Hydrogeologic Assessment of the Granite Gravel Aquifer in Burnet County, Texas

Prepared by

Central Texas Groundwater Conservation District

and

Tom Partridge P.E.

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May 6, 2011

Mr. John Simmons, President
Central Texas Groundwater
Conservation District
P.O. Box 870
Burnet, Texas 78611

Re: Delivery of Granite Gravel Report

Dear Mr. Simmons,

This report was prepared by Tom Partridge, P.E. in direct cooperation with the District, as per contract dated March 5, 2011.

I have enjoyed working with the District in the preparation of this Report.

Sincerely,

STATE OF TEXAS
TOMMY R. PARTRIDGE
55072
REGISTERED
PROFESSIONAL ENGINEER

5/6/2011

Tommy R. Partridge, P.E. #55072
Engineering Firm No. 5812

I. Geologic Setting

The Granite Gravel Aquifer is a local water bearing formation located in the southwest portion of Burnet County (Figure 1). It is located in what is known as the Llano Uplift area of Central Texas. The Llano Uplift is a structural anomaly that has exposed ancient Precambrian rock in the midst of the younger Cretaceous aged Edwards Plateau (Westward). The Precambrian Town Mountain Granite is part of the core of the Llano uplift and is the formation that forms the Granite Gravel Aquifer. The Town Mountain Granite is described as being coarse-grained, pink, quartz-plagioclase-microcline rock (Geologic Atlas, 1981). In Burnet County much of the formation is decomposed and weathered on the surface and down to the bedrock.

II. Description of Aquifer

The Granite Gravel Aquifer is composed of weathered or decomposed Town Mountain Granite. A solid bedrock of granite forms the base of the aquifer and its depth below surface can vary greatly. The saturated thickness of the aquifer is dependent on the depth to the bedrock which can range from a few feet in some locations, and up toward 100 ft in others. There exist locations in which the granite bedrock is exposed to the surface or just beneath it, therefore these areas contain little to no granite gravel. Flow in the Granite Gravel Aquifer is controlled by the depth to the top of the granite bedrock and presence of adjacent geologic formations that have been juxtaposed to the granite in some instances (Westward). The variations in the depth to the granite bedrock cause well yields to vary widely throughout the aquifer. Estimated well yields for the aquifer can range from as little as 5 gpm up to 100+ gpm (Figure 2). Given the unconsolidated nature of the Granite Gravel Aquifer, wells completed into it are typically cased from land surface (completion meets TDLR regulations) to the bottom. The bottom or lower portion of the casing is perforated or screened and the portion above the perforation is cemented (Westward).

It is important to note that numerous wells that are located in this area (Figure 1) of Town Mountain Granite are completed in the actual bedrock of granite. Wells that are completed in the bedrock are not characterized as Granite Gravel Aquifer wells. These wells are distinguished as “Granite Aquifer” wells and do not have the same characteristics as the Granite Gravel Aquifer wells. Wells are only completed in the granite bedrock because there was not sufficient water in the granite gravel at the location. The Granite Aquifer is a fractured aquifer system that is highly diversified in nature. Wells completed in the Granite Aquifer are generally suitable only for domestic use because well yields are typically low (less than 25 gpm) and many cannot sustain continuous pumping.

Water in the Granite Gravel Aquifer is generally fresh and suitable for all uses. The aquifer is generally shallow with high permeability; therefore the aquifer is susceptible to contamination. During times of heavy rain, the aquifer is most vulnerable to contaminants being carried into the aquifer from recharge. During past flooding events the Central Texas Groundwater Conservation District has indentified numerous wells to be positive for coliform bacteria. During normal conditions the wells that occasionally do test positive for coliform bacteria are due to problems within the well system (i.e. leaks) and not the aquifer itself.

III. Occurrence of Aquifer in the District

Figure 1 shows the areal extent of the Aquifer for Burnet County. The Aquifer is located in the Southwest portion of the county to the west of the city of Marble Falls, in two general areas named the Backbone and Hoover Valleys. The entire south and west sides of the aquifer are bounded by the Colorado River and Lake Lyndon B. Johnson. Backbone Ridge lies on the Northwest side creating Backbone valley to the south and Hoover Valley to the west. The Town Mountain Granite Formation covers approximately 30,300 surface acres in Burnet County.

Water is present in the Granite Gravel Aquifer throughout the formation of the Town Mountain Granite, except in places that contain little or no granite gravel. Figure 2 shows the general pumping capacities throughout the aquifer. The general area along Backbone and Sparerib creeks can produce high yielding wells in excess of 100 gpm. However, even in this high producing area there are some places where the granite gravel layer is thin and produces much less water. A general area around Elm Creek in the city of Granite Shoals is an area that contains numerous wells that are capable of producing 20-60 gpm. Throughout the area that is designated granite gravel, there exist scattered locations where the granite bedrock outcrops on the surface and therefore contains no granite gravel.

