Groundwater Management Plan

Adopted October 9, 2012

Post Oak Savannah Groundwater Conservation District
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1. DISTRICT MISSION

The Post Oak Savannah Groundwater Conservation District (POSGCD) mission is to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and to protect groundwater users, by adopting and enforcing Rules consistent with state law. The District will accomplish this mission by imposing spacing requirements, regulating production, requiring permits for wells and production, establishing water drawdown levels and monitoring groundwater levels and production, making appropriate adjustments to allowable and permitted production, and encouraging conservation.

2. TIME PERIOD OF THIS PLAN

This plan will become effective upon adoption by the POSGCD Board of Directors ("Board") and approval as administratively complete by the Texas Water Development Board. The plan will remain in effect for five (5) years after the date of certification, and thereafter until a revised plan is adopted and approved.

3. BACKGROUND

The POSGCD was created in Milam and Burleson counties by HB 1784, 77th Legislature, 2001, and a local confirmation election in November 2002. The purpose of this bill is to provide a locally controlled groundwater district to conserve and preserve groundwater, protect groundwater users, protect and recharge groundwater, prevent pollution or waste of groundwater in the central Carrizo-Wilcox area, control subsidence caused by withdrawal of water from the groundwater reservoirs in that area, and regulate the transport of water out of the boundaries of the districts. The POSGCD has 10 directors, 5 from each county. It does not have the power to tax and receives all of its revenue from fees imposed on municipal/commercial pumpers and transporters of groundwater. Successful confirmation elections were held in November 2002 in both counties in accordance with Sections 36.017, 36.018, and 36.019, Water Code, and Section 41.001, Election Code.

The POSGCD is a member of Groundwater Management Area 12 (GMA 12) and Groundwater Management Area 8 (GMA 8), whose areal extents are shown in Figure 1. To help establish desired future conditions for the relevant aquifers within the boundaries of GMA 12 and GMA 8, POSGCD will consider groundwater availability models and other data or information. As part of the joint planning process, POSGCD will establish management goals and objectives that are consistent with the desired future conditions adopted by GMA 8 and GMA 12.

4. GROUNDWATER RESOURCES

Located within the District's boundaries are portions of the Trinity, Wilcox, Carrizo, Queen City, Sparta, Yegua/Jackson, and the Brazos River Alluvium Aquifers. Figure 2 shows the locations of the outcrops of these aquifers based on the surface geology mapped by Barnes (1994), Kelley and others (2004), Deeds and others (2004), and Shah and Houston (2007). In Figure 2, the outcrop area for the Carrizo Aquifer includes the outcrop area associated with the Reklaw Formation, the outcrop area for the Queen City Aquifer includes the outcrop area associated with the Weches Formation, and the outcrop area for the Sparta Aquifer includes the outcrop area for the Catahoula Formation. Within the District, the Trinity Aquifer does not outcrop and is overlaid primarily by the Midway Formation. Table 4-1 provides the area associated with each aquifer outcrop.

Table 4-1. Aquifer Outcrop Areas in the District

Aquifer and/or Geologic Formation	Outcrop Area (square miles)
Midway Formation	346
Wilcox	348
Carrizo/Reklaw	70
Queen City/Weches	159
Sparta	76
Cook Mountain/Yegua-Jackson /Catahoula	321
Brazos River Alluvium	161
Shallow Alluvium	215
Total	1,699

(a) Trinity Aquifer. The Trinity Aquifer is located in the northwest corner of Milam County. The Trinity Aquifer refers to four geological formations considered to be relevant aquifers by GMA 8. These four geologic formations are the Paluxy Aquifer, the Glen Rose Aquifer, the Hensell Aquifer, and the Hosston Aquifer. The top and bottom surfaces for these four geological formations are defined by their model layer in the Northern Trinity GAM (Bene and others, 2004).

(b) Wilcox Aquifer. The Wilcox aquifer is a major regional aquifer system. The outcrop of the Wilcox Aquifer forms a southwest to northeast trending belt through central Milam County; the downdip portion of the Wilcox Aquifer underlies southern Milam County and all of Burleson County. Freshwater exists in the Wilcox Aquifer in both Milam County and Burleson Counties. The Wilcox Aquifer refers to three geological formations that are considered to be relevant aquifers by GMA 12. These three geologic formations are the Hooper, the Simsboro, and the Calvert Bluff. The top and bottom surfaces for these three geological formations are defined by their model layer in the Central Carrizo GAM (Dutton and others, 2003). The Upper Wilcox Aquifer is associated with the Calvert Bluff Formation. The Middle Wilcox Aquifer is associated with the Simsboro Formation. The Lower Wilcox Aquifer is associated with the Hooper Formation.

The unconfined portion of the Upper Wilcox Aquifer is where the Central Carrizo GAM (Dutton and others, 2003) simulates the water level in the Calvert Bluff Formation to be below the top of the Calvert Bluff Formation at January 2000. The unconfined portion of the Middle Wilcox Aquifer is where the Central Carrizo GAM (Dutton and others, 2003) simulates the water level in the Simsboro Formation to be below the top of the Simsboro Formation at January 2000. The unconfined portion of the Lower Wilcox Aquifer is where the Central Carrizo GAM (Dutton and others, 2003) simulates the water level in the Hooper Formation to be below the top of the Hooper Formation at January 2000

(c) Carrizo Aquifer. The Carrizo Aquifer is a regional aquifer system that occurs throughout most of the District. The outcrop of the Carrizo Aquifer forms a southwest to northeast trending belt through southern Milam County; the downdip portion of the Carrizo Aquifer underlies southern Milam County and all of Burleson County. Freshwater exists in the Carrizo Aquifer in both Milam County and Burleson Counties. The aquifer is a source of groundwater for numerous domestic wells and several large public water supply systems. The top and bottom surfaces for the Carrizo Aquifer are represented by its model layer in the Central Carrizo GAM (Dutton and others, 2003). The unconfined portion of the Carrizo Aquifer is where the Central Carrizo GAM (Dutton and others, 2003) simulates the water level in the Carrizo Formation to be below the top of the Carrizo Formation at January 2000.

(d) Queen City. The Queen City Aquifer outcrops across a 5 to 8 mile wide zone that is generally aligned along the Milam-Burleson County line. The aquifer extends down dip in Burleson County and is a source of groundwater for domestic wells and some public water supply wells. Freshwater exists in the Queen City Aquifer in both Milam County and Burleson Counties. The top and bottom surfaces for the Queen City Aquifer are represented by its model layer in the Central Carrizo GAM (Kelley and others, 2004). The unconfined portion of the Queen City Aquifer is defined as the area where the Central Carrizo GAM (Kelly and others, 2004) simulates the water table to be below the top of the Queen City Aquifer at January 2000.

(e) Sparta Aquifer. The Sparta Aquifer outcrops across a 3 to 5 mile wide zone trending southwest-northeast just north of Highway 21 in Burleson County. The Sparta extends downdip to the southeast throughout much of Burleson County. Like the Queen City Aquifer, the Sparta is used for numerous domestic water wells and some small public water supply systems in the District. Freshwater exists in the Sparta Aquifer in Burleson County. The top and bottom surfaces for the Sparta Aquifer are represented by its model layer in the Central Carrizo GAM (Kelley and others, 2004). The unconfined portion of the Sparta Aquifer is defined as the area where the Central Carrizo GAM (Kelly and others, 2004) simulates the water table to be below the top of the Sparta Aquifer at January 2000.

(f) Yegua/Jackson Aquifer. The Yegua/Jackson Aquifer outcrops across a 6 to 10 mile wide zone trending southwest-northeast south of Highway 21 in Burleson County. The Yegua/Jackson Aquifer extends down-dip to the southeast through much of Burleson County. The Yegua/Jackson Aquifer includes to all four geologic units (the upper Yegua, the lower Yegua, the upper Jackson, and the lower Jackson) represented by the model layers in the Yegua/Jackson GAM (Deeds and others, 2010). In Burleson County, the Yegua/Jackson Aquifer provides small to moderate amounts of freshwater to domestic and irrigation wells and to a few public water systems.

(g) Brazos River Alluvium Aquifer. The Brazos River Alluvium Aquifer is comprised of floodplain and terrace deposits of the Brazos River along the eastern boundary of Milam and Burleson counties. The Brazos River Alluvium Aquifer occurs only as an unconfined aquifer in POSGCD and the majority of it exists in Burleson County. The Brazos River Alluvium supplies freshwater to many irrigation wells and several domestic wells. For the most part, the water discharges from the alluvium mainly through seepage to the Brazos River, evapotranspiration, and wells. The bottom surfaces for the Brazos River Alluvium is represented by its model layer in the Central Queen City/Sparta GAM (Kelley and others, 2004).

(h) Shallow Alluvium Aquifers. Shallow alluvium aquifers have not been completely mapped across POSGCD. The aquifers represent floodplain and terrace deposits near major tributaries to the Brazos River. These aquifers are generally less than 30 feet thick, are characterized by mixtures of coarse sands and fine-grain materials, and are often well connected hydrologically to nearby streams. The area of these aquifers are denoted by alluvium deposits denoted in the BEG map of surface geology (Proctor and others, 1974).

5. MANAGEMENT ZONES

The District is divided into groundwater management zones for the purpose of evaluating and managing groundwater resources recognizing the different characteristics and anticipated future development of the aquifers in the District.

The District will establish and enforce Rules for the spacing of wells, the maximum allowable production of groundwater per acre of land located over an aquifer, require permits for production, regulate drawdown and provide for a reduction in the maximum allowable production and permitted production of groundwater per acre of land based on the different surface and subsurface characteristics and different evaluation and monitoring within the Management Zones.

The Management Zones are as follows:

(a) Trinity Management Zone. This management zone includes the Trinity Aquifer which is located beneath the footprint of the Midway outcrop shown in Figure 3. This management zone also includes the Midway Formation, which is generally a clayey deposit with low transmissivity.

(b) Brazos River Alluvium Management Zone. This management zone is located along the eastern boundaries of the District in Milam and Burleson Counties and is coterminous with the boundaries of the Brazos Alluvium outcrop in Figure 2. This zone extends to the depth of the water bearing alluvial sediments of the Brazos River Alluvium.

