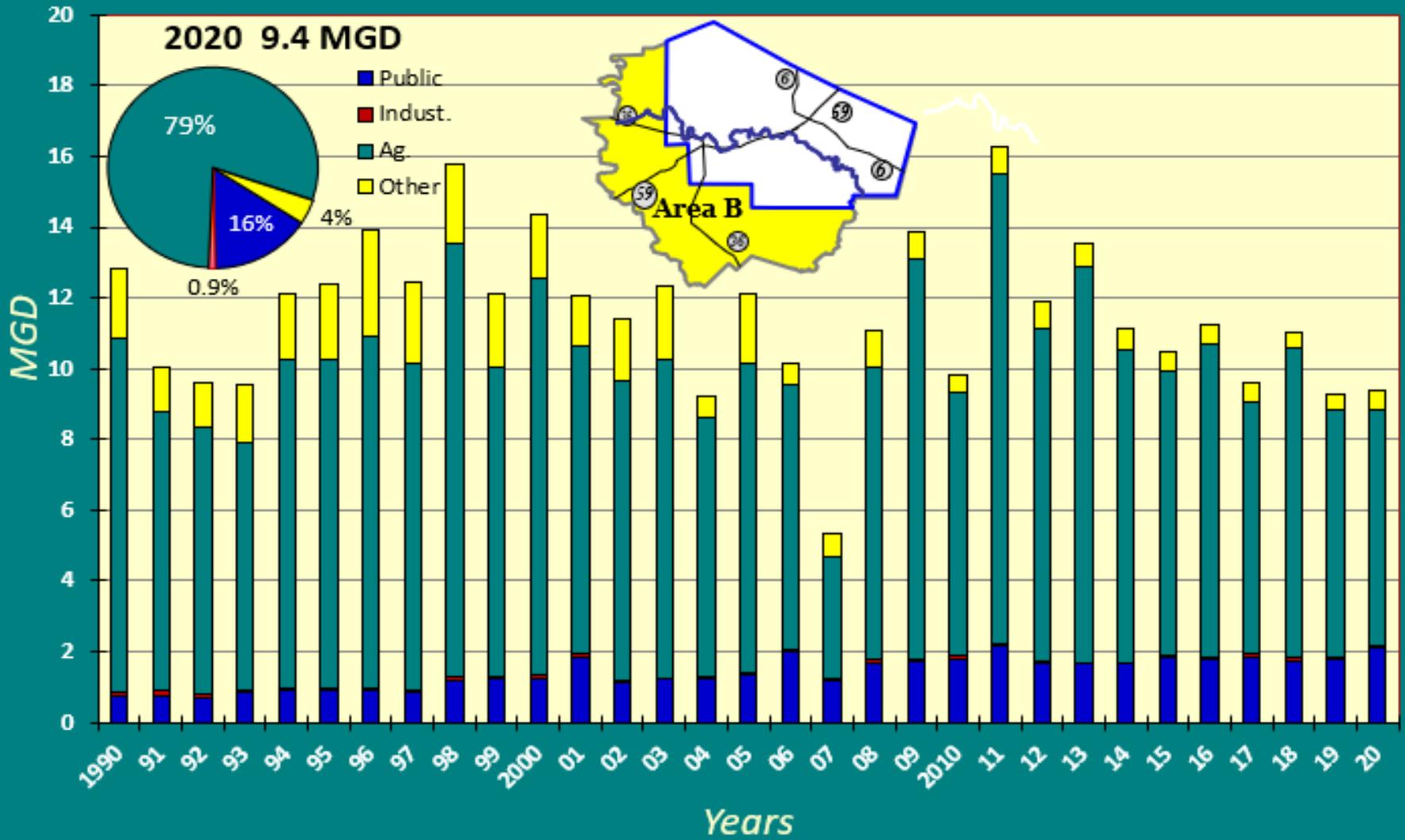
Grouped by Use - Regulatory Area A





Groundwater Withdrawals

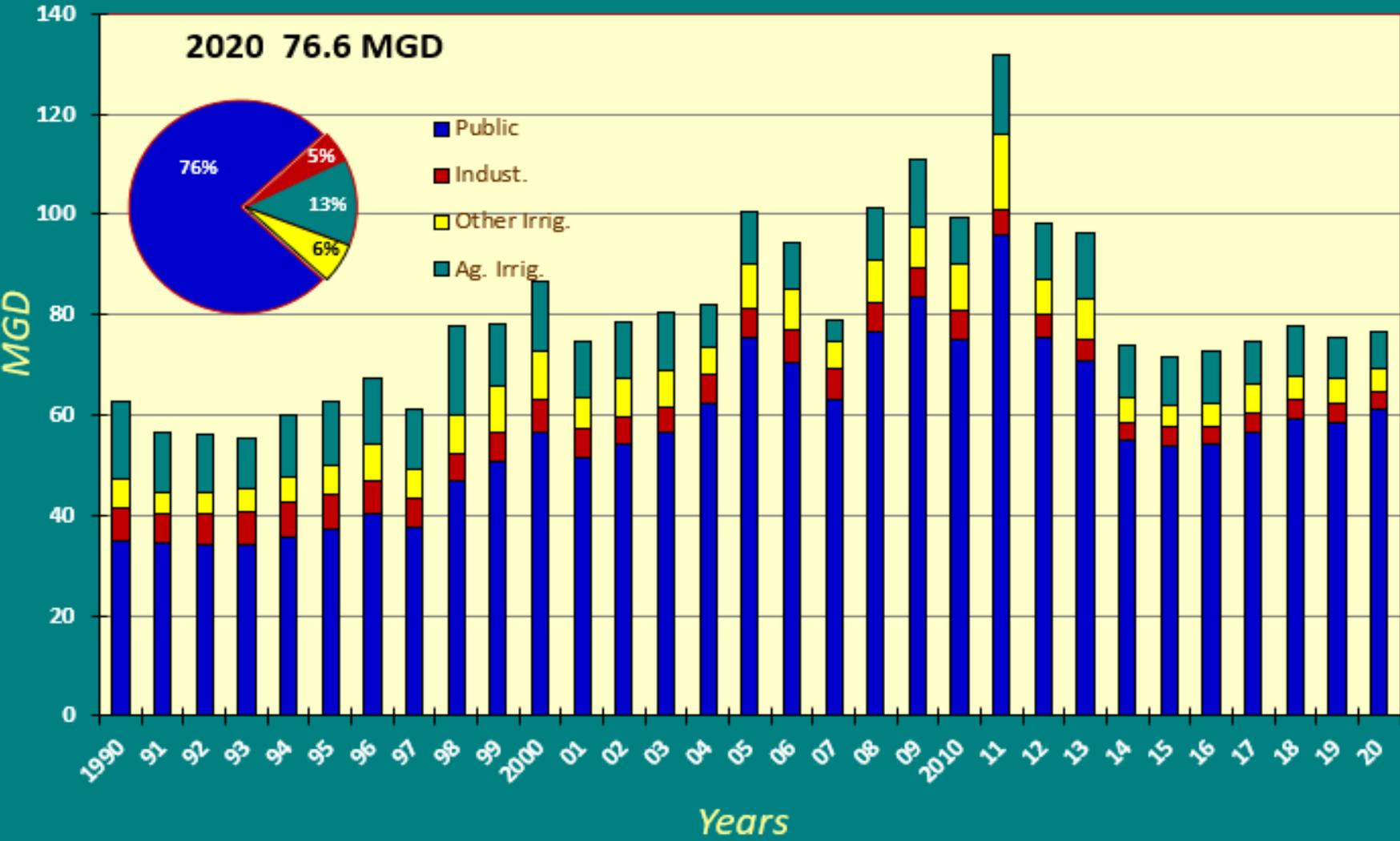
Grouped by Use - Regulatory Area B





Groundwater Withdrawals

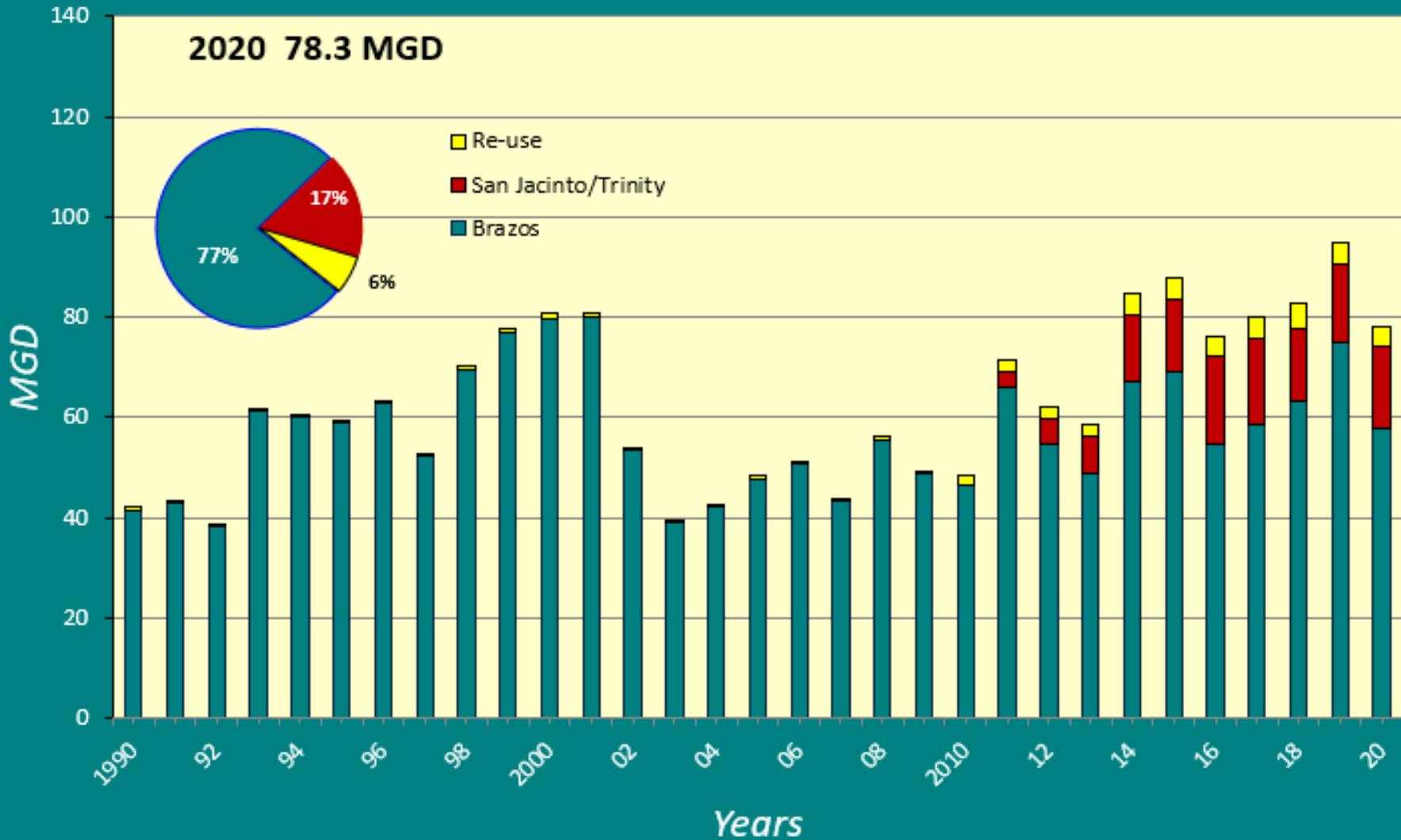
Grouped By Use - Entire District





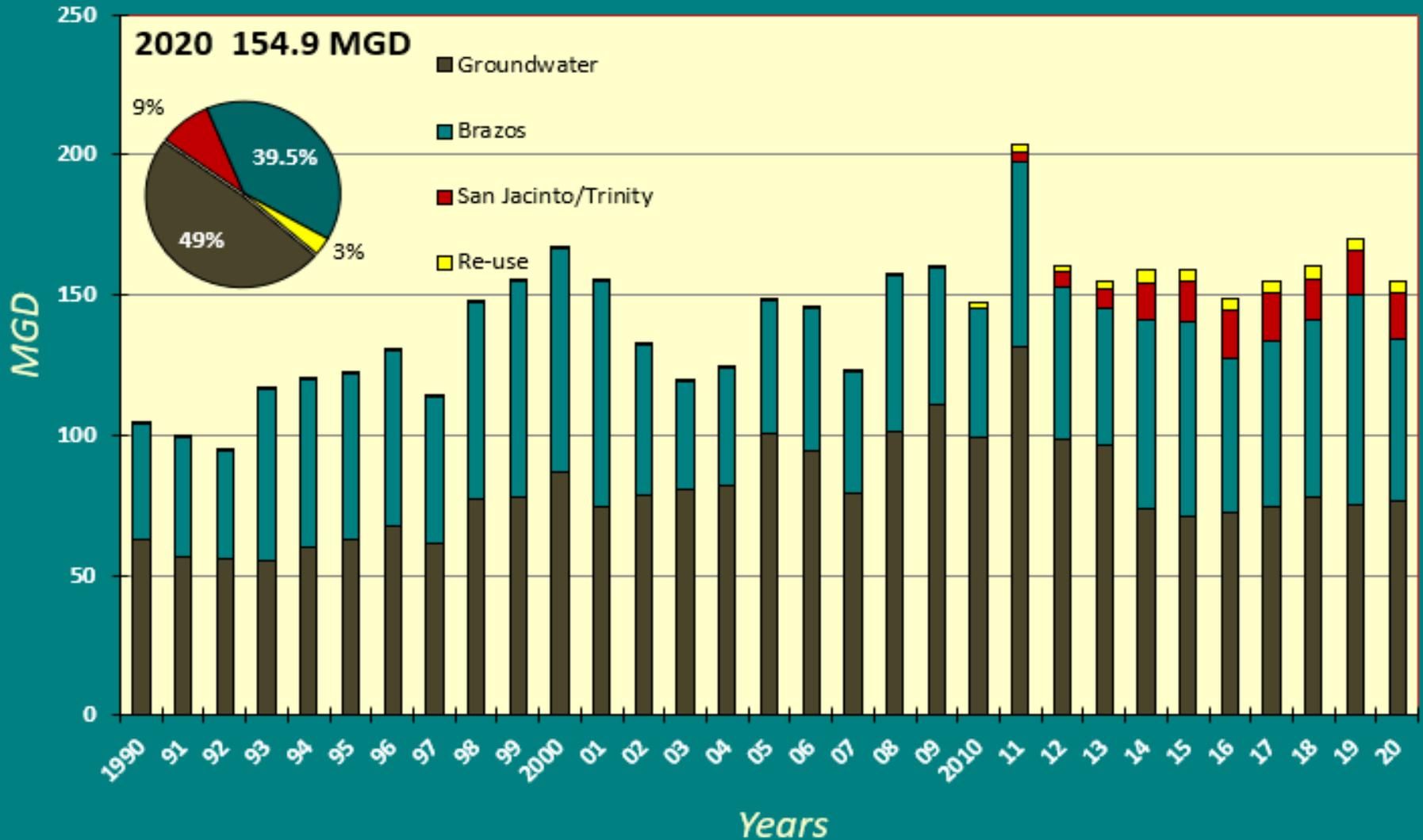
Surface & Re-Use Water Utilized

Grouped By Source - Entire District





Total Water Demand Grouped By Source - Entire District





Weather
Pumpage

Water Levels

Subsidence

Groundwater-level Altitudes (2021) and Changes Over Time in the Chicot-Evangeline (undifferentiated) and Jasper Aquifers and Compaction in the Chicot and Evangeline Portions of the Undifferentiated Aquifer (1973-2020)

For the Houston-Galveston Region

Jason Ramage, Hydrologist - jkramage@usgs.gov

Christopher Braun, Hydrologist | Groundwater Specialist - clbraun@usgs.gov

John Ellis, Hydrologist | Studies Chief - jellis@usgs.gov

4/29/2021



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Brazoria County
Groundwater Conservation District

2021 Water-Level Altitude Map Series

- **Chicot-Evangeline Aquifer (undifferentiated)**

- *2021 Water-Level Altitude*
- *2020 to 2021 Water-Level Change*
- *2016 to 2021 Water-Level Change*
- *1990 to 2021 Water-Level Altitude Change*

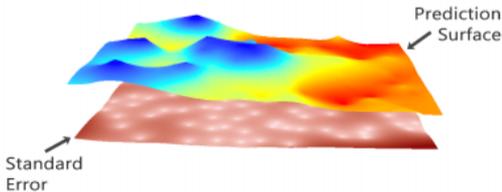
- **Compaction 1973-2020**

- *Compaction Data from 14 Extensometers*

Important Updates for 2021

- Chicot-Evangeline aquifer (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 south-east Harris County*
 - *Many of the wells previously designated as Evangeline are now designated as Chicot*
 - *Re-creation of the Chicot-Evangeline 1977 and 1990 and the Jasper 2000 needed*

- Altitude and Change maps are now represented by shaded grids (Kriging)

