DETERMINATION OF GROUNDWATER WITHDRAWAL AND SUBSIDENCE IN FORT BEND COUNTY – 2020

Executive Summary

by
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Fort Bend Subsidence District Report 2021-01

Fort Bend Subsidence District
Richmond, TX
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Executive Summary

Groundwater was the primary source of water for the municipal, agricultural, and industrial users over the last century. Rapid increase in population in the 1950s due to the expansion of the industrial complex in the Houston Ship Channel area led to a dramatic increase in water demand and groundwater withdrawal. The reliance on groundwater and subsequent subsidence that was caused by its regional development resulted in the creation of the Harris-Galveston Subsidence District (HGSD) in 1975 and the Fort Bend Subsidence District (District) in 1989. The District's mission is to regulate the use of groundwater in Fort Bend County, to cease ongoing and prevent future subsidence that can lead to infrastructure damage and contribute to flooding.

This report comprises the 31st Annual Groundwater Report for the District. Pursuant to District Resolution No. 2021-437 passed on February 24, 2021, the Board of Directors held a public hearing at 11:00 a.m. on April 29, 2021. This report provides an overview of the information presented during the Public Hearing, including climatic conditions, groundwater use, groundwater levels and measured subsidence within the District through December 31, 2020.

Description of Study Area

Fort Bend County withdraws groundwater from the Gulf Coast Aquifer System which includes two primary water bearing units: the shallow, hydrologically connected, system of the Chicot and Evangeline aquifers and the deeper Jasper aquifer. The regionally confining Burkeville unit separates the shallow and deeper systems. Only a small percentage of the total groundwater withdrawn within the District comes from the Jasper aquifer, consequently, most of the subsidence that has occurred in the District can be sourced to clay compaction in the shallow water bearing units.

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 2013, the District has been separated into two 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 each of the two regulatory areas. Area A permittees can produce groundwater for up to 40% of their total water demand; whereas, Area B permittees have no restrictions except that groundwater from Area B cannot be transferred to Area A.

Climate

Annual variations in precipitation can significantly impact the total water demand in the District. Groundwater use patterns fluctuate during periods of climatic variation, which results in changes in aquifer water-levels and potentially in subsidence rates. During periods of excessive rainfall, total water demand can decline; conversely, during periods of drought, water use can increase resulting in declining water-levels in the aquifer and increased rates of subsidence. The 2020 calendar year started out with normal to below normal rainfall accumulations, followed by Tropical Storm Beta that resulted in heavy rainfall across Fort Bend, Galveston, and Harris counties flooding roadways, bayous, and creeks in September. Towards the end of the year, rainfall accumulations averaged below normal. Overall, rainfall totals in 2020 were below normal for the majority of the District.