(c) Shallow Alluvium Management Zone. This management zone corresponds to the alluvium sediments associated with the major tributaries of the Brazos River shown in Figure 2. This zone extends to the depth of the water bearing alluvial sediments along the tributaries.

(d) Sparta and Shallow Sparta Management Zones. The Sparta Management Zone includes all of the water bearing formations of the Sparta Aquifer found in the District. The areal extent of the Sparta Management Zone is shown in Figure 3. The up-dip area of the Sparta Management Zone contains the Shallow Sparta Management Zone, which includes the unconfined portions of the Sparta Aquifer and covers the area shown in Figure 3.

(e) Queen City and Shallow Queen City Management Zones. The Queen City Management Zone includes all of the water bearing formations of the Queen City Aquifer found in the District. The areal extent of the Queen City Management Zone is shown in Figure 4. The up-dip area of the Queen City Management Zone contains the Shallow Queen City Management Zone, which includes the unconfined portions of the Queen City Aquifer and covers the area shown in Figure 4

(f) Carrizo and Shallow Carrizo Management Zones. The Carrizo Management Zone includes all of the water bearing formations of the Carrizo Aquifer found in the District. The areal extent of the Carrizo Management Zone is shown in Figure 4. The up-dip area of the Carrizo Management Zone contains the Shallow Carrizo Management Zone, which includes the unconfined portions of the Carrizo Aquifer and covers the area shown in Figure 4

(g) Upper Wilcox and Shallow Upper Wilcox Management Zones. The Upper Wilcox Management Zone includes all of the water bearing formations of the Calvert Bluff Formation found in the District. The areal extent of the Upper Wilcox Management Zone is shown in Figure 5. The up-dip area of the Upper Wilcox Management Zone contains the Shallow Upper Wilcox Management Zone, which includes the unconfined portions of the Calvert Bluff Formation and covers the area shown in Figure 5.

(h) Middle Wilcox and Shallow Middle Wilcox Management Zones. The Middle Wilcox Management Zone includes all of the water bearing formations of the Simsboro Formation found in the District. The areal extent of the Middle Wilcox Management Zone is shown in Figure 5. The up-dip area of the Middle Wilcox Management Zone contains the Shallow Middle Wilcox Management Zone, which includes the unconfined portions of the Simsboro Formation and covers the area shown in Figure 5.

(i) Lower Wilcox and Shallow Lower Wilcox Management Zones. The Lower Wilcox Management Zone includes all of the water bearing formations of the Hooper Formation found in the District. The areal extent of the Lower Wilcox Management Zone is shown in Figure 6. The up-dip area of the Lower Wilcox Management Zone contains the Shallow Lower Wilcox Management Zone, which includes the unconfined portions of the Hooper Formation and covers the area shown in Figure 6.

(j) Yegua/Jackson and Shallow Yegua/Jackson Management Zone. This zone includes the outcrop and downdip portions of the geologic units of the Yegua and the Jackson formations of

the Yegua/Jackson Aquifer, which occur in the southern portion of Burleson County. The areal extent of this management zone is shown in Figure 4. The Yegua/Jackson Management Zone contains the Shallow Yegual/Jackson Zone, which is defined as - the saturated thickness simulated by the Yegua/Jackson GAM (Deeds and others, 2010) for Model Layer 1at January 2000.

6. MANAGEMENT OF GROUNDWATER SUPPLIES

The District will evaluate and monitor groundwater conditions and regulate production consistent with this plan and the District Rules. Production will be regulated as needed to conserve groundwater, and protect groundwater users, in a manner not to unnecessarily and adversely limit production or impact the economic viability of the public, landowners and private groundwater users. In consideration of the importance of groundwater to the economy and culture of the District, the District will identify and engage in activities and practices that will permit groundwater production and, as appropriate, protect the aquifer and groundwater in accordance with this Management Plan and the District's rules. A monitoring well network will be maintained to monitor aquifer conditions within the District. The District will make a regular assessment of water supply and groundwater storage conditions and will report those conditions as appropriate in public meetings of the Board or public announcements. The District will undertake investigations, and co-operate with third-party investigations, of the groundwater resources within the District, and the results of the investigations will be made available to the public upon being presented at a meeting of the Board.

The District will adopt rules to regulate groundwater withdrawals by means of well spacing and production limits as appropriate to implement this Plan. In making a determination to grant a permit or limit groundwater withdrawals, the District will consider the available evidence and, as appropriate and applicable, weigh the public benefit against the individual needs and hardship.

The factors that the District may consider in making a determination to grant a drilling and operating or operating permit or limit groundwater withdrawals will include:

1. The purpose of the rules of the District;
2. The equitable distribution of the resource;
3. The economic hardship resulting from grant or denial of a permit, or the terms prescribed by the permit;
4. This Management Plan and Desired Future Conditions of the District as adopted in Joint Planning under Tex. Water Code, Sec. 36.108; and
5. The potential effect the permit may have on the aquifer, and groundwater users.

The transport of groundwater out of the District will be regulated by the District according to the Rules of the District.

In pursuit of the District's mission of protecting the groundwater resources, the District may require adjustment of groundwater withdrawals in accordance with the Rules and Management Plan. To achieve this purpose, the District may, at the Board's discretion after notice and hearing, amend or revoke any permit for non-compliance, or reduce the production authorized by permit for the purpose of protecting the aquifer and groundwater availability. The determination to seek the amendment of a permit will be based on aquifer conditions observed by the District as stated in the District's rules. The determination to seek revocation of a permit will be based on compliance and non-compliance with the District's rules and regulations. The District will enforce the terms and conditions of permits and the rules of the District, as necessary, by fine and enjoining the permit holder in a court of competent jurisdiction as provided for in Texas Water Code (TWC) Ch. 36.102, etc.

A contingency plan to cope with the effects of water supply deficits due to climatic or other conditions will be developed by the District and will be adopted by the Board after notice and hearing. In developing the contingency plan, the District will consider all relevant factors, including, but not limited to, the economic effect of conservation measures upon all water resource user groups, the local implications of the degree and

effect of changes in water storage conditions, the unique hydrogeologic conditions of the aquifers within the District and the appropriate conditions under which to implement the contingency plan.

The District will employ reasonable and necessary technical resources at its disposal to evaluate the groundwater resources available within the District and to determine the effectiveness of regulatory or conservation measures. A public or private user may appeal to the Board for discretion in enforcement of the provisions of the water supply deficit contingency plan on grounds of adverse economic hardship or unique local conditions. The exercise of discretion by the Board, shall not be construed as limiting the power of the Board.

7. DESIRED FUTURE CONDITIONS

The District shall participate in the joint planning process in GMA 8 and 12 as defined per TWC § 36.108, including establishment of Desired Future Conditions (DFCs) for management areas within the District. In its evaluation of potential DFCs, the District shall consider results from groundwater availability models, scientific reports, and the conditions of the aquifer within the management zones.

(a) DFCs Adopted by GMA 12. The District's current DFCs for the area covered by GMA 12 are the average drawdowns in Tables 7-1 and 7-2.

The average drawdowns in Table 7-1 are for a 60-year period beginning January 2000 and ending December 2059. For each of the aquifers, the DFC average drawdown are for the area covered by each aquifer in Milam and Burleson Counties as defined by the stratigraphy used in the TWDB Groundwater Availability Model for the Central Queen City Aquifer (Kelley and others, 2004). The average drawdowns in Table 7-2 represent declines in the saturated thickness measured over a 50-year period. The 50-year period begins in January 2010 and ends on December 2059.

Table 7-1. Adopted DFCs based on the Average Threshold that occurs between January 2000 and December 2059

Aquifer	Drawdown (ft)
Sparta	30
Queen City	30
Carrizo	65
Upper Wilcox (Calvert Bluff Fm)	140
Middle Wilcox (Simsboro Fm)	300
Lower Wilcox (Hooper Fm)	180
Yegua-Jackson	100

Table 7-2. Adopted DFCs for the Brazos River Alluvium based on decrease in the average saturated thickness that occurs between January 2010 and December 2059

County	Average Decrease in Saturated Thickness (ft)
Milam in GMA 12	5
Burleson in GMA 12	6

(b) Threshold values for Average Drawdown Adopted for the Shallow Management Zones . The District developed the DFCs in Table 7-1 using a methodology that include constraints to limit

drawdown in the up-dip regions of aquifers. One reason these constraints were developed is to help protect the production capacity of existing wells in the unconfined portions of the aquifer where the water level above the well screen tends to be less than in the confined portions of the aquifer.

Table 7-3 Threshold values for Average Drawdown for the Shallow Management Zones

Aquifer	Average Drawdown (ft) that Occurs between January 2000 and December 2059 in the Shallow Management Zone
Sparta	10
Queen City	10
Carrizo	20
Upper Wilcox (Calvert Bluff Fm)	20
Middle Wilcox (Simsboro Fm)	20
Lower Wilcox (Hooper Fm)	20
Yegua-Jackson	15

(c) DFCs Adopted by GMA 8. On the date of this Plan's adoption, the District did not have any permitted wells in the portion of the Brazos River Alluvium Aquifer and the Trinity Aquifer in GMA 8. POSGCD participated in the GMA 8 joint planning process to help establish DFCs for the Brazos River Alluvium Aquifer and the Trinity Aquifer within the District boundaries, but for the purpose of this Plan the District considers the portion of the Brazos River Alluvium Aquifer within GMA 8 as a non-relevant aquifer. The District will not monitor water levels in the GMA 8 portion of the Brazos River Alluvium until the GMA 8 portion of the Brazos River Alluvium is deemed as a relevant aquifer by the District. The District will also not monitor water levels in the Trinity Aquifer until there is at least one permitted well that pumps from the Trinity Aquifer.

The District's current DFCs for the area covered by GMA 8 are the average drawdowns in Table 7-5. The average drawdowns in Table 7-5 are for a 50-year period that begins on January 2000 and ends on December 2049 and the average drawdowns are for areas covered by each aquifer in Milam County as defined by the stratigraphy provided by the TWDB Groundwater Availability Model for the Northern Trinity Aquifer (Bene and others, 2004).

Table 7-5. Adopted DFCs based on Average Threshold that occurs between January 2000 and December 2049

Aquifer	Drawdown (ft)
Paluxy	252
Glen Rose	294
Hensell	337
Hosston	344

The POSGCD considers the portion of the Brazos River Alluvium Aquifer within GMA 8 as a non-relevant aquifer. As a result, there is no GMA 8 DFC for the Brazos River Alluvium.

