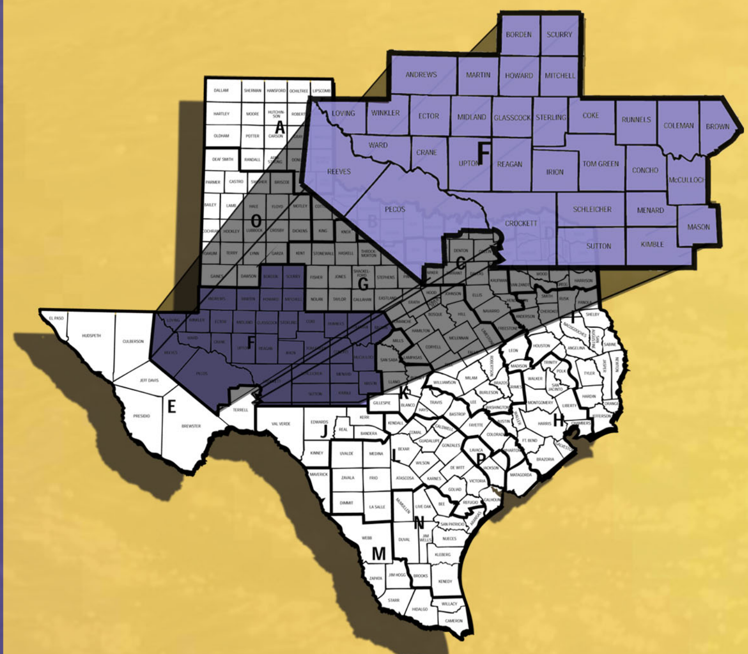
Region F
Regional Water Plan - Appendices



Freese and Nichols, Inc.
Alan Plummer Associates, Inc.
LBG - Guyton Associates, Inc.

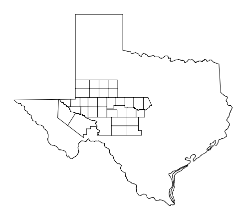
January 2006

Region F Water Plan

January 2006

Prepared for:

Region F Water Planning Group



Jon S. Albright

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Region F Water Planning Group

Chair	John Grant	At-Large	Richard Gist
Vice-Chair	Steven C. Hofer	At-Large	Stephen Brown

Voting Membership

Interest Group	**Member**	**Representing**
Agriculture	Kenneth Dierschke	Tom Green County
	Terry Scott	Coleman County
	Lowell Woodward	Pecos County
Counties	Marilyn Egan	Runnels County
	Johnny Jones	Crockett County
Electric Generating Utilities	Andrew Valencia	Texas Utilities
Environmental	Steven C. Hofer	Midland County
	Caroline Runge	Menard County
Industries	Buddy Sipes	Midland County
Municipalities	Will Wilde	San Angelo Utilities
Public	Len Wilson	Andrews County
	Wendell Moody	Concho County
River Authority	Stephen Brown	Upper Colorado River Authority
	John Grant	Colorado River MWD
Small Business	Stuart Coleman	Coleman Distributing
Water Districts	Cindy Cawley	Plateau UWCD
	Larry Turnbough	Reeves County
	Scott Holland	Irion County WCD
Water Utilities	Richard Gist	Zephyr WSC

Non-Voting Membership

Don Daniel	Mason County	Winton Milliff	Coke County
Gordon Hooper	Crane County	Joe David Ross	Sutton County
Gary Foster	Sterling County	John Sheppard	Winkler County
Rick Harston	Glasscock County	Cindy Weatherby	Reagan County
Billy Hopper	Loving County	Ken Carver	Martin Count
	Sue Young	Mitchell County	

Harvey Everheart	Region O	Kathy Webster	Region G
Bob Stovell	Region E		
Ruben Cantu	Texas Parks & Wildlife Department	Kit Owens	Texas Commission on Environmental Quality
Mark Henkhaus	Texas Railroad Commission	Sherry Cordry	Texas Water Development Board

Region F
Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

REGION F WATER PLAN

January 5, 2005

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Appendix 1A
Selected Bibliography of Studies in Region F

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Appendix 2A
Population and Water Demand Projections

Table 2A-1
Population Projections for Region F

Water User Group Name	County	Basin	Population						
			Historical	Projected					
			2000	2010	2020	2030	2040	2050	2060
ANDREWS	ANDREWS	COLORADO	9,652	10,519	11,247	11,754	12,232	12,453	12,701
COUNTY-OTHER	ANDREWS	COLORADO	3,308	3,565	3,781	3,931	4,072	4,137	4,211
COUNTY-OTHER	ANDREWS	RIO GRANDE	44	47	50	52	54	55	56
		ANDREWS Total	*13,004*	*14,131*	*15,078*	*15,737*	*16,358*	*16,645*	*16,968*
COUNTY-OTHER	BORDEN	BRAZOS	59	64	66	63	56	52	47
COUNTY-OTHER	BORDEN	COLORADO	670	728	754	719	637	592	535
		BORDEN Total	*729*	*792*	*820*	*782*	*693*	*644*	*582*
BANGS	BROWN	COLORADO	1,620	1,691	1,746	1,761	1,761	1,761	1,761
BROOKSMITH SUD	BROWN	COLORADO	7,579	7,911	8,168	8,240	8,240	8,240	8,240
BROWNWOOD	BROWN	COLORADO	18,813	20,703	21,376	21,563	21,563	21,563	21,563
COLEMAN COUNTY WSC	BROWN	COLORADO	140	146	151	152	152	152	152
COUNTY-OTHER	BROWN	BRAZOS	85	89	92	93	93	93	93
COUNTY-OTHER	BROWN	COLORADO	3,399	2,482	2,562	2,585	2,585	2,585	2,585
EARLY	BROWN	COLORADO	2,588	2,701	2,789	2,814	2,814	2,814	2,814
ZEPHYR WSC	BROWN	COLORADO	3,450	3,601	3,718	3,751	3,751	3,751	3,751
		BROWN Total	*37,674*	*39,324*	*40,602*	*40,959*	*40,959*	*40,959*	*40,959*
BRONTE VILLAGE	COKE	COLORADO	1,076	1,065	1,140	1,140	1,140	1,140	1,140
COUNTY-OTHER	COKE	COLORADO	1,617	1,547	1,474	1,474	1,474	1,474	1,474
ROBERT LEE	COKE	COLORADO	1,171	1,136	1,136	1,136	1,136	1,136	1,136
		COKE Total	*3,864*	*3,748*	*3,750*	*3,750*	*3,750*	*3,750*	*3,750*
BROOKSMITH SUD	COLEMAN	COLORADO	75	74	74	74	74	74	74
COLEMAN	COLEMAN	COLORADO	5,127	5,075	5,079	5,079	5,079	5,079	5,079
COLEMAN COUNTY WSC	COLEMAN	COLORADO	2,800	2,771	2,774	2,774	2,774	2,774	2,774
COUNTY-OTHER	COLEMAN	COLORADO	152	151	151	151	151	151	151
SANTA ANNA	COLEMAN	COLORADO	1,081	1,070	1,071	1,071	1,071	1,071	1,071
		COLEMAN Total	*9,235*	*9,141*	*9,149*	*9,149*	*9,149*	*9,149*	*9,149*
COUNTY-OTHER	CONCHO	COLORADO	538	605	628	628	628	628	628
EDEN	CONCHO	COLORADO	2,561	2,885	2,988	2,988	2,988	2,988	2,988
MILLERSVIEW-DOOLE WSC	CONCHO	COLORADO	867	977	1,012	1,012	1,012	1,012	1,012
		CONCHO Total	*3,966*	*4,467*	*4,628*	*4,628*	*4,628*	*4,628*	*4,628*
COUNTY-OTHER	CRANE	RIO GRANDE	805	1,031	1,280	1,415	1,518	1,629	1,745
CRANE	CRANE	RIO GRANDE	3,191	3,438	3,710	3,857	3,969	4,089	4,216
		CRANE Total	*3,996*	*4,469*	*4,990*	*5,272*	*5,487*	*5,718*	*5,961*
COUNTY-OTHER	CROCKETT	RIO GRANDE	229	225	221	217	213	209	205
CROCKETT COUNTY WCID #1	CROCKETT	RIO GRANDE	3,870	4,257	4,619	4,749	4,809	4,930	5,039
		CROCKETT Total	*4,099*	*4,482*	*4,840*	*4,966*	*5,022*	*5,139*	*5,244*
COUNTY-OTHER	ECTOR	COLORADO	27,214	33,888	40,100	44,733	47,970	49,153	49,641
COUNTY-OTHER	ECTOR	RIO GRANDE	1,008	1,091	1,172	1,244	1,308	1,359	1,407
ECTOR COUNTY UD	ECTOR	COLORADO	3,000	4,116	5,202	6,169	7,031	7,718	8,363
ODESSA	ECTOR	COLORADO	89,901	93,664	97,599	102,014	106,832	112,077	117,615
		ECTOR Total	*121,123*	*132,759*	*144,073*	*154,160*	*163,141*	*170,307*	*177,026*
COUNTY-OTHER	GLASSCOCK	COLORADO	1,406	1,582	1,783	1,891	1,921	1,915	1,954
		GLASSCOCK Total	*1,406*	*1,582*	*1,783*	*1,891*	*1,921*	*1,915*	*1,954*
BIG SPRING	HOWARD	COLORADO	25,233	25,944	26,592	26,803	26,803	26,803	26,803
COAHOMA	HOWARD	COLORADO	932	958	982	990	990	990	990
COUNTY-OTHER	HOWARD	COLORADO	7,462	7,672	7,864	7,926	7,926	7,926	7,926
		HOWARD Total	*33,627*	*34,574*	*35,438*	*35,719*	*35,719*	*35,719*	*35,719*
COUNTY-OTHER	IRION	COLORADO	932	994	1,020	996	934	884	845
MERTZON	IRION	COLORADO	839	894	918	896	840	796	761
		IRION Total	*1,771*	*1,888*	*1,938*	*1,892*	*1,774*	*1,680*	*1,606*
COUNTY-OTHER	KIMBLE	COLORADO	1,850	1,929	1,947	1,947	1,947	1,947	1,947
JUNCTION	KIMBLE	COLORADO	2,618	2,731	2,755	2,755	2,755	2,755	2,755
		KIMBLE Total	*4,468*	*4,660*	*4,702*	*4,702*	*4,702*	*4,702*	*4,702*
COUNTY-OTHER	LOVING	RIO GRANDE	67	67	67	67	67	67	67
		LOVING Total	*67*	*67*	*67*	*67*	*67*	*67*	*67*

Table 2A-1: Population Projections for Region F (Continued)

Water User Group Name	County	Basin	Population						
			Historical	Projected					
			2000	2010	2020	2030	2040	2050	2060
COUNTY-OTHER	MARTIN	COLORADO	2,190	2,401	2,628	2,739	2,806	2,738	2,599
STANTON	MARTIN	COLORADO	2,556	2,802	3,068	3,196	3,276	3,196	3,034
		MARTIN Total	*4,746*	*5,203*	*5,696*	*5,935*	*6,082*	*5,934*	*5,633*
COUNTY-OTHER	MASON	COLORADO	1,604	1,660	1,687	1,701	1,708	1,712	1,716
MASON	MASON	COLORADO	2,134	2,157	2,169	2,175	2,178	2,179	2,180
		MASON Total	*3,738*	*3,817*	*3,856*	*3,876*	*3,886*	*3,891*	*3,896*
BRADY	MCCULLOCH	COLORADO	5,523	5,593	5,689	5,689	5,689	5,689	5,689
COUNTY-OTHER	MCCULLOCH	COLORADO	135	86	88	88	88	88	88
MILLERSVIEW-DOOLE WSC	MCCULLOCH	COLORADO	1,916	1,923	1,956	1,956	1,956	1,956	1,956
RICHLAND SUD	MCCULLOCH	COLORADO	631	633	644	644	644	644	644
		MCCULLOCH Total	*8,205*	*8,235*	*8,377*	*8,377*	*8,377*	*8,377*	*8,377*
COUNTY-OTHER	MENARD	COLORADO	707	747	757	757	757	757	757
MENARD	MENARD	COLORADO	1,653	1,746	1,771	1,771	1,771	1,771	1,771
		MENARD Total	*2,360*	*2,493*	*2,528*	*2,528*	*2,528*	*2,528*	*2,528*
COUNTY-OTHER	MIDLAND	COLORADO	19,971	22,747	25,718	27,835	29,409	30,406	31,345
MIDLAND	MIDLAND	COLORADO	94,996	100,137	105,639	109,561	112,478	114,324	116,064
ODESSA	MIDLAND	COLORADO	1,042	1,826	2,665	3,263	3,708	3,990	4,255
		MIDLAND Total	*116,009*	*124,710*	*134,022*	*140,659*	*145,595*	*148,720*	*151,664*
COLORADO CITY	MITCHELL	COLORADO	4,281	4,298	4,288	4,213	4,119	4,003	3,761
COUNTY-OTHER	MITCHELL	COLORADO	4,761	4,779	4,769	4,686	4,582	4,453	4,184
LORAINE	MITCHELL	COLORADO	656	659	657	646	631	613	576
		MITCHELL Total	*9,698*	*9,736*	*9,714*	*9,545*	*9,332*	*9,069*	*8,521*
COUNTY-OTHER	PECOS	RIO GRANDE	4,405	4,677	4,922	5,058	5,132	5,144	5,044
FORT STOCKTON	PECOS	RIO GRANDE	7,846	8,332	8,766	9,009	9,139	9,163	8,984
IRAAN	PECOS	RIO GRANDE	1,238	1,315	1,383	1,421	1,442	1,446	1,417
PECOS COUNTY WCID #1	PECOS	RIO GRANDE	3,320	3,526	3,709	3,812	3,867	3,877	3,801
		PECOS Total	*16,809*	*17,850*	*18,780*	*19,300*	*19,580*	*19,630*	*19,246*
BIG LAKE	REAGAN	COLORADO	2,885	3,288	3,628	3,800	3,788	3,654	3,478
COUNTY-OTHER	REAGAN	COLORADO	441	503	554	581	579	559	532
		REAGAN Total	*3,326*	*3,791*	*4,182*	*4,381*	*4,367*	*4,213*	*4,010*
BALMORHEA	REEVES	RIO GRANDE	527	627	730	815	885	949	1,000
COUNTY-OTHER	REEVES	RIO GRANDE	809	729	646	577	520	469	428
MADERA VALLEY WSC	REEVES	RIO GRANDE	2,300	2,342	2,385	2,421	2,451	2,478	2,499
PECOS	REEVES	RIO GRANDE	9,501	10,583	11,690	12,604	13,363	14,053	14,600
		REEVES Total	*13,137*	*14,281*	*15,451*	*16,417*	*17,219*	*17,949*	*18,527*
BALLINGER	RUNNELS	COLORADO	4,243	4,379	4,871	5,243	5,654	5,974	6,274
COLEMAN COUNTY WSC	RUNNELS	COLORADO	112	140	243	321	407	474	559
COUNTY-OTHER	RUNNELS	COLORADO	2,688	2,534	2,126	1,817	1,476	1,210	1,000
MILES	RUNNELS	COLORADO	850	879	984	1,063	1,151	1,219	1,284
MILLERSVIEW-DOOLE WSC	RUNNELS	COLORADO	722	727	745	759	774	786	801
WINTERS	RUNNELS	COLORADO	2,880	2,951	3,056	3,136	3,224	3,293	3,380
		RUNNELS Total	*11,495*	*11,610*	*12,025*	*12,339*	*12,686*	*12,956*	*13,298*
COUNTY-OTHER	SCHLEICHER	COLORADO	810	766	722	701	693	682	670
COUNTY-OTHER	SCHLEICHER	RIO GRANDE	174	165	155	151	149	146	143
ELDORADO	SCHLEICHER	COLORADO	1,951	2,228	2,510	2,639	2,691	2,766	2,845
		SCHLEICHER Total	*2,935*	*3,159*	*3,387*	*3,491*	*3,533*	*3,594*	*3,658*
COUNTY-OTHER	SCURRY	BRAZOS	2,016	2,103	2,186	2,230	2,253	2,268	2,268
COUNTY-OTHER	SCURRY	COLORADO	3,562	3,716	3,862	3,940	3,981	4,008	4,008
SNYDER	SCURRY	COLORADO	10,783	11,179	11,554	11,753	11,858	11,927	11,927
		SCURRY Total	*16,361*	*16,998*	*17,602*	*17,923*	*18,092*	*18,203*	*18,203*
COUNTY-OTHER	STERLING	COLORADO	312	342	376	391	396	385	389
STERLING CITY	STERLING	COLORADO	1,081	1,187	1,304	1,353	1,370	1,332	1,350
		STERLING Total	*1,393*	*1,529*	*1,680*	*1,744*	*1,766*	*1,717*	*1,739*
COUNTY-OTHER	SUTTON	COLORADO	224	246	261	263	262	262	259
COUNTY-OTHER	SUTTON	RIO GRANDE	929	1,021	1,079	1,089	1,085	1,088	1,077
SONORA	SUTTON	RIO GRANDE	2,924	3,212	3,397	3,428	3,415	3,423	3,389
		SUTTON Total	*4,077*	*4,479*	*4,737*	*4,780*	*4,762*	*4,773*	*4,725*

Table 2A-1: Population Projections for Region F (Continued)

Water User Group Name	County	Basin	Population						
			Historical	Projected					
			2000	2010	2020	2030	2040	2050	2060
CONCHO RURAL WSC	TOM GREEN	COLORADO	3,909	6,082	7,876	9,014	9,644	10,143	10,255
COUNTY-OTHER	TOM GREEN	COLORADO	10,037	9,948	9,806	9,589	9,303	8,964	8,550
MILLERSVIEW-DOOLE WSC	TOM GREEN	COLORADO	1,625	1,847	2,099	2,386	2,711	3,081	3,502
SAN ANGELO	TOM GREEN	COLORADO	88,439	94,261	99,070	102,120	103,808	105,145	105,445
		TOM GREEN Total	*104,010*	*112,138*	*118,851*	*123,109*	*125,466*	*127,333*	*127,752*
COUNTY-OTHER	UPTON	COLORADO	275	292	307	312	317	323	328
COUNTY-OTHER	UPTON	RIO GRANDE	524	556	584	595	603	614	625
MCCAMEY	UPTON	RIO GRANDE	1,805	2,038	2,243	2,320	2,381	2,461	2,539
RANKIN	UPTON	RIO GRANDE	800	871	934	958	977	1,002	1,026
		UPTON Total	*3,404*	*3,757*	*4,068*	*4,185*	*4,278*	*4,400*	*4,518*
COUNTY-OTHER	WARD	RIO GRANDE	4,088	4,278	4,388	4,439	4,439	4,439	4,439
MONAHANS	WARD	RIO GRANDE	6,821	7,138	7,322	7,407	7,407	7,407	7,407
		WARD Total	*10,909*	*11,416*	*11,710*	*11,846*	*11,846*	*11,846*	*11,846*
COUNTY-OTHER	WINKLER	RIO GRANDE	540	572	599	604	606	594	575
KERMIT	WINKLER	RIO GRANDE	5,714	6,057	6,338	6,391	6,405	6,285	6,084
WINK	WINKLER	RIO GRANDE	919	974	1,019	1,028	1,030	1,011	979
		WINKLER Total	*7,173*	*7,603*	*7,956*	*8,023*	*8,041*	*7,890*	*7,638*
		Grand Total	***578,814***	***618,889***	***656,480***	***682,132***	***700,806***	***714,045***	***724,094***

Table 2A-2
Per Capita Water Demand Projections for Region F

Water User Group Name	County Name	Basin Name	Per Capita Water Demand (gallons per person per day) Historical 2000	Projected 2010	2020	2030	2040	2050	2060
ANDREWS	ANDREWS	COLORADO	266	262	259	256	253	252	252
COUNTY-OTHER	ANDREWS	COLORADO	138	133	130	127	124	123	123
COUNTY-OTHER	ANDREWS	RIO GRANDE	138	133	130	127	124	123	123
COUNTY-OTHER	BORDEN	BRAZOS	202	198	195	192	190	188	188
COUNTY-OTHER	BORDEN	COLORADO	202	198	195	192	190	188	188
BANGS	BROWN	COLORADO	143	140	136	133	130	129	129
BROOKSMITH SUD	BROWN	COLORADO	158	155	152	150	147	146	146
BROWNWOOD	BROWN	COLORADO	171	168	164	161	158	157	157
COLEMAN COUNTY WSC	BROWN	COLORADO	117	115	112	109	106	105	105
COUNTY-OTHER	BROWN	BRAZOS	127	123	119	116	113	112	112
COUNTY-OTHER	BROWN	COLORADO	127	123	119	116	113	112	112
EARLY	BROWN	COLORADO	267	264	260	257	254	253	253
ZEPHYR WSC	BROWN	COLORADO	102	99	97	95	93	92	92
BRONTE VILLAGE	COKE	COLORADO	192	205	202	199	196	195	195
COUNTY-OTHER	COKE	COLORADO	89	101	98	96	93	92	92
ROBERT LEE	COKE	COLORADO	278	276	272	269	266	264	264
BROOKSMITH SUD	COLEMAN	COLORADO	158	155	152	150	147	146	146
COLEMAN	COLEMAN	COLORADO	177	226	223	220	217	215	215
COLEMAN COUNTY WSC	COLEMAN	COLORADO	117	115	112	109	106	105	105
COUNTY-OTHER	COLEMAN	COLORADO	117	115	112	109	106	105	105
SANTA ANNA	COLEMAN	COLORADO	170	167	164	161	158	156	156
COUNTY-OTHER	CONCHO	COLORADO	282	277	274	271	268	267	267
EDEN	CONCHO	COLORADO	144	173	171	170	168	167	167
MILLERSVIEW-DOOLE WSC	CONCHO	COLORADO	119	115	112	109	105	104	104
COUNTY-OTHER	CRANE	RIO GRANDE	279	274	270	268	266	265	265
CRANE	CRANE	RIO GRANDE	248	244	241	238	235	234	234
COUNTY-OTHER	CROCKETT	COLORADO	172	169	166	163	160	158	158
COUNTY-OTHER	CROCKETT	RIO GRANDE	172	169	166	163	160	158	158
CROCKETT COUNTY WCID #1	CROCKETT	RIO GRANDE	354	349	346	343	340	339	339
COUNTY-OTHER	ECTOR	COLORADO	147	146	145	145	144	144	144
COUNTY-OTHER	ECTOR	RIO GRANDE	147	146	145	145	144	144	144
ECTOR COUNTY UD	ECTOR	COLORADO	327	321	317	315	314	313	313
ODESSA	ECTOR	COLORADO	208	205	202	198	195	194	194
COUNTY-OTHER	GLASSCOCK	COLORADO	106	102	98	96	93	92	92
BIG SPRING	HOWARD	COLORADO	198	207	204	201	198	197	197
COAHOMA	HOWARD	COLORADO	174	171	168	165	162	160	160
COUNTY-OTHER	HOWARD	COLORADO	132	129	126	123	120	118	118
COUNTY-OTHER	IRION	COLORADO	96	98	95	92	90	88	88
MERTZON	IRION	COLORADO	83	129	126	124	121	120	120
COUNTY-OTHER	KIMBLE	COLORADO	97	98	95	93	90	89	89
JUNCTION	KIMBLE	COLORADO	263	306	303	300	297	295	295
COUNTY-OTHER	LOVING	RIO GRANDE	147	143	140	137	134	132	132
COUNTY-OTHER	MARTIN	COLORADO	144	140	137	134	131	130	130
STANTON	MARTIN	COLORADO	102	131	128	125	122	121	121
COUNTY-OTHER	MASON	COLORADO	97	102	99	96	93	92	92
MASON	MASON	COLORADO	299	307	304	301	298	296	296
BRADY	MCCULLOCH	COLORADO	303	300	297	294	291	289	289
COUNTY-OTHER	MCCULLOCH	COLORADO	130	127	124	122	119	118	118
MILLERSVIEW-DOOLE WSC	MCCULLOCH	COLORADO	119	115	112	109	105	104	104
RICHLAND SUD	MCCULLOCH	COLORADO	164	160	157	154	151	150	150
COUNTY-OTHER	MENARD	COLORADO	128	124	120	117	114	113	113
MENARD	MENARD	COLORADO	176	181	178	175	172	171	171
COUNTY-OTHER	MIDLAND	COLORADO	112	126	123	121	119	118	118
MIDLAND	MIDLAND	COLORADO	262	258	254	251	248	247	247
ODESSA	MIDLAND	COLORADO	208	205	202	198	195	194	194

Table 2A-2: Per Capita Water Demand Projections for Region F (Continued)

Water User Group Name	County Name	Basin Name	Per Capita Water Demand (gallons per person per day)						
			Historical	Projected					
			2000	2010	2020	2030	2040	2050	2060
COLORADO CITY	MITCHELL	COLORADO	211	207	204	201	198	196	196
COUNTY-OTHER	MITCHELL	BRAZOS	118	116	114	113	111	110	110
COUNTY-OTHER	MITCHELL	COLORADO	118	116	114	113	111	110	110
LORAINE	MITCHELL	COLORADO	118	115	112	109	106	104	104
COUNTY-OTHER	PECOS	RIO GRANDE	136	134	131	129	127	126	126
FORT STOCKTON	PECOS	RIO GRANDE	353	350	346	343	340	339	339
IRAAN	PECOS	RIO GRANDE	310	307	303	300	297	296	296
PECOS COUNTY WCID #1	PECOS	RIO GRANDE	99	100	97	94	92	91	91
BIG LAKE	REAGAN	COLORADO	251	247	243	241	238	237	237
COUNTY-OTHER	REAGAN	COLORADO	227	222	218	216	213	212	212
COUNTY-OTHER	REAGAN	RIO GRANDE	227	222	218	216	213	212	212
BALMORHEA	REEVES	RIO GRANDE	163	157	154	151	149	148	148
COUNTY-OTHER	REEVES	RIO GRANDE	269	268	266	264	261	259	259
MADERA VALLEY WSC	REEVES	RIO GRANDE	269	265	262	259	256	254	254
PECOS	REEVES	RIO GRANDE	242	237	234	231	228	227	227
BALLINGER	RUNNELS	COLORADO	150	187	183	180	177	176	176
COLEMAN COUNTY WSC	RUNNELS	COLORADO	117	115	112	109	106	105	105
COUNTY-OTHER	RUNNELS	COLORADO	89	127	124	121	117	115	115
MILES	RUNNELS	COLORADO	135	152	148	145	142	141	141
MILLERSVIEW-DOOLE WSC	RUNNELS	COLORADO	119	115	112	109	105	104	104
WINTERS	RUNNELS	COLORADO	102	167	164	161	158	156	156
COUNTY-OTHER	SCHLEICHER	COLORADO	139	136	133	130	126	124	124
COUNTY-OTHER	SCHLEICHER	RIO GRANDE	139	136	133	130	126	124	124
ELDORADO	SCHLEICHER	COLORADO	237	233	229	227	224	223	223
COUNTY-OTHER	SCURRY	BRAZOS	138	134	130	127	124	123	123
COUNTY-OTHER	SCURRY	COLORADO	138	134	130	127	124	123	123
SNYDER	SCURRY	COLORADO	194	223	219	216	213	212	212
COUNTY-OTHER	STERLING	COLORADO	140	136	133	130	127	126	126
STERLING CITY	STERLING	COLORADO	227	223	220	218	215	214	214
COUNTY-OTHER	SUTTON	COLORADO	199	195	192	189	186	185	185
COUNTY-OTHER	SUTTON	RIO GRANDE	199	195	192	189	186	185	185
SONORA	SUTTON	RIO GRANDE	337	332	329	326	323	322	322
CONCHO RURAL WSC	TOM GREEN	COLORADO	108	102	99	98	97	96	96
COUNTY-OTHER	TOM GREEN	COLORADO	109	158	155	152	149	147	147
MILLERSVIEW-DOOLE WSC	TOM GREEN	COLORADO	119	115	112	109	105	104	104
SAN ANGELO	TOM GREEN	COLORADO	162	197	193	190	187	186	186
COUNTY-OTHER	UPTON	COLORADO	163	160	156	153	150	149	149
COUNTY-OTHER	UPTON	RIO GRANDE	163	160	156	153	150	149	149
MCCAMEY	UPTON	RIO GRANDE	249	245	241	239	236	235	235
RANKIN	UPTON	RIO GRANDE	241	237	234	231	228	227	227
COUNTY-OTHER	WARD	RIO GRANDE	197	193	189	186	183	182	182
MONAHANS	WARD	RIO GRANDE	324	320	316	313	310	309	309
COUNTY-OTHER	WINKLER	COLORADO	188	185	181	178	175	174	174
COUNTY-OTHER	WINKLER	RIO GRANDE	188	185	181	178	175	174	174
KERMIT	WINKLER	RIO GRANDE	287	284	280	277	274	273	273
WINK	WINKLER	RIO GRANDE	306	303	299	296	293	292	292

Table 2A-3
Municipal Water Demand Projections for Region F

WUG Name	County	Basin	Water Demand (Acre-Feet per Year)					
			2010	2020	2030	2040	2050	2060
ANDREWS	ANDREWS	COLORADO	3,087	3,263	3,371	3,467	3,515	3,585
COUNTY-OTHER	ANDREWS	COLORADO	531	551	559	566	570	580
COUNTY-OTHER	ANDREWS	RIO GRANDE	7	7	7	8	8	8
		ANDREWS Total	*3,625*	*3,821*	*3,937*	*4,041*	*4,093*	*4,173*
COUNTY-OTHER	BORDEN	BRAZOS	14	14	14	12	11	10
COUNTY-OTHER	BORDEN	COLORADO	161	165	155	136	125	113
		BORDEN Total	*175*	*179*	*169*	*148*	*136*	*123*
BANGS	BROWN	COLORADO	265	266	262	256	254	254
BROOKESMITH SUD	BROWN	COLORADO	1,374	1,391	1,384	1,357	1,348	1,348
BROWNWOOD	BROWN	COLORADO	3,896	3,927	3,889	3,816	3,792	3,792
COLEMAN COUNTY WSC	BROWN	COLORADO	19	19	19	18	18	18
COUNTY-OTHER	BROWN	BRAZOS	12	12	12	12	12	12
COUNTY-OTHER	BROWN	COLORADO	342	342	336	327	324	324
EARLY	BROWN	COLORADO	799	812	810	801	797	797
ZEPHYR WSC	BROWN	COLORADO	399	404	399	391	387	387
		BROWN Total	*7,106*	*7,173*	*7,111*	*6,978*	*6,932*	*6,932*
BRONTE VILLAGE	COKE	COLORADO	245	258	254	250	249	249
COUNTY-OTHER	COKE	COLORADO	175	162	159	154	152	152
ROBERT LEE	COKE	COLORADO	351	346	342	338	336	336
		COKE Total	*771*	*766*	*755*	*742*	*737*	*737*
BROOKESMITH SUD	COLEMAN	COLORADO	13	13	12	12	12	12
COLEMAN	COLEMAN	COLORADO	1,285	1,269	1,252	1,235	1,223	1,223
COLEMAN COUNTY WSC	COLEMAN	COLORADO	357	348	339	329	326	326
COUNTY-OTHER	COLEMAN	COLORADO	19	19	18	18	18	18
SANTA ANNA	COLEMAN	COLORADO	200	197	193	190	187	187
		COLEMAN Total	*1,874*	*1,846*	*1,814*	*1,784*	*1,766*	*1,766*
COUNTY-OTHER	CONCHO	COLORADO	188	193	191	189	188	188
EDEN	CONCHO	COLORADO	559	572	569	562	559	559
MILLERSVIEW-DOOLE WSC	CONCHO	COLORADO	126	127	124	119	118	118
		CONCHO Total	*873*	*892*	*884*	*870*	*865*	*865*
COUNTY-OTHER	CRANE	RIO GRANDE	316	387	425	452	484	518
CRANE	CRANE	RIO GRANDE	940	1,002	1,028	1,045	1,072	1,105
		CRANE Total	*1,256*	*1,389*	*1,453*	*1,497*	*1,556*	*1,623*
COUNTY-OTHER	CROCKETT	RIO GRANDE	43	41	40	38	37	36
CROCKETT COUNTY WCID #1	CROCKETT	RIO GRANDE	1,664	1,790	1,825	1,832	1,872	1,913
		CROCKETT Total	*1,707*	*1,831*	*1,865*	*1,870*	*1,909*	*1,949*
COUNTY-OTHER	ECTOR	COLORADO	5,542	6,513	7,266	7,738	7,928	8,007
COUNTY-OTHER	ECTOR	RIO GRANDE	178	190	202	211	219	227
ECTOR COUNTY UD	ECTOR	COLORADO	1,480	1,847	2,177	2,473	2,706	2,932
ODESSA	ECTOR	COLORADO	21,508	22,084	22,626	23,335	24,355	25,559
		ECTOR Total	*28,708*	*30,634*	*32,271*	*33,757*	*35,208*	*36,725*
COUNTY-OTHER	GLASSCOCK	COLORADO	181	196	203	200	197	201
		GLASSCOCK Total	*181*	*196*	*203*	*200*	*197*	*201*
BIG SPRING	HOWARD	COLORADO	6,016	6,077	6,035	5,945	5,915	5,915
COAHOMA	HOWARD	COLORADO	183	185	183	180	177	177
COUNTY-OTHER	HOWARD	COLORADO	1,109	1,110	1,092	1,065	1,048	1,048
		HOWARD Total	*7,308*	*7,372*	*7,310*	*7,190*	*7,140*	*7,140*
COUNTY-OTHER	IRION	COLORADO	109	109	103	94	87	83
MERTZON	IRION	COLORADO	129	130	124	114	107	102
		IRION Total	*238*	*239*	*227*	*208*	*194*	*185*
COUNTY-OTHER	KIMBLE	COLORADO	212	207	203	196	194	194
JUNCTION	KIMBLE	COLORADO	936	935	926	917	910	910
		KIMBLE Total	*1,148*	*1,142*	*1,129*	*1,113*	*1,104*	*1,104*
COUNTY-OTHER	LOVING	RIO GRANDE	11	11	10	10	10	10
		LOVING Total	*11*	*11*	*10*	*10*	*10*	*10*

Table 2A-3: Municipal Water Demand Projections for Region F (Continued)

WUG Name	County	Basin	Water Demand (Acre-Feet per Year)					
			2010	2020	2030	2040	2050	2060
COUNTY-OTHER	MARTIN	COLORADO	377	403	411	412	399	378
STANTON	MARTIN	COLORADO	411	440	447	448	433	411
		MARTIN Total	*788*	*843*	*858*	*860*	*832*	*789*
COUNTY-OTHER	MASON	COLORADO	190	187	183	178	176	177
MASON	MASON	COLORADO	742	739	733	727	722	723
		MASON Total	*932*	*926*	*916*	*905*	*898*	*900*
BRADY	MCCULLOCH	COLORADO	1,879	1,893	1,874	1,854	1,842	1,842
COUNTY-OTHER	MCCULLOCH	COLORADO	12	12	12	12	12	12
MILLERSVIEW-DOOLE WSC	MCCULLOCH	COLORADO	248	245	239	230	228	228
RICHLAND SUD	MCCULLOCH	COLORADO	113	113	111	109	108	108
		MCCULLOCH Total	*2,252*	*2,263*	*2,236*	*2,205*	*2,190*	*2,190*
COUNTY-OTHER	MENARD	COLORADO	104	102	99	97	96	96
MENARD	MENARD	COLORADO	354	353	347	341	339	339
		MENARD Total	*458*	*455*	*446*	*438*	*435*	*435*
COUNTY-OTHER	MIDLAND	COLORADO	3,210	3,543	3,773	3,920	4,019	4,143
MIDLAND	MIDLAND	COLORADO	28,939	30,056	30,804	31,246	31,631	32,112
ODESSA	MIDLAND	COLORADO	419	603	724	810	867	925
		MIDLAND Total	*32,568*	*34,202*	*35,301*	*35,976*	*36,517*	*37,180*
COLORADO CITY	MITCHELL	COLORADO	997	980	949	914	879	826
COUNTY-OTHER	MITCHELL	COLORADO	621	609	593	570	549	516
LORAINE	MITCHELL	COLORADO	85	82	79	75	71	67
		MITCHELL Total	*1,703*	*1,671*	*1,621*	*1,559*	*1,499*	*1,409*
COUNTY-OTHER	PECOS	RIO GRANDE	702	722	731	730	726	712
FORT STOCKTON	PECOS	RIO GRANDE	3,267	3,397	3,461	3,481	3,479	3,411
IRAAN	PECOS	RIO GRANDE	452	469	478	480	479	470
PECOS COUNTY WCID #1	PECOS	RIO GRANDE	395	403	401	399	395	387
		PECOS Total	*4,816*	*4,991*	*5,071*	*5,090*	*5,079*	*4,980*
BIG LAKE	REAGAN	COLORADO	910	988	1,026	1,010	970	923
COUNTY-OTHER	REAGAN	COLORADO	125	135	141	138	133	126
		REAGAN Total	*1,035*	*1,123*	*1,167*	*1,148*	*1,103*	*1,049*
BALMORHEA	REEVES	RIO GRANDE	110	126	138	148	157	166
COUNTY-OTHER	REEVES	RIO GRANDE	219	192	171	152	136	124
MADERA VALLEY WSC	REEVES	RIO GRANDE	695	700	702	703	705	711
PECOS	REEVES	RIO GRANDE	2,810	3,064	3,261	3,413	3,573	3,712
		REEVES Total	*3,834*	*4,082*	*4,272*	*4,416*	*4,571*	*4,713*
BALLINGER	RUNNELS	COLORADO	917	998	1,057	1,121	1,178	1,237
COLEMAN COUNTY WSC	RUNNELS	COLORADO	18	30	39	48	56	66
COUNTY-OTHER	RUNNELS	COLORADO	360	295	246	193	156	129
MILES	RUNNELS	COLORADO	150	163	173	183	193	203
MILLERSVIEW-DOOLE WSC	RUNNELS	COLORADO	94	93	93	91	92	93
WINTERS	RUNNELS	COLORADO	552	561	566	571	575	591
		RUNNELS Total	*2,091*	*2,140*	*2,174*	*2,207*	*2,250*	*2,319*
COUNTY-OTHER	SCHLEICHER	COLORADO	117	108	102	98	95	93
COUNTY-OTHER	SCHLEICHER	RIO GRANDE	25	23	22	21	20	20
ELDORADO	SCHLEICHER	COLORADO	581	644	671	675	691	711
		SCHLEICHER Total	*723*	*775*	*795*	*794*	*806*	*824*
COUNTY-OTHER	SCURRY	BRAZOS	316	318	317	313	312	312
COUNTY-OTHER	SCURRY	COLORADO	558	562	560	553	552	552
SNYDER	SCURRY	COLORADO	2,792	2,834	2,844	2,829	2,832	2,832
		SCURRY Total	*3,666*	*3,714*	*3,721*	*3,695*	*3,696*	*3,696*
COUNTY-OTHER	STERLING	COLORADO	52	56	57	56	54	55
STERLING CITY	STERLING	COLORADO	297	321	330	330	319	324
		STERLING Total	*349*	*377*	*387*	*386*	*373*	*379*
COUNTY-OTHER	SUTTON	COLORADO	54	56	56	55	54	54
COUNTY-OTHER	SUTTON	RIO GRANDE	223	232	231	226	225	223
SONORA	SUTTON	RIO GRANDE	1,195	1,252	1,252	1,236	1,235	1,222
		SUTTON Total	*1,472*	*1,540*	*1,539*	*1,517*	*1,514*	*1,499*

Table 2A-3: Municipal Water Demand Projections for Region F (Continued)

WUG Name	County	Basin	Water Demand (Acre-Feet per Year)					
			2010	2020	2030	2040	2050	2060
CONCHO RURAL WSC	TOM GREEN	COLORADO	695	873	990	1,048	1,091	1,103
COUNTY-OTHER	TOM GREEN	COLORADO	1,761	1,703	1,633	1,553	1,476	1,408
MILLERSVIEW-DOOLE WSC	TOM GREEN	COLORADO	238	263	291	319	359	408
SAN ANGELO	TOM GREEN	COLORADO	20,800	21,418	21,734	21,744	21,907	21,969
		TOM GREEN Total	*23,494*	*24,257*	*24,648*	*24,664*	*24,833*	*24,888*
COUNTY-OTHER	UPTON	COLORADO	52	54	53	53	54	55
COUNTY-OTHER	UPTON	RIO GRANDE	100	102	102	101	102	104
MCCAMEY	UPTON	RIO GRANDE	559	606	621	629	648	668
RANKIN	UPTON	RIO GRANDE	231	245	248	250	255	261
		UPTON Total	*942*	*1,007*	*1,024*	*1,033*	*1,059*	*1,088*
COUNTY-OTHER	WARD	RIO GRANDE	925	929	925	910	905	905
MONAHANS	WARD	RIO GRANDE	2,559	2,592	2,597	2,572	2,564	2,564
		WARD Total	*3,484*	*3,521*	*3,522*	*3,482*	*3,469*	*3,469*
COUNTY-OTHER	WINKLER	RIO GRANDE	119	121	120	119	116	112
KERMIT	WINKLER	RIO GRANDE	1,927	1,988	1,983	1,966	1,922	1,860
WINK	WINKLER	RIO GRANDE	331	341	341	338	331	320
		WINKLER Total	*2,377*	*2,450*	*2,444*	*2,423*	*2,369*	*2,292*
		Grand Total	***141,965***	***147,828***	***151,280***	***153,206***	***155,340***	***157,632***

Table 2A-4
Manufacturing Water Demand Projections for Region F

County	Basin	Water Demand (Acre-Feet per Year)					
		2010	2020	2030	2040	2050	2060
BROWN	COLORADO	577	636	686	734	775	837
COLEMAN	COLORADO	6	6	6	6	6	6
ECTOR	COLORADO	2,743	2,946	3,107	3,248	3,357	3,471
ECTOR	RIO GRANDE	16	17	18	19	19	20
HOWARD	COLORADO	1,648	1,753	1,832	1,910	1,976	2,099
KIMBLE	COLORADO	702	767	823	880	932	1,002
MCCULLOCH	COLORADO	844	929	1,004	1,075	1,137	1,233
MARTIN	COLORADO	39	41	42	43	44	47
MIDLAND	COLORADO	164	182	198	213	226	245
PECOS	RIO GRANDE	2	2	2	2	2	2
REEVES	RIO GRANDE	720	741	756	770	781	825
RUNNELS	COLORADO	63	70	76	82	87	94
TOM GREEN	COLORADO	2,226	2,498	2,737	2,971	3,175	3,425
WARD	RIO GRANDE	7	7	7	7	7	7
	Grand Total	***9,757***	***10,595***	***11,294***	***11,960***	***12,524***	***13,313***

Table 2A-5
Mining Water Demand Projections for Region F

County	Basin	Water Demand (Acre-Feet per Year)					
		2010	2020	2030	2040	2050	2060
ANDREWS	COLORADO	1,845	1,893	1,911	1,929	1,946	1,969
ANDREWS	RIO GRANDE	63	64	65	65	66	67
BORDEN	COLORADO	690	658	646	635	625	612
BROWN	BRAZOS	41	42	42	42	42	42
BROWN	COLORADO	2,446	2,462	2,468	2,474	2,480	2,488
COKE	COLORADO	488	528	550	572	593	614
COLEMAN	COLORADO	18	19	19	19	19	19
CRANE	RIO GRANDE	2,221	2,216	2,214	2,212	2,210	2,208
CROCKETT	RIO GRANDE	402	421	431	441	450	459
ECTOR	COLORADO	9,702	10,321	10,706	11,080	11,447	11,745
ECTOR	RIO GRANDE	186	198	205	212	219	225
GLASSCOCK	COLORADO	5	5	5	5	5	5
HOWARD	COLORADO	1,783	1,883	1,924	1,963	2,001	2,052
IRION	COLORADO	122	122	122	122	122	122
KIMBLE	COLORADO	71	67	65	63	61	60
LOVING	RIO GRANDE	2	2	2	2	2	2
MARTIN	COLORADO	674	645	634	624	615	603
MASON	COLORADO	6	6	6	6	6	6
MCCULLOCH	COLORADO	154	159	162	165	168	171
MIDLAND	COLORADO	677	778	846	915	986	1,046
MITCHELL	COLORADO	115	110	108	107	106	104
PECOS	RIO GRANDE	159	158	158	158	158	158
REAGAN	COLORADO	2,036	2,165	2,235	2,303	2,370	2,436
REEVES	RIO GRANDE	182	177	175	173	172	170
RUNNELS	COLORADO	44	45	45	45	45	45
SCHLEICHER	COLORADO	125	134	139	144	149	154
SCURRY	BRAZOS	2,244	2,403	2,465	2,525	2,583	2,667
SCURRY	COLORADO	863	924	948	971	994	1,026
STERLING	COLORADO	590	600	605	610	615	620
SUTTON	COLORADO	35	35	36	36	37	37
SUTTON	RIO GRANDE	45	47	47	48	48	49
TOM GREEN	COLORADO	73	80	85	90	95	99
UPTON	COLORADO	2,011	2,025	2,030	2,035	2,040	2,046
UPTON	RIO GRANDE	651	655	657	659	660	662
WARD	RIO GRANDE	153	155	156	157	158	159
WINKLER	RIO GRANDE	928	895	883	872	861	847
	Grand Total	***31,850***	***33,097***	***33,795***	***34,479***	***35,154***	***35,794***

Table 2A-6
Irrigation Water Demand Projections for Region F

County	Basin	Water Demand (Acre-Feet per Year)					
		2010	2020	2030	2040	2050	2060
ANDREWS	COLORADO	32,608	32,334	32,062	31,788	31,516	31,245
BORDEN	BRAZOS	1,103	1,102	1,100	1,099	1,097	1,096
BORDEN	COLORADO	1,587	1,585	1,582	1,581	1,578	1,577
BROWN	COLORADO	12,313	12,272	12,230	12,189	12,146	12,105
COKE	COLORADO	936	936	934	933	933	933
COLEMAN	COLORADO	1,379	1,379	1,379	1,379	1,379	1,379
CONCHO	COLORADO	4,297	4,280	4,262	4,245	4,229	4,213
CRANE	RIO GRANDE	337	337	337	337	337	337
CROCKETT	RIO GRANDE	525	518	508	498	492	482
ECTOR	COLORADO	5,477	5,412	5,348	5,281	5,219	5,152
ECTOR	RIO GRANDE	56	54	54	54	52	52
GLASSCOCK	COLORADO	52,272	51,854	51,438	51,021	50,603	50,190
HOWARD	COLORADO	4,799	4,744	4,690	4,635	4,581	4,527
IRION	COLORADO	2,803	2,742	2,682	2,621	2,561	2,501
KIMBLE	COLORADO	985	948	913	877	841	807
LOVING	RIO GRANDE	581	580	576	575	573	572
MARTIN	COLORADO	14,324	14,073	13,822	13,571	13,321	13,075
MASON	COLORADO	10,079	9,936	9,792	9,648	9,505	9,363
MCCULLOCH	COLORADO	2,824	2,789	2,754	2,718	2,683	2,649
MENARD	COLORADO	6,061	6,041	6,022	6,003	5,981	5,962
MIDLAND	COLORADO	41,493	41,170	40,848	40,526	40,203	39,884
MITCHELL	COLORADO	5,534	5,507	5,479	5,452	5,425	5,398
PECOS	RIO GRANDE	79,681	78,436	77,191	75,945	74,700	73,475
REAGAN	COLORADO	36,597	35,990	35,385	34,779	34,174	33,579
REEVES	RIO GRANDE	103,069	102,196	101,323	100,448	99,575	98,710
RUNNELS	COLORADO	4,331	4,317	4,298	4,279	4,260	4,241
SCHLEICHER	COLORADO	1,750	1,716	1,680	1,645	1,609	1,575
SCHLEICHER	RIO GRANDE	358	351	344	337	330	322
SCURRY	BRAZOS	788	762	736	710	684	659
SCURRY	COLORADO	2,027	1,961	1,894	1,827	1,760	1,696
STERLING	COLORADO	648	621	595	569	543	518
SUTTON	COLORADO	561	551	540	530	518	507
SUTTON	RIO GRANDE	1,250	1,226	1,202	1,178	1,155	1,132
TOM GREEN	COLORADO	104,621	104,362	104,107	103,852	103,593	103,338
UPTON	COLORADO	16,592	16,355	16,123	15,887	15,651	15,421
UPTON	RIO GRANDE	167	166	162	160	158	155
WARD	RIO GRANDE	13,793	13,624	13,454	13,284	13,115	12,947
WINKLER	RIO GRANDE	10,000	10,000	10,000	10,000	10,000	10,000
	Grand Total	***578,606***	***573,227***	***567,846***	***562,461***	***557,080***	***551,774***

Table 2A-7
Livestock Water Demand Projections for Region F

County	Basin	Water Demand (Acre-Feet per Year)					
		2010	2020	2030	2040	2050	2060
ANDREWS	COLORADO	360	360	360	360	360	360
ANDREWS	RIO GRANDE	78	78	78	78	78	78
BORDEN	BRAZOS	10	10	10	10	10	10
BORDEN	COLORADO	271	271	271	271	271	271
BROWN	BRAZOS	32	32	32	32	32	32
BROWN	COLORADO	1,604	1,604	1,604	1,604	1,604	1,604
COKE	COLORADO	593	593	593	593	593	593
COLEMAN	COLORADO	1,259	1,259	1,259	1,259	1,259	1,259
CONCHO	COLORADO	775	775	775	775	775	775
CRANE	RIO GRANDE	155	155	155	155	155	155
CROCKETT	COLORADO	30	30	30	30	30	30
CROCKETT	RIO GRANDE	967	967	967	967	967	967
ECTOR	COLORADO	198	198	198	198	198	198
ECTOR	RIO GRANDE	95	95	95	95	95	95
GLASSCOCK	COLORADO	232	232	232	232	232	232
HOWARD	COLORADO	366	366	366	366	366	366
IRION	COLORADO	460	460	460	460	460	460
KIMBLE	COLORADO	668	668	668	668	668	668
LOVING	RIO GRANDE	70	70	70	70	70	70
MCCULLOCH	COLORADO	1,027	1,027	1,027	1,027	1,027	1,027
MARTIN	COLORADO	273	273	273	273	273	273
MASON	COLORADO	1,036	1,036	1,036	1,036	1,036	1,036
MENARD	COLORADO	642	642	642	642	642	642
MIDLAND	COLORADO	904	904	904	904	904	904
MITCHELL	COLORADO	449	449	449	449	449	449
PECOS	RIO GRANDE	1,239	1,239	1,239	1,239	1,239	1,239
REAGAN	COLORADO	253	253	253	253	253	253
REAGAN	RIO GRANDE	19	19	19	19	19	19
REEVES	RIO GRANDE	2,283	2,283	2,283	2,283	2,283	2,283
RUNNELS	COLORADO	1,530	1,530	1,530	1,530	1,530	1,530
SCHLEICHER	COLORADO	583	583	583	583	583	583
SCHLEICHER	RIO GRANDE	204	204	204	204	204	204
SCURRY	BRAZOS	233	233	233	233	233	233
SCURRY	COLORADO	396	396	396	396	396	396
STERLING	COLORADO	503	503	503	503	503	503
SUTTON	COLORADO	358	358	358	358	358	358
SUTTON	RIO GRANDE	438	438	438	438	438	438
TOM GREEN	COLORADO	1,978	1,978	1,978	1,978	1,978	1,978
UPTON	COLORADO	78	78	78	78	78	78
UPTON	RIO GRANDE	134	134	134	134	134	134
WARD	RIO GRANDE	126	126	126	126	126	126
WINKLER	COLORADO	2	2	2	2	2	2
WINKLER	RIO GRANDE	149	149	149	149	149	149
	Grand Total	***23,060***	***23,060***	***23,060***	***23,060***	***23,060***	***23,060***

Table 2A-8
Steam-Electric Water Demand Projections for Region F

County	Basin	Water Demand (Acre-Feet per Year)					
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
COKE	COLORADO	310	247	289	339	401	477
CROCKETT	RIO GRANDE	973	776	907	1,067	1,262	1,500
ECTOR	COLORADO	6,375	9,125	10,668	12,549	14,842	17,637
MITCHELL	COLORADO	9,100	7,621	8,910	10,481	12,396	14,730
TOM GREEN	COLORADO	543	777	909	1,069	1,264	1,502
WARD	RIO GRANDE	4,914	4,223	4,937	5,807	6,868	8,162
	Grand Total	***22,215***	***22,769***	***26,620***	***31,312***	***37,033***	***44,008***

Appendix 3A
An Evaluation of Saline and Brackish Water Resources in Region F

FINAL REPORT

An Evaluation of Brackish and Saline Water Resources in Region F

Prepared for

Region F Regional Water Planning Group

September, 2004

Prepared by

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1.0 Introduction

Additional supplies of water in Region F may be obtained from the desalination of existing brackish or saline water sources. Desalination is the process of reducing the concentration of dissolved minerals in water to an acceptable level for its intended use. The feasibility of a desalination project lies in the cost effectiveness of producing and delivering the raw water supply to the plant, the construction and operation of the desalination plant, and the disposal of the concentrated waste stream. Recent improvements in membrane technology have resulted in making the desalination of brackish sources a viable water-supply alternative, with cost effectiveness being mostly dependent on the concentration level of the dissolved constituents in the originating supply source.

Very little, if any, surface water in Region F is available for desalination. Therefore, the emphasis of this report is a general overview of subsurface, water-producing, geologic formations that have the potential to meet desalination supply needs. For the purpose of this report, these groundwater sources are divided into the following categories:

- Groundwater formations that generally occur at relatively shallow depths and are designated by the Texas Water Development Board (TWDB) as major or minor aquifers; and
- Groundwater that is produced from deeper, hydrocarbon-producing geologic formations.

Water quality, hydraulic characteristics, and depth data used in the assessment of potential desalination supply sources were obtained from a number of sources. Of prime importance are water quality databases maintained by the TWDB and the US Geological Survey. In 2003, LBG-Guyton produced for the TWDB a survey of brackish groundwater resources in the state titled *"Brackish Groundwater Manual for*

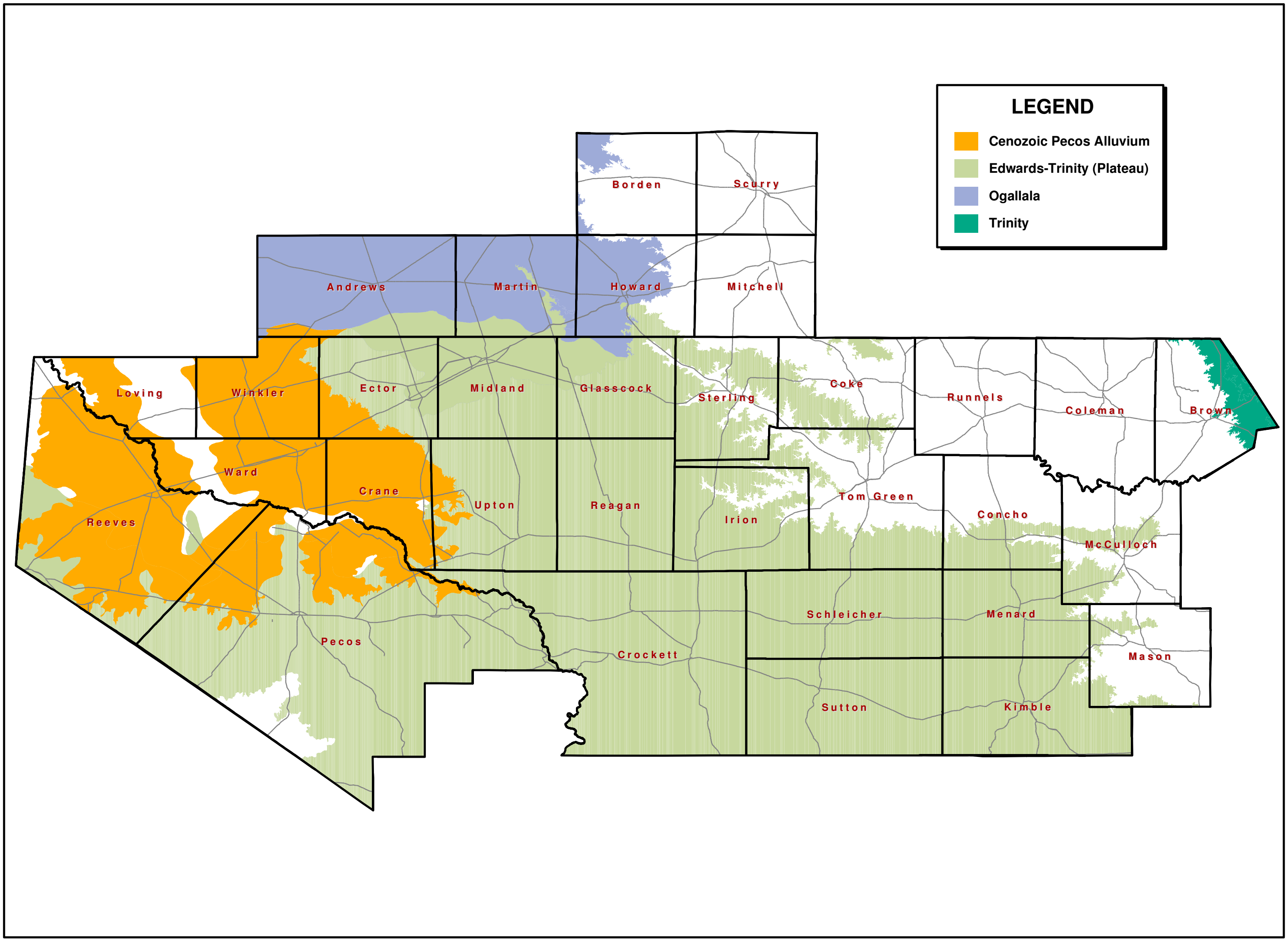

Figure 1 - Major Aquifers In Region F

Texas Regional Water Planning Groups" (LBG-Guyton, 2003). The report summarizes the brackish (1,000 to 10,000 mg/L TDS) groundwater resources of the Board's designated major and minor aquifers, and includes estimated volumes of available source water. Aquifer characteristics are available from the numerous county and regional reports prepared by the TWDB. Most of the information pertaining to deeper geologic formations is derived from TWDB Report 157, *"A Survey of the Subsurface Saline Water of Texas"* (Core Laboratories, 1972). An analysis of the potential use of oil-field produced water for desalination purposes was recently completed by Texas A&M University for the TWDB, and a draft report has been submitted. However, this draft report was not available at the time of the preparation of this report. A brief summary of the potential for oil-field produced water is included in his report. The final section in this report pertaining to desalination costs is summarized from the LBG-Guyton/TWDB brackish groundwater report.

2.0 Major and Minor Aquifers

Brackish groundwater is available from most of the major and minor aquifers present in Region F. The primary advantage of acquiring brackish groundwater supplies from major and minor aquifers is that these sources are relatively shallow and less costly to develop than other sources of groundwater that may be considered, in particular deeper, hydrocarbon-producing formations. However, in some cases, the distance from areas where the major and minor aquifers can be developed to the final destination where the water will be used to meet demands may be a detriment.

2.1 Major Aquifers

Four major aquifers are present in Region F, including the Ogallala, the Cenozoic Pecos Alluvium, the Edwards-Trinity (Plateau), and the Trinity. Figure 1 shows the location of these major aquifers within the region. Of these, the Trinity is only present in the extreme eastern portion of the region, and contains very limited brackish

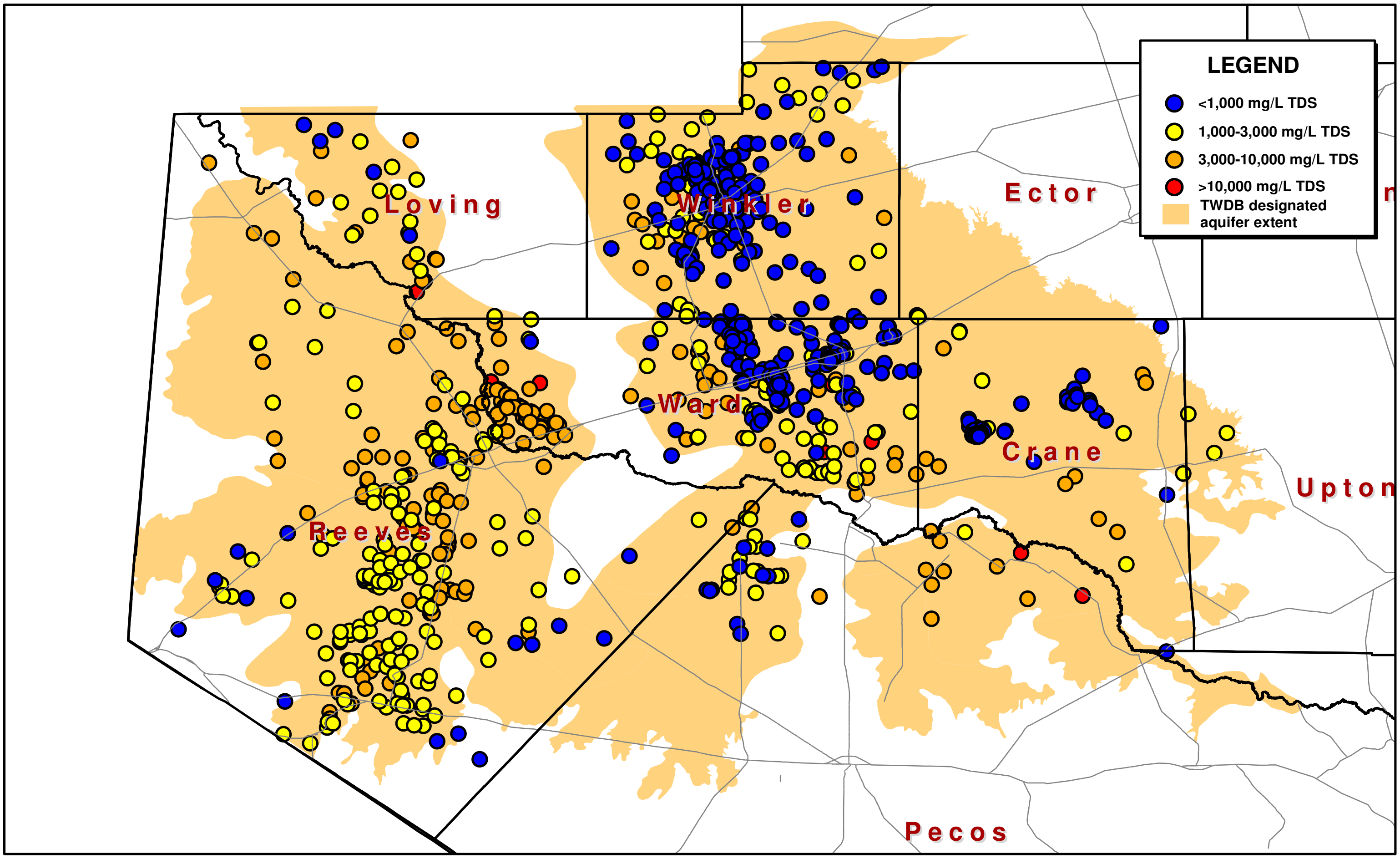

Figure 2 - Groundwater quality in the Cenozoic Pecos Alluvium Aquifer

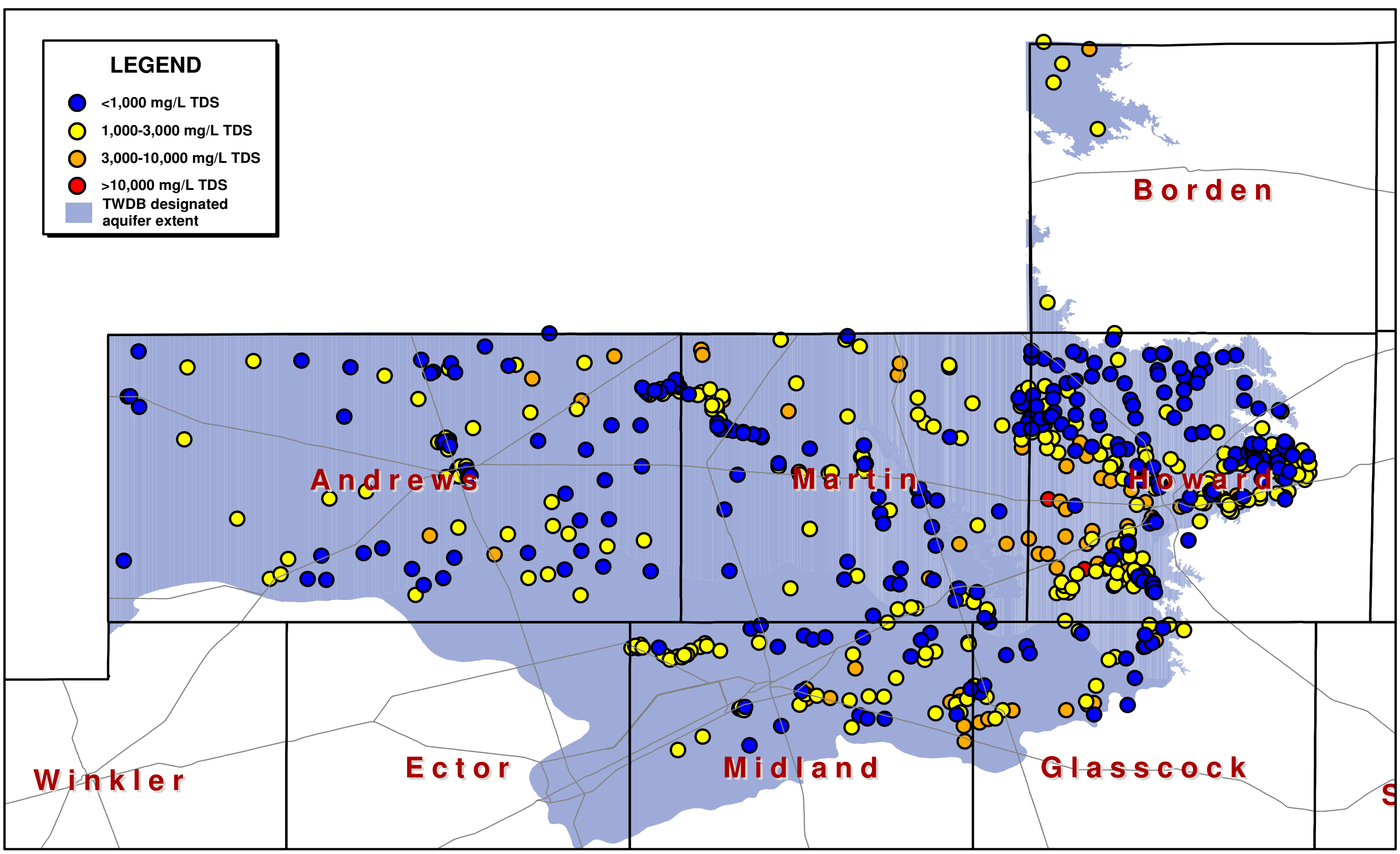

Figure 3 - Groundwater quality in the Ogallala Aquifer

groundwater. The other three major aquifers are more extensive in Region F and contain areas of brackish groundwater.

Cenozoic Pecos Alluvium - The Cenozoic Pecos Alluvium is located almost entirely within Region F, in Reeves, Loving, Winkler, Ward, Crane, and Pecos Counties, as shown in Figure 2. The aquifer consists of up to 1,500 feet of alluvial fill that occupies two hydrologically separate basins, the Pecos Trough to the west, mainly in Reeves County, and the Monument Draw Trough to the east, mainly in Winkler, Ward, and Crane Counties. This fill overlies, and in places is hydrologically connected to, the Edwards-Trinity (Plateau), the Dockum, and the Rustler aquifers. Most of the groundwater currently produced in the westerly Pecos Trough is used for irrigation, while most production in the Monument Draw Trough is exported to cities east of the aquifer area.

Water quality in the Cenozoic Pecos Alluvium aquifer is highly variable due to natural conditions as well as some anthropogenic affects, and brackish groundwater is found throughout the extent of the aquifer. Although water quality in the eastern trough tends to be better than groundwater in the west, significant portions of both sections of the aquifer contain poorer quality water, as shown in Figure 2.

Because the aquifer is thick, the volume of brackish groundwater in the Cenozoic Pecos Alluvium is large. As much as 116.5 million acre-feet of brackish groundwater is estimated to be available from the Cenozoic Pecos Alluvium making it one of the most significant sources of brackish groundwater supply in Region F (LBG-Guyton, 2003).

Ogallala - The southernmost portion of the Ogallala aquifer is present in Region F in Andrews, Borden, Ector, Martin, Howard, Midland, and Glasscock Counties, as shown in Figure 3. The aquifer is composed of Tertiary-aged sand, gravel, silt, and clay, with a maximum thickness of about several hundred feet, but becomes significantly thinner to the south and east, with an estimated average saturated thickness of only 50 feet.

Much of the groundwater produced from the Ogallala in Region F is slightly to moderately saline, as shown in Figure 3. As can be seen in this figure, the occurrence of

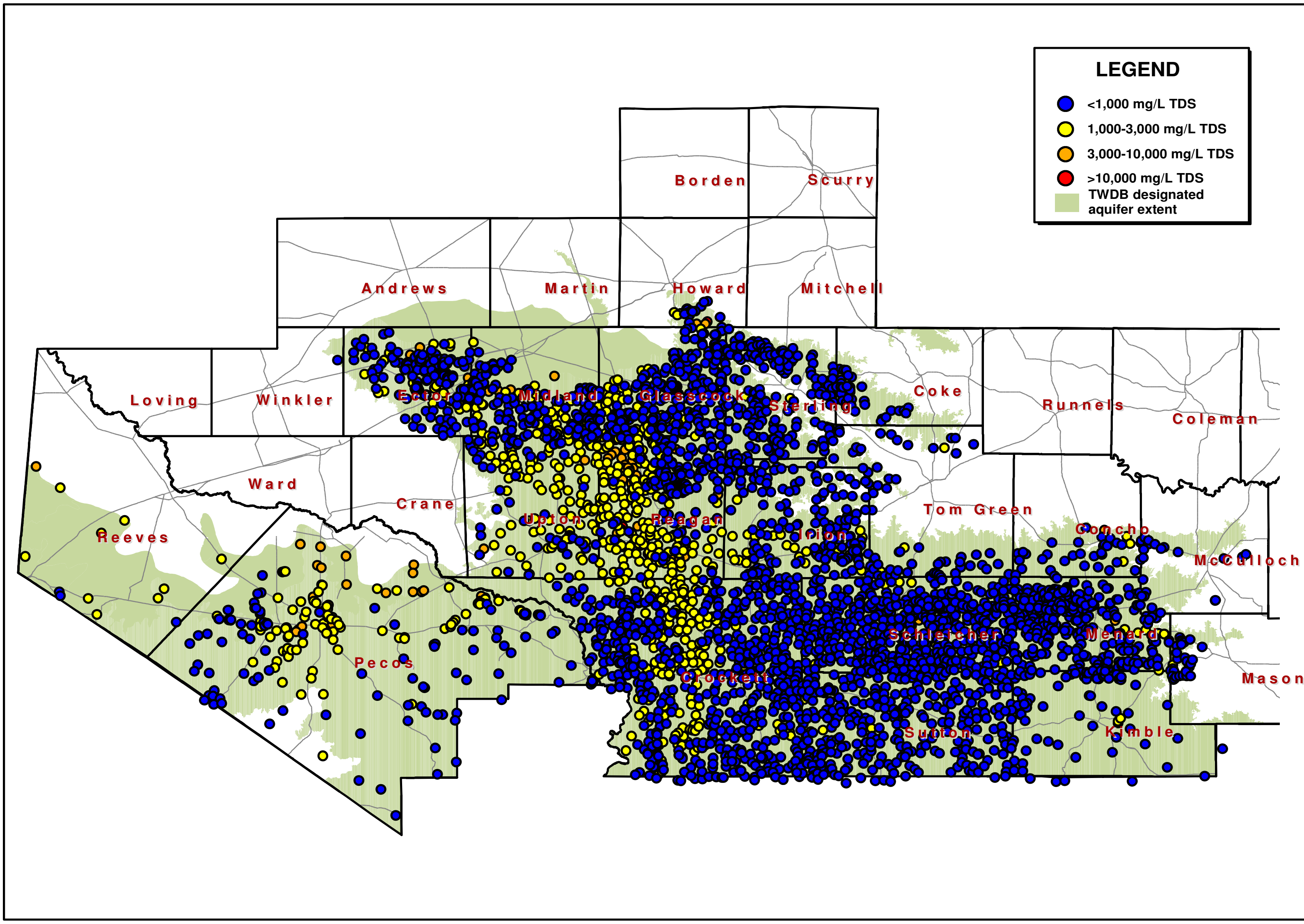

Figure 4 - Groundwater Quality in the Edwards-Trinity (Plateau) Aquifer

slightly to moderately saline groundwater is somewhat random, with no clear delineation between fresh and brackish section of the aquifer, although some areas appear to be more dominantly fresh or brackish than others. Approximately 7.7 million acre-feet of brackish groundwater are estimated to be available from the Ogallala in Region F (LBG-Guyton, 2003).

Edwards-Trinity (Plateau) - The Edwards-Trinity (Plateau) aquifer consists of Cretaceous-age limestones, sandstones, and dolomites and is present throughout much of Region F, as shown in Figure 4. Most water currently produced from the aquifer is used for irrigation purposes, however several municipalities also use water from this aquifer.

Groundwater in the Edwards portion of this aquifer occurs primarily in solution cavities that have developed along faults, fractures, and joints in the limestone. The Edwards is the main water-producing unit in about two-thirds of the aquifer extent. The underlying Trinity is used primarily in the northern third and on the extreme southeastern edge of the aquifer.

While wells producing from the Edwards-Trinity (Plateau) aquifer may be over 1,000 feet deep, a vast majority of wells present in Region F are less than 500 feet deep. The saturated thickness of the aquifer is generally less than 400 feet. Reported well yields commonly range from less than 50 gpm from the thinnest saturated section to 1,500 gpm in locations where wells are completed in jointed or cavernous limestone.

The water quality of the Edwards is generally better than that in the underlying Trinity in the Plateau region. Water produced from the Edwards units is characteristically very hard but fresh, with TDS ranges typically between 200 to 400 mg/l. The salinity of groundwater in the Trinity increases towards the west, with total dissolved solids ranging from 500 to 1,000 mg/l. Several areas of the Edwards-Trinity (Plateau) in Region F produce slightly to moderately saline groundwater, as shown in Figure 3. It is estimated that more than 24 million acre-feet of brackish groundwater is available from the Edwards-Trinity (Plateau).

Trinity - The Trinity aquifer is only present in Region F in the eastern third of Brown County, as well as a very small, isolated section in Coleman County, as shown in Figure 1. A majority of wells producing from the Trinity in these two areas are fresh,

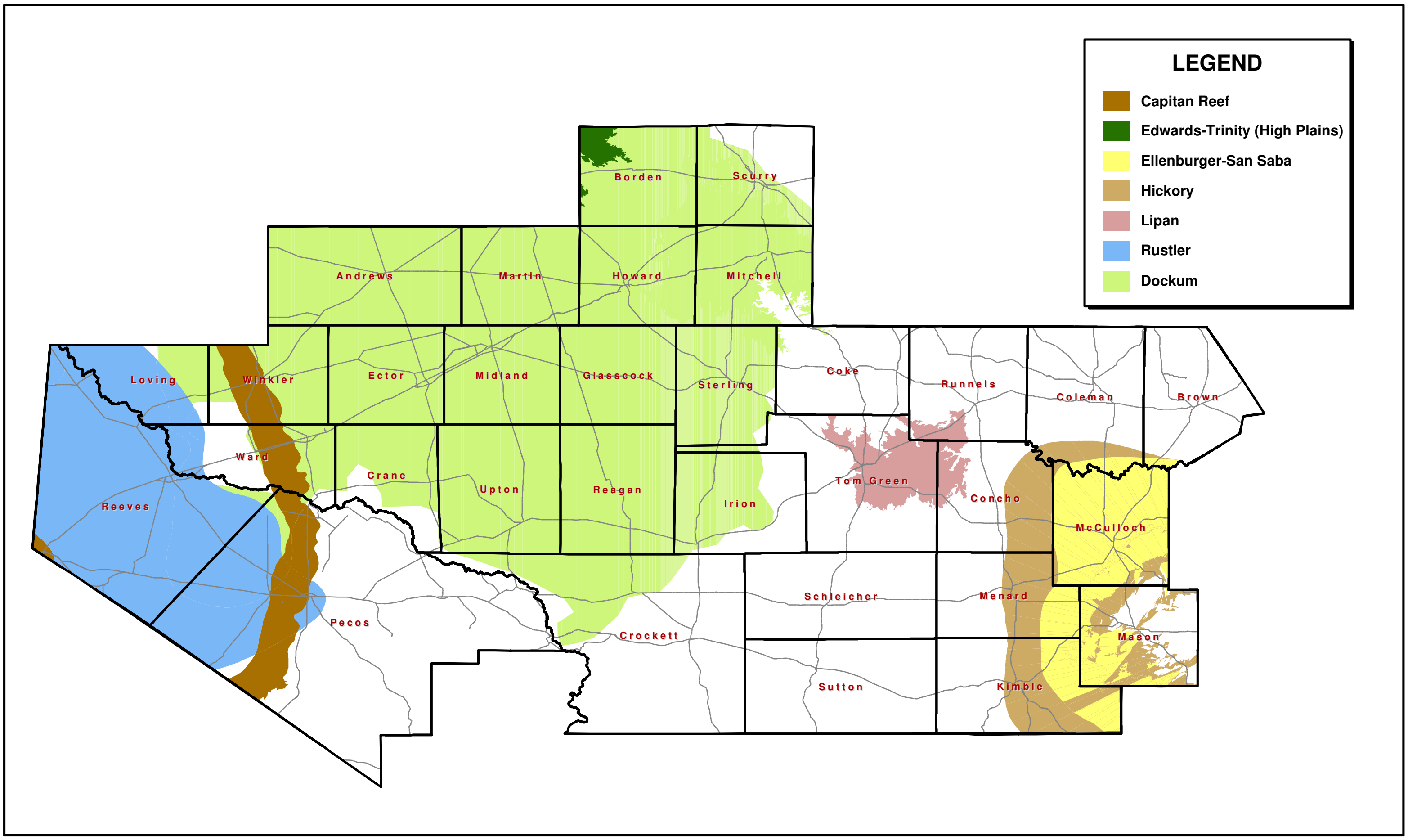

Figure 5 - Minor Aquifers In Region F

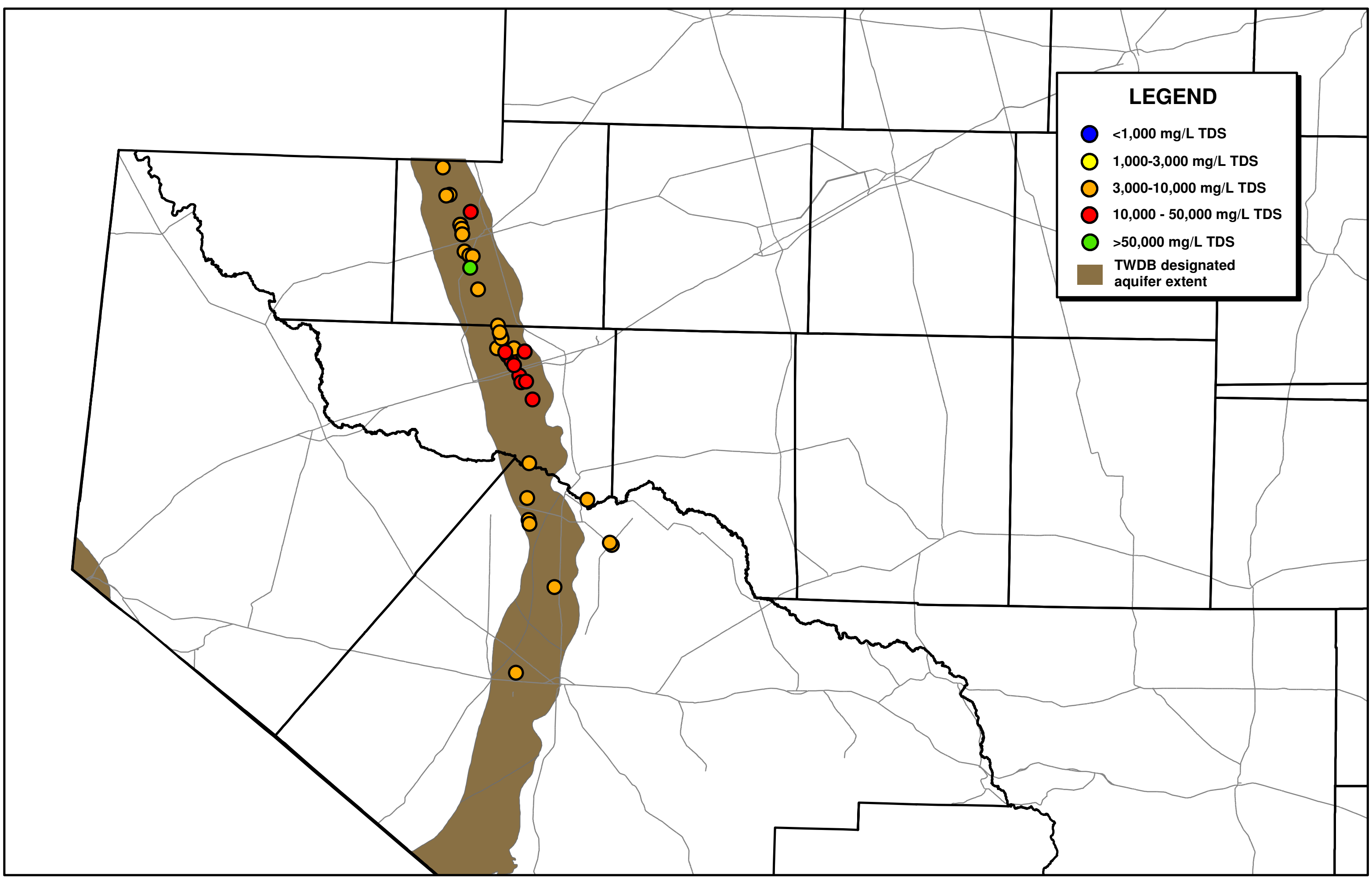

Figure 6 - Groundwater Quality in the Capitan Reef Aquifer

with approximately one-quarter producing slightly to moderately saline (1,000 to 8,000 mg/L) groundwater. Because of the limited extent of the Trinity aquifer in Region F, and because the brackish Trinity wells occur randomly in the region, no definitive supply of brackish groundwater is considered to be available from the Trinity in Region F.

