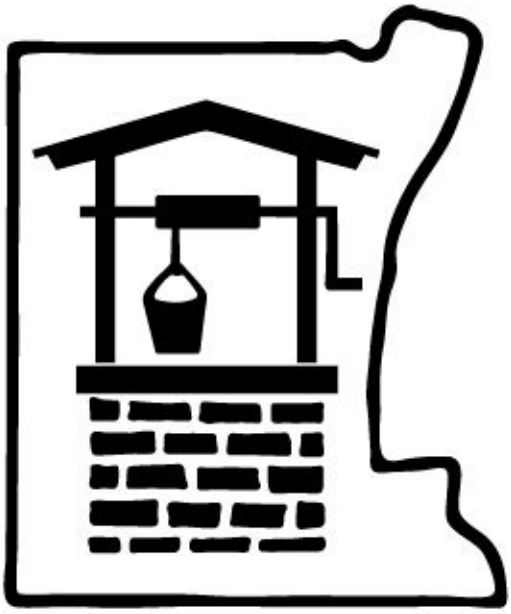
RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT

DISTRICT MANAGEMENT PLAN



ADOPTED – AUGUST 15, 2005
AMENDED – MARCH 3, 2008
AMENDED – JULY 19, 2010
AMENDED – NOVEMBER 8, 2010
AMENDED – AUGUST 31, 2015
ADOPTED & AMENDED – NOVEMBER 12, 2018

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SECTION 1. ABOUT THE RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT

1.1 District Mission

The Rusk County Groundwater Conservation District's (RCGCD) mission is to develop and implement a sound groundwater management program to protect and sustain the groundwater resources of the District.

1.2 Purpose of Management Plan

Senate Bill 1 (SB 1) enacted by the 75th Texas Legislature in 1997 requires all groundwater conservation districts to develop a management plan that defines the water needs and supplies within each district and the goals each district will use to manage the groundwater to meet the water needs of the district.

This groundwater management plan fulfills the requirements of the Texas Water Development Board (TWDB) Rules, specifically Texas Administrative Code, Chapter 356 (31 TAC §356). The plan includes the required planning elements, goals, objectives, performance standards, and tracking methods required by the TWDB.

1.3 District Creation and Background

The creation of the RCGCD was authorized in 2003 by the 78th Texas Legislature under HB 3569. The citizens of Rusk County confirmed creation of the District by an election held on June 5, 2004. This revised plan is being submitted within five years of the prior Management Plan, which was adopted on November 8, 2010, as required by Sec. 36.1072 (e) of the Texas Water Code.

The District was formed to protect the groundwater resources for the citizens of Rusk County. Beyond its enabling legislation, the District is governed primarily by the provisions of Chapter 36 of The Texas Water Code. The District has the capability and authority to undertake various studies and promote conservation; to adopt and amend, as needed, a management plan; to adopt rules; to establish a program for the registration and permitting of water wells; and to implement structural facilities and non-structural programs to achieve its statutory mandates. The District has rule-making authority to implement its policies and procedures to manage the groundwater resources.

The current members of the Board of Directors are Bobby Brown - President, David C. Powell - Vice President, John Langston - Treasurer, Roy Vannoy, William Sheehan, Ken Ragle, Harry Hamilton, Jim White, and Emily Whitworth who has been elected and replacing Bennie Whitworth at the November 2018 board meeting. The District General Manager is Amanda Maloukis.

1.4 District Location and Extent

Rusk County is located in the Piney Woods region of East Texas. The RCGCD maintains the same boundaries as Rusk County and its jurisdiction includes all the territory located within Rusk County, which encompasses approximately 924 square miles. The County is bordered by Gregg and Harrison counties to the North, Panola and Shelby counties to the East, Nacogdoches County to the South, and Cherokee and Smith counties to the West. Henderson, which is centrally located in the County, is the County seat.

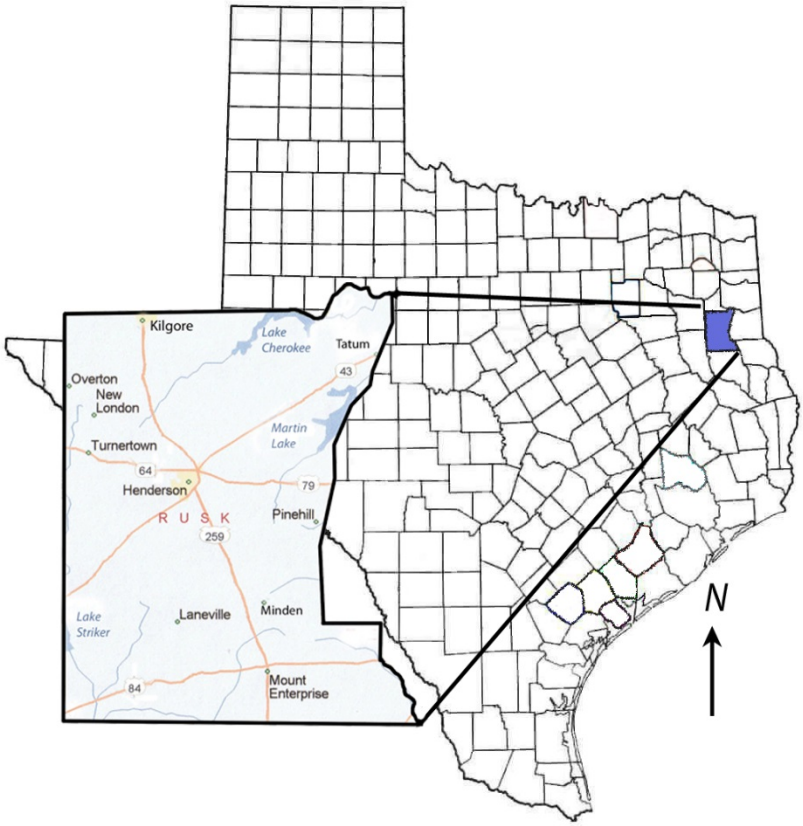

Figure 1. Rusk County Groundwater Conservation District

SECTION 2. RCGCD GEOGRAPHY AND HYDROGEOGRAPHY

2.1 District Setting and Topography

Rusk County is located within the eastern portion of the Interior Coastal Plains sub province of the Gulf Coastal Plains physiographic province (Figure 2). The sub province is comprised of alternating sequences of unconsolidated sands and clays. Erosion of the clay soils has resulted in terrain consisting of sand ridges that generally parallel the coast. In East Texas, the sub province is characterized by pine and hardwood forests and numerous permanent streams. West and northwest of Rusk County, faults associated with salt domes are characteristic of the region.

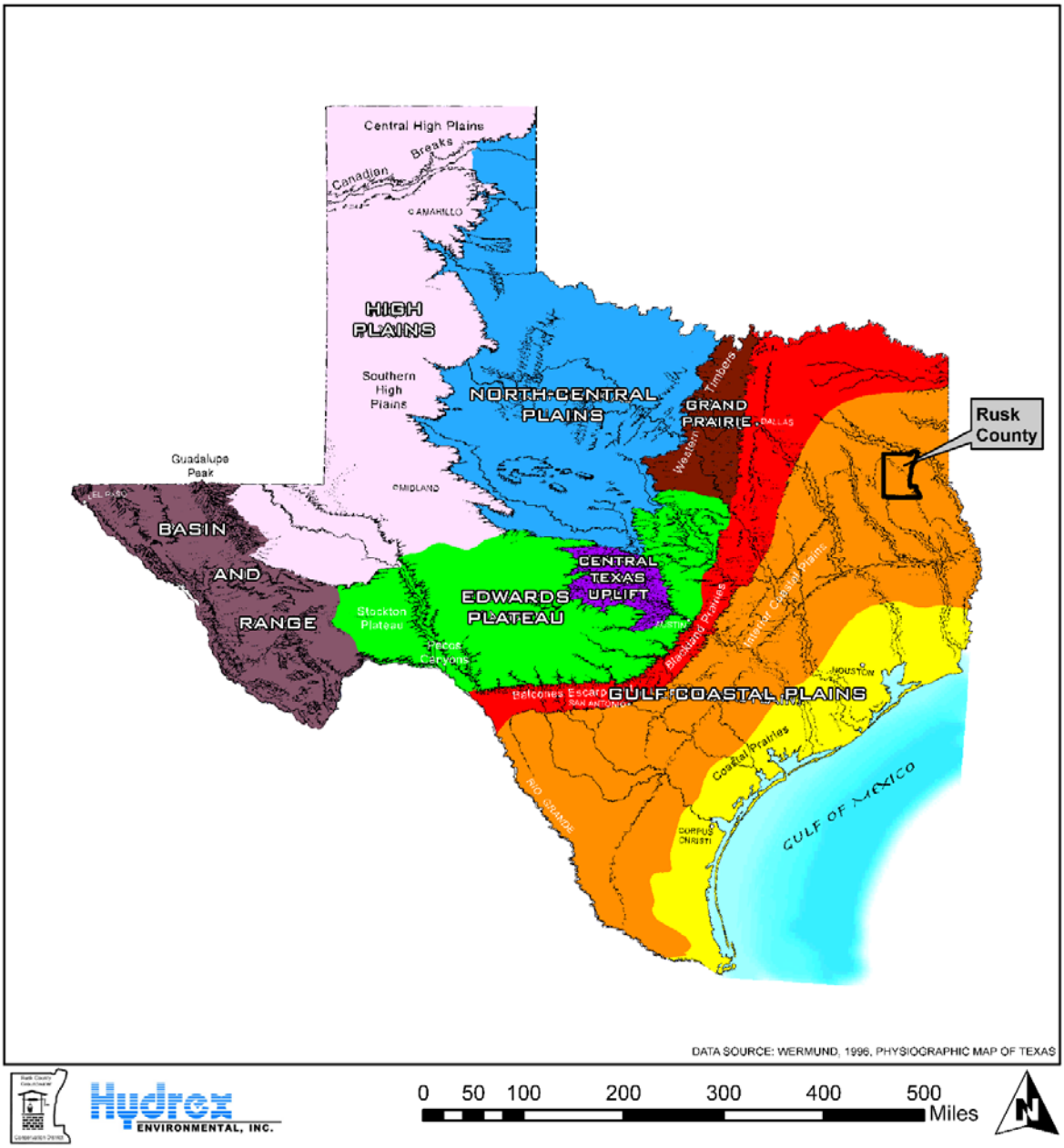

Figure 2. Physiographic Map of Texas identifying Rusk County.

Ecologically, Rusk County is situated in the South Central Plains ecoregion, which stretches across eastern Texas and into northwestern Louisiana and southwestern Arkansas (Figure 3). In eastern Texas, this ecoregion is commonly referred to as the Piney Woods. The Piney Woods region of eastern Texas is considered the western edge of the southern coniferous forest belt. Areas that were once dominated by long-leaf pine (*Pinus palustris*) savannas, are now predominantly classified more as oak-hickory-pine forest. Large areas

have been converted to plantations of loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) while some localized areas have been converted to agricultural pastureland. (Figure 3). In the northeastern portion of the county, surface mining for lignite has occurred in large areas of the Wilcox aquifer outcrop. Upon completion of mining activities, the land is reclaimed with the intent to restore pre-existing conditions, including slope and vegetation.

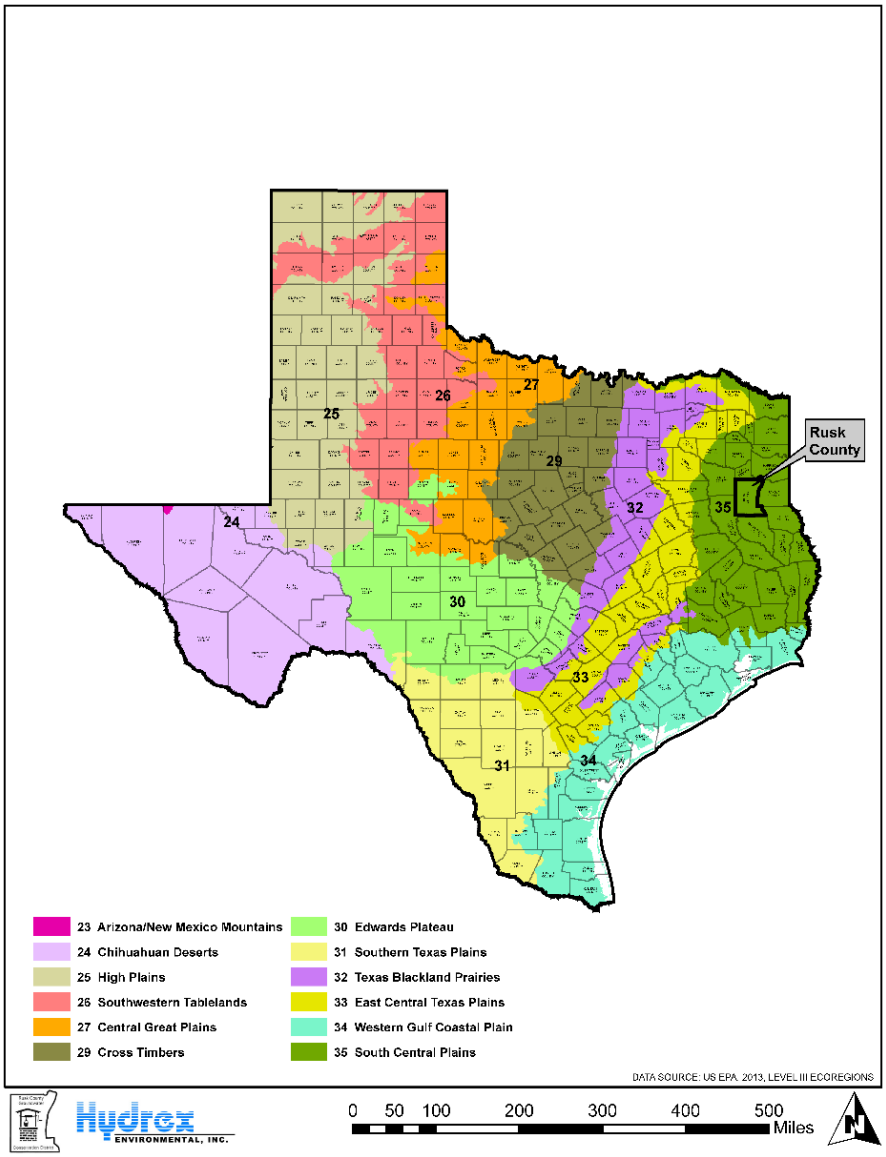

Figure 3. Ecoregions of Texas identifying Rusk County.

Topographically, Rusk County is situated atop a drainage divide that separates the Sabine River drainage basin to the northeast and the Neches River drainage basin to the southwest (Figure 4). The drainage divide generally follows a northwest-southeast trending ridge that extends through the interior of the county from just south of Overton and New London in the northwestern portion of the county to just north of Mt. Enterprise and the community

of Caledonia in the southeastern portion of the county.

Higher elevations along the ridge range from 539 feet to 623 feet, relative to mean sea level (MSL). North of the ridge, topography generally slopes downward towards the Sabine River to elevations as low as 211 feet, MSL, in the northeast corner of the county. South of the ridge, topography generally slopes downward towards the Angelina River to elevations as low as 243 feet, MSL, in the southwest corner of the county. Topography along the ridge generally represents the highest elevations in the county, with the exception of areas along the Mt. Enterprise Fault System in the southern portions of the county. Higher elevations along the Mt. Enterprise Fault System range from 575 feet to 719 feet, MSL (Figure 5).

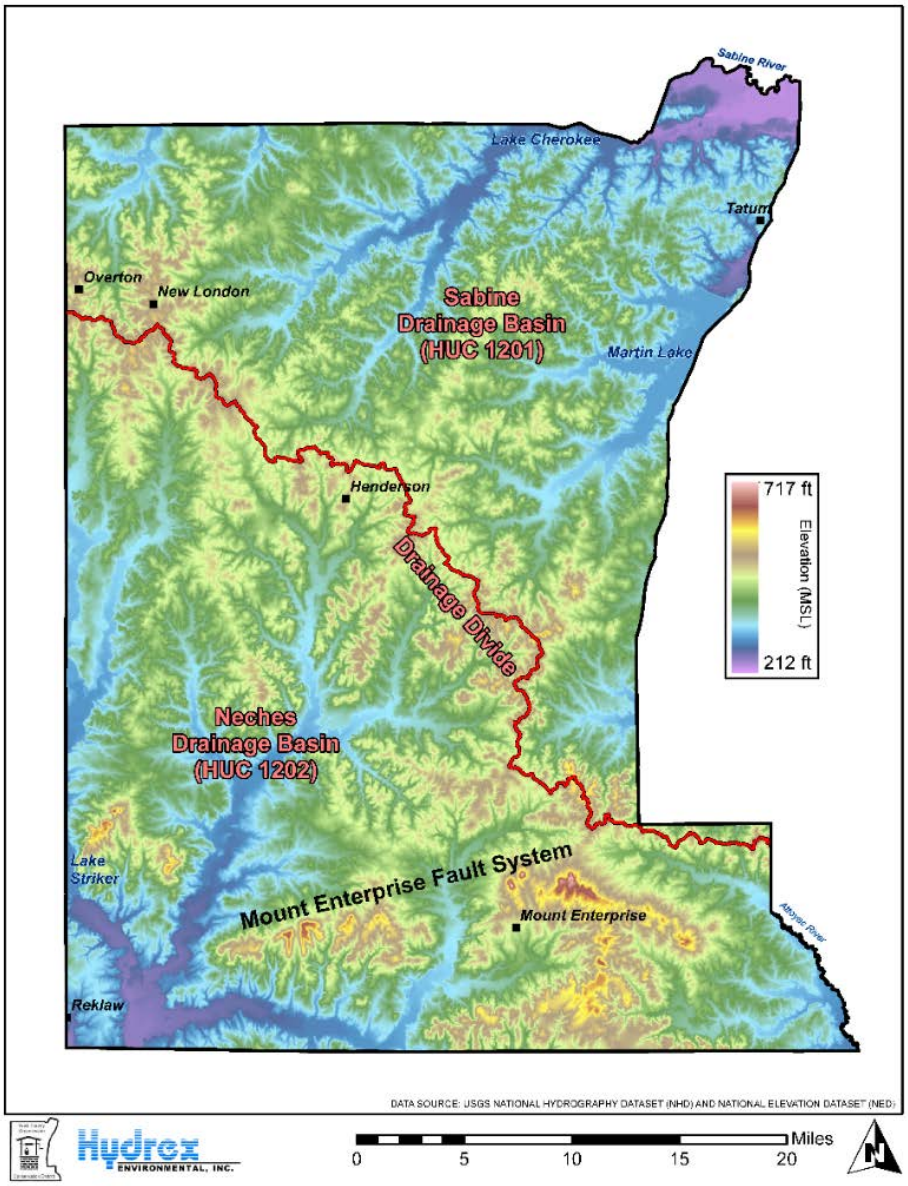

Figure 4. Topography and drainage within Rusk County.

Figure 5. USGS Topographic Map of Rusk County.

The majority of Rusk County, approximately 89 percent, is comprised of gently sloping to moderately steep rolling hills. Soil types throughout this land are predominantly well drained with moderate permeability. Approximately 11 percent of the county is located on nearly level flood plains with moderately slow permeable soils (Figure 6).

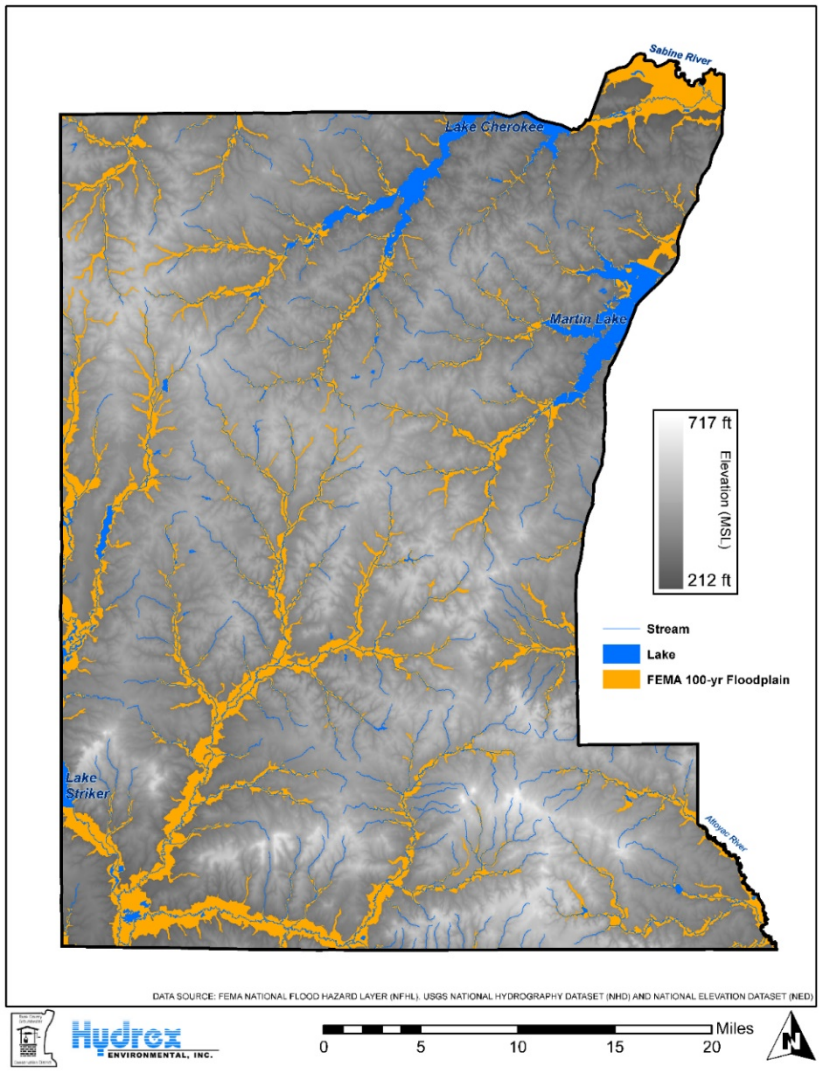

Figure 6. Digital elevation model showing FEMA 100-year floodplains within Rusk County.