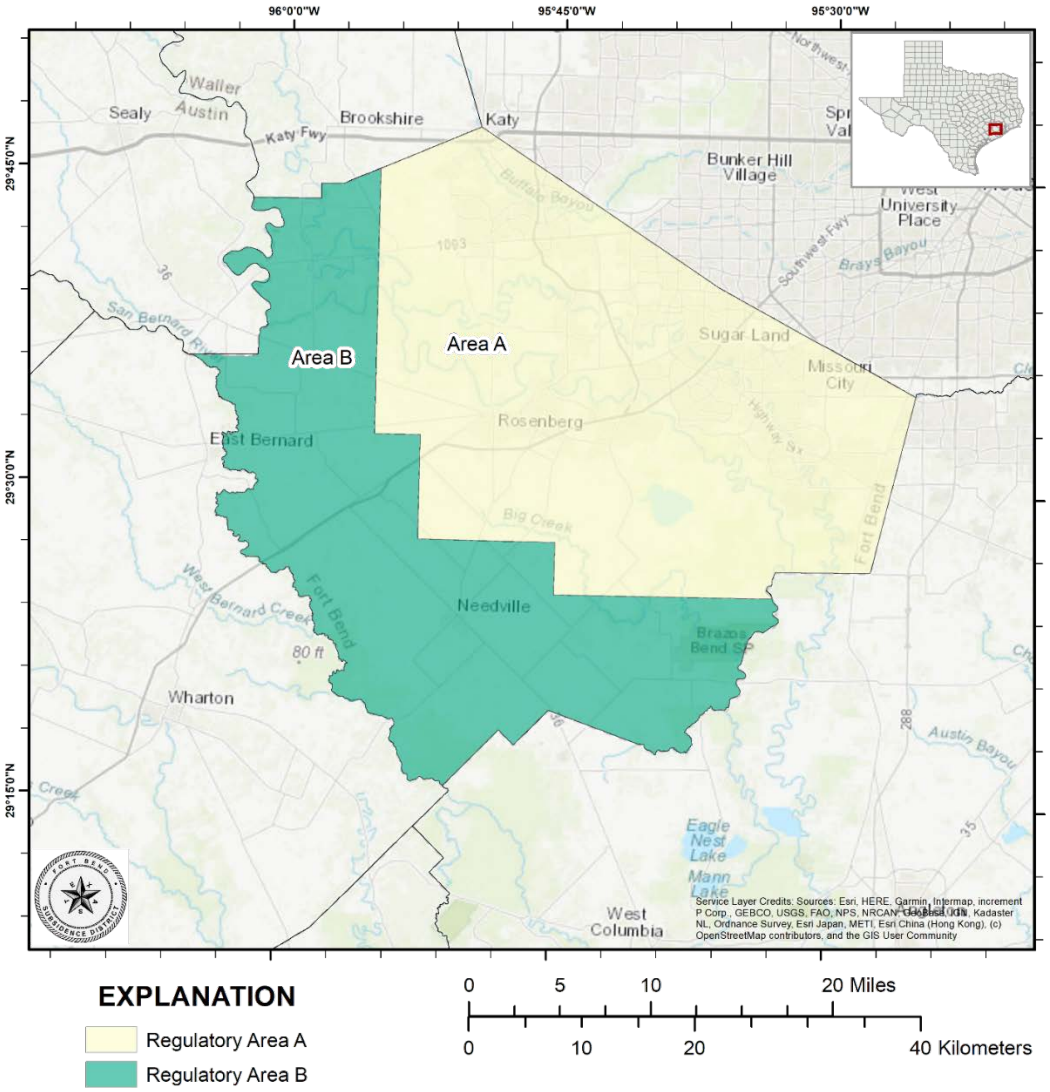

Figure 1. Location of the Fort Bend Subsidence District Regulatory Areas.

Water Use

Since 1989, water users in the District have been working to change their source water from primarily groundwater to alternative sources of water that will not contribute to subsidence, primarily treated surface water. The percent of total water demand sourced from groundwater has dropped from about 60 percent in 1990 to about 49 percent in 2020 (**Figure 2**).

