4.5 Projected Water Shortages

The large amount of information presented in Section 4.2 (County Summaries) and Section 4.3 (Major Water Providers) has been reviewed for projected shortages. The following sections summarize that information as follows:

1. Municipal Use Category – Section 4.5.1:
    - Incorporated cities and County-Other category projected to have water shortages.
    - Entities reporting water supply concerns.
    - Rural water supply entities in counties projected to have water shortages or where County-Other category is projected to have water shortages.
2. Counties showing projected Manufacturing Use projected shortages – Section 4.5.2.
3. Counties showing projected Steam-Electric Use projected shortages – Section 4.5.3.
4. Counties showing projected Mining Use projected shortages – Section 4.5.4.
5. Agricultural Water Demand and Supply - Section 4.5.5.
6. Counties showing projected Livestock Use projected shortages – Section 4.5.6.

4.5.1 Projected Municipal Shortages

4.5.1.1 Cities with Projected Shortages

The information presented in Sections 4.2.1 through 4.2.37 was reviewed for cities projected to have water shortages. Those water-short cities are listed in Table 4-75 and mapped in Figure 4-9. Table 4-75 also reports the projected year 2030 and 2050 shortage, and the approximate year that shortages would begin for each water-short city.

4.5.1.2 County-Other Projected Shortages

The County-Other category includes water supply corporations, water districts, privately owned utilities, small towns (less than 500 population), parks, federal and state institutions, and other entities. The county summary demand/supply tables (Tables 4-1 through 4-74) indicate nine counties where the County-Other category as a whole is projected to be water short. Those counties are Bosque, Coryell, Johnson, Jones, McLennan, Nolan, Somervell, Throckmorton, and Williamson. Sections 4.5.1.2.1 through 4.5.1.2.9 list the public water supply entities within these counties.

Table 4-75.
Cities with Projected Water Shortages

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bell County			
Fort Hood	2000	(3,098)	(3,098)
Holland	2020	(87)	(94)
Little River-Academy	2020	(127)	(124)
Morgans Point Resort	2000	(584)	(648)
Salado WSC	2020	(228)	(478)
Troy	2000	(255)	(274)
Bosque County			
Meridian	2000	(218)	(281)
Valley Mills	2000	(77)	(83)
Walnut Springs	2000	(41)	(43)
County-Other	2000	(992)	(1,194)
Brazos County			
Bryan	2040	0	(3,106)
College Station	2010	(6,381)	(12,295)
Burleson County			
None			
Callahan County			
Baird	2000	(149)	(118)
Comanche County			
None			
Coryell County			
Copperas Cove	2030	(426)	(3,296)
Fort Hood	2000	(2,365)	(2,261)
Gatesville	2020	(6,102)	(8,121)
County-Other	2000	(541)	(437)
Eastland County			
Cisco	2000	(185)	(119)
Eastland	2040	0	(875)
Ranger	2040	0	(460)
Erath County			
Stephenville	2000	(1,538)	(1,899)
Falls County			
None			
Fisher County			
Roby	2030	(54)	(48)
Grimes County			
None			

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Table 4-75 (continued)

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Hamilton County			
None			
Haskell County			
Haskell	2000	(526)	(538)
Hill County			
None			
Hood County			
Granbury	2010	(2,905)	(3,835)
Johnson County			
Alvarado	2020	(72)	(220)
Briar Oaks	2000	(36)	(38)
Burleson (P)	2010	(783)	(1,544)
Cleburne	2040	0	(2,822)
Godley	2000	(60)	(60)
Grandview	2000	(160)	(190)
Joshua	2030	(29)	(209)
Keene	2000	(1,149)	(1,495)
Rio Vista	2000	(34)	(36)
County-Other	2000	(7,377)	(9,464)
Jones County			
Hamlin	2000	(53)	(105)
Stamford	2000	(748)	(959)
County-Other	2000	(93)	(88)
Kent County			
None			
Knox County			
Knox City	2020	(235)	(235)
Munday	2000	(294)	(295)
Lampasas County			
Lampasas	2020	(544)	(1,501)
Lee County			
Giddings	2000	(337)	(542)
Limestone County			
Groesbeck	2000	(756)	(874)
McLennan County			
McGregor	2000	(313)	(360)
Robinson	2000	(551)	(615)
West	2000	(399)	(378)
County-Other	2000	(4,029)	(3,785)
Milam County			
Rockdale	2050	0	(30)

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Table 4-75 (continued)

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Nolan County			
County-Other	2020	(155)	(89)
Palo Pinto County			
Palo Pinto	2010	(82)	(83)
Robertson County			
Hearne	2030	(67)	(290)
Shackelford County			
None			
Somervell County			
Glen Rose	2000	(300)	(432)
County-Other	2000	(734)	(1,282)
Stephens County			
None			
Stonewall County			
None			
Taylor County			
Abilene	2020	(2,610)	(7,067)
Merkel	2000	(294)	(355)
Throckmorton County			
Throckmorton	2000	(158)	(140)
County-Other	2000	(50)	(43)
Washington County			
None			
Williamson County			
Brushy Creek	2010	(4,020)	(3,887)
Florence	2010	(136)	(212)
Georgetown	2010	(8,151)	(18,535)
Granger	2010	(129)	(224)
Hutto	2010	(265)	(550)
Leander	2050	0	(171)
Round Rock	2010	(12,157)	(21,543)
Taylor	2040	0	(1,507)
Thrall	2010	(40)	(63)
County-Other	2000	(11,750)	(11,302)
Young County			
None			
Number of cities on list: 58	Number of County-Others: 9		Total: 67
(P) Indicates city is in multiple counties.			