2.2 Geology and Hydrogeology of Rusk County

Rusk County lies between the Sabine Uplift on the east and the East Texas Basin on the west (Figure 7). These two prominent structural features resulted from faulting that began in the Triassic Period (200 to 250 million years ago). The axis of the East Texas Basin trends north to south generally along the western boundary of Smith County. The Sabine Uplift, which centers in Panola County, Texas and northwestern Louisiana, forms the eastern boundary of the basin. The development of the two complementary structural features (basin and uplift) contributed to the setting for some of the largest petroleum reservoirs in the world: the East Texas Oil Field and the Carthage Gas Field (Figure 7).

The Mt. Enterprise Fault System trends east-west across the southern part of Rusk County (Figure 7). Movement along the fault system has been variable. Some areas show a maximum vertical displacement of over 200 feet, with beds of the Queen City Sand downdropped against the Carrizo Sand. Strata in northern and central Rusk County show a general dip away from the Sabine Uplift. In the southern part of the county, the gradient increases and becomes more variable in close proximity to the Mt. Enterprise Fault System.

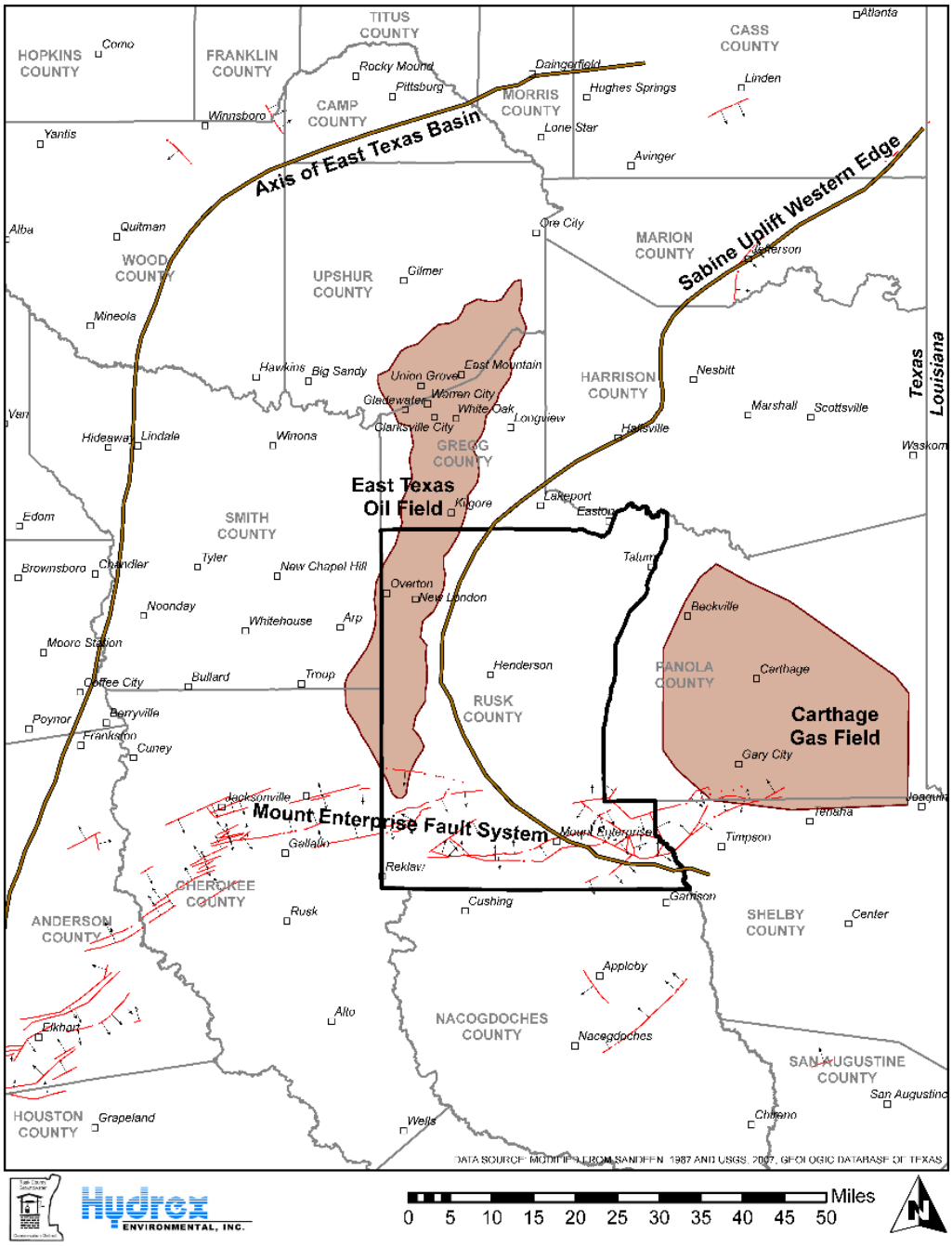

Figure 7. Structural Setting of Rusk County, Texas.

The geology of Rusk County, as it relates to fresh groundwater, is comprised of alternating sequences of continental, deltaic, and marine sediments that are predominantly of Eocene (33.9 to 56 million years ago) to Paleocene (56 to 66 million years ago) age (Figure 8). Continental and deltaic units, composed of quartz sand with varying amounts of silt and clay, contain the fresh groundwater in the area and form the major conduits for its movement. Marine portions of the section, consisting largely of clay or shale with lesser silt and glauconitic sandstone, form the intervening aquitards that restrict the movement of groundwater.

The deepest fresh water aquifer in Rusk County is the Carrizo-Wilcox aquifer, composed of the Wilcox Group and the immediately overlying Carrizo Sand. Excellent aquifer characteristics have made the Carrizo-Wilcox the most productive aquifer in East Texas. Recharge through its outcrop areas in Rusk County contributes significantly to the availability of Carrizo-Wilcox groundwater throughout much of the region.

The Wilcox is underlain by the Midway Group, a predominantly marine and lagoonal shale. No significant fresh groundwater is known to exist in the Midway or deeper strata; therefore, the top of the Midway marks the base of fresh groundwater in Rusk County.

The Midway Group is overlain successively by the Wilcox Group, Carrizo Sand, Reklaw Formation, Queen City Sand, Weches Formation, and Sparta Sand (Figure 9). The Reklaw and Weches have extremely poor water-bearing qualities and are insignificant as aquifers in Rusk County. Sparta and Queen City sediments are preserved on downdropped blocks of the Mt. Enterprise Fault System and on higher elevations in northern Rusk County. However, the limited areal extent of the Sparta and Queen City restricts their use as a water supply to low-yield, shallow wells.

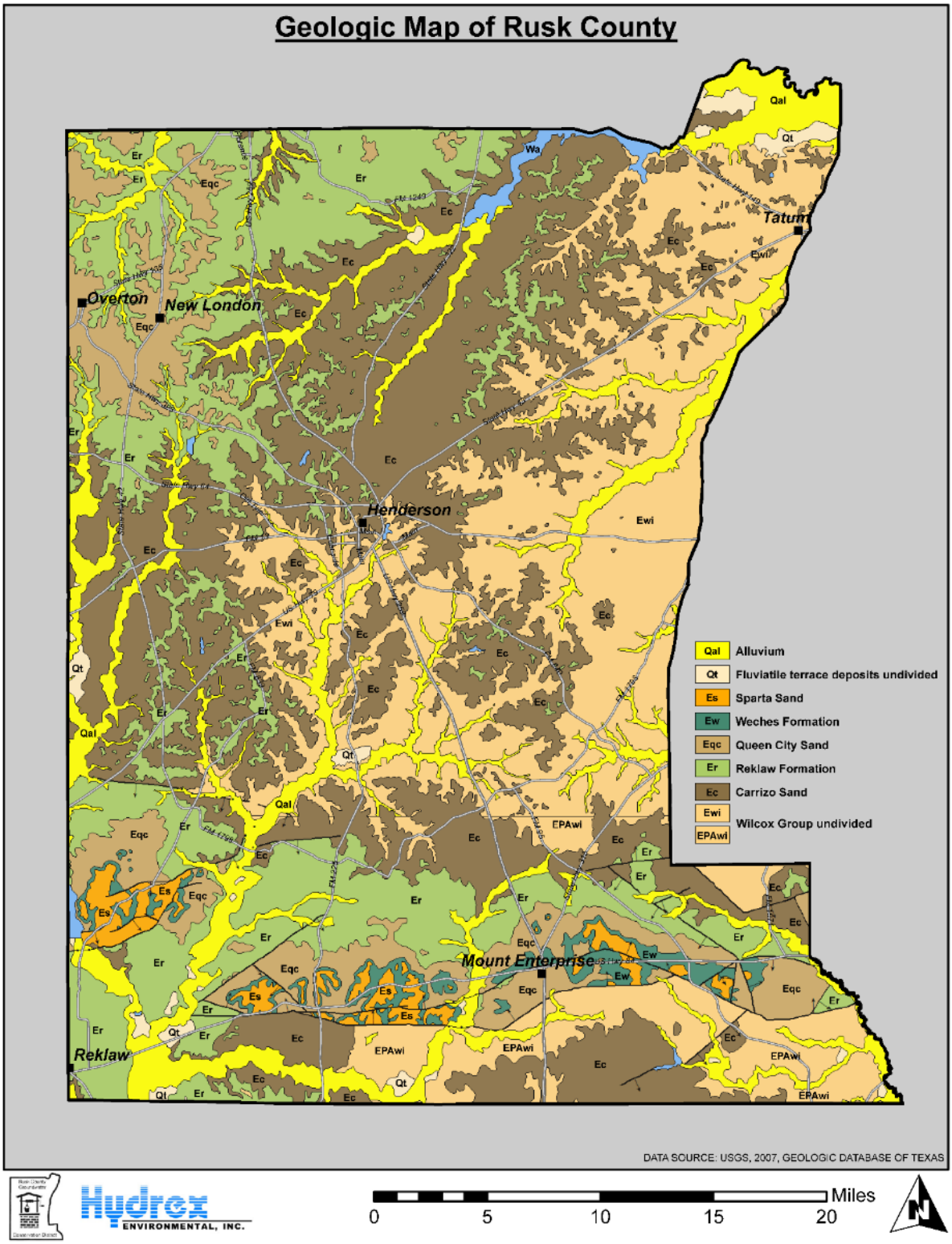

Figure 8. Geologic Map of Rusk County, Texas.

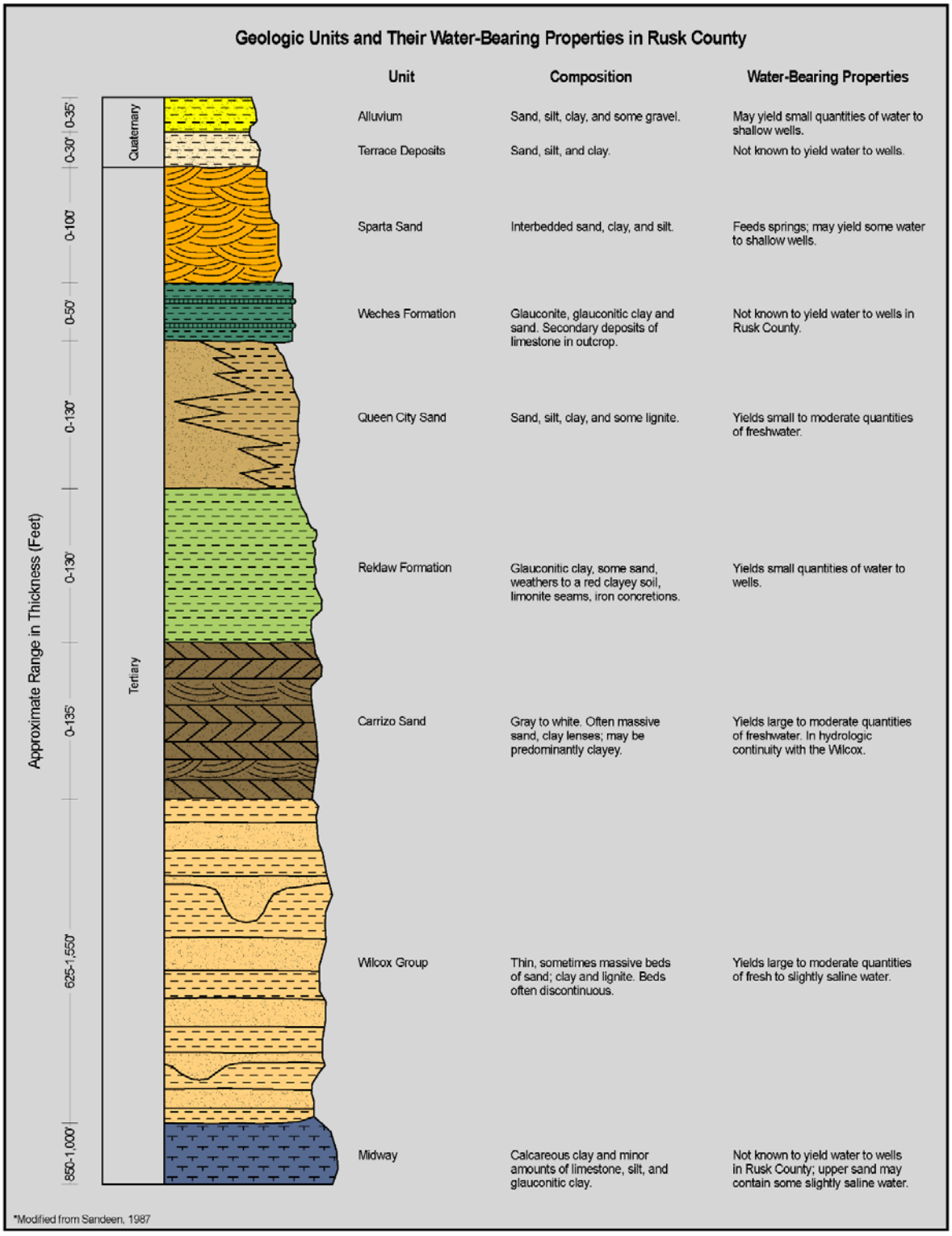

Figure 9. Geologic Units and Their Water-Bearing Properties in Rusk County, Texas.

2.3 Stratigraphy of Rusk County

The top of the Midway Group of Paleocene age marks the base of the extent of fresh groundwater in Rusk County. The Midway group is overlain successively by the Wilcox Group, Carrizo Sand, Reklaw Formation, Queen City Sand, Weches Formation, and Sparta Sand (Figure 9).

In Central Texas, the Wilcox Group of Paleocene to Eocene age, is subdivided into the Hooper, Simsboro, and Calvert Bluff formations, corresponding to deltaic, fluvial, and fluvial-deltaic facies, respectively. However, in East Texas, the Simsboro is no longer identifiable and the Wilcox Group is divided into informal lower and upper units. The lower Wilcox represents the facies equivalent of the Hooper Formation and the upper Wilcox includes both the Simsboro and the Calvert Bluff equivalent fluvial and fluvial-deltaic facies, respectively.

In East Texas and Rusk County, the Wilcox Group consists of beds of sand, silt, and clay, with locally economic amounts of lignite. These Wilcox Group sediments represent multi-facies, fluvial-deltaic systems where channels and associated sand facies form the framework for groundwater movement. The sand bodies are elongated, sinuous, and laterally discontinuous with axes generally oriented north to south consistent with the direction of sediment transport. The elongate sand bodies represent ancient fluvial systems and offer optimal locations for high yield water wells. In western Rusk County, the Wilcox reaches a maximum thickness of approximately 1500 feet. The unit thins toward the uplift and is reduced to slightly over 600 feet thick in its outcrop in the eastern portion of the county.

The Carrizo Sand is a massive, relatively homogenous sand of Eocene age consisting of medium- to fine-grain quartz sand with minor occurrences of interbedded gray clay. The Carrizo Sand is a clastic, near shore deposit with beach, dune, barrier island, and lagoonal facies represented in outcrops throughout East Texas. In Rusk County, where not thinned or entirely removed by erosion, the formation can reach a thickness of over 125 feet.

The Reklaw Formation of Eocene age is a shallow marine shelf deposit that is primarily composed of glauconitic clay and silt. In some locales, the formation commonly contains minor amounts of sand in the basal portion of the formation, near its contact with the underlying Carrizo Sand. In outcrop, the Reklaw forms a red clay soil that typically contains limonite seams and iron concretions. In Rusk County, the Reklaw Formation reaches a maximum thickness of approximately 130 feet and occurs primarily in the northern portion of the county and north of the Mt. Enterprise Fault System in the southern portion of the county.

The Queen City Sand of Eocene age was deposited by an extensive deltaic system and is primarily composed of sand, loosely cemented sandstone, and interbedded clay units with minor occurrences of lignite. In East Texas, sand facies of the Queen City Sand are thickest near the center of the East Texas Basin and generally thin eastward along the strike of the formation, pinching out in the subsurface just west of the Texas-Louisiana border. In Rusk

County, the Queen City Sand occurs in outcrop and subcrop in the northwestern portion of the county and also in the Mount Enterprise Fault System in the southern portion of the county. The formation ranges in thickness up to 130 feet.

The Weches Formation of Eocene age is a shallow marine shelf deposit that is primarily composed of glauconitic clay with only minor amounts of sand. The formation is green in unweathered sections but weathers to red when exposed. Relatively thin sections of the Weches Formation occur in the Mt. Enterprise Fault System in southern Rusk County where it attains a maximum thickness of approximately 50 feet.

The Sparta Sand of Eocene age consists of fine sand and interbedded sandy clay and silt deposited in a deltaic environment similar to the Queen City Sand. In Rusk County, the Sparta Sand only exists as laterally discontinuous units within the Mt. Enterprise Fault System where it attains maximum thicknesses of about 100 feet.

2.4 Groundwater Resources of Rusk County

The Texas Water Development Board recognizes the occurrence of one major aquifer, the Carrizo-Wilcox aquifer, and one minor aquifer, the Queen City aquifer, within Rusk County (Figures 10 and 11). Of these aquifers, the Carrizo-Wilcox aquifer is the most important and productive aquifer in Rusk County, historically supplying most of the groundwater produced within the county.

The Carrizo-Wilcox major aquifer is bound below by the marine deposits of the Midway Group and above by the Reklaw Formation. The marine deposits of the Midway Group represent a lower confining unit for the aquifer throughout its extent while the predominantly glauconitic clay sediments of the overlying Reklaw Formation represent an effective upper confining unit for the aquifer in its subcrop.

In Rusk County, much of the Carrizo-Wilcox aquifer occurs in outcrop (Figure 12). These outcrop areas serve as recharge zones for the downdip deep-lying sands of the aquifer in its subcrop. In its outcrop in the east-central portion of Rusk County, the Carrizo-Wilcox aquifer is often only represented by strata of the Wilcox Group. As the Wilcox sediments are predominantly comprised of fluvial and deltaic sands distributed among lower permeability interchannel silts and muds, the Wilcox portion of the Carrizo-Wilcox aquifer can be characterized as a multi-aquifer system. As opposed to the Carrizo aquifer, which can be characterized as a relatively homogenous, single aquifer system, the complex multi-aquifer system of the Wilcox requires an accurate description of both the arrangement of the various lithofacies (i.e. sand body distributions) and associated hydraulic properties in order for groundwater availability of the aquifer system to be properly modeled and understood.

Although considerably less important in Rusk County than the Carrizo-Wilcox aquifer, the Queen City minor aquifer is an important local source of groundwater primarily in its outcrop in the northwestern portion of Rusk County and in the Mt. Enterprise Fault System

in the southwestern portion of the county (Figure 12). The Queen City aquifer's limited extent and shallow occurrence in Rusk County make it a target for primarily low-yield production. In addition, its generally poorer water quality than the Carrizo-Wilcox aquifer make it a less desirable target for production and use as a primary drinking water source in Rusk County.

