Welcome to the 2024 Annual Groundwater Report Public Hearing

IN-PERSON ATTENDEES

- Check to make sure your mobile devices are muted.
- This board room is equipped with microphones that will be recording throughout the entirety of the hearing. Please be mindful of this to not disturb the audio for our virtual attendees.
- Public testimony and Q&As will be available at the end of this hearing.

VIRTUAL ATTENDEES

- Virtual attendees will be muted for the entirety of the hearing.
- The webinar will be recorded, including all chat between participants.
- For audio/visual issues, please chat with the organizer.

HARRIS-GALVESTON SUBSIDENCE DISTRICT

2024 Annual Groundwater Report

Public Hearing - April 29, 2025

Harris-Galveston Subsidence District

The Harris-Galveston Subsidence District (HGSD) is a special-purpose district created by the Texas Legislature in 1975 to prevent further land subsidence in Harris and Galveston counties.

HARRIS-GALVESTON SUBSIDENCE DISTRICT
1975 - 2025

GROUNDWATER REGULATION

- Collaborating with local groundwater conservation districts, regional water providers, and other water agencies to manage groundwater use through water planning and well permitting.

SCIENCE & RESEARCH

- Utilizing the highest quality data and research to monitor groundwater usage, aquifer characteristics, and land surface changes as well as analyzing the best-available predictive models.

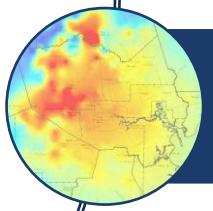
WATER CONSERVATION

- Equipping permittees, residents, businesses, and educators with water conservation tools and resources to reduce water usage and empower the community to value water.

Agenda

Climate

Water Use



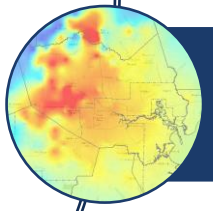
Groundwater Levels

Subsidence

Agenda


Climate


Water Use


Groundwater Levels


Subsidence

Exhibit 1

Location of National Weather Service (NWS) climate stations used for rainfall data for the 2024 calendar year.

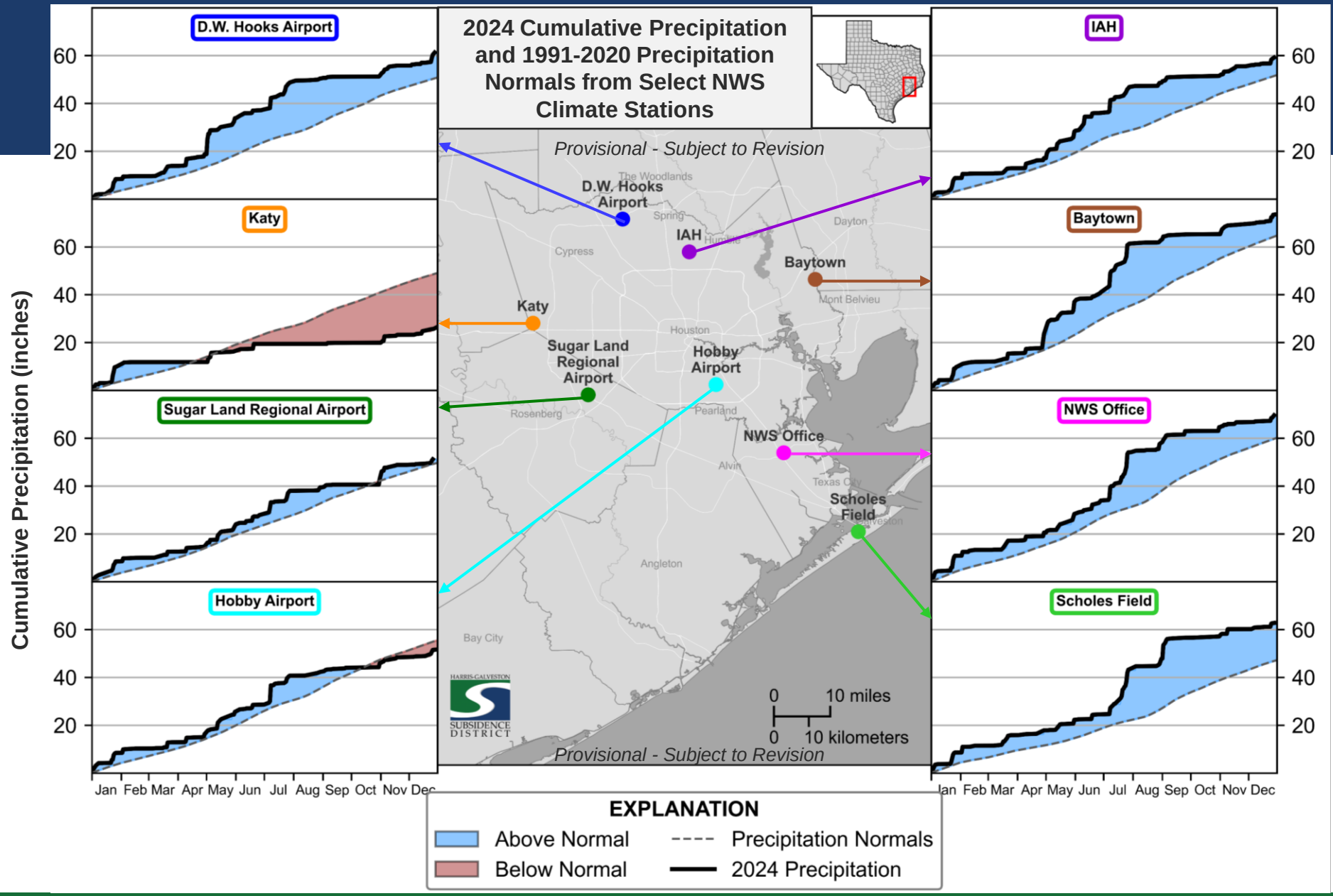
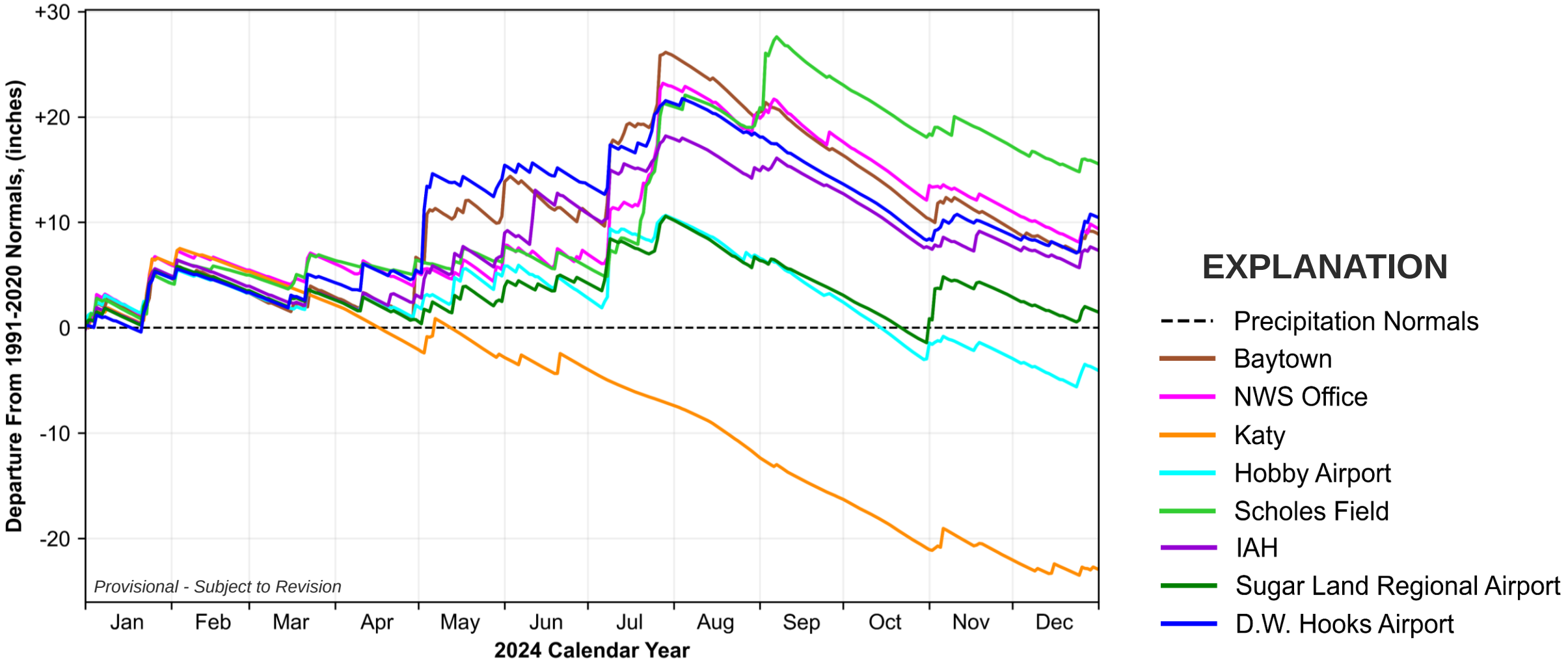


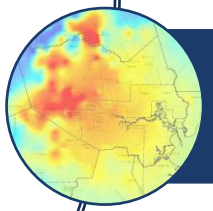
Exhibit 2 | 2024 Precipitation Data



Agenda

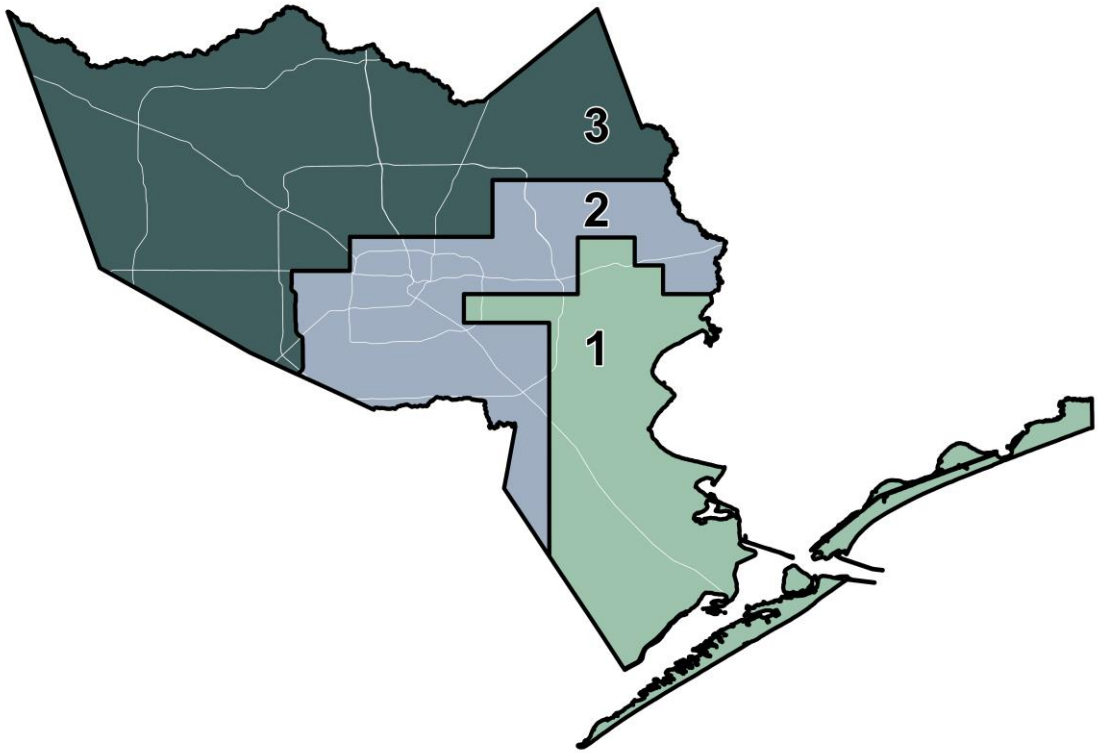

Climate


Water Use


Groundwater Levels

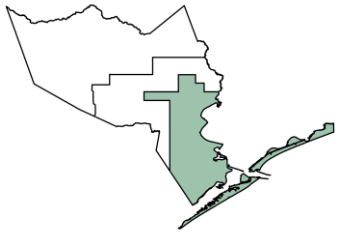

Subsidence

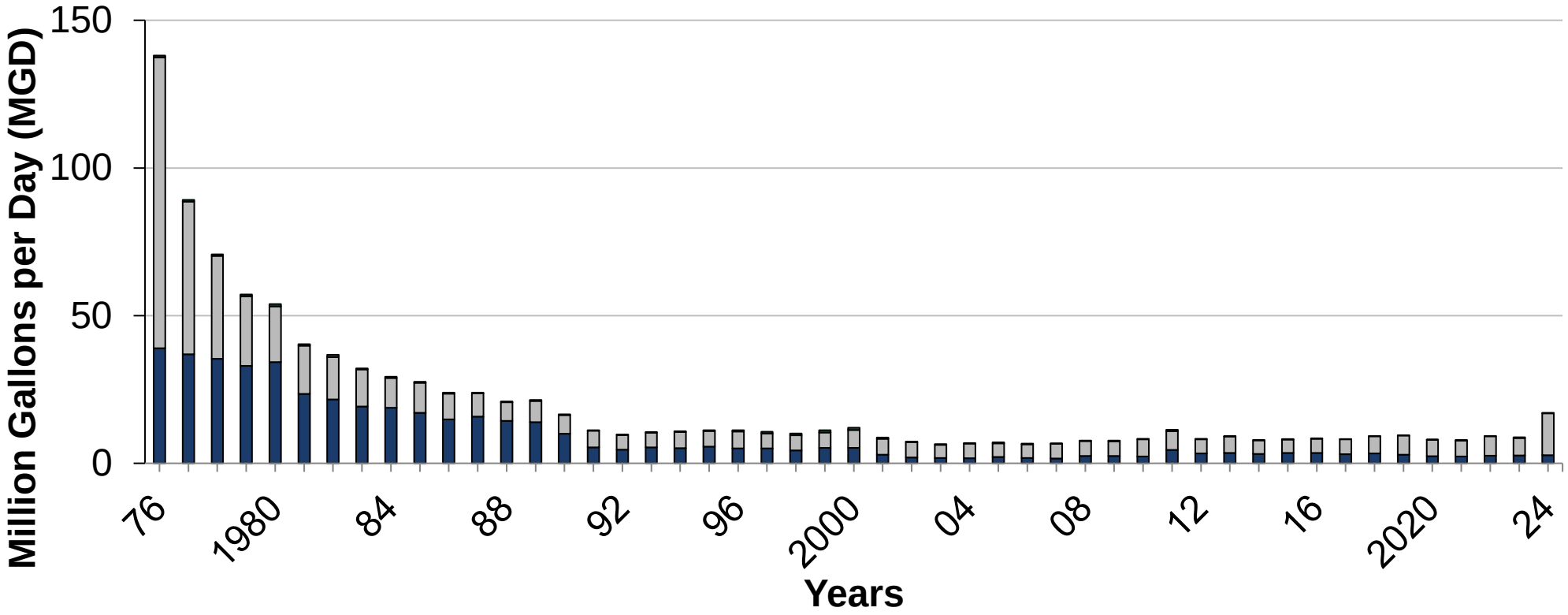
HGSD's Regulatory Areas



- **Area 1:** No more than 10% of Total Water Demand (TWD) may be sourced from groundwater.
- **Area 2:** No more than 20% of TWD may be sourced from groundwater.
  - Groundwater Reduction Plan (GRP) may be approved with conditions.
- **Area 3:** No more than 20% of TWD may be sourced from groundwater.
  - Permittees operating within an approved GRP have the following requirements:
    - 2025 – reduce groundwater use to no more than 40% of TWD
    - 2035 – reduce groundwater use to no more than 20% of TWD

