# Texas Water Development Board

# Facility Planning Report - TWDB # 1348321577

# Eastern Kerr County / Western Kendall County Regional Water Facility Plan

S. Keller Drozdick, P.E. PMP[1]

September 2014



[1] Tetra Tech

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## Executive Summary

This report has been developed with the support and cooperation of the participating entities:

- Kerr County
- Kendall County
- Upper Guadalupe River Authority (UGRA)
- Guadalupe Blanco River Authority (GBRA)
- Headwaters Groundwater Conservation District
- Cow Creek Groundwater Conservation District
- Kendall County Water Control & Improvement District #1 (KCWCID#1)

Funding and in-kind services for this report were provided by the participating entities and by a Regional Water Supply Planning Grant from the Texas Water Development Board (TWDB).

The objective of this report is to address questions regarding water needs, supplies, treatment, storage, and distribution for a service area that includes parts of Eastern Kerr County and Western Kendall County, in particular the communities of Center Point (Kerr Co.) and Comfort (Kendall Co.). This study builds on information from Region J and Region L 2011 regional water plans.

During the study period of 2020-2040, it is projected that the population will increase by 26% to 10,013 people; this is an increase of more than 50% from the 2012 date of the most currently available census data. This will result in an estimated 4,483 total water service connections by 2040, of which approximately 87% will be residential. This growth will have an average daily demand of 1.867 MGD, requiring 3.9 MGD of production capacity and 900,000 gallons of total storage to support it. This significantly exceeds the current combined capacity of the existing water utilities, which can only supply 1.7 MGD of production capacity and 780,000 gallons of storage.

Based on a recent geological study of existing well records and an analysis of alternatives identified in regional water plans, the following conclusions and recommendations were reached:

- There is a potential for additional groundwater supplies from the Ellenburger-San Saba aquifer. These require additional investigation, including test wells, to confirm; the potential of an additional water source and the low cost of this source make such investigations worthwhile.
- The current UGRA water rights are not sufficient to provide all of the water needed. Continued, though reduced, usage of groundwater is necessary to provide the balance. Procurement of additional water rights will allow further reduction in reliance on groundwater supplies.
- A surface reservoir is a viable method to store surface water; either alone or in combination with an ASR facility. The cost is higher than an ASR, but an ASR is requires additional study and a surface reservoir provides additional recreational uses. Participating in a larger regional reservoir may reduce these costs, if other entities can share in design and construction costs.

- Treatment of surface water by either conventional or membrane processes is viable, and the best economic fit will depend on specific water quality requirements and treatment processes. These clarifications will need to be developed in detailed planning.
- Storage of water in an ASR facility using the Lower Trinity aquifer may be viable. Determining this will require additional investigation, including test wells, to confirm; the comparatively low cost of this storage makes such investigations worthwhile.
- Official growth projections for the area are under revision, to reflect that the approved growth county population increases are expected to primarily occur in the study area.
- A detailed planning process is recommended to incorporate geological studies and finalize selections

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# Acronyms/Abbreviations

| Acronyms/Abbreviations | Definition |
|---|---|
| AMHI | Adjusted Median Household Income |
| ASR | Aquifer Storage and Recovery |
| CCN | Certificate of Convenience and Necessity |
| CDBG | Community Development Block Grant |
| cfs | Cubic Feet per Second ($ft^3/s$) |
| CWSRF | Clean Water State Revolving Fund |
| DWSRF | Drinking Water State Revolving Fund |
| EDAP | Economically Distressed Area Program |
| ft | Foot or Feet |
| GBRA | Guadalupe Blanco River Authority |
| gpcd | Gallons per Capita per Day |
| gpd | Gallons per Day |
| gpm | Gallons per Minute |
| KCWCID#1 | Kendall County Water Control and Improvement District #1 |
| MG | Million Gallons |
| MGD | Million Gallons Per Day ( = 694.44 gallons per minute or gpm) |
| MOU | Memorandum Of Understanding |
| MSL or m.s.l | Mean Sea Level |
| O&M | Operations and Maintenance |
| ORA | Office of Rural Affairs |
| PWS | Public Water System |
| RWAF | Rural Water Assistance Fund |
| RWPG | Regional Water Planning Group |
| SP | State Participation fund |
| TAC | Texas Administrative Code |
| TCEQ | Texas Commission on Environmental Quality |
| TDA | Texas Department of Agriculture |
| TWDB | Texas Water Development Board |
| UGRA | Upper Guadalupe River Authority |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| WIF | Water Infrastructure Fund |
| WSC | Water Supply Corporation |
| yr | Year |

# 1.0 Introduction

## 1.1 Overview

This report has been developed with the support and cooperation of the participating entities:

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Funding and in-kind services for this report were provided by the participating entities and by a Regional Water Supply Planning Grant from the Texas Water Development Board (TWDB), as approved by TWDB on February 28, 2013.

The objective of this report is to address questions regarding water needs, supplies, treatment, storage, and distribution for a service area that includes parts of Eastern Kerr County and Western Kendall County (see Figure 2: Service Area Map). The current population centers in this area are the communities of Center Point (Kerr Co.) and Comfort (Kendall Co.). This study builds on information from regional water plans and other prior reports to identify the best alternatives for further development in the future.

## 1.2 Background

The service area currently relies on groundwater from aquifers for its sole source of water. There are many wells in the area, mostly private wells for individual properties or small Water Supply Corporations (WSCs), but most wells utilize the same aquifer (the Middle Trinity) for their supplies. Some wells also use the Lower Trinity or Edwards-Trinity aquifer, but an exact count by aquifer is not available.

Over the last several years there has been documentation of a reduction in groundwater levels. Based on this reduction a study was funded by TWDB (under the EDAP program) in 2009 to develop alternatives for water supplies for the Center Point community. Subsequent to this study and other discussions, the entities participating in this report identified that a regional plan was most appropriate to comprehensively address water needs throughout the area. They also identified a number of potential resources and tools to address the water issues, which include the Regional Water Plans covering the study area. This report builds on the information contained in the applicable regional plans. These include the 2011 Plateau Regional Water Plan for Kerr County (Region J), and the South Central Texas Regional Planning Area 2011 Regional Water Plan for Kendall County (Region L).

The planning period for the current study is defined as from 2020-2040 to correspond with an estimated end of construction period and to align with TWDB population projection periods.

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# 2.0 Demographics

## 2.1 Population

One of the most important sets of data for this study is demographic, including current populations, projected growth, and other characteristics. The primary source of current demographic data is the US Census, which conducts estimates of the population, household income, and other information. For the proposed service area, the commonly used data set from the Texas State Data Center did not have sufficient detail, so the American Community Survey is used instead, whose most recent data set is for 2008-2012. US Census Data in this data set is organized by a geographic unit called a Block Group. The designated Census Block Groups that include the proposed service area do not closely correspond to the service area boundary (See Figure 3: Census Block Group Map), so an estimate must be made using the prorating method included in Appendix B, in Table B-1. The results of these calculations are shown in Table 2-1.

**Table 2-1: 2012 Demographic Data Summary**

| Area | Population | Household Size[2] | Households | Household Income |
|---|---|---|---|---|
| Kerr County Service Area | 3,001 | 2.16 | 1,388 | $42,851 |
| Kendall County Service Area | 3,532 | 3.03 | 1,164 | $40,630 |
| **Total Service Area** | **6,533** | **2.56** | **2,552** | **$41,838** |

The prorating of the census data was based on a count of all parcels (according to county appraisal district data) within each block group versus the count of the subset of those parcels that were also within the service area. This provides a relatively good estimate of population and households. However, it may be significantly less accurate regarding household income, as this method does not differentiate between locations or sizes of residential lots. For comparison, a household income survey within Center Point and eastern Kerr County in 2008 found an average household income of $28,000. Because of this potential inaccuracy, a more accurate income evaluation should be performed if income data is needed to apply for funding assistance or other needs.

This data of current demographic estimates can be combined with TWDB population projections to produce an estimate of population growth over the planning horizon. A planning period of 2020-2040 was selected to include a typical 20-year planning period and to use a starting point that will reflect a period of time necessary to pursue design and construction activities for any recommended project (as these timelines are refined, the planning period and associated projections should be updated).

Using the most recent TWDB decade projections for the period from 2020-2070 to project growth during the planning period, and using the previously adopted 2012 projections to project

[2] The household size data from the census has been reported to be potentially lower than actual for the service area. This is being reviewed as part of the regional water plan process.

growth until 2020, allows us to estimate the population growth through the study period. The resulting growth projections are summarized, shown in Table 2-2.

**Table 2-2: 2012-2040 Demographic Growth Rates**

| | Annual Growth Rates | | | Population | | | |
|---|---|---|---|---|---|---|---|
| **Area / Year:** | **2012-2020** | **2020-2030** | **2030-2040** | **2012** | **2020** | **2030** | **2040** |
| Kerr County Service Area | 1.09% | 0.67% | 0.38% | 3,001 | 3,273 | 3,500 | 3,635 |
| Kendall County Service Area | 3.60% | 1.63% | 1.47% | 3,532 | 4,686 | 5,509 | 6,378 |
| **Total Service Area** | **NA** | **NA** | **NA** | **6,533** | **7,959** | **9,009** | **10,013** |

As the data show, the service area is expected to increase in population by 26% during the 2020-2040 study period, and more than 50% from 2012.

## 2.2 Connection Types

To have a better understanding of the local developments, it is necessary to evaluate the different types of land use in the service area. For this study, this was accomplished by evaluating state tax codes associated with parcels identified in county appraisal district data. Because of differences in timing of Census data and county appraisal data, and different approaches to classification, a method was developed to combine the different data sets. The approach taken was to rely on census data for household counts (i.e. household water service connections), and use appraisal district data for non-residential connection counts. These counts are summarized in Table 2-3 below, with projected future connection counts based on the overall population growth described above. Specifically, the average household size is assumed to remain constant, as well as the proportion of non-residential to residential connections, so that the total connection count increases at the same rate as the overall population.

**Table 2-3: 2012 Estimated Connection Counts**

| | Potable Water Users | | | Non-Potable Water Users | | |
|---|---|---|---|---|---|---|
| **Area / Classification** | **Households** | **Commercial** | **Other** | **Agricultural** | **Vacant** | **Other** |
| Kerr County Service Area | 1,388 | 77 | 80 | 655 | 382 | 48 |
| Kendall County Service Area | 1,164 | 165 | 51 | 175 | 67 | 18 |
| Total Service Area | 2,552 | 242 | 131 | 830 | 449 | 66 |
| Total Connections | | | *2,925* | | | |
| Projected Connections, 2020 | | | *3,563* | | | |
| Projected Connections, 2040 | | | *4,483* | | | |

As shown in the table, there are 2,925 total water connections estimated in 2012, with the majority (87% being residential connections. The count also shows that there are large numbers

of non-potable water users such as agricultural and vacant land that may be subject to development in the future.

A review of local businesses indicated that there are no significant commercial or industrial water users (excluding agricultural users which would not be served by the proposed water system). Most non-residential water users are retail establishments or small manufacturing facilities that do not require special consideration in this analysis.

## 2.3 Water Production Capacity Requirements

Overall water requirements are based on the TCEQ regulations regarding water supply and distribution systems. These regulations require minimum production and storage capacity to be connected to the system to ensure reliable water supplies. The average demand by users will be significantly lower overall, but these capacity requirements help ensure that peak demands can be accommodated without overstressing the water system.

The primary applicable regulations are contained within 30 TAC § 290.43(b), subsections (1) for groundwater and (2) for surface water. Regardless of the source water, many of the requirements are the same:

- 0.6 gpm production capacity per connection (well pumps or raw water pumps and treatment)
- 2.0 gpm per connection of service pump capacity
- 200 gallons per connection of total storage
- 100 gallons per connection of elevated storage

At this time fire protection is not planned to be included in any proposed system. This does not impact the parameters above, but it can significantly change the size of pipes and storage tanks, as large lines and substantial storage volumes are required to accommodate “fire flows”. The key system parameters are calculated for the proposed service area in the table below.

**Table 2-4: 2012-2040 Water Production Requirements**

| | 2012 | 2020 | 2040 |
|---|---|---|---|
| Total Connections | 2,925 | 3,563 | 4,483 |
| Production Capacity [MGD] | 2.527 | 3.078 | 3.873 |
| Service Pumps [gpm] | 5,850 | 7,126 | 8,966 |
| Total Storage [gallons] | 585,000 | 712,600 | 896,600 |
| Elevated Storage [gallons] | 292,500 | 356,300 | 448,300 |

The table shows that by the end of the planning period, a total of 3.873 MGD of production capacity is needed, as well as almost 900,000 gallons of storage, of which at least half must be elevated storage.

## 2.4 Water Demand Requirements

The preceding section analyzed the regulatory requirements for production, distribution, and storage capacity. This section looks at potential demand based on historical data and demographic projections. The production capacity requirements are larger than the demand requirements, in part to ensure that there is sufficient capacity to accommodate short-term peaks in demand.

Two sets of historical demand data are available for water demand: existing WSCs in the proposed service area and county-level data from TWDB.

**Table 2-5: Area Water Utilities Demand Data**

| County | PWS ID | PWS Name (Owner, if different) | Connections | Avg. Daily Consumption [MGD] | Avg. Consumption per Connection [gpd / conn.] |
|---|---|---|---|---|---|
| Kendall | 1300002 | Kendall County WCID 1 | 1010 | 0.236 | 233.7 |
| Kerr | 1330015 | Westwood Water system (Wiedenfeld Water Works) | 104 | 0.023 | 221.2 |
| Kerr | 1330097 | Nickerson Farm Water System (Aqua Texas) | 62 | 0.000[1] | 0.0[3] |
| Kerr | 1330127 | Park Place Subdivision (Aqua Texas) | 40 | 0.003 | 75.0 |
| Kerr | 1330111 | Center Point North Water System (Aqua Texas) | 80 | 0.017 | 212.5 |
| Kerr | 1330007 | Center Point Wiedenfeld Water Works (Wiedenfeld Water Works) | 54 | 0.004 | 74.1 |
| Kerr | 1330010 | Center Point Taylor System (Aqua Texas) | 165 | 0.029 | 175.8 |
| Kerr | 1330151 | Hill River Country Estates (Hill River Water Works) | 66 | 0.009 | 136.4 |
| Kerr | 1330046 | Verde Hills WSC | 27 | 0.006 | 222.2 |
| Kerr | 1330144 | Generis Water Works | 81 | 0.015 | 185.2 |
| Kerr | 1330027 | Verde Park Estates (Wiedenfeld Water Works) | 65 | 0.012 | 184.6 |
| **Average** | | | | | **209.2** |

[3] The zero consumption data is as reported in the TCEQ Water Utility Database. It is not known if the system is not operational, if no data was reported, or if there is an error in the database. This data was not included in calculations of average consumption.

WSC data (Table 2-5) is taken from data reported to the TCEQ and tracked in the state Water Utility Database. This dataset is useful as it reflects demands from actual customers that would constitute a substantial portion of the proposed connections, but it also reflects usage patterns that may change when the water supply changes, and growth occurs with new people moving into the area. Furthermore, it does not reflect the water usage of other people that are not served by WSCs. Based on the average of existing WSCs, the average usage per connection has been 209 gallons per day per connection. This is significantly below common average demand numbers, and likely reflects water usage patterns influenced by 1) local WSC rates and policies, and 2) local land use patterns, such as limited residential landscape irrigation.

TWDB data (summarized in Table 2-6) is more comprehensive, in that it seeks to cover the entire county, and uses data reported by utilities, river authorities, and groundwater districts. Because of this scale, there is a mismatch in that the proposed service area is only a small portion of the area of each county. Also, the county data reflects water usage of larger population areas not in the study area such as Boerne and Kerrville. It does include water usage of users on individual wells (based on state-wide estimates at 118 gpcd), which is not included in the WSC data in Table 2-5. Furthermore, the most recent data is from 2011, which is both not current and reflects a period of extreme drought when water use was seen to be unusually high. The weighted average of Kendall and Kerr county data is 416 gallons per day per connection.

Clearly, there is a substantial difference between the WSC data of 209 gpd per connection and the TWDB county averages of 416 gpd per connection. Some of this difference can be explained by the fact the TWDB data reflects a worst-case drought year and heavily developed municipalities. Therefore, it is both a more conservative estimate and it may better reflect changing water usage patterns over the study period as the connection count increases due to future growth via development. Therefore, the TWDB derived data will be used in this report as the estimate average daily demand.

**Table 2-6: TWDB County Water Demand Data, 2011**

| County | Population | Municipal [acre-ft / yr] | Manufacturing [acre-ft / yr] | Muni. + Mfr. [acre-ft / yr] | Demand [gpcd] | Demand[4] [gpd / connection] |
|---|---|---|---|---|---|---|
| Kendall | 34,621 | 6,143 | 0 | 6,143 | 158.4 | 342 |
| Kerr | 49,912 | 9,274 | 8 | 9,282 | 166.0 | 503 |
| **Average[5]** | | | | | | **416** |

## 2.5 Summary

The foregoing analysis identifies the necessary characteristics of a water system to serve the proposed service area, considering population growth over the study period. As detailed in the tables above, the proposed service area will have a total of 4,483 connections at the end of the

[4] Based on household size estimates from Table 2-1

[5] Weighted average based on household count per county from Table 2-1

planning period (2040), requiring 3.873 MGD of production capacity, 0.896 MG of total storage, and 0.448 MG of elevated storage.

In addition, average daily demand was estimated based on available historical data. Both WSCs and county level data were reviewed, with the selected average daily demand number of 416 gpd per connection to be used in this report.

# 3.0 Existing Facilities

Portions of the service area are currently served by existing water utilities. These existing utilities and their current facilities represent the current production and storage capacity of the service area. This is tabulated to understand how the existing utilities and their facilities can accommodate the projected needs throughout the service area. Current utilities are listed in Table 3-1. Six different owners were identified, and they operate a total of eleven separate public water systems.

**Table 3-1: 2013 Area Water Utilities**

| County | CCN | Owner | PWS ID | PWS Name |
|---|---|---|---|---|
| Kendall | 10685 | Kendall Co WCID #1 | 1300002 | Kendall County WCID 1 |
| Kerr | 12052 | Wiedenfeld Water Works | 1330015 | Westwood Water system |
| Kerr | 11157 | Aqua Texas | 1330097 | Nickerson Farm Water System |
| Kerr | 11157 | Aqua Texas | 1330127 | Park Place Subdivision |
| Kerr | 11157 | Aqua Texas | 1330111 | Center Point North Water System |
| Kerr | 12052 | Wiedenfeld Water Works | 1330007 | Center Point Wiedenfeld Water Works |
| Kerr | 11157 | Aqua Texas | 1330010 | Center Point Taylor System |
| Kerr | 12939 | Hill River Water Works | 1330151 | Hill River Country Estates |
| Kerr | 12093 | Verde Hills WSC | 1330046 | Verde Hills WSC |
| Kerr | 12908 | Generis Water Works | 1330144 | Generis Water Works |
| Kerr | 12052 | Wiedenfeld Water Works | 1330027 | Verde Park Estates |

Each entity was directly contacted to collect information regarding existing facilities, connection counts, and demand history. In many cases the data could not be readily obtained or there was low confidence in data provided. As an alternative the TCEQ Water Utility Database was used to collect data as most recently reported to TCEQ. Therefore, the data shown was based on the data in that database at the time of collection. Based on local knowledge of the utilities, there is high confidence that there have been no substantial modifications to the systems recently that would substantially change this data. It was noted that some water systems had been sold or were in the process of being sold, but these transactions do not alter the capacity analysis.

## 3.1 Existing Capacity

This data in Table 3-2 is summarized across all utilities identified, with the detailed data included in Table 3-3 (See Table 2-5 above for connection count and demand data by water system). The age, condition, etc. of the existing facilities was not evaluated as part of this study.

Data was not available regarding disinfection equipment or groundwater levels. It is expected that existing systems have adequate disinfection facilities for their current connections, but that new disinfection facilities would be needed for any additional production capacity constructed as part of this project.

Numerous prior reports have documented the general decrease in aquifer levels in both Middle and Lower Trinity wells throughout the service area. Most recently, the 2009 Category A EDAP Eligibility Assessment Report conducted for UGRA by Naismith Engineering reviewed historical reports and well data from 1990 to 2008 and found that 79% of the wells investigated experienced decreasing groundwater levels.

**Table 3-2: 2013 Existing Facilities Capacity Summary**

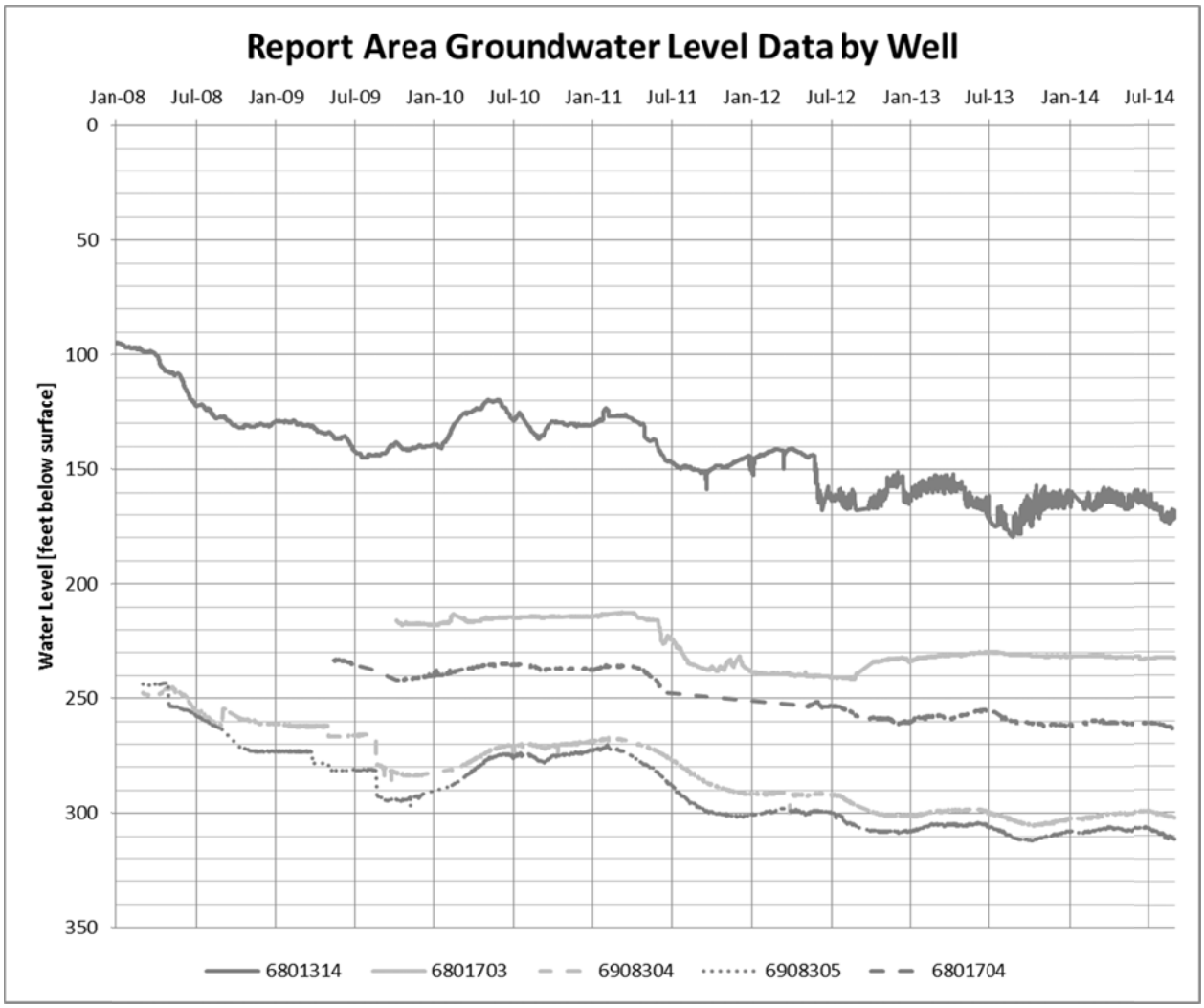
| | Existing Facilities |
|---|---|
| Total Connections | 1,751 |
| Production Capacity [MGD] | 1.688 |
| Service Pumps [gpm] | 5,312 |
| Total Storage [gallons] | 780,000 |
| Elevated Storage [gallons] | 204,000 |

**Table 3-3: Detailed Existing Facility Capacity Data**

| PWS | PWS Name | Total Storage [MG] | Elevated Storage [MG] | Total Production [MGD] | Service Pump Capacity [MGD] |
|---|---|---|---|---|---|
| 1300002 | Kendall County WCID 1 | 0.474 | 0.150 | 0.573 | 4.320 |
| 1330015 | Westwood Water System | 0.036 | 0.000 | 0.100 | 0.360 |
| 1330097 | Nickerson Farm Water System | 0.011 | 0.000 | 0.230 | 0.288 |
| 1330127 | Park Place Subdivision | 0.015 | 0.000 | 0.046 | 0.173 |
| 1330111 | Center Point North Water System | 0.020 | 0.000 | 0.216 | 0.576 |
| 1330007 | Center Point Wiedenfeld Water Works | 0.013 | 0.000 | 0.066 | 0.202 |
| 1330010 | Center Point Taylor System | 0.064 | 0.000 | 0.160 | 0.578 |
| 1330151 | Hill River Country Estates | 0.013 | 0.000 | 0.059 | 0.230 |
| 1330046 | Verde Hills WSC | 0.040 | 0.000 | 0.072 | 0.432 |
| 1330144 | Generis Water Works | 0.040 | 0.000 | 0.094 | 0.288 |
| 1330027 | Verde Park Estates | 0.054 | 0.054 | 0.072 | 0.202 |

A review of data from monitoring wells within the project data extended the earlier results by showing continued decrease in local groundwater levels from 2008 through August of 2014, as shown in Figure 1. This data is based on five monitoring wells, including one in Kendall County (TWDB well 6801314) and four in Kerr County (Headwaters GCD wells 6801703, 6801704, 6908304, and 6908305). For four of the five wells, data was only available since 2008 or later, so the common overlapping period was used for this comparison. These data show a continued trend of decreasing groundwater levels for all wells.

The 2011 Region L water plan describes the Trinity Aquifer as being "stressed due to rapid




growth in the number of wells being drilled" (p 1-36) and they note that "supply available from the Trinity Aquifer is projected to decline" (p 3-4). They also note specifically for Kendall

**Figure 1: Groundwater Well Data 2008-2014**

County Rural Areas that "Rural Areas are projected to need additional water supplies prior to 2010" (p 4B.2-160). The Region J 2011 water plan (section 3.2.9) notes that "The higher concentrations of wells in Kerr and Bandera Counties related to population growth may present water supply availability problems in the future."

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# 4.0 Geology

A separate geology report was performed as part of this study, to evaluate the geology and aquifers in the study area. This report was prepared by Wet Rock Groundwater Services and issued in December 2013.

The objectives of the report were to review existing data and investigate potential fresh water aquifers including the Trinity, Hickory, and Ellenburger-San Saba aquifers, the potential for ASR formations including the lower Trinity, and to identify any potential sources of brackish groundwater for desalination. Locations of future test wells were also to be identified.

The full report is included in Appendix B. The key findings include

- The Ellenburger-San Saba aquifer was found to be at shallower elevations than expected in portions of the study area, particularly around the Kerr-Kendall county line. Though the aquifer production can be quite variable, the potential of significant supplies warrant one or more test wells and additional study to evaluate its potential as a water source. As detailed in the report, likely well locations would be in the northeastern portion of the study area, corresponding to an area along the northern portion of the county line and in northeastern Kerr County.
- The Lower Trinity Aquifer is a potential candidate for ASR use, and therefore warrants one or more test wells and additional study. Such a study would also need to address the water quality, as other wells have had significant levels of radium. As detailed in the report, likely test well locations are in the southern portion of the study area. Also, there is a potential for additional investigation in portions of Kendall County to better define the aquifer potential there.
- There were no significant sources of brackish groundwater identified based on available data, in part because of uncertainty regarding formations in the area.

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# 5.0 Capacity & Demand Analysis

This section combines and compares the previously developed data regarding required production, estimated demand, and existing facilities with the objective of identifying quantified goals.

## 5.1 Production Capacity

Prior sections quantified the production, distribution, and storage needs based on the demographics, and documented the corresponding capacities available in existing systems. These two related sets of data are combined in the table below.

**Table 5-1: Existing and Required Water Facility Capacity**

| | Existing Facilities | Requirements | | | Required / Goal |
|---|---|---|---|---|---|
| | | 2012 | 2020 | 2040 | |
| Total Connections | 1,751 | 2,925 | 3,563 | 4,483 | NA |
| Production Capacity [MGD] | 1.688 | 2.527 | 3.078 | 3.873 | 3.900 |
| Service Pumps [gpm] | 5,312 | 5,850 | 7,126 | 8,966 | 9,000 |
| Total Storage [gallons] | 780,000 | 585,000 | 712,600 | 896,600 | 900,000 |
| Elevated Storage [gallons] | 204,000 | 292,500 | 356,300 | 448,300 | 450,000 |

As shown, the proposed service area includes a significant increase in the total number of connections compared to the existing facilities. The estimated increase from 1,751 for existing facilities to 2,925 in 2012 reflects primarily the fact that the service area includes many parcels not currently served by a utility. These are connections currently served by individual private wells that are planned to be connected to any future water system. The difference increases significantly throughout the planning period, reflecting the expectation that future connections will come from developments outside existing WSC areas.

The summarized data show that the production, pumping, and storage available in the existing facilities do not meet the needs of the proposed service area, particularly by the end of the planning period. This demonstrates that to serve the proposed area additional facilities must be constructed to produce, distribute, and store the necessary amounts of water. This is consistent with the fact that many new connections will be included in the service area. It may be possible to directly or indirectly use the existing facilities to reduce construction costs, but this would need to be assessed in detail as part of the future design and is beyond the scope of this study.

The final set of data in the table above is the specific “goal” for each capacity requirement. This goal can also be considered the required capacity necessary to meet the projected need. The numerical value was obtained by rounding up the required amount to the second significant figure to provide a slight margin and identify a clear number as a future design basis.

Table 5-1 summarizes the most recent groundwater availability data provided by TWDB (via e-mail July 28, 2014). This data shows that the draft long term plan is based on a reduced amount of groundwater to be available in the Trinity aquifer within the Guadalupe basin in Kerr County,

which is the majority of the area considered in this study. This is to allow for an increase in average drawdown in groundwater levels. These data, combined with the monitoring well data in Figure 1, shows that the groundwater supply in the project area has been decreasing and is projected to decrease more in the future. Therefore, additional water sources need to be identified and developed.

**Table 5-2: Modeled Available Groundwater Data, Trinity Aquifer [acre ft / yr]**

| County | RWPA | Basin | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|---|---|
| Kerr | J | Colorado | 318 | 318 | 318 | 318 | 318 | 318 |
| Kerr | J | Guadalupe | 15,646 | 14,129 | 14,056 | 13,767 | 13,450 | 13,434 |
| Kerr | J | Nueces | 0 | 0 | 0 | 0 | 0 | 0 |
| Kerr | J | San Antonio | 417 | 471 | 471 | 471 | 471 | 471 |
| Kendall | L | Colorado | 135 | 135 | 135 | 135 | 135 | 135 |
| Kendall | L | Guadalupe | 6,028 | 6,028 | 6,028 | 6,028 | 6,028 | 6,028 |
| Kendall | L | San Antonio | 4,976 | 4,976 | 4,976 | 4,976 | 4,976 | 4,976 |

## 5.2 Demand

Using the design average demand figure of 416 gpd per connection and the demographic growth data provides a demand projection (Table 5-3).

**Table 5-3: Projected Demand**

| Year | 2012 | 2020 | 2040 |
|---|---|---|---|
| Total Connections | 2,925 | 3,563 | 4,483 |
| Average Daily Demand [MGD] | 1.217 | 1.482 | 1.865 |
| Annual Demand [acre-ft / yr] | 1,363 | 1,660 | 2,089 |

These figures are used to size and evaluate alternatives; they also set a specific goal of supporting a total annual demand of at least 2,089 acre-ft / year.

## 5.3 Reservoir Capacity

A water supply system depends on a reservoir of raw water. For the current groundwater wells, the reservoir is the aquifer used by the groundwater pumps. For surface water (an option considered in this report), a reservoir is often a natural or man-made lake or impoundment. In this project area, there are several active and abandoned quarries and gravel pits that could be repurposed as reservoirs.

A more recently developed option is using underground aquifers to store water for later use: an Aquifer Storage and Recover (ASR) system. In the context of capacity analysis an ASR system can be treated much the same as a surface reservoir, in that overall storage capacity is a function

of demand and supply factors, not the type of reservoir. The following analysis will evaluate the factors that impact the amount of water needed for long term storage in either type of facility.

The regional plans have considered potential reservoir capacity from a regional standpoint, including both surface reservoirs and ASR. These include

- Region J - ASR feasibility in Kerr County (Plateau Region Water Plan, 2011, Appendix 1A): This considered a potential ASR facility that would store a maximum of 1,905 acre-ft / year.
- Region L - Storage above Canyon Reservoir (South Central Texas Regional Water Planning Area, 2011 Regional Water Plan, Water Management Strategy 4B.1.2.13) considered both surface reservoirs storing 51,086 to 140,153 acre-ft and an ASR project storing 10,000 acre-ft.

The regional plans considered reservoir options starting from regional considerations. This study considers the reservoir analysis from the perspective of users of a single system. From this approach, several factors are evaluated that impact reservoir volume requirements.

- User demand (operational withdrawals from the reservoir to meet treatment and distribution needs, based on the daily average demand)
- Limitations on withdrawals from the river (drought & legal restrictions)
- Losses (evaporation and seepage for surface water reservoirs, migration for ASR)

For the project area, the primary consideration is drought because of a history of significant and long term droughts. To identify potential drought severity and duration, we reviewed stream flow data from USGS for gauges in the Guadalupe River in or near the study area. The primary gauge utilized is located in Comfort (08167000) because of its location within the general project area, its long operational history (since 1939), and its location downstream of the confluence of the Guadalupe River and Cypress Creek.

The first approach to reservoir sizing is to have adequate capacity for the longest known single dry period. However, this does not consider

- longer term droughts with intermittent river level increases,
- ensuring maximum access to water rights by withdrawing water during “wet periods”, or
- long term “banking” of water over multiple years to store against extended droughts.

To address these objectives, a second approach with additional parameters is used. These additional factors include current water rights limitations, multi-year variations in river level, and other factors impacting both demand and supply. The details of this analysis and the methodology used are addressed in Appendix B. The required usable reservoir capacity that was determined from this analysis was 3,000 acre-ft. This capacity would be adequate to ensure a portion of the total demand throughout all but the driest years of the drought-of-record allowing groundwater supplies to be conserved for such periods, consistent with the GAM data provided by TWDB. It also maximizes the ability to capture river water when it is available, maximizing the use of that resource.

Acquisition of additional water rights such as those described in the October 1999 MOU between Kerr County and GBRA would allow greater utilization of this reservoir or a larger one (see Appendix B for copy of MOU).

The preceding discussion of reservoir use and sizing considers only the use for drinking water supply. Currently, a separate effort is underway to address flood control issues in Comfort, which could involve flood control structures along the Guadalupe River and/or Cypress Creek. While the current proposal does not have any direct relationship to flood control, as the two projects progress they should be coordinated to determine if the efforts could be combined for improved economics.

## 5.4 Water Rights

As mentioned above, the available water rights are a primary consideration in evaluating surface water usage. Currently, UGRA has existing water rights totaling 2,000 acre-ft / year, of which 1,661 acre-ft can be used for municipal consumption (these are described in detail below).

The existing water rights can only be exercised when the river has adequate flow, based on several conditions.

- Water can only be withdrawn from the river when the flow of the Guadalupe River exceeds
    - 30 cfs in June through September, or
    - 40 cfs in October through May, and
- 50 cfs exists in Canyon Reservoir inflows, otherwise 50 cfs must be allowed to pass
- Withdrawal rate is limited to a combined 4.7 cfs when added to other associated water right
- Daily withdrawal is limited to a value based on historical data that changes from month-to-month

The current water rights identify the diversion point as being at the same location as the current City of Kerrville withdrawal, which is significantly upstream of the project area.

Kerr County also has a Memorandum of Understanding with GBRA involving up to 6,000 acre-ft of additional water rights, but these are not included in this analysis because the specific conditions are not yet finalized. The MOU (included in Appendix B) provides for GBRA support and assistance of Kerr County's obtaining permits up to 6,000 acre-ft / year, at any time after January 1, 2021.

## 5.5 Summary

Existing facilities in the current utilities are not adequate to provide sufficient production, distribution, or storage capacity for the number of connections in the proposed service area. Furthermore, the overall groundwater supplies in the area have shown reduced levels and productivity over the last several years, and need to be supplemented with one or more new sources of water. It may be possible to incorporate some or all existing facilities into a regional system, but the extent to which this can be done will require detailed assessment of those facilities as part of a future design.

For surface water alternatives, a surface water reservoir and/or ASR reservoir of 3,000 acre-ft usable capacity is needed to ensure water supplies during all but the most extreme multi-year drought.