Another limited source of fresh groundwater in Rusk County is the Sparta aquifer. The Sparta aquifer provides small amounts of fresh groundwater to shallow, primarily low-yield wells in its outcrop within the Mt. Enterprise Fault System in southern Rusk County. Although the Sparta aquifer is recognized as a minor aquifer in other parts of Texas, the Sparta aquifer is not considered a minor aquifer in Rusk County due to its limited areal extent and its discontinuity with other Sparta Sand sediments outside of the Mt. Enterprise Fault System and Rusk County. As a result, the Sparta aquifer in Rusk County is not considered a significant source of groundwater for purposes of regional water planning and, thus, is not considered during regional-scale groundwater availability modeling.

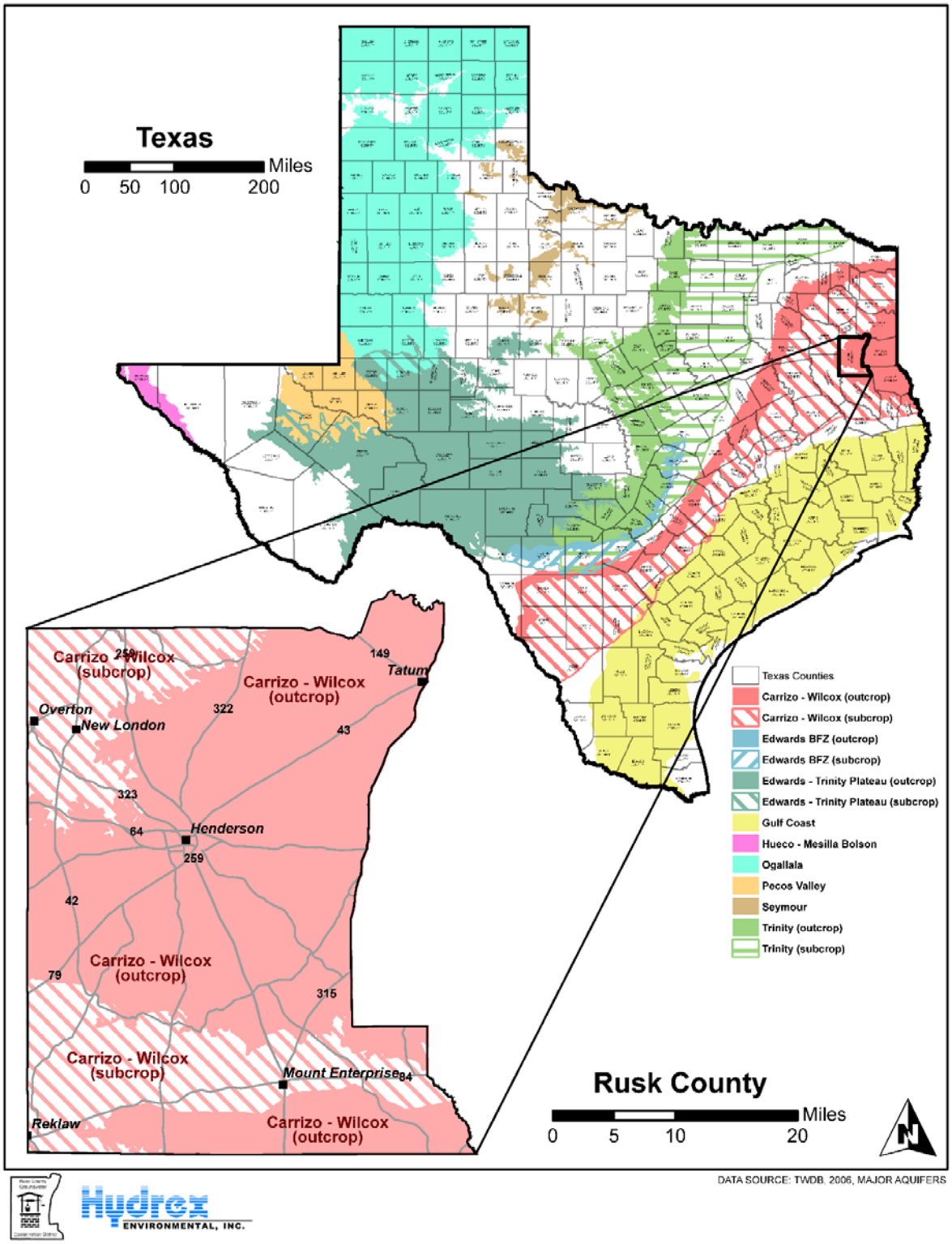

Figure 10. TWDB Major Aquifers of Texas and Rusk County.

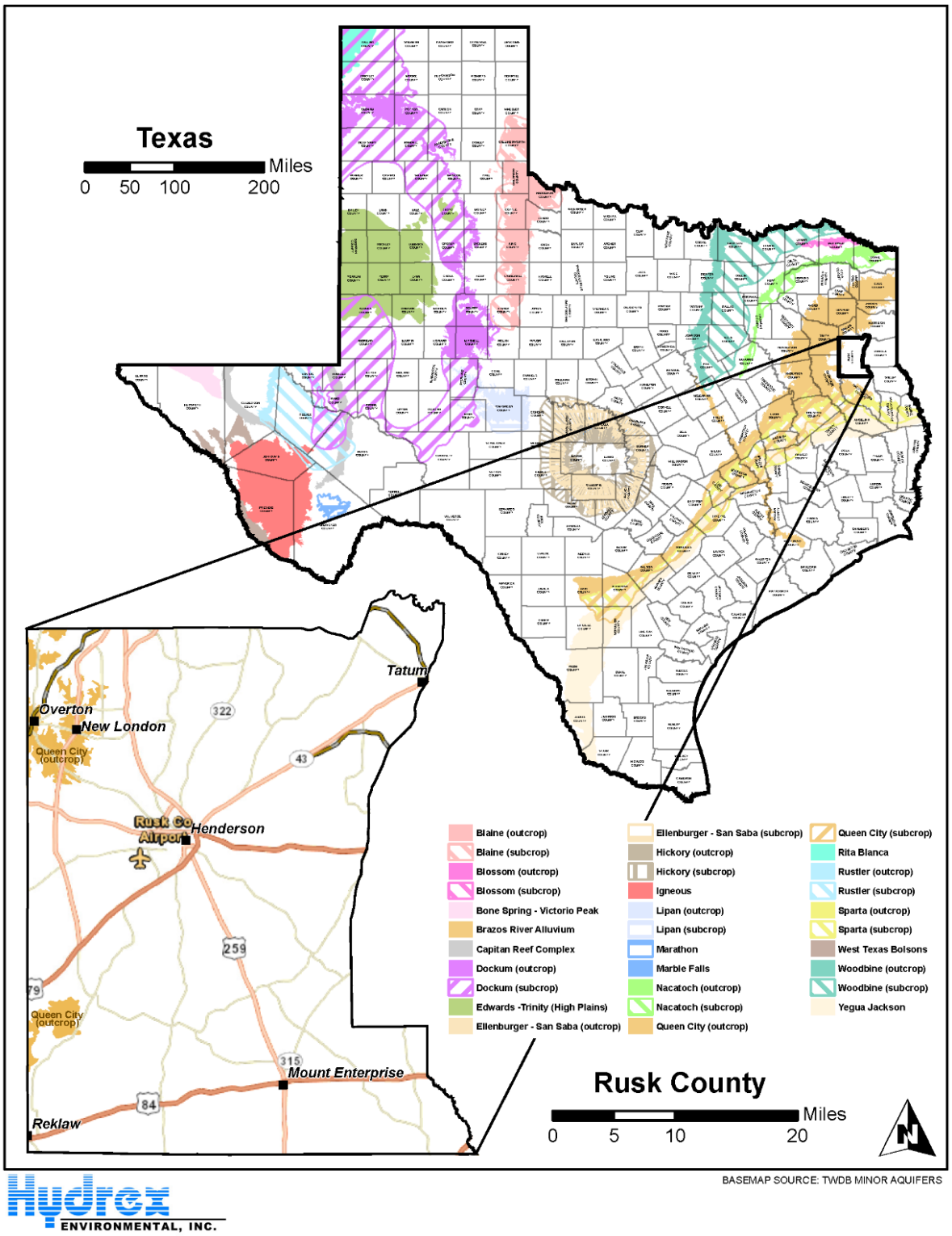

Figure 11. TWDB Minor Aquifers of Texas and Rusk County.

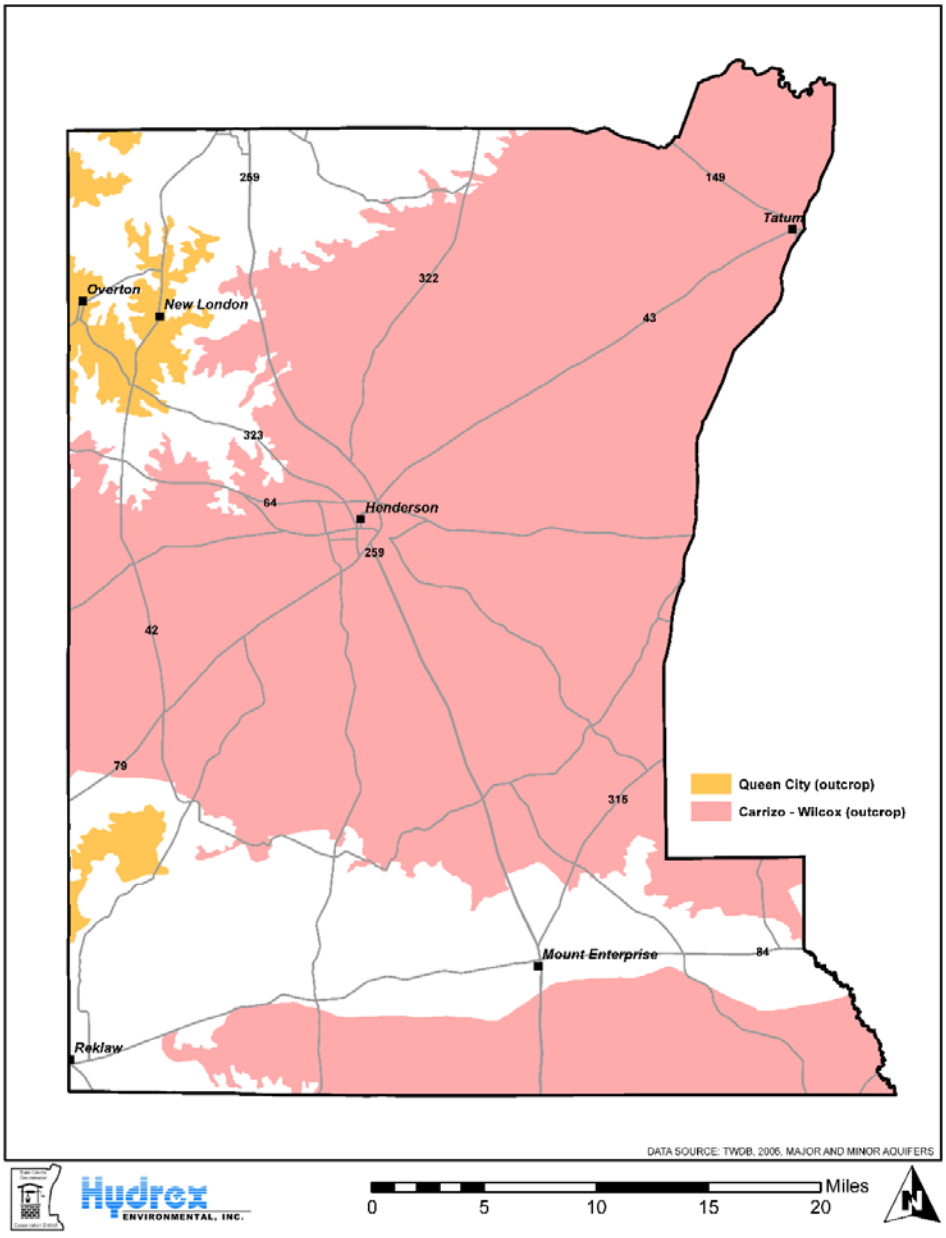

Figure 12. TWDB Major and Minor Aquifer outcrop areas in Rusk County, Texas.

Generally, groundwater movement in the different aquifers within Rusk County is from points of recharge in aquifer outcrop areas to points of discharge. In aquifer outcrops, groundwater movement is primarily downdip towards points of discharge, either along creeks, rivers, and streams or areas of significant groundwater production or withdrawal. In downdip portions of the Carrizo-Wilcox aquifer, groundwater movement is influenced by the regional dip of the Carrizo-Wilcox beds as well as cones of depression that have developed due to significant, prolonged production and/or withdrawal near the cities of Henderson and Tatum in Rusk County and Tyler in Smith County as well as the East Texas Oil Field.

SECTION 3. MODELED AVAILABLE GROUNDWATER

The 79th Texas Legislature enacted HB 1763 in 2005 that requires joint planning among districts that are in the same groundwater management area (GMA). These districts must jointly agree upon and establish the Desired Future Conditions (DFCs) of the aquifers within their respective GMAs. Through this process, the groundwater conservation districts will submit the DFC to the Executive Administrator of the Texas Water Development Board (TWDB) who, in turn, will provide each district within the GMA with the amount of Modeled Available Groundwater (MAG) within each district. The MAG will be based on the DFCs jointly established for each aquifer within the GMA.

According to the Texas Water Code Section 36.001, MAG is defined as "the amount of water that the Executive Administrator (of the TWDB) determines may be produced on an average annual basis to achieve a DFC established under §36.108." The DFC is defined in §36.001 of the Texas Water Code as "a quantitative description, adopted in accordance with §36.108 of the Texas Water Code, of the desired condition of the groundwater resources in a management area at one or more specified future times."

A summary of the MAG in RCGCD is summarized in Table 1, as provided by TWDB, based on the DFCs established under Texas Water Code §36.108 and initially adopted by GMA 11 in 2017. RCGCD will update the MAG in the future, once GMA 11 adopts new DFCs in 2022 and the Texas Water Development Board issues the accompanying MAG.

31 Tex. Admin. Code §356.52(a)(5)(A).

Rusk County MAG Values (acre-feet per year)									
		Regional Water	River	Year					
Aquifer	County	Planning Area	Basin	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox	Rusk	I	Neches	11,769	11,769	11,769	11,750	11,750	11,750
Carrizo-Wilcox	Rusk	I	Sabine	9,068	9,068	9,068	9,068	9,068	9,068
			Totals	**20,837**	**20,837**	**20,837**	**20,818**	**20,818**	**20,818**

Table 1: Groundwater Management Area 11 – MAG values for Rusk County as documented in TWDB GAM Run 17-024 MAG. See Appendix E for complete report. Units are in acre-feet per year.

SECTION 4. ANNUAL GROUNDWATER USE

To estimate the annual amount of groundwater being used in RCGCD, the RCGCD uses the TWDB Annual Water Use Survey Data, the Railroad Commission of Texas reported Mining Water Use Data, and develops its own estimates using RCGCD reported and estimated usage. The TWDB Water Use Survey Data is subject to variations in the completeness or accuracy of the data due to inconsistent reporting by some water user groups. TWDB data on estimated groundwater use is available from 2001 to 2016 and is presented in full in Appendix F. The District began documenting water use data in 2014 and has improved accuracy with each year.

Table 2 displays the amount of groundwater being used within RCGCD on an annual basis, pursuant to the TWDB Water Use Survey Groundwater Pumpage Estimates from 2012-2016.

31 Tex. Admin. Code §356.52(a)(5)(B).

Rusk County Annual Groundwater Use TWDB Survey Data (acre-feet per year)							
Year	**Municipal**	**Manufacturing**	**Mining**	**Steam Electric**	**Irrigation**	**Livestock**	**Total**
2016	6,911	12	1,804	16	148	353	**9,244**
2015	7,318	13	1,993	33	139	339	**9,835**
2014	6,217	17	454	49	166	325	**7,228**
2013	7,405	13	576	0	358	321	**8,673**
2012	7,885	15	425	2,377	123	308	**11,133**

Table 2: Estimated Historical Water Use as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report. Units are in acre-feet per year.

Table 3 displays the amount of groundwater being used within RCGCD on an annual basis, pursuant to the Railroad Commission of Texas recorded Groundwater Pumpage of lignite Mine usage from 2002-2015. The RCGCD obtains this information through Open Records with the Railroad Commission of Texas.

Railroad Commission of Texas Mining Groundwater Use in Rusk County (acre-feet per year)	
Year	**ac-ft**
2015	1,559
2014	2,090
2013	2,661
2012	1,215
2011	920
2010	566
2009	811
2008	1,069
2007	2,897
2006	3,723
2005	802
2004	664
2003	1,256
2002	1,787

Table 3: Railroad Commission of Texas Groundwater Use Reported in Rusk County Mines. Units are in acre-feet per year.

Table 4 displays the RCGCD-estimated water use and is considered a supplement to the TWDB estimated water use in Appendix F.

Rusk County Annual Groundwater Use RCGCD Reporting (acre-feet per year)						
Year	Municipal	Oil & Gas	Mining	Steam Electric	Non-Exempt Livestock, Irrigation	Total
2017	5,693	47	231	41	141	**6,154**
2016	5,920	85	1,989	7	40	**8,041**
2015	5,395	172	1,584	17	9	**7,176**

Table 4: Estimated Historical Water Use as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report. Units are in acre-feet per year.

SECTION 5. GROUNDWATER BUDGET

5.1 Annual Amount of Recharge from Precipitation

Table 5 displays the annual amount of recharge from precipitation, if any, to the groundwater resources within the District, as provided by the TWDB.

31 Tex. Admin. Code §356.52(a)(5)(C).

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	70,358
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	1,200

Table 5: Precipitation values for Rusk County as documented in TWDB GAM Run 14-011. See Appendix D for complete report. Units are in acre-feet per year.

5.2 Annual Volume Discharges

Table 6 displays the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers in the District, as provided by the TWDB.

31 Tex. Admin. Code §356.52(a)(5)(D).

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	25,743
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Queen City Aquifer	227

Table 6: Discharge values for Rusk County as documented in TWDB GAM Run 14-011. See Appendix D for complete report. Units are in acre-feet per year.

5.3 Annual Volume of Flow throughout Aquifers

Table 7 and 8 displays the annual volume of flow into and out of the District within each aquifer and between aquifers in the District, if a groundwater availability model is available from the TWDB.

31 Tex. Admin. Code §356.52(a)(5)(E).

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	4,016
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	14,269
Estimated net annual volume of flow between each aquifer in the district	To the Carrizo-Wilcox Aquifer from the Reklaw Formation confining unit	2,147

Table 7: Aquifer flow values for Rusk County as documented in TWDB GAM Run 14-011. See Appendix D for complete report. Units are in acre-feet per year.

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	63
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	62
Estimated net annual volume of flow between each aquifer in the district	From the Queen City Aquifer to the Reklaw Formation confining unit	1,176
	From the Queen City Formation to the Queen City Aquifer	75

Table 8: Aquifer flow values for Rusk County as documented in TWDB GAM Run 14-011. See Appendix D for complete report. Units are in acre-feet per year.

SECTION 6. PROJECTED SURFACE WATER SUPPLY IN RUSK COUNTY

6.1 Surface Water Resources of Rusk County

Rusk County is divided into two major watersheds by a northwest-southeast trending ridge that defines the boundary between the Sabine River drainage basin and the Neches River drainage basin (Figure 15). Both major watersheds are comprised of dendritic drainage systems that contain many large streams. Hydrology is provided by precipitation, surface water runoff, and groundwater discharge. Large streams throughout Rusk County are generally gaining streams, receiving an influx of water from both groundwater discharges as well as surface water run-off (Figure16). On average, Rusk County receives approximately 49.57 inches of precipitation annually.