2.2 Minor Aquifers

Nine minor aquifers as defined by the TWDB are present in Region F, including:

- Capitan Reef
- Rustler
- Dockum
- Blaine
- Lipan
- Hickory
- Ellenburger-San Saba
- Marble Falls
- Edwards-Trinity (High Plains)

The location of these aquifers within Region F is shown in Figure 5. Although technically located within Region F, the Edwards-Trinity (High Plains) aquifer is not considered a potential source of brackish groundwater in the region because of its very limited extent within the region, and therefore is not discussed in this report. Also, the Ellenburger, San Saba, and Marble Falls aquifers are discussed together because of their hydraulic similarities and because they are geographically located in the same area.

Capitan Reef – The Capitan Reef aquifer is located in the western part of Region F, in Winkler, Ward, and Pecos Counties, as shown in Figure 6. With well depths ranging over 4,000 feet, the aquifer is mainly used for oil-flood operations in Ward and Winkler Counties, and irrigation in Pecos Counties. Due to the cavernous nature of this aquifer, well yields commonly range from a few hundred to more than 1,000 gpm.

The aquifer generally contains water of marginal quality, with most wells yielding water between 1,000 and 3,000 mg/L TDS, as shown in Figure 6. Deeper wells in Pecos, Ward and Winkler Counties produce groundwater containing dissolved solids in excess

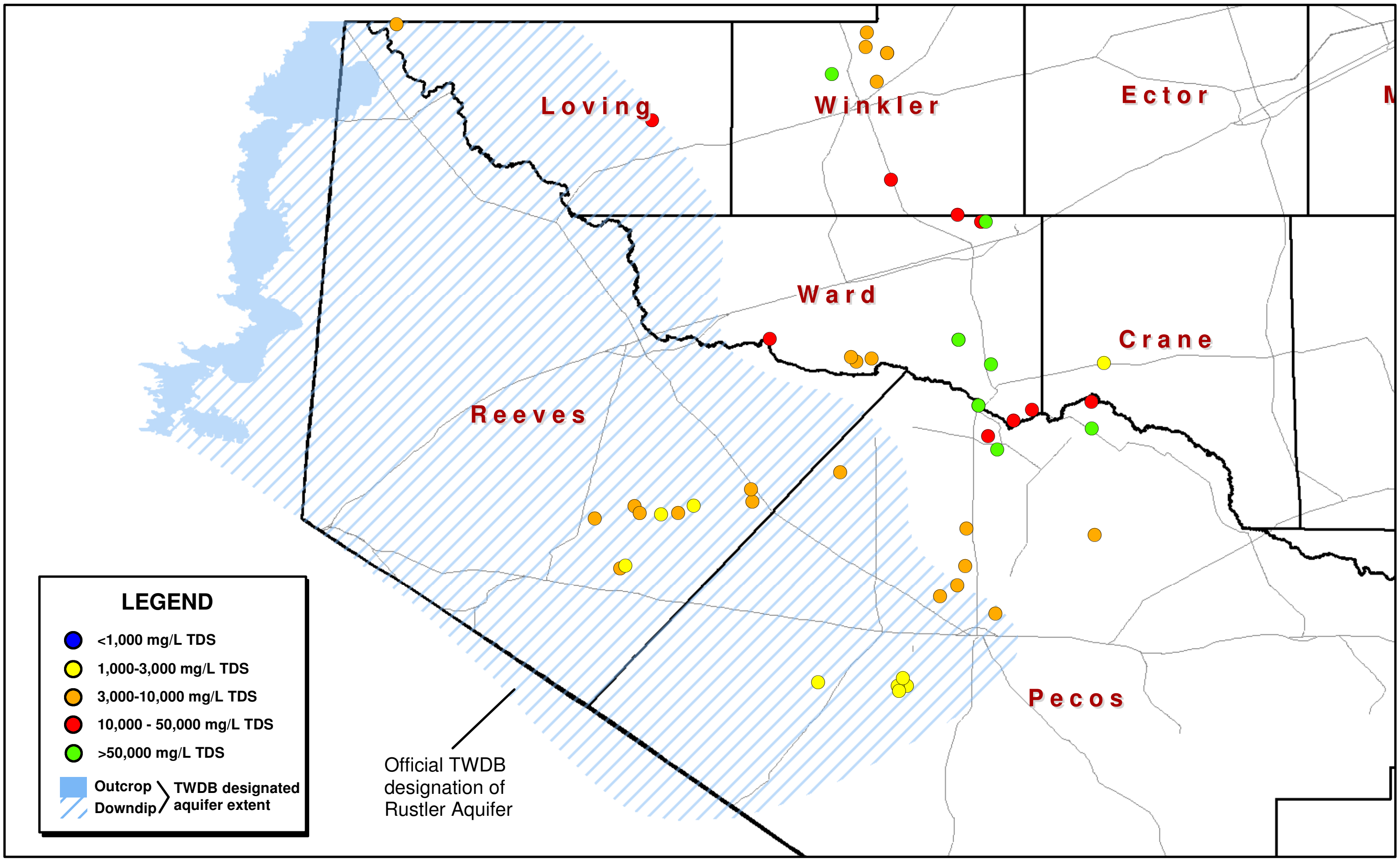

Figure 7 - Groundwater Quality in the Rustler Aquifer

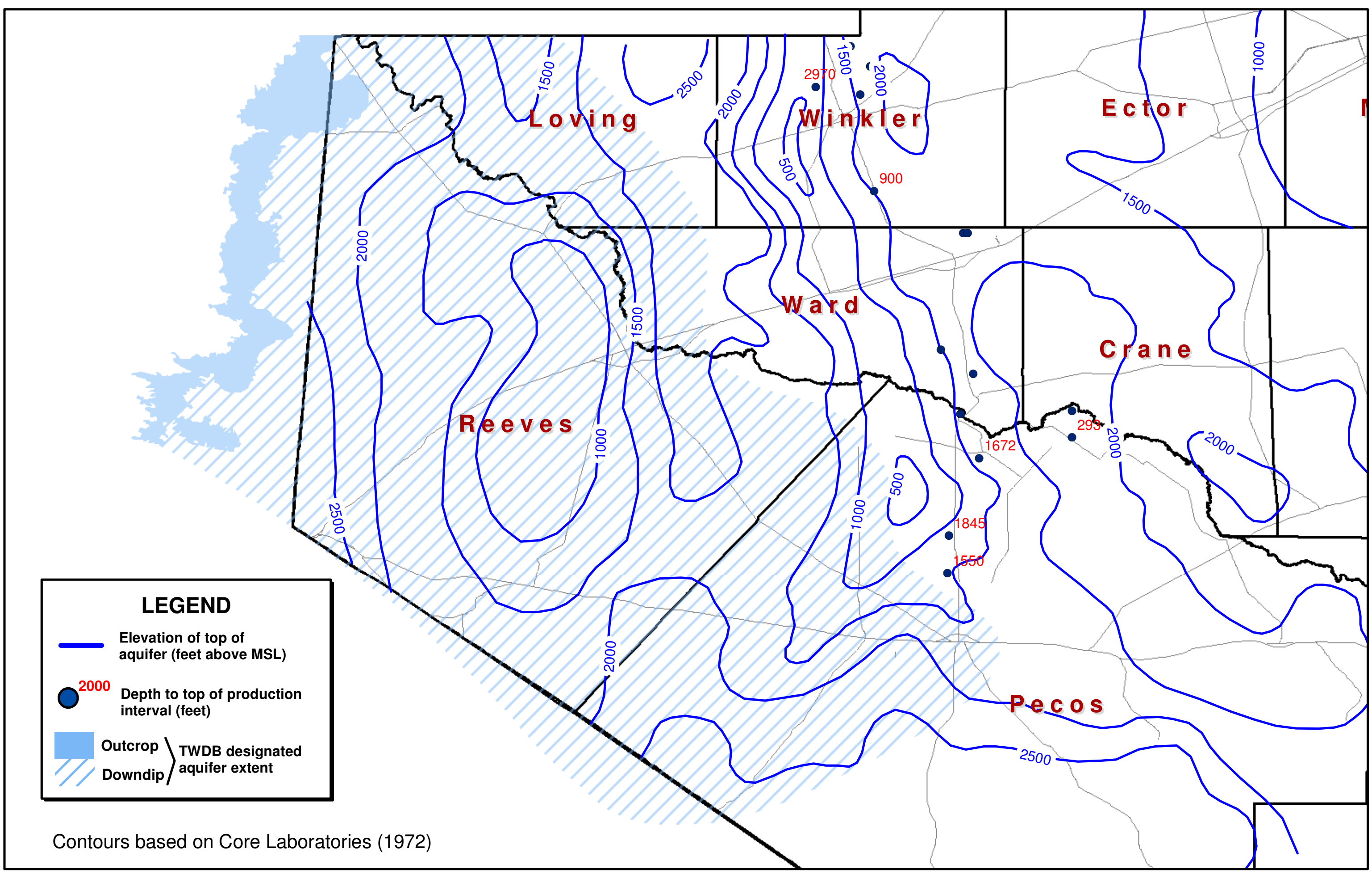

Figure 8 - Elevation of the top of the Rustler Aquifer

of 3,000 mg/L, with the highest concentrations in excess of 10,000 mg/L occurring in central Ward County. The Capitan Reef aquifer is also part of the Guadalupe aquifer system described later in this report. Approximately 48 million acre-feet of brackish groundwater are available from the Capitan Reef aquifer in Region F (LBG-Guyton, 2003).

Rustler – The Rustler Formation is located in the western part of Region F and is shown in Figure 7. The formation actually extends to the east beyond the TWDB aquifer boundary shown in this figure, although this is an area where hydrocarbons are produced and not considered to be an aquifer for water-supply purposes by the TWDB. Produced water data are also included in Figure 7 and indicate that Rustler Formation water is produced as far as eastern Crane County.

The elevation of the top of the 200 to 500 foot thick Rustler Formation is shown in Figure 8, and is generally between 1,000 and 2,000 feet above sea level, with well depths mostly between 1,000 and 2,000 feet below land surface. Yields from wells are variable, ranging from less than 10 to over 4,000 gpm. Some flowing artesian wells produce more than 1,000 gpm.

Groundwater quality in the Rustler generally contains between 1,000 and 5,000 mg/L TDS in the TWDB designated aquifer area. In general, water produced from the Upper Member of the Rustler is slightly- to moderately-saline, and the basal beds contain greater than 10,000 mg/L TDS groundwater.

As much as 4,000 acre-feet/year is estimate to be available without depleting storage, and nearly 35 million acre-feet is in storage in the region within the limits of the aquifer as defined by the TWDB (LBG-Guyton, 2003). Significant additional brackish and saline groundwater is available from the extent of the Rustler beyond the TWDB's minor aquifer designation.

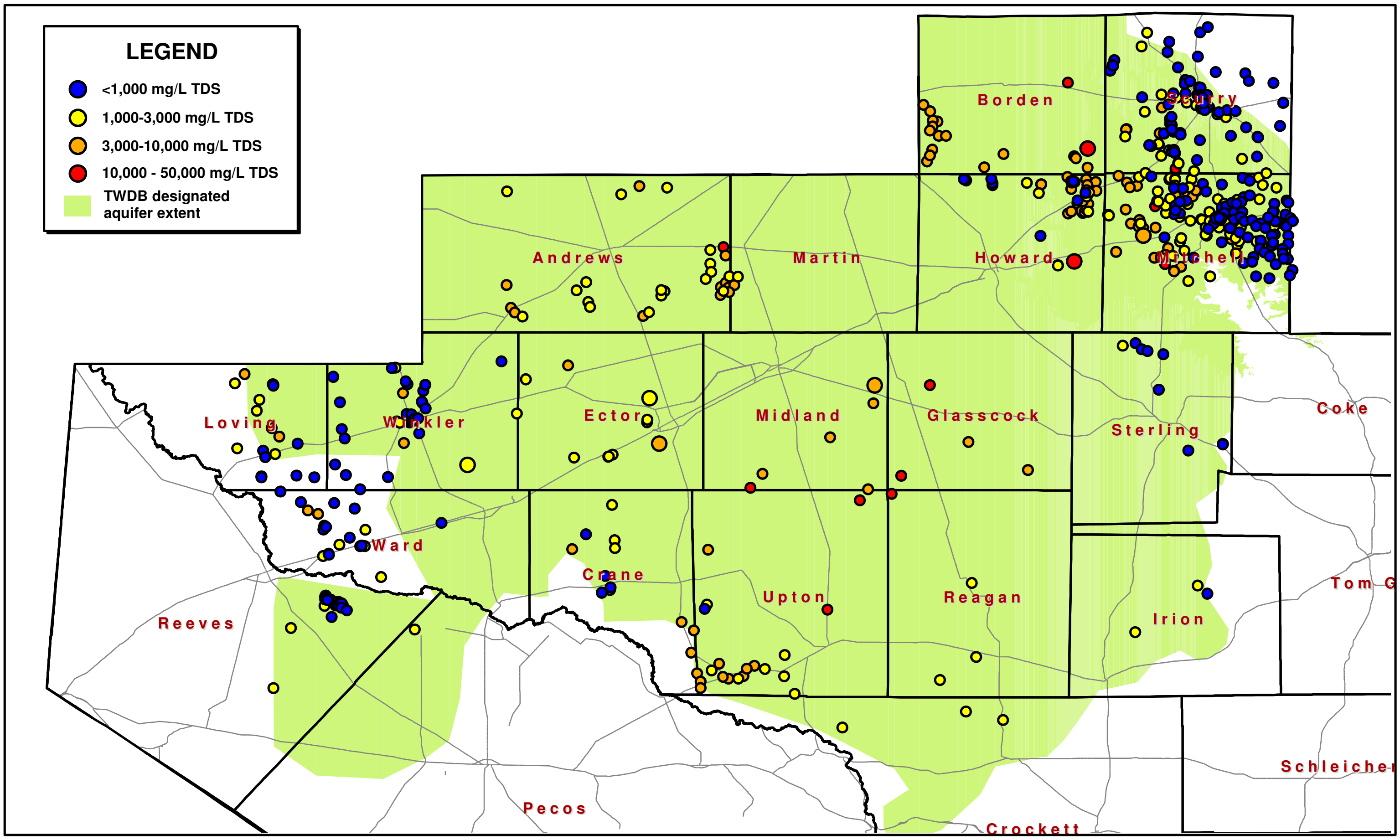

Figure 9 - Groundwater Quality in the Dockum (Santa Rosa) Aquifer

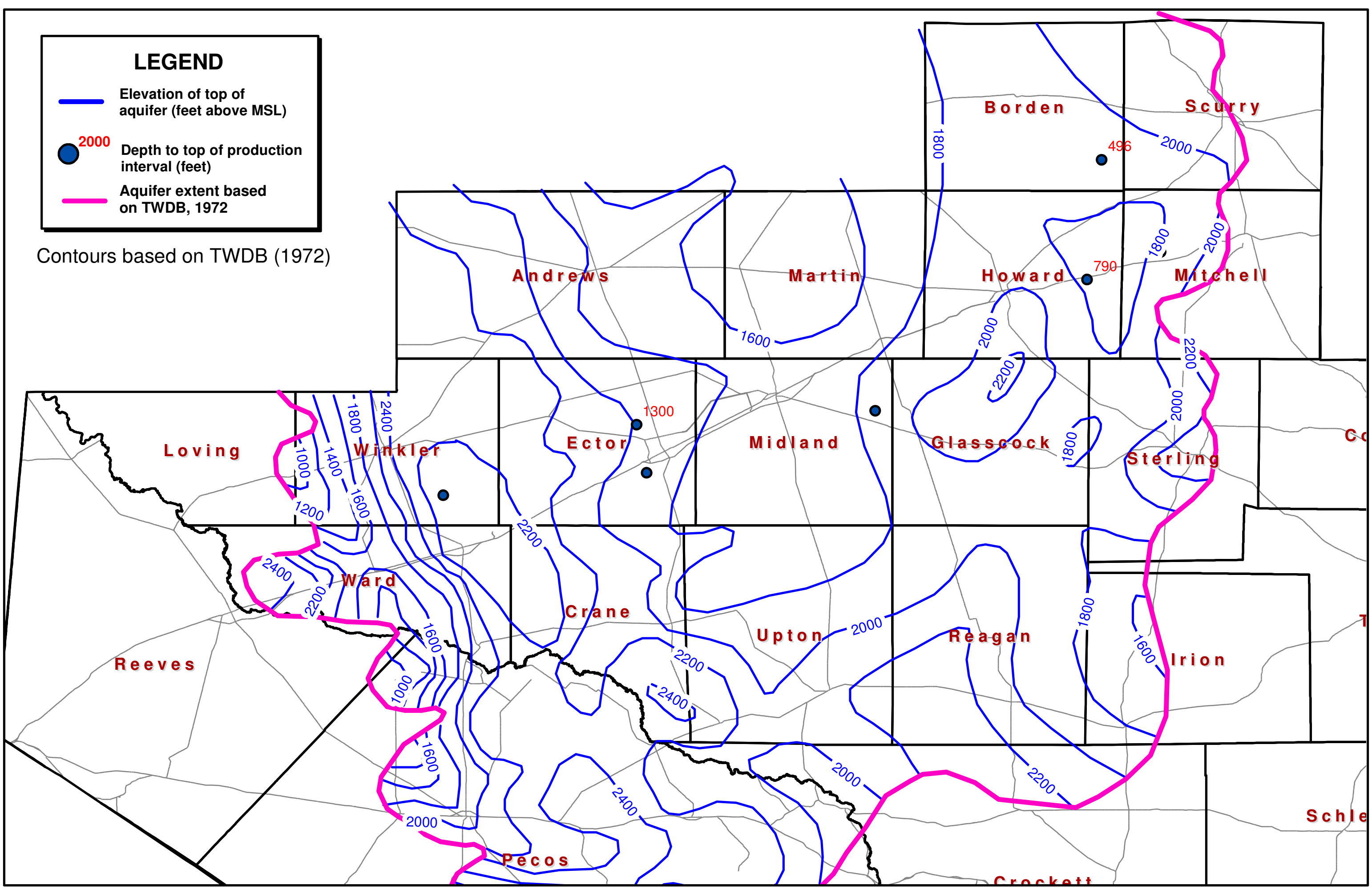

Figure 10 - Elevation of the top of and depth of production intervals for the Santa Rosa Aquifer

Dockum - The Triassic-age Dockum Group consists of up to 2,000 feet of mostly sand, silt, and shale that occurs in much of the central to western half of Region F, as shown in Figure 9. Groundwater produced from the Dockum is used primarily for irrigation in the southeastern outcrop area, and to a lesser extent for other uses elsewhere.

The primary water-bearing zone in the Dockum Group is the Santa Rosa Formation, which consists of up to 700 feet of sand, silt, and conglomerate. The elevation of the top of the Santa Rosa is generally between 1,600 and 2,400 feet above sea level throughout most of the Region F area, as shown in Figure 9. Well depths are less than 500 feet at the margins of the aquifer to depths of 1,000 to 2,000 feet in the central part of the aquifer, where brackish to saline groundwater is found. Because the permeability of the Dockum is typically low due to the fine-grained nature of the formation, most well yields are between 100 and 400 gpm.

Within Region F, the Dockum aquifer mostly contains brackish to saline groundwater (Figure 10). Approximately 65 million acre-feet of brackish groundwater are available from the aquifer in Region F. Although considered poor from a water-supply perspective, it may be a relatively attractive alternative for a source of brackish or saline groundwater, especially compared to other, deeper, hydrocarbon-producing aquifers. However, low well yields may be a limiting factor.

Blaine - The Blaine aquifer is present in outcrop only in Region F in Coke County. From the outcrop areas the beds of the Blaine dip into the subsurface to the west, reaching a maximum thickness of about 1,200 feet. The Blaine aquifer is also considered part of the Guadalupe aquifer system and thus its downdip portions are included in a description of this aquifer later in this report. Because the water quality is too poor from a drinking-water supply perspective, most of the groundwater currently produced from the Blaine is used for irrigation in counties to the north of Region F. Few, if any, wells currently produce groundwater from the Blaine outcrop in Region F.

The water quality from the Blaine aquifer varies greatly, but is generally slightly to moderately saline. Total dissolved solids range from less than 1,000 to greater than 10,000 mg/L, although higher TDS groundwater is almost certainly found downdip and farther away from the outcrop.

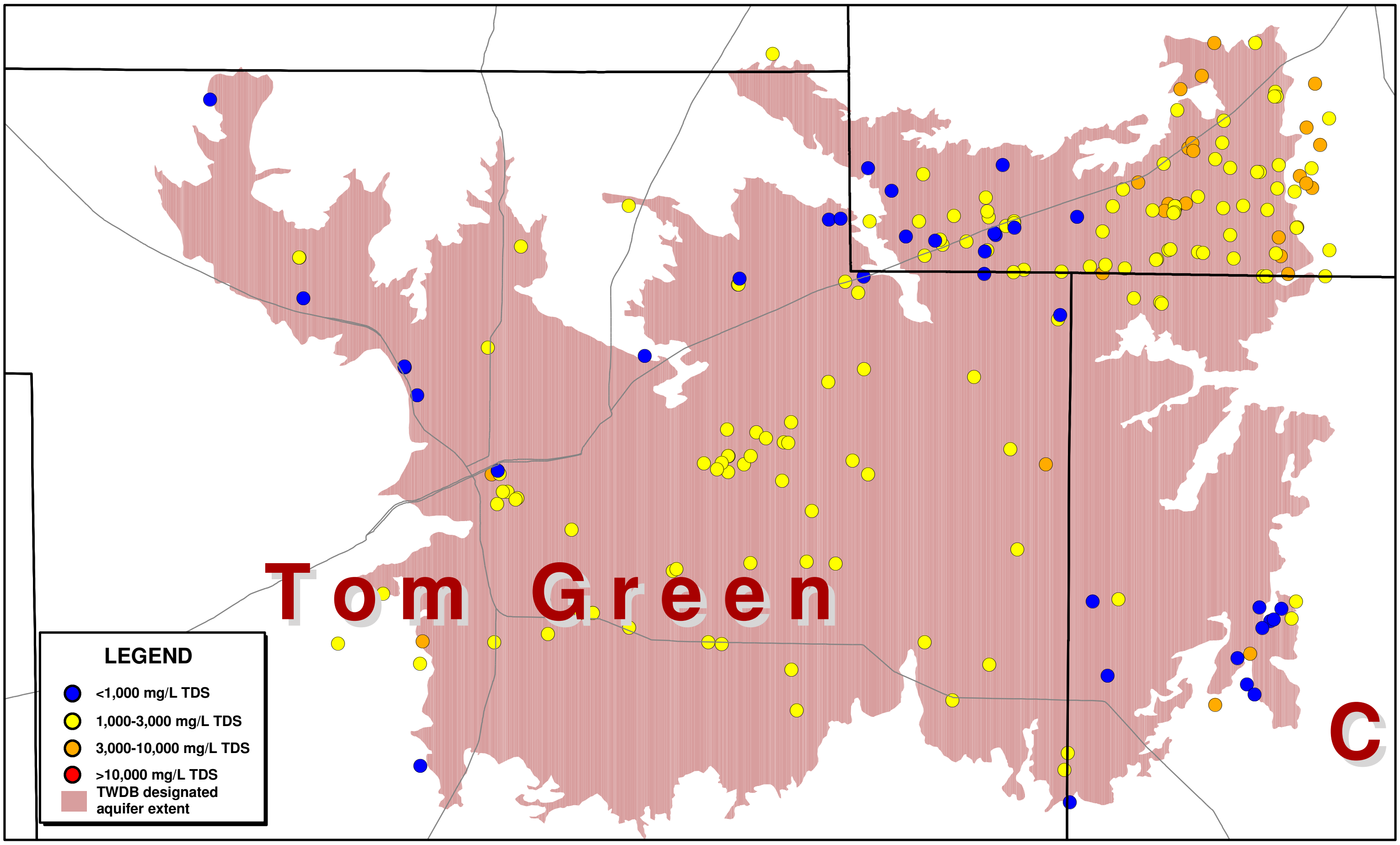

Figure 11 - Groundwater quality in the Lipan Aquifer

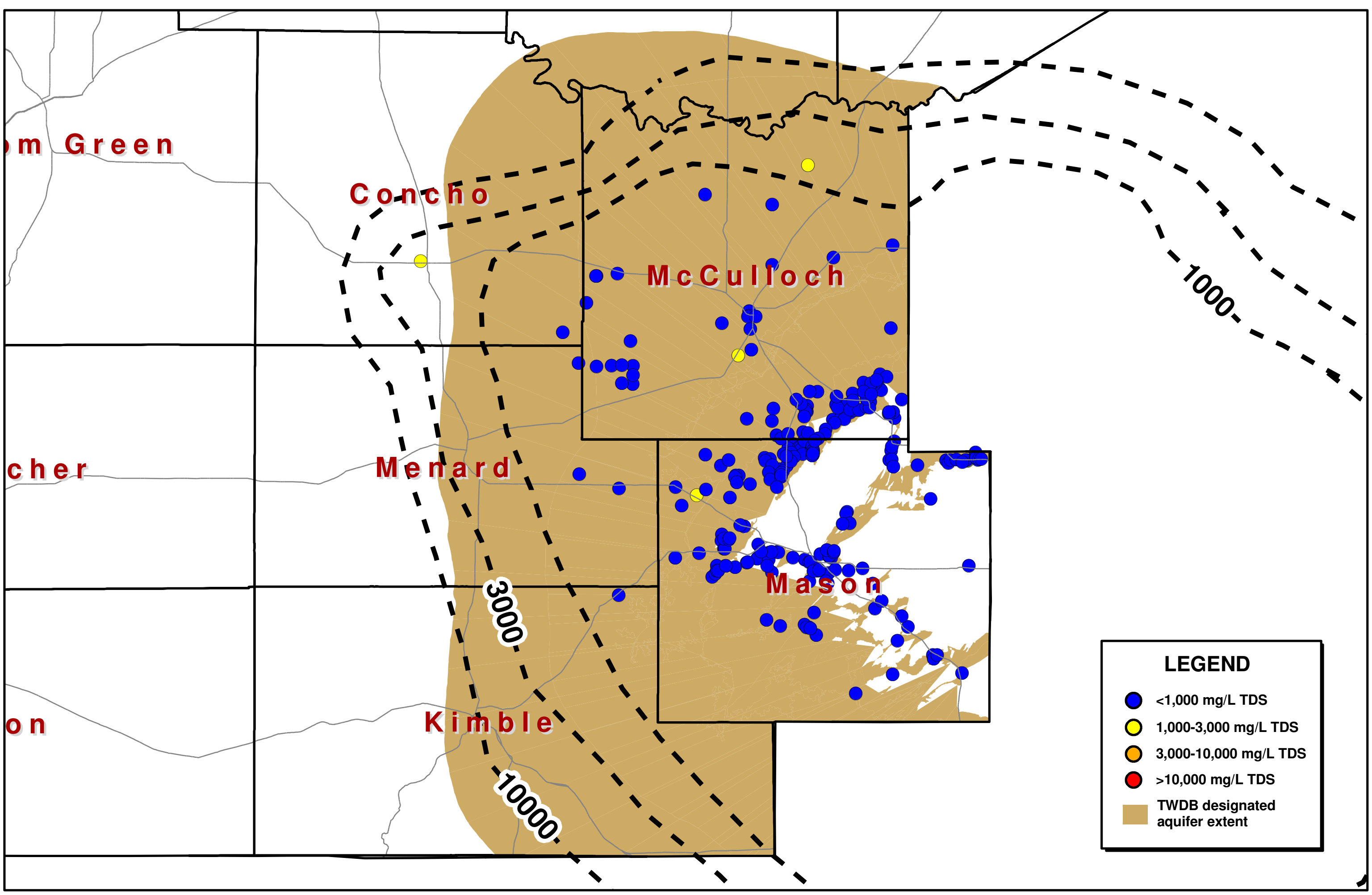

Figure 12 - Groundwater quality in the Hickory Aquifer

Lipan - The Lipan aquifer occurs in Concho, Runnels and Tom Green Counties (Figure 13) and is comprised of saturated alluvial deposits of the Quaternary-age Leona Formation and the underlying, hydrologically connected, portions of the Permian-age Choza and Bullwagon Formations. Groundwater produced from the Lipan is principally used for irrigation, with limited amounts used for rural domestic, livestock, and municipal purposes. Most of the current production from the Lipan aquifer occurs in Tom Green County. Well yields from the shallow aquifer range from 100 to 1,000 gpm.

Water quality in the Lipan aquifer ranges from fresh to moderately saline as shown in Figure 13. The total availability of brackish groundwater from the Lipan is restricted to the extent of the aquifer defined by the TWDB, and is estimated to be nearly 1.25 million acre-feet.

Hickory - The Hickory Sandstone occurs in the Llano Uplift region of Central Texas, in the extreme eastern portion of Region F, as shown in Figure 14. The Hickory is the basal unit of the Riley Formation and is the oldest unit (Cambrian age) producing groundwater in the region. Most of the water currently pumped from the Hickory is used for irrigation and livestock purposes, with a smaller amount used for municipal supply. The down-dip, confined portion of the Hickory aquifer encircles the uplift and extends to depths greater than 5,000 feet.

Yields of large-capacity Hickory wells usually range between 200 and 500 gpm, although some wells have yields in excess of 1,000 gpm. Typical well depths near the outcrop range from 50 to 200 feet, and can be as deep as 2,000 to 5,000 feet deep at the outer down-dip extents of the aquifer.

Groundwater from the Hickory aquifer is generally fresh near the outcrop of the aquifer and up to 30 miles down-dip. However, the aquifer also contains sporadic occurrences of water with 1,000 to 3,000 mg/L TDS throughout the entire extent of the aquifer as well as in the down-dip portions of the aquifer. The Hickory is only considered to be a potential source of brackish or saline groundwater in the immediate vicinity of the Llano Uplift. It is estimated that 51 million acre-feet of brackish groundwater is present in the Hickory in Region F in the area designated as a minor aquifer by the TWDB.

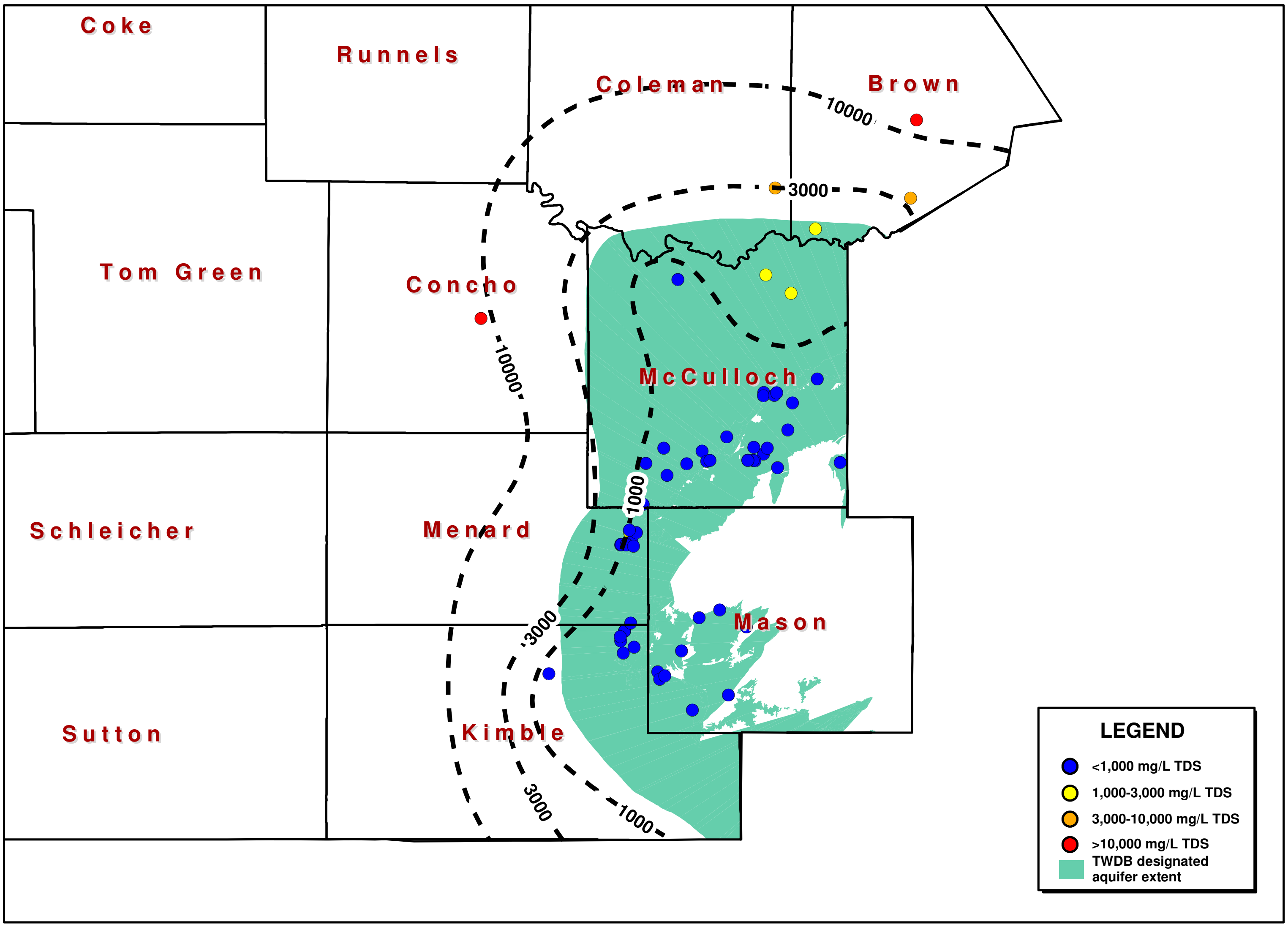

Figure 13 - Groundwater quality in the Ellenburger-San Saba Aquifer

<u>Ellenburger-San Saba-Marble Falls</u> - The Ellenburger-San Saba is an Ordovician to Cambrian age aquifer consisting of limestones and dolomites that crop out in the Llano Uplift area of Central Texas (Figure 15) and extend deep into the subsurface throughout all of Region F. Groundwater produced from this aquifer is primarily used for municipal and rural domestic supply in its shallow eastern extent. The Ellenburger Group is also a prolific hydrocarbon-producing formation throughout West Texas, and contains substantial brackish and saline groundwater beyond the aquifer area defined by the TWDB. This deeper part of the Ellenburger is further discussed in Section 3.0 below.

Groundwater near the outcrop of the Ellenburger-San Saba aquifer, and in some cases up to 20 miles down-dip, is generally fresh, with irregular occurrences of slightly saline groundwater, as shown in Figure 15. This portion of the aquifer is not considered a reasonable source of brackish groundwater for desalination use. However, salinity in the aquifer generally increases with distance down-dip. The down-dip extent of water containing more than 3,000 mg/L TDS ranges from about 10 miles on the south side of the outcrop to over 60 miles to the northwest of the outcrop.

It is estimated that 23 million acre-feet of brackish groundwater is present in the Ellenburger-San Saba aquifer in Region F in the official minor aquifer designated area, and substantial additional brackish to saline water is present in the Ellenburger throughout the rest of the region.

The Marble Falls aquifer occurs in the far eastern portion of Region F in the Llano Uplift area of Central Texas. Groundwater from the aquifer is mostly used for livestock watering, although small amounts are also used for municipal, domestic, and irrigation purposes. The aquifer is capable of producing small to moderate quantities of water to wells, with most wells producing less than 100 gpm.

Existing data for the Marble Falls aquifer show that it contains mostly fresh water in outcrop areas and becomes mineralized a short distance down-dip from the outcrop areas. However, the down-dip extent of the aquifer has not been explored and thus very few data exist to evaluate the extent of brackish water in the aquifer.

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Summary- Significant quantities of brackish groundwater are available from many of the major and minor aquifers located in Region F, which may be useful in helping the region meet growing water demands. For some of these aquifers, a significant amount of data is available to help estimate the volumes of brackish groundwater that may be available. However, there may be few data on other aquifers, requiring site-specific investigations to gather additional information if these are to be considered for brackish groundwater production.

Table 1 presents a summary of the brackish groundwater resources of major and minor aquifers in Region F (modified from LBG-Guyton, 2003). This table indicates that there are several aquifers with significant potential to produce brackish groundwater in large quantities with relatively low cost in the region.

Table 1- Summary of Brackish Groundwater in Major and Minor Aquifers

Aquifer	***Estimated Available Groundwater (acre-feet)***	***Productivity***	***Source Water Production Cost***
Cenozoic Pecos Alluvium	116 million	High	Moderate
Ogallala	7.7 million	High	Low to Moderate
Edwards-Trinity (Plateau)	24 million	Low	Low
Trinity	Negligible	Low	Low
Rustler	34 million	Low to High	Moderate to High
Capitan Reef	48 million	High	Moderate
Dockum	65 million	Low	High
Blaine	Unknown	Unknown	Unknown
Whitehorse-Artesia	Unknown	Low to Moderate	Moderate
Lipan	1.2 million	Moderate	Low to Moderate
Hickory	51 million	Moderate	Moderate to High
Ellenburger-San Saba-Marble Falls	23 million	Moderate	Moderate to High

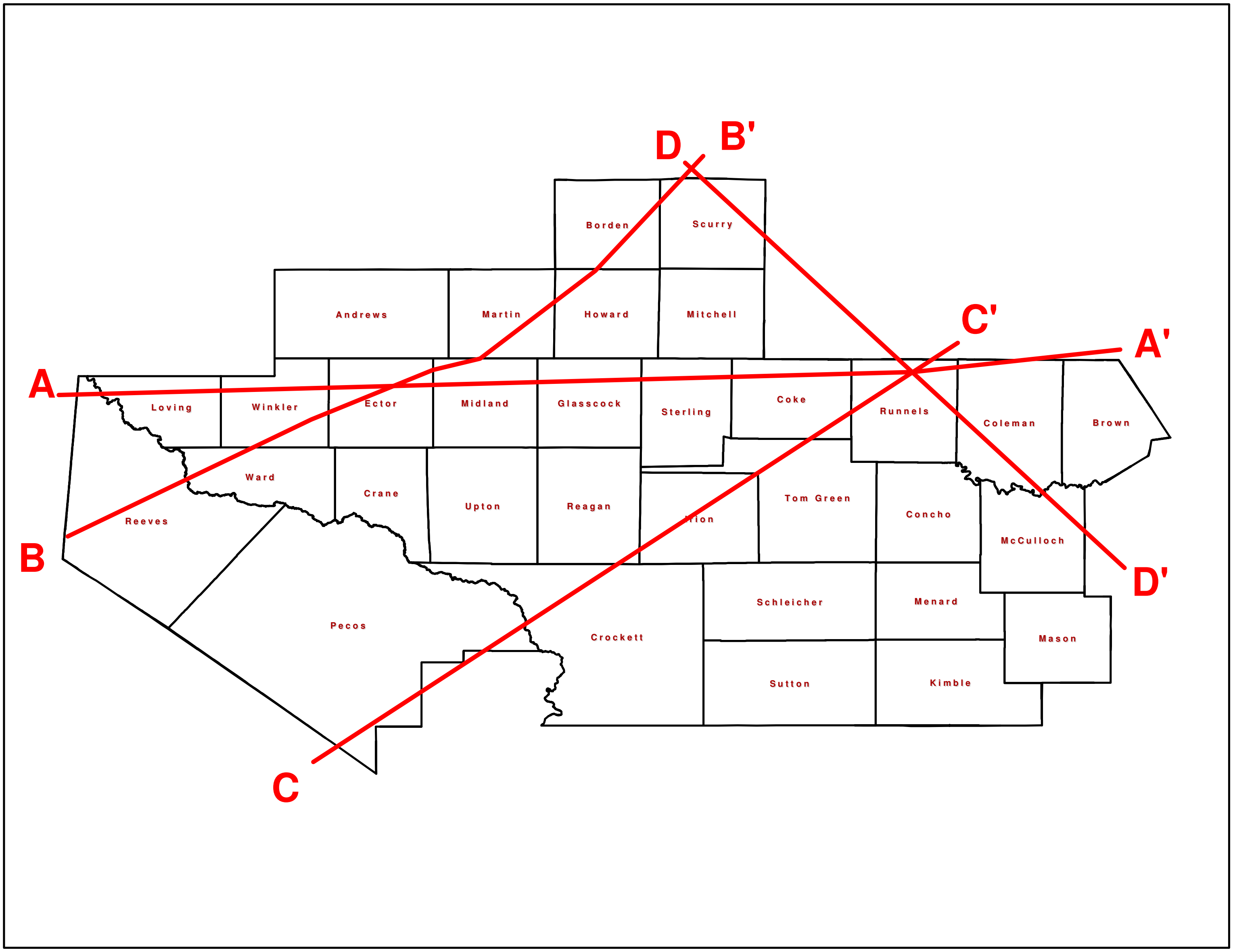
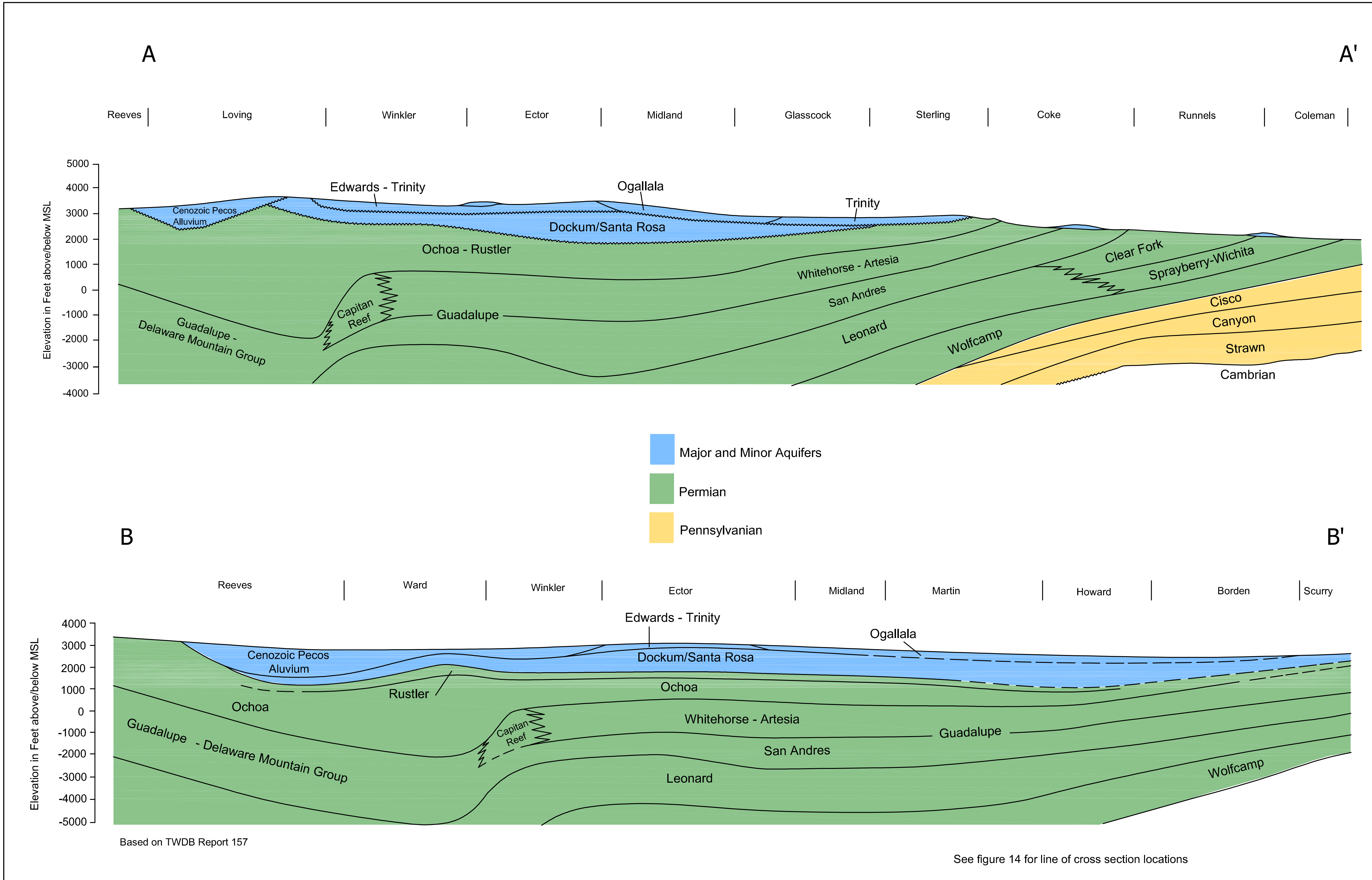


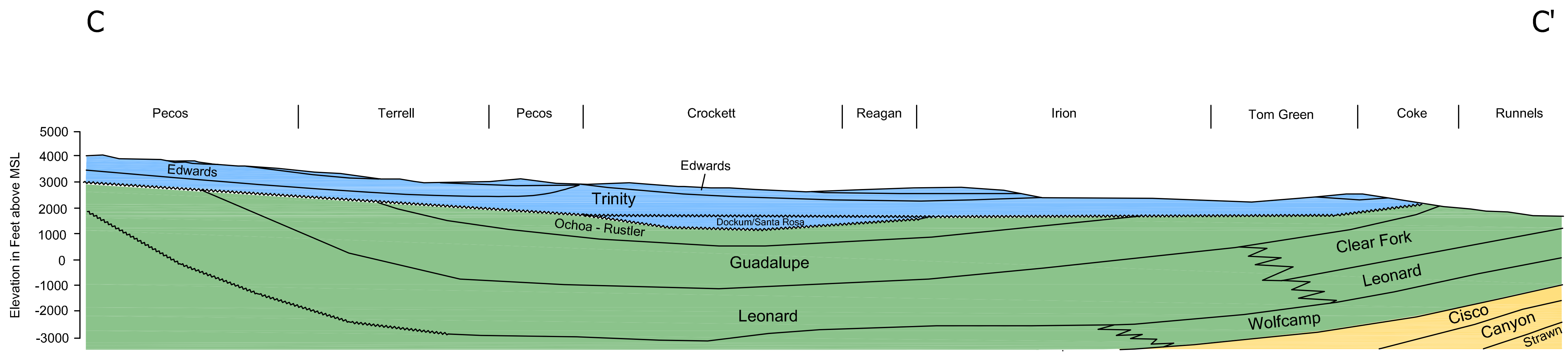
Figure 14 - Location of Cross-Sections

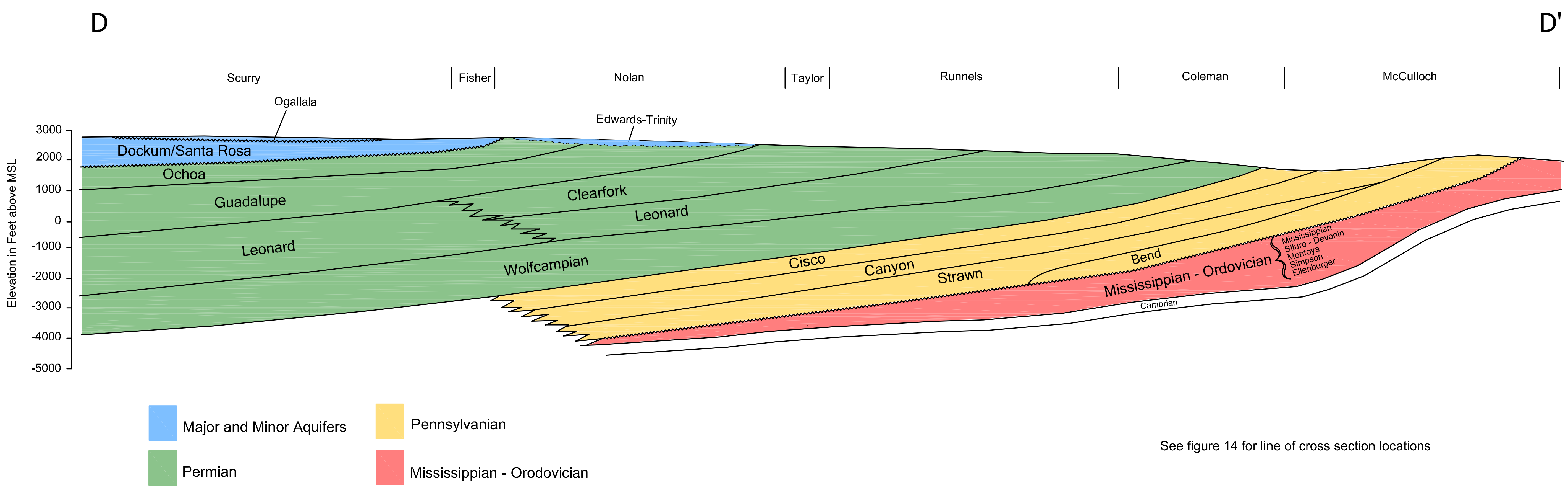


CROSS SECTIONS A - A' and B - B'

FIGURE 15

LBG-GUYTON ASSOCIATES





See figure 14 for line of cross section locations

CROSS SECTIONS C - C' and D - D'

FIGURE 16

LBG-Guyton Associates

3.0 Deep Oil-Field Formations

Numerous other sources of groundwater are present in Region F that are not officially designated as either major or minor aquifers by the TWDB. While not commonly described as "aquifers" due to the non-potable, high salinity nature of the groundwater contained in them, these formations are, in fact, aquifers and must be considered in order to fully assess all potential sources of brackish and saline groundwater available for desalination. These formations are typically deep, hydrocarbon-producing units, and include:

Permian-age aquifers

- Guadalupe (Delaware Mountain Group)
- Guadalupe (Whitehorse-Artesia)
- Guadalupe (San Andres)
- Leonard (Clear Fork-Wichita)
- Wolfcamp (Coleman Junction)

Pennsylvanian-age aquifers

- Cisco
- Canyon
- Strawn
- Bend

Mississippian – Ordovician-age aquifers

- Mississippian
- Siluro-Devonian
- Simpson-Montoya
- Ellenburger

Most of the above aquifers are found at much greater depths than the officially designated aquifers described in the preceding sections. Four cross-sections were developed across Region F in order to depict the location of these units stratigraphically. The location of each of the cross-sections is shown in Figure 14, and the cross-sections are shown in Figures 15 and 16.

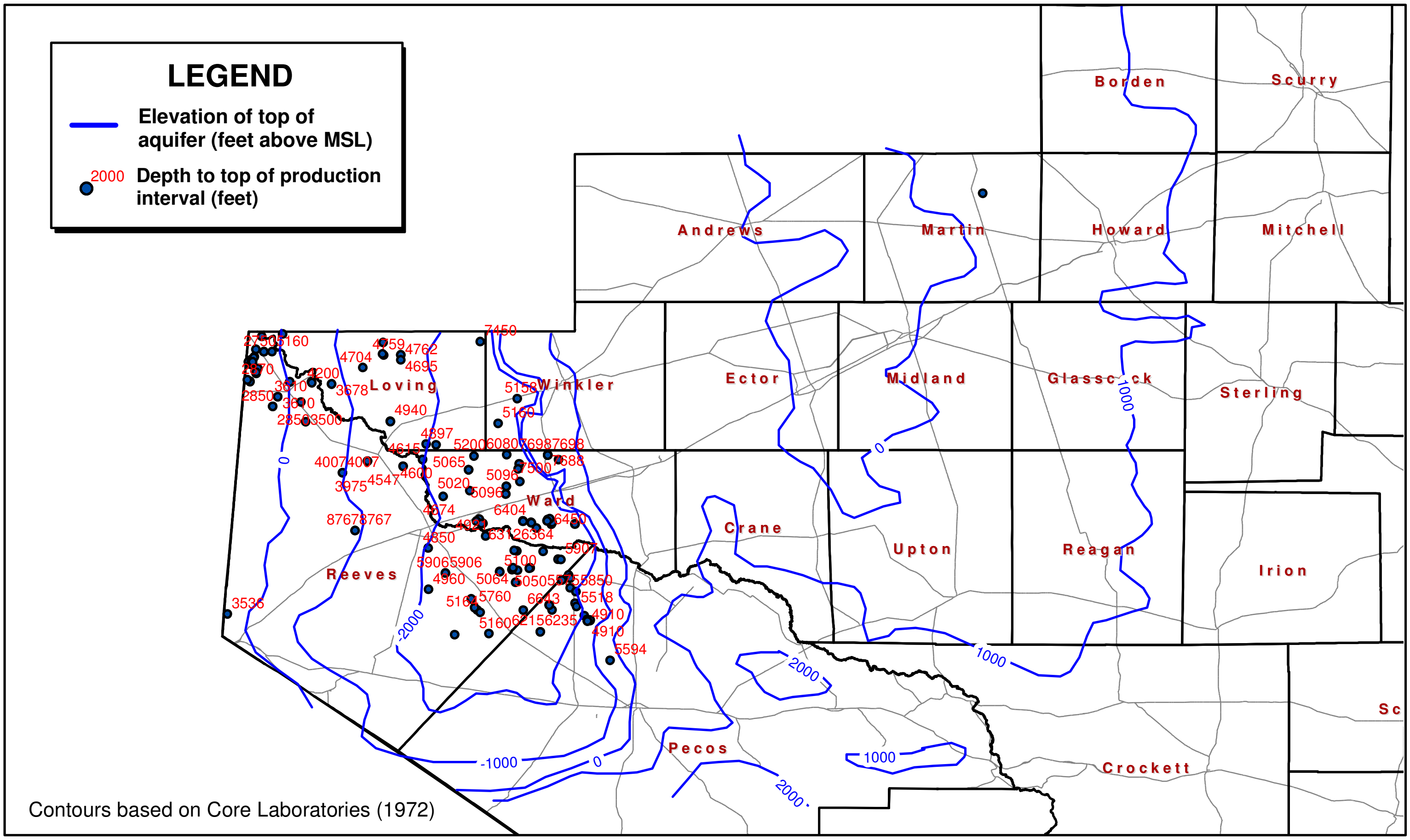


Figure 17a - Depth to the top of the Guadalupe (Delaware Mountain Group) Aquifer

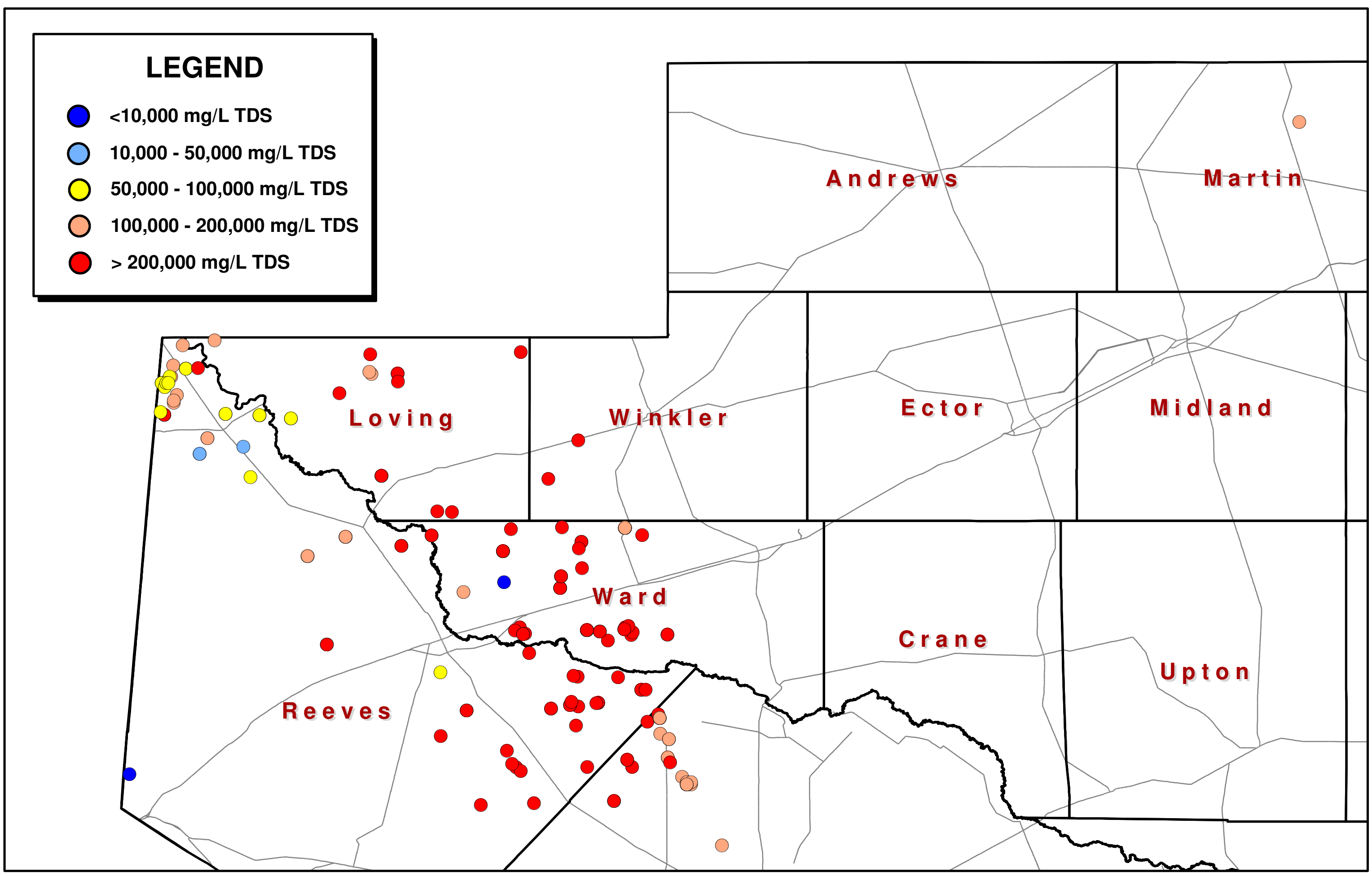


Figure 17b - Produced water quality in oil and gas wells in the Guadalupe (Delaware Mountain Group) Aquifer

3.1 Permian-age Aquifers

Guadalupe (Delaware Mountain Group) Aquifer- The Upper Guadalupe aquifer is found throughout much of West Texas, including most of the western half of Region F. The top of the Upper Guadalupe aquifer is found at depths of 1,000 to 5,000 feet (Core Laboratories, 1972). Most of the data from oil and gas wells in the western part of the region indicate production intervals between 3,000 and 8,000 feet below land surface. A structure map of the elevation of the top of the Upper Guadalupe aquifer is shown in Figure 17a.

The Upper Guadalupe Group includes the Whitehorse Group and the Capitan Reef Formation. This aquifer also includes the Delaware Mountain Group, even though technically this unit is equivalent to the San Andres and upper Guadalupe units combined. The Capitan Reef is described above in Section 2.2, and the Whitehorse is described separately below, and therefore the description of the Upper Guadalupe aquifer in this section will focus on the Delaware Mountain Group.

The Delaware Mountain Group includes the Brushy Canyon, Cherry Canyon, and Bell Canyon Formations. These units consist of sandstone, thin limestones, and shale. Porosities and permeabilities are highly variable and generally moderate to limited productivities can be expected from the sandstone formations (Core Laboratories, 1972). Salinities of produced water from the Delaware Mountain Group are shown in Figure 17b. These data indicate very high and variable salinities from this unit, which, along with the moderate to limited productivity, make the Upper Guadalupe aquifer (Delaware Mountain Group) a poor choice for a brackish or saline water resource.

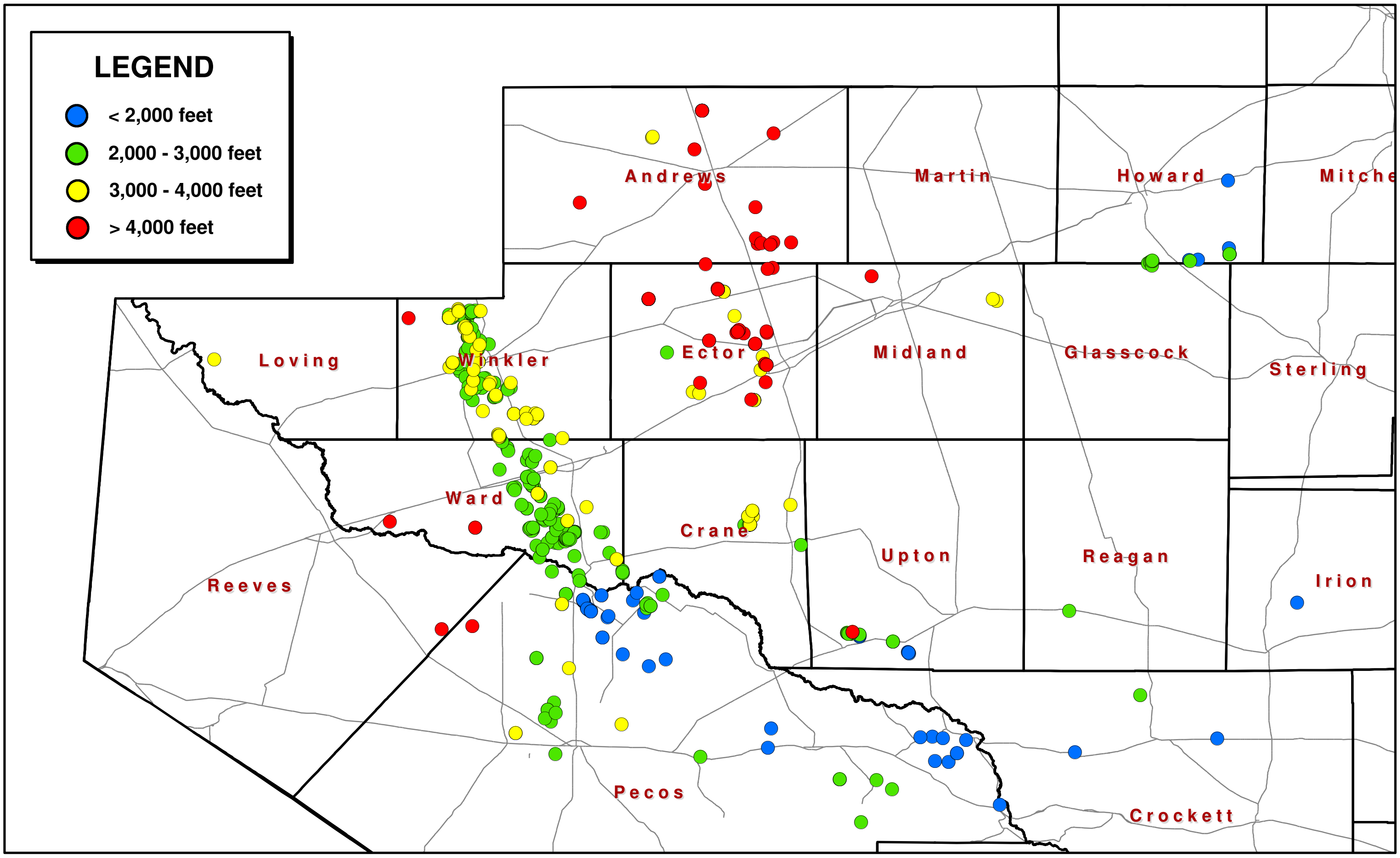


Figure 18a - Depth to the top of the production interval in oil and gas wells in the Whitehorse Aquifer

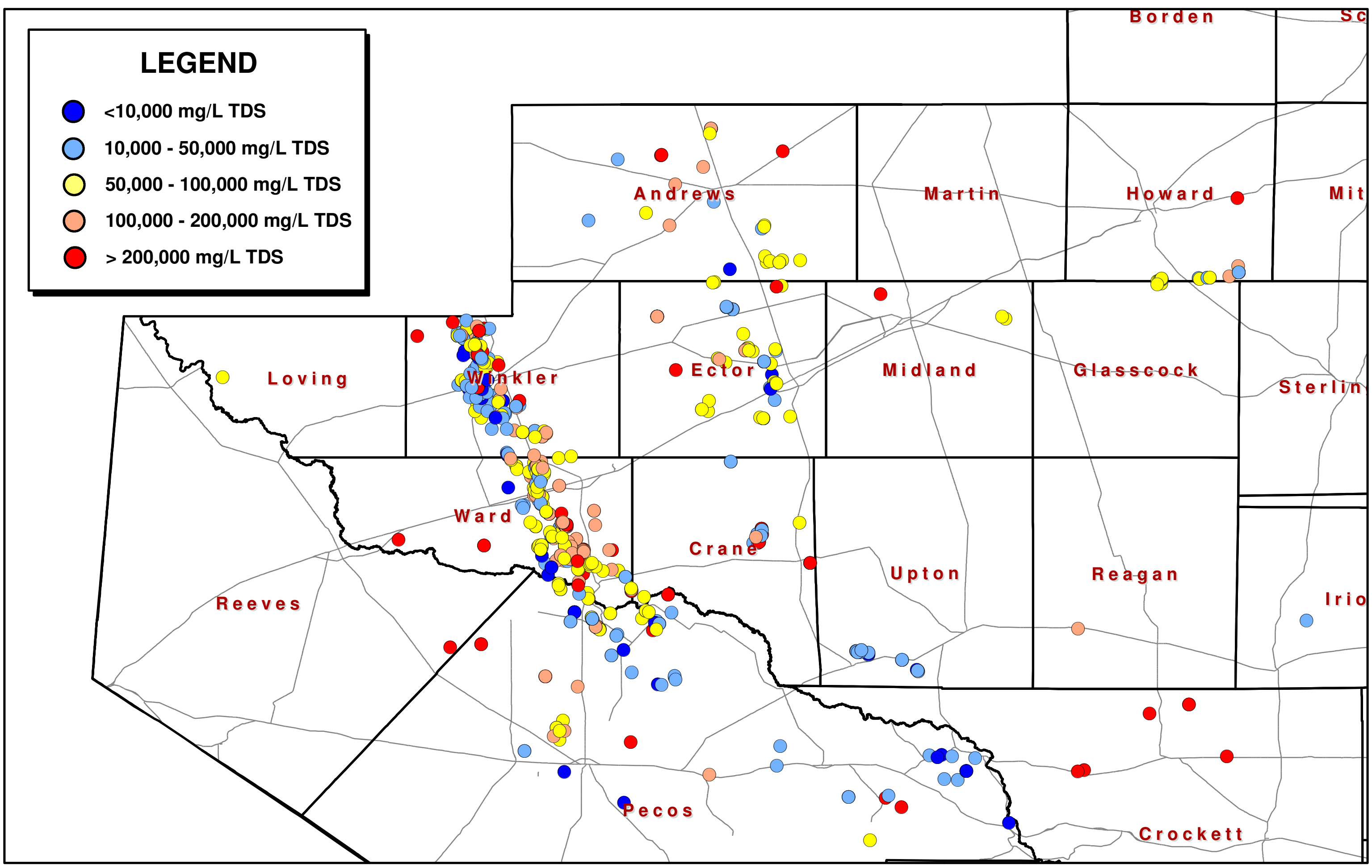


Figure 18b - Produced water quality in oil and gas wells in the Whitehorse Aquifer

Guadalupe (Whitehorse-Artesia) Aquifer - The Whitehorse and Artesia are Permian-age aquifers located in West-Central Texas. These aquifers have not produced enough water to be designated as "minor aquifers" by the TWDB; however, they hold sufficient potential as brackish groundwater supplies to be included in the TWDB brackish report as a separate aquifer. The formations that make up the Whitehorse Group are also prolific hydrocarbon producers in West Texas, and there are a large number of produced water data for these units from oil and gas wells.

The Whitehorse Group lies above the Blaine Formation and consists of up to 700 feet of fine-grained red sand, dolomite, and thick gypsum beds. Depths to the top of the production interval for some of the individual formations of the Whitehorse are between 1,000 and 5,000 feet throughout much of West Texas, as shown in Figure 18a (Core Laboratories, 1972). The downdip, hydrocarbon-producing portion of the Whitehorse Group consists of five individual formations; the Grayburg, Queen, Seven Rivers, Yates, and Tansill. High productivities can be expected from limited areas of the Whitehorse (Core Laboratories, 1972).

In the northern portion of the aquifer, yields from water-supply wells of greater than 600 gpm are possible, and in the central portion of the aquifer area, yields can be up to 1,000 gpm. Production capacity from the deeper, hydrocarbon-producing zones is unknown, but is likely not nearly as productive as from water supply wells described above.

Water quality from the Whitehorse-Artesia aquifer varies greatly. As with the Blaine, water quality from the Whitehorse-Artesia is fresh primarily in recharge areas, and TDS increases in down-dip portions of the aquifer. The TDS of produced water in the deeper sections of the aquifer ranges from less than 10,000 to over 250,000 mg/L. Several areas do contain formation water with less than 10,000 mg/L TDS, including through central Winkler and Ward Counties, as shown in Figure 18b.

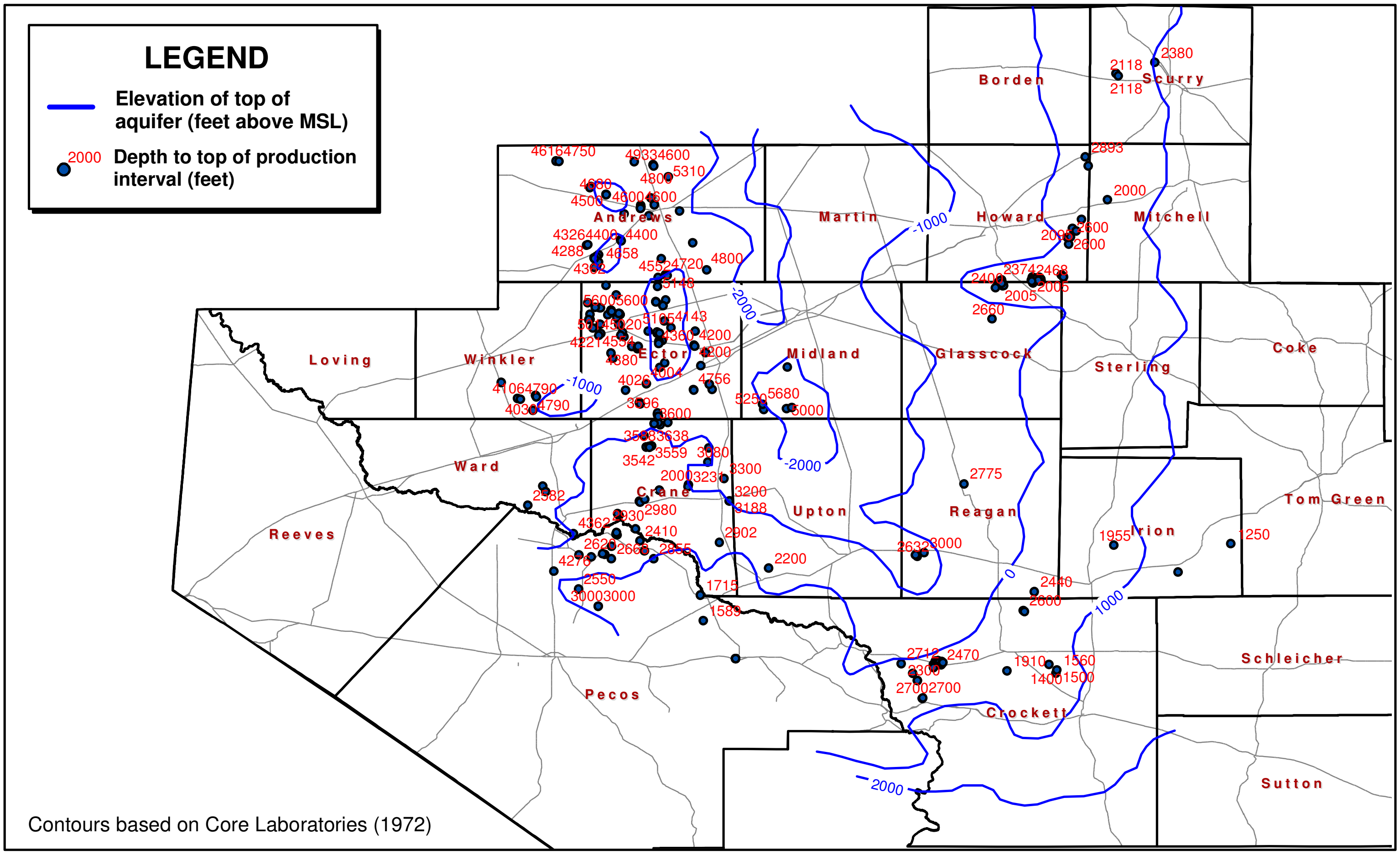


Figure 19a - Elevation of the top of the San Andres Aquifer

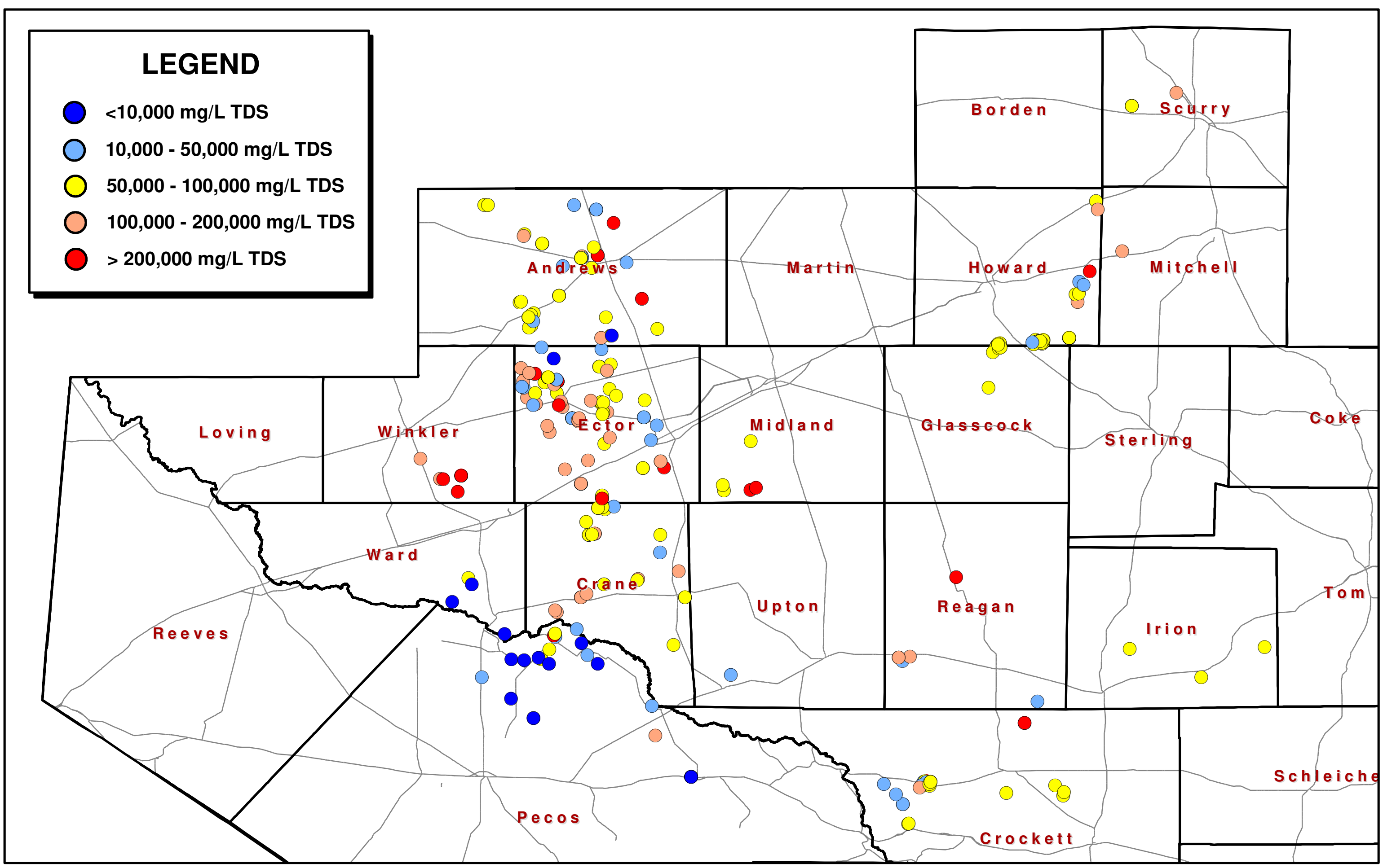


Figure 19b - Produced water quality in oil and gas wells in the San Andres Aquifer

Guadalupe (San Andres) Aquifer **–** The lower Guadalupian-age San Andres Formation is present in the central to western portion of Region F, and is the uppermost formation in the Pease River Group in the High Plains area and the lowermost formation in the Delaware Mountain Group in the Delaware Basin. The top of the formation is found at depths of 1,500 to 5,000 feet over most of its extent in Region F, as shown in Figure 19a . The formation consists of beds of limestone, dolomite, anhydrite, and sandstone with porosities averaging from 7 to 15 percent, and permeabilities from 1 to 500 millidarcies (Core Laboratories, 1972).