8. MODELED AVAILABLE GROUNDWATER (MAG)

Based on DFCs adopted by GMA 8 and GMA 12, the Texas Water Development Board is required by TWC § 36.108 9(o) to provide the District with a MAG for each DFC. Table 8-1 lists the draft MAGs received by the District from the TWDB. The Draft MAGs will be replaced by final MAGs values after the

final MAGs values have been set by the TWDB.

Table 8-1. Modeled Available Groundwater Values Calculated for 2060 by the TWDB based on the DFCs adopted by GMA 8 and 12

Aquifer	Acre-ft/year (AFY)
Brazos River Alluvium	
Declared a Non-relevant Aquifer in GMA 8	NA
In Milam and Burleson County and in GMA 12	25,138[1]
Aquifers in Trinity GAM	
Paluxy	0[2]
Glen Rose	149[2]
Hensel	36[2]
Hosston	103[2]
Subtotal	288
Aquifers in the Queen City/Sparta GAM	
Sparta	6,734[3]
Queen City	502[4]
Carrizo	7,059[5]
Upper Wilcox (Calvert Bluff Fm)	1,038[5]
Middle Wilcox (Simsboro Fm)	48,501[5]
Lower Wilcox (Hooper Fm)	4,422[5]
Subtotal	68,256
Yegua-Jackson Aquifer	12,923[6]
Total	106,605

[1] GTA AQUIFER ASSESSMENT 10-20 MAG(Bradley,2011)
[2] GAM RUN 10-063 MAG(Oliver and Bradley, 2011)
[3] GAM RUN 10-046 MAG(Oliver, 2012a)
[4] GAM RUN 10-045 MAG(Oliver, 2012b)
[5] GAM RUN 10-044 MAG(Oliver, 2012c)
[6] GAM RUN 10-060MAG(Oliver, 2012d)

9. WATER WELL INVENTORY

The District will assign permitted wells to a management zone and to an aquifer based on the location of the well's screen or well depth using the Rules of the District. If no well screen information is available then a permitted well will be assigned to a management zone and to an aquifer based on the total depth of the well. The assignment of the permitted well will be made at the time of permit. The District will assign exempt wells to a management zone and to an aquifer based on available information for the exempt well. The District will use the assignments to help track the permitted pumping and production for each aquifer and for each management zone.

10. GROUNDWATER MONITORING

The District will maintain a monitoring well network that will be used by the District to obtain measured water levels. Groundwater monitoring will be designed to monitor changes in groundwater conditions over time. The District encourages well owners to volunteer wells to be used as part of the monitoring network. The District will accept wells into, or replace an existing well in, the monitoring network. The selection process will consider the well proximity to other monitoring wells, to permitted and exempt wells, to streams, and to geographic and political boundaries. If no suitable well locations can be found to meet the monitoring objectives in a specific aquifer or management zone, the District may evaluate the benefits of converting an oil and gas well to a water well, drilling and installing a new well, or using modeled water levels for that area until such time as a suitable well can be obtained for monitoring.

The District shall perform groundwater monitoring. The monitoring of the wells will be performed under the direction of the general manager, by trained personnel using a Standard Operation Procedure adopted by the District.

11. THRESHOLD LEVELS AND ANALYSIS OF GROUNDWATER LEVEL DATA

The District shall use threshold levels to help achieve its DFCs and to conserve and preserve groundwater availability and protect groundwater users. The District shall administer separate threshold levels for each management zone based on the Rules of the District. As part of its evaluation and determinations, the District may also consider the pumping-induced impacts to groundwater resources, including production occurring outside of the District. The District will consider threshold levels based on one or more of the following metrics: estimated total annual production, measured water level change, and predicted water level change.

Among the factors to be considered to guide the District's actions are threshold levels established in the District's Rules. District actions which can be initiated if a threshold level has been exceeded are: additional aquifer studies to collect and analyze additional information, a re-evaluation of the Management Plan or rules, and/or a change in the Management Plan or rules.

12. PRODUCTION AND SPACING OF WELLS

Production and spacing of all wells within the District will be regulated by the District according to the Rules of the District. Well spacing and the rate of production of the well will be dependent on the management zone and the aquifer associated with the well, and other factors included in the Rules of the District.

13. ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

The District will implement this plan and utilize it as a guide for the on-going evaluation of, and the planning and establishing priorities for all District conservation and regulatory activities. All programs, permits and related operations of the District, and any additional planning efforts in which the District may participate will be consistent with this plan.

The District will adopt rules relating to the permitting of wells, the production and transport of groundwater and reducing permitted production. The rules adopted by the District shall be adopted pursuant to TWC Chapter 36 and provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on technical data recommended by competent professionals and accepted by the Board.

The District shall treat all citizens equally. Citizens may apply to the District for a variance in enforcement of the rules on grounds of adverse economic effect or unique local conditions. In granting a variance to any rule, the Board shall consider the potential for adverse effect on adjacent landowners and the aquifer(s). The exercise of discretion by the Board shall not be construed as limiting the power of the Board.

The District will endeavor to cooperate with other agencies in the implementation of this plan and the management of groundwater supplies within the District. All activities of the District will be undertaken in a spirit of co-operation and coordination with the appropriate state and regional agencies.

14. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

The general manager of the District will prepare and present to the Board an annual report on the District's performance and accomplishment of the management goals and objectives. The presentation of the report will occur during the last monthly Board meeting each fiscal year, beginning after the adoption and certification of this plan. The report will include the number of instances in which each of the activities specified in the management objectives was engaged in during the fiscal year. Each activity will be referenced to the estimated expenditure of staff time and budget in accomplishment of the activity. The notations of activity frequency, staff time and budget will be referenced to the appropriate performance standard for each management objective describing the activity, so that the effectiveness and efficiency of the Districts operations may be evaluated. The Board will maintain the adopted report on file, for public

inspection, at the District's offices. This methodology will apply to all management goals contained within this plan.

15. MANAGEMENT GOALS, OBJECTIVES, & PERFORMANCE STANDARDS

15.1 Efficient Use of Groundwater

Management Objectives:

1. The District will maintain a monitoring well network with at least 50 monitoring wells to provide coverage across management zones and aquifers within the District. The District will measure water levels at the monitoring well locations at least once every calendar year. A written analysis of the water level measurements from the monitoring wells will be made available through a presentation to the Board of the District at least once every three years.
2. The District will provide educational leadership to citizens within the District concerning this subject. The activity will be accomplished annually through at least one printed publication, such as a brochure, and public speaking at service organizations and public schools as provided for in the District's Public Education Program.

Performance Standards:

1. Maintain a monitoring well network and its criteria, and measure at least 50 monitoring wells at least once every calendar year.
2. Number of monitoring wells measured annually by the District.

   Written report presented to the Board to document that water levels at these monitoring wells have been measured a minimum of once each year.
3. The number of publications and speaking appearances by the District each year under the District's Public Education Program.

15.2 Controlling and Preventing Waste of Groundwater.

Management Objectives:

The District will provide educational leadership to citizens within the District concerning this subject. The activity will be accomplished annually through at least one printed publication, such as a brochure, and public speaking at service organizations and public schools as provided for in the District's Public Education Program. During years when District revenues are sufficient, the District will consider funding a grant to obtain a review, study, or report of pertinent groundwater issues, , or to sponsor the attendance of students at summer camps/seminars that place emphasis on the conservation of water resources.

Performance Standards:

The number of publications and speaking appearances by the District each year, and the number of grants considered and students actually accepting and attending an educational summer camp or seminar.

15.3 Control and Prevent Subsidence

Management Objectives:

The District will monitor drawdowns with due consideration to the potential for land subsidence. At least once every three years, the District will report projected land subsidence for areas where water levels will decrease more than 300 feet (over a 50 year period from the year 2000 baseline condition) based on GAM simulations used for the joint planning process.

Performance Standards:

The number of reports that provide estimates of projected land subsidence.

15.4 Conservation of Groundwater including Rainwater Harvesting, Precipitation Enhancement, Brush Control, Conjunctive Use, and/or Recharge Enhancement of Groundwater Resources in the District

Management Objectives:

1. The District will provide educational leadership to citizens within the District concerning this subject. The educational efforts will be through at least one printed publication, such as a brochure, and at least one public speaking program at a service organization and/or public school as provided for in the District's Public Education Program. Each of the following topics will be addressed in that program:

    A. Conservation
    B. Rainwater Harvesting
    C. Brush Control
    D. Recharge Enhancement
    E. Conjunctive Use
    F. Precipitation Enhancement

2. During years when District revenues are sufficient, the District will consider sponsoring the attendance of students and/or teachers at summer camps/seminars that place emphasis on the conservation of groundwater, rainwater harvesting, brush control, groundwater recharge enhancement, conjunctive use, precipitation enhancement of water resources, or a combination of such groundwater management programs.

3. The District will encourage and support projects and programs to conserve and/or preserve groundwater, and/or enhance groundwater recharge, by annually funding the District's Groundwater Conservation and Enhancement Grant Program, during years when the District's revenues remain at a level sufficient to fund the program. The objective of this program is to obtain the active participation and cooperation of local water utilities, fire departments and public agencies in the funding and successful completion of programs and projects that will result in the conservation of groundwater and the protection or enhancement of the aquifers in the District. The qualifying water conservation projects and programs will include, as appropriate, projects that: result in the conservation of groundwater, reduce the loss or waste of groundwater, recharge enhancement, rainwater harvesting, precipitation enhancement, brush control, or any combination thereof. The District's objective is to benefit the existing and future users of groundwater in the District by providing for the more efficient use of water, increasing recharge to aquifers, reducing waste, limiting groundwater level declines, and maintaining or increasing the amount of groundwater available, by awarding at least one grant under the program in each county annually.

Performance Standards:

1. The number of publications and speaking appearances by the District each year under the District's Public Education Program.

2. The number of students sponsored to attend a summer camp/seminar emphasizing the conservation of water.

3. Annual funding, when applicable, for the District's Groundwater Conservation and Enhancement Grant Program, and the number of projects and programs reviewed, approved, and funded under that program. A written report providing estimated benefit of the amount of groundwater conserved, of the recharge enhancement, and/or of addition groundwater protection provided by the program.