Exhibit 3 | Regulatory Area 1 Groundwater Use





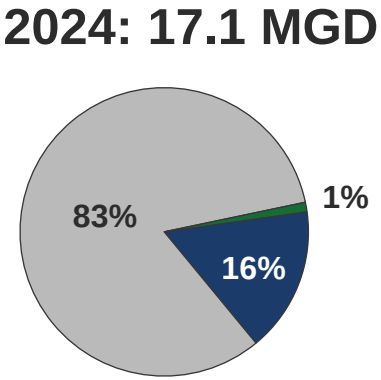
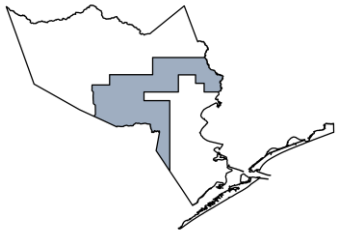
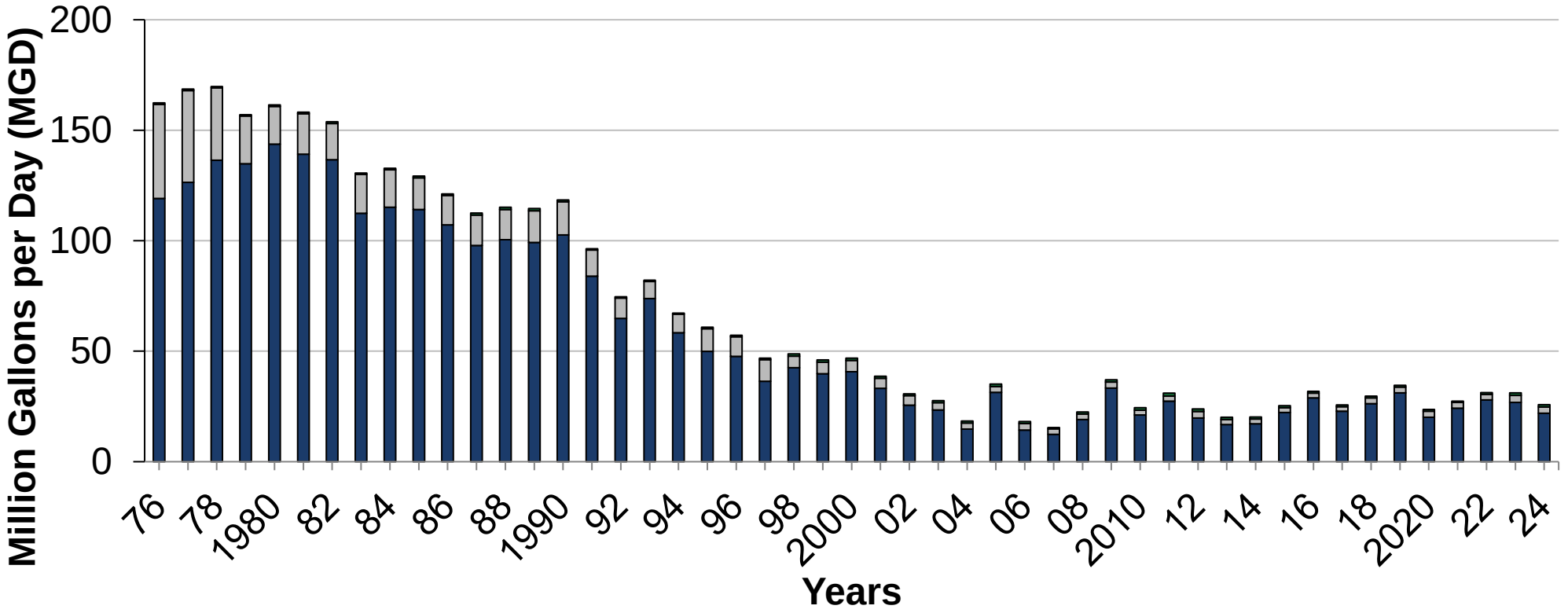


Exhibit 4 | Regulatory Area 2 Groundwater Use





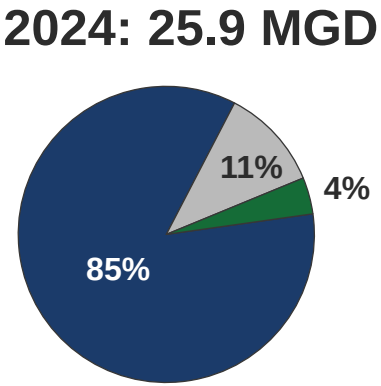
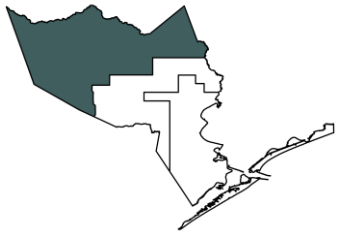
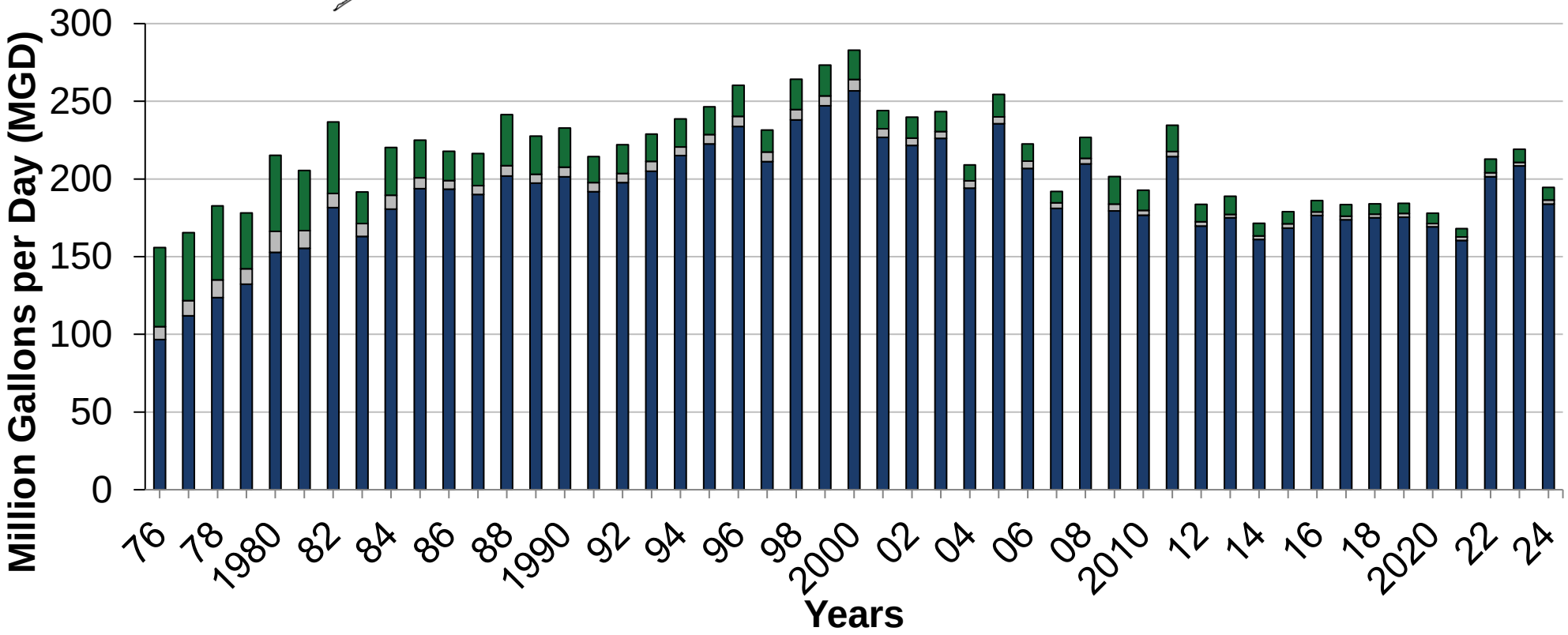


Exhibit 5 | Regulatory Area 3 Groundwater Use





2024: 194.7 MGD

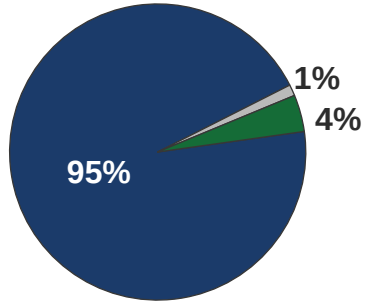
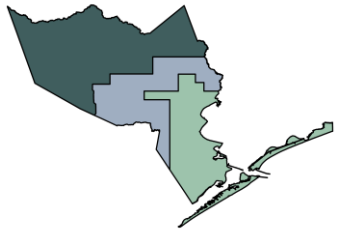
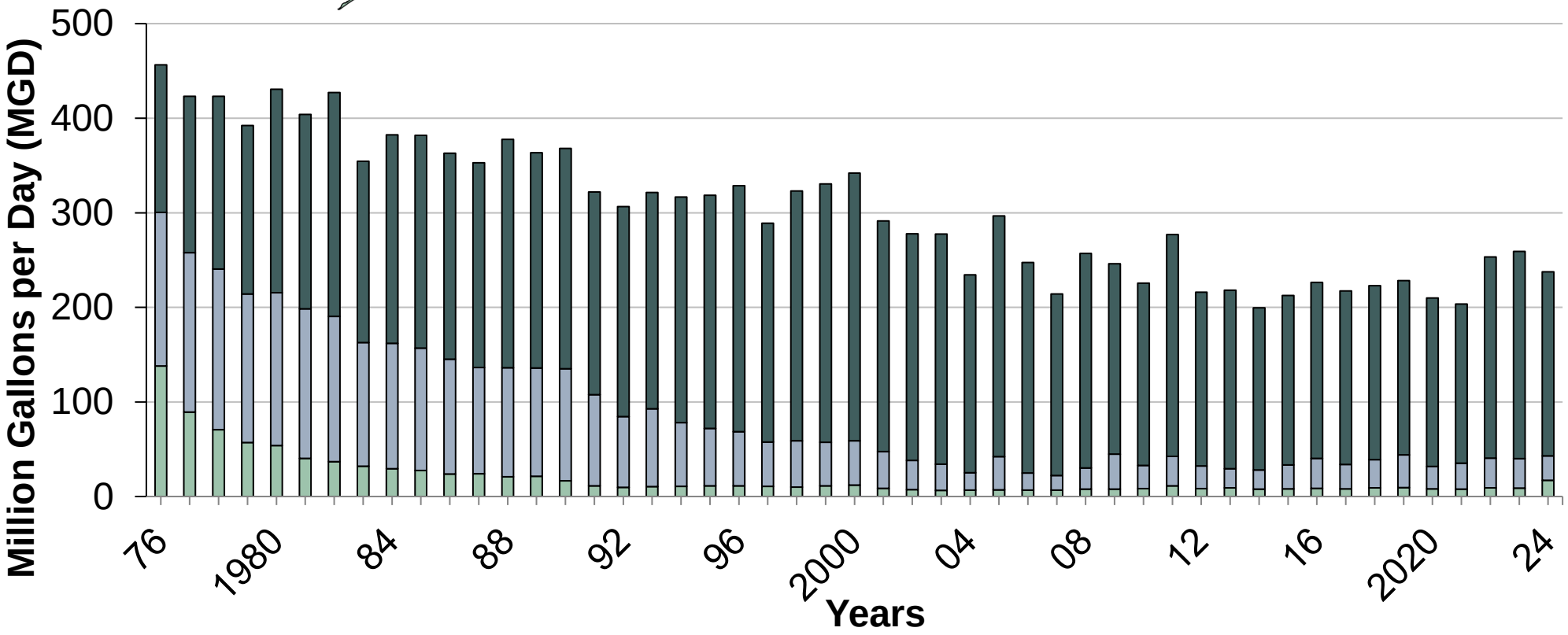


Exhibit 6 | All Regulatory Areas' Groundwater Use





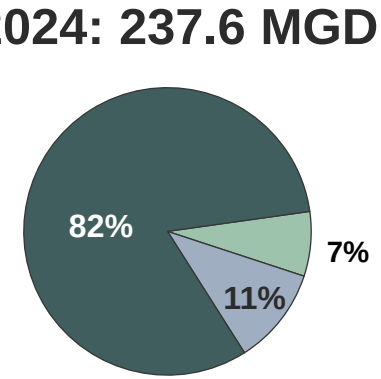
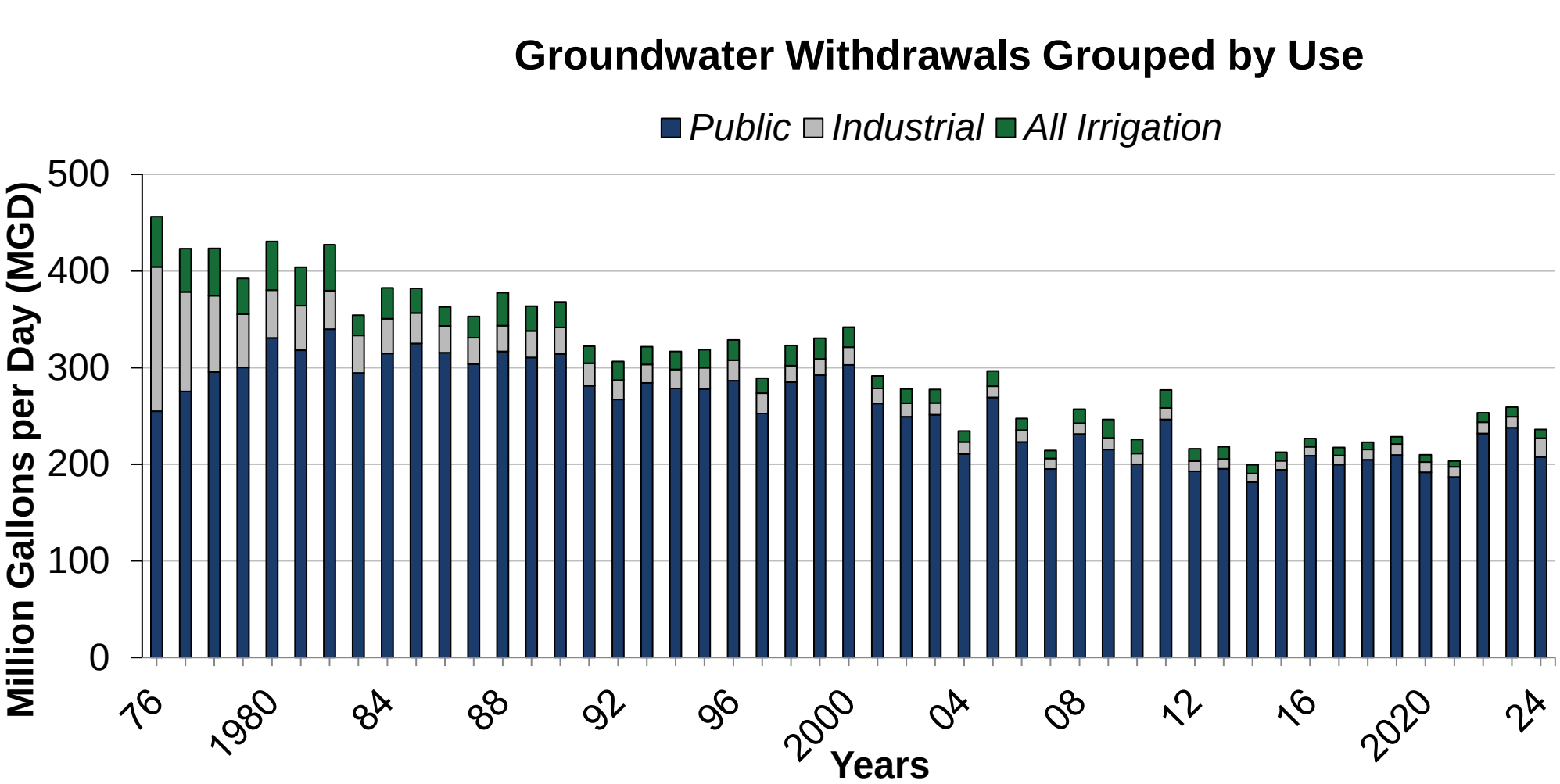
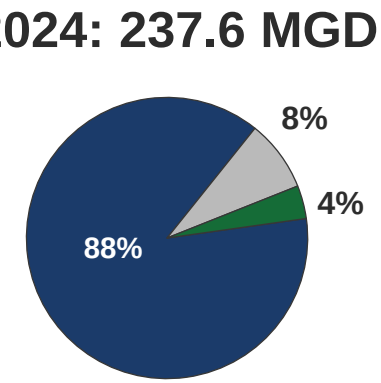


Exhibit 7 | Entire District Groundwater Use Type





Alternative Water Sources

Surface water sources:

- Trinity River
- San Jacinto River
- Brazos River

Reclaimed water is also utilized throughout the District.

