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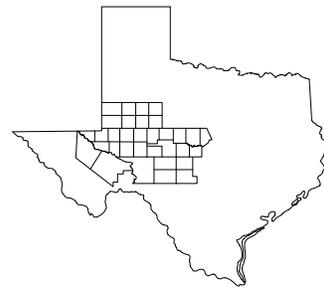
**IRRIGATION
SURVEY**

Glasscock, Midland,
Reagan, Pecos, Reeves
and Tom Green
Counties

April 2009

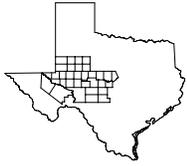
Prepared for

Region F Water
Planning Group



CMD07215

**Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.**



**IRRIGATION SURVEY
Glasscock, Midland, Reagan, Pecos, Reeves and Tom Green Counties**

April 2009

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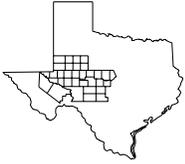
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IRRIGATION SURVEY

1 EXECUTIVE SUMMARY

Irrigation water use represents the largest demand category in Region F, and in the 2006 Water Plan there were significant unmet irrigation needs. Conservation was identified as the primary means to meet these needs but more information is needed to accurately quantify the projected water savings. This Irrigation Survey was conducted to better define historical irrigation data, identify data gaps in irrigation data that are needed to reasonably project future irrigation water use and identify means to collect the information needed to close those gaps. Six counties were selected for this survey: Glasscock, Midland, Reagan, Reeves, Pecos and Tom Green. These counties represent over 70 percent of the irrigation demand in the 32-county region, and 76 percent of the irrigation shortage¹.

Data were collected from available sources and compiled for review by county. Region F planning group members and interested public actively participated in providing and reviewing the available data. Of the ten sources contacted for data, four sources provided quantifiable data on historical water use and crop types: Texas Water Development Board (TWDB), Farm Service Agency, National Agricultural Statistical Services and members of the Irrigation Work Group (these members also represent groundwater conservation districts). The Environmental Quality Incentives Program (EQIP) and the TWDB also provided some data on irrigation equipment.

Irrigation data reported by the different sources are generally consistent with a few notable exceptions. The largest differences are based on the reporting categories (variety and types of crops reported as irrigated). For counties with few major crops, such as Glasscock and Reagan Counties, the differences are relatively small. For counties with wide varieties of crops or non-major crops, the differences are greater. The TWDB provides the most comprehensive data on irrigation. While this data represent the best available information it is at best an estimate of the irrigation water used in the study area. The data reported by these agencies are not metered water use and are based on application practices and crop types. Actual water use may differ significantly from one irrigator to the next.

The percentage of irrigated acres using high-efficiency irrigation methods are increasing in the six counties. The Irrigation Work Group data indicate over 90 percent of the irrigated acres in Glasscock County currently use either sprinkler or drip irrigation, which is up from 45 percent in 2000. In Reagan County 75 percent of the crops are irrigated using either sprinkler or drip. These percentages are considerably higher than the assumed adoption rate in the 2006 Region F water plan. However, there were limited data on type of equipment in other counties. Working with the EQIP program and local groundwater conservation districts may provide additional information.

Based on the findings of this study, it is recommended that the Region F regional water planning group continues to collect and monitor historical irrigation water use data to adequately plan for agricultural water needs. Additional information is needed regarding the implementation of conservation equipment. Where possible, conservation savings for irrigation should be refined for the 2011 Region F water plan to reflect current conservation equipment adoption rates.

2 INTRODUCTION

The 2006 Region F Regional Water Plan indicates there will be substantial unmet water supply needs for irrigation, particularly in the western portion of the region². Conservation will be the priority strategy for meeting those needs, but it was determined during the 2006 Region F planning period that more accurate information is needed regarding the number of acres irrigated, the type of crops, and the type of equipment used. As the largest demand category in Region F, accurate information on irrigated agriculture is of great concern to the Region F Water Planning Group.

Six counties were selected as the study area for the Irrigation Survey. These counties, Glasscock, Midland, Reagan, Reeves, Pecos and Tom Green, represent over 70 percent of the irrigation demand in the 32-county region, and 76 percent of the irrigation shortage¹. This study focuses on collecting and summarizing existing information on irrigated agriculture in the study area and identifying gaps or inaccuracies in the data. These data will be used to refine and further develop irrigation demand projections and conservation strategies for future water plans.

2.1 Authorization and Objectives

This study was authorized by the Region F Regional Water Planning Group and is funded through a Research and Planning Grant sponsored by the Texas Water Development Board.

The Irrigation Survey attempts to address several concerns raised during the development of the 2006 Region F Water Plan. These concerns include the accuracy of the irrigation data published by the Texas Water Development Board and the availability of county-specific data. Some of the data, particularly on the types of irrigation equipment in use, are not readily available, are out-of-date, or do not fit the experience of conservation district or irrigated agriculture representatives on the Region F Water Planning Group. The objectives of this study are to review and better define historical irrigation data, identify data gaps in irrigation data that are needed to reasonably project future irrigation water use and identify means to collect the information needed to close those gaps.

3 METHODOLOGY

The Region F Water Planning Group established an Irrigation Work Group to facilitate the collection and review of the data for this study. Work Group members included planning group members and interested public. A list of the members of the Irrigation Work Group is shown on Table 3-1.

Readily available data on historical irrigation water use, crop types, sources of water and locations of use were compiled and presented to the Irrigation Work Group. With direction from the Work Group, data were sought from the Texas Water Development Board (TWDB), the Natural Resource Conservation Service (NRCS), the Farm Service Agency (FSA), the Environmental Quality Incentives Program (EQIP), the State Conservationist, the National Agricultural Statistics Service (NASS) and the United States Department of Agriculture (USDA). The county offices of the Texas Cooperative Extension Service were also contacted to identify any data they collect. Work Group members provided data for Glasscock and Reagan County.

**Table 3-1
Irrigation Work Group**

| Work Group Member | Representing |
|----------------------------|---------------------|
| Ricky Harston (Vice-Chair) | Glasscock GCD |
| John Evridge | Public |
| Lynn Halfmann | Public |
| Paul Weatherby | Middle Pecos GCD |
| Woody Anderson | Agriculture - RWPG |
| Ken Carver | Martin County |
| Allan Lange (Chair) | Lipan-Kickapoo WCD |
| Ken Dierschke | Agriculture - RWPG |
| Joe David Ross | Sutton County |
| John Grant | Region - Chairman |
| Will Wilde | Tom Green County |

3.1 Sources of Data

Texas Water Development Board (TWDB) – The TWDB has historically compiled irrigation data collected through irrigation surveys conducted by the Natural Resources Conservation Service (NRCS) and Texas Agricultural Statistics Service (TASS). Year 2000 was the last year that the NRCS conducted irrigation surveys. After 2000, the TWDB³ computed estimated irrigation water use from data obtained from the USDA- Farm Service Agency, Texas Commission on Environmental Quality, and survey data from groundwater conservation districts and irrigation districts.

Natural Resources Conservation Service (NRCS) –The NRCS⁴ has not collected irrigation data since the irrigation survey in 2000. The data from the last survey in 2000 were provided to the TWDB. It was recommended that the FSA state office be contacted for the irrigation data they collect. All of the previous NRCS data could be located through the Surveys of Irrigation in Texas⁵

Farm Service Agency (FSA)–The state FSA⁶ office collects data for irrigated acres for all land enrolled in FSA programs. FSA data only includes acres enrolled in FSA programs. If a landowner is not enrolled in an FSA program their crops would not be reported. Thus the FSA data may not include every irrigated acre within a county. Based on the conversation with the FSA most of the landowners in these counties are enrolled in FSA programs. FSA provided irrigation data for the study counties from 2000-2007. The FSA does not collect data on the type of irrigation equipment used or the amount of water applied.

Environmental Quality Incentives Program (EQIP) – The national EQIP⁷ program provided data on enrollment in their programs. Seven programs are offered by EQIP in Texas with only four programs used in the study area. The four programs are: Micro-Irrigation Systems, Surface and Subsurface Irrigation Systems, Sprinkler Irrigation Systems and Irrigation System Management. The irrigation method in each of these programs as defined by EQIP can be found in Section 4.4. The data show the number of acres enrolled in each county by year from 2004 to 2007. The data do not indicate the types of crops irrigated and are not cumulative, reporting only new enrollment in the program each year.

State Conservationist⁸ –The State Conservation has not collected irrigation information or performed a survey since 2000. It was recommended that the FSA and the state office for the National Agricultural Statistics Service (NASS) be contacted for irrigation data.

National Agricultural Statistics Service (NASS)⁹ –The agency collects surveys from farmers and calculates irrigated acres for crops within a county based on their responses. The data for the survey counties were collected back to the 1970's. The NASS does not collect data on the type of irrigation equipment used or the amount of water applied. NASS has state offices, which act as liaisons for the agency but the state office is not responsible for maintaining the databases. In Texas, the state agency is called Texas Agricultural Statistics Service (TASS).

United States Department of Agriculture (USDA) – The USDA conducts a National Survey of Agriculture every five years. The survey provides information on the total number of irrigated acres in a county. The 2002 survey is listed for comparison. The 2007 survey has not been published at this time. The survey only includes the irrigated acres by county, not the type of irrigation method or the amount of water applied

Texas Cooperative Extension Service – The county extension offices were contacted. Local agents do not collect irrigation data and they suggested contacting other agencies listed above.

Region F Irrigation Work Group – The Glasscock County Groundwater Conservation District provided data in the same format as the TWDB data for Glasscock and Reagan Counties for 2007¹⁰. The data provided included irrigated acres by crop type, water use and type of irrigation equipment used.

Groundwater Conservation Districts – Four groundwater conservation districts (GCD) serve the six counties in this study. They are the Glasscock GCD, Lipan-Kickapoo WCD, Middle Pecos GCD and the Santa Rita UWCD. The Glasscock GCD, Middle Pecos GCD and the Santa Rita UWCD have provided data for the study.

3.2 Irrigated Acres and Type of Crops

Three agencies collect data on the types of crops irrigated in the six counties of the irrigation survey. The difficulty with comparing the data on irrigated acres from each agency is in their classification of crop types. Table 3-2 below shows the crop type categories for each agency.

**Table 3-2
Type of Irrigated Crops Reported by Agency**

| | TWDB | FSA | NASS | Irrigation Work Group |
|---|-------------|------------|-------------|----------------------------------|
| Irrigated Acres by Crop Type^a | X | X | X | X |
| cotton | X | X | X | X |
| rice | X | X | | X |
| forage crops | X | X | | X |
| other oil crops | X | X | | X |
| vineyard | X | X | | X |
| hay-pasture | X | X | | X |
| vegetables (shallow) | X | X | | X |
| grain sorghum | X | X | X | X |
| wheat | X | X | X | X |
| peanuts | X | X | | X |
| citrus | X | X | | X |
| other orchard | X | X | | X |
| sugar beets | X | X | | X |
| vegetables (deep) | X | X | | X |
| corn | X | X | X | X |
| other grain | X | X | X | X |
| soybeans | X | X | | X |
| pecans | X | X | | X |
| alfalfa | X | X | | X |
| Irish potatoes | X | X | | X |
| sugarcane | X | X | | X |
| failed acres | X | X | | |
| all other crops ^b | X | X | | X |
| waste water | X | | | |

- a. These reporting categories shown in the above table are for recent reporting years.
- b. Golf course water use is reported as irrigation use by the TWDB if the golf course has its own source of water. If the water is provided by a municipal provider, it is reported as municipal use.

Table 3-2 shows that the TWDB and the FSA crop list are similar with one additional category recorded by the TWDB. The category is waste water which several counties use for irrigation purposes. It is important to note that the failed acres category includes pre-irrigated dry-land cotton as well as acres that may have initially been irrigated, but failed to make a crop. In recent years, the NASS classifies only five crops in the six counties as irrigated crops. In certain cases the NASS showed a total for a crop and a non-irrigated total. The irrigated acres were calculated by subtracting the non-irrigated acres from the total acres.

The numbers of irrigated acres by crop type and the total irrigated acres per county for each of these agencies were compared in tables and graphically to identify trends and consistency amongst the agency data. In order to create parity between the agencies with different classifications of crop type, five crops were selected for individual analysis: Cotton, Corn, Wheat, Sorghum, and Pecans. Alfalfa was added for Pecos and Reeves counties due to the significant amount of irrigated acres of this crop in those counties. Additional crops were combined into an “Other” category which is shown graphically for each county. The graphs for each crop type in the six counties can be found in Appendix A.

Section 4.1 summarizes the data on irrigated acres for each county.

3.3 Irrigation Water Use

While not a part of the irrigation survey, the amount of water used for irrigation was provided by the TWDB³ and the Irrigation Work Group¹⁰. TWDB estimates water use for each crop using a water use factor. The water use factor varies by crop and county due to varying climatic conditions. The number of irrigated acres is then multiplied by the crop water use factor resulting in the water use in Acre-Feet. This methodology to estimate irrigation water has evolved over time, leading to some of the apparent discrepancies in historical trends. According to the TWDB, irrigation water use reported prior to 2003 was estimated using an average representative use factor expressed in inches per acre per crop type. Sources of the acreages and crop types were from the NRCS and TASS. The total irrigation water use reported by the TWDB Conservation Section was for on-farm use and did not reflect transmission losses associated with surface water sources.¹¹ [Note: Historical water use reports that include other use categories (such as municipal, manufacturing, etc.) do include the transmission losses associated with

irrigation use.] Beginning in 2003 the TWDB began to consider theoretical Potential Evaporation-Transpiration (PET) values in the irrigation use estimates. Also, since the NRCS no longer provided irrigation data, the primary source for acreages and crop types was the FSA. The TWDB also began to incorporate surface water diversion data to estimate transmission losses. Since 2003, the estimates of surface water use include distribution losses between diversion and delivery to farms. These data are reviewed by local groundwater conservation districts and irrigations districts before it is published. A memo describing the methodology used by TWDB to calculate irrigation can be found in Appendix B.

Water use estimates from the Irrigation Work Group were also calculated using crop acreages, type of crops and representative water use factors. The data were then compiled into a table by year and shown graphically. The projected irrigation demand in each county from the 2006 Region F Water Plan for 2010, 2020 and 2030 was included for comparison.

The actual water use data may be found in Section 4.1.

3.4 Sources of Water

While gathering data for irrigated acres and crop type, the TWDB also indicates the source of water, whether surface water, ground water or waste water. As part of this study, the source of water was identified for each county using information from the Region F Plan and the Texas Commission on Environmental Quality (TCEQ). Specific information on sources of water is found in Section 4.2.

3.5 Location of Use

Detailed maps were developed displaying the location of irrigation use for each of the six study counties as part of the NRCS irrigation surveys in 1994 and 2000¹¹. Comparison of the 2000 map to 1994 map shows little change in irrigated acres. Figures 4-19 through 4-22 are the maps created for this study. Appendix C contains the year 2000 maps from TWDB.

3.6 Summary of Data Sources

Of the nine entities contacted for irrigation data, data were available from five sources, including members of the Irrigation Work Group. Data were collected from the Texas Water

Development Board (TWDB), the Farm Service Agency, the National Agricultural Statistics Service (a branch of the Natural Resources Conservation Service), and the Environmental Quality Initiatives Program (EQIP). Supplemental data were provided by the Irrigation Work Group. Table 3-3 below shows a matrix of each source and the irrigation data available through that source.

**Table 3-3
 Currently Available Data by Agency^a**

| | TWDB | FSA | NASS | EQIP | Irrigation Work Group |
|-------------------------------------|-------------|------------|-------------|-------------|------------------------------|
| Irrigated Acres by Crop Type | X | X | X | | X |
| Water Use | X | | | | X |
| Source of Water | X | | | | |
| Location of Use | X | | | | |
| Irrigation Equipment Used | X | | | X | X |

a. NRCS no longer collects irrigation data. Historical data previously collected by NRCS were provided to the TWDB.

4 RESULTS

4.1 Irrigated Acres

The data were collected and compiled into a database for comparison. For each of the six counties in the study area, the total irrigated acres by county are shown graphically by year. The graphs show the irrigated acres from 1957 to 2007, a 50-year period. The irrigation water use is included for each county.

The irrigated acres reported by the different data sources vary due to the way the data are reported and what crops are reported. The TWDB attempts to report all acreages that irrigation water is applied, including golf courses in some cases. NASS reports data for only five major crop types, and the FSA reports data only for acreage enrolled in FSA programs. For some counties there will be little differences in the reported acreages because most of the crop types fall into the same reporting category used by the multiple reporting agencies. For counties with considerable acreages in the categories not reported by all the agencies, the differences are greater. Some examples of crops that are not reported by all agencies include vineyards, orchards, grass, and other crops.

4.1.1 Glasscock County

Table 4-1 shows the amount of irrigated acres in Glasscock County for the period 2000-2007. Table 4-2 shows the estimated irrigation water use and the projections from the 2006 Region F Water Plan². Figure 4-1 shows the irrigated acres for Glasscock County and Figure 4-2 shows the calculated water use. The irrigated acres by crop type are shown in Appendix A. Figure 4-3 shows the total number of irrigated acres in 2006 for Glasscock County by each crop type. The TWDB estimates for Glasscock County showed significant increases in irrigated acres between 2003 and 2005 due to a large number of acres classified as failed acres. Failed acres are acres that irrigation water was applied but did not produce a crop. It may also include dryland acreages that a single pre-season wetting application was applied. These acres were not counted in Glasscock County in estimates of irrigated acres from previous years. In many cases the amount of water applied to failed acres is very small. The recently released 2006 acreages from

TWDB, FSA and NASS are in line with what was provided by the Region F Irrigation Work Group.

Table 4-1: Historical Glasscock County Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TWDB | 28,721 | 25,965 | 26,644 | 56,932 | 56,678 | 56,602 | 26,231 | |
| 2002 Ag Census | | | 29,830 | | | | | |
| Region F Work Group | | | | | | | | 26,231 |
| FSA Irrigated Acres | 34,276 | 29,431 | 29,699 | 31,705 | 31,468 | 31,054 | 23,363 | 30,196 |
| NASS Irrigated Acres | 26,800 | 23,500 | 23,900 | 25,700 | 26,400 | 24,200 | 22,500 | |

Shaded cells indicate data are unavailable

Table 4-2: Historical and Projected Glasscock County Water Use (Acre-Feet/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2010 | 2020 | 2030 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TWDB | 35,456 | 25,756 | 26,398 | 45,092 | 44,305 | 44,231 | 45,579 | | | | |
| Region F Work Group | | | | | | | | 45,580 | | | |
| 2006 Region F Projections | | | | | | | | | 52,272 | 51,854 | 51,438 |

Shaded cells indicate data are unavailable

Figure 4-1: Historical Glasscock County Irrigated Acres by Agency

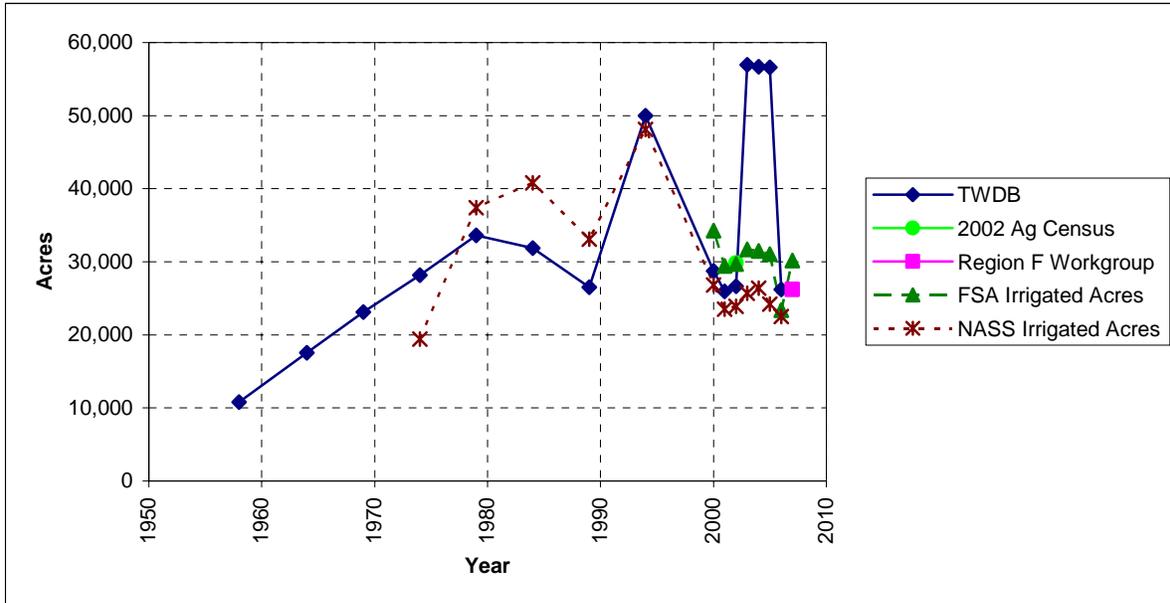


Figure 4-2: Historical and Projected Glasscock County Irrigation Water Use

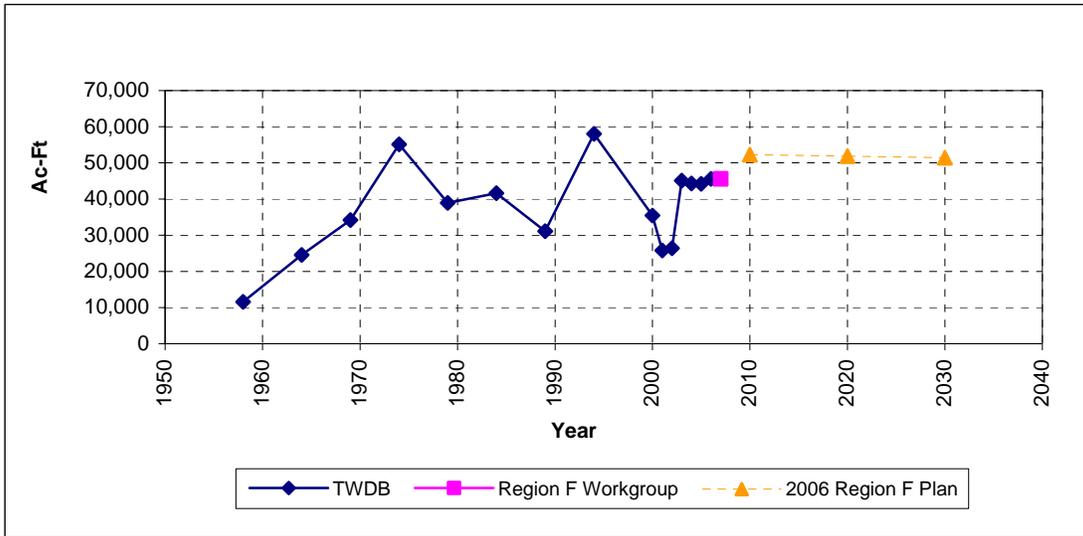
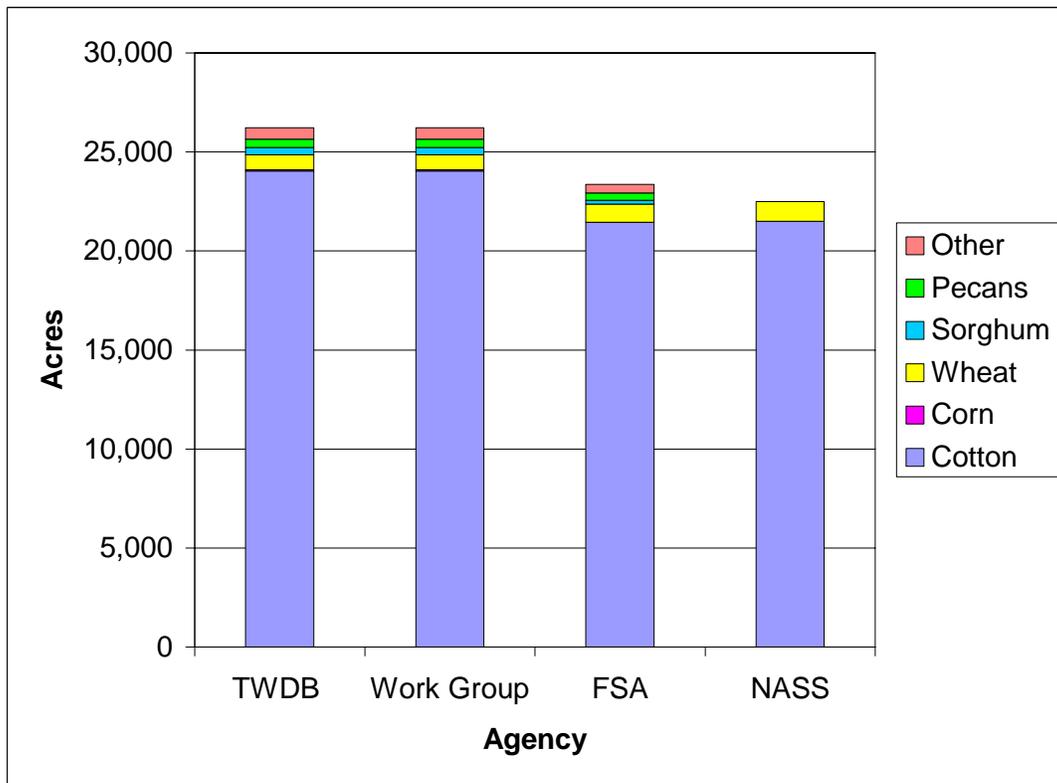


Figure 4-3: Historical Glasscock County 2006 Irrigated Acres by Crop



4.1.2 Midland County

Table 4-3 shows the number of irrigated acres in Midland County from 2000 to 2007. The irrigated acreages for TWDB and the FSA are fairly similar with the TWDB numbers slightly higher. Table 4-4 shows the estimated irrigation water use and the projected irrigation demand. Figure 4-4 shows the number of irrigated acres and Figure 4-5 shows the estimated water consumption. The historical irrigated acres by crop category are shown graphically in Appendix A. Figure 4-6 shows the 2006 total number of irrigated acres using each crop category. Midland is one of the counties using treated waste water in addition to surface and ground water sources.