4. The number and content of reports submitted regarding sponsored programs.

15.5 Conjunctive Use of Surface and Groundwater

Management Objective:

The District will confer annually with the Brazos River Authority (BRA) on cooperative opportunities for conjunctive resource management.

Performance Standard:

1. The number of conferences with the BRA on conjunctive resource management.
2. The number of times each year in which the applicant, general manager or the Board considers conjunctive use in the permitting process.

15.6 Drought Management Strategy

The aquifers within the District are substantially resistant to water level declines during drought conditions. As a result, the District does not have a drought management strategy based on precipitation metrics such as the Palmer Drought Index. The District management strategy is to review and to enforce Drought Management Plans adopted by District permit holders and entities that contract to purchase water transported out of the District.

Management Objective:

When permits or contracts are issued, as applicable, the District will confirm that all entities have an approved Drought Management Plan.

Performance Standard:

Documentation of District review of the State approved Drought Management Plans.

15.7 Natural Resource Issues That Impact the Use and Availability of Groundwater and Which are Impacted By the Use of Groundwater

Management Objective:

1. The District will confer at least once every two years with appropriate agencies on the impact of groundwater resources in the District.
2. The District will evaluate permit applications for new wells and the information submitted by the applicants on those wells prior to drilling. The District will assess the impact of these wells on the groundwater resources in the District.
3. The District will implement the POSGCD Well Closure Program. The objective of the well closure program is to obtain the closure and plugging of derelict and abandoned wells in a manner that is consistent with state law, for the protection of the aquifers, the environment, and the public safety. The District will conduct a program to identify, inspect, categorize and cause abandoned and derelict water, oil and gas wells to be closed and plugged, by annually funding the program or segments or phases of the program appropriate to be funded in such fiscal year. The District will fund the closure of at least one abandoned well during years when the District's revenues remain at a level sufficient to fund the program.

Performance Standard:

1. The number of conferences with a representative of appropriate agencies .
2. Reports to the Board on the number of new well permit applications filed, and the possible impacts of those new wells on the groundwater resources in the District.
3. Annual funding, when applicable, for the District’s Well Closure Program, and the number of wells closed and plugged as a result of the Well Closure Program.

15.8. Mitigation

Management Objective:

Within one year of adoption of this Plan, the District will review mitigation plans prepared by other agencies in Texas regarding impacts caused by groundwater pumping. Based upon this review and estimated impacts to groundwater levels caused by future pumping within and outside of the District, the District will determine whether or not to develop a mitigation plan. If appropriate, the District will develop a draft mitigation plan within three years after the adoption of this Plan and will seek public comment, hold appropriate hearings and adopt a plan. The plan will be reviewed on an annual basis thereafter.

Performance Standard:

1. The number of mitigation plans reviewed.
2. Reports and presentations that document the anticipated impacts of pumping within and outside of the District on groundwater resources in the District.

15.9 Desired Future Conditions (DFCs)

Management Objective:

1. At least once every three years, the District will monitor water levels and evaluate whether the change in water levels is in conformance with the DFCs adopted by the District. The District will estimate total annual groundwater production for each aquifer based on the water use reports, estimated exempted use, and other relevant information, and compare these production estimates to the MAGs listed in Table 8-1.

Performance Standard:

1. At least once every three years, the general manager will report to the Board the measured water levels obtained from the monitoring wells within each Management Zone, the average measured drawdown for each Management Zone calculated from the measured water levels of the monitoring wells within the Management Zone, a comparison of the average measured drawdowns for each Management Zone with the DFCs for each Management Zone, and the District's progress in conforming with the DFCs.
2. At least once every three years, the general manager will report to the Board the total permitted production and the estimated total annual production for each aquifer and compare these amounts to the MAGs listed in Table 8-1 for each aquifer.

16. PROJECTED WATER DEMANDS

Table 16-1 lists the projected net water demands within the District in acre-feet per year according to the 2012 State Water Plan Data.

Table 16-1 Projected Water Demands in the District According the 2012 State Water Planning Data

BURLESON COUNTY

Water Use Group	Category	2010	2020	2030	2040	2050	2060
CALDWELL	MUNICIPAL	807	835	854	865	878	894
COUNTY-OTHER	MUNICIPAL	1,139	1,263	1,349	1,404	1,450	1,504
IRRIGATION	IRRIGATION	17,480	16,749	16,052	15,431	14,741	14,082
LIVESTOCK	LIVESTOCK	1,422	1,422	1,422	1,422	1,422	1,422
MANUFACTURING	MANUFACTURING	196	233	270	307	340	370
MILANO WSC	MUNICIPAL	177	194	207	216	223	231
MINING	MINING	25	24	24	24	24	24
SNOOK	MUNICIPAL	147	160	167	173	178	183
SOMERVILLE	MUNICIPAL	328	344	353	358	364	372
SOUTHWEST MILAM WSC	MUNICIPAL	58	67	73	79	82	86
Total Projected Water Demands (acre-ft/yr)		21,779	21,291	20,771	20,279	19,702	19,168

MILAM COUNTY

Water Use Group	Category	2010	2020	2030	2040	2050	2060
BELL-MILAM FALLS WSC	MUNICIPAL	245	288	316	334	341	347
CAMERON	MUNICIPAL	1,606	1,756	1,840	1,881	1,880	1,888
COUNTY-OTHER	MUNICIPAL	401	291	211	152	111	82
IRRIGATION	IRRIGATION	2,372	2,352	2,333	2,312	2,294	2,275
LIVESTOCK	LIVESTOCK	1,779	1,779	1,779	1,779	1,779	1,779
MANUFACTURING	MUNICIPAL	6,820	8,250	8,250	8,250	9,800	9,800
MILANO WSC	MUNICIPAL	195	212	224	230	232	235
MINING	MINING	4,000	4,000	4,000	3,000	1,500	1,500
ROCKDALE	MUNICIPAL	1,254	1,287	1,310	1,325	1,332	1,337
SOUTHWEST MILAM WSC	MUNICIPAL	1,086	1,251	1,350	1,422	1,448	1,472
STEAM ELECTRIC POWER	STEAM ELECTRIC POWER	12,500	12,500	12,500	12,500	16,000	16,000
THORNDALE	MUNICIPAL	193	206	213	215	216	219
Total Projected Water Demands (acre-ft/yr)		32,451	34,172	34,326	33,400	36,933	36,934

Total Projected Water Demands (acre-ft/yr) for Burleson and Milam Counties	54,230	55,463	55,097	53,679	56,635	56,102

The District also established future Municipal Groundwater Use Demands in the District for planning purposes. The methodology and results of that effort are as follows:

Method for Establishing Future Municipal Use Demands of Groundwater. The District adopted a resolution, dated March 11, 2003, establishing production rights for Local Water Utilities within the District (water supply corporations, special utility districts, municipal utility districts and cities), as a rule. This rule allowed these Local Water Utilities to obtain a permit to produce a volume of water annually according to one of two methods:

1. An amount equal to the highest annual pumpage it reported from wells within the District in any consecutive twelve months prior to September 31, 2001; or
2. The Local Water Utility could present to the Board a Long-Term Plan prepared by a qualified engineer that projects the annualized long-term water needs as the official projection of the water required by that Local Water Utility in the planning period (for not more than forty (40) years) for providing retail water service within that Local Water Utility's defined service area. If a Local Water Utility adopted this plan on or before March 30, 2004, and the Board found the highest annual pumpage projected in the Long-Term Plan (the "Plan Amount") was not unreasonable, the Local Water Utility was authorized to obtain a permit to pump and produce up to the Plan Amount.

The table below contains the results of this effort:

Municipal Use Groundwater Demands Projected through 2044

Producer	Estimated Acre Feet per year
Burleson County	
Apache Hills	11
Birch Creek	16
Burl. Co. MUD	73
Burl. Investm.	7
Cade Lakes	123
Centerline	21

Caldwell	1,969
Snook	154
Somerville	670
Clara Hills	5
Clay	7
Cooks Point	10
Deanville	350
Lakeview	21
Little Oak Forrest	5
Lyons	106
Post Oak Hill	11
Shupak Utilities	19
Tunis	108
Whispering Woods	7
Wilderness Sound	15
Total for Burleson Co.	3,708

Milam County	
ALCOA	702
Rockdale	2,129
Gause	74
Marlow	108
Milano	673
Minerva	28
North Milam	369
Southwest Milam	2,492
Total for Milam Co.	6,575
DISTRICT TOTALS	10,283

17. PROJECTED WATER SUPPLIES WITHIN THE DISTRICT

Table 17-1 lists the projected water supplies within the District in acre-feet per year according to the 2007 State Water Planning Data and the 2012 State Water Plan Data. The groundwater supplies are based on the 2007 State Water Planning Data and the surface water supplies are based on the 2012 State Water Plan Data. The District has participated and will participate in future regional water planning, and will consider the water supply needs and water management strategies included in the adopted state water plan.

