2.0 LAKE GRANBURY WATERSHED OVERVIEW

Water quality conditions within Lake Granbury are influenced not only by river inflows but also by water draining into the lake from the surrounding watershed. Many watershed characteristics are important in determining the quantity and quality of water entering the lake, including climate, slope, vegetation and, particularly, soils composition. Wildlife and human activities become particularly important when they exceed the natural capacity of the watershed to assimilate changes.

This chapter presents both an overview of general watershed concepts and characteristics of the Lake Granbury watershed. Many of these watershed characteristics influence bacteria levels within the water body.

2.1 GENERAL WATERSHED CONCEPTS

2.1.1 Watershed Definition

A watershed is an area of land across, through or under which water flows on its way to a single common point in a stream, river, lake or ocean. Watersheds include not only waterbodies such as streams and lakes, but also the surrounding lands that contribute water to the system during and after precipitation as runoff. Water quality and quantity can have significant effects on the function and health of a watershed. Conversely, activities in the watershed can have dramatic impacts on water quality and quantity. Watersheds can be extremely large, covering many thousands of acres and are often divided into smaller “subwatersheds” and even smaller “microwatersheds” for the purpose of study and management.

2.1.2 Watersheds and Water Quality

To effectively address water issues, it is important to examine all natural processes and human activities occurring in a watershed that may affect water quality and quantity. Water from rainfall, snowmelt and irrigation that flows over agricultural, residential, industrial and undeveloped areas can carry pollutants into lakes, rivers, streams and oceans. Additionally, water from other sources containing pollutants may be released directly into a waterbody. To better enable identification and management, potential pollutants are classified based on their origin as to either point source or nonpoint source.

Point source pollution is pollution that is discharged from a defined location such as a pipe, ditch or channel. Point source pollution is typically deposited directly into a waterway and often contributes flow across all conditions, including both drought and flood. Point source pollution discharges must have a wastewater permit from the Texas Commission on Environmental Quality’s (TCEQ) Texas Pollutant Discharge Elimination System (TPDES). These permits require specific pollutant limits for the effluent that aims to reduce the discharge’s impact on the receiving waterbody.

Nonpoint source pollution refers to pollution that comes from a source that does not have a single point of origin. As the stormwater runoff from rain events moves over the land, it can pick up both natural and human-related pollutants, depositing them into waterbodies.

Ultimately, the types and amounts of pollutants entering a waterbody will determine the quality of water it contains and whether it is suitable for use for activities such as irrigation, fishing, swimming or drinking.

2.1.3 Watershed Approach to Improve Water Quality

This Lake Granbury Watershed Protection Plan was developed using a watershed-based approach. Because watersheds are determined by the topography of the landscape rather than political boundaries, watersheds often cross municipal, county and state boundaries. By using a watershed perspective, all potential sources of pollution entering a waterbody can be identified and evaluated.

Additionally, a watershed approach allows for all stakeholders in the watershed to be involved in the process. A watershed stakeholder is anyone who lives, works or engages in recreation in the watershed. They have a direct interest in the quality of the watershed and will be affected by planned efforts to address water quality issues. Municipalities, individuals, groups and organizations within a watershed can become involved as stakeholders in initiatives to protect and improve local water quality. Stakeholder involvement is critical for selecting, designing and implementing management measures to successfully improve water quality.

2.2 LAKE GRANBURY WATERSHED INVENTORY

The Lake Granbury watershed lies within the larger Brazos River Basin, which in total drains 44,000 square miles of Texas from the New Mexico Border near Lubbock across the State to its point of discharge into the Gulf of Mexico near Freeport. Areas contributing drainage to Lake Granbury include Possum Kingdom Lake's watershed of 14,030 square miles and a drainage area below Possum Kingdom Lake of 2,138 square miles. This area below Possum Kingdom Lake is Lake Granbury's watershed considered in this WPP project and includes all or portions of Erath, Hood, Palo Pinto and Parker counties. The total capacity of Lake Granbury is 136,823 ac-ft. For the purpose of this study and given the nature of the bacteria problem to be isolated in the immediate vicinity of the lake, stakeholders chose to evaluate a two-mile radius from the lake in great detail (Figure 1).