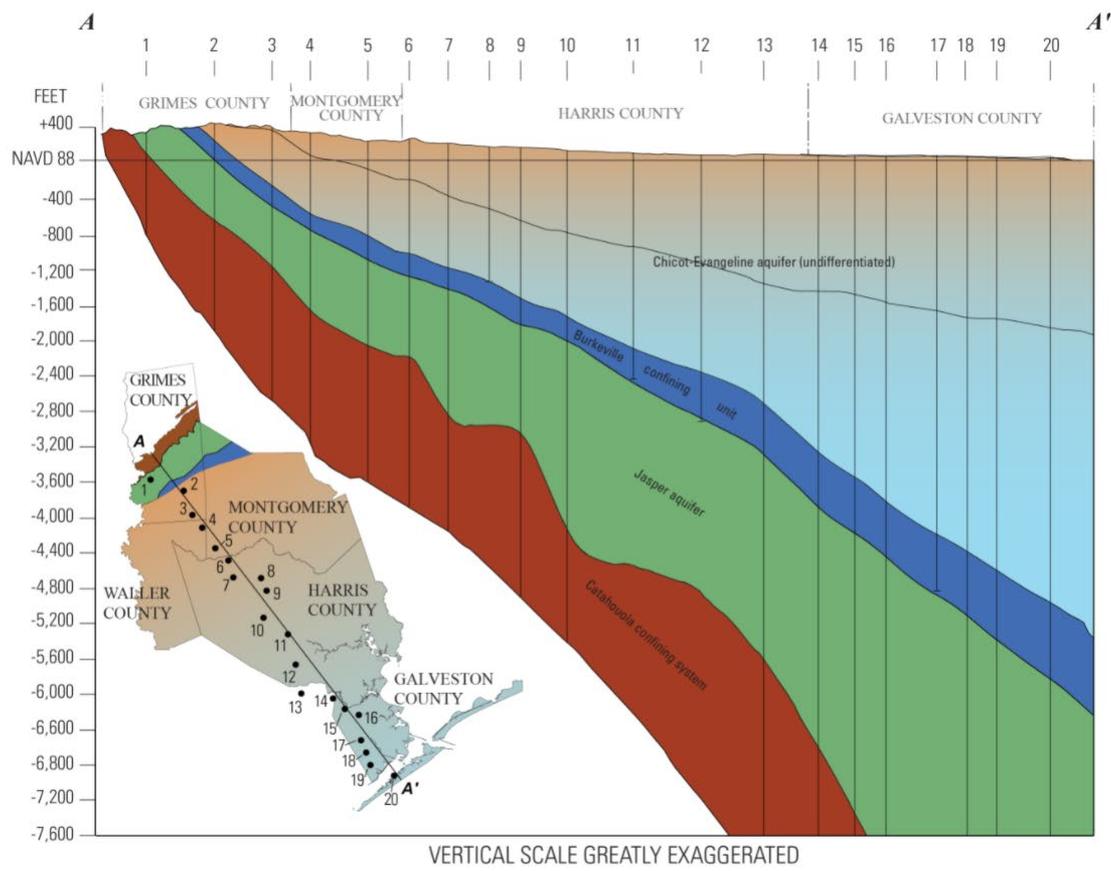


Geologic timescale		Prior to 2021		In 2021 and Moving Forward			
System	Series	Geologic units	Hydrogeologic units	Geologic units ¹	Hydrogeologic units ¹		
Quaternary	Holocene	Alluvium	Chicot aquifer	Alluvial, terrace, and dune deposits	Chicot - Evangeline aquifer (undifferentiated)		
	Pleistocene	Beaumont Formation		Beaumont Formation			
		Lissie Formation		Montgomery Formation		Lissie Formation	Montgomery Formation
				Bentley Formation		Bentley Formation	
		Willis Sand	Willis Sand				
Tertiary	Pliocene	Goliad Sand	Evangeline aquifer	Goliad Sand (upper part)	Goliad Sand (lower part)		
				Lagarto Clay (upper part)			
	Miocene	Fleming Formation	Burkeville confining unit	Lagarto Clay (middle part)	Burkeville confining unit		
		Lagarto Clay		Lagarto Clay (lower part)	Jasper aquifer		
		Oakville Sandstone	Jasper aquifer	Oakville Sandstone	Jasper aquifer		
	Oligocene	Catahoula Sandstone	Upper part of Catahoula Sandstone	Catahoula Confining System	Catahoula Formation	Catahoula Confining System	
			Anahuac Formation		Upper Catahoula Formation		
			Frio Formation	Frio Formation			

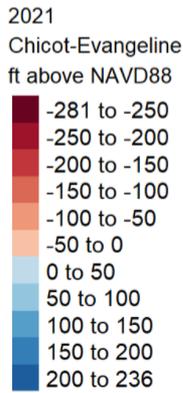
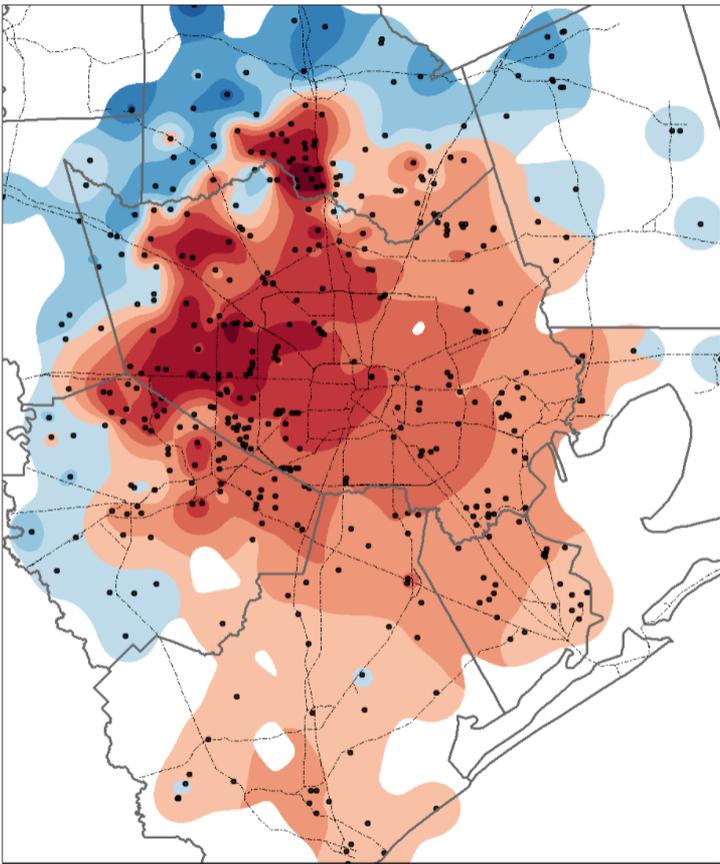
Network

- Data were collected across 11 counties (Harris and surrounding) from 2020-11-23 to 2021-03-11
- Requires collaboration and agreements with well owners and operators (MUDs)
- Variety of well types including public supply, irrigation, industrial and observation
- Number of Chicot-Evangeline water-levels collected: **527**
- Number of wells used to create 2021 Altitude maps
 - *Chicot-Evangeline: 434*

Stratigraphic cross section

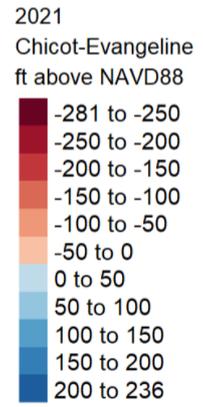
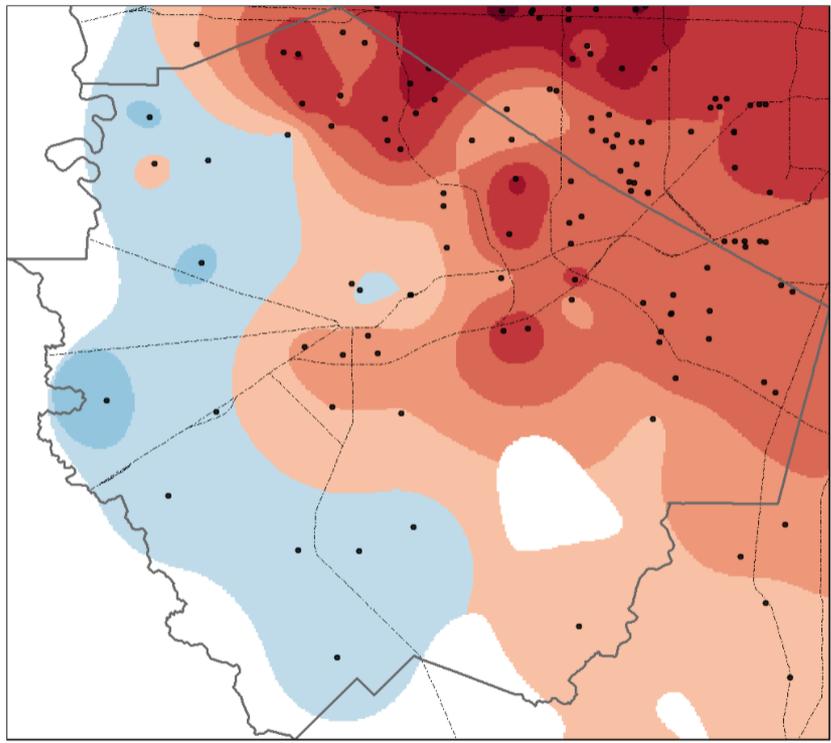


Chicot-Evangeline 2021 Altitude



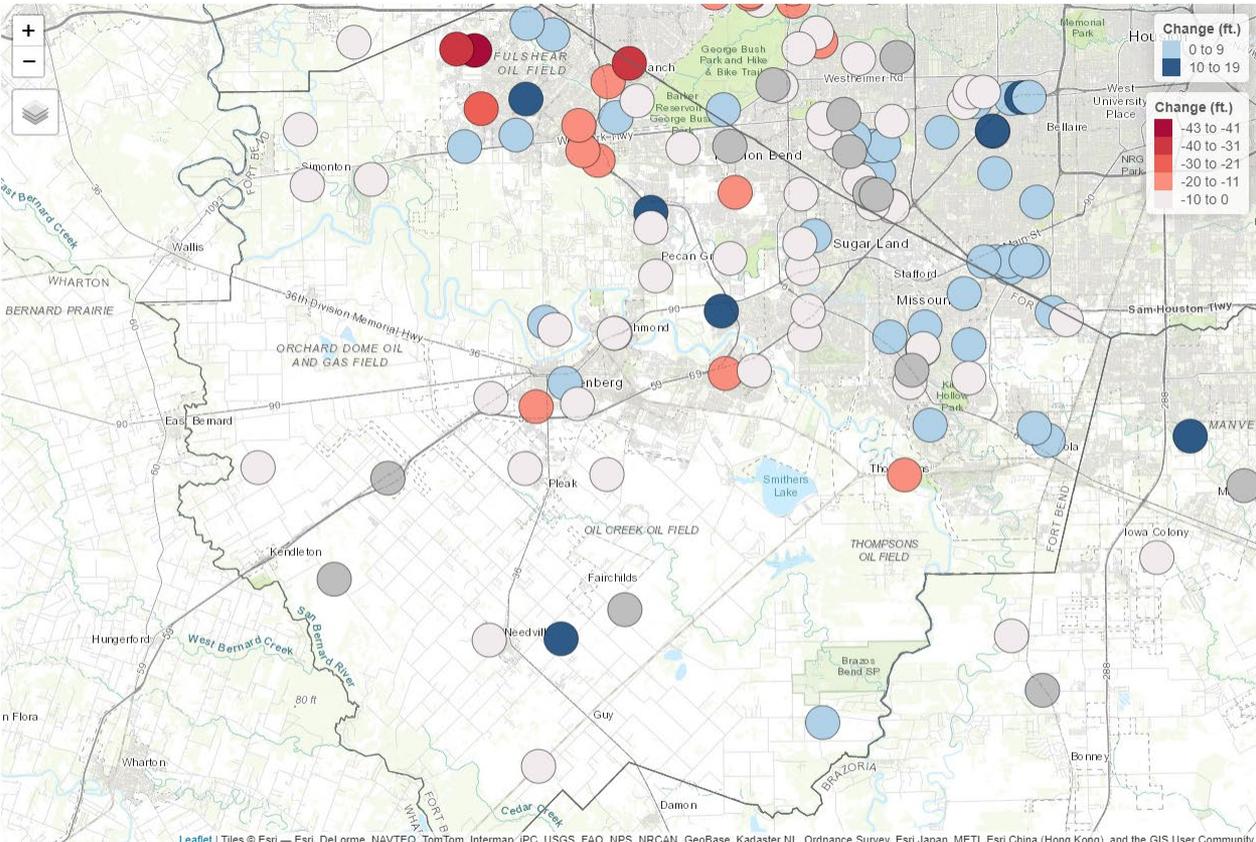
- Data Summary:
Min : -281
Mean : -46
Max : 236
- Highest areas of usage in western Harris County, and the south-central portion of Montgomery County