The current UGRA water rights are not sufficient to provide all of the water needed. Continued usage of groundwater is necessary to provide the balance, and procurement of additional water rights will allow further reduction in reliance on groundwater supplies.

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# 6.0 Alternatives

This section considers alternatives developed in the 2011 Region J & L regional water plans, and develops them further to evaluate the technical viability and whether they meet the needs identified previously, and whether or not they are economically feasible. For consistency with the regional plans, we have used the same project and O&M cost basis and methodology as established in those plans (primarily Appendix A of the 2011 Region L plan). Annual costs associated with debt service are not included since the funding mix is not yet known. Economic viability is determined based on order-of-magnitude cost considerations to rule in or out possible alternatives. More detailed cost comparisons between relatively close costs are included in Section 7.0.

Often in feasibility reports, a "Do Nothing" alternative is included for full analysis. For this project, this alternative would rely on existing groundwater supplies and facilities, which have been shown in previous sections to be inadequate. This alternative is considered in conjunction with the continued Trinity use below.

## 6.1 Source Water Alternatives

Because the existing Trinity groundwater sources are not sufficient to meet current or projected demand, additional source(s) need to be identified. This section addresses alternatives from regional water plans and other investigations.

### *6.1.1 Alternatives*

Three alternatives have been identified as potential additional water sources:

- A1: A different aquifer such as the Ellenburger-San Saba or Hickory
- A2: Brackish groundwater desalination
- A3: Surface water from the Guadalupe River via current water rights owned by UGRA and future rights potentially available to Kerr County
- A4: Continued use of Middle and Lower Trinity Aquifers

A1: While the Region L Plan does not address the potential of either aquifer within the study area, the Region J Plan does identify the Ellenburger-San Saba and Hickory aquifers as possible resources (section 3.2.7). Developing either of these aquifers would provide a new fresh groundwater source to supplement the current supplies and reduce demand on the Middle & Lower Trinity aquifers.

A2: Brackish groundwater is a potential resource identified in both regional plans. The Region L report specifically recommends a number of brackish groundwater desalination projects (Section 4B), while the Region J report notes that brackish productivity is usually low but that it should remain under consideration (Sections 3.2.11, 4.11.2). Neither report identifies specific potential options within the current study area.

A3: Accessing surface water from the Guadalupe River would include diverting the water within the study area and transferring to reservoirs and treatment. The current UGRA water right allows for municipal usage of up to 1,661, acre-ft, and Kerr has an MOU that supports acquisition of

additional water rights starting in 2021. This alternative is developed in the Region J plan (section 4.7.1 and in Appendix 1A). Further water rights could also be acquired as available.

A4: As noted, the Middle and Lower Trinity aquifers are currently overused, with falling groundwater levels and reduced well production. In this context, the continued use of existing wells is not viable on its own, but it can still provide a portion of the overall supply needs.

### *6.1.2 Technical Viability*

A1: This study has found that the Ellenburger-San Saba aquifer appears to be present at unexpectedly shallow depths in some parts of the study area, and that some existing wells are likely drawing from it currently. There is not enough information to identify the potential productivity of any wells that would be constructed, but there is enough information to justify additional study such as test wells and more focused geological investigations. The Hickory aquifer was not found to be a viable source in the study area, as it was not identified as present in the study area in any of the available well records.

A2: There are no productive brackish aquifers in the study area, based on a review of available well data included in the geological study that is part of this report. This is consistent with the Region J findings. Therefore, the brackish groundwater desalination alternative is not viable at this time based on available data.

A3: Withdrawing water from the Guadalupe River is viable from a technical standpoint, and would include a pump station, associated piping, and an intake structure. The current UGRA water rights call for diversion outside the project area, so either the diversion point would need to be added or moved downstream, or a transfer pumping system constructed. Such a change in the diversion point could be coordinated with modifications being considered at Flat Rock Lake. The current cost estimate is based on the diversion point near a treatment facility.

Another option is to acquire additional water rights, either in conjunction with the Kerr-GBRA MOU or on the open market. Depending on the terms the additional rights could eliminate issues with the diversion point of the UGRA water rights.

A related alternative raised in the initial development of this project was direct diversion of water from Canyon Reservoir by withdrawing water under one of the above water right scenarios and transferring it via pipeline to the service area, potentially using existing pipelines and/or easements for a portion of the route. This alternative proved to not be viable due to conflicting agreements already in place. Appendix B documents the concerns as raised by GBRA, as well as their acknowledgement of the elimination of this alternative.

A4: Existing Middle and Lower Trinity wells are no obstacle technically, but because of observed groundwater level reductions the total withdrawals would need to be decreased to ensure sustainability. For this study it has been assumed that a reduction to 1.0 MGD average daily use of existing groundwater is a sustainable level.

### *6.1.3 Address Needs*

A1: The Ellenburger-San Saba aquifer may meet the needs of an additional water source, depending on the actual productivity of the aquifer. This can be determined through construction of test wells and additional focused study.

A2: Since no brackish aquifers were found in the area, this does not meet the needs of an additional supply.

A3: Surface water from the Guadalupe River would address most of the local needs for additional water supplies. The existing UGRA water rights provide up to 1,661 acre-ft per year of water. Even if they could be fully utilized, they would only be adequate at the beginning of the study period; by the end of the study period they will be 428 acre-ft / year short of demand needs. Various restrictions on the amount and timing of daily withdrawals further reduce the usable amount of these water rights, so that the shortfall is even larger. This shortfall can be addressed through acquisition of additional water rights, maintaining limited use of the current Trinity wells and/or by development of Ellenburger-San Saba wells.

A4: As previously established, the Middle and Lower Trinity aquifers do not meet the current needs by themselves, and therefore can only address projected needs as part of a combination of different sources.

No single water source will meet the projected requirements, so at least one of the additional sources is needed to address the identified needs.

### *6.1.4 Economic Feasibility*

A1: The costs associated with one or more wells in the Ellenburger-San Saba aquifer are unknown at this time, as the productivity of the aquifer is unknown. At this point, there is no reason to believe there would be any unusual cost associated with such a well, so it retains the potential to be economically viable. Estimated costs make it the least expensive source option (see Table 6-1 below)

A2: Since there are no readily accessible brackish water aquifers, the brackish water desalination option is not economically feasible.

**Table 6-1: Cost Estimate, Water Sources**

| ID | Sources | Description | Project Cost | Annual O&M Cost |
|---|---|---|---|---|
| A1 | Ellenburger-San Saba Wells | 5 new wells, 3.9 MGD total | $ 4,410,000 | $ 53,300 |
| A2 | Brackish Groundwater | Not viable – no identified source | NA | NA |
| A3 | Surface Water Withdrawal | Pumps: 2 MGD; Piping: 18", 6,000 ft | $ 6,450,000 | $ 111,200 |
| A4 | Existing Middle & Lower Trinity Wells | existing wells | $ 0 | $ 53,300 |

A3: Surface water withdrawals would require a pump station and piping to deliver water to a treatment facility, surface reservoir, and/or ASR. Sizing the pumping station for TCEQ production requirements, a total pump station capacity of 3.9 MGD is necessary, but based on reservoir and water rights sizing analysis 2.1 MGD is recommended (See Appendix B for reservoir sizing methodology). This smaller size will require the remaining capacity to be achieved through well pumps. The pumping system also includes an estimated 6,000 LF of 36” water pipeline.

A4: Using existing Middle and Lower Trinity wells would require no new wells to be constructed, but would continue to incur O&M costs estimated as equivalent to the Ellenburger-San Saba wells.

## 6.2 Water Treatment Alternatives

Raw water requires some level of treatment prior to distribution, but the amount and type of treatment depends heavily on the source of the water. Fresh groundwater can often be used with only disinfection and sometimes targeted treatment for specific contaminants (e.g. iron, radium). Surface water requires significant treatment to remove suspended solids, microorganisms, and other contaminants, which is usually achieved through either traditional or membrane treatment.

### *6.2.1 Alternatives*

B1: The groundwater source considered (Ellenburger-San Saba) is a fresh water aquifer, so only treatment with disinfection is expected. Depending on the specific water quality encountered, some specific treatment may be necessary, but this cannot be determined until test wells are constructed and investigated. For the purposes of this report, it is assumed that a minimal level of additional treatment is required in addition to disinfection, such as low level iron removal.

B2: Brackish Groundwater would require treatment, but since there is not an available source the treatment alternative for this source does not apply.

B3, B4: Surface water from the Guadalupe River would require additional treatment. Such treatment could be either by a traditional treatment process (i.e. flocculation, clarification, & filtration) or by a membrane process.

### *6.2.2 Technical Viability*

All the identified treatment alternatives are technically viable, and have a history of success on similar raw waters. The only uncertainty is regarding any necessary treatment of the Ellenburger-San Saba, which can only be determined after additional study.

### *6.2.3 Address Needs*

Each of the treatment alternatives can successfully meet the treatment needs for the corresponding raw water. All can be designed and constructed in a capacity adequate to meet the identified goals.

### *6.2.4 Economic Feasibility*

B1: Treatment costs associated with Ellenburger-San Saba well(s) are unknown as the possible treatment needs are not yet identified. Any treatment that would be typical for a groundwater source would be feasible economically, and would be the least expensive treatment. If the water quality was too poor for use with minimal treatment it would need to be evaluated as a brackish aquifer.

B2: Since no brackish source has been identified, treatment is not viable.

B3, B4: Based on this preliminary analysis, membrane and traditional treatment are effectively the same in initial cost, while a membrane plant can have lower operating costs. One major source of uncertainty at this point is related to the water quality. Depending on the finalized

target and starting water qualities, these costs may change. A second source of uncertainty is O&M costs, which can be heavily impacted by changes to treatment processes, actual energy costs, and other factors. While at this point a membrane plant would be preferable based on operating costs, there is enough uncertainty to retain both treatment options through the next planning phase for more accurate estimates.

**Table 6-2: Cost Estimate, Water Treatment**

| ID | Treatments | Description | Project Cost | Annual O&M Cost |
|---|---|---|---|---|
| B1 | Ellenburger-San Saba Groundwater Treatment | 3.9 MGD, disinfection & minimal treatment | $ 450,000 | $ 182,900 |
| B2 | Brackish Groundwater Desalination Treatment | Not viable – no identified source | NA | NA |
| B3 | Surface Water - Traditional | 3.9 MGD, coagulation, filtration, disinfection | $ 17,020,000 | $ 873,900 |
| B4 | Surface Water - Membrane | 3.9 MGD, micro & nanofiltration | $ 16,960,000 | $ 221,000 |

## 6.3 Water Storage Alternatives

Storage considered in this alternative is bulk storage. Bulk storage involves retaining large quantities of water for the purpose of managing long term fluctuations in raw water, providing a stable water supply during seasonal droughts and insulating the water supply from other demands. Smaller, distribution storage used to store and manage treated water is considered as part of the general distribution system in a later section.

### *6.3.1 Alternatives*

In the bulk storage category three alternatives have been identified:

- C1, C2: new off-channel reservoir
- C3: a new ASR facility (conjunctive use when combined with surface water treatment alternative), and
- C4: the existing Center Point Lake.

New reservoirs may utilize existing quarries (i.e. gravel pits) near the river or other sites.

An ASR facility would utilize a suitable underground aquifer to store water that was already treated to drinking water standards. This water would be withdrawn as needed, and may be subject to minor additional treatment depending on the aquifer characteristics.

### *6.3.2 Technical Viability*

C1: Off-Channel Surface Reservoirs, whether new or constructed at existing quarries, are a proven technology that is technically viable (for this report only off-channel reservoirs are considered due to existing development). The primary question is whether or not the needed usable storage capacity (3,000 acre-ft) is available in the potential locations that have been identified. Existing Kerr County area quarries have combined areas totaling over 300 acres. Additional surface water reservoir sites (non-quarry) within Kerr County may be identified

through additional study as well. These types of reservoirs are included in the Region J recommended strategy J-11 described in section 4.7.2 of the 2011 regional water plan.

C2: The Region L report, under the "Storage above Canyon Lake" strategy (developed in detail in section 4C.9) identifies potential surface reservoir sites; site 8 from that report is within 2 miles of the currently defined service area. As described in that report, it would have a total capacity of 51,086 acre-ft and a firm yield of 11,390 acre-ft / year. This reservoir would be more than adequate to supply the projected service area, providing more than five times the needed capacity. A smaller version would be appropriate for this project, or the reservoir as described in that report could be viable if there were other parties also using it.

C3: The viability of an ASR facility depends on the geology of the reservoir. At this point, that is unknown, but there is potential for usable locations in the Lower Trinity aquifer, as identified in the geological report included in this study. The Region L report also identified a potential for ASR in western Kendall county (see section 4C.9 of the 2011 water plan), but the location was not as close and the geology was more speculative. For either location, the viability of this option would have to be determined through test wells and additional study. In any location, development of an ASR facility in combination with the utilization of surface water sources presents a conjunctive use alternative.

C4: Based on the reservoir sizing identified above, the existing Center Point Lake (approximately 9 acres) is not large enough to provide the needed storage capacity. Further, as an established recreational lake it is not well suited to modify to a dual purpose facility. These obstacles were encountered during the 2009-2010 EDAP assessment of potential surface water for Center Point.

### *6.3.3 Address Needs*

All of the technically viable alternatives above can address the storage needs identified, provided they are appropriately sized. This effectively excludes the Center Point Lake as it is simply too small to provide any significant portion of the reservoir needs.

### *6.3.4 Economic Feasibility*

A surface water reservoir is costly, but potentially viable with funding assistance. The larger regional reservoir (e.g. Site 8) is not economically viable solely within this project, but it could be a reasonable alternative if more parties were to participate in the associated cost. An ASR facility is the preferred option from an economic perspective, but the technical viability must be addressed before it can proceed.

**Table 6-3: Cost Estimate, Water Storage**

| ID | Storage | Description | Project Cost | Annual O&M Cost |
|---|---|---|---|---|
| C1 | Local Surface Reservoir | 3,000 acre-feet, within project area | $ 24,330,000 | $ 157,800 |
| C2 | Regional Reservoir | 51,086 acre-feet, from Region L Report | $ 197,390,000 | $ 1,882,100 |
| C3 | ASR | 3,000 acre-feet, within project area | $ 5,690,000 | $ 57,300 |
| C4 | Center Point Lake | Not viable – too small | NA | NA |

# 7.0 Evaluations & Recommendations

## 7.1 Evaluation

The details of the factors for evaluation are listed under the preceding Alternatives section. A summary of major alternatives and overall evaluation is described below.

### *7.1.1 Existing Aquifer*

Currently no single major new source of water has been identified or is anticipated. Therefore, a portion of the future needs will be met by continuing to use existing Middle and Lower Trinity aquifer wells. Developing new sources will allow the less productive wells to be eliminated. Further, reducing withdrawals overall will protect the aquifer overall by maintaining withdrawals at sustainable levels.

### *7.1.2 New Distribution*

Any water supply system for the project area will require a distribution system, including piping, service pumps, and ground and elevated storage tanks. The alternatives related to distribution will need to be evaluated in the context of the specific system design. Evaluating the overall project area, the elevations vary from approximately 1,400 ft MSL in Comfort to 1,620 ft MSL near Center Point across an area more than 10 miles across, so from a geographic standpoint at least two or three pressure zones will likely be needed. Other considerations for future planning and design include how to incorporate existing WSC systems and how to manage different water qualities from different sources.

The cost for continued usage of existing wells and construction and operation of a new distribution system would require those costs (see Table 7-1) to be incurred for any regional water project. This is effectively a baseline cost added to any new source alternative.

**Table 7-1: Cost Estimate, Existing Wells, & New Distribution**

| ID | Item | Description | Project Cost | Annual O&M Cost |
|---|---|---|---|---|
| A4 | Existing Middle & Lower Trinity Wells | Existing wells | $ 0 | $ 53,300 |
| D1 | Distribution | Pipes, pumps and tanks, etc. | $ 12,760,000 | $ 2,777,800 |
| **D2** | **Total Baseline Costs** | | **$ 12,760,000** | **$ 2,831,100** |

### *7.1.3 Ellenburger-San Saba Aquifer*

If the Ellenburger-San Saba aquifer proves to be productive, it will be the least expensive source of additional water. However, the potential supply capacity is unknown, as is the water quality in the area. These questions must be answered before it can be relied on for supply, but the cost effectiveness makes answering these questions a priority. This will require a more detailed geologic study including one or more test wells, and through existing data collection programs of the Headwaters and Cow Creek GCDs.

### *7.1.4 Surface Water, Treatment Options*

Surface water diverted from the Guadalupe River is a viable additional source, though the UGRA water right diversion point may need to be relocated from the current Kerrville location to a point near a future treatment facility, or a new diversion point added. A potential diversion point would be near Comfort downstream of the confluence of the Guadalupe River and Cypress Creek to provide the most reliable water supply. Additional water rights (such as described in the Kerr-GBRA MOU) are not immediately required, but may be needed in the future.

The capital costs of traditional treatment and membrane technologies are very comparable in this analysis, with membrane treatment having significantly lower operating costs (See Table 7-2). The competitiveness of the two approaches is demonstrated in the selection of a membrane plant in the Region J report, while the UGRA EDAP facility plan selected a traditional system. Because of the remaining uncertainties in the current analysis, neither should be excluded, but a detailed analysis should be a priority in the next planning phase to allow a single approach to be selected. A major consideration will be the source and target water quality.

### *7.1.5 Surface Water, Storage Options*

Bulk storage of water in ASR facilities as a conjunctive use project is economically preferable (See Table 7-2), but at this time it is unknown if it is a true alternative since the necessary aquifer data is not available. An ASR facility has the potential to save significant cost when compared to a surface reservoir. As with the Ellenburger-San Saba aquifer alternative above, the potential savings justify expediting the necessary additional investigation. This will require a more detailed geologic study including one or more test wells, and through existing data collection programs of the Headwaters and Cow Creek GCDs.

A surface water reservoir is generally viable within the service area, provided a suitable location can be acquired. Therefore, for this option to develop, it is important to investigate whether or not candidate properties are available. The site identified in the Region L plan (Site 8) is far larger than is needed for this project, though because of the scale the cost per acre-ft of storage is much lower. This option would only be viable if other parties participated in designing and constructing the facility for additional uses.

**Table 7-2: Cost Estimate, Alternatives[6]**

| Alternatives | IDs Included | Project Cost | O&M Cost |
|---|---|---|---|
| Ellenburger-San Saba – Production + Treatment | A1, B1, D2 | $ 17,620,000 | $ 3,067,300 |
| Surface Water - Traditional + Surface | A3, B3, C1, D2 | $ 60,560,000 | $ 3,974,000 |
| Surface Water - Traditional + ASR | A3, B3, C3, D2 | $ 41,920,000 | $ 3,873,500 |
| Surface Water - Membrane + Surface | A3, B4, C1, D2 | $ 60,800,000 | $ 3,321,100 |
| Surface Water - Membrane + ASR | A3, B4, C3, D2 | $ 42,160,000 | $ 3,220,600 |

[6] All costs based on individual component costs from Section 6.0. All Alternatives include 3.9 MGD production & treatment.

### *7.1.6 Institutional Arrangements*

While no special institutional arrangements have been identified, the cross-jurisdictional service area and combined surface and groundwater uses will require continued cooperation among the participants in this report, including (where necessary) formal agreements. This would include service agreements, groundwater permits, water rights, and other agreements. As with any such project, TCEQ will need to be involved and should be included in any stakeholder group. In addition, financial assistance is expected to be necessary for further development and implementation of any of the identified projects, so continued coordination with TWDB is critical.

### *7.1.7 Water Conservation & Drought Contingency Plans*

While some additional water sources are available in the study area, there are not large amounts of surplus water and the area is subject to extended droughts that will stress the limited supplies that do exist. Therefore, future water projects should include conservation and reuse measures from the onset to ensure most efficient possible use of the water available. Two aspects specifically addressed in this report are a Water Conservation Plan and a Drought Contingency Plan. While this study cannot provide a final version of either plan, draft versions of such plans are included in Appendix B for reference and to use as a starting point for future planning and design efforts.

The draft plan is based on a template from TCEQ, and also incorporates some data from the Region J & L water plans (see Region L sections 4B1.2.1, 6.1, and 8.5)

- GPCD data: Based on the per connection average demand of 416 gpd (see Table 2-5) and estimated household size of 2.56 (see Table 2-1), the estimated baseline demand is 163 gpcd
- Goals: Following the goals of the regional plans, 5 and 10 year goals can be established to implement a 1% per year reduction until reaching 140 gpcd, then 0.25% annually thereafter.
    - 5 year target – 155 gpcd
    - 10 year target – 147 gpcd

  These goals emphasize residential water use, as there are no significant industrial or commercial water users currently or projected.
- Water Loss: The Region L average water loss of 9.5% should be an initial goal of the system; as a largely newly constructed system it would be expected to have lower losses. Whatever actual water loss would be reported in the initial operation of the system should be monitored and improved upon.
- Recommended conservation strategies, based on Region J (Section 6) & L (Sections 6.1 & 8.5) plans and TWDB Report 362, include
    - Public education, emphasizing importance of water conservation, plumbing repair, and modification of personal behavior.
    - Regular system Water Audits and Water Loss accounting and analysis
    - Adoption of ordinances, plumbing codes, and/or rules requiring or encouraging water conserving plumbing fixtures and water-using appliances to be installed in

new structures and existing structures undergoing substantial modification or addition

- A program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures
- A program for reuse and/or recycling of gray water
- A program and/or ordinance(s) for landscape water management, such as
  - Seasonal or yearly limitation of landscape irrigation to between the hours of 6 pm and 10 am, or to a limited number of days a week, or similar.
  - Bans on runoff from landscape irrigation
- Education regarding land management and brush control
- A program for rainwater harvesting
- Banning use of hydrants and blow-offs for use unless specifically authorized
- A requirement to require customers to repair leaks within 24 hours of receiving notice of a leak

One significant consideration is that existing groundwater wells on properties to receive water supply should have their use of well water limited to non-potable applications such as landscaping. First, because of the falling aquifer levels, limiting the use of existing wells will help ensure any new sources developed do offset withdrawals from the Middle & Lower Trinity aquifers. Second, a property with a groundwater well that connects to a central distribution system presents a potential for cross-contamination. For both of these reasons restrictions on groundwater well use are required.

### *7.1.8 Management Strategy Evaluation Criteria*

This report has identified and analyzed a number of alternatives related to additional water supplies, treatment, and storage. As part of this evaluation, data related to water quantity and project cost were determined. To include the selected alternative in the regional plans, some additional criteria must be addressed depending on the option selected. These include

- Analyze selected alternative using unmodified TCEQ WAM run #3. This will capture in more detail the available source water under the identified water rights. If additional water rights are obtained as described previously in this report, those must be included in any analysis.
- Ensure that the overall analysis is in compliance with applicable regulations (31 TAC § 357.34 & 357.35, Senate Bill3, etc.)
- Quantity and reliability aspects should be investigated. Quantity data was developed in detail above, but if additional water rights are obtained, or if alternatives such as an ASR system or Ellenburger-San Saba wells are included, the quantities must be reevaluated with updated data.
- Financial cost should be updated using the TWDB costing tool as part of the overall regional plan WMS costing process.
- Environmental impacts should be specifically evaluated, which were outside the scope of this report.

In addition, the participating entities should ensure that notice is provided to adjacent planning regions that there will be shared WMSs to cover this study area, including water user groups in "Kerr County-Other", and "Kendall County-Other".

Since Kerr County is the lead agency of this report, Region J is the corresponding primary regional planning group. As the Region J planning group evaluates the recommended alternatives for inclusion in the next regional water plan, they should notify Region L about the projects so that they can be included as appropriate in the Region L regional plan as well.

## 7.2 Recommendations

To this point the report has developed the alternatives and evaluated their degree of viability. It has also identified where insufficient information is available. This section presents specific recommendations to advance the overall project.

### *7.2.1 Near Term Activities*

1. Define Ellenburger-San Saba - Perform geological investigations to identify the potential of the Ellenburger-San Saba aquifer for water production.
2. Define Trinity ASR - Perform geological investigations to identify the potential of the Lower Trinity for ASR usage.
3. Incorporate Existing GCD Data Collection – Headwaters and Cow Creek GCD have existing data collection efforts that could be used to directly inform both Ellenburger-San Saba and Trinity ASR alternatives. Further, updated data can be included in projections of available water levels.
4. Surface Reservoir Property - Investigate potential to acquire property rights for surface reservoir options
5. Working Group – Because of the critical nature of inter-agency cooperation for this project, a semi-permanent group should be established to maintain coordination and communication between the participating entities and with the separate Comfort flood control efforts. (e.g. coordinating committee)
6. Diversion Point Change – Consider pursuing addition or relocation of UGRA water rights diversion point to a location within the study area, possibly near Comfort downstream of the Guadalupe/Cypress confluence.
7. Planning and Design Funds - Identify and secure funding for detailed planning to arrive at final selection of alternatives and subsequent design
8. Water Conservation - Identify specific water conservation and reuse strategies to incorporate into the ongoing development of this project (e.g. rainwater catchment, gray water)

### *7.2.2 Medium Term Activities*

1. Detailed Planning - Perform detailed planning to
    a. incorporate results of additional geologic studies
    b. determine raw and finished water qualities for design purposes
    c. perform more detailed review of treatment alternatives for specific source and water quality.
    d. Recommend final source water, treatment, and storage options as well as initial distribution system configuration.

2. Interagency Cooperation - Advance interagency cooperation, and establish foundation for design and construction phases.

### *7.2.3 Long Term Activities*

1. Detailed Design - Perform design based on final detailed planning. Include multi-phase approach to project construction.
2. Construction Funds - Identify and secure funding for construction

# 8.0 Schedules

At this point schedules are approximate. The current planning phase, which includes this report, must be concluded by the end of September 2014. As described in the recommendations section of this report, additional investigation is needed regarding geology, among other factors.

For the purposes of generating an initial schedule, we established a Final Planning Phase that will include activities necessary to complete the project definition, including geology and water quality work, surface reservoir site investigations, water rights modifications, etc. This Final Planning Phase would lead to the Design Phase, which would generate complete construction documents. The Design Phase would then be followed by Construction. All these phases would require funding assistance, and it is assumed that Planning and Design would be funded together, with Construction funded separately.

For the purpose of this schedule it is assumed that DWSRF assistance would be used, with the fund acquisition process starting on the typical IUP priority submission deadline of March 1, and the funding acquisition process taking 8 months. Based on these assumptions, a milestone schedule is listed below.

**Table 8-1: Estimated Milestone Schedule**

| Phase | Duration | Start | End |
|---|---|---|---|
| Regional Facility Plan (current) | 15 months | July 2013 | September 2014 |
| Planning & Design Funding Acquisition | 8 months | March 2015 | October 2015 |
| Final Planning | 6 months | October 2015 | March 2016 |
| Design | 12 months | March 2016 | February 2017 |
| Construction Funding Acquisition | 8 months | March 2017 | October 2017 |
| Construction | 18 months | October 2017 | February 2019 |

# 9.0 Funding

The proposed project area has a low population density, low overall population, and many residents with relatively low income, so self-financing of the proposed projects is not considered viable by the participating entities. This is reinforced by other recent projects in the area, including the EDAP facility plans for water system and sewer systems and the ongoing CWSRF funded design project that qualified for disadvantaged funds. All these projects met the qualifications for disadvantaged communities with service areas that covered most of the same area as this study. Based on census data, their median household income is significantly below the state median household income.

Therefore, the projects in this report are expected to need funding assistance, and they are good candidates to qualify for additional disadvantaged funding assistance. Programs that are designed for disadvantaged communities are particularly good candidates for funding. It is not uncommon for larger projects to combine funding sources so that different aspects of the project are funded by the best suited program. The information below on individual funding programs is taken from the Region J & L 2011 regional water plans, a prior Texas Water Conference paper by the author, and the TWDB web site.

## 9.1 Drinking Water State Revolving Fund (DWSRF)

A state-administered program using federal funds, the DWSRF program is structured as reduced cost loans for planning, acquisition, design, and construction, though these components are often awarded separately due to timing requirements.

Projects that demonstrate service to an economically distressed area can qualify for loan forgiveness, which can dramatically reduce the overall project cost. CWSRF funds are currently being used for a Center Point wastewater project, and the program is similar to DWSRF, so this project should be a good candidate for DWSRF funding.

Because of the favorable financial terms and good fit to the project, this program is recommended as a priority.

## 9.2 Economically Distressed Areas Program (EDAP)

Both grants and zero percent interest loans for planning, design, and construction costs are offered through this state program, which are available to eligible small, low-income communities. Rural and economically distressed areas that meet population, income and other criteria are eligible to apply for these funds.

Based on project criteria and funding availability, EDAP can combine grants with loans for a single project, dramatically reducing the cost. The Region J Report specifically identified EDAP as a financing option for a Guadalupe surface water project. However, this program is not always funded, so the current funding status must be evaluated

Because of the favorable financial terms and good fit to the project, this program is recommended as a priority if there are sufficient funds available.

## 9.3 State Loan Program Texas Water Development Fund (DFund)

A state funded loan program, DFund provides reduced cost financial assistance for both water and wastewater projects. It can fund planning, acquisition, design, and construction.

Because this program has been mentioned in recent funding discussion related to the state-wide prioritization of water projects, it should be closely evaluated for its financial terms and availability. It may also be a priority funding source.

## 9.4 State Water Implementation Fund for Texas (SWIFT)

Under the recently approved Proposition 6, TWDB is developing the State Water Implementation Fund for Texas (SWIFT) and the State Water Implementation Revenue Fund for Texas (SWIRFT) to assist in financing water projects. These programs are still under development, but they will rely on projects recommended under State and Regional Water Plans.

Since the projects recommended within this study are aligned with the regional water plans, these projects could be good candidates for this funding source. To be eligible for these funds the recommended projects should be listed as recommended water management strategies in the state and regional water plans. This program should be monitored and considered in future funding applications.

## 9.5 Water Infrastructure Fund (WIF)

The Water Infrastructure Fund (WIF) provides subsidized interest rate loans for planning, design, and construction. The WIF-Deferred fund offers the option of deferring all interest and principal payments for up to 10 years for planning, design, and permitting costs, while the WIF-Construction fund offers subsidized interest for all construction costs including planning, acquisition, design, and construction.

This program may be a candidate for project funding depending on how its terms compare to other alternatives. Since the projects recommended within this study are aligned with the regional water plans, these projects could be good candidates for this funding source. To be eligible for these funds the recommended projects should be listed as recommended water management strategies in the state and regional water plans.

## 9.6 State Participation Fund (SP)

State Participation Fund (SP) is geared towards large projects which are regional in scope and meant to capitalize on economies of scale in design and construction, but where the local project sponsors are unable to assume the debt for an optimally sized facility. The TWDB assumes a temporary ownership interest in the project, and the local sponsor repays the cost of the funding through purchase payments on a deferred schedule. The goal of the program is to build a project that will be the right size for future needs, even if that results in the short term in building excess capacity, rather than constructing one or more smaller projects now. On new water supply projects, the TWDB can fund up to 80 percent of the costs provided that the applicant can fund the other 20 percent through an alternate source and that at least 20 percent of the total capacity of the project serves current needs. This program may be a candidate for project funding depending on how its terms compare.

## 9.7 Rural Water Assistance Fund (RWAF)

Designed for rural communities, RWAF is designed to provide low cost loans for water improvements for rural communities. Based on the population of the service area and the sponsoring counties, the projects in this service area are likely to qualify. It can fund planning, acquisition, design, and construction. This program may be a candidate for project funding depending on how its terms compare.

## 9.8 Texas Department of Agriculture (TDA) / USDA

The TDA has several programs targeted to assist smaller rural communities; many of these programs are designed to benefit economically distressed areas. TDA's Office of Rural Affairs (ORA) typically administers federal funds to provide the funding. The Community Development Fund is the largest fund category in the Texas Community Development Block Grant (CDBG) program, along with the Colonia Planning & Construction Fund and Colonia Economically Distressed Areas Program. These funding sources are grants, but are generally limited to design and construction and are often of smaller size. The proposed projects are likely eligible, and though the amount of funds available to a single project is usually limited, they can still significantly assist in a combined funding environment.

The USDA has similar programs, including an assortment of water/wastewater loan/grant programs and loan guarantees. Again, these can often be of limited size but can contribute to a funding portfolio.

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# Appendix A – Exhibits

Exhibits

- Figure 2 - Service Area Map
- Figure 3 - Census Block Group Map

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CITY OF KERRVILLE, CCN 12928

WIEDENFELD WATER WOR, CCN 12052

WIEDENFELD WATER WOR, CCN 12052

AQUA TEXAS INC, CCN 11157

AQUA TEXAS INC, CCN 11157

Center Point

AQUA TEXAS INC, CCN 11157

HILL RIVER WATER WOR, CCN 12939

AQUA TEXAS INC, CCN 11157

VERDE HILLS WSC, CCN 12093

CENTERIS WATER WORKS CCN 12908

WIEDENFELD WATER WOR, CCN 12052

AQUA TEXAS INC, CCN 11157

AQUA TEXAS INC, CCN 11157

WIEDENFELD WATER WOR, CCN 12052

Comfort

KENDALL CO WCID 1 CCN 10685

Kendall

SHERWOOD MT PISGAH W, CCN 13050

Hasenwinkel Creek

Cypress Creek

NORTH CREEK

DRY CREEK

FLAT ROCK CREEK

Bluff Creek

Steel Creek

Wilson Creek

GUADALUPE RIVER (AT COMFORT

Dam C Guadalupe Lake River

Verde Creek

Spring Creek

Elm Creek

Cherry Creek

HOLDEN CREEK

1341

10

87

473

27

1350

480

## Legend

- Service Area
- County Boundaries

**Roadways**

- Interstate
- Highways
- Farm to Market
- Other Roads

**Water**

- Creek
- Lake
- Minor Creek
- River or Stream

N

0 1,000 2,000 4,000 feet

Sources: Kerr CAD, Kendall AD, TNRIS, TxDOT, FEMA, TCEQ, US Census

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| MARK | DATE | DESCRIPTION | BY |
|---|---|---|---|

CENTER POINT - COMFORT
EASTERN KERR CO. / WESTERN KENDALL CO. REGIONAL WATER SYSTEM FEASIBILITY STUDY

# Service Area Map

Project No.: 131-09310-13002
Designed By: SKD
Drawn By: SKD
Checked By:

FIG. 1

Tract 960100
Block Group 2

Tract 960800
Block Group 1

Tract 960100
Block
Group 1

Tract 970100
Block Group 2

Tract
970100 Block
Group 4

Tract 970100
Block Group 1

Tract 970100
Block
Group 3

Tract 960800
Block Group 3

Tract 960800
Block
Group 2

1341
1350
1621
480
473
27
87
10
Kerr
Kendall

**Legend**

- Service Area
- County Boundaries
- Census Block Groups

**Roadways**

- Interstate
- Highways
- Farm to Market
- Other Roads

N

0 1,000 2,000 4,000
feet

Sources: Kerr CAD, Kendall AD, TNRIS, TxDOT, FEMA, TCEQ, US Census

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CENTER POINT - COMFORT
EASTERN KERR CO. / WESTERN KENDALL CO.
REGIONAL WATER SYSTEM FEASIBILITY STUDY

# Census Block Group Map

Project No.: 131-09310-13002
Designed By: SKD
Drawn By: SKD
Checked By:

FIG. 2

# Appendix B – Supporting Documentation

B.1 – Census Prorating Table

B.2 – Reservoir Sizing Methodology

B.3 – Water Conservation Plan, Customized Template

B.4 – Drought Contingency Plan, Customized Template

B.5 – Existing Water Rights & related documentation

B.6 – Report of Findings – Geology

B.7 – Kerr – GBRA MOU

B.8 – Scope of Work

B.9 – GBRA Correspondence regarding direct diversion

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## B.1 Census Prorating Table

Table below reflects the methodology and formatting required by WRD-284 for prorating US Census data by Census Block Group.

**Table B-1: US Census Block Group Data Prorating**

| A<br>US Census Tract | B<br>Block Group | C<br>Population | D<br>AMHI | E<br>Average Household Size | F<br>Number of Household Connections | G<br>Household Connections as a % of Total Household Connections | H<br>Entity's Population (ExF) | I<br>Entity's AMHI (DxG) | J<br>Entity's Average Household Size (ExG) | County | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9601 | 2 | 1,403 | $55,500 | 2.99 | 84 | 3.29% | 252 | $1,827 | 0.10 | Kerr | 2008-2012 ACS |
| 9608 | 1 | 1,103 | $43,551 | 2.22 | 349 | 13.68% | 775 | $5,956 | 0.30 | Kerr | 2008-2012 ACS |
| 9608 | 2 | 998 | $41,920 | 1.91 | 489 | 19.16% | 934 | $8,032 | 0.37 | Kerr | 2008-2012 ACS |
| 9608 | 3 | 1,017 | $41,023 | 2.23 | 466 | 18.26% | 1,040 | $7,491 | 0.41 | Kerr | 2008-2012 ACS |
| 9701 | 1 | 621 | $52,989 | 2.31 | 429 | 16.81% | 991 | $8,908 | 0.39 | Kendall | 2008-2012 ACS |
| 9701 | 2 | 2,333 | $67,234 | 2.49 | 29 | 1.14% | 73 | $764 | 0.03 | Kendall | 2008-2012 ACS |
| 9701 | 3 | 1,284 | $49,250 | 2.15 | 8 | 0.31% | 18 | $154 | 0.01 | Kendall | 2008-2012 ACS |
| 9701 | 4 | 1,860 | $31,830 | 3.51 | 698 | 27.35% | 2,450 | $8,706 | 0.96 | Kendall | 2008-2012 ACS |
| **Total** | | | | | **2,552** | **100.00%** | **6,533** | **$41,838** | **2.56** | | |

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## B.2 Reservoir Sizing Calculations

The reservoir in this study is not intended to be filled by an existing surface water source, but instead is essentially a large tank for storage of water for later treatment and distribution. From this perspective, reservoir sizing requires analysis of a water balance over time. Since the focus is on a water balance, the useful storage capacity determined applies similarly to either a traditional surface water reservoir or an ASR. For example, a surface reservoir will incur losses of water through evaporation and seepage; while an ASR will not experience these forms of loss, it will lose usable water through migration.