Produced water data from oil and gas wells shown in Figure 19b, along with other data sources, indicate a very wide range of salinities from the San Andres. Some wells have salinities below 10,000 mg/L and others are as high as nearly 400,000 mg/L. Several areas appear to produce water with less than 50,000 mg/L TDS, from Andrews County south to Pecos and Crockett Counties. Salinities of less than 10,000 mg/L are present in the southwestern portion of the extent of the aquifer, along the Pecos River, as shown in Figure 19b.

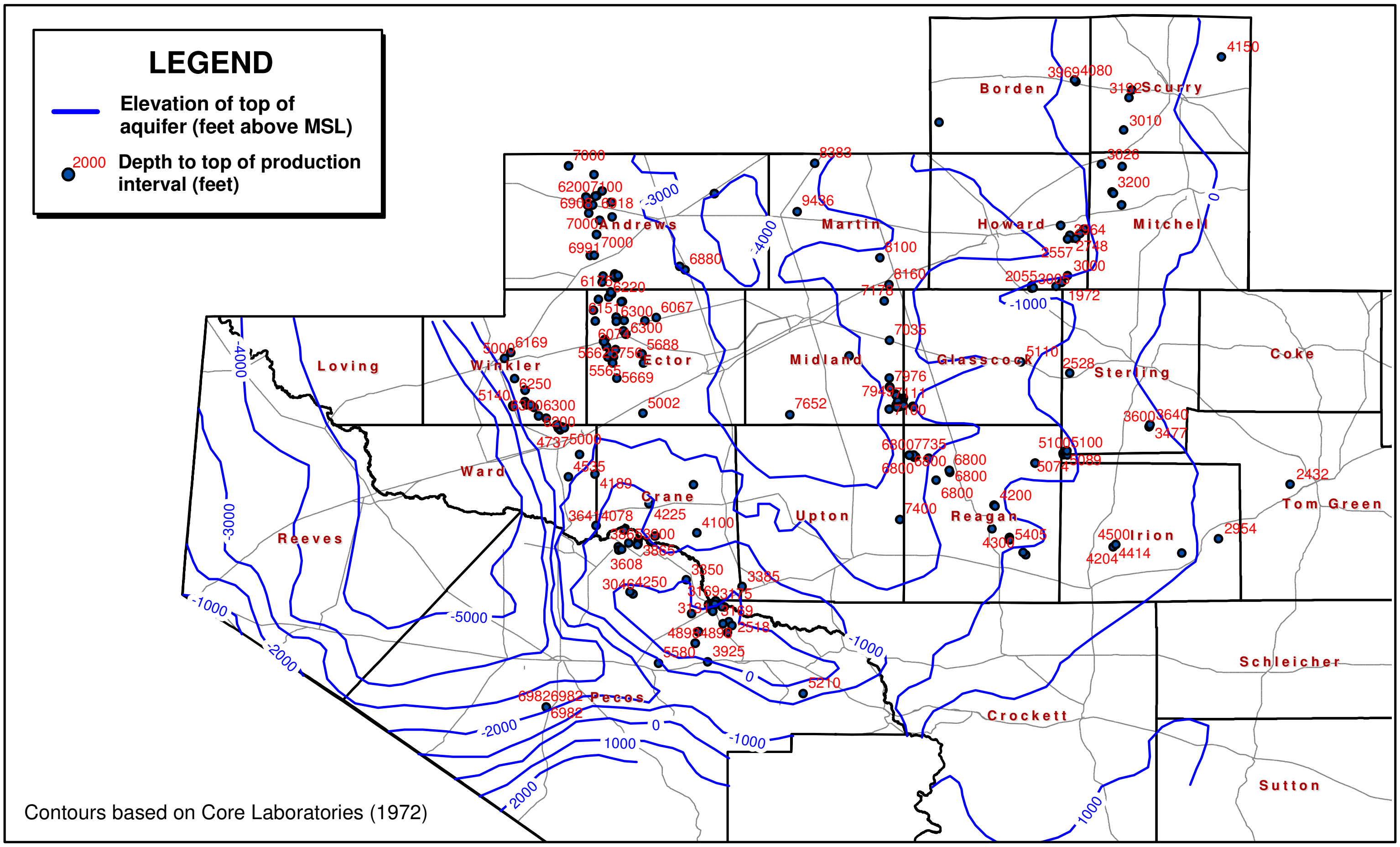


Figure 20a - Depth to the top of the Clear Fork-Wichita Aquifer

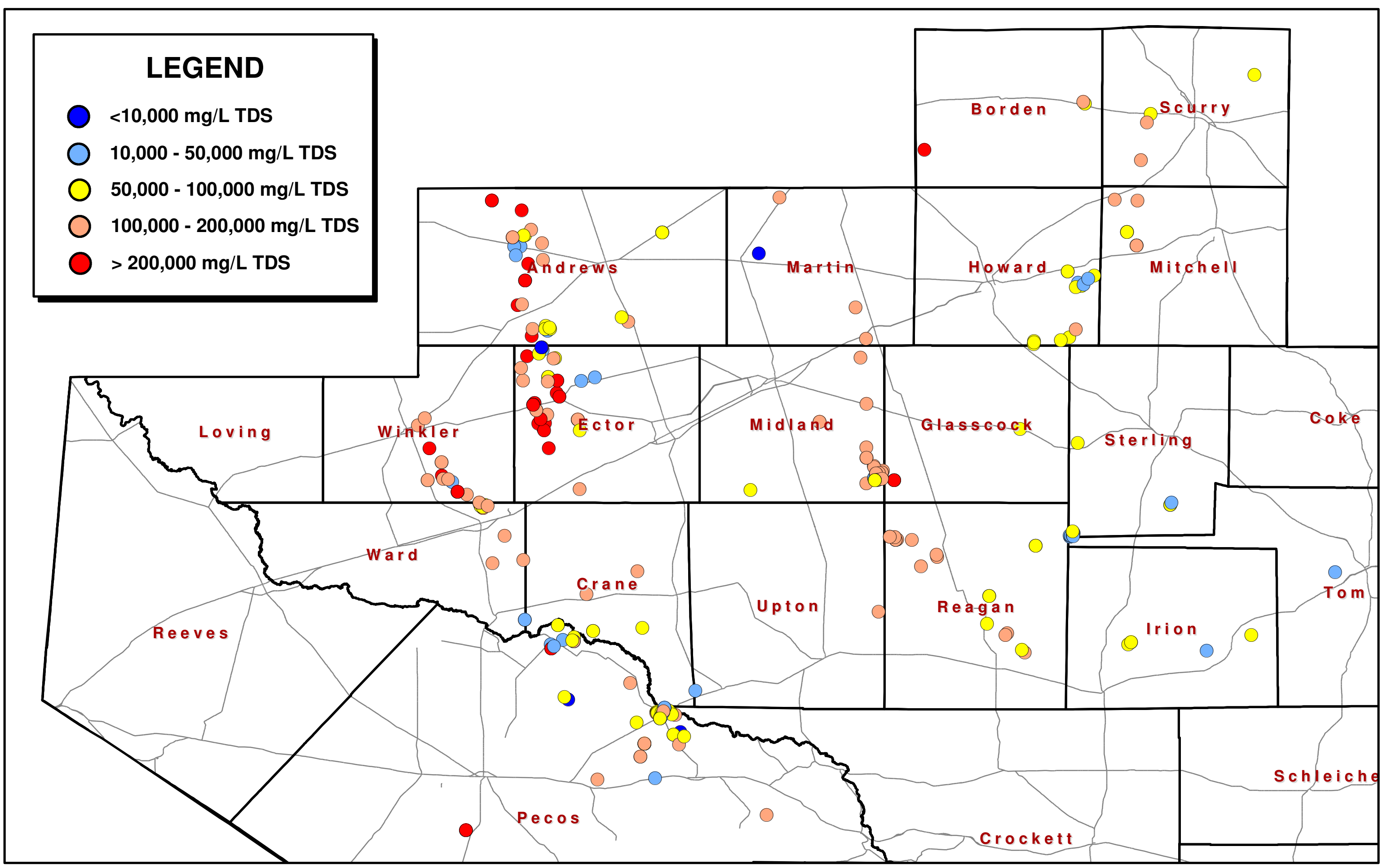


Figure 20b - Produced water quality in oil and gas wells in the Clear Fork-Wichita Aquifer

Leonard (Clear Fork-Wichita) Aquifer - The Leonard Series is a Permian-age unit located throughout much of West Texas. This series contains several well-known formations/groups, including the Spraberry Formation, the Clear Fork Group, the Victorio Peak and Bone Springs Formations, the upper Wichita (or Wichita-Albany) Group, and the Leuders Group, among others. A map of the elevation of the top of the Leonard aquifer is shown in Figure 20a, which is the structure of the top of the Clear Fork Group (Core Laboratories, 1972). Depth to the top of production intervals of oil and gas wells in the Leonard (also shown in Figure 20a) indicates a maximum depth of approximately 8,000 feet, and less than 5,000 feet in most of the region.

The individual units that make up the Leonard aquifer are quite variable from area to area, but generally consist of limestone, shale, sandstone, and anhydrite. Productivities and aquifer characteristics vary with the formations (Core Laboratories, 1972). The Clear Fork Group, which consists of the Choza, Vale, and Arroyo Formations in north-central Texas, is 1,200 to 1,500 feet thick and produces fresh to slightly saline water to wells where these rocks outcrop or are found in the shallow subsurface. Groundwater is produced from the Clear Fork Group in Coke, Runnels, and Coleman Counties, nearly all from wells less than 200 feet deep. In addition, the Lipan aquifer located in Tom Green, Runnels, and Concho Counties (described above in Section 2) includes water in the upper portions of the Choza, Bullwagon, and Vale Formations.

The Clear Fork and Wichita Groups are the principal aquifers in the Leonard Series, and productivity is generally high where these aquifers are present. Relatively low water productiveness occurs throughout most of the rest of the region where the undifferentiated Leonard units exists.

Water produced from the Clear Fork is generally slightly to moderately saline, although fresh water is produced in some areas. Salinities from produced waters from the Leonard aquifer vary widely (as shown in Figure 20b) ranging from less than 5,000 mg/L to over 300,000 mg/L.

The Leonard aquifer may be considered a potential brackish or saline water source for parts of Region F where it is encountered at depths of less than 5,000 feet. Salinities are high in much of the region, but are lower in some areas.

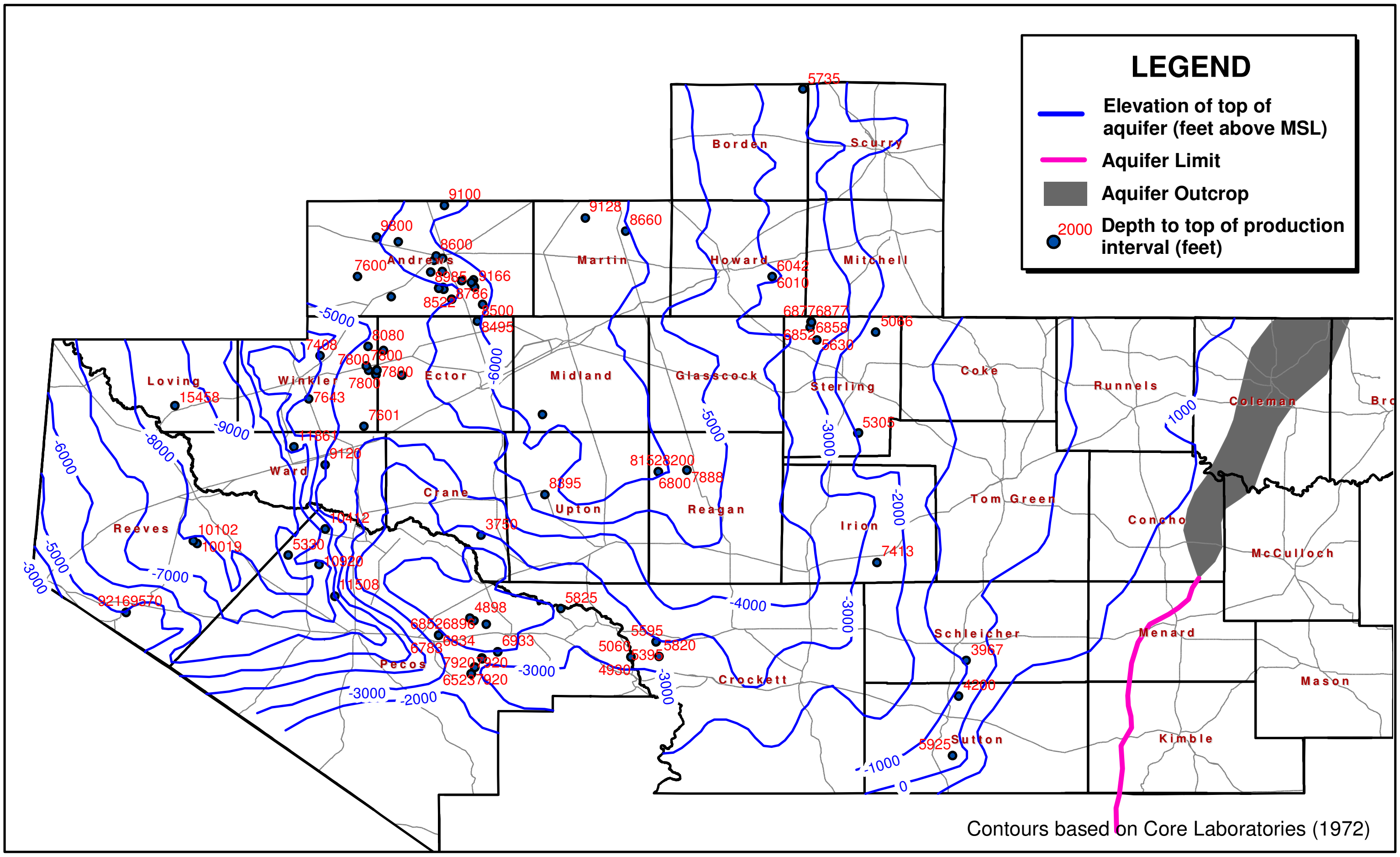


Figure 21a - Depth to the top of the Wolfcamp Aquifer

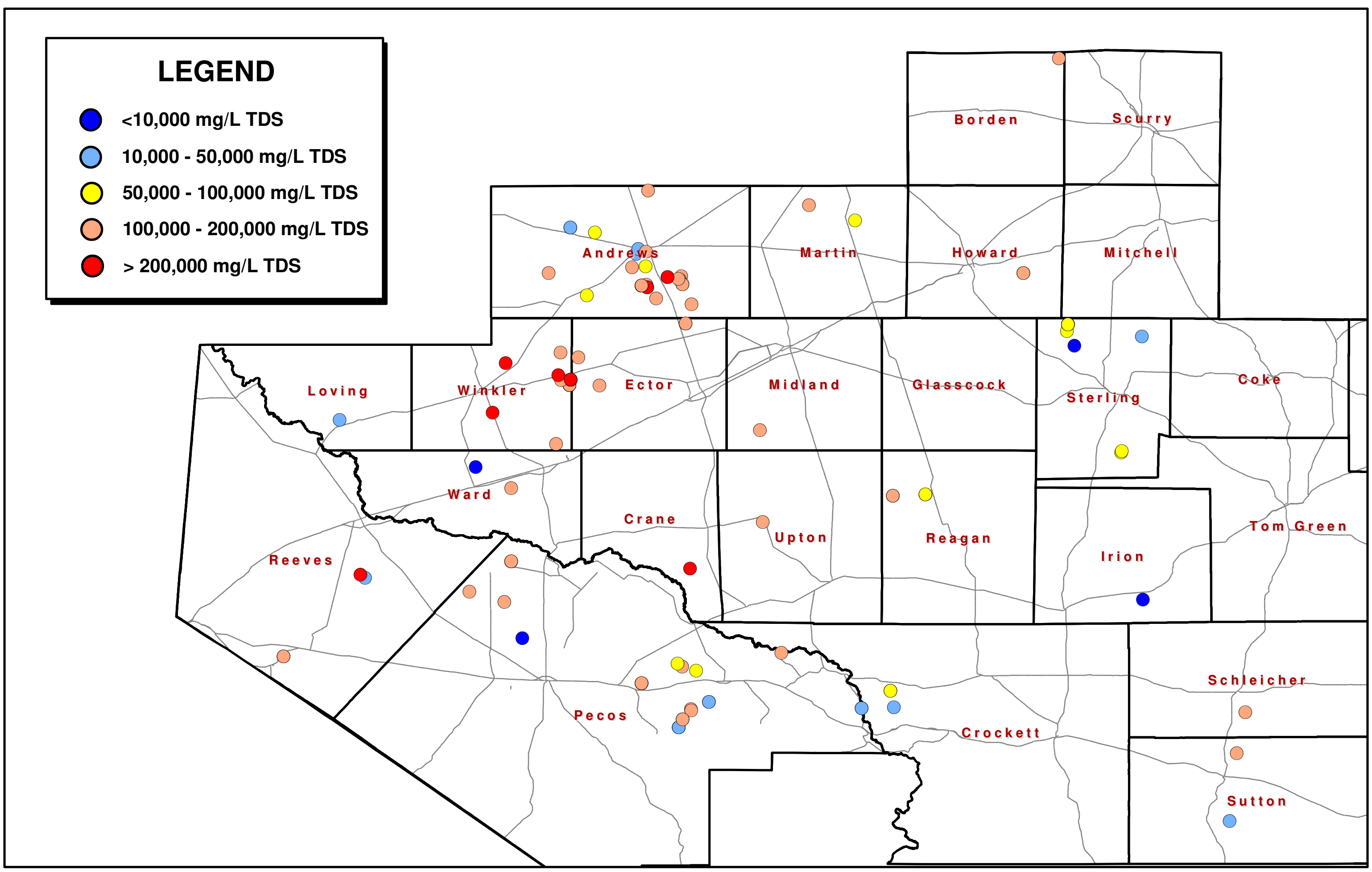


Figure 21b - Produced water quality in oil and gas wells in the Wolfcamp Aquifer

Wolfcamp (Coleman Junction) Aquifer - The Wolfcamp Series is the oldest of the Permian-aged units in West Texas, and is comprised of several formations, including most importantly in the eastern Region F area, the Coleman-Junction. The Wolfcamp Series is the thickest of any of the Paleozoic sequences in West Texas, reaching a maximum thickness of 14,000 feet in the Delaware Basin and Val Verde Trough in West Texas (Core Laboratories, 1972). From its outcrop in Concho and Coleman Counties, the formations dip into the subsurface, and are present throughout the western half of the state, including most of Region F. The elevation of the top of the Wolfcamp is shown in Figure 21a, along with depths to the top of production intervals for oil and gas wells in the region. The depths indicated on wells in this figure may be misleading, because they may not be at the top of the Wolfcamp and, as noted above, the Wolfcamp can be extremely thick in parts of the region, and therefore this depth may be significantly different than the true top of the aquifer.

Because the Wolfcamp is so widespread and so thick, the units contained within it have a wide range of lithologies and hydrologic properties. Porosities ranging from 5 to more than 25 percent, and permeabilities range from 1 millidarcy to more than 1 darcy (Core Laboratories, 1972). This also results in highly variable water quality. As with most other hydrocarbon-producing units in the region, salinities are highly variable on a regional basis (Figure 21b) ranging from lower salinities (less than 50,000 mg/L) to more than 300,000 mg/L TDS.

The Wolfcamp may be considered as a potential saline water source for Region F. It is very widespread throughout much of the region, and may contain significant quantities of saline groundwater. As with the other deeper, typically hydrocarbon-producing units being evaluated, site-specific studies should be conducted to determine the water quality and nature of the aquifer due to the variability in aquifer properties and formation water quality throughout the extent of the aquifer.

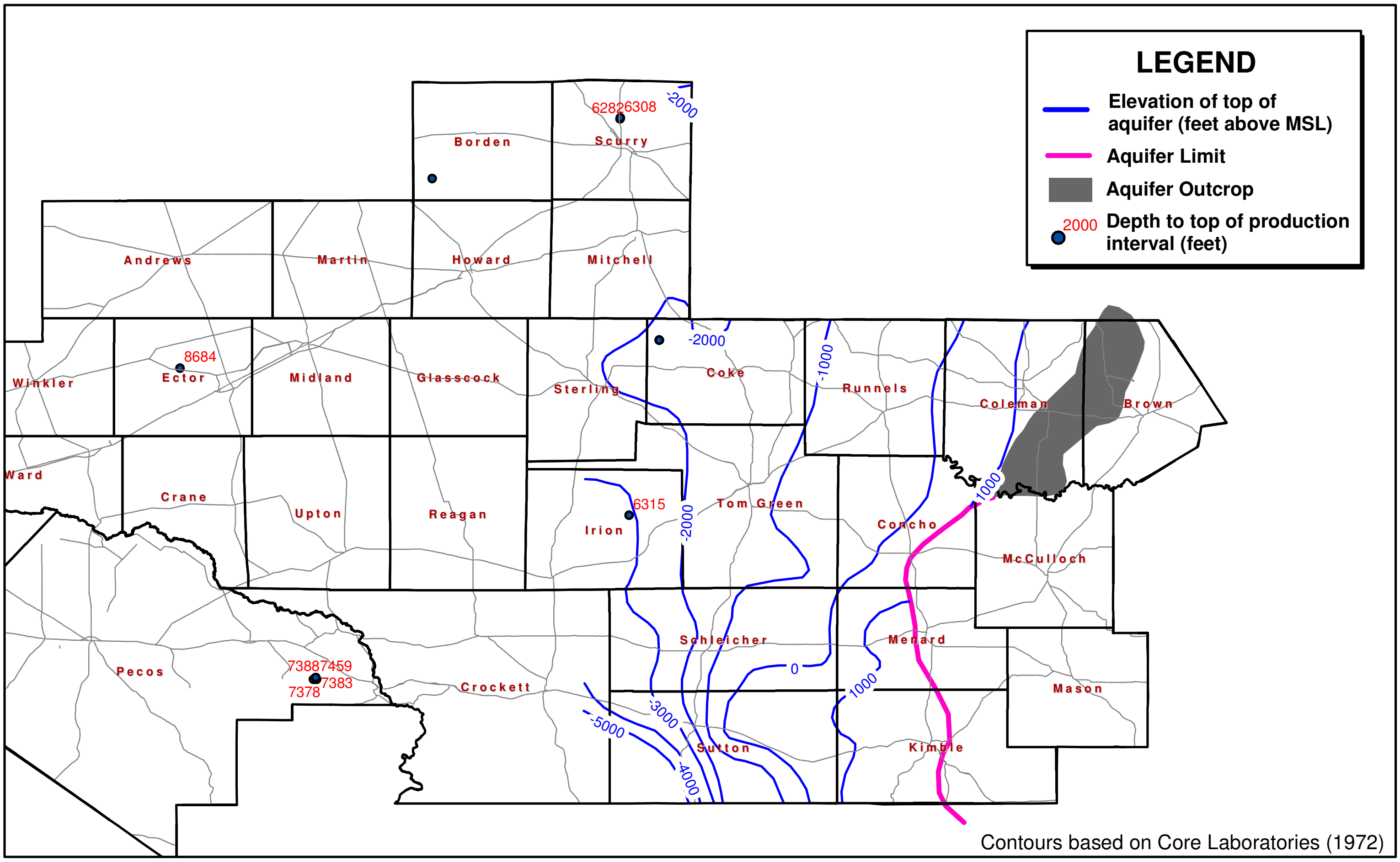


Figure 22a - Depth to the top of the Cisco Aquifer

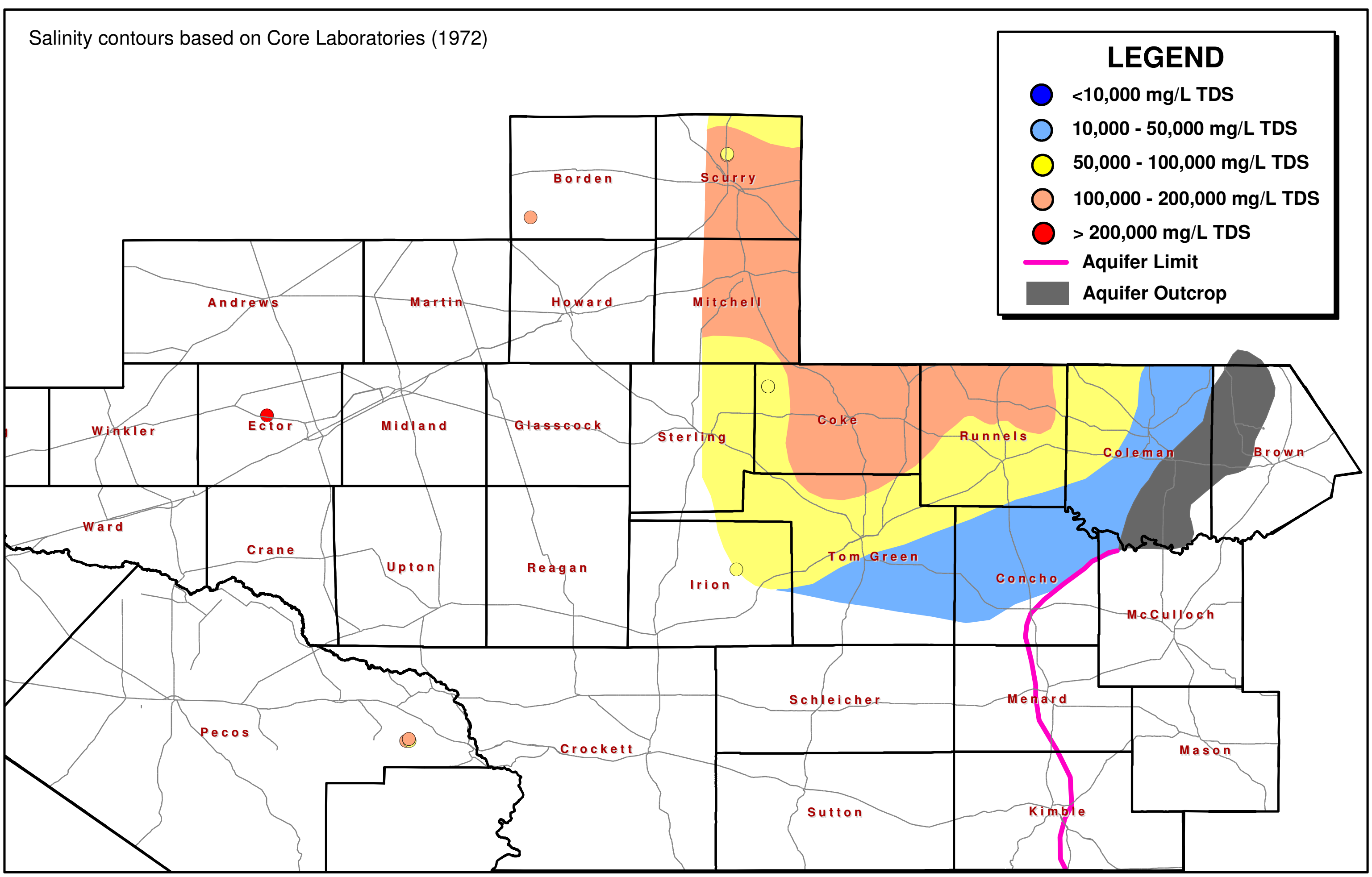


Figure 22b - Produced water quality in oil and gas wells in the Cisco Aquifer

3.2 Pennsylvanian-age Aquifers

Cisco Aquifer – The Cisco Group is the uppermost Pennsylvanian aged unit present in Central Texas. The Cisco Group outcrops in a 15 to 20 mile band in Concho, McCulloch, and Coleman Counties and rapidly dips into the subsurface away from the Llano Uplift area. The elevation of the top of the Cisco Group is shown in Figure 22a, along with depths to the top of production intervals in oil and gas wells producing from the Cisco.

The Cisco Group contains both the Thrifty and Graham Formations and is comprised of shales, sandstones, conglomerates, limestones, and coal beds. It is approximately 1,000 feet thick away from the outcrop, however net sand is only 10 to 15 percent of the total thickness. Porosities average 12 to 22 percent, and permeabilities range from 10 to 350 millidarcies (Core Laboratories, 1972).

The Cisco Group provides fresh to moderately saline water to wells in Coleman and Brown Counties, in and near where it outcrops. Of the water wells in the Region F area that are included in the TWDB database, just over half produce fresh water, with most of the remainder producing slightly saline (1,000-3,000 mg/L TDS) groundwater. A majority of these wells are less than 200 feet deep. In the downdip areas, salinities of produced water from the Cisco are shown in Figure 22b and have TDS ranging from 50,000 to 200,000 mg/L.

Because the Cisco produces groundwater with relatively low salinities, it may be considered a potential source of saline water within Region F, particularly in the eastern half of the region where the aquifer is found at shallower depths.

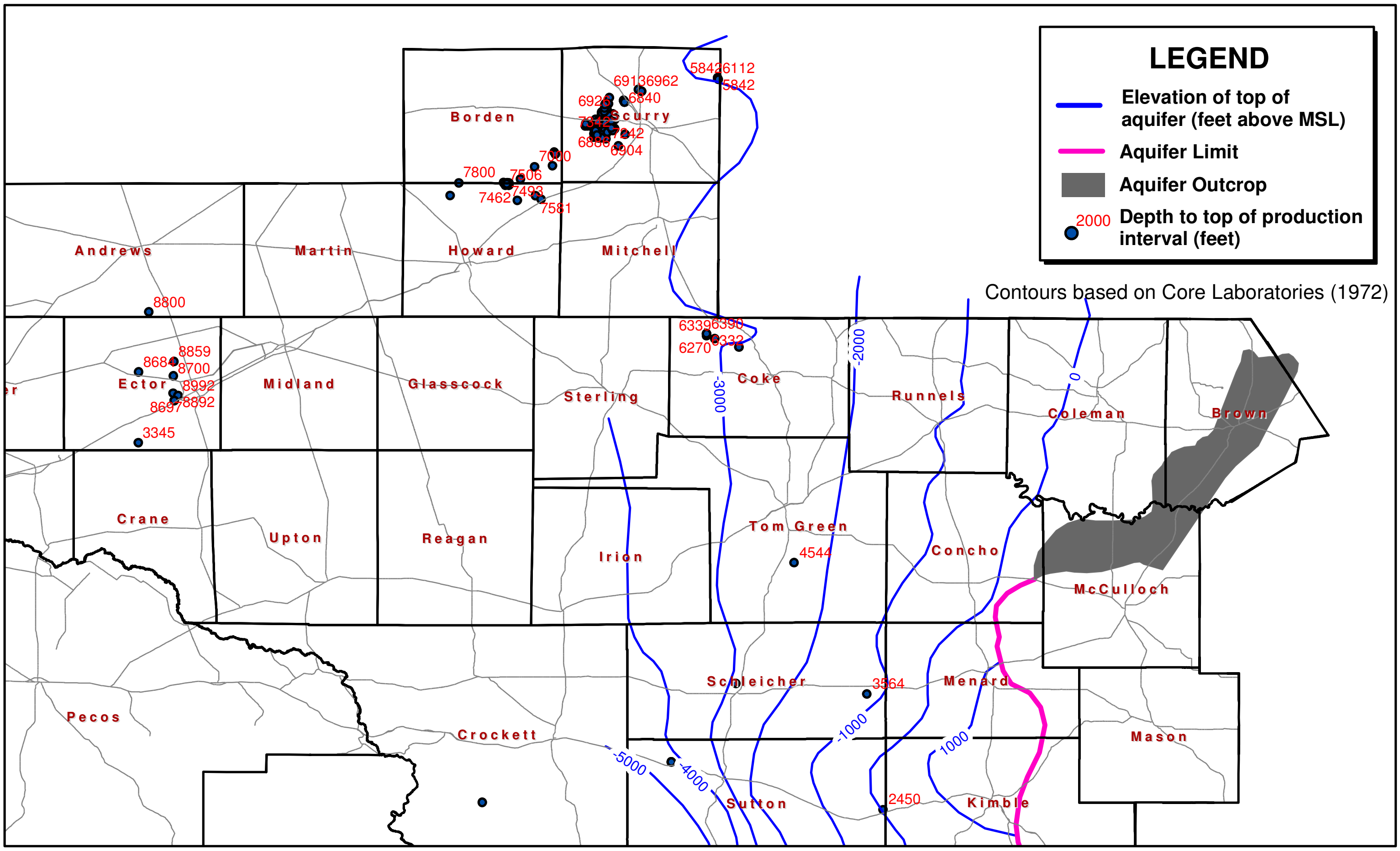


Figure 23a - Depth to the top of the Canyon Aquifer

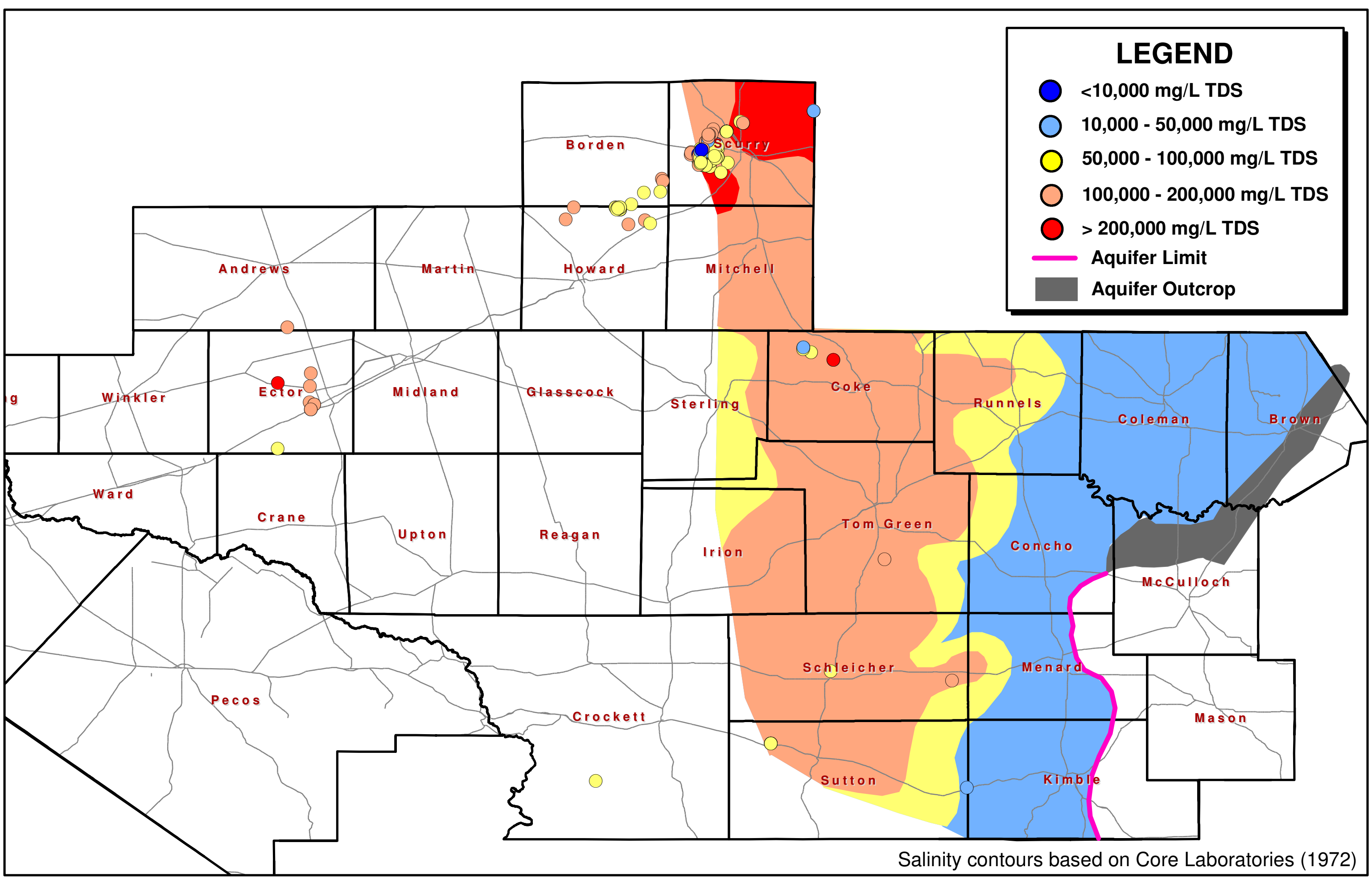


Figure 23b - Produced water quality in oil and gas wells in the Canyon Aquifer

Canyon Aquifer – The Pennsylvanian-age Canyon Group is located stratigraphically below the Cisco and includes four formations; the Palo Pinto, Graford, Brad, and Caddo Creek. The Canyon Group outcrops west and north of the Llano Uplift in Brown and McCulloch Counties, and, as with the Cisco, rapidly dips into the subsurface, occurring at depths of 3,000 feet within 50 miles of the outcrop, and much greater depths throughout the rest of Region F. The elevation of the top of the Canyon in the eastern to central portion of Region F is shown in Figure 23a. Depths to the upper zone of oil and gas wells from the Canyon are also included for the western portion of the region. These data show that depths to the top of production zones are 6,000 to 9,000 feet in the western half of the region. Porosities of the thick limestone beds in the Canyon range from 5 to 25 percent, and the porosity of the reef facies may be as high as thirty percent locally. Permeabilities range from 1 to over 500 millidarcies (Core Laboratories, 1972).

The Canyon provides some fresh but mostly slightly- to moderately-saline water to wells that are less than 400 feet deep in and near the outcrop area. In downdip areas, limited quality data from Canyon produced water suggests a wide range of salinity, ranging from less than 10,000 mg/L to greater than 200,000 mg/L (Figure 23b). As with other deeper, hydrocarbon-producing formations, the salinity of formation water may be more variable on a regional basis than the contours shown in Figure 23b suggest. Because the Canyon produces groundwater with relatively low salinities in the eastern third of the region where the aquifer is found at depths of less than 5,000 feet, it may be a potential source of saline water in this area.

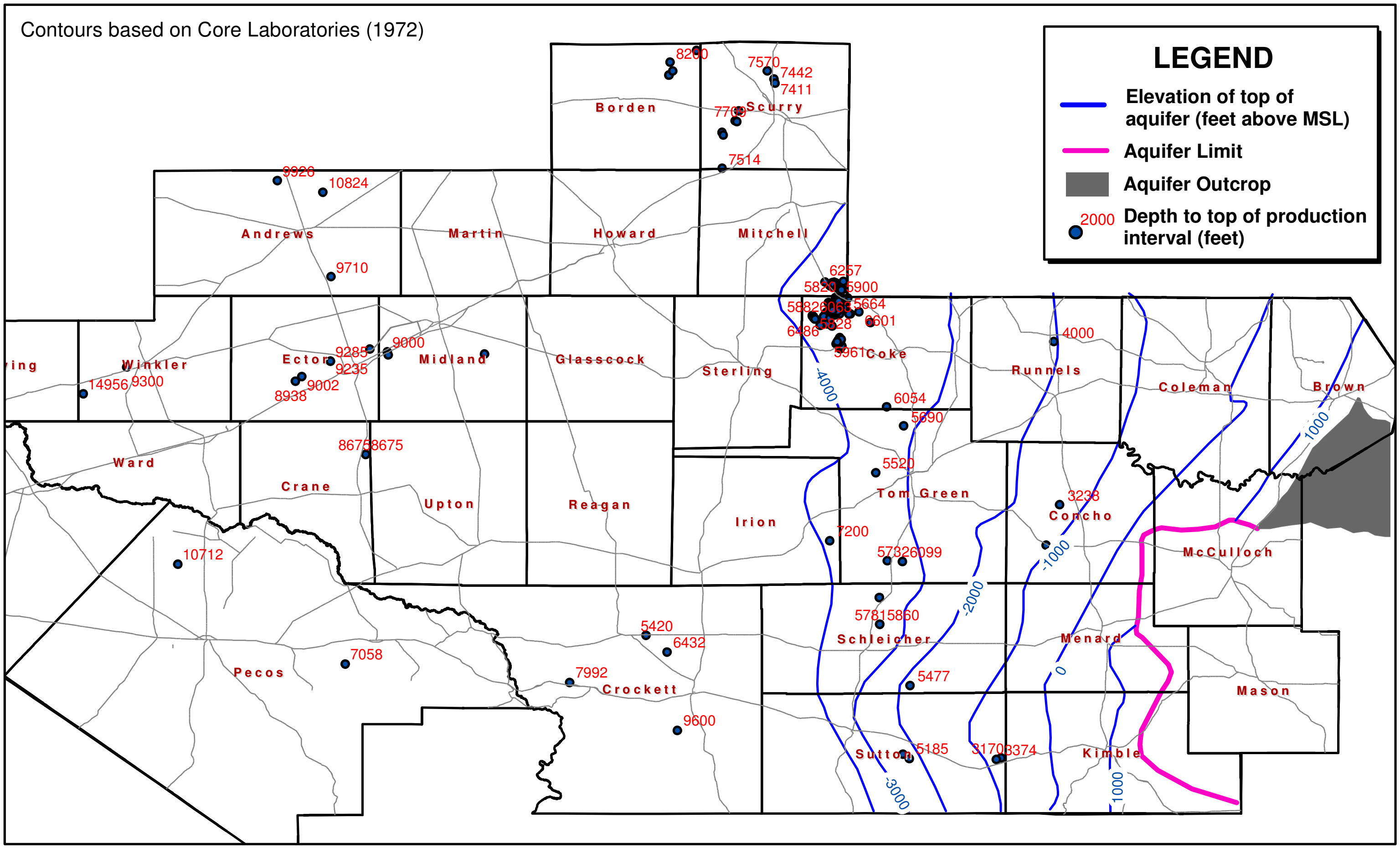


Figure 24a - Depth to the top of the Strawn Aquifer

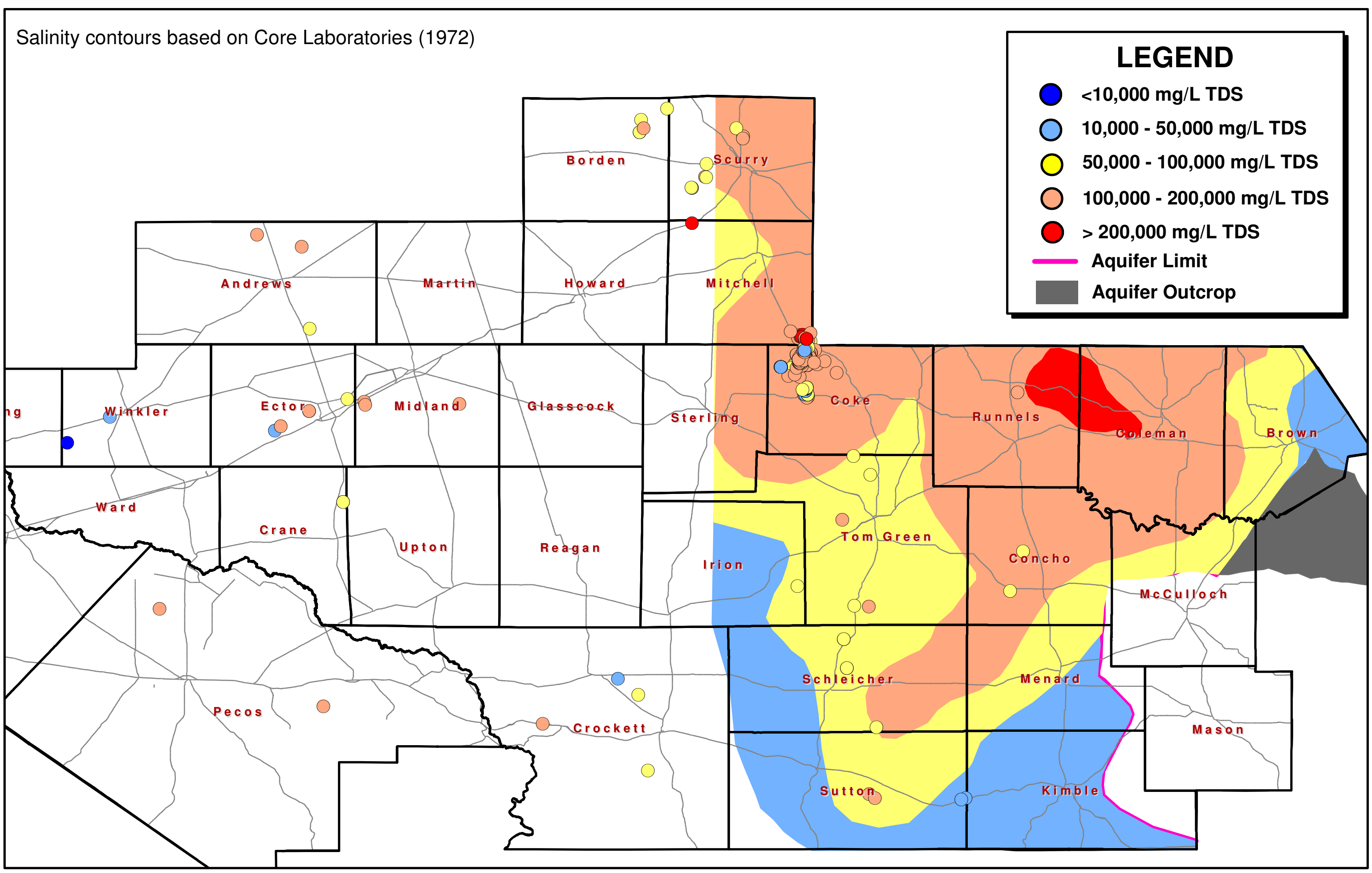


Figure 24b - Produced water quality in oil and gas wells in the Strawn Aquifer

Strawn Aquifer – The Strawn Group, located stratigraphically below the Canyon, is a Pennsylvanian aged unit found throughout Region F, and includes the Lone Camp, Millsap Lake, and Kickapoo Creek Formations. The Strawn Group outcrops in a very wide area immediately north of the Llano Uplift, including the extreme western portions of McCulloch and Brown Counties of Region F. The elevation of the top of the Strawn Group is shown in Figure 24a. As with the other Pennsylvanian-aged units, the Strawn rapidly dips into the subsurface away from the Llano Uplift, occurring at significant depths throughout much of the Region F area. Only in the easternmost counties in the planning area does the Strawn occur at depths of less than 5,000 feet. The Strawn Group consists of sandstones, shales, conglomerates, and limestones, and due to the variations in rock types, porosities and permeabilities are highly variable, with porosity ranges of 5 to 20 percent and permeability ranges of 5 to over 500 millidarcies (Core Laboratories, 1972).

The Strawn provides fresh to slightly saline water to numerous wells in and near the outcrop area in Brown County, and to some wells in the extreme northeastern corner of McCulloch County. The depths of these wells are generally less than 250 feet, although some wells are as deep as 500 feet. The Strawn is also a significant hydrocarbon-producing formation, and quality data of produced water is available from this unit in its western extent (Figure 24b). Produced formation water in the western extent of the Strawn is highly saline, with TDS concentrations of over 200,000 mg/L being common. A trend toward lower salinity (<50,000 mg/L) occurs in the aquifer's southeasterly extent.

Because of the depth to the Strawn aquifer, this aquifer may be a potential brackish or saline water source primarily in the eastern third of Region F. Salinities in this area tend to be high, but are lower than many other hydrocarbon-producing units in the region.

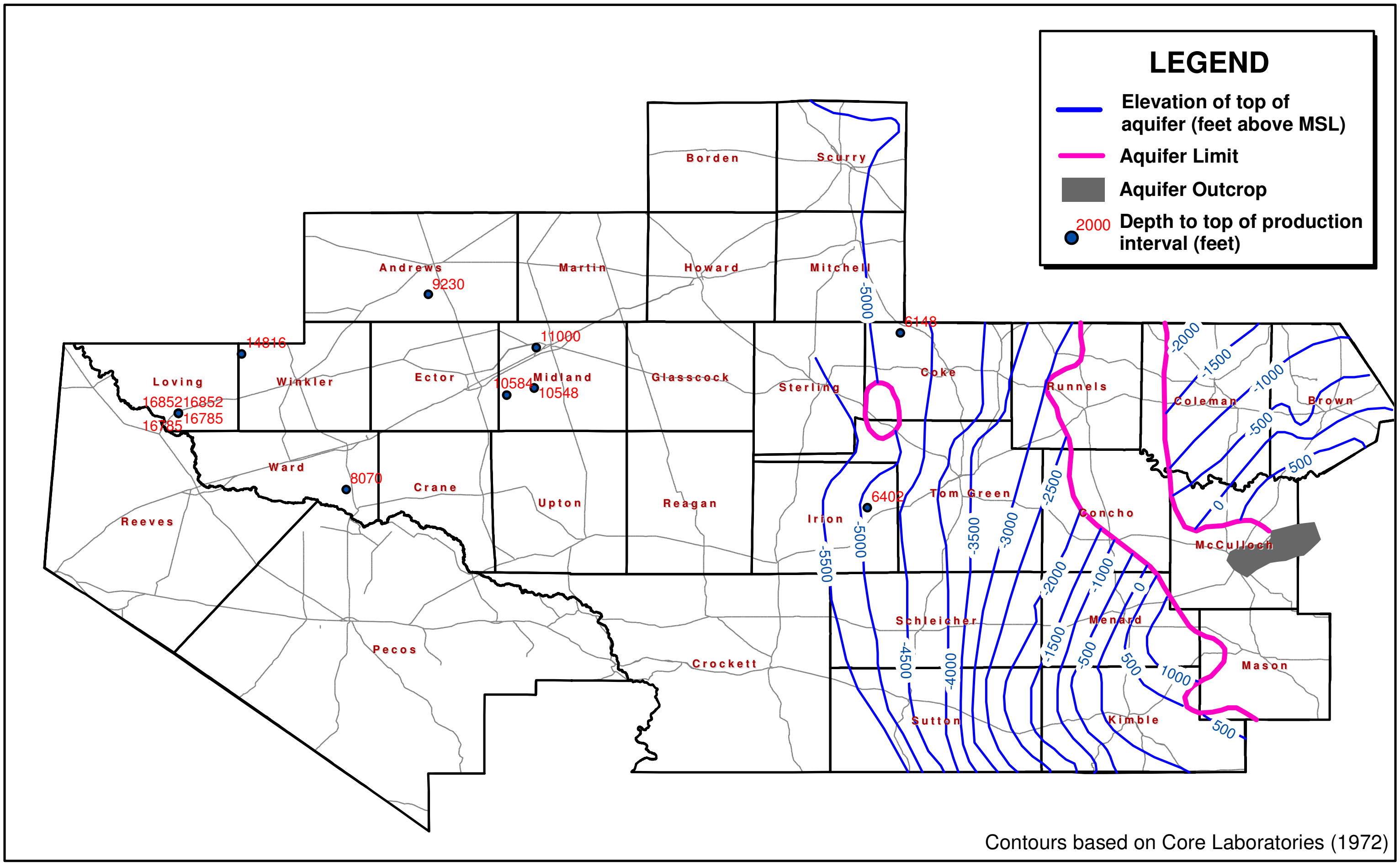


Figure 25a - Depth to the top of the Bend Aquifer

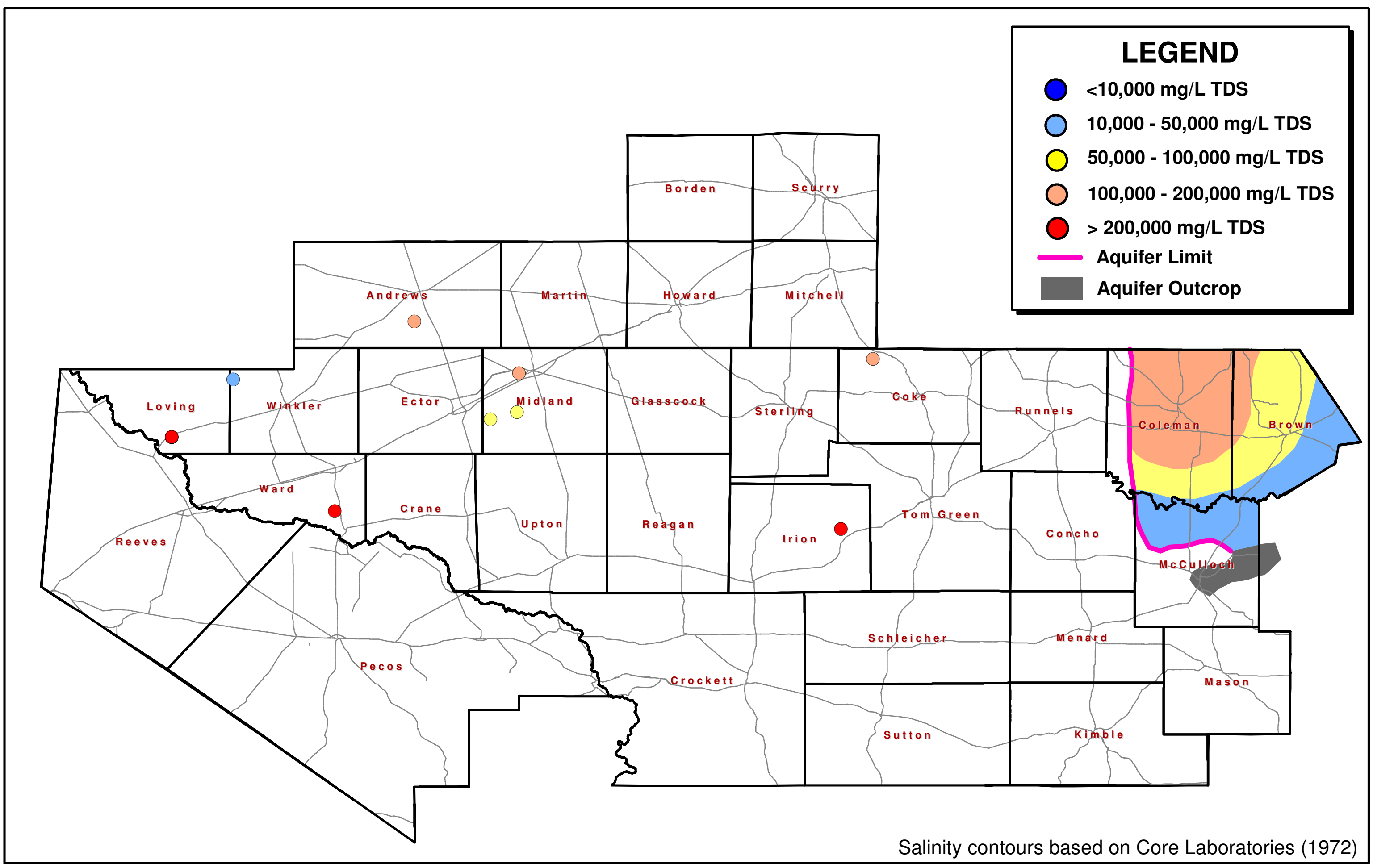


Figure 25b - Produced water quality in oil and gas wells in the Bend Aquifer

Bend Aquifer - The Bend Group is the oldest and deepest of four major Pennsylvanian aged units that are present throughout much of the Region F area, and is located stratigraphically below the Strawn. The Bend Group includes the Morrow and Atoka Formations in West Texas, and consists of shales, limestones, conglomerates, and thin sandstones. The formations crop out in the Llano Uplift area in the far eastern portion of the Region F, and dip rapidly into the subsurface, as shown in Figure 25a. Depths of wells producing from the Bend aquifer in the western portion of Region F exceed 15,000 feet. Permeabilities ranging from 5 to 600 millidarcies and porosities of 10 to 20 percent occur primarily coarse-grained sands and conglomerates (Core Laboratories, 1972).

Very few produced water data from Bend aquifer oil and gas wells are available, but those that are indicate that salinities range from 25,000 to 300,000 mg/L. In its eastern extent, salinity in the Bend aquifer ranges from 50,000 to 200,000 mg/L, with a slight decrease in salinity toward the south. Figure 25b shows the interpreted salinity contours of the Bend in the Llano Uplift area, plus additional quality data in the western region. Because the Bend aquifer is very thin, highly saline, and deep throughout much of the Region F area, it is not considered to be a good source of saline water.

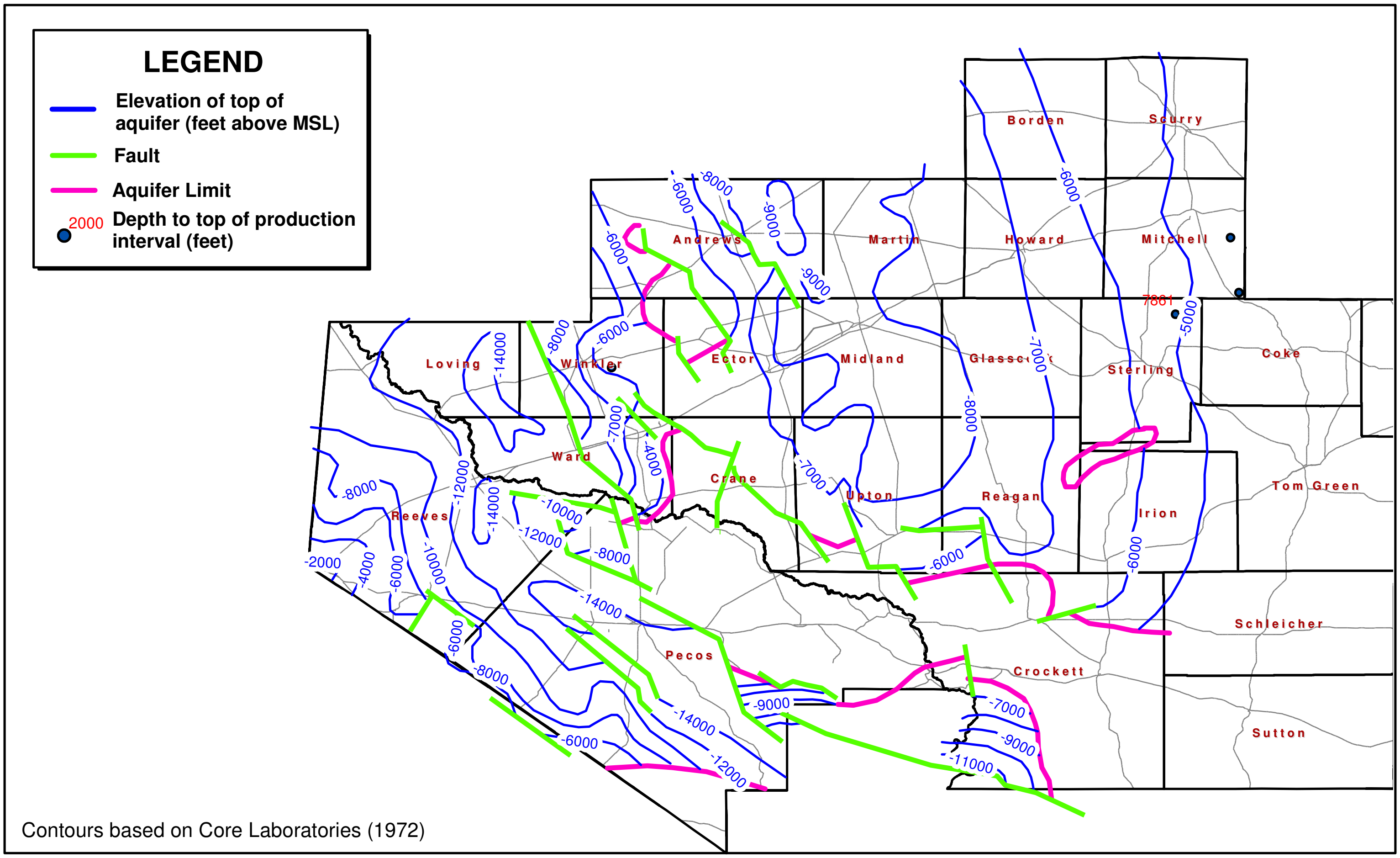


Figure 26a - Depth to the top of the Mississippian Aquifer

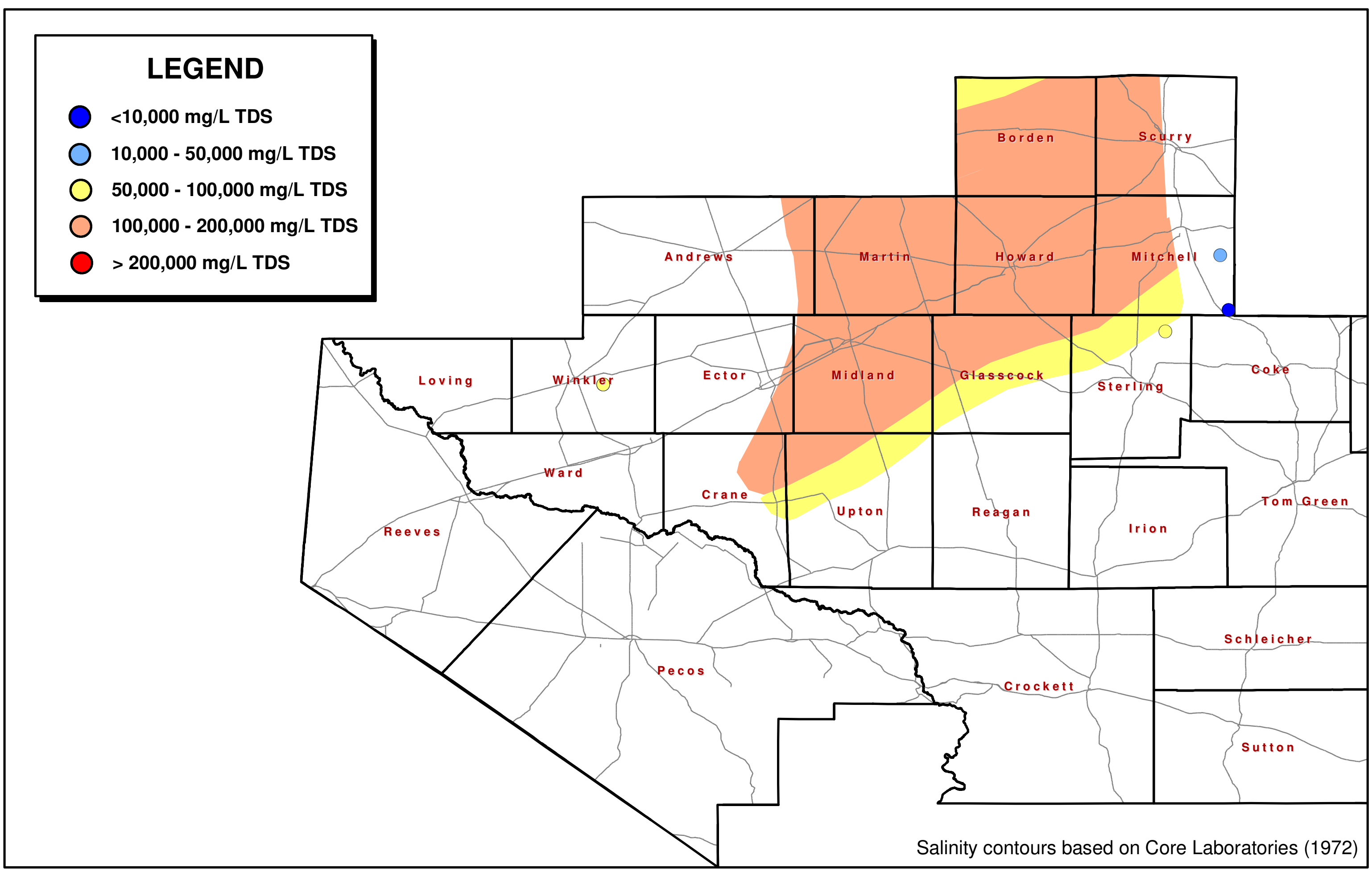


Figure 26b - Produced water quality in oil and gas wells in the Mississippian Aquifer

3.3 Mississippian through Ordovician-age Aquifers

Mississippian Aquifer - The Mississippian aquifer is present throughout much of West Texas. The elevation of the top of the Mississippian aquifer in the Region F area is shown in Figure 26a and varies from 4,000 to more than 15,000 feet below sea level, and is more than 5,000 feet below land surface throughout the Region F area.

The Mississippian aquifer consists mainly of limestone and siliceous limestone. Productivity data indicate porosities of 8 to 12 percent and permeabilities of 10 to 50 millidarcies (Core Laboratories, 1972). Very few salinity data exist on water present in the Mississippian aquifer. However, the data that are available indicate a TDS range of 50,000 to 150,000 mg/L. Figure 26b shows the interpreted salinity contours of produced water quality. However, as with other deep, hydrocarbon-producing formations in the region, it is likely that formation water quality in the Mississippian aquifer is much more variable than the contours might suggest.

Due to the depth to the Mississippian aquifer, and the very high TDS of water produced from them, this aquifer is not considered to be practical saline or brackish groundwater source for the purposes of this study.

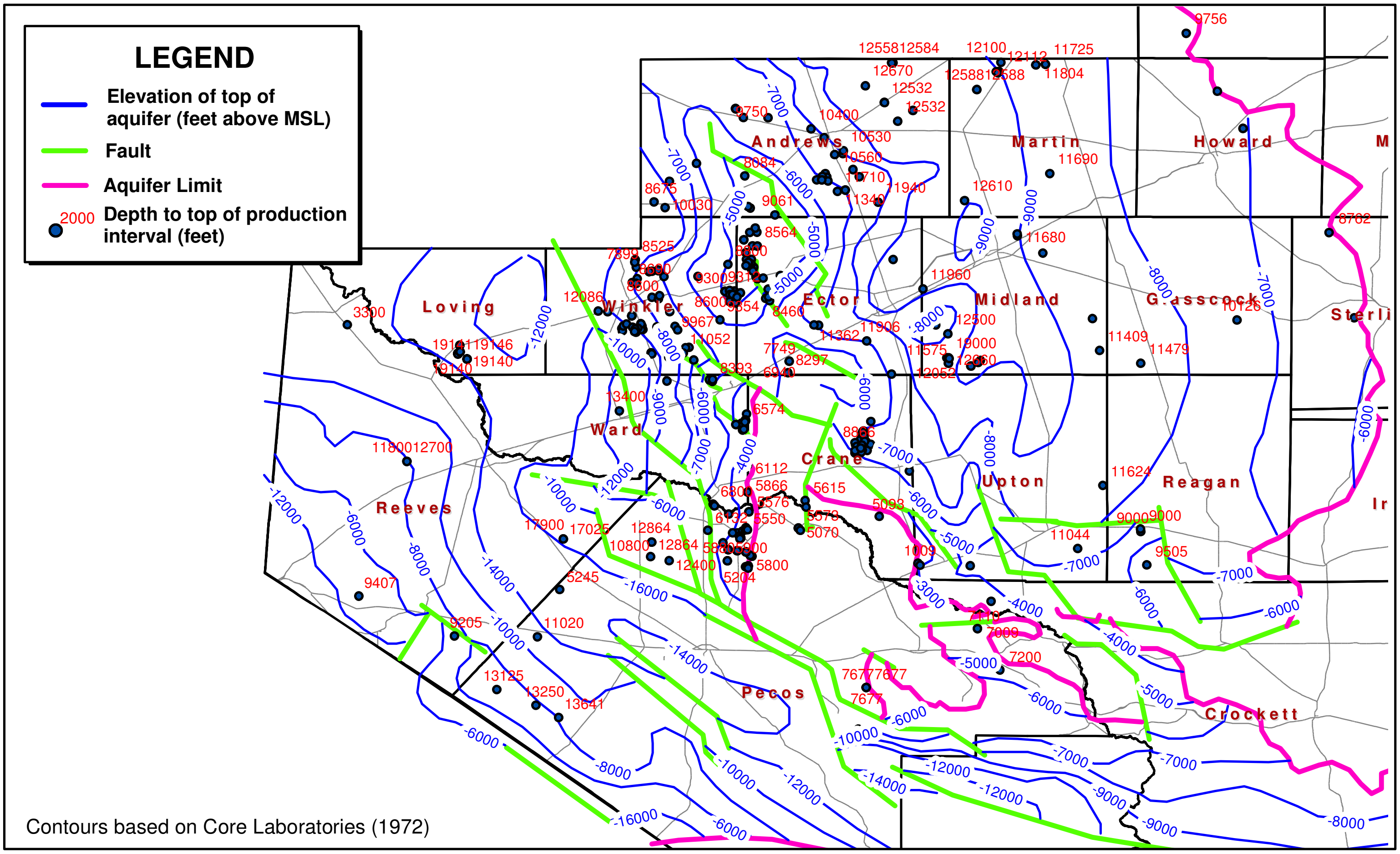


Figure 27a - Depth to the top of the Siluro-Devonian Aquifer

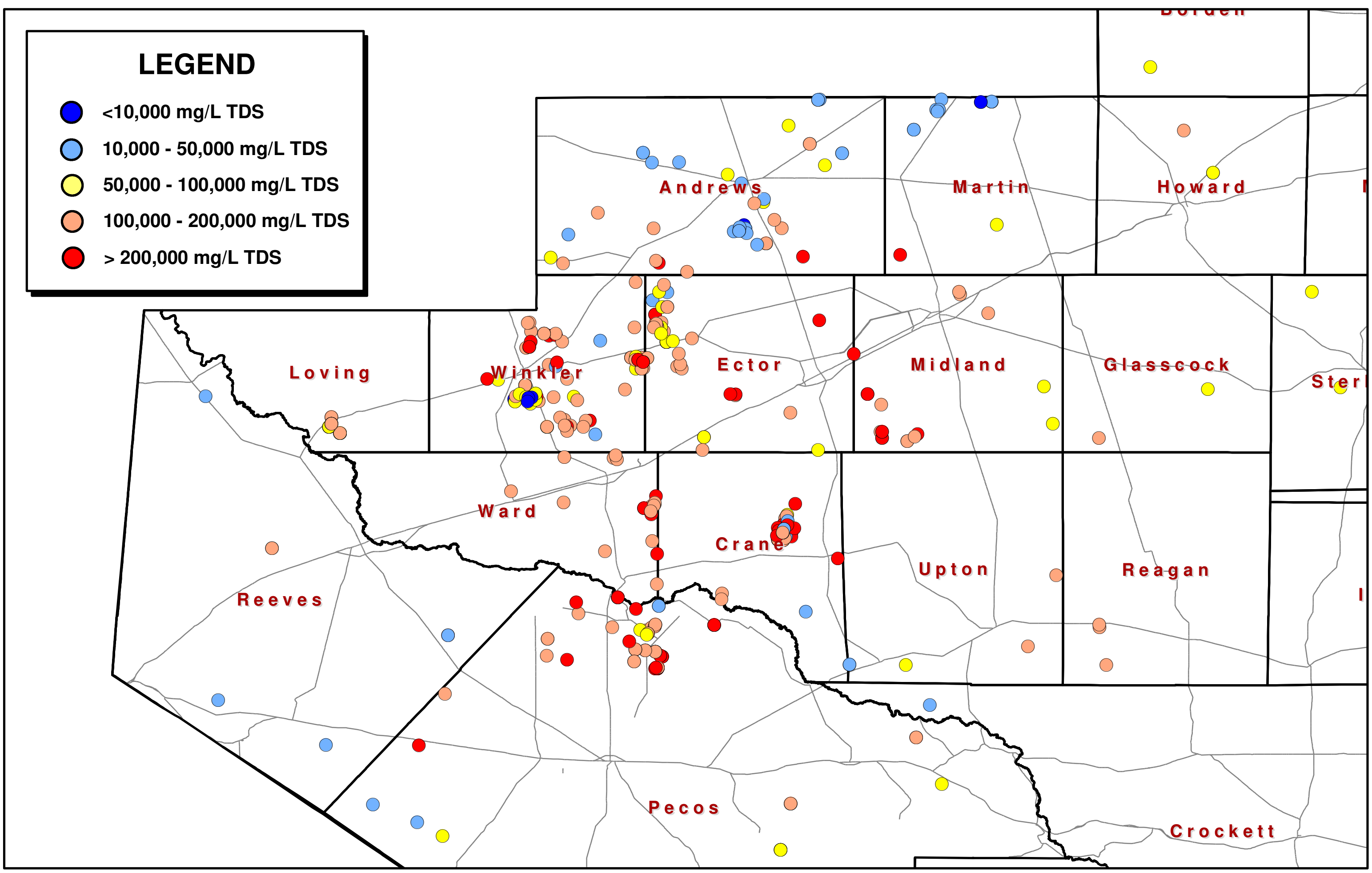


Figure 27b - Produced water quality in oil and gas wells in the Siluro-Devonian Aquifer

Siluro-Devonian Aquifer - Located under portions of West Texas, the Siluro-Devonian aquifer occurs at depths of greater than 5,000 feet in most of the areas where it is present in the region. The Silurian-age Fusselman Formation and the Devonian Limestone are the predominate units associated with this deep aquifer system. Figure 27a shows the elevation of the top of this aquifer in the Region F area.

The Siluro-Devonian aquifer consists mainly of limestone and chert. Porosities range from 5 to 10 percent, and permeabilities vary significantly, from less than 10 to greater than 100 millidarcies (Core Laboratories, 1972).

Figure 27b shows water quality of produced water from oil and gas wells, mostly for the Fusselman Formation. These analyses show high TDS ranging from 40,000 to more than 300,000 mg/L, with a large percentage being over 100,000 mg/L. Because of the depth to this aquifer, and the very high TDS of water produced from it, the Siluro-Devonian aquifer is considered to be a poor choice as a saline or brackish groundwater source for the purposes of this study.

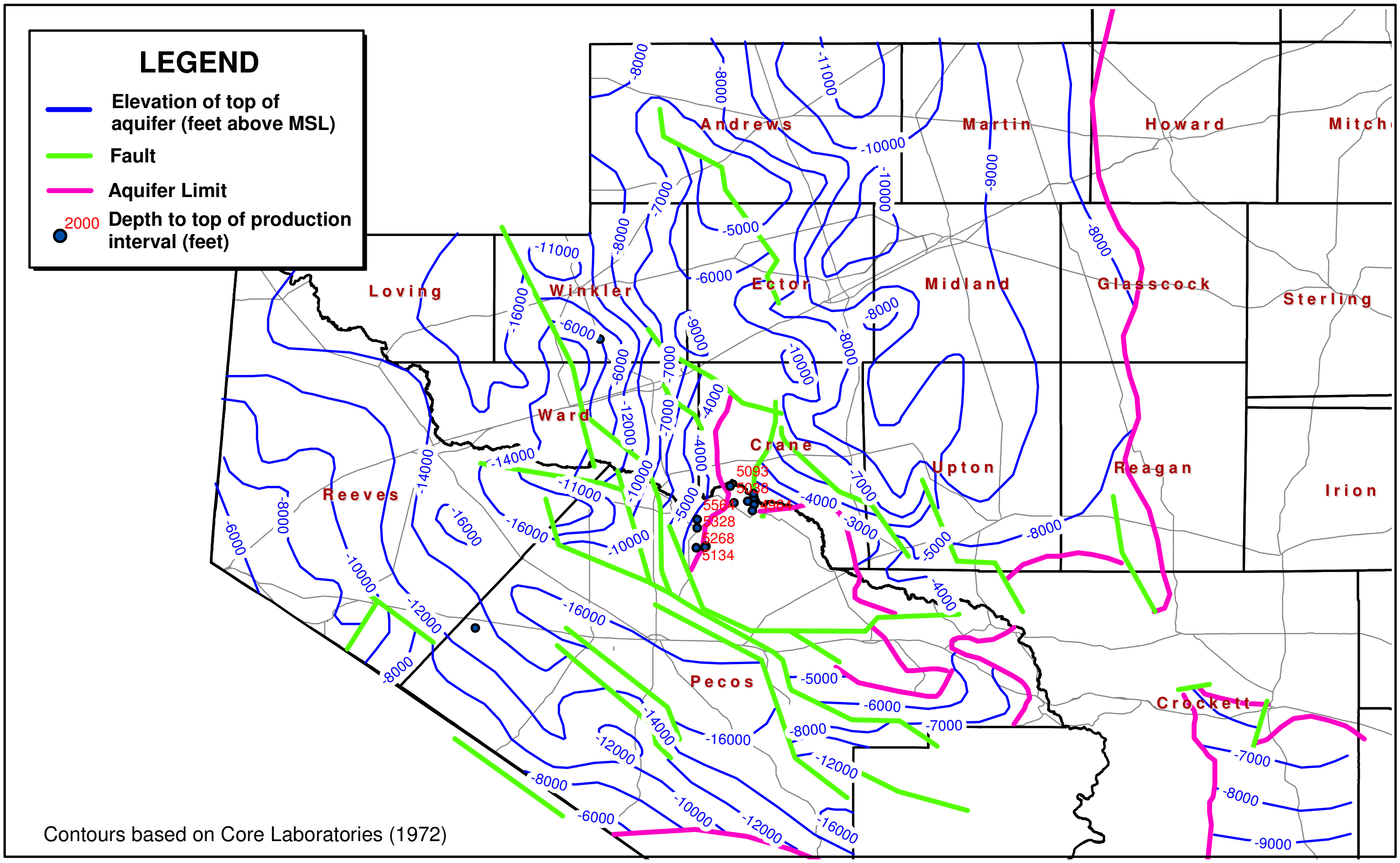


Figure 28a - Depth to the top of the Montoya Aquifer

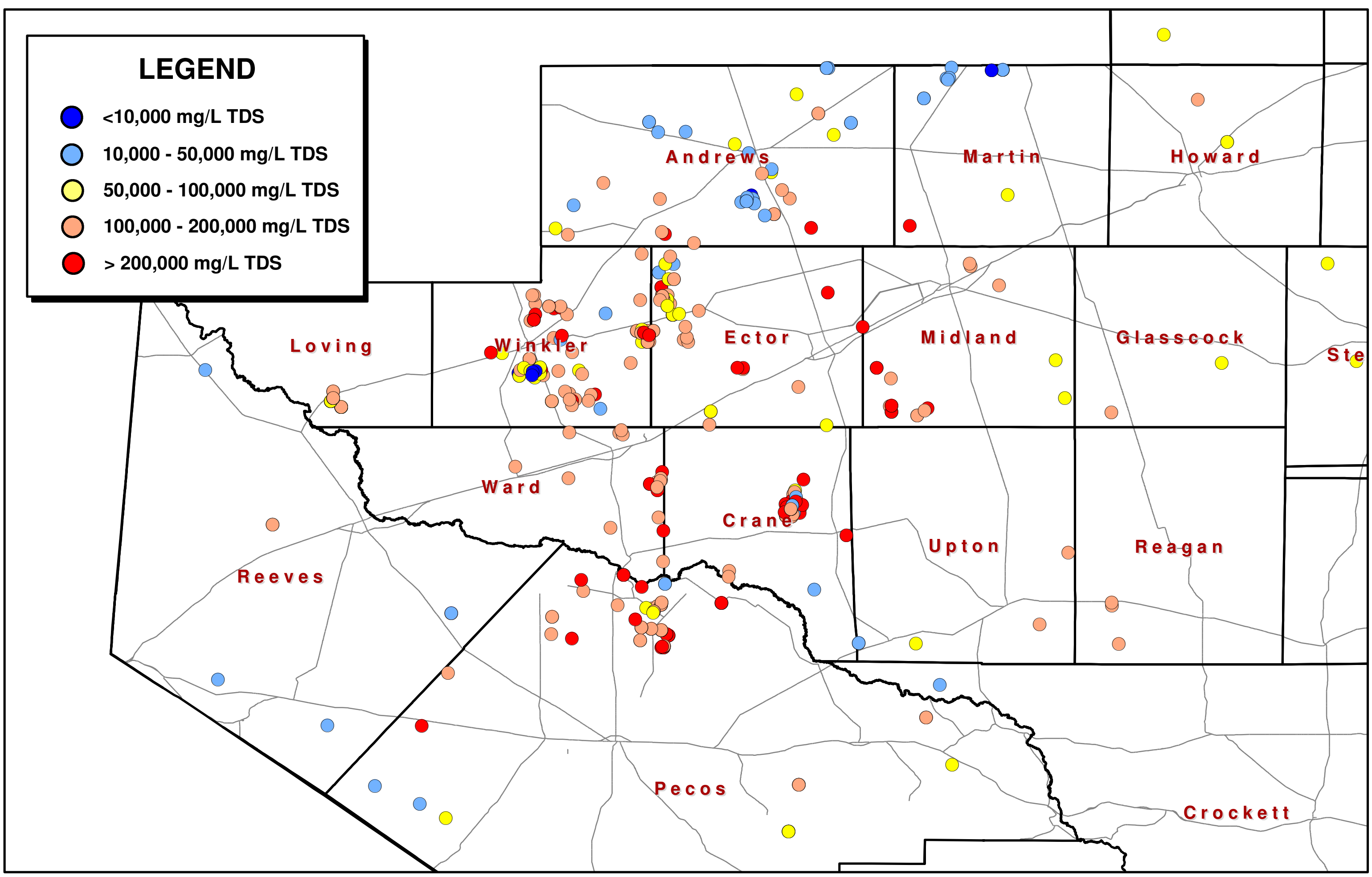


Figure 28b - Produced water quality in oil and gas wells in the Simpson and Montoya Aquifers

<u>Simpson-Montoya Aquifer</u> - The hydrocarbon producing Simpson and overlying Montoya Formations of Ordovician age are found at depths of greater than 5,000 feet throughout most the Region F area. Figure 28a shows the top of the Montoya formation in the Region F area. The Simpson aquifer consists mainly of shale with thin sandstone and limestone beds, and the Montoya consists mainly of dolomite, limestone, and chert. Productivity data for the Simpson are scarce, and porosities and permeabilities vary too much to give a meaningful assessment of their ranges. Productivity and rock property data for the Montoya indicate porosities range from 5 to 10 percent and permeabilities average 10 millidarcies (Core Laboratories, 1972).

