HARRIS-GALVESTON SUBSIDENCE DISTRICT

# Groundwater Withdrawal and Land Subsidence in Harris and Galveston Counties for the 2024 Calendar Year

## EXECUTIVE SUMMARY

by
Ashley Greuter, P.G.

Harris-Galveston Subsidence District Report 2025-01

Harris – Galveston Subsidence District
Friendswood, TX
2025

# Executive Summary

The District's mission is to regulate groundwater use in Harris and Galveston counties to prevent further subsidence. This report comprises the 49th Annual Groundwater Report for the District. Pursuant to District Resolution No. 2025-1126 passed on February 12, 2025, the Board of Directors held a public hearing at 9:00 a.m. on April 29, 2025, to present climatic conditions, groundwater use, groundwater levels and measured subsidence within the District for the 2024 calendar year. This report provides an overview of the information presented during the public hearing.

## Description of Study Area

Harris and Galveston counties withdraw groundwater from the Gulf Coast Aquifer System, which includes two primary water-bearing units: the shallow Chicot-Evangeline (undifferentiated) aquifers and the deeper Jasper aquifer. Only a small percentage of the total groundwater withdrawn within the District comes from the Jasper aquifer; consequently, most of the subsidence can be sourced to clay compaction in the Chicot-Evangeline (undifferentiated).

The District's Regulatory Plan was developed to reduce groundwater withdrawal to a level that ceases ongoing subsidence and prevents future subsidence within the District. Since 1999, the District has been separated into three regulatory areas (**Figure 1**). Utilizing a novel regulatory approach, the amount of groundwater that may be used by a permittee is dependent upon their total water demand and location within a specific regulatory area. Regulatory Area One permittees can produce groundwater for up to 10 percent of their total water demand; whereas, Regulatory Areas Two and Three permittees can produce groundwater for up to 20 percent of their total water demand unless they are in a certified groundwater reduction plan.

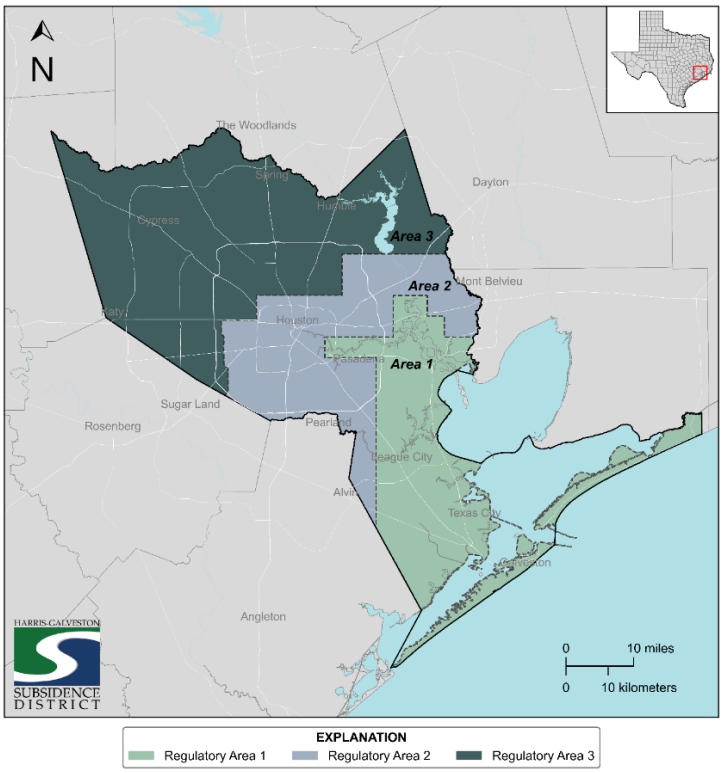


**Figure 1:** Location of the Harris-Galveston Subsidence District's Regulatory Areas.

The District's Regulatory Plan requires permittees to convert to alternative water supplies in order to reduce their reliance on groundwater sources. The primary alternative water supply is surface water sourced from three river basins: the Brazos River Basin, the San Jacinto River Basin and the Trinity River Basin.