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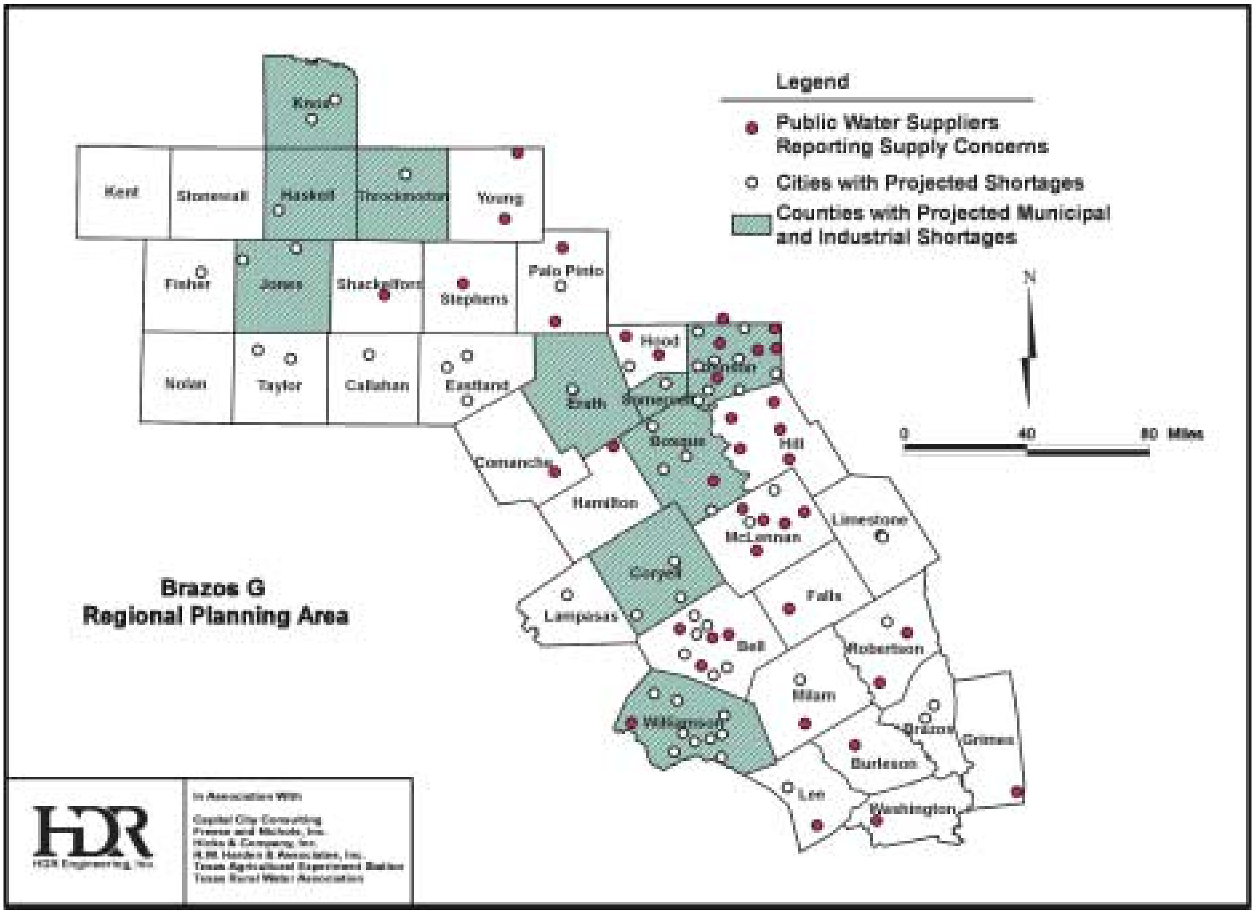

Figure 4-9. Projected Municipal Water Shortages and Entities Reporting Water Supply Concerns

4.5.1.2.1 Bosque County Entities in County-Other Category

Demand/supply projections for Bosque County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Aqua Pure Water Supply
- Bosque-Brazos Valley Water Supply
- Camelot Estates Water Supply
- Cedar Shores Estates Water Corp.
- Cedron Creek Ranch, Inc.
- Childress Creek WSC
- City of Cranfills Gap
- City of Iredell
- City of Morgan
- Kopperl ISD
- Lake Whitney Water Co., Inc.
- Lakeline Acres Water Co.
- Lakeside Water Supply District
- Lakewood Harbor
- Lame Duck Water System
- Mermaid Swimming Pool
- Mosheim WSC.
- Mustang Valley WSC

- Cliff Oaks Addition
- Cooney Cavern Lodge
- Glenshores Water System
- Highland Park Water Corp.
- Highlands Water Co.
- Hog Creek WSC
- Indian Lodge Water System
- Prairie Oaks Water Co.
- Shuler Point Water System
- Smith Bend WSC
- Smith Bend WSC
- Steele Creek Harbor Water Supply
- Texas Parks & Wildlife Dept.
- U. S. Corps of Engineers

4.5.1.2.2 Coryell County Entities in County-Other Category

Demand/supply projections for Coryell County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Amspachers Grocery & Station
- Bluestem Estates
- Cedar Grove Mfg. Home Community
- City of Copperas Cove
- City of Gatesville
- Coryell City Water Supply District
- Duren Village Multi-County WSC
- Elm Creek Water Supply Corporation
- Flat Water Supply Corporation
- North Fort Hood
- The Grove Water Supply Corporation
- Leon Junction Water Supply Corporation
- Mosheim Water Supply Corporation
- Mountain Water Supply Corporation
- Oglesby Water Supply Corporation
- Sun Set Estates
- Topsey Water Supply Corporation
- Whispering Oaks Subd. Water Supply

4.5.1.2.3 Johnson County Entities in County-Other Category

Demand/supply projections for Johnson County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- A & A Mobile Home Park
- Ace Mobile Home Park
- Bethesda WSC
- Blue Water Oaks
- Burleson Oaks Estates
- Chuck Bell Water Co.
- City of Venus
- Clearview Drive Water System
- Community of Bethany
- Community Water & Sewer Corp.
- Crest Water Co.
- Oakview Farms Subdivision Water System
- Parker WSC
- Peaceful Meadows Subdivision
- Primrose Water System
- Rancho Villa Estates
- Ridge Crest Addition
- Shaded Lane Estates
- Shady Hill Estates
- Shady Lane Water Co.
- Shady Meadows Estate
- Shorty's Mobile Home Village