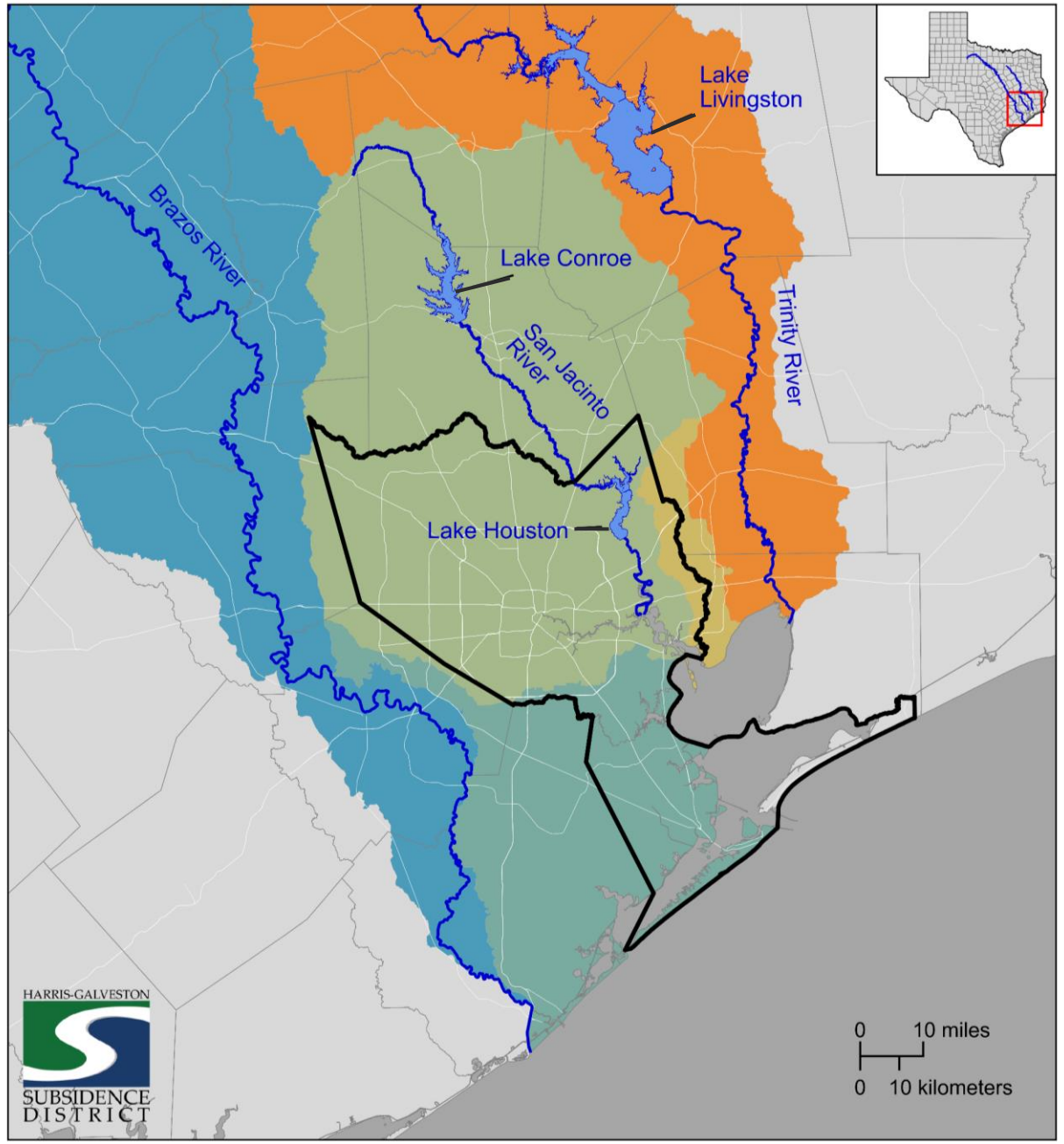


Exhibit 8 | Alternative Water Used for Entire District

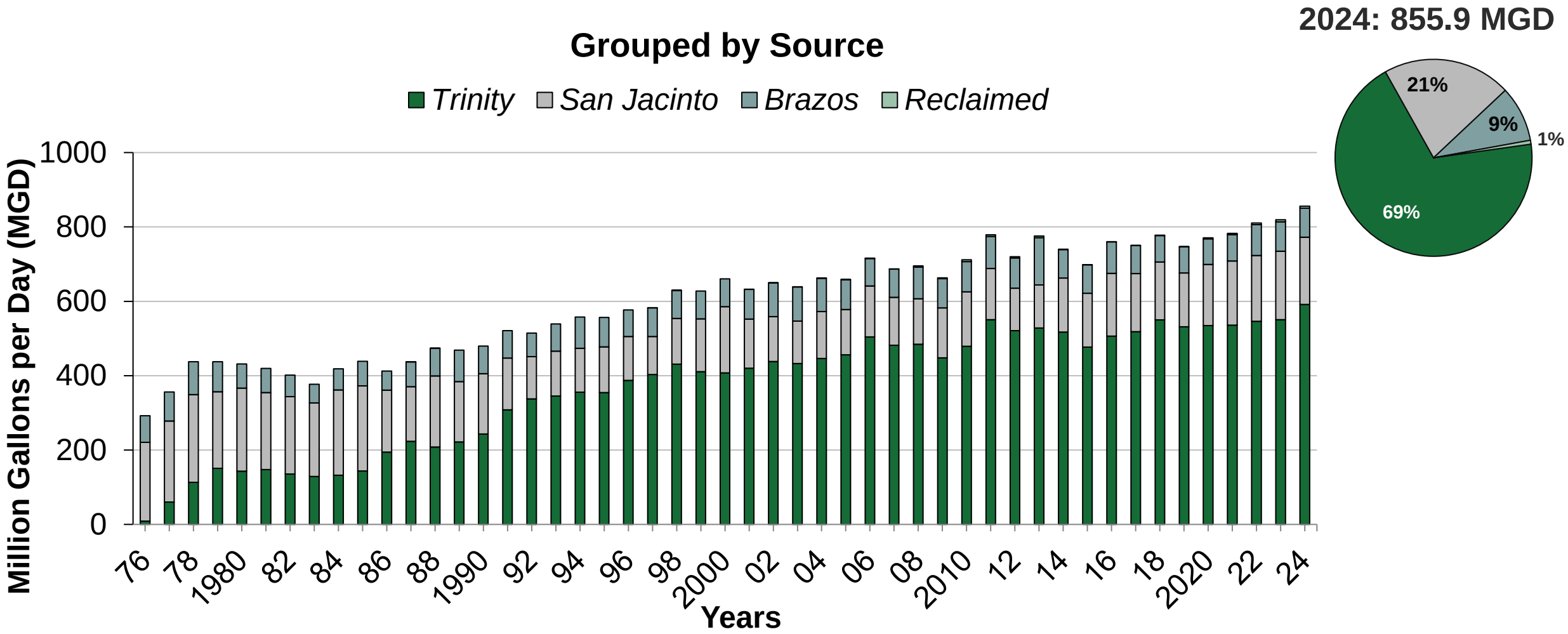
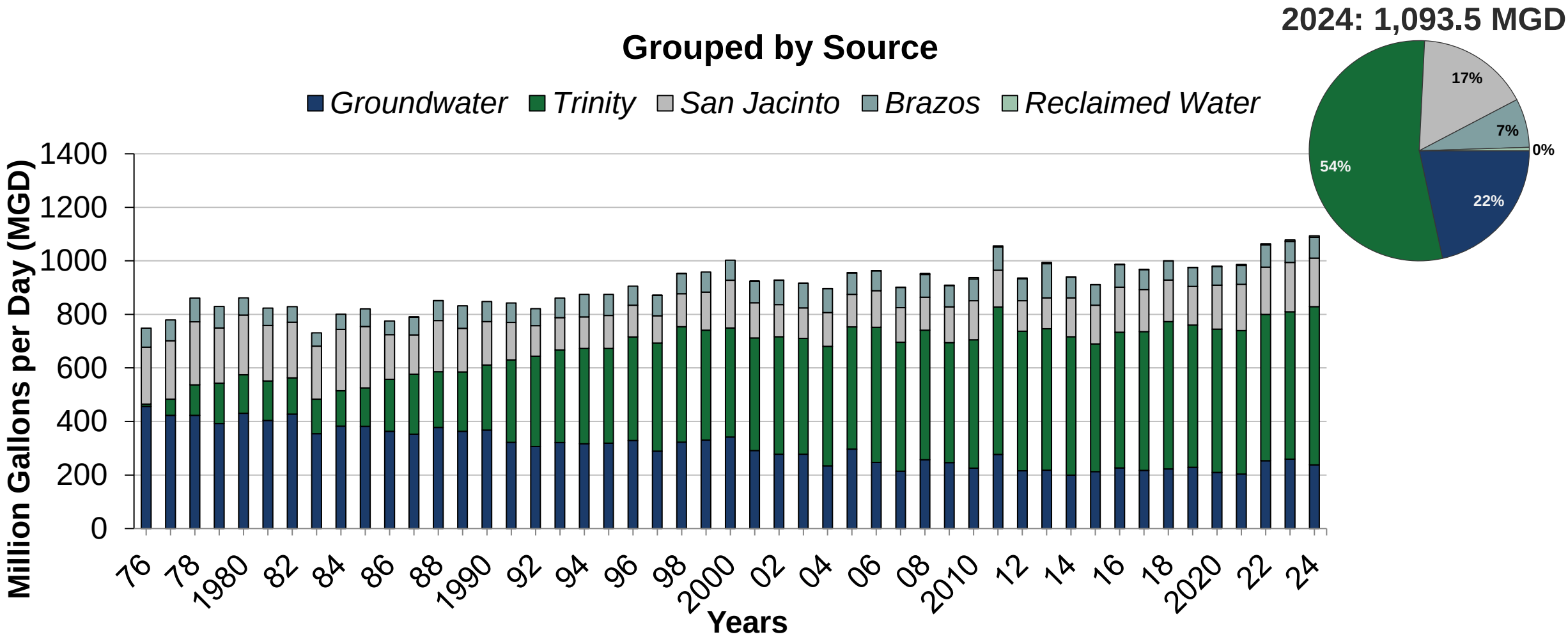