Chicot-Evangeline 2021 Altitude



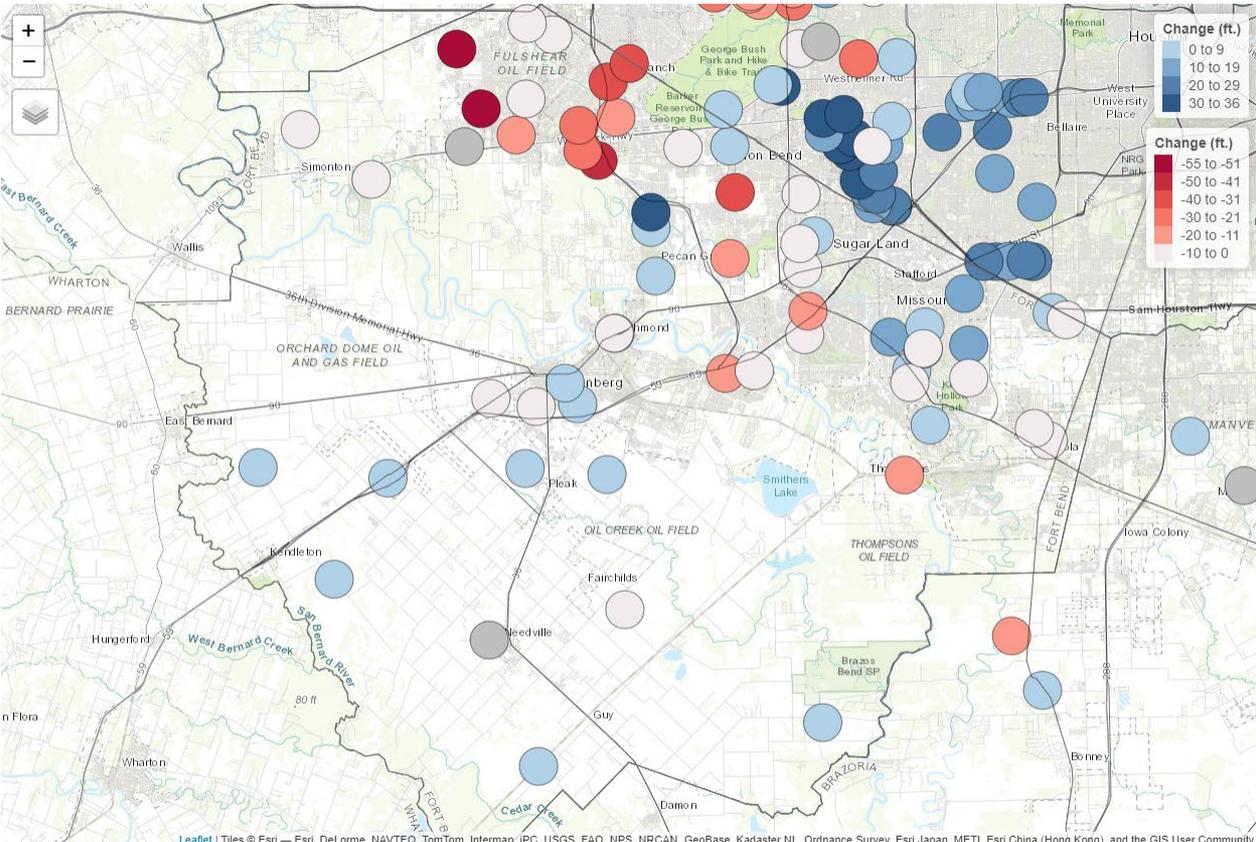
- Data Summary: For Fort Bend County
Min : -238
Mean : -44
Max : 65
- Highest areas of usage in western Harris County and some areas of northern Fort Bend County

Chicot-Evangeline 1 year change



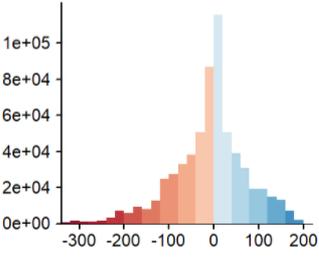
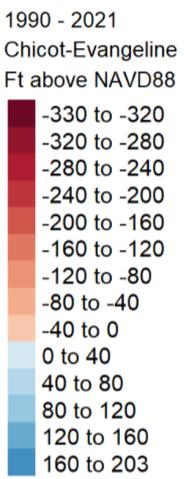
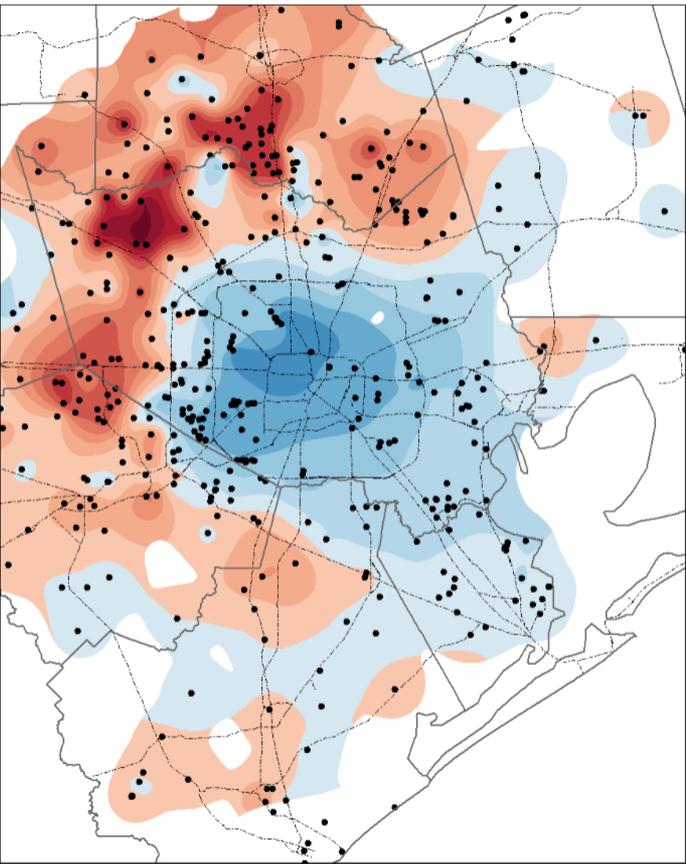
Number of wells: 67
 Rises: 32.8%
 Declines: 59.7%
 No Change: 7.57%

Chicot-Evangeline 5 year change



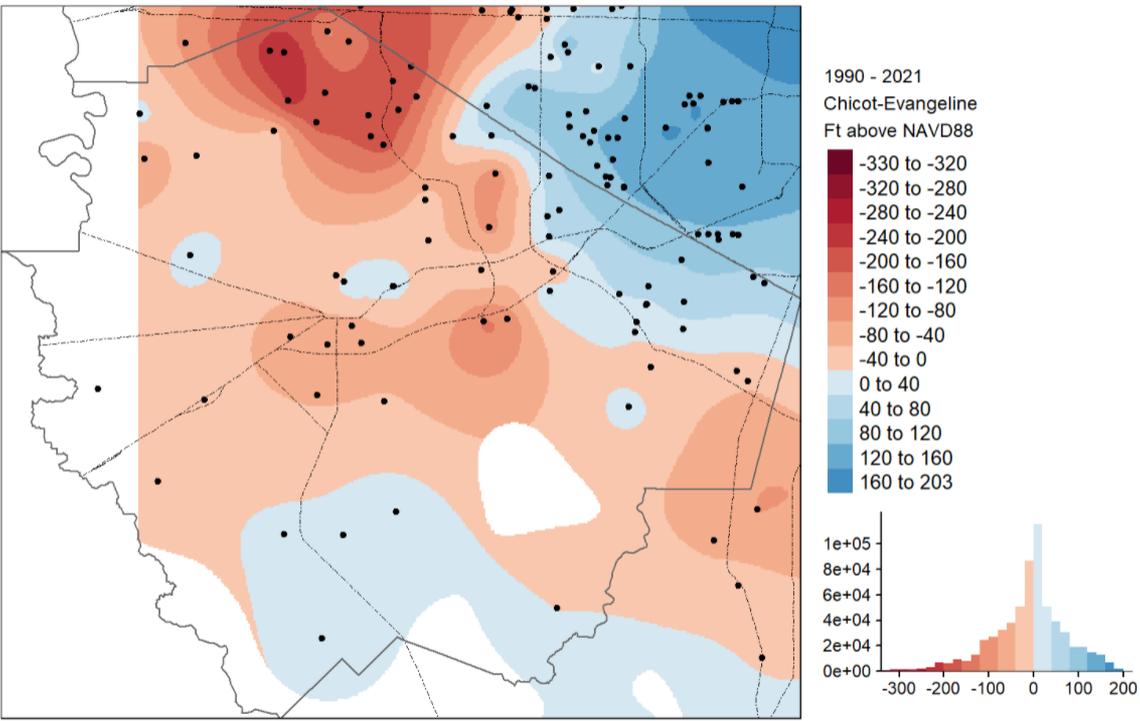
Number of wells: 60
 Rises: 38.3%
 Declines: 58.3%
 No Change: 0.03%

