Water in Supper

The District's Board maintains a strong committment to public education. One of the goals of education is communicating how important water is for each of our daily lives. Every person depends on water for survival.

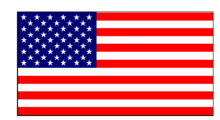
In the February issue of Furrow magazine, an article by Larry Reichenberger entitled "How Much Water is in Supper?" documents how much water is used in an average American meal.

Ice Cream	143 gallons
8 ounce steak	2,600 gallons
Glass of milk	65 gallons
Green beans	21 gallons
Mashed potatoes	57 gallons
Butter	92 gallons
Salad	5 gallons
A roll	15 gallons
Total	**2,998 gallons**

Calendar of Events

Sept. 6	*Labor Day Office Closed*
Sept. 7	*Board Meeting 1:30 pm District office*
Oct. 5	*Board Meeting 1:30 pm District office*
Nov. 2	*Board Meeting 1:30 pm District office*
Nov. 2	*Election Day*

Don't Forget to Vote



SOUTH PLAINS GROUNDWATER NEWS is published by the SOUTH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT, PO Box 986, 802 Tahoka Road, Brownfield, TX 79316. Directors: Dan Day, Doyle Moss, Scott Hamm, Matt Hogue, Larry Yowell; General Manager: Jason Coleman; Administrative Assistant: Lindy Harris. Subscriptions are free upon request.
Phone: (806) 637-7467
FAX: (806) 637-4364
E-mail: spuwcd@spuwcd.org
Web Address: www.spuwcd.org

SOUTH PLAINS GROUNDWATER NEWS

SOUTH PLAINS UNDERGROUND WATER
CONSERVATION DISTRICT
PO BOX 986
BROWNFIELD, TX 79316

ADDRESS SERVICE REQUESTED

BULK RATE
U.S. POSTAGE
PAID
PERMIT NO. 986
BROWNFIELD, TX

In this issue…

SOUTH PLAINS GROUNDWATER NEWS

AUGUST 2004 VOLUME 11, NUMBER 4

UNDERSTANDING THE OGALLALA
PART 3–WELL YIELDS

Note: This is the third article of the series entitled "Understanding the Ogallala".

The previous two articles the District has published in this series have included the origin of the Ogallala and groundwater movement. Educating ourselves, district constituents and others regarding this vast aquifer is a continuous process. As more information is revealed, we have a better understanding of more complicated aquifer concepts, although this understanding is far from complete.

The data presented here is specific to the SPUWCD, although much of it may also characterize other portions of the aquifer. Analysis of well data during periods of pumping serves as the basis for a better understanding of well hydraulics. This article contains an analysis of general features of the aquifer which affect a well's ability to yield a desired amount of groundwater.

The analysis presented within is divided into two sections. The first section includes a review of concepts presented in the last article, and how those affect well yields. The second section incorporates some examples of various declining well yields within the District.

Recall that the term hydraulic conductivity describes the capacity of a porous medium to transmit water. For example, large, coarse rocks exhibit higher hydraulic conductivity compared to a tightly cemented sand. This illustration occurs quite frequently, the result of which is observed when the wells are pumped. If the saturated thickness of the aquifer is equal for both wells, the well with higher hydraulic conductivity has a higher yield, or rate of production. However, it is also true that a well with a lower hydraulic conductivity may have a higher rate of production than the other, if the saturated thickness is sufficiently higher. This scenario is presented in Table 1.