Figure 28b shows the total dissolved solids concentrations for waters from both the Simpson and Montoya aquifers. Analytical data of the produced water from both formations indicate total dissolved solids concentrations of greater than 100,000 mg/L. Water quality of produced waters from the Simpson and Montoya Formations indicates that the TDS magnitude of the Montoya is between 40,000 and 150,000 mg/L, and of the Simpson is 50,000 to 200,000 mg/L (very few data exist for the Simpson).

Because of the depth to these formations and the very high TDS of water produced from them, neither the Simpson nor the Montoya aquifers are considered to be practical saline or brackish groundwater sources for the purposes of desalination.

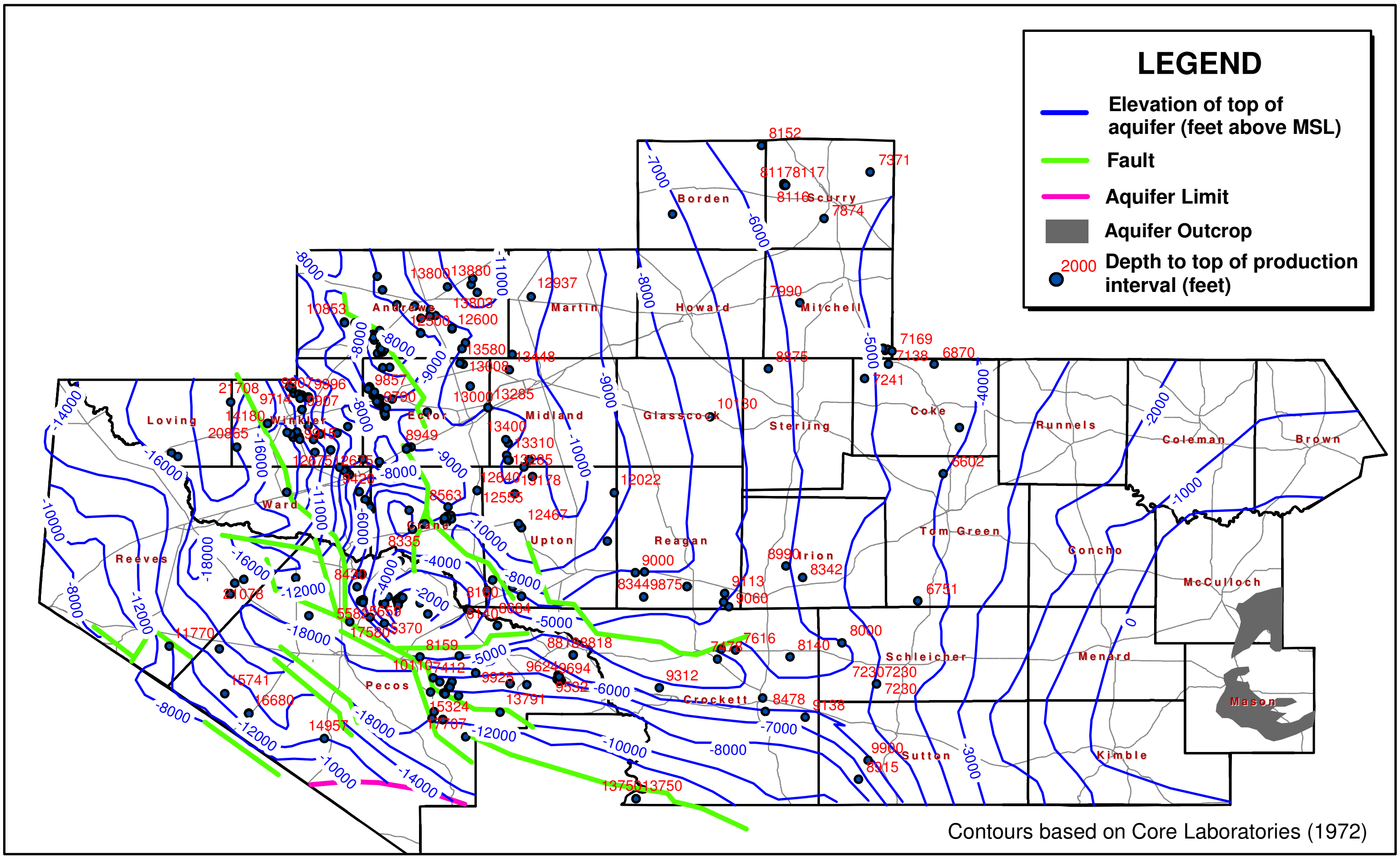


Figure 29a - Depth to the top of the Ellenburger Aquifer

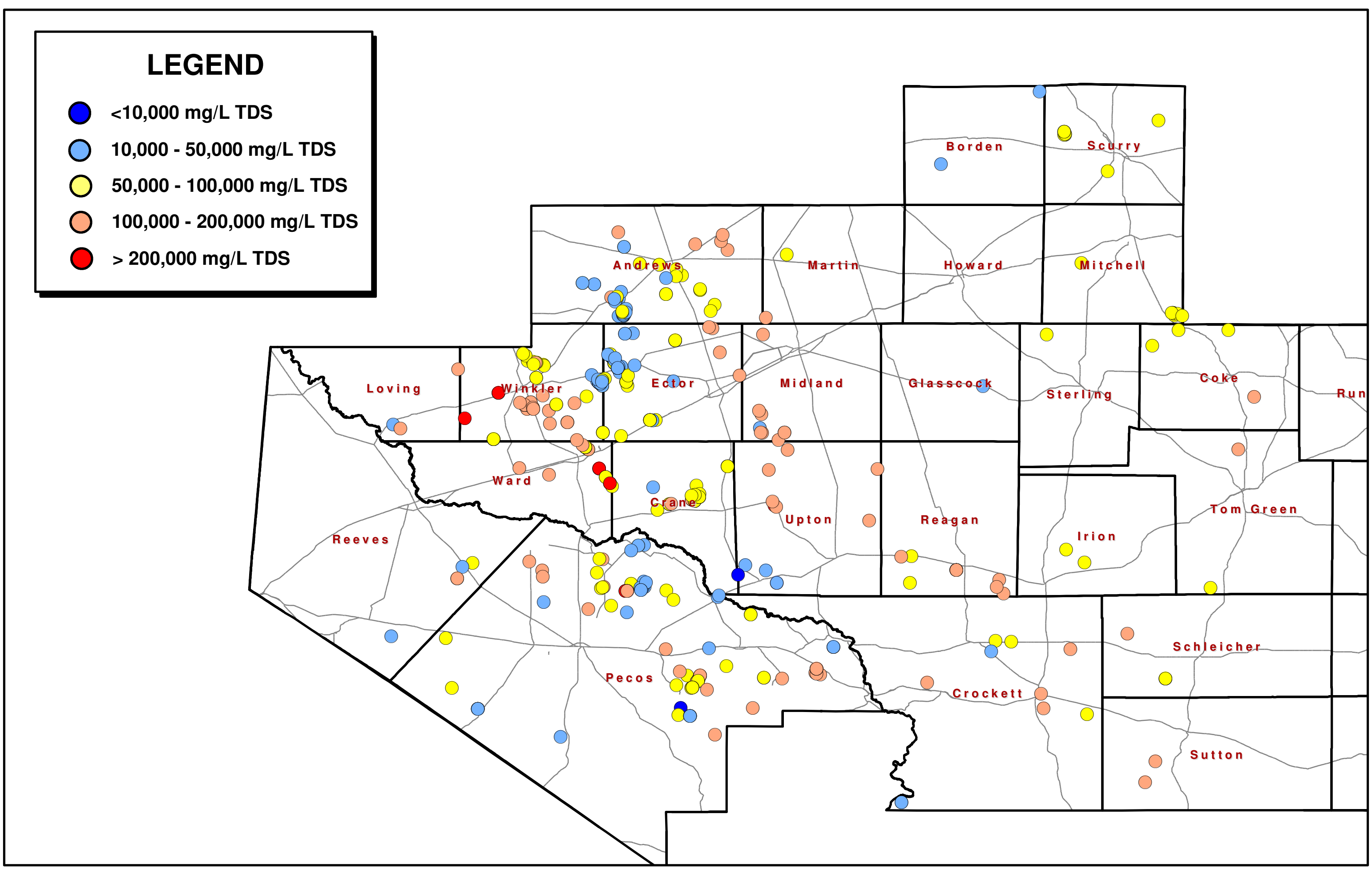


Figure 29b - Produced water quality in oil and gas wells in the Ellenburger Aquifer

Ellenburger Aquifer- The Ellenburger is a prolific hydrocarbon-producing unit and is the most widespread of all of the aquifers in the state. The elevation of the top of the Ellenburger is shown in Figure 29a, which shows that it occurs at depths that are likely too great to be considered a viable brackish or saline water source for water-supply purposes in most of the region. Only in the eastern third of Region F is the formation found at depths of less than 5,000 feet, where this formation is considered the Ellenburger-San Saba aquifer, as described above in Section 2.

As with the Ellenburger-San Saba aquifer described above, the Ellenburger throughout the rest of its extent in Region F consists mainly of dolomite and limestone. It is up to 4,000 feet thick, although it typically has thicknesses of up to 1,700 feet in the Midland and Delaware basins (TWDB, 1972). Productivities from the Ellenburger vary significantly. In general, porosities range from 2 to 12 percent and permeabilities range from 0.1 to 200 millidarcies (TWDB, 1972)

Figure 29b shows the salinity of produced water from the Ellenburger. These data vary enough to indicate that no definitive salinity trend exists on a regional basis, but some areas do contain produced waters with less than 50,000 mg/L TDS. However, this figure also shows that if the Ellenburger is to be considered a potential source of brackish or saline water, a site-specific investigation must be conducted to determine the properties and hydrochemistry of the formation.

Summary- Many of the deeper, hydrocarbon-producing formations present throughout most of Region F have brackish to saline groundwater resources available. Most of the data available for these units are from oil and gas wells producing from the deeper zones of these formations, which typically have highly variable, and usually very high, salinities. In addition, the productivities of these units from a water-supply perspective is unknown, as all of the available data are from oil and gas wells, and the units are highly variable in rock properties and productivities. It is possible that some of these deeper formations could be used as a brackish or saline groundwater resource on a very limited, site-specific basis, but this would not be expected to be typical.

However, many of these formations outcrop in the eastern third of Region F, and it is likely that some of them have the potential to produce adequate quantities of brackish groundwater from shallow to intermediate depth wells (less than 3,000 feet) in this portion of the region, so that they may be considered a potential source of brackish to saline groundwater. Because the data was not available to evaluate the updip portions of these aquifers, the potential for their use must be evaluated on a site-specific basis.

4.0 Oil-Field Produced Water

The Region F water-planning group has identified oil-field produced water as a potential source of brackish or saline water. However, from a water-supply perspective, in particular from a regional water-supply perspective, this is not a source of water that can be considered. While the potential exists for the desalination of oil-field produced water to become a very useful technology, several issues exist with oil-field produced water that limit it's use as a water supply for the purposes of regional water planning, as described below.

The first and foremost problem with oil-field produced water from a regional water supply perspective is the volume that is produced. This technology is mainly being evaluated as an economic alternative to the current methods of disposal for a by-product of hydrocarbon production (i.e. produced water), in particular when the cost of hauling the water is considered. This alternative also produces fresh water, but the economics of the technology are not as a new water supply, but as an alternative to current disposal methods. Volumes are low, similar to what a windmill might produce, and if this water has to then be hauled in order to move it to meet a demand, it becomes economically unfeasible (David Burnett, personal communication, 2004). Currently the fresh water by-product of this desalination is being considered for use in livestock ponds/tanks, discharge into intermittent streams, or for use in habitat restoration. If a demand exists for this water it is likely that it is for a demand that was created due to the water being available, rather than to meet an existing demand.

In addition, the current technology for on-site desalination of oil-field produced water has an upper limit of between 35,000 and 50,000 mg/L TDS, which significantly limits the applicability of this technology in the Region F area. As described in Section 3 above, the geochemistry of formation waters in the deeper, hydrocarbon-producing units in the Region F area are highly variable, but generally contain groundwater with greater than 50,000 mg/L TDS. Although this technology would be applicable for some produced-water in some locations, the limit on the TDS that can be treated also make it a poor choice for water-supply purposes.

5.0 Desalination Cost Analysis

The economics of constructing and operating a desalination facility must be considered when justifying its process over other more conventional water-supply alternatives. Cost estimates must be considered for all the various engineering aspects including source water acquisition (well field), supply distribution (pipeline), plant construction, operations and maintenance including energy cost, and concentrate disposal. Improved membrane technology is increasing the efficiency and effectiveness of the desalination process thus continuing to drive down the overall cost. In general, it is less expensive to desalinate lower TDS groundwater than higher TDS groundwater because of the reduction in energy requirements.

This section provides a basic overview of these costs. Estimates of the cost to desalinate brackish groundwater were given in the TWDB Brackish Groundwater Report (LBG-Guyton, 2003). In addition, the TWDB commissioned a desalination cost analysis study By HDR Engineering in 2000, which provides an overview of desalination technologies and summarizes the process selection for desalination, including water quality, treatment objectives, and costs (HDR, 2000). For a more complete discussion of the costs associated with desalination, interest should be directed to these original reports.

5.1 Total Capital Cost

Current cost information indicates that the total cost of brackish groundwater desalination can range from \$1.5/Kgal to \$2.75/Kgal (Figure 30, after HDR 2000). These figures represent the total treated water costs for brackish groundwater desalination for plant capacities up to 15 million gallons per day (MGD), without consideration of TDS concentration in source water supply. The total treated water costs are the sum of the amortized capital costs and the operation and maintenance (O&M) costs, but do not include the source-water supply and concentrate disposal. This figure clearly shows an economy of scale in the total treatment cost, with larger capacity plants having significantly lower unit rate than smaller capacity plants. Due to the rapid changes in treatment technology, cost estimates that are over two or three years old may be higher than current costs. Because of current technology advances, Figure 30 should be used

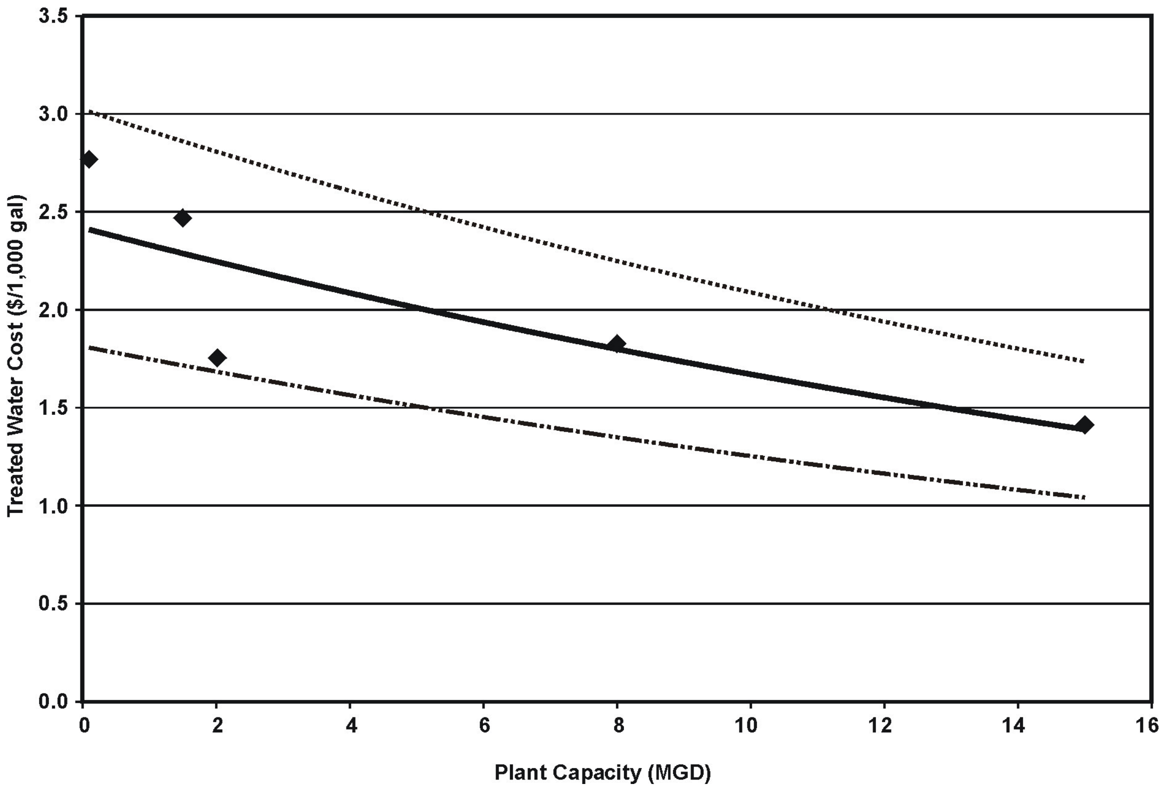


Figure 30 - Total Treatment Cost for Brackish Groundwater Desalination (after HDR and others, 2000)

only as a guideline, as recent data and projections indicate that costs for desalination are decreasing as technology develops. In addition, site-specific conditions can greatly increase or reduce projected costs.

5.2 Operation and Maintenance

Figure 31 (after HDR 2000) illustrates the estimated O&M costs associated with brackish groundwater desalination ranging from $0.60 to $1.60. This estimate includes the cost of personnel, chemicals, power, membrane parts replacement, concentrate disposal, and other costs. As with capital costs, O&M costs show a significant economy of scale. The report indicates that variations in O&M costs may reflect source-water quality such as TDS concentration.

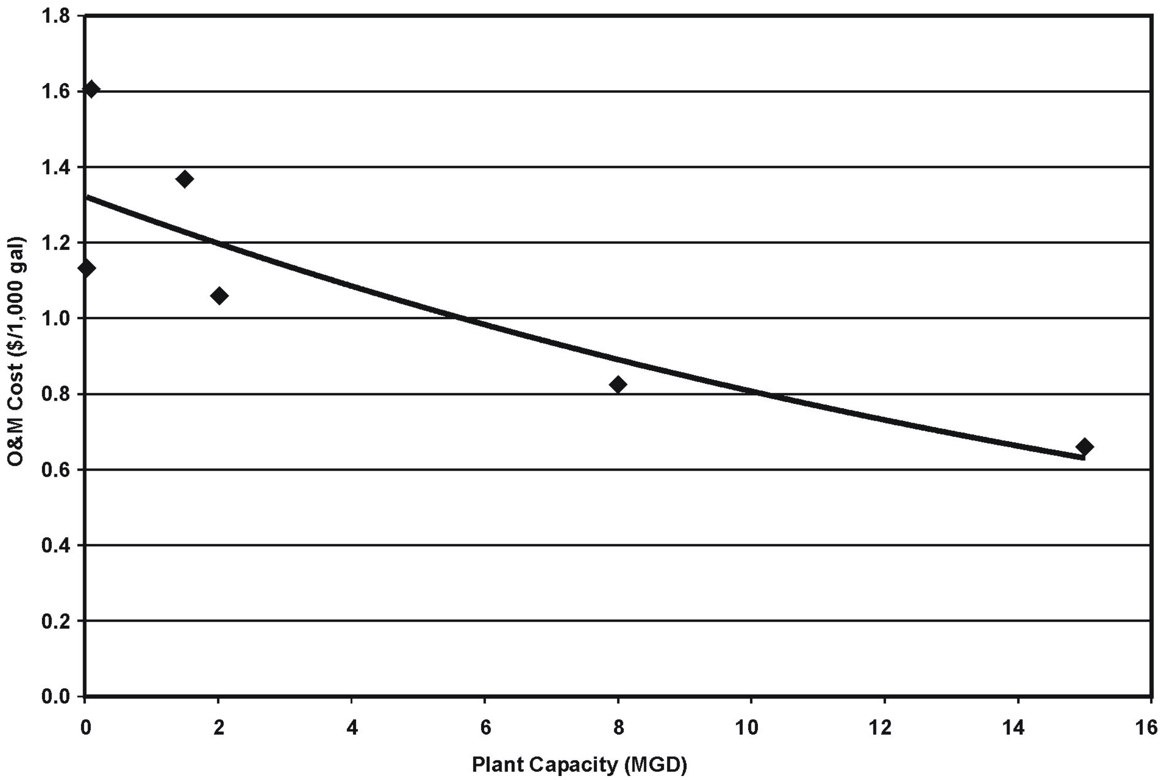


Figure 31 - O&M Costs for Brackish Groundwater Desalination
(after HDR and others, 2000)

5.3 Energy

Energy required to force brackish groundwater through the membranes is one of the most significant cost factors for desalination. As a general rule, the higher the salt content of the water being treated, the higher the pressure required for feed pumping. Compared to desalination of seawater, pressure requirements for brackish water (i.e., less than 10000 mg/L TDS) are significantly lower. Technological advances in membranes make it possible for TDS to be removed at much lower pressures than just a few years ago. There is generally no economy gained regarding energy costs with larger production facilities.

5.4 Pretreatment

Reverse osmosis systems may require pretreatment of the water being treated to adjust pH and prevent salt scaling, and to remove particulates that might foul, clog or damage membranes. As with capital and O&M expenses, there is an economy of scale in the construction and O&M costs for the pretreatment systems. Pretreatment costs are generally higher for surface water (brackish lakes and seawater) than for brackish groundwater because of the need for pretreatment filtration.

5.5 Source Water Wells

Well costs for brackish groundwater supply are shown in Table 2 (LBG-Guyton, 2003). These cost relationships are general in nature and are meant to be used only in the broad context of this report. The cost relationships assume construction methods required for public water supply wells, including carbon steel surface casing and pipe-based, stainless steel, and wire-wrap screen, and that wells would be gravel-packed in the screen sections and the surface casing cemented to their total depth. In addition, the cost estimates include the cost of drilling, completion, well development, well testing, pump (set at 300 feet below ground surface), motor, motor controls, column pipe, installation and mobilization. Not included in these cost estimates are engineering, contingency, financial and legal services, land costs, or permits. In addition, these cost relationships will not apply to wells producing from deep, typically hydrocarbon-producing formations that are also described in this report.

Table 2. Estimated Well Costs for Brackish Water Production Wells		
Well Diameter (inches)	**Typical Production Range (gpm)**	**Estimated Cost (2002 $)** a=production rate (gpm), b= well depth (feet)
6	25-150	7000 + 68a + 60b
8	150-300	10000 + 65a + 140b
10	300-500	15000 + 63a + 180b
12	500-800	20000 + 60a + 225b
16	800-2000	22000 + 60a + 320b

5.6 Concentrate Disposal

Concentrate disposal methods and processes are a critical element in the overall cost of the desalination process, and is a major decision in designing and planning the overall desalination strategy. The ability to estimate the quantity and quality of the concentrate stream allows proper selection of the disposal process and subsequent regulatory permitting.

Table 3 (after HDR, 2000) summarizes the potential advantages and constraints for different types of brine disposal. It is difficult to estimate generic disposal cost relationships because the costs vary significantly between projects, locations, and the disposal method selected. Prior to project implementation, a thorough review of pertinent regulations regarding brine disposal and associated water quality issues should be completed to ensure that proposed brine disposal methods and cost estimates are appropriate for planning purposes.

Table 3. Concentrate Disposal Options Summary (after HDR and others, 2000)		
Disposal Option	**Advantages**	**Disadvantages**
Direct surface water discharge	• Low up front cost	• Requires available receiving water body • Future regulations may restrict

		• Monitoring program
Pre-discharge mixing	• Low to medium up front cost	• Requires adequate mixing source • Monitoring program
Municipal wastewater system	• Low cost (if co-located) • Additional source for reclaimed water	• Higher wastewater treatment costs • Impacts to treatment process
Deep well injection	• Can handle large volumes • May be available to inland plants	• Difficult permitting • High cost up front • Costs vary due to many site-specific circumstances
Land application	• Best suited for small facilities	• Difficult to site
Evaporation ponds	• Relatively easy to design and construct • Low maintenance, little equipment required • Low cost for small volumes	• Require large tracts of land • Require clay or synthetic liners, which increase cost • Little to no economy of scale

6.0 Conclusions

Additional supplies of water in Region F may be obtained from the desalination of existing brackish or saline water sources. Because very little, if any, surface water in the region is available, subsurface, groundwater from a variety of aquifers should be evaluated to meet desalination supply needs. The technology for the desalination of brackish or saline water is improving, and the costs for desalination are continuing to decrease, meaning more and more brackish or saline groundwater supplies may become economically feasible to use as a water supply to meet regional water demands.

Table 4 provides a summary of the brackish and saline groundwater potential for all of the major and minor aquifers as well as the deeper, hydrocarbon-producing formations in Region F. Many of the major and minor aquifers in the region have significant potential to produce brackish groundwater for water-supply purposes, and contain millions of acre-feet of brackish groundwater, as indicated in the table.

Although extensive brackish and saline water resources are available in the deep, typically hydrocarbon-producing units throughout Region F, for the most part these are not potential water supplies for meeting regional water demands. Many of these units are found deep in the subsurface, at depths too great to be economically feasible as a water supply. These formations typically produce groundwater with highly variable, and generally very high, salinities. Productivities of wells from these formations from a water-supply perspective are unknown, as most of the data available are from oil and gas wells. However, it is unlikely that most of these formations can produce the quantities of water at rates sufficient enough to be considered a potential water supply, especially in the downdip portions of these units.

It should be noted that most of the deeper, hydrocarbon-producing formations do have some potential to produce brackish groundwater at reasonable rates from shallower depths in and near where they outcrop, which for many of these units is in the eastern third of the region. However, data was not available for most of these formations in these areas, and therefore the descriptions in Table 4 may not indicate the potential for these units in these areas. If areas in or near the outcrop area of any of these deeper units are to be targeted, additional data and study on a site-specific basis will be required.

Oil-field produced water with relatively lower salinities (less than 50,000 mg/L) have the potential to be treated on-site to create a fresh water source. However, due to the low productivity rates this source cannot be considered a viable water supply from a regional water planning perspective.

7.0 References

Core Laboratories, 1972, A Survey of the Subsurface Saline Water of Texas, Texas Water Development Board Report 157, October, 1972; 113 pp.

HDR Engineering Inc., Water Resources Associates, Malcolm Pirnie Inc., and PB Water, 2000, Desalination for Texas Water Supply. Part A: Membrane Technologies and Costs. Part B: Economic Importance of Siting Factors for Seawater Desalination

LBG-Guyton Associates, 2003, Brackish Groundwater Manual for Texas Regional Water Planning Groups, contract report prepared for the Texas Water Development Board, February, 2003, 188 pp.

Table 4- Summary of Brackish to Saline Groundwater Availability				
Aquifer	***Depth***	***Productivity***	***Salinity***	***Potential for Brackish Resource****
Cenozoic Pecos Alluvium	Shallow to Intermediate	High	Fresh to Brackish	Good
Ogallala	Shallow	High	Fresh to Brackish	Good
Edwards-Trinity (Plateau)	Shallow	Low to Moderate	Fresh to Brackish	Moderate
Trinity	Shallow	Low	Fresh to Brackish	Poor
Rustler	Intermediate to Deep	Low to High	Brackish to Saline	Moderate to Poor
Capitan Reef	Intermediate to Deep	High	Brackish to Saline	Moderate
Dockum	Shallow to Intermediate	Low to Moderate	Fresh to Saline	Moderate
Blaine	Shallow to Deep	Unknown	Fresh to Saline	Unknown
Whitehorse-Artesia	Shallow to Deep	Low to Moderate	Fresh to Saline	Moderate
Lipan	Shallow	Moderate	Fresh to Brackish	Moderate to Good
Hickory	Shallow to Deep	Moderate	Fresh to Saline	Moderate to Good
Ellenburger-San Saba-Marble Falls	Shallow to Deep	Moderate	Fresh to Saline	Moderate to Good
Guadalupe (Delaware Mtn.)	Intermediate to Deep	Unknown	Saline	Poor
Guadalupe (Whitehorse-Artesia)	Shallow to Deep	Unknown	Brackish to Saline	Poor to Moderate
Guadalupe (San Andres)	Intermediate to Deep	Unknown	Brackish to Saline	Poor to Moderate
Leonard (Clear Fork-Wichita)	Intermediate to Deep	Unknown	Saline	Poor

Wolfcamp	Shallow to Deep	Unknown	Brackish to Saline	Moderate to Poor
Cisco	Shallow to Deep	Unknown	Saline	Poor
Canyon	Shallow to Deep	Unknown	Saline	Poor
Strawn	Shallow to Deep	Unknown	Saline	Poor
Bend	Shallow to Deep	Unknown	Saline	Poor
Mississippian	Deep	Unknown	Saline	Poor
Siluro-Devonian	Deep	Unknown	Saline	Poor
Simpson-Montoya	Deep	Unknown	Saline	Poor
Ellenburger**	Deep	Unknown	Saline	Poor

*- Note: The potential ratings follow these general guidelines:

Good = Shallow to intermediate depth + high to moderate productivity + brackish quality
Moderate = Intermediate depth or moderate productivity
Poor = Deep depth or low productivity or saline quality

**- Note: Ellenburger characteristics do not include the area included in the "Ellenburger-San Saba-Marble Falls" area.

Appendix 3B
Water Rights in Region F

Table 3B-1
Water Rights in Borden County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Acreage	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1001	Adj	Borden	Colorado	8800000000	County of Borden	West Salt Draw	Mun	200		10	525		3/16/1964		Trib West Salt Draw, Also Rec- SC
1001	Adj	Borden	Colorado	8800000000	County of Borden	West Salt Draw	Mun				200		9/10/1973		Stand-By Purposes
3714	Adj	Borden	Brazos	8805000000	Martin Allen Parks	Dbl Mtn Fork Brazos River	Irr	63	42				12/11/1969		
3797	Permit	Borden	Colorado	8805000000	Coleman Farms, Inc.	West Salt Draw	Rec	158			158		7/25/1977		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	1	63	
Mine			
Mun	1	200	725
Rec	1	158	158
Other			
Total	**3**	**421**	**883**

Table 3B-2
Water Rights in Brown County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac ft/yr)	Irrigated Acres (Irr) or Consumption (Ind)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1685	Adj	Brown	Colorado	4744000000	Kent J Davis DVM	Turkey Creek	Irr	51.08	25.54		197		10/6/1969		Res Exempt
1685	Adj	Brown	Colorado	4744000000	Delia A Brannon et al	Turkey Creek	Irr	48.92	24.46				10/6/1969		
1686	Adj	Brown	Colorado	4734900000	Lawence Byrd	East Holloway	Irr	101	60		101		4/6/1970		480 Acre Tract, Res Exempt
1687	Adj	Brown	Colorado	4735000000	Harvel R Stambaugh	West Holloway	Irr	50	35		50		4/23/1969		407.9 Ac TR, Res Exempt
1688	Adj	Brown	Colorado	4734500000	Effie Lucile Ashworth Engle	Pecan Bayou	Irr	52	55				1/1/1965		178.95 Acre Tract
1690	Adj	Brown	Colorado	4719500000	Clayton Maxwell Chandler Tr	Pecan Bayou	Irr	452	226				5/30/1964		440 Acre Tract
1691	Adj	Brown	Colorado	4717900000	G A Day	Pecan Bayou	Irr	15	10				1/1/1964	Lake Brownwood	2 Tracts
1713	Adj	Brown	Colorado	4584500000	Harold W & Joann Cagle	Jim Ned Creek	Irr	33.9	27.25				6/1/1966		40.302 Ac Tract; New Owner RFI
1713	Adj	Brown	Colorado	4584500000	John Jacob Hegi et ux	Jim Ned Creek	Irr	139.1	165.281				6/1/1966		165.281 Ac Tract
1714	Adj	Brown	Colorado	4584250000	Jeff Fitzgerald	Jim Ned Creek	Irr	28	23				7/5/1964		108 Acre Tract
1715	Adj	Brown	Colorado	4579003000	Robert W Prince et ux	Jim Ned Creek	Irr	63	34				1/1/1927		56.78 Ac Tract, Rate same as 1716-1720
1715	Adj	Brown	Colorado	4579003000	D Jack Brewer Jr	Jim Ned Creek	Irr	234	117				1/1/1927		340.72-Acre Tract
1716	Adj	Brown	Colorado	4581000000	Joseph Cyril Prince Jr	Jim Ned Creek	Irr	19	15				1/1/1927		65 Ac TR, See 14-1715 For Rate
1717	Adj	Brown	Colorado	4580000000	Donald E Marsh	Jim Ned Creek	Irr	24	19				1/1/1927		125.84 Ac TR, See 14-1715 for Rate
1718	Adj	Brown	Colorado	4579002000	Herman Lewis Lehman et ux	Jim Ned Creek	Irr	104	52				1/1/1927		60.11 Ac TR, See 14-1715 for Rate
1719	Adj	Brown	Colorado	4579001000	Nada A Austin	Jim Ned Creek	Irr	120	60				1/1/1927		60.11 Ac TR, See 14-1715 for Rate
1720	Adj	Brown	Colorado	4579000000	A J Newton	Jim Ned Creek	Irr	29	23				1/1/1927		31.52 Ac TR, See 14-1715 for Rate
1721	Adj	Brown	Colorado	4578000000	J A Cate Jr Estate	Jim Ned Creek	Irr	427	195				1/1/1927		200 Acre Tract
1722	Adj	Brown	Colorado	4577000000	Joe Dan Weedon	Jim Ned Creek	Irr	27	20				1/1/1962	Lake Brownwood	201.33 Acre Tract
1723	Adj	Brown	Colorado	4547000000	D K & Madeline Wilson	Pecan Bayou	Irr	35	52				1/1/1960		156.4 Acre Tract
1725	Adj	Brown	Colorado	4545000000	O C & O T Jarvis	Salt Creek	Irr	30	30		62		1/23/1968		Res Exempt, 160 Acre Tract
1726	Adj	Brown	Colorado	4540000000	City of Brownwood	Pecan Bayou	Irr	32	24		825		6/26/1914		Both Out of the Same 202 Ac TR
1726	Adj	Brown	Colorado	4540000000	City of Brownwood	Pecan Bayou	Irr	105	35				6/30/1914		
1727	Adj	Brown	Colorado	4525000000	Wesley S Wise	Pecan Bayou	Irr	120	60				1/1/1960		75 Acre Tract
1728	Adj	Brown	Colorado	4520000000	City of Brownwood	Pecan Bayou	Irr	116	43				6/30/1914		138 Acre Tract
1729	Adj	Brown	Colorado	4500000000	Delton Caddell	Pecan Bayou	Irr	40	30				1/1/1910		265 Acre Tract
1730	Adj	Brown	Colorado	4490000000	A L Speck	Pecan Bayou	Irr	500	164				6/29/1914		208 Acre Tract
1731	Adj	Brown	Colorado	4480000000	Ted Simpson	Pecan Bayou	Irr	234	117				6/19/1914		309.9 Acre Tract
1732	Adj	Brown	Colorado	4440000000	City of Brownwood	Pecan Bayou	Irr	362	121		195		6/30/1914		3 Tracts Totaling 127.01 Acres
1733	Adj	Brown	Colorado	4430000000	Robert L Carson Estate	Adams Creek	Irr	38	38				1/1/1954		
1734	Adj	Brown	Colorado	4423100000	Bryant A Harris Family Ent	Willis Creek	Rec	506			506		3/12/1973		
1735	Adj	Brown	Colorado	4422800000	Braswell Locker	Pecan Bayou	Irr	100	40				1/1/1910		57.36 Acre Tract
1735	Adj	Brown	Colorado	4422800000	Braswell Locker	Pecan Bayou	Irr	63	25				1/1/1956		567.84 Acre Tract
1736	Adj	Brown	Colorado	4423000000	Gore's Inc	Pecan Bayou	Irr	963	275				1/1/1948		286.31 Acre Tract
1737	Adj	Brown	Colorado	4422500000	Marion Baugh Jr	Pecan Bayou	Irr	150	70				1/1/1954		400 Acre Tract
1739	Adj	Brown	Colorado	4422000000	Paula Carlock	East Fork Steppes	Irr	20	20		89		11/20/1967		Same Res as 1738, 86.943 Acre Tract
1740	Adj	Brown	Colorado	4421500000	Dr. Aaron Lee Speck	Pecan Bayou	Irr	571	196				1/1/1950		254.74 Acre Tract
1741	Adj	Brown	Colorado	4420000000	Bobby J Clark et ux	Pecan Bayou	Irr	1004	386				6/3/1914		1028.84 Acre Tract
1742	Adj	Brown	Colorado	4408000000	J Y Timmins	Double Creek	Irr	50	40		69		1/12/1968		429.9 Ac TR, Res Exempt
1743	Adj	Brown	Colorado	4404400000	L L Gilger	Pecan Bayou	Irr	17	30				1/1/1967		
1747	Adj	Brown	Colorado	4393500000	Zettie Jewell Norton Guthrie	Blanket Creek	Irr	4	10				1/1/1943		
2453	Adj	Brown	Colorado	4549500000	Leland A Hodges et al	Pecan Bayou	Irr	1246	1260		40		12/31/1966		
2454	Adj	Brown	Colorado	4560000000	Brown County WID 1	Pecan Bayou	Mun	15996			114000		9/29/1925	Lake Brownwood	
2454	Adj	Brown	Colorado	4560000000	Brown County WID 1	Pecan Bayou	Ind	5004					9/29/1925		
2454	Adj	Brown	Colorado	4560000000	Brown County WID 1	Pecan Bayou	Irr	8712	7891				9/29/1925		
2509	Adj	Brown	Colorado	4919800000	J W Adams	Double Creek	Irr	67	48				12/31/1909		
2513	Adj	Brown	Colorado	4875500000	Richard Garner McClatchy	West Fork Clear Creek	Irr	28	20		190		12/31/1958		
2514	Adj	Brown	Colorado	4875250000	Ima Lou Nabers	West Fork Clear Creek	Irr	108	54		196		12/31/1956		
2515	Adj	Brown	Colorado	4874500000	Ima Lou Nabers	Clear Creek	Irr	393	231		568		12/31/1928		JOINTLY OWNS 393 AF TO IRR 231 ACRES
2515	Adj	Brown	Colorado	4874500000	Lynn Nabers	Clear Creek	Irr						12/31/1928		JOINTLY OWNS 393 AF TO IRR 231 ACRES
2520	Adj	Brown	Colorado	4869750000	Gerald Perryman et ux	Indian Creek	Irr	120	80				12/6/1971		
2521	Adj	Brown	Colorado	4869650000	Seale T. Cutbirth	Terrapin Creek	Irr	100	50				3/5/1974		
2522	Adj	Brown	Colorado	4869570000	Jimmie Helen Boyd	East Fork Indian Creek	Irr	100	50				6/22/1973	East Fork Indian Creek	
3303	Permit	Brown	Colorado	4423050000	Brownwood Co Club Inc	South Willis Creek	Rec	100			100		11/25/1974		See Ca 294
3628	Permit	Brown	Colorado	4423060000	Martin E McGonagle et ux	South Willis Creek	Irr	35	104		70		7/12/1976		SCS No. 4B, 173.89 Ac-Tract

Use	Number of Rights	Authorized Diversion (ac ft/yr)	Impoundment (ac-ft)
Ind	1	5004	
Irr	49	17571	2652
Mine			
Mun	4	17644	114000
Rec	2	606	606
Other			
Total	**56**	**40825**	**117258**

Table 3B-3
Water Rights in Coke County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
993	Adj	Coke	Colorado	8480000000	Gene Mays Oil Co	Colorado River	Irr	169				2/19/1916		163.67-Acre Tract
994	Adj	Coke	Colorado	8479750000	Gladys Maye Sims	Colorado River	Irr	27				1/1/1956		133-Acre Tract
995	Adj	Coke	Colorado	8461000000	Lynn W Duncan et ux	West Kickapoo Creek	Irr	188		188		9/11/1967		SP-Use Bed & Banks
996	Adj	Coke	Colorado	8432200000	Carl Blair	Colorado River	Irr	0.65				1/1/1966		193-Acre Tract
996	Adj	Coke	Colorado	8432200000	Joseph A Sefick et ux	Colorado River	Irr	38.35				1/1/1966		
997	Adj	Coke	Colorado	8432000000	W Conn Johnson et ux	Colorado River	Irr	9				12/31/1955		240-Acre Tract
998	Adj	Coke	Colorado	8429500000	P J Cervenka et ux	Colorado River	Irr	289				12/31/1961		& CO 200, 696.5-Ac TR
999	Adj	Coke	Colorado	8420000000	Larry L Bryant et al	Colorado River	Irr	148				11/19/1913		& CO 200, 250-Ac TR
1008	Adj	Coke	Colorado	8528000000	Colorado River MWD	Colorado River	Mun	38573		488760		8/17/1964	Lake EV	4Pt OF Tot 332 Amnd 11/90,11/13/98
1008	Adj	Coke	Colorado	8528000000	Colorado River MWD	Colorado River	Ind	2000				8/17/1964	Red Draw Res	Spec Cond 4/84, "
1008	Adj	Coke	Colorado	8528000000	Colorado River MWD	Colorado River	Mine	8427		2500		8/17/1964		May Divert 6000 Af In Co 168. "
1008	Adj	Coke	Colorado	8528000000	Colorado River MWD	Colorado River	Mine	1000		27266		8/17/1964	Mitchell Res	May Divert 6000 Af In Co 168. "
1020	Adj	Coke	Colorado	8540000000	Effie L Roe	Colorado River	Irr	72				3/30/1914		
1021	Adj	Coke	Colorado	8524000000	Thomas C Lee et ux	Colorado River	Irr	17				1/1/1965		Amend 11/12/99:Add Div Pts And Use 4
1021	Adj	Coke	Colorado	8524000000	Thomas C Lee et ux	Colorado River	Mine	40				1/1/1965		& Use 3.Multiple Divpts.Amend 11/12/99
1022	Adj	Coke	Colorado	8523500000	David P Key Jr et ux	Colorado River	Irr	11				1/1/1963		18.5-Acre Tract
1023	Adj	Coke	Colorado	8520000000	Robert Lee Waterworks	Colorado River	Mun	42				6/17/1914		
1023	Adj	Coke	Colorado	8520000000	Robert Lee Waterworks	Colorado River	Mun				Contingent on Maint. Agrmnt	6/17/1914		Junior To 1021 & 1022
1024	Adj	Coke	Colorado	8500000000	Upper Colorado River Auth	Mountain Creek	Mun	250		950		12/16/1949		SC
1025	Adj	Coke	Colorado	8495000000	Sanco Materials Co	Colorado River	Mine	35			When Lease Agrmnt Becomes Invali	1/10/1966		Divert 309 Af. Amend 10/96,10/98. 3 Divpts
1026	Adj	Coke	Colorado	8493000000	Sanco Materials Co	Colorado River	Mine	32				4/27/1970		Divert 320 Af. SC. Am 10/98,9/99.2 Divpts
1026	Adj	Coke	Colorado	8493000000	Sanco Materials Co	Colorado River	Mine					4/27/1970		Divert 320 Af. SC. Am 10/98,9/99.2 Divpts
1031	Adj	Coke	Colorado	8380000000	City of Sweetwater	Oak Creek	Mun	5328		30000		4/27/1949	Oak Creek Res	To Sweetwater & Blackwell-3000 To
1031	Adj	Coke	Colorado	8380000000	City of Sweetwater	Oak Creek	Mun	672				4/27/1949	Oak Creek Res	To Upper Colorado RA
1031	Adj	Coke	Colorado	8380000000	City of Sweetwater	Oak Creek	Ind	4000				4/27/1949	Oak Creek Res	Bronte & Robert Lee Dom & Mun-SC

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind	4	6000	
Irr	10	969	188
Mine	4	9534	29766
Mun	5	44865	519710
Rec			
Other			
Total	**23**	**61368**	**549664**

Table 3B-4
Water Rights in Coleman County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1665	Adj	Coleman	Colorado	4768000000	Dennis Joe Holbert et ux	Pecan Bayou	Irr	30		18		8/7/1951		206.20 Acre Tract
1669	Adj	Coleman	Colorado	4766510000	The Baker Family Trust	Ltl Pecan	Irr	156		287		9/5/1972		479.62 Acre Tract - Same Res as 14-1670
1670	Adj	Coleman	Colorado	4766500000	Kenneth H Walker	Ltl Pecan	Irr	46		287		4/22/1975		56.27 Acre Tract - Same Res as 14-1669
1671	Adj	Coleman	Colorado	4766000000	Burkett Water Supply Corp	Pecan Bayou	Dom			90		10/28/1964		Domestic & Livestock Only
1698	Adj	Coleman	Colorado	4685000000	Danie May Aldridge et al	Buck Creek	Rec			324		10/20/1969		May Reduse use after 1/1/85
1699	Adj	Coleman	Colorado	4678000000	Central Colorado River Auth	S Fork Jim Ned Creek	Mun	51		150		3/14/1947		51 Af for Municipal & Industrial use
1699	Adj	Coleman	Colorado	4678000000	Central Colorado River Auth	S Fork Jim Ned Creek	Ind					3/14/1947		51 Af for Municipal & Industrial use
1701	Adj	Coleman	Colorado	4664250000	Brand Jones, et ux	Jim Ned Creek	Irr	90				1/1/1963		1200.95 Acre Tract
1702	Adj	Coleman	Colorado	4657000000	City of Coleman	Jim Ned Creek	Mun	4500		40000		8/25/1958	Lake Coleman	
1702	Adj	Coleman	Colorado	4657000000	City of Coleman	Jim Ned Creek	Ind	4500				8/25/1958	Lake Coleman	
1703	Adj	Coleman	Colorado	4613500000	City of Coleman	Jim Ned Creek	Irr	500				4/15/1974		104.27 Ac Tr, Reuse Wastewater 1702-4&5
1704	Adj	Coleman	Colorado	4642000000	City of Coleman	Indian Creek	Mun	769				8/29/1922	Lake Scarborough	
1704	Adj	Coleman	Colorado	4642000000	City of Coleman	Indian Creek	Rec			1360		8/29/1922	Lake Scarborough	
1705	Adj	Coleman	Colorado	4630000000	City of Coleman	Hords Creek	Mun	2240		7959		3/23/1946	Hords Creek Res	Mun to Dom,Amend 1/86
1705	Adj	Coleman	Colorado	4630000000	City of Coleman	Hords Creek	Mun	20				3/23/1946		Amend 1/24/86 Mun to Domestic
1706	Adj	Coleman	Colorado	4622850000	John D & Joyce W Rhone	Hords Creek	Irr	74				1/1/1962		297.06 Acre Tract
1707	Adj	Coleman	Colorado	4622750000	E & N Hodges Family Partnership	Hords Creek	Irr	124				1/1/1914		
1708	Adj	Coleman	Colorado	4622000000	Elithe Kirkland et al	Bachelor Prong	Irr	86		86		1/20/1965		Res Exempt, 519.6 Ac Tr
1709	Adj	Coleman	Colorado	4614000000	Wayne F Creek	Hords Creek	Irr	20				1/1/1930		
1710	Adj	Coleman	Colorado	4604500000	Warren Family Ranch Partnership	Jim Ned Creek	Irr	26				1/1/1948		326.5 Acre Tract
1711	Adj	Coleman	Colorado	4602000000	S E Weaver	Jim Ned Creek	Irr	28				1/1/1907		220 Acre Tract, Also Co 25
1712	Adj	Coleman	Colorado	4596000000	Central Colorado River Auth	Mud Creek	Mun	200		400		3/28/1939		
2470	Adj	Coleman	Colorado	4954000000	Padgitt Ranch Partnership Ltd	Colorado River	Irr	386				12/31/1949		Amend 9/13/99: Added Acreage (from 331)
2474	Adj	Coleman	Colorado	4952450000	Randolph Birk et ux	Colorado River	Irr	158				6/30/1962		
2475	Adj	Coleman	Colorado	4951700000	Gerald Kasberg et ux	Colorado River	Irr	182				4/15/1956		
2476	Adj	Coleman	Colorado	4951500000	Lee H Williams Sr Estate	Panther Creek	Irr	290		27		6/20/1955		
2477	Adj	Coleman	Colorado	4951431000	Lee H Williams Sr Estate et al	Panther Creek	Irr	248		100		4/15/1956		
2478	Adj	Coleman	Colorado	4951430000	William J Alguire	Panther Creek	Irr	66				4/15/1956		
2480	Adj	Coleman	Colorado	4951000000	WRJ Oil & Gas Inc et al	Colorado River	Irr	1396				8/31/1963		
2481	Adj	Coleman	Colorado	4950930000	Kathryn Hurst et al	Colorado River	Irr	62				3/1/1967		
2488	Adj	Coleman	Colorado	4950690000	K & B Powell Family Ltd Partner	Bull Creek	Irr	100				11/25/1912		Amended 6/13/2001:Comb 122Af from 2479-6
2488	Adj	Coleman	Colorado	4950720000	K & B Powell Family Ltd Partner	Colorado River	Irr					11/25/1912		Amended 6/13/2001:Comb 122Af from 2479-6
2488	Adj	Coleman	Colorado	4950720000	K & B Powell Family Ltd Partner	Colorado River	Irr	122				12/31/1936		Amended 6/13/2001:Comb 122Af from 2479-6
2489	Adj	Coleman	Colorado	4950700000	Allen Curtis Bryan	Colorado River	Irr	40				8/9/1969		
2490	Adj	Coleman	Colorado	4950600000	Jack Cooper	Colorado River	Irr	350				3/15/1960		
2492	Adj	Coleman	Colorado	4950570000	Mason L. Backus et al	Colorado River	Irr	68				12/31/1960		
2493	Adj	Coleman	Colorado	4950500000	Charles H. Greenlee	Colorado River	Irr	554				6/30/1951		
2495	Adj	Coleman	Colorado	4950200000	Jack Baird Horne	Wildcat Creek	Irr	25		82		7/31/1967		Jointly Owns 25 Af to Irr 25 Acres
2495	Adj	Coleman	Colorado	4950200000	James Arthur Horne	Wildcat Creek	Irr					7/31/1967		Jointly Owns 25 Af to Irr 25 Acres
2495	Adj	Coleman	Colorado	4950200000	Jare Horne Smith	Wildcat Creek	Irr					7/31/1967		Jointly Owns 25 Af to Irr 25 Acres
2496	Adj	Coleman	Colorado	4942000000	Shield Ranch Inc	Red Tank Draw	Irr	30				3/29/1971		
2497	Adj	Coleman	Colorado	4939400000	William Dean Garrett et al	Home Creek	Irr	54				8/31/1971		
2498	Adj	Coleman	Colorado	4939000000	John Hensley	Home Creek	Irr	16				12/31/1926		
2499	Adj	Coleman	Colorado	4938200000	Clay Alan Pevehouse	Home Creek	Irr	38		24		12/31/1952		
2500	Adj	Coleman	Colorado	4938100000	Clay Alan Pevehouse	Home Creek	Irr	97		20		9/30/1964		
2501	Adj	Coleman	Colorado	4938050000	Clay Alan Pevehouse	Home Creek	Irr	85		10		9/30/1964		
2502	Adj	Coleman	Colorado	4938000000	Lee E Abernathy et ux	Home Creek	Irr	63				12/31/1961		
2503	Adj	Coleman	Colorado	4937500000	James F Martin	Home Creek	Irr	6		12		12/31/1953		
2504	Adj	Coleman	Colorado	4933900000	Howard W. Norris & H.O.Norris	Mukewater Creek	Irr	40				7/17/1972		
2506	Adj	Coleman	Colorado	4933000000	Casey Herring	Mukewater Creek	Irr	15				11/30/1963		
2507	Adj	Coleman	Colorado	4931000000	C T McClatchy Jr et ux	Mukewater Creek	Irr	23				12/31/1952		
2508	Adj	Coleman	Colorado	4929500000	J H Martin	Mukewater Creek	Ind	9				10/31/1947		
3232	Permit	Coleman	Colorado	4603000000	Warren Family Ranch Partnership	Jim Ned Creek	Irr	175				6/24/1974		
3297	Permit	Coleman	Colorado	4673500000	John W. Casey	Jim Ned Creek	Irr	15		30		11/11/1974		
3323	Permit	Coleman	Colorado	4642150000	R O McCarty et ux	Indian Creek	Irr	90		90		12/9/1974		SCS Site 25A, Jim Ned CR WS Proj
3342	Permit	Coleman	Colorado	4595990000	City of Santa Anna	Mud Creek	Mun	75		703		1/13/1975	Lake San Tana	

Table 3B-4 Water Rights in Coleman County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
3424	Permit	Coleman	Colorado	4613750000	City of Coleman	Ltl Concho Creek	Rec			184		4/8/1975		SCS Site No 38A
3793	Permit	Coleman	Colorado	4953950000	Central Colorado River Auth	Grape Creek	Mun	75		232		7/18/1977		& Rec - SC
3866	Permit	Coleman	Colorado	4953400000	Colorado River MWD	Colorado River	Mun	103000		554340		2/21/1978	Stacy/Ivie	& Cos 048,200-Amnd 9/85,7/88,2/98,11/98
3866	Permit	Coleman	Colorado	4953400000	Colorado River MWD	Colorado River	Ind	10000				2/21/1978	Stacy/Ivie	200 Af Const Res,Intewr
3866	Permit	Coleman	Colorado	4953400000	Colorado River MWD	Colorado River	Rec					2/21/1978	Stacy/Ivie	200 Af Const Res,Intewr
4300	Permit	Coleman	Colorado	4950380000	Cleber J & Patricia A Massey	Colorado River	Irr	259				1/10/1983		Amend 3/8/90
5772	Permit	Coleman	Colorado	4614000000	Coleman ISD	Ltl Concho Creek	Irr	12			Contigent on Contract w/city of Coleman	4/18/2002	Memory Lake	SC

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom	1		90
Ind	4	14509	
Irr	41	6245	1073
Mine			
Mun	10	110930	603784
Rec	4		1684
Other			
Total	**60**	**131684**	**606631**

Table 3B-5
Water Rights in Concho County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1382	Adj	Concho	Colorado	5063000000	Wilburn Bailey Estate	Concho River	Irr	444				12/31/1905		3 Diversion pts; SC
1383	Adj	Concho	Colorado	5040000000	Robert A & Constance B Hamb	Concho River	Irr	200				11/10/1915		Amended 9/25/90; 2 Div Pts
1384	Adj	Concho	Colorado	5020000000	Ben A Willberg et al	Concho River	Irr	75				3/9/1917		
1385	Adj	Concho	Colorado	5011000000	Vinson Ranch Ltd	Concho River	Irr	453		450		5/12/1964		Flow Restriction, SC
1386	Adj	Concho	Colorado	5011500000	Elmer E Edgington	Concho River	Irr	0.95				12/31/1964		
1386	Adj	Concho	Colorado	5011500000	Juan Guajardo Perez et ux	Concho River	Irr	2.05				12/31/1964		
1387	Adj	Concho	Colorado	5005000000	David M Ellis et al	Kickapoo Creek	Irr	7		193		2/27/1956		Dam & Reservoir; SC
1387	Adj	Concho	Colorado	5005000000	Allen Wayne Weishuhn et ux	Kickapoo Creek	Irr	107.1				2/27/1956		
1388	Adj	Concho	Colorado	4980000000	City of Paint Rock	Concho River	Mun	35		110		3/5/1914		Amend 11/18/83, 4/15/1986
1389	Adj	Concho	Colorado	4960000000	A C Schwethlem	Concho River	Irr	36				12/31/1912		Amend 6/17/88; 3 Div Pts
1390	Adj	Concho	Colorado	4955600000	Stella E W Williams	Concho River	Irr	180				12/31/1957		
1392	Adj	Concho	Colorado	4955010000	Samie Calhoun Ewald	Concho River	Irr	51				12/31/1957		
1393	Adj	Concho	Colorado	4954450000	Louise Wardlaw Currie	Concho River	Irr	92				12/31/1957		
1394	Adj	Concho	Colorado	4954400000	Donald H Goehring	Concho River	Irr	230				12/31/1959		2 Other Diversion Pts
1395	Adj	Concho	Colorado	4954250000	Louie Blair	Concho River	Irr	20				3/1/1950		
1848	Adj	Concho	Colorado	3593000000	A H Floyd Estate	Pasche Creek	Irr	100		200		4/13/1959		320 Acre Tract
2471	Adj	Concho	Colorado	4953750000	Martin J Northern et ux	Colorado River	Irr	160				8/15/1961		Amend 5/21/99:Move Div Pt
2473	Adj	Concho	Colorado	4952500000	R. M. Zirkle	Colorado River	Irr	40				5/31/1964		
3612	Permit	Concho	Colorado	5017500000	Nancy Elizabeth Hruska Becke	Dry Hollow	Irr	169				6/14/1976	Chandler Lake	SC.Undivided Interest in Chandler Lake
3612	Permit	Concho	Colorado	5017500000	John Menke Hruska	Dry Hollow	Irr			185		6/14/1976	Chandler Lake	Undivided Interest in Chandler Lake & Dam
3612	Permit	Concho	Colorado	5017500000	Vinson Ranch Ltd	Dry Hollow	Irr	138				6/14/1976		Subject to Amendment
3637	Permit	Concho	Colorado	4955650000	Ronny Dale Alexander et ux	Concho River	Irr	6				7/26/1976		Uses 1 & 7; SC
3637	Permit	Concho	Colorado	4955650000	Ronny Dale Alexander et ux	Concho River	Other	16		26		7/26/1976		SC. Maintain Water Level of Impoundment
5341	Permit	Concho	Colorado	5017750000	Adrian L Fiveash	Dry Hollow	Irr					1/24/1991		Recovers Private Discharged Water;SC

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	18	2511.1	1028
Mine			
Mun	1	35	110
Rec			
Other	1	16	26
Total	**20**	**2562.1**	**1164**

Table 3B-6
Water Rights in Ector County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Irrigated Acres (Irr) or Consumption (Ind)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
3862	Permit	Ector	Colorado	8625250000	W T Averitt	Monahans Draw	Irr	1485	495		261		2/6/1978		Amend 1/4/85, 10/9/86
3862	Permit	Ector	Colorado	8625250000	W T Averitt	Monahans Draw	Irr	1715					2/6/1978		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	1	3200	261
Mine			
Mun			
Rec			
Stor			
Other			
Total	**1**	**3200**	**261**

Table 3B-7
Water Rights in Howard County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1012	Adj	Howard	Colorado	8625000000	Colorado River MWD	Beals Creek	Mine	2000				7/23/1973		Divert 2200 Af for Quality Imp
1013	Adj	Howard	Colorado	8621500000	City of Big Springs et al	Beals Creek	Irr	24				1/1/1965		185.39-Acre Tract
1014	Adj	Howard	Colorado	8620000000	City of Big Springs	Beals Creek	Rec			322		6/18/1914		Recreational Use Only
1016	Adj	Howard	Colorado	8617000000	Alon USA Refining Inc	Beals Creek	Mine	215		269		10/15/1973		Oil Well Flooding; & Use 2
1017	Adj	Howard	Colorado	8610000000	Clyde McMahon Concrete Co	Beals Creek	Irr	40				1/1/1966		
1018	Adj	Howard	Colorado	8600000000	City of Big Springs	Moss Creek	Mun	1700		5485		1/7/1939		Devils CR & Powell Ranch CR-See File-SC
1019	Adj	Howard	Colorado	8557000000	W F Co. LTD	Beals Creek	Mine	800				8/17/1964		12/12/79 Ch Pt of Div
3316	Permit	Howard	Colorado	8605000000	Paul H Allen	Guthrie Draw	Irr	25		96		12/9/1974		
5480	Permit	Howard	Colorado	8625400000	Colorado River MWD	Sulphur Spring	Mine	2500		54560		3/21/1994		&Co 159;& Use 8-Water Quality Ctrl; Imp

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	3	89	96
Mine	4	5515	54829
Mun	1	1700	5485
Rec			322
Stor			
Other			
Total	**8**	**7304**	**60732**

Table 3B-8
Water Rights in Irion County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1192	Adj	Irion	Colorado	7362900000	Bill M & Margie Tullos	M Concho River	Irr	30				1/1/1960		
1195	Adj	Irion	Colorado	7240000000	Elizabeth Scheuber	Spring Creek	Irr	264		50		6/27/1914		
1196	Adj	Irion	Colorado	7221800000	C A Shoemaker et ux	Spring Creek	Irr	24				6/23/1914		
1197	Adj	Irion	Colorado	7221700000	Thomas B Mase et ux	Spring Creek	Irr	22				6/23/1914		10/22/82
1198	Adj	Irion	Colorado	7221600000	Russell Neal Terral et ux	Spring Creek	Irr	24				6/23/1914		10/22/82
1199	Adj	Irion	Colorado	7221500000	William Franklin Bowen et ux	Spring Creek	Irr	21				6/23/1914		10/22/82
1200	Adj	Irion	Colorado	7221400000	Andrew Jack Russellet et ux	Spring Creek	Irr	20				6/23/1915		10/22/82
1201	Adj	Irion	Colorado	7221300000	Catarino Rico Jr et ux	Spring Creek	Irr	18				6/23/1914		10/22/82
1202	Adj	Irion	Colorado	7221200000	Jon Bill Whitley et ux	Spring Creek	Irr	17				6/23/1914		
1203	Adj	Irion	Colorado	7221100000	Charles H & Richard J Ferguson	Spring Creek	Irr	17				6/23/1914		
1204	Adj	Irion	Colorado	7221000000	Jack W Swanson et ux	Spring Creek	Irr	14				6/23/1914		
1205	Adj	Irion	Colorado	7220900000	Irion Land & Cattle Company	Spring Creek	Irr	15				6/23/1914		
1206	Adj	Irion	Colorado	7221550000	Irion Land & Cattle Company	Spring Creek	Irr	553.5		50		6/27/1914		Amend 4/4/84; 3 Div Pts
1207	Adj	Irion	Colorado	7202000000	Jane Mary Ellis Wardlaw	Spring Creek	Irr	40				6/27/1914		
1208	Adj	Irion	Colorado	7201000000	Claude L Tankersley Estate	Spring Creek	Irr	160				6/27/1914		
1210	Adj	Irion	Colorado	7200600000	Daniel E Batko	Spring Creek	Irr	4				6/27/1914		
1211	Adj	Irion	Colorado	7200500000	Winston L McInnis	Spring Creek	Irr	4				6/27/1914		
1212	Adj	Irion	Colorado	7200400000	Della E Boone	Spring Creek	Irr	1				6/27/1914		
1213	Adj	Irion	Colorado	7180000000	Upper Ditch Company	Spring Creek	Irr	596		55		3/14/1914		11/21/80 Correct Wording
1214	Adj	Irion	Colorado	7130000000	O K Wolfenbarger Jr et ux	Spring Creek	Irr	24				12/31/1964		
1215	Adj	Irion	Colorado	7100000000	Billy J McKibben et ux	Spring Creek	Irr	24				6/29/1914		
1216	Adj	Irion	Colorado	7090000000	Hoolihan Inc	Spring Creek	Irr	26				6/29/1914		
1217	Adj	Irion	Colorado	7060010000	Ida E Nutt	Spring Creek	Irr	48				5/30/1914		
1218	Adj	Irion	Colorado	7010000000	Harry J Blanek et al	Spring Creek	Irr	38				5/30/1914		
1219	Adj	Irion	Colorado	7030000000	Irion County Irrigation Assn	Spring Creek	Irr	490				5/22/1914		
1220	Adj	Irion	Colorado	7020000000	Edward J Filbin et ux	Spring Creek	Irr	40				5/7/1914		
1221	Adj	Irion	Colorado	6983000000	David E Powell	Spring Creek	Irr	2				5/21/1914		Owner Deceased for last 10 Yrs
1222	Adj	Irion	Colorado	6982000000	C H Ivey	Spring Creek	Irr	12				5/21/1914		
1223	Adj	Irion	Colorado	6982800000	Edward B Stabler	Spring Creek	Irr	54.9		6		6/17/1914		Same Res & Rate for 14-1225 thru 14-1231
1224	Adj	Irion	Colorado	6960000000	Jesse R Morris et ux	Spring Creek	Irr	2.65				5/30/1914		Shares Div Pt w/1396, 1400 & 1402
1224	Adj	Irion	Colorado	6960000000	G Dan McClung et ux	Spring Creek	Irr	14.35				5/30/1914		Shares Div Pt w/1396, 1400 & 1402
1225	Adj	Irion	Colorado	6982700000	Fred R Rogers et ux	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1226	Adj	Irion	Colorado	6982600000	John W & Nan S Duncan	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1227	Adj	Irion	Colorado	6982500000	Randy Moseley et ux	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1228	Adj	Irion	Colorado	6982400000	Frederick G Nawarskas	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1229	Adj	Irion	Colorado	6982300000	Gerald Fox et ux	Spring Creek	Irr	9.3				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1230	Adj	Irion	Colorado	6982200000	Paul E Hayes et ux	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225-1237
1231	Adj	Irion	Colorado	6982100000	Paul E Hayes et ux	Spring Creek	Irr	9				6/17/1914		Shares Div Pt w/1223, 1225 - 1230
1232	Adj	Irion	Colorado	6981000000	J S McComb Jr	Spring Creek	Irr	56				6/17/1914		2 Div Pts
1233	Adj	Irion	Colorado	6980000000	Joe & Lynda Clark	Spring Creek	Irr	14				6/17/1914		1233 - 1237 Share Diversion Point
1234	Adj	Irion	Colorado	6979000000	Fern D & Joanna L Smathers	Spring Creek	Irr	14				6/17/1914		1233 - 1237 Share Diversion Point
1235	Adj	Irion	Colorado	6978000000	Luther R & Sharon K Dorsey	Spring Creek	Irr	21				6/17/1914		1233 - 1237 Share Diversion Point
1236	Adj	Irion	Colorado	6977000000	Burl Terrill	Spring Creek	Irr	21				6/17/1914		1233 - 1237 Share Diversion Point
1237	Adj	Irion	Colorado	6976000000	Hubert & Jamie Jones	Spring Creek	Irr	20.6				6/17/1914		1233 - 1237 Share Diversion Point
1238	Adj	Irion	Colorado	6940000000	Carlton Nutt	Spring Creek	Irr	71				6/20/1914		
1239	Adj	Irion	Colorado	6922000000	Homer I & Nettie L Bryant	Spring Creek	Irr	76				5/30/1914		
1240	Adj	Irion	Colorado	6921000000	F W Word	Spring Creek	Irr	14				5/23/1914		
1241	Adj	Irion	Colorado	6920300000	Marc W Wimpee et ux	Spring Creek	Irr	13				5/23/1914		1241 - 1243 Share Diversion Point
1242	Adj	Irion	Colorado	6920200000	Robert E Eckert et ux	Spring Creek	Irr	21.8				5/23/1914		1241 - 1243 Share Diversion Point
1242	Adj	Irion	Colorado	6920200000	Dolores L Perez et ux	Spring Creek	Irr	4.2				5/23/1914		1241 - 1243 Share Diversion Point
1243	Adj	Irion	Colorado	6920100000	Texas Commerce BK-San Angelo	Spring Creek	Irr	100				5/23/1914		1241 - 1243 Share Diversion Point
1244	Adj	Irion	Colorado	6917300000	Ronnie Stinnett et ux	Spring Creek	Irr	38				5/23/1914		

Table 3B-8 Water Rights in Irion County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1245	Adj	Irion	Colorado	6882500000	Eugene Pavlicek Jr	Spring Creek	Irr	85				5/25/1914		2 Div Pts
1246	Adj	Irion	Colorado	6917100000	Willard L Piel et al	Spring Creek	Irr	11				2/28/1966		
1247	Adj	Irion	Colorado	6915000000	Audrey Mildred Larson	Spring Creek	Irr	6				11/30/1965		
1248	Adj	Irion	Colorado	6883000000	Randall Motors Inc	Spring Creek	Irr	9				12/31/1900		
1249	Adj	Irion	Colorado	6882000000	Charles Poulter & Sons Inc	Spring Creek	Irr	18				9/30/1959		
1250	Adj	Irion	Colorado	6881000000	I Zane Miller et ux	Spring Creek	Irr	24				12/31/1966		
1251	Adj	Irion	Colorado	6880000000	Jay Dickens et ux	Spring Creek	Irr	62		56		5/3/1924		
1252	Adj	Irion	Colorado	6870000000	Rena C Thorp	Spring Creek	Irr	4.49				12/31/1949		
1252	Adj	Irion	Colorado	6870000000	I Zane Miller et ux	Spring Creek	Irr	2.6				12/31/1949		
1252	Adj	Irion	Colorado	6870000000	Aubrey K Lange et ux	Spring Creek	Irr	4.91				12/31/1949		
1253	Adj	Irion	Colorado	6840000000	Irion County Farms LLC	Spring Creek	Irr	427		303		4/1/1924		2 Div Pts
1254	Adj	Irion	Colorado	6820000000	William H Armstrong	Spring Creek	Irr	98		18		6/20/1914		Amend 3/18/87,3/14/89;Ttl Comb Amt 230Af
1255	Adj	Irion	Colorado	6800000000	Denver C Marsh Jr et ux	Spring Creek	Irr	158		80		1/31/1927		
1261	Adj	Irion	Colorado	6720000000	Dove Creek Land & Cattle Co Lt	Dove Creek	Irr	1348		85		6/23/1914		& Co 226; Am 2/92, 5/93,12/01;Add Div Pts
1396	Adj	Irion	Colorado	6950000000	G Dan McClung et ux	Spring Creek	Irr	7				5/30/1914		Shares Div Pt w/1224, 1400 & 1402
1400	Adj	Irion	Colorado	6975000000	Jerry L Stokes et ux	Spring Creek	Irr	12				5/30/1914		Shares Div Pt w/ 1224, 1396 & 1402
1402	Adj	Irion	Colorado	6970000000	Jerry L Stokes et ux	Spring Creek	Irr	3				5/30/1914		Shares Div Pt w/ 1224, 1396 & 1400

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	65	5448.3	703
Mine			
Mun			
Rec			
Other			
Total	**65**	**5448.3**	**703**

Table 3B-9
Water Rights in Kimble County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1487	Adj	Kimble	Colorado	2030100000	Eldon W Long et ux	N Llano River	Irr	9				1/1/1913		& Co 134, 172.37 Acre Tract
1488	Adj	Kimble	Colorado	2018700000	Mrs Florence Rieck	N Llano River	Irr	30				1/1/1911		
1489	Adj	Kimble	Colorado	2018200000	James E Compton et ux	N Llano River	Irr	12				9/8/1975		15.21 Acre Tract
1490	Adj	Kimble	Colorado	2018000000	Wm F & Evelyn M Schwiening	N Llano River	Irr	8		1		1/1/1916		268 Acre Tract
1491	Adj	Kimble	Colorado	1962700000	Alice Mae Weiss	N Llano River	Irr	19				1/1/1918		Amend 10/20/95
1491	Adj	Kimble	Colorado	1962700000	Robert D Gorsche et ux	N Llano River	Irr	20				1/1/1918		Amend 10/20/95
1492	Adj	Kimble	Colorado	2010000000	Iola L Allison	N Llano River	Irr	39				1/1/1913		110 Acre Tract
1493	Adj	Kimble	Colorado	2007000000	Rodney C Allison	N Llano River	Irr	36.29				1/1/1913		
1493	Adj	Kimble	Colorado	2007000000	Rodney C Allison et al	N Llano River	Irr	2.71				1/1/1913		
1494	Adj	Kimble	Colorado	2009500000	Robert M Allison	N Llano River	Irr	3				1/1/1913		Amended 8/30/96
1494	Adj	Kimble	Colorado	2009500000	Clinton H Denny	N Llano River	Irr	3				1/1/1913		Amended 8/30/96
1495	Adj	Kimble	Colorado	2000000000	J P Rieck Estate et al	W Maynard Creek	Irr	34		53		1/1/1913		2 Res-3 Af WM/50 Af M, 320 T
1496	Adj	Kimble	Colorado	1985000000	Shannon Gardner	Maynard Creek	Irr	35		8		1/1/1898		6/03:Gardner No Longer the Owner
1497	Adj	Kimble	Colorado	1983000000	Phyllis Bernice Keller	N Llano River	Irr	32				4/1/1964		
1498	Adj	Kimble	Colorado	1976000000	David K & Margaret F Akers	M Copperas Creek	Irr	83		10		1/1/1912		
1499	Adj	Kimble	Colorado	1975500000	Osborn Fox et al	W Copperas Creek	Irr	13				6/1/1963		
1500	Adj	Kimble	Colorado	1975200000	Clint Smith	Copperas (Rush) Creek	Irr	18		5		10/1/1966		300 Acre Tract
1501	Adj	Kimble	Colorado	1975000000	Clinton A Smith et al	Copperas (Rush) Creek	Irr	24				1/1/1967		127.6 Acre Tract
1502	Adj	Kimble	Colorado	1966000000	K & Wanda Cowsert	N Llano River	Irr	24				4/1/1904		128.839 Acre Tract
1503	Adj	Kimble	Colorado	1963000000	G Byron Janik et ux	N Llano River	Irr	30				1/1/1936		Amend 1/10/86. Other 70 Af Exp 12/31/94.
1504	Adj	Kimble	Colorado	1960000000	Catherine Odeal Taylor	N Llano River	Irr	37				1/1/1911		106.25 Acre Tract
1505	Adj	Kimble	Colorado	1955000000	Donald J Burda et ux	N Llano River	Irr	3				1/1/1967		
1506	Adj	Kimble	Colorado	1950000000	Elsie Cunningham	N Llano River	Irr	24				4/1/1966		
1507	Adj	Kimble	Colorado	1940000000	Arthur L Mudge et al	N Llano River	Irr	50				5/15/1896		
1507	Adj	Kimble	Colorado	1940000000	Bobby A Weaver et al	N Llano River	Irr	85				5/15/1896		
1508	Adj	Kimble	Colorado	1900000000	Donald W Richardson	N Llano River	Irr	30				1/1/1904		35.42 Acre Tract
1508	Adj	Kimble	Colorado	1900000000	William B Farr	N Llano River	Irr					1/1/1904		
1509	Adj	Kimble	Colorado	1920000000	Arthur L & William G Mudge	N Llano River	Irr	5				6/14/1915		170.19 Acre Tract
1510	Adj	Kimble	Colorado	1920010000	Lenore Riley Mudge	N Llano River	Irr	12				6/14/1915		647.9 Acre Tract
1511	Adj	Kimble	Colorado	1889000000	James E Hubbell	N Llano River	Irr	24				6/15/1968		2 Tracts 153.3 Acres
1512	Adj	Kimble	Colorado	1880000000	Roy Cooper	N Llano River	Irr	52				6/1/1911		
1514	Adj	Kimble	Colorado	1865000000	Mrs Florence Rieck	N Llano River	Irr	27				1/1/1917		29.095 Acre Tract
1515	Adj	Kimble	Colorado	1860000000	Kenneth Alexander	N Llano River	Irr	150				1/1/1912		
1516	Adj	Kimble	Colorado	1840000000	Sue Bannowsky Ramsey	Bear Creek	Irr	3.5		3		9/3/1898		Amended 8/31/2000
1516	Adj	Kimble	Colorado	1840000000	Ruby Zibilski	Bear Creek	Irr	3.5				9/3/1898		Amended 8/31/2000
1517	Adj	Kimble	Colorado	1830000000	Huggins Interests Ltd et al	Bear Creek	Irr	40				9/3/1898		428.579 Acre Tract
1518	Adj	Kimble	Colorado	1826000000	Michael J Townsend et ux	W Bear Creek	Irr	19		5		1/1/1957		171.9 Acre Tract
1519	Adj	Kimble	Colorado	1820100000	Patton Estate Ltd	W Bear Creek	Irr	24		4		6/1/1911		20 Acre Tract
1520	Adj	Kimble	Colorado	1820010000	C G H & P Inc	W Bear Creek	Irr	4				6/1/1911		67.8 Acre Tract
1521	Adj	Kimble	Colorado	1820000000	James Micheal Patton	W Bear Creek	Irr	11		5		5/19/1914		74 Acre Tract
1522	Adj	Kimble	Colorado	1819000000	Michael James Patton	W Bear Creek	Irr	18		5		6/1/1911		138.7 Acr Tr, 6/11/90
1523	Adj	Kimble	Colorado	1817000000	Alamo Freight Lines Inc	W Bear Creek	Irr	5				1/1/1945		203 Acre Tract
1524	Adj	Kimble	Colorado	1800000000	Rhapsody Building Inc	N Llano River	Irr	140		35		1/22/1904		Amend 7/17/89
1525	Adj	Kimble	Colorado	1782000000	William R Chapman et ux	N Llano River	Irr	20				1/1/1963		
1526	Adj	Kimble	Colorado	1780000000	Don Baugh et al	N Llano River	Irr	15				6/1/1911		41.7 Acre Tract
1529	Adj	Kimble	Colorado	1740000000	Coke R Stevenson Jr	S Llano River	Irr	10				1/1/1911		
1530	Adj	Kimble	Colorado	1720000000	Marguerite K & Jane Stevenson	Christmas Spring	Irr	25		1		1/1/1895		
1531	Adj	Kimble	Colorado	1710000000	Little Paint Creek Ranch	S Llano River	Irr	9				1/1/1910		467.2 Acre Tract
1532	Adj	Kimble	Colorado	1700000000	Little Paint Creek Ranch	Ltl Paint Creek	Irr	88		11		1/1/1910		480 Acre Tract
1533	Adj	Kimble	Colorado	1680000000	Charles R Brightwell	S Llano River	Irr	86		1		1/1/1881		800 Acre Tract
1533	Adj	Kimble	Colorado	1680000000	Charles R Brightwell	S Llano River	Irr	79				7/1/1964		
1534	Adj	Kimble	Colorado	1660000000	W E Hooks Jr	S Llano River	Irr	120				1/1/1911		642.8 Acre Tract
1535	Adj	Kimble	Colorado	1640000000	Francis Marie Coleman	Cajac Creek	Irr	12				1/1/1885		640 Acre Tract
1536	Adj	Kimble	Colorado	1610000000	Beryl Jane H Henderson	Cajac Creek	Irr	4		1		1/1/1883		271 Acre Tract
1537	Adj	Kimble	Colorado	1594000000	Little Paint Creek Ranch	Cajac Creek	Irr	279				1/1/1883		593.6 Acre Tract
1538	Adj	Kimble	Colorado	1592500000	W E Hooks Jr	S Llano River	Irr	25				1/1/1893		108.33 Acre Tract
1539	Adj	Kimble	Colorado	1590000000	John F Younger	S Llano River	Irr	134				1/1/1964		
1540	Adj	Kimble	Colorado	1585000000	Mitchell Chuoke Plumbing Co	Bailey Creek	Irr	13		8		1/1/1908		
1541	Adj	Kimble	Colorado	1584000000	Bobbie Hunger	Bailey Creek	Irr	8.33		1		1/1/1940		On 286.5 Acres. Jointly Owns Res
1541	Adj	Kimble	Colorado	1584000000	Boyce Hunger	Bailey Creek	Irr	7.67				1/1/1940		On 263.5 Acres. Jointly Owns Res