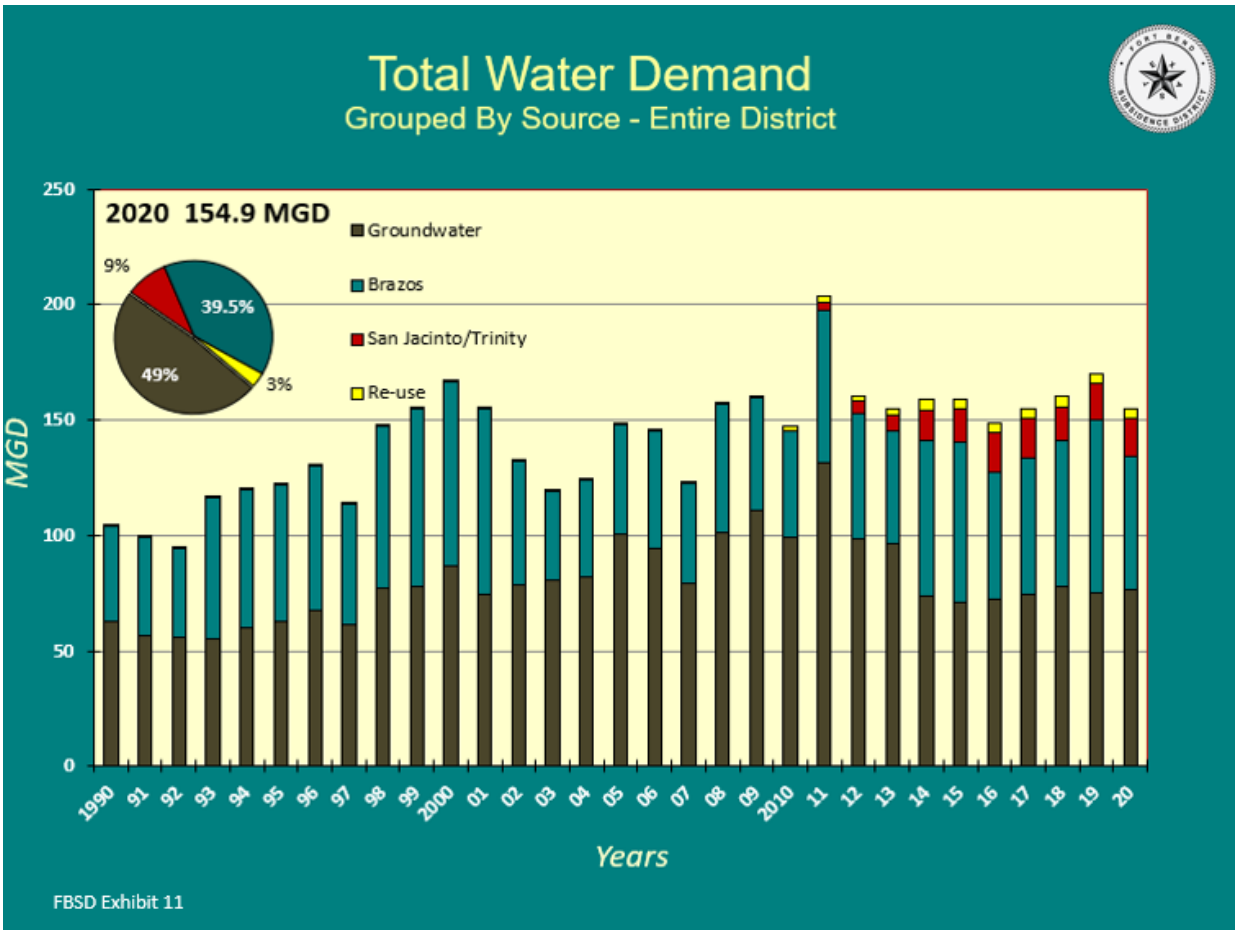

Figure 2: Total water use for District, in million gallons per day, by source water, from 1990 to 2020. The reported total water use for the District in 2020 was 154.9 MGD.

The three primary water uses in the District are public supply, industrial, and irrigation. Public supply groundwater use remains the largest single use category at 61.1 million gallons per day (MGD), a two percent increase from 2019, and accounts for 76 percent of groundwater used in the District. Since the last regulatory conversion milestone in 2014, public supply and industrial uses are generally unchanged, whereas irrigation uses have decreased by about 23 percent. The total groundwater use in the District in 2020 is 76.6 MGD (**Figure 3**).