K (ft/day)	B (ft)	Q (gpm)	Q/s (gpm/ft)
50	20	111	5.57
	40	446	11.15
	60	1003	16.72
25	20	56	2.79
	40	223	5.57
	60	502	8.36
15	20	33	1.67
	40	134	3.34
	60	301	5.02
5	20	11	0.56
	40	45	1.11
	60	100	1.67

where: K= hydraulic conductivity in feet per day
B= saturated thickness in feet
Q= well yield in gpm
Q/s= specific capacity of the well in gpm per foot

Table 1

Here, four different values of hydraulic conductivity (K) are given, each of which is representative of certain portions of the aquifer. By no means are these values the only representation of hydraulic conductivity observed within the District. However, because these values are frequently observed, this range is representative for much of the District. Now, for each corresponding K is given a saturated thickness (B). The three values of saturated thickness shown are the most common within the district. In fact, much irrigated land here overlies portions of the aquifer containing forty feet of saturated thickness. The comparisons shown in Table 1 indicate a maximum rate of production for each

Ogallala...continued on page 2

Ogallala Formation

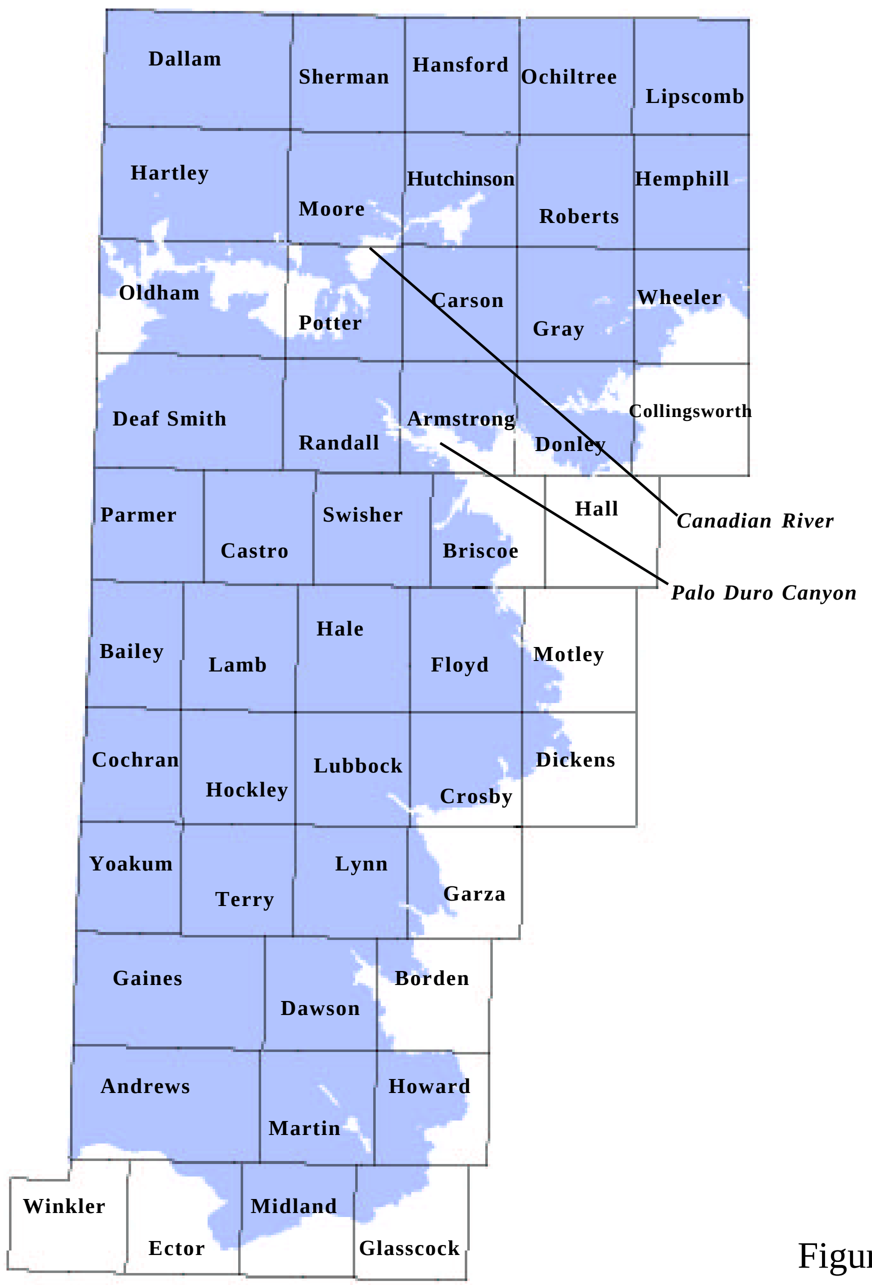


Figure 1

Ogallala...continued from page 1

scenario. Notice that the well with K=50 ft/day and B=40 ft has a potential for producing 446 gpm. Conversely, a well with K=25 ft/day and B=60 ft may produce a maximum of approximately 502 gpm. This comparison illustrates the interaction of several variables when determining well yields. Also shown in Table 1 is a variable defined as Q/s, which is termed specific capacity. Specific capacity is calculated by dividing the well's production rate by the measured draw down. The units of this calculation are gpm/ft. Specific capacity is used quite often as a tool for analyzing other aquifer parameters. Additionally, changes in specific capacity observed over time may help diagnose well problems, some of which may be corrected using rehabilitation methods. Often, changes in specific capacity are due to declining water levels.

One of the more troublesome issues facing our irrigated producers is the declining well yields over the past ten years. It is not uncommon to hear reports of yields declining from 300-400 gpm to 100-150 gpm. Also, producers often report that the best wells seem to have exhibited the greatest drop off. Prevailing wisdom suggests that declining well yields are primarily a result of water level declines. Is it possible that this magnitude of decline is likely to continue? Examining the information previously discussed provides us some understanding of this question.