Table 3B-9 Water Rights in Kimble County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1542	Adj	Kimble	Colorado	1583000000	Mrs Temple M Reynolds	S Llano River	Irr	21				1/1/1935		89.44 Acre Tract
1543	Adj	Kimble	Colorado	1582000000	Janis Watson Kirby	S Llano River	Irr	29				1/1/1919		89.44 Acre Tract
1544	Adj	Kimble	Colorado	1581000000	Raymond P James	S Llano River	Irr	2				1/1/1953		24.1 Acre Tract
1545	Adj	Kimble	Colorado	1580000000	Wanda Jenson	S Llano River	Irr	2				1/1/1935		14.04 Acre Tract-Rate Also for 1546-7-8
1546	Adj	Kimble	Colorado	1579020000	James Grover et ux	S Llano River	Irr	2				1/1/1935		13.14 Acre Tract, See 1545 For Rate
1547	Adj	Kimble	Colorado	1579010000	Theola Roper	S Llano River	Irr	2				1/1/1935		9.96 Acre Tract, See 1545 for Rate
1548	Adj	Kimble	Colorado	1579000000	Robert Hunger Jr	S Llano River	Irr	2				1/1/1935		9.35 Acre Tract, See 1545 for Rate
1549	Adj	Kimble	Colorado	1578000000	Mrs J Fred Burt	S Llano River	Irr	34				1/1/1913		
1550	Adj	Kimble	Colorado	1577200000	Thomas J Gass et ux	S Llano River	Irr	13.592				1/1/1953		
1550	Adj	Kimble	Colorado	1577200000	Bert Richard Bowen et ux	S Llano River	Irr	0.505				1/1/1953		
1550	Adj	Kimble	Colorado	1577200000	John R Klaische et ux	S Llano River	Irr	0.505				1/1/1953		Chg of Ownership Will be Sent in 6/2003
1550	Adj	Kimble	Colorado	1577200000	Earl Amundsen et ux	S Llano River	Irr	0.437				1/1/1953		
1550	Adj	Kimble	Colorado	1577200000	Jon Kenley Neal et ux	S Llano River	Irr	0.036				1/1/1953		
1550	Adj	Kimble	Colorado	1577200000	Micheal House	S Llano River	Irr	0.067				1/1/1953		
1550	Adj	Kimble	Colorado	1577200000	Marsha A Henke et al	S Llano River	Irr	8.858				1/1/1953		
1551	Adj	Kimble	Colorado	1577010000	Mason National Bank	S Llano River	Irr	12				1/1/1953		100 Acre Tract
1552	Adj	Kimble	Colorado	1575750000	Franklin Stuart McGinney et ux	S Llano River	Irr	23.5				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Eldon R Kaker et al	S Llano River	Irr	3.851				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Willis Ray Bynum et ux	S Llano River	Irr	3.917				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Troy Scott Burton et ux	S Llano River	Irr	3.917				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Peggy Jane Meacham Sanders	S Llano River	Irr	3.917				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Raldo Beal Meacham	S Llano River	Irr	3.917				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Jim Bell Meacham et ux	S Llano River	Irr	3.917				1/1/1951		
1552	Adj	Kimble	Colorado	1575750000	Texas Dept of Transportation	S Llano River	Irr	0.064				1/1/1951		
1553	Adj	Kimble	Colorado	1575600000	Pierce Hoggett	S Llano River	Irr	10				5/1/1964		21.98 Acre Tract
1554	Adj	Kimble	Colorado	1575500000	E Hugh Doyal	S Llano River	Irr	21				1/1/1963		14.69 Acre Tract
1555	Adj	Kimble	Colorado	1561000000	Bobby Don Blackburn	S Llano River	Irr	83				1/1/1912		
1556	Adj	Kimble	Colorado	1560000000	Junction ISD	S Llano River	Irr	25				3/22/1904		Amended 7/10/98, 9/29/99: Chg Div Pt
1556	Adj	Kimble	Colorado	1558000000	Junction ISD	S Llano River	Irr					3/22/1904		Amended 7/10/98, 9/29/99: Chg Div Pt
1556	Adj	Kimble	Colorado	1551700000	Junction ISD	S Llano River	Irr					3/22/1904		Amended 7/10/98, 9/29/99: Chg Div Pt
1556	Adj	Kimble	Colorado	1560000000	South Llano Farm Ltd	S Llano River	Irr	437				3/22/1904		Amended 7/10/98
1556	Adj	Kimble	Colorado	1508200000	Tommie Murr	S Llano River	Irr	50				3/22/1904		Amended 7/10/98.Different POFD.Junior Pr
1557	Adj	Kimble	Colorado	1551700000	South Llano Farm Ltd	S Llano River	Irr	288				3/22/1904		Div Rate With 1556-6 (6.02 Max Total)
1558	Adj	Kimble	Colorado	1553000000	Joseph L Benham et al	S Llano River	Irr	76				1/1/1954		330 Acre Tract
1559	Adj	Kimble	Colorado	1545000000	Mrs Hoy Smith	S Llano River	Irr	43				1/1/1910		119 Acre Tract
1560	Adj	Kimble	Colorado	1509500000	Dixie Jetton Hunt	S Llano River	Irr	196				1/1/1920		1076.99 Acre Tract
1561	Adj	Kimble	Colorado	1530000000	D Lloyd & Don K Henderson	S Llano River	Irr	1				7/31/1951		12/5/80 Correct Err.2001:No Longer Owns
1562	Adj	Kimble	Colorado	1510000000	James E Smith Estate	S Llano River	Irr	97				1/1/1910		73.32 Acre Tract; SC; Amend 4/15/02
1563	Adj	Kimble	Colorado	1508000000	Shelton J & Opal P Dickinson	S Llano River	Irr	8				1/1/1896		28.515 Acre Tract
1564	Adj	Kimble	Colorado	1507600000	William W Bivins III et ux	S Llano River	Irr	2				1/1/1953		10 Acre Tract; Amend 2/6/95
1564	Adj	Kimble	Colorado	1507600000	August Lee Simon et ux	S Llano River	Irr	6				1/1/1953		Amend 2/6/95
1565	Adj	Kimble	Colorado	1490000000	David O & Sally Beth Teel	S Llano River	Irr	7				4/1/1969		
1566	Adj	Kimble	Colorado	1480000000	Preston L Adams et al	S Llano River	Irr	45				1/1/1966		21.12 Acre Tract
1567	Adj	Kimble	Colorado	1460000000	Donald H Lewis et ux	S Llano River	Irr	43				1/1/1928		21.15 Acre Tract
1568	Adj	Kimble	Colorado	1445000000	Carl O Burton et al	Cedar Creek	Irr	12				1/1/1919		146 Acre Tract
1569	Adj	Kimble	Colorado	1440000000	Alton L Tondre Jr et al	Cedar Creek	Irr	39				1/1/1895		Switched et al 2/25/2002
1570	Adj	Kimble	Colorado	1390000000	City of Junction	S Llano River	Mun	1000				5/17/1931		Amend 2/9/87. Use 3 Expired 12/31/97.
1570	Adj	Kimble	Colorado	1390000000	City of Junction	S Llano River	Rec			300		11/23/1964	Lake Junction	
1571	Adj	Kimble	Colorado	1376000000	Weirich Bros Inc	Llano River	Mine	40				5/1/1910		Amend 11/8/94; Amend Exp 11/8/2004
1571	Adj	Kimble	Colorado	1376000000	Weirich Bros Inc	Llano River	Ind			35		5/1/1966		Circulation Thru Off-Channnel for Fish H
1572	Adj	Kimble	Colorado	1371100000	Weirich Brothers Inc	Llano River	Mine	60				2/2/1976		
1573	Adj	Kimble	Colorado	1369000000	Murpo Industries Inc	Llano River	Irr	15				6/18/1912		110 Acre Tract
1574	Adj	Kimble	Colorado	1368000000	Effie Roy Felps	Llano River	Irr	49				6/18/1912		
1575	Adj	Kimble	Colorado	1366500000	W C Oliver	Llano River	Irr	88				1/1/1947		
1576	Adj	Kimble	Colorado	1366000000	Marvin Blackburn Jr	Llano River	Irr	50				1/1/1910		146.1 Acre Tract
1577	Adj	Kimble	Colorado	1365500000	John Evans	Llano River	Irr	28				1/1/1904		320 Acre Tract
1578	Adj	Kimble	Colorado	1362000000	Bill I Neiman et ux	Llano River	Irr	136.05				12/1/1967		
1578	Adj	Kimble	Colorado	1362000000	Herbert P Haasch et ux	Llano River	Irr	13.95				12/1/1967		
1579	Adj	Kimble	Colorado	1360000000	Huggins Interests, Ltd	Llano River	Irr	78				12/22/1914		
1580	Adj	Kimble	Colorado	1350100000	E M Huggins Indep Exec	Llano River	Irr	36				1/1/1911		
1581	Adj	Kimble	Colorado	1350010000	Huggins Interests, Ltd	Llano River	Irr	72				1/1/1911		
1582	Adj	Kimble	Colorado	1349910000	Seven C's Pecan Orchard Inc	Llano River	Irr	56				1/1/1911		
1583	Adj	Kimble	Colorado	1349920000	Seven C's Pecan Orchard Ltd	Llano River	Irr	119				1/1/1911		See 1582 for Rate

Table 3B-9 Water Rights in Kimble County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1584	Adj	Kimble	Colorado	1349900000	Joana Elizabeth Laake	Llano River	Irr	50				1/1/1911		See 1582 for Rate
1585	Adj	Kimble	Colorado	1347000000	Two Star Development Inc	Llano River	Irr	2				1/1/1966		201.08 Acre Tract
1586	Adj	Kimble	Colorado	1345000000	Louis & Ann Lumbley	Llano River	Irr	39				1/1/1911		
1587	Adj	Kimble	Colorado	1344000000	Charles L Brewster et al	Llano River	Irr	9.352				1/1/1912		
1587	Adj	Kimble	Colorado	1344000000	Charles R Timm	Llano River	Irr	2.648				1/1/1912		
1588	Adj	Kimble	Colorado	1343000000	Dennis Fusilier	Llano River	Irr	3				1/1/1912		
1589	Adj	Kimble	Colorado	1320000000	Paul A & Lois R Davis	Johnson Fork	Irr	50				10/28/1914		853.3 Acre Tract
1589	Adj	Kimble	Colorado	1320000000	Paul A & Lois R Davis	Johnson Fork	Irr			29		1/1/1960		3 Impoundments
1590	Adj	Kimble	Colorado	1317200000	Ernest E Jones Jr et al	Joy Creek	Irr	8				1/1/1912		134.3 Acre Tract
1591	Adj	Kimble	Colorado	1316000000	C P Porter	Joy Creek	Irr	28		20		1/2/1900		89.7 Acre Tract - 2 Res
1592	Adj	Kimble	Colorado	1310000000	C P Porter	Johnson Fork	Irr	15				6/27/1914		
1593	Adj	Kimble	Colorado	1305000000	Claude H Bennett et ux	Johnson Fork	Irr	2				2/12/1904		
1593	Adj	Kimble	Colorado	1305000000	C P Porter	Johnson Fork	Irr	50.983				2/12/1904		
1593	Adj	Kimble	Colorado	1305000000	James Fred Porter	Johnson Fork	Irr	17.86				2/12/1904		
1593	Adj	Kimble	Colorado	1305000000	Bert F Winston Jr	Johnson Fork	Irr	5				2/12/1904		
1593	Adj	Kimble	Colorado	1305000000	Donald M Wreyford, et ux	Johnson Fork	Irr	6.157				2/12/1904		
1594	Adj	Kimble	Colorado	1302100000	C A Bierschwale	Johnson Fork	Irr	48				2/12/1904		70.2 Acre Tract
1595	Adj	Kimble	Colorado	1302070000	Jon R Wilson et ux	Johnson Fork	Irr	3				2/12/1904		9.62 Acre Tract
1596	Adj	Kimble	Colorado	1302050000	Carlton A. Bierschwale	Johnson Fork	Irr	49				2/12/1904		44.7 Acre Tract
1597	Adj	Kimble	Colorado	1302000000	Segovia Inc	Johnson Fork	Irr	20				2/12/1904		47.28 Acre Tract
1598	Adj	Kimble	Colorado	1301000000	Clayton Murr	Johnson Fork	Irr	75		12		2/12/1904		125.85 Acre Tract
1599	Adj	Kimble	Colorado	1267000000	Clayton Murr	Johnson Fork	Irr	30				1/1/1962		136.82 Acre Tract
1600	Adj	Kimble	Colorado	1264000000	Murpaks Inc	Johnson Fork	Ind	810		4.6		6/1/1970		
1600	Adj	Kimble	Colorado	1264000000	Murpaks Inc	Johnson Fork	Ind	1654				1/7/1974		
1601	Adj	Kimble	Colorado	1261000000	Hollis Phillips	Johnson Fork	Irr	3.59				10/1/1965		
1601	Adj	Kimble	Colorado	1261000000	Vincent Gate Bounds et ux	Johnson Fork	Irr	34.41				10/1/1965		
1602	Adj	Kimble	Colorado	1260000000	Gladys G Koerth	Johnson Fork	Irr	16				4/17/1913		426.274 Acre Tract
1603	Adj	Kimble	Colorado	1258000000	Charles E Trefflich III	Johnson Fork	Irr	10		9		6/1/1967		65.6 Acre Tract
1604	Adj	Kimble	Colorado	1199050000	David H Segrest	Johnson Fork	Irr	150				6/1/1903		
1605	Adj	Kimble	Colorado	1220000000	Texas-New Mexico Pipeline Co	Johnson Fork	Ind	2				5/11/1942		
1606	Adj	Kimble	Colorado	1210000000	Janice Ruth Low Guthrie	Johnson Fork	Irr	3				5/27/1914		
1607	Adj	Kimble	Colorado	1199100000	Gwyn House	Johnson Fork	Irr	4				5/27/1914		
1608	Adj	Kimble	Colorado	1195500000	Cecil C Scott Jr	Llano River	Irr	16				1/1/1913		79.54 Acre Tract
1609	Adj	Kimble	Colorado	1195450000	S M & Lorene B Rowe	Gentry	Irr	15				1/1/1913		369 Acre Tract
1610	Adj	Kimble	Colorado	1195420000	Mary G Watkins Tax Free Trust	Llano River	Irr	61				5/10/1913		
1611	Adj	Kimble	Colorado	1195400000	Deborah Sue Badgwell et al	Llano River	Irr	8				1/1/1966		50.3 Acre Tract
1612	Adj	Kimble	Colorado	1184650000	Frank Wootan	Llano River	Irr	21				1/1/1965		51.04 Acre Tract
1613	Adj	Kimble	Colorado	1184000000	Ruth C Terrell	Llano River	Irr	12				1/1/1966		Amend 11/27/90
1614	Adj	Kimble	Colorado	1183250000	Arthur A Price Jr	Llano River	Irr	118				1/1/1959		
1615	Adj	Kimble	Colorado	1183000000	Roy L Cooper et ux	Llano River	Irr	1				1/1/1953		Amended 8/16/2001:Add Div Pt
1615	Adj	Kimble	Colorado	1183000000	Clifton Don Knotts et ux	Llano River	Irr	10				1/1/1953		Amended 8/16/2001:Add Div Pt
1615	Adj	Kimble	Colorado	1183000000	Charles W Swift et ux	Llano River	Irr	25				1/1/1953		Amended 8/16/2001:Add Div Pt
1615	Adj	Kimble	Colorado	1183000000	Marie C Robinson	Llano River	Irr	35				1/1/1953		
1615	Adj	Kimble	Colorado	1183000000	Jerry D Wootan et ux	Llano River	Irr	20				1/1/1953		
1616	Adj	Kimble	Colorado	1182500000	Joseph W Luchini	Llano River	Irr	300				1/1/1935		200 Acre Tract
1617	Adj	Kimble	Colorado	1182010000	Delton Stewart	Llano River	Irr	10				1/1/1950		190.91 Acre Tract
1618	Adj	Kimble	Colorado	1182000000	Watt O & Vernell Crow	Llano River	Irr	28				1/1/1965		69.16 Acre Tract
1619	Adj	Kimble	Colorado	1181800000	Chester H Ivey et ux	Llano River	Irr	17.4				1/1/1965		
1619	Adj	Kimble	Colorado	1181800000	Melvin M Hull	Llano River	Irr	7.77				1/1/1965		
1619	Adj	Kimble	Colorado	1181800000	Harvey Hull	Llano River	Irr	3.83				1/1/1965		
1620	Adj	Kimble	Colorado	1181750000	Chester H Ivey	Llano River	Irr	8				1/1/1965		
1621	Adj	Kimble	Colorado	1181250000	C B Robinson	Llano River	Irr	30				1/1/1966		382.69 Acre Tract
1622	Adj	Kimble	Colorado	1181000000	Robert F McKinney	Llano River	Irr	20				1/1/1956		105.52 Acre Tract
1623	Adj	Kimble	Colorado	1180010000	Frederick Erck et ux	Llano River	Irr	400				1/1/1907		
1624	Adj	Kimble	Colorado	1180000000	Frederick Erck et ux	Llano River	Irr	1740				1/1/1907		
1625	Adj	Kimble	Colorado	1179800000	Robert D. Weitz et ux	Llano River	Irr	3				1/1/1963		18 Acre Tract
1626	Adj	Kimble	Colorado	1179000000	Raymond Pfluger Trust No. 1	Llano River	Irr	37.37				4/6/1966		
1626	Adj	Kimble	Colorado	1179000000	Robert D Weitz et ux	Llano River	Irr	52.63				4/6/1966		
1627	Adj	Kimble	Colorado	1177800000	Stirling Greenlee	E Fork James	Irr	3.66				1/1/1964		
1627	Adj	Kimble	Colorado	1177800000	Spring Canyon Ranches Ltd	E Fork James	Irr	14.34				1/1/1964		
1628	Adj	Kimble	Colorado	1177550000	Darla Anderegg Barker et al	E Fork James	Irr	153		27		1/1/1961		

Table 3B-9 Water Rights in Kimble County (continued)

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom			
Ind	3	2466	39.6
Irr	134	8490	254
Mine	2	100	
Mun	1	1000	
Rec	1		300
Other			
Total	**141**	**12056**	**593.6**

Table 3B-10
Water Rights in Martin County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
5457	Permit	Martin	Colorado	8625500000	Colorado River MWD	Sulphur Spring	Irr	2500		7997		4/1/1993	Sulphur Draw Res	& Mining Use
5457	Permit	Martin	Colorado	8625500000	Colorado River MWD	Sulphur Spring	Other			9150	Complete Constr Red Lake Levee by 2005	4/1/1993	Red Lake Off-Chan Res	Water Quality Control

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	1	2500	7997
Mine			
Mun			
Rec			
Other	1		9150
Total	1	**2500**	**17147**

Table 3B-11
Water Rights for Mason County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1629	Adj	Mason	Colorado	1177500000	Emeth Keller	Llano River	Irr	53				3/1/1954		640 Acre Tract
1630	Adj	Mason	Colorado	1177000000	Rick B Yeager et ux	Llano River	Irr	75				6/1/1955		
1631	Adj	Mason	Colorado	1176900000	Operation Orphans Inc	Llano River	Irr	15				1/1/1967		Also Rec - 320 Acre Tract
1633	Adj	Mason	Colorado	1176800000	Kerry Kordizik	Threadgill	Irr	3				5/1/1967		160 Acre Tract
1634	Adj	Mason	Colorado	1176600000	Everett George Brannies et al	Beaver Creek	Irr	38		6		4/1/1952	Beaver Creek	550 Acre Tract
1635	Adj	Mason	Colorado	1176510000	Franklin W Brandenberger	Beaver Creek	Irr	4				4/1/1967		179.067 Acre Tract
1636	Adj	Mason	Colorado	1176000000	Durst Cattle Co	Dog Branch	Irr	1		1		5/20/1974		0.5 Af Res, 341 Acre Tract
1637	Adj	Mason	Colorado	1175960000	Roy C Lehmberg	Llano River	Irr	58		4		1/1/1950		700.44 Acre Tract
1639	Adj	Mason	Colorado	1175940000	Joan Leifeste Kettner	Llano River	Irr	32		25		3/29/1976		100 Acre Tract, 11/25/91
1640	Adj	Mason	Colorado	1175850000	Herman Settemeyer	Llano River	Irr	45				8/5/1965		500.4 Acre Tract
1641	Adj	Mason	Colorado	1175800000	John Harold Schuessler	Llano River	Irr	24				1/1/1945		203 Acre Tract
5275	Permit	Mason	Colorado	1177200000	Keith D Graham Jr et ux	Llano River	Irr	40				2/26/1990		GW, Amend 10/15/91

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	12	388	36
Mine			
Mun			
Rec			
Other			
Total	**12**	**388**	**36**

Table 3B-12
Water Rights in McCulloch County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1843	Adj	McCullogh	Colorado	3630500000	Gray T V Ranch Ltd	San Saba River	Rec			15		5/20/1974		
1844	Adj	McCullogh	Colorado	3630000000	Carolyn Sue Graham et vir	San Saba River	Irr	30		10		11/1/1955		
1845	Adj	McCullogh	Colorado	3620000000	Hazle Burwell & Pauline Donley	San Saba River	Irr	64				10/13/1914		
1846	Adj	McCullogh	Colorado	3599000000	Peggy Owens and Jack Edmiston	Lost Creek	Irr	36				8/1/1963		
1849	Adj	McCullogh	Colorado	3565000000	City of Brady	Brady Creek	Mun	3500		30000		9/2/1959	Brady Creek Res	Amended 09/06/2001:Change to Multi-use
1849	Adj	McCullogh	Colorado	3565000000	City of Brady	Brady Creek	Ind					9/2/1959	Brady Creek Res	Amended 09/06/2001:Change to Multi-use
1850	Adj	McCullogh	Colorado	3563000000	Bernice Koy	Bowie Creek	Irr	90		175		3/30/1964		
1851	Adj	McCullogh	Colorado	3560900000	K D Vineyard	Brady Creek	Irr	121				1/1/1964		
1852	Adj	McCullogh	Colorado	3561000000	Moneta Jones Williamson	Brady Creek	Irr	8				1/1/1955		
1853	Adj	McCullogh	Colorado	3560000000	City of Brady	Brady Creek	Rec			45		9/23/1914		
1854	Adj	McCullogh	Colorado	3547000000	Nancy D Howard	Brady Creek	Irr	40		30		1/1/1948		273.87 Acre Tract
2479	Adj	McCullogh	Colorado	4951100000	K & B Powell Family Limited Partnr	Colorado River	Irr	117				11/25/1912		AM 12/94.Comb 122 OF 239Af w/2488 6/2001
2479	Adj	McCullogh	Colorado	4951100000	Stover Ranch-TX LP	Colorado River	Irr	290				11/25/1912		Amended 12/5/94
2479	Adj	McCullogh	Colorado	4951100000	Larry W Walker	Colorado River	Irr	35				11/25/1912		Amended 12/5/94; 2 Diversion Pts.
2479	Adj	McCullogh	Colorado	4951100000	Dana Collins Travis	Colorado River	Irr	59.75				11/25/1912		To be Amended
2479	Adj	McCullogh	Colorado	4951100000	John Patrick Collins	Colorado River	Irr	59.75				11/25/1912		To be Amended
2479	Adj	McCullogh	Colorado	4951100000	William Christopher Collins	Colorado River	Irr	59.75				11/25/1912		To be Amended
2479	Adj	McCullogh	Colorado	4951100000	Shelly Collins Kolle	Colorado River	Irr	59.75				11/25/1912		To be Amended
2482	Adj	McCullogh	Colorado	4950850000	Randel D Brookings et ux	Colorado River	Irr	104				12/31/1948		
2483	Adj	McCullogh	Colorado	4950840000	Randel D Brookings et ux	Colorado River	Irr	146				12/31/1951		
2484	Adj	McCullogh	Colorado	4950830000	Bobby Miller Goodson et ux	Colorado River	Irr	34				2/28/1965		
2485	Adj	McCullogh	Colorado	4950810000	Neyland McCrary et ux	Colorado River	Irr	36				2/28/1965		See 14-2484 Rate
2486	Adj	McCullogh	Colorado	4950800000	Bobby Crider et al	Colorado River	Irr	48				2/28/1965		
2487	Adj	McCullogh	Colorado	4950770000	Berryman M Breining	Colorado River	Irr	62				2/28/1965		
2491	Adj	McCullogh	Colorado	4950620000	Johnny S Chandler	Colorado River	Irr	70				12/31/1939		
2491	Adj	McCullogh	Colorado	4950620000	Randall Gardner et ux	Colorado River	Irr	64				12/31/1939		
2494	Adj	McCullogh	Colorado	4950400000	John T McCutcheon	Colorado River	Irr	270				12/31/1952		
2510	Adj	McCullogh	Colorado	4889500000	Mildred A. Bond	Colorado River	Irr	79				12/31/1954		
2511	Adj	McCullogh	Colorado	4884500000	Sam McCollum III	Colorado River	Irr	166				12/31/1907		
2512	Adj	McCullogh	Colorado	4880000000	Phillip R Lane et al	Dry Prong	Irr	80		157		3/23/1951		
4544	Permit	McCullogh	Colorado	4883000000	Joan Eckert et al	Deep Creek	Rec					2/26/1985		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom			
Ind	1		
Irr	19	2229	372
Mine			
Mun	1	3500	30000
Rec	3		60
Other			
Total	**24**	**5729**	**30432**

Table 3B-13
Water Rights in Menard County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1767	Adj	Menard	Colorado	4179000000	L W Hirschfeld et al	San Saba River	Irr	8				1/1/1969		81.1 Acre Tract
1768	Adj	Menard	Colorado	4170000000	Boy Scouts- Concho Valley	San Saba River	Irr	50				1/1/1967		2 Tracts 146.33 Acres
1769	Adj	Menard	Colorado	4160000000	Herbert H Mears Jr	San Saba River	Irr	125				6/22/1914		
1770	Adj	Menard	Colorado	4140000000	Olivia Bevans	San Saba River	Irr	60				6/23/1914		
1771	Adj	Menard	Colorado	4120000000	Olivia Bevans	San Saba River	Irr	126				3/13/1916		143 Acre Tract
1772	Adj	Menard	Colorado	4090000000	Sammie Jeanne Espy Trustee	San Saba River	Irr	60				6/23/1914		
1773	Adj	Menard	Colorado	4098000000	Sammie Jeanne Espy Trustee	Rocky Creek	Irr	260		24		1/1/1922		161-San Saba, 99-Rocky, 3 POFD
1774	Adj	Menard	Colorado	4085300000	W L Goode et ux	San Saba River	Irr	2.835				1/1/1964		
1774	Adj	Menard	Colorado	4085300000	Charles A Pratt et ux	San Saba River	Irr	0.165				1/1/1964		
1775	Adj	Menard	Colorado	4085200000	RR Herrell Properties Ltd	San Saba River	Irr	17				1/1/1954		80 Acre Tract
1776	Adj	Menard	Colorado	4084900000	Carolyn Dawson	San Saba River	Irr	4				1/1/1915		247 Acres
1776	Adj	Menard	Colorado	4084900000	Paula Hughes	San Saba River	Irr	4				1/1/1915		247 Acres
1777	Adj	Menard	Colorado	4084210000	Margaret Carroll	Clear Creek	Irr	41.47				8/19/1974		Irr Out of 25.5 Ac Portion of 77.49 Ac
1777	Adj	Menard	Colorado	4084210000	Addison Lee Pfluger	Clear Creek	Irr	84.53				8/19/1974		Amend 6/5/98: Multiple Diversion Points
1778	Adj	Menard	Colorado	4084000000	James L. Powell	Clear Creek	Irr	180		300		1/1/1939		160 Acre Tract
1779	Adj	Menard	Colorado	4083000000	Marvin Goetz Trustee	Clear Creek	Irr	24.42		8.14		1/1/1882		25.91 Acre Tract; Shares Div Pt w/1780
1779	Adj	Menard	Colorado	4083000000	Bobby Dean Williams	Clear Creek	Irr	23.58		7.86		1/1/1882		25.91 Acre Tract; Shares Div Pt w/1780
1780	Adj	Menard	Colorado	4083010000	Frances Grobe	Clear Creek	Irr	6				1/1/1882		Shares Div Pt w/ 1779
1781	Adj	Menard	Colorado	4080100000	James L. Powell	San Saba River	Irr	46				6/26/1914		Amend 4-15-82 Incr Acres Irr-160 Ac Tr
1782	Adj	Menard	Colorado	4059000000	Gloria Kieschnick McKay et vir	San Saba River	Irr	31				1/1/1896		
1783	Adj	Menard	Colorado	4058500000	Winnie Neel	San Saba River	Irr	200				1/1/1904		
1784	Adj	Menard	Colorado	4058000000	Alice Ellis Lee	San Saba River	Irr	108				6/26/1914		
1785	Adj	Menard	Colorado	4057500000	Helen V. S. Slaughter, et al	San Saba River	Irr	69				1/1/1956		92.5 Acre Tract
1786	Adj	Menard	Colorado	4040000000	James S. McBee, et ux	San Saba River	Irr	48				6/20/1914		51.1 Acre Tract
1787	Adj	Menard	Colorado	3984000000	Lynell Ellis Wheless	San Saba River	Irr	122				6/18/1914		156.5 Acre Tract
1788	Adj	Menard	Colorado	3980000000	James W Menzies	San Saba River	Irr	55				6/13/1914		99.2 Acre Tract
1789	Adj	Menard	Colorado	3985000000	Menard Irrigation Co	San Saba River	Irr	3228		50		3/29/1905		Divert 4890 Ac-Ft, 3 Tracts, Overlaps
1790	Adj	Menard	Colorado	3935010000	Billy Joe Haney, et ux	San Saba River	Irr	40				1/1/1899		90 Acre Tract
1791	Adj	Menard	Colorado	3935000000	Billy Joe & Mary Haney	San Saba River	Irr	26				1/1/1899		
1792	Adj	Menard	Colorado	3982000000	E A Bradford	San Saba River	Irr	43				1/1/1965		
1793	Adj	Menard	Colorado	3920000000	George Sultemeier et ux	San Saba River	Irr	250				6/27/1914		
1794	Adj	Menard	Colorado	3910080000	Steve Lemuel Holifield	San Saba River	Irr	32				6/13/1914		90 Acre Tract
1795	Adj	Menard	Colorado	3910020000	The Estate of William A Wright	San Saba River	Irr	177				1/1/1913		
1796	Adj	Menard	Colorado	3910010000	John R. Hill, et ux	San Saba River	Irr	59				1/1/1913		Same Diversion Pts as 14-1795
1797	Adj	Menard	Colorado	3910000000	Carl Kothman	San Saba River	Irr	17				1/1/1913		29.8 Acre Tract
1798	Adj	Menard	Colorado	3900100000	Kothmann Commission Co Inc	San Saba River	Irr	162				1/1/1895		
1799	Adj	Menard	Colorado	3900050000	Cameron M & Joanne C Wright	Las Moras Creek	Irr	12				5/18/1976		
1800	Adj	Menard	Colorado	3900041000	Barbara C Gibson	Las Moras Creek	Irr	21		21		10/25/1976		
1801	Adj	Menard	Colorado	3900020000	E E Lindley	Las Moras Creek	Irr	14				1/1/1925		
1802	Adj	Menard	Colorado	3900017000	Menard County	San Saba River	Irr	30				1/1/1946		27 Acre Tract
1803	Adj	Menard	Colorado	3880000000	City of Menard	San Saba River	Mun	1016		140		6/27/1914		Amended 10/18/83. Multiple Div Pts.
1803	Adj	Menard	Colorado	3880000000	City of Menard	San Saba River	Rec					6/27/1914		Amended 10/18/83. Multiple Div Pts.
1804	Adj	Menard	Colorado	3900000000	F. Wayne Pope	Celery Creek	Irr	55		24		10/15/1895		100 Acre Tract
1805	Adj	Menard	Colorado	3895000000	Horace Cooke	Celery Creek	Irr	65				10/15/1895	Trib of San Saba River	55 Acre Tract
1806	Adj	Menard	Colorado	3894000000	Morris L Strand et ux	Celery Creek	Irr	24.16				10/15/1895		
1806	Adj	Menard	Colorado	3894000000	Gary P Land et ux	Celery Creek	Irr	27.93				10/15/1895		
1806	Adj	Menard	Colorado	3894000000	Oatus K Green et ux	Celery Creek	Irr	27.91				10/15/1895		
1807	Adj	Menard	Colorado	3870000000	Mobley Company Inc	San Saba River	Mine	3				4/12/1970	Menard Co - San Saba River	
1808	Adj	Menard	Colorado	3860000000	L C Davis Jr et ux	San Saba River	Irr	23				1/1/1911		
1809	Adj	Menard	Colorado	3840100000	Richard F Spencer et ux	San Saba River	Irr	52				6/26/1914		29 Acre Tract, Same Div Pt as 14-1810
1810	Adj	Menard	Colorado	3840000000	Amy Laree Dickerson	San Saba River	Irr	60				6/26/1914		Same Diversion Point as 14-1809
1811	Adj	Menard	Colorado	3815000000	Jerry Mann Rambo	San Saba River	Irr	310				1/1/1892		
1812	Adj	Menard	Colorado	3837500000	Eddie Lee Nixon et ux	San Saba River	Irr	11				1/1/1955		
1812	Adj	Menard	Colorado	3837500000	Oatus K Green	San Saba River	Irr	13				1/1/1955		
1813	Adj	Menard	Colorado	3836000000	Shirley B Chenault	San Saba River	Irr	23				1/1/1925		46 Acre Tract
1814	Adj	Menard	Colorado	3835500000	James W Menzies	San Saba River	Irr	80				1/1/1912		
1815	Adj	Menard	Colorado	3833000000	Otis & Dionitia Lyckman	San Saba River	Irr	115				8/8/1893		
1815	Adj	Menard	Colorado	3833000000	Richard D Roll et al	San Saba River	Irr	50				8/8/1893		No Land Subject to Amendment
1816	Adj	Menard	Colorado	3822000000	Otis & Dionitia Lyckman	San Saba River	Irr	42				1/1/1882		
1817	Adj	Menard	Colorado	3810000000	L and A Ranch Company Inc	San Saba River	Irr	306		42		1/1/1963		

Table 3B-13 Water Rights in Menard County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1818	Adj	Menard	Colorado	3800030000	Raymond C Jaramillo et ux	San Saba River	Irr	23.57				6/26/1914		
1818	Adj	Menard	Colorado	3800030000	Jane Arnold Vaughan et al	San Saba River	Irr	23.68				6/26/1914		
1819	Adj	Menard	Colorado	3800010000	Donald Lee & Bobby M Huss	San Saba River	Irr	44				6/26/1914		34.2 Acre Tract, & Share POFD w/14-1818
1820	Adj	Menard	Colorado	3799000000	E James Holland et al	San Saba River	Irr	23				6/26/1914		21.162 Acre Tract
1821	Adj	Menard	Colorado	3790000000	Roger W Gilbert	San Saba River	Irr	165				1/1/1952		103.3 Acre Tract
1822	Adj	Menard	Colorado	3780000000	John Lee McWilliams et al	San Saba River	Irr	108				6/29/1914		224.5 Acre Tract
1823	Adj	Menard	Colorado	3779000000	Wanda Ellis Ellis	San Saba River	Irr	420				12/31/1931		
1823	Adj	Menard	Colorado	3678000000	M & M Partnership	San Saba River	Irr	10				12/31/1931		Junior to 10 Other WRs. Div Pt=3877-1
1823	Adj	Menard	Colorado	3678000000	Bill Doyle et ux	San Saba River	Irr	10				12/31/1931		Junior to 1823 Through 1836
1824	Adj	Menard	Colorado	3758000000	William Menzies Jr Estate	San Saba River	Irr	30				6/26/1914		105.88 Acre Tract
1825	Adj	Menard	Colorado	3760000000	Donald W Richardson et ux	San Saba River	Irr	105				6/6/1914		
1825	Adj	Menard	Colorado	3760000000	Donald W Richardson et ux	San Saba River	Irr	45				6/8/1914		
1826	Adj	Menard	Colorado	3755000000	Hampton Farming Company	San Saba River	Irr	180				6/26/1914		
1827	Adj	Menard	Colorado	3750000000	Bobby Jarvis et al	San Saba River	Irr	52				6/6/1914		86.5 Acre Tract, Same Pt of Div as 1828
1828	Adj	Menard	Colorado	3740000000	C Murff Hardy et ux	San Saba River	Irr	64				6/1/1914		86.5 Acre Tract, Same Pt of Div as 1827
1829	Adj	Menard	Colorado	3685000000	Douglas Phillips et ux	San Saba River	Irr	45		9		11/25/1974		100 Acre Tract
1830	Adj	Menard	Colorado	3680500000	Henry Phillips	San Saba River	Irr	15				1/1/1961		116.5 Acre Tract
1831	Adj	Menard	Colorado	3680010000	Live Oak Pine Enterprises, Inc	San Saba River	Irr	31				1/1/1904		271.67 Acre Tract
1832	Adj	Menard	Colorado	3677000000	Jimmy L Bray et ux	San Saba River	Irr	57				1/1/1904		30.48 Acre Tract
1833	Adj	Menard	Colorado	3670010000	Lonnie Jameson et ux	San Saba River	Irr	17				1/1/1904		25.58 Acre Tract
1834	Adj	Menard	Colorado	3670000000	Lonnie Jameson et ux	San Saba River	Irr	11				1/1/1904		
1835	Adj	Menard	Colorado	3669000000	Martha Anne Holmes et al	San Saba River	Irr	24				6/8/1914		34.18 Acre Tract
1836	Adj	Menard	Colorado	3668000000	Billy J Feathers et al	San Saba River	Irr	15				6/25/1914		
1836	Adj	Menard	Colorado	3668000000	Murray E Hill Jr et al	San Saba River	Irr	15				6/25/1914		
1837	Adj	Menard	Colorado	3667000000	Curtis C & Christine H Scott	San Saba River	Irr	14				6/8/1914		35.34 Acre Tract
1838	Adj	Menard	Colorado	3666000000	Douglas Phillips	San Saba River	Irr	12				6/25/1914		103.24 Acre Tract
1839	Adj	Menard	Colorado	3665000000	Gary B Brewer Sr et al	San Saba River	Irr	9				6/8/1914		
1840	Adj	Menard	Colorado	3660010000	Harlan E Blau et al	San Saba River	Irr	75				1/1/1895		
1841	Adj	Menard	Colorado	3645000000	Jerry M Baker et ux	San Saba River	Irr	125		40		2/19/1913		351 Acre Tract, Same POFD as 14-1842
1842	Adj	Menard	Colorado	3640010000	Charles Edwin Childrers et al	San Saba River	Irr	15				2/19/1913		Same POFD as 1841.Undivided 1/2 Interests

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom			
Ind			
Irr	74	8935.25	526
Mine	1	3	
Mun	1	1016	140
Rec	1		
Other			
Total	**77**	**9954.25**	**666**

Table 3B-14
Water Rights in Mitchell County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1009	Adj	Mitchell	Colorado	8643000000	TXU Electric Co	Champion Creek	Mun	5500		29934		11/22/1948	Lake Colorado City	Mun-Dom-Ind-S P P
1009	Adj	Mitchell	Colorado	8643000000	TXU Electric Co	Champion Creek	Mun	2700		40170		4/8/1957	Champion Creek Res	SC
1009	Adj	Mitchell	Colorado	8643000000	TXU Electric Co	Champion Creek	Ind	4050				4/8/1957	Champion Creek Res	
1010	Adj	Mitchell	Colorado	8640000000	Nathan C Hoyle et ux	Colorado River	Irr	93				6/27/1914		
3450	Permit	Mitchell	Colorado	8651010000	Daphne M Holt Testamentary Trust	North Fork Champion	Irr	30		15		5/19/1975		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind	1	4050	
Irr	2	123	15
Mine			
Mun	1	8200	70104
Rec			
Other			
Total	**4**	**12373**	**70119**

Table 3B-15
Water Rights in Pecos County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Class	Facility	Remarks
1179	Adj	Pecos	Rio Grande	6981000000	Ralph L. Lindsey Trust, et al	Barrilla Creek	Irr	200				6/1/1908			
1180	Adj	Pecos	Rio Grande	6980020000	Ralph L. Lindsey Trust, et al	Barrilla Creek	Irr	25				3/17/1917			
1181	Adj	Pecos	Rio Grande	6980010000	Ned Maddock	Barrilla Creek	Irr	160				3/17/1917			
1182	Adj	Pecos	Rio Grande	6980000000	Margaret Hayer Newton, et al	Barrilla Creek	Irr	90				3/17/1917			
1183	Adj	Pecos	Rio Grande	6960000000	Margaret Hayer Newton, et al	Barrilla Creek	Irr	176				2/17/1925			
5453	Adj	Pecos	Rio Grande	6365000000	Tassie Parker K Macuk et al	Coyanosa Draw	Irr	350				12/31/1941			
5454	Adj	Pecos	Rio Grande	6335000000	Tassie Parker K Macuk et al	Coyanosa Draw	Irr	40				12/31/1941			
5455	Adj	Pecos	Rio Grande	6320000000	Wayne Moore & W H Gilmore	Coyanosa Draw	Irr	18234				10/1/1914			
5456	Adj	Pecos	Rio Grande	5710000000	Pecos Co WCID No 1	Comanche Creek	Irr	25205		700		3/28/1913			Res also for Storage & Flood Control
5457	Adj	Pecos	Rio Grande	6100000000	Gerald D Lyda et ux	A-B Draw	Irr	3312				5/29/1915			
5457	Adj	Pecos	Rio Grande	6100000000	Gerald D Lyda et ux	A-B Draw	Irr	57.1				12/31/1915			
5458	Adj	Pecos	Rio Grande	6000000000	Gerald D Lyda et ux	A-B Draw	Irr	4438				5/29/1915			
5459	Adj	Pecos	Rio Grande	5960000000	Caramba Inc	Leon Creek	Irr	7540		2292		10/30/1915			
5460	Adj	Pecos	Rio Grande	5700000000	Gerald D Lyda et ux	Six Shooter Draw	Irr	800				5/19/1915			
5461	Adj	Pecos	Rio Grande	5680000000	Gerald D Lyda et ux	Six Shooter Draw	Irr	6275				5/29/1915			

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	14	66902.1	2992
Mine			
Mun			
Rec			
Other			
Total	**14**	**66902.1**	**2992**

Table 3B-16
Water Rights in Reeves County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Class	Facility	Remarks
60	Permit	Reeves	Rio Grande	7560000000	Reeves Co WID 1	Toyah Creek	Irr	41400		13583		10/5/1914		Lake Balmorhea	2 Res
235	Claim	Reeves	Rio Grande	7840000000	Reeves Co WID 1	Toyah Creek	Irr	45000				6/15/1914			
236	Claim	Reeves	Rio Grande	7840500000	Reeves Co WID 1	Toyah Creek	Irr	19950				6/19/1914			& Stockraising
645	Claim	Reeves	Rio Grande	7841000000	U S Bureau of Reclamation	Toyah Creek	Irr	36				6/20/1914			
645	Claim	Reeves	Rio Grande	7841000000	Joseph T Moore & J T Moore Inc	Toyah Creek	Irr					6/20/1914			
1184	Adj	Reeves	Rio Grande	6930000000	Hanging H Ranches Inc	Barrilla Creek	Irr	3600				1/1/1907			
1184	Adj	Reeves	Rio Grande	6930000000	Hanging H Ranches Inc	Barrilla Creek	Irr					1/1/1914			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water Power Control	Pecos River	Irr	292500		300000		1/1/1980		Red Bluff Res	COS 151, 238, 186
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water Power-Loving	Pecos River	Irr					4/11/1908			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Reeves WID 2	Pecos River	Irr					6/20/1908			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Ward WID 3	Pecos River	Irr					6/18/1906			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Ward WID 1	Pecos River	Irr					4/30/1988			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Ward WID 2	Pecos River	Irr					6/1/1990			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Ward WID 2	Pecos River	Irr					6/1/1990			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Pecos WID 2	Pecos River	Irr					1/1/1980			
5438	Adj	Reeves	Rio Grande	8480000000	Red Bluff Water-Pecos WID 3	Pecos River	Irr					1/1/1980			
5441	Adj	Reeves	Rio Grande	7780000000	R M Ranches	San Solomon Spring	Irr	595				12/1/1919			
5442	Adj	Reeves	Rio Grande	7780100000	R E Lyles Estate	San Solomon Spring	Irr	357				12/1/1919			
5443	Adj	Reeves	Rio Grande	7780200000	Hally D Oates	San Solomon Spring	Irr	833				12/1/1919			
5444	Adj	Reeves	Rio Grande	7760000000	Jack Hoffman	San Solomon Spring	Irr	422				6/20/1914			
5444	Adj	Reeves	Rio Grande	7760000000	RCS Inc	San Solomon Spring	Irr	160				6/20/1914			Amend 2/2/2001:Add Acres to be Irr
5445	Adj	Reeves	Rio Grande	7760500000	RCS Inc	San Solomon Spring	Irr	210				6/25/1914			
5446	Adj	Reeves	Rio Grande	7500000000	Reeves Co WID No 1	Sandia Creek	Irr	100				6/25/1914			Jointly owns 100 Af to Irr 30 Acres
5446	Adj	Reeves	Rio Grande	7500000000	Ralph Merkle	Sandia Creek	Irr					6/25/1914			Jointly owns 100 Af to Irr 30 Acres
5447	Adj	Reeves	Rio Grande	7475000000	Don Weinacht et al	Sandia Creek	Irr	50				6/25/1914			40 Ac Tract; Divided 25.5% & 24.5% Twice
5448	Adj	Reeves	Rio Grande	7725000000	Joseph T Moore & J T Moore Inc	Toyah Creek	Irr	4344				6/15/1914			Jointly owns 4434 + 1890 Af: Irr & D&L
5448	Adj	Reeves	Rio Grande	7725000000	Joseph T Moore & J T Moore Inc	Toyah Creek	Dom	1890		96		11/2/1914			Maintain Water Levels in Stock Tanks
5448	Adj	Reeves	Rio Grande	7725000000	Teresa Davis Moore et al	Toyah Creek	Irr					11/2/1914			Jointly owns 4434 + 1890 Af: Irr & D&L
5448	Adj	Reeves	Rio Grande	7725000000	Martha Ellen Moore Lethco	Toyah Creek	Irr					11/2/1914			Jointly owns 4434 + 1890 Af: Irr & D&L
5449	Adj	Reeves	Rio Grande	7390000000	Crews Adams	Cox Draw	Irr	1920				3/20/1972			
5450	Adj	Reeves	Rio Grande	7361000000	John J Bush Estate	Toyah Creek	Irr	875				1/9/1909			

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom	1	1890	96
Ind			
Irr	16	412352	313583
Mine			
Mun			
Rec			
Other			
Total	**17**	**414242**	**313679**

Table 3B-17
Water Rights in Runnels County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1000	Adj	Runnels	Colorado	7376000000	Woodrow Wilson et al	Colorado River	Irr	59				6/1/1964		353-Ac Tract Conrad Erben SUR
1011	Adj	Runnels	Colorado	7375000000	Rudolph A Hoffman et al	Colorado River	Irr	10				1/1/1938		Amend 1/12/82 Chg Div Pt & Place
1027	Adj	Runnels	Colorado	8415000000	Larry L Bryant et al	Colorado River	Irr	28				11/19/1913		306.9-Acre Tract
1028	Adj	Runnels	Colorado	8410000000	Claude N Sparks et al	Colorado River	Irr	80				1/1/1953		98-Acre Tract
1029	Adj	Runnels	Colorado	8190000000	Curtis Fletcher	Colorado River	Irr	95		120		5/31/1923		123-Acre Tract
1032	Adj	Runnels	Colorado	8320000000	Lanham M Carter	Oak Creek	Rec			83		3/19/1914		1/17/97: Impoundment Only. See 14-1132B
1033	Adj	Runnels	Colorado	8280000000	Annie Lois Borders Carlton	Oak Creek	Irr	17		21		2/2/1930		Amend 2/28/78. Jointly Owns 21 Af & Res
1033	Adj	Runnels	Colorado	8280000000	Cassandra Beth Wagner Robertson	Oak Creek	Irr	4				2/2/1930		Amend 2/28/78. Jointly Owns 21 Af & Res
1034	Adj	Runnels	Colorado	8220000000	Mancill Grant Lee et al	Oak Creek	Irr	80		50		10/23/1923		140-Acre Tract & 48.55-Acre Tract
1035	Adj	Runnels	Colorado	8180000000	Janell Ann Mucha	Colorado River	Irr	48		55		4/23/1917		122-Ac Tr, Same Res w/1036 & 1037 SC
1036	Adj	Runnels	Colorado	8160500000	John O Gurley III	Colorado River	Irr	30		55		1/1/1918		115-Ac Tr, Same Res w/1035 & 1037 SC
1037	Adj	Runnels	Colorado	8160000000	Martin Lee	Colorado River	Irr	195.6		55		4/1/1914		54.4-Ac Tract, Same Res w/1035 & 1036 SC
1037	Adj	Runnels	Colorado	8160000000	W L Caudle et ux	Colorado River	Irr	54.4				4/1/1914		195.6 Acre Tract
1038	Adj	Runnels	Colorado	8147000000	Michael D. Isham et ux	Colorado River	Irr	3				6/1/1967		15.4 Acre Tract
1039	Adj	Runnels	Colorado	8145000000	Alice V. Owens	Colorado River	Irr	34				1/1/1964		120.25 Ac Tr
1040	Adj	Runnels	Colorado	8140000000	Johnny P Lloyd Trust	Colorado River	Irr	300		21		6/22/1914	Res on Bull Hollow	
1041	Adj	Runnels	Colorado	8120000000	Lylie Currie	Colorado River	Irr	336				2/21/1914		2158.8-Acre Tract
1042	Adj	Runnels	Colorado	8100000000	Randall P Forse et ux	Colorado River	Irr	60				10/8/1917		120-Acre Tract
1043	Adj	Runnels	Colorado	8080000000	Michael M Egan et ux	Colorado River	Irr	168				7/14/1915		150-Acre Tract
1043	Adj	Runnels	Colorado	8080000000	Christopher Paul Piel	Colorado River	Irr	32				7/14/1915		
1044	Adj	Runnels	Colorado	8020000000	Donald Neal Spieker	Colorado River	Irr	110		55		2/19/1914		15.2-Ac Tr, Same Res w/1045
1045	Adj	Runnels	Colorado	8010000000	William J Cervenka	Colorado River	Irr	200		55		2/19/1914		125-Ac Tr, Same Res w/1044
1046	Adj	Runnels	Colorado	8000000000	Judy Frey	Colorado River	Irr	76		200		9/25/1914		Undivided 2/3 Interest in Dam & Res
1046	Adj	Runnels	Colorado	8000000000	Judy Frey	Colorado River	Irr	150				5/17/1954		Undivided 2/3 Interest in Dam & Res
1046	Adj	Runnels	Colorado	8000000000	Sarah J Buxkemper	Colorado River	Irr	38				9/25/1914		Undivided 1/3 Interest in Dam & Res
1046	Adj	Runnels	Colorado	8000000000	Sarah J Buxkemper	Colorado River	Irr	75				5/17/1954		Undivided 1/3 Interest in Dam & Res
1047	Adj	Runnels	Colorado	7960000000	Sarah J Buxkemper et al	Colorado River	Irr	80				6/20/1914		
1048	Adj	Runnels	Colorado	7920000000	Winton R Gray Jr	Colorado River	Irr	171				3/3/1914		99.5-Acre Tract
1049	Adj	Runnels	Colorado	7917900000	Raymond O & Dennis T Rohmfeld	Colorado River	Irr	31				1/1/1960		115-Ac Tr
1050	Adj	Runnels	Colorado	7811000000	Dennis T Rohmfeld et ux	Colorado River	Irr	14				1/1/1960		70-Acre Tract
1055	Adj	Runnels	Colorado	7866000000	H Lester Byrd	Valley Creek	Irr	21				1/1/1961		
1056	Adj	Runnels	Colorado	7864500000	O D Sumners et ux	Valley Creek	Irr	4				1/1/1952		60.19-Acre Tract
1057	Adj	Runnels	Colorado	7864000000	Barton E Rogers	Valley Creek	Irr	60				3/1/1967		
1058	Adj	Runnels	Colorado	7863700000	Jack Pritchard	Valley Creek	Irr	50				8/24/1966		167.5-Acre Tract
1059	Adj	Runnels	Colorado	7861000000	Jack Patton	Valley Creek	Irr	27				1/1/1968		220-Acre Tract
1060	Adj	Runnels	Colorado	7857000000	James D Hall et ux	Valley Creek	Irr	48				1/1/1962		
1062	Adj	Runnels	Colorado	7375500000	Woodrow Wilson et al	Colorado River	Irr	306				5/1/1927		685.4-Acre Tract
1063	Adj	Runnels	Colorado	7856950000	Jimmy Dane Bishop	Fish Creek	Irr	200				8/1/1962		2 Tracts, 195.2 Acres
1064	Adj	Runnels	Colorado	7856900000	Michael L Deike	Valley Creek	Irr	53				1/1/1963		113.57-Ac Tr
1065	Adj	Runnels	Colorado	7855000000	John S Belew	Valley Creek	Irr	55				5/1/1962		70-Acre Tract
1066	Adj	Runnels	Colorado	7854800000	Mary Denson	Valley Creek	Irr	5				1/1/1963		61-Acre Tract
1067	Adj	Runnels	Colorado	7854700000	Coy McNeill	Valley Creek	Irr	17				1/1/1958		56-Acre Tract
1068	Adj	Runnels	Colorado	7849000000	Carl A Gottschalk Jr	Valley Creek	Irr	33				1/1/1952		125.6-Ac Tr
1069	Adj	Runnels	Colorado	7848500000	A C Minzenmayer	Valley Creek	Irr	18				1/1/1956		247.4-Acre Tract
1070	Adj	Runnels	Colorado	7844000000	Dr Z. I. Hale Estate	Valley Creek	Irr	37				1/1/1956		140-Ac Tr
1071	Adj	Runnels	Colorado	7839000000	Lucius Evans	Valley Creek	Irr	17				1/3/1956		40-Acre Tract
1072	Adj	Runnels	Colorado	7812000000	City of Ballinger	Valley Creek	Mun	1000		6850		10/4/1946	Lake Ballinger, Moonen	800 A/F Lake Ballinger, 6050 Af Moonen
1073	Adj	Runnels	Colorado	7812010000	City of Ballinger	Valley Creek	Irr	40				4/6/1925		Amend 3/28/85
1074	Adj	Runnels	Colorado	7812020000	City of Ballinger	Valley Creek	Irr	50				11/3/1913		Amend 3/28/86
1075	Adj	Runnels	Colorado	7812050000	City of Ballinger	Valley Creek	Irr	36				2/7/1930		103-Ac Tr, Amend 3/28/85
1076	Adj	Runnels	Colorado	7806000000	Dennis T Rohmfeld et ux	Colorado River	Irr	14				1/1/1960		17-Acre Tract
1077	Adj	Runnels	Colorado	7805500000	E H Crawford et ux	Colorado River	Irr	119.43				11/3/1913		
1077	Adj	Runnels	Colorado	7805500000	Anthony G Huston et al	Colorado River	Irr	24.57				11/3/1913		
1078	Adj	Runnels	Colorado	7780000000	E H Crawford et ux	Colorado River	Irr	37.92				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Jim B Bradshaw et ux	Colorado River	Irr	0.16				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Guinevere McLarty	Colorado River	Irr	26.32				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Thomas Mell Young	Colorado River	Irr	2.9				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Gary B Worden et ux	Colorado River	Irr	2.9				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Jerry D Gibbs	Colorado River	Irr	2.9				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	John Timothy Nord	Colorado River	Irr	2.9				12/31/1966		
1078	Adj	Runnels	Colorado	7780000000	Danny R Fentress et ux	Colorado River	Irr	4				12/31/1966		
1079	Adj	Runnels	Colorado	7805000000	Galen A Moeller et al	Colorado River	Irr	35				1/1/1957		130-Ac Tr
1080	Adj	Runnels	Colorado	7800000000	Herbert Denton	Colorado River	Irr	5				11/25/1913		15.597-Acre Tract
1081	Adj	Runnels	Colorado	7669000000	J B Dankworth	Colorado River	Irr	45				11/25/1913		2 Tracts, 62.77 & 25 Acres
1082	Adj	Runnels	Colorado	7720000000	E H Dean	Colorado River	Irr	260				2/27/1914		142-Ac Tr

Table 3B-17 Water Rights in Runnels County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1083	Adj	Runnels	Colorado	7700000000	Ballinger Country Club Inc	Los Arroyos Creek	Irr	34		152		8/7/1972		& Rec, 85.5 Ac Tr
1084	Adj	Runnels	Colorado	7694000000	Kenneth Kump	Colorado River	Irr	9.18				2/27/1914		
1084	Adj	Runnels	Colorado	7694000000	Alfred P Frohlick et ux	Colorado River	Irr	90.82				2/27/1914		
1085	Adj	Runnels	Colorado	7692000000	Helen Marie Hovorak	Colorado River	Irr	119				1/7/1918		112-Ac Tr
1086	Adj	Runnels	Colorado	7691020000	Lewis O Woodward Jr	Colorado River	Irr	32				12/31/1928		50.49-Acre Tract, Amend 7/31/89, 11/25/91
1087	Adj	Runnels	Colorado	7691010000	Robert B Wilson et al	Colorado River	Irr	9				12/31/1928		60-Acre Tract
1091	Adj	Runnels	Colorado	7668000000	Herman Hallmark	Colorado River	Irr	120				2/27/1914		105.5-Ac Tr
1093	Adj	Runnels	Colorado	7667000000	Horace S Murphy III et al	Colorado River	Irr	19				1/1/1960		
1094	Adj	Runnels	Colorado	7640250000	Elaine Miller	Elm Creek	Irr	3				1/1/1959		40.62-Acre Tract
1095	Adj	Runnels	Colorado	7610000000	City of Winters	Elm Creek	Mun	1360		8347		12/18/1944		SC for Priority Dates-2/27/79 See Box
1095	Adj	Runnels	Colorado	7610000000	City of Winters	Elm Creek	Irr	395				12/18/1944		Amend 7/25/83
1096	Adj	Runnels	Colorado	7501250000	Luther L Minzenmayer et al	Coyote Creek	Irr	52				1/1/1954		Amend 5/1/2001:Move Div Pt Elm>Coyote
1097	Adj	Runnels	Colorado	7498000000	Clifford A Faubion	Elm Creek	Irr	53				1/1/1954		Jr in Priority to Some WRs. Amend 7/25/02
1098	Adj	Runnels	Colorado	7609000000	Herbert E Jacob	Elm Creek	Irr	38				4/1/1952		188.5-Acre Tract
1099	Adj	Runnels	Colorado	7608000000	Mrs Harris Davenport	Gap Creek	Irr	32				1/1/1964		
1100	Adj	Runnels	Colorado	7605750000	Keith M Collom et al	Elm Creek	Irr	38				1/1/1926		
1101	Adj	Runnels	Colorado	7605000000	Joseph Busenlehner Jr et ux	Elm Creek	Irr	20				4/1/1952		82-Ac Tract
1102	Adj	Runnels	Colorado	7604000000	Walter Adami	Elm Creek	Irr	76				1/1/1955		877-Ac Tract
1108	Adj	Runnels	Colorado	7570000000	Robert C. Davis et ux	Bluff Creek	Irr	1				7/9/1966		11.8-Ac Tr
1109	Adj	Runnels	Colorado	7560000000	Charles E Prewit	Adams Draw	Rec	200		200		6/25/1914		
1110	Adj	Runnels	Colorado	7555000000	Ionah Vinson	Adams Draw	Irr	16				9/5/1972		218.54-Acre Tract, 16 A/F Exempt Res
1111	Adj	Runnels	Colorado	7545000000	Byron D Jobe	Bluff Creek	Irr	6				3/1/1964		37.74-Acre Tract
1112	Adj	Runnels	Colorado	7544700000	Winters Country Club Inc	Bluff Creek	Irr	7		5		1/1/1946		51.9-Acre Tract
1113	Adj	Runnels	Colorado	7544500000	Ernestine Geistman	Bluff Creek	Irr	12				1/1/1952		
1114	Adj	Runnels	Colorado	7543800000	Glenn Hoppe et al	Bluff Creek	Irr	10				7/1/1958		72-Ac Tract
1115	Adj	Runnels	Colorado	7541000000	Lillian M Early	Bluff Creek	Irr	70				3/1/1962		
1116	Adj	Runnels	Colorado	7540000000	Gary W Gallant et ux	Elm Creek	Irr	68		20		12/1/1917		159-Acre Tract
1117	Adj	Runnels	Colorado	7520000000	R A Bagwell	Elm Creek	Rec	14		14		9/18/1917		Rec & Livestock
1118	Adj	Runnels	Colorado	7370000000	Norbert L Rohmfeld	Poney Creek	Irr	9				8/21/1967		Amend 3/20/85
1119	Adj	Runnels	Colorado	7507000000	Ellis Ueckert	Mulatto Creek	Irr	15				12/31/1937		54.73-Acre Tract
1120	Adj	Runnels	Colorado	7506000000	W E Bredemeyer	Big Coyote Creek	Irr	4		2		12/31/1958		200-Acre Tract
1121	Adj	Runnels	Colorado	7505750000	L L Chapmond	Big Coyote Creek	Irr	138				12/31/1959		422.5-Acre Tract
1122	Adj	Runnels	Colorado	7505500000	Clifton O Poe et ux	Little Coyote Creek	Irr	22		20		1/1/1964		Trib of Little Coyote CR, 2 Tract 67.92 Acre
1123	Adj	Runnels	Colorado	7505300000	Elma Lee Eubanks	Little Coyote Creek	Irr	104		2		1/1/1963		160-Acre Tract
1124	Adj	Runnels	Colorado	7505100000	Mrs Fritz F Deike et al	Little Coyote Creek	Irr	23		18		1/1/1955		2 Res, 93.31-Ac Tract
1125	Adj	Runnels	Colorado	7504000000	L L Chapmond	Little Coyote Creek	Irr	95		25		1/1/1958		
1126	Adj	Runnels	Colorado	7503500000	Jack C Burton et uk	Coyote Creek	Irr	22				1/1/1942		99.6-AC TR
1127	Adj	Runnels	Colorado	7503000000	Jack C Burton et uk	Coyote Creek	Irr	15				1/1/1957		154.6-Acre Tract
1128	Adj	Runnels	Colorado	7500000000	Bonnie Jo Blythe et al	Elm Creek	Irr	10				6/4/1914		Amend 1/10/86. Name Changed 5/20/98
1128	Adj	Runnels	Colorado	7500000000	Bonnie Jo Blythe et al	Elm Creek	Mine	70		57		6/4/1914		2 Tracts 531.4 Acres, SC. "
1129	Adj	Runnels	Colorado	7812030000	City of Ballinger	Elm Creek	Rec			44		6/11/1914	Res on Elm Cr	4/30/81 Res on Elm CR for Rec,See 1072A
1129	Adj	Runnels	Colorado	7812030000	City of Ballinger	Elm Creek	Rec			366		3/6/1929	Moonen Res on Valley	Use From Moonen Res on Valley, See 1072A
1129	Adj	Runnels	Colorado	7812030000	City of Ballinger	Elm Creek	Mun	499				3/6/1929		
1130	Adj	Runnels	Colorado	7812040000	City of Ballinger	Valley Creek	Rec	105		105		2/25/1957	Res on Elm	4/30/81 Res on Elm For Rec, See 1072A
1130	Adj	Runnels	Colorado	7812040000	City of Ballinger	Valley Creek	Mun	60				2/25/1957		
1131	Adj	Runnels	Colorado	7445000000	City of Ballinger	Colorado River	Irr	100				1/1/1964		201.3-Acre Tract
1132	Adj	Runnels	Colorado	7443000000	Gordon Euhus	Colorado River	Irr	62				12/31/1935		Amended 4/5/88, 01/17/97
1132	Adj	Runnels	Colorado	7443000000	Gordon Euhus	Colorado River	Irr	20				5/1/1964		Amended 4/5/88, 01/17/97
1132	Adj	Runnels	Colorado	7443000000	Gordon Euhus	Colorado River	Irr	20				3/19/1914		Amended 4/5/88, 01/17/97, 6/13/97
1132	Adj	Runnels	Colorado	7443000000	Delbet Hawkins	Colorado River	Irr	29				3/19/1914		Amended 4/5/88, 01/17/97, 6/13/98
1133	Adj	Runnels	Colorado	7440010000	Larry C Donham et ux	Colorado River	Irr	130				12/13/1913		325-Acre Tract
1134	Adj	Runnels	Colorado	7440000000	Ruth Watkins Stovall	Colorado River	Irr	35				12/13/1913		67-Acre Tract
1135	Adj	Runnels	Colorado	7420000000	Harvey Gordon Hays et al	Colorado River	Irr	224				2/13/1914		
1136	Adj	Runnels	Colorado	7415000000	Tony Virden et al	Colorado River	Irr	20				12/31/1955		
1136	Adj	Runnels	Colorado	7415000000	Loy Gene Yocham et ux	Colorado River	Irr	20				12/31/1955		
1137	Adj	Runnels	Colorado	7410010000	Larry N Lusby et ux	Colorado River	Irr	10				1/1/1955		19-Acre Tract
1138	Adj	Runnels	Colorado	7388000000	Louie Blair	Colorado River	Irr	30				3/1/1950		459-Acre Tract
1139	Adj	Runnels	Colorado	7380000000	Carlis Gene Martin	Colorado River	Irr	15				6/26/1914		100-Ac Tr
1140	Adj	Runnels	Colorado	7377500000	Wayne M Whitley et al	Colorado River	Irr	120				1/1/1964		78.8-Acre Tract
1141	Adj	Runnels	Colorado	7377000000	David S Googins III et ux	Colorado River	Irr	20				1/1/1965		78.8-Acre Tract
1391	Adj	Runnels	Colorado	4955200000	Joe & Cecilia Busenlehner	Fuzzy Creek	Irr	36				5/10/1967		
3510	Permit	Runnels	Colorado	7840010000	Raul Ray Galvan et ux	Valley Creek	Irr	20		20		10/20/1975		

Table 3B-17 Water Rights in Runnels County (continued)

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom			
Ind			
Irr	97	6937	951
Mine	1	70	57
Mun	4	2919	15197
Rec	5	319	812
Other			
Total	**107**	**10245**	**17017**

Table 3B-18
Water Rights in Schleicher County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1765	Adj	Schleicher	Colorado	4200000000	Live Oak Pine Ent., Inc	M Valley	Irr	38				6/29/1914		671.26 Acre Tract
1766	Adj	Schleicher	Colorado	4193000000	Mobley Co. Inc	Terrett Draw	Mine	3				4/2/1970	Schleicher Co - Terrett Draw	

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind			
Irr	1	38	
Mine	1	3	
Mun			
Rec			
Other			
Total	**2**	**41**	

Table 3B-19
Water Rights in Scurry County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1002	Adj	Scurry	Colorado	8740000000	Colorado River MWD	Bull Creek	Mun	30000		204000		8/5/1946	Lake J B Thomas	&CO 17.Amend 9/26/2001:Div Pts, Add Irr
1002	Adj	Scurry	Colorado	8740000000	Colorado River MWD	Bull Creek	Ind					8/5/1946	Lake J B Thomas	&CO 17.Amend 9/26/2001:Div Pts, Add Irr
1002	Adj	Scurry	Colorado	8740000000	Colorado River MWD	Bull Creek	Irr					8/5/1946	Lake J B Thomas	&CO 17.Amend 9/26/2001:Div Pts, Add Irr
1002	Adj	Scurry	Colorado	8740000000	Colorado River MWD	Bull Creek	Mine					8/5/1946	Lake J B Thomas	&CO 17.Amend 9/26/2001:Div Pts, Add Irr
1002	Adj	Scurry	Colorado	8740000000	Colorado River MWD	Bull Creek	Rec					8/5/1946	Lake J B Thomas	&CO 17.Amend 9/26/2001:Div Pts, Add Irr
1003	Adj	Scurry	Colorado	8713000000	Raymond B Robinson	South Fork Deep Creek	Irr	4		5		4/1/1967		20.7-Acre Tract
1004	Adj	Scurry	Colorado	8700020000	Billy John Voss	Thompson Draw	Irr	240		25		12/1/1916		
1005	Adj	Scurry	Colorado	8700010000	David L Thompson	Deep Creek	Irr	128		30		12/1/1916		
1006	Adj	Scurry	Colorado	8693000000	Dorothy Murphree Rosson et al	Deep Creek	Irr	22.57		22.57		6/10/1974		Amend 3/3/83 Remove SP Cond; Add 2 SCS
1006	Adj	Scurry	Colorado	8693000000	Dorothy Murphree Rosson et al	Deep Creek	Irr	77.43				6/10/1974		Amend 3/3/83 Remove SP Cond; Add 2 SCS
1007	Adj	Scurry	Colorado	8691500000	Lloyd Ainsworth Trustee	Deep Creek	Irr	31		18		1/1/1963		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Ind	1		
Irr	6	503	101
Mine	1		
Mun	2	30000	204000
Rec	1		
Other			
Total	**11**	**30503**	**204101**

Table 3B-20
Water Rights in Sterling County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1185	Adj	Sterling	Colorado	5840000000	J C Reed Estate	North Conch River	Irr	20		11		6/23/1914		
1186	Adj	Sterling	Colorado	5820000000	N H Reed	North Conch River	Irr	140		40		6/22/1914		
1187	Adj	Sterling	Colorado	5800000000	Nona G Grosshans	North Conch River	Irr	8				6/25/1914		

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Irr	3	168	51
Ind			
Mine			
Mun			
Rec			
Other			
Total	3	168	51

Table 3B-21
Water Rights in Sutton County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1483	Adj	Sutton	Colorado	2072000000	Fort Terrett Ranch Ltd	North Llano River	Irr	30		62		1/1/1946		Amend 11/8/88. 250 Af Expired 12/31/98
1484	Adj	Sutton	Colorado	2060000000	Lester L Shroyer et ux	North Llano River	Irr	67				3/8/1915		
1485	Adj	Sutton	Colorado	2055000000	Mobley Co Inc	North Llano River	Mine	3				4/2/1970	Sutton Co - North Llano River	
1486	Adj	Sutton	Colorado	2050000000	Wilna Schwiening Trust	North Llano River	Irr	2				4/1/1966		

Use	Number of Rights	Authorized Diversion (ac ft/yr)	Impoundment (ac-ft)
Ind			
Irr	3	99	62
Mine	1	3	
Mun			
Rec			
Other			
Total	**4**	**102**	**62**

Table 3B-22
Water Rights in Tom Green County

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1188	Adj	Tom Green	Colorado	5577000000	San Angelo Center	North Concho River	Irr	394				6/26/1914		
1189	Adj	Tom Green	Colorado	5567000000	Lewis Elliot	North Concho River	Irr	29.67				12/31/1935		4 Diversion Pts Total
1189	Adj	Tom Green	Colorado	5567000000	Tommy Matthew Tomerlin et al	North Concho River	Irr	9.92				12/31/1935		
1189	Adj	Tom Green	Colorado	5567000000	Larry Ray White et ux	North Concho River	Irr	5.41				12/31/1935		
1190	Adj	Tom Green	Colorado	5560000000	Upper Colorado River Auth	North Concho River	Mun	80400		80400		5/27/1949	O C Fisher Res	Storage Cap:391,500. Amended 12/19/97
1190	Adj	Tom Green	Colorado	5560000000	Upper Colorado River Auth	North Concho River	Ind					5/27/1949	O C Fisher Res	Amended 12/19/97
1190	Adj	Tom Green	Colorado	5560000000	Upper Colorado River Auth	North Concho River	Mine					5/27/1949	O C Fisher Res	Amended 12/19/97
1190	Adj	Tom Green	Colorado	5560000000	Upper Colorado River Auth	North Concho River	Rec					5/27/1949	O C Fisher Res	Amended 12/19/97
1191	Adj	Tom Green	Colorado	5520000000	City of San Angelo	North Concho River	Rec			150		10/13/1931		
1193	Adj	Tom Green	Colorado	7360000000	Blake Lewis Duncan et al	Main Concho River	Irr	124		76		12/3/1928		
1194	Adj	Tom Green	Colorado	7340000000	William Z Gassiot et ux	Main Concho River	Irr	35		80		8/2/1926		
1209	Adj	Tom Green	Colorado	5571000000	Bill Elliott et ux	North Concho River	Irr	4				6/27/1914		Amend 3/13/95; SC
1209	Adj	Tom Green	Colorado	5571000000	Bill Elliott et ux	North Concho River	Irr			8	12/31/2005	6/27/1914		Amend 3/13/95;Jr To COA#1189,1190,& 1191
1256	Adj	Tom Green	Colorado	6790000000	William H Armstrong II	SPRING CRK	Irr	123		42		7/31/1917		Amend 3/18/87;Div Pt 2 for #1254 use;SC
1257	Adj	Tom Green	Colorado	6780000000	William H Armstrong II	SPRING CRK	Irr	240		160		3/31/1925		Amend 3/18/87;Div Pt 2 for #1254 use;SC
1258	Adj	Tom Green	Colorado	6765000000	West Texas Boys Ranch	SPRING CRK	Irr	18				12/31/1946		
1259	Adj	Tom Green	Colorado	6760000000	Roy Lee Dusek et al	SPRING CRK	Irr	350		306		12/4/1922		12-4-22 for 256 Ac & 12-5-24 for 94 Ac
1260	Adj	Tom Green	Colorado	6545000000	Courtney Woehl	SPRING CRK	Irr	313				12/31/1904		
1262	Adj	Tom Green	Colorado	6680000000	Andrew Tweedy Family Trust	Dove Creek	Irr	50				6/19/1914		Amend 6/17/88, 3/6/91
1262	Adj	Tom Green	Colorado	6680000000	Elizabeth Sykes Fam Trst et al	Dove Creek	Irr	500				6/19/1914		Amend 6/17/88, 3/6/92
1263	Adj	Tom Green	Colorado	6670000000	Douglas J Cauble et al	Dove Creek	Irr	504				6/29/1914		
1264	Adj	Tom Green	Colorado	6576000000	Carey C Whitman et al	Dove Creek	Irr	110.7				6/27/1914		
1264	Adj	Tom Green	Colorado	6576000000	Jay Dickens	Dove Creek	Irr	59.3				6/27/1914		2 Div Pts (31.2567/100.6433); SC
1265	Adj	Tom Green	Colorado	6665000000	Drexell S Vincent et ux	Dove Creek	Irr	38				6/27/1914		
1266	Adj	Tom Green	Colorado	6575500000	Tod B Reed et al	Dove Creek	Irr	284				6/27/1914		
1267	Adj	Tom Green	Colorado	6660010000	Dove Creek Farms	Dove Creek	Irr	127				6/29/1914		
1267	Adj	Tom Green	Colorado	6660010000	L David Winston et ux	Dove Creek	Irr	20				6/29/1914		Amended 9/4/98:Chg Div Pt Jr in Priorty
1268	Adj	Tom Green	Colorado	6650000000	Carl W Heckaman	Dove Creek	Irr	89		26		11/18/1915		
1269	Adj	Tom Green	Colorado	6580100000	Walton A. Foster	Dove Creek	Irr	28				6/29/1914		
1270	Adj	Tom Green	Colorado	6578000000	E E Foster Jr Estate	Dove Creek	Irr	39				6/29/1914		
1271	Adj	Tom Green	Colorado	6577000000	John Jay West et al	Dove Creek	Irr	45				12/31/1942		
1272	Adj	Tom Green	Colorado	6560000000	Patrick Townsend et ux	Dove Creek	Irr	21.45		65		4/27/1920		Amend 1/15/80, 1/3/91, 8/22/97;SC
1272	Adj	Tom Green	Colorado	6560000000	Ray B Bunnell	Dove Creek	Irr	70				4/27/1920		SC
1272	Adj	Tom Green	Colorado	6560000000	William H Armstrong Trustee	Dove Creek	Irr	73				4/27/1920		To be Amended;SC
1272	Adj	Tom Green	Colorado	6560000000	Doyland Lewis et al	Dove Creek	Irr	121.55				4/27/1920		SC
1273	Adj	Tom Green	Colorado	6460000000	Edith A & Ford M Boulware	South Concho River	Irr	96				6/30/1914		
1274	Adj	Tom Green	Colorado	6442000000	Steven L Burleson et al	South Concho River	Irr	15		3		8/16/1898		
1275	Adj	Tom Green	Colorado	6441500000	Steven L Burleson et al	South Concho River	Irr	17.6				3/31/1967		
1275	Adj	Tom Green	Colorado	6441500000	Hazel Lair et al	South Concho River	Irr	12.4				3/31/1967		
1276	Adj	Tom Green	Colorado	6440000000	Winfree L Brown	South Concho River	Irr	32		34		2/24/1930		2 Div Pts
1276	Adj	Tom Green	Colorado	6440000000	Daniel F Brown	South Concho River	Irr	32		34		2/24/1930		
1277	Adj	Tom Green	Colorado	6400000000	John McLaughlin et al	South Concho River	Irr	46.66				6/29/1914		2 Div Pts
1277	Adj	Tom Green	Colorado	6400000000	C C Ducote et al	South Concho River	Irr	5.45				6/29/1914		
1277	Adj	Tom Green	Colorado	6400000000	Housley Family Limited Partnership	South Concho River	Irr	68.06				6/29/1914		
1277	Adj	Tom Green	Colorado	6400000000	Cynthia Latham Sutton	South Concho River	Irr	19.83				6/29/1914		
1278	Adj	Tom Green	Colorado	6397000000	Robert Kevin Housley et ux	South Concho River	Irr	16				12/31/1950		
1279	Adj	Tom Green	Colorado	6396000000	Eugene W & Sue W Jones	South Concho River	Irr	26				6/11/1914		Same Rate & Res 1280-1303,1314,1403-1404
1280	Adj	Tom Green	Colorado	6367000000	Lewis B Burleson Family Trust	South Concho River	Irr	69.9		50		7/29/1914		
1280	Adj	Tom Green	Colorado	6367000000	Lewis B Burleson Family Trust	South Concho River	Irr	38				12/31/1951		
1281	Adj	Tom Green	Colorado	6377100000	Del Duane Brittonet et ux	South Concho River	Irr	6		50		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1282	Adj	Tom Green	Colorado	6364000000	Everett Dupree et ux	South Concho River	Irr	28.68				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1282	Adj	Tom Green	Colorado	6364000000	Charlotte McNeil et al	South Concho River	Irr	9.22				12/31/1964		
1283	Adj	Tom Green	Colorado	6377800000	Louis James et ux	South Concho River	Irr	14.6				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1284	Adj	Tom Green	Colorado	6377700000	Nancy Salmon James	South Concho River	Irr	15				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1285	Adj	Tom Green	Colorado	6377600000	Nancy Salmon James	South Concho River	Irr	13				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1286	Adj	Tom Green	Colorado	6377500000	Bobby Randall Turner et ux	South Concho River	Irr	17.56				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1286	Adj	Tom Green	Colorado	6377500000	Billy Louis Sawyer et al	South Concho River	Irr	7.24				7/29/1914		
1287	Adj	Tom Green	Colorado	6377400000	John S. Ballard III, et ux	South Concho River	Irr	35				7/29/1914		Amend 5/17/85;Same Rate &Res 1280-1303;SC
1288	Adj	Tom Green	Colorado	6330000000	William Cody Elliott et ux	South Concho River	Irr	23.3				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1288	Adj	Tom Green	Colorado	6330000000	William Cody Elliott et ux	South Concho River	Irr	17				1/18/1962		