- Crowley 1 Acre - Sky Corp Water Co.
- Crowley Two Acre Water Co.
- G & H Management, Inc.
- Garden Acres System
- Granda Vista & Oakview Village
- Hilltop Water
- Johnson County FWSD 1
- Johnson County Rural WSC
- Lark Meadow Subdivision
- Mansfield South
- Metroplex Homesteads Water System
- Mockingbird Hill Mobile Home Park
- Mountain Peak WSC
- Mountainaire Mobile Home Park
- Mountainview Estates
- Northcrest-Burleson Oaks
- Oak Leaf Trail Subdivision
- Oak Ridge Subdivision
- Oakridge Square Mobile Home Park
- Skyline Drive Landowners Assn.
- Skyline Ranch
- Spring Valley Water Co-op.
- Stonefield Water System
- Summit Ridge Estates
- Sundance Addition
- Sunset Canyon
- Sunset Canyon Water Company
- Sunshine Country Acres
- Texas Parks & Wildlife Dept.
- Thomas Acres
- Three B Farms, Inc. Water System
- Union Hill Water System
- Walden Estates Water Co
- West Lakeview Water Supply Co-op
- Whispering Meadows Water System
- Williams Mobile Home Park
- Willow Bend Subdivision
- Woodland Oaks Estates

4.5.1.2.4 Jones County Entities in County-Other Category

Demand/supply projections for Jones County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- City of Lueders
- Ericksdahl WSC
- Hawley WSC

4.5.1.2.5 McLennan County Entities in County-Other Category

Demand/supply projections for McLennan County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Axtell WSC
- Behringer Water System
- Bold Springs WSC
- Bosque Basin WSC
- Bosqueville Green Acres WSC
- Midway ISD
- Moore's Water System
- Moses Hill Estates
- M-S WSC
- North Bosque WSC

- C S WSC
- Cedar Ridge Deep Well Water
- Central Bosque WSC
- Chalk Bluff WSC
- China Spings Water Co.
- Community Springs Water Co.
- Cottonwood WSC
- Country Aire Water System
- Cross Country WSC
- Driskell Suburban Mobile Estates
- Eagle Canyon Water Works
- East Crawfod WSC
- Elk-Oak Lake WSC
- Elm Creek WSC
- Faltrock Water Co.
- Gholson WSC
- Goodall Water System
- HYB Water Supply
- H and H WSC
- Harris Creek Water Co.
- Hilltop WSC
- Lake Waco Country Club
- Leroy-Tours-Gerald WSC
- Levi WSC
- McLennan Co. WCID No. 2
- North County Water Supply
- Ostrom Water Co.
- Patrick WSC
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- R K S Water Co., Inc.
- R.M.S. WSC
- Rivercrest Water Co. – Brune
- Rock Creek Water Supply, Inc.
- Rolling Hills Country Club
- Ross WSC
- Smith Water Co., Inc.
- South Bosque WSC
- Spring Valley WSC
- Town of Axtell
- Tubbs Water System
- Twin Bayou WSC
- Valley Mills High School
- Valley View Water Co.
- Wester Hills Water System
- Westlake Water System, Inc.
- Windsor Water Co.

4.5.1.2.6 Nolan County Entities in County-Other Category

Demand/supply projections for Nolan County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Bitter Creek Water Supply Corp.
- Blair Water Supply Corp.
- City of Roscoe
- City of Sweetwater
- City of Trent
- Nolan Co. FWSD #1

4.5.1.2.7 Somervell County Entities in County-Other Category

Demand/supply projections for Somervell County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Happy Hill Farm Water Supply
- Oak River Ranch
- Riverside Mobile Home Park
- Scruggs Mobile Home Park
- Squaw Creek Subdivision Water Supply
- Sunset Park Water System
- Texas Parks & Wildlife Dept.
- Young Women's Christian Assoc.

4.5.1.2.8 Throckmorton County Entities in County-Other Category

Demand/supply projections for Throckmorton County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Town of Woodson

4.5.1.2.9 Williamson County Entities in County-Other Category

Demand/supply projections for Williamson County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Blessing Mobile Home Park
- Blockhouse MUD
- Carriage Oaks Water System
- Cedar Park MUD 1
- Chandler Creek MUD
- Chaparral III
- Chisholm Trail Special Utility District
- City of Andice
- City of Weir
- Clearview Water District
- Durham Park WSC
- Fern Bluff MUD
- Green Acres Water Supply
- High Gabriel WSC
- Inner Space Cavern
- Liberty Hill WSC
- Manville WSC
- Meridell Achievement Center, Inc.
- Noack WSC
- Rays Retirement Village
- Round Rock WSC
- San Gabriel River Ranches
- South San Gabriel River Ranches
- Southern Hills WSC
- Springwoods MUD
- Tal/Tex, Inc. (Great Oaks)
- Tal/Tex, Inc. (Tonkawa Springs)
- Walburg Water Supply
- Williamson County MUD 3
- Williamson County MUD 5

- Jarrell-Schwertner WSC
- Jenks Brank WSC
- Jonah Water
- Lake Granger WSC
- Williamson County MUD 6
- Williamson County MUD 9
- Williamson County Water Co., Inc.
- Williamson-Travis MUD 1

4.5.1.3 Entities Reporting Water Supply Concerns

In June of 1998, surveys were mailed to all public water supply entities (about 800 entities) in the Brazos G region. These entities included cities, water supply corporations, water districts, private water companies, institutions, and others. The purpose of the survey was to obtain input regarding water supply and water infrastructure concerns. The survey included these questions:

1. Do you anticipate any problems in meeting your customer's water demands during this current dry period?
2. Are you currently limiting customer water use (by voluntary conservation or other means) to avoid water shortages?
3. Is your utility listed by TNRCC as an E (emergency), P (priority), or W (watch) water system and requiring water use limitations?
4. Do you anticipate any water supply problems within the next four years?
5. If you answered "yes" to any of the above, is the water supply problem related to your raw water supply, or to the capacity of your treatment and distribution system?
6. Are you under any compliance orders from TNRCC?

Of the approximately 800 surveys mailed, 335 responses were received. Out of the responses received, 69 of the entities answered "yes" to Question 4, thereby indicating a concern regarding their water supply. Table 4-76 lists the entities responding to Question 4 and whether their response is related to raw water supply or treatment and distribution. Fifty-six (56) of the responses had a concern with raw water supply, 10 were concerned with treatment and distribution, and 3 were concerned with both raw water and treatment/distribution. The locations of the entities responding to Question 4 are plotted on Figure 4-9.