Accurate sizing requires certain design details that are not yet known, such as exact dimensions and construction of the reservoir, pump sizing, etc. For the purposes of this report certain assumptions are made to enable a useful estimate to be made. Also involved in the reservoir sizing are constraints on flows of water into and out of the reservoir. These assumptions, constraints, and starting values from other sources are described below. Throughout this section, the variables are defined as

$Q_{River\text{-}Comfort}$ = Daily mean stream flow at the Guadalupe at Comfort USGS gauge (0816700). Varies based on historical data

$Q_{River\text{-}Spring\ Branch}$ = Daily mean stream flow at the Guadalupe at Spring Branch USGS Gauge (08167500). Varies based on historical data

$Q_{Pump}$ = Pumping station flow capacity. Selected at 2.1 MGD in this analysis. This flow is based on the approximate daily withdrawal limit contained within the applicable water right. The water right indicates that there is a total of 15.5 cfs maximum withdrawal available in the original water right (#3505), but that up to 9.7 can be withdrawn for other uses, leaving 5.8 cfs available if the full 9.7 cfs is exercised. Also, another water right up to 1.1 cfs is committed to the Buckhorn golf course, leaving 4.7 cfs as the amount reliably available. Further, that 4.7 cfs is available to both the water right that is the subject of this study (#5394A) and the companion water right held by the City of Kerrville (#5394B). To arrive at the pumping capacity of this water right, this remaining amount was prorated across both of the two companion rights, leaving 3.22 cfs (2.1 MGD), for the likely maximum daily withdrawal for the East Kerr system.

$Q_{Withdrawal}$ = Amount of water withdrawn from the river and pumped to the reservoir. Calculated based on constraints

$Q_{Consumption}$ = Water demand in the system, removed from the reservoir for treatment and distribution. Set at 1.865 MGD based on demand calculation previously in this report

$Q_{Groundwater}$ = Water supplied to system from groundwater sources, effectively reducing demand on reservoir. Assumed at 1.0 MGD for this analysis

$Q_{Evaporation}$ = Water lost from the reservoir to evaporation. Starting with the data from the Regional Water Plan of 60 inches / year based on data, we assumed the reservoir was designed to reduce those losses by 30%. The total rate was then calculated based on iterated reservoir size.

$Q_{Seepage}$ = Water lost from the reservoir to seepage into surrounding soils. Assumed at 0 for this analysis

$Q_{Daily\ Historical}$ = The governing water right includes a provision that the daily withdrawal is limited to an amount consistent with the City of Kerrville historical withdrawal. This amount ranges from 6% of the annual total in February, to 13.1 % of the annual total in August. This is equivalent to limits on the daily withdrawal ranging from 1.01 MG to 2.29 MG. This is accounted for by limiting the daily withdrawal flow rate to no more than these amounts, regardless of the stream flow or the pump capacity.

$V_{Reservoir}$ = Useable volume of the reservoir. Calculated iteratively as a result of this analysis. Assumed starting volume is 1,000 acre-ft, and incremented in 100 acre-ft steps. (reservoir was started at 50% full at the beginning of the first day)

$d_{Reservoir}$ = Average depth of the reservoir. Assumed to be 30 ft for this analysis

$A_{Reservoir}$ = Surface area of the reservoir. Calculated from A=V/d

Constraints include

- $Q_{Withdrawal}$ from the Guadalupe can only occur if $Q_{River\text{-}Comfort}$ is greater than 40 cfs during October through May, or greater than 30 cfs during June through September.
- A minimum $Q_{River\text{-}Comfort}$ must be maintained at 40 cfs during October through May, or 30 cfs during June through September (i.e. flow over these thresholds is not allowed to permit withdrawals to reduce flow to below the thresholds)
- If $Q_{River\text{-}Spring\ Branch}$ is less than 50 cfs, then $Q_{Withdrawal}$ must be reduced until $Q_{River\text{-}Comfort}$ equals 50 cfs
- Cumulative calendar year withdrawals are limited to 1,661 acre-ft
- $Q_{Withdrawal}$ cannot exceed $Q_{Pump}$ or $Q_{Daily\ Historical}$

The methodology utilized to calculate the needed reservoir usable storage volume was an iterative water balance on a daily basis using the parameters above. If on a given day, if water could be withdrawn from the river then as much was withdrawn as possible, until the reservoir was full. Also, each day consumption and losses were withdrawn from the reservoir. The resulting "end of day" stored volume in the reservoir was then carried forward to the next day, and the same process performed to calculate the next reservoir stored volume. This process was repeated for each day throughout the analysis period (May 31, 1939 through August 15 2014). Note that while this analysis incorporates all the limitations of the existing water use permit, it does not incorporate the impact of other permits, such as the full exercise of senior water rights. This analysis would require running a Water Availability Model (WAM), which was outside the scope of this study.

The resulting data was then checked to determine the number of days that ended with a dry reservoir, and the reservoir capacity was changed until the number of "dry days" was minimized. As anticipated, almost all of those days occurred during the commonly used drought of record, (July 1953 – October 1957). Another dry period started in January 2014 and continued through the end of the analysis period in August 2014.

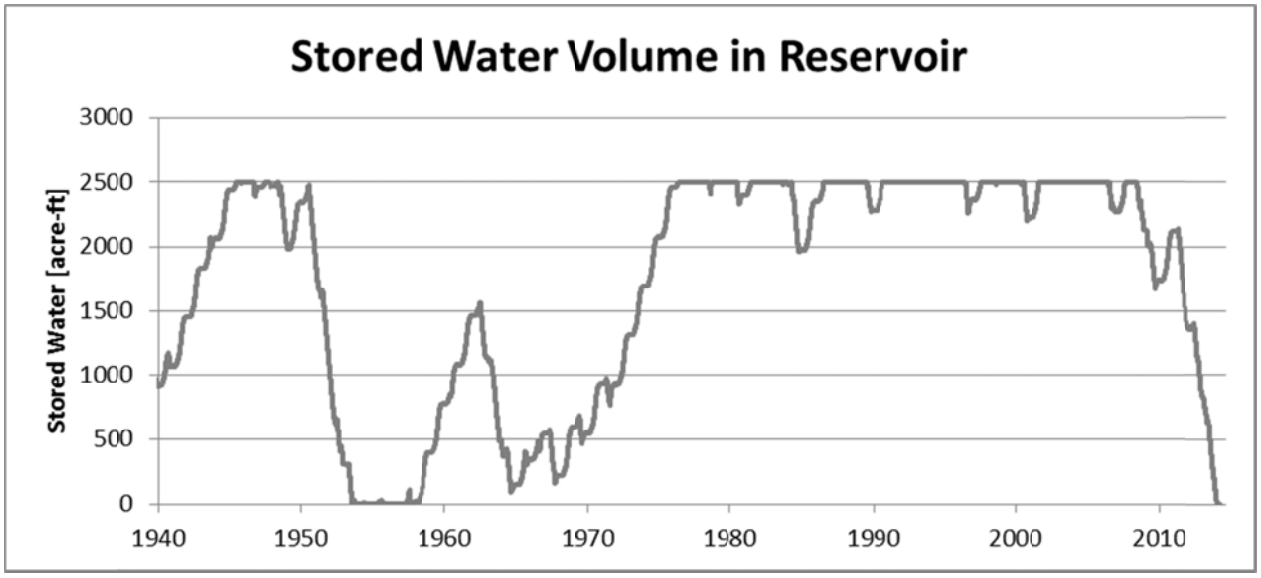



**Figure 4: Surface Reservoir Performance**

The calculated reservoir volume was 2,500 acre-ft. The performance of this reservoir during the analysis period is shown in Figure 4, with total amount of water stored graphed against time. This shows how a water balance approach over time provides a more complete picture of the needed reservoir size.

To provide a margin against the uncertainties present at this stage in the planning, the recommended usable reservoir volume is increased by 20% to 3,000 acre-ft (30 ft deep x 100 acres in area). This is larger than that evaluated based on just a single "dry" spell, since it incorporates longer term dry periods that are have brief occasional wet periods, and it incorporates the water rights aspect which a simpler estimate does not consider. Future detailed design and planning can reduce this margin by investigating in detail seepage, siltation, and other issues that can impact reservoir design.

## B.3 Water Conservation Plan

The water conservation plan presented below is based on TCEQ requirements, with portions completed as appropriate for the area that is the subject of this report. Information is included to comply with state regulations and be consistent with Region J & L water plans. Future planning and design effort can update and complete the plan.

A. Specific, Quantified 5 & 10-Year Targets

As a new system, no direct history is available to determine water usage. Therefore, the goals currently established for average water consumption are based on an average across existing water providers of 163 gpcd.

5 year target – 155 gpcd (gallons per capita per day)

10 year target – 147 gpcd

B. Metering Devices

Water use will be through water meters with a minimum accuracy of plus or minus 5.0%. For unplanned and intermittent uses otherwise unmetered (flushing of lines, etc.), the amount consumed will be estimated to be accounted for.

C. Universal Metering

All public and private water use (except for emergency and unplanned use) will be metered. A meter maintenance program will be developed to repair or replace meters on a regular basis to ensure reliable accuracy.

D. Unaccounted- For Water Use

System operators will perform visual inspection of distribution lines during routine daily activities to identify any visible leaks or evidence of unauthorized connections. An annual audit will be performed to check for abandoned services, evidence of unauthorized connections, etc.

E. Continuing Public Education & Information

The water supplier will regularly include water conservation information in its billing to its customers to ensure regular communication of water conservation information and news. Education programs will include

- Outreach through schools, broadcast media, and publications/ bill inserts
- Emphasis on importance of
    - water conservation
    - plumbing repair
    - modification of personal behavior.

F. Non-Promotional Water Rate Structure

The rate structure will be structured such that the cost of water per gallon will incrementally increase with increasing use. Such a progressive rate structure is intended to discourage excessive water use.

G. Reservoir Systems Operations Plan

If a surface reservoir option is implemented, an operations plan must be included.

H. Enforcement Procedure and Plan Adoption

The water conservation plan must include a means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan. This will likely include both Kerr and Kendall Counties, in addition to KCWCID#1.

I. Coordination with the Regional Water Planning Group(s)

As the final water plan is developed Region J & L should be included in the development to ensure consistency with regional objectives. Evidence of that coordination should be included in the final plan.

J. Plan Review and Update

The conservation plan should be revised and updated no less frequently than every five years after adoption, including a review of progress against 5 and 10 year plans and an implementation report.

K. Leak Detection and Repair

A detailed program of leak detection, repair, and water loss accounting must be developed. This should include regular leak detection studies; a specific repair program including identification, reporting, and repair work; and a detailed mechanism for water loss accounting.

L. Contract Requirements

A requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures consistent with this plan. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures consistent with this plan.

M. Additional Conservation Strategies

The strategies below are taken from best practices and other conservation plans. As the Eastern Kerr / Western Kendall project is developed, these strategies should be considered and selected strategies included in the planning process at early stages.

- Adoption of ordinances, plumbing codes, and/or rules requiring or encouraging water conserving plumbing fixtures and water-using appliances to be installed in new structures and existing structures undergoing substantial modification or addition
- A program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures

- A program for reuse and/or recycling of gray water
- A program and/or ordinance(s) for landscape water management, such as
    - Seasonal or yearly limitation of landscape irrigation to between the hours of 6 pm and 10 am, or to a limited number of days a week, or similar.
    - Bans on runoff from landscape irrigation
- Education regarding land management and brush control
- A program for rainwater harvesting
- Banning use of hydrants and blow-offs for use unless specifically authorized
- A requirement to require customers to repair leaks within 24 hours of receiving notice of a leak

## B.4 Drought Contingency Plan

The drought contingency plan presented below is based on the TCEQ Model Drought Contingency Plan for the Water Supply Corporation (TCEQ-20187), with portions completed as appropriate for the area that is the subject of this report. Future planning and design effort can update and complete the plan.

DROUGHT CONTINGENCY PLAN

FOR

_____

(Name of Utility)

_____

(Address, City, Zip Code)

_____

(CCN#)

_____

(PWS #s)

_____

(Date)

Section 1: Declaration of Policy, Purpose, and Intent

In cases of extreme drought, periods of abnormally high usage, system contamination, or extended reduction in ability to supply water due to equipment failure, temporary restrictions may be instituted to limit nonessential water usage. The purpose of the Drought Contingency Plan (Plan) is to encourage customer conservation in order to maintain supply, storage, or pressure or to comply with the requirements of a court, government agency or other authority.

Section 2: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by (check at least one):

- ☐ scheduling and providing public notice of a public meeting to accept input on the Plan

  The meeting took place at:

  Date: _____ Time: _____ Location: _____
- ☐ mailed survey with summary of results (attach survey and results)
- ☐ bill insert inviting comment (attach bill insert)
- ☐ other method _____

Section 3: Public Education

The _____ (name of utility) will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage.

Drought plan information will be provided by (check at least one):

- ☐ public meeting
- ☐ press releases
- ☐ utility bill inserts
- ☐ other _____

Section 4: Coordination with Regional Water Planning Groups

The service area of the _____ (name of your utility) is located within Regional Water Planning Groups (RWPGs) J & L.

_____ (name of your utility) has mailed a copy of this Plan to the RWPGs.

Section 5: Authorization

The _____ (designated official; for example, the mayor, city manager, utility director, general manager, etc.), or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _____, (designated

official) or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section 6: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the _____ (name of your water supplier). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section 7: Notice Requirements

Written notice will be provided to each customer prior to implementation or termination of each stage of the water restriction program. Mailed notice must be given to each customer 72 hours prior to the start of water restriction. If notice is hand delivered, the utility cannot enforce the provisions of the plan for 24 hours after notice is provided. The written notice to customers will contain the following information:

- the date restrictions will begin;
- the circumstances that triggered the restrictions;
- the stages of response and explanation of the restrictions to be implemented; and
- an explanation of the consequences for violations.

The utility must notify the TCEQ by telephone at (512) 239-4691, or electronic mail at watermon@tceq.state.tx.us prior to implementing Stage III and must notify in writing the Public Drinking Water Section at MC - 155, P.O. Box 13087, Austin, Texas 78711-3087 within five (5) working days of implementation including a copy of the utility's restriction notice. The utility must file a status report of its restriction program with the TCEQ at the initiation and termination of mandatory water use restrictions (i.e., Stages III and IV).

Section 6: Violations

1. First violation - The customer will be notified by written notice of their specific violation.
2. Subsequent violations:

   a. After written notice, the utility may install a flow restricting device in the line to limit the amount of water which will pass through the meter in a 24-hour period. The utility may charge the customer for the actual cost of installing and removing the flow restricting device, not to exceed $50.00.

   b. After written notice, the utility may discontinue service at the meter for a period of seven (7) days, or until the end of the calendar month, whichever is LESS. The normal reconnect fee of the utility will apply for restoration of service.

Section 7: Exemptions or Variances

The utility may grant any customer an exemption or variance from the drought contingency plan for good cause upon written request. A customer who is refused an exemption or variance may appeal such action of the utility in writing to the Texas Commission on Environmental Quality. The utility will treat all customers equally concerning exemptions and variances, and shall not discriminate in granting exemptions and variances. No exemption or variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section 8: Definitions

For the purposes of this Plan, the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by _____ (name of your water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;

(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;

(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;

(e) flushing gutters or permitting water to run or accumulate in any gutter or street;

(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;

(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;

(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

(i) use of water from hydrants for construction purposes or any other purposes other than firefighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section 9: Criteria for Initiation and Termination of Drought Response Stages

The _____ (designated official) or his/her designee shall monitor water supply and/or demand conditions on a _____ (example: daily, weekly, monthly) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached. The triggering criteria described below are based on _____

_____

_

(provide a brief description of the rationale for the triggering criteria; for example, triggering criteria / trigger levels based on a statistical analysis of the vulnerability of the water source under drought of record conditions, or based on known system capacity limits. Based on the recommendations of this report, if a surface water source is used, Guadalupe river levels should be used for trigger levels (including water rights restrictions), and if a surface reservoir is used then reservoir levels should also be incorporated. In addition, actual demand compared to production capacity should be considered. Other factors to consider should include: groundwater district rules, South Texas Watermaster coordination).

Section 8 Response Stages

Unless there is an immediate and extreme reduction in water production, or other absolute necessity to declare an emergency or severe condition, the utility will initially declare Stage I restrictions. If, after a reasonable period of time, demand is not reduced enough to alleviate outages, reduce the risk of outages, or comply with restrictions required by a court, government agency or other authority, Stage II may be implemented with Stage III to follow if necessary.

STAGE I - CUSTOMER AWARENESS

Stage I will begin:

Every April 1st, the utility will mail a public announcement to its customers. No notice to TCEQ required.

Stage I will end:

Every September 30th, the utility will mail a public announcement to it=s customers. No notice to TCEQ required.

Utility Measures:

This announcement will be designed to increase customer awareness of water conservation and encourage the most efficient use of water. A copy of the current public announcement on water conservation awareness shall be kept on file available for inspection by the TCEQ.

Voluntary Water Use Restrictions:

Water customers are requested to voluntarily limit the use of water for nonessential purposes and to practice water conservation.

STAGE II - VOLUNTARY WATER CONSERVATION:

Target: Achieve a _____ percent reduction in _____ (example: total water use, daily water demand, etc.)

The water utility will implement Stage II when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one):

- □ Well level reaches _____ ft. mean sea level (m.s.l.)
- □ Overnight recovery rate reaches _____ ft.
- □ Reservoir elevation reaches _____ ft. (m.s.l.)
- □ Stream flow reaches _____ cfs at USGS gage # _____
- □ Annual water use equals _____ % of Water Right
- □ Other _____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- □ Drinking water treatment as % of capacity _____ %
- □ Total daily demand as % of pumping capacity _____ %
- □ Total daily demand as % of storage capacity _____ %
- □ Pump hours per day _____ hrs.

- ☐ Production or distribution limitations
- ☐ Other _____

Upon initiation and termination of Stage II, the utility will mail a public announcement to its customers. No notice to TCEQ required.

Requirements for Termination:

Stage II of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage II, Stage I becomes operative.

Utility Measures:

Visually inspect lines and repair leaks on a daily basis. Monthly review of customer use records and follow-up on any that have unusually high usage. (Describe additional measures, if any, to be implemented directly by the utility to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes.)

The second water source for _____ (name of utility) is: (check one)

- ☐ Other well
- ☐ Inter-connection with other system
- ☐ Purchased water
- ☐ Other _____

Voluntary Water Use Restrictions:

1. Restricted Hours: (Outside watering is allowed daily, but only during periods specifically described in the customer notice; between 10:00 p.m. and 5:00 a.m. for example);

2. Restricted Days/Hours: (Water customers are requested to voluntarily limit the irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems. Customers are requested to limit outdoor water use to Mondays for water customers with a street address ending with the numbers 1, 2, or 3, Wednesdays for water customers with a street address ending with the numbers 4, 5, or 6, and Fridays for water customers with a street address ending with the numbers 7, 8, 9, or 0. Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system); or

3. Other uses that waste water such as water running down the gutter.

STAGE III - MANDATORY WATER USE RESTRICTIONS:

Target: Achieve a _____ percent reduction in _____ (example: total water use, daily water demand, etc.)

The water utility will implement Stage III when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Well level reaches _____ ft. (m.s.l.)
- ☐ Overnight recovery rate reaches _____ ft.
- ☐ Reservoir elevation reaches _____ ft. (m.s.l.)
- ☐ Stream flow reaches _____ cfs at USGS gage # _____
- ☐ Annual water use equals _____ % of Water Right
- ☐ Other _____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Drinking water treatment as % of capacity _____ %
- ☐ Total daily demand as % of pumping capacity _____ %
- ☐ Total daily demand as % of storage capacity _____ %
- ☐ Pump hours per day _____ hrs.
- ☐ Production or distribution limitations
- ☐ Other _____

Upon initiation and termination of Stage III, the utility will mail a public announcement to its customers. Notice to TCEQ required.

Requirements for Termination:

Stage III of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage III, Stage II becomes operative.

Utility Measures:

Visually inspect lines and repair leaks on a regular basis. Flushing is prohibited except for dead end mains. (Describe additional measures, if any, to be implemented directly by the utility to

manage limited water supplies and/or reduce water demand. Examples include: activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes; offering low-flow fixtures and water restrictors).

Mandatory Water Use Restrictions:

The following water use restrictions shall apply to all customers.

1. Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Mondays for water customers with a street address ending with the numbers 1, 2, or 3, Wednesdays for water customers with a street address ending with the numbers 4, 5, or 6, and Fridays for water customers with a street address ending with the numbers 7, 8, 9, or 0. Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

2. Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public are contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

3. Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or a Jacuzzi-type pool is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight.

4. Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

5. Use of water from hydrants or flush valves shall be limited to maintaining public health, safety, and welfare.

6. Use of water for the irrigation of golf courses, parks, and green belt area is prohibited except by hand-held hose and only on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight.

7. The following uses of water are defined as nonessential and are prohibited:

   a. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

   b. use of water to wash down buildings or structures for purposes other than immediate fire protection;

   c. use of water for dust control;

   d. flushing gutters or permitting water to run or accumulate in any gutter or street;

e. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

f. any waste of water.

STAGE IV - CRITICAL WATER USE RESTRICTIONS:

Target: Achieve a _____ percent reduction in _____ (example: total water use, daily water demand, etc.)

The water utility will implement Stage IV when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Well level reaches _____ ft. (m.s.l.)
- ☐ Overnight recovery rate reaches _____ ft.
- ☐ Reservoir elevation reaches _____ ft. (m.s.l.)
- ☐ Stream flow reaches _____ cfs at USGS gage # _____
- ☐ Annual water use equals _____ % of Water Right
- ☐ Supply contamination
- ☐ Other _____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Drinking water treatment as % of capacity _____ %
- ☐ Total daily demand as % of pumping capacity _____ %
- ☐ Total daily demand as % of storage capacity _____ %
- ☐ Pump hours per day _____ hrs.
- ☐ Production or distribution limitations
- ☐ System outage
- ☐ Other _____

Upon initiation and termination of Stage IV, the utility will mail a public announcement to its customers. Notice to TCEQ required.

Requirements for Termination:

Stage IV of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage IV, Stage III becomes operative.

Operational Measures:

The utility shall visually inspect lines and repair leaks on a daily basis. Flushing is prohibited except for dead end mains and only between the hours of 9:00 p.m. and 3:00 a.m. Emergency interconnects or alternative supply arrangements shall be initiated. All meters shall be read as often as necessary to insure compliance with this program for the benefit of all the customers. Describe additional measures, if any, to be implemented directly to manage limited water supplies and/or reduce water demand.

Mandatory Water Use Restrictions: (all outdoor use of water is prohibited)

1. Irrigation of landscaped areas is absolutely prohibited.

2. Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is absolutely prohibited.

SYSTEM OUTAGE or SUPPLY CONTAMINATION

Notify TCEQ Regional Office immediately.

## B.5 Existing Water Rights

The following pages include documentation of relevant water rights (aka Water Use Permits) as obtained from TCEQ on May 30, 2014. These include both Water Use Permits 5934 and 3505.

**TEXAS NATURAL RESOURCE CONSERVATION COMMISSION**
**INTEROFFICE MEMORANDUM**

TO : Records Management

DATE: April 6, 1998

Application No. 3769/Permit No. 3505
Kerr County
Guadalupe River Basin

FROM : Water Uses & Availability Section
Water Quantity Division

SUBJECT : Change of Ownership

DELETE : Upper Guadalupe River Authority as owner

ADD : City of Kerrville, Texas, as owner

Ownership of Record with Addresses and Remarks:

City of Kerrville, Texas
800 Junction Highway
Kerrville, Texas 78028-5069

This change is based on a copy of the "Termination, Asset Transfer & Acquisition & Settlement Agreement" dated November 20, 1997.

This permit authorizes (1) impoundment of 840 acre-feet of water in a reservoir on the Guadalupe River, (2) use of 3603 acre-feet of water per annum from said reservoir for municipal purposes and (3) secondary use of 2450 acre-feet per annum of waste water, produced from its sewage disposal System from the surface water diverted, for irrigation of 192 acres out of its adjacent tracts containing 533 acres.

Mohan A Reddy

Data Entry Made: _____ WU & A Section: _____

Change Noted: _____ Central Records/Date: _____

PERMIT TO
APPROPRIATE STATE WATER

| | | | |
|---|---|---|---|
| APPLICATION NO. 3769 | PERMIT NO. 3505 | TYPE: Section 5.121 | |
| Permittee : Upper Guadalupe River Authority | | Address : P. O. Box 1278 Kerrville, Texas 78028 | |
| Received : November 30, 1976 | | Filed : May 23, 1977 | |
| Granted : August 29, 1977 | | County : Kerr | |
| Watercourse : Guadalupe River | | Watershed: Guadalupe River | |

WHEREAS, during the pendency of Application No. 3769, the permit-issuing functions of the Texas Water Rights Commission were transferred and vested in the Texas Water Commission on September 1, 1977; and

WHEREAS, the vesting of said permit-issuing functions in the Texas Water Commission did not affect any action or proceeding commenced before the Texas Water Rights Commission prior to September 1, 1977; and

WHEREAS, the Texas Water Commission finds that jurisdiction of the application is established; and

WHEREAS, a public hearing has been held and specific findings of fact and conclusions of law adopted, as required by law.

NOW, THEREFORE, this permit to appropriate and use State water is issued to Upper Guadalupe River Authority subject to the following terms and conditions:

1. IMPOUNDMENT

Permittee is authorized to construct, and before acquiring any right hereunder shall construct, a dam and reservoir on the Guadalupe River and impound therein not to exceed 840 acre-feet of water at a normal maximum operating level of 1621 feet above mean sea level. The dam will be located adjacent to the West line of the Walter Fosgate Survey, Abstract No. 138, Kerr County, Texas. Station 0 + 00 on the centerline of the dam is S 40° E, 2470 feet from the SW corner of the aforesaid Fosgate Survey, within the city limits of Kerrville, Kerr County, Texas.

2. USE

(a) Permittee is authorized to divert and use not to exceed 10 acre-feet of water from the Guadalupe River for initial construction of the dam.

(b) Permittee is authorized to divert and use not to exceed 3603 acre-feet of water per annum from the reservoir for municipal purposes, Kerr County, Texas.

(c) Permittee is authorized to secondarily use not to exceed 2450 acre-feet per annum of the wastewater, which will be produced by the City of Kerrville's sewage disposal system from the surface water diverted, for the irrigation of 192 acres of two adjacent tracts containing 533 acres of land owned by City of Kerrville and located in the following surveys:

Samuel Wallace Survey No. 112, Abstract No. 360;
Samuel Wallace Survey No. 111, Abstract No. 359;
T. N. Minter Survey No. 110, Abstract No. 248;
William Watt Survey No. 68, Abstract No. 366;
J. W. Porter Survey No. 701, Abstract No. 450;
HE&WT RR Co. Survey No. 1425, Abstract No. 687; and
J. A. Rotge Survey No. 1426, Abstract No. 1450.

3. DIVERSION

(a) Point of Diversion: At a point on the west bank of the reservoir, S 27° E, 2450 feet from the SW corner of the aforesaid Fosgate Survey.

(b) Maximum Diversion Rate: 9.7 cfs (4375 gpm).

4. TIME LIMITATIONS

Construction or installation of all works herein authorized or required shall be in accordance with plans approved by the Commission and shall be commenced within two years and completed within three years from date of issuance of this permit.

5. SPECIAL CONDITIONS

(a) Failure to commence and complete any construction authorized or required by this permit within the period stated in Time Limitations shall cause this permit to expire and become of no further force and effect.

(b) Permittee is authorized to make diversions hereunder only when the water level in the reservoir is above elevation 1608 feet msl.

This permit is issued subject to all superior and senior water rights in the Guadalupe River Basin.

Permittee agrees to be bound by the terms, conditions and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Department of Water Resources and to the right of continual supervision of State water resources exercised by the Department.

TEXAS WATER COMMISSION

Date Issued:

October 14, 1977

/s/ Joe D. Carter

Joe D. Carter, Chairman

(SEAL)

/s/ Joe R. Carroll

Attest:

Joe R. Carroll, Commissioner

/s/ Mary Ann Hefner

Mary Ann Hefner, Chief Clerk

/s/ Dorsey B. Hardeman

Dorsey B. Hardeman, Commissioner

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AMENDMENT TO A
WATER USE PERMIT

PERMIT NO. 5394D TYPE: 11.122

| | | | |
|---|---|---|---|
| Permittee: | Upper Guadalupe River Authority | Address: | 125 Lehmann Drive, Suite 100 Kerrville, Texas 78028 |
| Filed: | November 20, 2012 | Granted: | February 7, 2013 |
| Purpose: | Municipal | County: | Kerr |
| Watercourse: | Guadalupe River | Watershed: | Guadalupe River Basin |

WHEREAS, the Upper Guadalupe River Authority (UGRA) owns a portion of Water Use Permit No. 5394 which authorizes the diversion and use of not to exceed 2,000 acre-feet of water per year, on a firm yield basis, from a point on an existing 840 acre-foot reservoir (authorized by City of Kerrville's Water Use Permit No. 3505) on the Guadalupe River, Guadalupe River Basin for municipal use and/or injection into the Hosston-Sligo Aquifer of the Lower Trinity Formation for subsequent retrieval for municipal use in Kerr County. The time priority of this right is January 6, 1992; and

WHEREAS, multiple Special Conditions apply including Special Condition 5.D. which states:

> Of the 2,000 acre-feet of water authorized for diversion in Paragraph 1. USE, such water shall be used as follows: (i) not to exceed 1,661 acre-feet of water per year may be contracted for municipal use by Kerr County entities other than the City of Kerrville (either water diverted directly from the river or surface water injected into the aforesaid aquifer and subsequently retrieved) and (ii) the remaining 339 acre-feet of water per year shall be used for injection into the said aquifer for storage to maintain the firm yield of the system; and

WHEREAS, UGRA seeks to amend its portion of Water Use Permit No. 5394 to remove "other than the City of Kerrville" from Special Condition 5.D.i. in order to authorize UGRA to contract for municipal use of the water by any Kerr County entity, including the City of Kerrville; and

WHEREAS, the Texas Commission on Environmental Quality finds that jurisdiction over the application is established; and

WHEREAS, this amendment, if granted, is subject to requirements and orders of the South Texas Watermaster; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Texas Commission on Environmental Quality in issuing this amendment;

NOW, THEREFORE, this amendment to Water Use Permit No. 5394, designated Water Use Permit No. 5394D, is issued to the Upper Guadalupe River Authority, subject to the following terms and conditions:

SPECIAL CONDITION

In lieu of SPECIAL CONDITION 5.D.i. of Water Use Permit No. 5394A, the following Special Condition applies:

Not to exceed 1,661 acre-feet of water per year may be contracted for municipal use by Kerr County entities (either water diverted directly from the river or surface water injected into the aforesaid aquifer and subsequently retrieved).

This amendment is issued subject to all terms, conditions, and provisions contained in Water Use Permit No. 5394, as amended, except as specifically amended herein.

This amendment is issued subject to all superior and senior water rights in the Guadalupe River Basin.

Permittee agrees to be bound by the terms, conditions, and provisions contained herein and such agreement is a condition precedent to the granting of this amendment.

All other matters requested in the application which are not specifically granted by this amendment are denied.

This amendment is issued subject to the Rules of the Texas Commission on Environmental Quality and to the right of continuing supervision of State water resources exercised by the Commission.

For the Commission

Date issued: **February 7, 2013**

18-5394-A-1

7/6/07

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AN ORDER voiding Special Condition No. 5E, Water Use Permit No. 5394A, issued to the Upper Guadalupe River Authority.

House Bill 891, 80th Texas Legislature, states Special Condition No. 5E, Water Use Permit No. 5394A, issued to the Upper Guadalupe River Authority, is void.

After considering the application and matters thereto related, the Commission is of the opinion that the order should be granted.

NOW, THEREFORE, BE IT ORDERED BY THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION Special Condition No. 5E, Water Use Permit No. 5394A, issued to the Upper Guadalupe River Authority is void.

All other terms and conditions contained in Water Use Permit No. 5469, which are not specifically contrary to the terms of this order shall remain in full force and effect.

For the Commission

DATE ISSUED: JUN 21 2007

5394-1-C

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

## AMENDMENT TO A WATER USE PERMIT

| | | | |
|---|---|---|---|
| APPLICATION NO. 5394C | PERMIT NO. 5394C | | TYPE: §11.122 |
| Permittee: | Upper Guadalupe River Authority | Address: | 125 Lehmann, Suite 100<br>Kerrville, Texas 78028 |
| Filed: | June 8, 2000 | Granted: | AUG 20 2002 |
| Purposes: | Municipal, Recharge, Agriculture | County: | Kerr and Kendall |
| Watercourse: | Guadalupe River | Basin: | Guadalupe River Basin |

WHEREAS, Water Use Permit No. 5394A, as amended, issued to the Upper Guadalupe River Authority (UGRA), authorizes the permittee to divert and use not to exceed 2,000 acre-feet of water per annum, on a firm yield basis, from an existing 840 acre-foot capacity reservoir on the Guadalupe River, Guadalupe River Basin, in the Walter Fosgate Survey, Abstract 138, in Kerr County for municipal use and/or injection into the Hosston-Sligo Aquifer of the Lower Trinity Formation for subsequent retrieval for municipal purposes; and

WHEREAS, a point on the center line of the aforesaid reservoir is located S 40°E, 2,470 feet from the southwest corner of the aforesaid survey, and is authorized by the UGRA's Water Use Permit No. 3505 (Application No. 3769); and

WHEREAS, water authorized for use by Water Use Permit No. 5394A is included in a Subordination Agreement between the Guadalupe-Blanco River Authority and the UGRA, and may be diverted at a maximum rate of 15.5 cfs (6,956 gpm) in combination with Water Use Permit No. 3505 (Application No. 3769) and the City of Kerrville's Water Use Permit No. 5394B; and

WHEREAS, the Upper Guadalupe River Authority has entered into a Water Supply Agreement with Buckhorn Golf II Ltd., a Texas Limited Partnership, dated April 10, 2000, to provide not to exceed 160 acre-feet of agricultural water per annum for a ten year period to irrigate 110 acres of land out of three tracts totaling 187.276 acres in Kendall County; and

WHEREAS, the UGRA seeks to amend Water Use Permit No. 5394A by adding agricultural use to irrigate160 acre-feet of water per annum currently authorized for municipal use, by adding

an additional point of diversion on the left bank of the Guadalupe River, Guadalupe River Basin one mile east of Comfort, Texas, and by changing the place of use of the agricultural water to the acreage owned or leased by Buckhorn Golf II Ltd. in Kendall County; and

WHEREAS, the Commission finds that jurisdiction over the application is established; and

WHEREAS, the Executive Director finds that at least 75% of the requested 160 acre-feet of water per annum would be available in only 14.3% of the years, and the monthly demand would be available in only 33.9 % of the months; and

WHEREAS, the existing authorization contains certain stream flow restrictions to prevent negative impact on existing instream uses which will remain in effect under this amendment; and

WHEREAS, no person protested the granting of this application; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and the Rules of the Texas Natural Resource Conservation Commission in issuing this amendment;

NOW THEREFORE, this amendment to Water Use Permit No. 5394A, designated Water Use Permit No. 5394C, is issued to the Upper Guadalupe River Authority, subject to the following terms and conditions:

1. USE

In lieu of the prior authorization contained in Water Use Permit No. 5394A, permittee is authorized to divert:

A. Not to exceed 2,000 acre-feet of water per annum on a firm yield basis from the Guadalupe River at the point of diversion included in Water Use Permit No. 3505. Such total amount of water shall be used for municipal use and/or injected into the Hosston-Sligo Aquifer of the Lower Trinity Formation for subsequent retrieval for municipal purposes.

B. Not to exceed 160 acre-feet of water per annum of the authorized 2000 acre-feet of water per annum, for a ten year period, for agricultural purposes, the irrigation of land owned by Buckhorn Golf II Ltd. described as 110 acres out of a 187.532 acre tract of land contained in six tracts located in the Justa Esqueda Survey No. 25, abstract 157, approximately one mile east of the town of Comfort in Kendall County, Texas.