Table 3B-22 Water Rights in Tom Green County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1289	Adj	Tom Green	Colorado	6310000000	Herbert J Untermeyer et ux	South Concho River	Irr	69.9				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1289	Adj	Tom Green	Colorado	6310000000	Herbert J Untermeyer et ux	South Concho River	Irr	70				1/31/1965		
1290	Adj	Tom Green	Colorado	6267000000	C L McMillan	South Concho River	Irr	110.4				7/29/1914		Amend 10/15/91;Same Rate &Res 1280-1303SC
1290	Adj	Tom Green	Colorado	6267000000	C L McMillan	South Concho River	Irr	56				3/12/1964		SC
1290	Adj	Tom Green	Colorado	6267000000	Christoval ISD	South Concho River	Irr	6				7/29/1914		Amend 10/15/91;Same Rate &Res 1280-1303SC
1291	Adj	Tom Green	Colorado	6377300000	H Rowland & Rose P Moore	South Concho River	Irr	12				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1292	Adj	Tom Green	Colorado	6377200000	Louis Jones, Jr., et al	South Concho River	Irr	122				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1293	Adj	Tom Green	Colorado	6377000000	David Darnell	South Concho River	Irr	94.6		99.416		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1293	Adj	Tom Green	Colorado	6377000000	Stuart W Seidel et ux	South Concho River	Irr	5				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1293	Adj	Tom Green	Colorado	6377000000	Bill Elliott	South Concho River	Irr	23				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1293	Adj	Tom Green	Colorado	6377000000	Kenneth V Huseman et ux	South Concho River	Irr	23				7/29/1914		
1294	Adj	Tom Green	Colorado	6376900000	L Kenneth & Jeanne Cleveland	South Concho River	Irr	12				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1295	Adj	Tom Green	Colorado	6376600000	Thomas R Reid et ux	South Concho River	Irr	5.82				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1295	Adj	Tom Green	Colorado	6376600000	Fred Gauntt	South Concho River	Irr	52.38		2		7/29/1914		Amend 8/31/83, 8/20/90;Same Rate 1280;SC
1296	Adj	Tom Green	Colorado	6376500000	Reynold Reed Scott	South Concho River	Irr	7				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1297	Adj	Tom Green	Colorado	6376400000	Carol A Doty Sr	South Concho River	Irr	3.65				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1297	Adj	Tom Green	Colorado	6376400000	Bryan W Schwiening et ux	South Concho River	Irr	3.65				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1298	Adj	Tom Green	Colorado	6230000000	City of San Angelo	South Concho River	Irr	128.1		50		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1298	Adj	Tom Green	Colorado	6230000000	City of San Angelo	South Concho River	Irr	124		8.44		10/8/1931		1 Div Pt Rate 2.67, 1 Div Pt Rate 1
1299	Adj	Tom Green	Colorado	6376300000	Grady C Roe	South Concho River	Irr	12				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1300	Adj	Tom Green	Colorado	6376200000	John T Gandy	South Concho River	Irr	23				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1300	Adj	Tom Green	Colorado	6376200000	John T Gandy	South Concho River	Irr	14				12/31/1966		Subj to Amend, Rate Determine @ Amend
1301	Adj	Tom Green	Colorado	6376100000	Texas Dept of Transportation	South Concho River	Stor	7.02		50		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1301	Adj	Tom Green	Colorado	6376100000	Donald L Kothmann et ux	South Concho River	Irr	33.78		1.25		7/29/1914		Amend 4/14/85; Same Rate & Res 1280-1303
1302	Adj	Tom Green	Colorado	6376000000	Denny Brown et al	South Concho River	Irr	174.7				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1303	Adj	Tom Green	Colorado	6225000000	John D Duncan et ux	South Concho River	Irr	34.9				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1303	Adj	Tom Green	Colorado	6225000000	John D Duncan et ux	South Concho River	Irr	90				12/31/1905		
1304	Adj	Tom Green	Colorado	6372500000	Alton G & Ruth Anne Callihan	South Concho River	Irr	2				12/31/1964		
1305	Adj	Tom Green	Colorado	6371000000	Randal Lee Robertson Custodian et a	South Concho River	Irr	19				12/31/1912		4 Owners with Undivided Interests
1306	Adj	Tom Green	Colorado	6370000000	Thomas R Reid et ux	South Concho River	Irr	20				12/31/1966		
1307	Adj	Tom Green	Colorado	6361000000	Hardy B Purvis, et ux	South Concho River	Irr	64				6/4/1914		
1308	Adj	Tom Green	Colorado	6360100000	Martha Kenley Dolliver, et al	South Concho River	Irr	100		20		6/4/1914		
1309	Adj	Tom Green	Colorado	6340000000	Donald L Hulse et ux	South Concho River	Irr	46				6/23/1914		
1310	Adj	Tom Green	Colorado	6320000000	Robert R Buescher	South Concho River	Irr	276		21		5/30/1914		3rd Div Pt Shared by COA 1311 Div Pt #2
1311	Adj	Tom Green	Colorado	6300000000	McWhorter Heirs Ltd	South Concho River	Irr	140				6/15/1914		2nd Div Pt Shared by COA 1310 Div Pt #3
1312	Adj	Tom Green	Colorado	6265000000	Eugene W Jones	South Concho River	Irr	270				4/1/1965		3 Div Pts
1313	Adj	Tom Green	Colorado	6240000000	Angelo River Ranches I Ltd	South Concho River	Irr	52				6/19/1914		
1313	Adj	Tom Green	Colorado	6240000000	Kent C Schwartz	South Concho River	Irr	640				6/19/1914		
1314	Adj	Tom Green	Colorado	6379000000	Cralle Family Trust et al	South Concho River	Irr	5.8		50		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1315	Adj	Tom Green	Colorado	6220000000	Arthur Micheal Hagan Jr et al	South Concho River	Irr	12				6/29/1914		
1316	Adj	Tom Green	Colorado	6200000000	Willie Lou Kirk Pritz	South Concho River	Irr	126				6/28/1914		
1317	Adj	Tom Green	Colorado	6199000000	Robert H Legrand Jr et ux	South Concho River	Irr	128				6/28/1914		
1318	Adj	Tom Green	Colorado	6185000000	San Angelo WSC	Main Concho River	Mun	4000		170000		5/6/1959	Twin Buttes Res	See 1319-6. Amend 5/9/97; SC
1318	Adj	Tom Green	Colorado	6185000000	San Angelo WSC	Main Concho River	Irr	25000				5/6/1959	Twin Buttes Res	Amend 5/9/97; SC
1319	Adj	Tom Green	Colorado	6100000000	City of San Angelo	Main Concho River	Mun	17000		12500		3/11/1929	Lake Nasworthy	SC; These Amts Same Water as 1318 use 3
1319	Adj	Tom Green	Colorado	6100000000	City of San Angelo	Main Concho River	Ind	7000				3/11/1929		SC; These Amts Same Water as 1318 use 3
1319	Adj	Tom Green	Colorado	6100000000	City of San Angelo	Main Concho River	Irr	1000				3/11/1929		SC; These Amts Same Water as 1318 use 4
1320	Adj	Tom Green	Colorado	6060000000	Norma Faye Butler Trustee	South Concho River	Irr	112				6/27/1914		
1320	Adj	Tom Green	Colorado	6060000000	Hudson Management Ltd	South Concho River	Irr	100				6/27/1914		To be Amend
1321	Adj	Tom Green	Colorado	6010000000	San Angelo Country Club	South Concho River	Irr	318				12/31/1911		
1322	Adj	Tom Green	Colorado	5980000000	Texas Parks & Wildlife Dept	South Concho River	Ind	1000				8/26/1929		Amended 3/14/97: 2 Diversion Pts
1323	Adj	Tom Green	Colorado	6005000000	City of San Angelo	South Concho River	Rec			1157		4/1/1914	Metcalfe Dam & Res	
1324	Adj	Tom Green	Colorado	5985000000	Century Park Investments Inc	South Concho River	Irr	45				6/25/1914		
1325	Adj	Tom Green	Colorado	5920000000	City of San Angelo	South Concho River	Mun	1534		300		5/16/1914	Lone Wolf Res	Uses 1 & 2
1325	Adj	Tom Green	Colorado	5920000000	City of San Angelo	South Concho River	Ind					5/16/1914		USES 1 & 2
1326	Adj	Tom Green	Colorado	5901000000	City of San Angelo	North Concho River	Mun			370		3/11/1953	Bell Street Res	Transport Wtr to Res Under 14-1325
1327	Adj	Tom Green	Colorado	5473500000	Vernon & Trilvia Ann Vines	Concho River	Irr	40				12/31/1931		
1328	Adj	Tom Green	Colorado	5473100000	Glendon P & Nancy L Snodgrass	Concho River	Irr	21				4/1/1967		
1329	Adj	Tom Green	Colorado	5473000000	Chapple & Loraine Bryan	Concho River	Irr	100				6/30/1953		
1330	Adj	Tom Green	Colorado	5472500000	Veribest Cattle Feeders Inc	Concho River	Irr	295				12/31/1955		Amended 2/14/94. 4/21/96: 2 Div Points
1330	Adj	Tom Green	Colorado	5472500000	Quicksand Partners Ltd	Concho River	Irr	443		1192		12/31/1955		3 Off-Chan Res;Uses 1,2,4,5,6,7,9;A-4/93
1331	Adj	Tom Green	Colorado	5469500000	Benny R Stuard	Concho River	Irr	11.9				4/30/1961		Amend 5/16/97.Addl 4.1 Af for Evapora;SC

Table 3B-22 Water Rights in Tom Green County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1331	Adj	Tom Green	Colorado	5469500000	John F Davis & Arby Holbrooks	Concho River	Dom			70		4/30/1961		Impoundment, D&L Use Only; SC
1332	Adj	Tom Green	Colorado	5465100000	Bonnie L Musick	Concho River	Irr	24				12/31/1957		
1333	Adj	Tom Green	Colorado	5465040000	City of San Angelo	Concho River	Irr	184				1/3/1921		
1334	Adj	Tom Green	Colorado	5465000000	F W (Dubb) Tubb et ux	Concho River	Irr	1.125				8/1/1962		
1334	Adj	Tom Green	Colorado	5465000000	Patrick L Mahan et ux	Concho River	Irr	43.875				8/1/1962		
1335	Adj	Tom Green	Colorado	5464950000	T J Warren	Concho River	Irr	40				8/1/1962		
1336	Adj	Tom Green	Colorado	5462000000	Clyde C Watkins et ux	Concho River	Irr	88				5/31/1925		
1337	Adj	Tom Green	Colorado	5460010000	City of San Angelo	Concho River	Irr	135		130		1/3/1921		
1338	Adj	Tom Green	Colorado	5440000000	Van W Carson et al	Concho River	Irr	500				12/19/1914		
1339	Adj	Tom Green	Colorado	5437000000	Lewis C Roach et ux	Concho River	Irr	48				3/31/1966		
1340	Adj	Tom Green	Colorado	5435010000	Hudson Management Ltd	Concho River	Irr	310		54		6/27/1914		Amended 8/30/96 Addt'l Div Pt
1341	Adj	Tom Green	Colorado	5435000000	Mrs Gladys M Lewis	Concho River	Irr	115		400		5/13/1916		
1342	Adj	Tom Green	Colorado	5400000000	John Charles Patterson et ux	Concho River	Irr	32				5/13/1916		Same Res With 14-1341
1343	Adj	Tom Green	Colorado	5380000000	John R Scott Jr	Concho River	Irr	211.9				12/22/1917		Amend 6/10/87.Part of 1344 was Combined.
1344	Adj	Tom Green	Colorado	5377000000	Kevin L Noland et ux	Concho River	Irr	2.63				12/22/1917		Res 14-1343, Appears to be Noland's
1344	Adj	Tom Green	Colorado	5377000000	Roland W Howard II et ux	Concho River	Irr	1.47				12/22/1917		Res 14-1343, Appears to be Noland's
1345	Adj	Tom Green	Colorado	5375000000	Ezequiel A Tapia et ux	Concho River	Irr	188				12/31/1918		
1346	Adj	Tom Green	Colorado	5372500000	Wilma Faye Crownover	Concho River	Irr	86			12/31/2007	3/31/1911		Amended 8/7/98;Extend Exp.SC.Jr in Prior
1347	Adj	Tom Green	Colorado	5352500000	Hayward E & Johnye M Krall	Concho River	Irr	110		55		2/28/1925		2/3 Intr in Res Held by 14-1348
1348	Adj	Tom Green	Colorado	5351000000	J Eldon Williams	Concho River	Irr	135		67		3/31/1911		Res A w/1347- Res B w/1350 2 Div Pts
1349	Adj	Tom Green	Colorado	5350000000	Schneemann Investment Corp	Concho River	Irr	306		122		12/31/1912		
1350	Adj	Tom Green	Colorado	5341000000	Wayne Chandler Jr	Concho River	Irr	51				12/31/1920		67 Af Res Shown on 14-1348 2 Div Pts
1351	Adj	Tom Green	Colorado	5315000000	Kenneth C Schwartz	Concho River	Irr	180		40		6/25/1914		Amend 7/20/93.FOW Restrictions & SC
1352	Adj	Tom Green	Colorado	5300000000	Edward E Werner	Concho River	Irr	270		70		10/31/1916		
1353	Adj	Tom Green	Colorado	5298000000	Suzanne Newman Watson	Concho River	Irr	258		50		12/31/1957		
1354	Adj	Tom Green	Colorado	5297500000	Kenneth C Schwartz et ux	Concho River	Irr	200				12/31/1917		Same Res With 14-1353
1355	Adj	Tom Green	Colorado	5290000000	Rene C Perez et ux	Concho River	Irr	24		40		1/17/1918		
1356	Adj	Tom Green	Colorado	5281000000	Lee Paul Fry & Jack S Rice	Concho River	Irr	69				1/17/1918		Res Shown on 14-1355
1357	Adj	Tom Green	Colorado	5260000000	Reva K McMillan et al	Concho River	Irr	200		75		10/31/1916		
1357	Adj	Tom Green	Colorado	5260000000	Reva K McMillan et al	Concho River	Irr	136				12/31/1918		
1358	Adj	Tom Green	Colorado	5230000000	Gena M Reichert Day	Concho River	Irr	83		77		12/12/1918		
1359	Adj	Tom Green	Colorado	5220000000	Carson C Miles estate	Concho River	Irr	150				11/5/1913		
1360	Adj	Tom Green	Colorado	5218000000	Milburn Wright Sr	Concho River	Irr	83				10/31/1922		
1360	Adj	Tom Green	Colorado	5218000000	Milburn Wright Sr	Concho River	Ind	2				12/31/1934		
1361	Adj	Tom Green	Colorado	5207000000	Leonard Grantham Jr	Concho River	Irr	76		15		12/31/1951		
1362	Adj	Tom Green	Colorado	5200000000	Lonnie Leonard Buck III	Concho River	Irr	22				8/29/1913		Amend 1/14/83 Chg POFD
1363	Adj	Tom Green	Colorado	5160800000	Lewis J Buck et ux	Concho River	Irr	24				8/29/1913		Amend 1/14/83 Chg POFD
1364	Adj	Tom Green	Colorado	5160100000	W G & Wanda M Dishroom	Concho River	Irr	16				8/29/1913		Amend 1/14/83 Chg POFD
1368	Adj	Tom Green	Colorado	5160050000	Kenneth R Windham, et ux	Concho River	Irr	30				8/29/1913		Amend 1/14/83 Chg POFD
1369	Adj	Tom Green	Colorado	5160040000	Thomas L Evridge	Concho River	Irr	14				8/29/1913		Amend 1/14/83:Chg POFD.
1370	Adj	Tom Green	Colorado	5160030000	B E Swift et ux	Concho River	Irr	14				8/29/1913		Amend 1/14/83:Chg POFD.New Owner:J Newman
1371	Adj	Tom Green	Colorado	5160020000	Tommy C. & Ann R Long	Concho River	Irr	16				8/29/1913		Amend 1/14/83:Chg POFD.New Owner:D Rushing
1372	Adj	Tom Green	Colorado	5160010000	Douglas O & Betty B John	Concho River	Irr	14				8/29/1913		Amend 1/17/83 Chg POFD
1373	Adj	Tom Green	Colorado	5160500000	Carroll D Blacklock et ux	Concho River	Irr	6				1/20/1914		
1374	Adj	Tom Green	Colorado	5160060000	Victor & Lorene C Merek	Concho River	Irr	45				1/20/1914		
1375	Adj	Tom Green	Colorado	5160000000	Bronwen Choate et al	Concho River	Irr	87				6/29/1914		
1376	Adj	Tom Green	Colorado	5154900000	John C Ketzler	Concho River	Irr	120				12/29/1905		
1377	Adj	Tom Green	Colorado	5140100000	Bronwen Choate et al	Concho River	Irr	40				6/29/1914		Amend 1/22/90. This Part Does Not Expire
1378	Adj	Tom Green	Colorado	5120000000	Marvin J & Leona Helwig	Concho River	Irr	270		700		6/29/1914		
1379	Adj	Tom Green	Colorado	5115000000	Bernie L & Lucy Mika	Concho River	Irr	204				12/29/1905		Res Shown on 14-1378
1380	Adj	Tom Green	Colorado	5100100000	Billy Louis Sawyer et al	Concho River	Irr	182				6/29/1914		Res Shown on 14-1378
1381	Adj	Tom Green	Colorado	5075000000	Willie Mae Ray	Concho River	Irr	59				2/29/1964		Jointly Owns 59 Af to Irr 59 Acres
1381	Adj	Tom Green	Colorado	5075000000	Homa Lee Ray	Concho River	Irr					2/29/1964		Jointly Owns 59 Af to Irr 59 Acres
1397	Adj	Tom Green	Colorado	5160400000	A J Jones Jr	Concho River	Irr	35.7				1/20/1914		Amend 1/3/91 Shares 1 Div Pt w/1373 &99
1397	Adj	Tom Green	Colorado	5160400000	A J Jones Jr	Concho River	Irr	30				8/29/1913		Amend 1/3/91 Shares 1 Div Pt w/1373 &99
1399	Adj	Tom Green	Colorado	5160200000	Carroll D Blacklock	Concho River	Irr	9				1/20/1914		Shares Rate w/1373 & 1397;SC
1401	Adj	Tom Green	Colorado	6000000000	City of San Angelo	South Concho River	Mun	5000		316		12/8/1916		
1403	Adj	Tom Green	Colorado	6376700000	Marlow Wojtek et ux	South Concho River	Irr	2.879		50		7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1403	Adj	Tom Green	Colorado	6376700000	Wilson T Corley	South Concho River	Irr	2.658				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1403	Adj	Tom Green	Colorado	6376700000	Beverly Jolene Wyatt	South Concho River	Irr	3.163				7/29/1914		Res Shown on 14-1280
1404	Adj	Tom Green	Colorado	6376800000	David Darnell et ux	South Concho River	Irr	3.3				7/29/1914		Same Rate & Res 1280-1303,1314,1403-1404
1404	Adj	Tom Green	Colorado	6376800000	Don Lee Cooksey	South Concho River	Irr	7.32				7/29/1914		Amend 9/15/82, 2/7/86

Table 3B-22 Water Rights in Tom Green County (continued)

Water Right #	Type	County	Basin	River Order	Owner Name	Stream	Use	Authorized Diversion (ac-ft/yr)	Maximum Diversion Rate (cfs)	Impoundment (ac-ft)	Expiration Date	Priority Date	Facility	Remarks
1404	Adj	Tom Green	Colorado	6376800000	Stuart William Seidel et al	South Concho River	Irr	11.8				7/29/1914		
1404	Adj	Tom Green	Colorado	6376800000	Bryan Kirk	South Concho River	Irr	5				7/29/1914		Amended 6/20/97
1404	Adj	Tom Green	Colorado	6376800000	Kenneth S Gunter	South Concho River	Irr	5				7/29/1914		Amended 6/20/97
1404	Adj	Tom Green	Colorado	6376800000	David Darnell et al	South Concho River	Irr	5.88				7/29/1914		
1404	Adj	Tom Green	Colorado	6376800000	Roy Hurd Manahan	South Concho River	Irr	2.5				7/29/1914		
3554	Permit	Tom Green	Colorado	5474160000	U S Dept Air Force	Concho River	Irr	85		3		12/15/1975		Flow Restrictions
3557	Permit	Tom Green	Colorado	5018500000	Whitehead Properties Inc	Lipan Creek	Irr	100		90		1/12/1976		Amend 10 22 86; SC
5335	Permit	Tom Green	Colorado	5049600000	Larry Wilde	Lipan Creek	Other					12/5/1990	Natural Pool/Lipan CR	Flow Restr;SC. Recovery of Private Water
5600	Permit	Tom Green	Colorado	5390000000	Hudson Management Ltd	Crows Nest Creek	Irr			5		7/7/1998		SC. Bed & Banks Conveyance of 250 Af GW

Use	Number of Rights	Authorized Diversion (ac-ft/yr)	Impoundment (ac-ft)
Dom	1		70
Ind	7	8002	
Irr	131	41,019	4421.106
Mine	1		
Mun	8	107934	263886
Rec	3		1307
Other	1		
Total	**152**	**156955.28**	**269684.106**

Appendix 3C
Water Supplies in the Colorado WAM

Region F
Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

TECHNICAL MEMORANDUM

To: Region F Water Planning Group

From: Jon S. Albright – Freese and Nichols, Inc.

Re: Water Supplies from the Colorado WAM

Date: March 8, 2005
Revised May 19, 2005
Revised December 19, 2005

Existing Surface Water Supplies

Surface water from reservoirs provides most of the municipal water supply in Region F. Run-of-the-river water rights are used primarily for irrigation. Table 1 shows information regarding the 15 major Colorado Basin reservoirs in Region F. Figure 1 shows the location of these reservoirs.

All surface water supplies are derived from Water Availability Models (WAMs) developed by the Texas Commission on Environmental Quality (TCEQ). The TWDB requires the use of the Full Authorization Run (Run 3) of the approved TCEQ WAM for each basin as the basis for water availability in regional water planning[1]. Three WAM models are available in Region F: the Colorado WAM, which covers most of the central and eastern portions of the region, and the Rio Grande WAM, which covers the Pecos Basin, and the Brazos WAM. This memorandum focuses on supplies from the Colorado WAM.

[1] Texas Water Development Board: Exhibit B Guidelines for Regional Water Plan Development, July 2002.

Table 1
Major Colorado Basin Reservoirs in Region F

Reservoir Name	Stream	County(ies)	Water Right Number(s)	Priority Date	Permitted Conservation Storage (Acre-Feet)	Permitted Diversion (Acre-Feet per Year)	Owner	Water Rights Holder(s)
Lake J. B. Thomas	Colorado River	Borden and Scurry	CA-1002	08/05/1946	204,000	30,050	CRMWD	CRMWD
Lake Colorado City	Morgan Creek	Mitchell	CA-1009	11/22/1948	29,934	5,500	TXU	TXU
Champion Creek Reservoir	Champion Creek	Mitchell	CA-1009	04/08/1957	40,170	6,750	TXU	TXU
Oak Creek Reservoir	Oak Creek	Coke	CA-1031	04/27/1949	30,000	10,000	City of Sweetwater	City of Sweetwater
Lake Coleman	Jim Ned Creek	Coleman	CA-1702	08/25/1958	40,000	9,000	City of Coleman	City of Coleman
E. V. Spence Reservoir	Colorado River	Coke	CA-1008	08/17/1964	488,760	38,573	CRMWD	CRMWD
Lake Winters/ New Lake Winters	Elm Creek	Runnels	CA-1095	12/18/1944	8,347	1,755	City of Winters	City of Winters
Lake Brownwood	Pecan Bayou	Brown	CA-2454	09/29/1925	114,000	29,712	Brown Co. WID	Brown Co. WID
Hords Creek Lake	Hords Creek	Coleman	CA-1705	03/23/1946	7,959	2,240	COE	City of Coleman
Lake Ballinger / Lake Moonen	Valley Creek	Runnels	CA-1072	10/04/1946	6,850	1,000	City of Ballinger	City of Ballinger
O. H. Ivie Reservoir	Colorado River	Coleman, Concho and Runnels	A-3866 P-3676	02/21/1978	554,340	113,000	CRMWD	CRMWD
O. C. Fisher Lake	North Concho River	Tom Green	CA-1190	05/27/1949	119,000	80,400	COE	Upper Colorado River Authority
Twin Buttes Reservoir	South Concho River	Tom Green	CA-1318	05/06/1959	186,000	29,000	U.S. Bureau of Reclamation	City of San Angelo
Lake Nasworthy	South Concho River	Tom Green	CA-1319	03/11/1929	12,500	25,000	City of San Angelo	City of San Angelo
Brady Creek Reservoir	Brady Creek	McCulloch	CA-1849	09/02/1959	30,000	3,500	City of Brady	City of Brady
Total					*1,871,860*	*358,500*		

Table 2 compares the firm yield of the 15 Colorado Basin reservoirs in Region F used in the 1997 State Water Plan[2], the 2001 Region F Plan[3], and from the Colorado WAM[4]. Table 3 compares run-of-the river supplies from the 2001 Region F Plan to the Colorado WAM. (In most cases, the run-of-the-river supplies from the 2001 Region F Plan are identical to those used in the 1997 Water Plan.) The supplies derived using the WAM are very different from those assumed in previous plans. Supplies from reservoirs are about 54 percent of that assumed in the 2001 Region F Plan. Run-of-the-river supplies are about 25 percent of the supplies in the previous plan. The reason for this change is because previous studies made significantly different assumptions about the operation of water rights in the Colorado Basin. The WAM assumes that priority of diversion and storage determines water availability regardless of the type of right or purpose of use. Previous water plans assumed that reservoir supplies were not subject to priority calls. It is unknown why run-of-the-river supplies are so much less with the WAM, largely because the source of these numbers is not well documented in the previous studies. However, we can speculate that these supplies were not modeled as thoroughly as in the current WAM.

Description of TCEQ WAM Program

TCEQ developed the water availability models specifically "to determine whether water would be available for a newly requested water right or amendment."[5] Although several different scenarios, referred to as "runs," were part of the original WAM program, the agency retained only two runs for use in processing permits:

- *Full Authorization (Run 3)* where all water rights are assumed to use their full permitted amount. There are no return flows unless they are specified in a water right (100% reuse). This scenario is used to evaluate new permanent water rights or amendments.

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[2] Texas Water Development Board, Final 1997 Water Plan Allocations from MADNESS model, 1998.
[3] Freese and Nichols, Inc. et al.: Region F Regional Water Plan, prepared for the Region F Regional Water Planning Group, January 2001.
[4] R.J. Brandes Company et al.: Water Availability Modeling for the Colorado/Brazos-Colorado Basin, prepared for the Texas Natural Resources Conservation Commission, December 2001.
[5] Texas Commission on Environmental Quality: "Water Availability Models," available online at http://www.tnrcc.state.tx.us/permitting/waterperm/wrpa/wam.html#files

Table 2
Comparison of Firm Yields of Region F Reservoirs from the 1997 State Water Plan, the 2001 Region F Plan, and the Colorado Water Availability Models
(Values in Acre-Feet per Year)

Reservoir Name	Yield from 1997 State Water Plan [a]	Yield from 2001 Region F Plan [a]	WAM Firm Yield [b]
Lake J. B. Thomas	151,800 [c]	9,900	780 [d]
E. V. Spence Reservoir		38,776	
O. H. Ivie Reservoir		96,169	86,110 [e]
Lake Colorado City	5,500	4,550	0
Champion Creek Reservoir	5,000	4,081	0
Oak Creek Reservoir	4,800	5,684	0
Lake Coleman	7,090	8,822	30
Lake Winters/ New Lake Winters	1,160	1,407	0
Lake Brownwood	31,400	41,800	40,612 [e]
Hords Creek Lake	1,200	1,425	0
Lake Ballinger / Lake Moonen	1,600	3,566	40
O. C. Fisher Lake	13,200	2,973	0
Twin Buttes Reservoir	31,400	8,900	50 [d]
Lake Nasworthy	500	7,900	
Brady Creek Reservoir	3,100	2,252	10
Total	*257,750*	*238,205*	*127,632*

a 1997 and 2001 Water Plan yields are for year 2000 sediment conditions
b WAM yields are for original sediment conditions except where noted
c Individual yields not reported for Thomas, Spence or Ivie in the 1997 State Water Plan
d Individual yields not computed in the Colorado WAM report
e WAM yield using year 2000 sediment conditions at reservoir

Table 3
Comparison of Run-of-the-River Colorado Basin Supplies from 2001 Plan to Supplies from the Water Availability Models [a]
(Values in Acre-Feet per Year)

County	2001 Plan Supplies	WAM Supplies	Change
Andrews	125	0	-125
Borden	89	0	-89
Brown	3,256	778	-2,478
Coke	275	48	-227
Coleman	2,326	31	-2,295
Concho	727	263	-464
Ector	1,800	23	-1,777
Howard	24	0	-24
Irion	1,980	580	-1,400
Kimble	3,502	1,488	-2,014
Martin	550	0	-550
Mason	0	0	0
McCulloch	550	128	-422
Menard	3,792	3,238	-554
Midland	1,400	0	-1,400
Mitchell	235	15	-220
Reagan	0	0	0
Runnels	5,500	771	-4,729
Schleicher	0	0	0
Scurry	1,170	69	-1,101
Sterling	0	48	48
Sutton	475	8	-467
Tom Green	15,839	3,454	-12,385
Total	*43,615*	*10,942*	*-32,673*

a Does not include unpermitted supplies for livestock or diverted water from chloride control projects

- *Current Conditions (Run 8)* where water rights are assumed to be used at current levels. Return flows are set at current levels as well. This scenario is used to process temporary permits and amendments, usually referred to as “term” permits.

TCEQ staff maintains these two runs, updating them as new water rights applications are received. In this memorandum, all references to the WAM refer to Run 3 unless otherwise stated. TWDB requires the use of Run 3 to determine availability in the regional water plans.**Error! Bookmark not defined.**

The WAM program uses the Water Rights Analysis Package (WRAP), a computer model developed by Dr. Ralph Wurbs of Texas A&M University. The WRAP model is specifically designed to model river basins using priority analysis.

There are several assumptions that need to be kept in mind when interpreting the results of the WAM models:

- Priority is the determining factor when allocating available water
- Storing water in a reservoir is given the same importance as diverting water for use
- All water rights divert and store water at their full authorized amounts
- Instream flow requirements apply not only to the original water right, but also to all water rights junior to the original water right
- Return flows from either surface water or groundwater sources are not available unless specifically required by a water right.

Each of these assumptions is discussed in more detail below.

Priority Determines Availability

Water availability in Texas is determined by the *prior appropriation doctrine*, or "first in time is first in right."[6] In times of shortage, water is distributed based upon the priority date of the water right. In older rights, the priority date of a right corresponds to the time that the water was first used for a beneficial purpose. In more recent rights the priority date corresponds to the date that the application for water use was deemed administratively complete by TCEQ. In Texas, both the right to divert and the right to store water are assigned a priority date. Many rights have multiple priority dates for diversion or storage of water.

In the WAM model each water right diverts and stores water according to its priority date. The water rights with the most senior priority divert first and downstream flows are reduced accordingly. If all flows downstream have been taken by senior water rights, then an upstream junior water right can no longer divert even if there is flow in the

[6] Texas Water Code §11.027

stream at the upstream junior water right's point of diversion. This prevents upstream junior water rights from causing a shortage downstream.

Although this allocation of water determined by priority follows current state law, it is not the way that the Colorado Basin has functioned historically. Water right holders have historically diverted and impounded streamflow as it was available to them. Water use is reported by water right holders on the honor system. Only in times of shortage may some junior water right holders be instructed to cease diversion in order to allow water to flow to downstream water rights. Because of budget, staffing and other constraints, TCEQ, the agency that regulates water diversions, is reluctant to enforce the priority of water rights unless a watermaster program has been established. Priority has not historically determined the day-to-day operation of the Colorado Basin.

Priority operation can be in direct conflict with efficient operation of some of the major water supplies in the Colorado Basin. For example, in the WAM Lake Thomas and Spence Reservoir both pass water downstream to Ivie Reservoir even though those reservoirs are all owned by the Colorado River Municipal Water District (CRMWD). If this type of operation was used for these reservoirs, the water would need to be pumped back uphill to CRMWD customers at considerably higher expense than pumping the water from Spence Reservoir or Lake Thomas. Lake Thomas has better water quality than either Spence Reservoir or Ivie Reservoir, so priority operation of the system would cause degradation of water quality for CRMWD customers.

Storing Water is Given the Same Importance as Diverting Water for Use

The WAM models assume that the right to store water has the same weight as the right to divert water. For senior rights with storage, the model assumes that junior water rights can only divert if there is enough water to both completely satisfy a senior water right's diversion amount *and* fill all of the senior water right's empty storage. This occurs even if a senior water right does not need to store the full amount of water to make its diversion reliable. If there is not enough water to fulfill both diversion and storage requirements of senior water rights, junior water rights must either use their own stored water or, if no storage is available, the junior water right will experience a shortage.

In actual practice, upstream junior water rights have historically impounded and diverted water even when a downstream senior reservoir is not full. Inflows are only passed when water is not needed, an upstream reservoir is full, or a downstream water right has made a priority call on inflows into a reservoir. Normally, a senior water right does not make a priority call unless a shortage is likely some time in the near future. A reservoir that is down by a few feet seldom qualifies as an imminent shortage.

In developing the WAM program, TCEQ recognized that giving storage the same weight as diversion "embodies what is perhaps the letter of the law conflicting with reality."[7] In the legal environment required for permit processing, it makes sense to assume that the right to store water has the same weight as the right to divert water. However, from a practical standpoint, this assumption is in conflict with the way that any river basin has been operated.

Diversion and Storage at Authorized Amounts

The Full Authorization run (Run 3) assumes that every water right in the basin stores and diverts water at the maximum amount authorized by its water right. There are no adjustments for storage capacity that has been lost due to accumulation of sediment in older reservoirs. For example, the authorized storage for Lake Nasworthy is 12,500 acre-feet. The 1993 survey of the reservoir shows a conservation storage of 10,108 acre feet[8], or a loss of about 18 percent of the storage volume of the reservoir. The City of San Angelo has dredged Lake Nasworthy, restoring much of the lost storage.

There are also no adjustments for water rights that authorize diversions in excess of the potential water supply from the reservoir. An example is O.C. Fisher Lake (CA

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[7] Texas Natural Resources Conservation Commission: WAM Resolved Technical Issue #4 Conservation Storage Protection, January 1999. Available online at http://www.tnrcc.state.tx.us/permitting/waterperm/wrpa/resolve.html#storage.
[8] Texas Water Development Board: Volumetric Survey of Lake Nasworthy, prepared for the City of San Angelo, December 1993.

1190), which authorizes 80,400 acre-feet per year diversion from 80,400 acre-feet of storage. The authorized diversion greatly exceeds the ability of the reservoir to supply water.

Instream Flow Requirements Apply to All Junior Water Rights

Instream flow requirements are minimum flows that must be maintained in the stream before a water right can divert or store water. Diversions by a water right may not cause flows to go below the minimum flow requirements. If flows are below the instream flow requirement, a water right cannot divert or store water (although a water right with storage can use stored water until it is exhausted). In more recent water rights, instream flow requirements are primarily designed to protect fish and wildlife habitats or bay and estuary inflows. In older water rights, instream flow requirements were designed to protect downstream senior water rights. If instream flow requirements are imposed, they are normally part of the special conditions of a water right permit.

TCEQ has assumed that instream flow requirements have the same priority as the associated water right. TCEQ also has elected to impose these requirements to every upstream junior water right even if that water right has no instream flow requirements. When modeling priority rights, this assumption is required to prevent diversions by upstream junior water rights from impacting the reliability of downstream senior water rights by causing flows to drop below the instream flow requirement[9]. However, in the real world this type of operation would be difficult to enforce. Upstream junior water rights holders are probably not aware of the special conditions of other water rights in the basin, and it would be difficult to prove which water right caused an impact on a senior right and to what extent that impact occurred.

The most significant instream flow requirements in the Colorado WAM are the target and critical flows in the LCRA Water Management Plan. The Water Management

[9] Texas Natural Resources Conservation Commission: WAM Resolved Technical Issue #3 Streamflow Reservations Associated with Permits, January 1999. Available online at http://www.tnrcc.state.tx.us/permitting/waterperm/wrpa/resolve.html#streamflow.

Plan itself does not specify a priority for these instream flow requirements. However, in its order upholding the LCRA Water Management Plan, TCEQ determined that the target and critical flows were part of the full amount of water appropriated to LCRA in its water rights for the Highland Lakes. In the WAM, both the target and critical instream flow requirements are assigned a 1926 priority date (the same as the Highland Lake storage) and apply to all water rights upstream with a priority after 1926. After all rights with priorities senior to 1926 divert, if there is not enough flow in the lower basin to meet these instream flow requirements, all water rights with junior priority dates must stop diverting or storing water, including water rights above the Highland Lakes.

No Return Flows

Return flows consist of either surface water or groundwater that is returned to a stream after first being used for a beneficial purpose. Most return flows consist of treated municipal sewage effluent, although other water discharged into a stream can be considered return flows as well. The Full Authorization run does not include return flows unless the water right permit specifies a volume of water that must be returned to the stream after being used. There are two reasons why TCEQ elected not to consider return flows when evaluating new permits. The first reason is that there is nothing in most water rights permits or in state law that compels either the generation or the discharge of wastewater. Use does not necessarily imply the generation of wastewater, and what wastewater is generated can be disposed of by means other than discharge to a stream. The second reason is that wastewater reuse will be widespread in the future. Therefore permanent water rights should not be granted assuming a specific level of flow originating as return flows from other water rights except on a temporary or contingent basis.

The most significant impact of this assumption in the Colorado WAM is associated with the reduction in: (1) the yield of reservoirs, (2) reliability of run-of-river water rights, and (3) flows available to meet instream flow and freshwater inflow needs associated with the LCRA Water Management Plan. Currently, the return flows from the

Austin metropolitan area are approximately 100,000 acre-feet per year. During low-flow periods, these return flows are a significant part of the flow in the lower Colorado River. If these flows are not available, upstream inflows that could have otherwise been diverted or stored by upstream water rights must be released or passed through to meet these requirements.

Impacts of Assumptions used in the Colorado WAM

Figures 2 and 3 illustrate the impact of the assumptions used in the Colorado WAM on water availability in Region F. Figure 2 is a graph of the variation in unappropriated flow at the confluence of the Concho and Colorado Rivers as a function of the priority date. The confluence is in the pool of Ivie Reservoir, just upstream from Freese Dam. The horizontal axis represents the priority date of each water right in the Colorado WAM. The vertical axis represents the percentage of total naturalized flow over the 59-year simulation period available for appropriation at each priority date. The WAM model appropriates water to each water right in priority order. As the model appropriates water, some of the naturalized flows at the confluence will be diverted and used upstream, while other portions of the flow will be reserved for use by water rights downstream. Water rights with priority dates of 1899 or earlier have no impact on water availability at the confluence. Water rights with a priority date of 1900 have the first impact on water availability at the confluence, reducing available flows by about 2 percent. The most significant change in available flows occurs in 1926. At this priority date, almost 50 percent of the total naturalized flows at the confluence are allocated to meet instream flow requirements associated with the LCRA water rights, and to fill storage in the Highland Lakes and Ivie Reservoir. (The Colorado WAM allows Ivie Reservoir to impound water at the same priority date as Lake Buchanan to model the impact of Ivie Reservoir on the firm yield of the Highland Lakes system as outlined in the LCRA Water Management Plan.) Note that by the end of the simulation period, only about 2 percent of the total flow at the confluence remains unappropriated. This does not mean that only

Figure 2
Percentage of Total Naturalized Flow Available at the Confluence of the Concho and Colorado Rivers by Priority Date

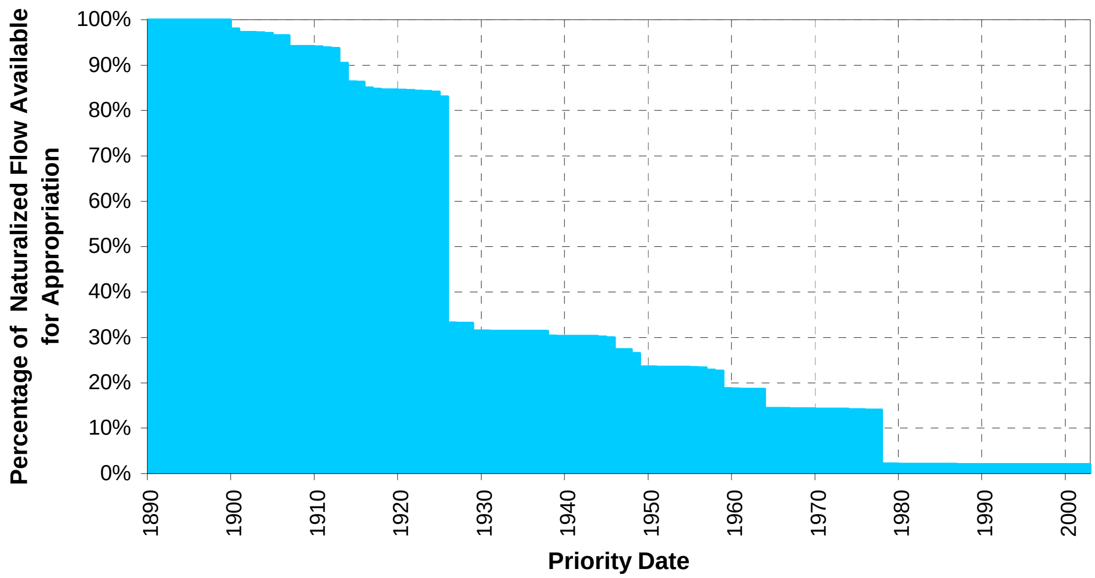
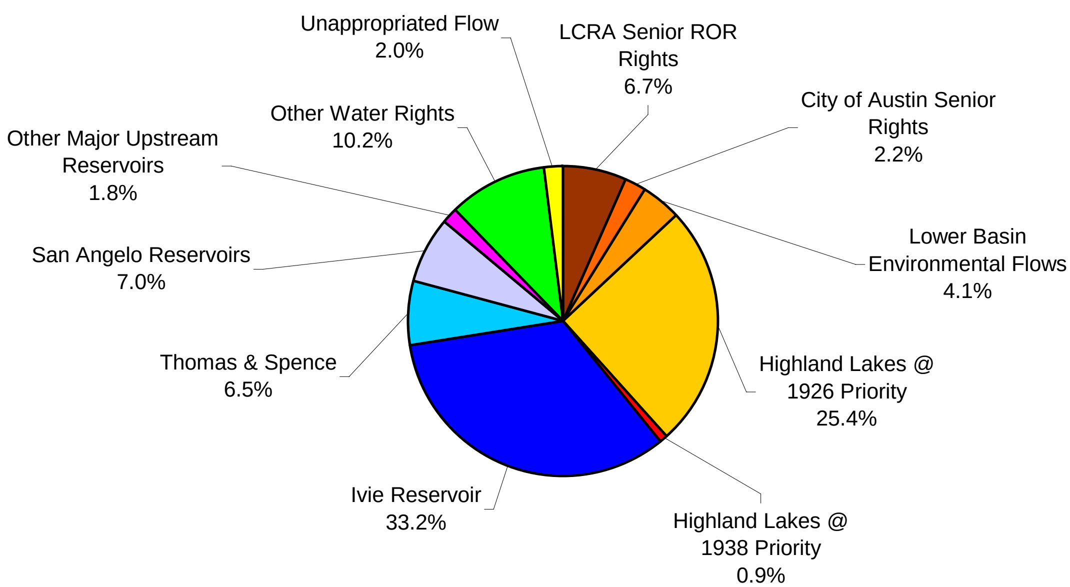


Figure 3
Distribution of Flows at the Colorado and Concho River Confluence



2 percent of the flow remains at the confluence. A significant portion of the flow has been reserved for downstream water rights and flows past the confluence.

Figure 3 shows the distribution of total naturalized flows at the confluence of the Colorado and Concho Rivers as a function of water rights. About 48% of the total flow is allocated to reservoirs upstream of the confluence, with the largest share going to Ivie Reservoir. Almost 40% of the flows at the confluence are reserved by senior water rights owned by LCRA, the City of Corpus Christi and the City of Austin. Over 25% of the flow at the confluence is used to fill storage in the Highland Lakes, which occurs at a 1926 priority date. Over 4% of the total flow is used to meet instream flow and bay and estuary requirements in the lower basin. About 2 percent of the total flow remains unappropriated.

Conclusions

Colorado WAM Run 3 is required by the TWDB for use in regional water planning. The Colorado WAM has significantly lower supplies for Region F than have been used in previous water plans. In many ways, the lower supplies are largely the results of the assumptions used in the Colorado WAM. Because of these assumptions, any water right with a priority date junior to 1926 will have essentially no yield. These assumptions are in conflict with the way that the basin has historically been operated.

The recent drought in most of Region F indicates that reliable supplies can be obtained from most reservoir sources in the region. In order to have a more realistic picture of supplies from these reservoirs, the Colorado WAM will need to be modified to subordinate senior downstream rights to reservoirs in Region F. This will be a complex analysis, and it will be difficult to evaluate this as a water management strategy following TWDB rules. However, since Region F is contractually obligated to use WAM Run 3 it will be necessary to either consider subordination or develop unnecessary strategies to meet the needs that result from the WAM.

Appendix 3D
Currently Available Water Supply by Water User Group and Wholesale Water Provider

Appendix 3D
Currently Available Water Supply by Water User Group
(Values in Acre-Feet per Year)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
ANDREWS	COLORADO	ANDREWS	OGALLALA AQUIFER	COLORADO	ANDREWS	2710	2416	2555	2641	2717	2755	2812	Supply from aquifer limited. Set to demands less assumed supply from University Lands.
COUNTY-OTHER	COLORADO	ANDREWS	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ANDREWS	16	16	16	16	16	16	16	Maximum use 1994 to 1999
COUNTY-OTHER	COLORADO	ANDREWS	OGALLALA AQUIFER	COLORADO	ANDREWS	687	515	535	543	550	554	564	Supply from aquifer limited. Set to demands.
COUNTY-OTHER	RIO GRANDE	ANDREWS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ANDREWS	6	7	7	7	8	8	8	No data. Set to demands.
IRRIGATION	COLORADO	ANDREWS	OGALLALA AQUIFER	COLORADO	ANDREWS	16418	17954	17710	17576	18692	18623	18520	Remaining supply after municipal, livestock & steam-electric
IRRIGATION	COLORADO	ANDREWS	DIRECT REUSE	COLORADO	ANDREWS	0	560	560	560	560	560	560	Historical use
LIVESTOCK	COLORADO	ANDREWS	LIVESTOCK LOCAL SUPPLY	COLORADO	ANDREWS	73	63	63	63	63	63	63	Average use 1996-2000
LIVESTOCK	COLORADO	ANDREWS	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ANDREWS	9	9	9	9	9	9	9	Maximum use 95-99
LIVESTOCK	COLORADO	ANDREWS	OGALLALA AQUIFER	COLORADO	ANDREWS	264	279	279	279	279	279	279	Supply from aquifer limited. Set to demands.
LIVESTOCK	COLORADO	ANDREWS	DOCKUM AQUIFER	COLORADO	ANDREWS	9	9	9	9	9	9	9	Maximum use 95-99
LIVESTOCK	RIO GRANDE	ANDREWS	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	ANDREWS	16	14	14	14	14	14	14	Average use 1996-2000
LIVESTOCK	RIO GRANDE	ANDREWS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ANDREWS	65	64	64	64	64	64	64	Set to remaining demand
MINING	COLORADO	ANDREWS	OGALLALA AQUIFER	COLORADO	ANDREWS	3070	1832	1880	1898	1916	1933	1956	Supply from aquifer limited. Set to demands.
MINING	COLORADO	ANDREWS	DOCKUM AQUIFER	COLORADO	ANDREWS	765	13	13	13	13	13	13	Maximum use 94-99
MINING	RIO GRANDE	ANDREWS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ANDREWS	121	120	120	120	120	120	120	Historical maximum between 1994 and 1999
COUNTY-OTHER	BRAZOS	BORDEN	OGALLALA AQUIFER	BRAZOS	BORDEN	5	14	14	14	12	11	10	
COUNTY-OTHER	COLORADO	BORDEN	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	11	0	0	0	0	0	0	
COUNTY-OTHER	COLORADO	BORDEN	OTHER AQUIFER	COLORADO	BORDEN	69	60	61	60	60	60	60	Max use '94-'99
COUNTY-OTHER	COLORADO	BORDEN	OGALLALA AQUIFER	COLORADO	BORDEN	3	3	3	3	3	3	3	Max use '94-'99
COUNTY-OTHER	COLORADO	BORDEN	OGALLALA AQUIFER	COLORADO	DAWSON	0	101	101	101	101	101	101	TWDB year 2000 use for the City of Gail
IRRIGATION	BRAZOS	BORDEN	BRAZOS RIVER RUN-OF-RIVER IRRIGATION	BRAZOS	BORDEN	56	0	0	0	0	0	0	
IRRIGATION	BRAZOS	BORDEN	OGALLALA AQUIFER	BRAZOS	BORDEN	92	84	84	84	86	87	88	
IRRIGATION	COLORADO	BORDEN	OGALLALA AQUIFER	COLORADO	BORDEN	727	759	759	759	759	759	759	Remaining supply after mun & stk
LIVESTOCK	BRAZOS	BORDEN	OGALLALA AQUIFER	BRAZOS	BORDEN	11	10	10	10	10	10	10	
LIVESTOCK	COLORADO	BORDEN	LIVESTOCK LOCAL SUPPLY	COLORADO	BORDEN	372	251	251	251	251	251	251	Average use '98-'00
LIVESTOCK	COLORADO	BORDEN	OGALLALA AQUIFER	COLORADO	BORDEN	4	20	20	20	20	20	20	
MINING	COLORADO	BORDEN	OTHER AQUIFER	COLORADO	BORDEN	1014	1014	1014	1014	1014	1014	1014	Max use '94-'99
BANGS	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	273	265	266	262	256	254	254	Set to demands
BROOKESMITH SUD	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	0	1413	1412	1413	1413	1413	1414	Less amount to Santa Anna, Coleman Co & Mills Co customers
BROWNWOOD	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	4502	3896	3927	3889	3816	3792	3792	100% of demand
COLEMAN COUNTY WSC	COLORADO	BROWN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COLEMAN COUNTY WSC	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	0	19	19	19	18	18	18	Assuming all of Brown County demand from this source. Overall up to 50% of CCWSC demand from Lake Brownwood. Provided through Brookesmith SUD.
COUNTY-OTHER	BRAZOS	BROWN	TRINITY AQUIFER	BRAZOS	BROWN	0	12	12	12	12	12	12	Set to demand
COUNTY-OTHER	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	1646	229	229	223	214	211	211	Bangs & Brownwood outside sales BCWID raw sales
COUNTY-OTHER	COLORADO	BROWN	OTHER AQUIFER	COLORADO	BROWN	117	9	9	9	9	9	9	1999 use. No data on source or reliability of aquifer.
COUNTY-OTHER	COLORADO	BROWN	TRINITY AQUIFER	COLORADO	BROWN	548	0	0	0	0	0	0	No supply left after allocation to livestock, mining and irrigation
EARLY	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	674	1228	1228	1228	1228	1228	1228	No longer selling to Zephyr WSC
IRRIGATION	COLORADO	BROWN	PECAN BAYOU COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	BROWN	3256	778	778	778	778	778	778	WAM supply
IRRIGATION	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	6970	6970	6970	6970	6970	6970	6970	Irrigation district demands + irrigation contracts
IRRIGATION	COLORADO	BROWN	TRINITY AQUIFER	COLORADO	BROWN	1282	1559	1542	1536	1536	1530	1516	
LIVESTOCK	BRAZOS	BROWN	LIVESTOCK LOCAL SUPPLY	BRAZOS	BROWN	41	27	27	27	27	27	27	2% of average use from '97 to '00
LIVESTOCK	BRAZOS	BROWN	TRINITY AQUIFER	BRAZOS	BROWN	0	5	5	5	5	5	5	Maxiumum historical use '94-'99
LIVESTOCK	COLORADO	BROWN	LIVESTOCK LOCAL SUPPLY	COLORADO	BROWN	1811	1296	1296	1296	1296	1296	1296	98% of avg '97-'00 use (remainder used in Brazos)
LIVESTOCK	COLORADO	BROWN	OTHER AQUIFER	COLORADO	BROWN	35	40	40	40	40	40	40	Max use '94-'99
LIVESTOCK	COLORADO	BROWN	TRINITY AQUIFER	COLORADO	BROWN	108	268	268	268	268	268	268	
MANUFACTURING	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	470	577	636	686	734	775	837	Assuming 100% of demand from Lake Brownwood
MANUFACTURING	COLORADO	BROWN	OTHER AQUIFER	COLORADO	BROWN	24	0	0	0	0	0	0	
MINING	BRAZOS	BROWN	TRINITY AQUIFER	BRAZOS	BROWN	0	41	42	42	42	42	42	Set to demand
MINING	COLORADO	BROWN	OTHER LOCAL SUPPLY	COLORADO	BROWN	2274	2274	2274	2274	2274	2274	2274	Source unknown. Assuming that demand is for recirculation of collected rainwater and does not reflect true consumptive use.
MINING	COLORADO	BROWN	OTHER AQUIFER	COLORADO	BROWN	27	31	31	31	31	31	31	Max use '94-'99
MINING	COLORADO	BROWN	TRINITY AQUIFER	COLORADO	BROWN	82	141	157	163	169	175	183	
ZEPHYR WSC	COLORADO	BROWN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	0	616	616	616	616	616	616	Brownwood & BCWID sales
BRONTE VILLAGE	COLORADO	COKE	OAK CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	403	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
BRONTE VILLAGE	COLORADO	COKE	OTHER AQUIFER	COLORADO	COKE	0	116	129	125	121	120	120	Rest of demand. Supply not proven.
COUNTY-OTHER	COLORADO	COKE	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	120	77	65	95	86	82	76	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	COKE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	COKE	0	15	15	15	15	15	15	Maximum use '94 to '99
COUNTY-OTHER	COLORADO	COKE	OTHER AQUIFER	COLORADO	COKE	47	55	50	49	47	46	46	Rest of demand
IRRIGATION	COLORADO	COKE	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	COKE	275	41	41	41	41	41	41	WAM supply
IRRIGATION	COLORADO	COKE	OTHER AQUIFER	COLORADO	COKE	534	532	532	532	532	532	532	Max use from '94-'99
LIVESTOCK	COLORADO	COKE	LIVESTOCK LOCAL SUPPLY	COLORADO	COKE	542	370	370	370	370	370	370	Average use '96-'00

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
LIVESTOCK	COLORADO	COKE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	COKE	136	184	184	184	184	184	184	Enough to meet demands
LIVESTOCK	COLORADO	COKE	OTHER AQUIFER	COLORADO	COKE	44	39	39	39	39	39	39	Max use '95-'99
MINING	COLORADO	COKE	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	232	239	378	378	380	372	WAM supply. See subordination strategy for actual supply used for planning. CRMWD diverted water. Several contracts.
MINING	COLORADO	COKE	OTHER AQUIFER	COLORADO	COKE	248	170	170	170	170	170	170	Historical max '95-'99
ROBERT LEE	COLORADO	COKE	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	350	256	231	340	317	302	281	WAM supply. See subordination strategy for actual supply used for planning.
ROBERT LEE	COLORADO	COKE	MOUNTAIN CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	342	0	0	0	0	0	0	assume no supply in drought
ROBERT LEE	COLORADO	COKE	COLORADO RIVER RUN-OF-RIVER CITY OF ROBERT LEE	COLORADO	COKE	0	7	7	7	7	7	7	
STEAM ELECTRIC POWER	COLORADO	COKE	OAK CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	1000	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
BROOKESMITH SUD	COLORADO	COLEMAN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	0	13	13	12	12	12	12	Set to demands
COLEMAN	COLORADO	COLEMAN	HORDS CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	504	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COLEMAN	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	1590	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COLEMAN COUNTY WSC	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COLEMAN COUNTY WSC	COLORADO	COLEMAN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	0	1381	1381	1381	1382	1382	1382	Through Brookesmith SUD.
COUNTY-OTHER	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	405	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
IRRIGATION	COLORADO	COLEMAN	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	COLEMAN	2310	31	31	31	31	31	31	WAM supply
IRRIGATION	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
IRRIGATION	COLORADO	COLEMAN	OTHER AQUIFER	COLORADO	COLEMAN	0	0	0	0	0	0	0	
LIVESTOCK	COLORADO	COLEMAN	LIVESTOCK LOCAL SUPPLY	COLORADO	COLEMAN	1579	1081	1081	1081	1081	1081	1081	Set to demands
LIVESTOCK	COLORADO	COLEMAN	OTHER AQUIFER	COLORADO	COLEMAN	178	178	178	178	178	178	178	Max use '95-'99. Includes supplies from Trinity formation.
MANUFACTURING	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	1	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MINING	COLORADO	COLEMAN	COLORADO RIVER COMBINED RUN-OF-RIVER CENTRAL CC	COLORADO	COLEMAN	16	0	0	0	0	0	0	WAM supply
MINING	COLORADO	COLEMAN	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MINING	COLORADO	COLEMAN	OTHER AQUIFER	COLORADO	COLEMAN	1	1	1	1	1	1	1	Recent historical use
SANTA ANNA	COLORADO	COLEMAN	COLORADO RIVER COMBINED RUN-OF-RIVER CENTRAL CC	COLORADO	COLEMAN	0	0	0	0	0	0	0	
SANTA ANNA	COLORADO	COLEMAN	BROWNWOOD LAKE/RESERVOIR	COLORADO	RESERVOIR	258	307	307	307	307	307	307	Supply through Brookesmith SUD
COUNTY-OTHER	COLORADO	CONCHO	CONCHO RIVER RUN-OF-RIVER CITY OF PAINT ROCK	COLORADO	CONCHO	67	35	35	35	35	35	35	City of Paint Rock, WAM supply
COUNTY-OTHER	COLORADO	CONCHO	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	CONCHO	56	40	40	40	40	40	40	Max use '95-'99
COUNTY-OTHER	COLORADO	CONCHO	OTHER AQUIFER	COLORADO	CONCHO	102	127	127	127	127	127	127	Max use '95-'99
COUNTY-OTHER	COLORADO	CONCHO	HICKORY AQUIFER	COLORADO	CONCHO	594	17	19	19	19	19	19	Eden sales
EDEN	COLORADO	CONCHO	OTHER AQUIFER	COLORADO	CONCHO	0	0	0	0	0	0	0	Assuming no supply available during drought-of-record conditions
EDEN	COLORADO	CONCHO	HICKORY AQUIFER	COLORADO	CONCHO	607	574	572	572	572	572	572	Set to maximum demand
IRRIGATION	COLORADO	CONCHO	CONCHO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	CONCHO	660	228	228	228	228	228	228	
IRRIGATION	COLORADO	CONCHO	LIPAN AQUIFER	COLORADO	CONCHO	6422	5037	5037	5037	5037	5037	5037	
LIVESTOCK	COLORADO	CONCHO	LIVESTOCK LOCAL SUPPLY	COLORADO	CONCHO	171	123	123	123	123	123	123	
LIVESTOCK	COLORADO	CONCHO	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	CONCHO	331	289	289	289	289	289	289	
LIVESTOCK	COLORADO	CONCHO	OTHER AQUIFER	COLORADO	CONCHO	457	363	363	363	363	363	363	
MILLERSVIEW-DOOLE WSC	COLORADO	CONCHO	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	92	85	123	112	0	0	14% of M-D share of Ivie WTP
MILLERSVIEW-DOOLE WSC	COLORADO	CONCHO	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	76	76	76	76	76	76	14% of supply, based on max use '96-'00
COUNTY-OTHER	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	CRANE	506	254	311	341	363	389	416	80% of demand
COUNTY-OTHER	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	49	62	76	84	89	95	102	20% of demand
CRANE	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	CRANE	893	755	804	826	839	861	887	80% of demand
CRANE	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	121	185	198	202	206	211	218	20% of demand
CRANE	RIO GRANDE	CRANE	DIRECT REUSE	RIO GRANDE	CRANE	91	0	0	0	0	0	0	
IRRIGATION	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	CRANE	337	337	337	337	337	337	337	Historical use
LIVESTOCK	RIO GRANDE	CRANE	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	CRANE	9	7	7	7	7	7	7	
LIVESTOCK	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	CRANE	109	148	148	148	148	148	148	
LIVESTOCK	RIO GRANDE	CRANE	DOCKUM AQUIFER	RIO GRANDE	CRANE	0	0	0	0	0	0	0	Historical use for livestock reported from Dockum. However, no supply available because no recharge.
MINING	RIO GRANDE	CRANE	OTHER LOCAL SUPPLY	RIO GRANDE	CRANE	1434	1430	1430	1430	1430	1430	1430	Historical water use reported by TWDB and used to calculate demands. Source unknown. No surface water rights in Crane County.
MINING	RIO GRANDE	CRANE	OTHER AQUIFER	RIO GRANDE	CRANE	134	81	81	81	81	81	81	Rustler aquifer
MINING	RIO GRANDE	CRANE	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	CRANE	1155	710	705	703	701	699	697	Set to demand
COUNTY-OTHER	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	CROCKETT	221	43	41	40	38	37	36	Set to demand
CROCKETT COUNTY WCID #1	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	CROCKETT	0	2503	2503	2503	2503	2503	2503	Ozona & Crockett Heights system capacity
IRRIGATION	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	CROCKETT	500	535	535	535	535	535	535	Average use '95-'99
LIVESTOCK	COLORADO	CROCKETT	LIVESTOCK LOCAL SUPPLY	COLORADO	CROCKETT	6	4	4	4	4	4	4	
LIVESTOCK	COLORADO	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	CROCKETT	24	26	26	26	26	26	26	Set to demand
LIVESTOCK	RIO GRANDE	CROCKETT	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	CROCKETT	153	127	127	127	127	127	127	97% average use '96-'00
LIVESTOCK	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	CROCKETT	814	840	840	840	840	840	840	Set to demand
MINING	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	CROCKETT	73	402	421	431	441	450	459	Set to demand
STEAM ELECTRIC POWER	RIO GRANDE	CROCKETT	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	2391	1500	1500	1500	1500	1500	1500	5-yr max (rounded up)
COUNTY-OTHER	COLORADO	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ECTOR	3168	3325	3908	4360	4643	4757	4804	60% of demands

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
COUNTY-OTHER	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	ECTOR	172	2136	2524	2825	3014	3090	3122	Remainder of demand
COUNTY-OTHER	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	GAINES	81	351	351	351	351	351	351	Great Plains to Goldsmith & W. Odessa Homeowners Assoc.
COUNTY-OTHER	RIO GRANDE	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	ECTOR	0	96	103	109	114	118	123	Maximum use '95-'99
COUNTY-OTHER	RIO GRANDE	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ECTOR	55	52	55	59	61	64	66	29% of demand
COUNTY-OTHER	RIO GRANDE	ECTOR	DOCKUM AQUIFER	RIO GRANDE	ECTOR	0	30	32	34	36	37	38	Rest of demand
ECTOR COUNTY UD	COLORADO	ECTOR	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	1080	1234	2166	2322	2434	2454	WAM supply. See subordination strategy for actual supply used for planning. Odessa Sales.
IRRIGATION	COLORADO	ECTOR	MONAHANS DRAW COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	ECTOR	1800	23	23	23	23	23	23	WAM supply
IRRIGATION	COLORADO	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ECTOR	60	1751	2074	2311	2433	2447	2412	Rest of demand
IRRIGATION	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	ECTOR	5667	3703	3315	3014	2825	2749	2717	Supply after municipal and livestock
IRRIGATION	RIO GRANDE	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ECTOR	518	56	54	54	54	52	52	Set to demand
LIVESTOCK	COLORADO	ECTOR	LIVESTOCK LOCAL SUPPLY	COLORADO	ECTOR	10	11	11	11	11	11	11	Average use '96-'00
LIVESTOCK	COLORADO	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ECTOR	120	171	171	171	171	171	171	Rest of demand
LIVESTOCK	COLORADO	ECTOR	DOCKUM AQUIFER	COLORADO	ECTOR	20	6	6	6	6	6	6	Average use '95-'99
LIVESTOCK	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	ECTOR	0	10	10	10	10	10	10	Average use '95-'99
LIVESTOCK	RIO GRANDE	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	ECTOR	48	50	50	50	50	50	50	Max use '95-'99 + 1AF
LIVESTOCK	RIO GRANDE	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ECTOR	30	29	29	29	29	29	29	Max use '95-'99 + 2AF
LIVESTOCK	RIO GRANDE	ECTOR	DOCKUM AQUIFER	RIO GRANDE	ECTOR	0	16	16	16	16	16	16	Max use '95-'99 + 1AF
MANUFACTURING	COLORADO	ECTOR	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	749	177	297	604	702	771	813	WAM supply. See subordination strategy for actual supply used for planning. Odessa Sales.
MANUFACTURING	COLORADO	ECTOR	DIRECT REUSE	COLORADO	ECTOR	2481	2500	2500	2500	2500	2500	2500	Preliminary
MANUFACTURING	RIO GRANDE	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ECTOR	0	16	17	18	19	19	20	Set to demand
MINING	COLORADO	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ECTOR	600	4443	3537	2848	2443	2315	2303	Remaining supply after municipal, livestock and irrigation
MINING	COLORADO	ECTOR	DOCKUM AQUIFER	COLORADO	ECTOR	0	0	0	0	0	0	0	Average use '95-'96
MINING	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	ECTOR	10	0	0	0	0	0	0	No supply left after municipal, livestock & irrigation
MINING	COLORADO	ECTOR	CAPITAN REEF AQUIFER	RIO GRANDE	WINKLER	0	5259	6784	7858	8637	9132	9442	From Oxy Permian distribution system. Enough to prevent shortage.
MINING	RIO GRANDE	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	ECTOR	0	23	23	23	23	23	23	Average use '95-'96
MINING	RIO GRANDE	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	ECTOR	0	1	1	1	1	1	1	Average use '95-'96
MINING	RIO GRANDE	ECTOR	DOCKUM AQUIFER	RIO GRANDE	ECTOR	700	348	348	348	348	348	348	Average use '95-'96
ODESSA	COLORADO	ECTOR	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	15567	11876	11257	17303	16993	17192	17006	WAM supply. See subordination strategy for actual supply used for planning. Member City.
ODESSA	COLORADO	ECTOR	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	ECTOR	432	440	440	440	440	440	440	Average use '96-'00
ODESSA	COLORADO	ECTOR	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	0	4800	0	0	0	0	0	CRMWD Ward County Well Field
STEAM ELECTRIC POWER	COLORADO	ECTOR	OGALLALA AQUIFER	COLORADO	ANDREWS	6700	6375	6375	6375	6375	6375	6375	Supply from aquifer limited. Set to 2010 demand.
COUNTY-OTHER	COLORADO	GLASSCOCK	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	GLASSCOCK	160	179	194	201	198	195	199	Set to demand
COUNTY-OTHER	COLORADO	GLASSCOCK	OGALLALA AQUIFER	COLORADO	GLASSCOCK	0	2	2	2	2	2	2	Historical use
IRRIGATION	COLORADO	GLASSCOCK	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	GLASSCOCK	16772	20586	20571	20564	20567	20570	20566	Supply less mun, stk & min
IRRIGATION	COLORADO	GLASSCOCK	OGALLALA AQUIFER	COLORADO	GLASSCOCK	3896	3902	3902	3902	3902	3902	3902	Supply less mun & stk
LIVESTOCK	COLORADO	GLASSCOCK	LIVESTOCK LOCAL SUPPLY	COLORADO	GLASSCOCK	42	40	40	40	40	40	40	
LIVESTOCK	COLORADO	GLASSCOCK	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	GLASSCOCK	167	168	168	168	168	168	168	Set to demand
LIVESTOCK	COLORADO	GLASSCOCK	OGALLALA AQUIFER	COLORADO	GLASSCOCK	32	24	24	24	24	24	24	5-yr max
MINING	COLORADO	GLASSCOCK	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	GLASSCOCK	5	5	5	5	5	5	5	Set to demands
BIG SPRING	COLORADO	HOWARD	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	6950	3636	3370	4976	4611	4389	4084	WAM supply. See subordination strategy for actual supply used for planning. Member City.
BIG SPRING	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	MARTIN	0	1035	1035	1035	1035	1035	1035	CRMWD Martin County well field
COAHOMA	COLORADO	HOWARD	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	171	134	124	182	169	159	148	WAM supply. See subordination strategy for actual supply used for planning. Big Spring sales through Howard County WCID#1.
COUNTY-OTHER	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	HOWARD	510	569	569	569	569	569	569	Max use '95-'99
COUNTY-OTHER	COLORADO	HOWARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	HOWARD	518	572	572	572	572	572	572	Max use '95-'99
COUNTY-OTHER	COLORADO	HOWARD	DOCKUM AQUIFER	COLORADO	HOWARD	0	12	12	12	12	12	12	Max use '95-'99
IRRIGATION	COLORADO	HOWARD	BEALS CREEK COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	HOWARD	24	0	0	0	0	0	0	No supply in WAM
IRRIGATION	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	HOWARD	4700	4638	4638	4638	4638	4638	4638	Max use '95-'99
IRRIGATION	COLORADO	HOWARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	HOWARD	0	183	183	183	183	183	183	Max use '95-'99
IRRIGATION	COLORADO	HOWARD	DOCKUM AQUIFER	COLORADO	HOWARD	0	41	41	41	41	41	41	Max use '95-'99
LIVESTOCK	COLORADO	HOWARD	LIVESTOCK LOCAL SUPPLY	COLORADO	HOWARD	73	62	62	62	62	62	62	Average use '96-'00
LIVESTOCK	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	HOWARD	230	225	225	225	225	225	225	Max use '95-'99 + 6 AF to prevent shortage
LIVESTOCK	COLORADO	HOWARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	HOWARD	85	70	70	70	70	70	70	Max use '95-'99 + 4 AF to prevent shortage
LIVESTOCK	COLORADO	HOWARD	DOCKUM AQUIFER	COLORADO	HOWARD	8	9	9	9	9	9	9	Max use '95-'99 + 1 AF to prevent shortage
MANUFACTURING	COLORADO	HOWARD	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	1723	722	703	1094	1090	1103	1130	WAM supply. See subordination strategy for actual supply used for planning. Both CRMWD contracts and customer sales.
MANUFACTURING	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	HOWARD	460	461	461	461	461	461	461	Max use '95-'99
MANUFACTURING	COLORADO	HOWARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	HOWARD	273	288	288	288	288	288	288	Max use '95-'99
MINING	COLORADO	HOWARD	BEALS CREEK RUN-OF-RIVER CRMWD DIVERTED WATER	COLORADO	HOWARD	1000	0	0	0	0	0	0	CRMWD diverted water. No supply in WAM.
MINING	COLORADO	HOWARD	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	1076	1053	1608	1555	1523	1460	WAM supply. See subordination strategy for actual supply used for planning. CRMWD diverted water. Several Contracts.
MINING	COLORADO	HOWARD	OGALLALA AQUIFER	COLORADO	HOWARD	150	119	119	119	119	119	119	Max use '95-'99
MINING	COLORADO	HOWARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	HOWARD	100	82	82	82	82	82	82	Max use '95-'99
MINING	COLORADO	HOWARD	DOCKUM AQUIFER	COLORADO	HOWARD	135	106	106	106	106	106	106	Max use '95-'99
COUNTY-OTHER	COLORADO	IRION	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	IRION	130	109	109	103	94	87	83	Set to demands
IRRIGATION	COLORADO	IRION	SPRING CREEK COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	IRION	1980	580	580	580	580	580	580	WAM supply
IRRIGATION	COLORADO	IRION	OTHER AQUIFER	COLORADO	IRION	1310	921	921	921	921	921	921	Average use '95-'99
LIVESTOCK	COLORADO	IRION	LIVESTOCK LOCAL SUPPLY	COLORADO	IRION	86	67	67	67	67	67	67	Average use '96-'00
LIVESTOCK	COLORADO	IRION	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	IRION	401	386	386	386	386	386	386	Set to demands
LIVESTOCK	COLORADO	IRION	OTHER AQUIFER	COLORADO	IRION	0	7	7	7	7	7	7	Average use '95-'99
MERTZON	COLORADO	IRION	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	IRION	125	139	139	139	139	139	139	
MINING	COLORADO	IRION	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	IRION	129	122	122	122	122	122	122	Set to demands
COUNTY-OTHER	COLORADO	KIMBLE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	KIMBLE	206	203	200	200	200	200	200	Max use '96-'00 + 3 AF in 2010 to prevent shortage