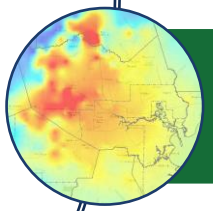
Exhibit 9 | Total Water Demand



Agenda


Climate


Water Use


Groundwater Levels


Subsidence

USGS
science for a changing world

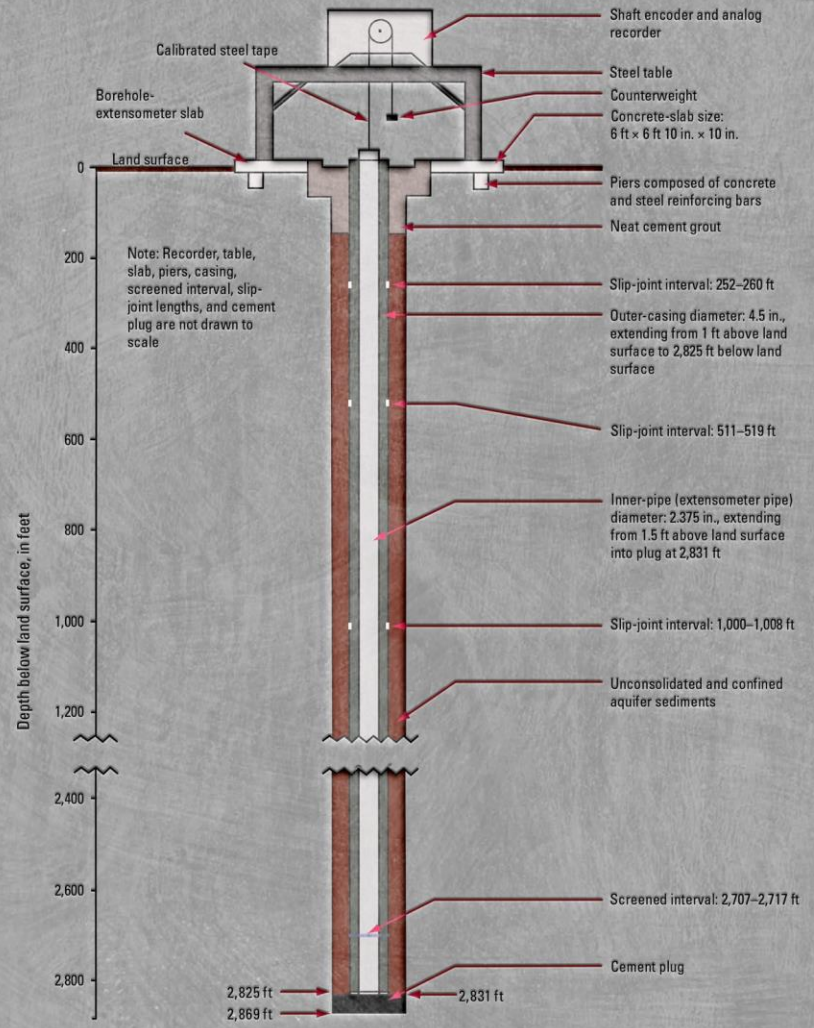


DIAGRAM OF A BOREHOLE EXTENSOMETER

HARRIS-GALVESTON SUBSIDENCE DISTRICT

FORT BEND SUBSIDENCE DISTRICT

Groundwater-level Altitudes, Long-Term Change & Compaction

CHICOT/EVANGELINE AND JASPER AQUIFERS

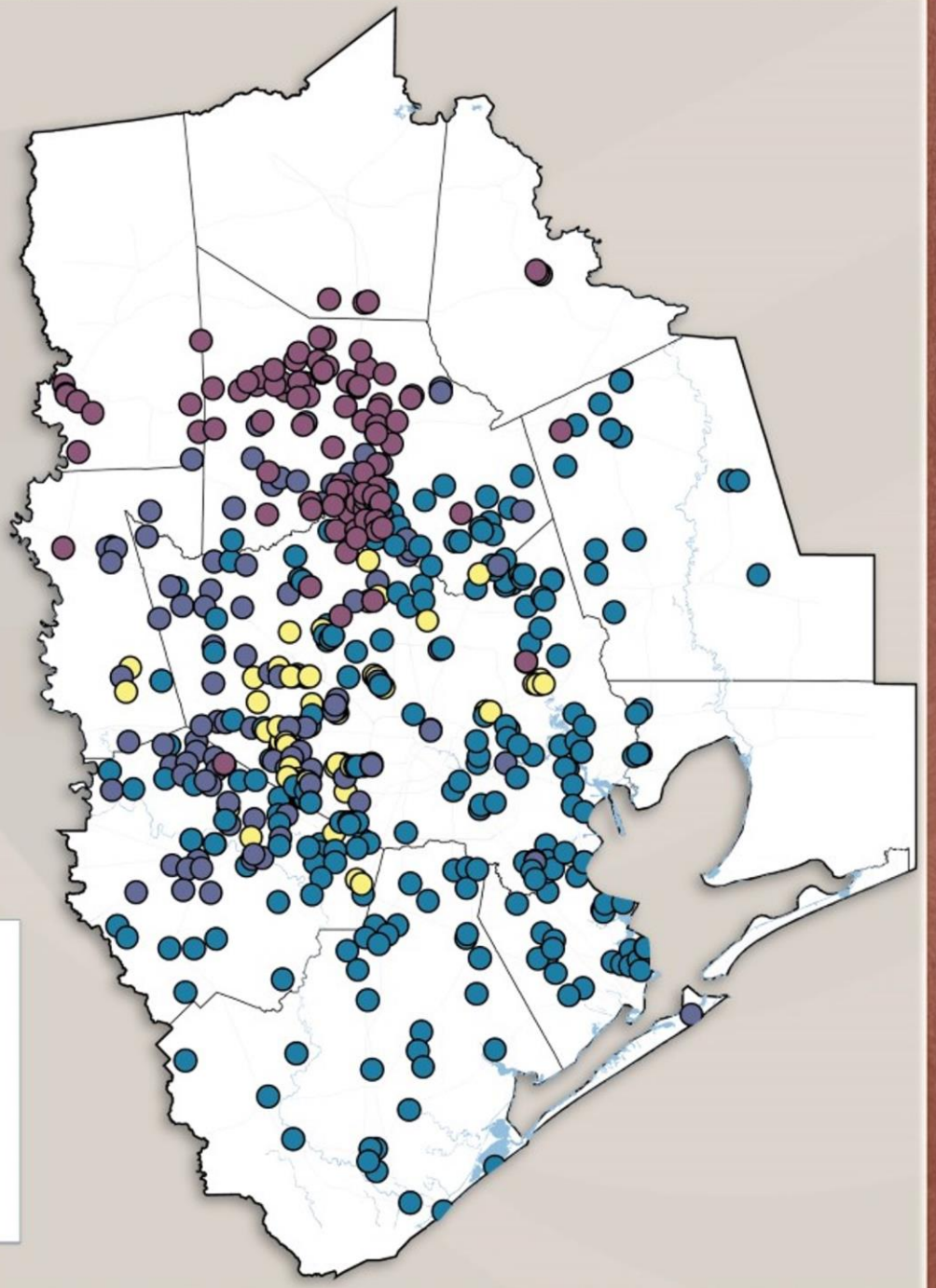
RESEARCH IN COOPERATION WITH THE HARRIS–GALVESTON & FORT BEND SUBSIDENCE DISTRICTS BRAZORIA GROUNDWATER CONSERVATION DISTRICT, THE CITY OF HOUSTON AND LONE STAR GROUNDWATER CONSERVATION DISTRICT

2025 Water-Level Map Series

- Chicot and Evangeline Aquifers (undifferentiated)
  - 2025 Water-Level Altitude
  - 2024 to 2025 Water-Level Change
  - 2020 to 2025 Water-Level Change
  - 1977 to 2025 Water-Level Change

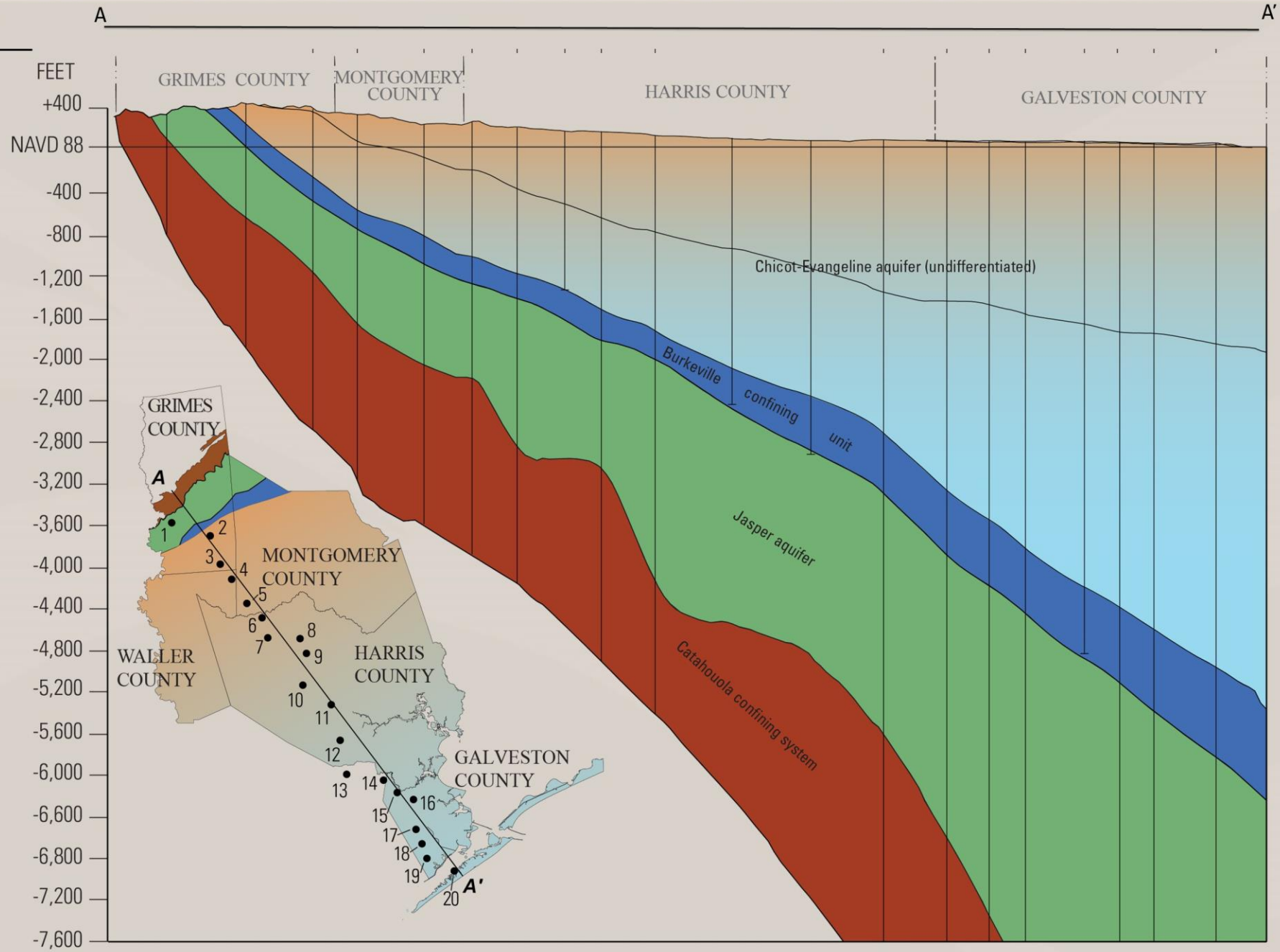
- Jasper Aquifer
  - 2025 Water-Level Altitude
  - 2024 to 2025 Water-Level Change
  - 2020 to 2025 Water-Level Change
  - 2000 to 2025 Water-Level Change

- Compaction 1973 to 2024
  - Compaction Data from 13 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 Formation	Upper Catahoula Formation	Catahoula Confining System
	Frio Formation	

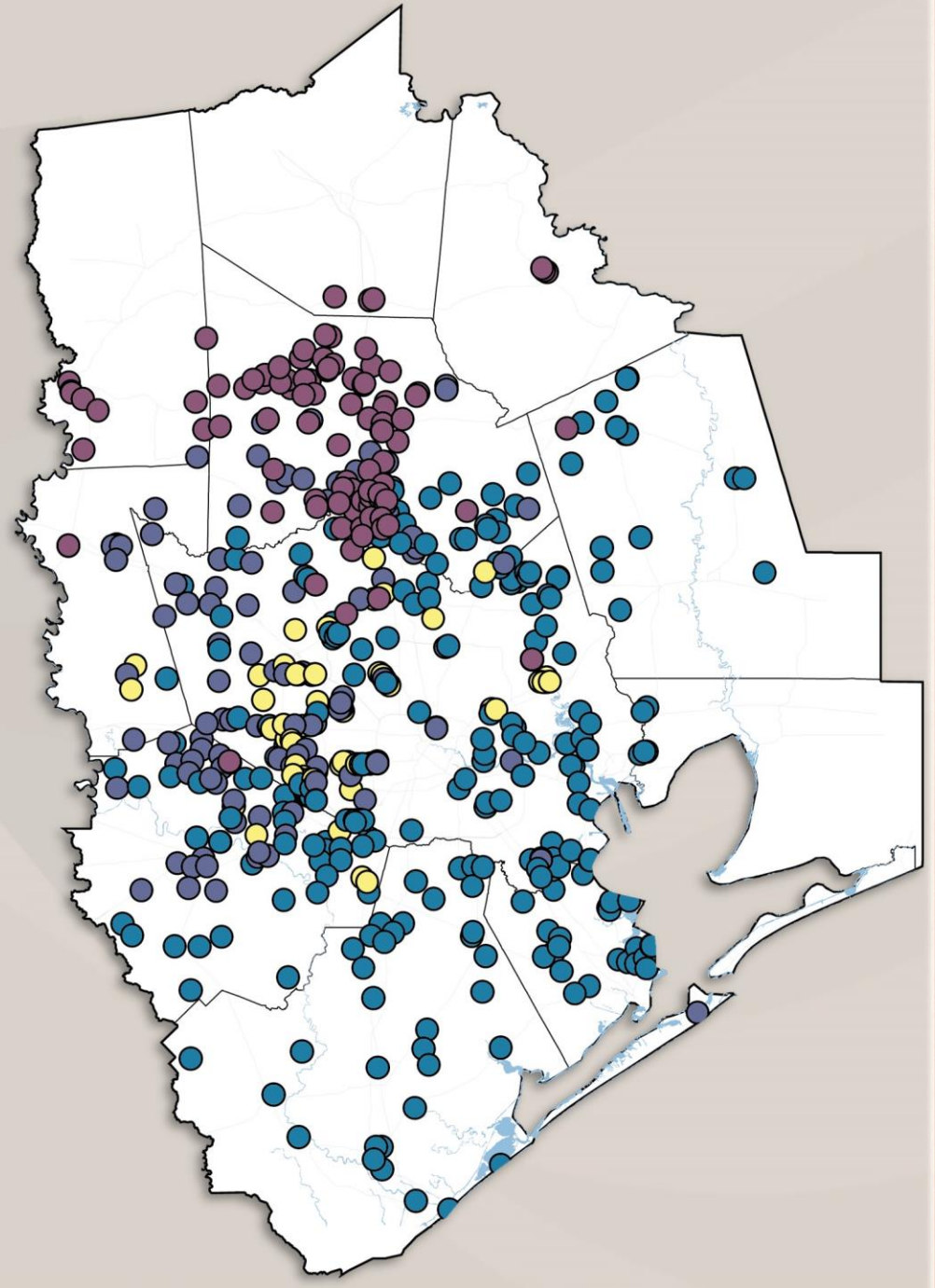


[1]Young, S.C., Kelley, V.A., Deeds, N., Hudson, C., Piemonti, D., Ewing, T.E., Banerji, D., Seifert, J., and Lyman, P., 2017

[1]Modified from Young and Draper, 2020 and Young and others (2012, 2014)

Network

- Data collected across 11 counties
- Data collection from 12-03-2024 to 3-13-2025
- Well Types:
  - Public Supply, Irrigation, Industrial, Observation
- Chicot and Evangeline (undifferentiated) water-levels: 562
- Jasper water-levels: 112
- Number of wells used to create the 2025 altitude maps
  - Chicot and Evangeline (undifferentiated): *525*
    - *Data from 39 wells were estimated*
  - Jasper: *108*
    - *Data from 15 wells were estimated*



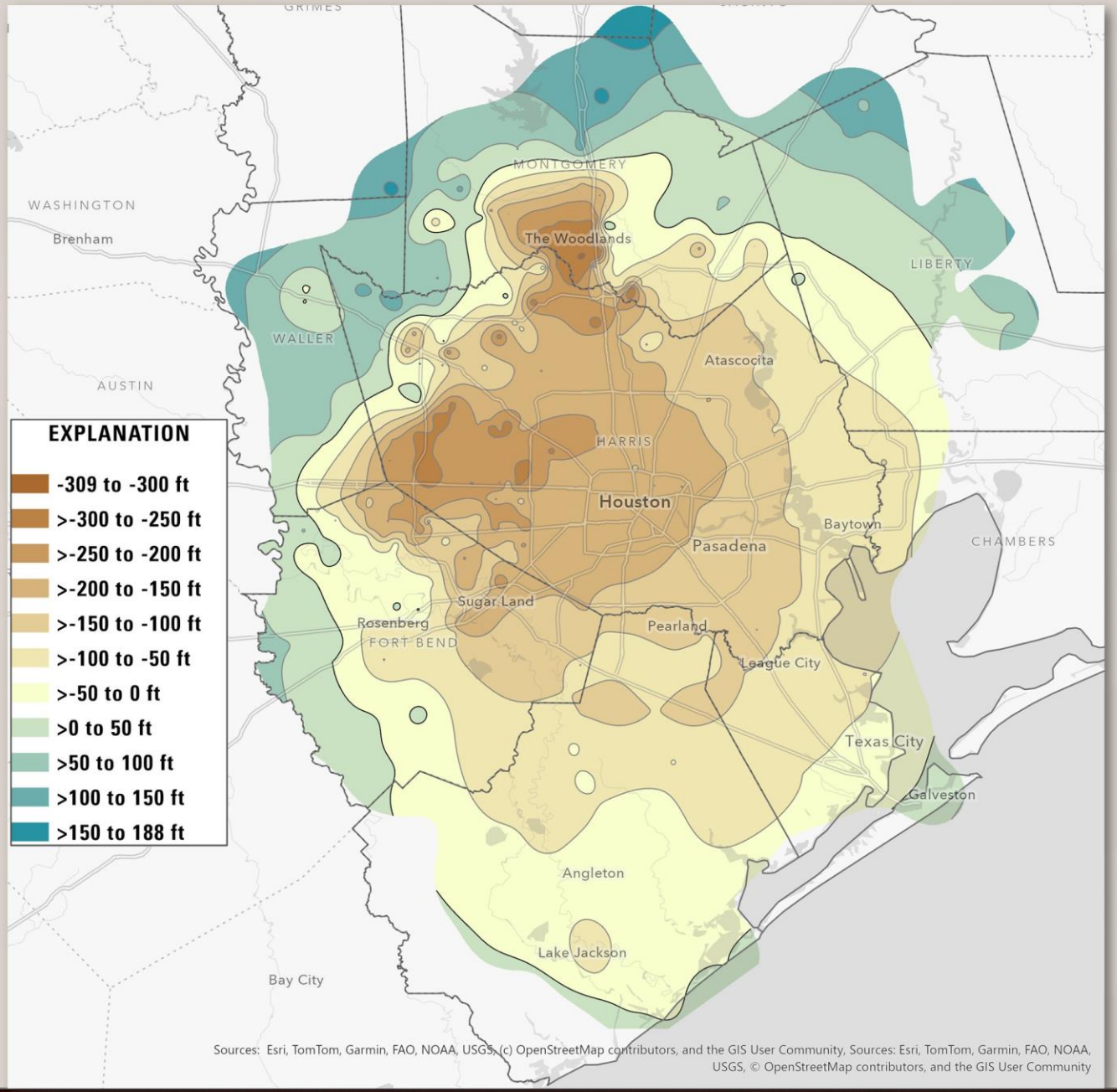
Water-Level Altitude

Chicot and Evangeline (undifferentiated)

Altitudes are referenced from NAVD 88

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

Highest altitudes in portions of south-eastern Grimes County, and northern Montgomery County