2. DIVERSION

A. Point: In addition to the diversion points currently authorized by Water Use Permit No. 5394A Permittee is also authorized to divert the water authorized herein at a point bearing S 41.245° E, 8,218 feet from the USGS published

benchmark/triangular station known as "Comfort 2" on the left, or north, bank of the Guadalupe River approximately 200 yards downstream of the IH-10 bridge, one mile east of Comfort, Texas, also described as 29.970°N Latitude and 98.883°W Longitude .

B. Rate: The maximum diversion rate for the water authorized herein is not to exceed 1.1 cfs (500 gpm), and the combined maximum diversion rate for all water diverted pursuant to Water Use Permit No. 5394A, as amended, shall not exceed 15.5 cfs (6,956.4 gpm) in combination with Water Use Permit No. 3505 and Water Use Permit No. 5394B.

3. TIME PRIORITY

The time priority of this amendment for use of the 160 acre-feet of water per annum for agricultural uses is January 6, 1992, except it shall be junior in priority to all water rights owners of record, as they appear on the date this amendment is granted, with diversion points on the Guadalupe River between the existing and proposed diversion points.

4. CONSERVATION

Owners shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water, so that a water supply is made available for future or alternative uses.

5. SPECIAL CONDITIONS

In addition to Paragraph 5, SPECIAL CONDITIONS A through H of Water Use Permit No. 5394A, the following additional special conditions shall also apply:

I. This amendment is subject to the maintenance, or extension, of the Water Supply Agreement, between Permittee and Buckhorn Golf II, Ltd. dated April 10, 2000.

J. Upon expiration of the aforesaid Water Supply Agreement, this amendment shall expire and become null and void without further Commission consideration, and the 160 acre-feet of water per annum authorized hereby for agriculture use (irrigation) shall revert back to municipal use with no further Commission action..

K. Permittee is required to contact the South Texas Watermaster prior to the diversion of any water authorized by this amendment.

L. Prior to diversion of the water authorized herein, Permittee shall install and maintain a measuring device at the described diversion point, capable of measuring within plus or minus 5% accuracy, to record the amount of water diverted from the stream for industrial purposes. Representatives of the TNRCC shall, upon demand, be provided physical access to the diversion (pump) sites for inspection and verification purposes.

This amendment is issued subject to all superior and senior water rights in the Guadalupe River Basin.

All other matters requested in the application which are not specifically granted by this amendment are denied.

Permittee agrees to be bound by the terms, conditions and provisions contained herein, and such agreement is a condition precedent to the granting of this amendment.

This amendment is issued subject to the Rules of the Texas Natural Resource Conservation Commission and to the right of continuing supervision of State water resources exercised by the Commission.

TEXAS NATURAL RESOURCE
CONSERVATION COMMISSION

For the Commission

Date Issued: AUG 20 2002

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

## AMENDMENT TO PERMIT TO APPROPRIATE AND USE STATE WATER

APPLICATION NO.5394B PERMIT NO. 5394B TYPE: 11.122

| | | | |
|---|---|---|---|
| Permittee: | City of Kerrville Texas | Address: | 800 Junction Highway<br>Kerrville, Texas 78029-5069 |
| Filed: | April 3, 1998 | Granted: | APR 10 1998 |
| Purposes: | Municipal and Recharge | County: | Kerr |
| Watercourse: | Guadalupe River | Watershed: | Guadalupe River Basin |

WHEREAS, the Upper Guadalupe River Authority (UGRA) holds Permit No. 5394 authorizing the diversion of up to 4169 acre-feet of water per annum from an existing 840 acre-foot capacity reservoir (included in UGRA's Water Use Permit No. 3505) in Kerr County, approximately 1.5 miles west-northwest of the Kerr County Courthouse on the Guadalupe River, for municipal purposes and/or injection via wells into an underground aquifer reservoir known as the Hosston-Sligo Sands of the Lower Trinity formation for subsequent retrieval and use for municipal purposes in Kerr County; and

WHEREAS, UGRA has conveyed Permit No. 3505 and the right under Permit No. 5394 to appropriate up to 2169 acre-feet of water per annum to the City of Kerrville, Texas; and

WHEREAS, Kerrville desires to have a water right transferring the rights associated with the 2169 acre-feet of water under Permit No. 5394 issued in its own name, without any change in the purpose or place of use, at the same rate of diversion; and

WHEREAS, the water requested in this application is included in a Subordination Agreement between the Upper Guadalupe River Authority and the Guadalupe-Blanco River Authority; and

WHEREAS, the Commission finds that jurisdiction over the application is established; and

WHEREAS, no public hearing was requested or held on the granting of this application after the publication of all notice requirements; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Commission in issuing this permit amendment.

NOW, THEREFORE, this permit amendment to appropriate and use State water is issued to the City of Kerrville, Texas, subject to the following terms and conditions:

1. USE

Permittee is authorized to divert not to exceed 2,169 acre-feet of water per annum from the reservoir on the Guadalupe River included in Water Use Permit No. 3505 and Permit No. 5394A. Of this total amount, 761 acre-feet per annum is available on a firm yield basis, with the remaining 1,408 acre-feet per annum available on a "run-of-river" basis. Such total amount of water shall be used for municipal use and/or injected into the Hosston-Sligo Aquifer of the Lower Trinity formation for subsequent retrieval for municipal use.

2. DIVERSION

Permittee is authorized to divert water from the point on the reservoir authorized in Permit No. 3505 at a maximum rate, in combination with the rate included in Permit No. 3505 and Permit No. 5394A, of not to exceed 15.5 cfs. Prior to the diversion of the water authorized hereunder, Permittee shall have installed a metering device in accordance with Commission rules.

3. POINT OF RETURN

Water diverted for use by the City of Kerrville but not consumed shall be returned to the City of Kerrville's wastewater treatment plant discharge outfall.

4. WATER CONSERVATION

Within one (1) year from issuance of this permit amendment, owner shall submit to the Executive Director of the Texas Natural Resource Conservation Commission a water conservation plan as described in Texas Administrative Code Section 288.2, which shall provide for the utilizing of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water, so that a water supply is made available for future use or alternative uses. Such plan shall include a requirement in every wholesale water supply contract entered into, on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement water conservation measures. If the customers intend to resell the water, then the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

5. SPECIAL CONDITIONS

A. Permittee is authorized to divert water hereunder only when the water level in the referenced existing reservoir is above 1,608 feet mean sea level.

B. During the months of October through May, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 40 cfs at a referenced device to be installed by the Permittee immediately downstream of the dam for the referenced reservoir at a location to be approved by the Executive Director. During the months of June through September, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 30 cfs at the aforesaid reference device.

C. In addition to the variable flow restrictions contained in Paragraph 5. SPECIAL CONDITIONS B., if inflows into the referenced reservoir are 50 cfs or greater. Permittee must restrict the diversions hereunder authorized to allow a flow of at least 50 cfs to pass the reference device described in that paragraph. The inflows are to be measured at a separate reference device or devices installed by Permittee upstream of the reservoir at a specific location to be approved by the Executive Director.

D. Of the 2,169 acre-feet of water authorized for diversion per annum in Paragraph 1. USE, such water shall be used as follows:

i. Not to exceed 1,100 acre-feet of water per annum for municipal use by the City of Kerrville (either water diverted directly from the river or surface water injected into the aforesaid aquifer and subsequently retrieved); and

ii. The remaining 1,069 acre-feet of water per annum shall be used for injection into the said aquifer for storage to maintain the firm yield of the system.

E. The authorizations hereunder are subject to the maintenance of the June 8, 1987 "Subordination Agreement" or amendments and extensions thereof, between the permittee and/or the Upper Guadalupe River Authority and the Guadalupe-Blanco River Authority. The Commission shall be notified immediately by the permittee upon amendment or expiration of such agreement and provided with copies of appropriate documents affecting such changes.

F. Water diverted under this permit for storage in the aquifer shall be treated to drinking water standards as per Texas Natural Resources Conservation Commission Rules.

G. The annual total of the diversions authorized under Permit No. 3505 and under this permit shall be allocated to each day based on historic patterns of usage, as reflected in Exhibit A attached to Permit 5394. If, on any given day, the daily allocation is not needed or not available under either permit, then such allocations shall not be made up on future days, except that allocations under this Permit No. 5394B may be made up on future days provided that flows at the downstream reference device described in Paragraph 5. SPECIAL CONDITIONS, B. are at least 60 cfs on those future days.

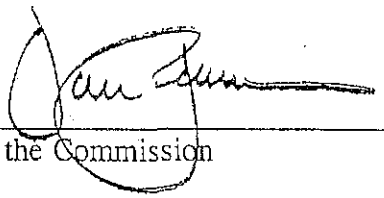
This permit amendment is issued subject to all superior and senior water rights in the Guadalupe River Basin.

Permittee agrees to be bound by the terms, conditions and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Natural Resources Conservation Commission and to the right of continuing supervision of State water resources exercised by the Commission.

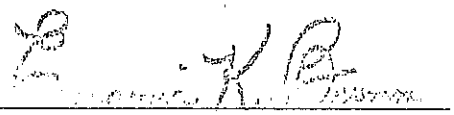
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



For the Commission

DATE ISSUED: APR 10 1998

ATTEST:



Dr. Eugenia K. Brumm, Chief Clerk

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

COUNTY OF TRAVIS

I hereby certify that this is a true and correct copy of a Texas Natural Resource Conservation Commission document, which is filed in the permanent records of the Commission.
Given under my hand and the seal of office on APR 13 1998

Eugenia K. Brumm, Chief Clerk
Texas Natural Resource
Conservation Commission

## AMENDMENT TO PERMIT TO APPROPRIATE AND USE STATE WATER

| | | | |
|---|---|---|---|
| APPLICATION NO. 5394A | PERMIT NO. 5394A | TYPE: | 11.122 |
| Permittee: | Upper Guadalupe River Authority | Address: | 215 Water Street<br>Kerrville, Texas 78028 |
| Filed: | April 3, 1998 | Granted: | APR 10 1998 |
| Purposes: | Municipal and Recharge | County: | Kerr |
| Watercourse: | Guadalupe River | Watershed: | Guadalupe River Basin |

WHEREAS, the Upper Guadalupe River Authority (UGRA) holds Permit No. 5394 authorizing the diversion of up to 4169 acre-feet of water per annum from an existing 840 acre-foot capacity reservoir (included in UGRA's Water Use Permit No. 3505) in Kerr County, approximately 1.5 miles west-northwest of the Kerr County Courthouse on the Guadalupe River, for municipal purposes and/or injection via wells into an underground aquifer reservoir known as the Hosston-Sligo Sands of the Lower Trinity formation for subsequent retrieval and use for municipal purposes in Kerr County; and

WHEREAS, UGRA has the right under Permit No. 5394 to appropriate up to 2169 acre-feet of water per annum for the City of Kerrville, Texas; and

WHEREAS, UGRA desires to amend its Permit to reflect the transfer of the rights associated with the 2169 acre-feet of water under Permit No. 5394 to Kerrville and to obtain a modified permit in its own name, without any change in the purpose or place of use, at the same rate of diversion for the 2000 acre-feet of water per annum retained by UGRA; and

WHEREAS, the water requested in this application is included in a Subordination Agreement between the Upper Guadalupe River Authority and the Guadalupe-Blanco River Authority; and

WHEREAS, the Commission finds that jurisdiction over the application is established; and

WHEREAS, no person has protested the granting of this application; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Commission in issuing this permit amendment.

NOW, THEREFORE, this permit amendment to appropriate and use State water is issued to the Upper Guadalupe River Authority (UGRA), subject to the following terms and conditions:

1. USE

Permittee is authorized to divert not to exceed 2,000 acre-feet of water per annum on a firm yield basis from the Guadalupe River at the point of diversion included in Water Use Permit No. 3505. Such total amount of water shall be used for municipal use and/or injected into the Hosston-Sligo Aquifer of the Lower Trinity formation for subsequent retrieval for municipal use.

2. DIVERSION

Permittee is authorized to divert water from the point on the reservoir authorized in Permit No. 3505 at a maximum rate, in combination with the rate included in Permit No. 3505 and Permit No. 5394B, of not to exceed 15.5 cfs. Prior to the diversion of the water authorized hereunder, Permittee shall have installed a metering device in accordance with Commission rules.

3. POINT OF RETURN

Water diverted for use but not consumed shall be returned to the water course or stream of origin if it can be returned by gravity flow and it is reasonably practicable to do so.

4. WATER CONSERVATION

Within one (1) year from issuance of this permit amendment, owner shall submit to the Executive Director of the Texas Natural Resource Conservation Commission a water conservation plan as described in Texas Administrative Code Section 288.2, which shall provide for the utilizing of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water, so that a water supply is made available for future use or alternative uses. Such plan shall include a requirement in every wholesale water supply contract entered into, on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement water conservation measures. If the customers intend to resell the water, then the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

5. SPECIAL CONDITIONS

A. Permittee is authorized to divert water hereunder only when the water level in the referenced reservoir authorized by Permit 3505 is above 1,608 feet mean sea level.

B. During the months of October through May, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 40 cfs at a referenced device to be installed immediately downstream of the dam for the referenced reservoir at a location to be approved by the Executive Director. During the months of June through September, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 30 cfs at the aforesaid reference device.

C. In addition to the variable flow restrictions contained in Paragraph 5. SPECIAL CONDITIONS B., if inflows into the referenced reservoir are 50 cfs or greater, Permittee must restrict the diversions hereunder authorized to allow a flow of at least 50 cfs to pass the reference device described in that paragraph. The inflows are to be measured at a separate reference device or devices installed by Permittee upstream of the reservoir at a specific location to be approved by the Executive Director.

D. Of the 2,000 acre-feet of water authorized for diversion per annum in Paragraph 1. USE, such water shall be used as follows:

i. Not to exceed 1,661 acre-feet of water per annum may be contracted for municipal use by Kerr County entities other than the City of Kerrville (either water diverted directly from the river or surface water injected into the aforesaid aquifer and subsequently retrieved); and

ii. The remaining 339 acre-feet of water per annum shall be used for injection into the said aquifer for storage to maintain the firm yield of the system.

E. Authorization to divert and use any portion of the 1,661 acre-feet of water per annum referenced in Paragraph 5. SPECIAL CONDITIONS, D. I. which UGRA has not committed to a binding take-or-pay contract and submitted to the Commission by midnight, December 31, 2010, will be subject to cancellation and by January 17, 2011, UGRA shall submit to the Commission a document requesting voluntary cancellation of that portion of the 1,661 acre-feet of water not included in a contract.

2007 VOID by HB891

F. The authorizations hereunder are subject to the maintenance of the June 8, 1987 "Subordination Agreement" or amendments and extensions thereof, between the permittee and/or the Upper Guadalupe River Authority and the Guadalupe-Blanco River Authority. The Commission shall be notified immediately by the permittee upon amendment or expiration of such agreement and provided with copies of appropriate documents affecting such changes.

G. Water diverted under this permit for storage in the aquifer shall be treated to drinking water standards as per Texas Natural Resources Conservation

Commission Rules.

H. The annual total of the diversions authorized under Permit No. 3505 and under this permit shall be allocated to each day based on historic patterns of usage, as reflected in Exhibit A attached to Permit 5394. If, on any given day, the daily allocation is not needed or not available under either permit, then such allocations shall not be made up on future days, except that allocations under this Permit No. 5394A may be made up on future days provided that flows at the downstream reference device described in Paragraph 5. SPECIAL CONDITIONS, B. are at least 60 cfs on those future days.

This permit amendment is issued subject to all superior and senior water rights in the Guadalupe River Basin.

Permittee agrees to be bound by the terms, conditions and provisions contained herein and such agreement is a condition precedent to the granting of this amendment.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Natural Resources Conservation Commission and to the right of continuing supervision of State water resources exercised by the Commission.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

For the Commission

DATE ISSUED: APR 10 1998

ATTEST:

Dr. Eugenia K. Brumm, Chief Clerk

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
## INTEROFFICE MEMORANDUM

TO : Records Management

DATE: April 6, 1998

Application No. 5394B/Permit No. 5394B
Kerr County
Guadalupe River Basin

FROM : Water Uses & Availability Section
Water Quantity Division

SUBJECT : Change of Ownership

ADD : City of Kerrville, Texas, as part owner

Ownership of Record with Addresses and Remarks:

1. Upper Guadalupe River Authority
P. O. Box 1278
Kerrville, Texas 78029-1278

2. City of Kerrville, Texas
800 Junction Highway
Kerrville, Texas 78028-5069

This change is based on a copy of the "Termination, Asset Transfer & Acquisition & Settlement Agreement" dated November 20, 1997, and on amendments--A & B--to be issued on or about April 9, 1998.

This permit authorizes the use, from a 840 acre-foot capacity reservoir on the Guadalupe River, of 4169 acre-feet of water per annum for municipal use and/or injection into the Hosson-Sligo Aquifer of the Lower Trinity formation for subsequent retrieval for municipal use. Of these 4169 acre-feet, 2761 acre-feet are on a firm yield basis and the remaining 1408 acre-feet on a "run-of-river" basis.

The ownership of the 4169 acre-feet per annum of municipal water rights is established as follows:

1. Upper Guadalupe RA
   - 1661.00 ac/ft on "firm yield" basis, from the reservoir and/or from the surface water injected into Hosson-Sligo aquifer, for municipal use by Kerr County entities other than the City of Kerrville
   - 339.00 ac/ft on "firm yield" basis, from the reservoir for injection into the aquifer for maintaining the firm yield of the system and for subsequent retrieval for municipal use

2. City of Kerrville
   - 761.00 ac/ft on "firm yield" basis &
   - 339.00 ac/ft on "run-of-river" basis, from the reservoir and/or from the surface water injected into the aquifer, for municipal use
   - 1069.00 ac/ft on 'run-of-river" basis, from the reservoir for injection into the aquifer for maintaining the firm yield of the system and for subsequent retrieval for municipal use

4169.00 ac/ft for municipal use

Data Entry Made: MC MAY 12 1998

Mohan A Reddy

WU & A Section: _____

Change Noted: _____

Central Records/Date: _____

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

**AN ORDER** amending a Commission Order dated October 12, 1993, granting in part application No. 5394 to Extend Time to File a Final Report Regarding the Upper Guadalupe River Authority's Aquifer Storage and Retrieval Project; Docket No. 98-0228-WR

On March 18, 1998, the Texas Natural Resource Conservation Commission ("Commission") considered the request of the Upper Guadalupe River Authority ("UGRA") to amend a Commission Order dated October 12, 1993, to extend time to file a final report regarding its Aquifer Storage and Retrieval ("ASR") Project authorized in Permit No. 5394. The Commission finds that UGRA's request is reasonable, grants its request for extension of time, and amends Ordering Provision No. 3 in its Order dated October 12, 1993.

The Commission's Order of October 12, 1993, issuing Permit No. 5394 to UGRA, authorized diversion of up to 4169 acre feet of water per year from UGRA's reservoir on the Guadalupe River. Twenty-seven hundred and sixty-one (2761) acre feet of that water is authorized for municipal purposed and may be injected into the aquifer described in the permit for storage and subsequent retrieval using UGRA's aquifer storage and recovery well, and fourteen hundred and eight (1408) acre feet is authorized for injection into the aquifer for storage to maintain the firm yield of the system. That Order also provides that UGRA shall submit to the Commission by October 1, 1997, a report analyzing the subterranean movement and behavior of water injected into the Hosston-Sligo aquifer of the Lower Trinity Formation pursuant to its Permit No. 5394 by October 1, 1997. UGRA has requested an extension of time to file this report until October 1, 2002.

The Commission finds that UGRA has been unable to fully implement its ASR project because it was unable to begin until the appeal of the Commission's order granting the permit was resolved lasted until the fall of 1996, after which UGRA had to obtain authorizations from the Underground Injection Control Program and the Water Utility Division, and to negotiate a contract with the United States Geological Survey. After proper authorizations and contracts were obtained, the state was in a severe drought. The South Texas Watermaster requested that UGRA postpone diversion of water for storage of surface water in the ASR project. Finally, UGRA's efforts to initiate the ASR project were postponed due to changes in the City of Kerrville's water distribution system.

The Commission finds that because of these delays, UGRA has limited data, and any report filed with the Executive Director on October 1, 1997, would have been inadequate. The Commission also finds that UGRA's delay is reasonable under the circumstances.

Therefore, the Texas Natural Resource Conservation Commission grants the Upper Guadalupe River Authority's request for extension of time to file its report regarding its aquifer storage and recovery project authorized in its Permit No. 5394, and amends Ordering Provision 3 of its October 12, 1993, Order, which grants in part Application No. 5394, to read as follows:

> On October 1, 2002, UGRA shall submit to the Executive Director of the Commission a report analyzing the subterranean movement and behavior of water injected into the Hosston-Sligo Aquifer of the Lower Trinity formation pursuant to Permit No. 5394, in order to ascertain the extent to which such water remains available and subject to retrieval for the municipal use of persons and entities served by UGRA; UGRA shall consult with the Executive Director to determine the appropriate scope and methodology of this analysis. The Executive Director may grant extensions of time to file the report on a showing of good cause.

Issue date: MAR 19 1998

TEXAS NATURAL RESOURCE
CONSERVATION COMMISSION

Barry R. McBee, Chairman

PERMIT TO
APPROPRIATE AND USE STATE WATER

APPLICATION NO. 5394 PERMIT NO. 5394 TYPE: 11.121

| | | | |
|---|---|---|---|
| Permittee: | Upper Guadalupe River Authority | Address: | P.O. Box 1278<br>Kerrville, Tx.<br>78029-1278 |
| Filed | January 6, 1992 | Granted: | August 25, 1993 |
| Purposes: | Municipal and Recharge | County: | Kerr |
| Watercourse: | Guadalupe River | Watershed: | Guadalupe River Basin |

WHEREAS, the Upper Guadalupe River Authority (UGRA) has requested authorization to divert not to exceed 4,760 acre-feet of water per annum on a firm-yield basis from an existing 840 acre-foot capacity reservoir (included in UGRA's Water Use Permit No. 3505) in Kerr County, approximately 1.5 miles west-northwest of the Kerr County Courthouse on the Guadalupe River, for municipal purposes and/or injection via wells into an underground aquifer reservoir known as the Hosston-Sligo Sands of the Lower Trinity formation for subsequent retrieval and use for municipal purposes in Kerr County; and

WHEREAS, UGRA has indicated that the water requested will be utilized to meet the future municipal demands of its existing wholesale customer the City of Kerrville, and anticipated wholesale customers in Kerr County, including but not limited to, the City of Ingram and the unincorporated community at Center Point; and

WHEREAS, Kerr County is included in a "critical groundwater area" as designated by the Texas Water Commission; and

WHEREAS, UGRA has indicated that water injected into the aquifer will also have an incidental effect of temporarily recharging the aquifer during the period of storage; and

WHEREAS, UGRA has indicated that diversions of the water requested will only be made when the elevation of the water in the referenced reservoir is above 1,608 feet mean sea level; and

WHEREAS, Permit No. 3505 includes authorization for the diversion of not to exceed 3,603 acre-feet of water per annum for municipal purposes from a point on the west bank of the referenced reservoir at a maximum diversion rate of 9.7 cfs and limits diversion of water to only those times when the water level in the reservoir is above 1,608 feet mean sea level; and

WHEREAS, the Commission finds that UGRA does not have existing contracts for all of the water requested for diversion under Application No. 5394; and

WHEREAS, the Commission finds that water sought to be diverted under Application No. 5394 for which UGRA does not have existing water supply contracts should be limited to a term of years if such contracts are not hereafter entered into, submitted to Commission staff and approved in accordance with Commission Rules; and

WHEREAS, the Commission considered the "Kerr County Water Conservation Plan and Drought Contingency Plan (May 12, 1992)" submitted by the Upper Guadalupe River Authority in support of this Application and such plan evidences that permittee shall use reasonable diligence to achieve water conservation; and

WHEREAS, the water requested in this application is included in a Subordination Agreement between the applicant and the Guadalupe-Blanco River Authority; and

WHEREAS, the Commission finds that jurisdiction over the application is established; and

WHEREAS, a public hearing was held on the granting of this application after the publication of all notice requirements; and

WHEREAS, the Commission has complied with the requirements of the Texas Water Code and Rules of the Commission in issuing this permit.

NOW, THEREFORE, this permit to appropriate and use State water is issued to the Upper Guadalupe River Authority, subject to the following terms and conditions:

1. USE

Permittee is authorized to divert not to exceed 4,169 acre-feet of water per annum from the reservoir on the Guadalupe River included in Water Use Permit No. 3505. Of this total amount, 2,761 acre-feet per annum is available on a firm yield basis, with the remaining 1,408 acre-feet per annum available on a "run-of-river" basis. Such total amount of water shall be used for municipal use and/or injected into the Hosston-Sligo Aquifer of the Lower Trinity formation for subsequent retrieval for municipal use.

2. DIVERSION

Permittee is authorized to divert water from the point on the reservoir authorized in Permit No. 3505 at a maximum rate, in combination with the rate included in Permit No. 3505, of not to exceed 15.5 cfs. Prior to the diversion of the water authorized hereunder, Permittee shall have installed a metering device in accordance with Commission Rules.

3. POINT OF RETURN

Water diverted for use by the City of Kerrville but not consumed shall be returned to the City of Kerrville's wastewater treatment plant discharge outfall.

4. WATER CONSERVATION

Permittee shall implement the aforesaid "Kerr County Water Conservation Plan and Drought Contingency Plan" dated May 12, 1992. Any subsequent plan used by permittee shall provide for the utilizing of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent of reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water, so that a water supply is made available for future use or alternative uses. Such plan shall include a requirement in every wholesale water supply contract entered into, on or after the effective date of this permit, including any contract extension or renewal, that each successive wholesale customer develop and implement water conservation measures. If the customer intends to resell the water, then the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures.

5. SPECIAL CONDITIONS

A. Permittee is authorized to divert water hereunder only when the water level in the referenced existing reservoir is above 1,608 feet mean sea level.

B. During the months of October through May, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 40 cfs at a reference device to be installed by the Permittee immediately downstream of the dam for the referenced reservoir at a location to be approved by the Executive Director. During the months of

June through September, Permittee is authorized to divert water hereunder only when the flow of the Guadalupe River exceeds 30 cfs at the aforesaid reference device.

C. In addition to the variable flow restrictions contained in Paragraph 5. SPECIAL CONDITIONS B., if inflows into the referenced reservoir are 50 cfs or greater, Permittee must restrict the diversions hereunder authorized to allow a flow of at least 50 cfs to pass the reference device described in that paragraph. The inflows are to be measured at a separate reference device or devices installed by Permittee upstream of the reservoir at a specific location to be approved by the Executive Director.

D. Of the 4,169 acre-feet of water authorized for diversion per annum in Paragraph 1. USE, such water shall be used as follows:

i. Not to exceed 1,100 acre-feet of water per annum may be contracted for municipal use by the City of Kerrville (either water diverted directly from the river or surface water injected into the aforesaid aquifer and subsequently retrieved);

ii. Not to exceed 1,661 acre-feet of water per annum may be contracted for municipal use by Kerr County entities other than the City of Kerrville (either water diverted directly from the river or surface water injected into the said aquifer and subsequently retrieved); and

iii. The remaining 1,408 acre-feet of water per annum shall be used for injection into the said aquifer for storage to maintain the firm yield of the system.

E. Authorization to divert and use any portion of the 1,661 acre-feet of water per annum referenced in Paragraph 5. SPECIAL CONDITIONS, D. ii. which UGRA has not committed to a binding take-or-pay contract and submitted to the Commission by midnight, December 31, 2010, will be subject to cancellation and by January 17, 2011, UGRA shall submit to the Commission a document requesting voluntary cancellation of that portion of the 1,661 acre-feet of water not included in a contract.

F. The authorizations hereunder are subject to the maintenance of the June 8, 1987 "Subordination

Agreement" or extensions thereof, between permittee and the Guadalupe-Blanco River Authority. The Commission shall be notified immediately by the permittee upon amendment or expiration of such agreement and provided with copies of appropriate documents effecting such changes.

G. Water diverted under this permit for storage in the aquifer shall be treated to drinking water standards as per Texas Water Commission Rules.

H. The annual total of the diversions authorized under Permit No. 3505 and under this permit shall be allocated to each day based on historic patterns of usage, as reflected in Exhibit A attached to this permit. If, on any given day, the daily allocation is not needed or not available under either permit, then such allocations shall not be made up on future days, except that allocations under this permit (No. 5394) may be made up on future days provided that flows at the downstream reference device described in Paragraph 5. SPECIAL CONDITIONS, B. are at least 60 cfs on those future days.

This permit is issued subject to all superior and senior water rights in the Guadalupe River Basin.

Permittee agrees to be bound by the terms, conditions and provisions contained herein and such agreement is a condition precedent to the granting of this permit.

All other matters requested in the application which are not specifically granted by this permit are denied.

This permit is issued subject to the Rules of the Texas Water Commission and to the right of continuing supervision of State water resources exercised by the Commission.

DATE ISSUED: OCT 12 1993

TEXAS WATER COMMISSION

John Hall, Chairman

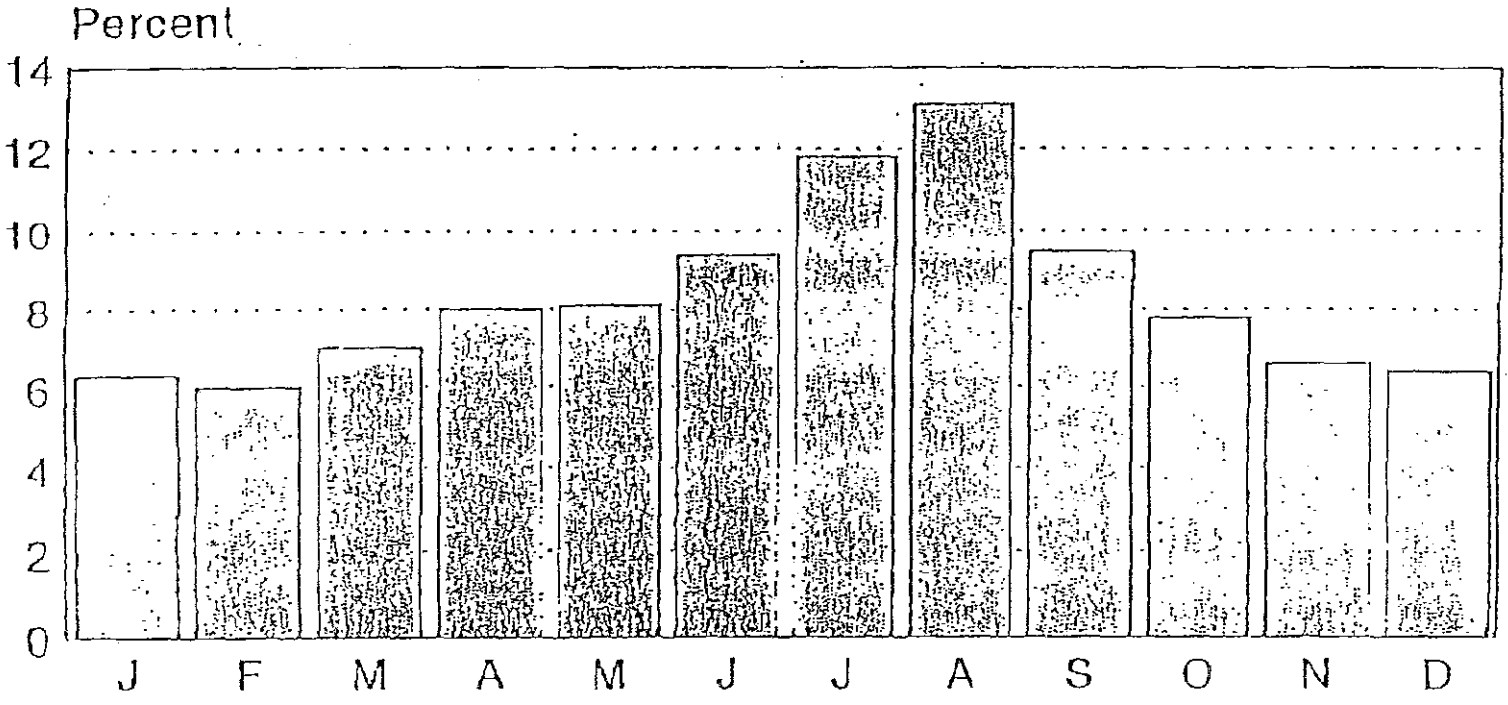
ATTEST:

for Gloria A. Vasquez, Chief Clerk

EXHIBIT A

# UGRA Demand Distribution

## (Used in Modeling)

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Based on historical use for City of Kerrville

# TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

AN ORDER granting in part Application No. 5394 of Upper Guadalupe River Authority for a Section 11.121 water rights permit

On August 25, 1993, the Texas Water Commission (Commission) considered the application of the Upper Guadalupe River Authority (UGRA) for a water rights permit (No. 5394) pursuant to Section 11.121 of the Texas Water Code (Code) to authorize the diversion of 4,760 acre-feet of water per annum from the Guadalupe River in Kerr County, Texas, for immediate municipal use or for injection into underground aquifer storage, with subsequent retrieval for municipal use. The application was presented to the Commission with a Proposal for Decision written by Mike Rogan, Attorney, a Commission Hearings Examiner.

The Examiner conducted adjudicative public hearings concerning the application in Austin, Texas, in June, July, September, and December, 1992, and in January and February, 1993. The Examiner designated the following as parties to the proceeding: the applicant, UGRA; the Executive Director of the Commission; the Public Interest Counsel of the Commission; the Texas Parks and Wildlife Department; and five protestants, including Texas River Protection Association, Lower Guadalupe Property Owners Association, William C. Perkins, Wendall Lyons, and Byno Salsman.

After considering the Examiner's Proposal for Decision and the evidence and arguments presented, the Texas Water Commission makes the following Findings of Fact and Conclusions of Law:

FINDINGS OF FACT

1. UGRA, a conservation and reclamation district with boundaries that coincide with those of Kerr County, was created by the Texas Legislature pursuant to Article XVI, Section 59 of the Texas Constitution and pursuant to Art. 8280-124, TEX. REV. CIV. STAT. ANN. (Vernon Supp. 1993).

2. On July 9, 1991, UGRA filed Application No. 5394 to appropriate 4,760 acre-feet of water from the Guadalupe River for municipal use, including the right to temporarily store a portion of that water in a fresh water bearing sand known as the Hosston-Sligo Aquifer in the Lower Trinity Formation.

3. On January 6, 1992, the Chief Clerk of the Commission, having determined that Application No. 5394 was in proper form and accompanied by all necessary fees, accepted the application for filing.

4. Proper notice was given pursuant to Section 11.132 of the Code and Sections 295.151, 295.152, and 295.153 of the Commission's permanent rules.

   a. Notice of application and Commission action was mailed on February 4, 1992, by the Chief Clerk of the Commission to all recorded holders of certified filings, permits and claims of water rights filed pursuant to Section 11.303

of the Code and to all navigation districts in the Guadalupe River Basin.

b. Notice of the application and Commission action was published on February 5, 1992, in the Kerrville Mountain Sun and in the Kerrville Daily Times, newspapers regularly published in Kerr County, Texas, and having a general circulation in that county.

c. Notice of the initial public hearing in this matter was mailed by the Hearings Examiner on June 11, 1992, to all persons who had requested notice of such hearing.

5. Public hearings on the application were held in Austin, Texas, on June 29, July 23, September 28 through October 1, and December 15 through 18, 1992; and on January 4 through 8, January 12 through 14, and February 23, 1993.

6. UGRA intends to inject water diverted pursuant to Permit No. 5394 into the Hosston-Sligo Aquifer of the Lower Trinity formation only for temporary storage and to be retrieved subsequently for municipal use, thereby effecting only incidental recharge of the aquifer.

7. UGRA will inject surface water into the aquifer through wells located in the City of Kerrville's existing well field.

8. Water in the aquifer beneath the well field is confined vertically and moves laterally at an average velocity of less than 120 feet per year.

9. Substantially all of the water injected into the aquifer beneath the City of Kerrville's well field will be recoverable by UGRA through wells located in that same field.

10. At least 75 to 80 percent of injected water will be recoverable from the aquifer without observable mixing between the injected water and native groundwater.

11. Mixing of injected water with native groundwater will be limited.

12. Water injected into the aquifer by UGRA will be treated to drinking water standards prior to injection.

13. UGRA's injection of water poses no significant threat of polluting or otherwise damaging the aquifer.

14. Because UGRA's authorized diversion point is more than 200 river miles upstream of the nearest bays and estuaries, any effects of the proposed diversions under Application No. 5394 upon the bays and estuaries will be countered by inflows from intervening tributaries and watersheds and by the effects of intervening reservoirs.

15. UGRA's proposed diversion of water will have no discernible effect upon the bays and estuaries of the State of Texas.

16. UGRA conducted and presented at hearing a technical assessment of the impacts of the proposed diversion upon downstream fish and wildlife habitats, instream uses, and water quality within the Guadalupe River.

17. UGRA's assessment of impacts upon fish and wildlife habitats addressed the survival of six species with high public

visibility (the baldcypress tree and five species of game fish).

18. The proposed diversion creates the potential for significant negative impacts upon riparian fish and wildlife habitats.