Table 4-3: Historical Midland County Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 19,525 | 17,255 | 17,012 | 17,121 | 17,709 | 11,962 | 12,395 | |
| 2002 Ag Census | | | 7,355 | | | | | |
| Region F Work Group | | | | | | | | |
| FSA Irrigated Acres | 17,272 | 12,040 | 13,254 | 13,098 | 13,285 | 11,223 | 10,340 | 11,973 |
| NASS Irrigated Acres | 10,800 | 8,000 | 7,800 | 7,800 | 6,300 | 5,700 | 5,700 | |

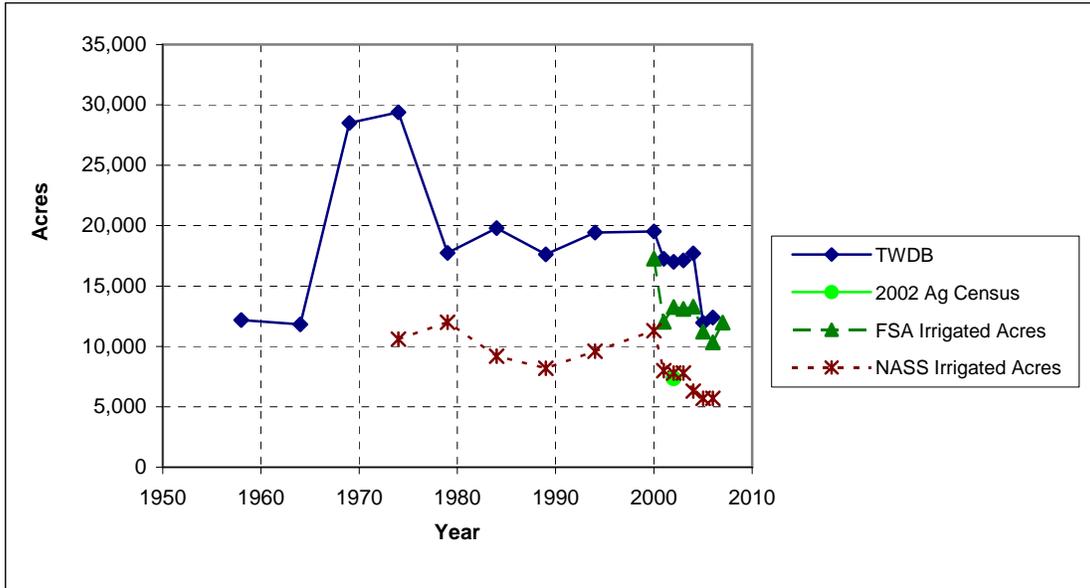
Shaded cells indicate data are unavailable

Table 4-4: Historical and Projected Midland County Water Use (Acre-Foot/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2010 | 2020 | 2030 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 30,483 | 27,710 | 26,187 | 29,065 | 31,364 | 23,027 | 24,687 | | | |
| 2006 Region F Projections | | | | | | | | 41,493 | 41,170 | 40,848 |

Shaded cells indicate data are unavailable

Figure 4-4: Historical Midland County Irrigated Acres by Agency



* Work Group data not available for Midland County

Figure 4-5: Historical and Projected Midland County Irrigation Water Use

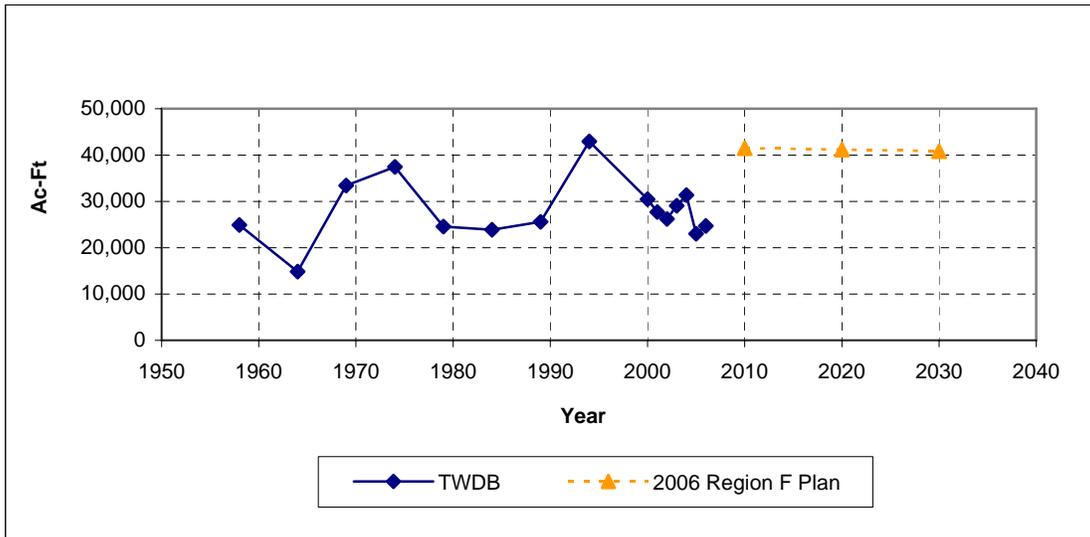
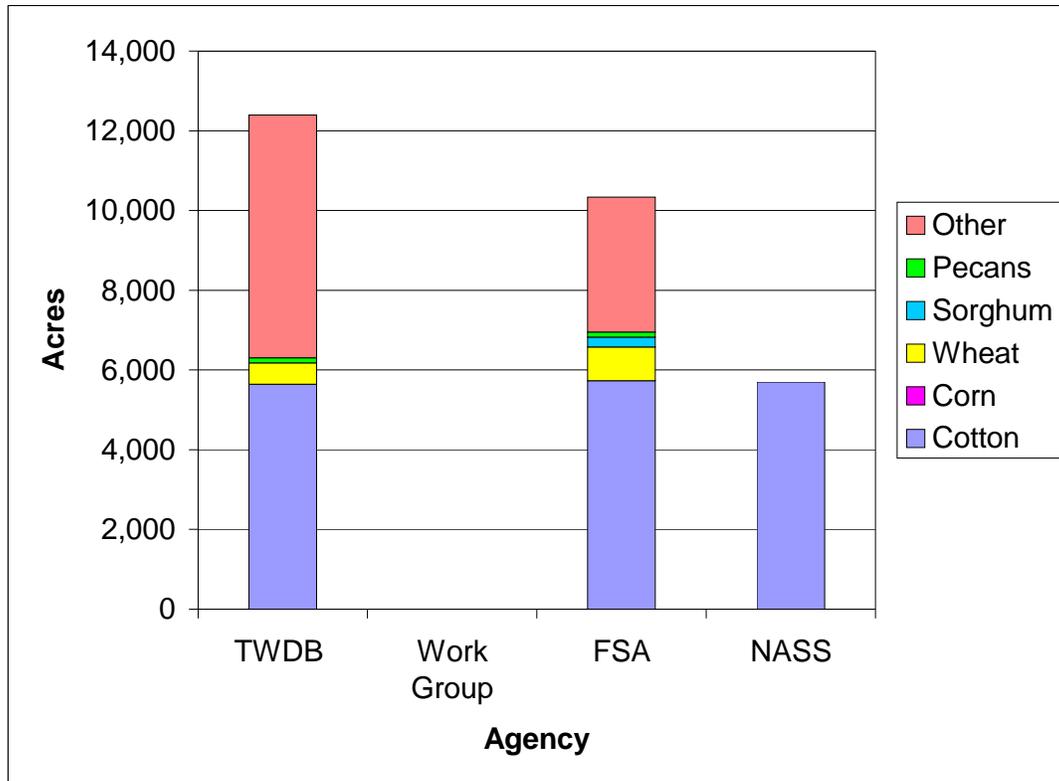


Figure 4-6 Midland County 2006 Irrigated Acres by Crop



* Work Group data not available for Midland County

4.1.3 Pecos County

As shown in Figure 4-7, the amount of irrigated acres in Pecos County has decreased significantly from the historical acreages prior to 1970. Table 4-5 shows the irrigated acres from 2000 to 2007, which generally range from 17,000 to 25,000 acres. Table 4-6 shows the estimated water use from irrigation and the projected irrigation demand. Figure 4-7 shows the irrigated acres from 1957 to 2007 and Figure 4-8 shows the estimated water use. Figure 4-9 shows the 2006 total irrigated acres by crop category. Pecos County uses a small amount of waste water to supplement their other sources.

Table 4-5: Historical Pecos Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 27,644 | 25,744 | 24,104 | 17,202 | 17,974 | 18,843 | 24,455 | |
| 2002 Ag Census | | | 34,321 | | | | | |
| Region F Work Group | | | | | | | | |
| FSA Irrigated Acres | 24,738 | 16,390 | 19,077 | 18,447 | 19,019 | 19,715 | 16,379 | 18,648 |
| NASS Irrigated Acres | 14,600 | 12,300 | 8,900 | 9,000 | 11,800 | 8,100 | 6,200 | |

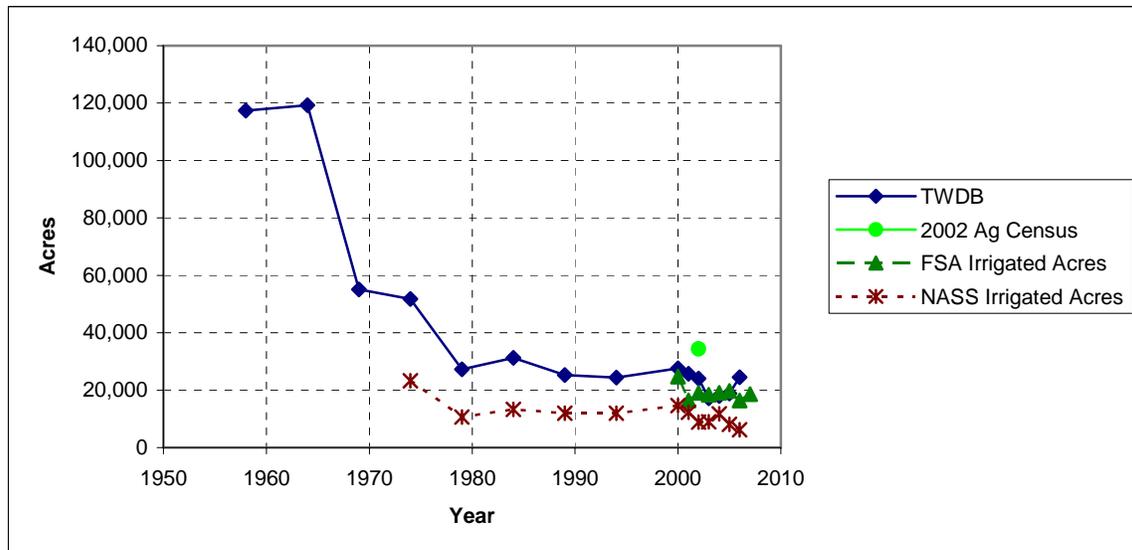
Shaded cells indicate data are unavailable

Table 4-6: Historical and Projected Pecos County Water Use (Acre-Feet/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2010 | 2020 | 2030 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 74,236 | 65,566 | 62,505 | 37,644 | 42,669 | 47,741 | 70,194 | | | |
| 2006 Region F Projections | | | | | | | | 79,681 | 78,436 | 77,191 |

Shaded cells indicate data are unavailable

Figure 4-7: Historical Pecos County Irrigated Acres by Agency



* Work Group data not available for Pecos County

Figure 4-8: Historical and Projected Pecos County Irrigation Water Use

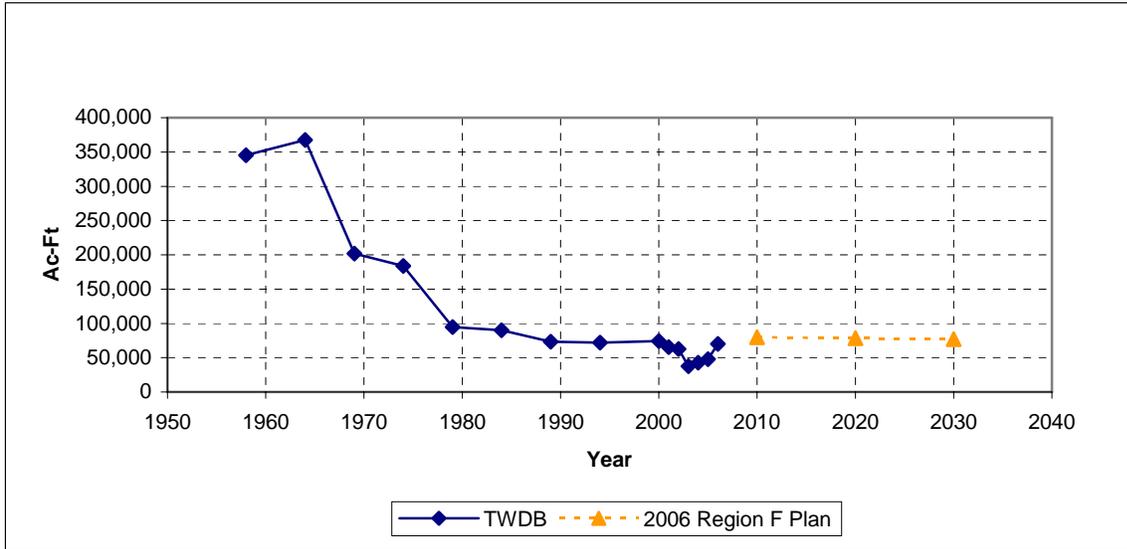
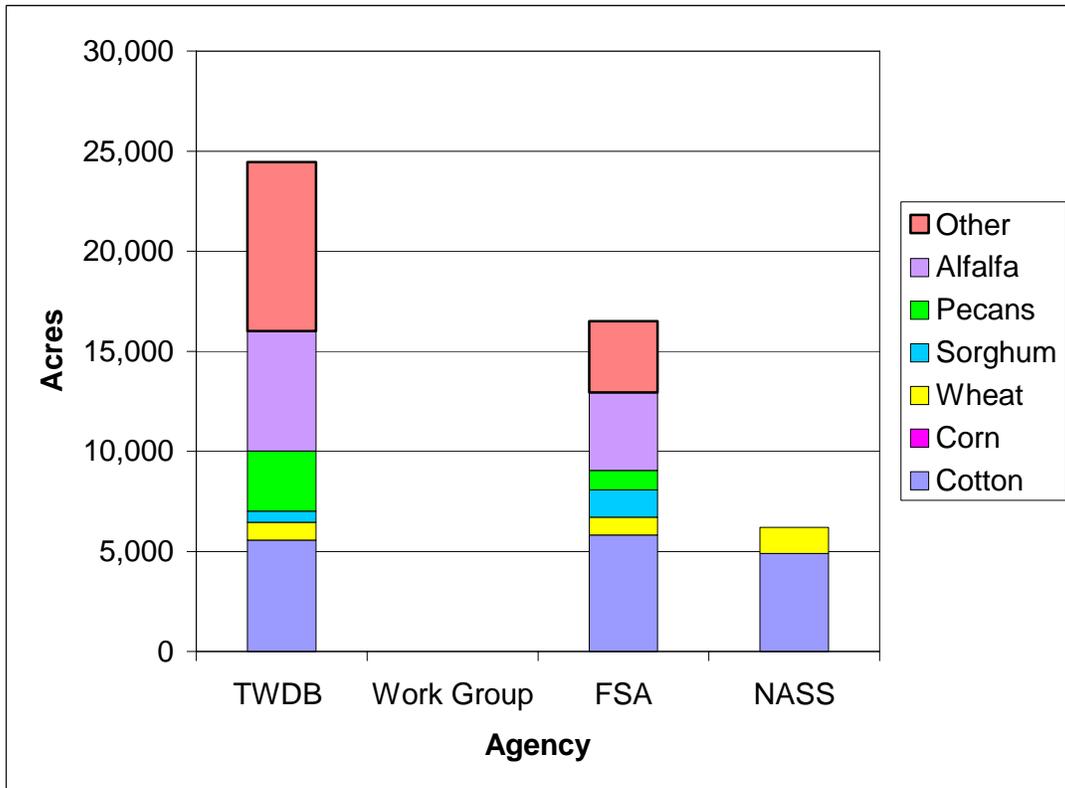


Figure 4-9: Pecos County 2006 Irrigated Acres by Crop Type



* Work Group data not available for Pecos County

4.1.4 Reagan County

The number of irrigated acres in Reagan County for the period from 2000 to 2007 is presented in Table 4-7. Table 4-8 shows the estimated irrigation water use and the projected irrigation demand. As shown in Figure 4-10 the number of irrigated acres in Reagan County had an increase during the 1980s and 1990s, but has declined in recent years. The calculated irrigation water use shown in Figure 4-11 follows the same pattern as the number of irrigated acres. Figure 4-12 shows the 2006 total irrigated acres by crop category. The recently released 2006 acreages from TWDB are in line with what was provided by the Region F Irrigation Work Group. Figures showing irrigated acres by crop type are in Appendix A.

Table 4-7: Historical Reagan County Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|--------|-------|--------|-------|-------|-------|--------|--------|
| TWDB | 12,076 | 8,074 | 10,732 | 7,563 | 7,820 | 9,364 | 11,046 | |
| 2002 Ag Census | | | 10,408 | | | | | |
| Region F Work Group | | | | | | | | 11,046 |
| FSA Irrigated Acres | 10,863 | 7,948 | 10,685 | 7,606 | 7,906 | 9,367 | 9,580 | 11,794 |
| NASS Irrigated Acres | 10,000 | 7,400 | 8,700 | 7,400 | 7,300 | 9,500 | | |

Shaded cells indicate data are unavailable

Table 4-8: Historical and Projected Reagan County Water Use (Acre-Foot/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2010 | 2020 | 2030 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 15,879 | 11,731 | 14,881 | 10,002 | 10,379 | 12,257 | 18,741 | | | | |
| Region F Work Group | | | | | | | | 18,741 | | | |
| 2006 Region F Projections | | | | | | | | | 36,597 | 35,990 | 35,385 |

Shaded cells indicate data are unavailable

Figure 4-10: Historical Reagan County Irrigated Acres by Agency

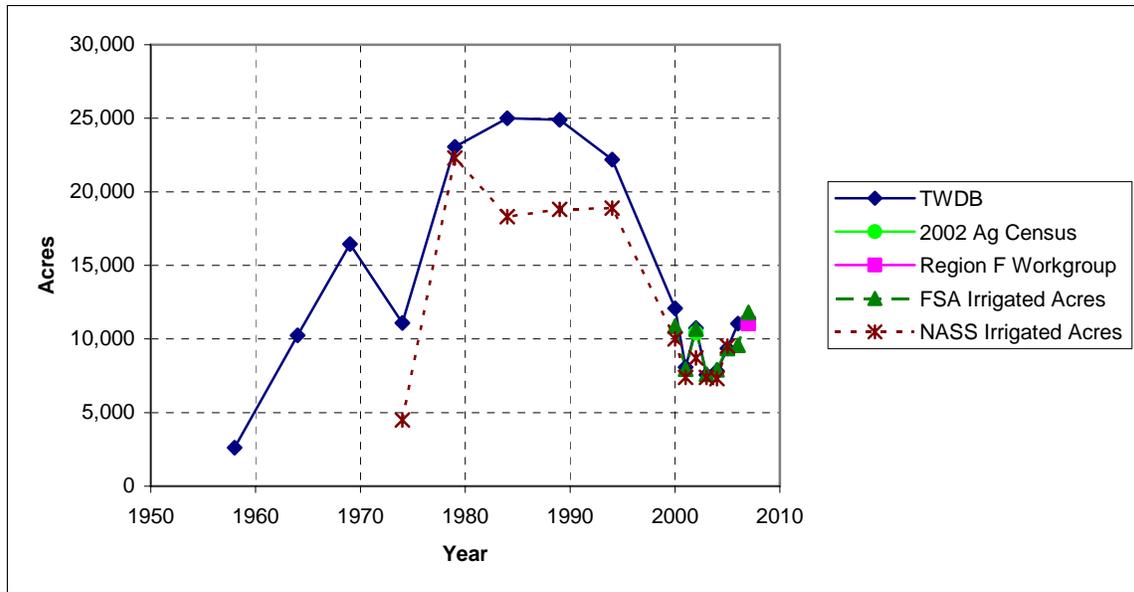


Figure 4-11: Historical and Projected Reagan County Irrigation Water Use

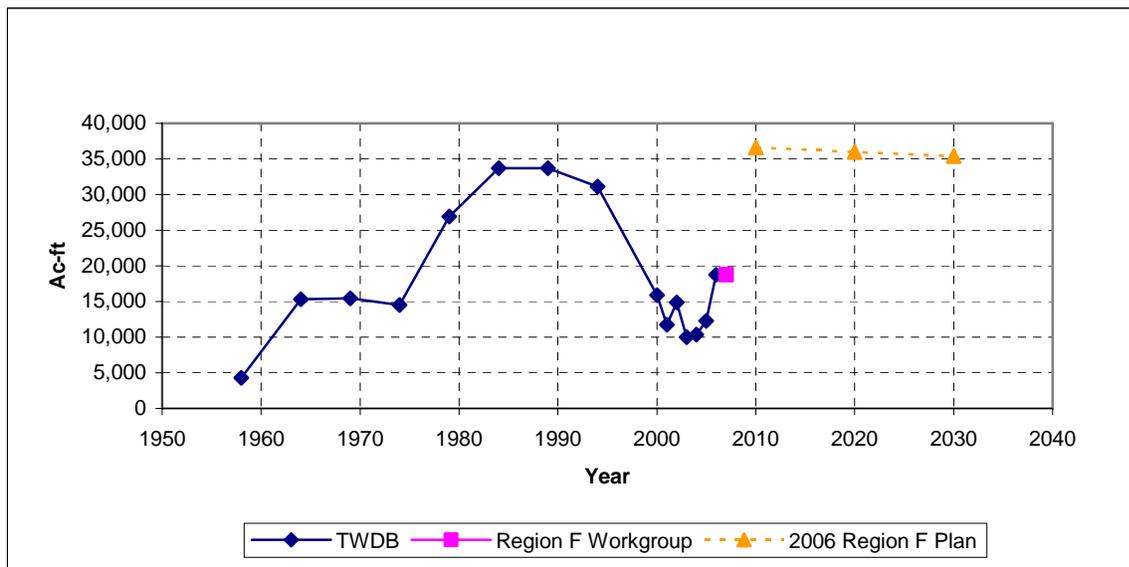
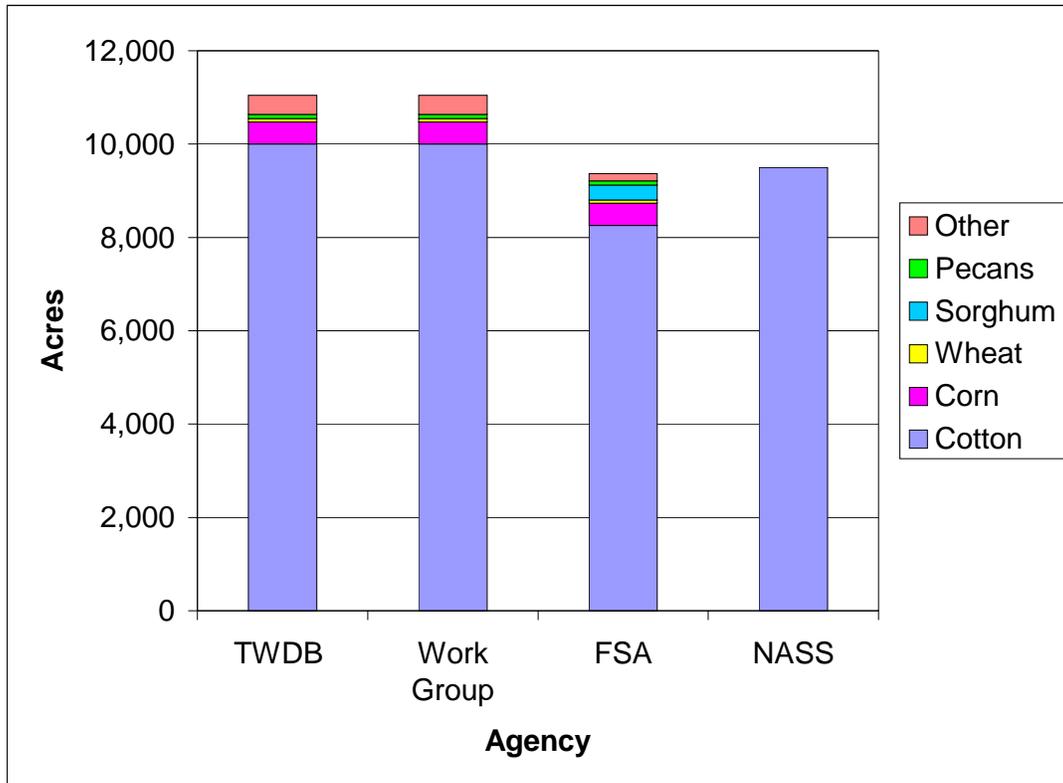


Figure 4-12: Reagan County 2006 Irrigated Acres by Crop Type



4.1.5 Reeves County

There are significant differences in reported irrigated acreages in Reeves County by the reporting agencies. As shown in Table 4-9, the TWDB’s number of irrigated acres in Reeves County is almost twice that of the FSA numbers for the year 2004 to 2006. This is due to the substantial difference in the “Other Crops” category (see Section 3.2). The TWDB data indicates that 10,000 acres were classified as Other Crop from 2004 to 2007. Table 4-10 shows the irrigation water use from 2000-2006 and the projected irrigation demand. Figure 4-13 shows the number of irrigated acres in Reeves County from 1957 to 2007. The number of irrigated acres has decreased substantially from a high in 1964 to the current amounts. Figure 4-14 shows the calculated irrigation water use. Figures showing the irrigated acres by crop type are in Appendix A. Figure 4-15 shows the 2006 total irrigated acres by crop category.