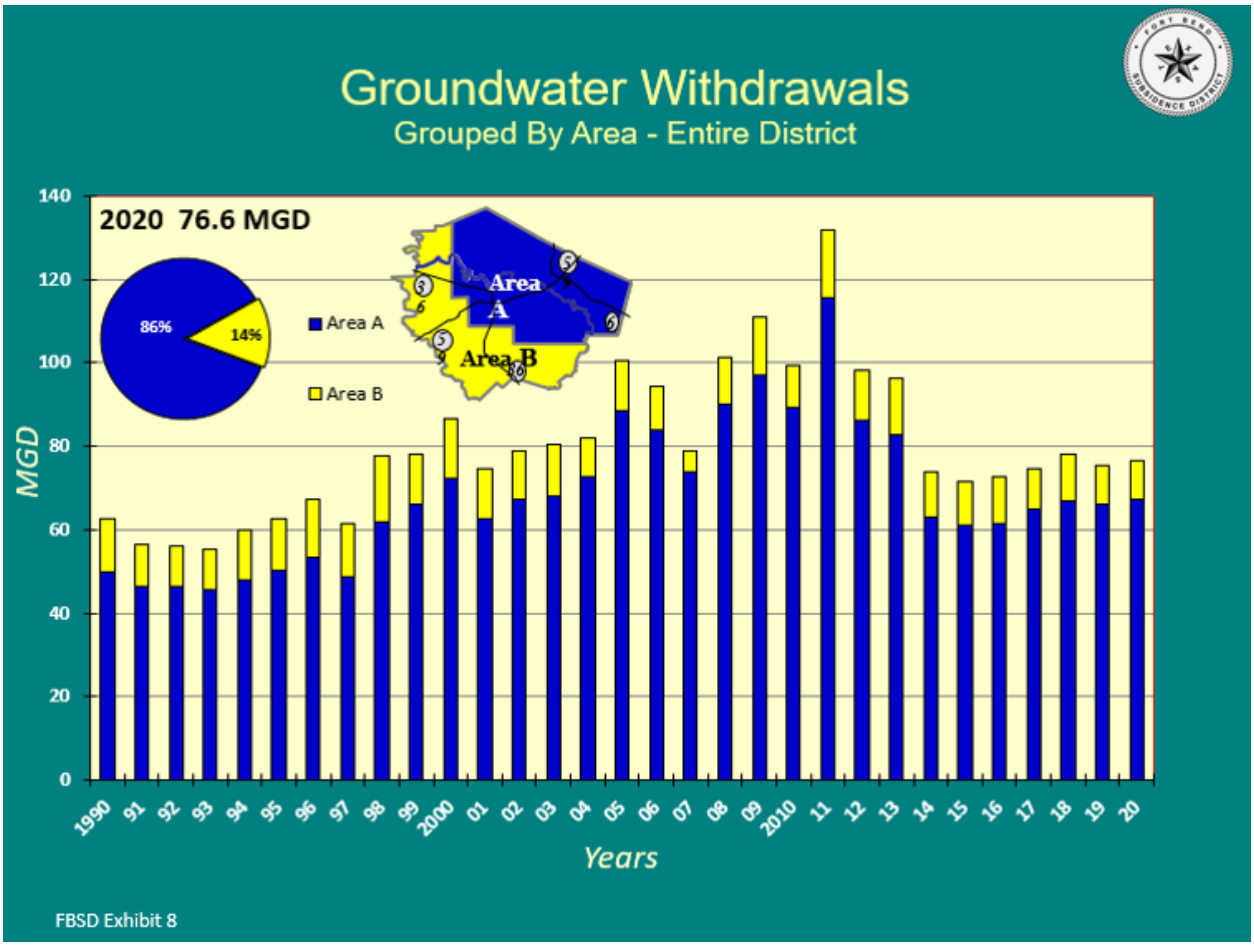

Figure 3: Groundwater withdrawals, in million gallons per day, by regulatory area from 1990 to 2020. In 2020, a total of 67.2 MGD of groundwater was used in Regulatory Area A, with 9.4 MGD used in Regulatory Area B.

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 used in our region is surface water sourced from three river basins, the Brazos River Basin, the San Jacinto River Basin and the Trinity River Basin. Total alternative water use for 2020 was 78.3 MGD, with the Brazos River remaining the single largest source of alternative water providing a total of 57.8 MGD in surface water supply. Groundwater remains the largest source of water supply within the District as a whole. The total water use for the District was determined to be 154.9 MGD in 2020, which is nine percent lower than 2019 (**Figure 2**).

Groundwater Levels

Annually, since 1990, the United States Geological Survey (USGS) has measured the water level in hundreds of wells throughout the Houston region in cooperation with the District through a joint funding agreement along with additional cities, subsidence districts and groundwater conservation districts to monitor and provide reports on groundwater level altitude data for the Chicot, Evangeline and Jasper aquifers. Since aquifer water level is the best measure of the pressure in the aquifer, this information is also of vital importance to understanding the impact of changes in water use on subsidence.

The change in water-level in the Chicot/Evangeline aquifer since 1990 shows the impact of District regulation on the aquifers (**Figure 4**). The area of rise with as much as 80 feet in the Chicot/Evangeline aquifer is a result of the reduction of groundwater use required by the District's Regulatory Plan. In northwestern Fort Bend County, water-levels continue to be significantly lower than the historical benchmark, declines of over 240 feet in the Chicot/Evangeline aquifer. These areas are growing rapidly and the conversion to alternative sources of water will not be completed in the District until 2025.