Chicot-Evangeline water-level change since 1990



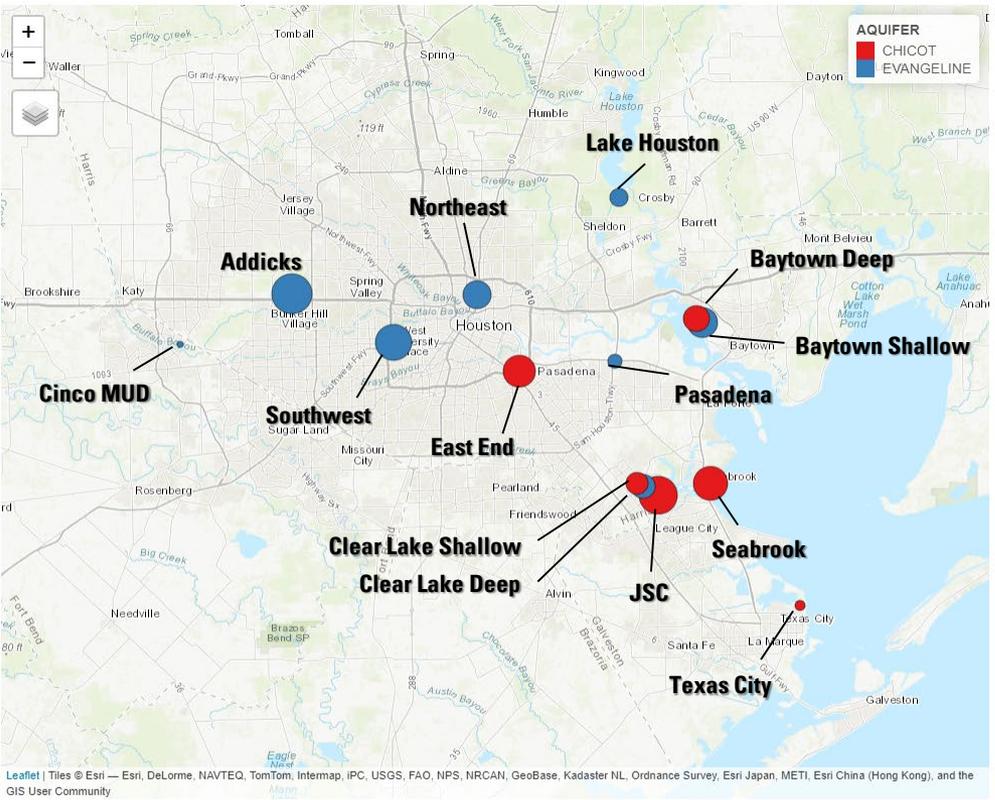
- Data Summary:
Min : -330
Mean : -9
Max : 203
- Water-level rises across most of central and eastern Harris County as well as Galveston and Brazoria Counties
- Water-level declines in the Northern part of Fort Bend County, NW portions of Harris County, and most of Montgomery County

Chicot-Evangeline water-level change since 1990



- Data Summary: For Fort Bend County
Min : -239
Mean : -26
Max : 114
- Water-level rises across most of central and eastern Harris County as well as Galveston and Brazoria Counties
- Water-level declines in the Northern part of Fort Bend County, NW portions of Harris County, and most of Montgomery County

Compaction



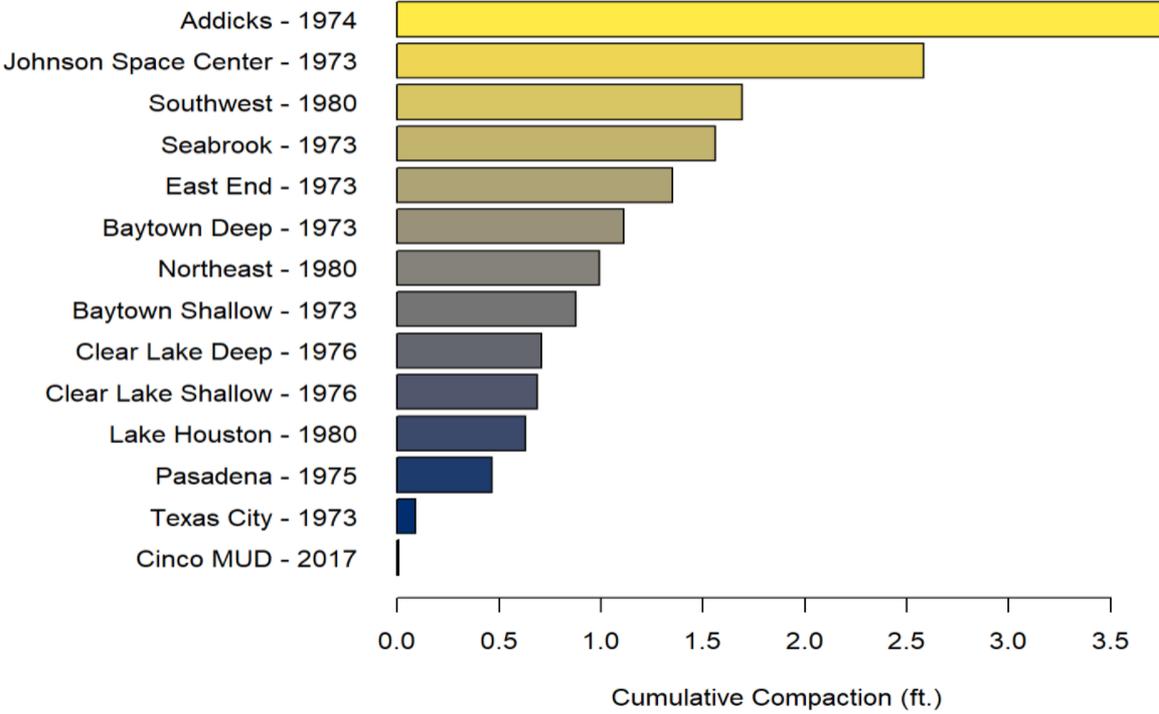
Size of symbol reflects amount of total cumulative compaction

■ Cumulative compaction recorded at each location as of December 2020

- 1974-Addicks-3.760 ft.
- 1973-Baytown Deep-1.110 ft.
- 1973-Baytown Shallow-0.875 ft.
- 2017-Cinco MUD-0.006 ft.
- 1976-Clear Lake Deep-0.706 ft.
- 1976-Clear Lake Shallow-0.685 ft.
- 1973-East End-1.350 ft.
- 1973-Johnson Space Center-2.580 ft.
- 1980-Lake Houston-0.628 ft.
- 1980-Northeast-0.990 ft.
- 1975-Pasadena-0.464 ft.
- 1973-Seabrook-1.560 ft.
- 1980-Southwest-1.690 ft.
- 1973-Texas City-0.090 ft.

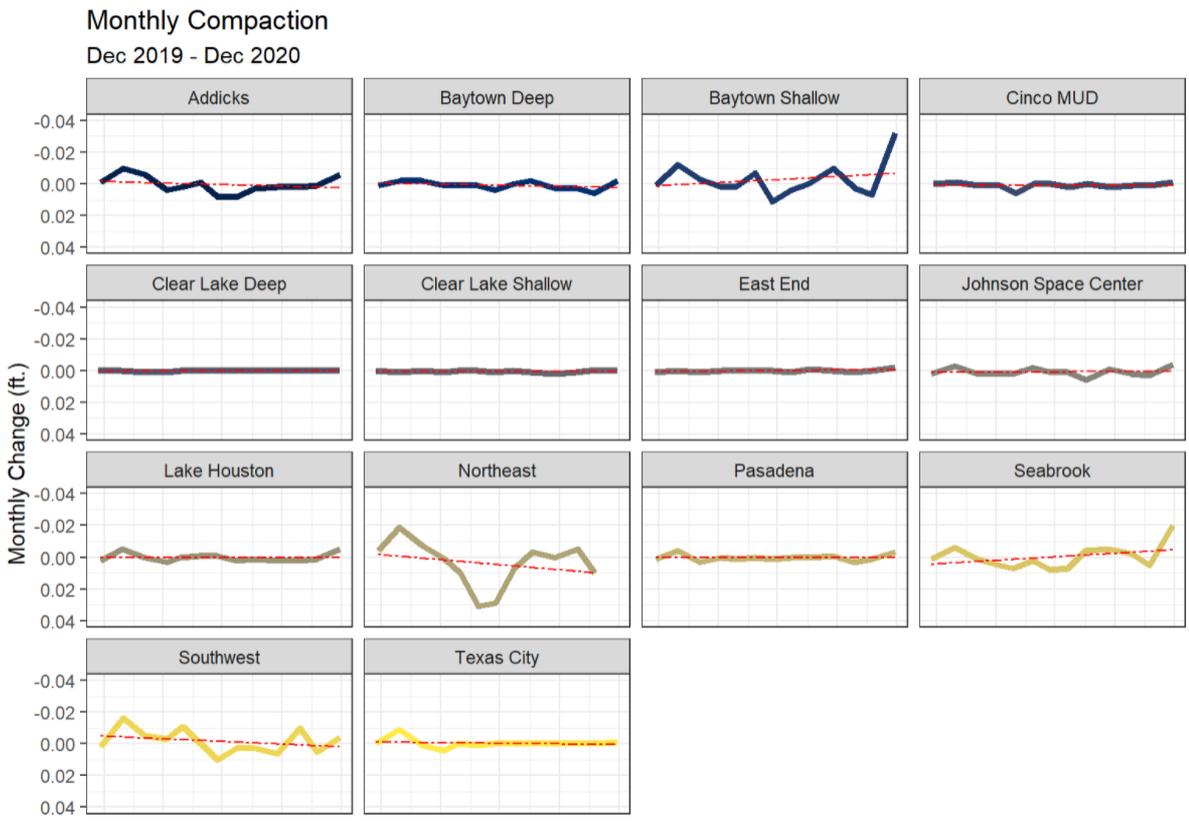
Compaction (cont.)