Table 4-76.
Public Water Supply Entities Responding to Survey with Water Supply Concerns

County	Entity	Water Supply Concern is Related to	
		Raw Water Supply	Treatment and Distribution
Bell	Prairie Haynes Youth Camp	X	
	City of Temple		X
	439 WSC		X
	Salado WSC	X	
Bosque	Lakeline Acres WC	X	
	City of Meridian	X	
Brazos	Texas A&M Main Campus		X
Burleson	Tunis WSC – D&S WS	X	
	Cade Lake WSC	X	
Comanche	City of Gustine	X	
Coryell	Multi-County WSC		X
Erath	City of Stephenville	X	
Falls	City of Lott		X
Grimes	Dobbin-Plantersville WSC 2	X	
Hamilton	City of Hico	X	X
Hill	Files Valley WSC	X	
	City of Abbot	X	
	City of Blum	X	
	City of Carl's Corner	X	
	White Bluff Community Water Supply	X	
	Hill County WSC	X	
	Bosque-Brazos Valley Water Supply	X	
	City of Whitney		X
Hood	Oak Trail Shores SW Water Supply	X	
	Arrowhead Shores SW Water Supply	X	
	Comanche Cove	X	
	Western Hills Harbor	X	
	Sky Harbor WSC – Hood Co. WC	X	
	Lipan Water Works – Hood County WC	X	
Johnson	City of Alvarado	X	
	Blue Water Oaks Subdivision	X	
	Bethany WSC	X	
	City of Burleson	X	
	Johnson County Rural Water Supply		X
	Bell Manor Subdivision	X	
	Skyline Dr. Assn. – Crest Water Corp.	X	
	City of Keene	X	
	City of Venus-Sky Corp. Water Corp.	X	
	Villa Condominiums Assn.	X	
Lee	Lee County WSC	X	
Limestone	City of Groesbeck	X	
McLennan	Cross Country WSC	X	
	Cedar Ridge Deep Well WSC		X
	Leroy-Tours-Gerald WSC	X	X
	City of West	X	
	Bold Springs WSC	X	
	City of Woodway WUD	X	
	Bosqueville Green Acres WSC		X
	Windsor Water Company	X	
	Pure WSC	X	
Milam	City of Rockdale	X	
Nolan	City of Sweetwater	X	
Palo Pinto	P-K Lodge	X	
	Rock Creek Camp	X	
	Barton WSC	X	
Robertson	Robertson County WSC	X	
	Humble Addition WSC	X	X
Shackelford	City of Albany		X
Stephens	City of Breckenridge	X	
	Stephens County WSC	X	
Washington	Deep Water Subdivision Water	X	
Williamson	Chisholm Trail SUD	X	
	Florence-Eco Resources	X	
	City of Taylor	X	X
	Jonah Water SUD	X	
	Liberty Hill WSC	X	
	Brushy Creek MUD	X	
Young	Four S Service Inc.	X	

4.5.2 Projected Manufacturing Shortages

Table 4-77 lists the counties projected to have shortages in the Manufacturing Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented previously in Sections 4.2.1 through 4.2.37.

Table 4-77.
Counties with Projected Water Shortages for Manufacturing Use

County	***Shortages Begin Prior To:***	***Projected Shortages (acft/yr)***	
		Year 2030	***Year 2050***
Bell County	2000	(7,315)	(8,395)
Bosque County	2000	(704)	(903)
Coryell County	2000	(15)	(17)
Hill County	2000	(56)	(84)
Johnson County	2000	(1,309)	(1,839)
Jones County	2000	(380)	(436)
Lampasas County	2000	(108)	(128)
Limestone County	2000	(777)	(1,059)
McLennan County	2000	(4,384)	(5,617)
Nolan County	2000	(697)	(835)
Palo Pinto County	2000	(86)	(118)
Stephens County	2030	(1)	(1)
Taylor County	2000	(1,953)	(2,327)
Williamson County*	2010	0	0
Young County	2010	(223)	(299)

* Projected manufacturing demand is reported from the 1997 Consensus State Water Plan data and appears relatively low for the level of economic activity in the county. Previously, the Trans-Texas Water Plan had projected 23,700 acft/yr of manufacturing demand in the county by 2050. This additional manufacturing water demand will be planned for accordingly.

4.5.3 Projected Steam-Electric Shortages

Table 4-78 lists the counties projected to have shortages in the Steam-electric Cooling Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37.

Deregulation of the electric generating industry has caused a recent increase in new "merchant" power plants being sited or planned in the region. These plants typically require 5,000 to 8,000 acft/yr of water for cooling purposes. Merchant generating plants are either planned or in construction in Bosque, Bell, and Johnson[1] Counties, and probably other locations. Projected shortages in Bosque County (and Johnson County, once projections are updated) are the result of merchant plants. Shortages in Haskell, Jones, and Young Counties result from projected expansion of existing generating facilities.

Table 4-78.
Counties with Projected Water Shortages for Steam-Electric Use

County	Year Shortages Begin Prior to	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bell County	2010	(11,200)	(11,200)
Bosque County	2010	(5,600)	(5,600)
Haskell County	2010	(1,709)	(1,825)
Jones County	2020	(3,824)	(3,824)
Milam County	2020	(3,498)	(6,998)
Young County	2000	(3,500)	(3,500)

4.5.4 Projected Mining Shortages

Table 4-79 lists the counties projected to have shortages in the Mining Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37.

[1] The planned Johnson County plant is a recent development and its demand is not included in the demand projections. This additional demand will be planned for.

Table 4-79.
Counties with Projected Water Shortages for Mining Use

County	Year Shortages Begin Prior to	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bosque County	2000	(136)	(235)
Johnson County	2000	(33)	(21)
McLennan County	2000	(1,071)	(1,322)
Nolan County	2000	0	0
Shackelford County	2000	(333)	(340)
Somervell County	2000	0	(6)
Williamson County	2000	(1,543)	(1,663)

4.5.5 Agricultural Water Supply and Demand

4.5.5.1 Water Resources for Agriculture

The projections for agricultural water supply and demand through 2050 were based on a 1990 database that included trends of decreasing irrigated acreage and declining profitability in agriculture.[2,3] The projections did not include impacts of future farm bills, which represent federal policy to address agricultural issues and concerns. The 1996 farm bill contained significant changes in the peanut price support program, which had a major impact on the irrigated peanut acreage in the Cross Timbers counties of Erath, Hood, Comanche, and Eastland. As a result, the irrigated acreage now is less than that of the projections. The water that is not required for irrigation now should not, however, be regarded as available for other uses. In long-range planning, an increasing profitability of agriculture should be included as a scenario. What is important to agriculture is that the land suitable for irrigated production, if brought into production, should be irrigated with existing water supplies. Future changes in economics of agricultural production, future farm bills that emphasize rural economies, and future crops could increase the profitability for irrigated crops. Energy crops, pharmaceutical crops, biomass crops, specialty or niche market crops, new fiber crops, oil-producing crops, higher transportation costs