## Climate

Annual variations in precipitation can significantly impact the amount of water used (i.e., total water demand) in the District. Groundwater use patterns fluctuate based on total rainfall received, which results in changes in aquifer water levels and, potentially, in land subsidence. During periods of excessive rainfall, total water demand can decline; conversely, during periods of drought, groundwater use can increase, resulting in declining groundwater levels. The 2024 calendar year began with above normal rainfall for all of the eight National Weather Service (NWS) climate stations analyzed for the region. The year progressed with seven stations recording above the 1991-2020 average normal precipitation and increased in summer through fall (**Figure 2**). The year ended with six stations above normal and two stations, Katy and Hobby Airport, below normal rainfall. The most cumulative rainfall was measured at Scholes Field, in Galveston, with almost 63 inches, placing it over 15.5 inches above normal. The lowest total rainfall measured in 2024 was recorded at Katy with only 26 inches, placing it almost 23 inches below normal.

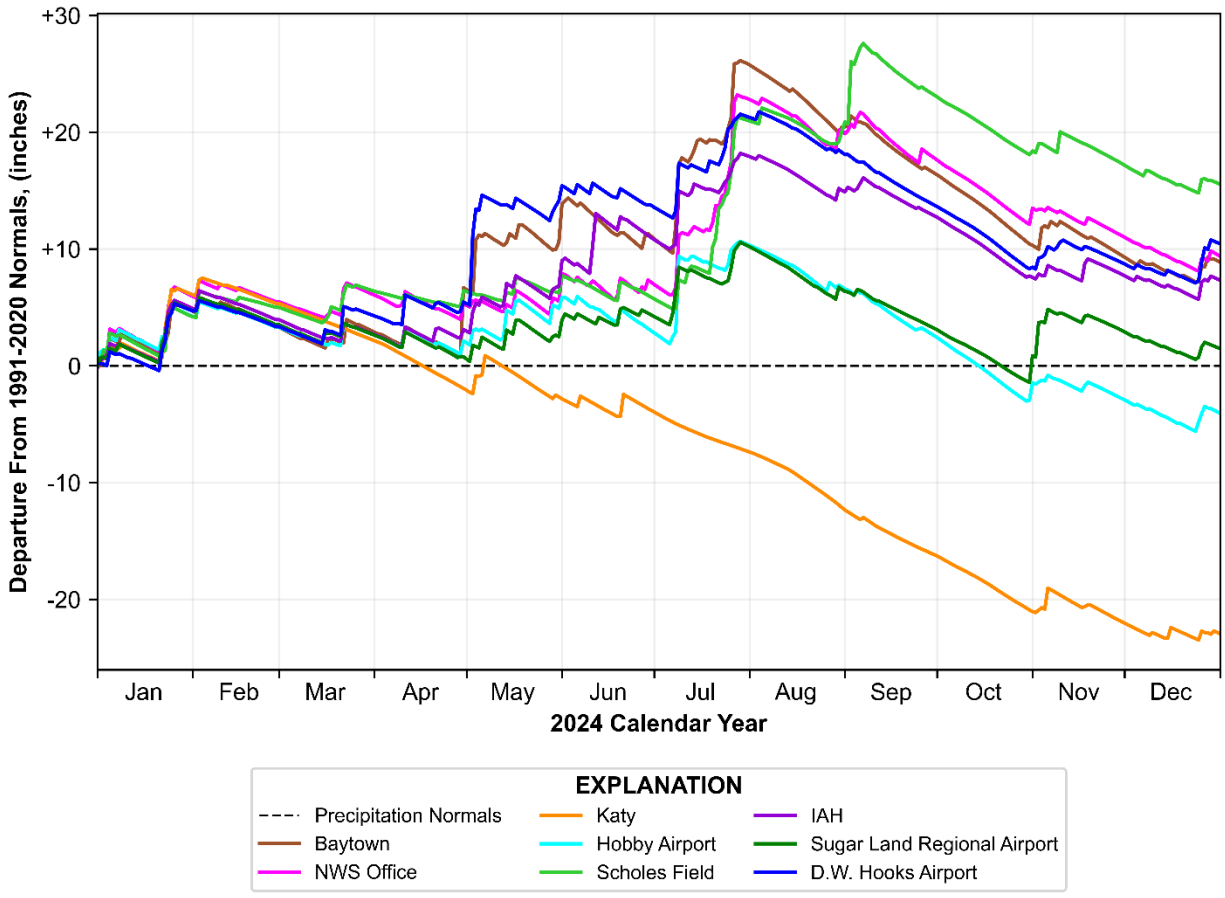


**Figure 2**: Cumulative 2024 precipitation departure from 1991-2020 normals precipitation, in inches, at select NWS climate stations within and surrounding the District. Source: https://www.ncei.noaa.gov/access.

## Water Use

Since 1976, water users in the District have been working to change their primary source of water from groundwater to alternative water as required by the District's Regulatory Plan to prevent subsidence. The percentage of total water demand sourced from groundwater has decreased from about 61 percent in 1976 to about 22 percent in 2024. The majority of groundwater use, approximately 82 percent, occurs in Regulatory Area Three, where the regulatory compliance timeline will not be completed until 2035. The three primary water uses in the District are public supply, industrial, and irrigation. The overall groundwater use within the District in 2024 is 237.6 million gallons per day (MGD), which is an eight percent decrease from 2023 (**Figure 3**). Groundwater used for public supply remains the largest use category at about 208.6 MGD, a twelve percent decrease from the previous year, and accounts for approximately 88 percent of all groundwater used in the District.