Table 4-9: Historical Reeves Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|--------|--------|--------|--------|--------|--------|--------|-------|
| TWDB | 25,597 | 21,424 | 22,001 | 12,864 | 22,663 | 24,789 | 23,281 | |
| 2002 Ag Census | | | 10,759 | | | | | |
| Region F Work Group | | | | | | | | |
| FSA Irrigated Acres | 23,941 | 21,040 | 17,590 | 14,001 | 14,179 | 14,789 | 13,313 | 9,722 |
| NASS Irrigated Acres | 14,500 | 9,700 | 5,800 | 8,000 | 7,200 | 8,300 | 7,300 | |

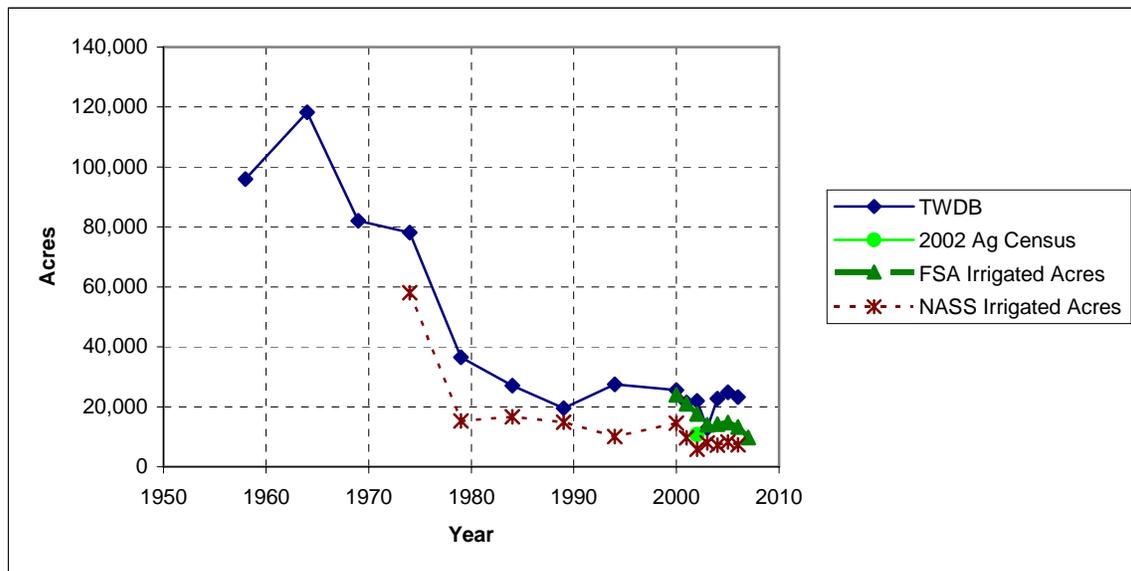
Shaded cells indicate data are unavailable

Table 4-10: Historical and Projected Reeves County Water use (Acre-Feet/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2010 | 2020 | 2030 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|
| TWDB | 75,477 | 67,699 | 63,532 | 33,951 | 89,059 | 92,137 | 88,925 | | | |
| 2006 Region F Projections | | | | | | | | 103,069 | 102,196 | 101,323 |

Shaded cells indicate data are unavailable

Figure 4-13: Historical Reeves County Irrigated Acres by Agency



* Work Group data not available for Reeves County

Figure 4-14: Historical and Projected Reeves County Irrigation Water Use

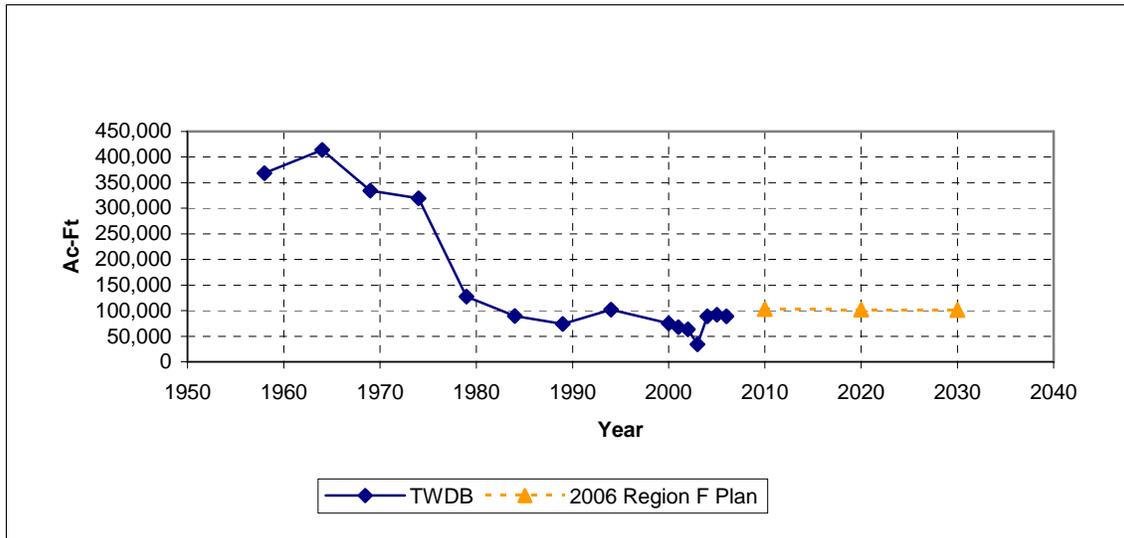
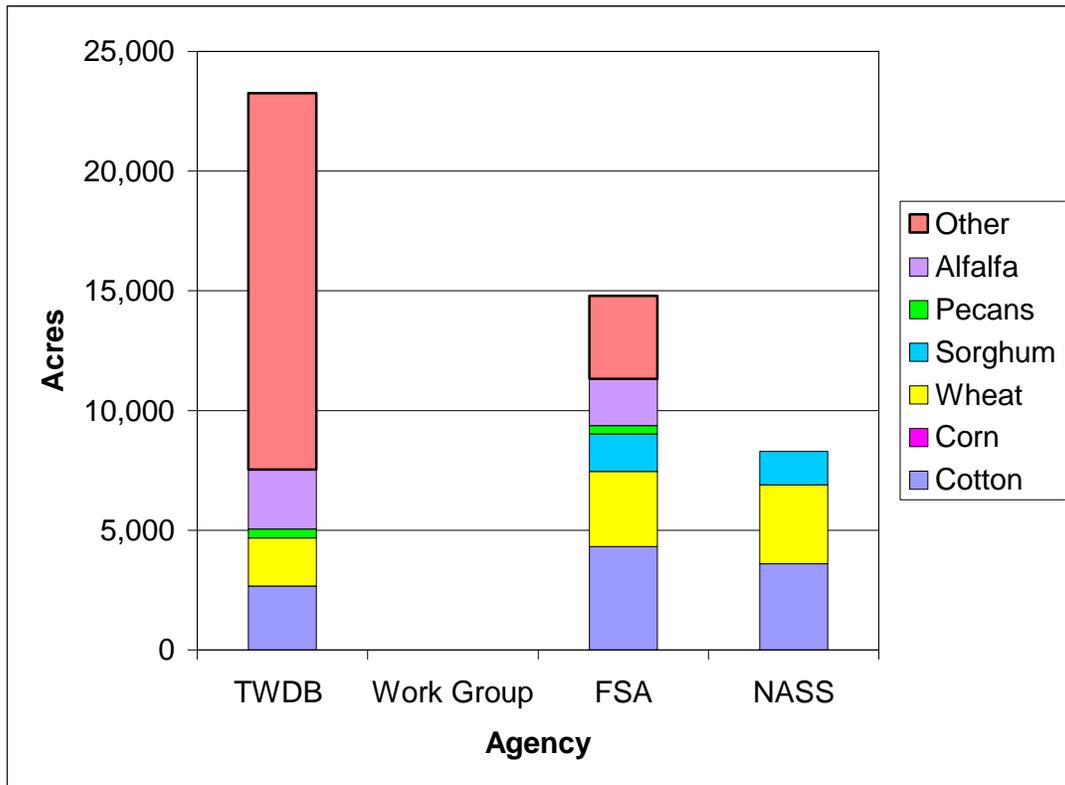


Figure 4-15: Reeves County 2006 Irrigated Acres by Crop Type



* Work Group data not available for Reeves County

4.1.6 Tom Green County

As seen in Table 4-11, the number of irrigated acres in Tom Green increased from 2000 to 2007. Table 4-12 shows the estimated irrigation water use from 2000 to 2006 and the projected irrigation demand. Figure 4-16 shows the historical amount of irrigated acres and Figure 4-17 shows the estimated irrigation water use. The irrigated acres by crop category are included in Appendix A. Figure 4-18 shows the 2006 total irrigated acres by crop type for Tom Green County.

Table 4-11: Historical Tom Green Irrigated Acres 2000-2007

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| TWDB | 31,227 | 28,756 | 31,582 | 31,100 | 28,939 | 33,561 | 39,129 | |
| 2002 Ag Census | | | 26,924 | | | | | |
| Region F Work Group | | | | | | | | |
| FSA Irrigated Acres | 30,379 | 28,926 | 29,426 | 31,354 | 29,933 | 33,725 | 39,594 | 42,756 |
| NASS Irrigated Acres | 29,700 | 28,600 | 31,200 | 32,100 | 30,500 | 35,800 | 42,400 | |

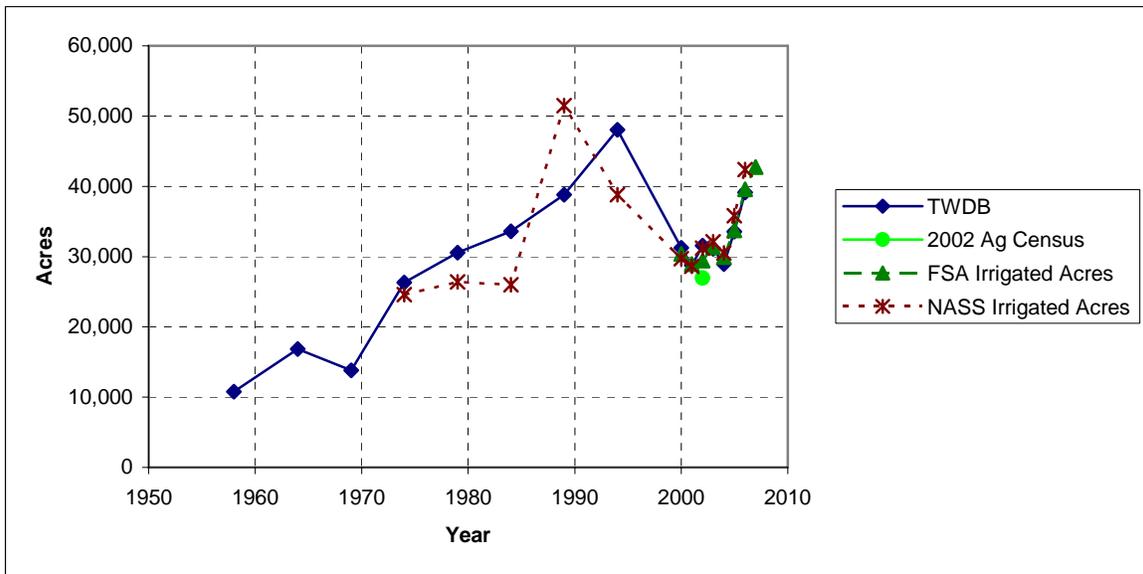
Shaded cells indicate data are unavailable

Table 4-12: Historical and Projected Tom Green County Water Use (Acre-Feet/Year)

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2010 | 2020 | 2030 |
|---------------------------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|
| TWDB | 30,415 | 39,934 | 42,567 | 39,347 | 37,490 | 40,809 | 49,140 | | | |
| 2006 Region F Projections | | | | | | | | 104,621 | 104,362 | 104,107 |

Shaded cells indicate data are unavailable

Figure 4-16: Historical Tom Green Irrigated Acres by Agency



* Work Group data not available for Tom Green County

Figure 4-17: Historical and Projected Tom Green Irrigation Water Use

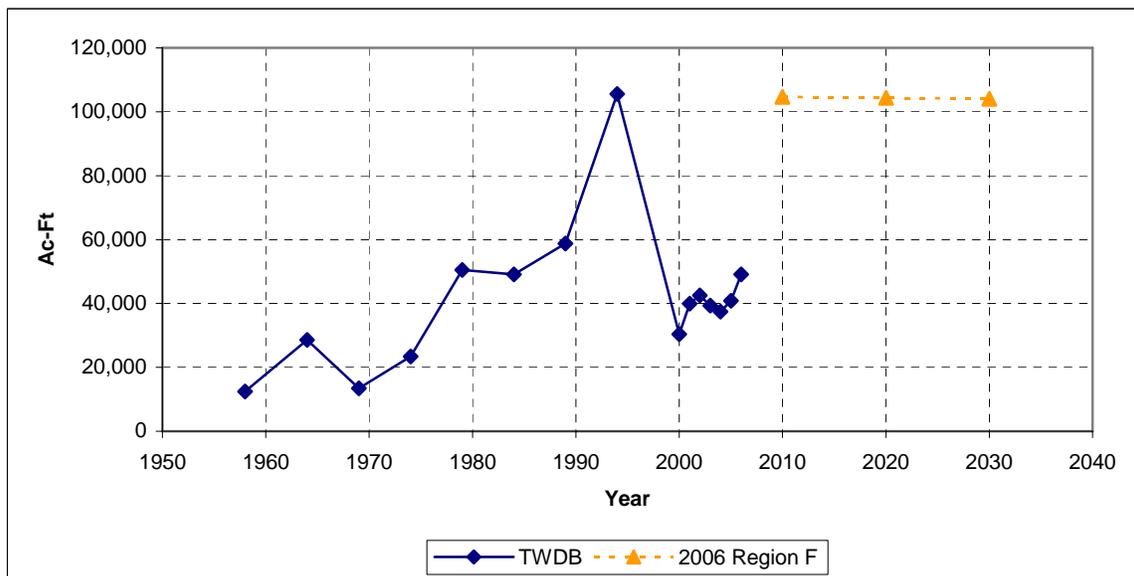
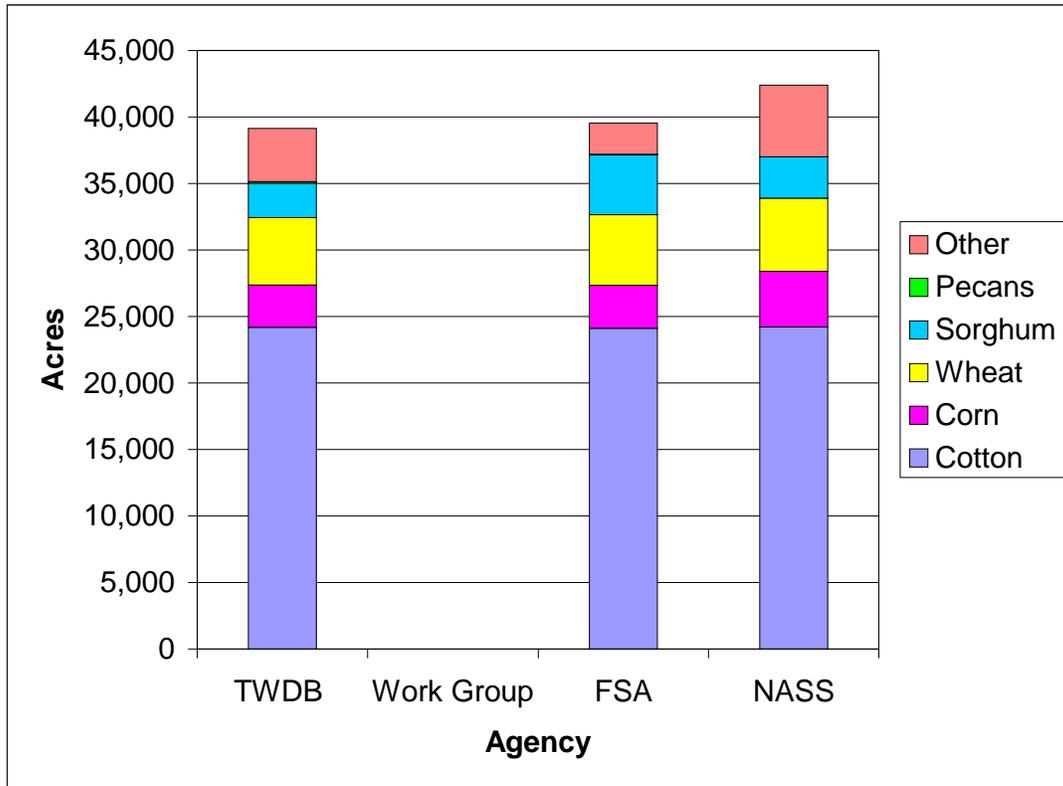


Figure 4-18: Tom Green County 2006 Irrigated Acres by Crop Type



* Work Group data not available for Tom Green County

4.2 Sources of Water

In Region F a large percentage of the water used for irrigation comes from groundwater. As shown in Table 4-13, five of the six counties obtain more than 80 percent of their water for irrigation from groundwater sources. Only in Tom Green County uses a significant quantity of surface water. In Table 4-14 the source of water for each of the six counties is listed.

Table 4-13: 2006 Percentage of Water Use by Source Type

| | Ground Water | Surface Water |
|------------------|--------------|---------------|
| Glasscock | 100% | 0% |
| Midland | 82% | 18% |
| Pecos | 97% | 3% |
| Reagan | 100% | 0% |
| Reeves | 90% | 10% |
| Tom Green | 60% | 40% |

Data are based on the total volume of surface and groundwater used from 1974 to 2004 as reported by TWDB¹².

Table 4-14: Current Source of Water for Irrigation

| County | Source of Water^a |
|------------------|--|
| Glasscock | Edwards-Trinity Plateau aquifer, Ogallala aquifer |
| Midland | Edwards-Trinity Plateau aquifer, Ogallala aquifer, Direct Reuse |
| Pecos | Edwards-Trinity Plateau aquifer ^c , Cenozoic Pecos Alluvium aquifer ^c , Rustler aquifer, Red-Bluff Reservoir ^b , Pecos River tributaries ^d |
| Reagan | Edwards-Trinity Plateau aquifer, Dockum aquifer |
| Reeves | Cenozoic Pecos Alluvium Aquifer, Direct Reuse, Pecos River tributaries ^e , Red-Bluff Reservoir ^b |
| Tom Green | Concho River, Twin Buttes Reservoir, Nasworthy Lake, Other aquifer, Lipan aquifer, Edwards-Trinity Plateau aquifer, Direct Reuse ^f |

- a. Source is from the 2006 Region F Water Plan.
- b. Water use from Red Bluff Reservoir can fluctuate considerably from year to year. In some years there is no water available for irrigation.
- c. Work group members expressed concern that some of the groundwater for Pecos County may be from the Dockum Aquifer instead of the Pecos-Alluvium and Edwards-Trinity aquifers. Data used for the 2006 Region F Water Plan were obtained from the TWDB.
- d. Includes Six Shooter Draw, A-B Draw, Leon Creek, Coyanosa Draw, Comanche Creek and Barilla Creek^{1, 13}
- e. Includes Lake Balmorhea, San Solomon Springs, Giffin Springs, Phantom Springs¹⁴, Sandia Creek, Toyah Creek, Cox Draw, Barilla Creek^{1, 13}.
- f. TWDB reports irrigation with San Angelo return flows as surface water use instead of reuse because the water is being substituted for surface water use from Twin Buttes Reservoir.

4.3 Location of Use

The location of irrigated acres is not always easily identified. Figure 4-19 is a map showing the location of the irrigated acres for Region F based on data from 1994. The six study counties are highlighted in blue. Figures 4-20 through 4-22 are enlarged images of the study counties to show greater detail. Scanned copies of the original hand drawn maps from the 2000 NRCS irrigation were obtained from TWDB and are included in Appendix C³.

Figure 4-19: Region F Irrigated Area

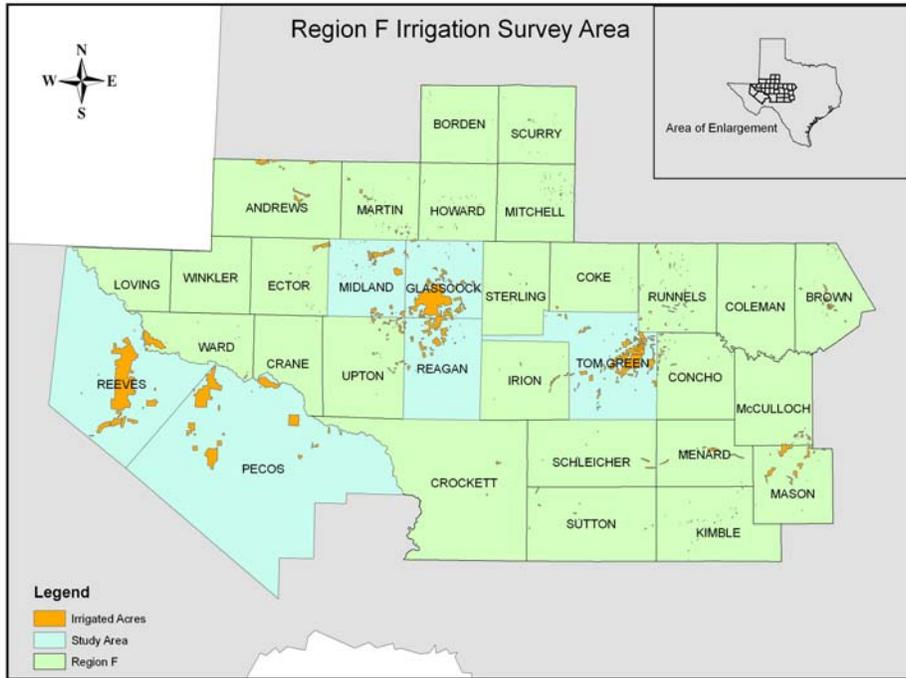


Figure 4-20: Midland, Glasscock, and Reagan Counties Irrigated Areas

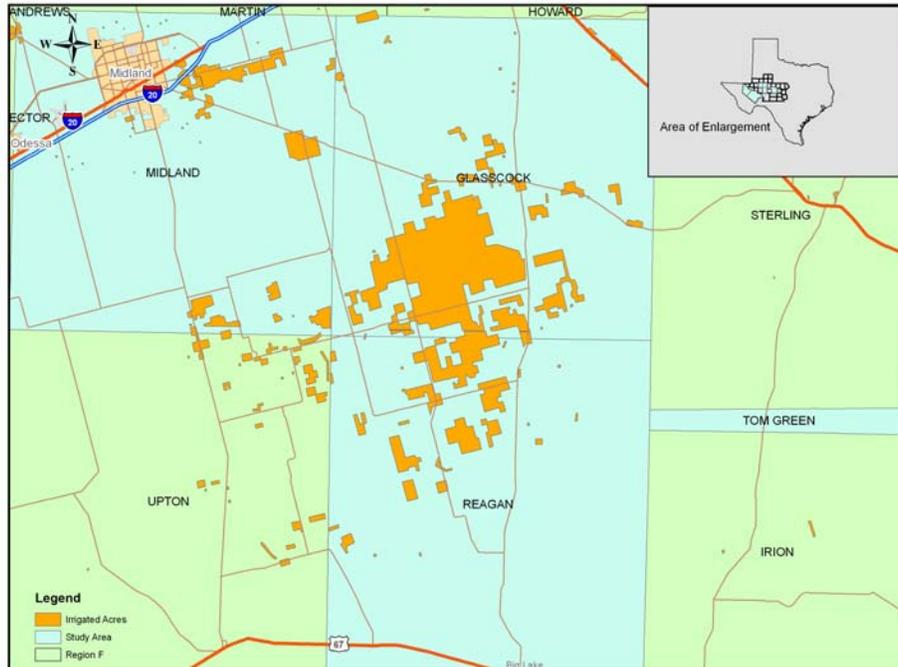


Figure 4-21: Pecos and Reeves Counties Irrigated Areas

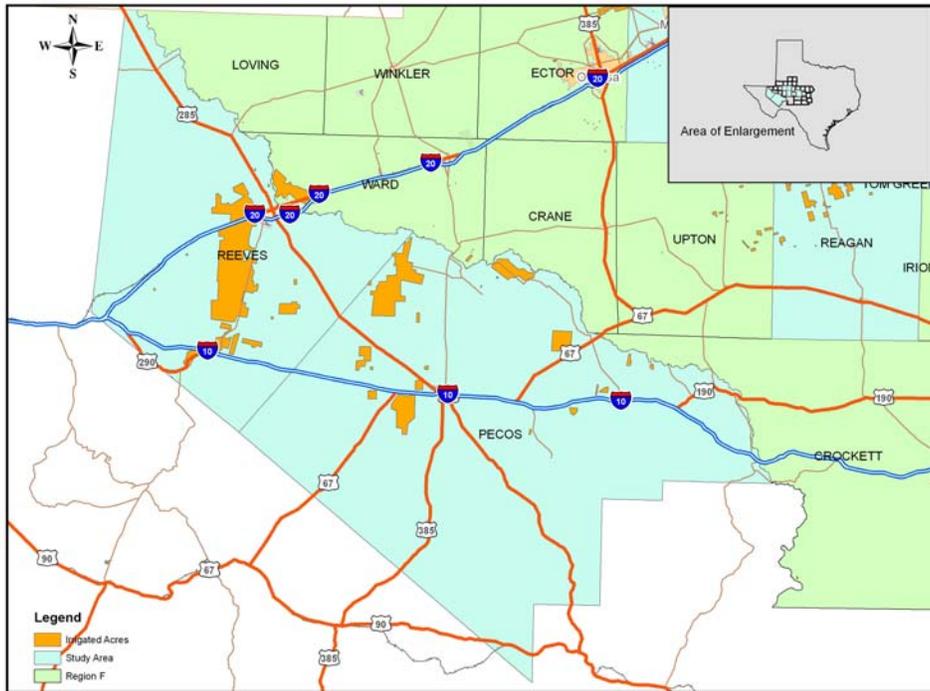
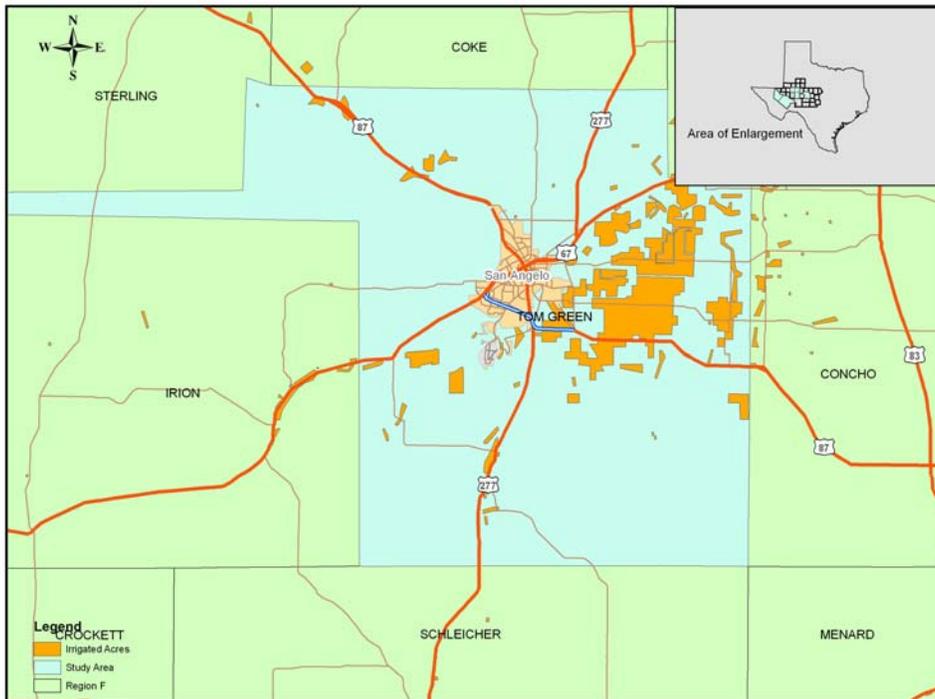


Figure 4-22: Tom Green County Irrigated Areas



4.4 Type of Irrigation Equipment

In gathering data for this study it became evident that very little data are collected on the type of irrigation equipment used in these counties. Only two agencies collected data on the type of irrigation equipment used: TWDB³ and the EQIP⁷ program. The TWDB data were from 2000 and were collected using a survey. EQIP funds programs to convert to more efficient irrigation equipment and maintains a database of the number of acres enrolled in each of their programs from 2004-2007. These data are not cumulative and represents only the number of acres enrolled in a given year. These data do not include the irrigation method previously used. Four EQIP programs are being used in the study counties:

- *Irrigation System Micro irrigation:* An irrigation system for distribution of water directly to the plant root zone by means of surface or subsurface applicators.
- *Irrigation System Surface and Subsurface:* A system in which all necessary water-control structures have been installed for the efficient distribution of water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means.
- *Irrigation System Sprinkler:* An irrigation system in which all necessary equipment and facilities are installed for efficiently applying water by means of nozzles operated under pressure.
- *Irrigation Water Management:* The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner.