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
COUNTY-OTHER	COLORADO	KIMBLE	LLANO RIVER RUN-OF-RIVER CITY OF JUNCTION	COLORADO	KIMBLE	0	0	0	0	0	0	0	Junction sales. No supply left.
IRRIGATION	COLORADO	KIMBLE	LLANO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	KIMBLE	1980	1475	1475	1475	1475	1475	1475	WAM supply
IRRIGATION	COLORADO	KIMBLE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	KIMBLE	296	296	296	296	296	296	296	Max use '96-'00
JUNCTION	COLORADO	KIMBLE	LLANO RIVER RUN-OF-RIVER CITY OF JUNCTION	COLORADO	KIMBLE	0	0	0	0	0	0	0	No supply in WAM
LIVESTOCK	COLORADO	KIMBLE	LIVESTOCK LOCAL SUPPLY	COLORADO	KIMBLE	98	89	89	89	89	89	89	Average use '96-'00
LIVESTOCK	COLORADO	KIMBLE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	KIMBLE	466	579	579	579	579	579	579	Set to demand
MANUFACTURING	COLORADO	KIMBLE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	KIMBLE	31	3	3	3	3	3	3	Max use '96-'00
MANUFACTURING	COLORADO	KIMBLE	LLANO RIVER COMBINED RUN-OF-RIVER MANUFACTURING	COLORADO	KIMBLE	0	0	0	0	0	0	0	Johnson Fork. No supply in WAM.
MINING	COLORADO	KIMBLE	LLANO RIVER COMBINED RUN-OF-RIVER MINING	COLORADO	KIMBLE	0	13	13	13	13	13	13	WAM supply
MINING	COLORADO	KIMBLE	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	KIMBLE	105	91	91	91	91	91	91	Max use '96-'00
COUNTY-OTHER	RIO GRANDE	LOVING	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	LOVING	7	11	11	10	10	10	10	Set to demand
IRRIGATION	RIO GRANDE	LOVING	RED BLUFF LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	324	583	583	583	583	583	583	1999 use
LIVESTOCK	RIO GRANDE	LOVING	DOCKUM AQUIFER	RIO GRANDE	LOVING	0	6	6	6	6	6	6	Max use '95-'99 + 1 AF to prevent shortage
LIVESTOCK	RIO GRANDE	LOVING	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	LOVING	65	54	54	54	54	54	54	Max use '95-'99 + 2 AF to prevent shortage
LIVESTOCK	RIO GRANDE	LOVING	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	LOVING	0	10	10	10	10	10	10	Historical use
MINING	RIO GRANDE	LOVING	DOCKUM AQUIFER	RIO GRANDE	LOVING	0	3	3	3	3	3	3	Max use '96-'00
COUNTY-OTHER	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	300	377	403	411	412	399	378	Set to demand. Assume Stanton sales from local supplies
IRRIGATION	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	13888	13536	13509	13500	13571	13321	13075	Set to demands. Supply limited through 2030.
LIVESTOCK	COLORADO	MARTIN	LIVESTOCK LOCAL SUPPLY	COLORADO	MARTIN	79	67	67	67	67	67	67	Average use '96-'00
LIVESTOCK	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	357	206	206	206	206	206	206	Set to demands
MANUFACTURING	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	32	39	41	42	43	44	47	Set to demand
MINING	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	300	705	705	705	705	705	705	Average use '96-'00
STANTON	COLORADO	MARTIN	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	379	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
STANTON	COLORADO	MARTIN	OGALLALA AQUIFER	COLORADO	MARTIN	20	19	18	18	18	18	18	Average use '95-'99, less municipal sales
COUNTY-OTHER	COLORADO	MASON	ELLENBURGER-SAN SABA AQUIFER	COLORADO	MASON	37	38	38	38	38	38	38	Max use '95-99 + 1
COUNTY-OTHER	COLORADO	MASON	HICKORY AQUIFER	COLORADO	MASON	113	115	115	115	115	115	115	Max use '95-99 +1 plus Mason sales
COUNTY-OTHER	COLORADO	MASON	MARBLE FALLS AQUIFER	COLORADO	MASON	0	37	37	37	37	37	37	Historical use
IRRIGATION	COLORADO	MASON	HICKORY AQUIFER	COLORADO	MASON	18000	16099	16099	16099	16099	16099	16099	Total permitted amount for irrigation, provided by the Hickory UWCD
LIVESTOCK	COLORADO	MASON	LIVESTOCK LOCAL SUPPLY	COLORADO	MASON	628	451	451	451	451	451	451	Average use '96-'00
LIVESTOCK	COLORADO	MASON	ELLENBURGER-SAN SABA AQUIFER	COLORADO	MASON	200	102	102	102	102	102	102	Max use '95-'99
LIVESTOCK	COLORADO	MASON	HICKORY AQUIFER	COLORADO	MASON	509	386	386	386	386	386	386	Set to demands
LIVESTOCK	COLORADO	MASON	MARBLE FALLS AQUIFER	COLORADO	MASON	0	97	97	97	97	97	97	Historical use
MASON	COLORADO	MASON	HICKORY AQUIFER	COLORADO	MASON	783	766	765	766	766	766	766	Historical use less outside sales
MINING	COLORADO	MASON	HICKORY AQUIFER	COLORADO	MASON	12	6	6	6	6	6	6	Average use '96-'00
BRADY	COLORADO	MCCULLOCH	BRADY CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
BRADY	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	2047	1009	1009	1009	1009	1009	1009	Set to half of maximum demand (including outside sales)
COUNTY-OTHER	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	1294	12	12	12	12	12	12	Set to demands
IRRIGATION	COLORADO	MCCULLOCH	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	MCCULLOCH	550	128	128	128	128	128	128	WAM supply
IRRIGATION	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	2856	5975	5975	5975	5975	5975	5975	Total permitted amount for irrigation, provided by Hickory UWCD
LIVESTOCK	COLORADO	MCCULLOCH	LIVESTOCK LOCAL SUPPLY	COLORADO	MCCULLOCH	205	164	164	164	164	164	164	Average use '96-'00
LIVESTOCK	COLORADO	MCCULLOCH	OTHER AQUIFER	COLORADO	MCCULLOCH	140	104	104	104	104	104	104	Max use '95-'99
LIVESTOCK	COLORADO	MCCULLOCH	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MCCULLOCH	18	16	16	16	16	16	16	Max use '95-'99
LIVESTOCK	COLORADO	MCCULLOCH	ELLENBURGER-SAN SABA AQUIFER	COLORADO	MCCULLOCH	414	355	355	355	355	355	355	Max use '95-'99
LIVESTOCK	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	452	373	373	373	373	373	373	Set to demand
LIVESTOCK	COLORADO	MCCULLOCH	MARBLE FALLS AQUIFER	COLORADO	MCCULLOCH	0	15	15	15	15	15	15	Max use '95-'99
MANUFACTURING	COLORADO	MCCULLOCH	BRADY CREEK LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	Assigning all Brady sales to Hickory aquifer
MANUFACTURING	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	831	844	929	1004	1075	1137	1233	Set to demand. Assuming Brady sales are exclusively from Hickory.
MILLERSVIEW-DOOLE WSC	COLORADO	MCCULLOCH	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	161	164	238	216	0	0	28% of M-D share of Ivie WTP
MILLERSVIEW-DOOLE WSC	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	148	148	148	148	148	148	28% of supply
MINING	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	146	154	159	162	165	168	171	Set to demand
RICHLAND SUD	COLORADO	MCCULLOCH	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	186	186	186	186	186	186	
COUNTY-OTHER	COLORADO	MENARD	SAN SABA RIVER RUN-OF-RIVER CITY OF MENARD	COLORADO	MENARD	0	0	0	0	0	0	0	Menard sales. No supply left.
COUNTY-OTHER	COLORADO	MENARD	ELLENBURGER-SAN SABA AQUIFER	COLORADO	MENARD	0	1	1	1	1	1	1	Max use '95-'99
COUNTY-OTHER	COLORADO	MENARD	OTHER AQUIFER	COLORADO	MENARD	0	14	13	13	13	13	13	Max use '95-'99. Increased 2010 supply to prevent small shortage.
COUNTY-OTHER	COLORADO	MENARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MENARD	65	69	67	66	66	66	66	Max use '95-'99. Increased in 2010 and 2020 to prevent small shortage.
IRRIGATION	COLORADO	MENARD	SAN SABA RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	MENARD	3465	2934	2934	2934	2934	2934	2934	WAM supply
IRRIGATION	COLORADO	MENARD	OTHER AQUIFER	COLORADO	MENARD	200	0	0	0	0	0	0	Max use '95-'99
IRRIGATION	COLORADO	MENARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MENARD	2415	627	627	627	627	627	627	Max use '95-'99
IRRIGATION	COLORADO	MENARD	HICKORY AQUIFER	COLORADO	MENARD	0	59	59	59	59	59	59	Max use '95-'99
LIVESTOCK	COLORADO	MENARD	LIVESTOCK LOCAL SUPPLY	COLORADO	MENARD	113	86	86	86	86	86	86	Average use '96-'00
LIVESTOCK	COLORADO	MENARD	ELLENBURGER-SAN SABA AQUIFER	COLORADO	MENARD	0	6	6	6	6	6	6	Max use '95-'99
LIVESTOCK	COLORADO	MENARD	OTHER AQUIFER	COLORADO	MENARD	34	34	34	34	34	34	34	Max use '95-'99
LIVESTOCK	COLORADO	MENARD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MENARD	439	516	516	516	516	516	516	Set to demand
MENARD	COLORADO	MENARD	SAN SABA RIVER RUN-OF-RIVER CITY OF MENARD	COLORADO	MENARD	307	304	304	304	304	304	304	WAM supply
COUNTY-OTHER	COLORADO	MIDLAND	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	20	0	0	0	0	0	0	
COUNTY-OTHER	COLORADO	MIDLAND	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MIDLAND	1835	2296	2536	2701	2807	2879	2968	72% of demand (less Midland sales)
COUNTY-OTHER	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MIDLAND	1136	893	986	1051	1092	1119	1154	28 % of demand (less Midland sales)
COUNTY-OTHER	COLORADO	MIDLAND	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	21	21	21	21	21	21	Midland Ivie Contract.
IRRIGATION	COLORADO	MIDLAND	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MIDLAND	11357	15843	15502	15269	15094	14951	14802	Supply after mun, stk, min
IRRIGATION	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MIDLAND	3404	3430	3322	3244	3191	3153	3102	Supply after mun, mfg, stk

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
IRRIGATION	COLORADO	MIDLAND	DIRECT REUSE	COLORADO	MIDLAND	15773	5987	5987	5987	5987	5987	5987	No surface rights in Midland Co, must be reuse
LIVESTOCK	COLORADO	MIDLAND	LIVESTOCK LOCAL SUPPLY	COLORADO	MIDLAND	182	117	117	117	117	117	117	Average use '96-'00
LIVESTOCK	COLORADO	MIDLAND	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MIDLAND	440	579	579	579	579	579	579	Max use '95-'99
LIVESTOCK	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MIDLAND	122	208	208	208	208	208	208	Max use '95-'99
MANUFACTURING	COLORADO	MIDLAND	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	46	0	0	0	0	0	0	
MANUFACTURING	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MIDLAND	5	136	151	164	176	187	203	
MANUFACTURING	COLORADO	MIDLAND	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	28	31	34	37	39	42	Estimated Midland sales (17% of demand). Midland Ivie Contract.
MIDLAND	COLORADO	MIDLAND	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	29925	12136	12202	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MIDLAND	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	ANDREWS	1237	0	0	0	0	0	0	Supply from source limited. Set to approximate current use. City expects well field to be depleted by 2035.
MIDLAND	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MARTIN	3791	0	0	0	0	0	0	City expects well field to be depleted by 2035
MIDLAND	COLORADO	MIDLAND	OGALLALA AQUIFER	COLORADO	MIDLAND	0	0	0	0	0	0	0	Well field no longer in use.
MIDLAND	COLORADO	MIDLAND	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	10925	10669	10473	10246	10021	9795	No expiration on contract. Less sales. Assuming 16.54% of safe yield.
MINING	COLORADO	MIDLAND	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	MIDLAND	0	677	778	846	915	986	1046	Max use '96-'00
ODESSA	COLORADO	MIDLAND	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	51	306	403	720	761	780	774	WAM supply. See subordination strategy for actual supply used for planning. Member City.
COLORADO CITY	COLORADO	MITCHELL	COLORADO CITY-CHAMPION LAKE/RESERVOIR SYSTEM	COLORADO	RESERVOIR	1000	0	0	0	0	0	0	No longer using this source
COLORADO CITY	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	1500	997	999	1001	1004	1008	1013	
COLORADO CITY	COLORADO	MITCHELL	DIRECT REUSE	COLORADO	MITCHELL	450	0	0	0	0	0	0	
COUNTY-OTHER	COLORADO	MITCHELL	COLORADO CITY-CHAMPION LAKE/RESERVOIR SYSTEM	COLORADO	RESERVOIR	190	0	0	0	0	0	0	Source no longer used for municipal supplies
COUNTY-OTHER	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	168	621	609	593	570	549	516	No basis, set to demand
IRRIGATION	COLORADO	MITCHELL	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	MITCHELL	235	15	15	15	15	15	15	WAM supply
IRRIGATION	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	2200	5549	5549	5549	5549	5549	5549	2000 use
LIVESTOCK	COLORADO	MITCHELL	LIVESTOCK LOCAL SUPPLY	COLORADO	MITCHELL	455	381	381	381	381	381	381	Average use '96-'00
LIVESTOCK	COLORADO	MITCHELL	OTHER AQUIFER	COLORADO	MITCHELL	0	2	2	2	2	2	2	Max use '95-'99
LIVESTOCK	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	75	66	66	66	66	66	66	Set to demands
LORAINE	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	130	110	110	110	110	110	110	System capacity less outside sales
MINING	COLORADO	MITCHELL	COLORADO RIVER RUN-OF-RIVER CRMWD DIVERTED WAT	COLORADO	COKE	0	0	0	0	0	0	0	
MINING	COLORADO	MITCHELL	DOCKUM AQUIFER	COLORADO	MITCHELL	500	141	141	141	141	141	141	2000 use
STEAM ELECTRIC POWER	COLORADO	MITCHELL	COLORADO CITY-CHAMPION LAKE/RESERVOIR SYSTEM	COLORADO	RESERVOIR	3970	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	600	674	694	703	702	698	684	Rest of demand
COUNTY-OTHER	RIO GRANDE	PECOS	OTHER AQUIFER	RIO GRANDE	PECOS	0	1	1	1	1	1	1	Historical use
COUNTY-OTHER	RIO GRANDE	PECOS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	PECOS	302	27	27	27	27	27	27	9% of demand
FORT STOCKTON	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	5600	5913	5913	5913	5913	5913	5913	TCEQ capacity less outside sales
IRAAN	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	525	567	567	567	567	567	567	TCEQ capacity
IRRIGATION	RIO GRANDE	PECOS	RED BLUFF LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	1558	1558	1558	1558	1558	1558	1558	Old Plan
IRRIGATION	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	58713	47740	47740	47740	47740	47740	47740	Avg use 95-99
IRRIGATION	RIO GRANDE	PECOS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	PECOS	19846	27456	27456	27456	27456	27456	27456	Avg use 95-99
IRRIGATION	RIO GRANDE	PECOS	RUSTLER AQUIFER	RIO GRANDE	PECOS	0	1385	1385	1385	1385	1385	1385	Historical use
IRRIGATION	RIO GRANDE	PECOS	PECOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	RIO GRANDE	PECOS	0	4444	4444	4444	4444	4444	4444	WAM supply
LIVESTOCK	RIO GRANDE	PECOS	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	PECOS	57	52	52	52	52	52	52	Avg use 96-00
LIVESTOCK	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	1070	911	911	911	911	911	911	Max use 95-99 + 50
LIVESTOCK	RIO GRANDE	PECOS	OTHER AQUIFER	RIO GRANDE	PECOS	10	4	4	4	4	4	4	Max use 95-99
LIVESTOCK	RIO GRANDE	PECOS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	PECOS	220	269	269	269	269	269	269	Max use 95-99 + 50
LIVESTOCK	RIO GRANDE	PECOS	RUSTLER AQUIFER	RIO GRANDE	PECOS	0	4	4	4	4	4	4	Max use 95-99
MANUFACTURING	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	8	3	3	3	3	3	3	Avg use 95-99
MINING	RIO GRANDE	PECOS	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	PECOS	249	249	249	249	249	249	249	Max use 95-99
MINING	RIO GRANDE	PECOS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	PECOS	40	37	37	37	37	37	37	Max use 95-99
PECOS COUNTY WCID #1	RIO GRANDE	PECOS	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	PECOS	0	478	478	478	478	478	478	TCEQ capacity
BIG LAKE	COLORADO	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	REAGAN	922	910	988	1026	1010	970	923	Supply limited. Set to demands.
BIG LAKE	COLORADO	REAGAN	DIRECT REUSE	COLORADO	REAGAN	40	0	0	0	0	0	0	
COUNTY-OTHER	COLORADO	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	REAGAN	115	124	135	141	138	133	126	Supply limited. Set to demands.
IRRIGATION	COLORADO	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	REAGAN	28014	25600	25383	25269	25220	25198	25186	Remainder of supply
IRRIGATION	COLORADO	REAGAN	DOCKUM AQUIFER	RIO GRANDE	REAGAN	50	0	0	0	0	0	0	No demand
LIVESTOCK	COLORADO	REAGAN	LIVESTOCK LOCAL SUPPLY	COLORADO	REAGAN	42	38	38	38	38	38	38	93% of 96-00 average
LIVESTOCK	COLORADO	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	REAGAN	110	215	215	215	215	215	215	Rest of demand
LIVESTOCK	RIO GRANDE	REAGAN	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	REAGAN	3	3	3	3	3	3	3	7% of 96-00 average
LIVESTOCK	RIO GRANDE	REAGAN	DOCKUM AQUIFER	RIO GRANDE	REAGAN	4	10	10	10	10	10	10	Max use 95-99
LIVESTOCK	RIO GRANDE	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	REAGAN	0	13	13	13	13	13	13	Max use 95-99
MINING	COLORADO	REAGAN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	REAGAN	0	2036	2165	2235	2303	2370	2436	Supply limited. Set to demands.
BALMORHEA	RIO GRANDE	REEVES	BALMORHEA LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	30	0	0	0	0	0	0	WAM Supply
BALMORHEA	RIO GRANDE	REEVES	OTHER AQUIFER	RIO GRANDE	JEFF DAVIS	100	122	132	139	148	157	166	1996 use less outside sales. Still need Region E to add 2060 supply
BALMORHEA	RIO GRANDE	REEVES	BIG AGUJA CREEK RUN-OF-RIVER CITY OF BALMORHEA	RIO GRANDE	JEFF DAVIS	0	0	0	0	0	0	0	WAM supply
COUNTY-OTHER	RIO GRANDE	REEVES	BALMORHEA LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	50	0	0	0	0	0	0	
COUNTY-OTHER	RIO GRANDE	REEVES	OTHER AQUIFER	RIO GRANDE	JEFF DAVIS	0	76	66	59	50	41	32	Balmorhea sales
COUNTY-OTHER	RIO GRANDE	REEVES	DOCKUM AQUIFER	RIO GRANDE	REEVES	130	26	23	20	18	16	14	From Pecos
COUNTY-OTHER	RIO GRANDE	REEVES	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	REEVES	76	68	68	68	68	68	68	
COUNTY-OTHER	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	260	49	43	39	34	29	28	From Pecos
IRRIGATION	RIO GRANDE	REEVES	RED BLUFF LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	9110	9110	9110	9110	9110	9110	9110	Old plan
IRRIGATION	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	REEVES	56868	57862	57841	57826	57813	57801	57753	Rest of supply
IRRIGATION	RIO GRANDE	REEVES	DIRECT REUSE	RIO GRANDE	REEVES	689	0	0	0	0	0	0	
IRRIGATION	RIO GRANDE	REEVES	PECOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	RIO GRANDE	REEVES	0	0	0	0	0	0	0	WAM supply

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
LIVESTOCK	RIO GRANDE	REEVES	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	REEVES	106	66	66	66	66	66	66	Avg use '96-'00
LIVESTOCK	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	REEVES	1060	1211	1211	1211	1211	1211	1211	Max use '95-'99 + 100 AF to prevent shortage
LIVESTOCK	RIO GRANDE	REEVES	DOCKUM AQUIFER	RIO GRANDE	REEVES	80	130	130	130	130	130	130	Max use '95-'99 + 50 AF to prevent shortage
LIVESTOCK	RIO GRANDE	REEVES	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	REEVES	900	773	773	773	773	773	773	Max use '95-'99 + 50 AF to prevent shortage
LIVESTOCK	RIO GRANDE	REEVES	RUSTLER AQUIFER	RIO GRANDE	REEVES	0	103	103	103	103	103	103	Historical use
MADERA VALLEY WSC	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	REEVES	0	695	700	702	703	705	711	Supply limited. Set to demands.
MANUFACTURING	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	REEVES	13	570	591	606	620	631	675	Rest of demand
MANUFACTURING	RIO GRANDE	REEVES	DOCKUM AQUIFER	RIO GRANDE	REEVES	0	52	52	52	52	52	52	Assumed Pecos sales
MANUFACTURING	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	0	98	98	98	98	98	98	Assumed Pecos sales
MINING	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	REEVES	0	182	177	175	173	172	170	Supply limited. Set to demands.
PECOS	RIO GRANDE	REEVES	DOCKUM AQUIFER	RIO GRANDE	REEVES	1270	1269	1272	1275	1277	1279	1281	1996 use less municipal & manufacturing sales
PECOS	RIO GRANDE	REEVES	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	1840	1541	1792	1986	2136	2294	2431	1998 use less municipal & manufacturing sales
BALLINGER	COLORADO	RUNNELS	BALLINGER/MOONEN LAKE/RESERVOIR	COLORADO	RESERVOIR	912	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
BALLINGER	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	0	0	0	0	0	0	0	No basis, set to zero.
BALLINGER	COLORADO	RUNNELS	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	0	0	0	0	0	0	Emergency supply from Abilene contract
COLEMAN COUNTY WSC	COLORADO	RUNNELS	COLEMAN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	RUNNELS	BALLINGER/MOONEN LAKE/RESERVOIR	COLORADO	RESERVOIR	88	0	0	0	0	0	0	No supply left. Sales from City of Ballinger.
COUNTY-OTHER	COLORADO	RUNNELS	WINTERS LAKE/RESERVOIR	COLORADO	RESERVOIR	231	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	160	30	29	29	28	31	52	No basis, set to demand
IRRIGATION	COLORADO	RUNNELS	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	RUNNELS	5500	771	771	771	771	771	771	WAM supply
IRRIGATION	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	3000	1984	1984	1984	1984	1984	1984	Average use '95-'99
IRRIGATION	COLORADO	RUNNELS	DIRECT REUSE	COLORADO	RUNNELS	298	218	218	218	218	218	218	Year 2000 reuse, Ballinger & Winters
LIVESTOCK	COLORADO	RUNNELS	LIVESTOCK LOCAL SUPPLY	COLORADO	RUNNELS	1779	1148	1148	1148	1148	1148	1148	Average use '96-'00
LIVESTOCK	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	198	382	382	382	382	382	382	Set to demand
MANUFACTURING	COLORADO	RUNNELS	BALLINGER/MOONEN LAKE/RESERVOIR	COLORADO	RESERVOIR	0	0	0	0	0	0	0	No supply left
MANUFACTURING	COLORADO	RUNNELS	WINTERS LAKE/RESERVOIR	COLORADO	RESERVOIR	47	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MILES	COLORADO	RUNNELS	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	0	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MILES	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	130	134	134	134	134	134	134	Average historical use '96-'00
MILLERSVIEW-DOOLE WSC	COLORADO	RUNNELS	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	69	62	93	85	0	0	11% of supply
MILLERSVIEW-DOOLE WSC	COLORADO	RUNNELS	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	56	56	56	56	56	56	11% of supply
MINING	COLORADO	RUNNELS	OTHER AQUIFER	COLORADO	RUNNELS	40	44	45	45	45	45	45	Set to demand
WINTERS	COLORADO	RUNNELS	WINTERS LAKE/RESERVOIR	COLORADO	RESERVOIR	550	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SCHLEICHER	124	117	108	102	98	95	93	Set to demands
COUNTY-OTHER	RIO GRANDE	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SCHLEICHER	30	25	23	22	21	20	20	Set to demands
ELDORADO	COLORADO	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SCHLEICHER	490	710	710	710	710	710	711	1998 use less estimated sales
IRRIGATION	COLORADO	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SCHLEICHER	1500	2286	2286	2286	2286	2286	2286	Max use '95-'99
IRRIGATION	COLORADO	SCHLEICHER	SAN SABA RIVER RUN-OF-RIVER IRRIGATION	COLORADO	SCHLEICHER	0	0	0	0	0	0	0	WAM supply
IRRIGATION	RIO GRANDE	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SCHLEICHER	500	846	846	846	846	846	846	Max use '95-'99
LIVESTOCK	COLORADO	SCHLEICHER	LIVESTOCK LOCAL SUPPLY	COLORADO	SCHLEICHER	100	83	83	83	83	83	83	74% of average use '96-'00
LIVESTOCK	COLORADO	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SCHLEICHER	400	500	500	500	500	500	500	Set to demands
LIVESTOCK	RIO GRANDE	SCHLEICHER	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	SCHLEICHER	35	29	29	29	29	29	29	26% of average use '96-'00
LIVESTOCK	RIO GRANDE	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SCHLEICHER	140	175	175	175	175	175	175	Set to demands
MINING	COLORADO	SCHLEICHER	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SCHLEICHER	150	150	150	150	150	150	154	Max use '96-'00, increased in 2060 to prevent small shortage
MINING	COLORADO	SCHLEICHER	SAN SABA RIVER RUN-OF-RIVER MINING	COLORADO	SCHLEICHER	0	0	0	0	0	0	0	WAM supply
COUNTY-OTHER	BRAZOS	SCURRY	OTHER AQUIFER	BRAZOS	SCURRY	25	43	43	43	43	43	43	Max use '95-'99
COUNTY-OTHER	BRAZOS	SCURRY	DOCKUM AQUIFER	BRAZOS	SCURRY	165	273	275	274	270	269	269	Set to demands
COUNTY-OTHER	COLORADO	SCURRY	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	207	146	134	199	188	180	167	WAM supply. See subordination strategy for actual supply used for planning. Assign to CRMWD system.
COUNTY-OTHER	COLORADO	SCURRY	DOCKUM AQUIFER	COLORADO	SCURRY	200	120	124	122	115	114	114	Set to demands
COUNTY-OTHER	COLORADO	SCURRY	OTHER AQUIFER	COLORADO	SCURRY	230	238	238	238	238	238	238	Max use '95-'99
IRRIGATION	BRAZOS	SCURRY	DOCKUM AQUIFER	BRAZOS	SCURRY	956	788	762	736	710	684	659	Set to demand
IRRIGATION	COLORADO	SCURRY	DEEP CREEK COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	SCURRY	1170	69	69	69	69	69	69	WAM supply
IRRIGATION	COLORADO	SCURRY	DOCKUM AQUIFER	COLORADO	SCURRY	1210	2672	2672	2672	2672	2672	2672	Max use '95-'99
IRRIGATION	COLORADO	SCURRY	DIRECT REUSE	COLORADO	SCURRY	406	0	0	0	0	0	0	
LIVESTOCK	BRAZOS	SCURRY	LIVESTOCK LOCAL SUPPLY	BRAZOS	SCURRY	266	198	198	198	198	198	198	37% of average use from '96-'00
LIVESTOCK	BRAZOS	SCURRY	OTHER AQUIFER	BRAZOS	SCURRY	30	8	8	8	8	8	8	Max use '95-'99
LIVESTOCK	BRAZOS	SCURRY	DOCKUM AQUIFER	BRAZOS	SCURRY	0	27	27	27	27	27	27	Set to demands
LIVESTOCK	COLORADO	SCURRY	LIVESTOCK LOCAL SUPPLY	COLORADO	SCURRY	453	336	336	336	336	336	336	63% of average use from '96-'00
LIVESTOCK	COLORADO	SCURRY	DOCKUM AQUIFER	COLORADO	SCURRY	150	40	40	40	40	40	40	Set to demands
LIVESTOCK	COLORADO	SCURRY	OTHER AQUIFER	COLORADO	SCURRY	0	20	20	20	20	20	20	Max use '95-'99
MINING	BRAZOS	SCURRY	DOCKUM AQUIFER	BRAZOS	SCURRY	2800	2921	2921	2921	2921	2921	2921	Max use '95-'99
MINING	COLORADO	SCURRY	COLORADO RIVER RUN-OF-RIVER CRMWD DIVERTED WAT	COLORADO	COKE	2000	0	0	0	0	0	0	
MINING	COLORADO	SCURRY	DOCKUM AQUIFER	COLORADO	SCURRY	1000	954	954	954	966	989	1021	Max use '95-'99, increased to prevent shortage
MINING	COLORADO	SCURRY	OTHER AQUIFER	COLORADO	SCURRY	0	5	5	5	5	5	5	Max use '95-'99
SNYDER	COLORADO	SCURRY	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	3005	1381	1293	1935	1812	1738	1617	WAM supply. See subordination strategy for actual supply used for planning. Member City.
SNYDER	COLORADO	SCURRY	DOCKUM AQUIFER	COLORADO	SCURRY	30	900	900	900	900	900	900	Well field capacity
COUNTY-OTHER	COLORADO	STERLING	OTHER AQUIFER	COLORADO	STERLING	0	6	6	6	6	6	6	Historical use
COUNTY-OTHER	COLORADO	STERLING	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	STERLING	45	46	50	51	50	48	49	Set to demands
IRRIGATION	COLORADO	STERLING	OTHER AQUIFER	COLORADO	STERLING	600	595	595	595	595	595	595	Max use '95-'99
IRRIGATION	COLORADO	STERLING	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	STERLING	315	102	102	102	102	102	102	Max use '95-'99
IRRIGATION	COLORADO	STERLING	DIRECT REUSE	COLORADO	STERLING	65	0	0	0	0	0	0	

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
IRRIGATION	COLORADO	STERLING	NORTH CONCHO RIVER COMBINED RUN-OF-RIVER IRRIGA	COLORADO	STERLING	0	48	48	48	48	48	48	WAM supply
LIVESTOCK	COLORADO	STERLING	LIVESTOCK LOCAL SUPPLY	COLORADO	STERLING	99	74	74	74	74	74	74	Avg use '96-'00
LIVESTOCK	COLORADO	STERLING	OTHER AQUIFER	COLORADO	STERLING	77	77	77	77	77	77	77	Max use '95-'99
LIVESTOCK	COLORADO	STERLING	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	STERLING	395	352	352	352	352	352	352	Set to demands
MINING	COLORADO	STERLING	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	STERLING	585	590	600	605	610	615	620	Set to demand
STERLING CITY	COLORADO	STERLING	OTHER AQUIFER	COLORADO	STERLING	273	297	321	330	330	319	324	
COUNTY-OTHER	COLORADO	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SUTTON	40	54	56	56	55	54	54	Set to demand
COUNTY-OTHER	RIO GRANDE	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SUTTON	259	223	232	231	226	225	223	Set to demand
IRRIGATION	COLORADO	SUTTON	N LLANO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	SUTTON	475	8	8	8	8	8	8	WAM supply
IRRIGATION	COLORADO	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SUTTON	0	554	554	554	554	554	554	31% of maximum use from 1995-1999
IRRIGATION	RIO GRANDE	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SUTTON	1786	1250	1232	1232	1232	1232	1232	69% of 5 yr max
LIVESTOCK	COLORADO	SUTTON	LIVESTOCK LOCAL SUPPLY	COLORADO	SUTTON	71	46	46	46	46	46	46	45% of average use '96-'00
LIVESTOCK	COLORADO	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SUTTON	284	312	312	312	312	312	312	Set to demands
LIVESTOCK	RIO GRANDE	SUTTON	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	SUTTON	85	57	57	57	57	57	57	55% of average use '96-'00
LIVESTOCK	RIO GRANDE	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SUTTON	339	381	381	381	381	381	381	Set to demands
MINING	COLORADO	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	SUTTON	0	35	35	36	36	37	37	Set to demands
MINING	RIO GRANDE	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SUTTON	46	45	47	47	48	48	49	Set to demands
SONORA	RIO GRANDE	SUTTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	SUTTON	1150	1919	1919	1919	1919	1919	1919	TCEQ capacity less assumed sales
CONCHO RURAL WSC	COLORADO	TOM GREEN	LIPAN AQUIFER	COLORADO	TOM GREEN	0	1062	1062	1062	1062	1062	1062	Set to 2060 demands
CONCHO RURAL WSC	COLORADO	TOM GREEN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	TOM GREEN	0	41	41	41	41	41	41	Set to 2060 demands
COUNTY-OTHER	COLORADO	TOM GREEN	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	15	0	0	0	0	0	0	All supplies taken from Lake Nasworthy
COUNTY-OTHER	COLORADO	TOM GREEN	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	35	0	0	0	0	0	0	Assume all San Angelo sales from Lake Nasworthy
COUNTY-OTHER	COLORADO	TOM GREEN	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	64	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	TOM GREEN	OTHER AQUIFER	COLORADO	TOM GREEN	682	682	682	682	682	682	682	Max use '94-99
COUNTY-OTHER	COLORADO	TOM GREEN	LIPAN AQUIFER	COLORADO	TOM GREEN	910	502	502	502	502	502	502	Max use '94-99 less CRWSC
COUNTY-OTHER	COLORADO	TOM GREEN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	TOM GREEN	551	536	536	536	536	536	536	Max use '94-99 less CRWSC
IRRIGATION	COLORADO	TOM GREEN	CONCHO RIVER COMBINED RUN-OF-RIVER IRRIGATION	COLORADO	TOM GREEN	15839	2812	2812	2812	2812	2812	2812	WAM supply
IRRIGATION	COLORADO	TOM GREEN	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	7672	0	0	0	0	0	0	Assuming interruptible supplies of 18,000 ac-ft per year available fro irrigation pool with no supply during drought of record
IRRIGATION	COLORADO	TOM GREEN	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	316	0	0	0	0	0	0	Assuming no supply during drought of record
IRRIGATION	COLORADO	TOM GREEN	OTHER AQUIFER	COLORADO	TOM GREEN	10000	9853	9853	9853	9853	9853	9853	Max use '94-'99
IRRIGATION	COLORADO	TOM GREEN	LIPAN AQUIFER	COLORADO	TOM GREEN	36362	35846	35846	35846	35846	35846	35846	Remaining supply
IRRIGATION	COLORADO	TOM GREEN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	TOM GREEN	520	520	520	520	520	520	520	Max use '94-'99
IRRIGATION	COLORADO	TOM GREEN	DIRECT REUSE	COLORADO	TOM GREEN	11530	8500	8500	8500	8500	8500	8500	
LIVESTOCK	COLORADO	TOM GREEN	LIVESTOCK LOCAL SUPPLY	COLORADO	TOM GREEN	1990	1644	1644	1644	1644	1644	1644	Avg use '96-'00
LIVESTOCK	COLORADO	TOM GREEN	OTHER AQUIFER	COLORADO	TOM GREEN	33	30	30	30	30	30	30	Max use '94-'99 + 5%
LIVESTOCK	COLORADO	TOM GREEN	LIPAN AQUIFER	COLORADO	TOM GREEN	34	31	31	31	31	31	31	Max use '94-'99 + 5%
LIVESTOCK	COLORADO	TOM GREEN	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	TOM GREEN	267	273	273	273	273	273	273	Set to demands
MANUFACTURING	COLORADO	TOM GREEN	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	0	0	0	0	0	0	0	All supplies taken from Lake Nasworthy
MANUFACTURING	COLORADO	TOM GREEN	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	0	0	0	0	0	0	0	Assume all San Angelo sales from Lake Nasworthy
MANUFACTURING	COLORADO	TOM GREEN	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	610	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
MILLERSVIEW-DOOLE WSC	COLORADO	TOM GREEN	COLORADO RIVER MWD SYSTEM	COLORADO	RESERVOIR	0	174	176	290	300	0	0	47% of supply
MILLERSVIEW-DOOLE WSC	COLORADO	TOM GREEN	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	244	244	244	244	244	244	47% of supply
MINING	COLORADO	TOM GREEN	OTHER AQUIFER	COLORADO	TOM GREEN	192	105	105	105	105	105	105	Max use '94-'99
MINING	COLORADO	TOM GREEN	LIPAN AQUIFER	COLORADO	TOM GREEN	0	45	45	45	45	45	45	Max use '94-'99
SAN ANGELO	COLORADO	TOM GREEN	SAN ANGELO SYSTEM GAIN	COLORADO	RESERVOIR	0	0	0	0	0	0	0	Water Mangement Strategy
SAN ANGELO	COLORADO	TOM GREEN	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	1213	0	0	0	0	0	0	All supplies taken from Lake Nasworthy
SAN ANGELO	COLORADO	TOM GREEN	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	2938	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
SAN ANGELO	COLORADO	TOM GREEN	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	5308	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
SAN ANGELO	COLORADO	TOM GREEN	HICKORY AQUIFER	COLORADO	MCCULLOCH	0	0	0	0	0	0	0	Water mangement strategy
SAN ANGELO	COLORADO	TOM GREEN	CONCHO RIVER COMBINED RUN-OF-RIVER CITY OF SAN A	COLORADO	TOM GREEN	0	642	642	642	642	642	642	WAM supply
SAN ANGELO	COLORADO	TOM GREEN	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	10974	10751	10528	10304	10081	9858	No contract expiration. 16.54% of safe yield.
SAN ANGELO	COLORADO	TOM GREEN	EV SPENCE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	RESERVOIR	0	34	34	34	34	34	34	WAM supply. See subordination strategy for actual supply used for planning. 6% of safe yield. No expiration on contract.
STEAM ELECTRIC POWER	COLORADO	TOM GREEN	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	RESERVOIR	1602	0	0	0	0	0	0	WAM supply. See subordination strategy for actual supply used for planning.
COUNTY-OTHER	COLORADO	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	UPTON	61	52	54	53	53	54	55	Supply limited. Set to demands
COUNTY-OTHER	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	132	100	102	102	101	102	104	Set to demands
IRRIGATION	COLORADO	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	UPTON	14481	5920	5904	5900	5895	5889	5882	Remaining supply
IRRIGATION	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	0	199	199	199	199	199	199	Max use '95-'99
LIVESTOCK	COLORADO	UPTON	LIVESTOCK LOCAL SUPPLY	COLORADO	UPTON	15	13	13	13	13	13	13	37% of average use '96-'00
LIVESTOCK	COLORADO	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	UPTON	24	65	65	65	65	65	65	Set to demands
LIVESTOCK	RIO GRANDE	UPTON	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	UPTON	27	23	23	23	23	23	23	63% of average use '96-'00
LIVESTOCK	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	100	91	91	91	91	91	91	Max use '95-'99
LIVESTOCK	RIO GRANDE	UPTON	DOCKUM AQUIFER	RIO GRANDE	UPTON	0	20	20	20	20	20	20	Max use '95-'99
MCCAMEY	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	550	1071	1070	1070	1071	1070	1069	TCEQ capacity less assumed sales
MCCAMEY	RIO GRANDE	UPTON	DIRECT REUSE	RIO GRANDE	UPTON	77	0	0	0	0	0	0	
MINING	COLORADO	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	UPTON	0	2011	2025	2030	2035	2040	2046	Supply limited. Set to demands
MINING	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	618	651	655	657	659	660	662	Set to demand
RANKIN	RIO GRANDE	UPTON	EDWARDS-TRINITY-PLATEAU AQUIFER	RIO GRANDE	UPTON	226	327	326	326	326	326	325	TCEQ capacity less assumed sales
RANKIN	RIO GRANDE	UPTON	DIRECT REUSE	RIO GRANDE	UPTON	10	0	0	0	0	0	0	
COUNTY-OTHER	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	568	910	514	510	495	490	490	400 ac-ft of supply from CRMWD contract with University Lands, which expires in 2019
COUNTY-OTHER	RIO GRANDE	WARD	DOCKUM AQUIFER	RIO GRANDE	WARD	0	15	15	15	15	15	15	Max use '94-'99

Table 3D-1: Currently Available Supply by Water User Group (Cont.)

Water User Group Name	Basin	County	Source Name	Source Basin	Source County	Water Supply 2000	Water Supply 2010	Water Supply 2020	Water Supply 2030	Water Supply 2040	Water Supply 2050	Water Supply 2060	Comments
IRRIGATION	RIO GRANDE	WARD	RED BLUFF LAKE/RESERVOIR	RIO GRANDE	RESERVOIR	5009	5009	5009	5009	5009	5009	5009	Supply from 2001 plan
IRRIGATION	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	534	2271	2656	1738	750	215	64	Remaining supply
IRRIGATION	RIO GRANDE	WARD	DOCKUM AQUIFER	RIO GRANDE	WARD	300	316	316	316	316	316	316	Max use '94-'99
IRRIGATION	RIO GRANDE	WARD	DIRECT REUSE	RIO GRANDE	WARD	0	670	670	670	670	670	670	TWDB reuse database
LIVESTOCK	RIO GRANDE	WARD	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	WARD	12	5	5	5	5	5	5	Avg use '96-'00
LIVESTOCK	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	250	116	116	116	116	116	116	Max use '94-'99
LIVESTOCK	RIO GRANDE	WARD	DOCKUM AQUIFER	RIO GRANDE	WARD	25	5	5	5	5	5	5	Max use '94-'99
MANUFACTURING	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	4	7	7	7	7	7	7	Set to demands
MINING	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	0	153	155	156	157	158	159	Set to demands
MONAHANS	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	2139	2182	2210	2215	2193	2186	2186	Supply limited. Set to demands
MONAHANS	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	0	377	382	382	379	378	378	14% of demand
MONAHANS	RIO GRANDE	WARD	DIRECT REUSE	RIO GRANDE	WARD	1200	0	0	0	0	0	0	
STEAM ELECTRIC POWER	RIO GRANDE	WARD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WARD	5728	4914	4223	4937	5807	6189	6189	Demand limited to max use '96-'00
COUNTY-OTHER	RIO GRANDE	WINKLER	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	50	57	57	57	57	57	57	1999 use & estimated Wink sales
COUNTY-OTHER	RIO GRANDE	WINKLER	DOCKUM AQUIFER	RIO GRANDE	WINKLER	100	64	64	64	64	64	64	1999 use & estimated Kermit sales
IRRIGATION	RIO GRANDE	WINKLER	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	0	10000	10000	10000	10000	10000	10000	Set to demands
KERMIT	RIO GRANDE	WINKLER	DOCKUM AQUIFER	RIO GRANDE	WINKLER	2387	3943	3943	3943	3943	3943	3943	Capacity less estimated sales
LIVESTOCK	COLORADO	WINKLER	DOCKUM AQUIFER	COLORADO	WINKLER	0	2	2	2	2	2	2	Max use '94-'99
LIVESTOCK	RIO GRANDE	WINKLER	LIVESTOCK LOCAL SUPPLY	RIO GRANDE	WINKLER	8	7	7	7	7	7	7	Avg use '96-'00
LIVESTOCK	RIO GRANDE	WINKLER	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	180	140	140	140	140	140	140	Max use '94-'99
LIVESTOCK	RIO GRANDE	WINKLER	DOCKUM AQUIFER	RIO GRANDE	WINKLER	0	20	20	20	20	20	20	Max use '94-'99
MINING	RIO GRANDE	WINKLER	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	0	109	109	109	109	109	109	Max use '94-'99
MINING	RIO GRANDE	WINKLER	DOCKUM AQUIFER	RIO GRANDE	WINKLER	2040	1769	1769	1769	1769	1769	1769	Max use '94-'99
WINK	RIO GRANDE	WINKLER	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	WINKLER	339	657	657	657	657	657	657	Capacity less estimated sales

Table 3D-2
Currently Available Water Supply for Wholesale Water Providers
(Values in Acre-Feet per Year)

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
BROWN COUNTY WID #1	EARLY	BROWNWOOD LAKE/RESERVOIR	COLORADO	1,228	1,228	1,228	1,228	1,228	1,228	
BROWN COUNTY WID #1	CITY OF BROWNWOOD	BROWNWOOD LAKE/RESERVOIR	COLORADO	3,896	3,927	3,889	3,816	3,792	3,792	
BROWN COUNTY WID #1	BANGS	BROWNWOOD LAKE/RESERVOIR	COLORADO	265	266	262	256	254	254	
BROWN COUNTY WID #1	CITY OF SANTA ANNA	BROWNWOOD LAKE/RESERVOIR	COLORADO	307	307	307	307	307	307	
BROWN COUNTY WID #1	BROWNWOOD SALES	BROWNWOOD LAKE/RESERVOIR	COLORADO	229	229	223	214	211	211	
BROWN COUNTY WID #1	BROWN COUNTY MFG	BROWNWOOD LAKE/RESERVOIR	COLORADO	577	636	686	734	775	837	
BROWN COUNTY WID #1	BROOKESMITH SUD	BROWNWOOD LAKE/RESERVOIR	COLORADO	1,413	1,412	1,413	1,413	1,413	1,414	
BROWN COUNTY WID #1	BROOKESMITH SUD	BROWNWOOD LAKE/RESERVOIR	COLORADO	13	13	12	12	12	12	
BROWN COUNTY WID #1	BROOKESMITH SUD	BROWNWOOD LAKE/RESERVOIR	COLORADO	7	8	8	8	8	7	
BROWN COUNTY WID #1	ZEPHRYR WSC	BROWNWOOD LAKE/RESERVOIR	COLORADO	616	616	616	616	616	616	
BROWN COUNTY WID #1	COLEMAN COUNTY WSC	BROWNWOOD LAKE/RESERVOIR	COLORADO	19	19	19	18	18	18	
BROWN COUNTY WID #1	COLEMAN COUNTY WSC	BROWNWOOD LAKE/RESERVOIR	COLORADO	1,381	1,381	1,381	1,382	1,382	1,382	
BROWN COUNTY WID #1	IRRIGATION	BROWNWOOD LAKE/RESERVOIR	COLORADO	6,970	6,970	6,970	6,970	6,970	6,970	
				16,921	*17,012*	*17,014*	*16,974*	*16,986*	*17,048*	

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
COLORADO RIVER MWD	SAN ANGELO - IVIE CONTRACT	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	10,974	10,751	10,528	10,304	10,081	9,858	
COLORADO RIVER MWD	SAN ANGELO - SPENCE CONTRACT	EV SPENCE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	34	34	34	34	34	34	
COLORADO RIVER MWD	COAHOMA - HOWARD COUNTY WCID#1	COLORADO RIVER MWD SYSTEM	COLORADO	134	124	182	169	159	148	Big Spring sales though Howard County WCID #1
COLORADO RIVER MWD	ROTAN	COLORADO RIVER MWD SYSTEM	COLORADO	203	181	248	217	200	170	Snyder sales
COLORADO RIVER MWD	ROBERT LEE	COLORADO RIVER MWD SYSTEM	COLORADO	256	231	340	317	302	281	
COLORADO RIVER MWD	ABILENE IVIE CONTRACT	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	10,974	10,751	10,528	10,304	10,081	9,858	Less Ballinger supplies
COLORADO RIVER MWD	MIDLAND - 1966 CONTRACT	COLORADO RIVER MWD SYSTEM	COLORADO	12,136	12,202	0	0	0	0	
COLORADO RIVER MWD	MIDLAND - IVIE CONTRACT	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	10,925	10,699	10,473	10,246	10,021	9,795	Less sales
COLORADO RIVER MWD	BIG SPRING	COLORADO RIVER MWD SYSTEM	COLORADO	3,636	3,370	4,976	4,611	4,389	4,084	
COLORADO RIVER MWD	BIG SPRING	OGALLALA AQUIFER	COLORADO	1,035	1,035	1,035	1,035	1,035	1,035	Martin Co. Well Field
COLORADO RIVER MWD	COUNTY OTHER - ROBERT LEE SALES	COLORADO RIVER MWD SYSTEM	COLORADO	77	65	95	86	82	76	
COLORADO RIVER MWD	ECTOR COUNTY UD - ODESSA SALES	COLORADO RIVER MWD SYSTEM	COLORADO	1,080	1,234	2,166	2,322	2,434	2,454	Odessa sales
COLORADO RIVER MWD	MANUFACTURING - ODESSA SALES	COLORADO RIVER MWD SYSTEM	COLORADO	177	297	604	702	771	813	Odessa sales
COLORADO RIVER MWD	ODESSA - CRMWD SYSTEM	COLORADO RIVER MWD SYSTEM	COLORADO	11,876	11,257	17,303	16,993	17,192	17,006	
COLORADO RIVER MWD	ODESSA - ECTOR COUNTY WELL FIELD	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	440	440	440	440	440	440	Ector County well field
COLORADO RIVER MWD	ODESSA - CRMWD SYSTEM	COLORADO RIVER MWD SYSTEM	COLORADO	306	403	720	761	780	774	
COLORADO RIVER MWD	ODESSA - WARD COUNTY WELL FIELD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	4,800	0	0	0	0	0	University Lands
COLORADO RIVER MWD	MANUFACTURING - HOWARD COUNTY	COLORADO RIVER MWD SYSTEM	COLORADO	722	703	1,094	1,090	1,103	1,130	Both CRMWD contracts and customer sales
COLORADO RIVER MWD	MILLERSVIEW-DOOLE WSC - MCCULLOCH	COLORADO RIVER MWD SYSTEM	COLORADO	181	164	238	216	0	0	
COLORADO RIVER MWD	MILLERSVIEW-DOOLE WSC - CONCHO	COLORADO RIVER MWD SYSTEM	COLORADO	92	85	123	112	0	0	
COLORADO RIVER MWD	MILLERSVIEW-DOOLE WSC - RUNNELS	COLORADO RIVER MWD SYSTEM	COLORADO	69	62	93	85	0	0	
COLORADO RIVER MWD	MILLERSVIEW-DOOLE WSC - TOM GREEN	COLORADO RIVER MWD SYSTEM	COLORADO	174	176	290	300	0	0	
COLORADO RIVER MWD	COUNTY-OTHER - MIDLAND SALES	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	21	21	21	21	21	21	Midland Ivie contract
COLORADO RIVER MWD	MANUFACTURING - MIDLAND SALES	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	28	31	34	37	39	42	
COLORADO RIVER MWD	BALLINGER - ABILENE IVIE CONTRACT	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	0	0	0	0	0	0	Emergency supply from Abilene
COLORADO RIVER MWD	COUNTY-OTHER - SNYDER SALES	COLORADO RIVER MWD SYSTEM	COLORADO	146	134	199	188	180	167	
COLORADO RIVER MWD	SNYDER	COLORADO RIVER MWD SYSTEM	COLORADO	1,381	1,293	1,935	1,812	1,738	1,617	
COLORADO RIVER MWD	SNYDER	DOCKUM AQUIFER	COLORADO	900	900	900	900	900	900	Scurry County well field
COLORADO RIVER MWD	COUNTY-OTHER - PYOTE ET AL.	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	400	0	0	0	0	0	University Lands
COLORADO RIVER MWD	MINING - HOWARD	COLORADO RIVER MWD SYSTEM	COLORADO	1,076	1,053	1,608	1,555	1,523	1,460	CRMWD diverted water. Several contracts.
COLORADO RIVER MWD	MINING - COKE	COLORADO RIVER MWD SYSTEM	COLORADO	232	239	378	378	380	372	CRMWD diverted water. Several contracts.
				74,485	*67,935*	*66,585*	*65,235*	*63,885*	*62,535*	

Table 3D-2: Currently Available Water Supply for Wholesale Water Providers (Continued)

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
ODESSA CITY OF	ECTOR COUNTY UD - ODESSA SALES	COLORADO RIVER MWD SYSTEM	COLORADO	1,080	1,234	2,166	2,322	2,434	2,454	
ODESSA CITY OF	MANUFACTURING - ODESSA SALES	COLORADO RIVER MWD SYSTEM	COLORADO	177	297	604	702	771	813	
ODESSA CITY OF	MANUFACTURING - REUSE	DIRECT REUSE	COLORADO	2,500	2,500	2,500	2,500	2,500	2,500	
ODESSA CITY OF	CITY OF ODESSA	COLORADO RIVER MWD SYSTEM	COLORADO	306	403	720	761	780	774	
ODESSA CITY OF	CITY OF ODESSA	COLORADO RIVER MWD SYSTEM	COLORADO	11,876	11,257	17,303	16,993	17,192	17,006	
ODESSA CITY OF	CITY OF ODESSA	EDWARDS-TRINITY-PLATEAU AQUIFER	COLORADO	440	440	440	440	440	440	
ODESSA CITY OF	CITY OF ODESSA	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	4,800	0	0	0	0	0	
				21,179	*16,131*	*23,733*	*23,718*	*24,117*	*23,987*	

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
SAN ANGELO CITY OF	SAN ANGELO MUNICIPAL SALES	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
SAN ANGELO CITY OF	SAN ANGELO MUNICIPAL SALES	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
SAN ANGELO CITY OF	SAN ANGELO MUNICIPAL SALES	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	Municipal sales outside city limits
SAN ANGELO CITY OF	MANUFACTURING	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
SAN ANGELO CITY OF	WEST TEXAS UTILTIES	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	Limited to 1998 use
SAN ANGELO CITY OF	MILES	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	Treated water from UCRA.
SAN ANGELO CITY OF	TOM GREEN COUNTY WCID #1	DIRECT REUSE	COLORADO	8,500	8,500	8,500	8,500	8,500	8,500	
SAN ANGELO CITY OF	CITY OF SAN ANGELO	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
SAN ANGELO CITY OF	CITY OF SAN ANGELO	NASWORTHY LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
SAN ANGELO CITY OF	CITY OF SAN ANGELO	CONCHO RIVER COMBINED RUN-OF-RIVER CITY OF SAN ANGELO	COLORADO	642	642	642	642	642	642	
SAN ANGELO CITY OF	CITY OF SAN ANGELO	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	10974	10751	10528	10304	10081	9858	
SAN ANGELO CITY OF	CITY OF SAN ANGELO	EV SPENCE LAKE/RESERVOIR NON-SYSTEM PORTION	COLORADO	0	0	0	0	0	0	Pipeline not functioning
SAN ANGELO CITY OF	TOM GREEN COUNTY WCID #1	TWIN BUTTES LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	Variable, depends on content of flood pool.
				20,116	*19,893*	*19,670*	*19,446*	*19,223*	*19,000*	

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
GREAT PLAINS WATER SY	ECTOR COUNTY MUNICIPAL	OGALLALA AQUIFER	COLORADO	351	351	351	351	351	351	
GREAT PLAINS WATER SY	ODESSA POWER GENERATION FACILITY	OGALLALA AQUIFER	COLORADO	6,375	6,375	6,375	6,375	6,375	6,375	
				6,726	*6,726*	*6,726*	*6,726*	*6,726*	*6,726*	

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
UPPER COLORADO RIVER	MILES	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	Treated by San Angelo
UPPER COLORADO RIVER	SAN ANGELO	OC FISHER LAKE/RESERVOIR SAN ANGELO SYSTEM	COLORADO	0	0	0	0	0	0	
UPPER COLORADO RIVER	ROBERT LEE	MOUNTAIN CREEK LAKE/RESERVOIR	COLORADO	0	0	0	0	0	0	
				0	*0*	*0*	*0*	*0*	*0*	

Wholesale Water Provider	Recipient	Source	Source Basin	2010	2020	2030	2040	2050	2060	Comments
UNIVERSITY LANDS	CRMWD	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	4,800	0	0	0	0	0	CRMWD Ward County Well Field
UNIVERSITY LANDS	COUNTY OTHER-PYOTE ET AL.	CENOZOIC PECOS ALLUVIUM AQUIFER	RIO GRANDE	400	0	0	0	0	0	CRMWD Ward County Well Field
UNIVERSITY LANDS	ANDREWS	OGALLALA AQUIFER	COLORADO	0	0	0	0	0	0	
UNIVERSITY LANDS	MIDLAND	OGALLALA AQUIFER	COLORADO	0	0	0	0	0	0	
UNIVERSITY LANDS	MIDLAND	OGALLALA AQUIFER	COLORADO	0	0	0	0	0	0	
				5,200	*0*	*0*	*0*	*0*	*0*	

Appendix 4A
Comparison of Supply and Demand by Water User Group

Appendix 4A
Comparison of Supply and Demand by Water User Group
(Values in Acre-Feet per Year)

County	Basin	WUG	Demand 2010	Demand 2020	Demand 2030	Demand 2040	Demand 2050	Demand 2060	Supply 2010	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Surplus (Need) 2010	Surplus (Need) 2020	Surplus (Need) 2030	Surplus (Need) 2040	Surplus (Need) 2050	Surplus (Need) 2060
ANDREWS	COLORADO	ANDREWS	3,087	3,263	3,371	3,467	3,515	3,585	2,416	2,555	2,641	2,717	2,755	2,812	(671)	(708)	(730)	(750)	(760)	(773)
		COUNTY-OTHER	531	551	559	566	570	580	531	551	559	566	570	580	0	0	0	0	0	0
		IRRIGATION	32,608	32,334	32,062	31,788	31,516	31,245	18,514	18,270	18,136	19,252	19,183	19,080	(14,094)	(14,064)	(13,926)	(12,536)	(12,333)	(12,165)
		LIVESTOCK	360	360	360	360	360	360	360	360	360	360	360	360	0	0	0	0	0	0
		MINING	1,845	1,893	1,911	1,929	1,946	1,969	1,845	1,893	1,911	1,929	1,946	1,969	0	0	0	0	0	0
	RIO GRANDE	COUNTY-OTHER	7	7	7	8	8	8	7	7	7	8	8	8	0	0	0	0	0	0
		LIVESTOCK	78	78	78	78	78	78	78	78	78	78	78	78	0	0	0	0	0	0
		MINING	63	64	65	65	66	67	120	120	120	120	120	120	57	56	55	55	54	53
BORDEN	BRAZOS	COUNTY-OTHER	14	14	14	12	11	10	14	14	14	12	11	10	0	0	0	0	0	0
		IRRIGATION	1,103	1,102	1,100	1,099	1,097	1,096	84	84	84	86	87	88	(1,019)	(1,018)	(1,016)	(1,013)	(1,010)	(1,008)
		LIVESTOCK	10	10	10	10	10	10	10	10	10	10	10	10	0	0	0	0	0	0
	COLORADO	COUNTY-OTHER	161	165	155	136	125	113	164	165	164	164	164	164	3	0	9	28	39	51
		IRRIGATION	1,587	1,585	1,582	1,581	1,578	1,577	759	759	759	759	759	759	(828)	(826)	(823)	(822)	(819)	(818)
		LIVESTOCK	271	271	271	271	271	271	271	271	271	271	271	271	0	0	0	0	0	0
		MINING	690	658	646	635	625	612	1,014	1,014	1,014	1,014	1,014	1,014	324	356	368	379	389	402
BROWN	BRAZOS	COUNTY-OTHER	12	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0	0
		LIVESTOCK	32	32	32	32	32	32	32	32	32	32	32	32	0	0	0	0	0	0
		MINING	41	42	42	42	42	42	41	42	42	42	42	42	0	0	0	0	0	0
	COLORADO	BANGS	265	266	262	256	254	254	265	266	262	256	254	254	0	0	0	0	0	0
		BROWNWOOD	3,896	3,927	3,889	3,816	3,792	3,792	3,896	3,927	3,889	3,816	3,792	3,792	0	0	0	0	0	0
		COLEMAN COUNTY WSC	19	19	19	18	18	18	19	19	19	18	18	18	0	0	0	0	0	0
		COUNTY-OTHER	342	342	336	327	324	324	238	238	232	223	220	220	(104)	(104)	(104)	(104)	(104)	(104)
		EARLY	799	812	810	801	797	797	1,228	1,228	1,228	1,228	1,228	1,228	429	416	418	427	431	431
		IRRIGATION	12,313	12,272	12,230	12,189	12,146	12,105	9,307	9,290	9,284	9,284	9,278	9,264	(3,006)	(2,982)	(2,946)	(2,905)	(2,868)	(2,841)
		LIVESTOCK	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	1,604	0	0	0	0	0	0
		MANUFACTURING	577	636	686	734	775	837	577	636	686	734	775	837	0	0	0	0	0	0
		MINING	2,446	2,462	2,468	2,474	2,480	2,488	2,446	2,462	2,468	2,474	2,480	2,488	0	0	0	0	0	0
		ZEPHYR WSC	399	404	399	391	387	387	616	616	616	616	616	616	217	212	217	225	229	229
		BROOKESMITH SUD	1,374	1,391	1,384	1,357	1,348	1,348	1,413	1,412	1,413	1,413	1,413	1,414	39	21	29	56	65	66
COKE	COLORADO	BRONTE VILLAGE	245	258	254	250	249	249	116	129	125	121	120	120	(129)	(129)	(129)	(129)	(129)	(129)
		COUNTY-OTHER	175	162	159	154	152	152	147	130	159	148	143	137	(28)	(32)	0	(6)	(9)	(15)
		IRRIGATION	936	936	934	933	933	933	573	573	573	573	573	573	(363)	(363)	(361)	(360)	(360)	(360)
		LIVESTOCK	593	593	593	593	593	593	593	593	593	593	593	593	0	0	0	0	0	0
		MINING	488	528	550	572	593	614	402	409	548	548	550	542	(86)	(119)	(2)	(24)	(43)	(72)
		ROBERT LEE	351	346	342	338	336	336	263	238	347	324	309	288	(88)	(108)	5	(14)	(27)	(48)
		STEAM ELECTRIC POWER	310	247	289	339	401	477	0	0	0	0	0	0	(310)	(247)	(289)	(339)	(401)	(477)
COLEMAN	COLORADO	COLEMAN	1,285	1,269	1,252	1,235	1,223	1,223	0	0	0	0	0	0	(1,285)	(1,269)	(1,252)	(1,235)	(1,223)	(1,223)
		COLEMAN COUNTY WSC	357	348	339	329	326	326	1,381	1,381	1,381	1,382	1,382	1,382	1,024	1,033	1,042	1,053	1,056	1,056
		COUNTY-OTHER	19	19	18	18	18	18	0	0	0	0	0	0	(19)	(19)	(18)	(18)	(18)	(18)
		IRRIGATION	1,379	1,379	1,379	1,379	1,379	1,379	31	31	31	31	31	31	(1,348)	(1,348)	(1,348)	(1,348)	(1,348)	(1,348)
		LIVESTOCK	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259	0	0	0	0	0	0
		MANUFACTURING	6	6	6	6	6	6	0	0	0	0	0	0	(6)	(6)	(6)	(6)	(6)	(6)
		MINING	18	19	19	19	19	19	1	1	1	1	1	1	(17)	(18)	(18)	(18)	(18)	(18)
		SANTA ANNA	200	197	193	190	187	187	307	307	307	307	307	307	107	110	114	117	120	120
		BROOKESMITH SUD	13	13	12	12	12	12	13	13	12	12	12	12	0	0	0	0	0	0
CONCHO	COLORADO	COUNTY-OTHER	188	193	191	189	188	188	219	221	221	221	221	221	31	28	30	32	33	33
		EDEN	559	572	569	562	559	559	574	572	572	572	572	572	15	0	3	10	13	13
		IRRIGATION	4,297	4,280	4,262	4,245	4,229	4,213	5,265	5,265	5,265	5,265	5,265	5,265	968	985	1,003	1,020	1,036	1,052
		LIVESTOCK	775	775	775	775	775	775	775	775	775	775	775	775	0	0	0	0	0	0
		MILLERSVIEW-DOOLE WSC	126	127	124	119	118	118	168	161	199	188	76	76	42	34	75	69	(42)	(42)

Appendix 4A
Comparison of Supply and Demand by Water User Group
(Values in Acre-Feet per Year)

County	Basin	WUG	Demand 2010	Demand 2020	Demand 2030	Demand 2040	Demand 2050	Demand 2060	Supply 2010	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Surplus (Need) 2010	Surplus (Need) 2020	Surplus (Need) 2030	Surplus (Need) 2040	Surplus (Need) 2050	Surplus (Need) 2060
CRANE	RIO GRANDE	COUNTY-OTHER	316	387	425	452	484	518	316	387	425	452	484	518	0	0	0	0	0	0
		CRANE	940	1,002	1,028	1,045	1,072	1,105	940	1,002	1,028	1,045	1,072	1,105	0	0	0	0	0	0
		IRRIGATION	337	337	337	337	337	337	337	337	337	337	337	337	0	0	0	0	0	0
		LIVESTOCK	155	155	155	155	155	155	155	155	155	155	155	155	0	0	0	0	0	0
		MINING	2,221	2,216	2,214	2,212	2,210	2,208	2,221	2,216	2,214	2,212	2,210	2,208	0	0	0	0	0	0
CROCKETT	COLORADO	LIVESTOCK	30	30	30	30	30	30	30	30	30	30	30	30	0	0	0	0	0	0
	RIO GRANDE	COUNTY-OTHER	43	41	40	38	37	36	43	41	40	38	37	36	0	0	0	0	0	0
		CROCKETT COUNTY WCID #1	1,664	1,790	1,825	1,832	1,872	1,913	2,503	2,503	2,503	2,503	2,503	2,503	839	713	678	671	631	590
		IRRIGATION	525	518	508	498	492	482	535	535	535	535	535	535	10	17	27	37	43	53
		LIVESTOCK	967	967	967	967	967	967	967	967	967	967	967	967	0	0	0	0	0	0
		MINING	402	421	431	441	450	459	402	421	431	441	450	459	0	0	0	0	0	0
		STEAM ELECTRIC POWER	973	776	907	1,067	1,262	1,500	1,500	1,500	1,500	1,500	1,500	1,500	527	724	593	433	238	0
ECTOR	COLORADO	COUNTY-OTHER	5,542	6,513	7,266	7,738	7,928	8,007	5,812	6,783	7,536	8,008	8,198	8,277	270	270	270	270	270	270
		ECTOR COUNTY UD	1,480	1,847	2,177	2,473	2,706	2,932	1,080	1,234	2,166	2,322	2,434	2,454	(400)	(613)	(11)	(151)	(272)	(478)
		IRRIGATION	5,477	5,412	5,348	5,281	5,219	5,152	5,477	5,412	5,348	5,281	5,219	5,152	0	0	0	0	0	0
		LIVESTOCK	198	198	198	198	198	198	198	198	198	198	198	198	0	0	0	0	0	0
		MANUFACTURING	2,743	2,946	3,107	3,248	3,357	3,471	2,677	2,797	3,104	3,202	3,271	3,313	(66)	(149)	(3)	(46)	(86)	(158)
		MINING	9,702	10,321	10,706	11,080	11,447	11,745	9,702	10,321	10,706	11,080	11,447	11,745	0	0	0	0	0	0
		ODESSA	21,508	22,084	22,626	23,335	24,355	25,559	17,116	11,697	17,743	17,433	17,632	17,446	(4,392)	(10,387)	(4,883)	(5,902)	(6,723)	(8,113)
		STEAM ELECTRIC POWER	6,375	9,125	10,668	12,549	14,842	17,637	6,375	6,375	6,375	6,375	6,375	6,375	0	(2,750)	(4,293)	(6,174)	(8,467)	(11,262)
	RIO GRANDE	COUNTY-OTHER	178	190	202	211	219	227	178	190	202	211	219	227	0	0	0	0	0	0
		IRRIGATION	56	54	54	54	52	52	56	54	54	54	52	52	0	0	0	0	0	0
		LIVESTOCK	95	95	95	95	95	95	95	95	95	95	95	95	0	0	0	0	0	0
		MANUFACTURING	16	17	18	19	19	20	16	17	18	19	19	20	0	0	0	0	0	0
		MINING	186	198	205	212	219	225	372	372	372	372	372	372	186	174	167	160	153	147
GLASSCOCK	COLORADO	COUNTY-OTHER	181	196	203	200	197	201	181	196	203	200	197	201	0	0	0	0	0	0
		IRRIGATION	52,272	51,854	51,438	51,021	50,603	50,190	24,488	24,473	24,466	24,469	24,472	24,468	(27,784)	(27,381)	(26,972)	(26,552)	(26,131)	(25,722)
		LIVESTOCK	232	232	232	232	232	232	232	232	232	232	232	232	0	0	0	0	0	0
		MINING	5	5	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0
HOWARD	COLORADO	BIG SPRING	6,016	6,077	6,035	5,945	5,915	5,915	4,671	4,405	6,011	5,646	5,424	5,119	(1,345)	(1,672)	(24)	(299)	(491)	(796)
		COAHOMA	183	185	183	180	177	177	134	124	182	169	159	148	(49)	(61)	(1)	(11)	(18)	(29)
		COUNTY-OTHER	1,109	1,110	1,092	1,065	1,048	1,048	1,153	1,153	1,153	1,153	1,153	1,153	44	43	61	88	105	105
		IRRIGATION	4,799	4,744	4,690	4,635	4,581	4,527	4,862	4,862	4,862	4,862	4,862	4,862	63	118	172	227	281	335
		LIVESTOCK	366	366	366	366	366	366	366	366	366	366	366	366	0	0	0	0	0	0
		MANUFACTURING	1,648	1,753	1,832	1,910	1,976	2,099	1,471	1,452	1,843	1,839	1,852	1,879	(177)	(301)	11	(71)	(124)	(220)
		MINING	1,783	1,883	1,924	1,963	2,001	2,052	1,383	1,360	1,915	1,862	1,830	1,767	(400)	(523)	(9)	(101)	(171)	(285)
IRION	COLORADO	COUNTY-OTHER	109	109	103	94	87	83	109	109	103	94	87	83	0	0	0	0	0	0
		IRRIGATION	2,803	2,742	2,682	2,621	2,561	2,501	1,501	1,501	1,501	1,501	1,501	1,501	(1,302)	(1,241)	(1,181)	(1,120)	(1,060)	(1,000)
		LIVESTOCK	460	460	460	460	460	460	460	460	460	460	460	460	0	0	0	0	0	0
		MERTZON	129	130	124	114	107	102	139	139	139	139	139	139	10	9	15	25	32	37
		MINING	122	122	122	122	122	122	122	122	122	122	122	122	0	0	0	0	0	0
KIMBLE	COLORADO	COUNTY-OTHER	212	207	203	196	194	194	203	200	200	200	200	200	(9)	(7)	(3)	4	6	6
		IRRIGATION	985	948	913	877	841	807	1,771	1,771	1,771	1,771	1,771	1,771	786	823	858	894	930	964
		JUNCTION	936	935	926	917	910	910	0	0	0	0	0	0	(936)	(935)	(926)	(917)	(910)	(910)
		LIVESTOCK	668	668	668	668	668	668	668	668	668	668	668	668	0	0	0	0	0	0
		MANUFACTURING	702	767	823	880	932	1,002	3	3	3	3	3	3	(699)	(764)	(820)	(877)	(929)	(999)
		MINING	71	67	65	63	61	60	104	104	104	104	104	104	33	37	39	41	43	44
LOVING	RIO GRANDE	COUNTY-OTHER	11	11	10	10	10	10	11	11	10	10	10	10	0	0	0	0	0	0
		IRRIGATION	581	580	576	575	573	572	583	583	583	583	583	583	2	3	7	8	10	11
		LIVESTOCK	70	70	70	70	70	70	70	70	70	70	70	70	0	0	0	0	0	0
		MINING	2	2	2	2	2	2	3	3	3	3	3	3	1	1	1	1	1	1

Comparison of Supply and Demand by Water User Group

(Values in Acre-Feet per Year)

County	Basin	WUG	Demand 2010	Demand 2020	Demand 2030	Demand 2040	Demand 2050	Demand 2060	Supply 2010	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Surplus (Need) 2010	Surplus (Need) 2020	Surplus (Need) 2030	Surplus (Need) 2040	Surplus (Need) 2050	Surplus (Need) 2060
MARTIN	COLORADO	COUNTY-OTHER	377	403	411	412	399	378	377	403	411	412	399	378	0	0	0	0	0	0
		IRRIGATION	14,324	14,073	13,822	13,571	13,321	13,075	13,536	13,509	13,500	13,571	13,321	13,075	(788)	(564)	(322)	0	0	0
		LIVESTOCK	273	273	273	273	273	273	273	273	273	273	273	273	0	0	0	0	0	0
		MANUFACTURING	39	41	42	43	44	47	39	41	42	43	44	47	0	0	0	0	0	0
		MINING	674	645	634	624	615	603	705	705	705	705	705	705	31	60	71	81	90	102
		STANTON	411	440	447	448	433	411	19	18	18	18	18	18	(392)	(422)	(429)	(430)	(415)	(393)
MASON	COLORADO	COUNTY-OTHER	190	187	183	178	176	177	190	190	190	190	190	190	0	3	7	12	14	13
		IRRIGATION	10,079	9,936	9,792	9,648	9,505	9,363	16,099	16,099	16,099	16,099	16,099	16,099	6,020	6,163	6,307	6,451	6,594	6,736
		LIVESTOCK	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	0	0	0	0	0	0
		MASON	742	739	733	727	722	723	766	765	766	766	766	766	24	26	33	39	44	43
		MINING	6	6	6	6	6	6	6	6	6	6	6	6	0	0	0	0	0	0
MCCULLOCH	COLORADO	BRADY	1,879	1,893	1,874	1,854	1,842	1,842	1,009	1,009	1,009	1,009	1,009	1,009	(870)	(884)	(865)	(845)	(833)	(833)
		COUNTY-OTHER	12	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0	0
		IRRIGATION	2,824	2,789	2,754	2,718	2,683	2,649	6,103	6,103	6,103	6,103	6,103	6,103	3,279	3,314	3,349	3,385	3,420	3,454
		LIVESTOCK	1,027	1,027	1,027	1,027	1,027	1,027	1,027	1,027	1,027	1,027	1,027	1,027	0	0	0	0	0	0
		MANUFACTURING	844	929	1,004	1,075	1,137	1,233	844	929	1,004	1,075	1,137	1,233	0	0	0	0	0	0
		MILLERSVIEW-DOOLE WSC	248	245	239	230	228	228	309	312	386	364	148	148	61	67	147	134	(80)	(80)
		MINING	154	159	162	165	168	171	154	159	162	165	168	171	0	0	0	0	0	0
		RICHLAND SUD	113	113	111	109	108	108	186	186	186	186	186	186	73	73	75	77	78	78
MENARD	COLORADO	COUNTY-OTHER	104	102	99	97	96	96	84	81	80	80	80	80	(20)	(21)	(19)	(17)	(16)	(16)
		IRRIGATION	6,061	6,041	6,022	6,003	5,981	5,962	3,620	3,620	3,620	3,620	3,620	3,620	(2,441)	(2,421)	(2,402)	(2,383)	(2,361)	(2,342)
		LIVESTOCK	642	642	642	642	642	642	642	642	642	642	642	642	0	0	0	0	0	0
		MENARD	354	353	347	341	339	339	304	304	304	304	304	304	(50)	(49)	(43)	(37)	(35)	(35)
MIDLAND	COLORADO	COUNTY-OTHER	3,210	3,543	3,773	3,920	4,019	4,143	3,210	3,543	3,773	3,920	4,019	4,143	0	0	0	0	0	0
		IRRIGATION	41,493	41,170	40,848	40,526	40,203	39,884	25,260	24,811	24,500	24,272	24,091	23,891	(16,233)	(16,359)	(16,348)	(16,254)	(16,112)	(15,993)
		LIVESTOCK	904	904	904	904	904	904	904	904	904	904	904	904	0	0	0	0	0	0
		MANUFACTURING	164	182	198	213	226	245	164	182	198	213	226	245	0	0	0	0	0	0
		MIDLAND	28,939	30,056	30,804	31,246	31,631	32,112	23,061	22,871	10,473	10,246	10,021	9,795	(5,878)	(7,185)	(20,331)	(21,000)	(21,610)	(22,317)
		MINING	677	778	846	915	986	1,046	677	778	846	915	986	1,046	0	0	0	0	0	0
		ODESSA	419	603	724	810	867	925	306	403	720	761	780	774	(113)	(200)	(4)	(49)	(87)	(151)
MITCHELL	COLORADO	COLORADO CITY	997	980	949	914	879	826	997	999	1,001	1,004	1,008	1,013	0	19	52	90	129	187
		COUNTY-OTHER	621	609	593	570	549	516	621	609	593	570	549	516	0	0	0	0	0	0
		IRRIGATION	5,534	5,507	5,479	5,452	5,425	5,398	5,564	5,564	5,564	5,564	5,564	5,564	30	57	85	112	139	166
		LIVESTOCK	449	449	449	449	449	449	449	449	449	449	449	449	0	0	0	0	0	0
		LORAINE	85	82	79	75	71	67	110	110	110	110	110	110	25	28	31	35	39	43
		MINING	115	110	108	107	106	104	141	141	141	141	141	141	26	31	33	34	35	37
		STEAM ELECTRIC POWER	9,100	7,621	8,910	10,481	12,396	14,730	0	0	0	0	0	0	(9,100)	(7,621)	(8,910)	(10,481)	(12,396)	(14,730)
PECOS	RIO GRANDE	COUNTY-OTHER	702	722	731	730	726	712	702	722	731	730	726	712	0	0	0	0	0	0
		FORT STOCKTON	3,267	3,397	3,461	3,481	3,479	3,411	5,913	5,913	5,913	5,913	5,913	5,913	2,646	2,516	2,452	2,432	2,434	2,502
		IRAAN	452	469	478	480	479	470	567	567	567	567	567	567	115	98	89	87	88	97
		IRRIGATION	79,681	78,436	77,191	75,945	74,700	73,475	82,583	82,583	82,583	82,583	82,583	82,583	2,902	4,147	5,392	6,638	7,883	9,108
		LIVESTOCK	1,239	1,239	1,239	1,239	1,239	1,239	1,240	1,240	1,240	1,240	1,240	1,240	1	1	1	1	1	1
		MANUFACTURING	2	2	2	2	2	2	3	3	3	3	3	3	1	1	1	1	1	1
		MINING	159	158	158	158	158	158	286	286	286	286	286	286	127	128	128	128	128	128
		PECOS COUNTY WCID #1	395	403	401	399	395	387	395	403	401	399	395	387	0	0	0	0	0	0
REAGAN	COLORADO	BIG LAKE	910	988	1,026	1,010	970	923	478	478	478	478	478	478	(432)	(510)	(548)	(532)	(492)	(445)
		COUNTY-OTHER	125	135	141	138	133	126	910	988	1,026	1,010	970	923	785	853	885	872	837	797
		IRRIGATION	36,597	35,990	35,385	34,779	34,174	33,579	125	135	141	138	133	126	(36,472)	(35,855)	(35,244)	(34,641)	(34,041)	(33,453)
		LIVESTOCK	253	253	253	253	253	253	25,600	25,383	25,269	25,220	25,198	25,186	25,347	25,130	25,016	24,967	24,945	24,933
		MINING	2,036	2,165	2,235	2,303	2,370	2,436	253	253	253	253	253	253	(1,783)	(1,912)	(1,982)	(2,050)	(2,117)	(2,183)
	RIO GRANDE	LIVESTOCK	19	19	19	19	19	19	2,036	2,165	2,235	2,303	2,370	2,436	2,017	2,146	2,216	2,284	2,351	2,417

Appendix 4A
Comparison of Supply and Demand by Water User Group
(Values in Acre-Feet per Year)