Table 17-1 Projected Water Supplies in acre-feet per year Within the District According the 2012 State Regional Water Planning Data for Surface Water and 2007 State Water Plan Data for Groundwater

BURLESON COUNTY

Water Use Group	Source Name	Source Type	2010	2020	2030	2040	2050	2060
CALDWELL	CARRIZO-WILCOX AQUIFER	GROUNDWATER	2,476	2,476	2,476	2,476	2,476	2,476
SNOOK	SPARTA AQUIFER	GROUNDWATER	183	183	183	183	183	183
SOMERVILLE	SPARTA AQUIFER	GROUNDWATER	403	403	403	403	403	403
COUNTY-OTHER	CARRIZO-WILCOX AQUIFER	GROUNDWATER	397	397	397	397	397	397

COUNTY-OTHER	QUEEN CITY AQUIFER	GROUNDWATER	612	612	612	612	612	612
COUNTY-OTHER	SPARTA AQUIFER	GROUNDWATER	495	495	495	495	495	495
IRRIGATION	BRAZOS RIVER ALLUVIUM AQUIFER	GROUNDWATER	8,583	8,224	7,882	7,577	7,238	6,914
IRRIGATION	BRAZOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	SURFACE WATER	8,840	8,840	8,840	8,840	8,840	8,840
LIVESTOCK	LIVESTOCK LOCAL SUPPLY	SURFACE WATER	1,422	1,422	1,422	1,422	1,422	1,422
MANUFACTURING	BRAZOS RIVER COMBINED RUN-OF-RIVER MANUFACTURING	SURFACE WATER	95	95	95	95	95	95
MANUFACTURING	SPARTA AQUIFER	GROUNDWATER	195	195	195	195	195	195
MINING	SPARTA AQUIFER	GROUNDWATER	25	24	24	24	24	24
Total Projected Water Supply (acre-ft/yr)			23,726	23,366	23,024	22,719	22,380	22,056

MILAM COUNTY

Water Use Group	Source Name	Source Type	2010	2020	2030	2040	2050	2060
BELL-MILAM FALLS WSC	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	SURFACE WATER	132	132	132	132	132	132
CAMERON	BRAZOS RIVER RUN-OF-RIVER	SURFACE WATER	2,629	2,629	2,629	2,629	2,629	2,629
COUNTY-OTHER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	SURFACE WATER	321	321	321	321	321	321
COUNTY-OTHER	BRAZOS RIVER RUN-OF-RIVER	SURFACE WATER	163	163	163	163	163	163
COUNTY-OTHER	CARRIZO-WILCOX AQUIFER	Groundwater	342	342	342	342	342	342
IRRIGATION	BRAZOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	SURFACE WATER	8,801	8.806	8,810	8,814	8,819	8,823
IRRIGATION	CARRIZO-WILCOX AQUIFER	Groundwater	489	485	481	476	473	469
LIVESTOCK	LIVESTOCK LOCAL SUPPLY	SURFACE WATER	1,779	1,779	1,779	1,779	1,779	1,779
Manufacturing	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	SURFACE WATER	4,239	4,239	4,239	4,239	4,239	4,239
Manufacturing	BRAZOS RIVER COMBINED RUN-OF-RIVER MANUFACTURING	SURFACE WATER	656	656	657	657	657	657
Manufacturing	CARRIZO-WILCOX AQUIFER	GROUNDWATER	5,346	5,346	5,346	5,346	5,346	5,346
MILANO WSC	CARRIZO-WILCOX AQUIFER	GROUNDWATER	279	279	279	279	279	279
MINING	CARRIZO-WILCOX AQUIFER	GROUNDWATER	4,000	4,000	4,000	3,000	1,500	1,500
ROCKDALE	CARRIZO-WILCOX AQUIFER	GROUNDWATER	2,577	2,577	2,577	2,577	2,577	2,577

SOUTHWEST MILAM WSC	CARRIZO-WILCOX AQUIFER	GROUNDWATER	1,355	1,283	1,395	1,395	1,395	1,395
STEAM ELECTRIC POWER	ALCOA LAKE/RESERVOIR	SURFACE WATER	14,000	14,000	14,000	14,000	14,000	14,000
THORNDALE	CARRIZO-WILCOX AQUIFER	GROUNDWATER	230	230	230	230	230	230
Total Projected Water Supply (acre-ft/yr)			47,338	47,262	47,371	46,366	44,863	44,859
Total Projected Water Supply (acre-ft/yr) for Burleson and Milam Counties			71,064	70,628	70,395	69,085	67,243	66,915

18. PROJECTED WATER NEEDS AND WATER STRATEGIES

Table 18-1 lists the projected water needs within the District in acre-feet per year according to the 2012 State Water Plan Data. In Table 18-1, negative values reflect a water need and positive values reflect a surplus.

Table 18-1 Projected Water Needs in acre-ft/yr Within the District According the 2012 State Water Plan Data

BURLESON COUNTY

Water Use Group	Category	2010	2020	2030	2040	2050	2060
CALDWELL	MUNICIPAL	1,545	1,517	1,498	1,487	1,474	1,458
COUNTY-OTHER	**MUNICIPAL**	369	245	159	104	58	4
IRRIGATION	IRRIGATION	760	1,491	2,188	2,809	3,499	4,158
LIVESTOCK	LIVESTOCK	0	0	0	0	0	0
MANUFACTURING	MANUFACTURING	190	153	116	79	46	16
MILANO WSC	MUNICIPAL	57	40	27	22	15	7
MINING	MINING	4	5	5	5	5	5
SNOOK	MUNICIPAL	153	140	133	127	122	117
SOMERVILLE	MUNICIPAL	235	219	210	205	199	191
SOUTHWEST MILAM WSC	MUNICIPAL	5	-4	-10	-15	-18	-22
Total Projected Water Needs (acre-ft/yr)		0	-4	-10	-15	-18	-22

MILAM COUNTY

Water Use Group	Category	2010	2020	2030	2040	2050	2060
BELL-MILAM FALLS WSC	**MUNICIPAL**	-7	-50	-78	-96	-103	-109
CAMERON	MUNICIPAL	1,023	873	789	748	749	741
COUNTY-OTHER	MUNICIPAL	419	529	609	674	715	744
IRRIGATION	IRRIGATION	6,913	6,938	6,961	6,995	7,018	7,041
LIVESTOCK	**LIVESTOCK**	0	0	0	0	0	0
MANUFACTURING	**MUNICIPAL**	3,328	1,898	1,898	1,992	442	442
MILANO WSC	MUNICIPAL	58	41	29	28	26	23
MINING	MINING	-70	-70	-70	0	0	0
ROCKDALE	MUNICIPAL	903	870	847	870	863	858
SOUTHWEST MILAM WSC	MUNICIPAL	-143	-308	-407	-458	-484	-508
STEAM ELECTRIC POWER	STEAM ELECTRIC POWER	1,500	1,500	1,500	1,500	-2,000	-2,000
THORNDALE	MUNICIPAL	37	24	17	15	14	11
``Total Projected Water Needs (acre-ft/yr)		-220	-428	-555	-554	-2,587	-2,617

Total Projected Water Needs (acre-ft/yr) for Burleson and Milam Counties	-220	-432	-565	-569	-2,605	-2,639

Table 18.2 Projected Water Strategies in acre-ft/yr within the District in acre-feet per year according to the 2012 State Water Plan Data.

BURLESON COUNTY

Water Use Group	Water Management Strategy	Source County	2010	2020	2030	2040	2050	2060
SOUTHWEST MILAM WSC	ADDITIONAL CARRIZO AQUIFER DEVELOPMENT (INCLUDES OVERDRAFTING) - CARRIZO-WILCOX AQUIFER	Burleson	0	4	10	15	18	22
Total	-	-	0	4	10	15	18	22

MILAM COUNTY

Water Use Group	Water Management Strategy	Source County	2010	2020	2030	2040	2050	2060
BELL-MILAM FALLS WSC	VOLUNTARY REDISTRIBUTION - BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE	Reservoir	7	50	78	96	103	109
MINING	ADDITIONAL CARRIZO AQUIFER DEVELOPMENT - CARRIZO-WILCOX AQUIFER	Milam	100	100	100	0	0	0
SOUTHWEST MILAM WSC	ADDITIONAL CARRIZO AQUIFER DEVELOPMENT (INCLUDES OVERDRAFTING) - CARRIZO-WILCOX AQUIFER	Burleson	143	308	407	458	484	508
STEAM ELECTRIC POWER	STEAM-ELECTRIC CONSERVATION-CONSERVATION	Milam	375	625	875	875	1,120	1,120
STEAM ELECTRIC POWER	ADDITIONAL CARRIZO AQUIFER DEVELOPMENT (INCLUDES OVERDRAFTING) - CARRIZO-WILCOX AQUIFER	Milam	0	0	0	0	1,613	1,613
Total	-	-	625	1,083	1,460	1,429	3,320	3,350

19. Estimate of Groundwater Use Within the District

Table 19-1 lists the estimated groundwater use (in acre-feet per year) within the District based on groundwater pumpage estimates found in the Texas Water Development Board's Water User Survey Database: (http://www.twdb.state.tx.us/wushistorical/DesktopDefault.aspx?PageID=2)

Table 19-1 Estimated Groundwater Use in acre-feet/year Within the District Based on TWDB Pumping Estimates

Burleson County

Year	Aquifer	Municipal	Manufac-turing	Steam Electric	Irrigation	Mining	Livestock	Total
2004	BRAZOS RIVER ALLUVIUM	0	0	0	19,677	0	0	19,677
	CARRIZO-WILCOX	677	0	0	153	0	18	848
	OTHER	147	0	0	760	0	73	980
	QUEEN CITY	490	0	0	0	0	190	680
	SPARTA	855	111	0	0	0	118	1,084
	YEGUA-JACKSON	215	0	0	76	0	190	481
	TOTAL	2,384	111	0	20,666	0	589	23,750
2005	BRAZOS RIVER ALLUVIUM	0	0	0	20,300	0	0	20,300
	CARRIZO-WILCOX	790	0	0	158	0	16	964
	OTHER	170	0	0	785	0	64	1,019
	QUEEN CITY	465	0	0	0	0	168	633
	SPARTA	884	111	0	0	0	104	1,099
	YEGUA-JACKSON	235	0	0	79	0	168	482
	TOTAL	2,544	111	0	21,322	0	520	24,497
2006	BRAZOS RIVER ALLUVIUM	0	0	0	21,010	0	0	21,010
	CARRIZO-WILCOX	936	0	0	163	0	16	1,115
	OTHER	176	0	0	812	0	62	1,050
	QUEEN CITY	506	0	0	0	0	163	669
	SPARTA	896	111	0	0	0	101	1,108
	YEGUA-JACKSON	253	0	0	82	0	163	498
	TOTAL	2,767	111	0	22,067	0	505	25,450
2007	BRAZOS RIVER ALLUVIUM	0	0	0	5,483	0	0	5,483
	CARRIZO-WILCOX	683	0	0	43	0	15	741
	OTHER	146	0	0	212	0	60	418
	QUEEN CITY	419	0	0	0	0	158	577
	SPARTA	851	111	0	0	0	98	1,060
	YEGUA-JACKSON	209	0	0	21	0	158	388
	TOTAL	2,308	111	0	5,759	0	489	8,667
2008	BRAZOS RIVER ALLUVIUM	0	0	0	14,823	0	0	14,823
	CARRIZO-WILCOX	804	0	0	115	0	12	931
	OTHER	170	0	0	573	0	48	791
	QUEEN CITY	510	0	0	0	0	127	637
	SPARTA	765	111	0	0	0	78	954
	YEGUA-JACKSON	233	0	0	58	0	127	418
	TOTAL	2,482	111	0	15,569	0	392	18,554