The information from the TWDB has been supplemented by the Irrigation Work Group where available. Table 4-15 shows irrigated acres by equipment type from the TWDB and the Work Group. Table 4-16 shows the number of irrigated acres enrolled in each of the EQIP programs.

Table 4-15: Irrigated Acres by Equipment Type

| County | TWDB (Year 2000) | | | Region F Work Group (Year 2007) | | |
|-----------|-------------------|--------------|-------------------------------------|---------------------------------|--------------|-------------------------------------|
| | Sprinkler (acres) | Drip (acres) | Percentage of Total Irrigated Acres | Sprinkler (acres) | Drip (acres) | Percentage of Total Irrigated Acres |
| Glasscock | 4,607 | 8,678 | 46.26% | 4,607 | 19,904 | 93% |
| Midland | 14,092 | 1,148 | 78.05% | | | |
| Pecos | 4,150 | 2,052 | 22.44% | | | |
| Reagan | 1,184 | 2,509 | 23.26% | 500 | 7,805 | 75% |
| Reeves | 10,743 | 315 | 43.20% | | | |
| Tom Green | 11,970 | 785 | 40.85% | | | |

Data are from the Texas Water Development Board³ and the Region F Water Planning Group¹⁰. Shaded cells indicate data are unavailable

Table 4-16: EQIP Acres Enrolled in Programs by County for the Years 2004 to 2007

| Location | Year | Irrigation System, Micro irrigation (acres) | Irrigation System, Surface and Subsurface (acres) | Irrigation System, Sprinkler (acres) | Irrigation Water Management(acres) | Percentage of Total Irrigated Acres |
|-----------|------|---|---|--------------------------------------|------------------------------------|-------------------------------------|
| Glasscock | 2007 | 1,379 | | 491 | 2,520 | 17% |
| Glasscock | 2006 | 1,827 | | | 1,488 | 13% |
| Glasscock | 2005 | 1,289 | | | 496 | 3% |
| Glasscock | 2004 | 1,289 | | | 496 | 3% |
| Midland | 2007 | 248 | | 221 | 536 | 8% |
| Midland | 2006 | 274 | | 31 | 1,046 | 10% |
| Midland | 2005 | 1,886 | | 855 | 3,827 | 55% |
| Midland | 2004 | 1,886 | | 855 | 3,827 | 37% |
| Pecos | 2007 | 363 | 457 | 126 | 713 | 7% |
| Pecos | 2006 | 545 | 1 | 1 | 343 | 4% |
| Pecos | 2005 | 107 | | | 104 | 1% |
| Pecos | 2004 | 107 | | | 104 | 1% |
| Reagan | 2007 | 394 | | | 1,864 | 20% |
| Reagan | 2006 | 1,149 | | | 693 | 17% |
| Reagan | 2005 | 681 | | | 723 | 11% |
| Reagan | 2004 | 681 | | | 723 | 14% |
| Reeves | 2007 | | | | 2,532 | 11% |
| Reeves | 2006 | | 172 | | 172 | 1% |
| Reeves | 2005 | | | | 1,215 | 5% |
| Reeves | 2004 | | | | 1,215 | 5% |
| Tom Green | 2007 | 445 | 143 | 274 | 1,060 | 5% |
| Tom Green | 2006 | 481 | | 6,544 | 3,708 | 27% |
| Tom Green | 2005 | 259 | | 1,350 | 560 | 6% |
| Tom Green | 2004 | 259 | | 1,350 | 560 | 7% |

These data are not cumulative and represents only the number of acres enrolled in the each year.

4.5 Data Gaps

Identified data gaps include:

- Replacement of data previously collected by the NRCS. The NRCS has not conducted an irrigation survey since the year 2000. As a result, Region F and TWDB will need to rely on the FSA, groundwater districts and other local sources for data.
- Information about the current types of irrigation equipment. Data on type of equipment in use are limited. These data are the basis for methodology previously employed to estimate savings due to water conservation in Region F. EQIP data may be useful for developing future estimates of savings by changing irrigation practices.
- Location of Use. None of the agencies contacted collect or produce data on the location of irrigation use. The limited data available on the location of use may be a potential future area of focus for the Irrigation Work Group.

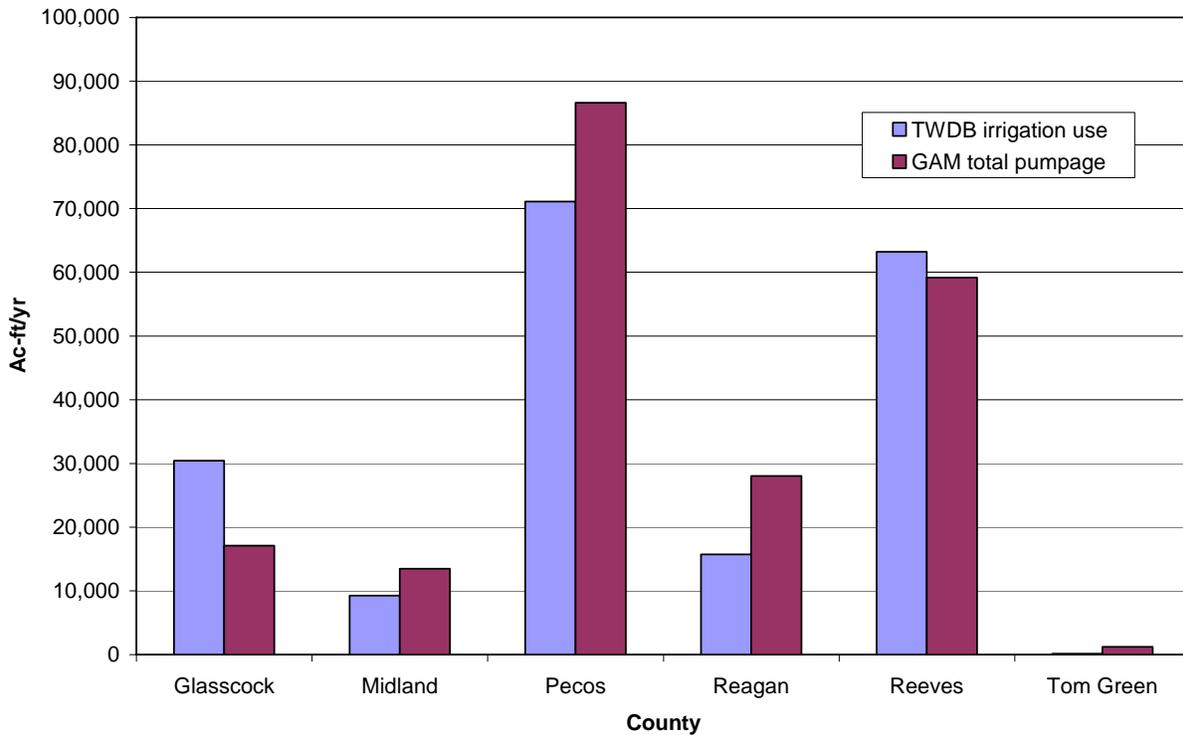
4.6 Review of Irrigation Data for Edwards-Trinity Groundwater Availability Model

The groundwater availability models are tools that are used by local groundwater conservation districts and the regional water planning groups to assess current and future groundwater availability. Accurate input data is a necessary component for reliable assessments of available groundwater. The major aquifers that lie within our study area include the Edwards-Trinity (Plateau) and the Cenozoic Pecos Alluvium. These aquifers are inter-connected and are modeled as different layers in the Edwards-Trinity (Plateau) Groundwater Availability Model (GAM).

As part of this study, a comparison of the historical irrigation use data to the pumping data in the Edwards-Trinity GAM was made to identify if demand refinements may be needed. The TWDB was contacted to obtain the GAM pumpage by use type. However, the information by

use type was not retrievable; only the total pumpage by county was available. A comparison of the total GAM pumpage to the Year 2000 irrigation water usage is shown on Figure 4-23.

Figure 4-23 Comparison of Year 2000 Irrigation Use to Edwards-Trinity GAM Pumpage



Based on this comparison, the pumpage amount for Glasscock County in the Edwards-Trinity GAM appears to underestimate the actual water use. The slightly higher historical pumpage in 2000 for Reeves County does not necessarily indicate under pumpage in the GAM. TWDB data for this county show pumpage amounts ranging from 25,000 to 100,000 acre-feet per year over the past ten years. GAM pumpages for the other counties are higher than the year 2000 irrigation use. Some of this difference can be explained by water use for purposes other than irrigation. Overall, the data are consistent with TWDB historical data.

5 CONCLUSIONS AND RECOMMENDATIONS

Irrigation data reported by the different sources are generally consistent with a few notable exceptions. The largest differences are based on the reporting categories (variety and types of crops reported as irrigated). For counties with few major crops, such as Glasscock and Reagan Counties, the differences are relatively small. For counties with wide varieties of crops or non-major crops, the differences are greater. The TWDB provides the most comprehensive data on irrigation. However, it is important to understand the sources of the data and what data are reported. Over the years, the TWDB reporting data have evolved to capture all water that could be considered irrigation. This includes some golf courses, failed crops and pre-wetting applications. Some of the notable differences in the reporting data include:

- Glasscock County- the TWDB reported a substantial amount of failed acres from 2003 to 2005. Recent data are in line with the Irrigation Work Group data.
- Reeves County – the TWDB reported 10,000 acres in the “Other Category” from 2004 to 2006, which other agencies are not reporting.

The TWDB has historically relied on other sources to develop estimates of irrigation water use. With the NRCS no longer collecting data, the TWDB is now using data from multiple sources, including the FSA, local groundwater and irrigation districts, and reported surface water use from the TCEQ. Comparisons of TWDB water use data from 2000 to 2007 to the projected demand for 2010 from the 2006 Region F Water Plan indicate that current irrigation use is lower for most of the counties. Reeves and Pecos Counties’ historical water use is similar to the projected future use. For Tom Green County, much of the reduced irrigation water use is due to the limited availability of surface water from Twin Buttes Reservoir.

The percentage of irrigated acres using high-efficiency irrigation methods are increasing in the six counties. The Irrigation Work Group data indicate over 90 percent of the irrigated acres in Glasscock County currently use either sprinkler or drip irrigation, which is up from 45 percent in 2000. In Reagan County 75 percent of the crops are irrigated using either sprinkler or drip. This is an increase from 23 percent in 2000. The EQIP data show the percentage has been increasing from 2004-2007 for several counties. However, data on the type and extent of irrigation

equipment are limited. If the sprinkler and drip percentages reported for Reagan and Glasscock Counties are typical across the region, the potential for significant additional irrigation savings due to conversion to water saving equipment is greatly reduced. Extrapolation of the limited data for other counties in Region F may not be appropriate, especially in counties with significant surface water use.

Based on the findings of this study, it is recommended that:

- The Region F regional water planning group continues to collect and monitor historical irrigation water use data to adequately plan for agricultural water needs. Region F does not plan to modify irrigation demands for the 2011 regional water plan.
- In light of the historical water use, adoption of advanced conservation equipment and projected agricultural trends, Region F may consider modifying projected irrigation demands for the 2016 regional water plan.
- Additional information is needed regarding the implementation of conservation equipment. Where possible, conservation savings for irrigation should be refined for the 2011 Region F water plan to reflect current conservation equipment adoption rates.
- TWDB review the pumpage in the Edwards-Trinity GAM for Glasscock County.

6 LIST OF REFERENCES

- ¹ Texas Water Development Board: Regional Water Planning Data Web Interface (DB07), available on-line at <http://www.twdb.state.tx.us/data/db07/DefaultSelect.asp>
- ² Freese and Nichols, Inc., et al.: Region F Regional Water Plan, prepared for the Texas Water Development Board, January 2006.
- ³ Mark Michon, Texas Water Development Board, Austin Texas, 09/25/2007, 01/30/2008 and 04/24/2008.
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- ⁵ Texas Water Development Board. Report 347; Surveys of Irrigation in Texas 1958, 1964, 1969, 1974, 1979, 1984, 1989, 1994, 2000; Austin Texas, August 2001.
- ⁶ Ted Peabody, Farm Service Agency, College Station, Texas, 09/25/07.
- ⁷ Edward Brzostek, Environmental Quality Incentive Program, <http://ias.sc.egov.usda.gov/prsreport2007/>, website accessed 06/13/07.
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- ⁹ National Agriculture Statistics Service, http://www.nass.usda.gov/QuickStats/Create_County_All.jsp, website accessed 09/06/2007.
- ¹⁰ Ricky Harston, Glasscock Groundwater Conservation District, e-mail 09/20/2007
- ¹¹ Tuck, Comer. TWDB Irrigation Water Use Methodologies: 1994-2007, Handout for Irrigation Work Group Meeting, 2/25/08.
- ¹² Texas Water Development Board: Historical Water Use Information, available on-line at <http://www.twdb.state.tx.us/wushistorical/>, accessed 9/6/2007.
- ¹³ Texas Commission on Environmental Quality: Water Rights Database, available on-line at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/wr_databases.html
- ¹⁴ Alan R. Zeman, Region F Water Planning Group, personal communication.

Appendix A: Irrigated Acres by Crop Type

Glasscock County

Figure 1: Glasscock County Irrigated Acres Cotton

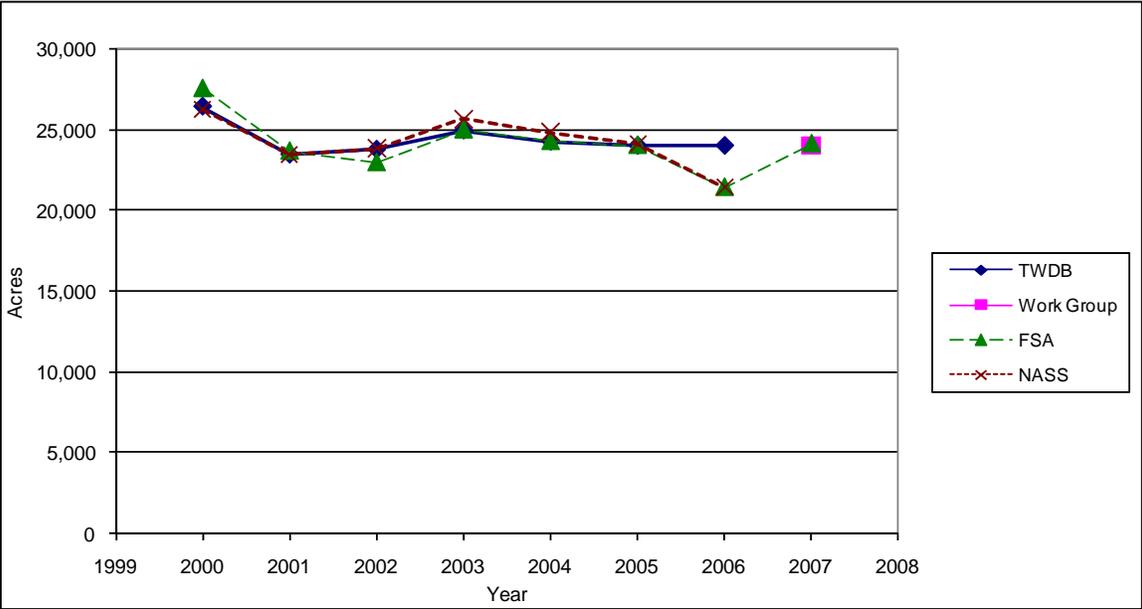


Figure 2: Glasscock County Irrigated Acres Corn

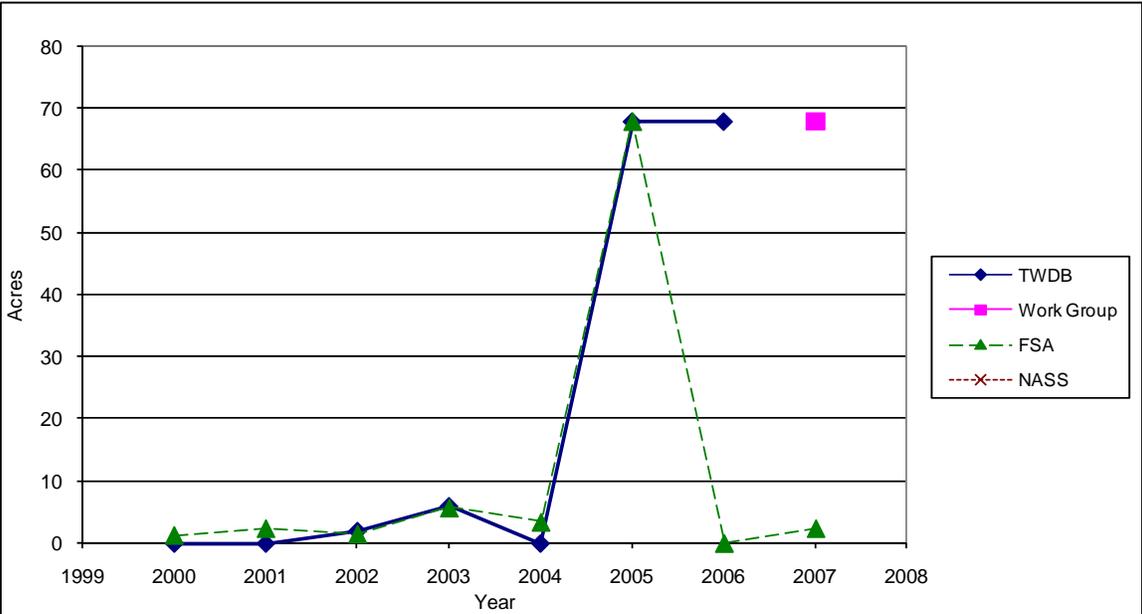


Figure 3: Glasscock County Irrigated Acres Wheat

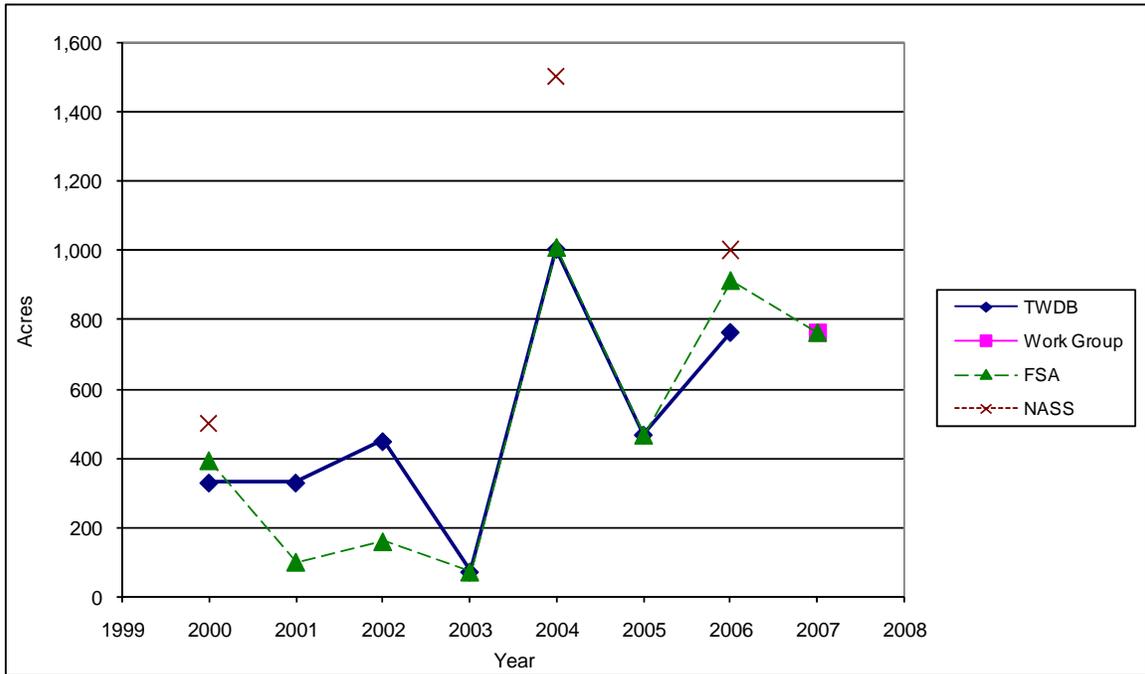


Figure 4: Glasscock County Irrigated Acres Sorghum

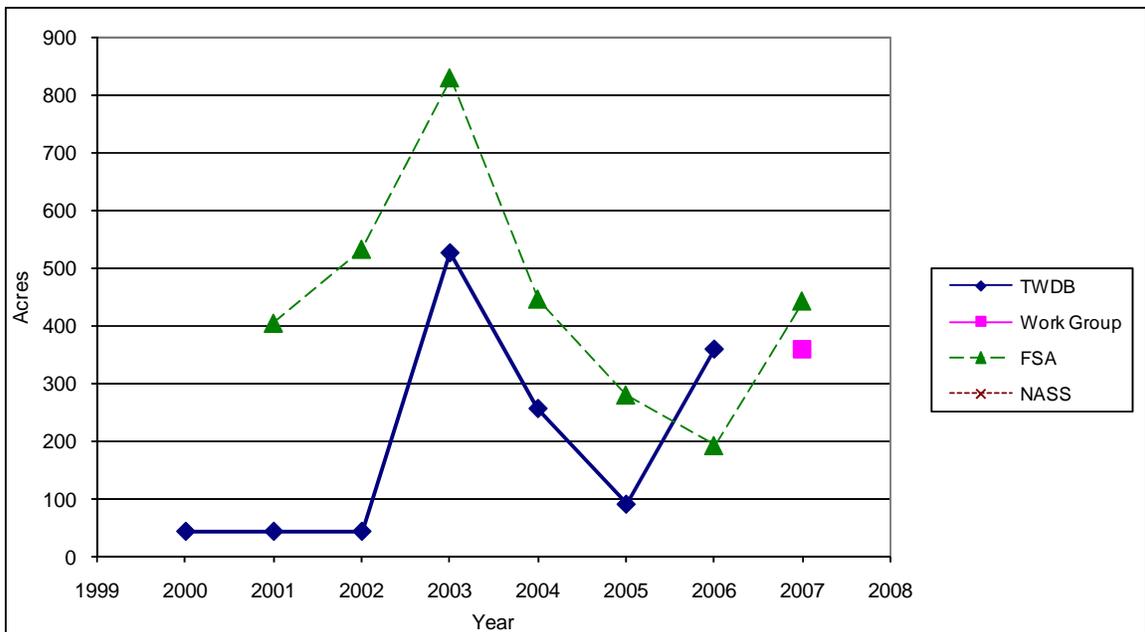


Figure 5: Glasscock County Irrigated Acres Pecans

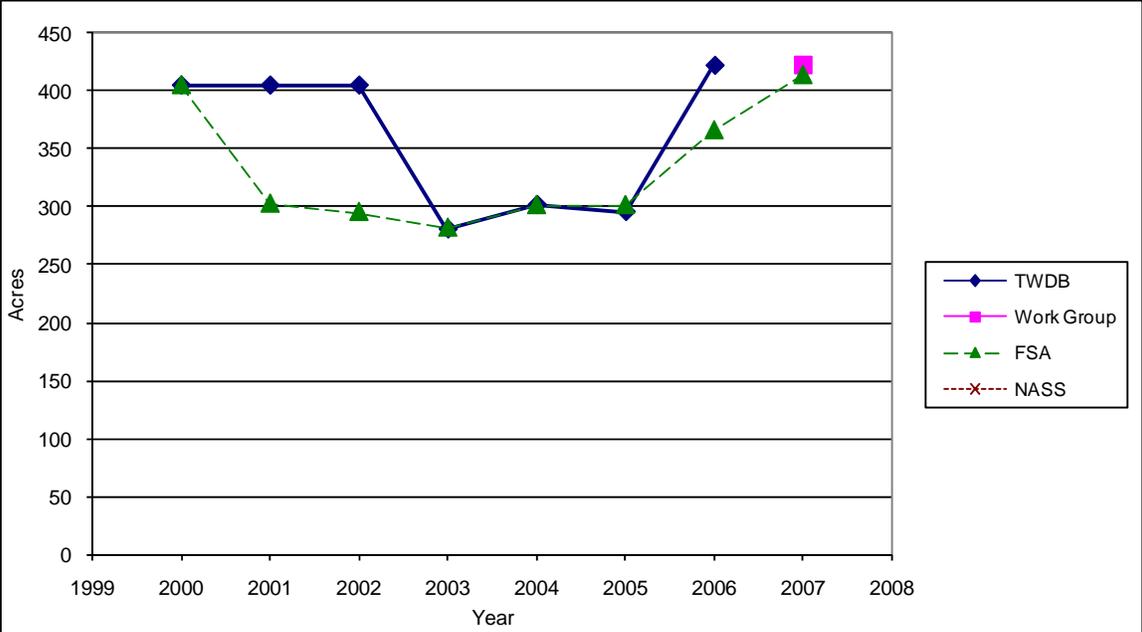
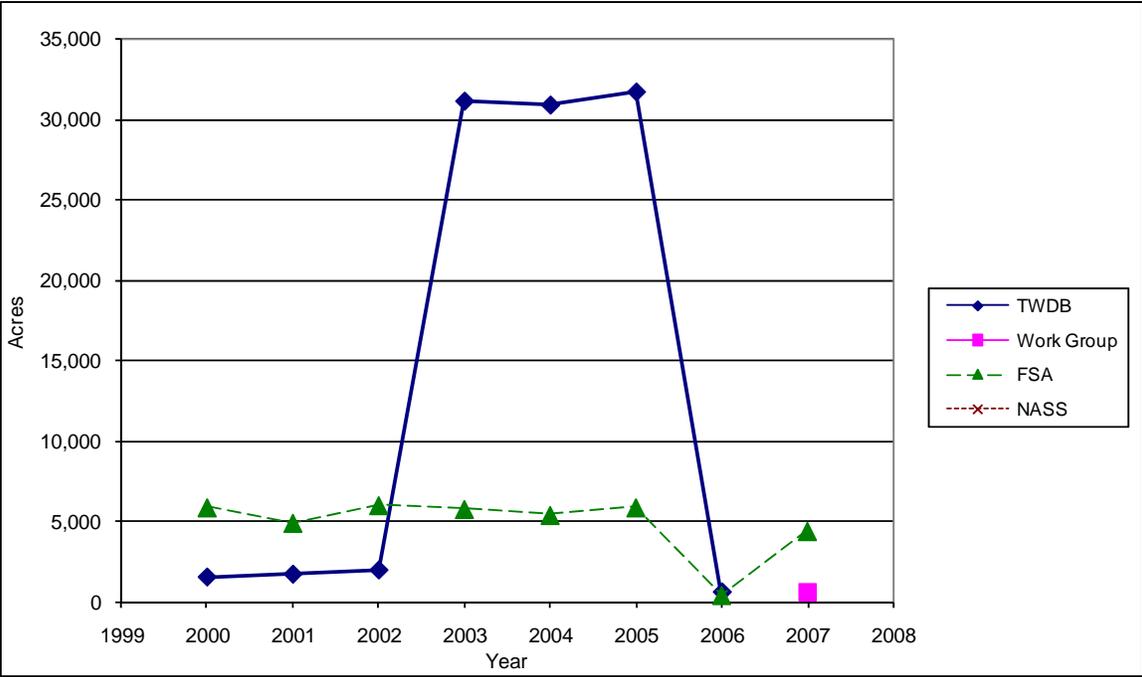