Total compaction recorded since date of initial recording



Year indicates beginning of record, all data current through

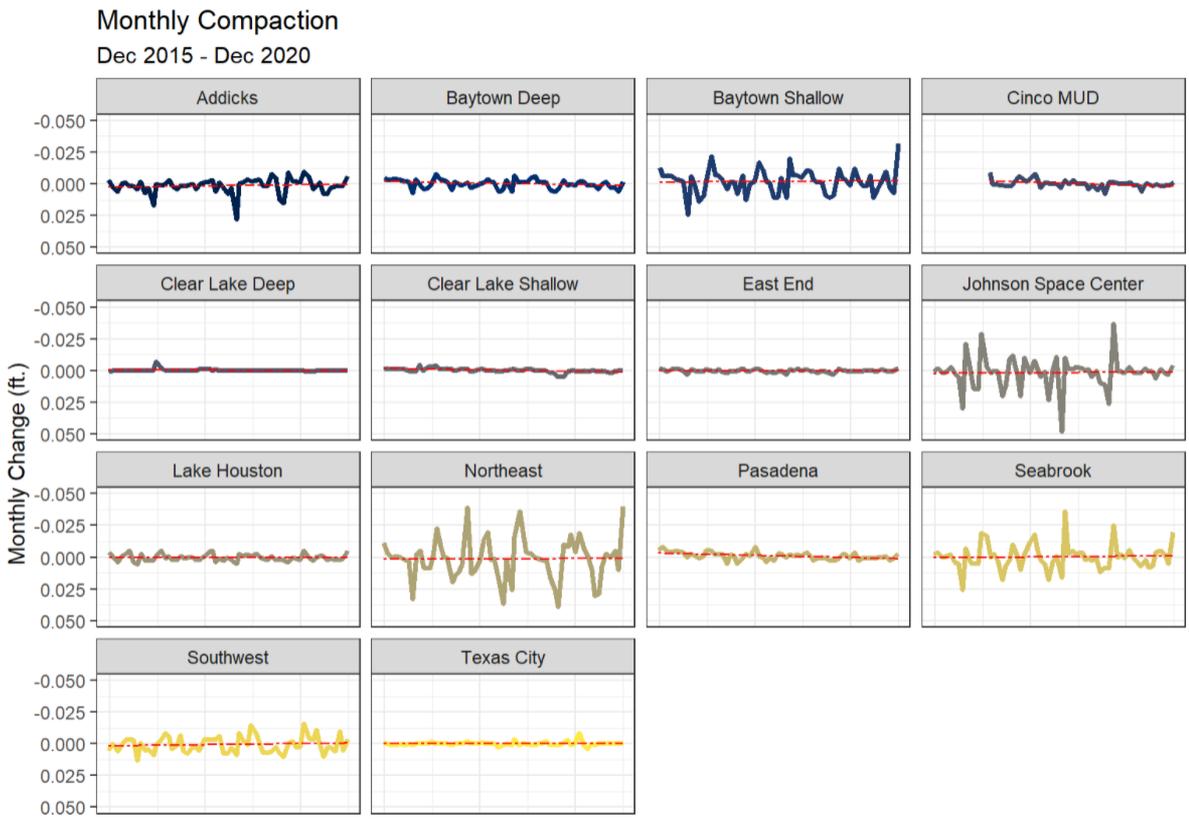
Compaction 1 year monthly changes



- Slight increase (compaction) in trend
 - Addicks
 - Northeast
 - Southwest
 - Baytown Deep
- Slight decrease (uplift) in trend
 - Baytown Shallow
 - Seabrook

Monthly change in land surface elevation at each location

Compaction 5 year monthly changes

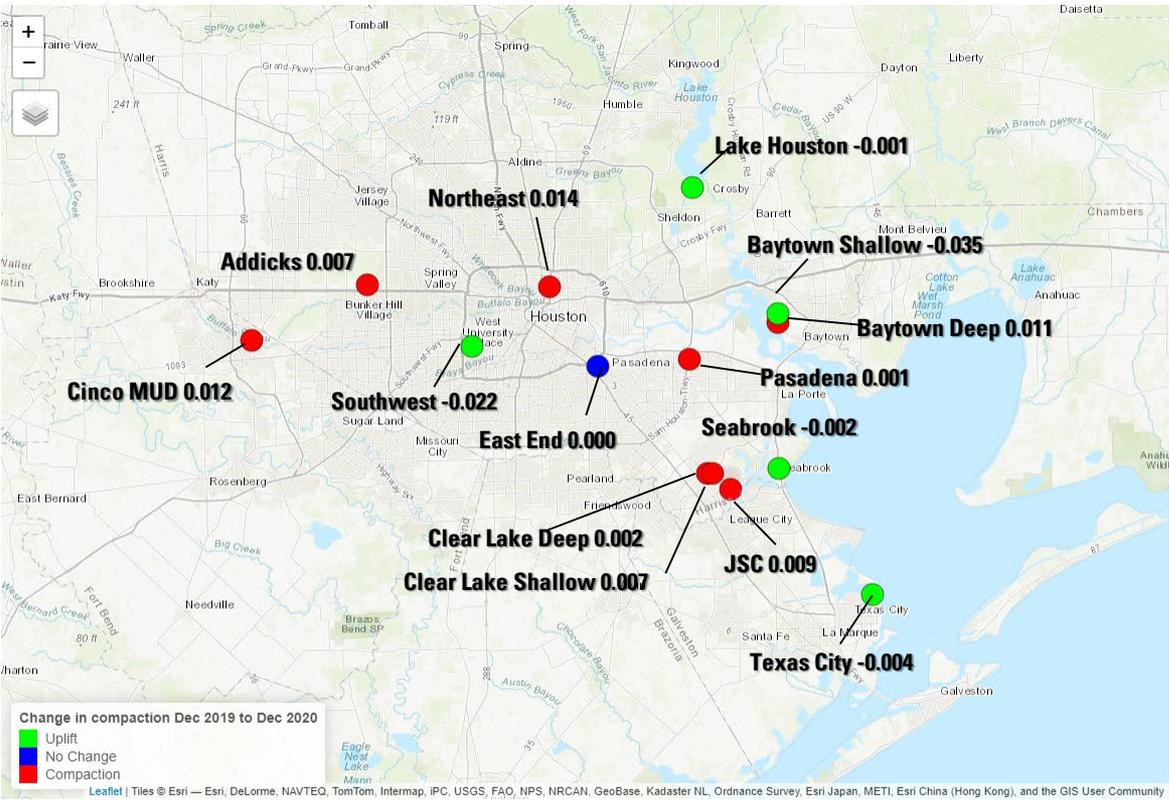


- Slight increase (compaction) in trend
 - Pasadena
 - Cinco MUD

- Slight decrease (uplift) in trend
 - Addicks
 - Seabrook
 - Baytown Shallow

Monthly change in land surface elevation at each location

Summary: Compaction



Absolute changes for the period December 2019 through December 2020, in ft.

- 5 sites recorded uplift ranging from 0.001 ft. to 0.035 ft.
- 8 sites recorded compaction ranging from 0.001 ft. to 0.014 ft.
- 1 site recorded no change