In response to the first issue, it is possible that pronounced declines of well yields may result from water level declines of the severity we have experienced. Notice in Table 1 that when K=50 ft/day and B=60 ft, the well could theoretically produce about 1,000 gpm. Now, if the saturated thickness is only 20 ft, the well's production may only be 111 gpm! This correlates to an approximate 90% reduction in yield. This example is not unrealistic, considering there are areas that have experienced over 40 feet of decline during the last decade.

The District's water level measurements indicate the areas experiencing the most significant declines are often the same areas where well yields were once greatest. However, since production capabilities have decreased, water level declines have also slowed in many of these cases. Alternatively, the opposite scenario is often observed in areas where well yields have traditionally been moderate. Specifically, consider a well where K=15 ft/day and B=60 ft (see Table 2). Initially, the theoretical maximum production is about 300 gpm. Also, suppose the water level declines over 10 years amount to 10 ft. In this example, the decline in production is about 31%. While this is still not desirable, it is not as severe as the 90% reduction in the former example. Figure 2 contains the data for approximate changes in production expected for varying amounts of saturated thickness. Also, Figure 2 is useful when examining the effects of declining saturated thickness. Four values of hydraulic conductivity are plotted over the range of 20-60 ft of saturated thickness. Again, note the sharp drop in production for a well where K=50 ft/day. Additionally, notice the trends of well yields as the saturated thickness approaches 40 ft and less. The separation between the lines narrows quite noticeably. When the saturated thickness is 40 ft, the difference in well yields for K=50 ft/day and K=25 ft/day is about 225 gpm. Then, when the saturated thickness declines to 30 ft, the difference is about 125 gpm. At 30 ft or less of saturated thickness, only areas where hydraulic conductivity is 50 ft/day (or greater) can a well yield more than 200 gpm.

Finally, predicting the future magnitude of decline in well yields may be estimated, but certain limitations may prevent the estimate from being very accurate. If the study area is one in which reliable data exists, the estimate is much more likely to be realistic. Absent of nearby data, at best the estimate may simply be a guess. It appears that the magnitude of declining well production **may** not be as severe for the near future. This is because the reduced well yields may prevent declines from being as severe as once observed.

One thing is certain, though, which is illustrated quite simply in both Figure 2 and Table 2: water well yields will continue declining when saturated thickness decreases. These declines may not be as large as previous ones, but the loss of any production is significant, especially at lower levels of available saturated thickness.