Figure 6: Glasscock County Irrigated Acres Other



Midland County

Figure 7: Midland County Irrigated Acres Cotton

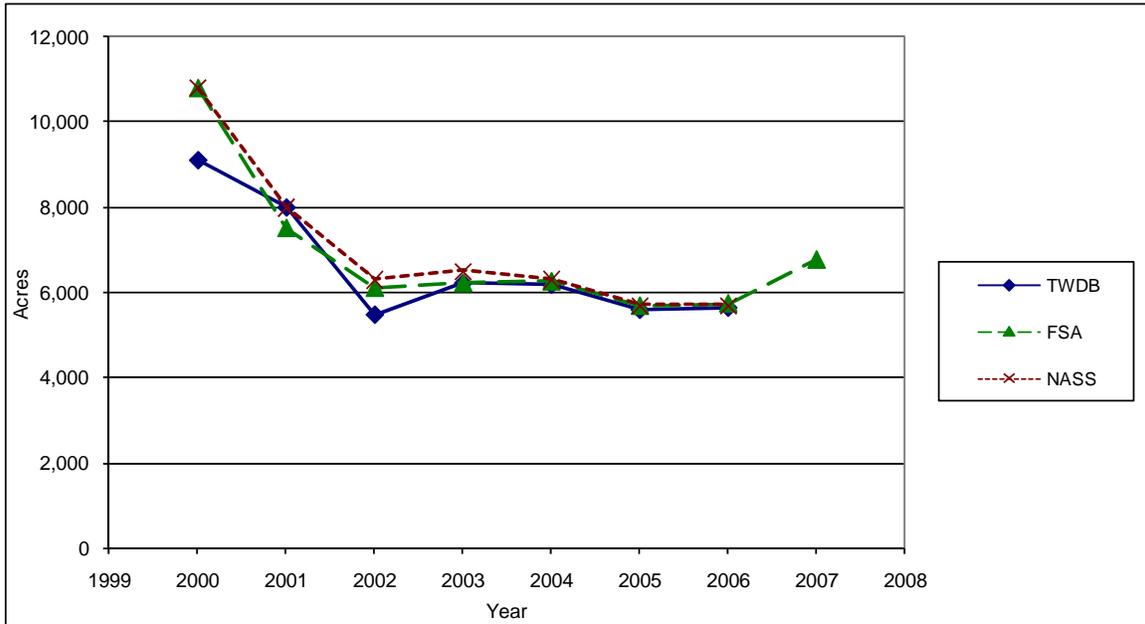


Figure 8: Midland County Irrigated Acres Corn

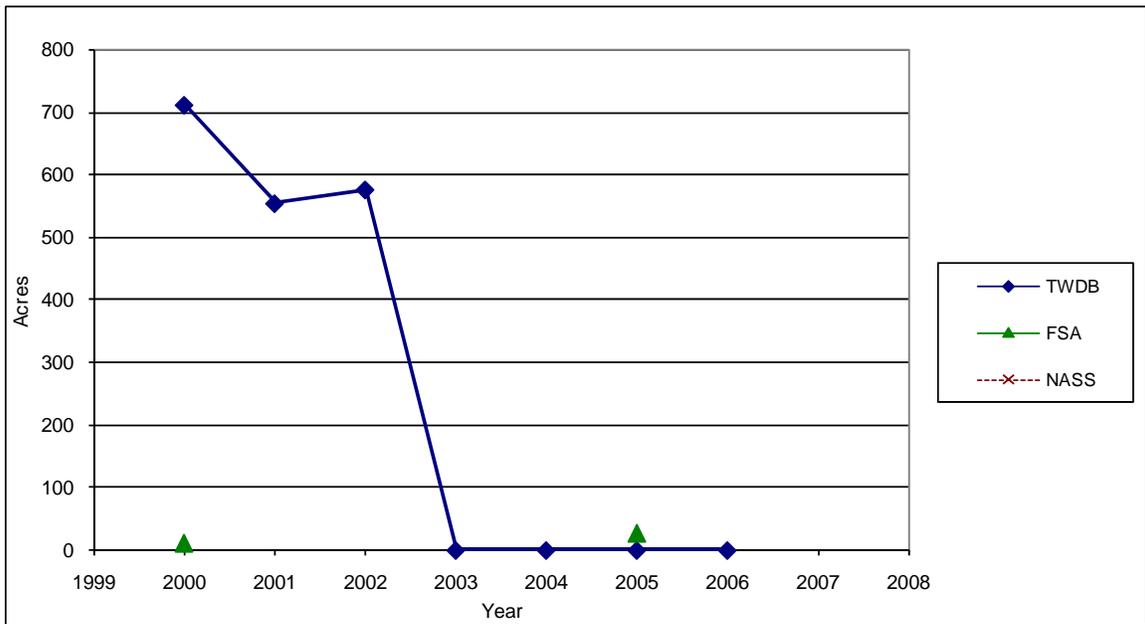


Figure 9: Midland County Irrigated Acres Wheat

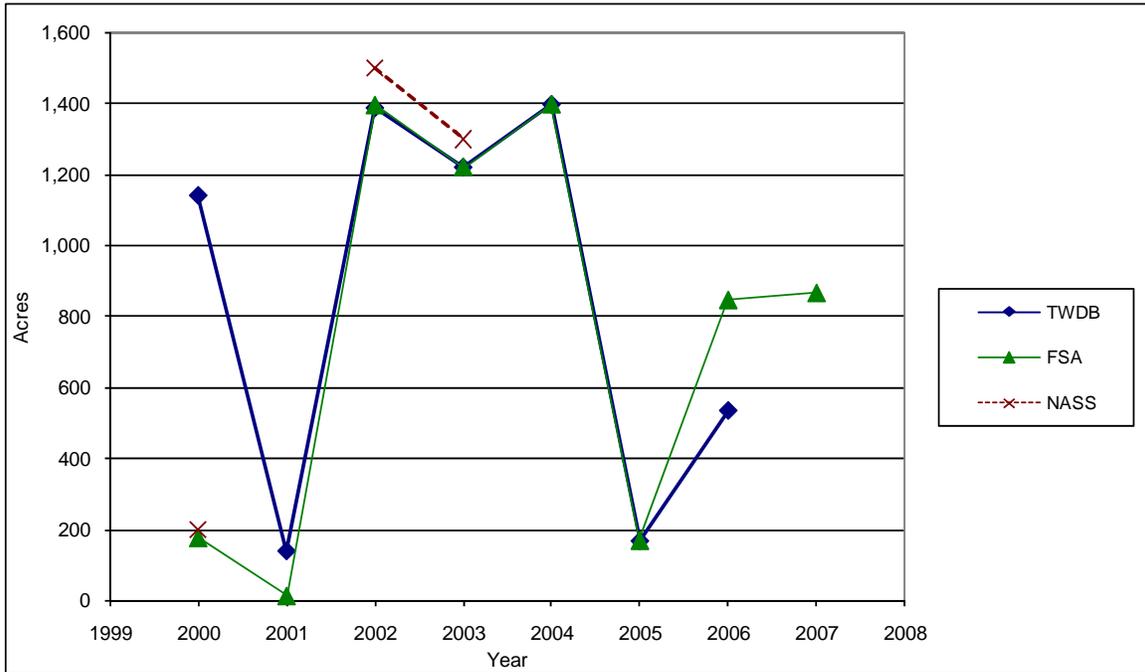


Figure 10: Midland County Irrigated Acres Sorghum

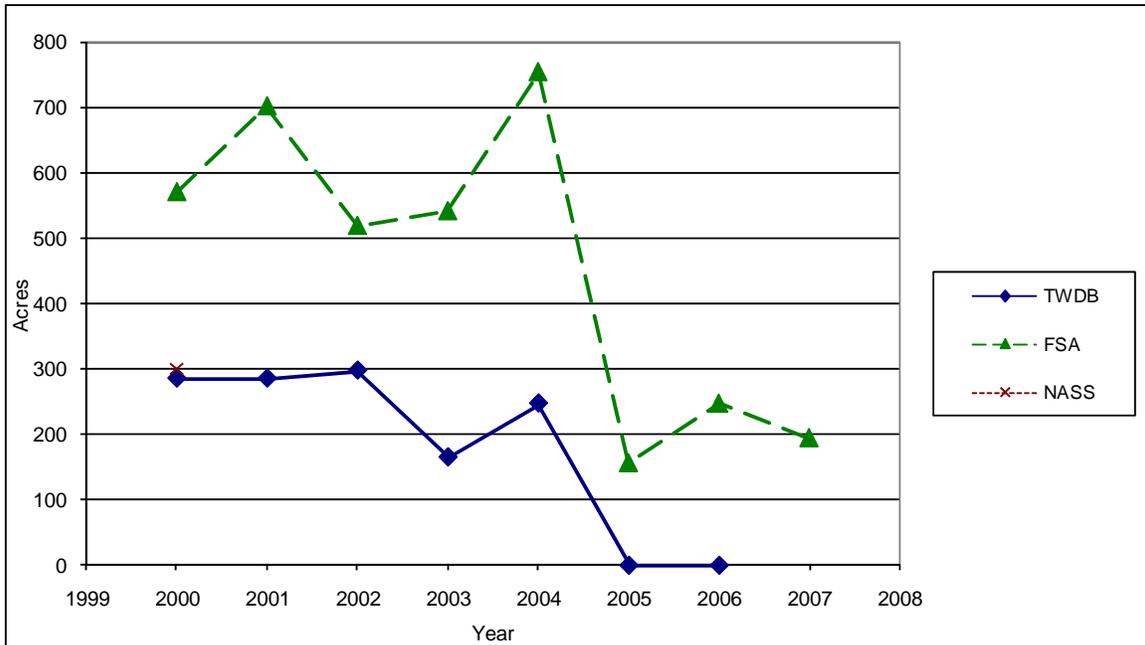


Figure 11: Midland County Irrigated Acres Pecans

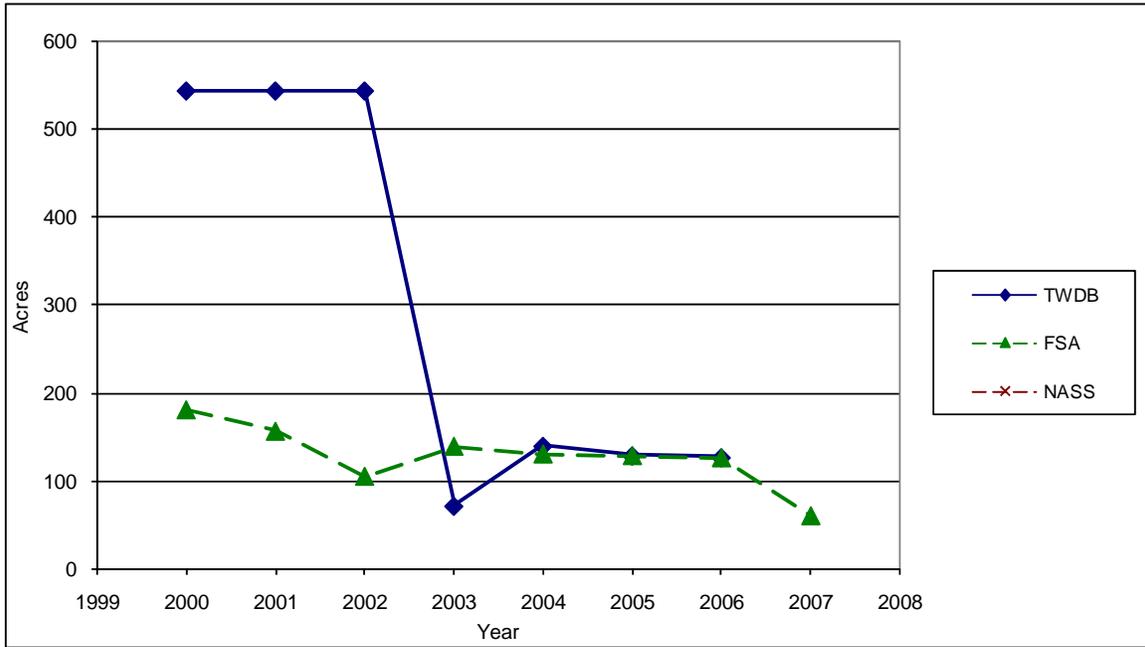
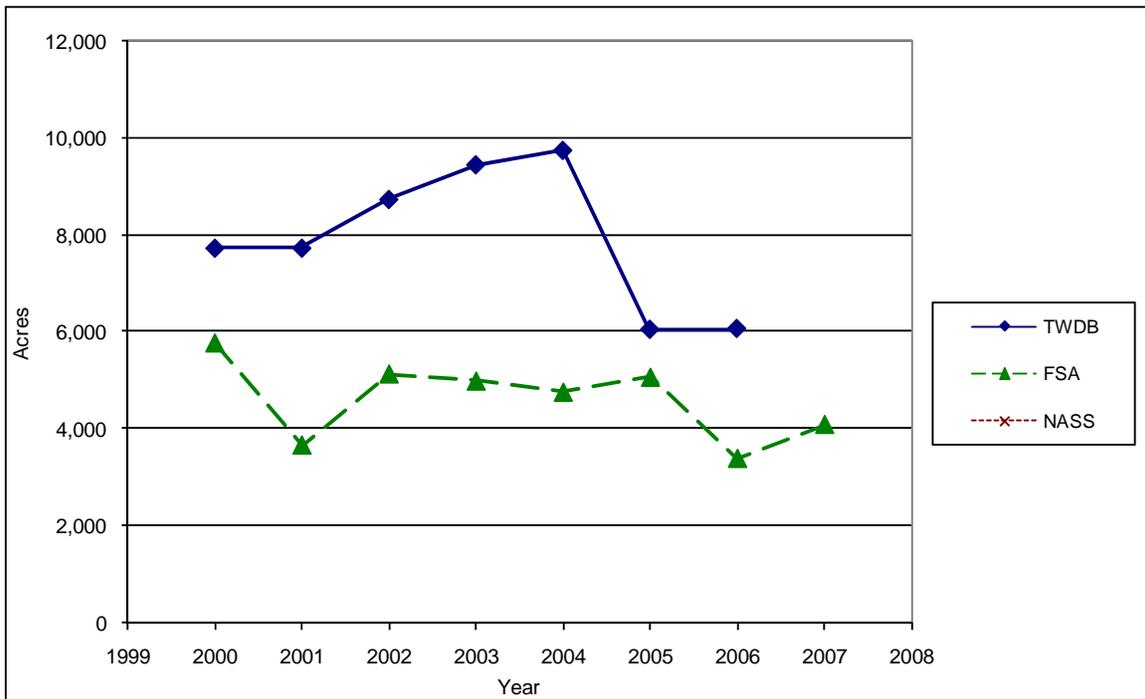