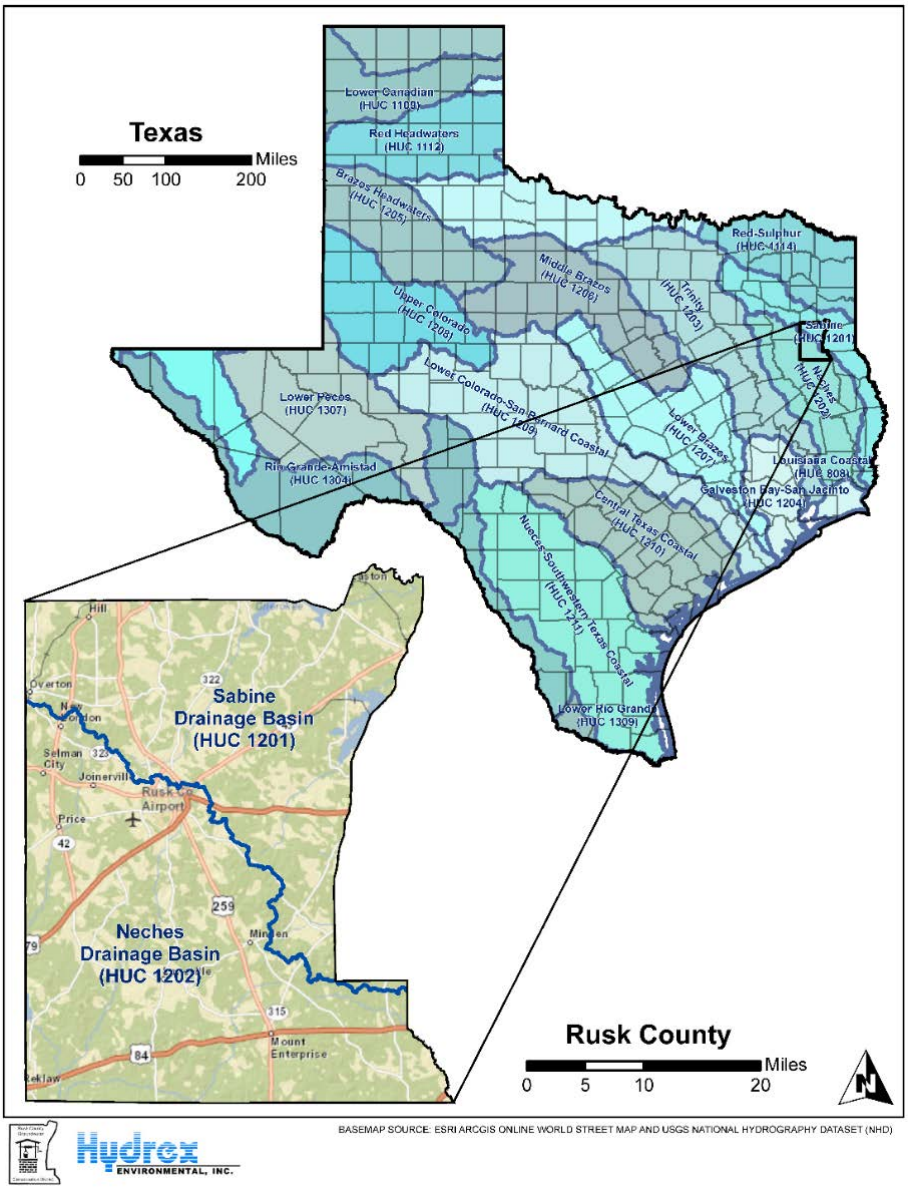

Figure 15. Major drainage basins within Texas and Rusk County.

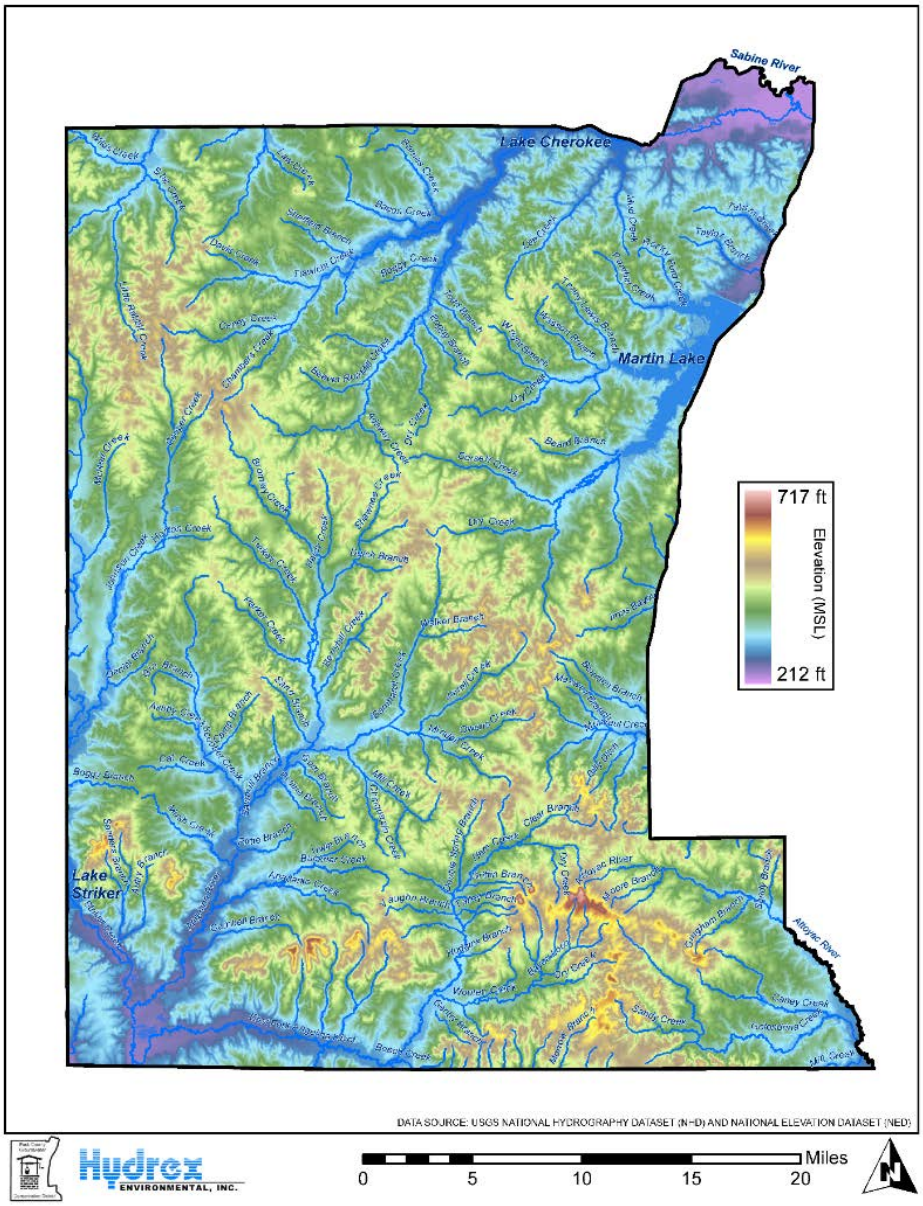

Figure 16. Topography and surface hydrology within Rusk County.

The northwestern, northeastern, and eastern portions of Rusk County lie within the Sabine River drainage basin, hydrologic unit code (HUC) 1201. Surface water in the northwestern and northeastern portions of the county, specifically in the Rabbit Creek-Sabine River (HUC 1201000206), Cherokee Bayou-Sabine River (HUC 1201000207), and Martin Creek (HUC 1201000209) sub-watersheds, generally flows in a northeasterly direction towards the Sabine River. Surface water in the eastern portions, specifically Irons Bayou (HUC 1201000210) and Murvaul Creek-Sabine River (HUC 1201000211) sub-watersheds, generally flows in an easterly direction towards the Sabine River. The Sabine River serves as the county boundary in the extreme northeastern corner of Rusk County (Figure 17).

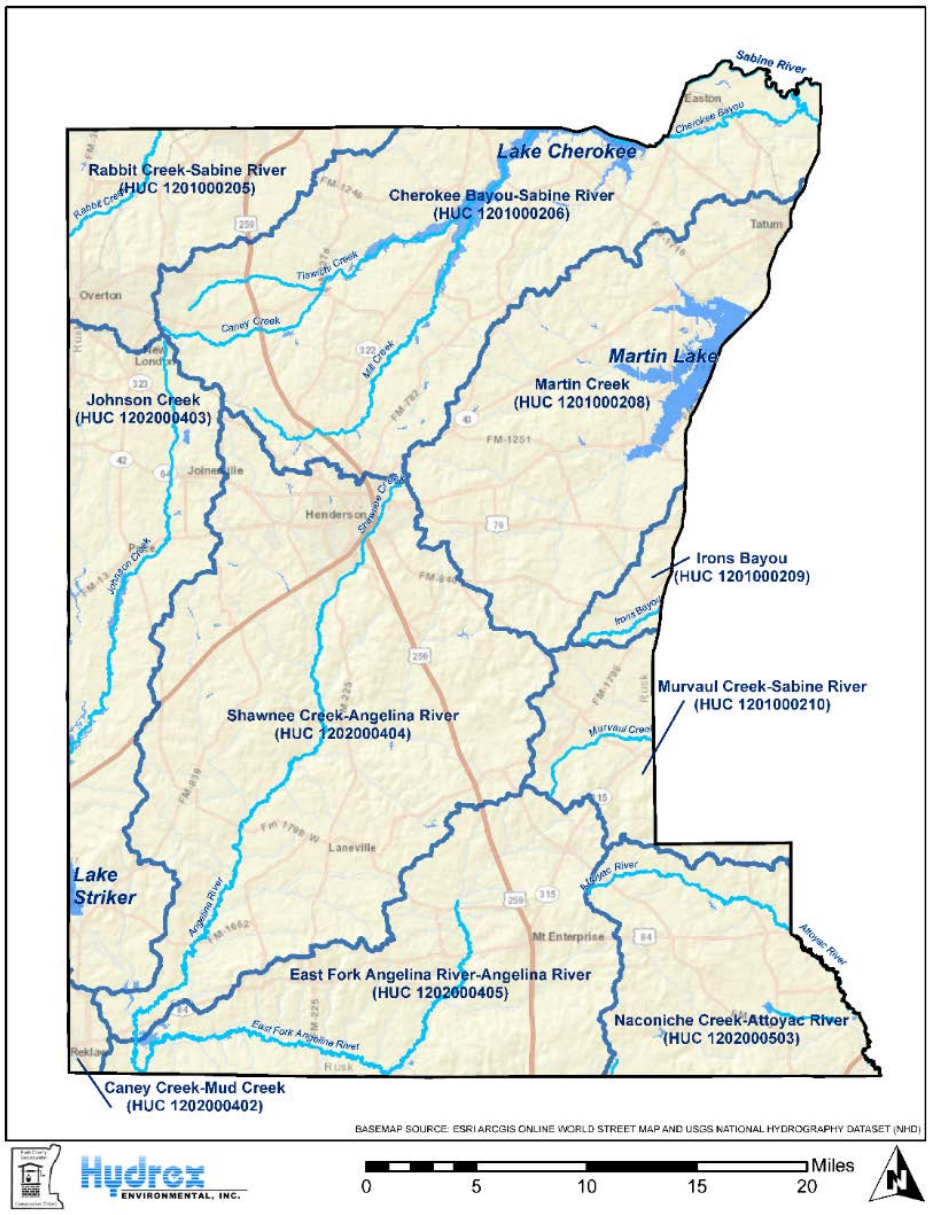

Figure 17. Sub-watersheds within Rusk County.

Lake Cherokee is located along the northern boundary of Rusk County within the Cherokee Bayou-Sabine River sub-watershed (Figure 17). Lake Cherokee, operated by Lake Cherokee Water Company, was constructed in 1948 and is currently used for municipal, industrial, and recreational purposes. The City of Longview diverts water for municipal water supply and Southwestern Power Company diverts water for cooling purposes at the Knox Lee Power Plant. At normal pool elevation of 280 feet, relative to mean sea level, Lake Cherokee yields approximately 3,497 surface acres and has a capacity of approximately 46,737 acre-feet. The drainage area above Lake Cherokee is approximately 158 square-miles. Downstream of Lake Cherokee, Cherokee Bayou converges with the Sabine River in the northeastern portion of Rusk County.

Martin Lake is located along the eastern boundary of Rusk County within the Martin Creek sub-watershed (Figure 17). Martin Lake was constructed in the 1970s for purposes of generating electricity and to serve as a cooling lake for Luminant's Martin Lake power plant. As such, the lake is not currently used as a source for municipal water supply. Martin Lake yields approximately 4,981 surface acres at normal pool elevation of 306 feet, relative to mean sea level, and has a capacity of approximately 75,116 acre-feet. The drainage area above Martin Lake is approximately 130 square-miles. Downstream of Martin Lake, Martin Creek converges with the Sabine River approximately 12.3 miles east of Rusk County.

The western, southwestern, and southeastern portions of Rusk County lie within the Neches River drainage basin, HUC 1201. Surface water in the western and southwestern portions of the county, specifically in the Johnson Creek (HUC 1202000404), Shawnee Creek-Angelina River (HUC 1202000405), East Fork Angelina River-Angelina River (HUC 1202000406), and Caney Creek-Mud Creek (HUC 1202000407) sub-watersheds, generally flows in a southwesterly direction forming the headwaters of the Angelina River (Figure 17). Surface water in the southeastern portion of the county, specifically in the Naconiche Creek-Attoyac River (HUC 1202000504) sub-watershed, generally flows in a southeasterly direction forming the headwaters of the Attoyac Bayou (Figure 17). The Attoyac Bayou converges with the Angelina River at Sam Rayburn Reservoir, approximately 40 miles south of Rusk County. Approximately 14.5 miles downstream of the Sam Rayburn Reservoir dam, the Angelina River discharges into the Neches River.

Lake Striker is located along the western boundary of Rusk County within the Johnson Creek sub-watershed (Figure 17). Lake Striker, owned by the Angelina-Nacogdoches Counties Water Control and Improvement District No. 1, was constructed in 1956 and 1957. The District provides water to Luminant Energy for industrial use at their power plant on the west side of the reservoir and also to Southern Power Company for cooling water at the biomass fired power plant near Sacul in northwestern Nacogdoches County, Texas. The City of Henderson also holds water rights in Lake Striker that may be used in the future. At normal pool elevation of 293 feet, relative to mean sea level, Lake Striker yields approximately 1,920 surface acres and has a capacity of approximately 22,865 acre-feet. The drainage area above Lake Striker is approximately 182 square-miles. Downstream of Lake Striker, Striker Creek converges with the Angelina River in the southwestern portion of Rusk County.

6.2 Projected Surface Water Supplies

Table 9 displays the projected surface water supplies within Rusk County for Water User Groups (WUGs) determined by Region Water Planning Group I.

31 Tex. Admin. Code §356.52(a)(5)(F)

WUG	WUG Basin	Source	Rusk County Surface Water Supply (acre-feet per year)					
			2020	2030	2040	2050	2060	2070
CROSSROADS SUD	SABINE	FORK LAKE/RESERVOIR	248	248	249	249	248	248
EASTON	SABINE	CHEROKEE LAKE/RESERVOIR	4	5	5	6	6	7
ELDERVILLE WSC	SABINE	CHEROKEE LAKE/RESERVOIR	95	96	96	96	95	94
ELDERVILLE WSC	SABINE	FORK LAKE/RESERVOIR	97	97	97	97	97	96
HENDERSON	NECHES	FORK LAKE/RESERVOIR	3,470	3,469	3,470	3,470	3,470	3,470
HENDERSON	NECHES	STRIKER LAKE/RESERVOIR	0	0	0	0	0	0
HENDERSON	SABINE	FORK LAKE/RESERVOIR	603	604	603	603	603	603
HENDERSON	SABINE	SABINE RUN-OF-RIVER	10	10	10	10	10	10
HENDERSON	SABINE	STRIKER LAKE/RESERVOIR	0	0	0	0	0	0
IRRIGATION, RUSK	NECHES	NECHES RUN-OF-RIVER	86	86	86	86	86	86
IRRIGATION, RUSK	SABINE	SABINE RUN-OF-RIVER	127	127	127	127	127	127
KILGORE	SABINE	FORK LAKE/RESERVOIR	506	841	841	839	832	821
LIVESTOCK, RUSK	NECHES	NECHES LIVESTOCK LOCAL SUPPLY	808	808	808	808	808	808
LIVESTOCK, RUSK	SABINE	SABINE LIVESTOCK LOCAL SUPPLY	308	308	308	308	308	308
MANUFAC-TURING, RUSK	NECHES	NECHES RUN-OF-RIVER	2	2	2	2	2	2
MANUFAC-TURING, RUSK	SABINE	FORK LAKE/RESERVOIR	1	1	1	1	1	1
MINING	NECHES	SABINE OTHER LOCAL SUPPLY	210	0	0	0	0	0
MINING	SABINE	SABINE OTHER LOCAL SUPPLY	1,020	1,230	1,230	1,230	1,230	1,230
STEAM ELECTRIC POWER, RUSK	SABINE	MARTIN LAKE/RESERVOIR	25,000	25,000	25,000	25,000	25,000	25,000
STEAM ELECTRIC POWER, RUSK	SABINE	TOLEDO BEND LAKE/RESERVOIR	17,922	17,922	17,922	17,922	17,922	17,922
Sum of Projected Surface Water Supplies			**50,517**	**50,854**	**50,855**	**50,854**	**50,845**	**50,833**

Table 9: Projected Surface Water Supplies for Rusk County as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report.

SECTION 7. PROJECTED WATER DEMANDS

The projected water demands for Rusk County through 2070 are shown in Table 10. All estimates are from the 2017 State Water Plan. As shown in table ten, the total water demand to water user groups (WUGs) in the year 2020 is 41,450 acre-feet and in year 2070 will be 82,579 acre-feet.

31 Tex. Admin. Code §356.52(a)(5)(G).

RWPG	WUG	WUG BASIN	Rusk County Projected Water Demand (acre-feet per year)					
			2020	2030	2040	2050	2060	2070
I	CHALK HILL SUD	SABINE	323	343	364	393	428	464
I	COUNTY-OTHER, RUSK	NECHES	1,697	1,803	1,916	2,071	2,255	2,450
I	COUNTY-OTHER, RUSK	SABINE	1,192	1,267	1,346	1,455	1,584	1,722
I	CROSSROADS	SABINE	238	251	265	285	310	336
I	EASTON	SABINE	4	5	5	6	6	7
I	ELDERVILLE WSC	SABINE	119	132	145	159	174	189
I	HENDERSON	NECHES	3,254	3,564	3,874	4,226	4,611	5,014
I	HENDERSON	SABINE	566	620	673	735	801	871
I	IRRIGATION, RUSK	NECHES	56	56	56	56	56	56
I	IRRIGATION, RUSK	SABINE	44	44	44	44	44	44
I	KILGORE	SABINE	723	789	855	931	1,016	1,104
I	LIVESTOCK, RUSK	NECHES	675	684	697	709	722	722
I	LIVESTOCK,RUSK	SABINE	532	540	549	560	570	570
I	MANUFACTURING, RUSK	NECHES	304	328	348	366	393	421
I	MANUFACTURING, RUSK	SABINE	13	14	15	15	16	18
I	MINING, RUSK	NECHES	1,555	2,084	2,012	1,936	1,873	1,868
I	MINING, RUSK	SABINE	1,435	1,923	1,858	1,788	1,728	1,724
I	NEW LONDON	NECHES	215	235	257	281	306	333
I	NEW LONDON	SABINE	173	191	207	226	247	268
I	OVERTON	NECHES	61	66	72	78	85	93
I	OVERTON	SABINE	499	545	590	643	701	762
I	STEAM ELECTRIC POWER, RUSK	SABINE	27,458	32,102	37,762	44,663	53,074	63,069
I	TATUM	SABINE	240	261	283	308	336	365
I	WEST GREGG SUD	SABINE	17	18	19	20	22	24
I	WRIGHT CITY WSC	NECHES	57	62	66	72	78	85
Sum of Projected Water Demand			**41,450**	**47,927**	**54,278**	**62,026**	**71,436**	**82,579**

Table 10: Projected Water Demand for Rusk County as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report.

The projected water supply needs for Rusk County through 2070 are shown in Table 11. All estimates are from the 2017 State Water Plan. As shown in table eleven, there are three water user groups that have projected a water supply need. These groups are mining, steam electric, and the City of Overton.

Texas Water Code §36.1071(e)(4)

RWPG	WUG	WUG BASIN	Rusk County Projected Water Supply Needs (acre-feet per year)					
			2020	2030	2040	2050	2060	2070
I	CHALK HILL SUD	SABINE	720	700	679	650	615	579
I	COUNTY-OTHER, RUSK	NECHES	753	647	534	379	195	0
I	COUNTY-OTHER, RUSK	SABINE	689	614	535	426	297	159
I	CROSS ROADS SUD	SABINE	407	395	383	363	336	309
I	EASTON	SABINE	0	0	0	0	0	0
I	ELDERVILLE WSC	SABINE	73	61	48	34	18	1
I	HENDERSON	NECHES	2,682	2,371	2,062	1,710	1,325	922
I	HENDERSON	SABINE	447	394	340	278	212	142
I	IRRIGATION, RUSK	NECHES	245	245	245	245	245	245
I	IRRIGATION, RUSK	SABINE	253	253	253	253	253	253
I	KILGORE	SABINE	148	422	356	277	182	78
I	LIVESTOCK, RUSK	NECHES	289	280	267	255	242	242
I	LIVESTOCK, RUSK	SABINE	0	0	0	0	0	0
I	MANUFACTURING, RUSK	NECHES	31	31	31	31	31	31
I	MANUFACTURING, RUSK	SABINE	1	1	1	1	1	1
I	MINING, RUSK	NECHES	-1,075	-1,814	-1,742	-1,666	-1,603	-1,598
I	MINING, RUSK	SABINE	0	-278	-213	-143	-83	-79
I	NEW LONDON	NECHES	118	98	76	52	27	0
I	NEW LONDON	SABINE	95	77	61	42	21	0
I	OVERTON	NECHES	39	34	28	22	15	7
I	OVERTON	SABINE	79	33	-12	-65	-123	-184
I	STEAM ELECTRIC POWER, RUSK	SABINE	16,743	12,099	6,439	-462	-8,873	-18,868
I	TATUM	SABINE	118	87	59	28	0	2
I	WEST GREGG SUD	SABINE	10	10	9	7	5	3
I	WRIGHT CITY WSC	NECHES	27	22	18	12	6	0
Sum of Projected Water Supply Need			**-1,075**	**-2,092**	**-1,967**	**-2,336**	**-10,682**	**-20,729**

Table 11: Projected Water Supply Needs for Rusk County as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report.