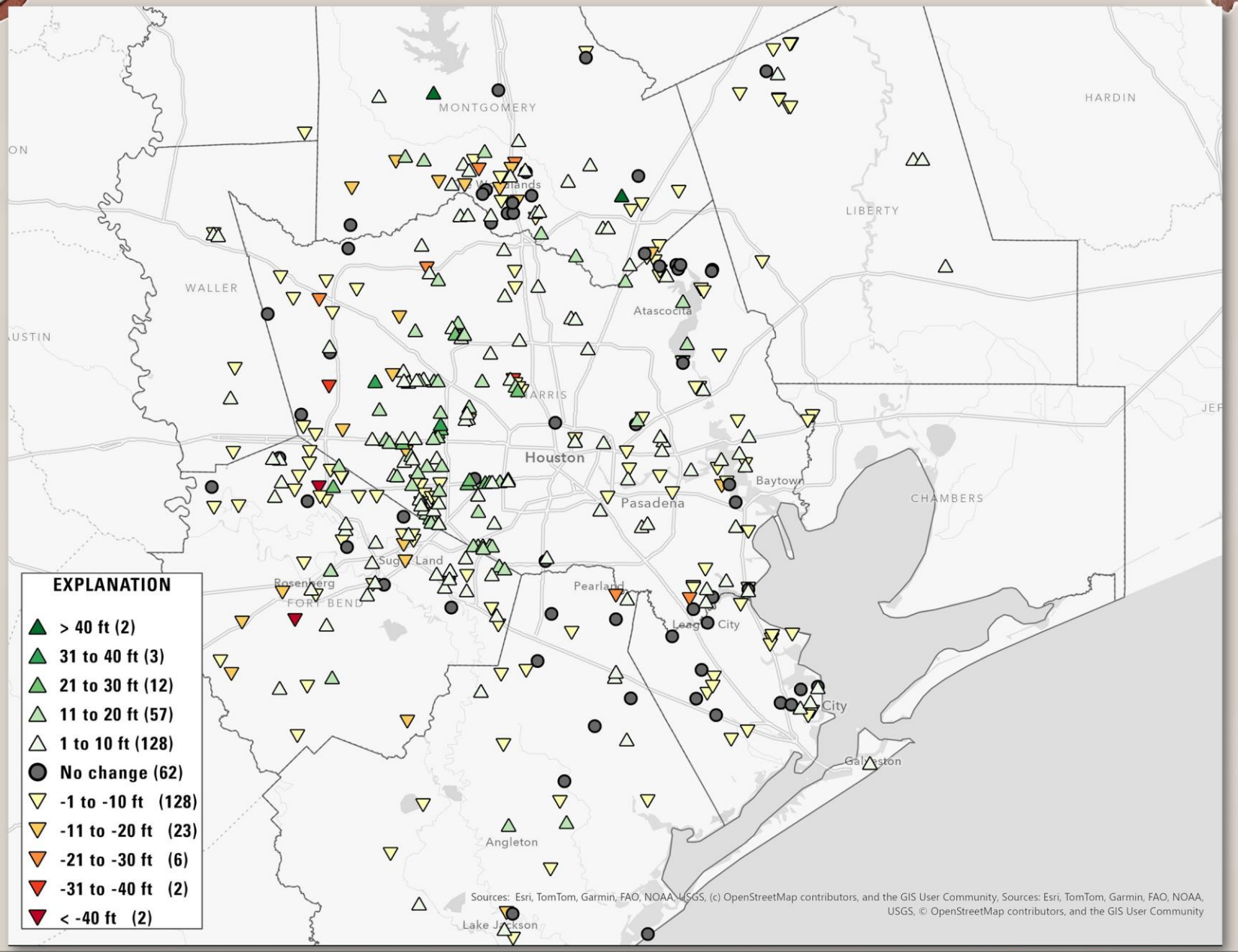
USGS science for a changing world

2024 to 2025 Water-Level Change

Chicot and Evangeline (undifferentiated)

- 427 water-level pairs*
  - About 47.3% were rises
    - Of the rises, about 63% were in the 1 to 10 ft range.
    - Largest rises (> 40 ft)
      - 2 in Montgomery County
  - About 38.2% were declines
    - Largest declines (< -40 ft)
      - 2 in Fort Bend County

* note: 26 wells used estimated data to produce the 1-year change.

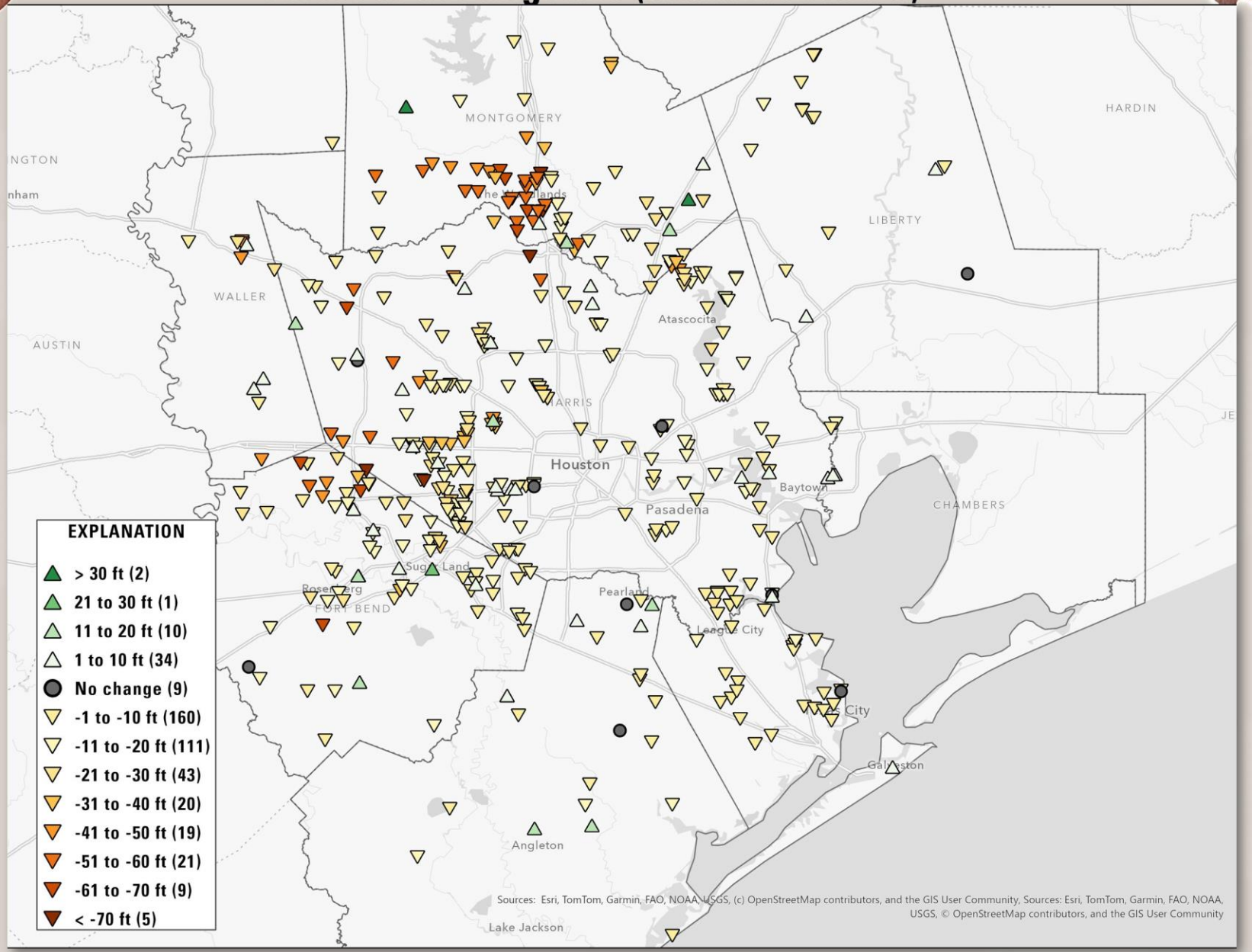


2020 to 2025 Water-Level Change

- 449 water-level pairs*
  - About 87.5% were declines
    - Of the declines, ~ 69% are in the 1 to 20 ft range.
    - Largest declines (>50 ft)
      - portions of southern Montgomery, northwestern and western Harris and northern Fort Bend counties
  - About 10.5% were rises
    - Rises primarily in southern Montgomery County, western portion of Harris County and Fort Bend County.
    - Largest rises (>30 ft)
      - Western and eastern Montgomery County

* note: 38 wells used estimated data to produce the 5-year change.

Chicot and Evangeline (undifferentiated)



USGS science for a changing world

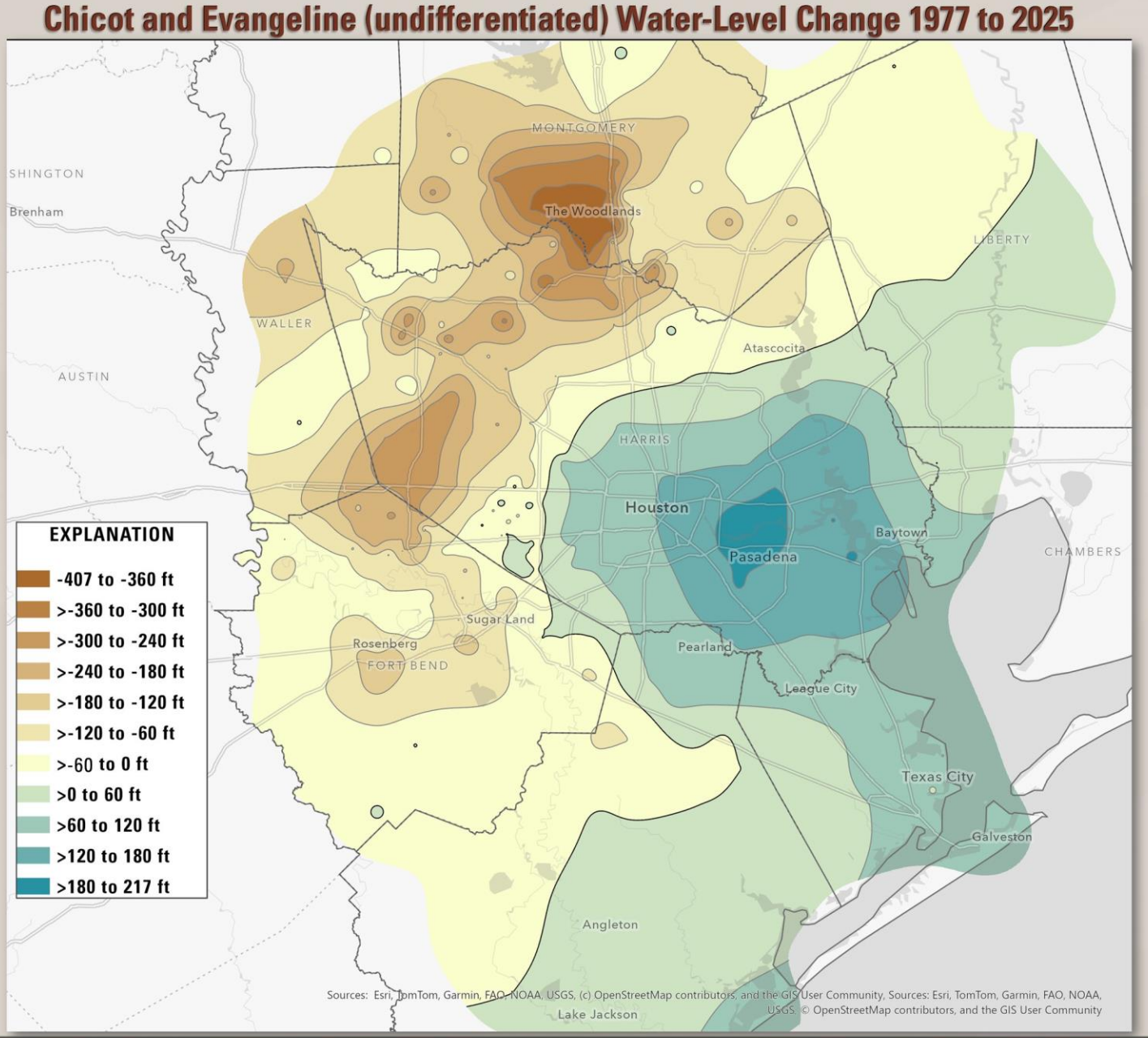
Long term change

Water-level rises (blues):

- most of central and eastern Harris County
- Galveston County
- Brazoria County

Water-level declines (yellows and browns):

- western Brazoria County
- much of Fort Bend County
- western and northern Harris County
- portions of Waller County
- portions of Montgomery County