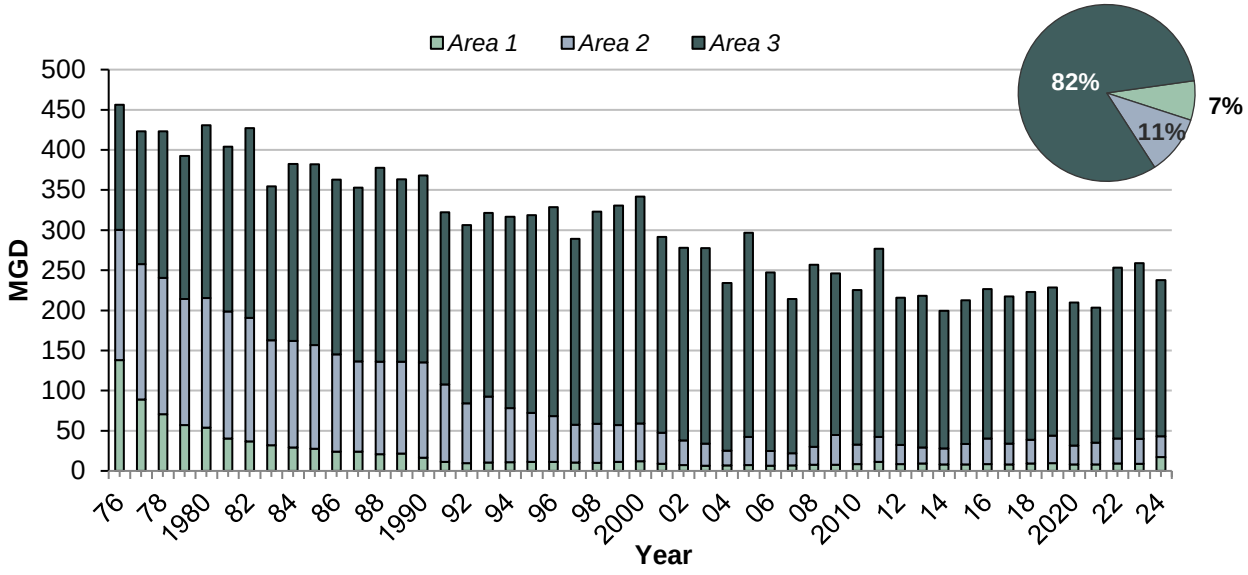


**Figure 3**: Groundwater withdrawals, in million gallons per day (MGD), by regulatory area from 1976 to 2024. The total groundwater used in the District was 237.6 MGD in 2024 with the majority used in Area Three as shown in the pie chart**.**

The District's Regulatory Plan requires permittees to convert to alternative water sources in order to reduce their reliance on groundwater. The primary alternative water supply used in the District is treated surface water sourced from three river basins: the Trinity River Basin, the San Jacinto River Basin and the Brazos River Basin. In 2024, the total alternative water used was 855.9 MGD, with the Trinity River remaining the