2.2.1 Water Resources

The watershed overlies the Trinity Aquifer which is a water-bearing geologic formation. The Trinity Aquifer is classified by the Texas Water Development Board (TWDB) as a major aquifer and furnishes small to moderate amounts of groundwater to entities in 17 counties. Hood County is in the recharge zone of the aquifer where development has resulted in significant declines in the water table.

Lake Granbury plays a major role in the watershed and supplies water for approximately 75,000 people in Hood and Johnson counties. Generally, its water quality is sufficient for agricultural uses, but elevated salinities caused by brine springs in the upper portion of the Brazos River basin require advanced treatment for municipal and most industrial uses.

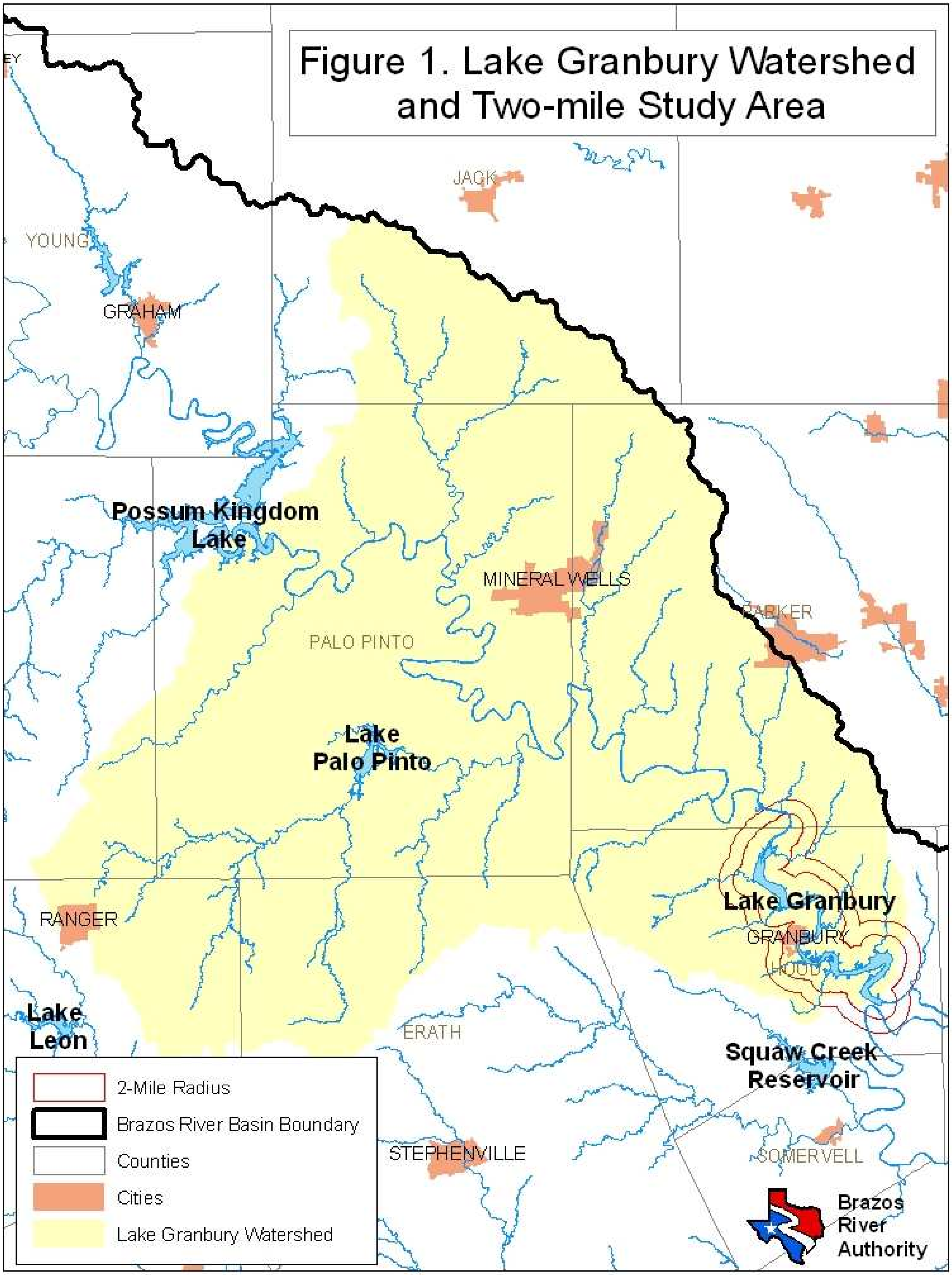

Figure 1. Lake Granbury watershed and 2-mile radius

2.2.2 Soils

Soils across the watershed are highly varied (Figure 2 and Figure 3) and tend to require significant planning or modification for the installation and proper function of traditional on-site sewage facilities (OSSFs, OWTFs or septic systems). Evaluation of soil characteristics assisted stakeholders in assessment of land use and potential bacteria sources (see subsequent chapters).