Figure 12: Midland County Irrigated Acres Other



Pecos County

Figure 13: Pecos County Irrigated Acres Cotton

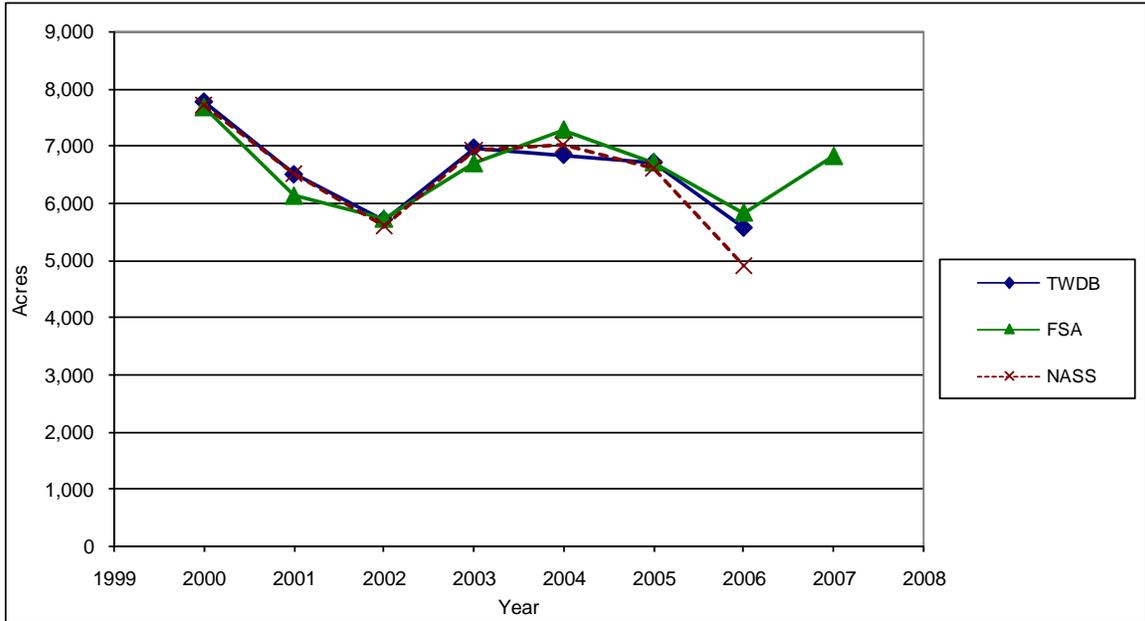


Figure 14: Pecos County Irrigated Acres Corn

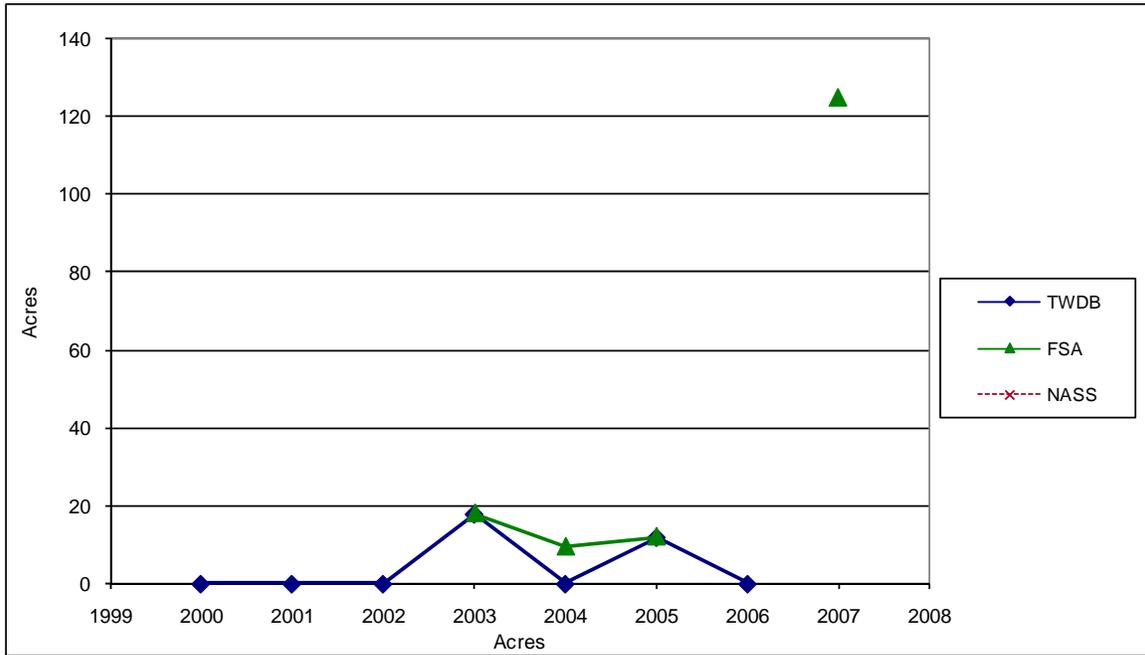


Figure 15: Pecos County Irrigated Acres Wheat

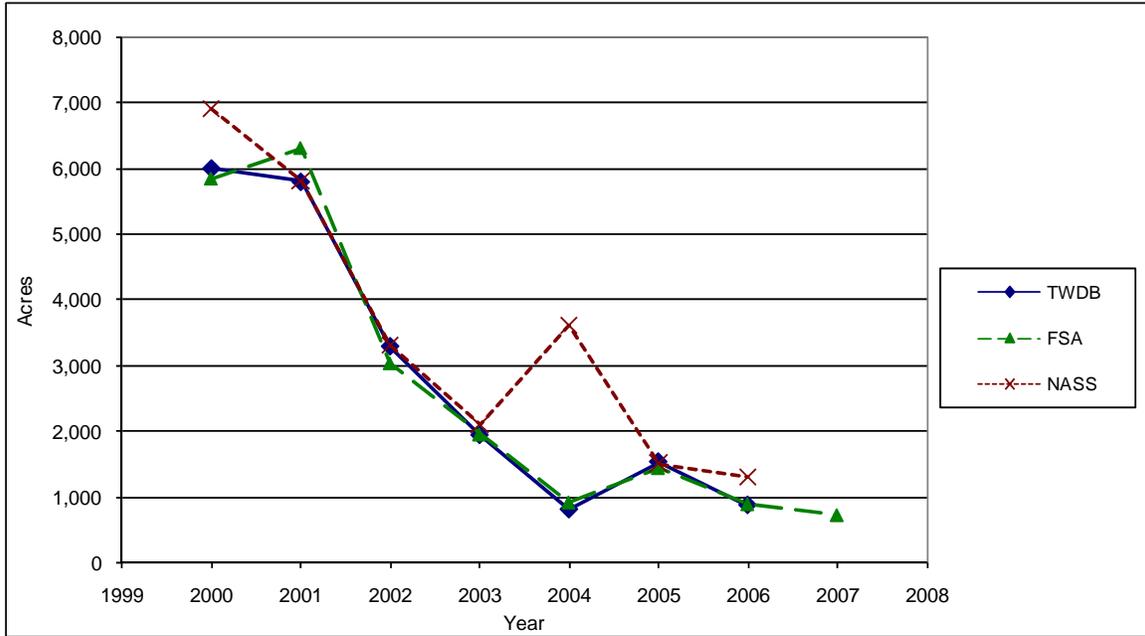


Figure 16: Pecos County Irrigated Acres Sorghum

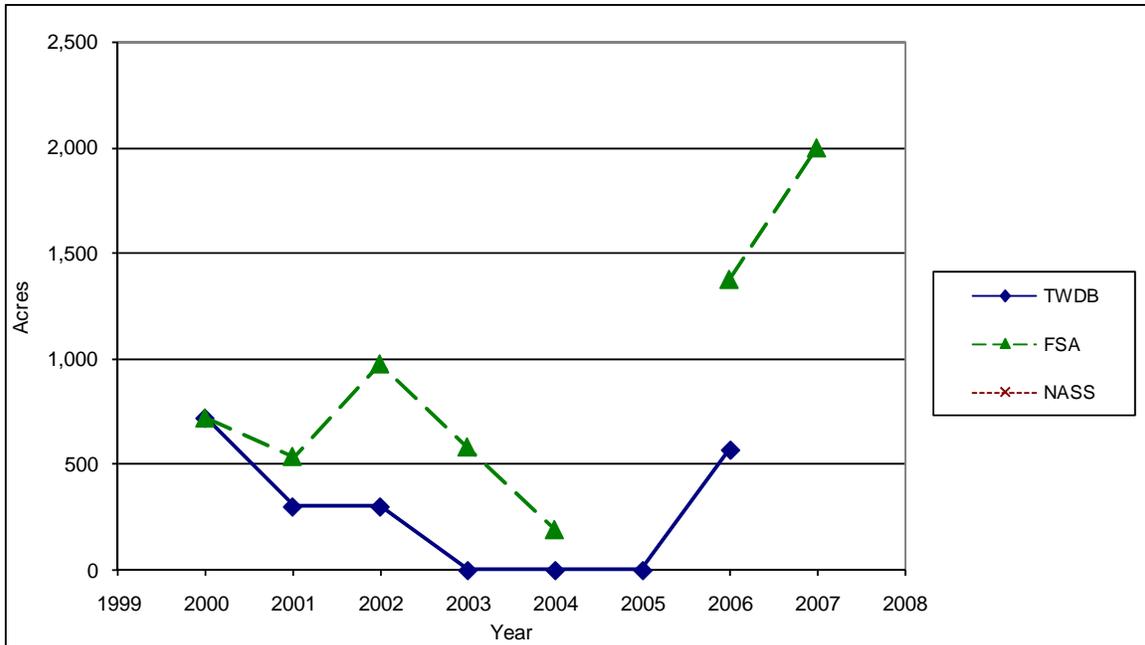


Figure 17: Pecos County Irrigated Acres Pecans

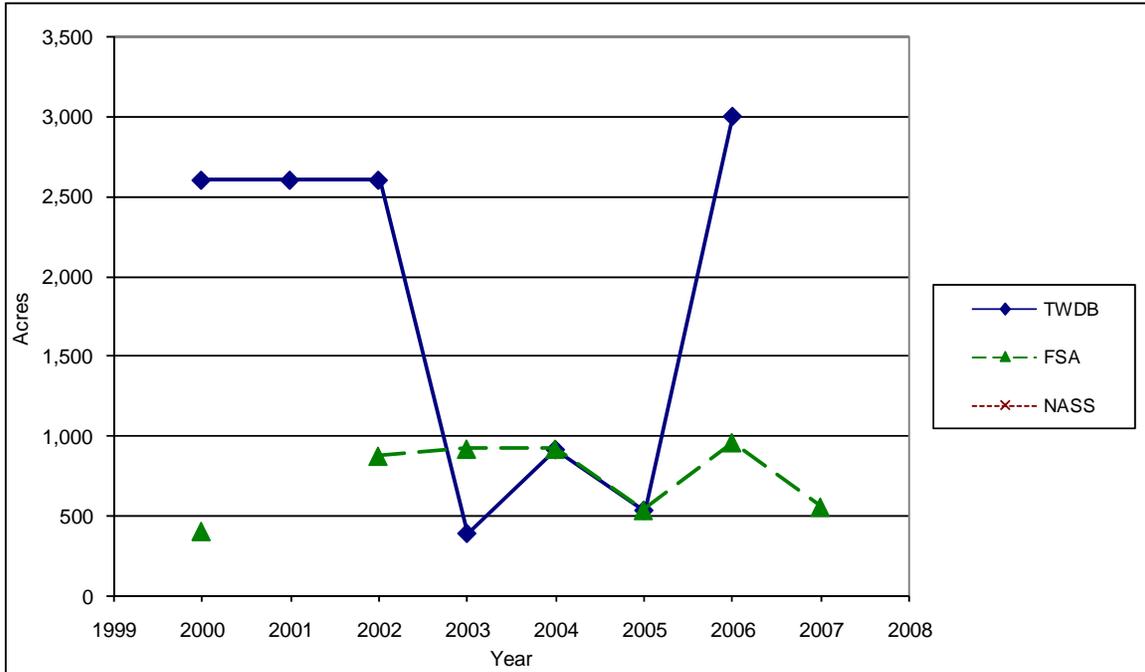


Figure 18: Pecos County Irrigated Acres Alfalfa

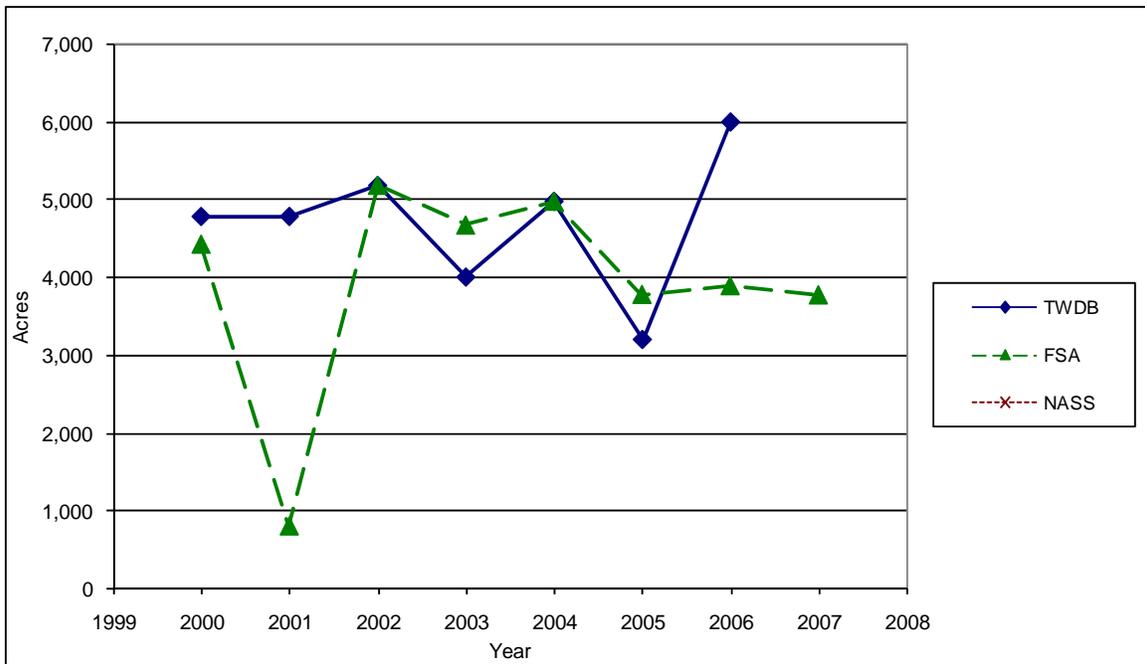
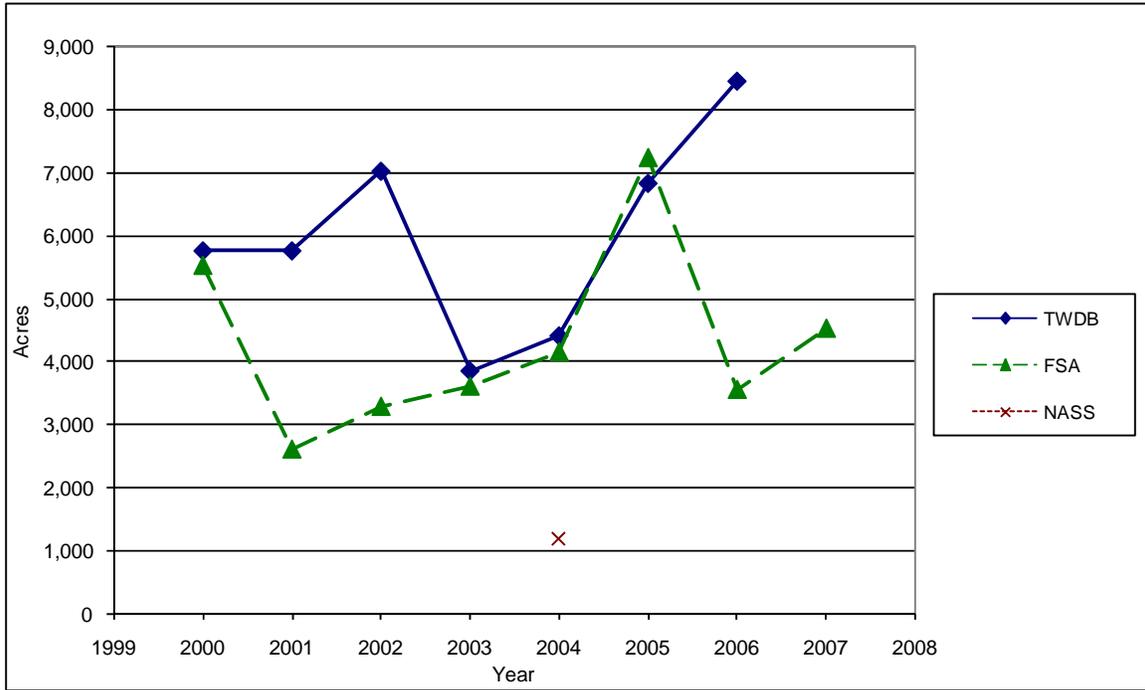


Figure 19: Pecos County Irrigated Acres Other



Reagan County

Figure 20: Reagan County Irrigated Acres Cotton

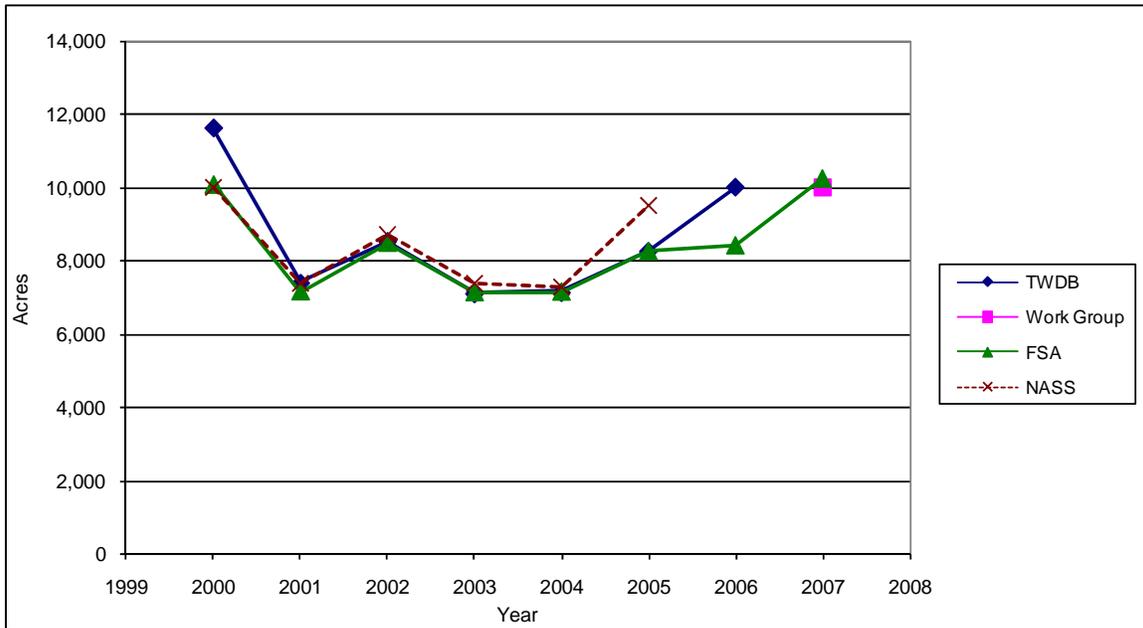


Figure 21: Reagan County Irrigated Acres Corn

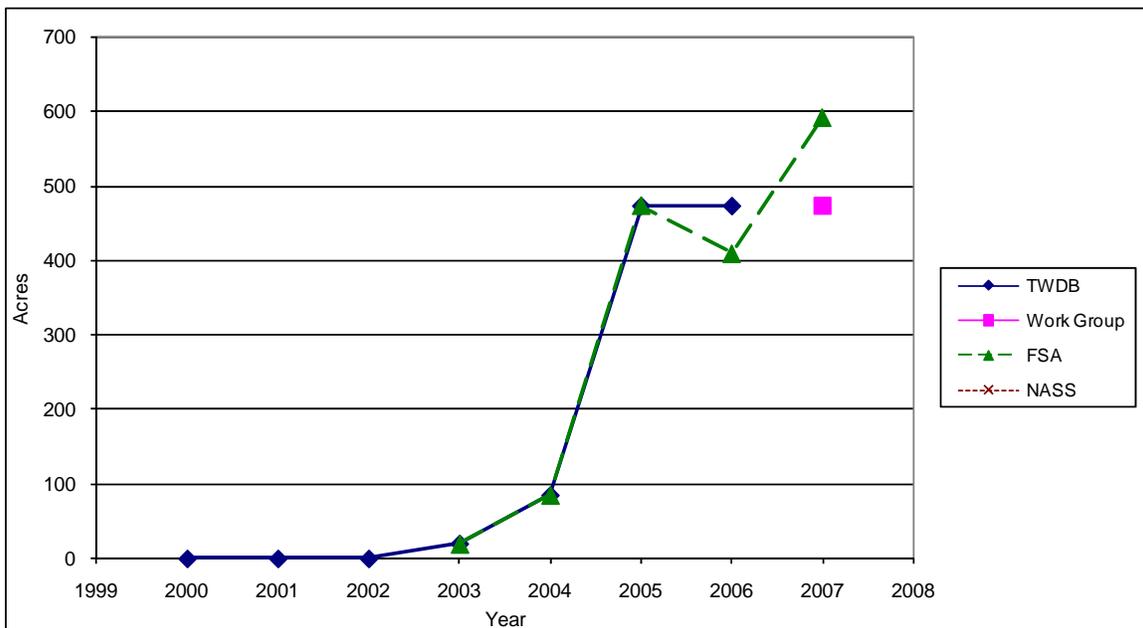


Figure 22: Reagan County Irrigated Acres Wheat

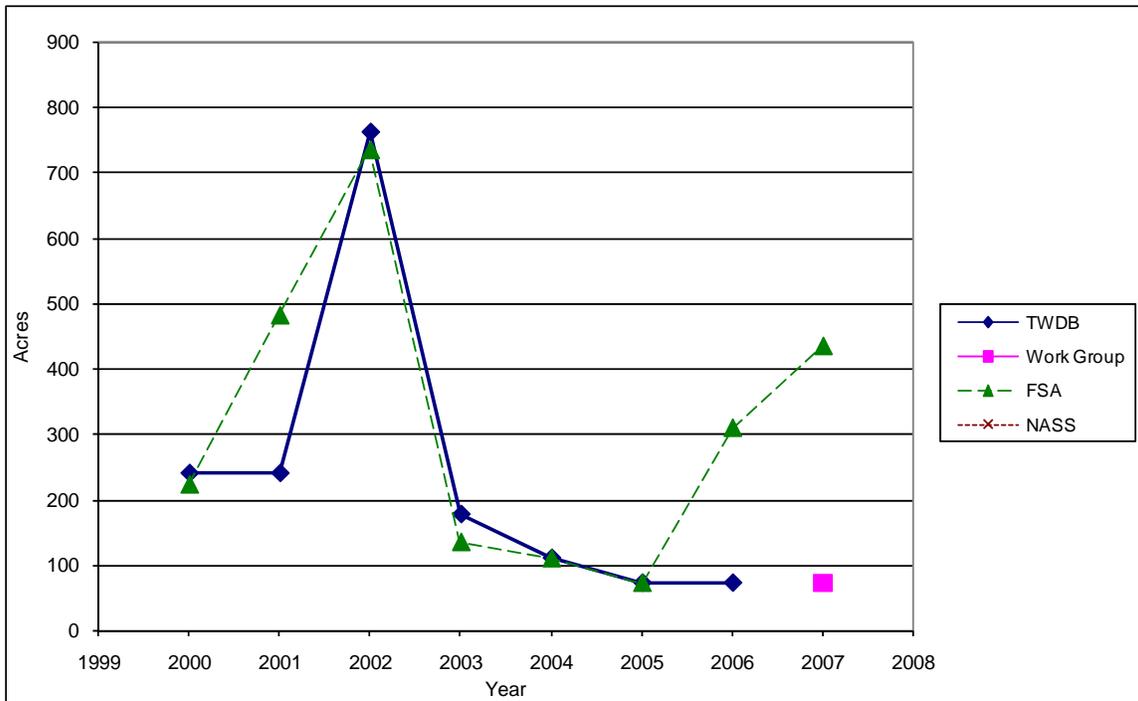


Figure 23: Reagan County Irrigated Acres Sorghum

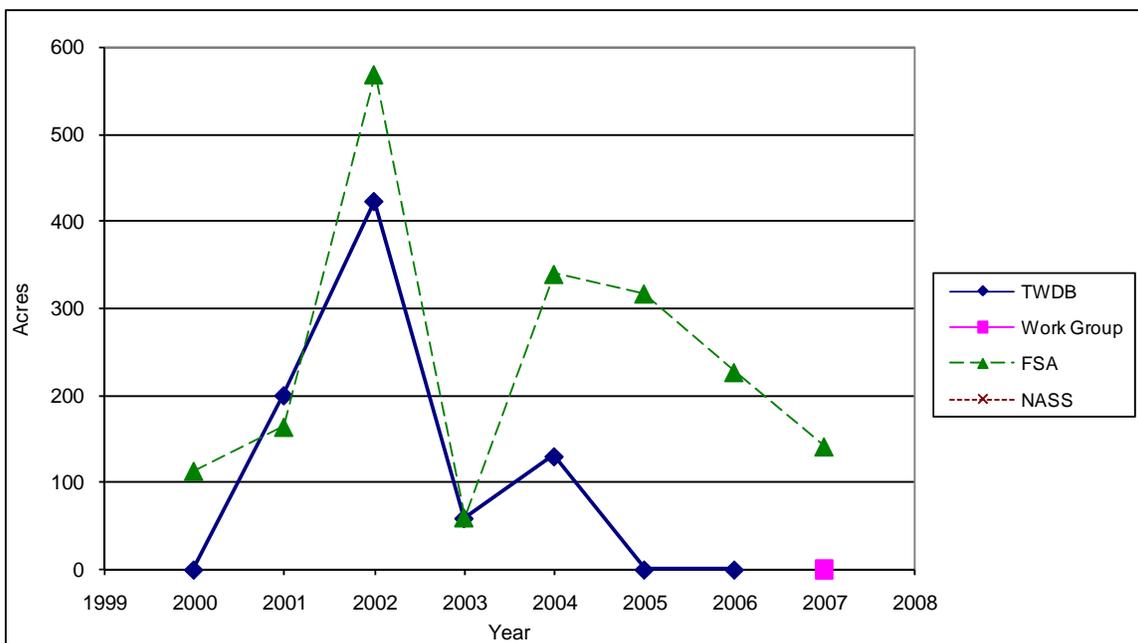


Figure 24: Reagan County Irrigated Acres Pecans

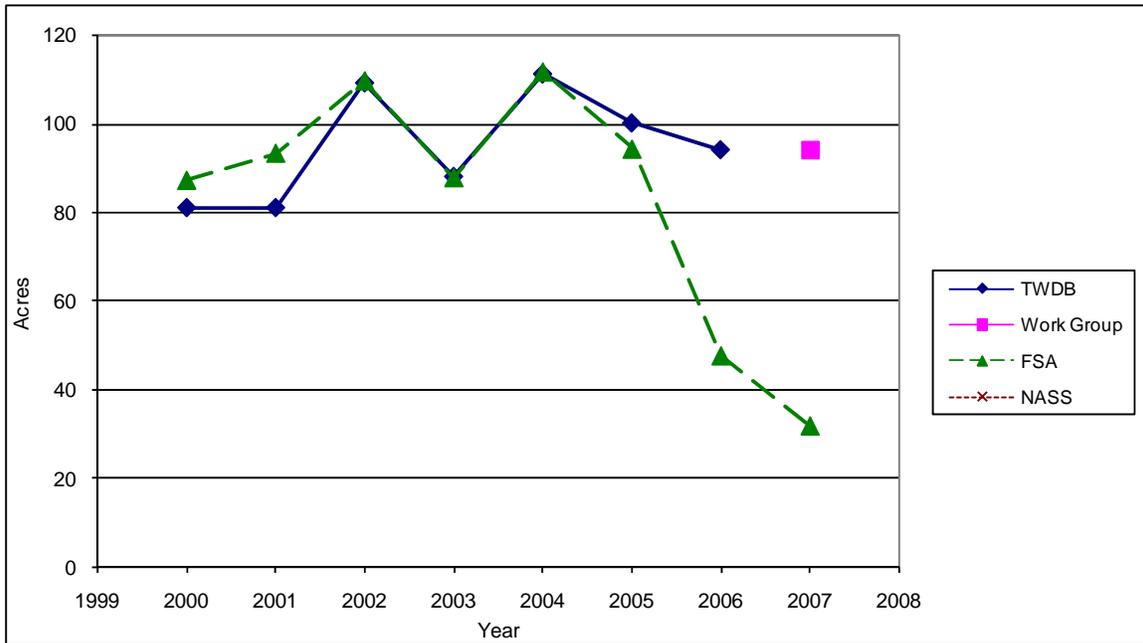
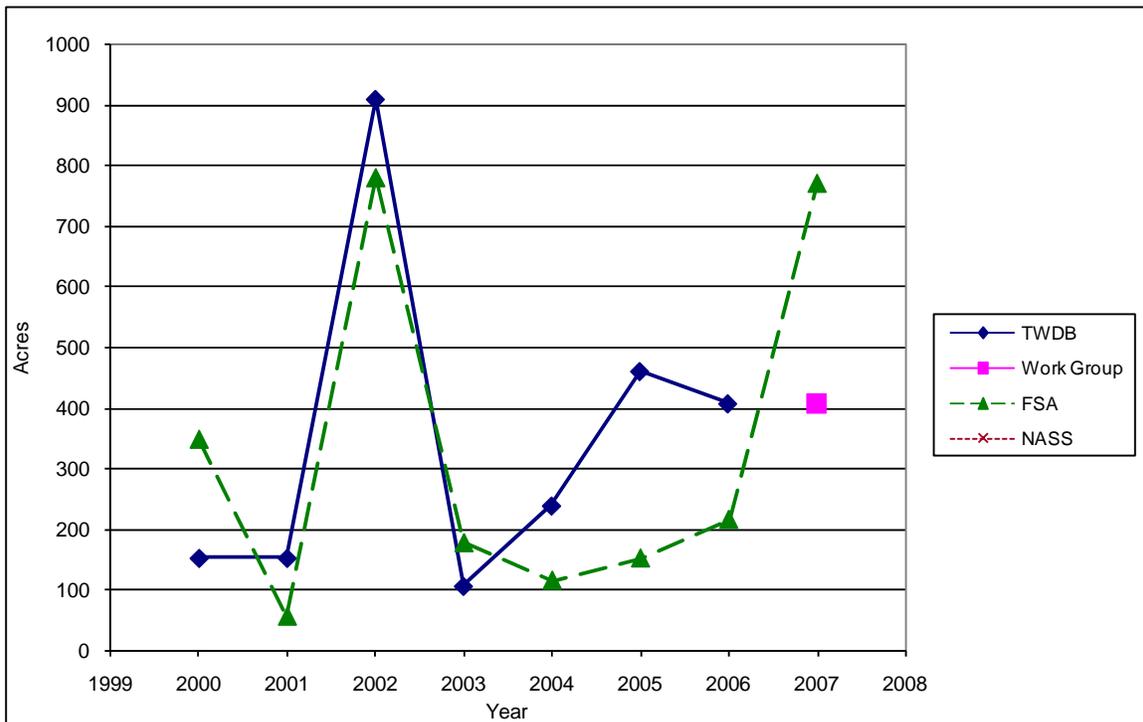