19. The Commission staff recently has recalculated the 7Q2 streamflow of the Guadalupe River downstream of UGRA's diversion point from 25 cubic feet per second (cfs) to 27.5 cfs.

20. The 7Q2 streamflow--which is the statistically derived lowest average flow that continues for seven consecutive days and is expected to recur at two-year intervals--defines a flow level below which the Commission's stream standards for water quality generally do not apply.

21. The generally very high water quality of Segment No. 1806 of the Guadalupe River (in which the proposed diversion will take place) is reflected in its designated use as exceptional quality aquatic habitat, according to the Commission's stream standards for water quality.

22. Kerrville-Schreiner State Park is located adjacent to Flat Rock Lake on the Guadalupe River, 4 to 5 miles downstream of UGRA's diversion point.

23. Recreational navigation and related uses of the Guadalupe River below UGRA's diversion point become limited during periods when streamflow is less than 50 cfs.

24. A streamflow restriction limiting UGRA's diversions under the proposed permit to only those times when streamflow in the

Guadalupe River equals or exceeds 25 cfs would be adequate to protect existing downstream water rights and vested riparian rights.

25. A streamflow restriction of 30 cfs would provide adequate protection of water quality, by assuring that UGRA will not reduce natural streamflow below the 7Q2 level and by providing an additional margin of protection to reflect the very high water quality of the Guadalupe River and the siting of Kerrville-Schreiner State Park adjacent to the river.

26. A streamflow restriction of 30 cfs would provide appropriate protection for fish and wildlife habitat, by assuring that UGRA will not reduce natural streamflow to levels that isolate significant portions of the river's baldcypress tree populations from flow and otherwise increase stress upon the riparian biological community.

27. A streamflow restriction of 40 cfs during all months except June through September would provide appropriate protection for fish and wildlife habitat, by simulating the seasonal fluctuation in flow that is characteristic of the natural yearly cycle to which native organisms are adapted.

28. A streamflow restriction of 50 cfs during all times when streamflow above the UGRA diversion point equals or exceeds 50 cfs would maintain minimum levels of flow needed for recreational navigation and related instream uses.

29. The combination of elements in the 30, 40, and 50 cfs streamflow restrictions described in Findings of Fact Nos. 25

through 28 is referred to as a "30/40/50 cfs" streamflow restriction.

30. UGRA has adopted a water conservation plan in compliance with Section 11.1271 of the Code.

31. The City of Kerrville, UGRA's sole current wholesale customer, has adopted a water conservation plan (pursuant to Ordinance No. 91-05, dated February 12, 1991), complementing UGRA's plan.

32. The policy of the Commission in recent years has been to limit diversions under water rights permits for municipal use to the firm yield (i.e., the annual amount of water that can be obtained regularly, dependably and without interruption) from the permittee's system, and this policy promotes the public welfare by assuring constant and dependable municipal water supplies.

33. Unappropriated water is generally unavailable at UGRA's point of diversion.

34. In 1987 UGRA entered a "subordination agreement" with the Guadalupe-Blanco River Authority (GBRA), by which GBRA agreed to suspend its right, vis-a-vis UGRA, to assert the priority of 4,760 acre-feet of GBRA's pre-existing rights to use water of the Guadalupe River for non-consumptive hydroelectric power-generating purposes; the term of the agreement extends until the year 2027 and is renewable at the parties' option.

35. UGRA is authorized to supply water throughout Kerr County.

36. As of the date the hearing in this matter ended, UGRA had entered no contracts nor any formal negotiations with entities in Kerr County (other than the City of Kerrville) seeking additional water supplies.

37. UGRA has projected Kerr County's maximum net demand for additional municipal-use water in the year 2040 to be 3,702 acre-feet per year.

38. UGRA has projected the City of Kerrville's maximum net demand for additional municipal-use water in the year 2040 to be 1,489 acre-feet per year.

39. The City of Kerrville holds a certificate of adjudication from the Commission entitling it to divert 225 acre-feet of water per year for municipal purposes and park irrigation; UGRA did not account for this source of water in determining net year 2040 demand.

40. UGRA's use of unrepresentative figures for current per capita water usage in the City of Kerrville inflated the projection of the city's net year 2040 demand by 11 percent, or 164 acre-feet per year.

41. The City of Kerrville's reasonable projected net demand for additional municipal-use water in the year 2040 is 389 acre-feet less than UGRA's projections, or 1,100 acre-feet per year.

42. The firm yield of UGRA's proposed aquifer storage system, assuming a 30/40/50 cfs streamflow restriction and a maximum annual diversion of 4,760 acre-feet (as determined by UGRA's

subordination agreement with GBRA) is 3,150 acre-feet per year.

43. The firm yield of UGRA's system, less 389 acre-feet of over-projections in the City of Kerrville's year 2040 demands, equals 2,761 acre-feet.

44. The amount of water needed to provide a firm yield of 2,761 acre-feet per year from UGRA's proposed system, assuming a 30/40/50 cfs streamflow restriction, is approximately 4,169 acre-feet per year.

45. UGRA has committed to relinquishing rights to any portion of the water sought under Application No. 5394 for municipal customers within Kerr County (other than the City of Kerrville) which is not under contract by December 31, 2010.

46. UGRA requested the transcript in this hearing; possesses greater resources than other parties to pay for the transcript; participated at least as extensively as any party in generating the record; was the only party with exclusive, unimpeded use of a copy of the transcript and made greatest use of it; and is the only party that can anticipate a direct, additional benefit from this proceeding.

CONCLUSIONS OF LAW

1. The public hearing regarding the permit application was held under the authority of and in accordance with Chapter 11 of the Code and the Texas Water Commission Permanent Rules.

2. The Commission has jurisdiction to consider the application and is authorized to issue a permit for the appropriation of state water.

3. By injecting water into an aquifer for storage and subsequent retrieval, UGRA will provide a supply of water for municipal use, with only incidental recharging of the aquifer.

4. Section 11.023(c) of the Code does not proscribe UGRA's injection of surface water into an aquifer for storage and subsequent retrieval for municipal use, in accordance with the proposed permit.

5. Water injected by UGRA into aquifer storage will not be lost or wasted, but will be retrievable for beneficial use.

6. The Commission adequately has assessed the effects of the proposed diversion upon the bays and estuaries of Texas, existing instream uses, water quality of the Guadalupe River, and fish and wildlife habitats.

7. Although the Guadalupe River adjacent to Kerrville-Schreiner State Park are "outstanding national resource waters" as defined in 31 TAC Sec. 307.5(b)(3) and deserve consideration for that status in the assessment of the proposed diversion's effects, the specific legal standards and requirements of 31 TAC Sec. 307.5 are not applicable to this action under Chapter 11 of the Code.

8. Water is available for appropriation at UGRA's proposed point of diversion only by means of the 1987 subordination agreement between UGRA and GBRA; the maintenance of this agreement or an

instrument of like effect is a prerequisite to the continued effectiveness of the proposed permit.

9. The imposition upon the proposed diversion of a permit condition defining a 30/40/50 cfs streamflow restriction (as noted in Findings of Fact Nos. 25 through 29) is necessary to serve the public welfare, by protecting existing water rights, existing instream uses, water quality in the Guadalupe River, and fish and wildlife habitats.

10. With a 30/40/50 cfs streamflow restriction, issuance of the proposed permit does not impair existing water rights or vested riparian rights.

11. With a 30/40/50 cfs streamflow restriction and other conditions incorporated in the proposed permit, issuance of the permit is not detrimental to the public welfare.

12. UGRA has provided evidence that reasonable diligence will be used to avoid waste and achieve water conservation as defined by Section 11.002(8)(B) of the Code.

13. The requirement that permitted diversions of water for municipal use be limited to the firm yield of the permittee's system, in order to assure uninterrupted supplies to dependent urban populations, is established Commission policy and contributes significantly to the public welfare.

14. UGRA has demonstrated reasonably impending need or demand for 2,761 acre-feet of water per year on a firm-yield basis, which can be obtained through UGRA's proposed system with a maximum

diversion of 4,169 acre-feet of water per year from the Guadalupe River.

15. Under the developed waters doctrine, water appropriated and injected into the Hosston-Sligo Aquifer of the Lower Trinity formation for storage and retrieval pursuant to Permit No. 5394 would remain state waters.

16. It is reasonable to impose upon Permit No. 5394 a condition agreed to by the parties that the annual total of the diversions authorized under Permit No. 3505 and under Permit No. 5394 shall be allocated to each day based on historic patterns of usage, as reflected in Exhibit A attached to Permit No. 5394; if on any given day, the daily allocation is not needed or not available under either permit, then such allocations shall not be made up on future days, except that allocations under Permit No. 5394 may be made up on future days provided that flows at the downstream reference device described in Paragraph 5. SPECIAL CONDITIONS, B. of Permit No. 5394 are at least 60 cfs on those future days.

17. Transcript costs are reasonably borne wholly by the applicant.

18. In order to effectuate the policies of this State as set forth in Chapter 11 of the Code and to administer all powers and duties described therein, the application should be approved and Permit No. 5394 issued.

WHEREAS Chairman John Hall, Commissioner Pam Reed and Commissioner Peggy Garner vote unanimously to issue this Order;

NOW, THEREFORE, BE IT ORDERED BY THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION THAT:

1. The application by UGRA for Permit No. 5394 be approved in accordance with the terms and conditions contained in the attached permit.
2. The Chief Clerk of the Commission forward a copy of this Order and attached permit to all parties and, subject to the filing of motions for rehearing, issue the attached permit.
3. On October 1, 1997, UGRA submit to the Executive Director of the Commission a report analyzing the subterranean movement and behavior of water injected into the Hosston-Sligo Aquifer of the Lower Trinity formation pursuant to Permit No. 5394, in order to ascertain the extent to which such water remains available and subject to retrieval for the municipal use of persons and entities served by UGRA; UGRA shall consult with the Executive Director to determine the appropriate scope and methodology for this analysis.
4. If any provision, sentence, clause, or phrase of this Order is for any reason held to be invalid, the invalidity of any portion shall not affect the validity of the remaining portions of the Order.

Issue date: OCT 12 1993

TEXAS WATER COMMISSION

John Hall, Chairman

ATTEST:

for Marie M. Black
Gloria A. Vasquez, Chief Clerk

# SUBORDINATION AGREEMENT
# BETWEEN
# GUADALUPE-BLANCO RIVER AUTHORITY
# AND
# KERRVILLE, TEXAS

This Subordination Agreement ("Agreement") is entered into effective the 15th day of April, 1998, between GUADALUPE-BLANCO RIVER AUTHORITY, a conservation district and political subdivision of the State of Texas (hereinafter called the "Authority"), and the City of Kerrville, Texas, a municipal corporation and home-rule city (hereinafter called "User").

## WITNESSETH:

## RECITALS

User has entered into that certain "Termination, Asset Transfer & Acquisition, & Settlement Agreement" with the Upper Guadalupe River Authority, dated November 20, 1997 (the "Settlement Agreement") which, inter alia, contains an agreement to transfer, at Closing, a portion of Permit No. 5394 to Kerrville, in a particular manner and configuration, authorizing User to divert 2169 acre-feet per year ("User's Permit").

Authority has an existing Subordination Agreement with the Upper Guadalupe River Authority ("UGRA"), dated June 8, 1987, as amended September 20, 1993 (the "UGRA Subordination"). Pursuant to the UGRA Subordination, the UGRA is authorized in Permit No. 5394 to divert water from the Guadalupe River at times when the entire flow of the Guadalupe River in Kerr County is required to be allowed to pass to honor the Authority's hydropower rights, but less than the entire flow required to be allowed to pass to honor all other water rights.

User desires that the Authority amend the UGRA Subordination to transfer, effective upon Closing of the Settlement Agreement, a portion of the rights therein regarding Authority's subordination its hydropower rights to make water available for use by User under User's Permit for 2,169 acre-feet of water per year.

Contemporaneous with the execution of this Subordination Agreement, UGRA and the Authority have entered into Amendment No. 2 to the UGRA Subordination. The Parties acknowledge that Amendment No. 2 to the UGRA Subordination and this Agreement are to become effective upon the Closing of the Settlement Agreement.

## AGREEMENT

NOW, THEREFORE, for and in consideration of the mutual promises, obligations, and benefits hereinafter set forth, the Authority and User agree as follows:

User proposes to obtain, pursuant to that certain "Termination, Asset Transfer & Acquisition, & Settlement Agreement" with the Upper Guadalupe River Authority, dated November 20, 1997 (the "Settlement Agreement"), a portion of the water rights authorized pursuant

to Permit No. 5394 to authorize the diversion and primary use for municipal purposes of not to exceed 2169 acre-feet of water per year from the Guadalupe River at the Point of Diversion in Kerr County, Texas identified in Permit No. 5394 as amended ("User's Permit"). Accordingly, from and after Closing of the Settlement Agreement:

1. The Authority agrees to subordinate its hydropower rights to make water available for the appropriation proposed by User under User's Permit at times when the entire flow of the Guadalupe River in Kerr County is required to be allowed to pass to honor the Authority's hydropower rights, but less than the entire flow is required to be allowed to pass to honor all other water rights.

2. For purposes of this Agreement, the Parties agree that the proposed use of water under User's Permit may result in a decrease in the flow of water available for utilization by the Authority's hydroelectric system in any given year. The reduction in flow in any given year for which compensation is made (the "Flow Reduction") shall be the number of acre-feet of water diverted during a calendar year by User under the User's Permit, less any Return Flow (hereinafter defined) during that year. User agrees to pay the Authority at its office in Guadalupe County, Texas, or such other place as the Authority may designate in writing, not later than the thirtieth (30th) day of each January beginning in January 1999, the cost resulting from multiplying the Flow Reduction for the preceding calendar year times the Rate in dollars per acre-foot determined by the Board of Directors of the Authority to be in effect during the preceding year for reductions of flow through the Authority's hydroelectric system. The present Rate is $5.00 per acre-foot. The rate may be adjusted by the Authority at any time and from time to time, with any adjustment to take effect on the first (lst) day of the January immediately following the date the Authority gives written notice of the adjustment, provided, that:

a. Written notice of any adjustment of the Rate must be given to User at least sixty (60) days prior to the January 1st on which the adjustment is to take effect;

b. The Rate shall not be increased more than 25% from any one billing to another; and

c. The Rate shall be based on (1) the revenue lost to the authority's hydroelectric system due to the Flow Reduction as defined herein caused by the diversion, (2) compensation to the Authority's power customers for the higher cost of replacement power, and (3) costs of the Authority in administering the subordination program.

3. The "Point of Diversion" shall be a point of diversion authorized under User's Permit, more specifically described at present as a point on the west bank of the Guadalupe River, S 27° E 2450 feet from the SW corner of the Fosgate Survey, Abstract No. 138, Kerr County, Texas.

4. "Return Flow" as used in this Agreement shall mean the measured amount of water returned to the Guadalupe River or its tributaries upstream of Canyon Reservoir by User or any of User's customers during the same calendar year.

5. User shall, at its own cost and expense, install and maintain a measuring device or devices at specific points established by mutual agreement of the parties to measure the quantity of water diverted at the point of Diversion and return flows from User or User's customers within five

percent (5%) above or below the amount actually diverted or returned. User shall maintain a record of the total quantity of water diverted at the Point of Diversion or returned at each point of return each day. On or before the fifteen the (15th) day of each January, beginning January 1999, User shall deliver a complete copy of such record of diversions and returns during the previous year to Authority, at Authority's office in Guadalupe County, Texas.

Measuring devices required hereunder shall be subject at all reasonable times to inspection, examination and testing by any employee or agent of the Authority. Any measuring device which fails to function or which functions incorrectly shall, at User's expense, promptly be adjusted, repaired or replaced by a like device having the required accuracy. The Authority may, at its expense, install and maintain such measuring devices as it deems appropriate, in which case measurements for the purpose of this Agreement shall be made by the Authority's measuring devices.

6. This Agreement does not apply to the Authority's Certificates of Adjudication Nos. 18-5172 and 18-5488 (the "Certificates"), and nothing herein shall be construed to be an agreement by the Authority to subordinate any of its water rights to make water available under the Certificates. Nothing herein shall be construed as prohibiting diversions under the Certificates during times when User is lawfully entitled to make such diversions.

7. The effectiveness of this Agreement is dependent upon Closing of the Settlement Agreement, and compliance with any applicable rules of the Texas Water Development Board or the Texas Natural Resource Conservation Commission, and all of the terms and conditions in User's Permit. This Agreement is subject to the terms of the Authority's rights under its Certificates and to such laws, rules and regulations as may be applicable to similar agreements in the State of Texas. The Authority and User will cooperate with each other to obtain any permits, approvals or other authorizations as may be required to comply therewith.

8. The Authority makes no representations and shall have no responsibility with respect to the availability or quality of water at the Point of Diversion, and except as specifically provided herein, User's rights to said water, if available. User understands and agrees that the Authority may subordinate any of its water rights to other rights held by the Authority and others. This Agreement shall not be construed as an Agreement for the benefit of a third party.

9. User may terminate this Agreement at any time upon giving the Authority written notice of termination at least thirty (30) days prior to the date of termination. If User fails to pay any amounts under this Agreement when due and payable, the Authority may give written notice of such delinquency to User, and if all amounts due and unpaid, including interest thereon from the date payment was due at the maximum legal rate, are not paid within forty-five (45) days after delivery of such notice, then the Authority shall be authorized, at its option, to institute suit for the collection thereof and to utilize such other remedies as may exist to collect any amounts due and unpaid, together with interest thereon at the maximum legal rate, and attorneys' fees. In addition to all other remedies, the Authority may, at its option, if such amounts are not paid within said 45 day period, terminate this Agreement without recourse.

10. No waiver by the Authority of any breach or default by User of any term, covenant, condition or liability hereunder, or the exercise by the Authority of any right or privilege hereunder, shall be deemed or construed to be a waiver by the Authority of subsequent breaches or defaults by

User of any kind, under any circumstances, or of the subsequent exercise by the Authority of rights or privileges of any kind, under any circumstances.

11. This Agreement shall extend for a term to expire on December 31, 2040, unless earlier terminated pursuant to the terms hereof. Upon expiration of said term, this Agreement may be renewed or extended for such term or terms, as may be agreed upon by the Authority and User.

12. This Agreement may be amended from time to time by the parties to it through the execution of such amendments as the parties shall mutually deem agreeable and reasonable by attaching the language of any amendment to this Agreement in multiple copies corresponding to the number of executed copies of this original Agreement.

13. In the event of a disagreement between the Authority and the User over the rate established by the Board of Directors of the Authority for subordination of hydroelectric water rights under the Certificates, the Authority and the User may apply by appropriate means to the Texas Natural Resource Conservation Commission to establish just and reasonable rates for the sale of water under this Subordination Agreement.

IN WITNESS WHEREOF, the Authority and User have caused this Agreement to be executed in multiple copies, each of which shall be deemed to be an original, on their behalf by their duly authorized representatives, to be effective April 15, 1998. As evidence of UGRA's knowledge and acceptance of the issuance of this Subordination Agreement to the City of Kerrville pursuant to Amendment No. 2 to the UGRA Subordination, the Authority and User have sought and secured the approval of UGRA as evidenced by the executed acknowledgment below.

**GUADALUPE-BLANCO RIVER AUTHORITY**

By _____
William E. West, Jr., General Manager

ATTEST:

_____

**CITY OF KERRVILLE**

By _____
Glenn Brown, City Manager

ATTEST:

_____
Sheila L. Brand, City Secretary

APPROVED AS TO FORM:

_____
Kevin B. Laughlin, City Attorney

**ACKNOWLEDGEMENT:**

Acknowledged and accepted on behalf of the Upper Guadalupe River Authority this 14th day of April, 1998.

**UPPER GUADALUPE RIVER AUTHORITY**

By _____
Jim T. Brown, General Manager

ATTEST:

_____
T. Beck Gipson

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## B.6 Geology Report

The following pages include the Report of Findings developed by the Geologist as part of this report.

Report of Findings: WRGS 13-010

# Report of Findings
# Eastern Kerr County/Western Kendall County Regional Water System Project - Geology Section

for:

Cow Creek Groundwater Conservation District
201 E. San Antonio Ave., Suite 100
Boerne, Texas 78006

Headwaters Groundwater Conservation District
125 Lehmann Dr., Suite 102
Kerrville, Texas 78028


**Wet Rock Groundwater Services, L.L.C.**
Groundwater Specialists
TBPG Firm No: 50038
311 Ranch Road 620 South, Suite 103
Austin, TX 78734 Ph: 512.773.3226
www.wetrockgs.com

REPORT OF FINDINGS
WRGS 13-010

# Eastern Kerr County/Western Kendall County Regional Water System Project – Geology Section

*for*

Cow Creek Groundwater Conservation District
201 E. San Antonio Ave., Suite 100
Boerne, Texas 78006

Headwaters Groundwater Conservation District
125 Lehmann Dr., Suite 102
Kerrville, Texas 78028

Kerr and Kendall Counties, Texas
December 2013

WRGS Project No. 055/072-003-13

**Wet Rock Groundwater Services, L.L.C.**
*Groundwater Specialists*
311 Ranch Road 620 South, Suite 103
Austin, Texas 78734
Phone: 512-773-3226 • www.wetrockgs.com
TBPG Firm No: 50038

The seal appearing on this document was authorized by Kaveh Khorzad, P.G. 1126 on December 18, 2013.


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## Section I: Executive Summary

The Texas Water Development Board has awarded a grant to develop a regional solution to water needs in Kerr and Kendall counties. As a part of the larger grant study, this report describes the geology of the study area which encompasses Eastern Kerr/Western Kendall counties. The goal of this study is to provide a preliminary review of the Lower Trinity Aquifer as a potential target for a regional Aquifer Storage and Recovery project as well as utilizing the Ellenburger Aquifer as an alternative source of water for the area.

The Eastern Kerr/Western Kendall area is located south of the Llano Uplift; an area marked by the uplift of Precambrian igneous granites and metamorphic rocks forming a gentle dome surrounded by Cretaceous aged limestone. The area is structurally complex with extensive faulting and contains three minor aquifers (The Hickory Sandstone, Ellenburger-San Saba and Marble Falls aquifers) and two major aquifers (Trinity and Edwards-Trinity aquifers). The Middle Trinity Aquifer has historically been the primary groundwater source for the area. To a lesser extent the Edwards-Trinity Aquifer and the Lower Trinity Aquifer have also provided water to domestic and stock wells. These aquifers make up a thick and regionally extensive aquifer system composed of Cretaceous aged carbonates that were deposited throughout central Texas.

Structurally, the area is dominated by the Llano Uplift, a structural dome of Precambrian igneous granitic pluton that was uplifted during the Ouachita Orogeny causing the surrounding Paleozoic aged rocks to fold and uplift. Another major structural feature that impacts the study area is the Fredericksburg High.

As part of this study the elevations to the top of the Upper Glen Rose, Lower Glen Rose, Hensell, Hosston (top and bottom) and the Ellenburger were determined based upon electric logs of wells drilled within the study area and outside of the study area within Bandera County. In addition, north-south, east-west and downdip (northwest-southeast) cross sections were developed.

Electric logs of water wells were provided by the Headwaters Groundwater Conservation District (HGCD), the Cow Creek Groundwater Conservation District (CCGCD) and GeoCam, Inc. The majority of the water well electric logs were of wells completed to the base of the Middle Trinity Aquifer and in some cases to the top of the Ellenburger Group. Gamma, spontaneous potential (SP), single point resistivity, 4-point resistivity, conductivity and caliper logs were included in electric logs conducted on the water wells. In addition, electric logs of oil and gas wells were obtained through the Railroad Commission of Texas (RRC) for wells completed to at least the top of the Ellenburger Group. The logs contained in most cases a resistivity and SP curve; in other logs gamma and density logs were included.

The elevation of the top of the Ellenburger Group ranges from a high of 1,272 feet MSL within the northern portion of the study area in Kerr County to a low of -3,173 feet MSL just southwest of the study area. Structural features such as Paleozoic faults and the Fredericksburg High affect the total depth to the Ellenburger Group. The Fredericksburg High, located approximately NE to SW along the eastern portion of the study area, has pushed up the Ellenburger Group causing it to be encountered at shallower elevations.

The need for additional water supply to the Eastern Kerr/Western Kendall area has been documented through the regional water planning process. To be able to meet projected water demand and to allow for diversification of the area's water resources, stakeholders have identified alternative groundwater sources such as the Ellenburger Aquifer and ASR using the Lower Trinity Aquifer. Based upon the electric logs, the depth to the top of the Ellenburger Group varies greatly from north to south going downdip and within the Fredericksburg High. The electric logs of three wells analyzed as part of this study (HGCD MW3, HGCD MW 14 and Q-17 (Kendall County) have encountered the Ellenburger Group at a shallower than expected depth potentially due to the Fredericksburg High. Test well locations updip within the northern 1/3 section of the study area and/or within the Fredericksburg High would provide the best opportunity for further study and evaluation.

The Lower Trinity is composed of the Hosston Sand and its thickness varies within the study area between 87 feet at well Q-7 (Kendall County) and 272 feet thick at well Q-2 (Kendall County). It is also nonexistent at wells Q-17 (Kendall), HGCD MW 3 and HGCD MW 14, possibly due to the Fredericksburg High. Within the Lower Trinity Aquifer further study should concentrate around areas where the Hosston Sand produces at larger production rates and thereby has higher transmissivities in addition to areas where the Hosston is thicker. Based upon the data collected in this study, the Hosston is thickest at wells further away from the Fredericksburg High and downdip within the aquifer near the southern boundary of the study area. This includes the area northwest of the City of Boerne, within the City of Kerrville and southeast of the City of Kerrville near the Bandera County line.

## Section II: Introduction

The Texas Water Development Board (TWDB) awarded a grant to Kerr County, Kendall County, Upper Guadalupe River Authority (UGRA), Guadalupe-Blanco River Authority (GBRA), Headwaters Groundwater Conservation District (HGCD), Cow Creek Groundwater Conservation District (CCGCD) and the Kendall County Water Control and Improvement District (KCGWCID) #1 to develop a regional solution to water needs in Kerr and Kendall counties.

As a part of the larger grant study, this report details the geology of the Eastern Kerr/Western Kendall counties area and in particular, the Lower Trinity and the Ellenburger aquifers. This geologic investigation provides a preliminary review for the potential of using the Lower Trinity Aquifer for a regional Aquifer Storage and Recovery (ASR) project and the Ellenburger Aquifer as an alternative source of water for the area. Figure 1 provides a location map showing the study area.

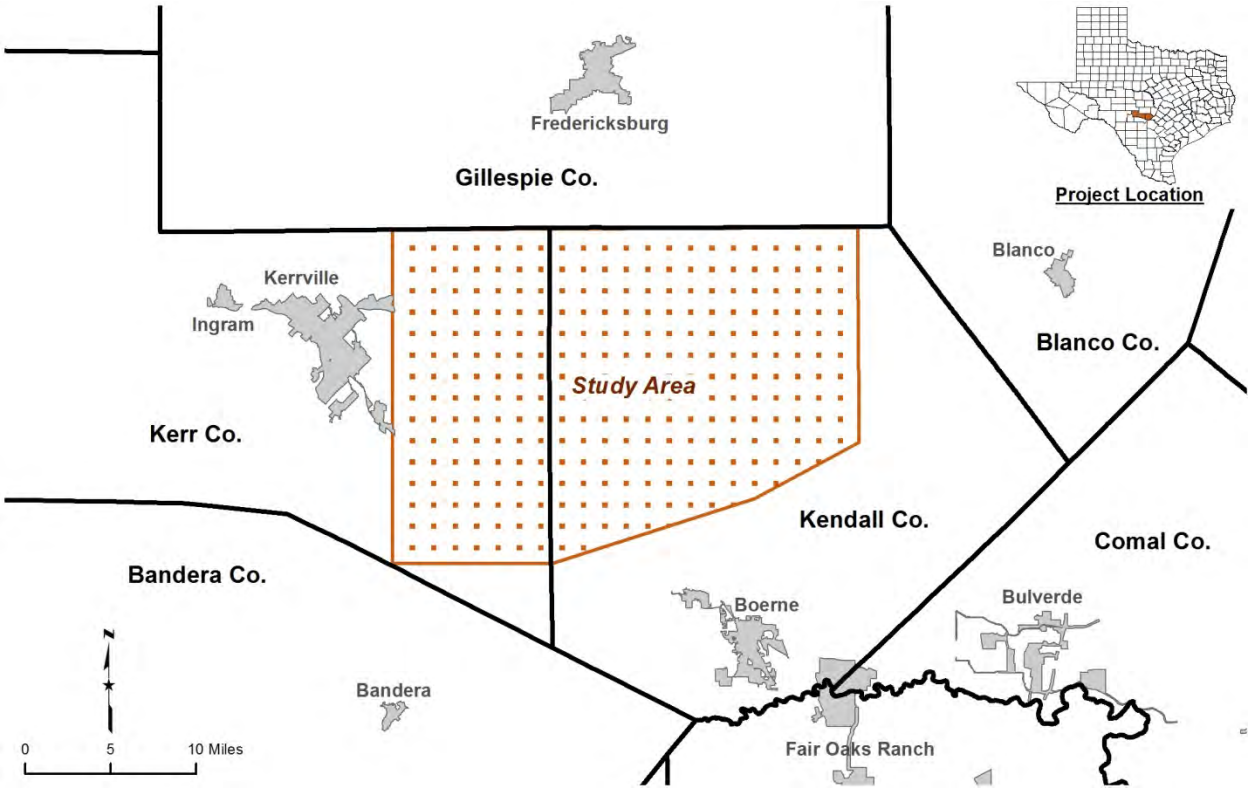


**Figure 1: Location map of the study area**

The objectives of this report are to:

1. Provide a regional geologic summary which describes the stratigraphic units and overall structure of the study area;

2. Analyze geophysical logs to delineate the following: Edwards Group (Segovia and Fort Terrett), Upper and Lower Glen Rose Limestone, Hensell Sand, Hammett Shale, Hosston, Pennsylvanian aged deposits and the Ellenburger Group;

3. Develop individual maps showing the elevation to the top of the various formations in the study area;

4. Develop a north-south, east-west and downdip (northwest-southeast) cross section of the study area; and

5. Provide a description of the methodology used to determine the formational elevations and based upon findings, recommend locations within the study area that warrant further investigation within the Ellenburger Aquifer and ASR within the Lower Trinity Aquifer.

## Section III: Geology of the Study Area

### III.1. Introduction

The Eastern Kerr/Western Kendall area is located south of the Llano Uplift; an area marked by the uplift of Precambrian igneous granites and metamorphic rocks forming a gentle dome surrounded by Cretaceous aged limestone. The area is structurally complex with extensive faulting and contains three minor aquifer (The Hickory Sandstone, Ellenburger-San Saba and Marble Falls aquifers) and two major aquifers (Trinity and Edwards-Trinity aquifers).

The Middle Trinity Aquifer has historically been the primary groundwater source for the area. To a lesser extent the Edwards-Trinity Aquifer and the Lower Trinity Aquifer have also provided water to domestic and stock wells. These aquifers make up a thick and regionally extensive aquifer system composed of Cretaceous aged carbonates that were deposited throughout central Texas.

### III.2. Stratigraphic Units of the Eastern Kerr/Western Kendall Area

Figure 2 provides the geologic and hydrogeologic units found within the study area with the oldest units located at the bottom and progressively younger units moving upward.

#### *III.2.1 Precambrian*

Precambrian aged gneiss (Valley Spring Gneiss, Lost Creek Gneiss), schist (Packsaddle Schist) and granites (Town Mountain Granite) form the basement within the Llano Uplift area. The age of these Precambrian rocks is up to approximately 1.36 billion years old (Reese, et. al, 2000). Much of the metamorphosis including compression and folding of the rocks are known to occur as far back as 1.2 billion years ago (Roback et. al., 1999) with fracturing of the rock occurring in multiple orientations (Johnson, 2004). The surface of the Precambrian rocks was eroded and during the Cambrian with the Hickory Sandstone deposited on top under fluvial conditions. The thickness of the Hickory is dependent upon the erosional surface of the Precambrian basement rocks (Krause, 1996).

#### *III.2.2 Cambrian System (Moore Hollow Group)*

Located above the Precambrian basement is the Riley and Wilberns formations of the Moore Hollow Group. The Riley Formation consists of from oldest to youngest, the Hickory, Cap Mountain and Lion Mountain Members.

The Hickory Sandstone is a white, yellow, or reddish brown cross-bedded quartz sandstone deposited predominately within shallow seas (Preston, et. al., 1996) on top of an irregular erosional surface of the Precambrian. The Hickory can be up to 530 feet at its thickest where the more erodible Precambrian Packsaddle Schist, Valley Spring Gneiss and granites formed lowland areas (Barnes and Bell, 1977) and encircles the Llano Uplift where it becomes thicker radially outward.

Barnes and Bell (1977) divided the Hickory into three sections; the basal section consists of thick massive beds with rounded to sub-rounded poorly sorted sand with some conglomerates near the base. The middle section consists of thin beds of sandstone with silty and micaceous layers interbedded.

<table>
<tr><th>ERA</th><th>System</th><th>Group</th><th>Formation</th><th>Member</th><th>Hydrologic Unit</th></tr>
<tr><td rowspan="8">Mesozoic</td><td rowspan="8">Cretaceous</td><td rowspan="2">Fredricksburg</td><td rowspan="2">Edwards</td><td>Segovia</td><td>Edwards Plateau Aquifer</td></tr>
<tr><td>Fort Terrett</td><td>Confining Bed</td></tr>
<tr><td rowspan="6">Trinity</td><td rowspan="2">Glen Rose</td><td>Upper Unit</td><td>Upper Trinity Aquifer</td></tr>
<tr><td>Lower Unit</td><td rowspan="3">Middle Trinity Aquifer</td></tr>
<tr><td rowspan="4">Travis Peak</td><td>Hensell / Bexar</td></tr>
<tr><td>Cow Creek</td></tr>
<tr><td>Hammett</td><td>Confining Bed</td></tr>
<tr><td>Sligo / Hosston</td><td>Lower Trinity Aquifer</td></tr>
<tr><td rowspan="11">Paleozoic</td><td rowspan="3">Pennsylvanian</td><td>Canyon</td><td>undifferentiated</td><td>undifferentiated</td><td rowspan="2">Confining Bed</td></tr>
<tr><td rowspan="2">Bend</td><td>Smithwick</td><td>undifferentiated</td></tr>
<tr><td>Marble Falls Limestone</td><td>Upper Unit</td><td rowspan="2">Marble Falls Aquifer</td></tr>
<tr><td colspan="4">Devonian & Mississippian (undifferentiated) where present</td><td>Lower Unit</td></tr>
<tr><td colspan="4"></td><td>Confining Bed</td></tr>
<tr><td rowspan="4">Ordovician</td><td rowspan="4">Ellenburger</td><td>Honeycut</td><td>undifferentiated</td><td rowspan="6">Ellenburger-San Saba Aquifer</td></tr>
<tr><td>Gorman</td><td>undifferentiated</td></tr>
<tr><td rowspan="2">Tanyard</td><td>Staendebach</td></tr>
<tr><td>Threadgill</td></tr>
<tr><td rowspan="7">Cambrian</td><td rowspan="7">Moore Hollow</td><td rowspan="4">Wilberns</td><td>San Saba</td></tr>
<tr><td>Point Peak</td><td rowspan="2">Confining Bed</td></tr>
<tr><td>Morgan Creek</td></tr>
<tr><td>Welge</td><td rowspan="2">Mid-Cambrian Aquifer</td></tr>
<tr><td rowspan="3">Riley</td><td>Lion Mountain</td></tr>
<tr><td>Camp Mountain</td><td>Confining Bed</td></tr>
<tr><td>Hickory</td><td>Hickory Aquifer</td></tr>
<tr><td colspan="6">Precambrian Base</td></tr>
</table>

***Sources: TWDB Numbered Report 339 (Bluntzer, 1992), TWDB Report: Llano Uplift Aquifers Structure and Stratigraphy (Standen & Ruggiero, 2007)***

**Figure 2: Geologic and hydrogeologic units within the Eastern Kerr/Western Kendall area**

The upper section is a distinctive red, hematite cemented, medium to coarse grained sandstone with well rounded grains. The upper section of the Hickory contains large amounts of iron (hematite) owing to its reddish color and has a gradational contact with the overlying Cap Mountain limestone where it can contain some lime rich sandstone (Preston, et. al., 1996). The sandstone grains within the Hickory are typically well rounded especially at the upper section where the sandstone is coated in iron oxide (Barnes and Bell, 1977).

The Hickory Sandstone is considered a minor Aquifer by the Texas Water Development Board (TWDB). The TWDB defines a major aquifer as an aquifer that produces large amounts of water over large areas and a minor aquifers as an aquifer that produces minor amounts of water over large areas or large amounts of water over small areas. The Hickory Aquifer produces moderate to large amounts of water to areas within the Llano Uplift. The aquifer contains some minerals that were deposited with the quartz sandstone that are a source of elevated radium concentration in groundwater produces in some areas of the aquifer.