IV. Monitor Well Program

The Central Texas Groundwater Conservation District has installed various monitor wells in the granite gravel aquifer since late 2008. At the time of this report there are eight wells equipped with Levellogger instruments to record water level changes. Figure 3 shows where these monitor wells are located throughout the aquifer. Ongoing water level monitoring will continue to gather more information on this aquifer.

V. Volume and recharge rate

The Aquifer covers approximately 30,300 surface acres. According to Kresic (2007), the recharge amount can range from 6.6%-16.6% of annual precipitation. The recharge rate is assumed to be approximately 10% of rainfall for the Granite Gravel Aquifer. Based upon this assumption, the net recharge to the aquifer using an of average 30 inches of rain per year for Burnet County, and 30,300 acres of outcrop, is 7,575 ac-ft per year.

VI. Pump Test

A pump test was conducted on March 23, 2011 on a well located at the Backbone Valley Nursery growing field (Figure 4). This was a single well test that consisted of a constant pumping rate of 82 gpm. The water level was monitored and recorded for 100 minutes, at which point the drawdown stabilized. The data was analyzed using AQTESOLV computer software and the results are shown in Figure 5. This single well test did not provide accurate outcomes for a Storativity value, therefore it was estimated using the Theis method to be 0.4 (this is reasonably inside the range of 0.2-0.45 for weathered granite provided by Batu, 1998). A Transmissivity value was determined using the Cooper-Jacobs method for unconfined aquifer to be 43, 880 gpd/ft. The saturated thickness at this well was 30 ft, therefore the hydraulic conductivity value is 1,462.67

gpd/ft^2. An estimate of the maximum well yield for the aquifer was determined to be approximately 240 gpm.

VII. Projected Drawdown

The following equation was used to determine the drawdown from a single pumping well with varying pumping rates and distances:

$$s = (264Q/T)\log(0.3Tt/r^2S)$$

s= drawdown at specified time and distance (ft)
Q= pumping rate (gpm)
T= Transmissivity (gal/day/ft)
t= time since pumping started (days)
r= distance from pumping well (ft)
S= Storativity (dimensionless)

Figure 6 displays the drawdown for a single well pumping 82 gpm for 1 day and 1 year time periods. Figure 7 displays the drawdown for a single well pumping 240 gpm for 1 day and 1 year time periods. Figure 8 displays the drawdown for a single well pumping certain ac-ft/yr volumes. The pumping rate used for the given volumes was determined by evenly distributing the pumping throughout the year.