Milam County

Year	Aquifer	Municipal	Manufactur-ing	Steam Electric	Irrigation	Mining	Livestock	Total
2004	CARRIZO-WILCOX	2,692	36,435	0	1,282	0	552	40,961
	OTHER	65	0	0	1,795	0	174	2,034
	QUEEN CITY	9	0	0	513	0	29	551
	TOTAL	2,766	36,435	0	3,590	0	755	43,546
2005	CARRIZO-WILCOX	3,601	34,762	0	1,844	0	417	40,624
	OTHER	70	0	0	2,581	0	132	2,783
	QUEEN CITY	10	0	0	738	0	22	770
	TOTAL	3,681	34,762	0	5,163	0	571	44,177
2006	CARRIZO-WILCOX	3,510	30,116	0	2,019	0	412	36,057
	OTHER	75	0	0	2,827	0	130	3,032
	QUEEN CITY	11	0	0	808	0	22	841
	TOTAL	3,596	30,116	0	5,654	0	564	39,930
2007	CARRIZO-WILCOX	2,964	24,894	0	1,503	0	372	29,733
	OTHER	61	0	0	2,105	0	117	2,283
	QUEEN CITY	9	0	0	602	0	20	631
	TOTAL	3,034	24,894	0	4,210	0	509	32,647
2008	CARRIZO-WILCOX	3,478	451	0	1,107	0	393	5,429
	OTHER	68	0	0	1,549	0	124	1,741
	QUEEN CITY	10	0	0	443	0	21	474
	TOTAL	3,556	451	0	3,099	0	538	7,644

20. ESTIMATED ANNUAL RECHARGE OF GROUNDWATER RESOURCES WITHIN THE DISTRICT

Table 20-1 lists the estimated annual recharge from precipitation to groundwater within the District. The recharge estimates in acre-feet/year were compiled from GAM Run 10-029 (Aschenbach, 2011) and GTA Aquifer Assessment 10-20 MAG (Bradley, 2011).

Table 20-1 Estimated annual recharge from precipitation

Aquifer	Recharge (acre-ft/yr)
Trinity	0
Sparta	7,424
Queen City	8,812
Carrizo	4,018
Upper Wilcox (Calvert Bluff Fm)	7,330
Middle Wilcox (Simsboro Fm)	12,540
Lower Wilcox (Hooper Fm)	2,391
Yegua-Jackson	22,459
Brazos River Alluvium	23,456
Total	88,430

21. ESTIMATED ANNUAL DISCHARGES FROM THE AQUIFER TO SPRINGS AND ANY SURFACE WATER BODIES, INCLUDING LAKES, STREAMS AND RIVERS

Table 21-1 lists the estimated annual discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers. All of the discharge estimates were compiled from GAM Run 10-029 (Aschenbach, 2011) except those for the Brazos River Alluivum. The Brazos River Alluvium values were estimated based on the assumption that the Brazos River is primarily a gaining stream through Milam and Burleson Counties, which in turn is based on the hydraulic head gradients presented by Chowdhury and others (2010), and by taking the difference between the estimated annual recharge and annual pumping. Annual recharge is estimated at 23,456 AFY based on Table 20-1 and average pumping is estimated at 12,400 AFY based on Table 19-1. Thus, the average discharge from the Brazos River Alluvium to the Brazos River is approximately 11,056 AFY .

Table 21-1 Estimated annual discharge to surface water bodies

Aquifer	Discharge to Surface Water Bodies (acre-ft/yr)
Trinity	0
Sparta	4,807
Queen City	12,028
Carrizo	1,964
Upper Wilcox (Calvert Bluff Fm)	7,995
Middle Wilcox (Simsboro Fm)	18,827
Lower Wilcox (Hooper Fm)	1,748
Yegua-Jackson	13,923
Brazos River Alluvium	11,056
Total	72,348

22. ESTIMATED ANNUAL GROUNDWATER FLOW INTO AND OUT OF THE DISTRICT WITHIN EACH AQUIFER AND BETWEEN AQUIFERS IN THE DISTRICT

Table 22-1 lists the estimated annual groundwater flow into and out of the District within each aquifer and between aquifers in the District. The estimates in Table 22-1 were compiled from GAM Run 10-029 (Aschenbach, 2011). Additional details on the annual aquifer discharges between the aquifers are provided in Aschenbach (2011).

Table 22-1 Estimated annual aquifer discharge in acre-ft/yr into and out of the District and between aquifers in the District

Aquifer	Flow Into the District (acre-ft/yr)	Flow Out of the District t(acre-ft/yr)	Flow Between Aquifer and Overlying Geologic Unit [1] (acre-ft/yr)	Flow Between Aquifer and Underlying Geologic Unit[1] (acre-ft/yr)
Trinity	423	678	NA	NA
Sparta	739	1226	NA	1569[2]
Queen City	1,316	947	-1435[2]	861[3]
Carrizo	3,810	2,424	-233[3]	-317[4]
Upper Wilcox (Calvert Bluff Fm)	2,416	2,000	317[4]	-3,451
Middle Wilcox (Simsboro Fm)	10,804	18,025	3,451	1,537
Lower Wilcox (Hooper Fm)	3,572	3,232	-1,537	NA
Yegua-Jackson	4,436	8,017	NA	NA
Total	27,516	36,549	NA	NA

Note: NA – not applicable

[1] positive values indicate flow into the aquifer; negative numbers indicate flow out of the aquifer

[2] Weches is the confining unit directly beneath the Sparta Aquifer and directly above the Queen City Aquifer
[3] Reklaw is the confining unit directly beneath the Queen City Aquifer and directly above the Carrizo Aquifer
[4] Upper Wilcox Aquifer is directly below the Carrizo Aquifer
[5] Middle Wilcox Aquifer is directly below the Upper Wilcox Aquifer
[6] Lower Wilcox Aquifer is directly below the Middle Wilcox Aquifer

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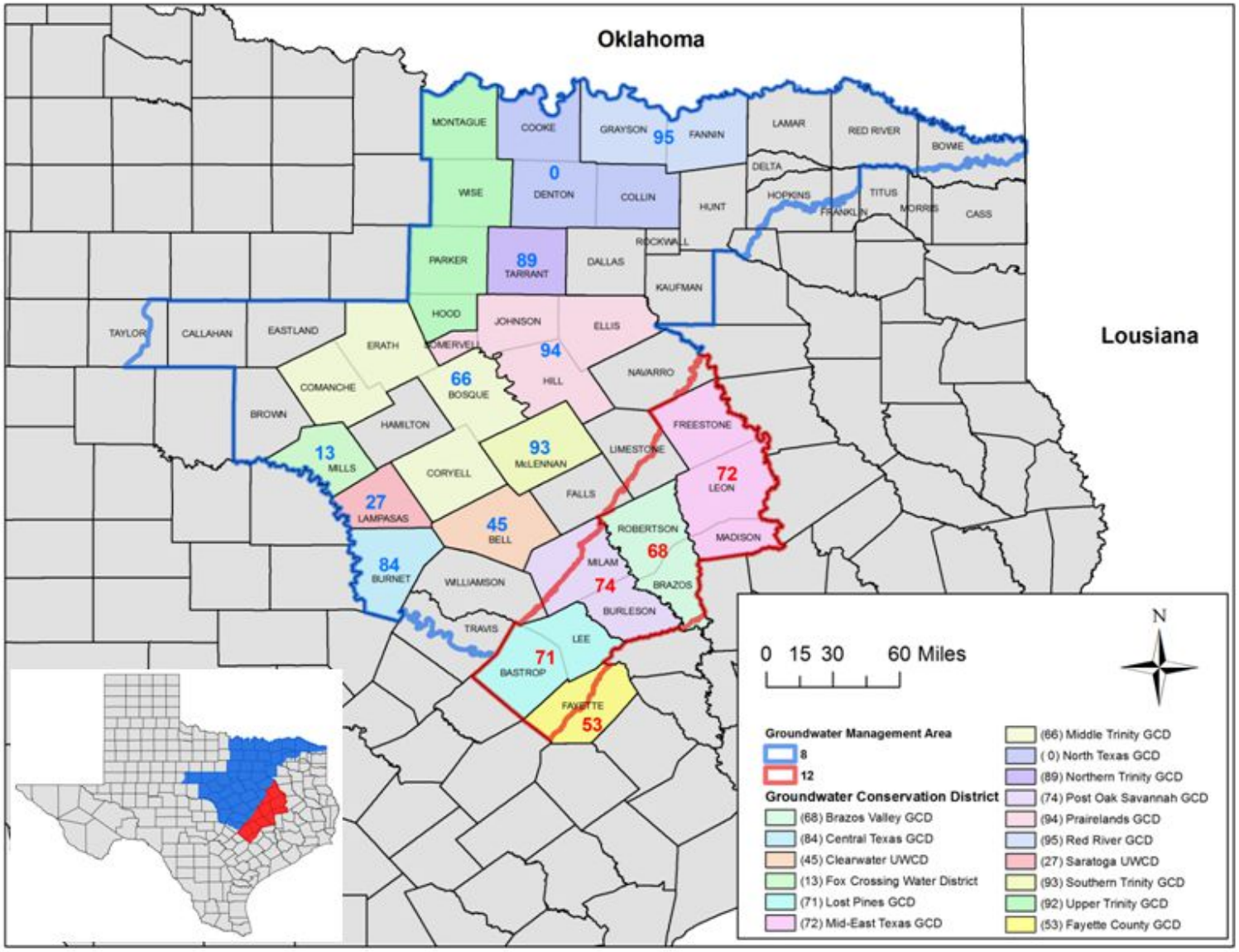


Figure 1. Counties and Groundwater Districts Associated with Groundwater Management Areas 8 and 12