2021 Water-Level Altitude Map Series

Jason Ramage, Hydrologist - jkramage@usgs.gov

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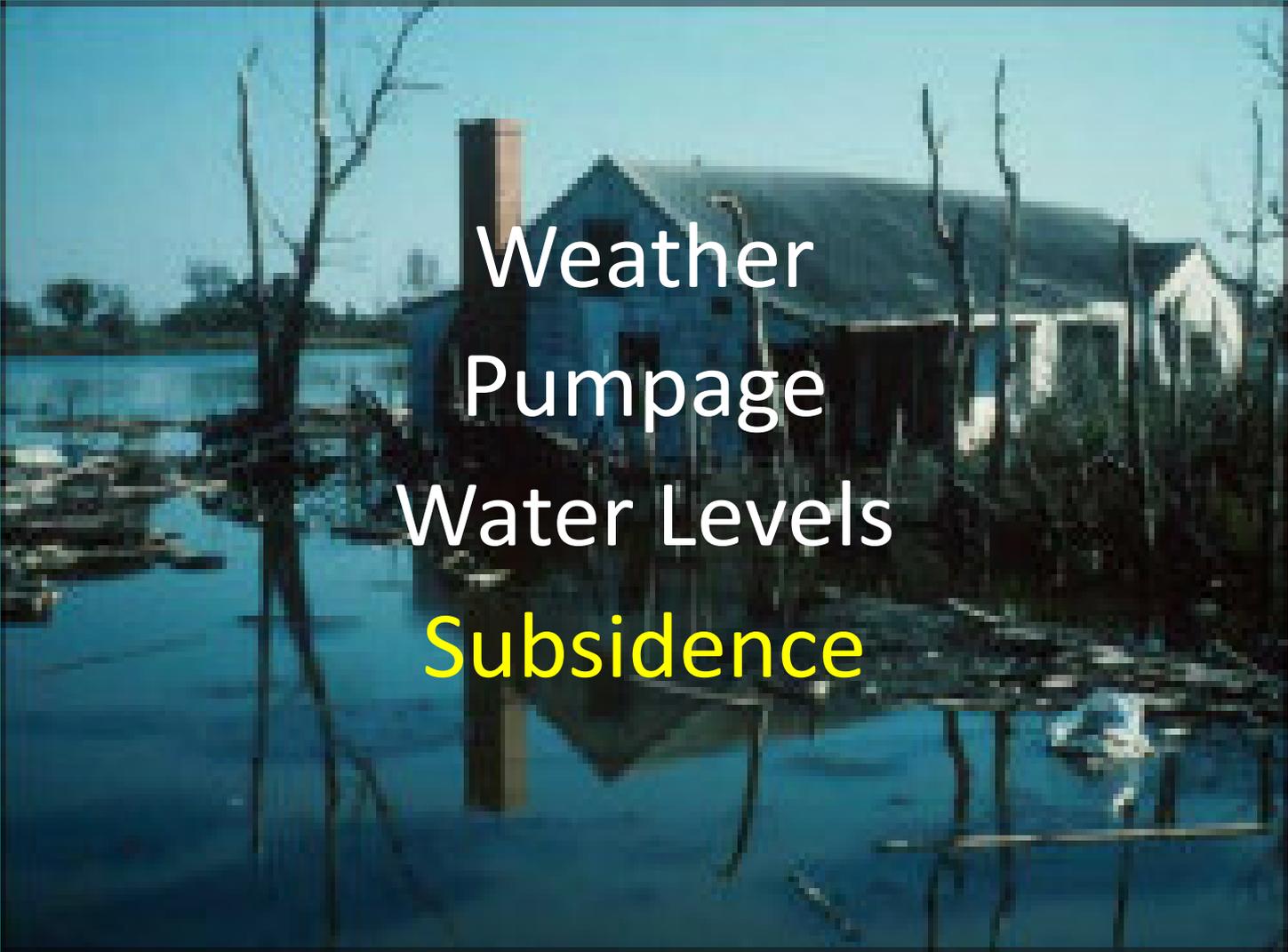
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SUBSIDENCE DISTRICT



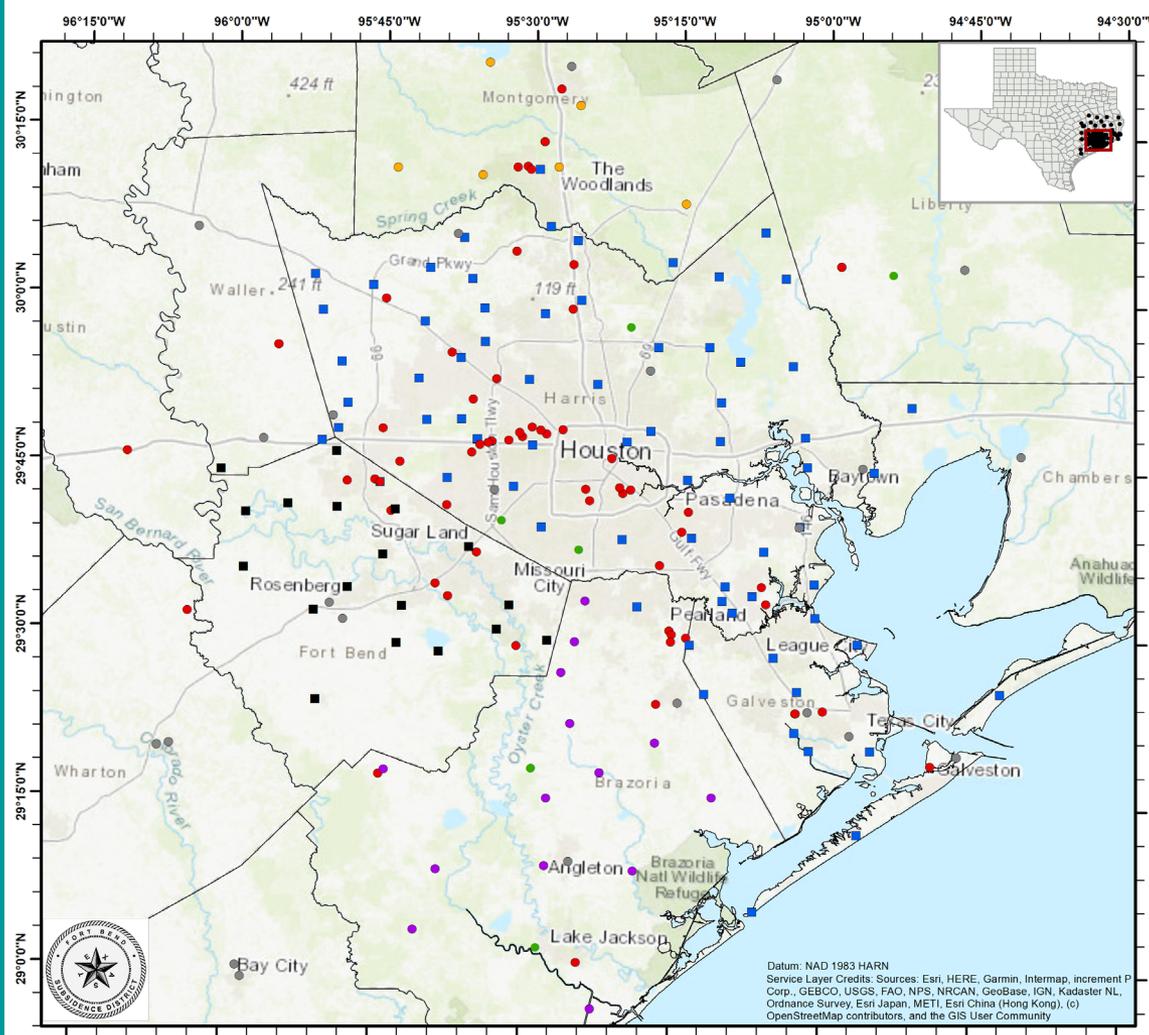
Fort Bend
Subsidence District



Brazoria County
Groundwater Conservation District



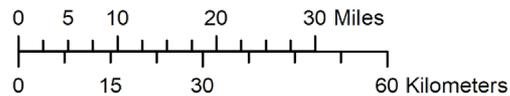
Weather
Pumpage
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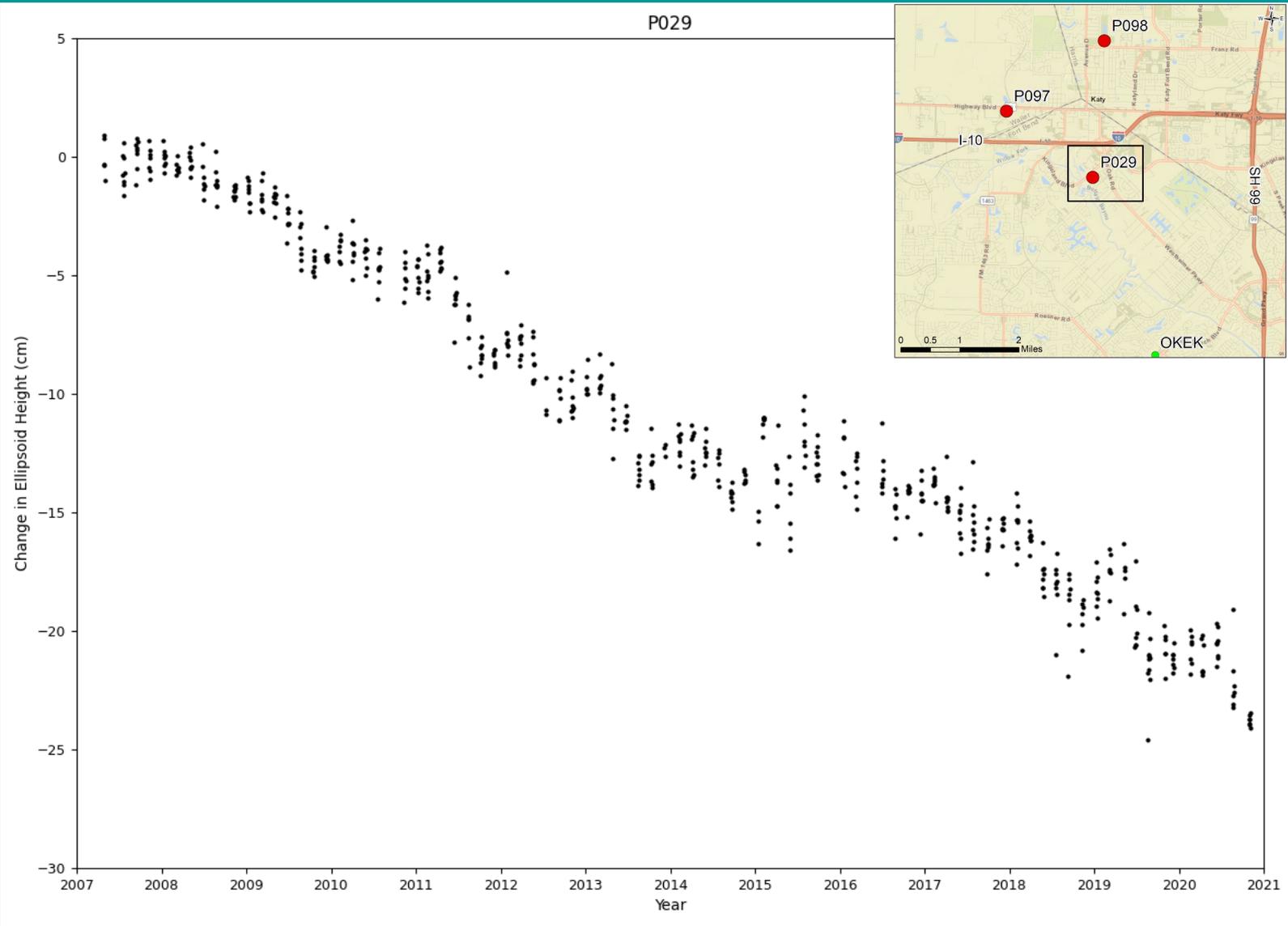
EXPLANATION