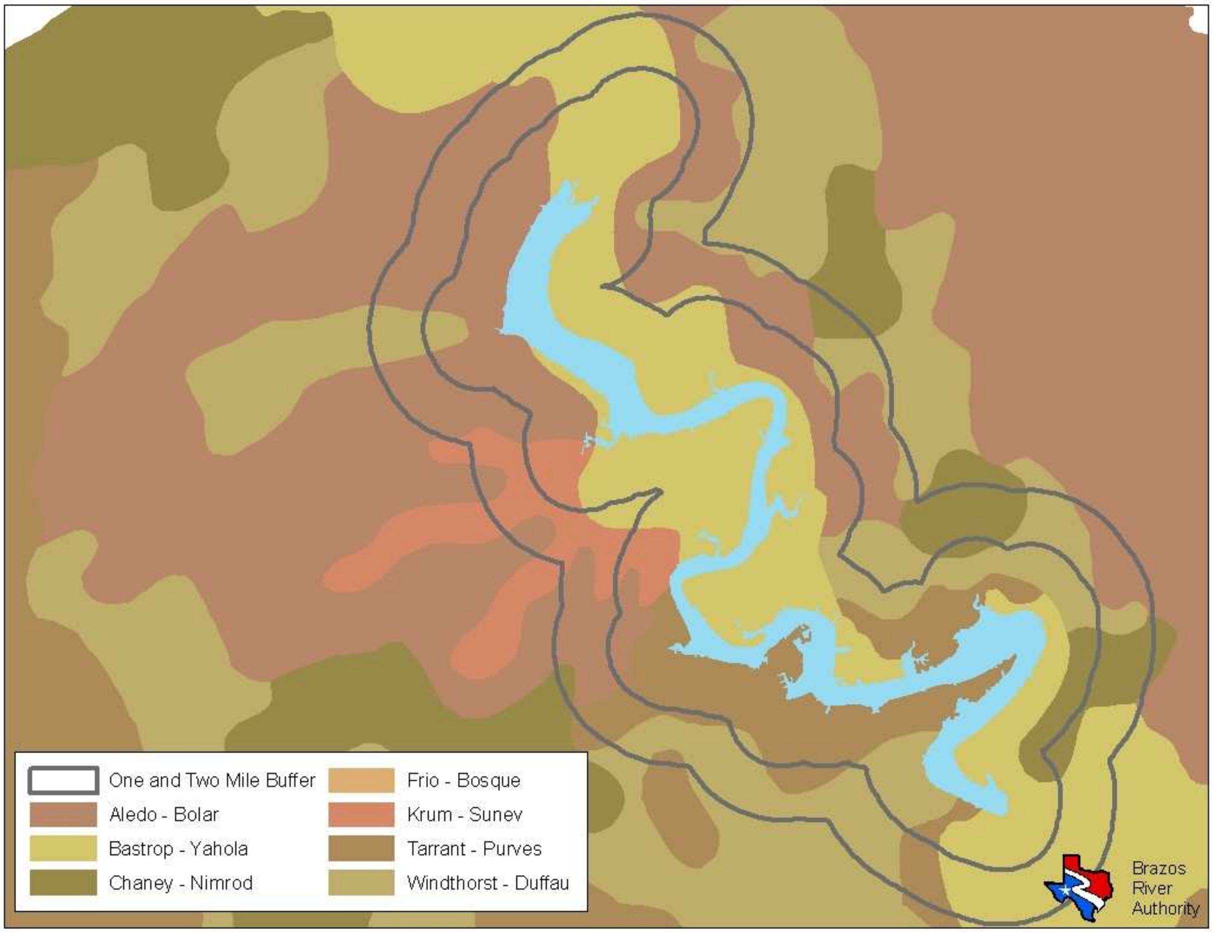

Figure 2. Major soil associations near Lake Granbury

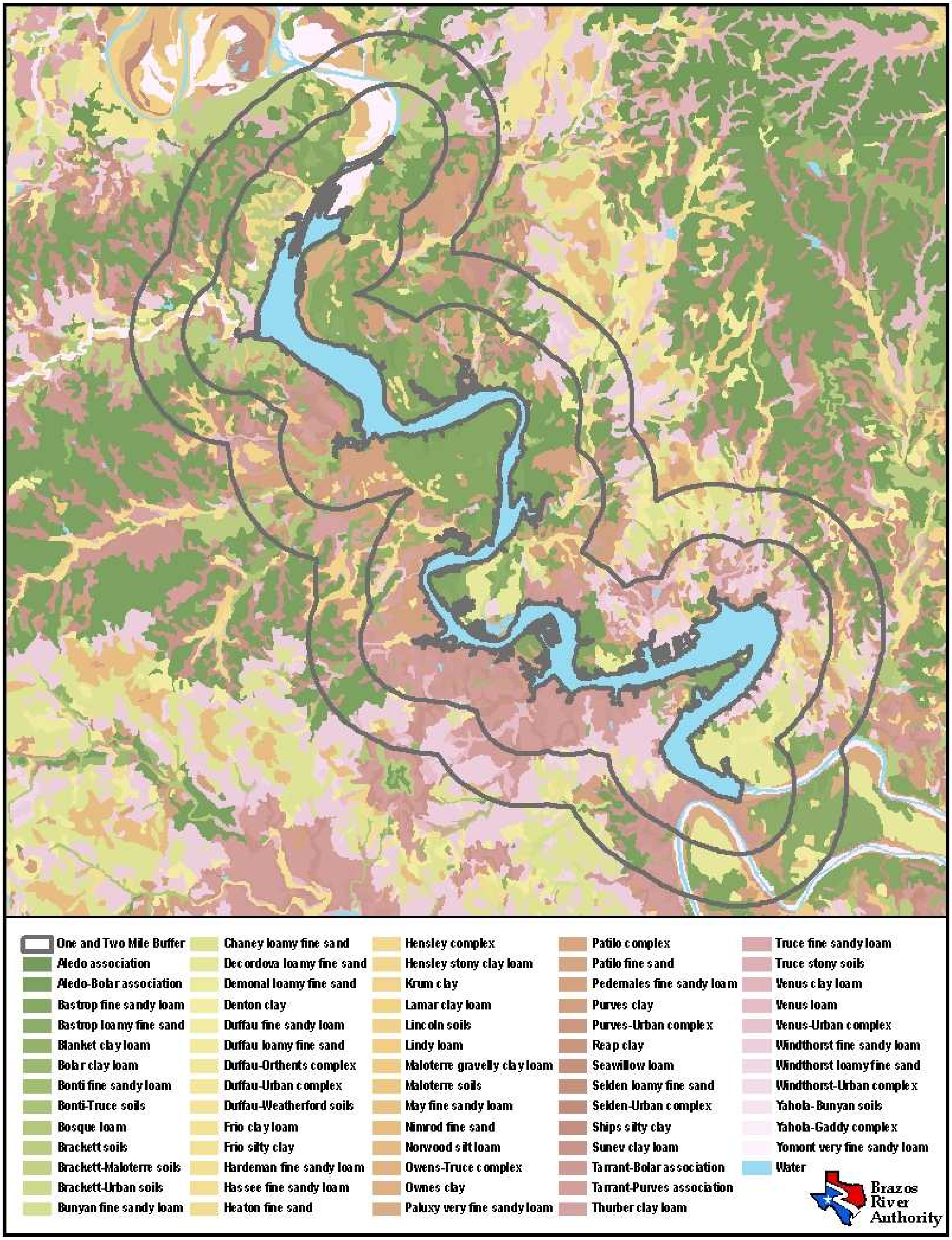

Figure 3. Hood and Parker County Individual Soil Types

2.2.3 Climate

The rainfall and temperature patterns in the watershed are typical and characteristic of the Cross Timbers ecoregion. These rainfall and temperature patterns have influence on bacteria levels in the watershed and receiving water bodies.