Figure 1

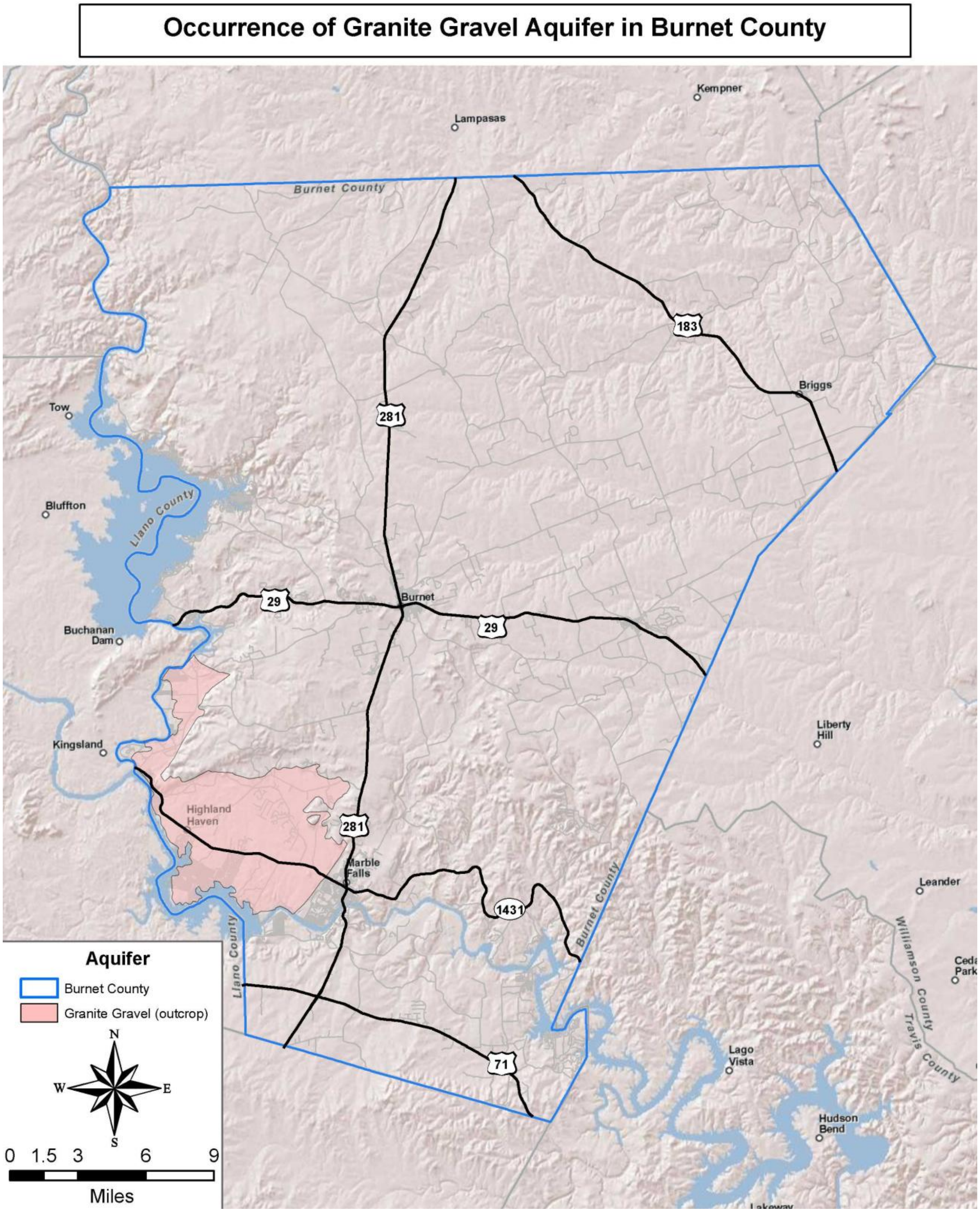

Occurrence of Granite Gravel Aquifer in Burnet County
Kempner
Lampasas
Burnet County
183
Briggs
281
Tow
Bluffton
Llano County
29
Burnet
Buchanan Dam
Liberty Hill
Kingsland
Highland Haven
Marble Falls
1431
Leander
Burnet County
Llano County
Williamson County
Travis County
Cedar Park
71
Lago Vista
Hudson Bend
Aquifer
Burnet County
Granite Gravel (outcrop)
N
W
E
S
0 1.5 3 6 9
Miles