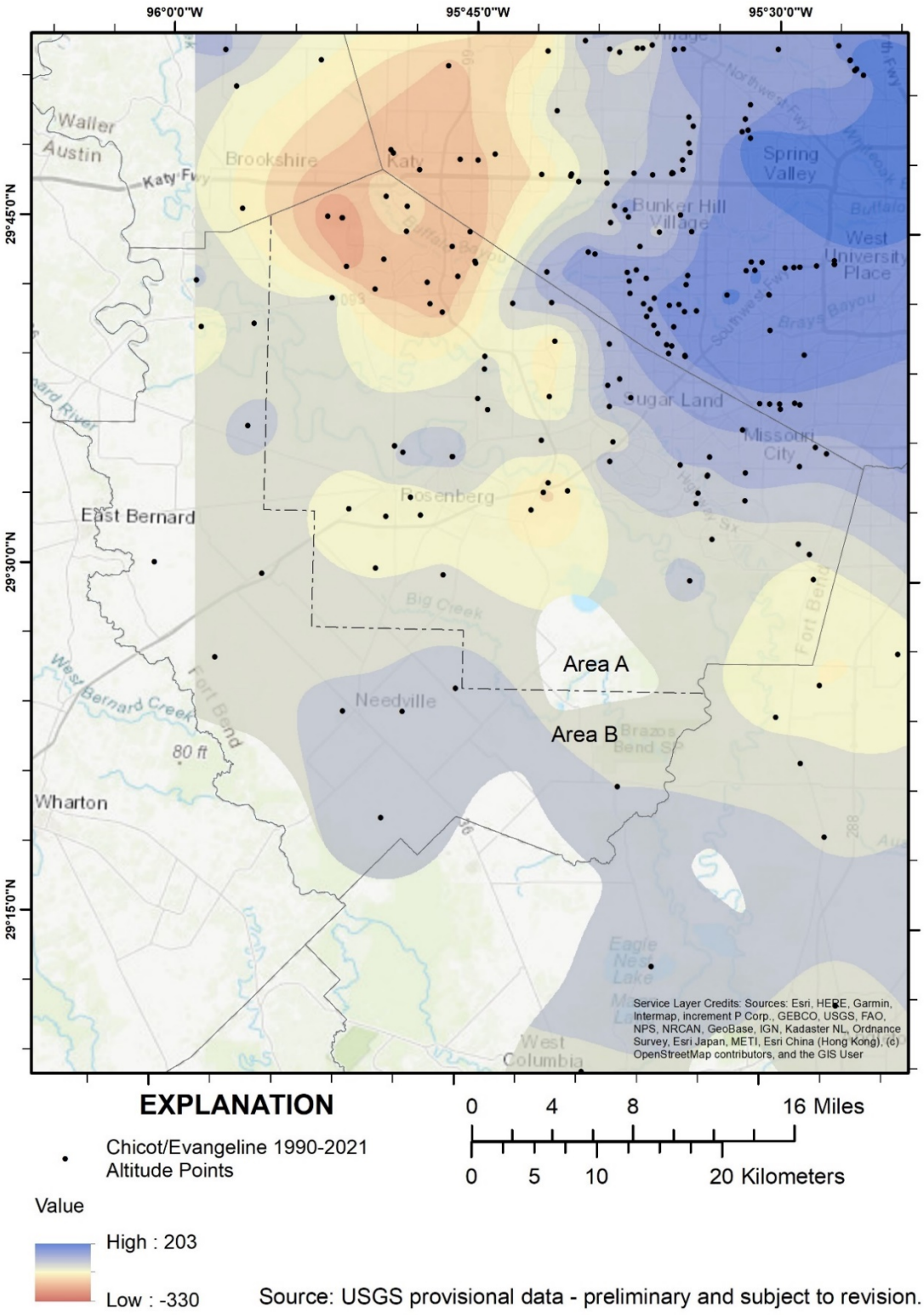

Figure 4: Potentiometric water-level change at wells screened in the Chicot/Evangeline aquifer, Fort Bend County, Texas, 1990 to 2021 (Source: USGS provisional data – preliminary and subject to change).

Subsidence

Since the late 1990s, the District has been utilizing global positioning (GPS) stations to monitor the land surface elevation in the area. Working collaboratively with the University of Houston (UH) researchers, the monitoring network has grown to over 250 GPS stations throughout the region that area operated by the District, the HGSD, the UH, the Lone Star Groundwater Conservation District (LSGCD), the Brazoria County Groundwater Conservation District (BCGCD), the City of Houston, the Texas Department of Transportation (TXDOT), and other local entities.

The average annual rate of movement is a useful measure to show the current activity at a GPS station. Subsidence rates greater than 1.0 centimeters (cm) per year were measured in northeastern Fort Bend County and are the greatest near the boundary to the Harris and Waller County line near Interstate 10. The southern portion of Regulatory A and all of Regulatory Area B show very little subsidence based on the subsidence rate averaged from 2016 to 2020 (**Figure 5**).