single largest source of alternative water at 69 percent of the total and provided about 591.4 MGD in surface water supply. Groundwater remains the second largest source of water supply representing approximately 22 percent of the total water demand. The total water demand for the District was 1,093.5 MGD in 2024, which is over one percent higher than the reported water use in the previous year (**Figure 4**).

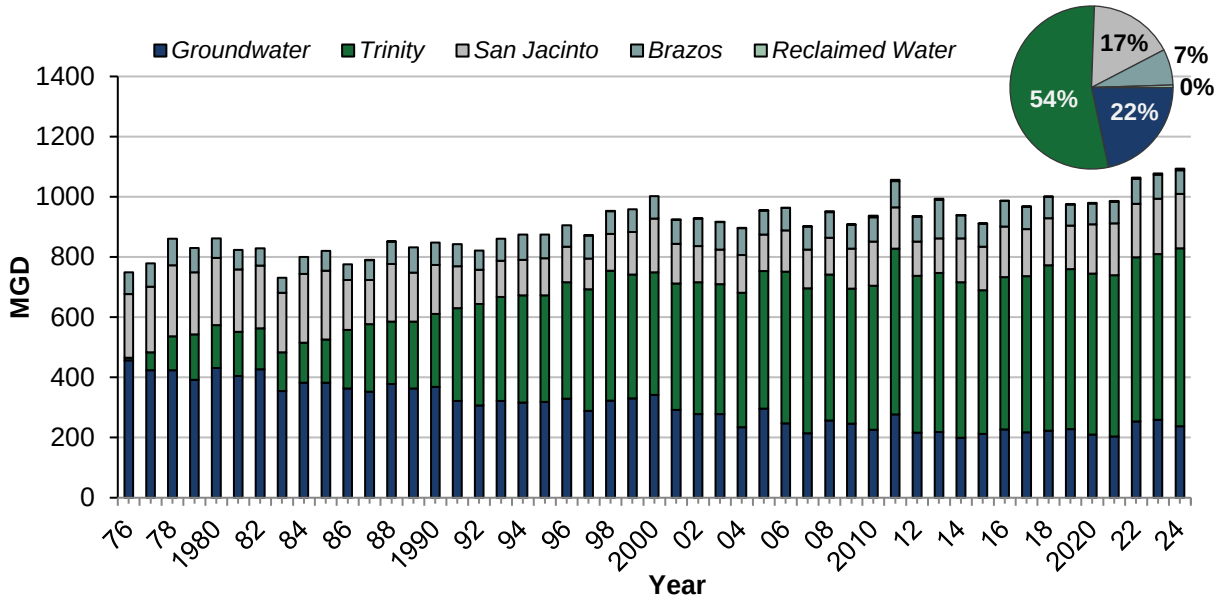


**Figure 4**: Total water use for the District, in million gallons per day (MGD), by source water, from 1976 to 2024. The reported total water used in the District in 2024 was 1,093.5 MGD with the majority sourced from the Trinity as shown in the pie chart.