[2] Prepared by Dr. Joe McFarland, Texas Agriculture Experiment Station, Stephenville, Texas.
[3] Texas Water Development Board (TWDB) web site, http://www.twdb.state.tx.us/wrp/reg-plan/docs/reg-plan-docs/plan-docs-index.htm

for imported food, and possibly many more economic possibilities are within the realm of the next 50 years. The water resources for future agricultural use should be preserved. An unacceptable scenario for agriculture is to advance the hypothesis that the current low profitability for agriculture will continue for the next 50 years, so the unused and available irrigation water may be transferred to municipal and industrial use. The scenario of marked declines in irrigated agriculture over the next several decades is also a scenario of significant increases in imported food at a time when the state population is also increasing dramatically. This does not bode well for regional economies of rural areas, and has implications in food security and food safety.

New, affordable water supplies cannot be developed for agricultural crop production. In virtually all of irrigated agriculture, water is managed on the demand side, not the supply side. New water supply options for agriculture include development of new wells for groundwater and acquisition of additional surface water rights. The wells will be on or very near (within a few thousand feet) to the land to be irrigated. Additional surface water rights usually come from purchase of nearby land and the attendant water rights. Historically, irrigated agriculture has expanded to make economic use of the water that is available. Conservation measures are then used to increase the economics of production and to increase the productivity. Water supply development projects in Brazos G, such as new reservoirs, have a water cost that is much too high for irrigated agriculture.

Demand side management is characterized by conservation, and virtually all irrigated agriculture producers practice water conservation in various forms. The conserved water for groundwater is available to that producer for future crop or livestock use. If the water supply is surface water, the conserved water is not withdrawn from the stream or reservoir, so it is available for other users.

Numerous text and reference books address water conservation in irrigated agriculture. Water conservation practices in widespread use in Brazos G include winter fallow for soil moisture, cultivation for weed control and soil mulch, selection and management of irrigation systems to optimize application and distribution efficiency, and scheduling irrigation to reduce deep percolation and surface runoff. Conversion of irrigation systems to increase efficiency includes converting side roll systems to center pivots with low-pressure drop nozzles and converting solid set or hand move sprinklers to drip irrigation. Demand side management has considerable potential for the future. Additional gains in water use efficiency include continued conversion of irrigation systems, improved crops and cultural practices, and improved irrigation scheduling with the use of real-time crop, soil, and weather information. These methods have costs of implementation, however.

Groundwater conservation districts are perhaps the best example of demand side management, or conservation, of water resources for agriculture.[4] Of the 45 groundwater districts in Texas, only a few (the Edwards Aquifer and the Subsidence Districts) are non-agricultural in scope. The High Plains Underground Water Conservation District No. 1 is the oldest (formed in 1951) and largest (serving all or parts of 15 counties). This district regulates well spacing and well production. Special activities include soil moisture monitoring program, pumping plant efficiency testing, tailwater abatement program, leak detection program for towns and cities, soil chemistry monitoring, low interest agricultural irrigation loan program, cost-in-water income tax depletion allowance program, and irrigation scheduling based on a potential evapotranspiration network.[5]

As of June 2000 the following groundwater conservation districts exist in the Brazos G Region:

- Clearwater Underground Water Conservation District
- Brazos Valley Groundwater Conservation District
- Lost Pines Groundwater Conservation District
- Lone Wolf Groundwater Conservation District
- Haskell/Knox Underground Water Conservation District
- Salt Fork Underground Water Conservation District

4.5.5.2 Irrigation Supply and Demand

Several aspects of irrigation water supply and demand may be different from those of municipal water supply and demand. In the areas of Brazos G northwest of IH-35, many farmers with arable land could make economic and beneficial use of increased water supplies. More land could be brought into cultivation with irrigation, or if the water had a lower cost or the crop had a greater value, more crops (such as forages) could be irrigated or could be irrigated more

[4] Texas Agricultural Extension Service (TAEX), “Managing Texas’ Groundwater Resources through Groundwater Conservation Districts,” TAEX Publication B-1612, College Station, Texas, 1998.
[5] Texas Alliance of Groundwater Districts (TAGD), “Texas Alliance of Groundwater Districts: Membership Directory and District Activities,” TAGD, Austin, Texas, 1999.

frequently. This does not constitute an unmet demand, however. To a farmer or rancher, an unmet demand is when the crop or animal is in need of water, and the water is not readily available. When a farmer plants a crop that requires irrigation, he or she would not purposefully plan for a demand that could not be met with available supply or alternative. If the water supplies are known to be short, as in low reservoir or aquifer levels, the farmer will not plant the crop. Thus, the demand will not materialize and there may even be water supply that is not used. Because drought and limited water supplies are not at all uncommon in Texas, agricultural producers, on an individual basis, plan for drought or limited water availability. Agricultural producers have three planning horizons for assessment of irrigation water supply and demand. These are the financial, the annual, and the immediate.

The financial planning horizon is for the development of irrigation capability and capacity. The cost of development of efficient irrigation systems, such as a center pivot with low-pressure drop nozzles and various forms of micro-irrigation, may approach $1000 per acre. The production value of the land, even with the irrigation system, may only be in the neighborhood of twice this value. The availability of water is the dominant factor in the decision process to develop an irrigation system. The economics of agricultural production are also very important in the financial timeframe. Irrigation operational costs (labor, electricity, maintenance, repair, and other variable costs) may be one-third to one-half or more of the total production costs. These annual costs typically are in the $25 to $75 per acft range. Except for horticultural crops or high value crops such as peanuts, the economics of agriculture preclude higher costs of water. A firm water yield must be reasonably present over the length of the financed period for a full irrigation system, which could be 20 years. Increased efficiency of irrigation equipment also requires financial planning, but over a shorter period such as a few years.