The amount of rainfall in the watershed varies considerably from year to year, but the average annual rainfall is approximately 34.7 inches (Table 4). In exceptionally wet years, much of the rain comes within short periods and causes excessive runoff; these events have high potential to cause overflows in sewage systems leading to migration of bacteria into water bodies. Additionally, runoff from these events flush accumulated organic material, including fecal matter, from terrestrial natural areas into water bodies. Sources of bacteria near a drainage pathway or a water body (for example feral hog rooting areas or lake-side developments with septic systems and pets) have greater potential to contribute bacteria to the water body compared to sources that are distant from drainage pathways.

Temperature changes are rapid, especially in winter and early spring when cold, dry polar air replaces warm, moist tropical air. Periods of cold weather are short and occur mostly in January; fair, mild weather is frequent. High daytime temperatures prevail for a long period in the summer when the maximum temperature reaches or exceeds 90°F daily. July is the hottest month with an average daily maximum temperature of 95°F. The high temperatures of summer are associated with fair skies, westerly winds and low humidity.

High ambient air temperatures with associated fair skies cause high water temperatures that are conducive to bacteria viability in the canals.

2.2.4 Ecology, Wildlife and Vegetation

The Lake Granbury watershed is located within the Osage Plains section of the Central Lowlands physiographic province. Topographic elevations range from about 600 to 1,600 feet above sea level for a total relief of 1,000 feet. In general, the land surface is gently rolling to semi-level. Prominent northeast sloping escarpments are formed by limestones and sandstones.

The ecology of the watershed reflects a history of negative disturbances including improper grazing procedures, soil erosion, lowered water tables in some areas, declining native grasslands and altered river ecosystems. The historic tall and mid-grass prairies have become a mesquite-short grass savanna.

Animals native to the area include white-tailed deer, beaver, bobcat, coyote, fox, skunk, raccoon, skunk, squirrel, turkey and a diverse array of small mammals and birds. In addition, feral hog populations in the area are believed to be significant and on the rise.

All rivers and streams in the Lake Granbury watershed are typical prairie stream ecosystems characterized by extreme fluctuations in water level. The native fish fauna are adapted to the variable flow regimes and extremes.

Lake Granbury supports fish species not typical of streams, including common carp, gizzard shad, warmouth, bluegill sunfish, longear sunfish, largemouth bass, white bass, spotted bass, striped bass, white crappie, flathead catfish and walleye.

The watershed, in addition to the remainder of the Cross Timbers, is important to migratory and winter waterfowl. During the migratory season, ducks and coots are distributed throughout the watershed wherever there are ponds or natural wetlands. Many species of migrating shorebirds, raptors, Neotropical songbirds and other birds stop over in the watershed to feed and rest.

At least 30 species of amphibians, reptiles and mammals are known to inhabit the watershed. Many of these species are aquatic or semi-aquatic. All toads require aquatic habitats to reproduce. A number of snakes known in the watershed are restricted to riparian habitats, including the copperhead, the western ribbon snake, the eastern coral snake and the Brazos water snake.

The golden-cheeked warbler is currently on the Federal list of endangered species and its known range includes the Lake Granbury watershed. The most significant threat to the existence of the warbler is the loss and fragmentation of habitat due to clearing of oak-juniper woodlands and brood parasitism by brown-headed cowbirds. The golden-cheeked warbler breeds exclusively in Texas, are present from early March to late August and winters from southern Mexico to Nicaragua.

The Brazos water snake is mostly aquatic, non-venomous and found only in north central Texas along the Brazos River system. Due to its limited range, it is considered to be a threatened species in the state of Texas. An adult snake can range from 16-32 inches in length. Its dorsal color ranges from brown to olive with two longitudinal rows of brown spots on each side of its body that creates the look of stripes, while the ventral surface is pink to orange with one row of dark spots on each side of the belly.

The original vegetation was tallgrass prairie in the upland areas and elm, pecan and hackberry in riparian areas, where deeper soils have developed in floodplain deposits or where the underlying clays have been exposed by limestone erosion. The invasive species Ashe juniper and, to a lesser extent, honey mesquite have increased since settlement. Cross Timbers grasses include big bluestem, yellow Indiangrass, little bluestem, hairy grama, Texas wintergrass, sideoats grama and Texas cupgrass. Present land uses include grazing on ridges with shallow soils and farming of corn, grain sorghum and wheat on the deeper soils on the flats.