## Groundwater Levels

Annually, since 1975, the United States Geological Survey (USGS) has measured the aquifer potentiometric water level (water-level) in hundreds of wells throughout southeast Texas in cooperation with the District through a joint funding agreement along with additional cities, subsidence districts and groundwater conservation districts. These data are used to monitor the water-level altitude for the Chicot/Evangeline and Jasper aquifers and evaluate the temporal change in water level. Since aquifer water-level is the best measure of the pressure in the aquifer, this information is also of vital importance to understanding how groundwater pumping may stress the aquifer and its resulting impacts on land subsidence.

The change in water-level in the Chicot-Evangeline (undifferentiated) aquifer from 1977 to 2025 highlights the impact of District regulation on the aquifer (**Figure 5**). Generally, Regulatory Areas One and Two have seen a substantial rise in the water-level of over 200 feet (60 meters) in the Chicot-Evangeline (undifferentiated) aquifer measured in areas like the Houston Ship Channel. The area of rise is a result of the reduction of groundwater use required by the District's Regulatory Plan. Conversely, in Regulatory Area Three, water-levels measured in 2024 were consistently lower than the 1977 benchmark water-levels, with some declines over 300 feet (91 meters) in the Chicot-Evangeline (undifferentiated) aquifer in northern Harris County. These areas are growing rapidly and the conversion to alternative sources of water will not be completed until 2035. The highest historical water-level declines were measured in south-central Montgomery County, with over 400 feet (122 meters) around The Woodlands.