Figure 25: Reagan County Irrigated Acres Other



Reeves County

Figure 26 Reeves County Irrigated Acres Cotton

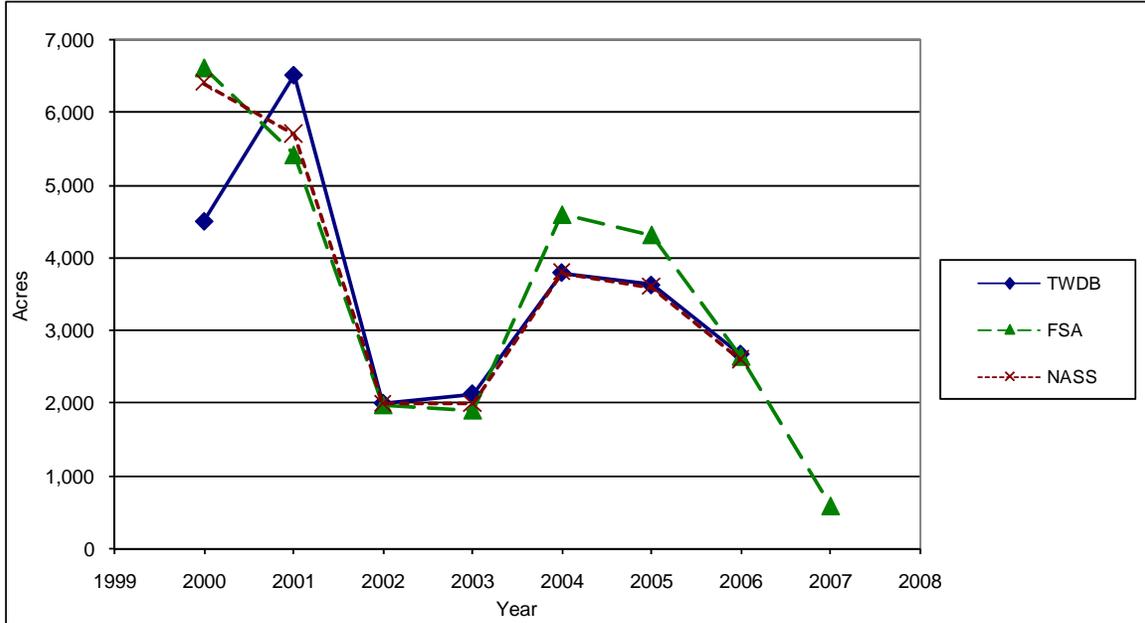


Figure 27: Reeves County Irrigated Acres Corn

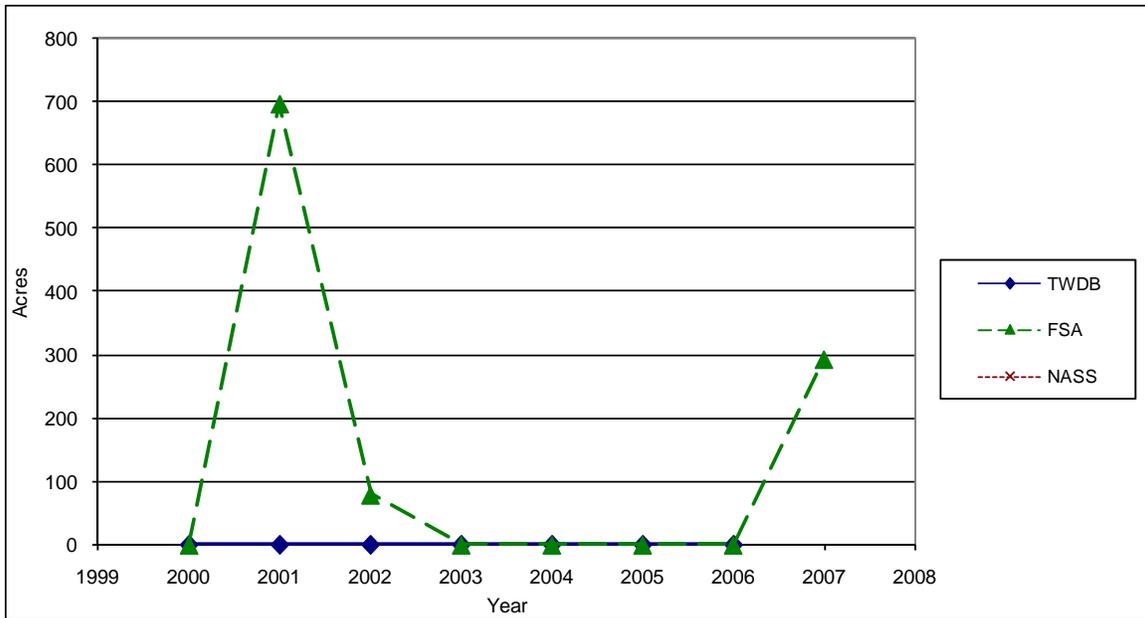


Figure 28: Reeves County Irrigated Acres Wheat

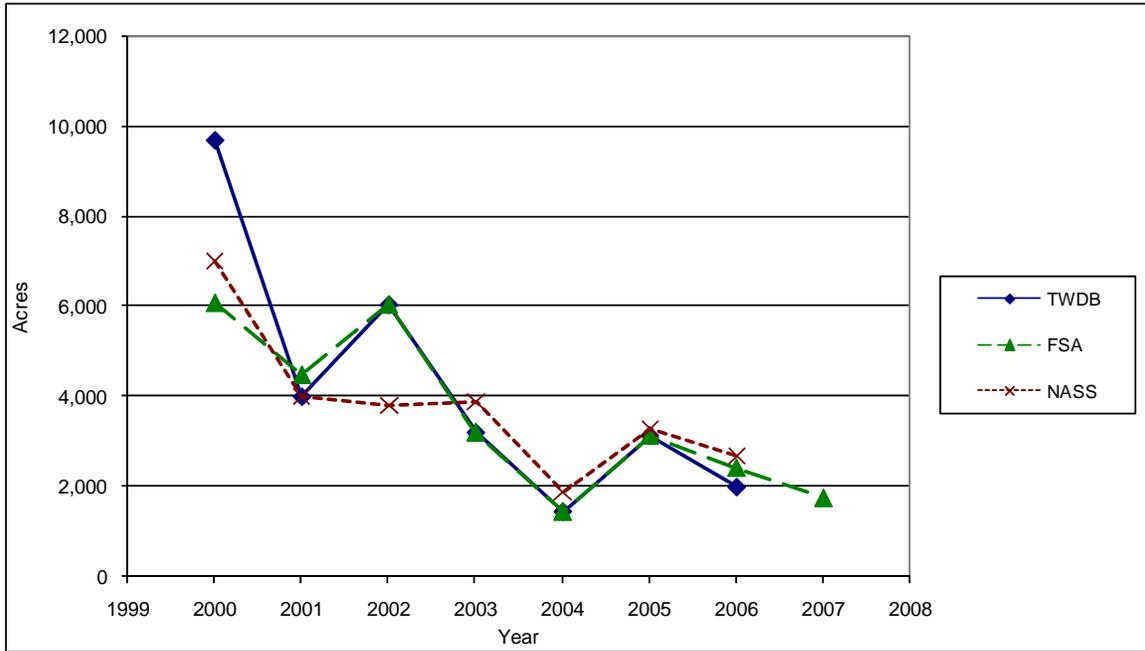


Figure 29: Reeves County Irrigated Acres Sorghum

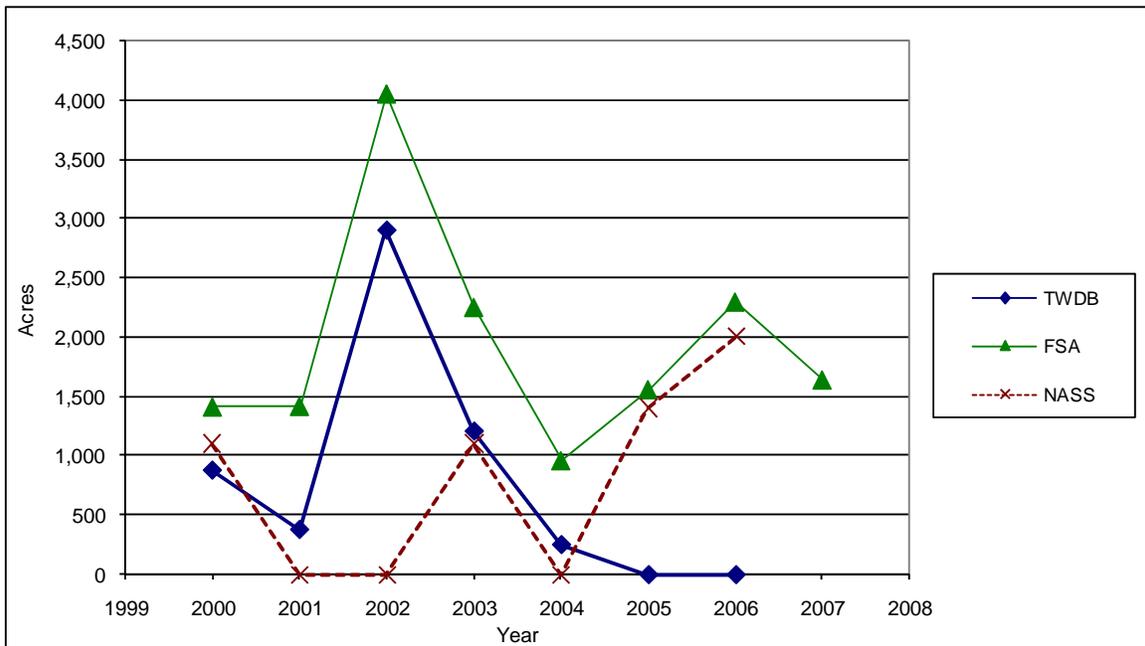


Figure 30: Reeves County Irrigated Acres Pecans

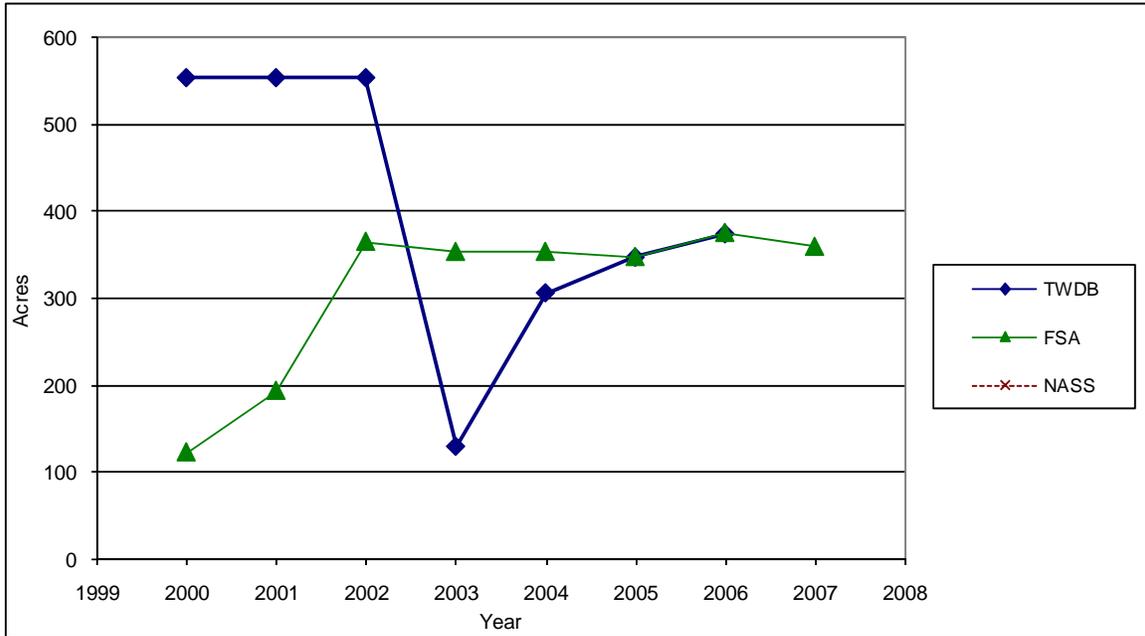


Figure 31: Reeves County Irrigated Acres Alfalfa

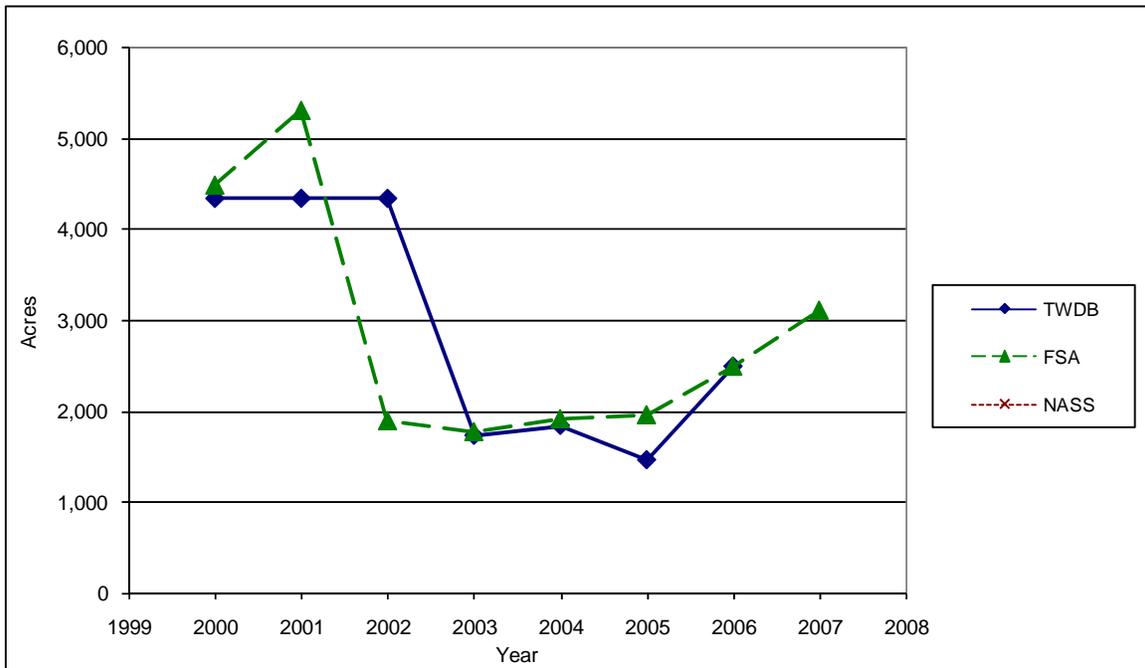
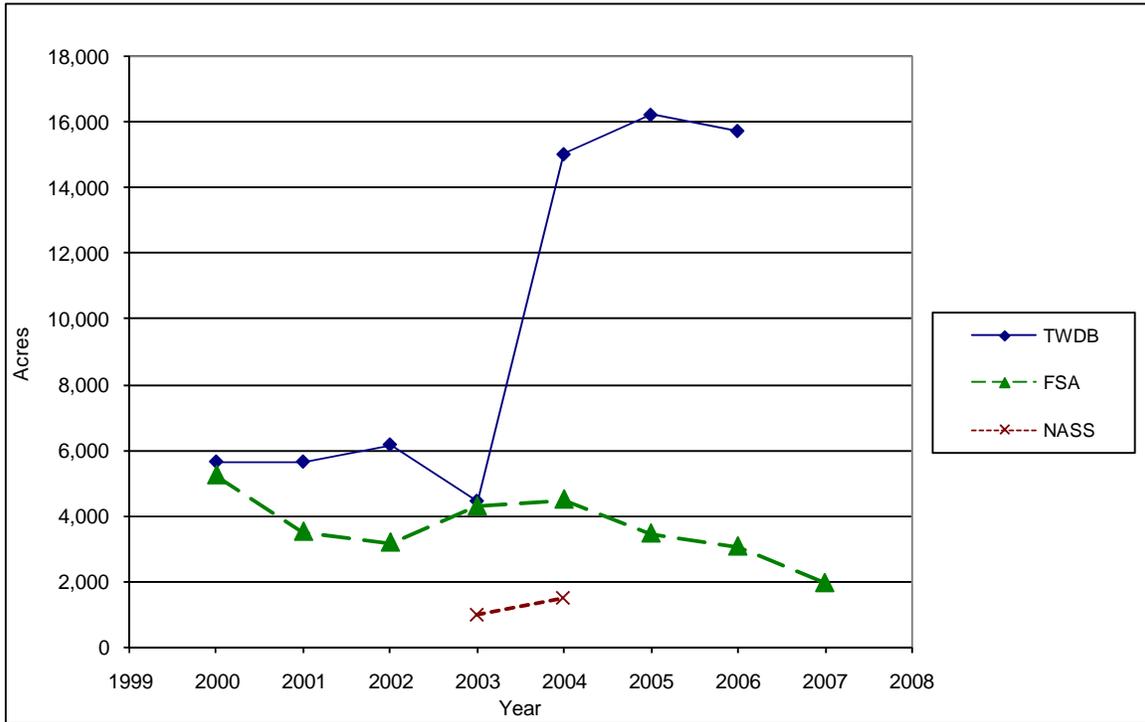


Figure 32: Reeves County Irrigated Acres Other



Tom Green County

Figure 33: Tom Green County Irrigated Acres Cotton

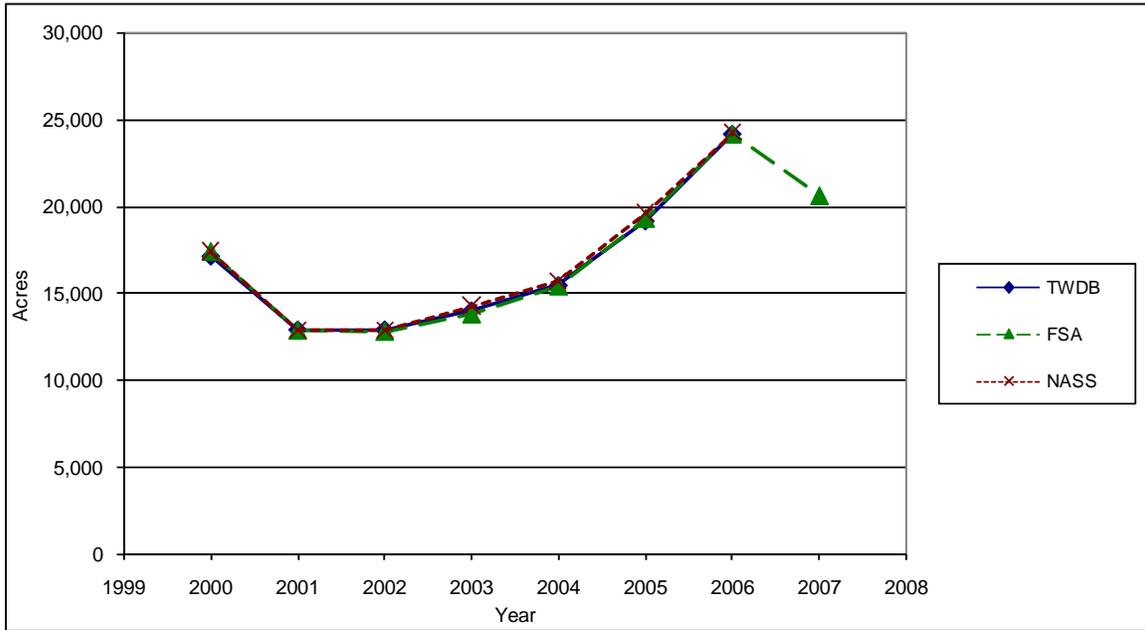


Figure 34: Tom Green County Irrigated Acres Corn

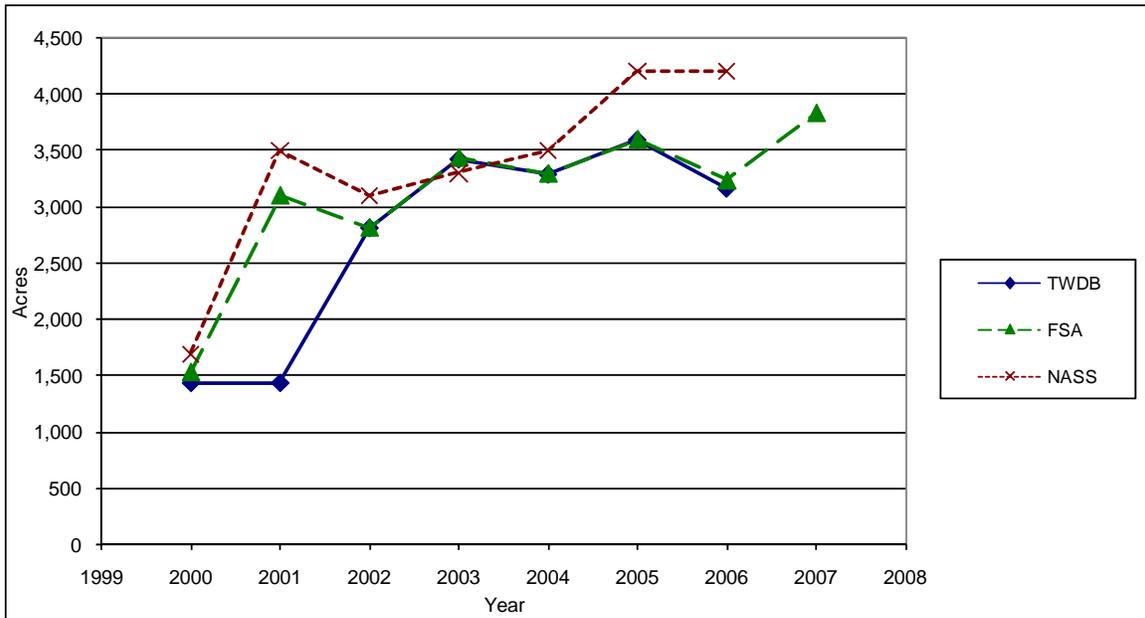


Figure 35: Tom Green County Irrigated Acres Wheat

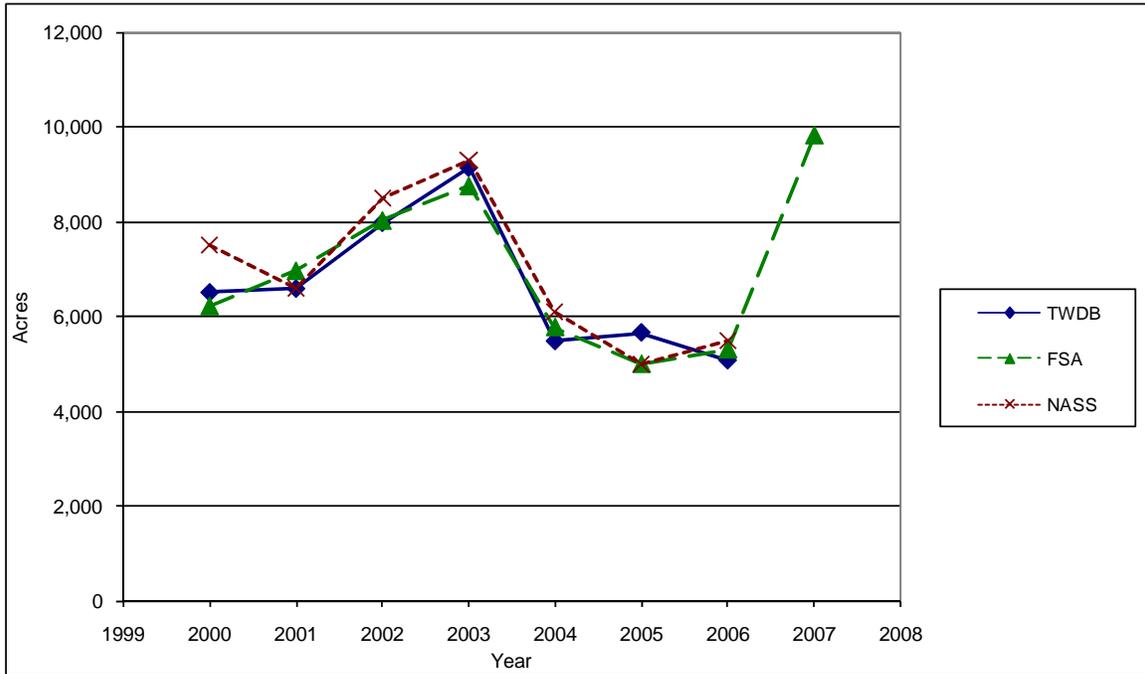


Figure 36: Tom Green County Irrigated Acres Sorghum

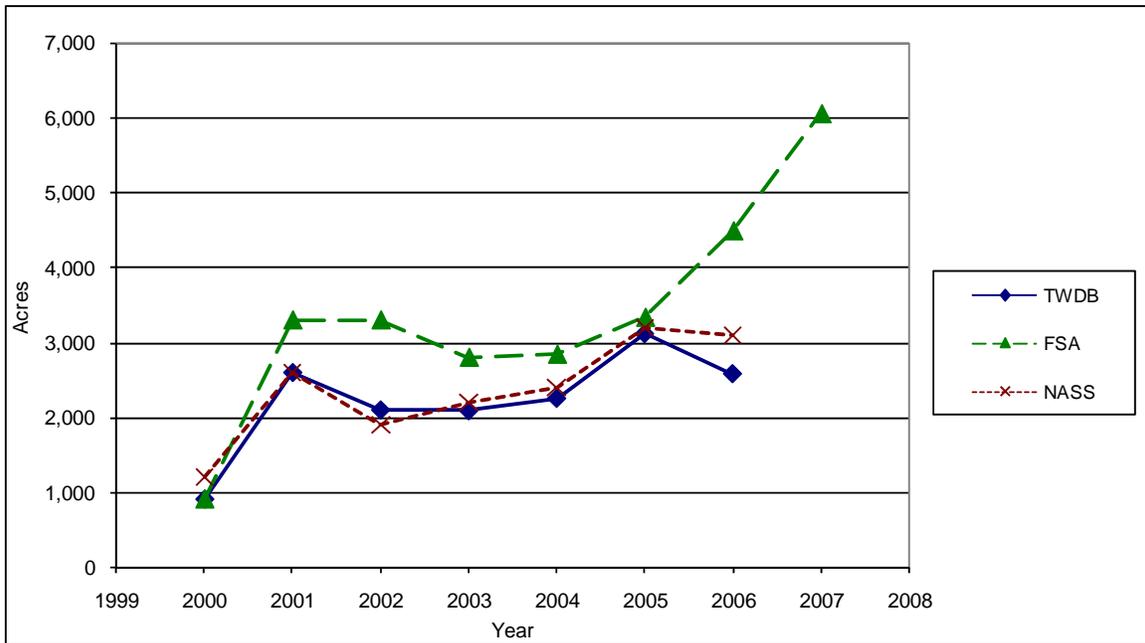


Figure 37: Tom Green County Irrigated Acres Pecans

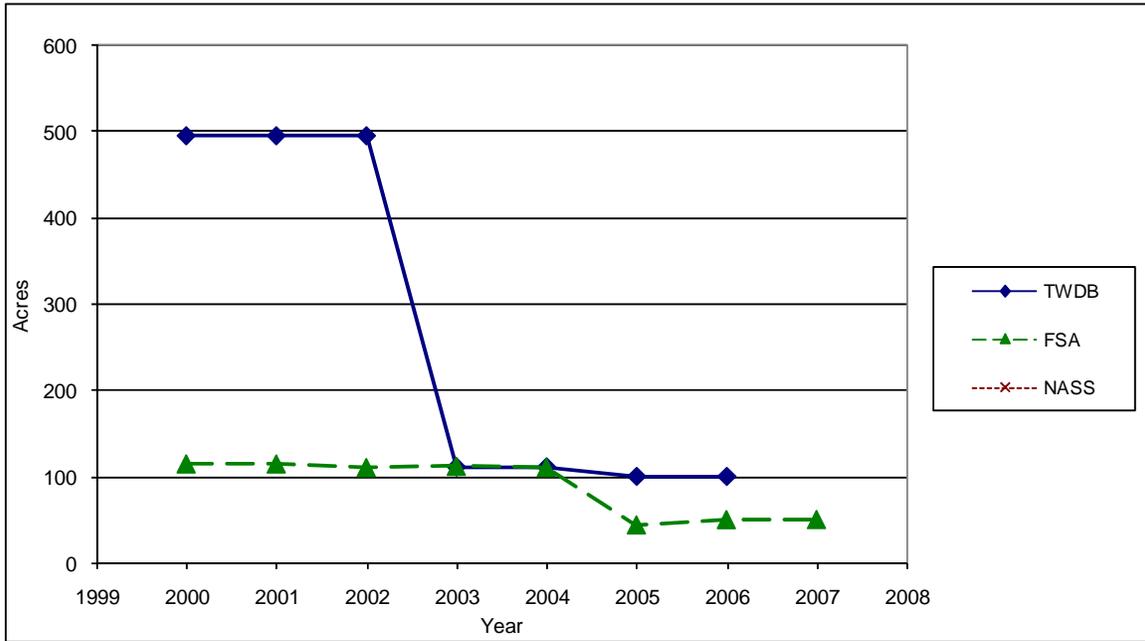
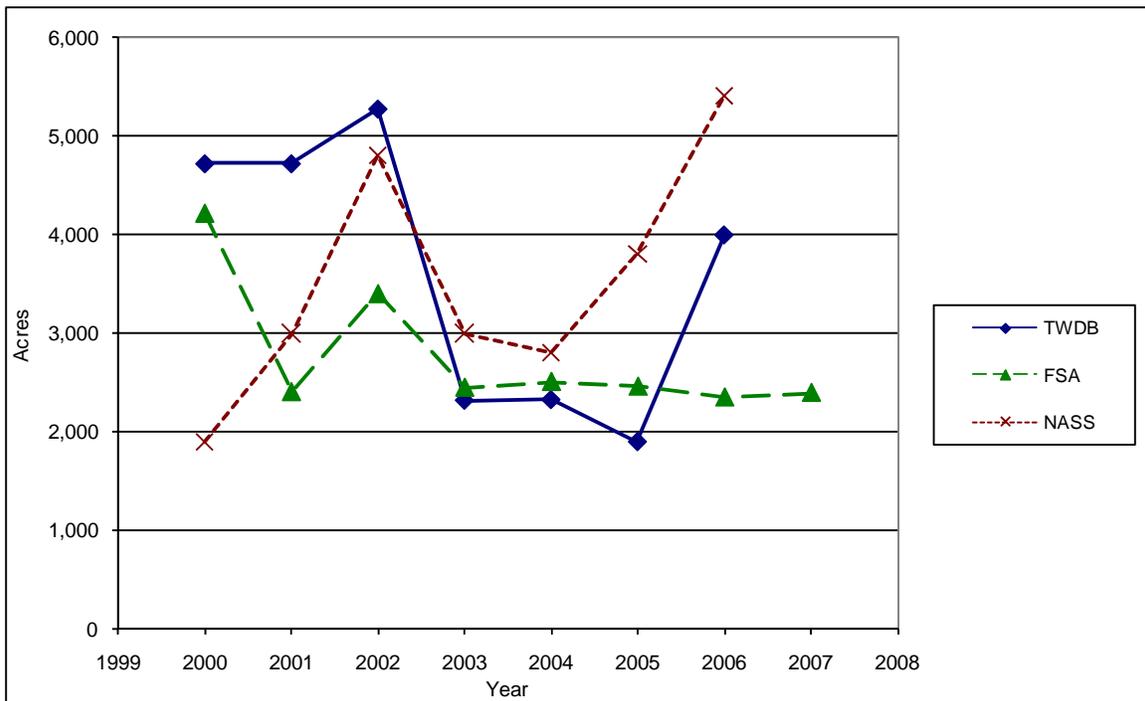


Figure 38: Tom Green Irrigated Acres Other



**Appendix B: TWDB Irrigation Water Use Methodologies:
1994-2007**

TWDB Irrigation Water Use Methodologies: 1994-2007

A frequent issue is the considerable variation in annual irrigation use for some counties when viewing a table of historic irrigation water use presented by TWDB staff. TWDB staff believes that the reason for this variation is that this includes information essentially developed from four different sources of information and methodologies that we have had to utilize to obtain our information. In addition, actual conditions of changes in irrigated acreage and availability of groundwater and surface water supplies has affected several counties during this historic period. The following describes the methodologies used to calculate annual irrigation water for the periods of: 1994 and 2000; 1995-1999; 2001-2002; and 2003-2007.