Water-Level Altitude

Jasper

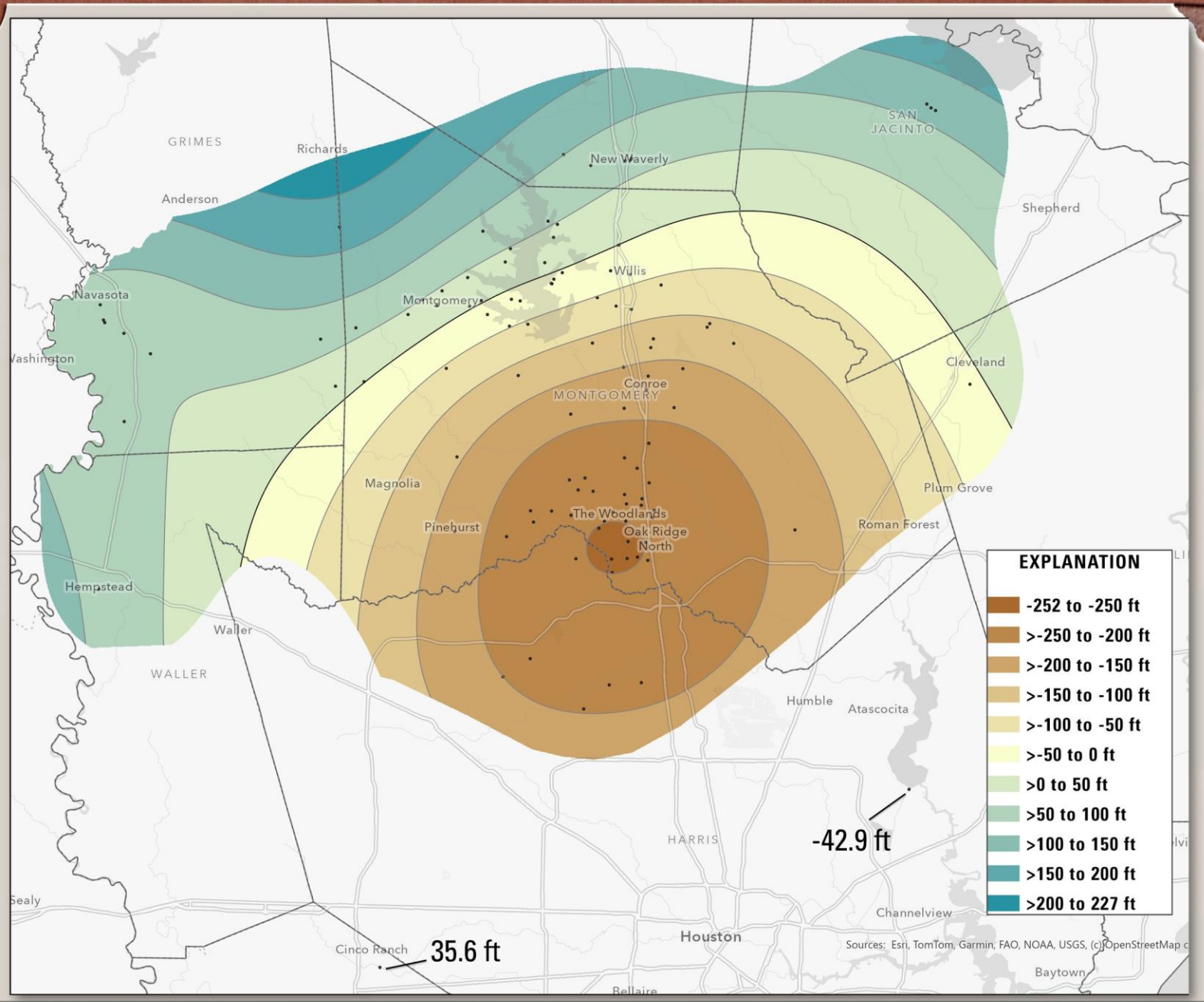
Altitudes are referenced from NAVD 88

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

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

Cinco Mud (Fort Bend County): 35.6 ft above NAVD 88

Monitoring well in Harris County: -42.9 ft above NAVD 88



2024 to 2025 Water-Level Change

Jasper

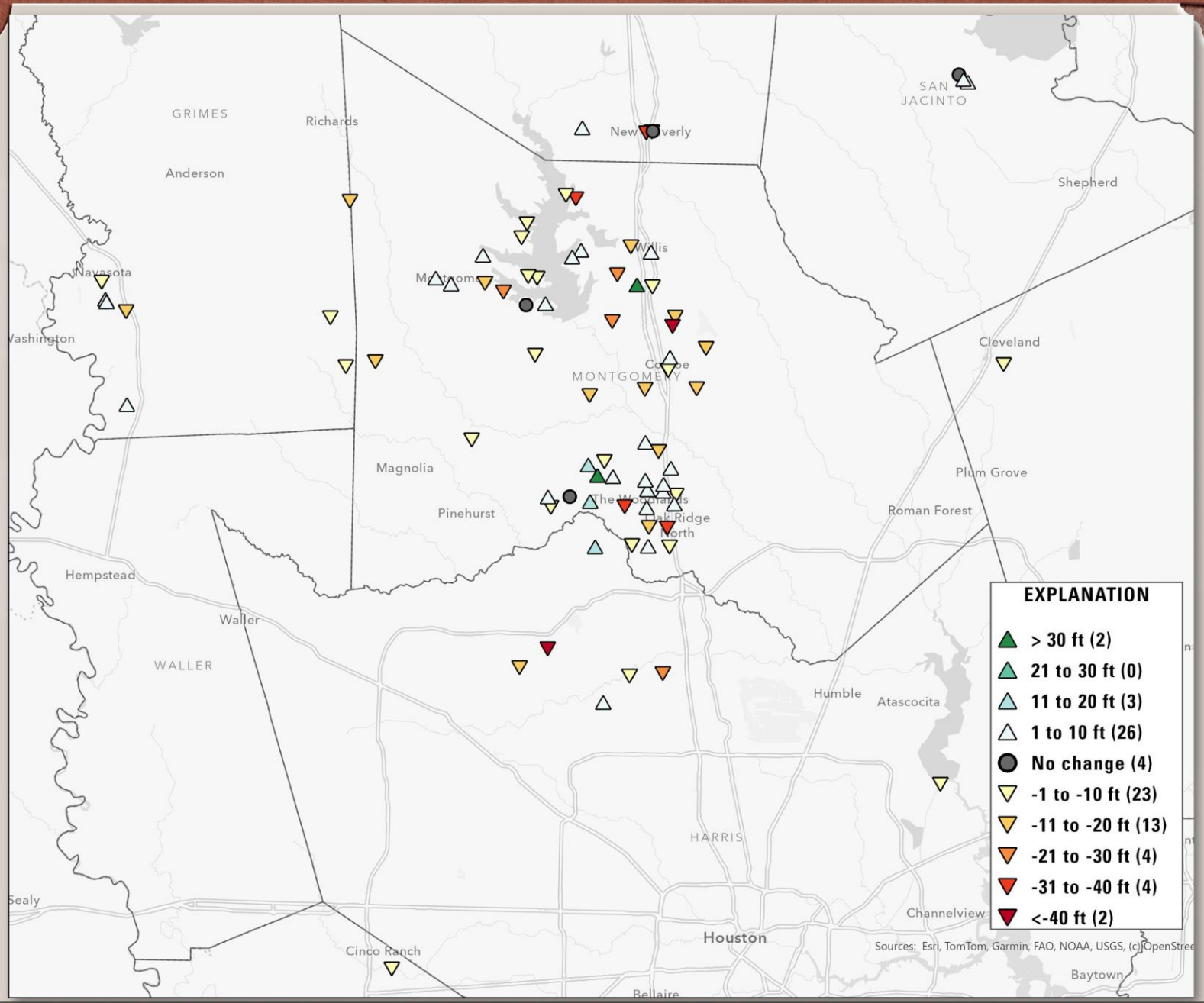
- 81 water-level pairs*
  - ~ 57% declines
  - ~ 38% rises
  - ~ 5% no change

Most changes within 1 to 10 ft

– Largest declines (>40 ft):
  - 1 in northwest Harris County
  - 1 in central Montgomery County

– Largest rises (> 30 ft):
  - 1 in west-central Montgomery County
  - 1 in south-central Montgomery County

* note: 11 wells used estimated data to produce the 1-year change.



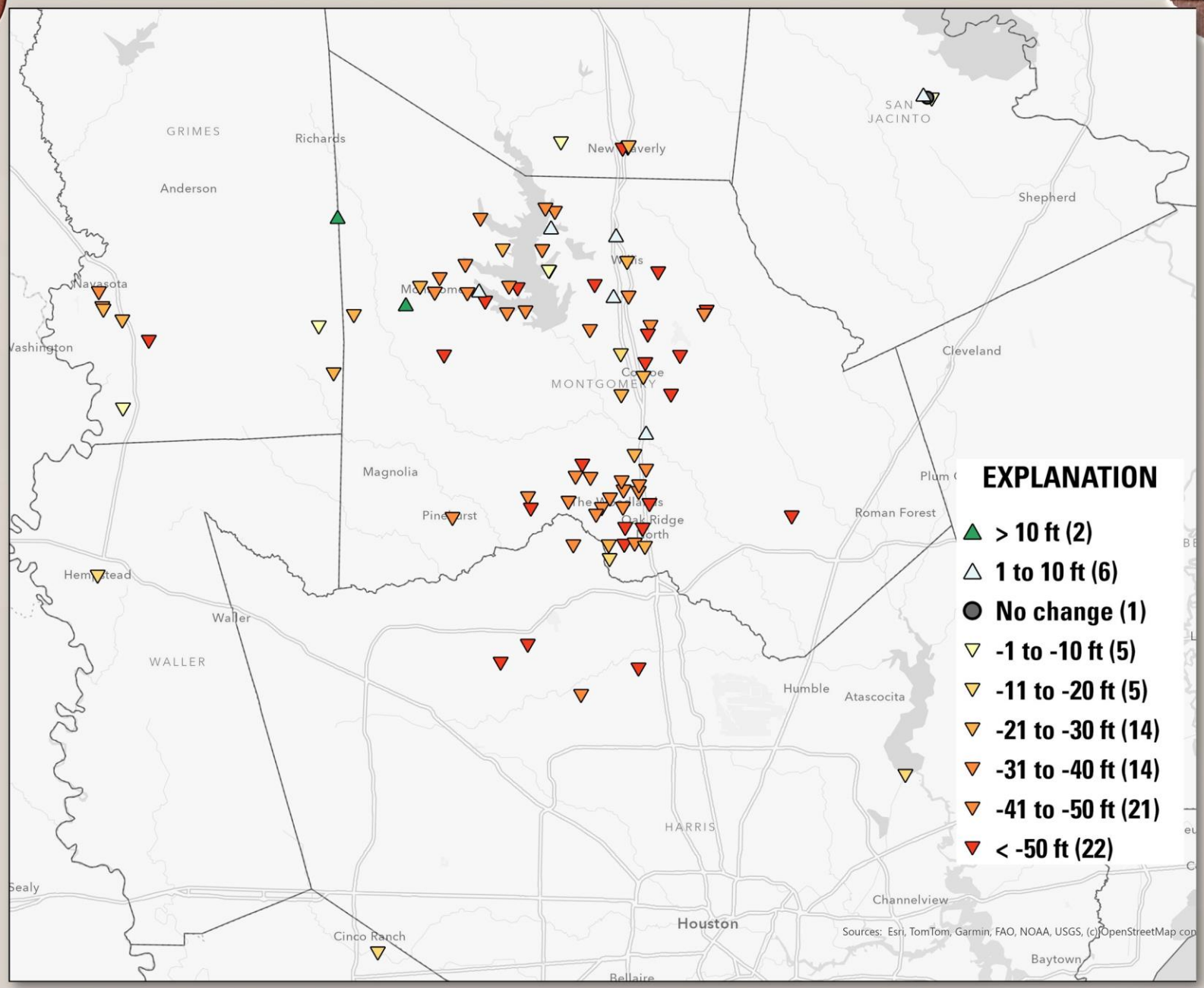
2020 to 2025 Water-Level Change

Jasper

- 90 water-level pairs*
  - ~ 90% declines
  - ~ 9% rises
  - ~ 1% no change

Declines >50 ft across much of central and southern Montgomery County and northern Harris County

* note: 12 wells used estimated data to produce the 5-year change.



Long term change

Water-level rises (blues):

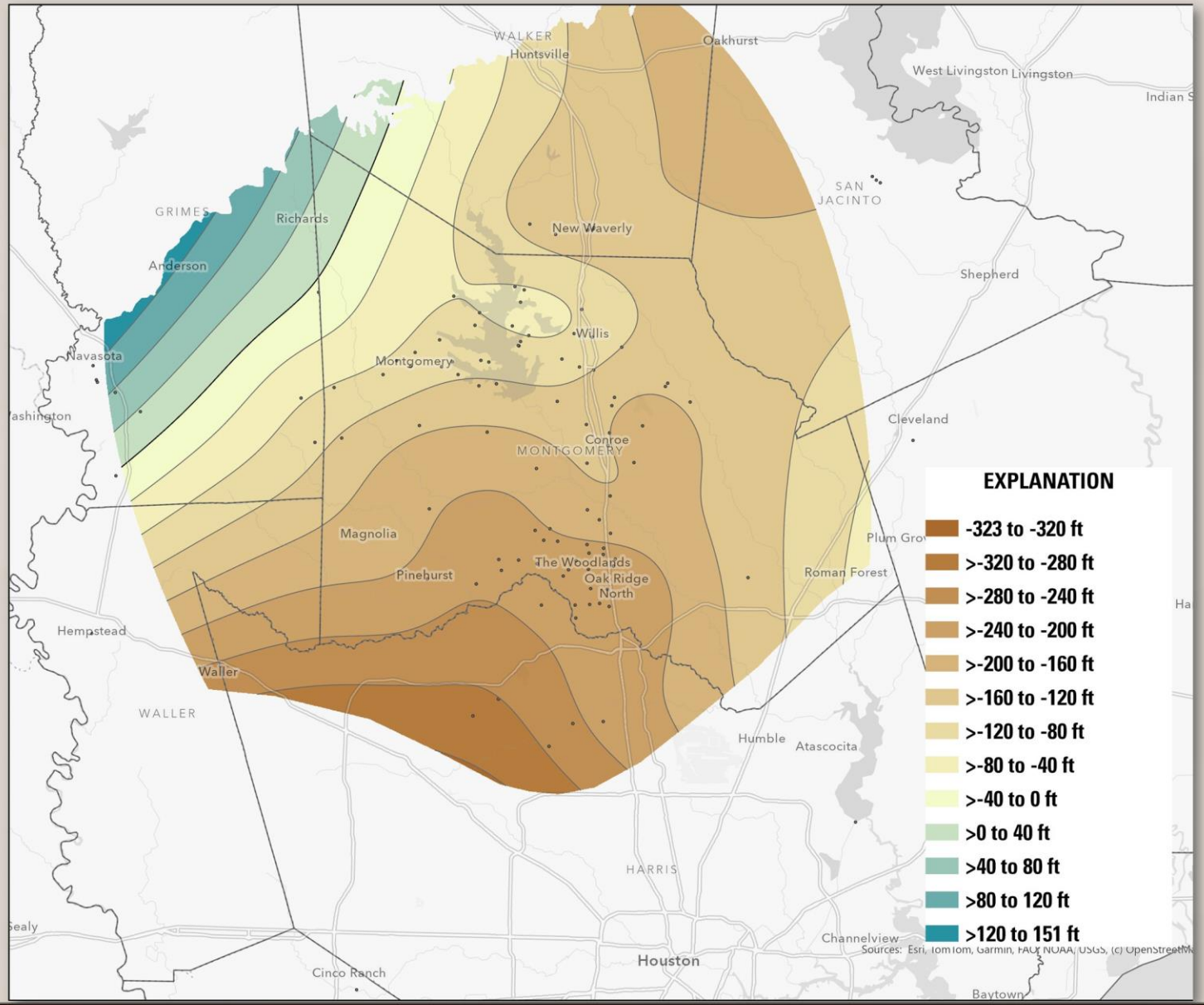
- Rises in northwestern Montgomery County and portions of central Grimes County

Water-level declines (yellows and browns):

- Most of Montgomery County – declines increasing in general down-dip direction into northern Harris County

*note that some extreme estimates are beyond data control points

Jasper Water-Level Change 2000 to 2025



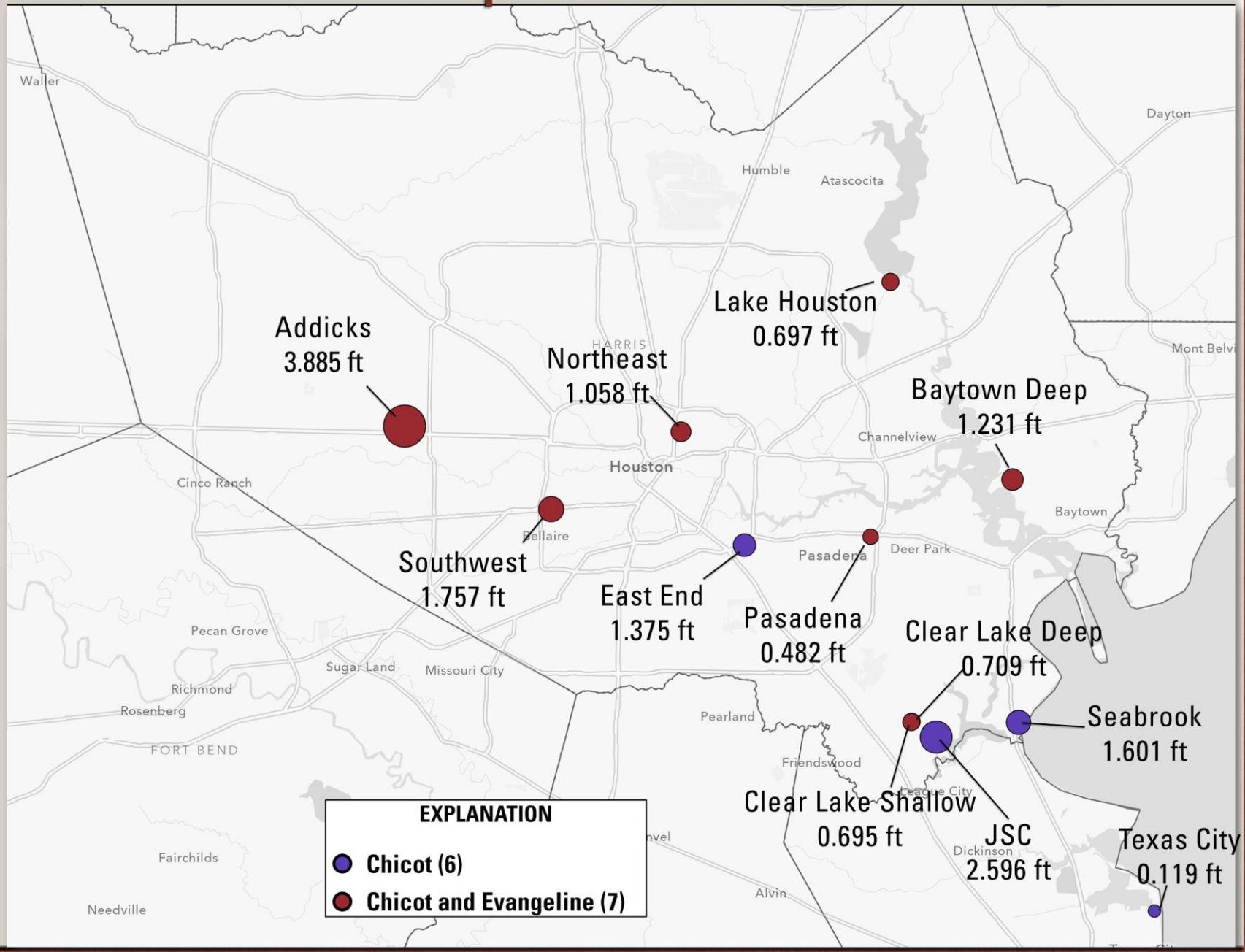
Compaction 1973 - 2024

Compaction Interval:
Chicot

1. 1973 | Baytown Shallow 1.032 ft.
2. 1973 | East End 1.375 ft.
3. 1962 | Johnson Space Center 2.596 ft.
4. 1973 | Seabrook 1.601 ft.
5. 1973 | Texas City 0.119 ft.
6. 1976 | Clear Lake Shallow 0.695 ft.