The Cap Mountain Limestone of the Riley Formation is located unconformably above the Hickory and consists of thinly bedded limestone with moderate amounts of sand in the basal section where the contact with the Hickory Sandstone is gradational. The Cap Mountain grades upward into thicker beds of siltstone, silty limestone and limestone (Preston et. al., 1996) and is thinnest near the Llano Uplift where it thickens radially up to 650 feet (Preston et. al., 1996). The Cap Mountain is considered an aquitard or confining unit.

The Lion Mountain Sandstone is the uppermost Member of the Riley Formation and is composed of thin beds of glaconitic quartz sandstone, quartzose greensand, sandy limestone, impure fossiliferous limestone, crossbeds of trilobite coquinite and minor amounts of shale and siltstone (Barnes and Bell, 1977). The Lion Mountain ranges in thickness up to 85 feet (Preston et. al., 1996) and forms an unconformable boundary with the Welge Member of the Wilberns Formation. Both the Welge and Lion Mountain are hydraulically connected and together form the Mid-Cambrian Aquifer. The Mid-Cambrian Aquifer is considered a minor aquifer by the TWDB.

Located above the Riley Formation is the Wilberns Formation of the Moore Hollow Group. The Wilberns Formation consists of from oldest to youngest, the Welge, Morgan Creek, Point Peak and San Saba Members.

The Welge Sandstone is the lowermost member of the Wilberns Formation and is composed of thick beds of non-glauconitic sandstone (Barnes and Bell, 1977). The non-glauconitic Welge is distinguishable from the green glauconitic sandstone of the Lion Mountain and can vary in thickness from 5 feet to over 30 feet (Preston et. al., 1996).

The Morgan Creek Limestone of the Wilberns Formation is composed of coarse grained clastic limestone which is sandy at the base of the member with silty beds near the top (Barnes and Bell, 1977) and forms a gradational boundary between both the Welge beneath and the Point Peak above. The Morgan Creek is fossiliferous and varies in color; thicknesses of the Morgan Creek range from 90 to 190 feet (Preston et. al., 1996).

The Point Peak Shale together with the Morgan Creek Limestone form a confining layer separating the Mid-Cambrian Aquifer from the Ellenburger-San Saba Aquifer. The Point Peak is a siltstone at the base and increases in limestone content near the top where it forms a gradational contact with the San Saba Member. Thickness of the Point Peak Shale can range up to 220 feet thick (Preston et. al., 1996).

The youngest member of the Wilberns Formation is the San Saba Limestone. The San Saba is the thickest of the Wilberns Formation making up half of its thickness (Barnes and Bell, 1977). Depending upon the location, it is composed of limestone or dolomite varying with thick and thin beds. The upper portion of the San Saba is thought to be Ordovician in age because of Ordovician trilobites found within the San Saba (Barnes and Bell, 1977). The contact with the above lying Threadgill Member of the Tanyard Formation is conformable and shows evidence of continuous deposition across the Cambrian – Ordovician time (Barnes and Bell, 1977). The San Saba varies in thickness from 250 feet to 850 feet (Preston et. al., 1996) and together with the Ellenburger Group forms the Ellenburger-San Saba Aquifer.

### *III.2.3 Ordovician System (Ellenburger Group)*

Located above the Cambrian Moore Hollow Group is the Ordovician Ellenburger Group which consists of from oldest to youngest, the Tanyard, Gorman and Honeycut formations. Together these formations form the Ellenburger Aquifer.

The Tanyard Formation is the lower most formation of the Ellenburger Group and consists of the Threadgill and Staendebach members. The Tanyard ranges in thickness from 475 feet to 730 feet thinning westward (Preston et. al., 1996). The Threadgill Member is a limestone but also can be dolomitic and consists of thinly bedded to massive limestone and both coarse and fine grained dolomite (Barnes and Bell, 1977). Overlying the Threadgill is the Staendebach Member, which typically is near 300 feet in thickness but can range from 229 feet up to 456 feet (Barnes and Bell, 1977). The Staendebach is composed of both limestone and very fine grained dolomite and typically contains chert nodules within the limestone and dolomite beds (Barnes and Bell, 1977). Above the Tanyard Formation lies the Gorman and Honeycut formations which in total comprise the Ellenburger Group. Both the Gorman and Honeycut are limestone and dolomite in composition and are undifferentiated. The Ellenburger – San Saba Aquifer is considered a minor aquifer by the TWDB with a thickness that ranges up to 2,400 feet.

Figure 3 provides the elevation to the top of the Ellenburger Group taken from electric logs of wells within Eastern Kerr, Western Kendall and Northern Bandera counties. In addition, the location of Paleozoic faults taken from Standen and Ruggiero (2007) and Ewing (1991) are shown. Of the 30 electric logs obtained within the study area, 12 were logged to the top of the Ellenburger Group. The data are sparse, however Figure 3 provides elevations to the top of the Ellenburger Group in different portions of the study area. The elevation ranges from a high of 1,272 feet above Mean Sea Level (MSL) within the northern portion of the study area in Kerr County to a low of -3,173 feet MSL just southwest of the study area.

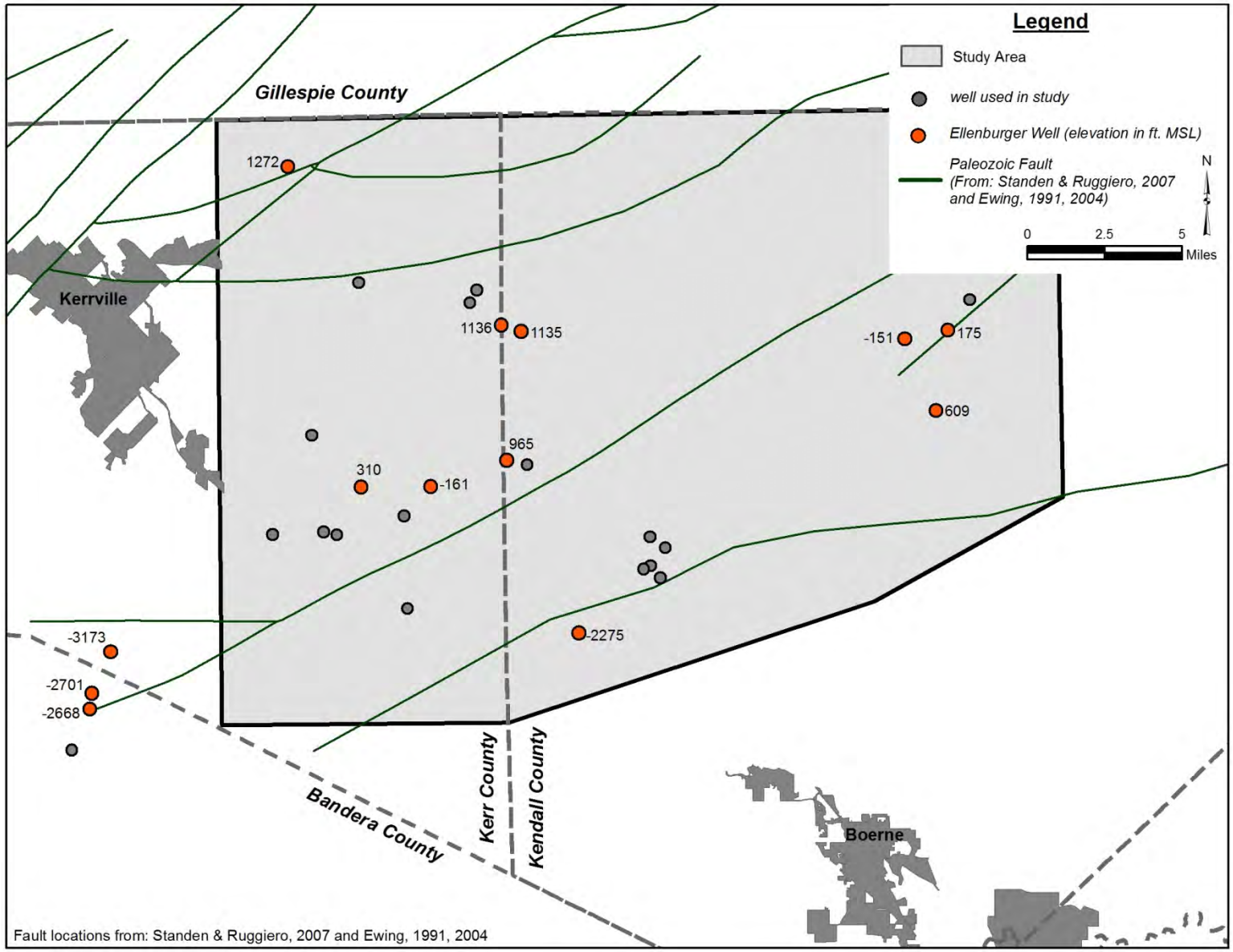


**Figure 3: Elevation to the top of the Ellenburger Group**

### *III.2.4 Devonian and Mississippian Systems*

Devonian and Mississippian formations are generally thin, not deposited or have been eroded away (Standen and Ruggiero, 2007; Preston et. al., 1996) and are not discussed within this study. These formations where present act as a confining bed.

### *III.2.5 Pennsylvanian System (Bend and Canyon Groups)*

The Pennsylvanian System contains from oldest to youngest, the Bend Group consisting of the Marble Falls and Smithwick formations and the undifferentiated Canyon Group.

The Marble Falls Limestone is separated into a lower unit and upper unit with a total thickness that ranges up to 460 feet (Preston et. al., 1996). The lower unit consists of a massive very fine grained limestone reef with thin shale beds in the lower section of the lower unit. The lower unit lies unconformably above the Ellenburger Group and where present Devonian and Mississippian formations (Preston et. al., 1996). The upper unit contains very fine grained limestone with varying bed thickness and fossiliferous chert nodules (Preston et. al., 1996). The Marble Falls Limestone forms the Marble Falls Aquifer which is considered a minor aquifer. The aquifer occurs in separated sections north of the Llano Uplift and east within Burnet and Blanco counties.

The Smithwick Shale lies unconformably above the Marble Falls Limestone and can range in thickness from 300 to 500 feet (Preston et. al., 1996). The Smithwick is comprised of claystone, siltstone and some sandstone (Preston et. al., 1996) and together with the Bend Group acts as an aquitard or confining bed separating the Marble Falls Aquifer from the Lower Trinity Aquifer. When drilling an open borehole using air rotary drilling through the Smithwick the formation will tend to slough into the borehole making it difficult to keep open.

The Canyon Group of the Pennsylvanian System ranges in thickness up to 1,500 feet and is mostly comprised of interbedded limestone with shale and fine grained sandstone (Preston et. al., 1996).

### *III.2.6 Cretaceous System (Trinity and Fredericksburg Groups)*

A major unconformity separates the Pennsylvanian System from the much younger Cretaceous System. During the Cretaceous, shallow seas advanced and retreated over the region depositing the Trinity and Fredericksburg groups. From oldest to youngest, the Trinity Group is comprised of the Travis Peak Formation overlain by the Glen Rose Formation.

The Travis Peak Formation from oldest to youngest is divided into the Hosston/Sligo, Hammet, Cow Creek and Hensell/Bexar members. The Hosston consists of a conglomerate of gravel, sand and clay cemented by both calcite and quartz. The Hosston also contains sections of sandstone, siltstone, claystone, dolomite, limestone and shale. Within the study area, the Sligo Limestone is not present; the Hosston varies in color from red and white to gray.

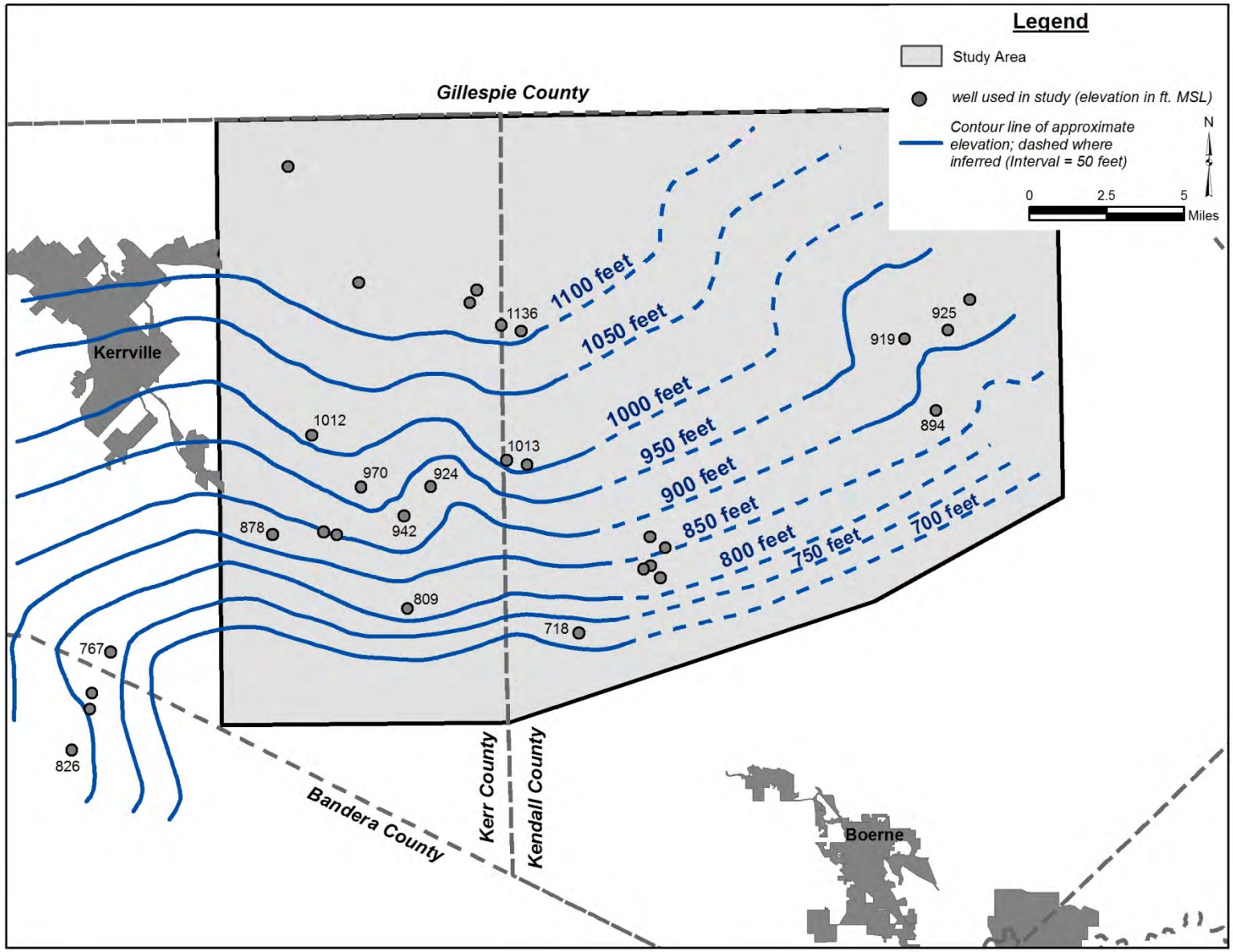


**Figure 4: Elevation to the base of the Hosston Member**

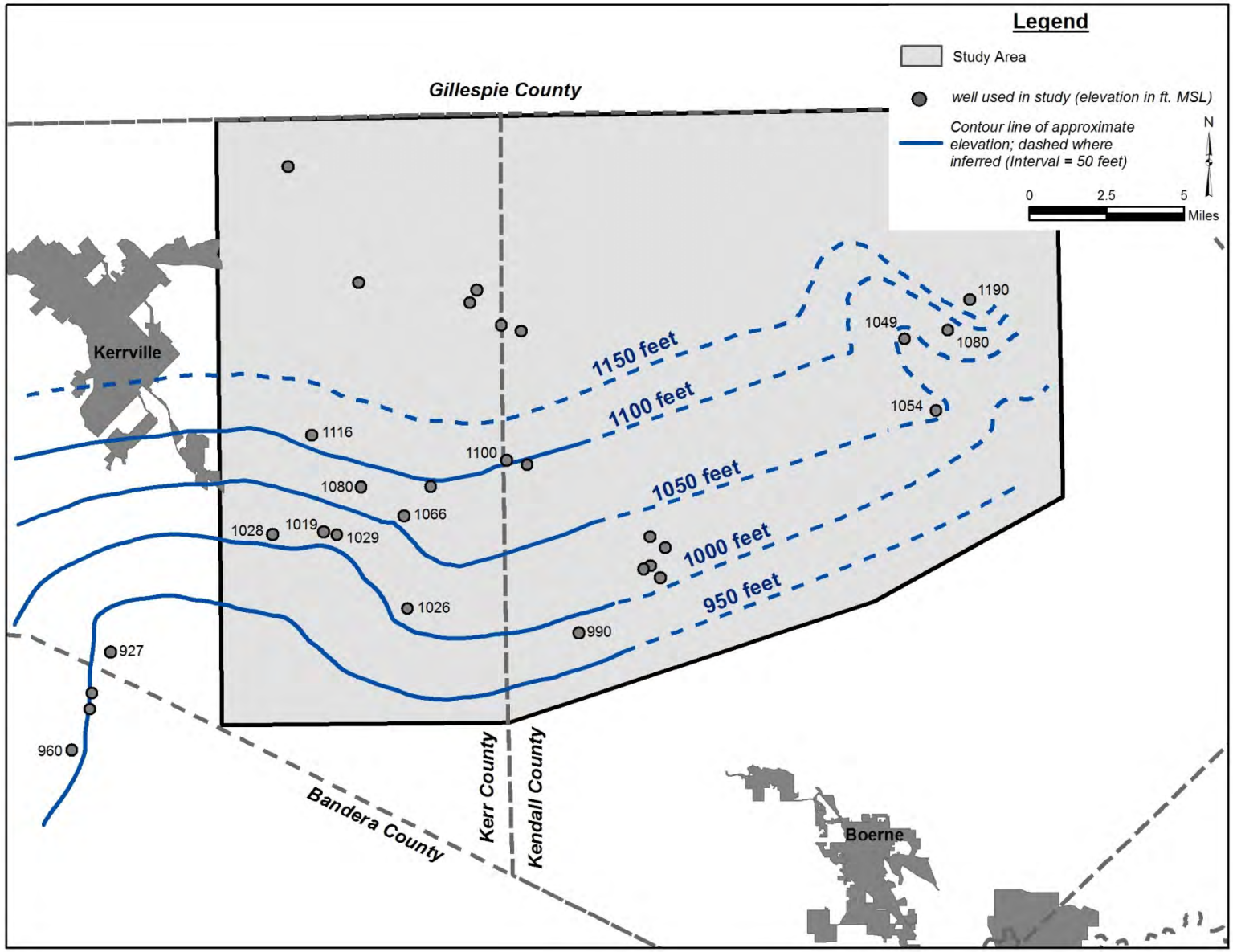


**Figure 5: Elevation to the top of the Hosston Member**

Figure 4 and Figure 5 provide a contour map of the elevations to the base and top of the Hosston Member which forms the Lower Trinity Aquifer within the study area. As the name suggests, the Trinity Aquifer is a grouping of three aquifers, the Upper, Middle and Lower Trinity. The Lower Trinity Aquifer within the study area is relatively less produced than the more prolific Middle Trinity Aquifer. Located at greater depths, a well completed within the Lower Trinity Aquifer involves greater cost due to the necessity of sealing off the Hammett Clay via casing and cement. The Hammett Clay is located above the Lower Trinity Aquifer and is a heavily sloughing formation which causes difficulty in keeping the well bore open. Within the study area, well yields within the Lower Trinity Aquifer are generally less than 50 gpm however, there are localized areas within the City of Kerrville where Lower Trinity Wells produce in excess of 500 gpm.

Located stratigraphically above the Hosston Sand is the Hammett Clay Member or also known by some as the Pine Island Shale. The Hammett Clay ranges in thickness up to approximately 60 feet within the study area; it is clay rich with some thin limestone beds that form a gradational contact with the Hosston. Color can be dark gray to black, blue, greenish gray and gray. The Hammett is a confining bed separating the Lower Trinity Aquifer from the Middle Trinity Aquifer.

The Cow Creek Limestone Member of the Travis Peak Formation is a massive, fossiliferous limestone and dolomite which contains some interbeds of sand, clay, and evaporite minerals such as gypsum and anhydrite (Preston et. al., 1996). The Cow Creek Limestone can range in thickness up to approximately 80 feet and is typically yellow to gray in color. Based upon drill cuttings from wells completed to the top of the Hammett Clay and from driller's logs within the study area, the Cow Creek Limestone appears to pinch out and is not observed within the study area. The Cow Creek Limestone forms part of the Middle Trinity Aquifer along with the Hensell Sand/Bexar Shale, and the Lower Glen Rose Limestone. It is heavily fractured in some locations and provides large well yields where encountered. The gypsum and anhydrite layers found within some areas of the Cow Creek can be a source of elevated sulfate concentration in wells.

The Hensell Sand Member of the Travis Peak Formation is composed of sand, silt, clay, sandstone conglomerate and thin beds of limestone (Preston et. al., 1996); within the study area, the Hensell Sand is predominately a fine to medium quartz sand. Further south of the study area, the Hensell grades into the Bexar Shale Member which is composed of thin beds of shaley limestone, dolomite and calcareous shale. Within the study area the Hensell Sand is found beneath the Lower Glen Rose and above the Hammett Clay. The Hensell, along with the Lower Glen Rose forms the Middle Trinity Aquifer. Much of the larger yielding Middle Trinity wells produce the majority of their water through the Hensell Sand. Figure 6 provides a contour map of the elevation of the top of the Hensell Sand Member of the Travis Peak Formation within the study area determined from electric logs.

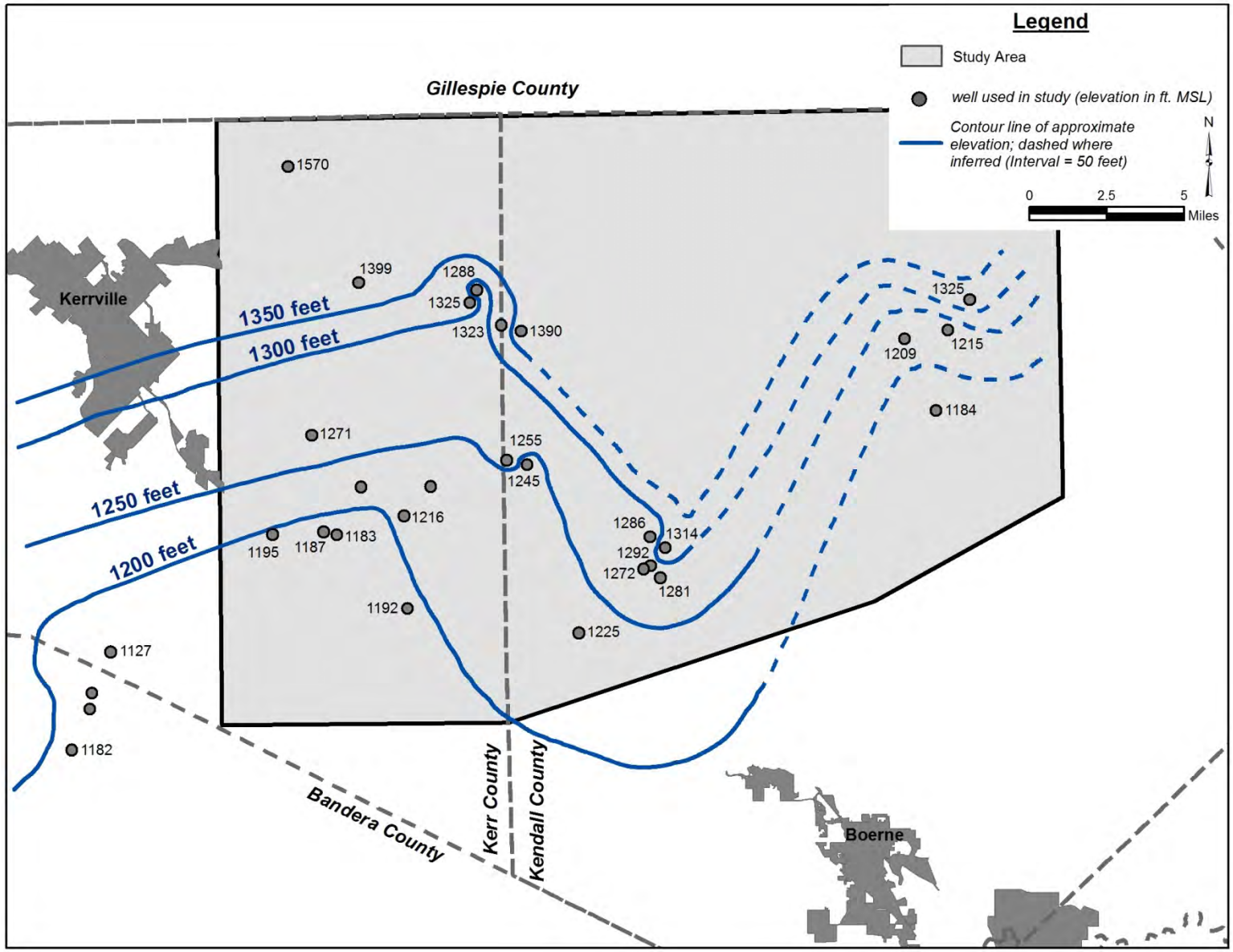


**Figure 6: Elevation to the top of the Hensell Sand Member**

The Glen Rose Limestone is divided into a Lower and Upper Member; the separation between the two units is marked by the presence of a fossil marker bed called the Corbula Bed. The Corbula bed is a heavily fossiliferous layer that contains the small fossil clam called *Corbula martinae*. The separation between the two units is also distinguishable on electric logs where two distinct evaporite zones are found within the Upper Glen Rose; one midway through the Upper Glen Rose and another near the base shown by resistivity spikes on the electric log. The basal section of the Lower Glen Rose contains massive limestone beds with various degree of fracturing grading up into thinner beds of alternating marly, limestone and dolomite. Near the top of the Lower Glen Rose in some locations is a reef deposit which can range up to 40 feet in thickness that is cavernous and heavily fractured. Where the reef deposit is encountered, the Lower Glen Rose provides high yielding wells with rates exceeding 1,000 gpm. Figure 7 provides a contour map of the elevation of the top of the Lower Glen Rose based upon an analyses of electric logs.

The Cow Creek, Hensell/Bexar Shale and the Lower Glen Rose Members form the Middle Trinity Aquifer. The Middle Trinity Aquifer provides the primary source of groundwater to the study area with some well yields near 1,000 gpm.

The Upper Member of the Glen Rose Formation consists of alternating beds of limestone and dolomite with marly sections forming the characteristic stair step topography of the Upper Glen Rose. The Upper Glen Rose contains thinner beds of limestone and contains two distinct evaporite beds of gypsum or anhydrite which are the source of elevated sulfate concentrations in groundwater. The Upper Glen Rose Limestone forms the Upper Trinity Aquifer, which in some locations provides the primary source of water to stock and domestic wells. Figure 8 provides a contour map of the elevation to the top of the Upper Glen Rose based upon an analyses of electric logs.

Located above the Trinity Group is the Fredericksburg Group which consist of the Fort Terrett and Segovia Members. The Fort Terrett Member contains three sections with the bottom section comprised of a nodular limestone and marly clay (Preston et. al., 1996) which provides a confining bed separating the Upper Trinity Aquifer from the Edwards Plateau Aquifer. The middle section contains chert filled, fossiliferous limestone and dolomite (Preston et. al., 1996) and the upper section contains limestone with collapsed breccia and chert (Preston et. al., 1996).

Above the Fort Terrett stratigraphically lies the Segovia Member of the Fredericksburg Group. The Segovia is divided into a lower section which contains fossiliferous limestone and marly sections, a middle section containing vuggy chert filled dolomite with collapsed breccia and an upper section containing chert filled fossiliferous limestone (Preston et. al., 1996). The Segovia Member together with the middle and upper section of the Fort Terrett forms the Edwards Plateau Aquifer. Within the study area the Edwards Plateau provides groundwater to domestic and stock wells.

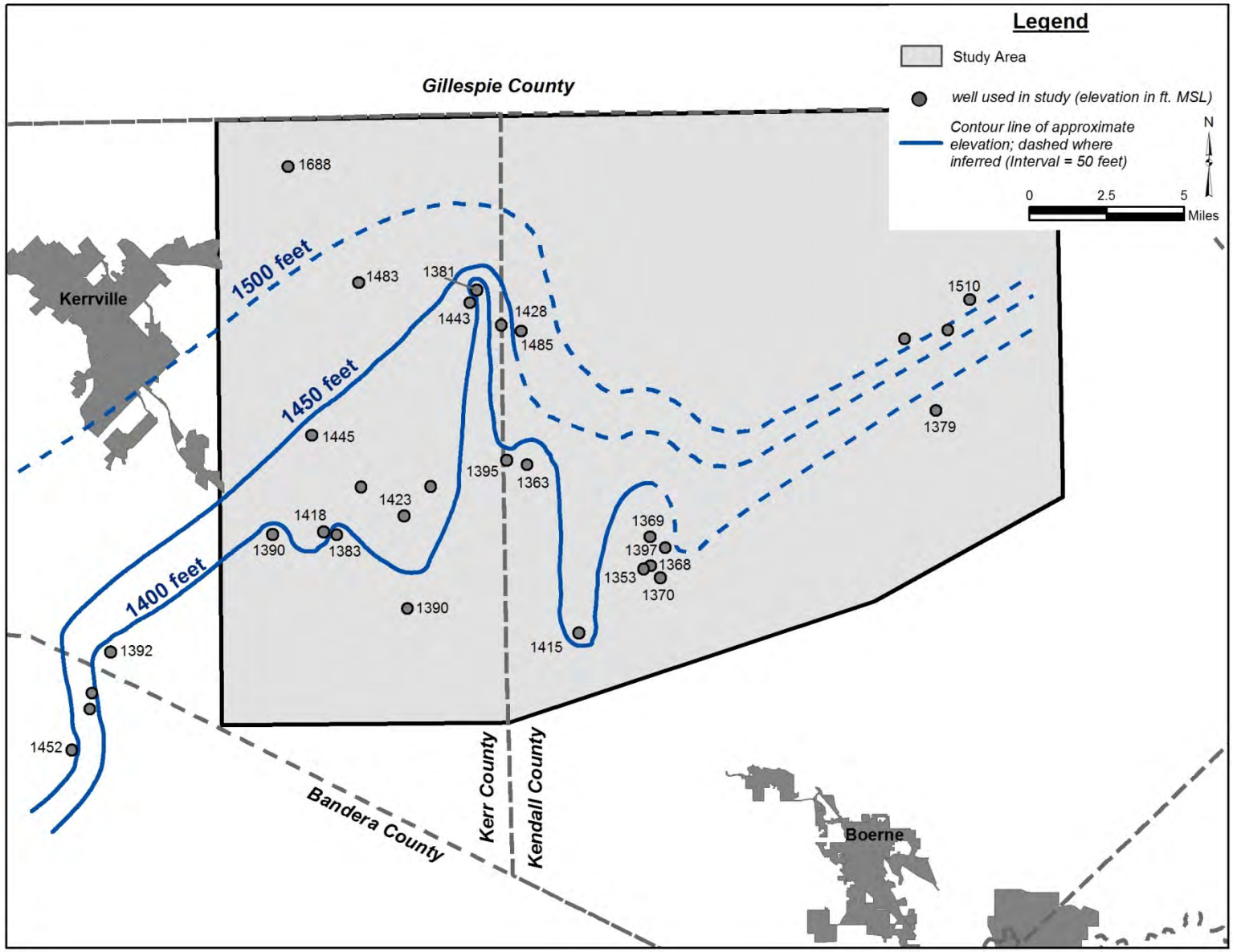


**Figure 7: Elevation to the top of the Lower Glen Rose**

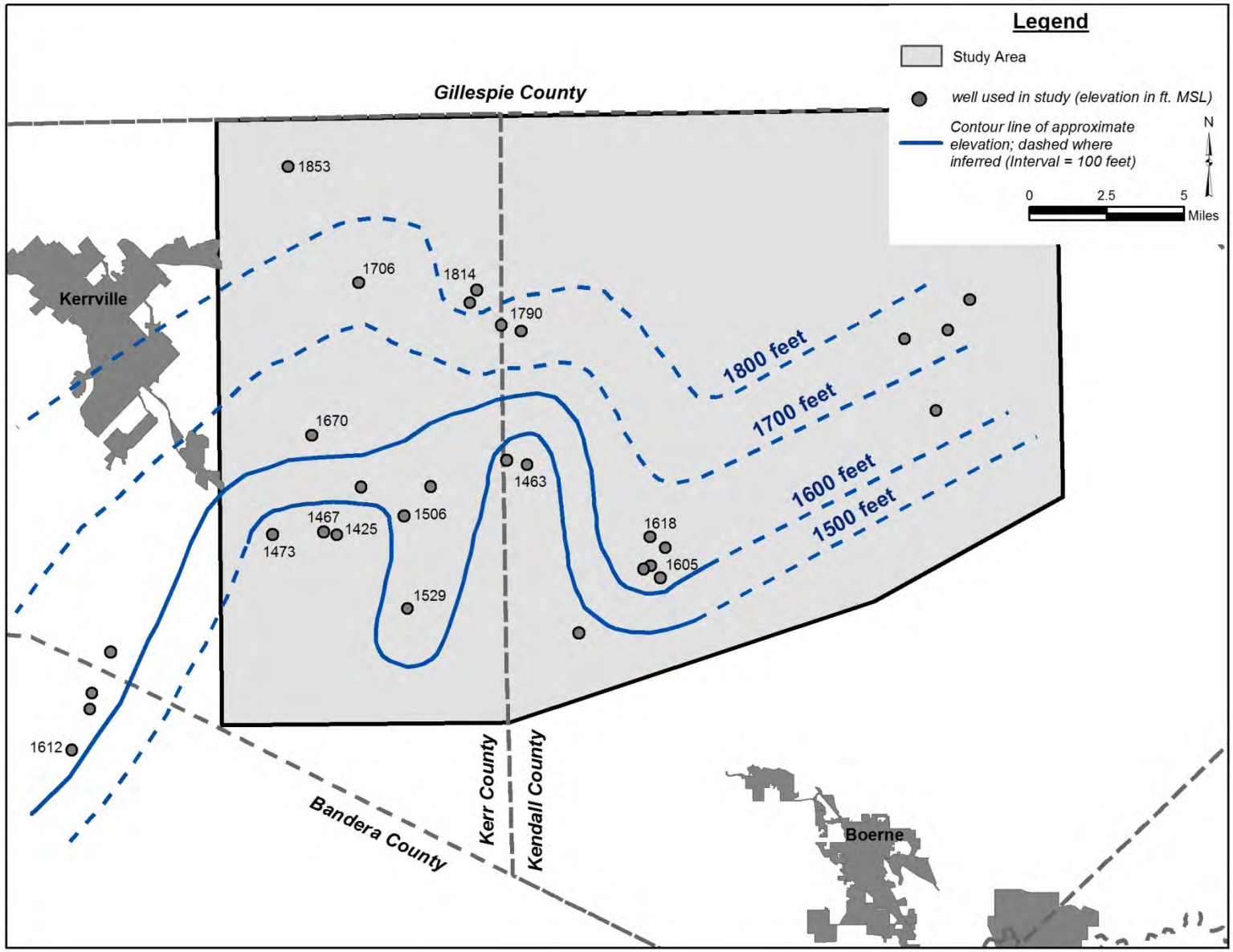


**Figure 8: Elevation to the top of the Upper Glen Rose**

## III.3. Structure

Structurally, the area is dominated by the Llano Uplift, a structural dome of Precambrian igneous granitic pluton that was uplifted during the Ouachita Orogeny causing the surrounding Paleozoic aged rocks to fold and uplift. The uplift, weathering, erosion and subsequent deposition of the igneous and metamorphic sediments from the Llano formed part of the Cretaceous sediments. Figure 9 provides a geologic map of the study area, the Llano Uplift area is shown by the pinkish colored formations shown in Llano and Mason counties. Figure 10 shows the location of three cross sections constructed based upon analyses of electric logs in and near the study area. Figures 11, 12 and 13 include cross sections across the study area.

Another major structural feature that impacts the study area is the Fredericksburg High. The Fredericksburg High is a narrow subsurface ridge of structurally high Precambrian and Paleozoic rocks (Bluntzer, 1992) underlying the Cretaceous Trinity Group that extends southwest from the Llano Uplift through Gillespie County and Eastern Kerr County into Bandera County. This structural features causes the Paleozoic aged rocks to be encountered at lower elevations; a good example is seen in electric logs of wells completed in the Eastern Kerr/Western Kendall County line specifically HGCD MW 3, HGCD MW 14, and Kendall County well Q-17 (Figure 10, 12 and 13). At these locations, the Pennsylvanian System has been eroded away leaving the Cretaceous formations to be deposited on top of the Ellenburger Group.