Figure 2

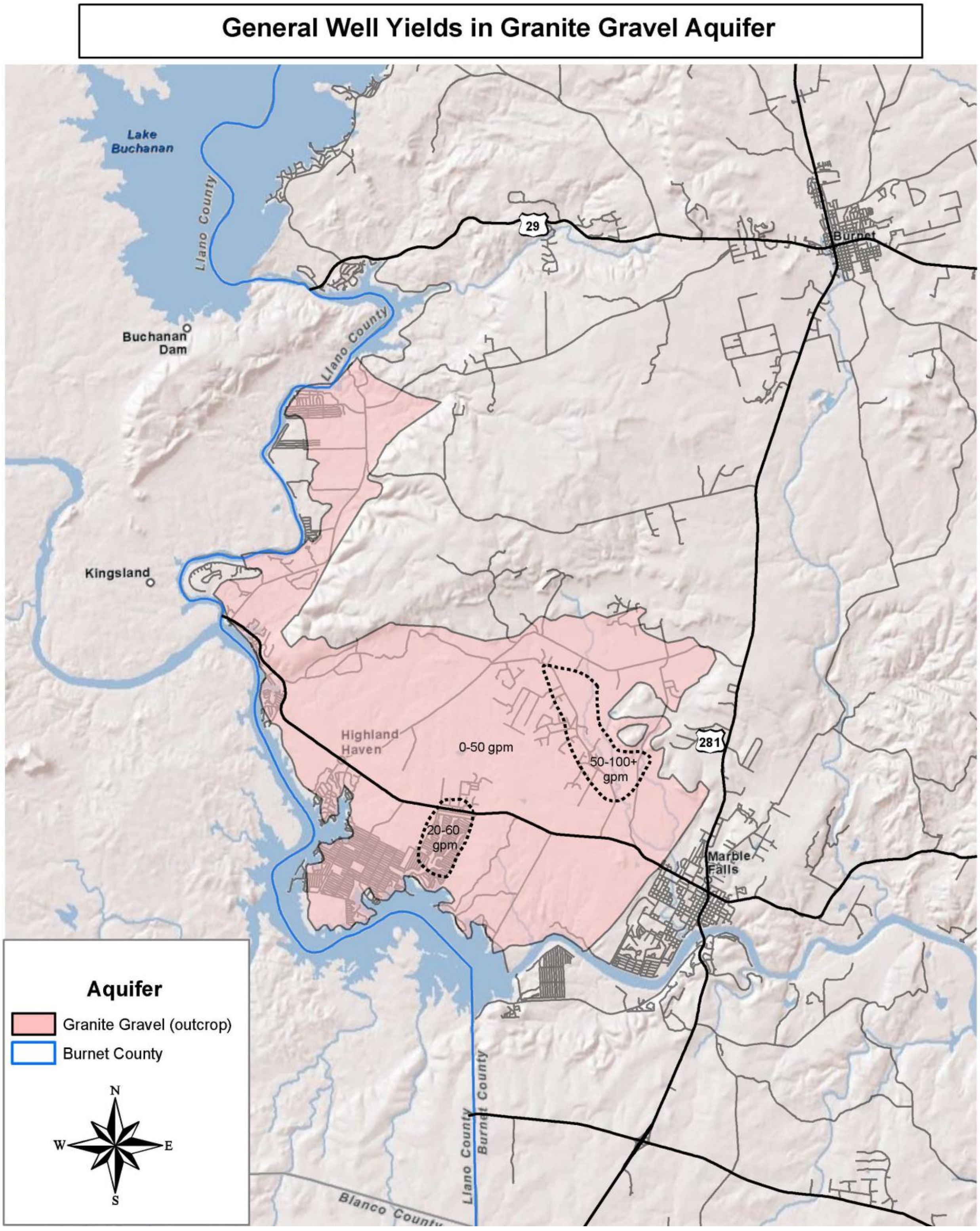

General Well Yields in Granite Gravel Aquifer
Lake Buchanan
Llano County
Buchanan Dam
Llano County
Kingsland
Burnet
29
Highland Haven
0-50 gpm
50-100+ gpm
20-60 gpm
281
Marble Falls
Aquifer
Granite Gravel (outcrop)
Burnet County
N
E
S
W
Llano County
Burnet County
Blanco County