Compaction Interval:
Chicot and Evangeline

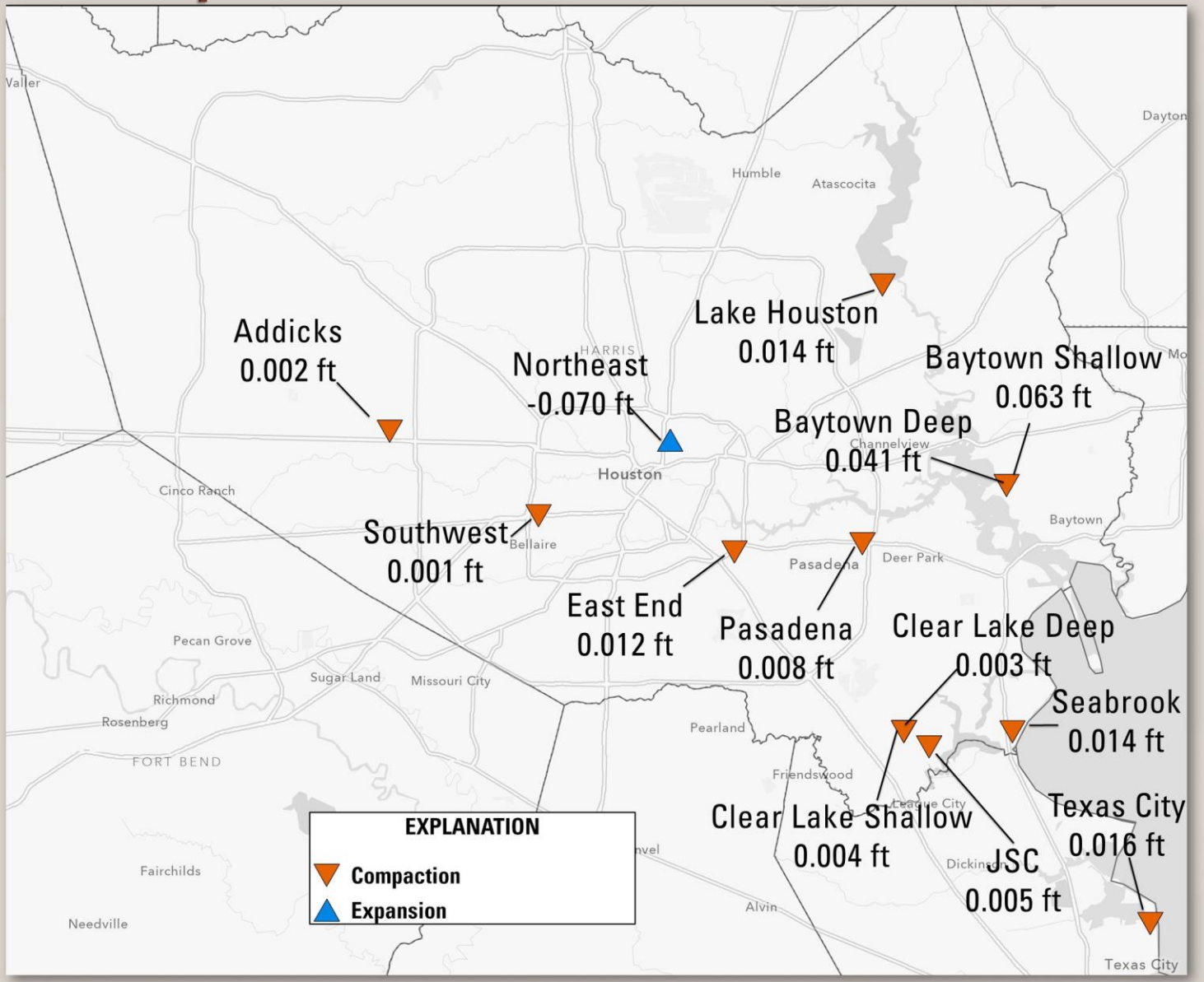
7. 1973 | Baytown Deep 1.231 ft.
8. 1974 | Addicks 3.885 ft.
9. 1974 | Pasadena 0.482 ft.
10. 1976 | Clear Lake Deep 0.709 ft.
11. 1980 | Lake Houston 0.697 ft.
12. 1980 | Northeast 1.058 ft.
13. 1980 | Southwest 1.757 ft.
14. 2017 | Cinco MUD --- ft.



2024 Compaction Summary

- Northeast recorded expansion for the period
- All other sites recorded compaction
- Compaction ranged from -0.070 ft (expansion) to 0.063 ft (compaction)

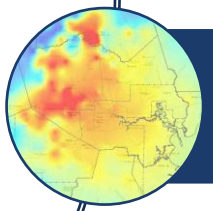
Compaction December 2023 to December 2024



Agenda

Climate

Water Use



Groundwater Levels

Subsidence

Subsidence Monitoring

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

GPS data are collected for one week every two months (periodic monitoring). A conversion to continuous monitoring (data collection every day of the year) began in 2023 and will continue through 2027.

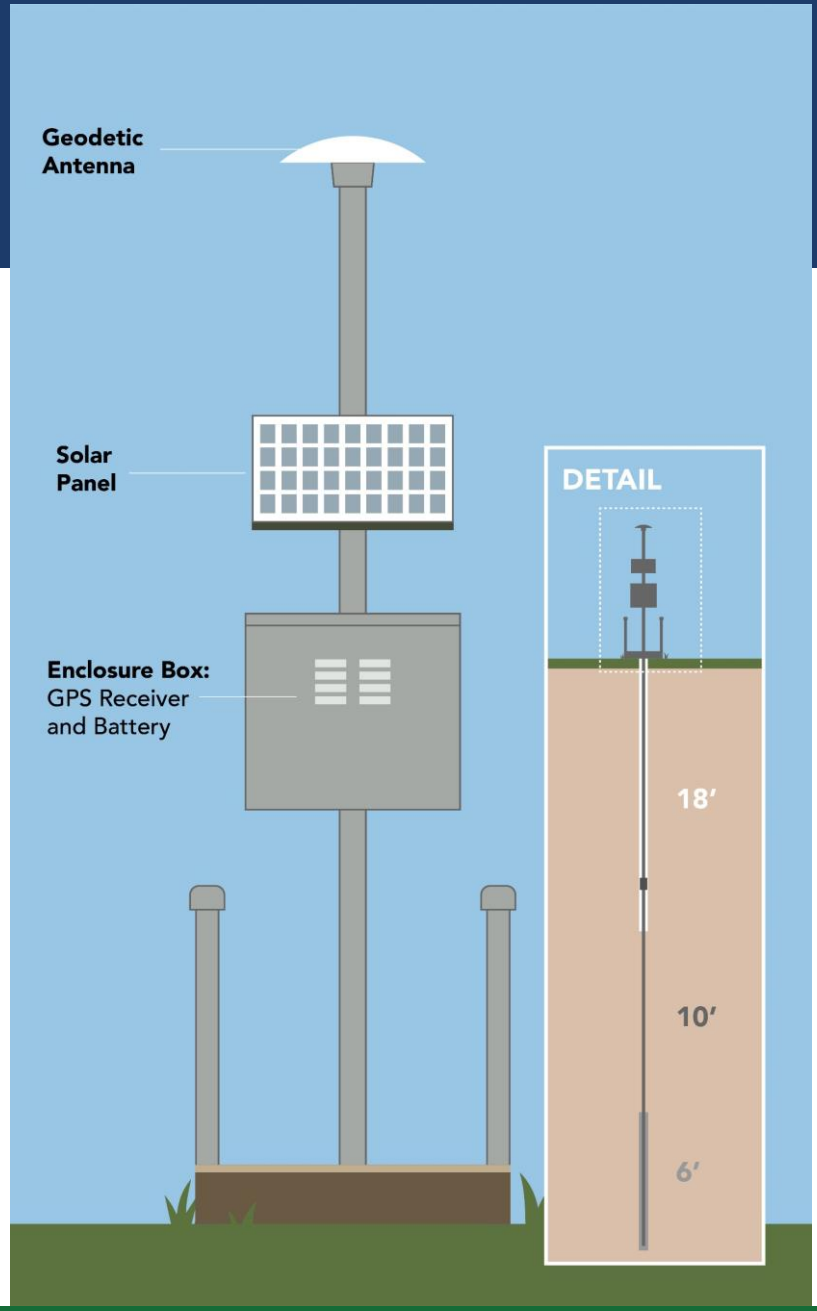
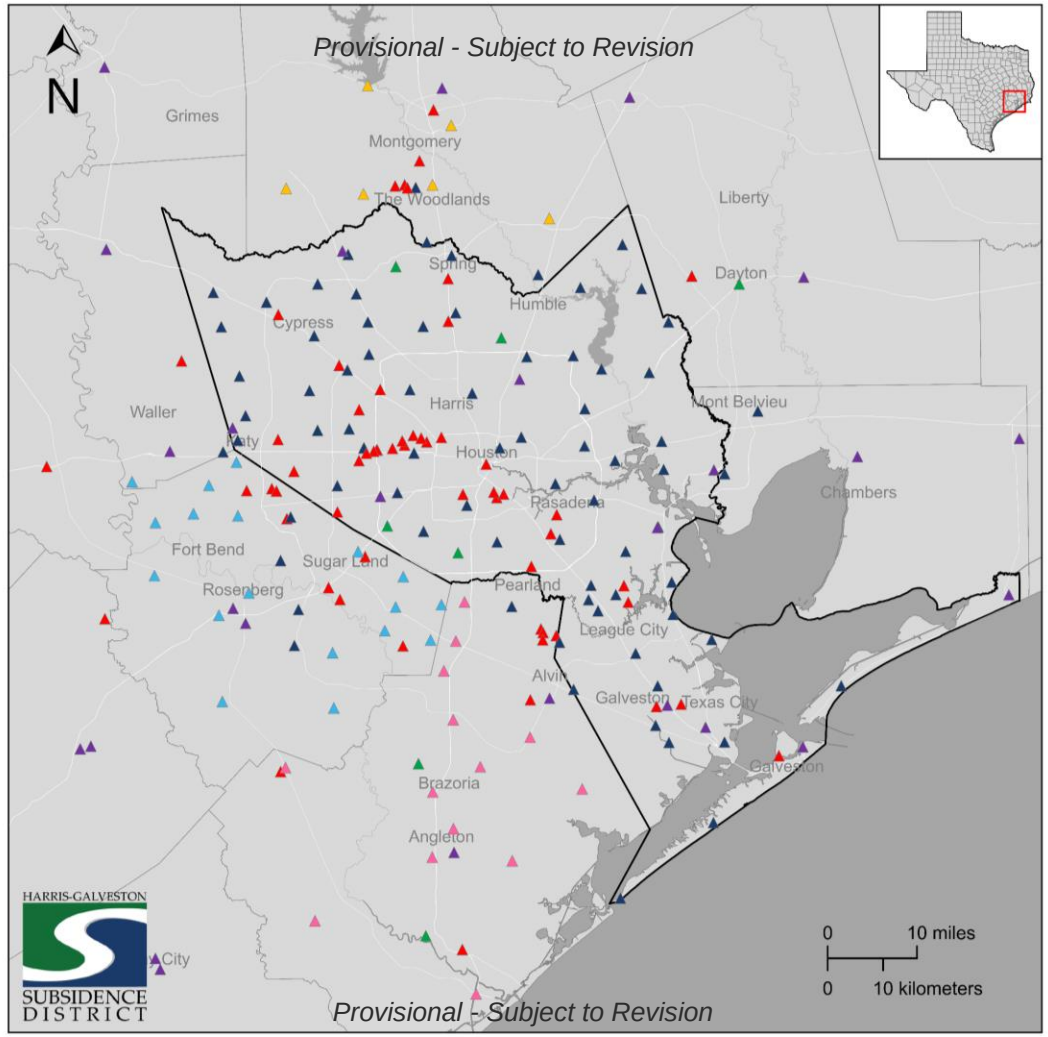


Exhibit 10 | Subsidence Monitoring Network

Location and operator of GPS stations that monitor land surface deformation periodically or continuously within southeast Texas in 2024.

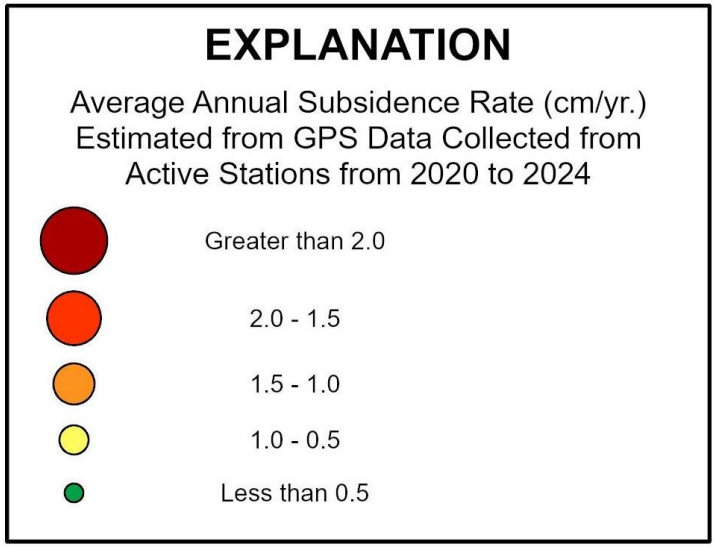


EXPLANATION

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

Exhibit 11 | Subsidence Rates from GPS Stations

Annual subsidence rate, in centimeters per year (cm/yr.), estimated from GPS data collected at active stations with three or more years of data averaged from 2020 to 2024.