Table 4. Monthly Temperature, Precipitation and Evaporation of the Lake Granbury Watershed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature Data (1971-2000)													
Mean Minimum Temperature (°F)	29.0	33.9	41.3	49.6	59.5	67.4	71.3	70.1	62.8	51.4	40.4	31.7	50.7
Mean Maximum Temperature (°F)	54.2	59.5	67.8	75.8	82.7	90.1	95.2	95.2	88.0	78.1	65.6	56.9	75.8
Mean Temperature (°F)	41.6	46.7	54.6	62.7	71.1	78.8	83.3	82.7	75.4	64.8	53.0	44.3	63.3
Precipitation (1940 – 2000)													
Minimum Total Precipitation (inches)	0.01	0.11	0.38	0.29	1.19	0.11	0.00	0.00	0.26	0.04	0.24	0.03	19.40
Maximum Total Precipitation (inches)	5.05	7.93	6.89	11.72	9.85	10.73	5.97	7.30	7.27	9.79	8.35	9.78	52.20
Mean Total Precipitation (inches)	1.79	2.40	2.50	3.53	4.50	3.47	2.13	2.29	3.01	3.34	2.44	2.26	33.65
Evaporation (1954 – 2004)													
Minimum Total Evaporation (inches)	1.03	1.36	2.66	3.03	3.49	4.39	5.78	5.46	3.47	3.05	2.14	1.47	43.49
Maximum Total Evaporation (inches)	3.66	4.47	5.75	6.19	7.08	9.58	11.41	11.42	9.26	6.56	4.92	3.53	78.64
Mean Total Evaporation (inches)	2.06	2.46	4.04	4.84	5.05	6.84	8.38	7.84	5.96	4.73	3.14	2.29	57.63

Source: Temperature – National Climatic Data Center, Ashville, North Carolina; Precipitation and Evaporation – Texas Water Development Board, Austin, TX

2.3 HISTORY OF THE LAKE GRANBURY WATERSHED

Before settlers from the East ventured onto the prairie, the area was home to the Comanches, the Lipan Apaches and Kiowas. Settlers began to arrive in the area 10 or 15 years before the Civil War. The main concern facing these early settlers was the frequent raids by the Comanches.

In a move to spur settlement after the Mexican War for Independence, numerous colonies/municipalities were chartered in the 1820s and 1830s. The area now known as Hood County had been within the municipality of San Felipe de Austin as early as 1823 and the Municipality of Viesca in 1834. Hood County was formed in November 1866 by an act of the 11th Texas Legislature. Land donated to the newly formed county by two influential land owners and its vicinity to the Brazos River led to Granbury being named the county seat.

Table 5. Population Trends for Hood County

1900	9,146
1910	10,008
1920	8,759
1930	6,779
1940	6,674
1950	5,287
1960	5,443
1970	6,368
1980	17,714
1990	28,981
2000	41,100
2010	54,900*
2014	64,200*
2030	100,000*
Sources: 1900 – 2000 (United States Bureau of the Census); *Projections from 2010 – 2030 (Hood County)	

The last three decades of the 19th century saw a steady increase in the population. When the Fort Worth and Rio Grande Railway came through Granbury in 1887, residents were able to send their produce and livestock to market leading to a boom in agriculture in the county. By 1910, farming had reached a zenith in the area. The expansion of the rail lines fueled further settlement and led to construction of many buildings. Between 1910 and 1920, farming activities began to decline in the watershed and have continued to decline through the present. Cattle production in the watershed has been somewhat variable with many periods of high production followed by extreme declines in production.

In the late 1950s, discussions began regarding the construction of a dam in the area of DeCordova Bend of the Brazos River near Granbury. Negotiations regarding the dam and its configuration continued throughout most of the early 1960s with construction commencing in December 1966. The dam was completed by early 1969 and received the formal name of DeCordova Bend Dam and Lake Granbury. The reservoir filled by June 1970. The dam is a concrete and earthen structure 2,220 feet long and 82 feet high.

Economically, the effects of the development of Lake Granbury on the City of Granbury and Hood County have been astounding. The completion of the dam transformed Hood County into a popular recreation center, retirement community and tourist center virtually overnight. Between 1970 and 1980, Hood County ranked sixth among all United States counties in the category of highest growth rate.

Table 5 presents population data for Hood County from 1900 to 2000 and population projections from 2010 to 2030. The county has experienced steady growth from 1990 to 2000 increasing by 42 percent. A 100 percent growth is projected to occur from 2010 to 2030.