For the Seymour and Trinity Aquifers agricultural areas, in general, more land is available than water supply. Consequently, not all the producer holdings may be irrigated or the crop rotation will have to be established to match the available water supply. In the Carrizo-Wilcox Aquifer area of the Brazos Valley, sufficient groundwater is available for full irrigation of all the land area. The irrigation constraint is more the lack of suitable land for cultivation. Also, a more-or-less normal rainfall is projected throughout the period of the financing. For the horizon of the financial planning, the projected water demand will not exceed the known supply.

The annual planning horizon takes into account costs of irrigated operation, projected market values of the produce, the labor availability and costs, and other production factors. The anticipated availability of water is a major factor in this annual planning horizon. If the aquifer levels are low, if the winter carryover of stored soil moisture is low, or if the surface water supplies (e.g., lake levels) are low, the planning takes into account the decreased supply. Crops that do not require as much water may be selected, even though the projected economic return will be less. For example, grain corn and peanuts require significantly more water than silage corn or sorghum. Crops such as cotton or grain sorghum may be selected based on their ability to produce an economic return when grown under a dryland or deficit irrigation strategy. Irrigation scheduling will be more important for a producer. Measurement of water applied will be important. Producers know how to space a specified number of irrigations through the growing season for many crops such as cotton and sorghum. Other crops, especially vegetable crops, cannot produce acceptable quality if the water requirements are not met during all of the growing season. Water conservation measures such as conservation tillage may be used. The seeding rate and fertilizer rate may be decreased to increase productivity without additional water. Crop insurance is extremely important as a drought (unmet demand) strategy. The net result is that the water demand is adjusted downward to meet the projected water supply.

The third planning horizon is the immediate time frame. In Brazos G, the Texas Water Development Board (TWDB) irrigation statistics show that the average irrigation water amount applied is about 1 acft of water per acre each year.[6] The average is slightly higher in the northwest counties and slightly lower in the southeast counties. An average water use across most crops is about 2 or more acft of water each year. The difference in water availability is in the use of stored soil moisture at planting time and in rainfall during the growing season. The irrigation strategy is basically that of supplementing rainfall. If the rainfall is lacking, the irrigation demand may easily exceed the supply, especially if the system is not designed to meet the total water requirements of the crop. During dry periods, in shallow aquifer areas such as the outcrop area of the Trinity Aquifer in the Cross Timbers region, the yield of the wells decreases and salinity may be a problem. The irrigated cropland may exceed the water supply. For this short-range planning horizon, the irrigation demand will frequently exceed the supply. When the

[6] TWDB, "Surveys of Irrigation in Texas – 1958, 1964, 1969, 1974, 1979, 1984, 1989, and 1994," TWDB Report 347, Austin, Texas, 1996.

water demand increases during a drought, the water supply decreases. The strategies to adapt to the water shortage include doing nothing in short period droughts, cloud seeding, harvesting some crops early for forage, relying on crop insurance, to finally abandoning the crop.

4.5.5.3 Agricultural Attitudes toward Water

Agricultural producers with irrigation are independent water supply providers in Brazos G. In other regions, irrigation supply districts may be sources of irrigation water, but in all of Brazos G, each producer is a separate entity. Some have access to groundwater, some have surface water rights, and some have both. These independent suppliers have different attitudes and beliefs, but some generalizations may be made if for nothing more than discussion purposes.

Private property rights are fundamentally important to agricultural producers.[7] The surface water rights and the right to capture groundwater beneath their properties are viewed as rights that should not be interfered with through governmental regulation, restriction, or even oversight. This view includes central planning that involves their water rights. Local planning that protects or preserves their water rights should be an acceptable course of action, but lines may be drawn. These include access to private property, reporting of water pumped, and restrictions on the ultimate use of water (which could include water marketing). These restrictions include permitting of wells, definitions and enforcement of "waste" of the water, limitations on the amount of water that may be used, and perhaps many more examples.

The preference for voluntary actions in agriculture to address water quantity and quality issues is strongly held in agriculture. Voluntary actions do not threaten private property rights and avoid the problems inherent with regulatory programs. When the benefits of the voluntary actions do not result in significant personal economic returns to the agricultural producer, the adoption of practices to conserve water or protect water quality will be modest at best, and will be ineffective at worst. Programs for agriculture to conserve water quantity or protect water quality for the benefit of downstream users should have very strong and effective education, technical assistance, and financial assistance components.[8]

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[7] Smith, George F., "Water Quality and Quantity Issues for the South – Preparing for the Challenges of the 21st Century," No. 7, Southern Rural Development Center, Mississippi State, Mississippi, 2000.
[8] Tuck, Comer, "Agricultural Water Conservation Programs in Texas. In: The new water agenda," Proceedings of Conserv93, Dec 12-16, 1993, Las Vegas, Nevada, American Water Works Association (AWWA), Denver, Colorado, 1587-1592, 1993.

Regionally, agriculture views the water as "their water." Agriculture interests, in general, believe that water should not be an exportable commodity, but should remain as a resource for current or future regional use. This is the sustainability concern that is national in scope. The next generation should have the same or better opportunity as the current generation. This applies not only to water quantity, but also to water quality, soil, exotic plants and pests, and regional infrastructure. Agriculture will not take a favorable view of export of water from one region to another, because the loss of the water also represents a loss of future development capability. The Owens Valley of California is a classic example of an area that will never develop economically because the land is owned, the groundwater is developed, and the water is exported by the City of Los Angeles, 250 miles to the west.

Agricultural interests have had to rely on water conservation and management strategies to keep water demands in line with water supplies. The development of new sources of water, with two exceptions, has not been an option in a state without a federal subsidy of surface water development. The two exceptions of water resource development are cloud seeding and brush control. These are effective, but a firm yield cannot be assigned. Agricultural interests fully expect those entities representing water planning for municipal and industrial use to make full use of water conservation and management strategies, as opposed to the reallocation of agricultural water supplies to meet future needs. A strategy of market forces to reallocate the water supplies of the state for future needs will not be supported by agriculture in general and rural areas in specific. Transfers of water from irrigation to urban and industrial use will occur as urban and suburban areas expand into agricultural areas. The loss of farmland to urban areas is a separate but related national issue.