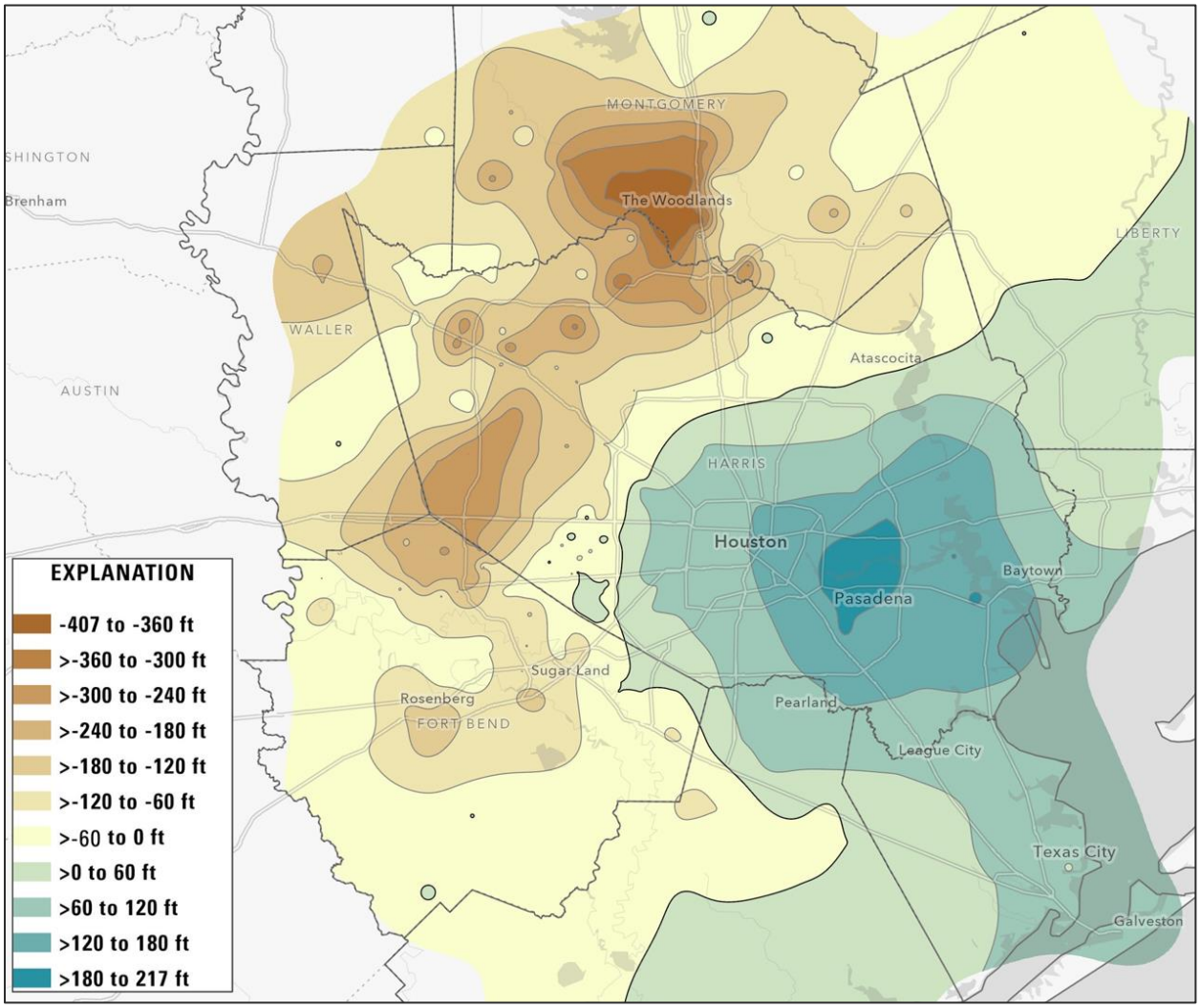


**Figure 5**: Potentiometric water level change at wells screened in the Chicot-Evangeline (undifferentiated) aquifer, Houston region, Texas, from 1977 to 2025 (Source: USGS provisional data – preliminary and subject to change).

## Subsidence

Since the 1990s, the District has developed a subsidence monitoring network utilizing global positioning system (GPS) technology to monitor land surface deformation within and surrounding the District. This network involves collaboration amongst GPS station operators such as the Fort Bend Subsidence District, the University of Houston, the Lone Star Groundwater Conservation District, the Brazoria County Groundwater Conservation District, Texas Department of Transportation, and other local entities. The subsidence monitoring network includes over 190 GPS stations throughout southeast Texas that collected data in 2024.

The District estimates the average annual subsidence rate as the linear regression of the change in ellipsoidal height, which represents the vertical movement in the GPS data collected from the GPS stations, from the five most current years (i.e., 2020 through 2024). The subsidence rates observed in Regulatory Areas One are stable, since it has reached the full regulatory conversion level, and Chicot-Evangeline (undifferentiated) water-levels have risen (**Figure 6**). Subsidence

rates are generally above half a centimeter per year throughout Regulatory Area Three, as groundwater is still the primary water source in this area, and Chicot-Evangeline (undifferentiated) water-levels have significantly declined. The highest subsidence rate was measured at a GPS station in the Katy and Fulshear area at over three centimeters per year.

Since 2019, the District has sponsored research conducted by Southern Methodist University that utilizes a novel remote sensing methodology to evaluate land-surface changes in the Houston-Galveston region. This project involves interferometric synthetic aperture radar (InSAR) to estimate changes in the land surface from a regional scale and complements the District's subsidence monitoring network by providing data in between the GPS stations. Results from InSAR-derived subsidence rates closely resemble rates calculated from the GPS stations such that Regulatory Area One shows minimal subsidence to uplift; whereas western and northern portions of Regulatory Area Three have subsidence rates greater than one centimeter per year.