SECTION 8. PROJECTED WATER MANAGEMENT STRATEGIES

Water management strategies are specific plans to increase water supply or maximize existing water supply to meet a specific need. The Regional Water Planning Group I has several recommendations throughout the planning area. Fourteen viable strategies were

recognized for Rusk County as is displayed in Table 12. There are two water management strategies that use groundwater as a source, the Angelina-Neches River Authority has planned for wells in Rusk County to be used for manufacturing use in Cherokee and Rusk Counties.

Texas Water Code §36.1071(e)(4).

RWPG	WUG	Basin	Water Management Strategy	Source Name (Origin)	Rusk County Projected Water Management Strategies (acre-feet per 2020	2030	2040	2050	2060	2070
I	HENDERSON	NECHES	LAKE STRIKER DREDGING	STRIKER LAKE/RESERVOIR (RESERVOIR)	0	0	4,771	4,770	4,771	4,771
I	HENDERSON	SABINE	LAKE STRIKER DREDGING	STRIKER LAKE/RESERVOIR (RESERVOIR)	0	0	829	830	829	829
I	MANUFACTU-RING, RUSK	NECHES	ANRA-GW-NEW WELLS IN CARRIZO WILCOX AQUIFER IN RUSK COUNTY	CARRIZO-WILCOX AQUIFER (CHEROKEE)	1,600	1,600	1,600	1,600	1,600	1,600
I	MANUFACTU-RING, RUSK	NECHES	ANRA-GW-NEW WELLS IN CARRIZO WILCOX AQUIFER IN RUSK COUNTY	CARRIZO-WILCOX AQUIFER (RUSK)	4,000	4,000	4,000	4,000	4,000	4,000
I	MINING	NECHES	ANRA-RUN-OF-RIVER (SUBMITTED APPLICATION)	NECHES RUN-OF-RIVER (RUSK)	1,075	1,814	1,742	1,666	1,691	1,686
I	MINING	SABINE	ANRA-RUN-OF-RIVER (SUBMITTED APPLICATION)	NECHES RUN-OF-RIVER (RUSK)	0	278	213	143	83	79
I	NEW LONDON	NECHES	ANRA-COL - LAKE COLUMBIA	COLUMBIA LAKE/RESERVOIR (RESERVOIR)	0	472	474	474	473	94
I	NEW LONDON	SABINE	ANRA-COL - LAKE COLUMBIA	COLUMBIA LAKE/RESERVOIR (RESERVOIR)	0	383	381	381	382	76
I	OVERTON	NECHES	OVER ENHANCED PUBLIC AND SCHOOL EDUCATION	DEMAND REDUCTION (RUSK)	0	0	0	1	1	1
I	OVERTON	NECHES	OVER WATER CONSERVATION PRICING	DEMAND REDUCTION (RUSK)	0	0	0	1	1	1
I	OVERTON	SABINE	OVER ENHANCED PUBLIC AND SCHOOL EDUCATION	DEMAND REDUCTION (RUSK)	0	0	5	5	7	9
I	OVERTON	SABINE	OVER ENHANCED WATER LOSS CONTROL PROGRAM	DEMAND REDUCTION (RUSK)	0	0	76	144	196	238
I	OVERTON	SABINE	OVER WATER CONSERVATION PRICING	DEMAND REDUCTION (RUSK)	0	0	4	6	7	7
I	STEAM ELECTRIC POWER	SABINE	RUSK-SEP NEW CONTRACT	SABINE RUN-OF-RIVER (NEWTON)	0	0	0	462	8,873	18,868
				Sum of Projected Water Management Strategies	**6,675**	**8,547**	**14,095**	**14,483**	**22,914**	**32,259**

Table 12: Projected Water Management Strategies for Rusk County as documented in the TWDB Estimated Historical Water Use & 2017 State Water Plan Data Set. See Appendix F for complete report.

SECTION 9. MANAGEMENT OF GROUNDWATER SUPPLIES

To meet the requirements of 31 Tex. Admin. Code §356.52(a)(4), the RCGCD provides the following details on how it manages groundwater supplies in the District.

Groundwater conservation districts have statutorily been designated as the preferred method of groundwater management in Texas, through the rules developed, adopted, and promulgated by individual groundwater districts, as authorized by Chapter 36 of the Texas Water Code and the individual district's enabling act (Texas Water Code §36.0015). The RCGCD manages groundwater supplies, in part, by regulating the spacing and production of wells, to minimize drawdown of the water table or reduction of artesian pressure, to control subsidence, to prevent interference between wells, to prevent degradation of water quality, and to prevent waste (Texas Water Code § 36.116). The method of groundwater production regulation is based on hydrogeological conditions of aquifers in the District.

The RCGCD, as authorized by law, has adopted the following groundwater management strategies:

A. PUMPING RATE LIMIT

The District regulates groundwater withdrawal through permitting efforts. New non-exempt wells producing water from all RCGCD aquifers will be required to have land legally assigned to the well in an amount to be determined in relationship to the average annual production rate of the well.

B. BENEFICIAL USE

The District regulates groundwater withdrawal by setting production limits on wells based on evidence of beneficial use.

C. WELL SPACING

To minimize as far as practicable the drawdown of the water table and the reduction of artesian pressure, to control subsidence, to prevent interference between wells, to prevent degradation of water quality, and to prevent waste, the District enforces spacing requirements on all new wells in the District.

There are two types of spacing requirements, both of which apply to all new non-exempt wells in the District and water wells that require registration for production activities related to oil and gas exploration and production. The first spacing rule is the distance that the well site must be from the perimeter of the real property that is assigned to that well under Rule 8.1(b). The second spacing rule is the distance that the well site must be from all permitted non-exempt wells and all registered exempt wells.

(a) Spacing of new non-exempt wells completed in the District shall be one-half foot per gallon per minute (½ ft / gpm) of production capacity from the perimeter of the property that is legally assigned to that well.

(b) Spacing of new non-exempt wells completed in the District shall be one foot per one gallon per minute (1 ft / gpm) of production capacity from permitted or registered wells in the District.

The District's Rules are available on the District's website: http://www.rcgcd.org

SECTION 10. ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

To meet the requirements of Texas Water Code §36.107(e)(2), the District will act on the goals and directives established in this District Management Plan. The District will use the objectives and provisions of the Management Plan as a guideline in its policy implementation and decision-making. In both its daily operations and long-term planning efforts, the District will continuously strive to comply with the initiatives and standards created by the Management Plan for the District.

The District will amend rules in accordance with Chapter 36 of the Texas Water Code and rules will be followed and enforced. The District may amend the District rules as necessary to comply with changes to Chapter 36 of the Texas Water Code and to ensure the best management of the groundwater within the District. The development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District.

The District will encourage public cooperation and coordination in the implementation of the District Management Plan. All operations and activities of the District will be performed in a manner that best encourages cooperation with the appropriate state, regional, and local water entities as well as landowners and the general public. Meetings of the District's Board of Directors will be noticed (announced) and conducted in accordance with the Texas Open Meetings Act. The District will also make available for public inspection all official documents, reports, records, and minutes of the District pursuant with the Texas Public Information Act.

SECTION 11. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

An annual report will be prepared and presented to the Board of Directors on District performance with regard to achieving management goals and objectives. The presentation of this report will occur within the first quarter of the following fiscal year. The Annual Report will be prepared in a format that will be reflective of the performance standards listed following each management objective. The District will maintain the reports on file for public inspection at the District's office upon adoption.

SECTION 12. GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

The management goals, objectives, performance standards and tracking methods of the Rusk County Groundwater Conservation District in the emphasis areas defined in 31 TAC §356 as follows.

12.1. Providing the Most Efficient Use of Groundwater

12.1.A. Maintain a Well Registration Process

Objective: The District will require the registration of all groundwater wells, exempt and non-exempt, new and existing, within the boundaries of the District to be registered in accordance with the District Rules.

Performance Standard: The number of new and existing water wells registered with the District will be provided at the regular District Board meetings and in the District's Annual Report.

12.1.B. Maintain a Well Permitting Process

Objective: The District will require all new and existing non-exempt water wells within the boundaries of the District to be permitted in accordance with the District Rules.

Performance Standard: The District will process applications for operating permits of all non-exempt water wells pursuant to the permitting process of the District Rules. A summary of the number of applications for permitted use of groundwater will be provided at the regular District Board meetings and in the District's Annual Report.

12.1.C. Maintain an Electronic Database

Objective: Maintain the District's Groundwater Well Database for registrations, permits, and groundwater production volume. The database shall include information deemed necessary by the District to enable effective monitoring and regulation of groundwater in the District.

Performance Standard: The District will document all new and existing wells in the District's database. All new and existing wells documented will be included in the District's Annual Report.

Performance Standard: The District will include a summary of the estimated volume of water produced within Rusk County in the District's Annual Report.

12.2. Controlling and Preventing Waste of Groundwater

12.2.A. Disseminate Information on Waste Prevention

Objective: The District will provide information on an annual basis for the purpose of educating the public on elimination, reduction, and prevention of the waste of groundwater. The District will use at least one of the following methods to provide information to the public annually:

a. Distribute literature packets or brochures;
b. Conduct public or school presentations;
c. Sponsor an educational program or course;
d. Provide information on the District's web site;
e. Submit an article for publication with local papers;
f. Present displays at public events.

Performance Standard: A summary of the District's efforts to disseminate information on waste prevention will be included in the District's Annual Report.

12.2.B. Identify Wasteful Practices

Objective: The District will identify wasteful practices within the boundaries of the District through the following methods:

a. Track water loss for all water utilities within the District;
b. Enforce District Rule 9.2.5 requiring inspection and/or plugging of oil and gas groundwater wells.

Performance Standard: The District will include a summary of the total volume of water loss from water utilities in the District's Annual Report.

Performance Standard: The District will include the total oil and gas groundwater wells inspected and plugged each fiscal year in the District's Annual Report.

12.3. Addressing Conjunctive Surface Water Management Issues

12.3.A. Participating in the Regional Water Planning Process

Objective: The District will attend at least one East Texas Regional Water Planning Group (Region I) and the North East Texas Regional Water Planning Group (Region D) meeting each fiscal year.

Performance Standard: The District will participate in the regional

planning process by attending at least one meeting of Region I and Region D meetings each fiscal year. A report will be presented at a regular board meeting of the District on conjunctive surface water issues of the appropriate Regional Water Planning Groups. Attendance of meetings for Region I and Region D will be included in the District's Annual Report.

12.4. Addressing Natural Resource Issues

12.4.A. Monitor Water Levels

Objective: The District will manage and maintain its existing water level monitoring program. The District will monitor water levels within the District boundaries at least annually and will be recorded in the District's database.

Performance Standard: A description of the number of wells measured and the monitoring results of the year will be included in the District's Annual Report.

12.4.B. Address Abandoned and Nuisance Wells

Objective: The District will encourage the plugging of abandoned and nuisance groundwater wells. The District will conduct inspections of groundwater wells within the District's boundaries to encourage proper maintenance of groundwater wells and to document abandoned and nuisance groundwater wells that pose a risk to the District's groundwater resources.

Performance Standard: A description of the number of wells inspected, the number of wells in violation, and the number of wells brought into compliance or plugged will be included in the District's Annual Report.

12.5. Addressing Drought Conditions

12.5.A. Drought Contingency Plan

Objective: The District will implement its Drought Contingency Plan if conditions meet the criteria listed in the plan. The District will evaluate its Drought Contingency Plan annually to determine if any amendments are necessary and properly respond to drought conditions locally.

Performance Standard: A summary of the evaluation of the District's Drought Contingency Plan and any revisions to the plan for proper response to drought conditions will be included in the District's Annual Report.

12.5.B. Track Drought Conditions

Objective: The District will monitor drought conditions using a suitable source such as the U.S. Drought Monitor or the Palmer Drought Severity Index Map.

Performance Standard: Link's on the District's web page to the Palmer Drought Severity Index, U.S. Drought Monitor, and the TWDB's website on drought will be made available to the public.

Performance Standard: A summary of monitored drought conditions will be provided at the regular District Board meetings and in the District's Annual Report.

12.6. Addressing Conservation, Recharge Enhancement, and Rainwater Harvesting

12.6.A. Public Education to Emphasize Water Conservation

Objective: In coordination with efforts in waste prevention, the District will provide information on an annual basis to promote conservation. The District will use at least one of the following methods to provide information to the public annually:

a. Distribute literature packets or brochures;
b. Conduct public or school presentations;
c. Sponsor an educational program or course;
d. Provide information on the District's web site;
e. Submit an article for publication with local papers; and
f. Present displays at public events.

Performance Standard: A summary of the District's efforts to disseminate information on water conservation will be included in the District's Annual Report.

12.6.B. Recharge Enhancement

Objective: To continue education on the diversity of the resource, the District will provide information relating to recharge enhancement on the District web site.

Performance Standard: Information that has been provided on the District web site will be included or summarized in the District's Annual Report.

12.6.C. Rainwater Harvesting

Objective: The District will promote rainwater harvesting by providing information about rainwater harvesting on the District web site.

Performance Standard: Information that has been provided on the District web site will be included or summarized in the District's Annual Report.

12.7. Addressing the Desired Future Conditions of the Groundwater Resources

12.7.A. Manage and Maintain a Water Level Monitoring Program

Objective: The District will manage and maintain its existing water level monitoring program. The District will monitor water levels within the District boundaries at least annually and will be recorded in the District's database, as part of Objective 12.4.A. The District will evaluate water level trends and compare to the DFCs adopted by the District's.

Performance Standard: A description of the number of wells measured and the monitoring results of the year will be included in the District's Annual Report.

Performance Standard: An annual comparison of water level changes to the District's DFC will be evaluated and included in the District's Annual Report.

12.7.B. Monitor estimate Annual Production

Objective: The District will estimate the total annual groundwater production based on groundwater production reports, estimated exempt use, and other relevant information and compare production estimates to the Modeled Available Groundwater (MAG).

Performance Standard: An annual comparison of total recorded and estimated annual production to the District's MAG will be evaluated and included in the District's Annual Report.

12.8. Management Goals Determined Not Applicable

12.8.A. Control and Prevention of Subsidence

The geologic framework of the region precludes significant subsidence from occurring.

12.8.B. Precipitation Enhancement

With the high amount of rainfall in the District, precipitation enhancement does not appear needed. Therefore, this goal is not applicable at this time.

12.8.C. Brush Control

A significant amount of the area of the District is heavily forested with other areas in improved pasture or cultivated land. Brush control as a goal, is not applicable at this time.

REFERENCES

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APPENDICES

APPENDIX A

PUBLIC NOTICES FOR ADOPTION OF MANAGEMENT PLAN

Rusk County Groundwater Conservation District

Board of Directors Public Hearing

DISTRICT OFFICE
Conference Room
500 North High Street, Henderson, Texas 75652
November 12, 2018
4:00 P.M.

The Rusk County Groundwater Conservation District (District), in compliance with Chapter 36 of the Texas Water Code and its Rules, will receive public comment on the proposed adoption of the Management Plan of the District at a public hearing at the District's Office Conference Room, located at 500 N. High St., Henderson, Texas, 75652 on Monday, November 12, 2018 at 4:00 p.m. The District Board, at the conclusion of the public hearing, will discuss comments received and consider possible adoption of the Management Plan. Written comments may be submitted to the District on or prior to the hearing date.

A complete copy of the current Management Plan of the District and the Proposed Management Plan of the District are available at http://rcgcd.org/documents/ and the District Office, 500 North High Street, Henderson, Texas; 903.657.1900.

This notice is posted in accordance with the open meeting act.
Date Posted: October 9, 2018

FILED FOR RECORD

Oct 09,2018 01:35P

TRUDY MCGILL, COUNTY CLERK
RUSK COUNTY, TEXAS

BY:Alesha Richmond, DEPUTY

PUBLISHER'S AFFIDAVIT

THE STATE OF TEXAS

COUNTY OF RUSK

Before me, the undersigned authority, on this day personally appeared Dan Moore who being by me duly sworn, deposes and says that he is representing The Henderson News and that said newspaper meets requirements of Section 2051.044 of the Texas Government Code, to wit:

1. it devotes not less than twenty-five percent (25%) of its total column lineage to general interest items;
2. it is published at least once each week;
3. it is entered as second-class postal matter in the county where it is published;
4. it has been published regularly and continuously since 1931; and
5. it is generally circulated within Rusk County.

Publisher further deposes and says that the attached notice was publisher in said newspaper on the following date(s) to wit:

October 10, , A.D. 20 18

Dan Moore
Publisher

SUBSCRIBED AND SWORN BEFORE ME by Dan Moore who is personally known to me, on this The 10 day of October, A.D. 20 18 to certify which witness my hand and seal of office.

Notary Public, State of Texas

NANCY HARRIS
Notary Public
STATE OF TEXAS
My Comm. Exp. 04-26-2019

Reach more than

13,000 readers

each week!

THE HENDERS

Classi

CALL 903-6

classifieds@thehend

Legals

PUBLIC NOTICE COMMUNITY DEVELOPMENT BLOCK GRANT

The City of New London invites all citizens to a public hearing at 5:05 p.m. on October 15th, at the City Hall, 180 Phillips Street, New London, to review performance and obtain comments regarding its 2016 Texas CDBG Program Community Development Contract 7216341. Disabled persons or those who require auxiliary aids or services who wish to attend this meeting should contact the City Secretary at 903-895-4466 at least two days before the meeting to make arrangements.

AVISO PÚBLICO COMMUNITY DEVELOPMENT BLOCK GRANT

La ciudad de New London invita a todos sus ciudadanos a una audiencia pública el 15 de Octubre del 2018, a las 5:05 p.m. en la sala municipal localizada en 180 Philips Street en New London, para evaluar el desempeño y obtener comentarios sobre el contrato CDBG del 2016, numero 7216341. Las personas discapacitadas interesadas en atender a la audiencia pública que requieren de acomodaciones o servicios especiales, deben comunicarse con la Secretaría de la ciudad al 903-895-4466 no menos de dos días

Legals

hacer arreglos necesarios. Residentes que necesiten un intérprete deben comunicarse con la ciudad por lo menos 24 horas antes de la audiencia pública.

Tillman Infrastructure, LLC is proposing to build a **370** -foot guyed tower (**390**-ft w/appurtenances) located at: North side HWY 79, appx 0.8 miles west of County Line Rd, Henderson, TX 75652. Structure coordinates are: (N32-09-08.99/W94-35-52.08).The tower is anticipated to have FAA Style E (dual medium intensity) lighting. The Federal Communications Commission (FCC) Antenna Structure Registration (ASR Form 854) file number is **A1116899**. Interested persons may review the application at www.fcc.gov/asr/applications by entering the file number. Environmental concerns may be raised by filing a Request for Environmental Review at www.fcc.gov/asr/environmentalrequest within 30 days of the date that notice of the project is published on the FCC's website. FCC strongly encourages online filing. A mailing address for a paper filing is: FCC Requests for Environmental Review, ATTN: Ramon Williams, 445 12th Street SW,

Legals

"The Rusk County Groundwater Conservation District (District) in compliance with Chapter 36 of the Texas Water Code and its Rules, will receive public comment on the proposed adoption of the Management Plan of the District at a public hearing at the District Office, located at 500 N. High St., Henderson, Texas, 75652 on Monday, November 12, 2018 at 4:00 pm. The District Board, at the conclusion of the public hearing, will discuss comments received and consider possible adoption of the Management Plan. Written comments may be submitted to the General Manager before the date of the public hearing.