Figure 3

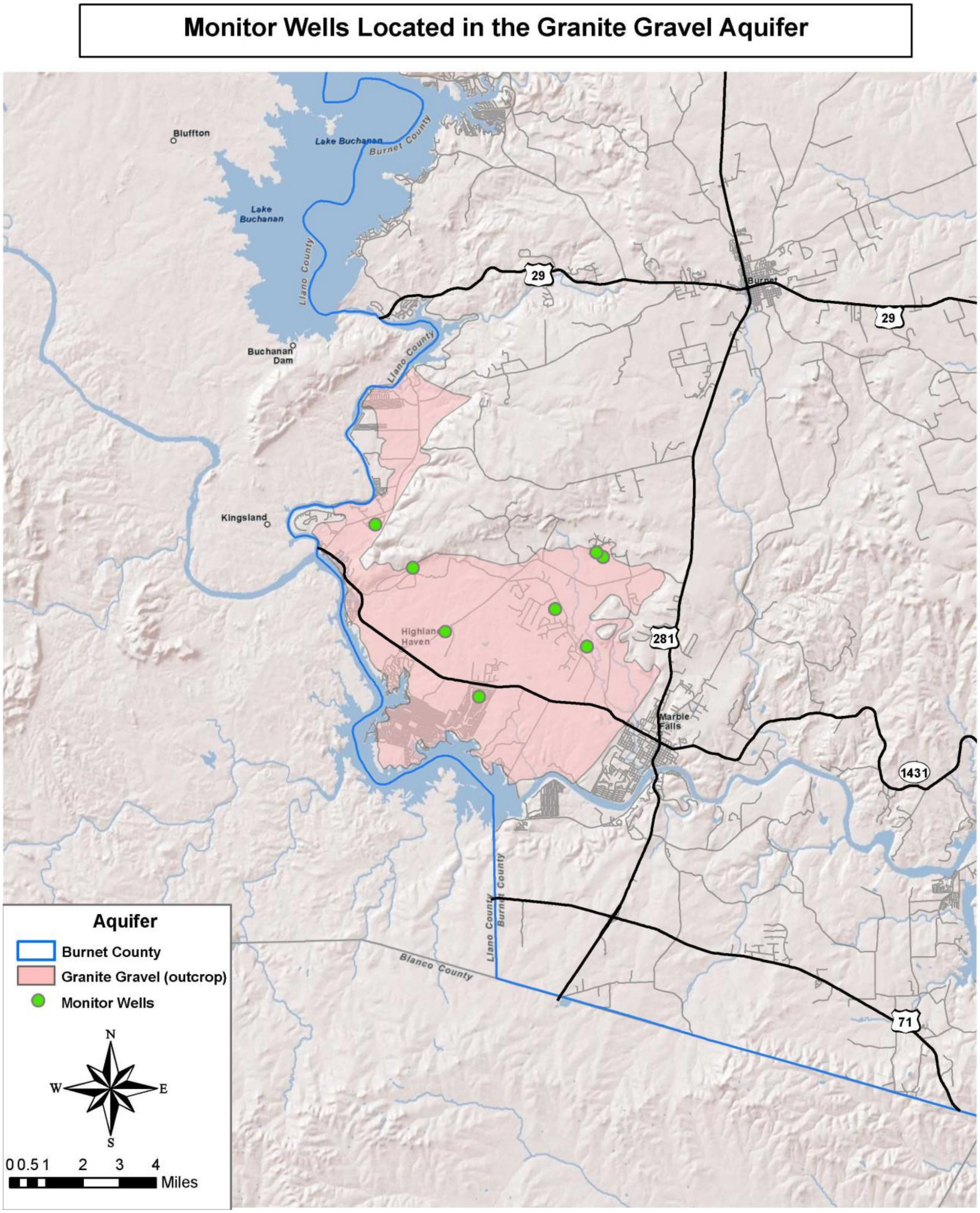

Monitor Wells Located in the Granite Gravel Aquifer
Bluffton
Lake Buchanan
Burnet County
Lake Buchanan
Llano County
29
Burnet
29
Buchanan Dam
Llano County
Kingsland
Highland Haven
281
Marble Falls
1431
Llano County
Burnet County
Blanco County
71
Aquifer
Burnet County
Granite Gravel (outcrop)
Monitor Wells
N
W
E
S
0 0.5 1 2 3 4
Miles

Figure 4

Location of Well for Pump Test - FM 1980 (3-23-11)
Stone Mountain Dr
Cowgirl Xing
Shady Ln
CR 120A
CR 120
Meador Rd
Crider Rd
CR 123
Los Encinos Dr
CR 120
Quartz St
Leaning Tree
CR 123A
FM 1980
Sims Ln
CR 144
Oak Forest Rd
CR 144B
Tasajillo
Quail TRL
CR 144A
Lariat Ln
Ancient Oaks Dr
Sparerib Rd
Granite Blvd
Paseo de Vaca
Sundown Trl
Dry Creek Trl
Field Crest Dr
Layton Ln
Toby Dr
CR 124
N
W
E
S

