

### 3.0 DESCRIPTION OF STUDY AREA

#### 3.1 The Galveston Bay Estuary System

The Galveston Bay system covers about 560 square miles (1,430 square kilometers) and includes East Bay, Galveston Bay, Trinity Bay, West Bay and other smaller bays. The Trinity-San Jacinto estuary, to which Galveston Bay is sometimes referred, tends to be shallow with average depths ranging from 1.6 m in its upper bays to between 2 and 4 m in the lower reaches. Drainage areas contributing freshwater to the Galveston Bay system include the Trinity and San Jacinto River basins, the Trinity-San Jacinto coastal basin, and parts of the Neches-Trinity and San Jacinto-Brazos coastal basins.

The Trinity River basin, by far the largest of the drainage basins (17,969 square miles or 46,540 square kilometers, Stanley, 1989), empties into Trinity Bay. Lake Livingston is the largest reservoir in the Trinity River basin and is the only lake on the main stem of the Trinity between Dallas and Galveston Bay. The San Jacinto River basin has a much smaller drainage area - 3,976 square miles (10,230 square kilometers). Emptying into the Houston Ship Channel, the San Jacinto depends for its flow almost entirely upon overflow at the dam on Lake Houston, which is the principal water supply reservoir for the City of Houston.

While the San Jacinto is generally the most important source of freshwater to the lower Houston Ship Channel, the principal source of inflow to the upper channel during dry periods is wastewater discharge. This is primarily because of the small watershed of Buffalo Bayou, the lower reach of which was widened and deepened in the early part of this century to form the Ship Channel. Much of the growth and development of the Houston area is attributable to the completion of the Ship Channel in 1914, in combination with the discovery of oil in the State. The channel permitted ocean-going vessels to traverse the shallow Galveston Bay all the way to Houston, resulting in a tremendous upsurge in industrial growth in Houston.

The Galveston Bay system is integral to the economy of the State. Over 3.2 million people live in the four-county area adjacent to the bay (Harris, Galveston, Brazoria, and Chambers), with most of the population residing northwest of the bay in Harris County. Nearly one-half of the total chemical production in the U. S. takes place in the four-county area surrounding the bay. Thirty percent of the total U. S. petroleum industry is located adjacent to the bay, mostly along the upper Houston Ship Channel and in the Texas City vicinity (Stanley, 1989). Galveston Bay historically has been the overall leading fisheries resource base in Texas. In addition, the bay has supported many recreational industries such as boating, sport fishing, duck hunting, swimming, camping, picnicking and sightseeing. Two national wildlife refuges, Brazoria and Anahuac, and several State parks exist in the bay area.

### 3.2 Major Watersheds

The focus of this NPS study was on the 4,238 square mile drainage area comprised of land immediately downstream of the Lake Houston and Lake Livingston reservoirs and adjacent watersheds (Figure 3.1), all of which drain directly into Galveston Bay. Major urban watersheds within the drainage basin include the Houston Ship Channel-Buffalo Bayou system and its associated tributaries: Whiteoak Bayou, Brays Bayou, Sims Bayou, Hunting Bayou, and Greens Bayou. Significant rural watersheds include the lower Trinity River, Chocolate Bayou, and Austin/Bastrop Bayous.

### 3.3 Soils

Most of the soils in the project area are comprised of clay, clay loams, and fine sandy loams that are poorly drained and have low permeability. These soils exhibit very low infiltration rates when wetted and have a very high runoff potential. A small section of more permeable sandy loams are found in the upper part of the Trinity Basin in Polk County.

### 3.4 Hydrology

The climate of the Houston area, including Galveston Bay, is characterized by short mild winters, long hot summers, high relative humidity, and prevailing southeasterly winds. The mean annual Houston temperature (1941-70) is 68.9°F (20.5°C); the lowest temperature recorded was 5°F (-15°C) in 1930; and the maximum recorded was 108°F (42°C) in 1909.

The average annual rainfall for Houston is approximately 48 inches/year, which is distributed uniformly throughout the year. The maximum annual rainfall was 72.86 inches in 1900; the minimum was 17.66 inches in 1917. The primary spatial trend for precipitation shows higher rainfalls as one heads east across the basin. Although rainfall is generally uniform throughout the year, very significant rainfall can occur over short time periods due to hurricanes and intense thunderstorm cells. For example, in 1979 more than 43 inches of rain was recorded from an unofficial rain gauge in Alvin, Texas, in a 24 hour period.

Runoff varies significantly across the basin and is usually controlled by land use and land cover. In the urbanized Brays Bayou watershed, for example, 1.4 cubic feet per second per square mile are observed compared to 0.94 cubic feet per second per square mile for the less urbanized Greens Bayou watershed. Although flooding and calculation of peak flows are important hydrologic issues, this project focused on the calculation of runoff volume to estimate non-point source loads to the bay.

### 3.5 Land Use

Generally, intense urbanization is located in and around the Ship Channel, downtown Houston and Buffalo Bayou, and residential patterns extend northward to Cypress Creek, westward and northward past Addicks-Barker Reservoir, and southward into Brays and Sims Bayous. Other large high intensity urbanized areas are located near Clear Creek and Clear Lake and further south in the Texas City area and on Galveston Island.

Land use in the non-urban portion of the study area consists of roughly equivalent fractions of open/pasture, agriculture and forest. Wetlands account for 5-15% of the total area, and water and barren areas each account for less than 1%.

The bulk of the Trinity River basin (1,099 square miles below Lake Livingston Dam) is forested and has large areas of open/pasture, agriculture and wetlands, especially near Trinity Bay. Residential and urban areas are minimal. Much of Chambers County to the east is composed of wetlands, agriculture and open/pasture. The west bay drainage area consists largely of open/pasture, wetlands and agriculture. The far western area (west of Addicks-Barker) consists of mostly agricultural and open/pasture areas.