GPS Station Operator

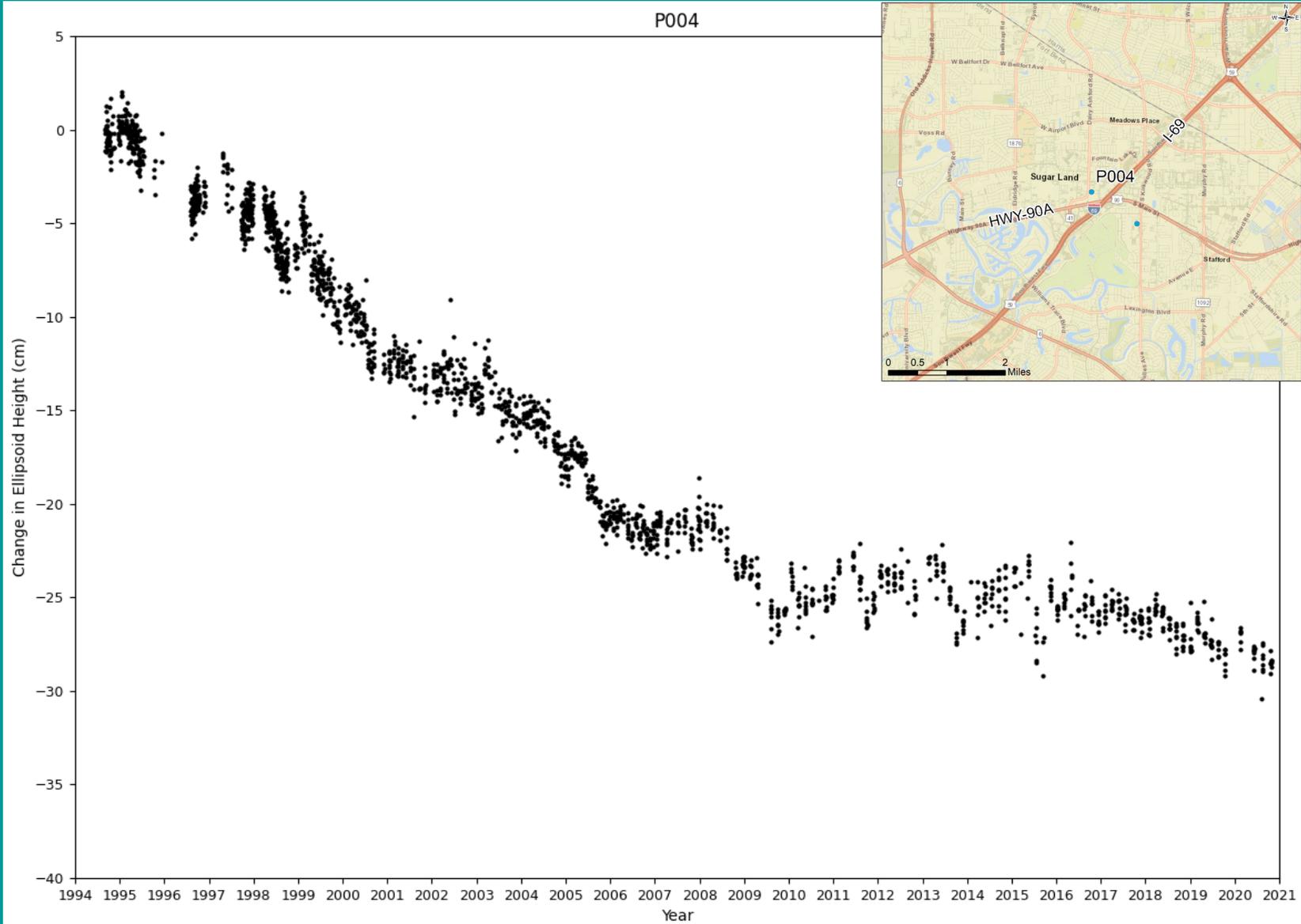
- Fort Bend Subsidence District
- Harris-Galveston Subsidence District
- Brazoria County Groundwater Conservation District
- Lone Star Groundwater Conservation District
- Texas Department of Transportation
- University of Houston
- Other Agencies



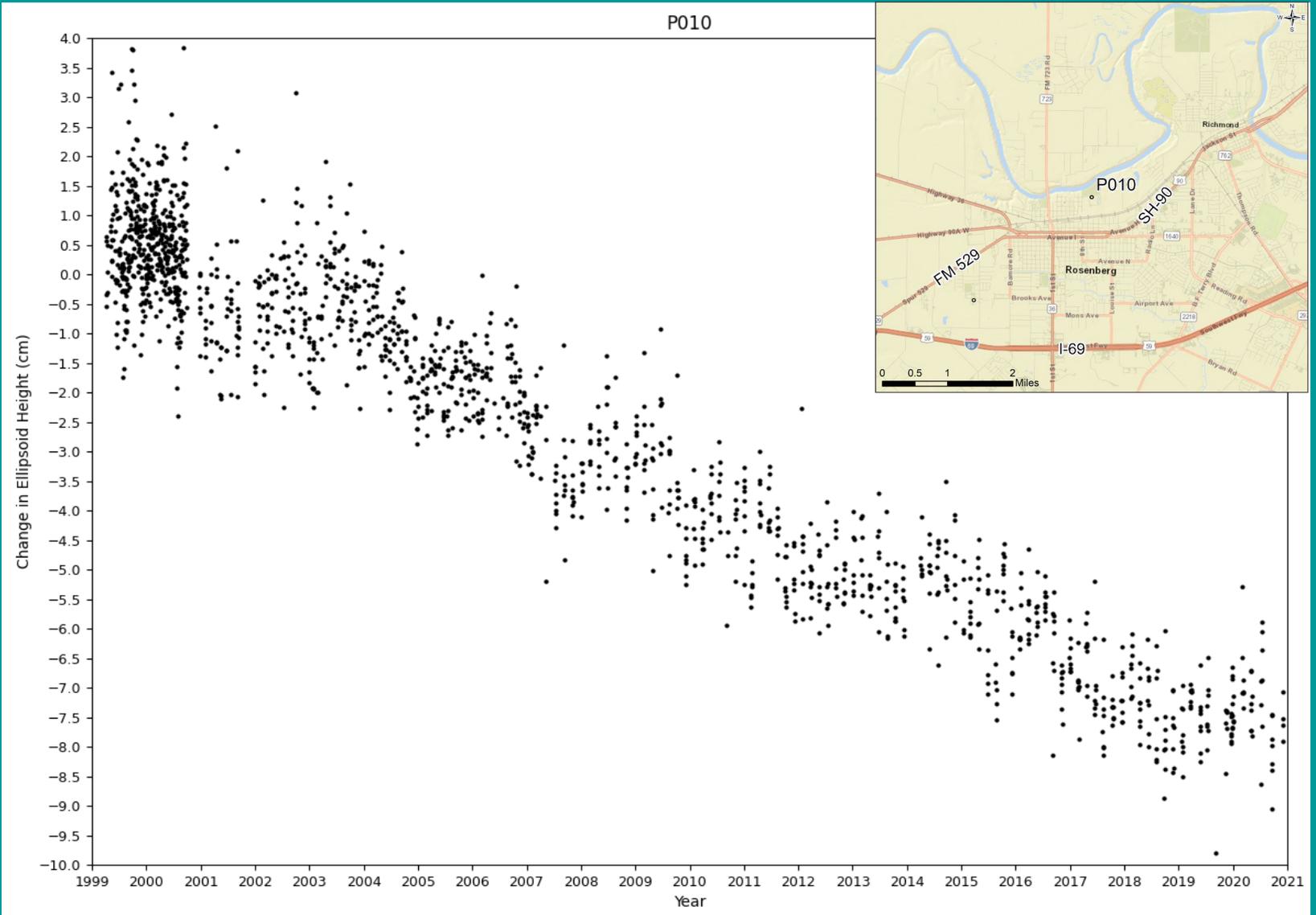
Katy



Sugar Land



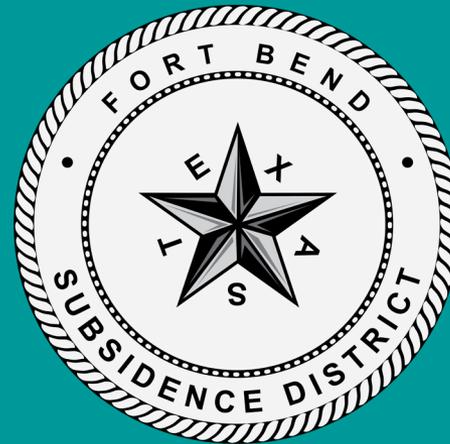
Rosenberg



Fort Bend Subsidence District



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