Figure 5: AQTESOLV Data and Results

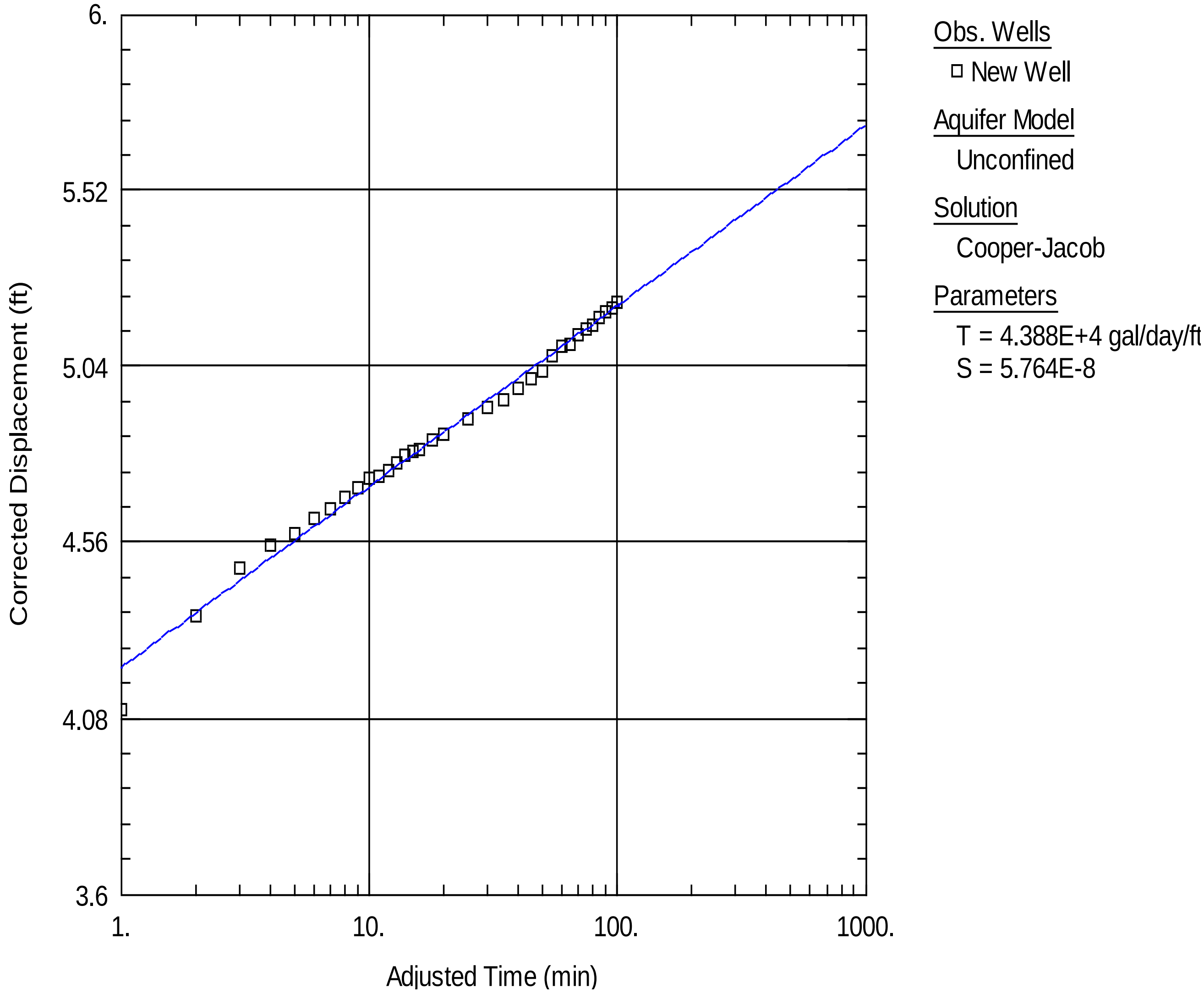


Figure 6: Drawdown Curves for 82 gpm Pumping Rate

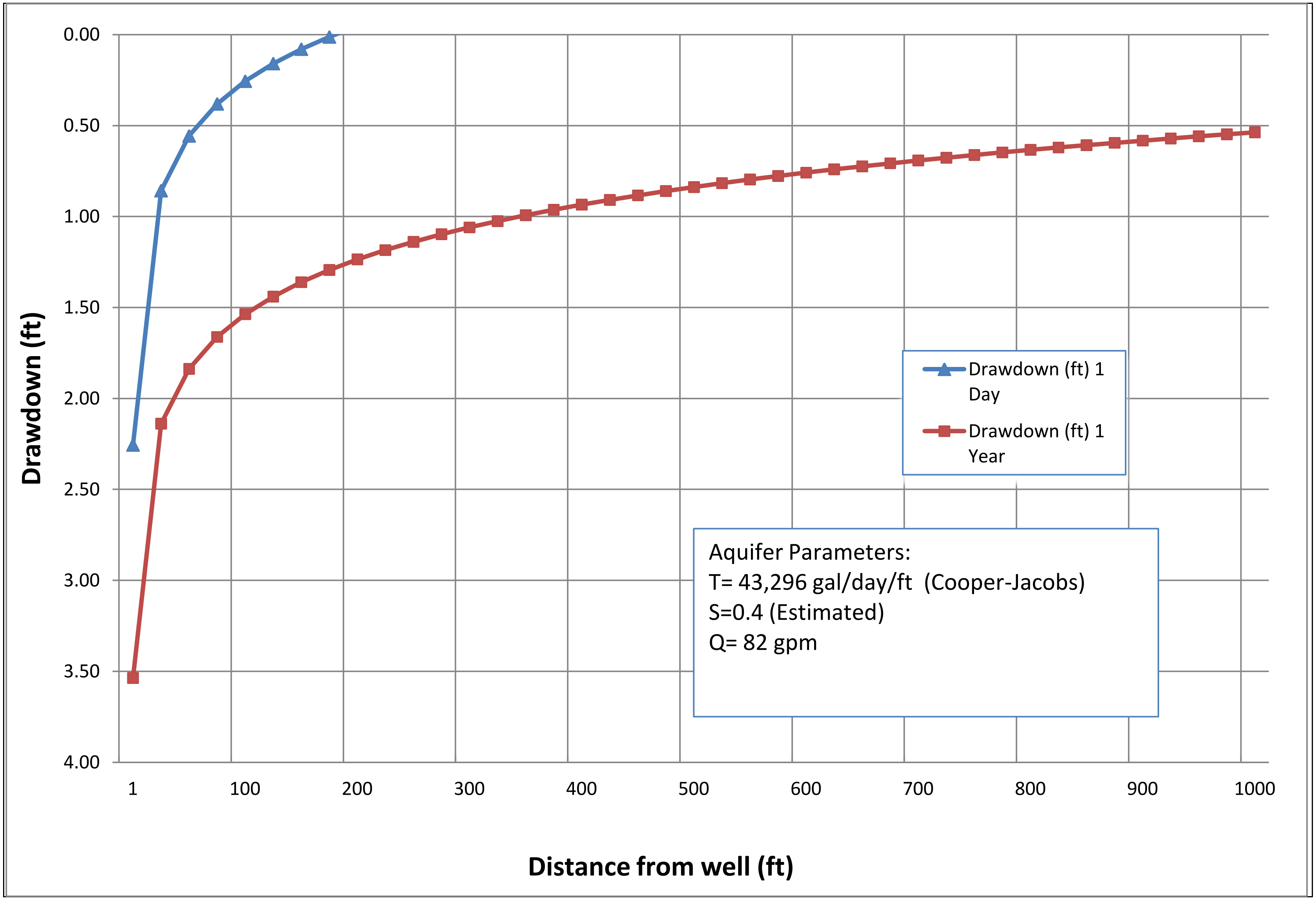


Figure 7: Drawdown Curves for 240 gpm Pumping Rate.