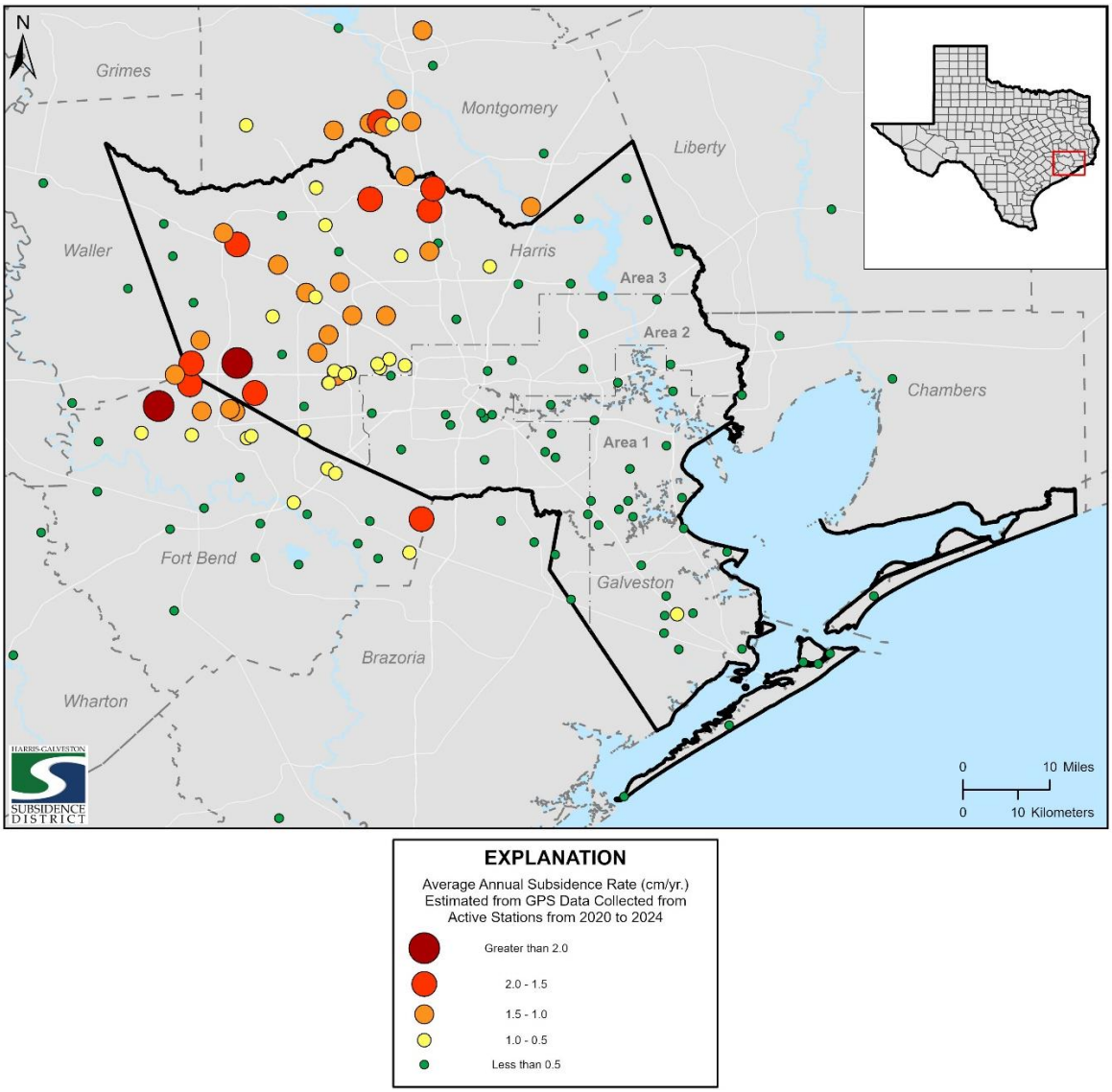


**Figure 6**: Annual subsidence rate, measured in centimeters per year, from 2020 to 2024, referenced to Houston20 and estimated from three or more years of GPS data collected from active GPS stations in Harris, Galveston, and surrounding counties, Texas.