A complete copy of the current Management Plan of the District and proposed Management Plan are available at the District website http://rcgcd.org/Documents.htm and the District office, 500 North High Street, Henderson, Texas, 75652; 903.657.1900"

Call An Expert

Help Wanted

Seeking a well qualified person to run a small business in Rusk Co specifically Henderson. 6-8 hours pe 5 days per week. Must be computer li and a self starter who is able to ma at least 5 employees. Would be expe to represent the company in the comn Salary negotiable. For more informa please send a letter of inquiry along a brief resume, to the following

Department E
P.O. Box 30
Henderson, Texas 75653

We will get back to you with mor information and to set up an intervi

Help Wanted

HELP WANTED

Temporary Work – 5 Job Oper

Starting: 12/01/2018 and end 05/30/2019

We need seasonal employees to help with our b ing operation. Employees will transport bees ar to designated locations, set up and over see t Employees will check on a regular route of e and the status of the bees, hives and will extra from the hives. Assemble new boxes, frames an They will check for damages or any other mish occur. Medicate and treat bees as directed. San pallets and boxes. Load bees and boxes to mov ers will do minor repairs and regular mainter all transportation vehicles, trailers and other eq used. Workers must be capable of lifting and 50 pounds and no allergic reaction to bee sti phones are limited to business calls only. N No smoking or drinking of alcoholic beverage working hours. Require a regular driver's lice employer, Linda Mackrill DBA Beckville Bee fr ville, TX will pay the adverse effect wage rate o hr. The employer guarantees ¾ of the workda work contract. The work tools, supplies and e are provided without cost to the worker, if a Free housing is provided to workers who canno ably return to their permanent residence at t the workday. Transportation and subsistence to the worksite will be provided or paid by the upon completion of 50% of the work contrac lier. Workers interested in the job should con local office 101 E 15th St, Room 202T, Austin, Phone: 512-475-2571 or contact their near State Workforce agency and mention job order

APPENDIX B

NOTIFICATION & EVIDENCE OF COORDINATING WITH SURFACE WATER ENTITIES

From:	Amanda Maloukis
To:	"Kelley Holcomb"
Subject:	RCGCD Management Plan to ANRA
Date:	Tuesday, November 13, 2018 11:01:30 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Holcomb,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	rchote@hendersontx.us
Cc:	Matt Linthicum
Subject:	RCGCD Management Plan to City of Henderson
Date:	Tuesday, November 13, 2018 11:25:27 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Chote,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	josh.selleck@cityofkilgore.com
Cc:	Clay Evers (clay.evers@cityofkilgore.com)
Subject:	RCGCD Management Plan to City of Kilgore
Date:	Tuesday, November 13, 2018 11:26:50 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Selleck,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	crossroadssud@hotmail.com
Subject:	RCGCD Management Plan to Crossroads SUD
Date:	Tuesday, November 13, 2018 11:44:29 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Slayton,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	eldervillewsc@yahoo.com
Subject:	RCGCD Management Plan to Elderville WSC
Date:	Tuesday, November 13, 2018 11:50:03 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

---

To Elderville WSC,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	erin@lkcherokee.com
Subject:	RCGCD Management Plan to Lake Cherokee
Date:	Tuesday, November 13, 2018 11:31:52 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Ms. Summerlin,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	David Mason
Subject:	RCGCD Management Plan to Lake Striker
Date:	Tuesday, November 13, 2018 11:29:26 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Mason,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	Spicer, Gary
Cc:	Bayle, Ryan
Subject:	RCGCD Management Plan to Luminant
Date:	Tuesday, November 13, 2018 11:42:17 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Spicer,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	"Michael R. Farrell"
Subject:	RCGCD Management Plan to Southern Utilities
Date:	Tuesday, November 13, 2018 11:46:02 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Farrell,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	"dmontagne@sratx.org"
Cc:	"lpeveto@sratx.org"
Subject:	RCGCD Management Plan to SRA
Date:	Tuesday, November 13, 2018 11:23:31 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

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Dear Mr. Montagne,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with 31 TAC §356.51 and TWC §36.1071(a), the District is providing a digital copy of the Management Plan for your review. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	David Alford
Subject:	RCGCD Management Plan Adopted
Date:	Tuesday, November 13, 2018 10:43:34 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Alford,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with District Rules, the District is providing a digital copy of the Management Plan. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab or here.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	awhitaker@pcgcd.org
Subject:	RCGCD Management Plan Adopted
Date:	Tuesday, November 13, 2018 10:48:33 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Ms. Whitaker,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with District Rules, the District is providing a digital copy of the Management Plan. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	Jackie Risner
Subject:	RCGCD Management Plan Adopted
Date:	Tuesday, November 13, 2018 10:49:21 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Mr. Risner,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with District Rules, the District is providing a digital copy of the Management Plan. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab or here.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

From:	Amanda Maloukis
To:	Corley, Stacy
Subject:	RCGCD Management Plan Adopted
Date:	Tuesday, November 13, 2018 10:51:53 AM
Attachments:	RCGCD Amended MP - DFC for 11-2018 with Appendices.pdf

Dear Ms. Corley,

The Rusk County Groundwater Conservation District (District) adopted its most recent Management Plan November 12, 2018 after public hearing by the District's Board of Directors.

In accordance with District Rules, the District is providing a digital copy of the Management Plan to RWPG I. The Management Plan can also be viewed at the District's website, www.rcgcd.org located in the 'Documents' tab.

If you would like to provide any comments or have any concerns, please contact the District Office, (903)657-1900.

Sincerely,

Amanda Maloukis

General Manager
Rusk County Groundwater Conservation District
500 North High St. | Henderson, TX 75652
Phone (903)657-1900 | Fax (903)657-1922 | amanda@rcgcd.org

APPENDIX C

CERTIFIED COPY OF ADOPTED RESOLUTION

RUSK COUNTY
GROUNDWATER CONSERVATION DISTRICT

Certificate of Resolution
Resolution 2018-04

A RESOLUTION OF THE RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT ADOPTING ITS UPDATED MANAGEMENT PLAN FOR SUBMITTAL TO THE TEXAS WATER DEVELOPMENT BOARD FOR CERTIFICATION

WHEREAS, the Rusk County Groundwater Conservation District ("District") is charged by the Texas Legislature with providing for the conservation, preservation, protection, and prevention of waste of groundwater, and of groundwater resources in Rusk County, Texas, under §36.0015, Tex. Water Code;

WHEREAS, the District is authorized to make and enforce fair and impartial rules to manage groundwater resources as scientifically necessary to conserve and protect groundwater resources in the area under §36.101, Tex. Water Code;

WHEREAS, pursuant to §§36.1071 and 36.1072, Tex. Water Code, following notice and hearing, the District developed a comprehensive management plan that addresses the required management goals, as applicable, and shall submit the updated Management Plan to the Texas Water Development Board as provided under §§36.1071, 36.1072, and 36.1073 Tex. Water Code; and

WHEREAS, the District initially submitted its Management Plan to the Texas Water Development Board in July of 2018 for pre-review, made revisions requested by the Texas Water Development Board staff and received their preliminary approval.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT THAT:

THE DISTRICT ADOPTS THE RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT UPDATED MANAGEMENT PLAN AND SUBMITS IT TO THE TEXAS WATER DEVELOPMENT BOARD FOR REVIEW AND APPROVAL.

The motion passed with 5 ayes, and 0 nayes.

PASSED AND APPROVED this the 12th day of November 2018.

RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT

SIGNED AND SEALED the 12th day of November 2018

Bobby Brown, President

ATTESTED BY:

David C. Powell, Vice President

APPENDIX D

GAM RUN 14-011

GAM Run 14-011: Rusk County Groundwater Conservation District Management Plan

by Rohit R. Goswami, Ph.D.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-0495
June 2, 2014

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Rohit Raj Goswami under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on June 2, 2014

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GAM RUN 14-011: RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Rohit R. Goswami, Ph.D.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-095
June 2, 2014

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report—Part 2 of a two-part package of information from the TWDB to Rusk County Groundwater Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Historical Water Use/State Water Plan data report. The district will receive the Historical Water Use/State Water Plan data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, stephen.allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for Rusk County Groundwater Conservation District should be adopted by the district on or before September 15, 2015 and submitted to the executive administrator of the TWDB on or before October 15, 2015. The current management plan for Rusk County Groundwater Conservation District expires on December 14, 2015.

This report discusses the methods, assumptions, and results from a model run using the groundwater availability model for the Carrizo-Wilcox, Queen City and Sparta aquifers. This model run replaces the results of GAM Run 09-020 (Aschenbach, 2009). GAM Run 14-011 meets current standards set after the release of GAM Run 09-020 including use of the official aquifer boundaries within the district rather than the entire active area of the model within the district. Rusk County Groundwater Conservation District does not contain the Sparta Aquifer. Tables 1 and 2 summarize the groundwater availability model data required by statute, and Figures 1 and 2 show the area of the model from which the values in the tables were extracted. If after review of the figures, Rusk County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the northern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was run for this analysis. Water budgets for Rusk County Groundwater Conservation District were extracted for the historical model period (1980-1999) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of each aquifer located within the district is summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used version 2.01 of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

- This groundwater availability model includes eight layers which generally represent the Sparta Aquifer (Layer 1), the Weches Formation confining unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Formation confining unit (Layer 4), the Carrizo Formation (Layer 5), the Calvert Bluff Formation (Layer 6), the Simsboro Formation (Layer 7), and the Hooper Formation (Layer 8). Individual water budgets for the district were determined for the the Queen City Aquifer (Layer 3) and the Carrizo-Wilcox Aquifer (Layer 5 through Layer 8, collectively).

- Groundwater in the Carrizo-Wilcox and Queen City aquifers ranges from fresh to brackish in composition (Kelley and others, 2004). Groundwater with total dissolved solids of less than 1,000 milligrams per liter are considered fresh and total dissolved solids of 1,000 to 10,000 milligrams per liter are considered brackish.

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the respective aquifers located within the district and averaged over the duration of the calibration and verification portion of the model run in the district, as shown in Tables 1 and 2.

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers—where the aquifer is exposed at land surface—within the district.

- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow” to an aquifer from an

overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

The information needed for the district's management plan is summarized in Tables 1 and 2. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located (Figures 1 and 2).

TABLE 1: SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER THAT IS NEEDED FOR RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	70,358
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	25,743
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	4,016
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	14,269
Estimated net annual volume of flow between each aquifer in the district	To the Carrizo-Wilcox Aquifer from the Reklaw Formation confining unit	2,147

gcd boundary date = 09.25.13, county boundary date = 02.02.11, qcsp_n model grid date = 05.01.14

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE QUEEN CITY, SPARTA, AND CARRIZO-WILCOX AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE CARRIZO-WILCOX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE QUEEN CITY AQUIFER THAT IS NEEDED FOR RUSK COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	1,200
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Queen City Aquifer	227
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	63
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	62
Estimated net annual volume of flow between each aquifer in the district	From the Queen City Aquifer to the Reklaw Formation confining unit	1,176
	From the Queen City Formation to the Queen City Aquifer	75

gcd boundary date = 09.25.13, county boundary date = 02.02.11, qcsp_n model grid date = 05.01.14

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE QUEEN CITY, SPARTA, AND CARRIZO-WILCOX AQUIFERS FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE QUEEN CITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional-scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

Aschenbach, E., 2009, GAM Run 09-020: Texas Water Development Board, GAM Run 09-020 Report, 6 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR09-20.pdf.

Fryar, D., Senger, R., Deeds, N., Pickens, J., Jones, T., Whallon, A. J., and Dean, K. E., 2003, Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer: contract report to the Texas Water Development Board, 529 p., http://www.twdb.texas.gov/groundwater/models/gam/czwx_n/CZWX_N_Full_Report.pdf

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models, U.S. Geological Survey Groundwater Software.

Harbaugh, A. W., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference ground-water flow model: U.S. Geological Survey Open-File Report 96–485, 56 p.

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p., http://www.twdb.texas.gov/groundwater/models/gam/qcsp/qcsp.asp.

National Research Council, 2007, Models in Environmental Regulatory Decision Making Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p., http://www.nap.edu/catalog.php?record_id=11972.

Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf

APPENDIX E

GAM RUN 17-024 MAG

GAM RUN 17-024 MAG: MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 11

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Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
June 19, 2017

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6/19/17

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GAM RUN 17-024 MAG: MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 11

Shirley C. Wade, Ph.D., P.G.
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Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
June 19, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 11 for the Carrizo-Wilcox, Queen City, and Sparta aquifers is summarized by decade for the groundwater conservation districts (Tables 2 through 4 respectively) and for use in the regional water planning process (Tables 5 through 7 respectively). The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 349,000 acre-feet per year in 2010 to approximately 341,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 223,000 acre-feet per year in 2010 to approximately 222,000 acre-feet per year in 2070 (Table 3). The modeled available groundwater estimate for the Sparta Aquifer is approximately 2,700 acre-feet per year for each decade from 2010 to 2070 (Table 4). The estimates were extracted from results of a model run using the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (version 2.01). The model run files, which meet the desired future conditions adopted by district representatives of Groundwater Management Area 11, were submitted to the Texas Water Development Board (TWDB) on February 15, 2017, as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 11. The explanatory report and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on March 13, 2017.

REQUESTOR:

Ms. Leah Adams, coordinator of Groundwater Management Area 11.

DESCRIPTION OF REQUEST:

In a letter dated February 15, 2017, Dr. William R. Hutchison, on behalf of Groundwater Management Area 11, provided the TWDB with the desired future conditions of the Carrizo-Wilcox, Queen City, and Sparta aquifers adopted by the groundwater conservation districts in Groundwater Management Area 11. The desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers are described in Attachment B of the Resolution to Adopt Desired Future Conditions for Aquifers in Groundwater Management Area 11, adopted January 11, 2017, by the groundwater conservation districts within Groundwater Management Area 11. The desired future conditions, excerpted from Attachment B, are presented below:

"Table 5 [Table 1 below] from GMA 11 Technical Memorandum 16-02 (Draft 2), dated March 25, 2016 lists the proposed desired future conditions, and is presented below [Table 1]. As described in the technical memorandum, the proposed desired future conditions are average drawdowns (in feet) from year 2000 conditions to 2070 conditions were largely based on GAM Scenario 4. Based on an analysis of model output and model limitations, the output from the model was modified to develop the proposed desired future conditions as follows:

- Layers 2 and 4 (the confining units) were eliminated, and Table 5 includes only aquifer units. Areas that have no active cells are designated as NP (for not present).
- Layers 5, 6, 7, and 8 are combined, and a single drawdown value for the Carrizo-Wilcox Aquifer are [sic] listed.
- All areas that are less than 200 square miles are eliminated (noted as NRS, or not relevant for purposes of joint planning due to size of area).
- Areas with negative drawdown that are greater than 200 square miles have had the negative drawdown cells eliminated from the average drawdown calculation, effectively assuming that those cells have a zero drawdown, and that the negative drawdown areas are a result of model limitations, as discussed (designated in yellow).
- The desired future condition in Panola County for the Carrizo-Wilcox Aquifer is listed as 3 feet. The actual average using all data from the model is 2 feet. If the areas with negative drawdown are assumed to be zero, the revised average is 4 feet. As presented at the March 22, 2016 GMA 11 meeting, Mr. Wade Oliver (representing the Panola County GCD) evaluated the average drawdown under Scenario 4 using an alternative analytical modeling approach and concluded that the drawdown was 3 feet. Thus, Mr. Oliver's result is consistent with the midpoint between the two GAM-based drawdown approaches."

TABLE 1. DRAWDOWN FOR USE AS DESIRED FUTURE CONDITIONS (2000 TO 2070 IN FEET) [TABLE 5 FROM GMA 11 TECHNICAL MEMORANDUM 16-02 (DRAFT 2), DATED MARCH 25, 2016].).

County	Sparta	Queen City	Carrizo-Wilcox
Anderson	NRS	9	90
Angelina	16	NRS	48
Bowie	NP	NP	5
Camp	NP	NRS	33
Cass	NP	10	68
Cherokee	NRS	14	99
Franklin	NP	NP	14
Gregg	NP	NRS	58
Harrison	NP	1	18
Henderson	NP	5	50
Hopkins	NP	NP	3
Houston	3	6	80
Marion	NP	24	45
Morris	NP	NRS	46
Nacogdoches	5	4	29
Panola	NP	NP	3
Rains	NP	NP	1
Rusk	NP	NRS	23
Sabine	1	NP	9
San Augustine	2	NP	7
Shelby	NP	NP	1
Smith	NP	17	119
Titus	NP	NRS	11
Trinity	9	NRS	51
Upshur	NP	9	77
Van Zandt	NP	NRS	21
Wood	NP	5	89
Grand Total	4	10	56

Notes: NP = Not present
NRS = Not relevant due to size (less than 200 square miles)
Yellow Cells represent average drawdown calculations that assume negative drawdown is zero (model artifact and model limitation)
Green Cell represents the recommended DFC for Panola County as described above

TWDB staff reviewed the model files associated with the desired future conditions and received clarification on procedures and assumptions from the Groundwater Management Area 11 Technical Coordinator on March 13 and 15, 2017. Questions included whether drawdown averages and modeled available groundwater values are based on official aquifer extent or model extent, whether to include dry cells in drawdown averaging, methods for calculating Panola County drawdown, and how to re-calculate average drawdowns for counties with net negative average drawdowns. The clarifications are included in the Parameters and Assumptions Section of this report.

The Groundwater Management Area 11 Technical Coordinator was notified on May 3, 2017 that the modeled available groundwater values for several counties would not necessarily match the pumping values presented in Technical Memorandum 16-02 (Hutchison, 2016). The pumping values presented in Technical Memorandum 16-02 appear to be based on the model extent, while the modeled available groundwater values have been extracted based on the official aquifer.

METHODS:

The groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Figures 1 through 4) was run using the model files submitted with the explanatory report (Hutchison, 2017). Model-calculated drawdowns were extracted for the year 2070. Drawdown averages were calculated for each county by aquifer and for the entire Groundwater Management Area 11 by aquifer. As specified in the desired future condition resolution and further clarification, drawdown for cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions within one foot.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 11 (Tables 2 through 4). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 11 (Tables 5 through 7).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), “modeled available groundwater” is the estimated average amount of water that may be produced annually to

achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the modeled available groundwater estimates are described below:

- We used Version 2.01 of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo (Layer 5), the Upper Wilcox (Layer 6), the Middle Wilcox (Layer 7), and the Lower Wilcox (Layer 8). Layers represent equivalent geologic units outside of the official aquifer extents. In the case of Layers 6 through 8 in areas where the Upper, Middle, or Lower Wilcox are not distinct, then the corresponding layer represents part of an adjoining Wilcox unit.

- In the Sabine Uplift area, the Simsboro Formation (Middle Wilcox Aquifer) is not distinguishable and the Wilcox Group is informally divided into the Upper Wilcox and the Lower Wilcox aquifers (Fryar and others, 2003). In the current version of the groundwater availability model, layers 6 and 7 represent the Upper Wilcox and Lower Wilcox aquifers in this area. Layer 8 is included in the model in this area, but it is of nominal thickness.

- The model was run with MODFLOW-96 (Harbaugh and others, 1996).

- Drawdown averages and modeled available groundwater values were based on the official aquifer boundaries rather than the extent of the model area (Figures 2, 3, and 4).

- Drawdown for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.

- If a county with an area greater than 200 square miles had a net negative drawdown average the average was re-calculated by assuming all negative drawdowns were zero. The zero values were included in the averaging. This assumption applies to San Augustine County in the Sparta Aquifer and Wood County in the Queen City Aquifer as noted in Table 1. It also applies to Hopkins and Rains counties in the Carrizo-Wilcox Aquifer although those counties were not noted in Table 1 (Table 1 of the Resolution).

- A tolerance of one foot was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.

- Drawdown for Panola County was estimated from the groundwater availability modeling results and the average drawdown is within the one foot tolerance of the desired future condition for Panola County (model results drawdown = 2 feet and desired future condition drawdown= 3 feet).

- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 349,000 acre-feet per year in 2010 to approximately 341,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 223,000 acre-feet per year in 2010 to approximately 222,000 acre-feet per year in 2070 (Table 3). The modeled available groundwater estimate for the Sparta Aquifer is approximately 2,700 acre-feet per year for each decade from 2010 to 2070 (Table 4). The modeled available groundwater is summarized by groundwater conservation district and county for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 2, 3, and 4 respectively). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 5, 6, and 7 respectively). Small differences of values between table summaries are due to rounding.

The Gulf Coast, Nacatoch, Trinity, and Yegua-Jackson aquifers were declared non-relevant for the purpose of adopting desired future conditions by the Groundwater Management Area 11 Districts; therefore, modeled available groundwater values were not calculated for those aquifers.