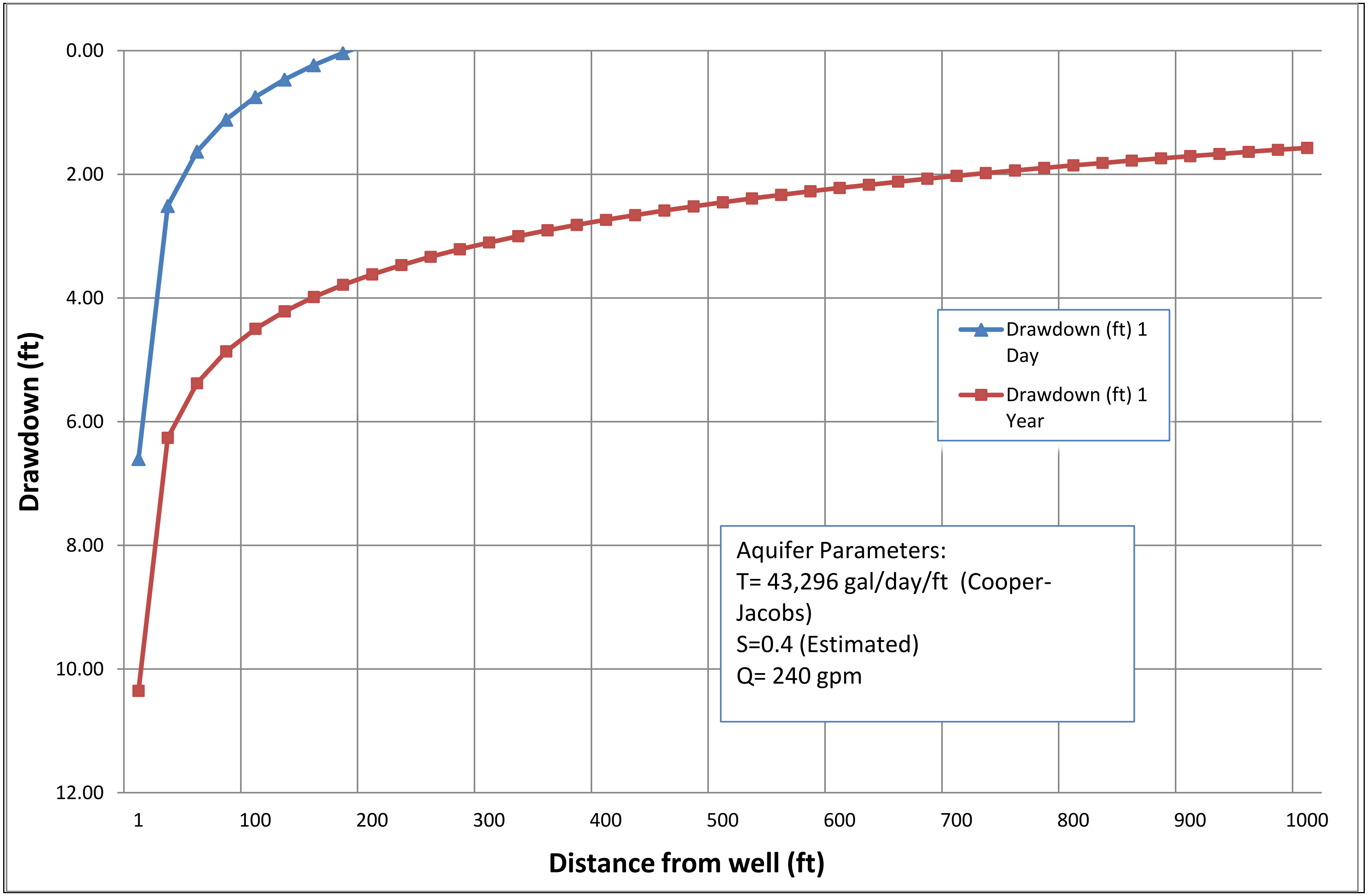
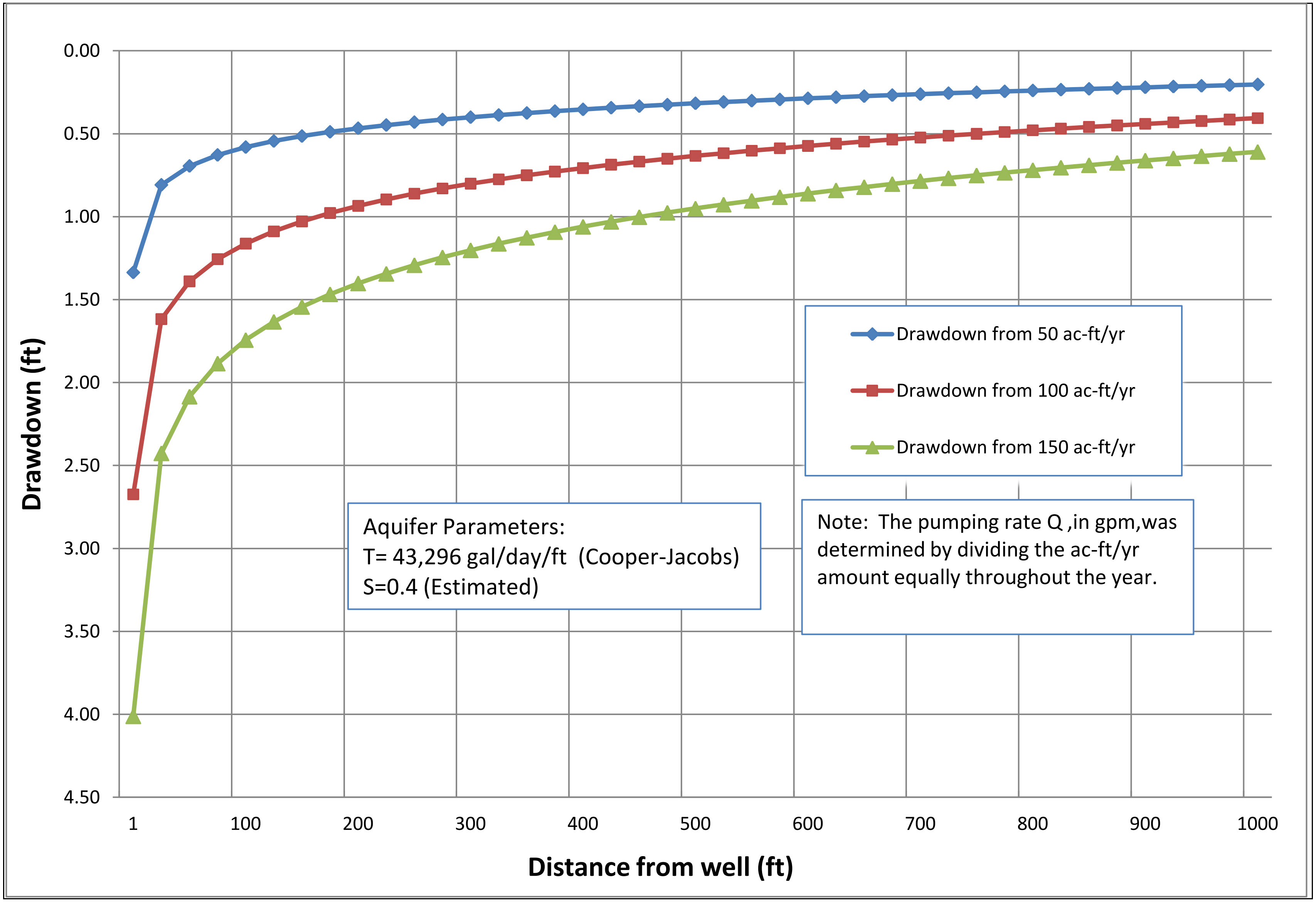


Figure 8: Drawdown Curves for Various ac-ft/yr Amounts.



References

ArcGis -9, ESRI, 2006

Batu, Zedat, “Aquifer Hydraulics”, John Wiley and Sons, 1998.

Geologic Atlas of Texas, Llano Sheet, Virgil E. Barnes Edition, The University of Texas at Austin, Bureau of Economic Geology, 1981.

Geologic Atlas of Texas, Llano Sheet, Virgil Everett Barnes Edition, The University of Texas at Austin, Bureau of Economic Geology, 1986.

Geologic Map Database, Douglas B. Stoeser, Nancy Shock, Gregory N. Green, Gayle M. Dumonceaux, and William D. Heran, Based on Barnes 1992 Geologic Map of Texas, 2007.

Kresic, Neven, “Hydrogeology & Groundwater Modeling”, 2nd Edition, CRC Press, Boca Raton, Florida, 2007.

Westward Environmental, Inc., “Hydrogeologic Report Collier Materials Tract Marble Falls, Burnet County, Texas”, Project Number 10553-003, Prepared for Lower Colorado River Authority, Austin Texas, May 2009.