The overlying Cretaceous rocks exhibit gently dipping beds at approximately 100 feet per mile towards the southeast; below the Paleozoic rocks dip at significantly greater angles also towards the southeast between 400 and 900 feet per mile (Bluntzer, 1992). During the Late Paleozoic to Early Mesozoic faults occurred within the Paleozoic and Precambrian rocks which were subsequently covered by the Cretaceous rocks of the Trinity and Fredericksburg Groups (Bluntzer, 1992). Figure 9 shows the location of the Paleozoic faults taken from Standen and Ruggiero (2007) and Ewing (1991, 2004). The location of these faults by Standen and Ruggiero (2007) and Ewing (1991, 2004) were determined by interpretation of electric logs and other published and unpublished sources (Standen and Ruggiero, 2007). The majority of the Paleozoic faults are normal faults that are steeply dipping and strike northeast-southwest with displacement of formations on either side of the fault (Bluntzer, 1992). Fracture traces commonly mimic the orientation of the faults.

Further to the southeast of the study area the Balcones Fault Zone is seen in Figure 9 running across Hays, Comal, Bexar and Medina counties. The Balcones Fault Zone is a series of normal en echelon faults that trend in a general northeast-to-southwest direction. Faulting in the area associated with the Balcones Fault Zone has caused some rock units to be upthrown against others, creating both barriers to flow and conduits for water to pass through.

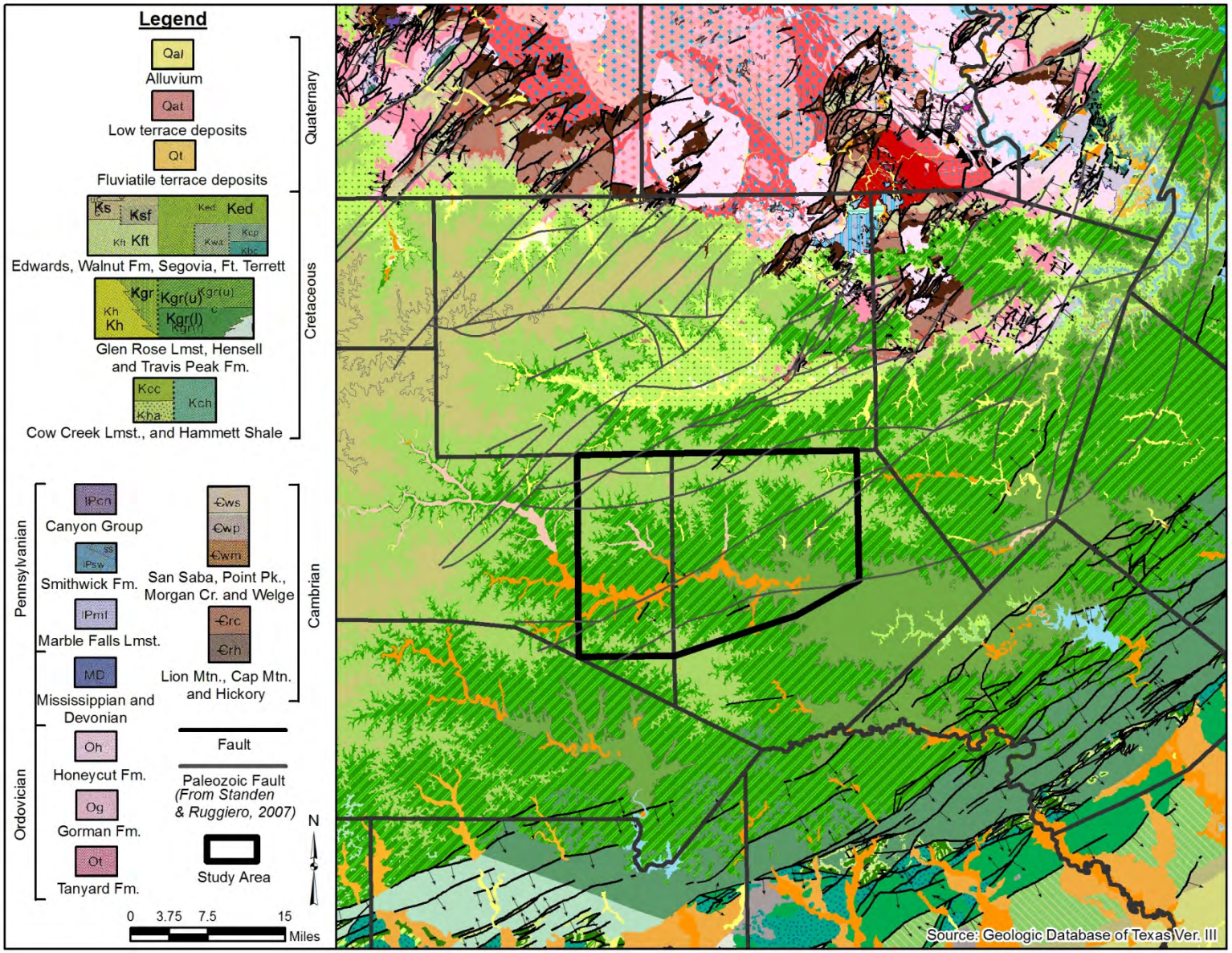


**Figure 9: Geologic map of study area**

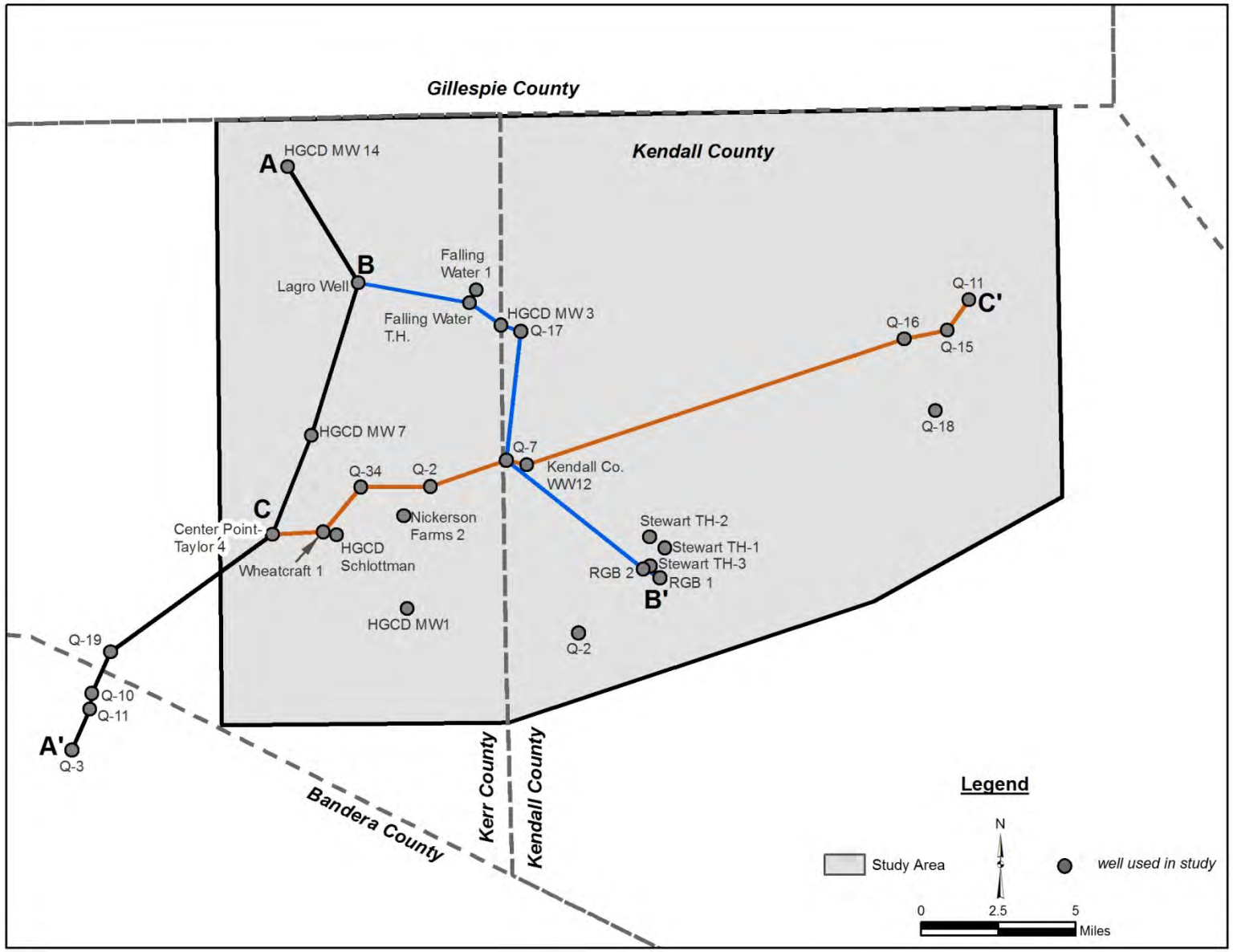


**Figure 10: Cross section location map**

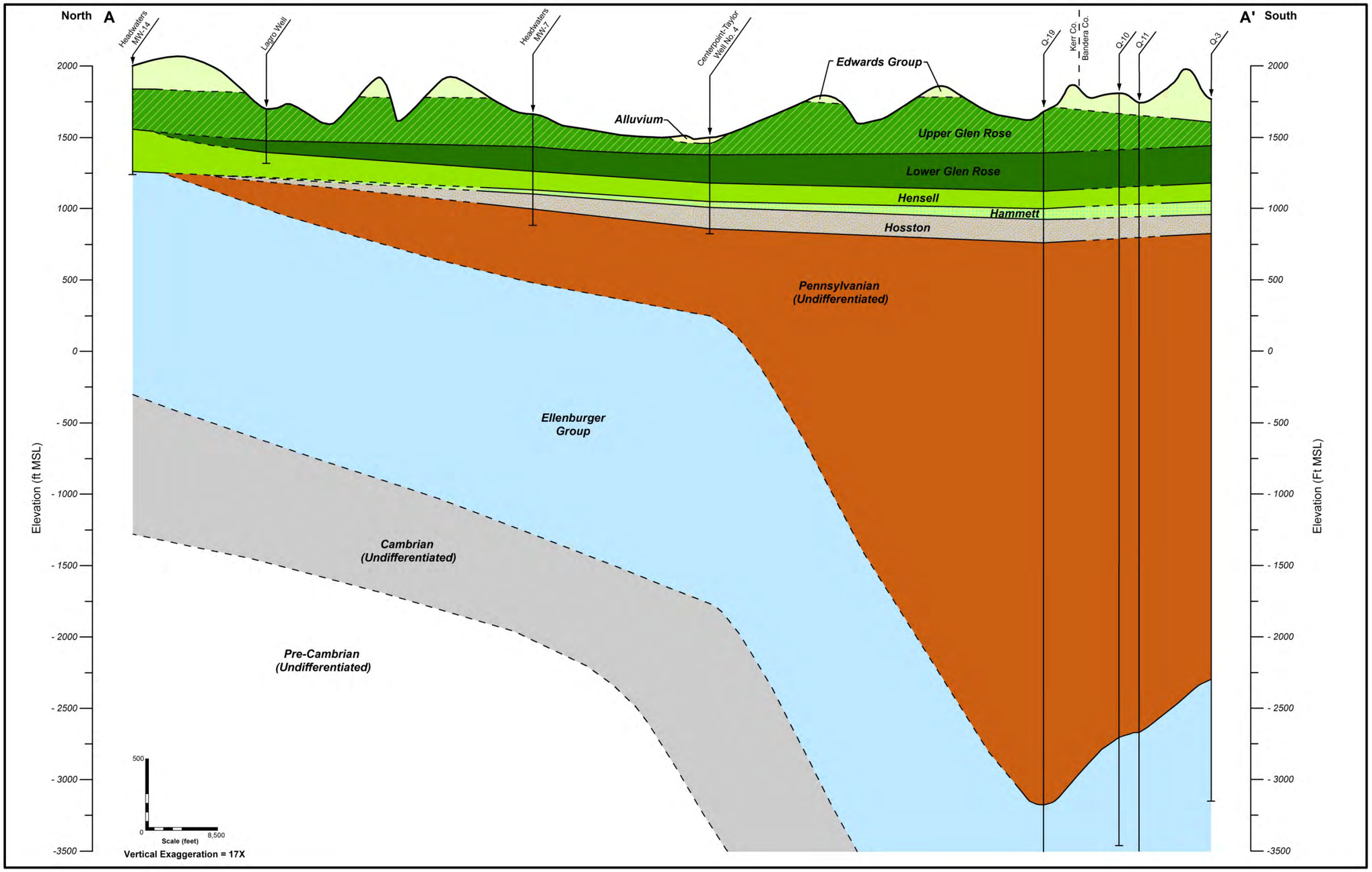


**Figure 11: Cross section A – A'**

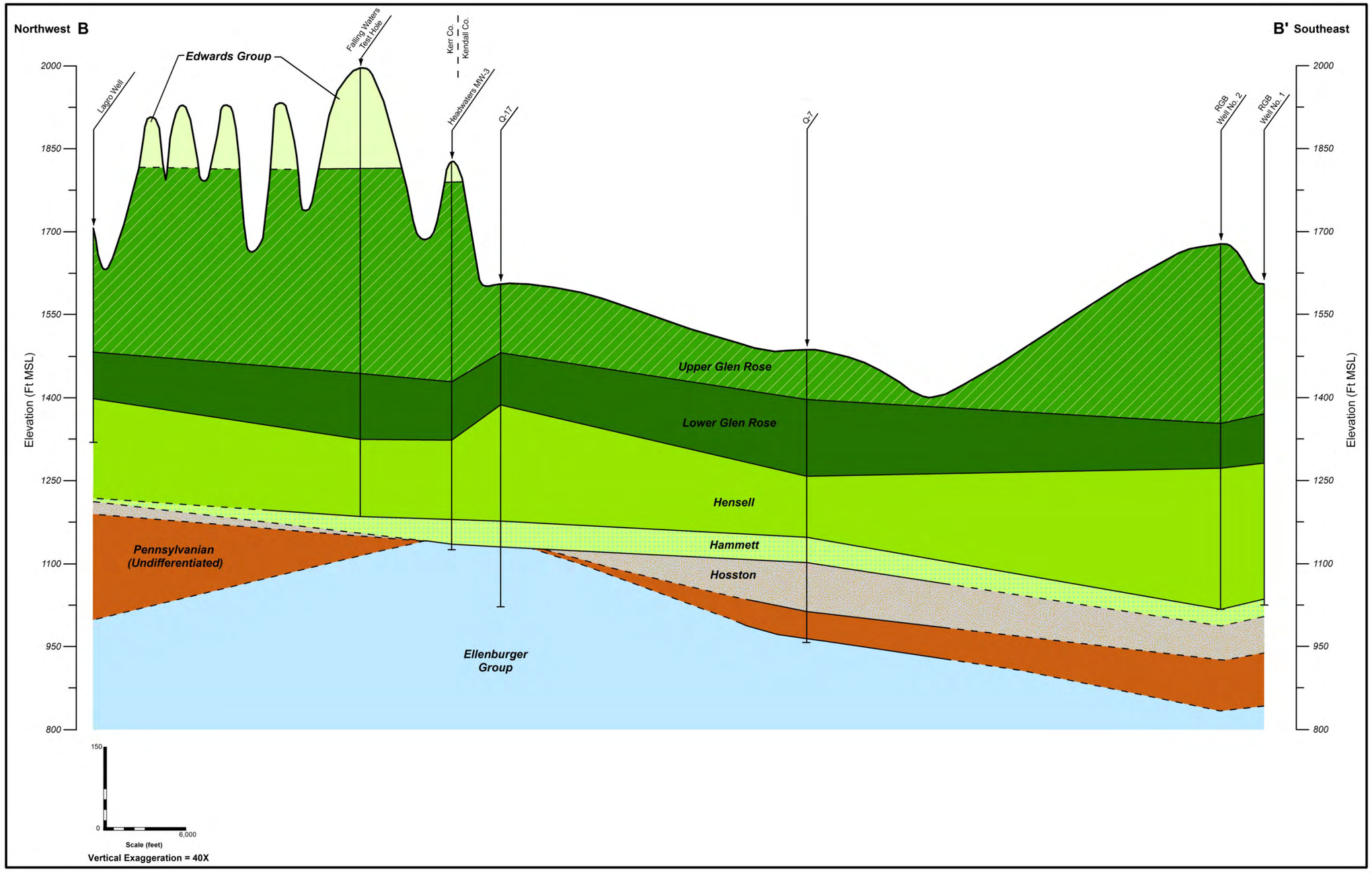


**Figure 12: Cross section B – B'**

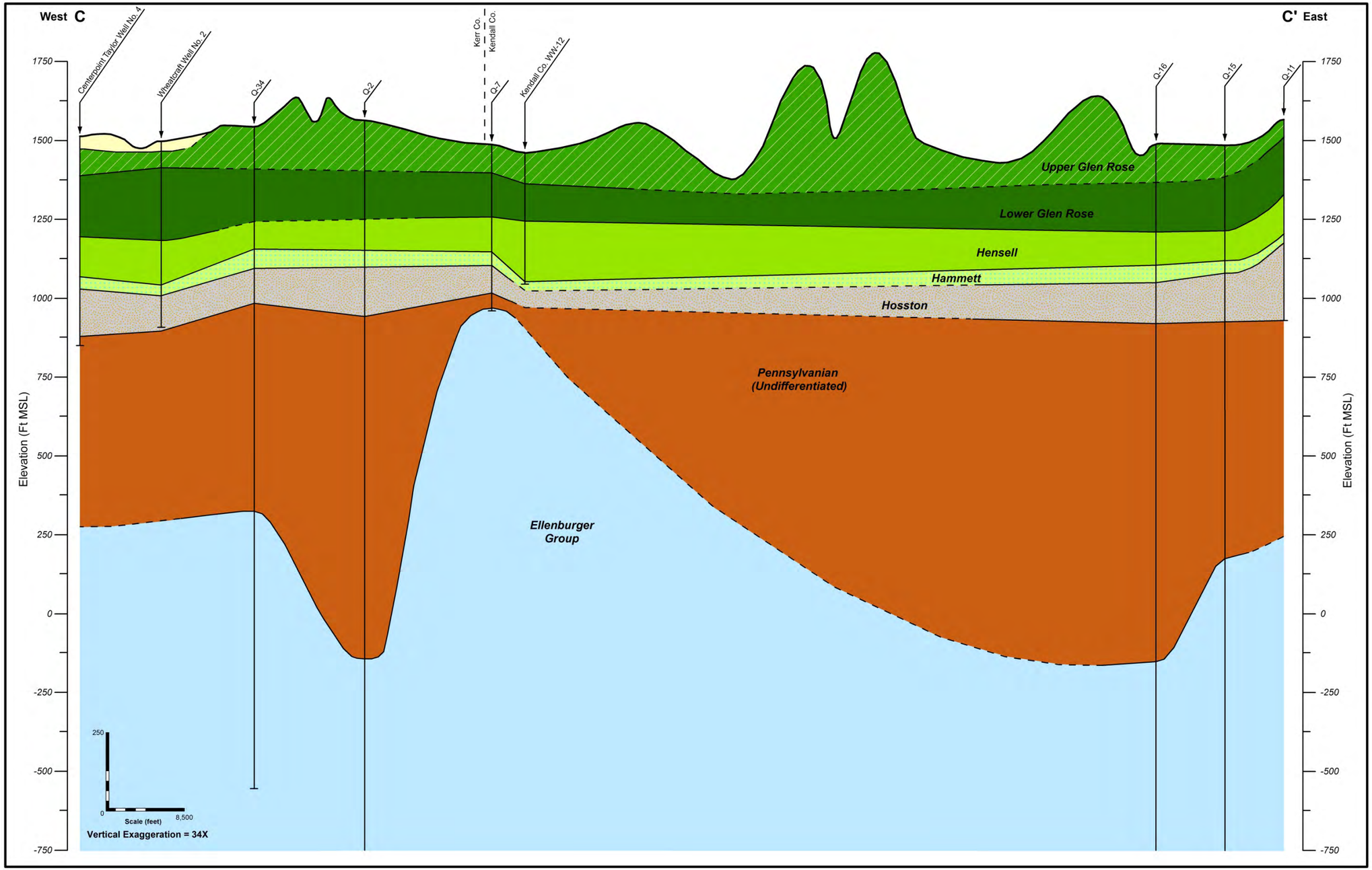


**Figure 13: Cross section C – C'**

## Section IV: Methodology

The elevations to the top of the Upper Glen Rose, Lower Glen Rose, Hensell, Hosston (top and bottom) and the Ellenburger were determined based upon electric logs of wells drilled within the study area and outside of the study area within Bandera County. Electric logs of water wells were provided by the Headwaters Groundwater Conservation District (HGCD), the Cow Creek Groundwater Conservation District (CCGCD) and GeoCam, Inc. The majority of the water well electric logs were of wells completed to the base of the Middle Trinity Aquifer and in some cases to the top of the Ellenburger Group. Gamma, spontaneous potential (SP), single point resistivity, 4-point resistivity, conductivity and caliper logs were included in electric logs conducted on the water wells.

In addition, electric logs of oil and gas wells were obtained through the Railroad Commission of Texas (RRC) for wells completed to at least the top of the Ellenburger Group. In most cases the logs contained a resistivity and SP curve and in other logs gamma and density logs were included.

Each of the electric logs were analyzed and formational tops and bottoms were chosen. The formation tops and bottoms were chosen based upon the following criteria:

- Base of the Edwards Group/Top of the Upper Glen Rose Limestone – The base of the Edwards Group/Top of the Upper Glen Rose includes the basal nodular member of the Fort Terrett Member of the Edwards Group. This is shown within the gamma log by a characteristic grouping of humps with spikes within the gamma log;

- Top of the Lower Glen Rose Limestone – The top of the Lower Glen Rose is characterized by the presence of the Corbula bed and an evaporite bed which shows an elevated resistivity spike coupled with a decrease in the gamma count;

- Top of the Hensell Sand – The Hensell Sand forms a gradational contact with the base of the Lower Glen Rose Limestone and is observed from drillers logs and cuttings by the presence of sand to sandy limestone. It is observed on the gamma and resistivity logs by a decrease in the gamma count coupled with an increase in the resistivity;

- Top of the Hammett Clay – The Hammett Clay is a good stratigraphic correlation surface seen easily in drill cuttings and the electric log. The Hammett Clay forms a gradational contact with the Hensell Sand within the study area. It is observed in drill cuttings by the presence of a gummy clay to clay and within the gamma log and resistivity log by a sharp increase in gamma coupled with a sharp decrease in resistivity;

- Top of the Hosston Sand – The top of the Hosston Sand is distinguished within the gamma and resistivity log by an decrease in gamma count coupled by an increase in resistivity;

- Bottom of the Hosston Sand – The base of the Hosston Sand within the study area is commonly marked by the top of the Pennsylvanian System which contains a hard shale surface. This is seen on electric logs by a sharp increase in gamma count coupled by a sharp decrease in resistivity. Where the Pennsylvanian is not present, the Ellenburger Group is observed at the base of the Hosston Sand in Eastern Kerr County; and

- Top of the Ellenburger Group – The top of the Ellenburger Group is found within the study area beneath either the Hosston Sand due to the Fredericksburg High, the Marble Falls Limestone where the Mississippian and Devonian System is not present or beneath the Mississippian and Devonian System. The top of the Ellenburger is characterized in electric logs by a decrease in the gamma count and a sharp increase in resistivity.

## Section V: Alternative Water Source within Study Area

### V.1. Introduction

The need for additional water supply to the Eastern Kerr/Western Kendall area has been documented through the regional water planning process. Studies conducted for this region have recognized the variability of water available from the Guadalupe River and long term reliability of water from the Middle Trinity Aquifer to meet future growth in the area. To be able to meet projected water demand and to allow for diversification of the area's water resources, stakeholders have identified four potential water resources for further evaluation. These include: 1) the availability of water rights held by the Upper Guadalupe River Authority (UGRA) and Kerr County; 2) alternative groundwater sources such as the Ellenburger Aquifer; 3) groundwater desalination; and 4) ASR.

This section will review two of the options in the context of the geology of the area; Ellenburger Aquifer as an alternate groundwater resource and the Lower Trinity Aquifer targeted as an option for ASR.

### V.2. Ellenburger – San Saba Aquifer

The Ellenburger – San Saba Aquifer is considered a minor aquifer by the TWDB with a thickness that ranges up to 2,400 feet. The formations which comprise the aquifer were deposited around the Llano Uplift and dip radially in all directions. Groundwater is produced in wells which transect fractures within the Ellenburger – San Saba Aquifer and well yields are variable depending upon fracture connectivity and faulting with well yields up to 1,000 gpm observed in some counties. Regional faults have compartmentalized the aquifer which restrict groundwater flow in some areas and increased production in other portions of the aquifer.

Based upon the electric logs analyzed in this study, the depth to the top of the Ellenburger Group (Figure 3) varies greatly from north to south going downdip and within the Fredericksburg High (Figures 11, 12, 13 and 14). Figure 14 provides a location map of the aquifers within the study area from the TWDB, in addition to the inferred location of the Fredericksburg High by Bluntzer (1992). The exact location of the Fredericksburg High is uncertain however electric logs from the HGCD MW 3, HGCD MW 14 and Q-17 (Kendall County) indicate that these wells encountered the Ellenburger Group at a shallower than expected depths potentially due to the Fredericksburg High.

Criteria for test well locations to evaluate the Ellenburger – San Saba Aquifer as a potential alternative water source should include the following:

- Areas where fresh water is most likely to be encountered;
- Areas where higher yielding wells would be encountered; and
- Areas where the Ellenburger Group is located at shallower depths to limit construction costs.

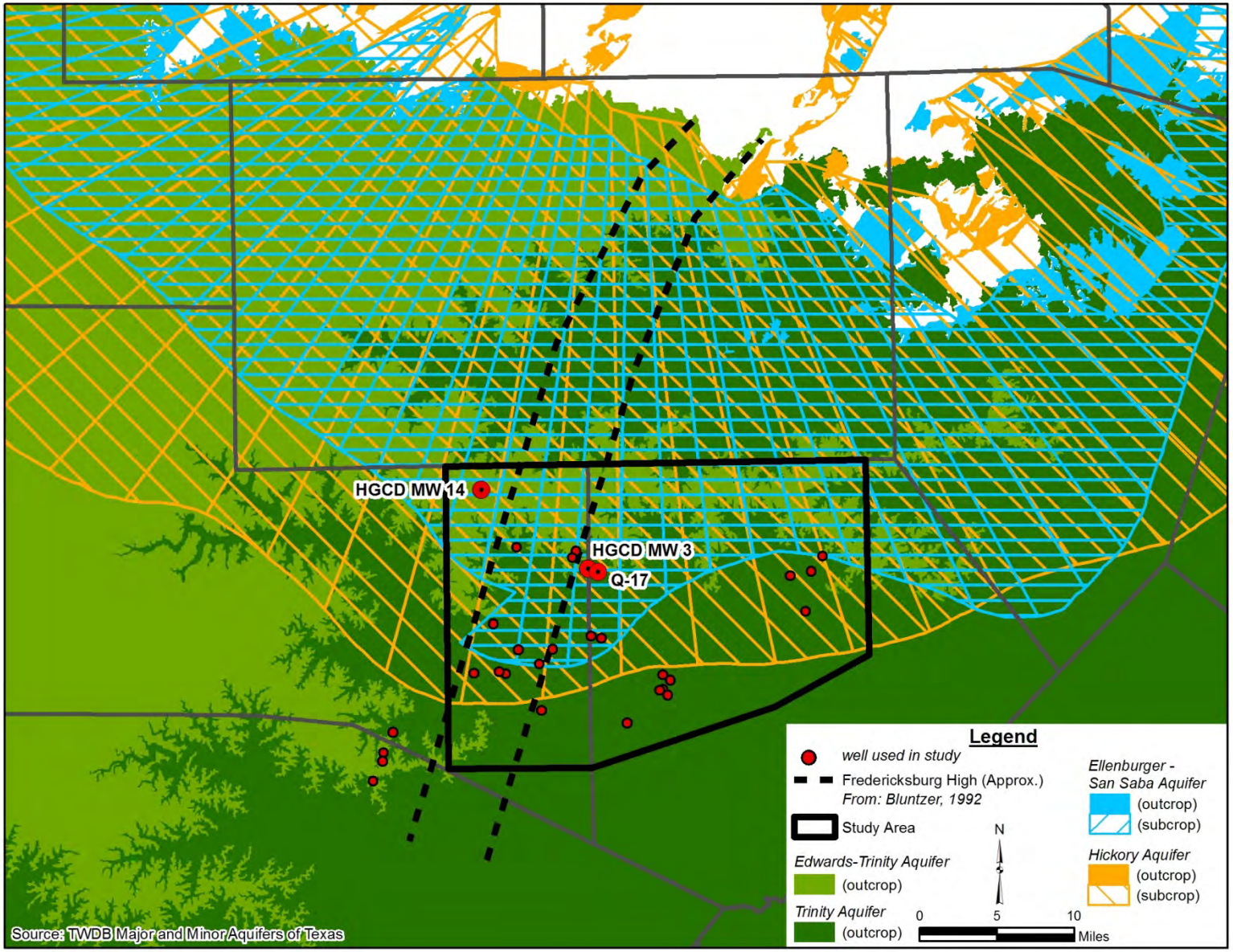


**Figure 14: Alternative water sources within the study area**

Based upon the criteria, test well locations updip within the northern 1/3 section of the study area and/or within the Fredericksburg High would provide the best opportunity for further study and evaluation.

## V.3. ASR - Lower Trinity Aquifer

ASR is the storage of either surface water or groundwater into an aquifer during times of excess water for recovery through a well during times of need or drought. ASR has been utilized in the City of Kerrville since the 1990s with excess surface water from the Guadalupe River being pumped into wells completed within the Lower Trinity Aquifer.

The Lower Trinity Aquifer has been identified as a potential aquifer for use in ASR for the Eastern Kerr/Western Kendall area. The Middle Trinity Aquifer provides the majority of groundwater for the study area with relatively little production within the Lower Trinity Aquifer. The Lower Trinity is composed of the Hosston Sand and its thickness varies within the study area between 87 feet at well Q-7 (Kendall County) and 272 feet thick at well Q-2 (Kendall County). It is also nonexistent at wells Q-17 (Kendall County), HGCD MW 3 and HGCD MW 14, possibly due to the Fredericksburg High. Figure 15 provides a contour map of the thickness of the Lower Trinity Aquifer.

The Lower Trinity is separated from the Middle Trinity Aquifer by the Hammett Clay. The Hammett Clay is present throughout the study area but thins out north of the City of Kerrville where there can be some hydraulic communication between the Middle Trinity and the Lower Trinity. In the City of Kerrville, the ASR wells completed within the Lower Trinity Aquifer produce at rates in excess of 500 gpm up to near 1,000 gpm. Elsewhere, within Kerr and Kendall Counties, Lower Trinity wells have lower transmissivities and generally produce at rates less than 50 gpm.

A good candidate for a target aquifer used in ASR would include a formation(s) that can both produce the required quantity of water necessary for the project as well as accept the required injection rates of stored water. This storage of injected water will produce a cone of inversion for use at a later point in time when additional water is required for the project.

Within the Lower Trinity Aquifer further study should concentrate around areas where the Hosston Sand produces at larger production rates and thereby has higher transmissivities in addition to areas where the Hosston is thicker. Based upon the data collected in this study, the Hosston is thickest at wells further away from the Fredericksburg High and downdip within the aquifer near the southern boundary of the study area. This includes the area northwest of the City of Boerne, within the City of Kerrville and southeast of the City of Kerrville near the Bandera County line. There is limited data in the north-central and southeast section of the study area which limits the ability to identify thicknesses of the Hosston.

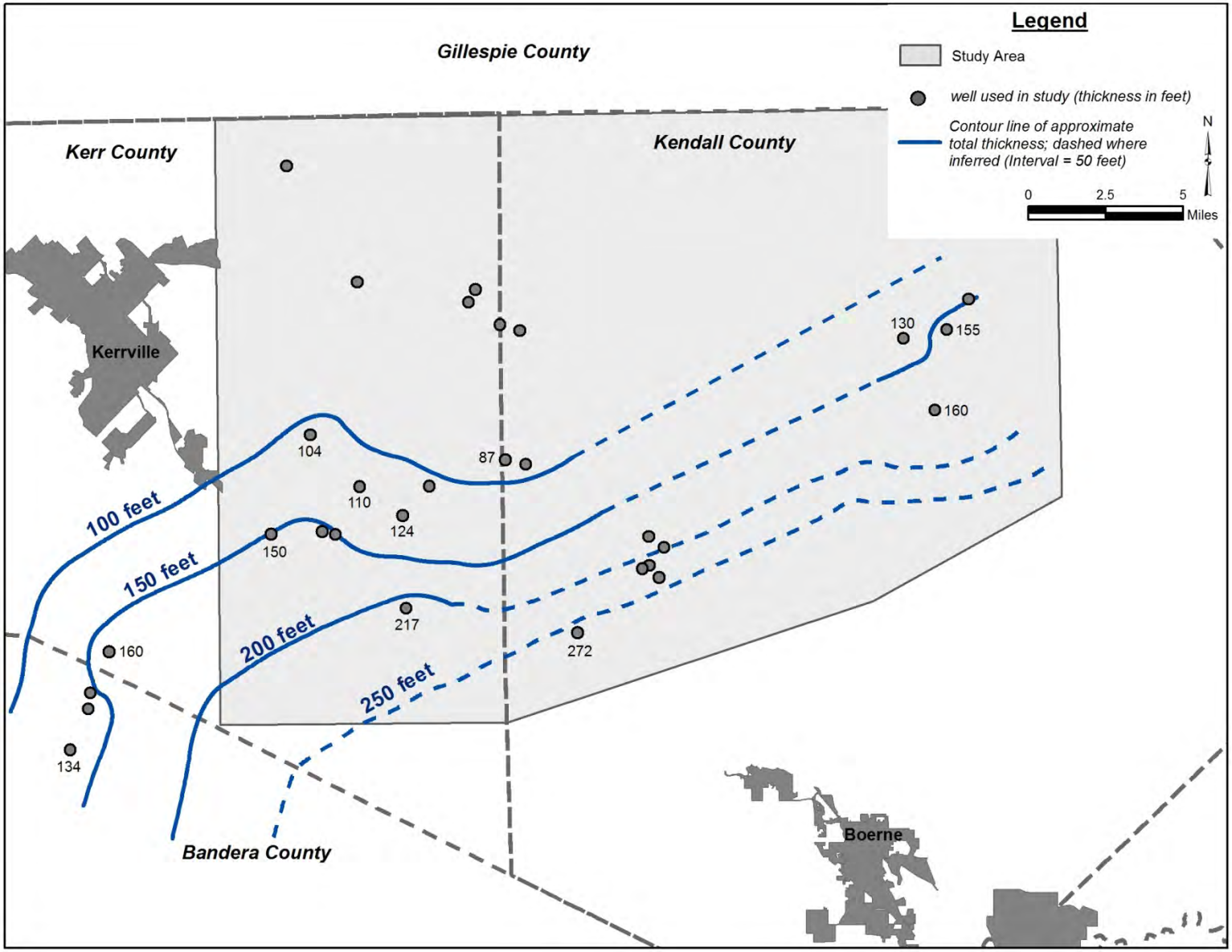


**Figure 15: Total thickness of the Lower Trinity Aquifer**

## Section VI: Conclusions

The Texas Water Development Board has awarded a grant to develop a regional solution to water needs in Kerr and Kendall counties. As a part of the larger grant study, this report describes the geology of the study area which encompasses Eastern Kerr/Western Kendall counties. The goal of this study is to provide a preliminary review of the Lower Trinity Aquifer as a potential target for a regional Aquifer Storage and Recovery project as well as utilizing the Ellenburger Aquifer as an alternative source of water for the area.

The objectives of this study were to analyze geophysical logs to delineate the Edwards Group (Segovia and Fort Terrett), Upper and Lower Glen Rose Limestone, Hensell Sand, Hammett Shale, Hosston, Pennsylvanian aged deposits and the Ellenburger Group and to develop maps showing the elevation to the tops of the these formations. In addition, cross sections were developed detailing the geology of the region.

The conclusions from this study are:

- Structurally, the area is dominated by the Llano Uplift, a structural dome of Precambrian igneous granitic pluton that was uplifted during the Ouachita Orogeny causing the surrounding Paleozoic aged rocks to fold and uplift. Another major structural feature that impacts the study area is the Fredericksburg High. The Fredericksburg High is a narrow subsurface ridge of structurally high Precambrian and Paleozoic rocks underlying the Cretaceous Trinity Group that extends southwest from the Llano Uplift through Gillespie County and Eastern Kerr County into Bandera County;

- The elevation of the top of the Ellenburger Group ranges from a high of 1,272 feet MSL within the northern portion of the study area in Kerr County to a low of -3,173 feet MSL just southwest of the study area. Structural features such as Paleozoic faults and the Fredericksburg High affect the total depth to the Ellenburger Group. The Fredericksburg High, located approximately NE to SW along the eastern portion of the study area, has pushed up the Ellenburger Group causing it to be encountered at shallower elevations;

- The need for additional water supply to the Eastern Kerr/Western Kendall area has been documented through the regional water planning process. To be able to meet projected water demand and to allow for diversification of the area's water resources, stakeholders have identified alternative groundwater sources such as the Ellenburger Aquifer and ASR using the Lower Trinity Aquifer;

- Based upon the electric logs analyzed in this study, the depth to the top of the Ellenburger Group varies greatly from north to south going downdip and within the Fredericksburg High. The electric logs of three wells analyzed as part of this study (HGCD MW3, HGCD MW 14 and Q-17 (Kendall County) have encountered the Ellenburger Group at a shallower than expected depth potentially due to the Fredericksburg High. Test well locations updip within the northern 1/3 section of the study area and/or within the Fredericksburg High would provide the best opportunity for further study and evaluation; and

- The Lower Trinity is composed of the Hosston Sand and its thickness varies within the study area between 87 feet at well Q-7 (Kendall County) and 272 feet thick at well Q-2 (Kendall County). It is also nonexistent at wells Q-17 (Kendall), HGCD MW 3 and HGCD MW 14, possibly due to the Fredericksburg High. Within the Lower Trinity Aquifer further study should concentrate around areas where the Hosston Sand produces at larger production rates and thereby has higher transmissivities in addition to areas where the Hosston is thicker. Based upon the data collected in this study, the Hosston is thickest at wells further away from the Fredericksburg High and downdip within the aquifer near the southern boundary of the study area. This includes the area northwest of the City of Boerne, within the City of Kerrville and southeast of the City of Kerrville near the Bandera County line.