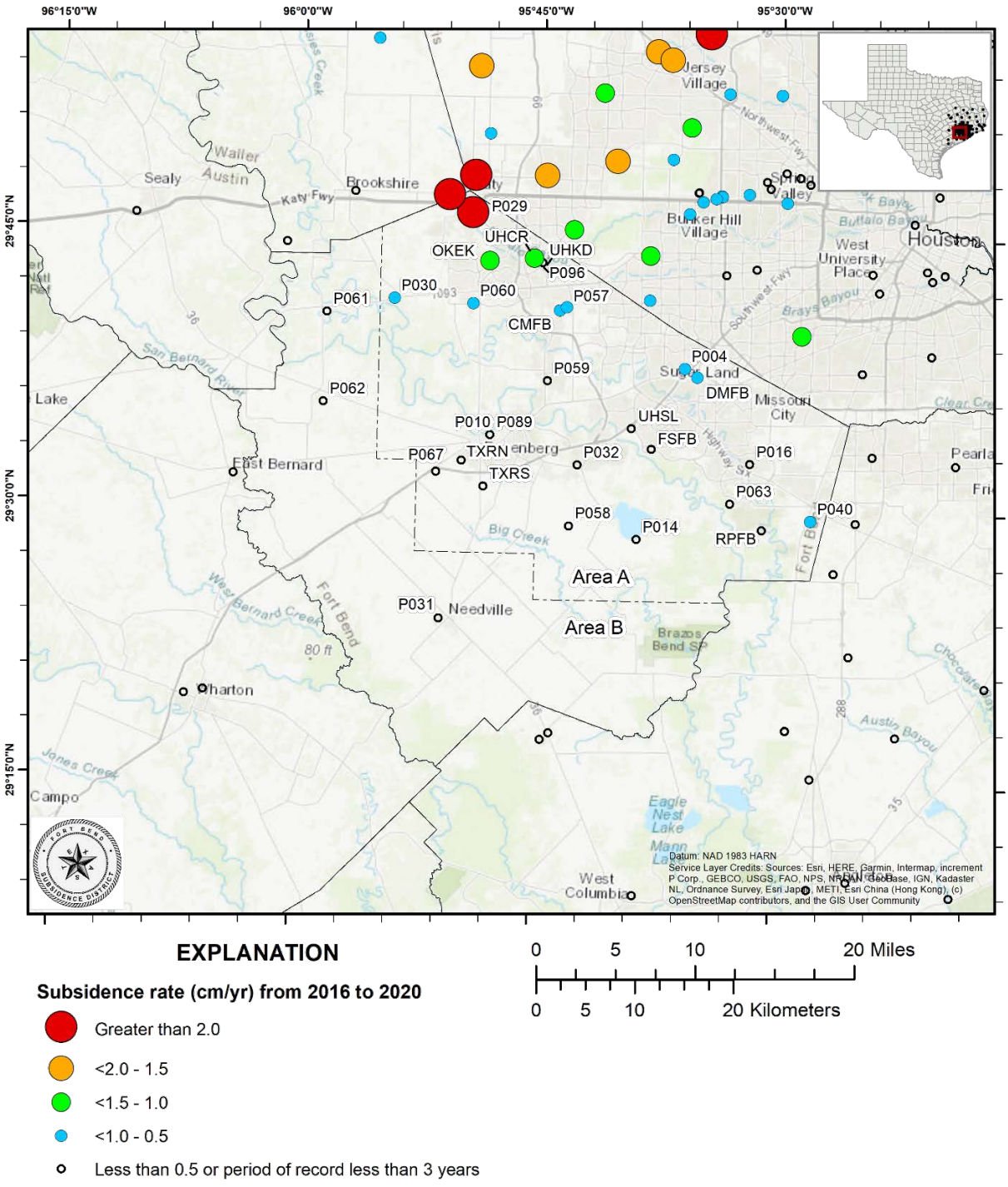

Figure 5: Annual subsidence rate, measured in centimeters per year, referenced to Houston20 and estimated from three or more years of GPS data collected from GPS stations in Fort Bend and surrounding counties, Texas, averaged from 2016 to 2020.