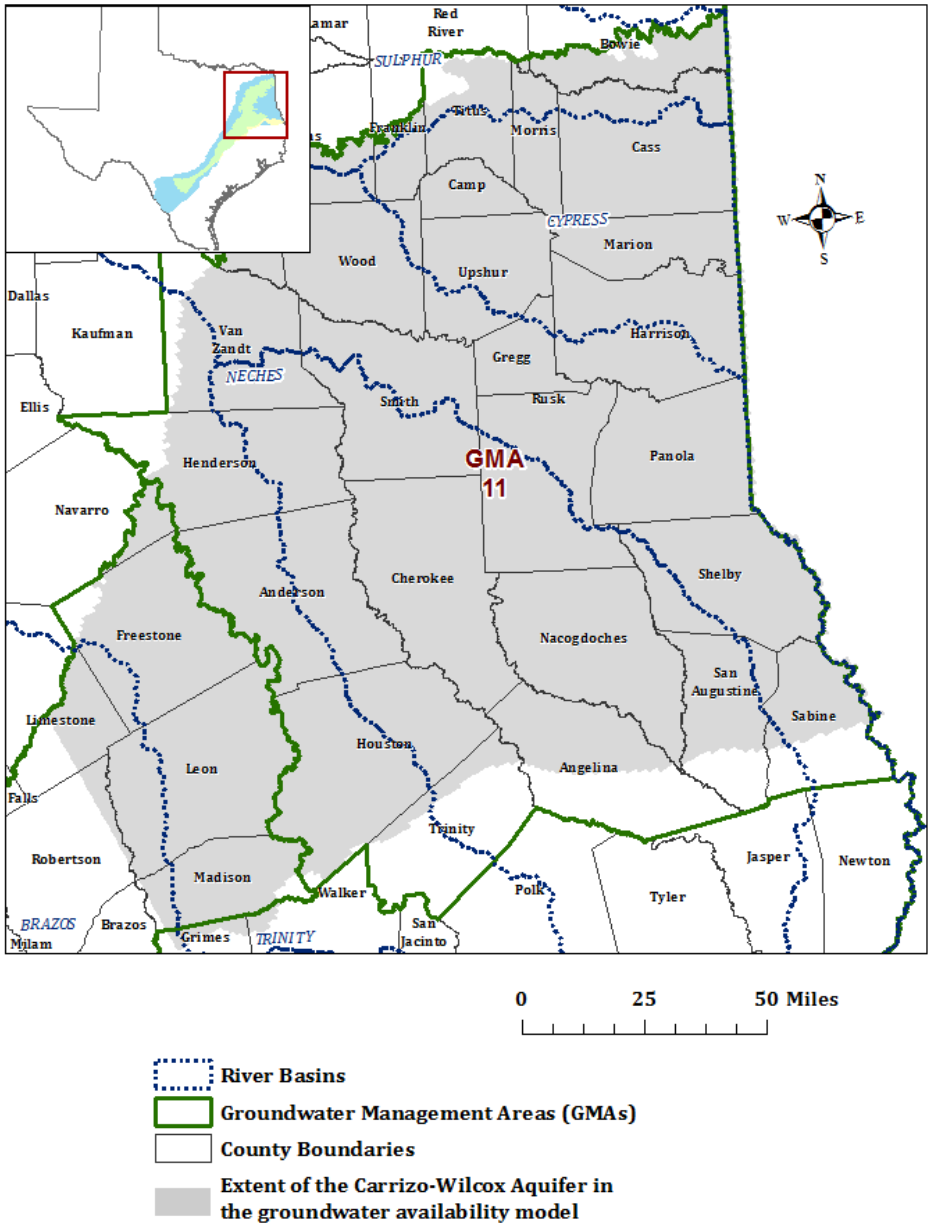

FIGURE 1. GROUNDWATER MANAGEMENT AREA (GMA) 11 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

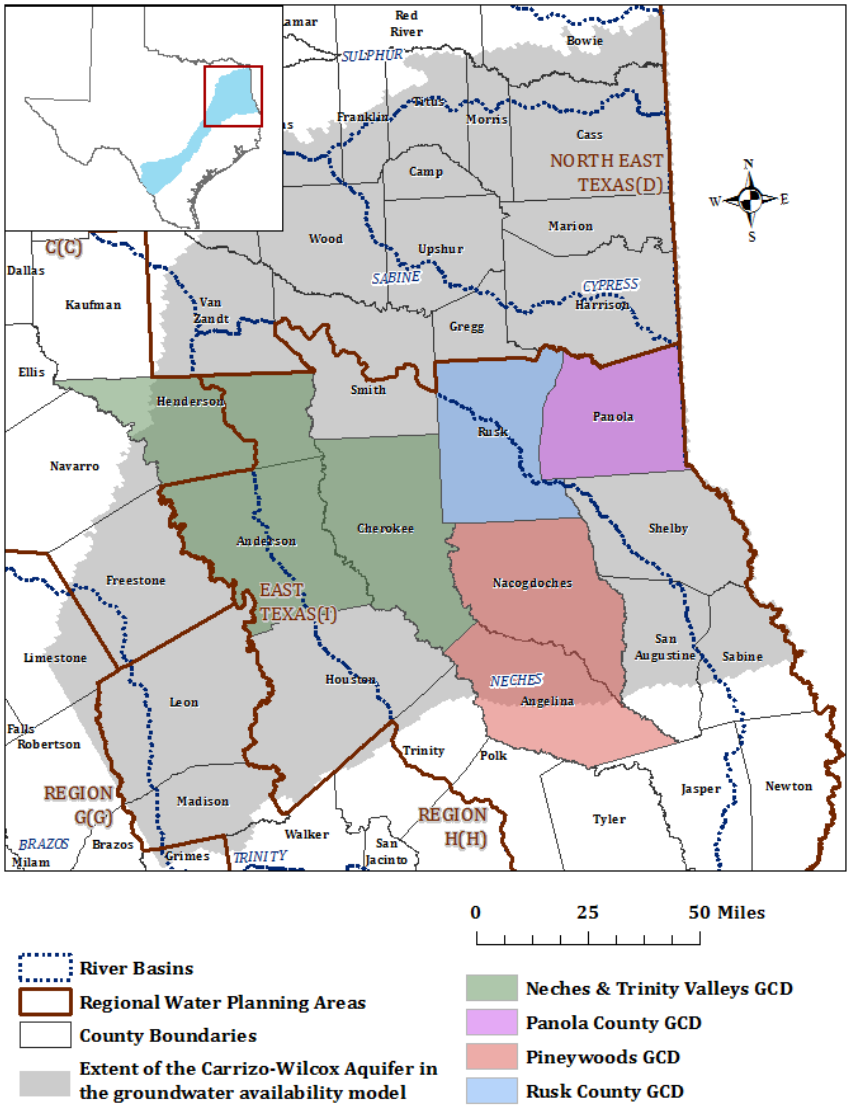

FIGURE 2. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

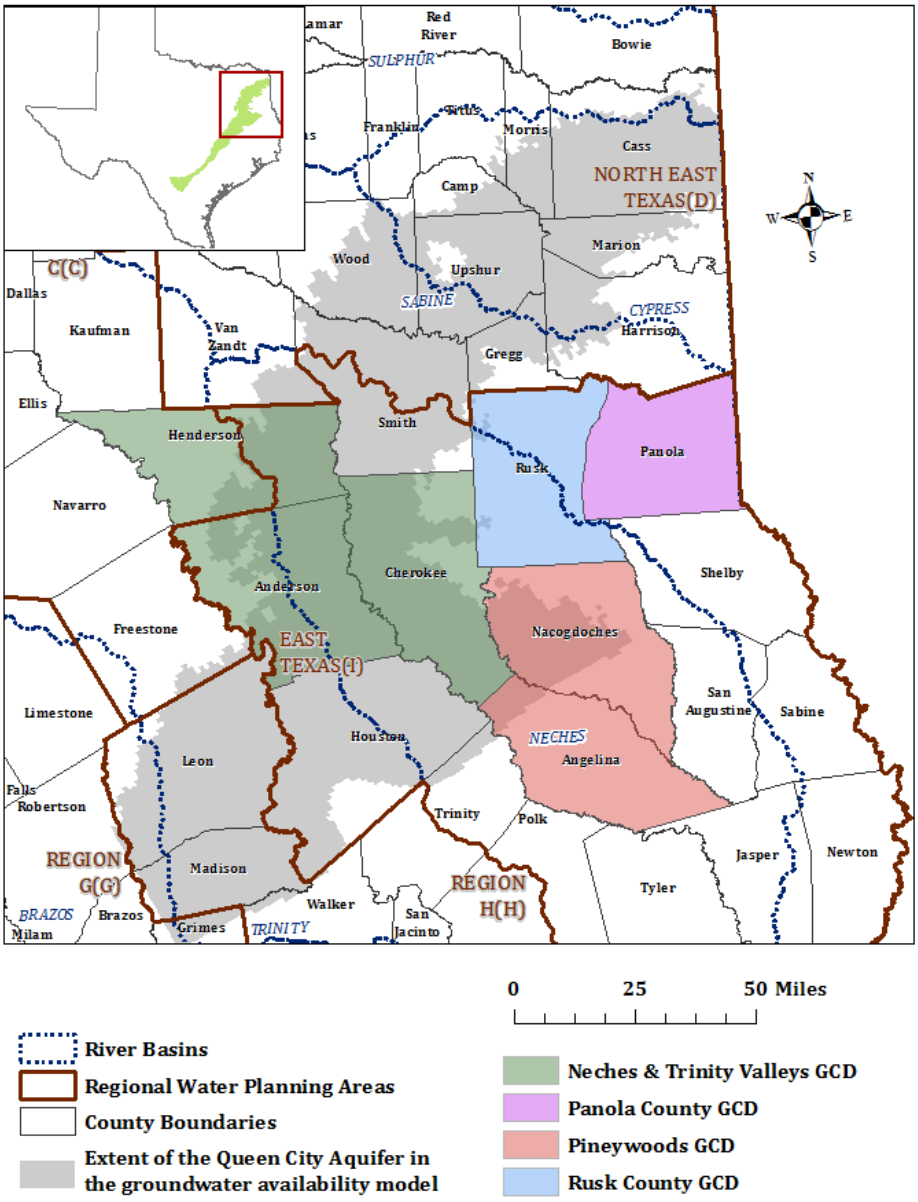

FIGURE 3. REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE QUEEN CITY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

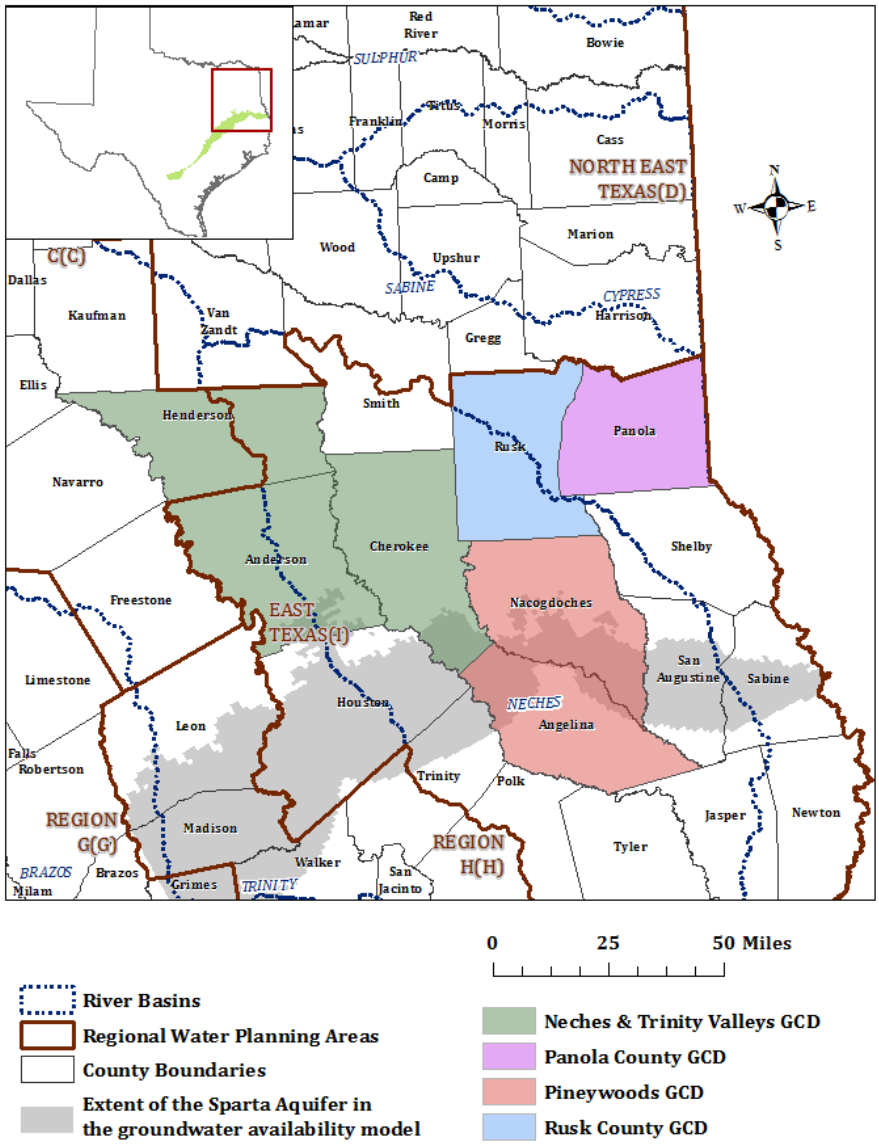

FIGURE 4. REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE SPARTA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 11 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
Neches & Trinity Valleys GCD	Anderson	Carrizo-Wilcox	29,088	29,088	29,088	29,088	29,088	29,088	29,088
Neches & Trinity Valleys GCD	Cherokee	Carrizo-Wilcox	20,933	20,933	20,933	20,933	20,933	20,933	20,470
Neches & Trinity Valleys GCD	Henderson	Carrizo-Wilcox	13,866	13,866	13,866	13,866	13,768	13,614	13,585
Neches & Trinity Valleys GCD Total		**Carrizo-Wilcox**	**63,886**	**63,886**	**63,886**	**63,886**	**63,789**	**63,634**	**63,143**
Panola County GCD	Panola	**Carrizo-Wilcox**	**8,376**	**8,376**	**8,218**	**8,218**	**8,218**	**8,068**	**8,068**
Pineywoods GCD	Angelina	Carrizo-Wilcox	27,591	27,591	27,591	27,591	27,591	27,591	27,591
Pineywoods GCD	Nacogdoches	Carrizo-Wilcox	24,181	24,181	24,181	24,181	24,181	24,181	24,181
Pineywoods GCD Total		**Carrizo-Wilcox**	**51,773**	**51,773**	**51,773**	**51,773**	**51,773**	**51,773**	**51,773**
Rusk County GCD Total	Rusk	**Carrizo-Wilcox**	**20,847**	**20,837**	**20,837**	**20,837**	**20,818**	**20,818**	**20,818**
Total (GCDs)		**Carrizo-Wilcox**	**144,882**	**144,872**	**144,714**	**144,714**	**144,598**	**144,293**	**143,801**
No District-County	Bowie	Carrizo-Wilcox	10,845	9,872	9,558	9,278	9,278	8,999	8,999
No District-County	Camp	Carrizo-Wilcox	4,050	4,050	4,050	4,050	4,050	4,050	4,050
No District-County	Cass	Carrizo-Wilcox	18,078	18,023	17,925	17,863	17,786	17,702	17,626
No District-County	Franklin	Carrizo-Wilcox	9,786	9,786	9,786	9,786	9,786	9,786	9,786
No District-County	Gregg	Carrizo-Wilcox	8,041	8,041	8,041	8,041	8,041	8,041	8,041
No District-County	Harrison	Carrizo-Wilcox	11,165	11,035	10,961	10,921	10,873	10,853	10,827
No District-County	Hopkins	Carrizo-Wilcox	6,392	6,392	6,392	6,392	6,392	6,392	6,392
No District-County	Houston	Carrizo-Wilcox	26,294	26,294	26,294	26,294	26,294	26,294	26,294
No District-County	Marion	Carrizo-Wilcox	2,729	2,726	2,726	2,726	2,726	2,726	2,726

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
No District-County	Morris	Carrizo-Wilcox	2,627	2,569	2,569	2,569	2,569	2,569	2,569
No District-County	Rains	Carrizo-Wilcox	1,922	1,839	1,839	1,839	1,802	1,802	1,745
No District-County	Red River	Carrizo-Wilcox	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Sabine	Carrizo-Wilcox	3,606	3,606	3,606	3,606	3,606	3,606	3,606
No District-County	San Augustine	Carrizo-Wilcox	1,439	1,439	1,439	1,439	1,439	1,439	1,439
No District-County	Shelby	Carrizo-Wilcox	11,210	10,894	10,441	10,305	9,723	9,287	9,100
No District-County	Smith	Carrizo-Wilcox	35,951	35,951	35,925	35,925	35,925	35,912	35,889
No District-County	Titus	Carrizo-Wilcox	10,354	10,052	9,902	9,672	9,624	9,573	9,472
No District-County	Trinity	Carrizo-Wilcox	368	368	368	368	368	368	368
No District-County	Upshur	Carrizo-Wilcox	7,132	7,132	7,132	7,132	7,132	7,132	7,132
No District-County	Van Zandt	Carrizo-Wilcox	10,330	10,330	10,330	10,157	10,098	10,098	9,971
No District-County	Wood	Carrizo-Wilcox	21,544	21,457	21,413	21,338	21,316	21,292	21,237
No District-County Total		**Carrizo-Wilcox**	**203,863**	**201,856**	**200,696**	**199,700**	**198,827**	**197,920**	**197,268**
Total for GMA 11		**Carrizo-Wilcox**	**348,745**	**346,728**	**345,410**	**344,414**	**343,424**	**342,213**	**341,069**

[1]A desired future condition was not specified for the Carrizo-Wilcox Aquifer in Red River County; however, other counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater.

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 11 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
Neches & Trinity Valleys GCD	Anderson	Queen City	19,101	19,101	19,101	19,101	19,101	19,101	19,101
Neches & Trinity Valleys GCD	Cherokee	Queen City	23,211	23,211	23,211	23,211	23,211	23,039	22,866
Neches & Trinity Valleys GCD	Henderson	Queen City	15,412	15,412	15,412	15,412	15,412	15,412	15,412
Neches & Trinity Valleys GCD Total		**Queen City**	**57,725**	**57,725**	**57,725**	**57,725**	**57,725**	**57,552**	**57,380**
Pineywoods GCD	Angelina	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Pineywoods GCD	Nacogdoches	Queen City	2,985	2,985	2,985	2,985	2,985	2,985	2,985
Pineywoods GCD Total		**Queen City**	**2,985**	**2,985**	**2,985**	**2,985**	**2,985**	**2,985**	**2,985**
Rusk County GCD Total	**Rusk**	**Queen City**	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Total (GCDs)		**Queen City**	**60,710**	**60,710**	**60,710**	**60,710**	**60,710**	**60,537**	**60,365**
No District-County	Camp	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Cass	Queen City	38,509	38,509	38,509	38,509	38,509	38,509	38,509
No District-County	Gregg	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Harrison	Queen City	10,071	10,071	10,071	10,071	10,071	10,071	10,071
No District-County	Houston	Queen City	2,301	2,301	2,301	2,301	2,301	2,301	2,301
No District-County	Marion	Queen City	15,407	15,407	15,407	15,407	15,407	15,338	15,271
No District-County	Morris	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Smith	Queen City	59,034	59,034	59,034	59,034	58,904	58,709	58,578
No District-County	Titus	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Trinity	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Upshur	Queen City	27,391	27,391	27,391	27,197	27,197	27,197	27,145

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
No District-County	Van Zandt	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
No District-County	Wood	Queen City	10,046	10,046	10,046	10,046	10,046	10,046	10,046
No District-County Total		**Queen City**	**162,759**	**162,759**	**162,759**	**162,566**	**162,435**	**162,172**	**161,922**
Total for GMA 11		**Queen City**	**223,469**	**223,469**	**223,469**	**223,275**	**223,145**	**222,709**	**222,287**

[1]Counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater. For additional information in pumping in the model run see Table 6 from Technical Memorandum 16-02 (Hutchison, 2016).

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 11 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
Neches & Trinity Valleys GCD	Anderson	Sparta	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Neches & Trinity Valleys GCD	Cherokee	Sparta	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Neches & Trinity Valleys GCD Total		**Sparta**	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Pineywoods GCD	Angelina	Sparta	371	371	371	371	371	371	371
Pineywoods GCD	Nacogdoches	Sparta	365	365	365	365	365	365	365
Pineywoods GCD Total		**Sparta**	**737**	**737**	**737**	**737**	**737**	**737**	**737**
Total (GCDs)		**Sparta**	**737**	**737**	**737**	**737**	**737**	**737**	**737**
No District-County	Houston	Sparta	1,454	1,454	1,454	1,454	1,454	1,454	1,454
No District-County	Sabine	Sparta	197	197	197	197	197	197	197
No District-County	San Augustine	Sparta	166	166	166	166	166	166	166
No District-County	Trinity	Sparta	182	182	182	182	182	182	182
No District-County Total		**Sparta**	**1,999**	**1,999**	**1,999**	**1,999**	**1,999**	**1,999**	**1,999**
Total for GMA 11		**Sparta**	**2,736**	**2,736**	**2,736**	**2,736**	**2,736**	**2,736**	**2,736**

[1]Counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater. For additional information in pumping in the model run see Table 6 from Technical Memorandum 16-02 (Hutchison, 2016).