## Section VIII: References


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## B.7 Kerr County – GBRA MOU

The following pages include a copy of the October 1, 1999 Kerr County – GBRA MOU regarding support of future water rights acquisition.

# MEMORANDUM OF UNDERSTANDING
# BETWEEN
# THE COMMISSIONERS' COURT OF KERR COUNTY
# AND
# GUADALUPE-BLANCE RIVER AUTHORITY

This Memorandum of Understanding (this "MOU") is dated as of October 1, 1999, by and between the Kerr County Commissioners' Court (the "Court") and the Guadalupe-Blanco River Authority ("GBRA").

## Recitals

**WHEREAS**, GBRA holds Certificate of Adjudication No. 18-2074, as amended, (the "Canyon Water Right"), which currently authorizes GBRA to impound water in Canyon Reservoir and divert and use therefrom not to exceed an average of 50,000 acre-feet of water per year for domestic, municipal, industrial, irrigation and recreational purposes; and

**WHEREAS**, GBRA has filed with the Texas Natural Resource Conservation Commission ("TNRCC") on August 29, 1997, an application for various amendments to the Canyon Water Right (hereinafter referred to as "GBRA's Application to Amend the Canyon Water Right"), including a request to authorize use of an amount of stored water from Canyon Reservoir in excess of the 50,000 acre-foot-per-year average that is currently authorized to be used under the Canyon Water Right; and

**WHEREAS**, the Court desires that a portion of the water supply benefits provided by the granting of GBRA's Application to Amend the Canyon Water Right be used to assist Kerr County in obtaining additional water supplies to provide for its future needs; and

**WHEREAS**, the Court anticipates that permits to divert a total of up to 6,000 acre-feet of water per year from the Guadalupe River or its tributaries at one or more diversion points within Kerr County, in addition to existing or future rights, may be sought by Kerr County from TNRCC in the future as a source of supply of raw water for use within the County; and

**WHEREAS**, the Court and GBRA recognize the importance of regional planning for water supply purposes; and

**WHEREAS**, the Court and GBRA are entering into this MOU to confirm that GBRA will make provision, in its planning, for this amount of possible additional permits, as provided in this MOU.

## Agreement

**IN CONSIDERATION** of the foregoing and the mutual benefits and agreements contained herein, the Court and GBRA agree as follows:

1. Upon request from Kerr County, at any time after January 1, 2021 and prior to December 31, 2050, GBRA will support and assist Kerr County in obtaining from the TNRCC permits to divert water from the Guadalupe River or its tributaries at one or more diversion points within Kerr County for use within the County, up to a total diversion of not to exceed 6,000 acre-feet of water per year, pursuant to GBRA's then-standard agreement for "upstream

sales of water from storage". Such 6,000 acre-feet of water shall be in addition to and exclusive of any water rights granted to any applicant from Kerr County between January 1, 1999 and the date of such request including, but without limitation, the Upper Guadalupe River Authority and/or the City of Kerrville. Kerr County shall have and hereby reserves the right to transfer, convey, and assign all or any portion of such water or water rights to any person or entity for use within Kerr County.

2. GBRA will reserve sufficient firm yield in Canyon Reservoir and/or other source of supply to allow GBRA to enter into such agreements for water from storage with Kerr County for such permits, through at least December 31, 2050, or such later date to be defined by GBRA; GBRA will give the County notice specifying such date at least 180 days prior to the date. After such date, any portion of the reserved firm yield not committed by contract with Kerr County may be made available to other GBRA customers. However, nothing in this Section 2 is intended to preclude GBRA from assisting any future applicant within Kerr County, to the extent GBRA has sufficient firm yield available at the time.

3. This MOU is subject to and conditioned upon the TNRCC granting, in whole, GBRA's Application to Amend the Canyon Water Right. The Court has no objection to GBRA's application.

**KERR COUNTY COMMISSIONERS' COURT**

BY: _____
Fred Henneke
Kerr County Judge

**GUADALUPE-BLANCO RIVER AUTHORITY**

BY: _____
W.E. West, Jr.
General Manager

## B.8 Scope Of Work

The following pages include the Scope of Work from the contract for this report

# EXHIBIT B

## SCOPE OF WORK

The proposed planning effort will collect the necessary information to review potential water sources, as well as their associated treatment, storage, and distribution alternatives. This information will then be analyzed to develop a set of specific, actionable recommendations for projects which can be pursued to address the regional water needs, including both source water options and infrastructure needs. All analysis and recommendations will be performed within the context of the approved 2011 water plans for Regions J (Plateau) & L (South Central Texas) and the plans of the participating entities.

This proposed planning effort (regional study) overlaps two counties, two groundwater conservation districts, two river authorities, and two regional water planning groups. This planning effort will be performed by building on existing planning efforts by and between each of these entities. This will entail incorporating and aligning the recommendations of the two regional water plans, including where recommendations from one regional plan may be applied to the other. Specific examples of this include Guadalupe Off-Channel Storage in Kerr County and gaining a more detailed geologic understanding of the Ellenburger-San Saba and Hickory aquifers in Kendall County.

The planning process will be performed with field work limited to basic field reconnaissance. The planning activity will build on the regional plans. An internal draft report will be prepared for review by each of the participating entities review and comment. Once all these comments are addressed, a draft report will be delivered to TWDB which will incorporate all findings and recommendations, as well as all supporting documentation.

Task 0 – Project Management

Monitor budget & schedule, coordinate in-kind work, provide stakeholders with progress updates and projections, and maintain communications with stakeholders.

Task 1 – Grant Administration

Execute necessary agreements, receive and process invoices and payments, ensure necessary documentation is submitted as required.

Task 2 Data Collection – Demographics

The first step will be to collect detailed and up-to-date demographic information, including residential populations, household income data, and tabulations of commercial, industrial, and other entities (schools, etc.). The original funding application includes some of this data, but only at an estimated level based on regional census area definitions; a more accurate dataset specific to the proposed area is necessary. Once the current baseline demographic data is collected, growth projections will be established to estimate future water needs. In addition, consideration will be given to whether or not to provide fire hydrant service, and if so defining criteria for what areas will receive this protection.

a. Coordinate In-Kind Services

b. Collect population data
c. Collect income data
d. Collect property data
e. Collect non-residential data
f. Collect growth projection data
g. Collect fire protection data
h. Calculate water demand profiles
i. Write Demographics Section

Task 3 Data Collection – Existing Facilities

Once the demographics are established, an inventory of the existing water facilities will be performed. This inventory will include, to the extent practical, both the non-profit and for-profit water supply entities. The inventory will work to include source water data (i.e. groundwater level), supply capacities, treatment and storage facilities and conditions, disinfection equipment, and distribution systems. This will include well pumps, supply/distribution pumps, storage tanks, number and type of service connections, and any other information to fully characterize the existing facilities.

a. Coordinate In-Kind Services
b. Collect KCWCID data
c. Collect Wiedenfelds data
d. Collect Aqua Texas data
e. Collect Generis data
f. Collect Verde Hills data
g. Collect Hill River Water Works
h. Calculate water facility capacities
i. Write Existing Facilities Section

Task 4 Data Collection – Geology

Geological investigations will include investigation of existing fresh water aquifers, potential ASR formations, and sources of brackish water. Fresh water investigations will include evaluating options for the potential of the Hickory & Ellenberger-San Saba aquifers in northeast Kerr and northern Kendall Counties. ASR investigation will include additional geological investigation of the lower Trinity aquifer, with an objective of identifying potential test well locations for future studies. Possible sources of brackish water for groundwater desalination was mentioned in the regional water plans, will also be investigated.

a. Review and analyze Hickory & Ellenburger-San Saba aquifers freshwater potential
b. Review and identify potential ASR candidate aquifer(s)
c. Review and identify recommended ASR test well locations
d. Review and analyze potential brackish water aquifers

Task 5 Data Collection & Analysis– Existing Capacity

Information from regulations will be collected and compared against both existing facility data and demographic information to perform an analysis to identify any potential or existing deficits. Areas reviewed will include source water availability (groundwater levels, etc.), supply capacity (well pumps), treatment capacity, storage & distribution capacity, and fire protection. Based on this analysis, specific targets will be set for each area where a deficit is identified (e.g. quantity of additional ground of elevated storage, additional well pump capacity, etc.). This analysis will be summarized in a listing of existing, projected, required, and goal values for each area.

a. Coordinate In-Kind Services
b. Analyze source water availability
c. Analyze supply capacity
d. Analyze treatment capacity
e. Analyze storage capacity
f. Analyze distribution capacity
g. Analyze fire protection capacity
h. Develop goals
i. Write Capacity Analysis Section

Task 6 – Develop Alternatives

Based on identified regional water needs and supply options the study will develop each potential alternative. This development will identify how well each alternative meets the identified needs, its technical viability, and its economic viability.

Separately, other potential water sources will be reviewed. This will include in particular the use of existing Guadalupe River water rights held by UGRA and Kerr County and off- channel storage surface reservoirs as identified in the regional water plans and/or in the plans of the participating entities.

a. Identify alternative aquifer supplies
b. Identify brackish groundwater supplies
c. Identify surface water supplies & applicable water rights
d. Identify ASR potential
e. Identify Surface Reservoir potential
f. Write Develop Alternatives Section

Task 7 – Evaluate Alternatives and Develop Recommendations

This evaluation will generate the final recommendations of the report, identifying which project or set of projects should be considered for further development, their associated costs, and any necessary institutional arrangements. A water conservation plan and drought management plan will also be developed. Any major issues to be resolved as part of the future project development will be identified.

a. Evaluate alternative aquifers
b. Evaluate brackish groundwater desalination

c. Evaluate surface water & applicable water rights
d. Evaluate ASR
e. Evaluate Surface Reservoirs
f. Identify recommendations

Task 8 Data Collection & Analysis – Funding Sources

Once one or more projects are identified, potential funding options will be explored. These would include the economics of local funding, as well as determining which funding assistance programs are and are not available for the defined project(s). Options considered will include local, regional, state, and national funding sources, with an emphasis on local funding and TWDB programs.

a. Coordinate In-Kind Services
b. Analyze local funding
c. Identify potential funding assistance
d. Analyze potential funding assistance

Task 9 – Write Report

All previously developed information, assessments, and recommendations will be compiled into a report to be submitted to stakeholders. Items addressed will include. Funding for this task is spread among Tasks 2-7.

a. Introduction
b. Executive Summary
c. Demographics
d. Existing Sources, Facilities, & Capacity
e. Alternatives
f. Evaluations & Recommendations
g. Funding Options
h. Exhibits
i. Schedules

## B.9 GBRA Correspondence regarding direct diversion

The following pages include correspondence from GBRA regarding issues with direct diversion of water from Canyon Reservoir

November 19, 2013

The Honorable Pat Tinley
County Judge
Kerry County, Texas
700 Main
Kerrville, TX 78028

Dear Judge Tinley:

This letter is a summary of recent water supply planning efforts in the upper Guadalupe River Basin and an attempt to clarify the position of the Guadalupe-Blanco River Authority (GBRA) regarding options under consideration.

GBRA began discussions in 2012 with water and government entities in Kendall and Kerr Counties to jointly evaluate water supply options. In entering these discussions the parties recognized that the potential for development of water resource options in the upper basin region is limited. The parties believed, however that by combining resources, a cost effective project might present itself. Accordingly, a Memorandum of Understanding (MOU) was executed in September 2012 among Kerr County, Kendall County, UGRA, Kendall County WCID #1, Head Waters GCD, and Cow Creek GCD.

GBRA continues to support partnerships for Regional water supply activities and in June 2013 provided a resolution supporting Kerr County's application for a TWDB water supply planning grant. GBRA also agreed to contribute $5,000 toward costs of the grant study. It is GBRA's view that the study and development of an ASR option has real potential and should be explored.

GBRA has recently become aware that several of the MOU participants strongly believe that the study should include an option to divert 2,000 to 6,000 acre-feet of water directly from Canyon Reservoir. GBRA has concerns regarding the feasibility of a direct diversion option which is, moreover inconsistent with the MOU between GBRA and Kerr County executed in 1999. A direct diversion is also inconsistent with the MOU between Comal County and GBRA, also executed in 1999.

Furthermore, GBRA is troubled by Kerr County, UGRA and the City of Kerrville's decision to oppose GBRA's draft Gonzales Permit 18-2378. The permit does not impact Kerr County water supply in any way, however blocking the permit will impact other communities in the Guadalupe River Basin which depend on that source of water supply.

For the foregoing reasons, GBRA no longer wishes to participate in the Kerr County study. GBRA will honor our $5,000 commitment but will refrain from endorsing the study. We ask that GBRA's position be adequately stated in the final report.

Main Office: 933 East Court Street ~ Seguin, Texas 78155
830-379-5822 ~ 800-413-4130 ~ 830-379-9718 fax ~ www.gbra.org

GBRA Guadalupe-Blanco River Authority
*flowing solutions*

Again GBRA is interested in developing partnerships to provide an effective solution for providing a firm water supply to Kendall County. We also encourage the study participants to look at ASR which we believe has the most likely chance at being developed.

Sincerely,

W.E. West, Jr.
General Manager

cc: Jonathan Letz, Commissioner, Kerr County
Ray Buck, General Manager, UGRA
Judge Gaylon L. Schroeder, Kendall County
Randolph Bohnert, Kendall County WCID 1
Gene Williams, General Manager, Headwaters GCD
Micha Voulgaris, Cow Creek GCD

July 7, 2014

The Honorable Pat Tinley
County Judge
Kerr County, Texas
700 Main
Kerrville, TX 78028

Dear Judge Tinley,

On November 19, 2013 GBRA sent a letter outlining the reasons we did not wish to participate in the TWDB Planning Grant Study for the Kerr-Kendall area.

We understand that after further consideration the study partners have agreed not to study the Canyon Lake direct diversion option. Based on this understanding, GBRA is pleased this option has been dropped since it is inconsistent with the MOU between GBRA and Kerr County executed in 1999. GBRA wishes to continue our participation in the study.

We appreciate your decision to drop the Canyon option and your understanding of our position.

Sincerely,

James L. Murphy

James L. Murphy, Esq.
Executive Manager, Water Resources & Utility Operations

cc: Johnathan Letz, Commissioner, Kerr County

Main Office: 933 East Court Street ~ Seguin, Texas 78155
830-379-5822 ~ 800-413-4130 ~ 830-379-9718 fax ~ www.gbra.org

GBRA Guadalupe-Blanco River Authority
*flowing solutions*

# Appendix C – Draft Report Comments

C.1 – 100% Public Meeting Notice

C.2 – 100% Public Meeting Sign In Sheet

C.3 – 100% Public Meeting Comments & Presentaiton

C.4 – TWDB Comments

C.5. – TWDB MAG Data

## C.1 100% Public Meeting Notice

The following pages include the notice for the 100% Public Meeting

# PUBLIC MEETING

AGENDA
June 2, 2014
4:30 PM
Regional Water Supply Facility Planning Grant
Center Point Independent School District
School Cafeteria
200-B Avenue B
Center Point, TX 78013

The purpose of this meeting is to give citizens a presentation on the completed study and receive written and oral comments on the Final Draft of the Eastern Kerr County/ Western Kendal County Regional Water System Project – Facility Planning Report – TWDB contract #1348321577 Report. The grant is from the Texas Water Development Board. The planning area covers Eastern Kerr County and Western Kendall County.

1. Project Overview
2. Overview and Results of Final Draft Report
3. Study Recommendations and Next Steps
4. Public Comment

For questions relating to the meeting please contact:
Comm. Jonathan Letz, Precinct 3
jletz@co.kerr.tx.us
(830) 739-1699
or
Keller Drozdick, P.E.
Tetra Tech Inc.
Keller.Drozdick@tetratech.com
(210) 226-2922

## C.2 100% Public Meeting Sign In Sheet

The following pages include the Sign In Sheet for the 100% Public Meeting

6/2/14 Public Mtg Kerr Co FPG

| Name | | Number |
|---|---|---|
| Thomas D. Hill | GBRA | — 830-379-5922 |
| Tom Moser | Kerr County | 830-792-2214 |
| Bonnie Arnold | HCJ | 459-5418 |
| | larnold@ktc.com | |
| Les Ferguson | ferguson@gvtc.com GRA | 830 377-7240 |
| Connie Townsend | TWDB | 512-463-8200 |
| | connie.townsend@twdb.texas.gov | |
| Charlie Hastings | Kerr County | 830-257-2993 |
| Kenneth M. Rusch | Kendall County | 830 995-3798 |

* Please email PP slides to all attendees.

* Send Bonnie digital copy of Draft Report.

## C.3 100% Public Meeting Comments & Presentation

A public meeting to present the draft report findings and comments to date was held on June 2, 2014 at the Center Point ISD Cafeteria in Kerr County. Comments below include those received prior to and at that public meeting. Responses to comments are listed following original comment. The Presentation from the meeting follows the comments.

Public Comments

- Add language to describe potential coordination with separate flood control reservoir on Cypress Creek and/or Guadalupe River
    - Response: This will be added in relevant sections
- Modify language regarding the GBRA MOU to reflect greater certainty.
    - Response: This language will be modified in relevant sections
- Include potential to acquire or use other water rights.
    - Response: This language will be modified in relevant sections
- Note need to run WAM to validate reservoir sizing.
    - Response: This language will be modified in relevant sections
- Considering withdrawal restrictions on permits, expected only about 2 cfs of withdrawal would be allowed (Notes: Reduction of withdrawal to within water rights limits reduces ability of reservoir to accommodate sustain supplies through drought of record, even when taking measures to significantly reduce evaporation.)
    - Response: Full water use permit restrictions will be incorporated into the report and particularly the reservoir analysis. Note that the actual permit terms do not set a specific limit on the amount of withdrawal, but based on a total withdrawal of 4.7 cfs when combined with the companion water right 5394B, and further impose a varying maximum daily withdrawal each month based on historical data.
- Incorporate complete water rights restrictions into report, including revised reservoir analysis.
    - Response: See previous response
- Make MOU more prominent
    - Response: This language will be modified in relevant sections
- Clarify relationship to potential flood control
    - Response: This will be added in relevant sections
- Change language related to water right related time of use to mention banking and recreational use
    - Response: This will be added in relevant sections
- State need for future study of surface water and ASR
    - Response: This will be added in relevant sections
- Note flood control under separate study, and that projects could be tied together for economy
    - Response: This will be added in relevant sections
- Consider additional sites (i.e. old quarries) for possible reservoir locations
    - Response: This is indicated in the report currently, and the language will be clarified
- Note potential to reduce evaporation by designing for prevailing winds
    - Response: This will be added in relevant sections
- Note that diversion point “may” be moved
    - Response: This language will be modified in relevant sections
- Reference potential modifications to Flat Rock lake

  - Response: This will be added in relevant section
- Note need for continued inter-agency cooperation to continue advancement of project
  - Response: Language will be added to the recommendations section
- Clarify what water management strategy (WMS) criteria still need to be evaluated
  - Response: A section will be added to identify criteria that are and are not addressed in this report
- Add that notice needs to be given to adjacent planning regions that they will be sharing WMSs to cover this study area (Kerr County-Other & Kendall County-Other water user groups, etc.)

TETRA TECH

# 100% Public Comment Meeting

## Eastern Kerr County / Western Kendall County Regional Water System Project

Jonathan Letz – Kerr County Commissioner, Precinct 3
S. Keller Drozdick, P.E. – Tetra Tech
June 2, 2014

# Meeting Overview

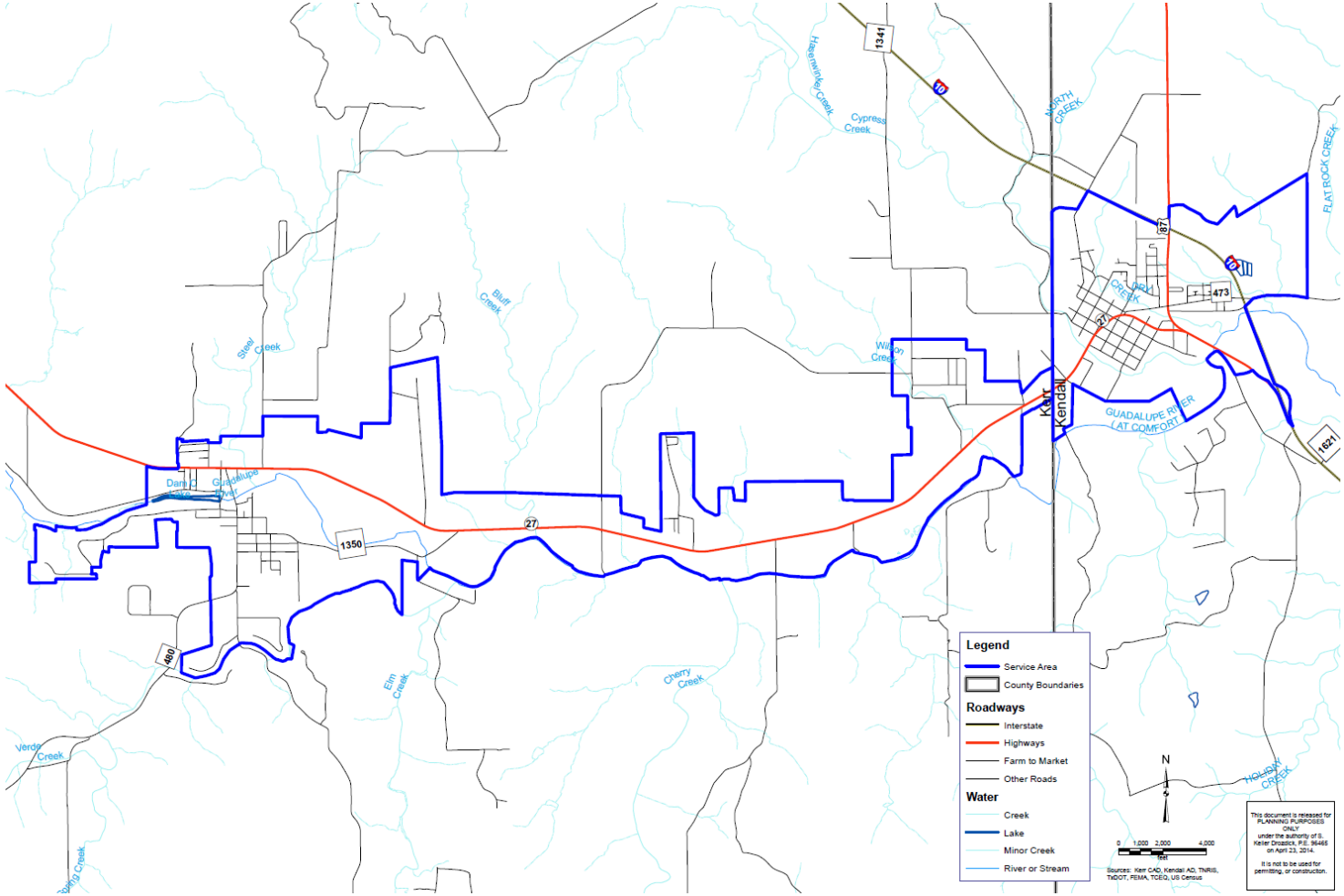
- Introductions
- Project Overview
- Report Overview & Results
- Report Recommendations
- Comments to Date
- Next Steps
- Public Comment

# Project Overview

- Service Area:  Comfort to Center Point
- Evaluate Drinking Water Needs and Supplies
- Find Options to Current Groundwater Supplies
- Use Existing Data
- Recommend Options for Future Investigation

TETRA TECH

# Project Overview – Service Area



# Report - Demographics

- Draft Final Status
- Population Projections – Official Estimates
  - 2012 Population: 6,533 (2.56 per household)
  - 2040 Population: 10,013
  - 87% Residential Connections
- Capacity Requirements
  - 3.8 MGD Production, 0.90 MG Storage
- Average Demand Requirements
  - 2012: 1.2 MGD, 2040: 1.9 MGD

# Report – Existing Facilities

- 11 Water Utilities
  - 1.7 MGD Production, 0.78 MG Storage
- All Groundwater, Mostly Middle Trinity
- Long Term Drop in Groundwater

# Report - Results

- Continue Reduced Trinity Use
- Add Additional Sources
  - Guadalupe River
  - Ellenburger-San Saba
- Add Storage
  - Surface Reservoir(s)
  - ASR
- Add Distribution

# Draft Final Report – Recommendations

- Ellenburger-San Saba Test Well
- Trinity ASR Test Well
- Existing UGRA Water Rights Adequate*
- Surface Reservoir*
- Working Group
- Water Conservation
- Detailed Planning
- Funding

# Comments To Date

- Restrictions on Existing UGRA Water Rights
  - Require additional water rights (GBRA MOU, etc.)
  - Change Reservoir Size
- Coordination with Flood Control
- Official Population Growth Data
- Editorial

# Next Steps

- Receive TWDB comments: July 16, 2014
- Address & Incorporate All Comments
- Submit Final Report: August 31, 2014
- TWDB Approves/Rejects Report: September 30, 2014

# Public Comment

## C.4 TWDB Comments

A copy of the comments received from the TWDB is attached. Responses to each comment are included below

TWDB Comments

- 1: Include Scope of Work
  - Response: This will be added
- 2: Provide Documentation of required public meetings
  - Response: Copies of the public notice, presentation, and sign in sheet will be added
- 3: Reconcile population estimate date set statements
  - Response: This will be added
- 4: Reconcile statement regarding TWDB county water use estimates for private wells
  - Response: This will be added
- 5: Provide additional data and description regarding existing facility data
  - Response: This will be added
- 6: Explain why groundwater well monitoring data was not used
  - Response: Groundwater well monitoring data was added
- 7: Explain why existing groundwater estimate data for from regional water plans and/or DFC and MAG data was not used
  - Response: This will be added
- 8: Water Conservation Plan, consider adding GPCD data from regional plans
  - Response: This will be added
- 9: Water Conservation Plan, consider adding discussion of best management practices, conservation activities, and water conservation strategies from regional plans
  - Response: This will be added
- 10: Correct funding eligibility statement regarding SWIFT program
  - Response: This will be changed
- 11: Correct funding eligibility statement regarding WIF program
  - Response: This will be changed
- 12: Include comments and responses
  - Response: This will be added
- 13: Correct errors in TOC, spell, grammar, and other editorial errors
  - Response: This will be corrected
- 14: Consider adding entries to bibliography to capture more data sources
  - Response: This will be added

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

July 24, 2014

Jonathan Letz
Kerr County Commissioner, Pct. 3
700 E. Main Street, Suite 101
Kerrville, Texas 78208

RE: Regional Water and/or Wastewater Facility Grant Contract between the Texas Water Development Board (TWDB) and Kerr County (County); TWDB Contract No. 1348321577, Draft Report Comments

Dear Mr. Letz:

Staff members of the TWDB have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT I provides the comments resulting from this review. As stated in the TWDB contract, the County will consider revising the final report in response to comments from the Executive Administrator and other reviewers. In addition, the County will include a copy of the Executive Administrator's draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. **Please further note, that in compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report must comply with the requirements and standards specified in statute. For more information, visit http://www.sos.state.tx.us/tac/index.shtml.** If you have any questions on accessibility, please contact David Carter with the Contract Administration Division at (512) 936-6079 or David.Carter@twdb.texas.gov

The County shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions concerning this contract, please contact Connie Townsend, the TWDB's designated Contract Manager for this planning project at (512) 463-8290.

Sincerely,

Jeff Walker
Deputy Executive Administrator
Water Supply & Infrastructure

Enclosures

c: Connie Townsend, TWDB

Attachment 1
TWDB Comments on Eastern Kerr County/Western
Kendall County Regional Water System Project
TWDB Contract No. 1348321577

**Draft Report Review Comments**

1. Scope of Work (SOW): Please include a copy of the contract Exhibit B Scope of Work as a referenced appendix in the final report.

2. SOW Task 0 – Please provide documentation in the final report for the required public meetings.

3. Section 2.1/paragraph 1 – In the final report, please reconcile the statement regarding "the TWDB preferred data set". The population estimates data actually "preferred" by the TWDB are the annual population estimates from the Texas State Data Center (TSDC). However, in cases where the TSDC data does not provide a sufficient level of detail, then the Census/American Community Survey data would be a good alternative.

4. Section 2.4/paragraph 4 – In the final report, please reconcile statements regarding county water use estimates. The TWDB 2011 county water use estimates do include estimated water use for users on individual wells. In 2011, the state-wide estimated water use of this non-system population was 118 GPCD, which is based on the average water use rates of water supply corporations and industrial utilities.

5. SOW Task 3 – The SOW identifies six water supply entities from which to collect existing facilities data. In the final report, please describe the data collection process and provide the missing detailed information collected for each SOW-identified water supply entity, broken out by the individual utilities listed in Table 3-1.

6. SOW Task 5 – The SOW states that data on source water availability including groundwater levels will be collected. In the final report, Section 3.1/paragraphs 2 and 3, please explain why relevant groundwater well monitoring data available from the study participant(s) was not used to assist in the documentation of the aquifer levels for the Middle and Lower Trinity aquifers within Kerr and Kendall counties.

7. SOW Task 5 – The SOW states that data on source water availability will be collected. In the final report, Section 5.1/paragraph 3, please explain why relevant existing groundwater availability estimate data for Kerr and Kendall counties from the 2011 regional water plans for Regions J & L; and/or the most current available TWDB Desired Future Conditions (DFC) and Modeled Available Groundwater (MAG) data were not used.

8. SOW Task 7 – The SOW states that a water conservation plan will also be developed. In the final report for an approvable water conservation plan, Section 7.1.7 and Appendix B, Water Conservation Plan ***(Section A)***, please consider including: (i.) any relevant general and/or specific GPCD data that may be available from the 2011 regional water plans for Regions J & L and/or participating entities for this study; and, (ii.) 5-year and 10-year GPCD goals for total water use, residential use, and water loss.

9. SOW Task 7 – The SOW states that a water conservation plan will also be developed. In the final report for an approvable water conservation plan, Section 7.1.7 and Appendix B, Water Conservation Plan ***(Section M)***, please consider including discussion of best management practices and conservation activities and relevant water conservation strategies identified in the 2011 regional water plans for Regions J & L.

10. Section 9.4/paragraph 2 – In the final report, please correct the statement "*Since the projects recommended within this study are aligned with the regional water plans, these projects should be good candidates for this funding source.*" SWIFT program eligibility requires a water supply project to be specifically listed as a

recommended water management strategy in the most recent TWDB-approved regional water plan and approved State Water Plan; plan consistency is not sufficient.

11. Section 9.5/paragraph 1 – In the final report, please correct the statement "*This program may be a candidate for project funding depending on how its terms compare.*" WIF program eligibility requires a water supply project to be specifically listed as a recommended water management strategy in the most recent TWDB-approved regional water plan and approved State Water Plan; plan consistency is not sufficient.

12. SOW Task 9 – Please include all comments received on this study and draft report and contractor responses to these comments as a referenced appendix in the final report.

13. SOW Task 9 – In the final report, Please correct errors in the Table of Contents (TOC), as well as spelling grammar errors found throughout draft report. (such as: TOC p. iii, sub items under Section 10 belong under the Appendix B Section on p. iv.; TOC p. iv. Table B-1 and Figures 1,2, 3 have wrong page number references; Section 2.1 p. 3, line 5 has extra word "in"; Section 3.1, p.10, paragraph 3, line 3 "Count" should be "County"; Section 10, last line, "Informaiton" should be "Information")

14. SOW Task 9 – Please consider adding entries to the Section 10 Bibliography to better document source detail for the data obtained from the TWDB, TCEQ, and study-area water supply corporations (WSC), including any pertinent data web links.

## C.5 TWDB MAG Data

The following pages are a copy of the Modeled Available Groundwater (MAG) data provided by TWDB via e-mail on July 28, 2014

| Aquifer | County | RWPA | Basin | GMA | MAG 2010 | MAG 2020 | MAG 2030 | MAG 2040 | MAG 2050 | MAG 2060 | Report # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trinity | Kerr | J | Colorado | 9 | 318 | 318 | 318 | 318 | 318 | 318 | GR 10-050 MAG |
| Trinity | Kerr | J | Guadalupe | 9 | 15646 | 14129 | 14056 | 13767 | 13450 | 13434 | |
| Trinity | Kerr | J | Nueces | 9 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Trinity | Kerr | J | San Antonio | 9 | 471 | 471 | 471 | 471 | 471 | 471 | |

MAG = Modeled Available Groundwater

| GMA | Aquifer | Desired Future Condition (DFC) | e DFC Ador | Notes |
|---|---|---|---|---|
| 7 | Edwards-Trinity (Plateau), Trinity | Average drawdown of 7 feet for Edwards-Trinity (Plateau), [Pecos Valley, and Trinity] except Kinney County GCD, based on scenario 10 of GR09-35. Kinney County drawdown consistent with maintaining annual average flow of 23.9 cfs and median flow of 24.4 cfs at Los Moras Springs based on Scenario 3 | 40388 | The DFC statement for the Edwards-Trinity (Plateau) only explicitly references the ETP, however the GMA confirmed it was the intent to also incorporate the Trinity and Pecos Valley aquifers. |
| 9 | Edwards-Trinity (Plateau) | No net increase in average drawdown for those portions located in Kendall and Bandera counties. Declared not relevant in Kerr and Blanco counties. | 40385 | |
| 9 | Trinity | Allow for an increase in average drawdown of approximately 30 feet through 2060 consistent with Scenario 6 in TWDB Draft GAM Task 10-005. | 40385 | |
| 10 | Edwards BFZ (Kinney County) | Water level in well number 70-38-902 shall not fall below 1184 mean sea level. | 40394 | |

| Aquifer | County | RWPA | Basin | GMA | MAG 2010 | MAG 2020 | MAG 2030 | MAG 2040 | MAG 2050 | MAG 2060 | Report # | Partial MAG | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edwards-Trinity (Plateau) | Kendall | L | Colorado | 9 | 46 | 46 | 46 | 46 | 46 | 46 | GR 10-049 MAG | | |
| Edwards-Trinity (Plateau) | Kendall | L | Guadalupe | 9 | 103 | 103 | 103 | 103 | 103 | 103 | GR 10-049 MAG | | |
| Edwards-Trinity (Plateau) | Kendall | L | San Antonio | 9 | 169 | 169 | 169 | 169 | 169 | 169 | GR 10-049 MAG | | |
| Trinity | Kendall | L | Colorado | 9 | 135 | 135 | 135 | 135 | 135 | 135 | GR 10-050 MAG | | |
| Trinity | Kendall | L | Guadalupe | 9 | 6028 | 6028 | 6028 | 6028 | 6028 | 6028 | GR 10-050 MAG | | |
| Trinity | Kendall | L | San Antonio | 9 | 4976 | 4976 | 4976 | 4976 | 4976 | 4976 | GR 10-050 MAG | | |

| GMA | Aquifer | Desired Future Condition (DFC) | Date DFC Adopted | Assumed recharge conditions | Drought? |
|---|---|---|---|---|---|
| 7 | Edwards-Trinity (Plateau) | Average drawdown of 7 feet for Edwards-Trinity (Plateau) except Kinney County GCD, based on scenario 10 of 09-35. Kinney County drawdown consistent with maintaining annual average flow of 23.9 cfs and median flow of 24.4 cfs at Los Moras Springs based on Scenario 3 | 40388 | average recharge | |
| 9 | Trinity | Allow for an increase in average drawdown of approximately 30 feet through 2060 consistent with Scenario 6 in TWDB Draft GAM Task 10-005. | 40385 | The 387 50-year simulations were developed based on tree-ring precipitation estimates from 1537 to 1972 for the Edwards Plateau (Cleaveland, 2006). | x |
| 10 | Trinity | Regional average well drawdown during average recharge conditions that does not exceed 25 feet (including exempt and non-exempt well use); within the jurisdiction of Hays-Trinity GCD regional average well drawdown during average recharge conditions of 0 feet (including exempt and non-exempt well use); in Uvalde County the regional average well drawdown during average recharge conditions of no more than 20 feet (including exempt and non-exempt use); and the Trinity Aquifer in Trinity-Glen Rose GCD is non-relevant. | 40413 | GTA-average recharge | |