Agricultural interests are joined by environmental and recreational interests in the belief that water should be allocated and/or protected for lower value uses. This coalition will not support any strategy that relies on market value of water to meet growth corridor needs. The value of water as a utility in urban use is greater by a factor of about ten than the value of water for agricultural production. A 1994 water policy report[9] stated that many are questioning whether the state's overriding principle for water planning should be to ensure a sufficient supply to meet projected growth or whether greater reliance should be placed on improved water

[9] Lyndon B. Johnson School of Public Affairs, "Squeezing a Dry Sponge: Water Planning in Texas," Policy Research Project on Water for the Environment, Policy Research Project Report Number 111, Austin, Texas, 1994.

management techniques to control the need for new supplies. Growth management based on consensus regional planning is generally advocated by agricultural and environmental interests.

Texas A&M University conducted a survey of regional planning officials in the 16 Regional Water Planning Groups.[10] The questionnaire was returned by 205 of the officials, which represented a 65 percent return. The attitudes, expressed as a preference-feasibility analysis, ranked 20 strategies for water conservation. Agricultural water conservation strategies in the survey were: require planting drought-resistant crops, require agricultural irrigation schedule, require lining of water conveyance canals, require efficient agricultural irrigation equipment, and brush control. A ranking by the sum of the preferences and the feasibility on 1 to 5 scale (5 being high) showed efficient irrigation equipment to be the fourth-highest overall. Brush management was tenth, and the other strategies were fourteenth and a tie for sixteenth.

A related survey is interesting from the standpoint of agricultural producer attitudes toward water conservation and assistance programs.[11] In 1985, Texas voters approved the sale of bonds to finance low interest agricultural loans to finance water efficient irrigation equipment. The legislation authorized the TWDB to lend funds to the soil and water conservation districts to finance the purchase of approved water conservation equipment. A $5 million pilot program produced only a limited response, according to a Texas A&M University and Texas Tech University study in 1994. The response from 254 producers in the Texas High Plains, the Winter Garden, and the Lower Rio Grande Valley showed a 94 percent belief that water conserving irrigation equipment is an approach to increasing efficiency of water use in agriculture. However, 63 percent opposed any government intervention through legislative actions. Only 57 percent believed that the benefits exceeded the costs of implementation. The factors that were identified in the study were interest rates, amount of paperwork, income level, and amount of short-term debt.

One general, albeit arguable, conclusion about agricultural attitudes toward water is that farmers and ranchers are strong advocates of demand side management of water resources. The supply side management options of groundwater and surface water development have been

[10] Kaiser, Ronald A., Bruce J. Lesikar, C. Scott Shafer, and Jan R. Gersten, “Water Management Strategies: Ranking the Options,” The Texas A&M University System, College Station, Texas, 2000.
[11] Stanaland, B. S. Misra, E. Segarra, and R. Lacewell, “Producer Response to A Subsidized Agricultural Water Conservation Program,” Unpublished Manuscript, Department of Agricultural Economics, Texas A&M University and Department of Agricultural Sciences, Texas Tech University, College Station and Lubbock, Texas, September 1994.

developed. Without the presence of a federal agency, such as the Bureau of Reclamation, to develop a subsidized water supply from new reservoirs, there will be no new water supplies for agriculture. Agricultural interests expect other users to manage water supplies on the demand side also.

The history of water planning in Texas parallels the water planning in agriculture. Prior to the 1970s, the emphasis was on water supply management.[12] It was viewed as the responsibility of the State to develop sufficient water supplies to meet the needs of an increasing population and industrial base. New reservoirs were constructed and water treatment and delivery systems were developed. During the 1970s, the emphasis on water supply management began to change to water demand management, with conservation as a major focus. The statewide average per capita municipal water use is decreasing, and the TWDB projections through 2050 reflect this trend. The trend can be attributed to more efficient plumbing fixtures and appliances, demographic and housing changes, increasing water and wastewater costs, and the advent of organized water conservation educational programs. Water-use rates in industry have also been declining as a result of new technologies, market forces, regulatory considerations, and reuse of water.

The Texas Water Plan of 1984 marked the first time that water conservation was explicitly factored into the long-range water plans.[13] This may have been triggered by the failure of Proposition Four in 1981, which could have provided funding for massive intrastate and interstate water transfer plans. The passage of House Bill 2 in 1985 greatly expanded the statutory meaning of water conservation and laid the groundwork for much of the current water conservation policies and programs in the municipal, industrial, and agricultural sectors. The State Water Plans of 1990,[14] 1992, and 1997[15] reflect a balanced approach of supply and demand side water planning. Agricultural interests strongly support demand side water planning, as opposed to planning strategies that focus on supply side transfers of water from irrigated agriculture to municipal and industrial use.

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[12] Personett, Mike, "The Evolutions of State Water Conservation Policy in Texas," In: The New Water Agenda, Proceedings of Conserv93, Dec 12-16, 1993, Las Vegas, Nevada, AWWA, Denver, Colorado. 957-965.
[13] Ibid.
[14] TWDB, "Water for Texas: Today and Tomorrow," TWDB Report GP-5-1, Austin, Texas, 1990.
[15] TWDB, "Water for Texas," TWDB Report GP-6-2, Austin, Texas, 1997.

4.5.5.4 Livestock

Livestock water may be managed on the supply side through the construction of non-permitted surface water impoundments of less than 200 acft capacity. These stock tanks, typically with a capacity of only a few acft, are constructed in any available ephemeral stream channel to impound water for livestock on pasture or range. Confined livestock water supply is in the same economic category as irrigated agriculture. Confined livestock operations, such as the poultry industry in the Brazos Valley and the dairy industry in the Cross Timbers, is reliant on groundwater. The water resource is managed on the demand side.

4.5.5.5 Summary of Agricultural Supply and Demand

Agricultural water is planned and managed on the demand side to keep the variable demand in approximate balance with the projected supply. When the supply is known to be decreased, the demand is reduced through conservation and other management actions. The economics of development of new water supplies preclude the development of new water supplies for agriculture. Construction of stock tanks for livestock water is a minor, but important exception.

4.5.5.6 Projected Irrigation Shortages

Table 4-80 lists the counties projected to have shortages in the Irrigation Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37. Figure 4-10 contains a map indicating counties with projected shortages.