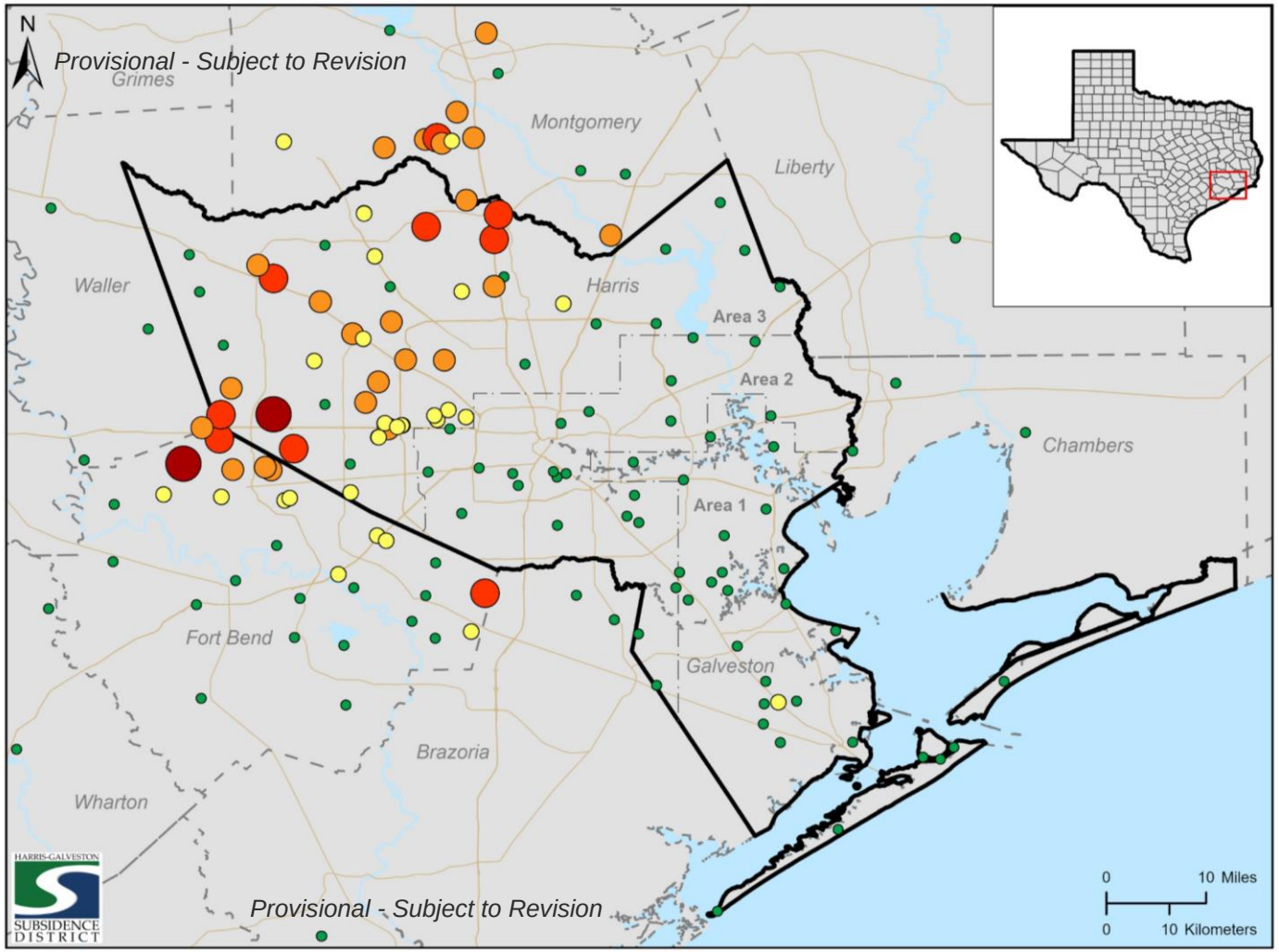
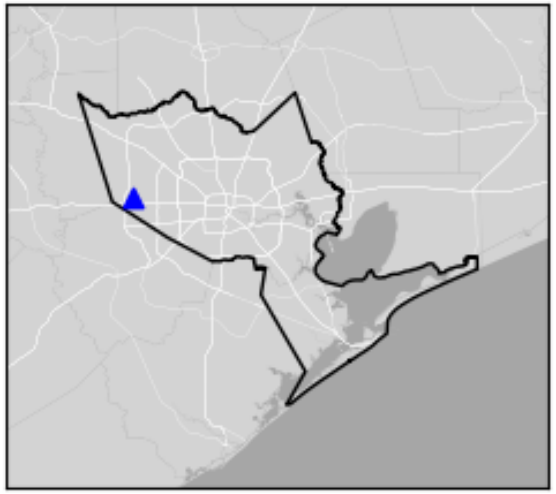
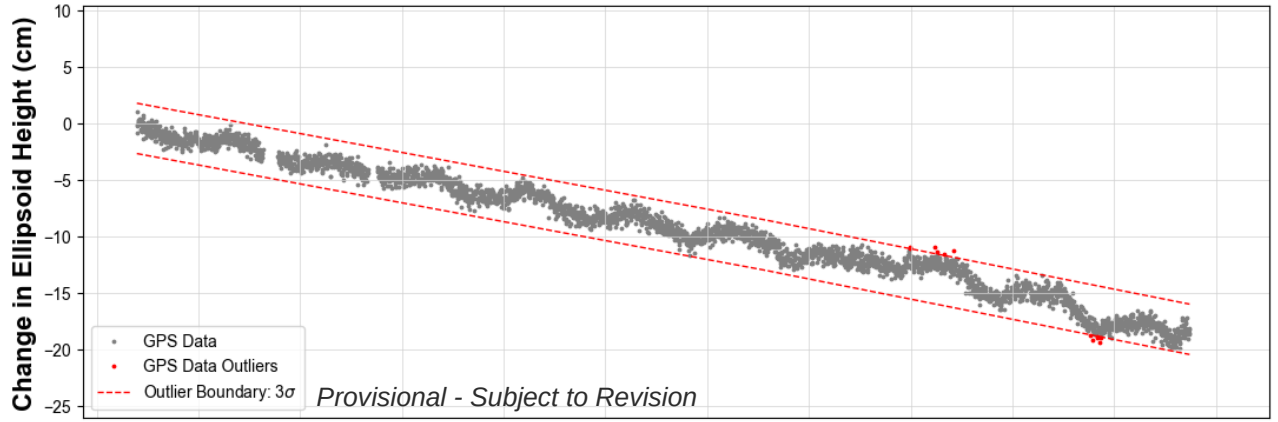


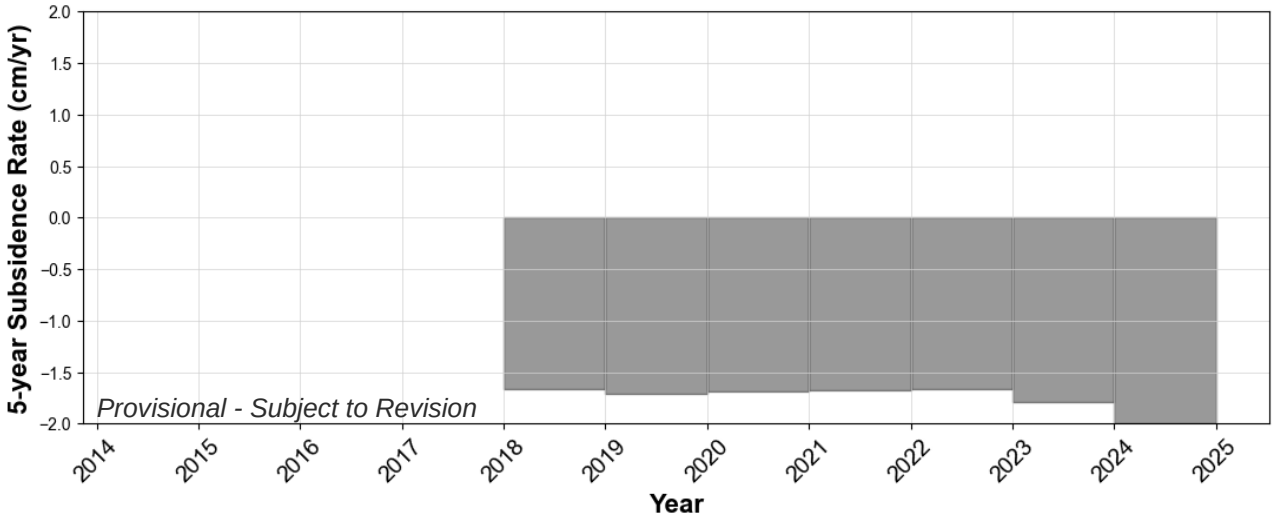
Exhibit 12 | Greatest Subsidence Rate

GPS station **MRHK**, located in Katy, has measured a total of 18.2 cm of subsidence since 2014 with an average rate of 2.07 cm/yr.



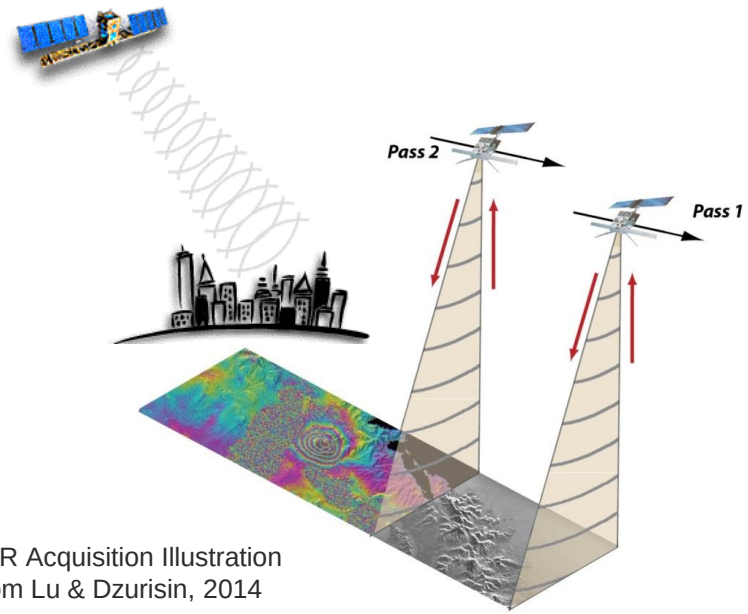
Processed GPS data (source: UH) over period of record. Processed data (grey circles) located inside the outlier boundary (red dashed lines) are used when calculating subsidence rates. Processed GPS data identified as outliers (red circles) are excluded from subsidence rate calculations and are shown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





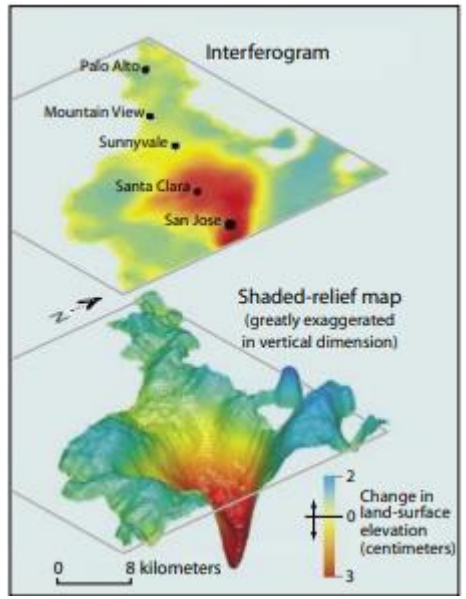
Interferometric Synthetic Aperture Radar (InSAR)

- Synthetic aperture radar (SAR) data are generated by transmitting radio waves from the sensor to the ground and back to the sensor.
- InSAR compares two SAR images of the same area at different times to detect small changes in distances between them. This processed pair of SAR images is the interferogram.
- Processing techniques can be used to achieve an accuracy of millimeters.



InSAR Acquisition Illustration
from Lu & Dzurisin, 2014

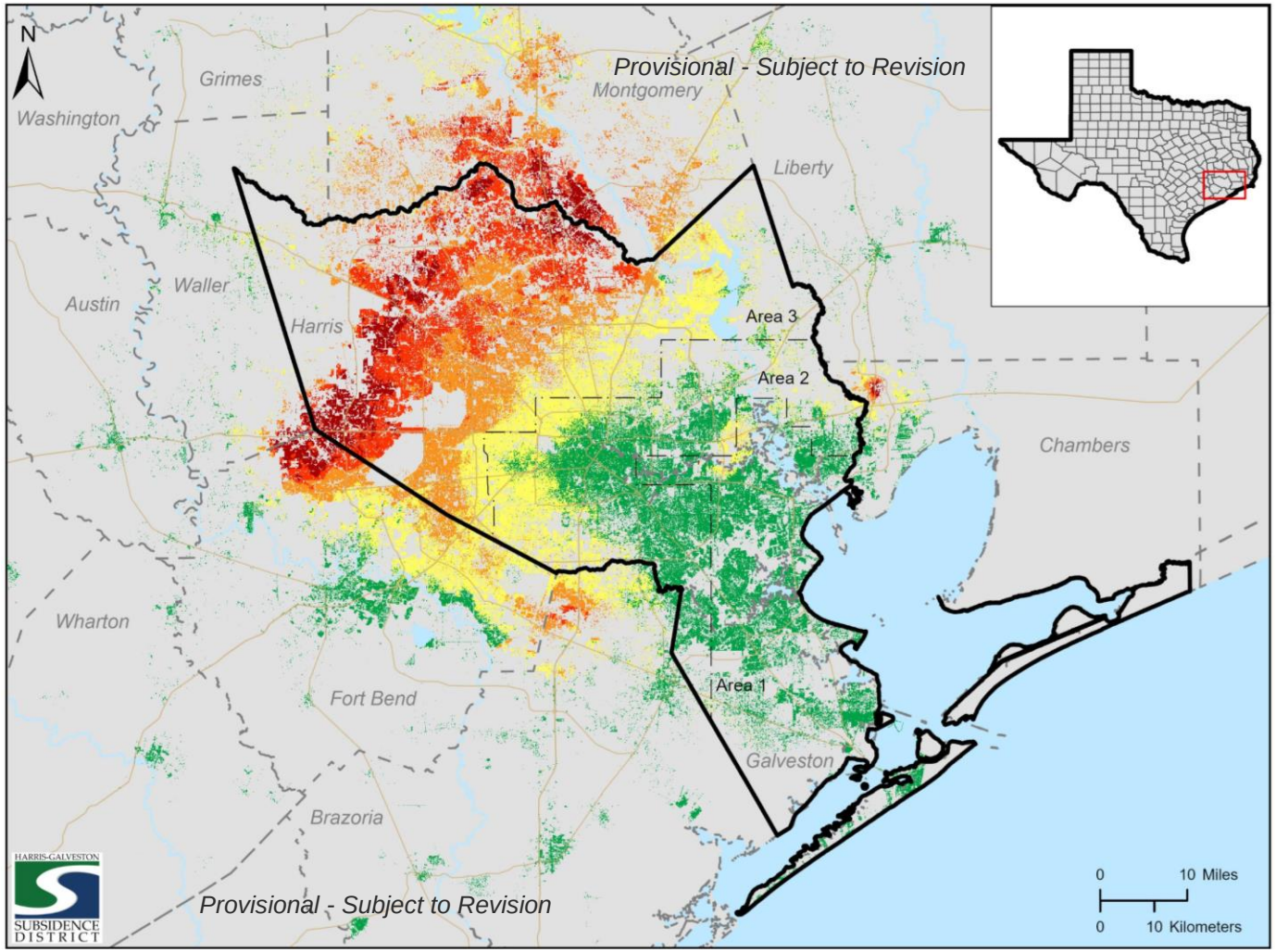
Processing



Interferogram (top) and 3-D topography (bottom)
from USGS Fact Sheet 2005-3025

Exhibit 13 | Subsidence Rates from InSAR

Annual subsidence rate, in centimeters per year (cm/yr.), estimated from Sentinel 1A derived time-series interferograms averaged from 2020 to 2024.



EXPLANATION

Sentinel-1 Derived Average Annual Subsidence Rate (cm/yr.) Processed from 2020 to 2024

- Greater than 2.0
- 2.0 - 1.5
- 1.5 - 1.0
- 1.0 - 0.5
- Less than 0.5

Gray areas show no data as the accuracy of InSAR decreases in rural areas due to tropospheric errors and seasonal vegetative growth.

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 2024 Annual Groundwater Report Public Hearing

- The record will remain open until **May 7, 2025**. You may provide comments by sending an email to **info@subsidence.org**.

- The 2024 Annual Groundwater Report will be presented to the Harris-Galveston Subsidence District Board of Directors at their next meeting on **May 14, 2025,** for approval.

- Upon Board approval, the 2024 Annual Groundwater Report will be posted on our website, **hgsubsidence.org** - located within the Science and Research section.

Scan the QR code to visit the Annual Groundwater Reports page on our website. →

HARRIS-GALVESTON SUBSIDENCE DISTRICT
1975 - 2025

Contact Information

Connect with us!

(281) 486-1105

info@subsidence.org

www.hgsubsidence.org

1660 W. Bay Area Blvd.
Friendswood, TX 77546