1994 and 2000

Data for these two years was provided exclusively by USDA-Natural Resources Conservation Service (NRCS) and is often referred to as the detailed irrigation surveys. Each local county office of NRCS was responsible for completion of a paper copy map showing location and extent of irrigated land supplied by either groundwater or surface water. Each county office also completed a worksheet containing data on about 23 crops (if applicable). This data was the irrigated acreage of that crop (cotton for example) and the average representative value of irrigation water applied (inches per acre) to that crop during that specific year. Data was supplied separately for acreage supplied by groundwater or surface water. Summation of these data inputs provided the total irrigated acreage and groundwater and surface water use for the county. It is important to note that the estimated irrigation water use is for on-farm use and did not reflect the total amount of surface water that was initially diverted for delivery to the farmers' fields.(*)

1995-1999

During this period, the annual irrigation water use estimates were developed by a combination of NRCS irrigated crop water use data and Texas Agricultural Statistics Service irrigated acreage data. NRCS did not want to supply the maps or irrigated acreage data but did continue to provide estimates of irrigation water use by crop type in each county. Again, this was the average representative value of irrigation water applied (inches per acre) to that crop during that specific year. Texas Agricultural Statistics Service (TASS) could provide estimates on irrigated acreages for the major crop types. For crops not included in these data, TWDB relied on data from the most recent NRCS detailed survey. The distribution of the resulting total irrigated acreage and total irrigation water use was divided into groundwater and surface water use based on estimates provided by NRCS based on the detailed surveys. Again, the surface water use component is on-farm use (*).

2001-2002

These two years were a transition period. NRCS decided it could no longer provide any of the data it was previously providing. For irrigated acreage data we had to continue using the TASS major crop acreage data and data from 2000 NRCS survey for the other crop types. Irrigation water use (inches per acre) was based on the historic data and adjusted if necessary for rainfall conditions in 2001 and 2002. Once again, the surface water use component is on-farm use (*).

(*) **On the TWDB web site under irrigation water use estimates:**

<http://www.twdb.state.tx.us/assistance/conservation/ASPApps/Survey.asp>

the data presented is for this on-farm use. In the data files of the combination annual water use surveys:

<http://www.twdb.state.tx.us/wushistorical/>

and in data used in regional planning studies, irrigation use of surface water is sometimes adjusted to account for some distribution losses between diversion point and delivery to the farmers' field.

2003-2007

Beginning with the year 2003, TWDB was able to obtain data that was not previously available. The State Office of USDA-Farm Service Agency (FSA) finally agreed that they could/would provide us their data of irrigated crop acreages for each county in the state. Discussions with Texas Commission of Environmental Quality (TCEQ) resulted in our requests to obtain annual reported irrigation water use from files in the Austin TCEQ Office and from the Watermaster offices.

To develop irrigation water use estimates by crop by county, TWDB staff instituted a procedure of developing a tabulation of the historic estimates by crop by county. Then, for the same time period and same crops a tabulation of theoretical Potential Evaporation-Transpiration (PET) values was developed. Using these data, a ratio value of historic use versus PET was developed by crop by county whenever possible. Then for calculations for a given year, rainfall and PET data for that county is used with the ratio value to estimate irrigated crop water use in that year. This procedure attempts to take into account variations due to rainfall and weather conditions. TWDB staff is attempting to obtain better information on availability of PET data and then utilize this data in our calculations. However, it must be pointed out that regardless of the number and location of PET stations and the accuracy of PET data, the irrigation farmer may or may not be utilizing irrigation water as estimated by the PET calculations.

Using FSA irrigated crop acreage data and estimates of irrigated crop water use, the data is compiled on county worksheets. Using data on use of surface water obtained from TCEQ, the total irrigation water use is distributed between groundwater and surface water in each county to complete the INITIAL estimates for each county. Since 2003, the estimates of surface water use do include any distribution losses between diversion and delivery to farms. In some cases, this value can be considerable larger than the amount of irrigation water actually used on the field. This initial applicable county data is then mailed to each groundwater conservation district and most irrigation districts in the state asking for their review and comments on our estimates of irrigated crop acreages, irrigation water use by crops, and the total volume of groundwater and surface water use. To the extent possible, comments and proposed revisions are utilized in the final version of the annual irrigation water use estimates.

The critical point is that this is our attempt to account for the variation from year to year in actual irrigation water use as influenced by actual conditions of effective rainfall, availability of groundwater and surface water supplies, irrigated cropping patterns, and efficiency of irrigation systems.

Appendix C: Irrigated Area Maps by County

Figure 1: Glasscock County Irrigated Areas 2000

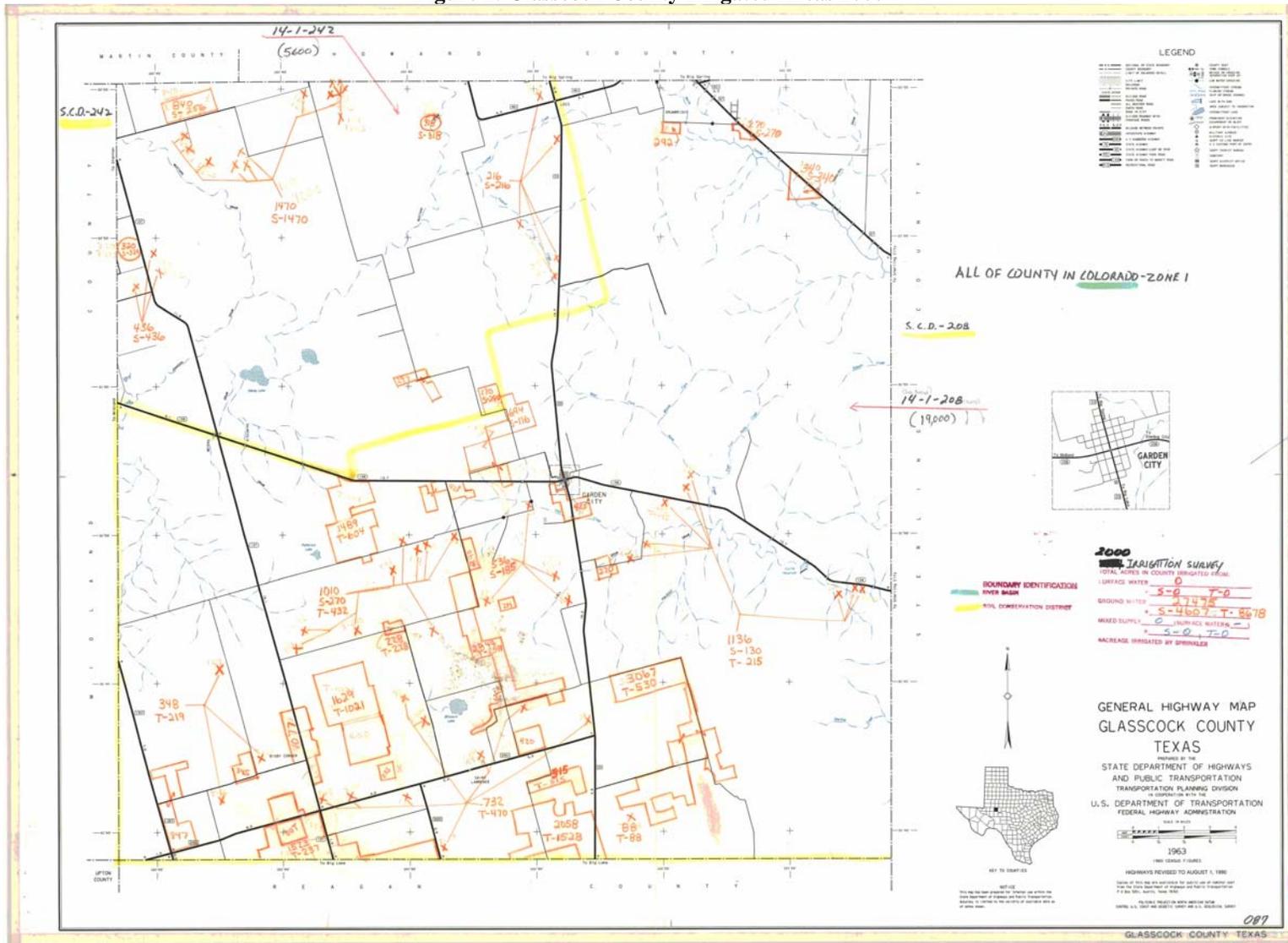


Figure 3: Pecos County Irrigated Areas 2000

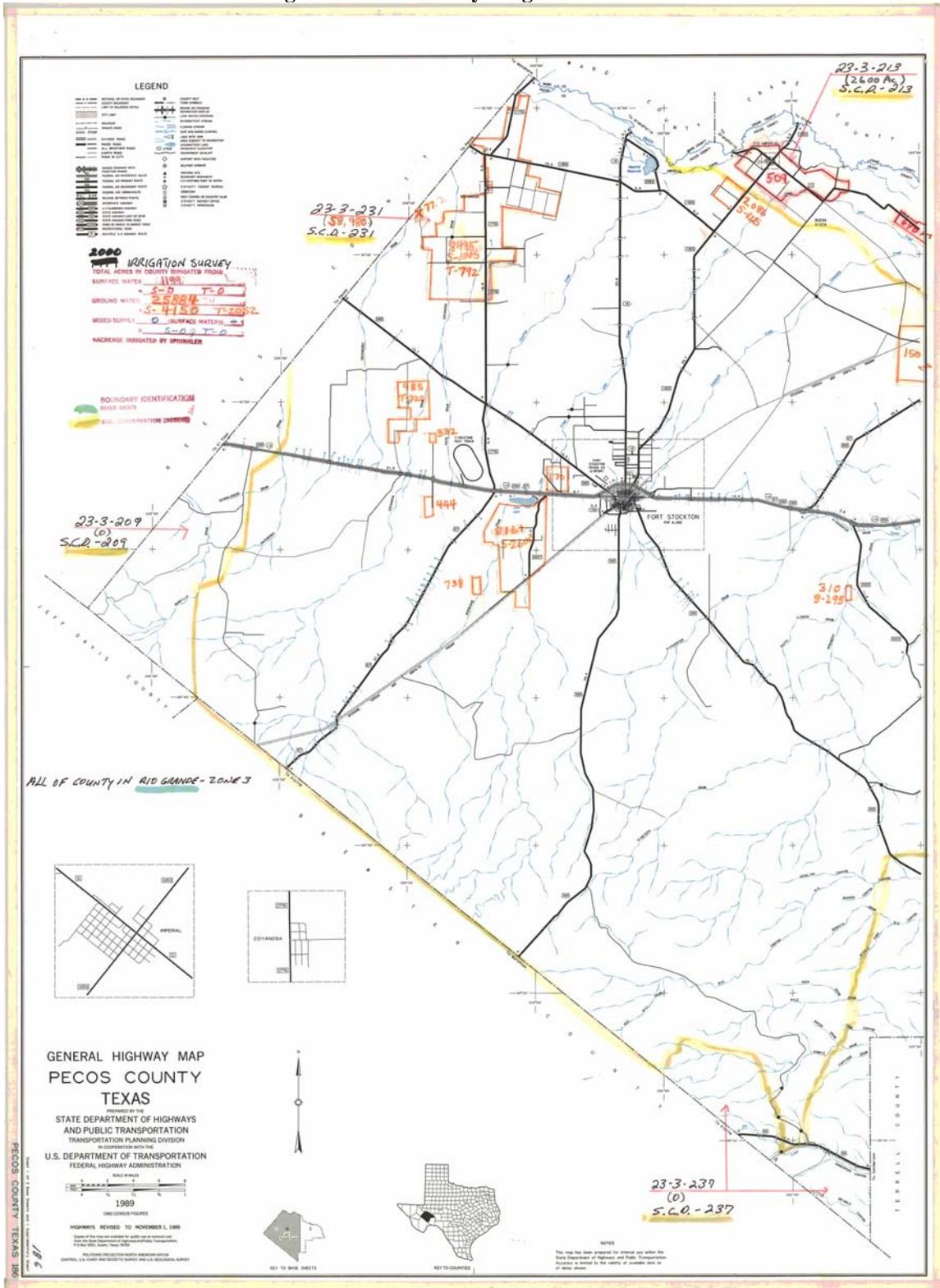


Figure 4: Pecos County Irrigated Areas 2000

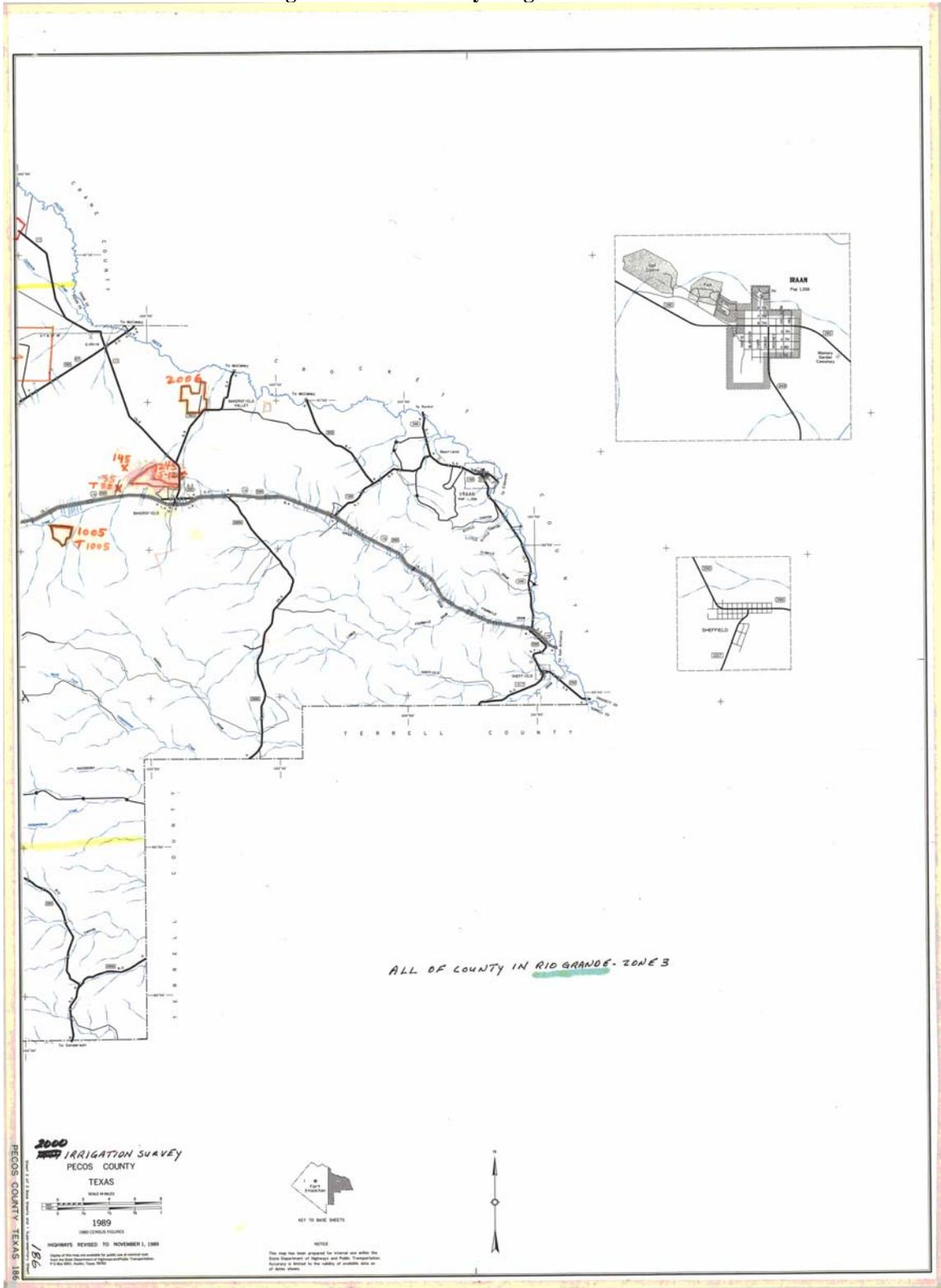


Figure 5: Reagan County Irrigated Areas 2000

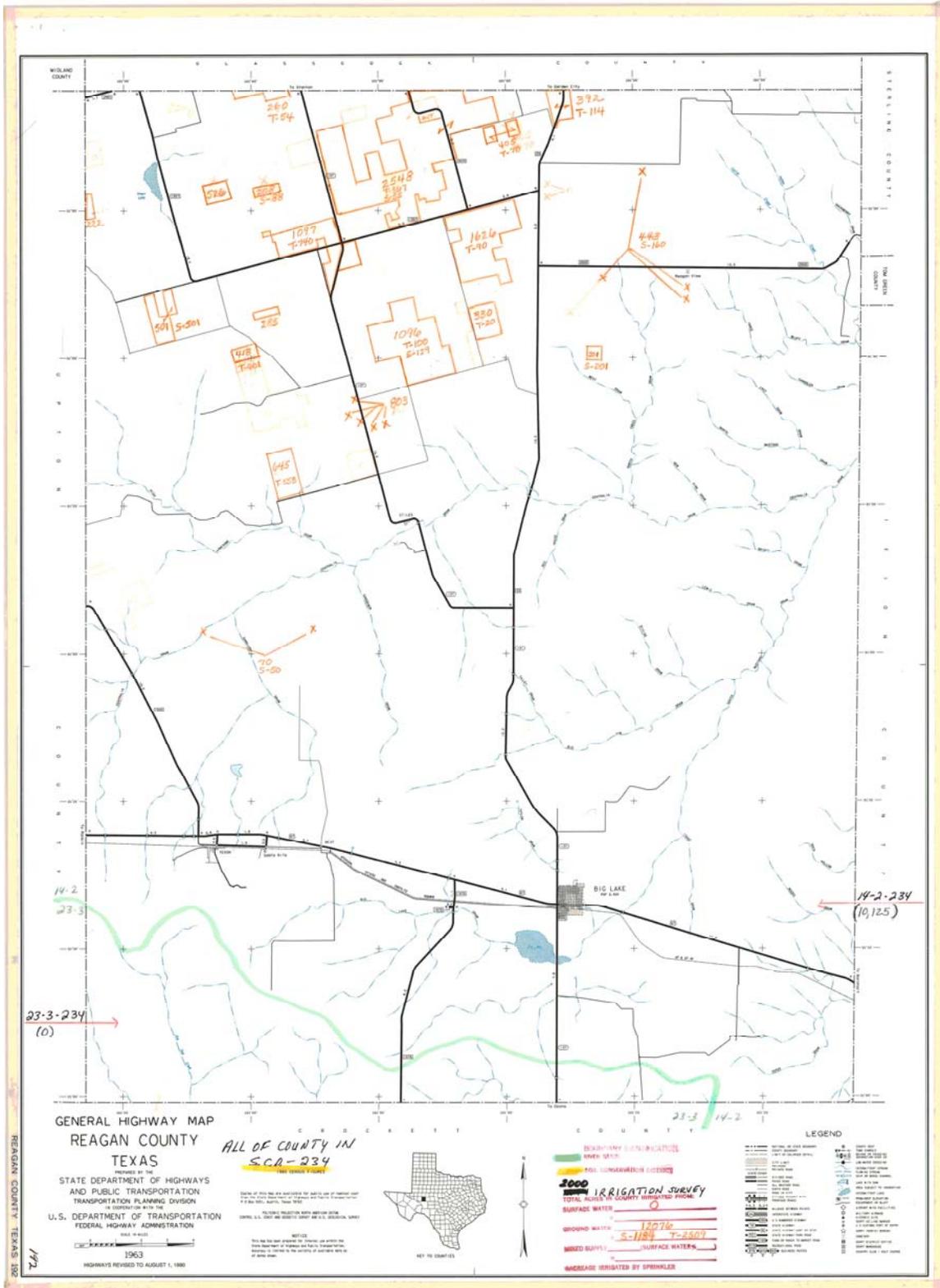


Figure 6: Reeves County Irrigated Areas 2000

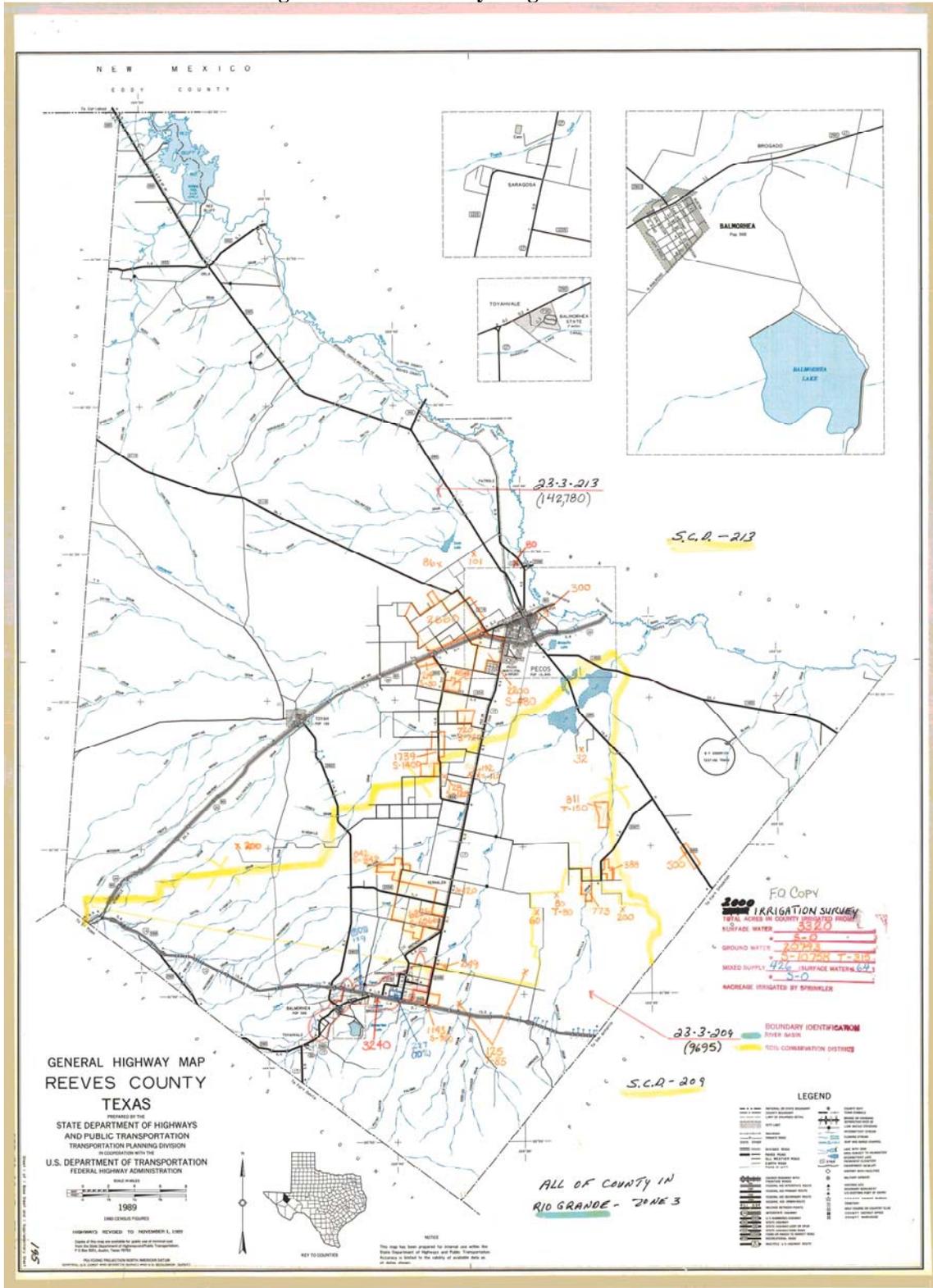


Figure 7: Tom Green County Irrigated Areas 2000

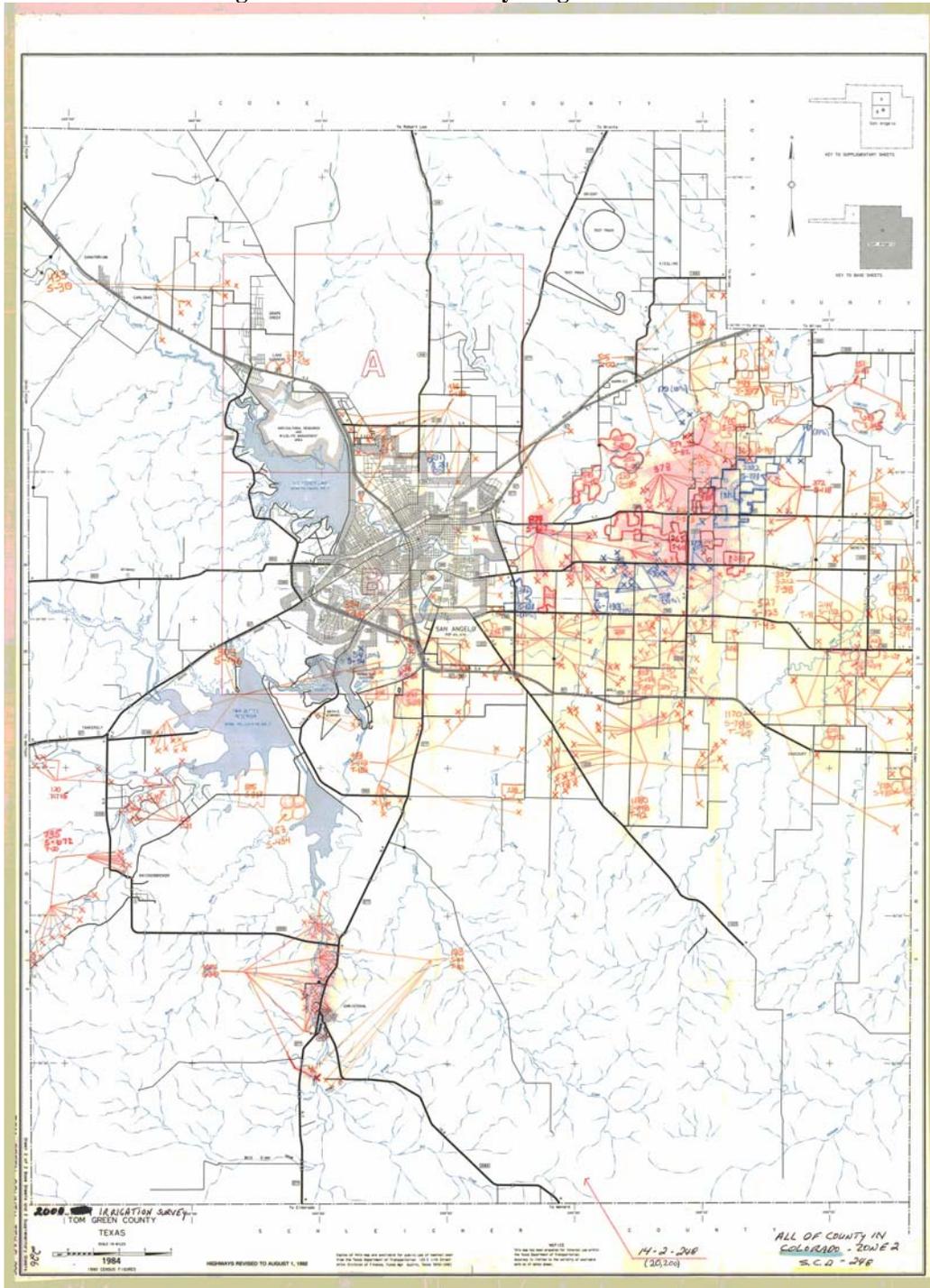


Figure 8: Tom Green County Irrigated Acres 2000