Evaluating well data is a complicated process that requires patience, a commitment to understanding, and some assumptions. The available pumping test data compiled by the District offers additional understanding of the dynamic conditions within the aquifer. Areas of sparse data are not understood very well. The largest decline in production is often observed where well yields were once the greatest. Future water level declines will result in additional losses of productivity, although these may not be as severe as once experienced.

When K=15 ft/day

B (ft)	Q/s (gpm/ft)	Q (gpm)
60	5.02	301
58	4.85	281
56	4.68	262
54	4.51	244
52	4.35	226
50	4.18	209
48	4.01	193
46	3.85	177
44	3.68	162
42	3.51	147
40	3.34	134
38	3.18	121
36	3.01	108
34	2.84	97
32	2.68	86
30	2.51	75
28	2.34	66
26	2.17	57
24	2.01	48
22	1.84	40
20	1.67	33

Table 2

Board Approves Rule Changes

Following an invitation for public comment, the District's Board of Directors approved several rule changes during the August 3, 2004 meeting. During the past 10 months, the Board has evaluated several rule changes, and worked with the staff to address those areas of need. The last changes made to the District's rules were in 1999. The adopted changes mainly deal with administrative procedures. The following summary provides an overview of the rules which were changed.

Section 5—Simplification of language defining wells exempt from permitting.

Section 6—Changes the length of time for deposits to be refunded to 120 days.

Section 9—Clarification of permitting and approval process and time permits are valid.

Section 11—Addresses water quality when drilling into formations beneath the Ogallala.

Section 12—Qualifications for replacement well state the well must have been drilled and/or equipped as an irrigation well.

Section 13—Removes the portion requiring annual irrigation system registration.

Section 14—Replaces existing language (regarding waste) with language from Ch. 36, TWC.

Section 16—Shorter, more concise language regarding hearings.

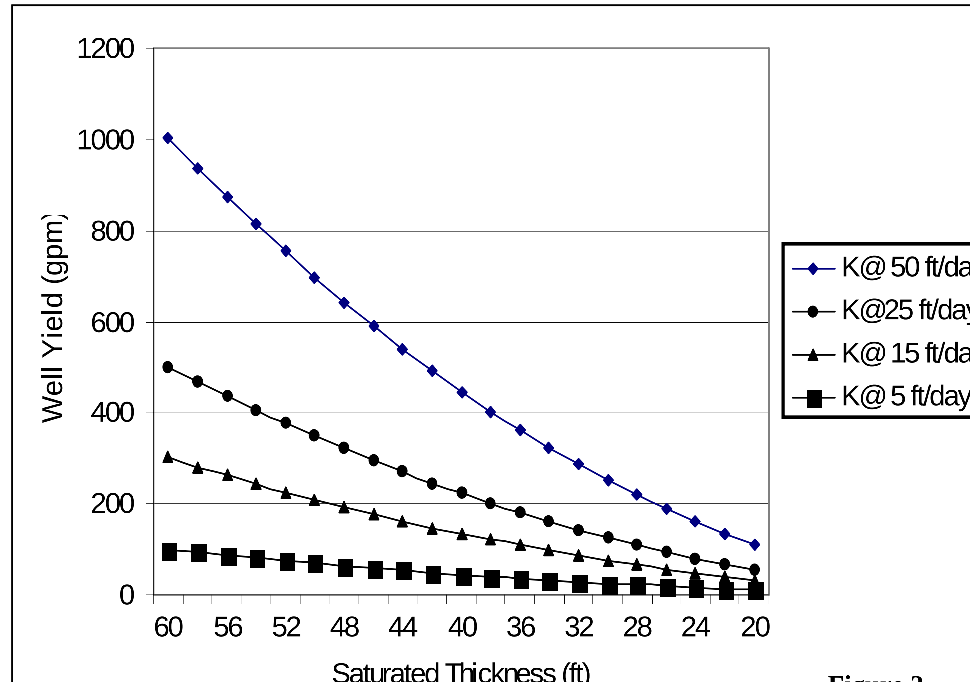


Figure 2