Table 4-80.
Counties with Projected Water Shortages
for Irrigation Use

County	Approximate Year Shortages Begin	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Comanche County	2000	(13,475)	(12,477)
Eastland County	2000	(7,423)	(7,443)
Knox County	2000	(2,199)	(779)
Shackelford County	2000	(179)	(167)
Stephens County	2000	(341)	(328)
Taylor County	2000	(68)	(47)
Young County	2000	(265)	(235)

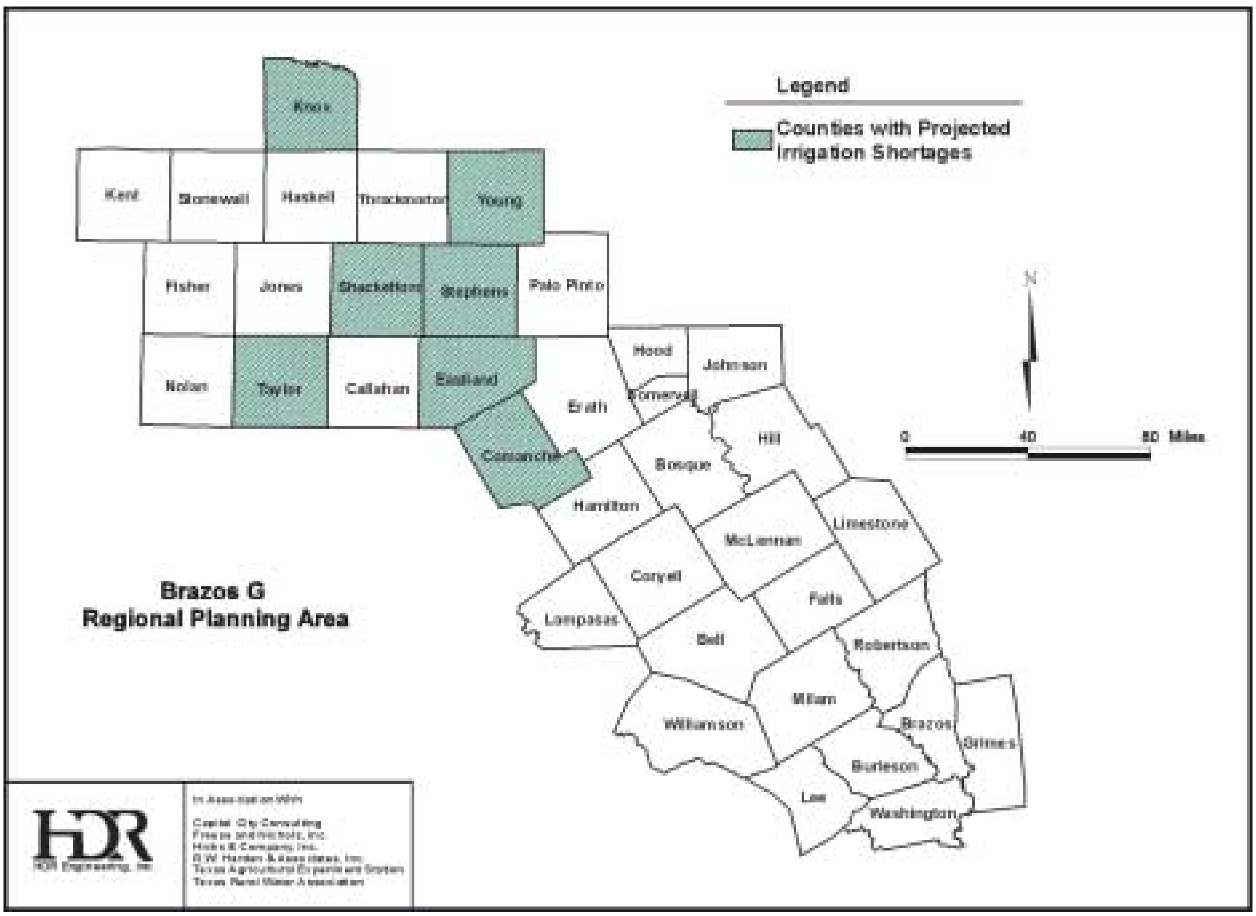

Figure 4-10. Projected Irrigation Water Shortages

Projected irrigation demand (and resulting projected shortages) necessarily contain a number of assumptions and are based on trends in existence at the time the projections were published in 1996. In most of the counties in Brazos G, the actual changes between 1990 and 1999 have been greater than the projected changes from 1990 to 2050. For Comanche and Eastland Counties, the 1996 Farm Bill changed the peanut price support and quota system, with the result that irrigated acreage and water use of peanuts decreased markedly from 1997 to the present. Changes in farm policy, as contained in the Farm Bills, were not included in the projections. Based on actual irrigated acres and estimated irrigation water volumes in 1999, the projected irrigation demand in 2050 is lower than the projected irrigation supply. If there are no changes in farm policy or farm economics, there will not be irrigation water shortages in Comanche or Eastland Counties. However, if the farm economies and/or farm policy change, the groundwater in the Trinity Aquifer and surface water from the Leon River System (Lake Leon, Lake Proctor, and the Leon River) will be a valuable resource for renewed agricultural production. Irrigation shortages could easily exist for all areas of the Trinity Aquifer area that underlay productive soils.

Knox County projections for irrigation shortages similarly reflect the base year of 1990 and the assumptions inherent with the projections. However, the shortages actually decrease with time from 6,346 acft in 2000 to 2,660 acft in 2050. This indicates that much of the irrigation in Knox County and the rest of the Seymour Aquifer area in Brazos G is deficit irrigation; that is, the amount of irrigation water applied to the crop is not sufficient to meet the full water requirements of the crop. This is especially true in a year with limited rainfall prior to and during the growing season. The projection scenario indicates that irrigated acreage will decrease, but that the amount of irrigation water will remain the same. As with the counties in the Trinity Aquifer area, any change in farm policy or farm economics that makes row crop agriculture more productive will increase the irrigation demands. The projected shortages could easily be at or above the year 2000 levels.

For the other counties in Table 4-80, the irrigated acreage is relatively low and the irrigation water available is also low. These shortages should not have a significant impact on irrigated agriculture or water availability.

4.5.6 Projected Livestock Shortages

There are no livestock shortages. As explained in Section 4.1, surface water from stock ponds and streams was shown to be available to meet livestock needs when groundwater supplies were insufficient to meet those demands.