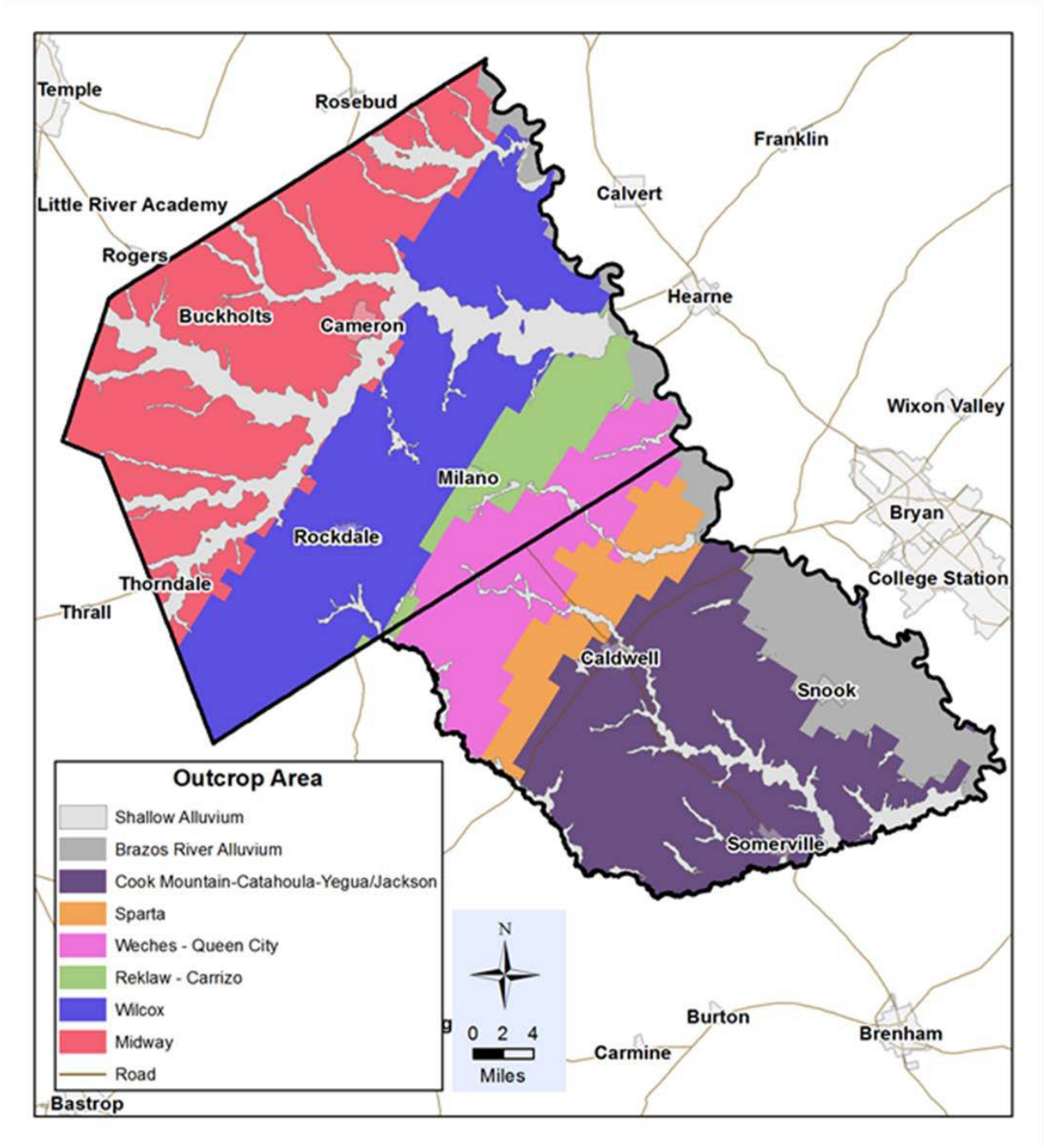


Figure 2. Outcrops Associated with Aquifers and Geological Formations in the District

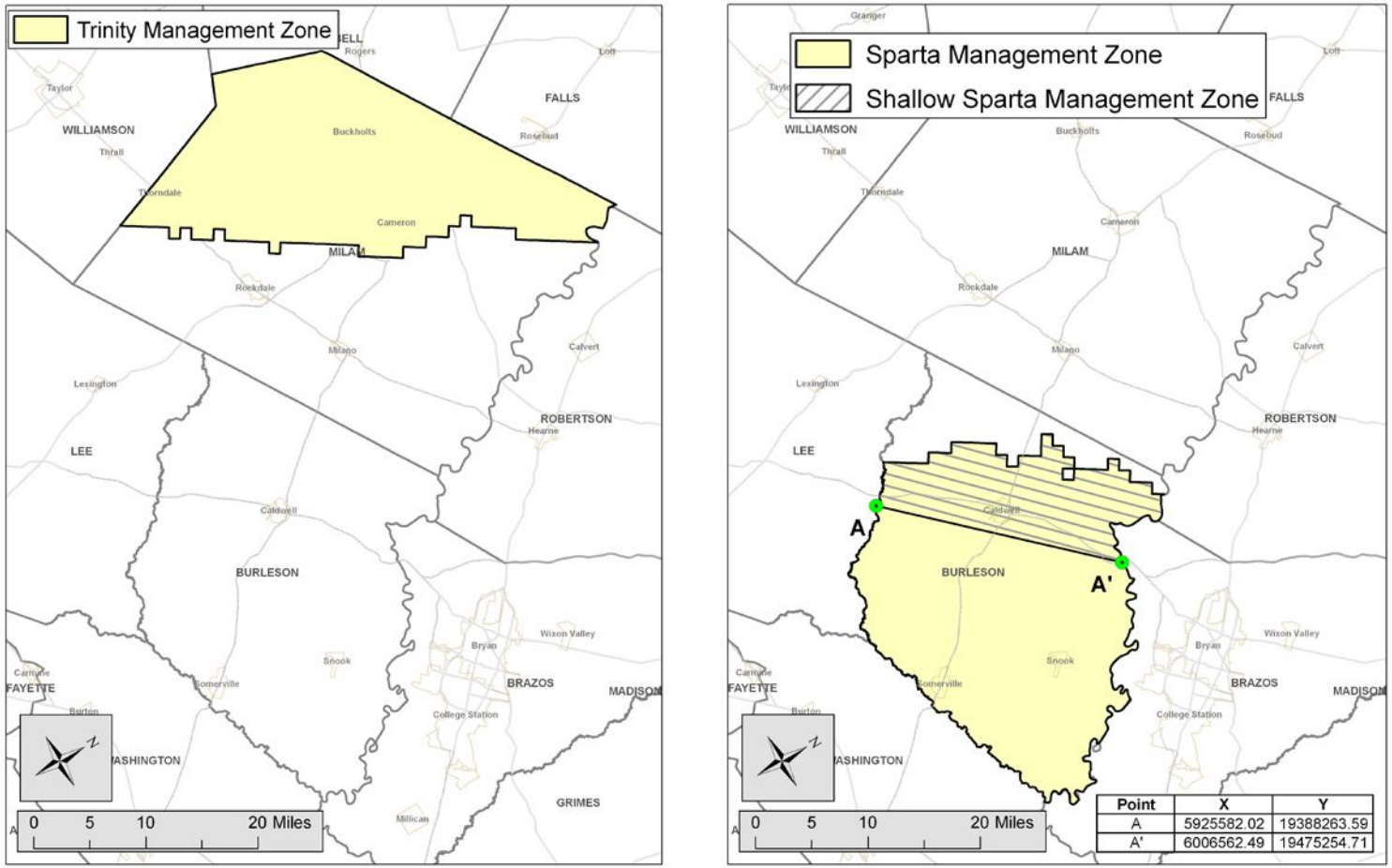
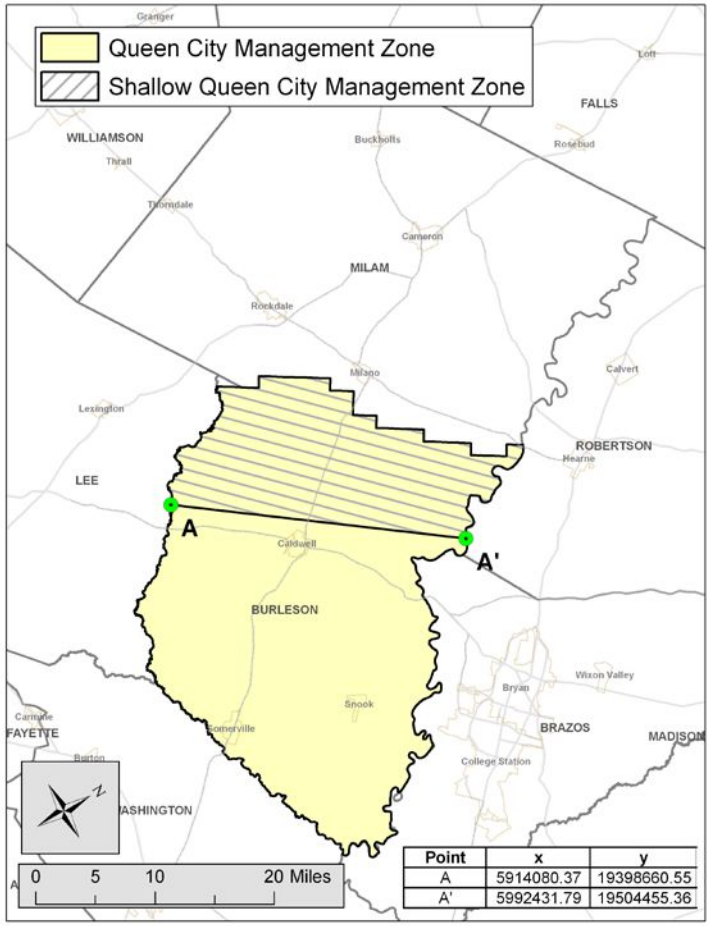


Figure 3. Areal Coverage for the Trinity Management Zone and the Sparta Management Zone