TABLE 5. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 11. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Anderson	I	Neches	Carrizo-Wilcox	23,335	23,335	23,335	23,335	23,335	23,335
Anderson	I	Trinity	Carrizo-Wilcox	5,753	5,753	5,753	5,753	5,753	5,753
Angelina	I	Neches	Carrizo-Wilcox	27,591	27,591	27,591	27,591	27,591	27,591
Bowie	D	Sulphur	Carrizo-Wilcox	9,872	9,558	9,278	9,278	8,999	8,999
Camp	D	Cypress	Carrizo-Wilcox	4,050	4,050	4,050	4,050	4,050	4,050
Cass	D	Cypress	Carrizo-Wilcox	15,159	15,132	15,132	15,119	15,106	15,094
Cass	D	Sulphur	Carrizo-Wilcox	2,864	2,794	2,731	2,667	2,596	2,532
Cherokee	I	Neches	Carrizo-Wilcox	20,933	20,933	20,933	20,933	20,933	20,470
Franklin	D	Cypress	Carrizo-Wilcox	7,765	7,765	7,765	7,765	7,765	7,765
Franklin	D	Sulphur	Carrizo-Wilcox	2,021	2,021	2,021	2,021	2,021	2,021
Gregg	D	Cypress	Carrizo-Wilcox	862	862	862	862	862	862
Gregg	D	Sabine	Carrizo-Wilcox	7,179	7,179	7,179	7,179	7,179	7,179
Harrison	D	Cypress	Carrizo-Wilcox	6,183	6,109	6,070	6,036	6,016	5,990
Harrison	D	Sabine	Carrizo-Wilcox	4,851	4,851	4,851	4,837	4,837	4,837
Henderson	C	Trinity	Carrizo-Wilcox	7,829	7,829	7,829	7,732	7,577	7,548
Henderson	I	Neches	Carrizo-Wilcox	6,036	6,036	6,036	6,036	6,036	6,036
Hopkins	D	Cypress	Carrizo-Wilcox	313	313	313	313	313	313
Hopkins	D	Sabine	Carrizo-Wilcox	2,842	2,842	2,842	2,842	2,842	2,842
Hopkins	D	Sulphur	Carrizo-Wilcox	3,237	3,237	3,237	3,237	3,237	3,237
Houston	I	Neches	Carrizo-Wilcox	22,488	22,488	22,488	22,488	22,488	22,488
Houston	I	Trinity	Carrizo-Wilcox	3,806	3,806	3,806	3,806	3,806	3,806
Marion	D	Cypress	Carrizo-Wilcox	2,726	2,726	2,726	2,726	2,726	2,726
Morris	D	Cypress	Carrizo-Wilcox	2,166	2,166	2,166	2,166	2,166	2,166
Morris	D	Sulphur	Carrizo-Wilcox	402	402	402	402	402	402
Nacogdoches	I	Neches	Carrizo-Wilcox	24,181	24,181	24,181	24,181	24,181	24,181
Panola	I	Cypress	Carrizo-Wilcox	6	6	6	6	6	6

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Panola	I	Sabine	Carrizo-Wilcox	8,370	8,212	8,212	8,212	8,062	8,062
Rains	D	Sabine	Carrizo-Wilcox	1,839	1,839	1,839	1,802	1,802	1,745
Red River	D	Sulphur	Carrizo-Wilcox	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Rusk	I	Neches	Carrizo-Wilcox	11,769	11,769	11,769	11,750	11,750	11,750
Rusk	I	Sabine	Carrizo-Wilcox	9,068	9,068	9,068	9,068	9,068	9,068
Sabine	I	Neches	Carrizo-Wilcox	356	356	356	356	356	356
Sabine	I	Sabine	Carrizo-Wilcox	3,249	3,249	3,249	3,249	3,249	3,249
San Augustine	I	Neches	Carrizo-Wilcox	1,149	1,149	1,149	1,149	1,149	1,149
San Augustine	I	Sabine	Carrizo-Wilcox	290	290	290	290	290	290
Shelby	I	Neches	Carrizo-Wilcox	2,577	2,288	2,151	2,018	2,018	2,018
Shelby	I	Sabine	Carrizo-Wilcox	8,317	8,154	8,154	7,705	7,269	7,081
Smith	D	Sabine	Carrizo-Wilcox	13,246	13,220	13,220	13,220	13,206	13,196
Smith	I	Neches	Carrizo-Wilcox	22,705	22,705	22,705	22,705	22,705	22,693
Titus	D	Cypress	Carrizo-Wilcox	7,215	7,064	6,834	6,786	6,735	6,634
Titus	D	Sulphur	Carrizo-Wilcox	2,838	2,838	2,838	2,838	2,838	2,838
Trinity	H	Trinity	Carrizo-Wilcox	99	99	99	99	99	99
Trinity	I	Neches	Carrizo-Wilcox	269	269	269	269	269	269
Upshur	D	Cypress	Carrizo-Wilcox	5,442	5,442	5,442	5,442	5,442	5,442
Upshur	D	Sabine	Carrizo-Wilcox	1,689	1,689	1,689	1,689	1,689	1,689
Van Zandt	D	Neches	Carrizo-Wilcox	4,317	4,317	4,317	4,317	4,317	4,317
Van Zandt	D	Sabine	Carrizo-Wilcox	4,629	4,629	4,456	4,397	4,397	4,270
Van Zandt	D	Trinity	Carrizo-Wilcox	1,384	1,384	1,384	1,384	1,384	1,384
Wood	D	Cypress	Carrizo-Wilcox	2,053	2,053	2,053	2,053	2,053	2,053
Wood	D	Sabine	Carrizo-Wilcox	19,404	19,360	19,285	19,263	19,239	19,184
GMA 11 Total			**Carrizo-Wilcox**	**346,728**	**345,410**	**344,414**	**343,424**	**342,213**	**341,069**

[1] A desired future condition was not specified for the Carrizo-Wilcox Aquifer in Red River County; however, other counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater.

TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 11. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Anderson	I	Neches	Queen City	11,828	11,828	11,828	11,828	11,828	11,828
Anderson	I	Trinity	Queen City	7,274	7,274	7,274	7,274	7,274	7,274
Angelina	I	Neches	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Camp	D	Cypress	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Cass	D	Cypress	Queen City	35,499	35,499	35,499	35,499	35,499	35,499
Cass	D	Sulphur	Queen City	3,010	3,010	3,010	3,010	3,010	3,010
Cherokee	I	Neches	Queen City	23,211	23,211	23,211	23,211	23,039	22,866
Gregg	D	Cypress	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Gregg	D	Sabine	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Harrison	D	Cypress	Queen City	7,762	7,762	7,762	7,762	7,762	7,762
Harrison	D	Sabine	Queen City	2,310	2,310	2,310	2,310	2,310	2,310
Henderson	C	Trinity	Queen City	3,345	3,345	3,345	3,345	3,345	3,345
Henderson	I	Neches	Queen City	12,067	12,067	12,067	12,067	12,067	12,067
Houston	I	Neches	Queen City	2,043	2,043	2,043	2,043	2,043	2,043
Houston	I	Trinity	Queen City	258	258	258	258	258	258
Marion	D	Cypress	Queen City	15,407	15,407	15,407	15,407	15,338	15,271
Morris	D	Cypress	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Nacogdoches	I	Neches	Queen City	2,985	2,985	2,985	2,985	2,985	2,985
Rusk	I	Neches	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Rusk	I	Sabine	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Smith	D	Sabine	Queen City	28,343	28,343	28,343	28,213	28,018	27,887
Smith	I	Neches	Queen City	30,692	30,692	30,692	30,692	30,692	30,692
Titus	D	Cypress	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Trinity	H	Trinity	Queen City	0	0	0	0	0	0
Trinity	I	Neches	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Upshur	D	Cypress	Queen City	19,642	19,642	19,448	19,448	19,448	19,396
Upshur	D	Sabine	Queen City	7,749	7,749	7,749	7,749	7,749	7,749
Van Zandt	D	Neches	Queen City	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Wood	D	Cypress	Queen City	986	986	986	986	986	986
Wood	D	Sabine	Queen City	9,060	9,060	9,060	9,060	9,060	9,060
GMA 11 Total			**Queen City**	**223,469**	**223,469**	**223,276**	**223,145**	**222,709**	**222,287**

[1]Counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater. For additional information in pumping in the model run see Table 6 from Technical Memorandum 16-02 (Hutchison, 2016).

TABLE 7. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 11. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Anderson	I	Neches	Sparta Aquifer	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Anderson	I	Trinity	Sparta Aquifer	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Angelina	I	Neches	Sparta Aquifer	371	371	371	371	371	371
Cherokee	I	Neches	Sparta Aquifer	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]	NULL[1]
Houston	I	Neches	Sparta Aquifer	477	477	477	477	477	477
Houston	I	Trinity	Sparta Aquifer	977	977	977	977	977	977
Nacogdoches	I	Neches	Sparta Aquifer	365	365	365	365	365	365
Sabine	I	Neches	Sparta Aquifer	37	37	37	37	37	37
Sabine	I	Sabine	Sparta Aquifer	160	160	160	160	160	160
San Augustine	I	Neches	Sparta Aquifer	163	163	163	163	163	163
San Augustine	I	Sabine	Sparta Aquifer	3	3	3	3	3	3
Trinity	H	Trinity	Sparta Aquifer	29	29	29	29	29	29
Trinity	I	Neches	Sparta Aquifer	154	154	154	154	154	154
GMA 11 Total			**Sparta Aquifer**	**2,736**	**2,736**	**2,736**	**2,736**	**2,736**	**2,736**

[1] Counties with fewer than 200 square miles of aquifer were noted as not relevant due to size (NRS) in the desired future condition statement. Areas which are not relevant due to size are listed with a NULL value for modeled available groundwater. For additional information in pumping in the model run see Table 6 from Technical Memorandum 16-02 (Hutchison, 2016).

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> "Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historic time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and groundwater levels in the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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APPENDIX F

ESTIMATED HISTORICAL WATER USE
&
2017 STATE WATER PLAN DATASETS

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Rusk County Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
October 2, 2018

GROUNDWATER MANAGEMENT PLAN DATA:

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)
2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2017 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 10/2/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317).

Estimated Historical Water Use
TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2017. TWDB staff anticipates the calculation and posting of these estimates at a later date.

RUSK COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	6,910	12	1,804	16	148	353	9,243
	SW	924	0	313	16,295	0	1,413	18,945
2015	GW	7,318	13	1,993	33	139	339	9,835
	SW	1,182	1	540	13,828	0	1,354	16,905
2014	GW	6,217	17	454	49	166	325	7,228
	SW	643	1	415	17,130	0	1,302	19,491
2013	GW	7,405	13	576	0	358	321	8,673
	SW	1,248	0	639	28,292	0	1,288	31,467
2012	GW	7,885	15	425	2,377	123	308	11,133
	SW	1,399	0	603	38,434	150	1,232	41,818
2011	GW	8,954	26	547	1,023	308	351	11,209
	SW	1,688	1	984	32,947	0	1,405	37,025
2010	GW	7,517	31	1,058	358	0	353	9,317
	SW	1,525	1	1,258	21,129	0	1,415	25,328
2009	GW	6,719	219	1,059	183	0	194	8,374
	SW	1,639	386	655	21,535	0	776	24,991
2008	GW	7,071	177	1,233	147	29	209	8,866
	SW	1,705	1	763	25,771	0	838	29,078
2007	GW	6,778	172	0	356	25	216	7,547
	SW	1,675	9	0	24,366	0	866	26,916
2006	GW	6,973	293	0	287	100	202	7,855
	SW	1,379	55	0	24,872	0	806	27,112
2005	GW	6,751	233	3	0	92	231	7,310
	SW	1,231	407	0	17,008	0	924	19,570
2004	GW	7,180	192	6	113	92	221	7,804
	SW	464	24	0	6,982	0	872	8,342
2003	GW	7,168	200	6	99	73	215	7,761
	SW	491	3	0	7,574	0	844	8,912
2002	GW	7,097	203	6	97	49	231	7,683
	SW	477	2	0	10,794	210	911	12,394
2001	GW	6,857	243	8	12	49	236	7,405
	SW	208	55	0	15,222	210	931	16,626

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

RUSK COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
I	CROSS ROADS SUD	SABINE	FORK LAKE/RESERVOIR	248	248	249	249	248	248
I	EASTON	SABINE	CHEROKEE LAKE/RESERVOIR	4	5	5	6	6	7
I	ELDERVILLE WSC	SABINE	CHEROKEE LAKE/RESERVOIR	95	96	96	96	95	94
I	ELDERVILLE WSC	SABINE	FORK LAKE/RESERVOIR	97	97	97	97	97	96
I	HENDERSON	NECHES	FORK LAKE/RESERVOIR	3,470	3,469	3,470	3,470	3,470	3,470
I	HENDERSON	NECHES	STRIKER LAKE/RESERVOIR	0	0	0	0	0	0
I	HENDERSON	SABINE	FORK LAKE/RESERVOIR	603	604	603	603	603	603
I	HENDERSON	SABINE	SABINE RUN-OF-RIVER	10	10	10	10	10	10
I	HENDERSON	SABINE	STRIKER LAKE/RESERVOIR	0	0	0	0	0	0
I	IRRIGATION, RUSK	NECHES	NECHES RUN-OF-RIVER	86	86	86	86	86	86
I	IRRIGATION, RUSK	SABINE	SABINE RUN-OF-RIVER	127	127	127	127	127	127
I	KILGORE	SABINE	FORK LAKE/RESERVOIR	506	841	841	839	832	821
I	LIVESTOCK, RUSK	NECHES	NECHES LIVESTOCK LOCAL SUPPLY	808	808	808	808	808	808
I	LIVESTOCK, RUSK	SABINE	SABINE LIVESTOCK LOCAL SUPPLY	308	308	308	308	308	308
I	MANUFACTURING, RUSK	NECHES	NECHES RUN-OF-RIVER	2	2	2	2	2	2
I	MANUFACTURING, RUSK	SABINE	FORK LAKE/RESERVOIR	1	1	1	1	1	1
I	MINING, RUSK	NECHES	SABINE OTHER LOCAL SUPPLY	210	0	0	0	0	0
I	MINING, RUSK	SABINE	SABINE OTHER LOCAL SUPPLY	1,020	1,230	1,230	1,230	1,230	1,230
I	STEAM ELECTRIC POWER, RUSK	SABINE	MARTIN LAKE/RESERVOIR	25,000	25,000	25,000	25,000	25,000	25,000
I	STEAM ELECTRIC POWER, RUSK	SABINE	TOLEDO BEND LAKE/RESERVOIR	17,922	17,922	17,922	17,922	17,922	17,922
	Sum of Projected Surface Water Supplies (acre-feet)			**50,517**	**50,854**	**50,855**	**50,854**	**50,845**	**50,833**

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

RUSK COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
I	CHALK HILL SUD	SABINE	323	343	364	393	428	464
I	COUNTY-OTHER, RUSK	NECHES	1,697	1,803	1,916	2,071	2,255	2,450
I	COUNTY-OTHER, RUSK	SABINE	1,192	1,267	1,346	1,455	1,584	1,722
I	CROSS ROADS SUD	SABINE	238	251	265	285	310	336
I	EASTON	SABINE	4	5	5	6	6	7
I	ELDERVILLE WSC	SABINE	119	132	145	159	174	189
I	HENDERSON	NECHES	3,254	3,564	3,874	4,226	4,611	5,014
I	HENDERSON	SABINE	566	620	673	735	801	871
I	IRRIGATION, RUSK	NECHES	56	56	56	56	56	56
I	IRRIGATION, RUSK	SABINE	44	44	44	44	44	44
I	KILGORE	SABINE	723	789	855	931	1,016	1,104
I	LIVESTOCK, RUSK	NECHES	675	684	697	709	722	722
I	LIVESTOCK, RUSK	SABINE	532	540	549	560	570	570
I	MANUFACTURING, RUSK	NECHES	304	328	348	366	393	421
I	MANUFACTURING, RUSK	SABINE	13	14	15	15	16	18
I	MINING, RUSK	NECHES	1,555	2,084	2,012	1,936	1,873	1,868
I	MINING, RUSK	SABINE	1,435	1,923	1,858	1,788	1,728	1,724
I	NEW LONDON	NECHES	215	235	257	281	306	333
I	NEW LONDON	SABINE	173	191	207	226	247	268
I	OVERTON	NECHES	61	66	72	78	85	93
I	OVERTON	SABINE	499	545	590	643	701	762
I	STEAM ELECTRIC POWER, RUSK	SABINE	27,458	32,102	37,762	44,663	53,074	63,069
I	TATUM	SABINE	240	261	283	308	336	365
I	WEST GREGG SUD	SABINE	17	18	19	20	22	24
I	WRIGHT CITY WSC	NECHES	57	62	66	72	78	85
	Sum of Projected Water Demands (acre-feet)		**41,450**	**47,927**	**54,278**	**62,026**	**71,436**	**82,579**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

RUSK COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
I	CHALK HILL SUD	SABINE	720	700	679	650	615	579
I	COUNTY-OTHER, RUSK	NECHES	753	647	534	379	195	0
I	COUNTY-OTHER, RUSK	SABINE	689	614	535	426	297	159
I	CROSS ROADS SUD	SABINE	407	395	383	363	336	309
I	EASTON	SABINE	0	0	0	0	0	0
I	ELDERVILLE WSC	SABINE	73	61	48	34	18	1
I	HENDERSON	NECHES	2,682	2,371	2,062	1,710	1,325	922
I	HENDERSON	SABINE	447	394	340	278	212	142
I	IRRIGATION, RUSK	NECHES	245	245	245	245	245	245
I	IRRIGATION, RUSK	SABINE	253	253	253	253	253	253
I	KILGORE	SABINE	148	422	356	277	182	78
I	LIVESTOCK, RUSK	NECHES	289	280	267	255	242	242
I	LIVESTOCK, RUSK	SABINE	0	0	0	0	0	0
I	MANUFACTURING, RUSK	NECHES	31	31	31	31	31	31
I	MANUFACTURING, RUSK	SABINE	1	1	1	1	1	1
I	MINING, RUSK	NECHES	-1,075	-1,814	-1,742	-1,666	-1,603	-1,598
I	MINING, RUSK	SABINE	0	-278	-213	-143	-83	-79
I	NEW LONDON	NECHES	118	98	76	52	27	0
I	NEW LONDON	SABINE	95	77	61	42	21	0
I	OVERTON	NECHES	39	34	28	22	15	7
I	OVERTON	SABINE	79	33	-12	-65	-123	-184
I	STEAM ELECTRIC POWER, RUSK	SABINE	16,743	12,099	6,439	-462	-8,873	-18,868
I	TATUM	SABINE	118	87	59	28	0	2
I	WEST GREGG SUD	SABINE	10	10	9	7	5	3
I	WRIGHT CITY WSC	NECHES	27	22	18	12	6	0
	Sum of Projected Water Supply Needs (acre-feet)		**-1,075**	**-2,092**	**-1,967**	**-2,336**	**-10,682**	**-20,729**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

RUSK COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
HENDERSON, NECHES (I)							
LAKE STRIKER DREDGING	STRIKER LAKE/RESERVOIR [RESERVOIR]	0	0	4,771	4,770	4,771	4,771
		0	**0**	**4,771**	**4,770**	**4,771**	**4,771**
HENDERSON, SABINE (I)							
LAKE STRIKER DREDGING	STRIKER LAKE/RESERVOIR [RESERVOIR]	0	0	829	830	829	829
		0	**0**	**829**	**830**	**829**	**829**
MANUFACTURING, RUSK, NECHES (I)							
ANRA-GW-NEW WELLS IN CARRIZO WILCOX AQUIFER IN RUSK COUNTY	CARRIZO-WILCOX AQUIFER [CHEROKEE]	1,600	1,600	1,600	1,600	1,600	1,600
ANRA-GW-NEW WELLS IN CARRIZO WILCOX AQUIFER IN RUSK COUNTY	CARRIZO-WILCOX AQUIFER [RUSK]	4,000	4,000	4,000	4,000	4,000	4,000
		5,600	**5,600**	**5,600**	**5,600**	**5,600**	**5,600**
MINING, RUSK, NECHES (I)							
ANRA-RUN-OF-RIVER (SUBMITTED APPLICATION)	NECHES RUN-OF-RIVER [RUSK]	1,075	1,814	1,742	1,666	1,691	1,686
		1,075	**1,814**	**1,742**	**1,666**	**1,691**	**1,686**
MINING, RUSK, SABINE (I)							
ANRA-RUN-OF-RIVER (SUBMITTED APPLICATION)	NECHES RUN-OF-RIVER [RUSK]	0	278	213	143	83	79
		0	**278**	**213**	**143**	**83**	**79**
NEW LONDON, NECHES (I)							
ANRA-COL - LAKE COLUMBIA	COLUMBIA LAKE/RESERVOIR [RESERVOIR]	0	472	474	474	473	94
		0	**472**	**474**	**474**	**473**	**94**
NEW LONDON, SABINE (I)							
ANRA-COL - LAKE COLUMBIA	COLUMBIA LAKE/RESERVOIR [RESERVOIR]	0	383	381	381	382	76
		0	**383**	**381**	**381**	**382**	**76**
OVERTON, NECHES (I)							
OVER ENHANCED PUBLIC AND SCHOOL EDUCATION	DEMAND REDUCTION [RUSK]	0	0	0	1	1	1
OVER WATER CONSERVATION PRICING	DEMAND REDUCTION [RUSK]	0	0	0	1	1	1

		0	**0**	**0**	**2**	**2**	**2**
OVERTON, SABINE (I)							
OVER ENHANCED PUBLIC AND SCHOOL EDUCATION	DEMAND REDUCTION [RUSK]	0	0	5	5	7	9
OVER ENHANCED WATER LOSS CONTROL PROGRAM	DEMAND REDUCTION [RUSK]	0	0	76	144	196	238
OVER WATER CONSERVATION PRICING	DEMAND REDUCTION [RUSK]	0	0	4	6	7	7
		0	**0**	**85**	**155**	**210**	**254**
STEAM ELECTRIC POWER, RUSK, SABINE (I)							
RUSK-SEP NEW CONTRACT	SABINE RUN-OF-RIVER [NEWTON]	0	0	0	462	8,873	18,868
		0	**0**	**0**	**462**	**8,873**	**18,868**
Sum of Projected Water Management Strategies (acre-feet)		**6,675**	**8,547**	**14,095**	**14,483**	**22,914**	**32,259**