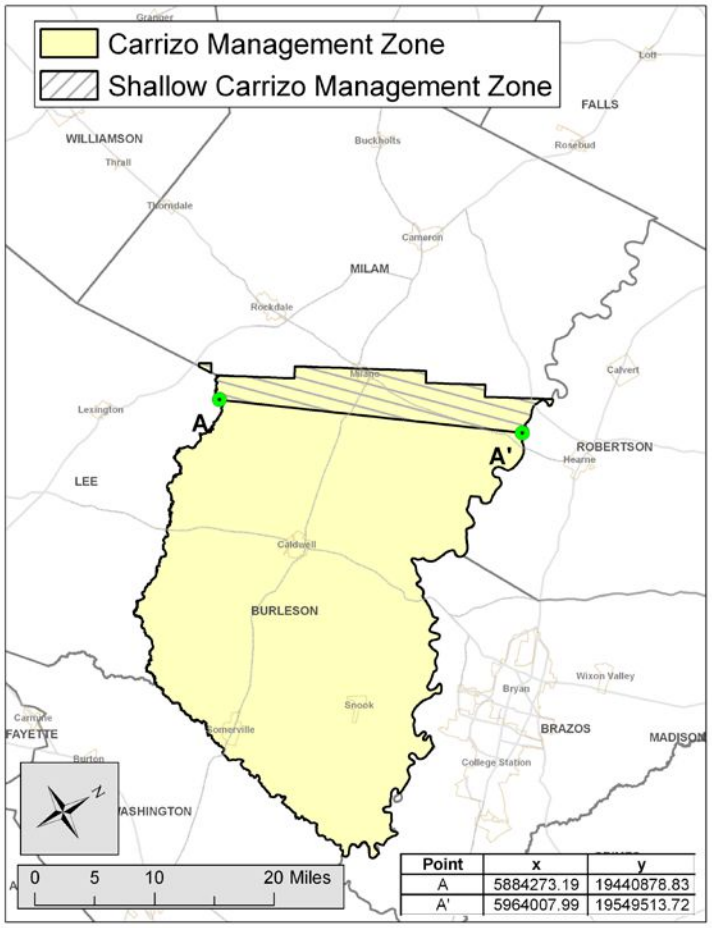


Figure 4. Areal Coverage for the Queen City Management Zone and the Carrizo Management Zone

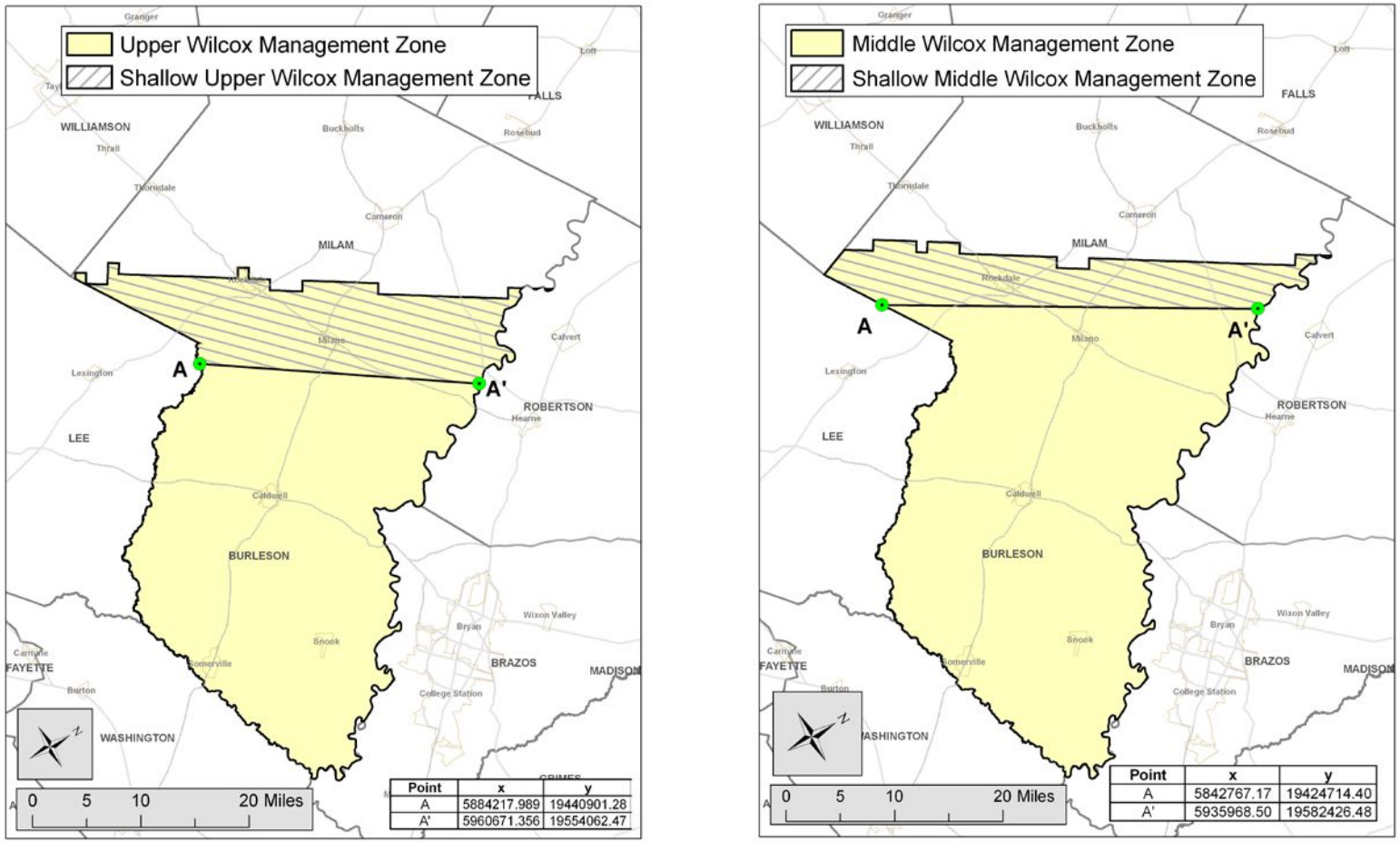
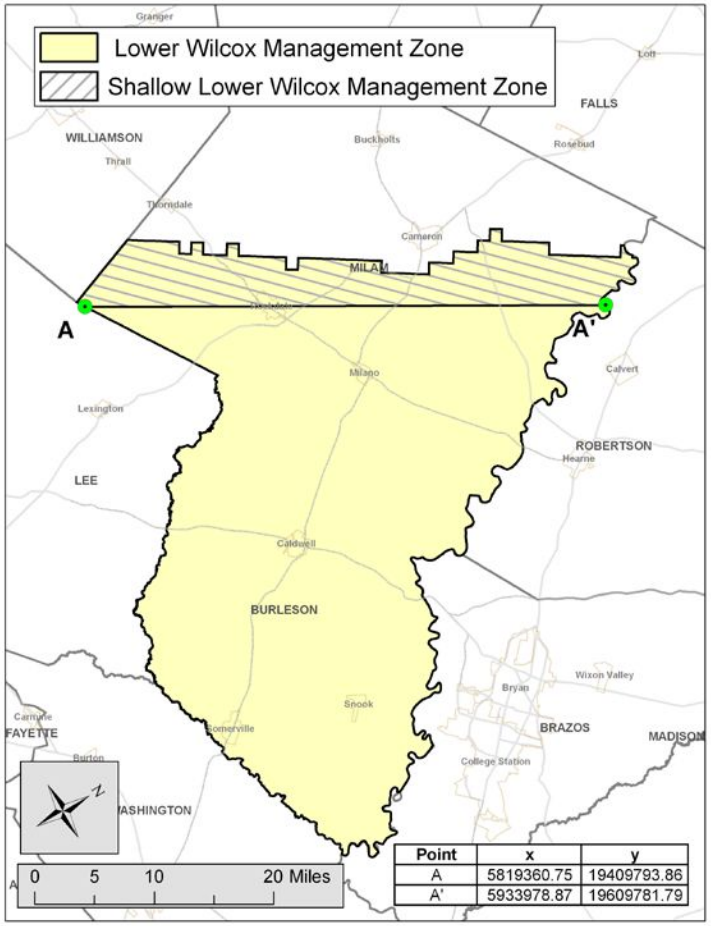


Figure 5. Areal Coverage for the Upper Wilcox (Calvert Bluff Formation) Management Zone and the Middle Wilcox (Simsboro Formation) Management Zone



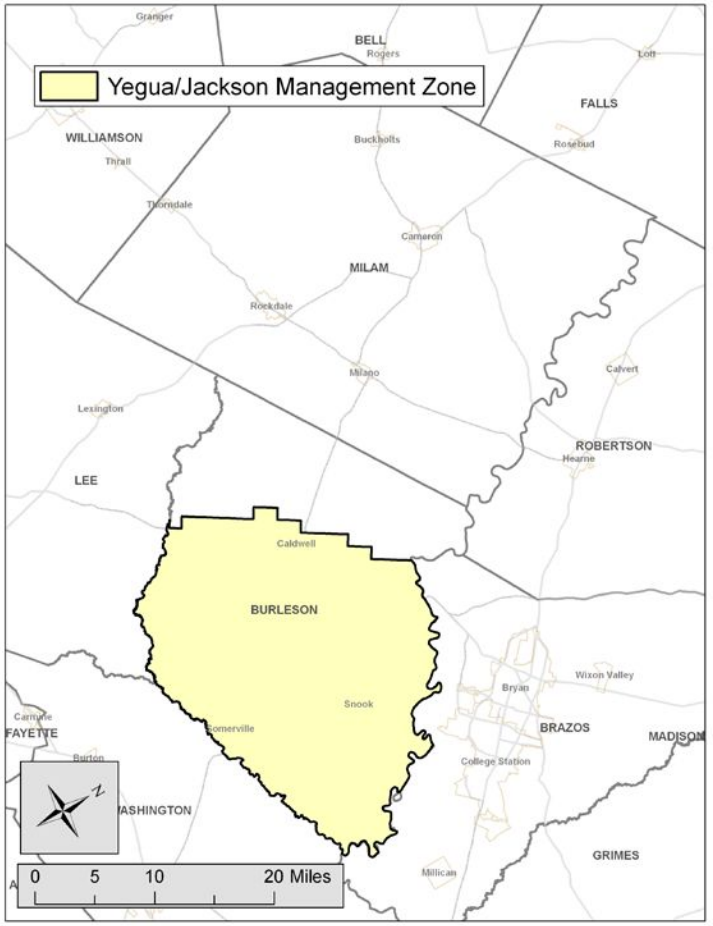


Figure 6. Areal Coverage for the Lower Wilcox (Hooper Formation) Management Zone and the Yegua-Jackson Management Zone