County	Basin	WUG	Demand 2010	Demand 2020	Demand 2030	Demand 2040	Demand 2050	Demand 2060	Supply 2010	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Surplus (Need) 2010	Surplus (Need) 2020	Surplus (Need) 2030	Surplus (Need) 2040	Surplus (Need) 2050	Surplus (Need) 2060
REEVES	RIO GRANDE	BALMORHEA	110	126	138	148	157	166	26	26	26	26	26	26	(84)	(100)	(112)	(122)	(131)	(140)
		COUNTY-OTHER	219	192	171	152	136	124	122	132	139	148	157	166	(97)	(60)	(32)	(4)	21	42
		IRRIGATION	103,069	102,196	101,323	100,448	99,575	98,710	219	200	186	170	154	142	(102,850)	(101,996)	(101,137)	(100,278)	(99,421)	(98,568)
		LIVESTOCK	2,283	2,283	2,283	2,283	2,283	2,283	66,972	66,951	66,936	66,923	66,911	66,863	64,689	64,668	64,653	64,640	64,628	64,580
		MADERA VALLEY WSC	695	700	702	703	705	711	2,283	2,283	2,283	2,283	2,283	2,283	1,588	1,583	1,581	1,580	1,578	1,572
		MANUFACTURING	720	741	756	770	781	825	695	700	702	703	705	711	(25)	(41)	(54)	(67)	(76)	(114)
		MINING	182	177	175	173	172	170	720	741	756	770	781	825	538	564	581	597	609	655
		PECOS	2,810	3,064	3,261	3,413	3,573	3,712	182	177	175	173	172	170	(2,628)	(2,887)	(3,086)	(3,240)	(3,401)	(3,542)
RUNNELS	COLORADO	BALLINGER	917	998	1,057	1,121	1,178	1,237	2,810	3,064	3,261	3,413	3,573	3,712	1,893	2,066	2,204	2,292	2,395	2,475
		COLEMAN COUNTY WSC	18	30	39	48	56	66	0	0	0	0	0	0	(18)	(30)	(39)	(48)	(56)	(66)
		COUNTY-OTHER	360	295	246	193	156	129	0	0	0	0	0	0	(360)	(295)	(246)	(193)	(156)	(129)
		IRRIGATION	4,331	4,317	4,298	4,279	4,260	4,241	30	29	29	28	31	52	(4,301)	(4,288)	(4,269)	(4,251)	(4,229)	(4,189)
		LIVESTOCK	1,530	1,530	1,530	1,530	1,530	1,530	2,973	2,973	2,973	2,973	2,973	2,973	1,443	1,443	1,443	1,443	1,443	1,443
		MANUFACTURING	63	70	76	82	87	94	1,530	1,530	1,530	1,530	1,530	1,530	1,467	1,460	1,454	1,448	1,443	1,436
		MILES	150	163	173	183	193	203	0	0	0	0	0	0	(150)	(163)	(173)	(183)	(193)	(203)
		MILLERSVIEW-DOOLE WSC	94	93	93	91	92	93	134	134	134	134	134	134	40	41	41	43	42	41
		MINING	44	45	45	45	45	45	125	118	149	141	56	56	81	73	104	96	11	11
		WINTERS	552	561	566	571	575	591	44	45	45	45	45	45	(508)	(516)	(521)	(526)	(530)	(546)
SCHLEICHER	COLORADO	COUNTY-OTHER	117	108	102	98	95	93	0	0	0	0	0	0	(117)	(108)	(102)	(98)	(95)	(93)
		ELDORADO	581	644	671	675	691	711	117	108	102	98	95	93	(464)	(536)	(569)	(577)	(596)	(618)
		IRRIGATION	1,750	1,716	1,680	1,645	1,609	1,575	710	710	710	710	710	711	(1,040)	(1,006)	(970)	(935)	(899)	(864)
		LIVESTOCK	583	583	583	583	583	583	2,286	2,286	2,286	2,286	2,286	2,286	1,703	1,703	1,703	1,703	1,703	1,703
		MINING	125	134	139	144	149	154	583	583	583	583	583	583	458	449	444	439	434	429
	RIO GRANDE	COUNTY-OTHER	25	23	22	21	20	20	150	150	150	150	150	154	125	127	128	129	130	134
		IRRIGATION	358	351	344	337	330	322	25	23	22	21	20	20	(333)	(328)	(322)	(316)	(310)	(302)
		LIVESTOCK	204	204	204	204	204	204	846	846	846	846	846	846	642	642	642	642	642	642
SCURRY	BRAZOS	COUNTY-OTHER	316	318	317	313	312	312	204	204	204	204	204	204	(112)	(114)	(113)	(109)	(108)	(108)
		IRRIGATION	788	762	736	710	684	659	316	318	317	313	312	312	(472)	(444)	(419)	(397)	(372)	(347)
		LIVESTOCK	233	233	233	233	233	233	788	762	736	710	684	659	555	529	503	477	451	426
		MINING	2,244	2,403	2,465	2,525	2,583	2,667	233	233	233	233	233	233	(2,011)	(2,170)	(2,232)	(2,292)	(2,350)	(2,434)
	COLORADO	COUNTY-OTHER	558	562	560	553	552	552	2,921	2,921	2,921	2,921	2,921	2,921	2,363	2,359	2,361	2,368	2,369	2,369
		IRRIGATION	2,027	1,961	1,894	1,827	1,760	1,696	504	496	559	541	532	519	(1,523)	(1,465)	(1,335)	(1,286)	(1,228)	(1,177)
		LIVESTOCK	396	396	396	396	396	396	2,741	2,741	2,741	2,741	2,741	2,741	2,345	2,345	2,345	2,345	2,345	2,345
		MINING	863	924	948	971	994	1,026	396	396	396	396	396	396	(467)	(528)	(552)	(575)	(598)	(630)
		SNYDER	2,792	2,834	2,844	2,829	2,832	2,832	959	959	959	971	994	1,026	(1,833)	(1,875)	(1,885)	(1,858)	(1,838)	(1,806)
STERLING	COLORADO	COUNTY-OTHER	52	56	57	56	54	55	2,281	2,193	2,835	2,712	2,638	2,517	2,229	2,137	2,778	2,656	2,584	2,462
		IRRIGATION	648	621	595	569	543	518	52	56	57	56	54	55	(596)	(565)	(538)	(513)	(489)	(463)
		LIVESTOCK	503	503	503	503	503	503	745	745	745	745	745	745	242	242	242	242	242	242
		MINING	590	600	605	610	615	620	503	503	503	503	503	503	(87)	(97)	(102)	(107)	(112)	(117)
		STERLING CITY	297	321	330	330	319	324	590	600	605	610	615	620	293	279	275	280	296	296
SUTTON	COLORADO	COUNTY-OTHER	54	56	56	55	54	54	297	321	330	330	319	324	243	265	274	275	265	270
		IRRIGATION	561	551	540	530	518	507	54	56	56	55	54	54	(507)	(495)	(484)	(475)	(464)	(453)
		LIVESTOCK	358	358	358	358	358	358	562	562	562	562	562	562	204	204	204	204	204	204
		MINING	35	35	36	36	37	37	358	358	358	358	358	358	323	323	322	322	321	321
	RIO GRANDE	COUNTY-OTHER	223	232	231	226	225	223	35	35	36	36	37	37	(188)	(197)	(195)	(190)	(188)	(186)
		IRRIGATION	1,250	1,226	1,202	1,178	1,155	1,132	223	232	231	226	225	223	(1,027)	(994)	(971)	(952)	(930)	(909)
		LIVESTOCK	438	438	438	438	438	438	1,250	1,232	1,232	1,232	1,232	1,232	812	794	794	794	794	794
		MINING	45	47	47	48	48	49	438	438	438	438	438	438	393	391	391	390	390	389
		SONORA	1,195	1,252	1,252	1,236	1,235	1,222	45	47	47	48	48	49	(1,150)	(1,205)	(1,205)	(1,188)	(1,187)	(1,173)

Appendix 4A
Comparison of Supply and Demand by Water User Group
(Values in Acre-Feet per Year)

County	Basin	WUG	Demand 2010	Demand 2020	Demand 2030	Demand 2040	Demand 2050	Demand 2060	Supply 2010	Supply 2020	Supply 2030	Supply 2040	Supply 2050	Supply 2060	Surplus (Need) 2010	Surplus (Need) 2020	Surplus (Need) 2030	Surplus (Need) 2040	Surplus (Need) 2050	Surplus (Need) 2060
TOM GREEN	COLORADO	CONCHO RURAL WSC	695	873	990	1,048	1,091	1,103	1,919	1,919	1,919	1,919	1,919	1,919	1,224	1,046	929	871	828	816
		COUNTY-OTHER	1,761	1,703	1,633	1,553	1,476	1,408	1,103	1,103	1,103	1,103	1,103	1,103	(658)	(600)	(530)	(450)	(373)	(305)
		IRRIGATION	104,621	104,362	104,107	103,852	103,593	103,338	1,720	1,720	1,720	1,720	1,720	1,720	(102,901)	(102,642)	(102,387)	(102,132)	(101,873)	(101,618)
		LIVESTOCK	1,978	1,978	1,978	1,978	1,978	1,978	57,531	57,531	57,531	57,531	57,531	57,531	55,553	55,553	55,553	55,553	55,553	55,553
		MANUFACTURING	2,226	2,498	2,737	2,971	3,175	3,425	1,978	1,978	1,978	1,978	1,978	1,978	(248)	(520)	(759)	(993)	(1,197)	(1,447)
		MILLERSVIEW-DOOLE WSC	238	263	291	319	359	408	0	0	0	0	0	0	(238)	(263)	(291)	(319)	(359)	(408)
		MINING	73	80	85	90	95	99	418	420	534	544	244	244	345	340	449	454	149	145
		SAN ANGELO	20,800	21,418	21,734	21,744	21,907	21,969	150	150	150	150	150	150	(20,650)	(21,268)	(21,584)	(21,594)	(21,757)	(21,819)
		STEAM ELECTRIC POWER	543	777	909	1,069	1,264	1,502	11,650	11,427	11,204	10,980	10,757	10,534	11,107	10,650	10,295	9,911	9,493	9,032
UPTON	COLORADO	COUNTY-OTHER	52	54	53	53	54	55	0	0	0	0	0	0	(52)	(54)	(53)	(53)	(54)	(55)
		IRRIGATION	16,592	16,355	16,123	15,887	15,651	15,421	52	54	53	53	54	55	(16,540)	(16,301)	(16,070)	(15,834)	(15,597)	(15,366)
		LIVESTOCK	78	78	78	78	78	78	5,920	5,904	5,900	5,895	5,889	5,882	5,842	5,826	5,822	5,817	5,811	5,804
		MINING	2,011	2,025	2,030	2,035	2,040	2,046	78	78	78	78	78	78	(1,933)	(1,947)	(1,952)	(1,957)	(1,962)	(1,968)
	RIO GRANDE	COUNTY-OTHER	100	102	102	101	102	104	2,011	2,025	2,030	2,035	2,040	2,046	1,911	1,923	1,928	1,934	1,938	1,942
		IRRIGATION	167	166	162	160	158	155	100	102	102	101	102	104	(67)	(64)	(60)	(59)	(56)	(51)
		LIVESTOCK	134	134	134	134	134	134	199	199	199	199	199	199	65	65	65	65	65	65
		MCCAMEY	559	606	621	629	648	668	134	134	134	134	134	134	(425)	(472)	(487)	(495)	(514)	(534)
		MINING	651	655	657	659	660	662	1,071	1,070	1,070	1,071	1,070	1,069	420	415	413	412	410	407
		RANKIN	231	245	248	250	255	261	651	655	657	659	660	662	420	410	409	409	405	401
WARD	RIO GRANDE	COUNTY-OTHER	925	929	925	910	905	905	327	326	326	326	326	325	(598)	(603)	(599)	(584)	(579)	(580)
		IRRIGATION	13,793	13,624	13,454	13,284	13,115	12,947	925	529	525	510	505	505	(12,868)	(13,095)	(12,929)	(12,774)	(12,610)	(12,442)
		LIVESTOCK	126	126	126	126	126	126	8,266	8,651	7,733	6,745	6,210	6,059	8,140	8,525	7,607	6,619	6,084	5,933
		MANUFACTURING	7	7	7	7	7	7	126	126	126	126	126	126	119	119	119	119	119	119
		MINING	153	155	156	157	158	159	7	7	7	7	7	7	(146)	(148)	(149)	(150)	(151)	(152)
		MONAHANS	2,559	2,592	2,597	2,572	2,564	2,564	153	155	156	157	158	159	(2,406)	(2,437)	(2,441)	(2,415)	(2,406)	(2,405)
		STEAM ELECTRIC POWER	4,914	4,223	4,937	5,807	6,868	8,162	2,559	2,592	2,597	2,572	2,564	2,564	(2,355)	(1,631)	(2,340)	(3,235)	(4,304)	(5,598)
WINKLER	COLORADO	LIVESTOCK	2	2	2	2	2	2	4,914	4,223	4,937	5,807	6,189	6,189	4,912	4,221	4,935	5,805	6,187	6,187
	RIO GRANDE	COUNTY-OTHER	119	121	120	119	116	112	2	2	2	2	2	2	(117)	(119)	(118)	(117)	(114)	(110)
		IRRIGATION	10,000	10,000	10,000	10,000	10,000	10,000	121	121	121	121	121	121	(9,879)	(9,879)	(9,879)	(9,879)	(9,879)	(9,879)
		KERMIT	1,927	1,988	1,983	1,966	1,922	1,860	10,000	10,000	10,000	10,000	10,000	10,000	8,073	8,012	8,017	8,034	8,078	8,140
		LIVESTOCK	149	149	149	149	149	149	3,943	3,943	3,943	3,943	3,943	3,943	3,794	3,794	3,794	3,794	3,794	3,794
		MINING	928	895	883	872	861	847	167	167	167	167	167	167	(761)	(728)	(716)	(705)	(694)	(680)
		WINK	331	341	341	338	331	320	1,878	1,878	1,878	1,878	1,878	1,878	1,547	1,537	1,537	1,540	1,547	1,558
		Total	*807,453*	*810,576*	*813,895*	*816,478*	*820,191*	*825,581*	*613,809*	*609,322*	*609,323*	*610,318*	*609,519*	*608,668*	*(193,644)*	*(201,254)*	*(204,572)*	*(206,160)*	*(210,672)*	*(216,913)*

Appendix 4B
Socioeconomic Impacts of Unmet Water Needs in the Region F Water Planning Area

Socioeconomic Impacts of Unmet Water Needs in the Region F Water Planning Area

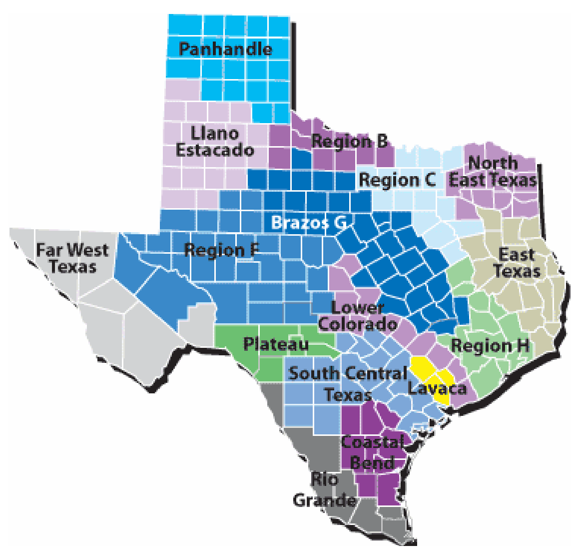
Prepared by:

Stuart Norvell and Kevin Kluge of The Texas Water Development Board's Office of Water Resources Planning

Prepared in support of the:

Region F Water Planning Group and the 2006 Texas State Water Plan

August 2005



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Background

Water shortages due to severe drought combined with infrastructure limitations would likely curtail or eliminate economic activity in business and industries heavily reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on business and industry, but they might also bias corporate decision makers against plant expansion or plant location in Texas. From a societal perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Section 357.7(4) of the rules for implementing Texas Senate Bill 1 requires regional water planning groups to evaluate the social and economic impacts of projected water shortages (i.e., "unmet water needs") as part of the planning process. The rules contain provisions that direct the Texas Water Development Board (TWDB) to provide technical assistance to complete socioeconomic impact assessments. In response to requests from regional planning groups, staff of the TWDB's Office of Water Resources Planning designed and conducted analyses to evaluate socioeconomic impacts of unmet water needs.

Overview of Methodology

Two components make up the overall approach to this study: 1) an economic impact module and 2) a social impact module. Economic analysis addresses potential impacts of unmet water needs including effects on residential water consumers and losses to regional economies stemming from reductions in economic output for agricultural, industrial and commercial water uses. Impacts to agriculture, industry and commercial enterprises were estimated using regional "input-output" models commonly used by researchers to estimate how reductions in business activity might affect a given economy. Estimated impacts are *independent* and distinct "what if" scenarios for a given point in time (i.e., 2010, 2020, 2030, 2040, 2050 and 2060). Reported figures are scenarios that illustrate what could happen in a given year if: 1) water supply infrastructure and/or water management strategies do not change through time, 2) the drought of record recurs. Details regarding the methodology and assumptions for individual water use categories (i.e., municipal consumers including residential and commercial water users, manufacturing, steam-electric, mining, and agriculture) are in the main body of the report.

The social component focuses on demographic effects including changes in population and school enrollment. Methods are based on population projection models developed by the TWDB for regional and state water planning. With the assistance of the Texas State Data Center, TWDB staff modified these models and applied them for use here. Basically, the social impact module incorporates results from the economic impact module and assesses how changes in a region's economy due to water shortages could affect patterns of migration in a region.

Summary of Results

Table E-1 and Figure E-1 summarize estimated economic impacts. Variables shown include:[1]

- **sales** - economic output measured by sales revenue;
- **jobs -** number of full and part-time jobs required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments for the region; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include any type of income tax).

If drought of record conditions return and water supplies are not developed, study results indicate that the Region F Water Planning Area would suffer significant losses. If such conditions occurred 2010, lost income to residents in the region could total $474 million with associated job losses as high as 8,185. State and local governments could forgo $35 million in tax receipts. If such conditions occurred in 2060, income losses could run $962 million, and job losses could total 15,855. Nearly $82 million worth of state and local taxes would be lost. Reported figures are probably conservative because they are based on estimated costs for a single year; however, in much of Texas the drought of record lasted several years. For example, in 2030 models indicate that shortages would cost residents and businesses in the region $797 million in lost income. Thus, if shortages lasted for three years total losses related to unmet needs could easily approach $2,391 million.

Table E-1: Annual Economic Impacts of Unmet Water Needs
(years, 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Income ($millions)	Jobs	State and Local Taxes ($millions)
2010	$1,133.61	$474.96	8,185	$34.83
2020	$1,324.81	$573.60	9,335	$42.52
2030	$1,437.43	$636.60	10,175	$48.20
2040	$1,739.89	$797.11	13,430	$64.37
2050	$1,909.06	$877.55	14,570	$73.45
2060	$2,090.54	$962.72	15,855	$82.19

Source: Texas Water Development Board, Office of Water Resources Planning

[1] When aggregated at a regional level, total sales are not necessarily a good measure of economic prosperity because they include sales to other industries for further processing. For example, a farmer sells rice to a rice mill, which the rice mill processes and sells it to another consumer. Both transactions are counted in an input-output model. Thus, total sales “double count.” Regional income plus business taxes are more suitable because they are a better measure of net economic returns.

Figure E-1: Distribution of Lost Income by Water Use Category
(years, 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

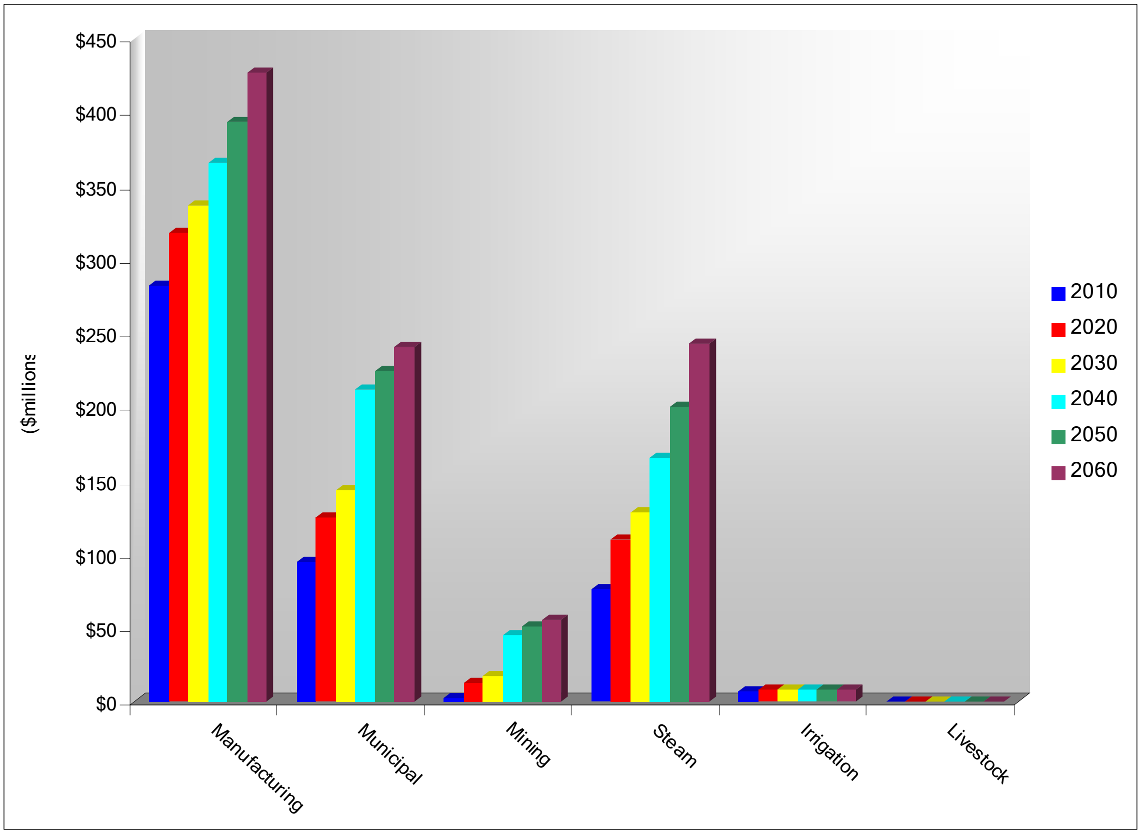

Table E-2 shows potential losses in population and school enrollment. Changes in population stem directly from the number of lost jobs estimated as part of the economic impact module. In other words, many – but not all - people would likely relocate due to a job loss and some have families with school age children. Section 1.2 in the main body of the report discusses methodology in detail.

Table E-2: Estimated Regional Social Impacts of Unmet Water Needs
(years, 2010, 2020, 2030, 2040, 2050 and 2060)

Year	Population Losses	Declines in School Enrollment
2010	13,830	3,590
2020	15,920	4,130
2030	17,360	4,500
2040	23,080	5,990
2050	25,070	6,500
2060	27,450	7,120

Source: Based on models developed by the Texas Water Development Board, Office of Water Resources Planning and the Texas State Data Center.

Introduction

Texas is one the nation's fastest growing states. From 1950 to 2000, population in the state grew from about 8 million to nearly 21 million. By the year 2050, the total number of people living in Texas is expected to reach 40 million. Rapid growth combined with Texas' susceptibility to severe drought makes water supply a crucial issue. If water infrastructure and water management strategies are not improved, Texas could face serious social, economic and environmental consequences - not only in our large metropolitan cities, but also on our farms and rural areas.

Water shortages due to severe drought combined with infrastructure limitations would likely curtail or eliminate economic activity in business and industries heavily reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on business and industry, but they might also bias corporate decision makers against plant expansion or plant location in Texas. From a societal perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Section 357.7(4) of the rules for implementing Texas Senate Bill 1 requires regional water planning groups to evaluate the social and economic impacts of unmet water needs as part of the planning process. The rules contain provisions that direct the Texas Water Development Board (TWDB) to provide technical assistance to complete socioeconomic impact analyses. In response to requests from regional planning groups, TWDB staff designed and conducted required studies. The following document prepared by the TWDB's Office of Water Resources Planning summarizes analysis and results for the Region F Water Planning Area. Section 1 provides an overview of concepts and methodologies used in the study. Sections 2 and 3 provide detailed information and analyses for each water use category employed in the planning process (i.e., irrigation, livestock, municipal, manufacturing, mining and steam-electric).

1. Overview of Terms and Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Measuring Economic Impacts

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts and benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. Specifically, it addresses the potential economic impacts of unmet water needs including: 1) losses to regional economies stemming from reductions in economic output, and 2) costs to residential water consumers associated with implementing emergency water procurement and conservation programs.

1.1.2 Impacts to Agriculture, Business and Industry

As mentioned earlier, severe water shortages would likely affect the ability of business and industry to operate resulting in lost output, which would adversely affect the regional economy. A variety tools are available to estimate such impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Basically, an IO/SAM model is an accounting framework that traces spending and consumption between different economic sectors including businesses, households, government and “foreign” economies in the form of exports and imports. As an example, Table 1 shows a highly aggregated segment of an IO/SAM model that focuses on key agricultural sectors in a local economy. The table contains transactions data for three agricultural sectors (cattle ranchers, dairies and alfalfa farms). Rows in Table 1 reflect sales from each sector to other local industries and institutions including households, government and consumers outside of the region in the form of exports. Columns in the table show purchases by each sector in the same fashion. For instance, the dairy industry buys $11.62 million worth of goods and services needed to produce milk. Local alfalfa farmers provide $2.11 million worth of hay and local households provide about $1.03 million worth of labor. Dairies import $4.17 million worth of inputs and pay $2.37 million in taxes and profits. Total economic activity in the region amounts to about $807.45 million. The entire table is like an accounting balance sheet where total sales equal total purchases.

Table 1: Example of a County-level Transaction and Social Accounting Matrix for Agricultural Sectors ($millions)

Sectors	Cattle	Dairy	Alfalfa	All other Industries	Taxes, govt. & profits	Households	Exports	Total
Cattle	$3.10	$0.01	$0.00	$0.03	$0.02	$0.06	$10.76	$13.98
Dairy	$0.07	$0.13	$0.00	$0.25	$0.01	$0.00	$11.14	$11.60
Alfalfa	$0.00	$2.11	$0.00	$0.01	$0.02	$0.01	$10.38	$12.53
Other industries	$2.20	$1.56	$2.90	$50.02	$70.64	$66.03	$48.48	$241.83
Taxes, govt. & profits	$2.37	$2.61	$5.10	$77.42	$0.23	$49.43	$83.29	$220.45
Households	$0.82	$1.03	$1.38	$50.94	$45.36	$7.13	$14.64	$121.30
Imports	$5.41	$4.17	$3.16	$63.32	$104.17	$5.53	$0.00	$185.76
Total	$13.97	$11.62	$12.54	$241.99	$220.45	$128.19	$178.69	$807.45

* Columns contain purchases and rows represent sales. Source: Adapted from Harris, T.R., Narayanan, R., Englin, J.E., MacDiarmid, T.R., Stoddard, S.W. and Reid, M.E. “*Economic Linkages of Churchill County*.” University of Nevada Reno. May 1993.

To understand how an IO/SAM model works, first visualize that $1 of additional sales of milk is injected into the dairy industry in Table 1. For every $1 the dairies receive in revenue, they spend 18 cents on alfalfa to feed their cows; nine cents is paid to households who provide farm labor, and another 13 cents goes to the category “other industries” to buy items such as machinery, fuel, transportation, accounting services etc. Nearly 22 cents is paid out in the form of profits (i.e., returns to dairy owners) and taxes/fees to local, state and federal government. The value of the initial $1 of revenue in the dairy sector is referred to as a first-round or **direct effect.**

As the name implies, first-round or direct effects are only part of the story. In the example above, alfalfa farmers must make 18 cents worth of hay to supply the increased demand for their product. To do so, they purchase their own inputs, and thus, they spend part of the original 18 cents that they received from the dairies on firms that support their own operations. For example, 12 cents is spent on fertilizers and other chemicals needed to grow alfalfa. The fertilizer industry in turn would take these 12 cents and spend them on inputs in its production process and so on. The sum of all re-spending is referred to as the **indirect effect** of an initial increase in output in the dairy sector.

While direct and indirect impacts capture how industries respond to a change, **induced impacts** measure the behavior of the labor force. As demand for production increases, employees in base industries and supporting industries will have to work more; or alternatively, businesses will have to hire more people. As employment increases, household spending rises. Thus, seemingly unrelated businesses such as video stores, supermarkets and car dealers also feel the effects of an initial change.

Collectively, indirect and induced effects are referred to as **secondary impacts**. In their entirety, all of the above changes (direct and secondary) are referred to as **total economic impacts**. By nature, total impacts are greater than initial changes because of secondary effects. The magnitude of the increase is what is popularly termed a multiplier effect. Input-output models generate numerical multipliers that estimate indirect and induced effects.

In an IO/SAM model impacts stem from changes in output measured by sales revenue that in turn come from changes in consumer demand. In the case of water shortages, one is not assuming a change in demand, but rather a supply shock – in this case severe drought. Demand for a product such as corn has not necessarily changed during a drought. However, farmers in question lack a crucial input (i.e., irrigation water) for which there is no *short-term* substitute. Without irrigation, she cannot grow irrigated crops. As a result, her cash flows decline or cease all together depending upon the severity of the situation. As cash flows dwindle, the farmer's income falls, and she has to reduce expenditures on farm inputs such as labor. Lower revenues not only affect her operation and her employees directly, but they also indirectly affect businesses who sell her inputs such as fuel, chemicals, seeds, consultant services, fertilizer etc.

The methodology used to estimate regional economic impacts consists of three steps: 1) develop IO/SAM models for each county in the region and for the region as whole, 2) estimate direct impacts to economic sectors resulting from water shortages, and 3) calculate total economic impacts (i.e., direct plus secondary effects).

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[2] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously (see Table 1 on page 9) were estimated for

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[2]The basic IMPLAN database consists of national level technology matrices based on the Benchmark Input-Output Accounts generated the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN's regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to the national totals using a matrix ratio allocation system and county data are balanced to state totals. In other words, much of the data in IMPLAN is based on a national average for all industries.

each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industry within a given region;
- **final sales** – sales to end users in a region and exports out of a region;
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in year 2000 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as "output" in an IO model. Thus, total sales double-count or overstate the true economic value of goods and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. All sectors in the IMPLAN database were assigned to a specific water use category (see Attachment A of this report).

Step 2: *Estimate Direct Economic Impacts of Water Shortages*

As mentioned above, direct impacts accrue to immediate businesses and industries that rely on water. Without water industrial processes could suffer. However, output responses would likely vary depending upon the severity of a shortage. A small shortage relative to total water use may have a nominal effect, but as shortages became more critical, effects on productive capacity would increase.

For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky. As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production. But it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[3]

Note that the efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[4]

- if unmet water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;
- if water shortages are 5 to 30 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 0.25 percent reduction in output;
- if water shortages are 30 to 50 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 0.50 percent reduction in output; and
- if water shortages are greater than 50 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 1.0 percent (i.e., a proportional reduction).

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. When calculating direct effects for the municipal, steam electric, manufacturing and livestock water use categories, sales to final demand were applied to avoid double counting impacts. The formula for a given IMPLAN sector is:

$$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$$

where:

[3] See, Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[4] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages*." Prepared by Spectrum Economics, Inc. November, 1991.

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Direct impacts to irrigation and mining are based upon the same formula; however, total sales as opposed to final sales were used. To avoid double counting, secondary impacts in sectors other than irrigation and mining (e.g., manufacturing) were reduced by an amount equal to or less than direct losses to irrigation and mining. In addition, in some instances closely linked sectors were moved from one water use category to another. For example, although meat packers and rice mills are technically manufacturers, in some regions they were reclassified as either livestock or irrigation. All direct effects were estimated at the county level and then summed to arrive at a regional figure. See Section 2 of this report for additional discussion regarding methodology and caveats used when estimating direct impacts for each water use category.

Step 3: *Estimate Secondary and Total Economic Impacts of Water Shortages*

As noted earlier, the effects of reduced output would extend well beyond sectors directly affected. Secondary impacts were derived using the same formula used to estimate direct impacts; however, regional level *indirect* and *induced* multiplier coefficients were applied and only final sales were multiplied.

1.1.3 Impacts Associated with Domestic Water Uses

IO/SAM models are not well suited for measuring impacts of shortages for domestic uses, which make up the majority of the municipal category.[5] To estimate impacts associated with domestic uses, municipal water demand and thus needs were subdivided into two categories – residential and commercial. Residential water is considered “domestic” and includes water that people use in their homes for things such as cooking, bathing, drinking and removing household waste and for outdoor purposes including lawn watering, car-washing and swimming pools. Shortages to residential uses were valued using a tiered approach. In other words, the more severe the shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic costs would be much higher in this case because people could probably not live with such a reduction, and would be forced to find emergency alternatives. The alternative assumed in this study is a very uneconomical and worst-case scenario (i.e., hauling water in from other communities by truck or rail). Section 2.3.3 of this report discusses methodology for municipal uses in greater detail.

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[5] A notable exception is the potential impacts to the nursery and landscaping industry that could arise due to reductions in outdoor residential uses and impacts to “water intensive” commercial businesses (see Section 2.3.3).

1.2 Measuring Social Impacts

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are much harder to measure in quantitative terms. Nevertheless, social effects associated with drought and water shortages usually have close ties to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[6]

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on models used by the TWDB for state water planning and by the U.S. Census Bureau for national level population projections. With the assistance of the Texas State Data Center (TSDC), TWDB staff modified population projection models used for state water planning and applied them here. Basically, the social impact model incorporates results from the economic component of the study and assesses how changes in labor demand due to unmet water needs could affect migration patterns in a region. Before discussing particulars of the approach model, some background information regarding population projection models is useful in understanding the overall approach.

1.2.1 Overview of Demographic Projection Models

More often than not, population projections are reported as a single number that represents the size of an overall population. While useful in many cases, a single number says nothing about the composition of projected populations, which is critical to public officials who must make decisions regarding future spending on public services. For example, will a population in the future have more elderly people relative to today, or will it have more children? More children might mean that more schools are needed. Conversely, a population with a greater percentage of elderly people may need additional healthcare facilities. When projecting future populations, cohort-survival models break down a population into groups (i.e., cohorts) based on factors such as age, sex and race. Once a population is separated into cohorts, one can estimate the magnitude and composition of future population changes.

Changes in a population's size and makeup in survival cohort models are driven by three factors:

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[6] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

1. *Births:* Obviously, more babies mean more people. However, only certain groups in a population are physically capable of bearing children– typically women between the ages of 13 and 49. The U.S. Census Bureau and the TSDC continually updates fertility rates for different cohorts. For each race/ethnicity category, birth rates decline and then stabilize in the future.

2. *Deaths:* When people die, populations shrink. Unlike giving birth, however, everyone is capable of dying and mortality rates are applied to all cohorts in a given population. Hence their name, cohort-survival models use survival rates as opposed to mortality rates. A survival rate is simply the probability that a given person with certain attributes (i.e., race, age and sex) will survive over a given period of time.

3. *Migration*: Migration is the movement of people in or out of a region. Migration rates used to project future changes in a region are usually based on historic population data. When analyzing historic data, losses or increases that are not attributed to births or deaths are assumed to be the result of migration. Migration can be further broken down into changes resulting from economic and non-economic factors. Economic migrants include workers and their families that relocate because of job losses (or gains), while non-economic migrants move due to lifestyles choices (e.g., retirees fleeing winter cold in the nation's heartland and moving to Texas).

In summary, knowledge of a population's composition in terms of age, sex and race combined with information regarding birth and survival rates, and migratory patterns, allows a great deal of flexibility and realism when estimating future populations. For example, an analyst can isolate population changes due to deaths and births from changes due to people moving in and out of a region. Or perhaps, one could analyze how potential changes in medical technology would affect population by reducing death rates among certain cohorts. Lastly, one could assess how changes in *economic conditions* might affect a regional population

1.2.2 Methodology for Social Impacts

Two components make up the model. The first component projects populations for a given year based on the following six steps:

1) *Separate "special" populations from the "general" population of a region:* The general population of a region includes the portion subject to rates of survival, fertility, economic migration and non-economic migration. In other words, they live, die, have children and can move in and out of a region freely. "Special populations," on the other hand, include college students, prisoners and military personnel. Special populations are treated differently than the general population. For example, fertility rates are not applied to prisoners because in general inmates at correctional facilities do not have children, and they are incapable of freely migrating or out of a region. Projections for special populations were compiled by the TSDC using data from the Higher Education Coordinating Board, the Texas Department of Criminal Justice and the U.S. Department of Defense. Starting from the 2000 Census, general and special populations were broken down into the following cohorts:

• age cohorts ranging from age zero to 75 and older,
• race/ethnicity cohorts, including Anglo, Black, Hispanic and "other," and
• gender cohorts (male and female).

2) *Apply survival and fertility rates to the general population* : Survival and fertility rates were compiled by the TSDC with data from the Texas Department of Health (TDH). Natural decreases (i.e., deaths) are estimated by applying survival rates to each cohort and then subtracting estimated deaths from the total population. Birth rates were then applied to females in each age

and race cohort in general and special populations (college and military only) to arrive at a total figure for new births.

3) *Estimate economic migration based on labor supply and demand*: TSDC year 2000 labor supply estimates include all non-disabled and non-incarcerated civilians between the ages of 16 and 65. Thus, prisoners are not included. Labor supply for years beyond 2001 was calculated by converting year 2000 data to rates according to cohort and applying these rates to future years. Projected labor demand was estimated based on historical employment rates. Differences between total labor supply and labor demand determines the amount of in or out migration in a region. If supply is greater than demand, there is an out-migration of labor. Conversely, if demand is greater than supply, there is an in-migration of labor. The number of migrants does not necessarily reflect total population changes because some migrants have families. To estimate how many people might accompany workers, a migrant worker profile was developed based on the U.S. Census Bureau's Public Use Microdata Samples (PUMs) data. Migrant profiles estimate the number of additional family members, by age and gender that accompany migrating workers. Together, workers and their families constitute economic migration for a given year.

4) *Estimate non-economic migration*: As noted previously, migration patterns of individuals age 65 and older are generally independent of economic conditions. Retirees usually do not work, and when they relocate, it is primarily because of lifestyle preferences. Migratory patterns for people age 65 or older are based on historical PUMs data from the U.S. Census.

5) *Calculate ending population for a given year*: The total year-ending population is estimated by adding together: 1) surviving population from the previous year, 2) new births, 3) net economic migration, 4) net non-economic migration and 5) special populations. This figure serves as the baseline population for the next year and the process repeats itself.

The second component of the social impact model is identical to the first and includes the five steps listed above for each year where water shortages are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060). The only difference is that labor demand changes in years with shortages. Shifts in labor demand stem from employment impacts estimated as part of the economic analysis component of this study with some slight modifications. IMPLAN employment data is based on the number of full and part-time jobs as opposed to the number of people working. To remedy discrepancies, employment impacts from IMPLAN were adjusted to reflect the number of people employed by using simple ratios (i.e., labor supply divided by number of jobs) at the county level. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

1.3 Clarifications, Assumptions and Limitations of Analysis

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1) While useful for planning purposes, this study is not a benefit-cost analysis (BCA). BCA is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a BCA if done so properly.

2) Since this is not a BCA, future impacts are not weighted differently. In other words, estimates are not “discounted.” If used as a measure of benefits in a BCA, one must consider the uncertainty of estimated monetary impacts.

3) All monetary figures are reported in constant year 2000 dollars.

4) Shortages reported by regional planning groups are the starting point for socioeconomic analyses. No adjustments or assumptions regarding the magnitude or distributions of unmet needs among different water use categories are incorporated in the analysis.

5) Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They are independent and distinct “what if” scenarios for each particular year and water shortages are assumed to be temporary events resulting from severe drought conditions combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, *regardless of whether or not there is a drought*. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under “normal” or “most likely” future climatic conditions.

6) IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as “final sales,” multipliers for the ranching sector do fully account for all losses to a region’s economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

7) Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on ”fixed-proportion production functions,” which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses for employment and secondary losses in sales and employment should be considered an *upper bound*. Similarly, since population projections are based on reduced employment in the region, they should be considered an upper bound as well.

8) IO models are static in nature. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in the year 2000. In contrast, unmet water needs are projected to occur well into the future (i.e., 2010 through 2060). Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon.

9) With respect to municipal needs, an important assumption is that people would eliminate all outdoor water use before indoor water uses were affected, and people would implement emergency indoor water conservation measures before commercial businesses had to curtail operations, and households had to seek alternative sources of water. Section 2.3.3 discusses this in greater detail.

10) Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in Texas for many communities lasted several years.

2. Economic Impacts

Part 2 of this report summarizes analysis for individual water use categories. Section 2.1 presents the year 2000 economic baseline for Region F. Section 2.2 summarizes results for agricultural water uses including livestock and irrigated crop production, while Section 2.3 reviews impacts to municipal and industrial water uses including manufacturing, mining, steam-electric and municipal demands. Attachment B of this report contains tables showing the distribution of impacts at the county level and city level (municipal uses only).

2.1 Economic Baseline

Table 2 summarizes baseline economic variables for Region F. In 2000, the region generated $17,389 million in income that supported almost 324,000 jobs. Businesses and industries also generated slightly more $1,633 million worth of taxes for state, local and federal government. Sections 2.2.and 2.3 discuss contributions of individual water use categories in greater detail.

Table 2: Economic Baseline for Region F (Year 2000, monetary figures are reported in $millions)

	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Irrigation	$59.48	$6.60	$52.88	1,843	$29.76	$2.23
% of Total	< 1%	< 1%	< 1%	1%	< 1%	< 1%
Livestock	$367.01	$193.98	$173.04	10365	$172.40	$10.62
% of Total	1%	2%	1%	3%	1%	1%
Manufacturing	$4,947.14	$756.69	$4,190.45	21,734	$1,402.01	$48.32
% of Total	14%	7%	17%	7%	8%	3%
Mining	$10,405.50	$2,294.36	$8,111.14	17,738	$4,441.40	$546.06
% of Total	29%	21%	33%	5%	26%	33%
Steam Electric	$415.29	$129.07	$286.22	796	$296.98	$53.19
% of Total	1%	1%	1%	< 1%	2%	3%
Municipal	$19,116.80	$7,308.54	$11,808.26	271,524	$11,046.52	$972.57
% of Total	54%	68%	48%	84%	64%	60%
Total	$35,311.22	$10,689.24	$24,621.98	323,999	$17,389.07	$1,633.00
% of Total	100%	100%	100%	100%	100%	100%

*Does not include dry-land agriculture. Municipal includes all non-industrial commercial enterprises and institutional water uses such as the military, schools and other government organizations. Source: Based input-output models generated using IMPLAN Pro software from MIG Inc.

2.2 Agriculture

In 2000, Region F farmers using irrigation produced nearly $60 million dollars worth of crops that generated about $30 million worth of income Region F residents. Livestock producers sold about $367 million worth meat and related products and created $172 million worth of income for area residents. Collectively, irrigated farming and the livestock industry accounted for about two percent of regional income and four percent of regional jobs.

2.2.1 Irrigation

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Natural Resources Conservation Service (NRCS) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 3 shows the TWDB crops included in corresponding IMPLAN sectors. Table 4 summarizes acreage and estimated annual water use for each crop classification (year 2000). Table 5 shows year 2000 economic data for irrigated crop production in the region. When measured in dollars, cotton and vegetables are the largest sectors accounting for about one-half of all sales revenues for irrigated farms.

Table 3: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors Applied in Socioeconomic Impact Analysis

IMPLAN Sector	TWDB Sector
Cotton	Cotton
Feed Grains	Corn, sorghum and “forage crops”
Food Grains	Wheat and "other grains"
Hay and Pasture	Alfalfa and “other hay and pasture”
Oil Crops	Peanuts, soybeans and “other oil crops”
Tree Nuts	Pecans
Vegetables *	Deep-rooted vegetables, shallow-rooted vegetables and potatoes
Other Crops	"All other crops" "other orchards" and vineyards

* includes melons.

Table 4. Summary of Irrigated Crop Acreage and Water Demand for Region F (Year 2000)				
Sector	Acres (1000s)	Distribution of Acres	Water Use (1000s of AF)	Distribution of Water Use
Cotton	116	49%	166	41%
Food Grains	43	18%	63	16%
Hay and Pasture	30	13%	72	18%
Feed Grains	18	8%	24	6%
Oil Bearing Crops	12	5%	19	5%
Tree Nuts	9	4%	28	7%
Vegetables	5	2%	13	3%
Other	3	1%	9	2%
Total	236	100%	394	100%

Source: Water demand figures are taken from the Texas Water Development Board 2006 Water Plan Projections data for year 2000. Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the National Resources Conservation Service (USDA).

Table 5: Year 2000 Economic Baseline for Irrigation in Region F (monetary figures reported in $millions)						
Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Cotton	$20.93	$0.35	$20.57	279	$9.35	$0.81
Vegetables	$11.56	$2.07	$9.49	143	$4.72	$0.17
Hay and Pasture	$9.22	$1.47	$7.75	776	$4.03	$0.40
Oil Bearing Crops	$6.80	$2.36	$4.44	325	$4.81	$0.47
Tree Nuts	$6.52	$0.06	$6.45	160	$4.16	$0.11
Food Grains	$2.93	$0.04	$2.89	125	$1.76	$0.17
Feed Grains	$1.53	$0.24	$1.28	36	$0.92	$0.10
Total	$59.48	$6.60	$52.88	1,843	$29.76	$2.23

Source: Based on data from the Texas Water Development Board, the Texas Agricultural Statistics Service and the Minnesota IMPLAN Group, Inc.

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[7] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell

[7] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. "*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a." Western Consortium for Public Health. May 1993.

water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a *substantial* amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. “Predominant” in this case are crops that comprise at least one percent of total acreage in the region (see Table 4).

The following steps outline the overall method used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage in 2000.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed in Section 1.2.1 and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2000 baseline. Given that 2000 may have been an unusually poor or productive year for some crops and not necessarily representative of normal conditions, statistics regarding yield, price and acreage for crop sectors were averaged over a five-year period (1995-2000) if sufficient data were available.

3. *Offset reductions in output by revenues from dry-land production.* If TASS acreage data indicate that farmers grow a dry-land version of a given crop in the region (e.g., cotton or corn), estimated losses from irrigated acreage are offset by assumed revenues from dry-land harvests. Basically, the analysis assumes that farmers who use irrigation would try and grow something even if irrigation water were not available. Given that water shortages are expected to occur under drought conditions, values per acre for dry-land crops are based on 1998 and/or 1996 yields and prices. Both 1996 and 1998 were particularly bad drought years for most of West Texas. Table 6 summarizes data used to estimate the value of lost output.

Table 6: Data Used to Estimate Impacts to Irrigated Crop Production in Region F.			
Crop sector	Gross sales revenue per irrigated acre	Gross sales revenue per dry-land acre (drought conditions)	Data Sources for yield, prices and planted acreage used to estimate gross sales per acre
Cotton	$300	$40	Gross sales per acre based on averages (1995 - 2000) for cotton in the TASS Southern High Plains district. Dry-land same data based on 1996 yields and prices for non-irrigated cotton.
Vegetables	$2,200	$0	Average (1995-2000) weighted by acreage for deep and shallow rooted vegetables. Acreage data from TWDB. Prices and yields based on state level TASS data.
Hay and Pasture	$380	$40	Gross sales per irrigated acre = average weighted by alfalfa and "other hay" acreage. Economic data for alfalfa based TASS state average values for prices and yields (1995-2000). Gross sales for hay other = TAMU 2000 values for coastal Bermuda hay and coastal pasture for West Central District. Dry-land value is based on TAMU value for dry-land Bermuda pasture in West Central District.
Oil Bearing Crops	$690	$85	Dry-land value based on 1998 peanut yields and harvest for TASS Southern High Plains data.
Tree Nuts	$600	$0	Based on TAMU Crop Enterprise Budgets for Pecans (Southwest District). No dry-land production assumed.
Food Grains	$105	$30	Gross sales = averages (1995-2000) for wheat in Edwards Plateau District. Dry-land same data, but based on 1998 yields and prices for non-irrigated wheat.
Feed Grains	$140	$15	Value is an average weighted by acreage for corn, forage crops and sorghum grain. Gross sales for corn = TASS average (1995-2000). Gross sales for forage crops and sorghum based on TAMU data for irrigated sorghum and oats in Southern Plains District. Dry-land value TASS sorghum and corn data for Southern High Plains district (1996 and 1998).
*All values are rounded. TASS = Texas Agricultural Statistics Service. TAMU = Texas A&M University.			

The Region F 2006 Water Plan indicates that under drought of record conditions, shortages to irrigation would occur in Andrews, Borden, Brown, Coke, Coleman, Ector, Glasscock, Irion, Martin, Menard, Midland, Reagan, Reeves, Runnels, Tom Green, Upton and Ward counties. Table 7 summarizes estimated impacts. Attachment B of this report shows impacts by county, and Attachment C shows impacts by major river basin.

Table 7: Annual Economic Impacts of Unmet Water Needs for Irrigation (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$14.10	$7.44	333	$0.63
2020	$15.21	$8.07	366	$0.68
2030	$15.21	$8.07	366	$0.68
2040	$14.81	$7.86	358	$0.66
2050	$14.78	$7.84	357	$0.66
2060	$14.77	$7.84	356	$0.66
* Source: Generated by the Texas Water Development Board, Office of Water Planning.				

2.2.2 Livestock

Reported shortages to livestock sectors are nominal and are not included.

2.3 Municipal and Industrial

Municipal and industrial (M&I) water uses make up the majority of economic activity in Region F. In 2000, M&I uses generated $34,844 million in sales and nearly $17,186 million worth of income for residents in the region. M&I added nearly $1,630 million to state, local and federal tax coffers and provided 311,111 jobs.

2.3.1 Manufacturing

Table 8 summarizes baseline economic data for manufacturing sectors. Petroleum refining, plastics, meat packing and surgical equipment are the four largest sectors in the region. Collectively, these four sectors account for 40 percent income and roughly 20 percent of jobs supported by regional manufacturers. Petroleum refining, meat packing and plastics are all heavily reliant on water for production.

Table 8: Year 2000 Economic Baseline for Manufacturing in Region F (monetary figures reported in $millions)						
Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Petroleum Refining	$863.80	$166.33	$697.47	328	$80.05	$5.59
Miscellaneous Plastics Products	$318.96	$5.39	$313.57	1,704	$103.83	$2.44
Surgical Appliances and Supplies	$293.04	$25.53	$267.50	1,366	$96.36	$3.90
Meat Packing Plants	$265.56	$19.54	$246.02	703	$21.73	$1.56
Plastics Materials and Resins	$227.79	$94.46	$133.33	336	$54.92	$2.10
All other Manufacturing Sectors	$2,794.13	$445.23	$2,348.90	17,098	$939.97	$28.26
Total	$4,947.10	$756.70	$4,190.40	21,730	$1,402.00	$48.30
Source: Generated using IMPLAN models and data from MIG, Inc.						

Direct impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. Care was taken to include only sectors recorded in the TWDB Water Uses database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable uses. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes in TWDB databases were matched to IMPLAN sector codes for each affected county. Non-matches were excluded when calculating direct impacts.

The distribution of water shortages among TWDB manufacturing sectors is weighted according to year 2000 water use. Accordingly, industries with the greatest use are affected the most. As a general observation, these sectors include petroleum and chemical refineries, plastic producers, paper mills, food processors and cement manufacturers. Other manufacturing sectors use considerably less water for productive processes and are less likely to suffer substantial negative effects due to water shortages.

The Region F 2006 Water Plan indicates that under drought of record conditions, shortages to manufacturing water uses would occur in Coleman, Ector, Howard, Kimble, Runnels and Tom Green counties. Table 9 summarizes estimated impacts at the regional level. Attachment B of this report shows impacts by county. Approximately 99 percent of socioeconomic impacts are associated with unmet needs in the Colorado River Basin.

Table 9: Annual Economic Impacts Associated with Unmet Manufacturing Water Needs (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$905.25	$282.26	6,140	$15.10
2020	$1,021.51	$317.48	6,890	$17.05
2030	$1,079.54	$336.14	7,380	$18.06
2040	$1,174.75	$365.95	8,045	$19.63
2050	$1,265.19	$393.27	8,615	$21.15
2060	$1,372.96	$426.34	9,320	$22.95
* Estimates are based on *projected* economic activity in the region. Source: Texas Water Development Board, Office of Water Resources Planning.				

2.3.2 Mining

The mining industry is a significant force in the Region F economy. As shown in Table 10, in 2000 mining generated about $4,441 million worth of income and provided jobs for 17,738 workers in the area. Natural gas and petroleum extraction accounts for 80 percent or more of all activity. Most crude oil (nearly 80) is exported out of the region for refining. At this juncture, it important to stress that output for the natural gas and oil sectors represent transactions by corporate entities based in Region F. However, it does not necessarily reflect the *physical* production of gas or oil in the region. To account for potential discrepancies related to data reporting, TWDB analysts used data from the Texas Railroad Commission (TRC) to estimate actual production for the gas and oil sectors in affected counties by comparing average well-head market prices for crude and gas to TRC production statistics. TRC records show that in year 2000 $4,463 million worth of gas and oil came from wells in Region F counties and the remainder came from wells located outside of regional boundaries.

Table 10: Year 2000 Economic Baseline for Mining in Region F (monetary figures reported in $millions)						
Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Natural Gas & Crude Petroleum*	$8,039.87	$1,782.90	$6,256.97	15,667	$3,701.82	$434.30
Natural Gas Liquids*	$2,288.87	$507.57	$1,781.30	1,610	$693.56	$109.08
All other Mining Sectors	$76.77	$3.89	$72.88	462	$46.02	$2.68
Total	$10,405.50	$2,294.36	$8,111.14	17,738	$4,441.40	$546.06
* Represents sales from corporations located in Region F as opposed to physical production from wells located in the region. Some sales stem from wells outside of regional boundaries. Based on production figures published by the Texas Railroad Commission, physical production from counties in Region F was worth $7,578 million in year 2000. Source of tabular data: generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.						

Other considerations with respect to mining include:

1) The petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as “enhanced” or “water flood” extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level TRC data that shows the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

2) A substantial portion of output from the crude extraction sector goes directly to other regional industries in the form of intermediate sales. Obviously, most goes to oil refineries, which are an important forward linkage for the gas and crude mining sector. Thus, reduced drilling activity resulting from water shortages might affect regional oil refineries. However, these impacts were not included here to avoid double counting. Impacts to refineries were incorporated when estimating impacts to manufacturing sectors (see Section 2.3.1).

3) Unlike output in other sectors including manufacturing and municipal, output in the crude and natural gas sectors is not assumed to grow over the planning horizon. Water use will likely increase as secondary recovery occurs in more fields, but the volume of oil and gas extracted from on-shore wells in the state is not likely to grow significantly.

The 2006 Region F Water Plan indicates that under drought of record conditions, shortages to mining would occur in Coke, Coleman, Ector and Howard counties and would primarily affect the oil and gas industry. Table 11 summarizes estimated impacts. Attachment B of this report shows impacts by county. All impacts are associated with unmet water needs in the Colorado River Basin.

Table 11: Annual Economic Impacts of Unmet Water Needs for Mining
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$6.06	$2.83	15	$0.33
2020	$29.27	$13.26	110	$1.66
2030	$40.17	$18.09	165	$2.29
2040	$101.25	$45.51	415	$5.78
2050	$114.94	$51.66	470	$6.56
2060	$123.66	$55.59	505	$7.05

* Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

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2.3.3 Municipal Uses

Table 12 summarizes economic activity for municipal uses in the region. In 2000, these businesses and institutions produced $19,116 million worth of goods and services. In return, they received $11,046 million in wages, salaries and profits. Municipal uses generate the bulk of business taxes in the region – nearly $973 million (60 percent of all state and local taxes generated in the region). Top commercial sectors in terms of income and output include wholesale trade, banking, real estate, state and local government and the communications sector.

Table 12: Year 2000 Economic Baseline for Municipal Water Uses in Region F
(monetary figures are reported in $millions)

Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Wholesale trade	$1,223.28	$615.65	$607.63	12,664	$670.76	$174.48
Banking	$934.09	$292.65	$641.44	4,559	$603.47	$15.10
Real estate	$836.55	$548.55	$288.00	4,618	$496.09	$98.97
State & Local Government (Education)	$834.485	$834.48	$0.00	26,278	$834.48	$0.00
State & Local Government (Non-Education)	$733.503	$733.50	$0.00	18,290	$733.50	$0.00
Maintenance and Repair Oil and Gas Wells	$727.43	$596.99	$130.43	6,741	$419.79	$28.63
Communications (except Radio and TV)	$723.15	$229.45	$493.70	2,692	$365.80	$38.94
All other municipal sectors	$13,104.32	$3,457.26	$9,647.06	195,682	$6,922.62	$616.45
Total	$19,116.80	$7,308.54	$11,808.26	271,524	$11,046.52	$972.57

Source: Generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.

Estimating direct economics impacts for the municipal category is complicated for several reasons. For one, municipal uses comprise a range of different consumers including commercial businesses, institutions (e.g., schools and government) and households. However, reported shortages do not specify how needs are distributed among different consumers. In other words, how much of a municipal need is commercial and how much is residential? The amount of commercial water use as a percentage of total municipal demand was estimated based on "GED" coefficients (gallons per employee per day) published in secondary sources (see Attachment A). For example, if year 2000 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x 200 = 6,000 gallons) and thus annual use is 6.7 acre-feet. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as "county-other." The estimated proportion of water used for commercial purposes ranges from about 5 to 35 percent of total municipal demand at the county level. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

As mentioned earlier, a key study assumption is that people would eliminate outdoor water use before indoor water consumption was affected; and they would implement *voluntary* emergency indoor water conservation measures before people had to curtail business operations or seek emergency sources of water. This is logical because most water utilities have drought contingency plans. Plans usually specify curtailment or elimination of outdoor water use during periods of drought. In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of "non-essential water uses."[8] Thus, when assessing municipal needs there are several important considerations: 1) how much of a need would people reduce via eliminating outdoor uses and implementing emergency indoor conservation measures; and 2) what are the economic implications of such measures?

Determining how much water is used for outdoor purposes is key to answering these questions. The proportion used here is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[9]Earlier findings of the U.S. Water Resources Council showed a national average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[10] A study conducted for the California Urban Water Agencies (CUWA) calculated values ranging from 25 to 35 percent.[11] Unfortunately, there does not appear to be any comprehensive research that has estimated non-agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study. With respect to emergency indoor conservation measures, this analysis assumes that citizens in affected communities would reduce needs by an additional 20 percent. Thus, 50 percent of total needs could be eliminated before households and businesses had to implement emergency water procurement activities.

Eliminating outdoor watering would have a range of economic implications. For one, such a restriction would likely have adverse impacts on the landscaping and horticultural industry. If people are unable to water their lawns, they will likely purchase less lawn and garden materials such as plants and fertilizers. On the other hand, during a bad drought people may decide to invest in drought tolerant landscaping, or they might install more efficient landscape plumbing and other water saving devices. But in general, the horticultural industry would probably suffer considerable losses if outdoor water uses were restricted or eliminated. For example, many communities in Colorado, which is in the midst of a prolonged drought, have severely restricted lawn irrigation. In response, the turf industry in Colorado has laid off at least 50 percent of its 2,000 employees.[12] To capture impacts to the horticultural industry, regional sales net of exports for the greenhouse and nursery sectors and the landscaping services sector were reduced in proportion to reductions in outdoor water use. Note that these losses would not necessarily appear as losses to the regional or state economies because people would likely spend the money that they would have spent on landscaping on other goods in the economy. Thus, the net effect on state or regional accounts could be neutral.

Other considerations include the "welfare" losses to consumers who had to forgo outdoor and indoor water uses to reduce needs. In other words, the water that people would have to give

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[8] Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[9] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. "*Residential End Uses of Water*." Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

[10] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[11] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

[12] Based on assessments of the Rocky Mountain Sod Growers. See, "*Drought Drying Up Business for Landscapers*." Associated Press. September, 17 2002.

up has an economic value. Estimating the economic value of this forgone water for each planning area would be a very time consuming and costly task, and thus secondary sources served as a proxy. Previous research funded by the TWDB, explored consumer "willingness to pay" for avoiding restrictions on water use.[13] Surveys revealed that residential water consumers in Texas would be willing to pay – on average across all income levels - $36 to avoid a 30 percent reduction in water availability lasting for at least 28 days. Assuming the average person in Texas uses 140 gallons per day and the typical household in the state has 2.7 persons (based on U.S. Census data), total monthly water use is 13,205 gallons per household. Therefore, the value of restoring 30 percent of average monthly water use during shortages to residential consumers is roughly one cent per gallon or $2,930 per acre-foot. This figure serves as a proxy to measure consumer welfare losses that would result from restricted outdoor uses and emergency indoor restrictions.

The above data help address the impacts of incurring water needs that are 50 percent or less of projected use. Any amount greater than 50 percent would result in municipal water consumers having to seek alternative sources. Costs to residential and non-water intensive commercial operations (i.e., those that use water only for sanitary purposes) are based on the most likely alternative source of water in the absence of water management strategies. In this case, the most likely alternative is assumed to be "hauled-in" water from other communities at annual cost of $6,530 per acre-foot for small rural communities and approximately and $10,995 per acre-foot for metropolitan areas.[14]

This is not an unreasonable assumption. It happened during the 1950s drought and more recently in Texas and elsewhere. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water hauled delivered to their homes by private contractors.[15] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[16] In Australia, four cities have run out of water as a result of drought, and residents have been trucking in water since November 2002. One town has five trucks carting about one acre-foot eight times daily from a source 20 miles away. They had to build new roads and infrastructure to accommodate the trucks. Residents are currently restricted to indoor water use only.[17]

Direct impacts to commercial sectors were estimated in a fashion similar to other business sectors. Output was reduced among "water intensive" commercial sectors according to the severity of projected shortages. Water intensive is defined as non-medical related sectors that are heavily dependent upon water to provide their services. These include:

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[13] See, Griffin, R.C., and Mjelde, W.M. "*Valuing and Managing Water Supply Reliability*. Final Research Report for the Texas Water Development Board: Contract no. 95-483-140." December 1997.

[14] For rural communities, figure assumes an average truck hauling distance of 50 miles at a cost of 8.4 cents per ton-mile (an acre foot of water weighs about 1,350 tons) with no rail shipment. For communities in metropolitan areas, figure assumes a 50 mile truck haul, and a rail haul of 300 miles at a cost of 1.2 cents per ton-mile. Cents per ton-mile are based on figures in: Forkenbrock, D.J., "*Comparison of External Costs of Rail and Truck Freight Transportation*." Transportation Research. Vol. 35 (2001).

[15] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[16] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

[17] Healey, N. (2003) *Water on Wheels*, Water: Journal of the Australian Water Association, June 2003.

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hotels and lodging places, and
- eating and drinking establishments.

For non-water intensive sectors, it is assumed that businesses would haul water by truck and/or rail.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City B has an unmet need of 50 acre feet in 2020 and projected demands of 200 acre-feet. In this case, residents of City B could eliminate needs via restricting all outdoor water use. City A, on the other hand, has an unmet need of 150 acre-feet in 2020 with a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and indoor conservation measures would eliminate 50 percent of projected needs; however, 50 acre-feet would still remain. This remaining portion would result in costs to residential and commercial water users. Water intensive businesses such as car washes, restaurants, motels, race tracks would have to curtail operations (i.e., output would decline), and residents and non-water intensive businesses would have to have water hauled-in assuming it was available.

The last element of municipal water shortages considered focused on lost water utility revenues. Estimating these was straightforward. Analyst used annual data from the "*Water and Wastewater Rate Survey*" published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, averages rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as "county-other" were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or "unaccountable" water that comprises things such leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the "miscellaneous gross receipts tax, "which the state collects from utilities located in most incorporated cities or towns in Texas.

The Region F 2006 Water Plan indicates that under drought of record conditions, municipal water shortages would occur in Brown, Coke, Coleman, Concho, Ector, Howard, Kimble, Martin, McCulloch, Menard, Midland, Runnels, Scurry, Tom Green and Ward counties. Tables 13 through 16 summarize estimated impacts to domestic uses, commercial businesses, water utilities and the horticultural industry. Attachment B of this report shows impacts by county. Approximately 99 percent of socioeconomic impacts are associated with unmet needs in the Colorado River Basin.

Table 13: Annual Economic Impacts of Unmet Water Needs for Water Intensive Commercial Businesses (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$38.45	$20.10	825	$2.53
2020	$38.73	$20.24	830	$2.55
2030	$42.48	$22.21	925	$2.76
2040	$123.95	$64.84	2,940	$7.40
2050	$133.06	$69.61	3,165	$7.92
2060	$143.05	$74.83	3,410	$8.49

* Estimates are based on *projected* economic activity in the region. Source: Texas Water Development Board, Office of Water Resources Planning.

Table 14: Annual Economic Impacts of Unmet Water Needs for the Horticultural Industry (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$9.69	$5.04	200	$0.12
2020	$13.91	$7.23	285	$0.17
2030	$15.79	$8.22	325	$0.19
2040	$18.78	$9.79	390	$0.23
2050	$19.69	$10.27	405	$0.24
2060	$22.30	$11.60	460	$0.27

Source: Generated by the Texas Water Development Board, Office of Water Resources Planning.

Table 15: Annual Impacts Associated with Unmet Domestic Water Needs (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)	
Year	$millions
2010	$70.15
2020	$97.37
2030	$113.47
2040	$137.66
2050	$144.80
2060	$154.18

Source: Generated by Texas Water Development Board, Office of Water Resources Planning.

Table 16: Impacts to Water Utilities (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)		
Year	Revenues ($millions)	Utility Taxes ($millions)
2010	$29.60	$0.52
2020	$41.44	$0.73
2030	$48.86	$0.86
2040	$58.35	$1.03
2050	$61.56	$1.08
2060	$65.65	$1.16
Source: Texas Water Development Board, Office of Water Resources Planning.		

2.3.4 Steam-Electric

The steam electric sector represents economy activity associated with retail and wholesale transactions of electricity. As shown in Table 17, in 2000 the electric services sector generated annual sales of $415 million that resulted in nearly $296 million in income for Region F residents.[18] The electric services sector directly supports an estimated 796 full and part-time jobs.

Table 17:Year 2000 Baseline for Steam Electric (monetary figures are in $millions)						
Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Electric Services	$415.29	$129.07	$286.22	796	$296.98	$53.19
Source: Generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.						

Without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline, particularly during drought when surface flows are reduced. Low water levels could affect raw water intakes and water discharge outlets (i.e., outfalls) at power facilities in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low lake or river levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[19] But the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This could affect safety related pumps, increase operating costs and/or result in

[18] IMPLAN output data report all sales transactions for particular utility in a given county - including sales generated from stations outside a county. As a countermeasure, analysts estimated sales for affected counties using production and price data from the U.S. Energy Information Administration.

[19] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity, which implies that output (i.e., sales of electricity) would decline.

Among all water use categories, steam-electric is unique and cautions are necessary when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenue. In the case of water shortages, one assumes that businesses will suffer lost output if process water is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several power plants in a given region. If one plant became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily water (e.g., gas powered turbines or "peaking plants") might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[20] In Region F projected shortages for are severe enough that sustained power outages would likely result and not only would electric utilities lose revenue, but businesses without power would suffer huge economic losses as well. However, potential lost economic activity for utility customers resulting from power outages are not included here to avoid double counting lost output.

The Region F 2006 Water Plan indicates that under drought of record conditions, steam-electric water shortages would occur in Coke, Ector, Mitchell, Tom Green and Ward counties. Table 18 summarizes estimated impacts. Attachment B of this report shows impacts by county. Approximately 99 percent of impacts associated with unmet needs for the power industry would result from shortages in the Colorado River Basin.

Table 18: Annual Economic Impacts of Unmet Water Needs for Steam-electric Water Uses
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Total Sales	Regional Income ($millions)	Jobs	Business Taxes
2010	$130.46	$87.13	675	$15.61
2020	$164.73	$109.94	855	$19.69
2030	$195.39	$130.40	1,015	$23.36
2040	$248.00	$165.50	1,285	$29.64
2050	$299.84	$200.09	1,555	$35.84
2060	$348.15	$232.34	1,805	$41.61

Source: Generated by the Texas Water Development Board, Office of Water Planning.

[20] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place (e.g., transmission constraints); utilities could offset lost power that resulted from waters shortages with purchases via the power grid. Losses offset through grid purchases or from peaking plants would likely result in higher production costs, which utilities would ultimately pass on to consumers in the form of higher utility bills. Determining the impacts of higher costs is not considered in this study.

3. Regional Social Impacts

As discussed previously in Section 1.2, estimated social impacts focus changes including population loss and subsequent related in school enrollment. As shown in Table 19, water shortages in 2010 could result in a population loss of 13,830 people with a corresponding reduction in school enrollment of 3,590. Models indicate that shortages in 2060 could cause population in the region to fall by 27,540 people and school enrollment by 7,120 students.

Table 19: Estimated Regional Social Impacts of Unmet Water Needs
(years, 2010, 2020, 2030, 2040, 2050 and 2060)

Year	Population Losses	Declines in School Enrollment
2010	13,830	3,590
2020	15,920	4,130
2030	17,360	4,500
2040	23,080	5,990
2050	25,070	6,500
2060	27,450	7,120

Source: Generated by the Texas Water Development Board, Office of Water Planning.

Attachment A: Baseline Regional Economic Data

Tables A-1 through A-6 contain data from several sources that form a basis of analyses in this report. Economic statistics were extracted and processed via databases purchased from MIG, Inc. using IMPLAN Pro™ software. Values for gallons per employee (i.e. GED coefficients) for the municipal water use category are based on several secondary sources.[21] County-level data sets along with multipliers are not included given their large sizes (i.e., 528 sectors per county each with 12 different multiplier coefficients). Fields in Tables A-1 through A-6 contain the following variables:

- *GED -* average gallons of water use per employee per day (municipal use only);
- *total sales -* total industry production measured in millions of dollars (equal to shipments plus net additions to inventories);
- *intermediate sales -* sales to other industries in the region measured in millions of dollars;
- *final sales -* all sales to end-users including sales to households in the region and exports out of the region;
- *jobs -* number of full and part-time jobs (annual average) required by a given industry;
- *regional income -* total payroll costs (wages and salaries plus benefits), proprietor income, corporate income, rental income and interest payments;
- *business taxes –* sales taxes, excise taxes, fees, licenses and other taxes paid during normal business operations (includes all payments to federal, state and local government except income taxes).

[21] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: "*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*," Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, "*Evaluation of Water Conservation for Municipal and Industrial Water Supply*." U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

Table A-1: Economic Data for Irrigated Agriculture in Region F (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Cotton	$20.93	$0.35	$20.57	279	$9.35	$0.81
Feed Grains	$1.53	$0.24	$1.28	36	$0.92	$0.10
Food Grains	$2.93	$0.04	$2.89	125	$1.76	$0.17
Hay and Pasture	$9.22	$1.47	$7.75	776	$4.03	$0.40
Oil Bearing Crops	$6.80	$2.36	4.43533	325	$4.81	$0.47
Tree Nuts	$6.52	$0.06	$6.45	160	$4.16	$0.11
Vegetables	$11.56	$2.07	$9.49	143	$4.72	$0.17
Total	$59.48	$6.60	$52.88	1,843	$29.76	$2.23

* Does not include activity for dry-land acreage.

Table A-2: Economic Data for Livestock Sectors, Region F (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Range Fed Cattle	$146.47	$53.65	$92.82	4,400	$60.21	$3.87
Cattle Feedlots	$77.59	$75.87	$1.72	440	$55.33	$4.39
Ranch Fed Cattle	$50.46	$49.32	$1.15	1,579	$18.56	$1.32
Dairy Farm Products	$36.93	$1.06	$35.87	424	$20.16	$0.15
Sheep, Lambs and Goats	$24.60	$4.12	$20.49	2,637	$8.60	$0.49
Poultry and Eggs	$12.65	$4.34	$8.30	118	$4.09	$0.07
Other Meat Animal Products	$8.04	$0.85	$7.19	192	$1.83	$0.15
Miscellaneous Livestock	$7.24	$1.79	$5.45	496	$2.71	$0.07
Hogs, Pigs and Swine	$3.03	$2.97	$0.05	78	$0.92	$0.11
Total	$367.01	$193.98	$173.04	10365	$172.40	$10.62

Table A-3: Economic Data for Municipal Sectors, Region F (Year 2000)

Sector	GED	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Accounting, Auditing and Bookkeeping	120	$200.88	$144.77	$56.11	3,512	$158.31	$1.80
Advertising	117	$32.30	$29.42	$2.89	335	$15.47	$0.28
Agricultural, Forestry, Fishery Services	-	$46.13	$26.41	$19.72	2,475	$25.47	$1.12
Air Transportation	171	$58.38	$18.22	$40.16	634	$28.88	$4.13
Amusement and Recreation Services,	427	$17.31	$0.11	$17.20	821	$9.54	$0.92
Apparel & Accessory Stores	68	$69.79	$4.38	$65.41	1,987	$38.57	$11.14
Arrangement Of Passenger	130	$61.59	$6.13	$55.46	458	$42.53	$1.84
Automobile Parking and Car Wash	681	$23.70	$2.55	$21.15	770	$16.00	$1.10
Automobile Rental and Leasing	147	$34.37	$23.80	$10.58	414	$20.07	$2.72
Automobile Repair and Services	55	$236.97	$43.95	$193.03	2,872	$120.72	$10.94
Automotive Dealers & Service Stations	49	$422.23	$71.75	$350.47	5,678	$251.80	$65.30
Banking	59	$934.09	$292.65	$641.44	4,559	$603.47	$15.10
Beauty and Barber Shops	216	$26.85	$1.94	$24.91	1,038	$16.26	$0.32
Bowling Alleys and Pool Halls	86	$4.22	$0.01	$4.21	254	$2.17	$0.35
Building Materials & Gardening	35	$98.28	$12.59	$85.70	2,078	$70.12	$16.17
Business Associations	160	$43.77	$13.49	$30.28	866	$32.99	$0.03
Child Day Care Services	120	$81.46	$0.00	$81.46	2,094	$25.12	$0.72
Colleges, Universities, Schools	75	$14.39	$0.18	$14.21	510	$9.55	$0.00
Commercial Fishing	-	$3.97	$0.43	$3.53	159	$3.60	$0.12
Commercial Sports Except Racing	391	$3.19	$1.87	$1.32	96	$2.08	$0.17
Commodity Credit Corporation	-	0.000	$0.00	0.000	0	$0.00	0.000
Communications, Except Radio and TV	47	$723.15	$229.45	$493.70	2,692	$365.80	$38.94
Computer and Data Processing Services	40	$59.52	$45.92	$13.60	1,318	$48.16	$0.91
Credit Agencies	156	$279.35	$143.67	$135.69	7,425	$149.75	$9.69
Detective and Protective Services	84	$15.00	$8.75	$6.25	443	$11.40	$0.21
Doctors and Dentists	203	$639.81	$0.00	$639.81	6,235	$430.90	$8.27
Domestic Services	-	47.866	$47.87	0.000	6,257	$48.40	0.000
Eating & Drinking	157	$607.96	$39.81	$568.14	17,931	$272.16	$37.98

Table A-3: Economic Data for Municipal Sectors, Region F (Year 2000)

Electrical Repair Service	37	$41.15	$11.43	$29.73	511	$17.07	$1.47
Elementary and Secondary Schools	169	$21.80	$0.00	$21.80	930	$13.20	$0.00
Engineering, Architectural Services	87	$113.34	$99.86	$13.47	1,179	$51.96	$0.77
Equipment Rental and Leasing	29	$204.03	$48.79	$155.24	1,588	$93.03	$6.46
Federal Government - Military	61	319.204	$319.20	0.000	4,503	$319.20	0.000
Federal Government - Non-Military	61	204.022	$204.02	0.000	3,610	$204.02	0.000
Food Stores	98	$287.37	$8.70	$278.67	8,219	$215.44	$45.92
Funeral Service and Crematories	111	$23.70	$0.00	$23.70	646	$15.70	$0.67
Furniture & Home Furnishings Stores	42	$65.68	$6.75	$58.93	1,836	$42.62	$10.30
Gas Production and Distribution	51	$456.45	$359.66	$96.79	468	$108.28	$29.95
General Merchandise Stores	47	$214.53	$7.90	$206.63	6,876	$134.91	$34.23
Hospitals	76	$314.92	$0.37	$314.55	4,823	$194.99	$1.09
Hotels and Lodging Places	230	$97.90	$45.40	$52.50	2,263	$50.66	$6.52
Insurance Agents and Brokers	89	$116.63	$18.30	$98.34	2,480	$90.51	$1.24
Insurance Carriers	136	$77.07	$7.96	$69.11	668	$39.86	$4.08
Job Trainings & Related Services	141	$3.72	$1.55	$2.17	134	$1.25	$0.01
Labor and Civic Organizations	122	$52.65	$0.28	$52.37	3,624	$39.05	$0.01
Landscape and Horticultural Services	-	$36.74	$26.03	$10.71	1,242	$21.67	$0.93
Laundry, Cleaning and Shoe Repair	517	$62.16	$11.45	$50.71	2,909	$45.75	$1.59
Legal Services	76	$149.96	$73.14	$76.82	1,743	$115.43	$1.35
Local Government Passenger Transit	61	$0.28	$0.04	$0.24	11	-$1.27	$0.00
Local, Interurban Passenger Transit	68	$11.13	$1.80	$9.33	342	$5.91	$0.21
Maintenance and Repair Oil and Gas	25	$727.43	$596.99	$130.43	6,741	$419.79	$28.63
Maintenance and Repair Other Facilities	25	$316.46	$155.98	$160.48	5,846	$212.73	$1.42
Maintenance and Repair, Residential	25	$239.12	$65.73	$173.39	1,854	$62.50	$0.85
Management and Consulting Services	87	$112.95	$82.31	$30.64	1,489	$53.05	$0.70
Membership Sports and Recreation	427	$36.27	$1.16	$35.11	1,336	$18.25	$1.29
Miscellaneous Personal Services	129	$55.29	$4.65	$50.63	837	$14.42	$1.09
Miscellaneous Repair Shops	124	$124.06	$33.37	$90.68	1,869	$56.70	$3.54
Miscellaneous Retail	132	$325.02	$25.14	$299.88	8,878	$203.85	$49.66
Motion Pictures	113	$46.60	$26.18	$20.42	631	$13.87	$0.49
Motor Freight Transport and	85	$486.98	$334.62	$152.36	4,788	$190.51	$5.99
New Government Facilities	63	$406.12	$0.00	$406.12	2,810	$144.68	$2.27
New Highways and Streets	45	$98.96	$0.00	$98.96	951	$35.41	$0.58
New Industrial and Commercial	63	$390.97	$0.00	$390.97	3,495	$128.08	$2.65
New Mineral Extraction Facilities	63	$251.55	$2.85	$248.71	4,167	$150.84	$12.17
New Residential Structures	35	$757.99	$0.00	$757.99	4,991	$130.72	$4.42
New Utility Structures	63	$168.74	$0.00	$168.74	1,711	$64.92	$0.85
Nursing and Protective Care	197	$130.99	$0.00	$130.99	4,627	$93.73	$3.18
Other Business Services	84	$276.78	$193.49	$83.29	3,333	$93.66	$3.41
Other Educational Services	116	$20.31	$2.75	$17.56	483	$6.28	$0.47
Other Federal Government Enterprises	61	$17.83	$8.19	$9.65	139	$2.14	$0.00
Other Medical and Health Services	168	$303.97	$12.68	$291.29	7,518	$144.74	$4.52
Other Nonprofit Organizations	122	$29.14	$1.43	$27.71	971	$17.23	$0.21
Other State and Local Govt Enterprises	61	$244.03	$80.66	$163.36	1,329	$79.08	$0.00
Owner-occupied Dwellings	89	$1,208.90	$0.00	$1,208.90	0	$758.96	$156.76
Personnel Supply Services	484	$72.16	$61.50	$10.66	3,930	$69.49	$1.37
Photofinishing, Commercial	112	$17.32	$11.93	$5.39	184	$5.82	$0.36
Pipe Lines, Except Natural Gas	49	$247.00	$23.29	$223.71	394	$171.37	$20.39
Portrait and Photographic Studios	184	$8.60	$0.72	$7.88	245	$3.83	$0.19
Racing and Track Operation	391	$0.91	$0.05	$0.86	20	$0.35	$0.17
Radio and TV Broadcasting	64	$112.67	$95.10	$17.57	753	$38.44	$1.41
Railroads and Related Services	68	$66.75	$33.64	$33.11	335	$33.71	$1.79
Real Estate	89	$836.55	$548.55	$288.00	4,618	$496.09	$98.97
Religious Organizations	328	$20.53	$0.00	$20.53	170	$1.95	$0.00
Research, Development & Testing	123	$64.61	$44.30	$20.31	1,218	$32.22	$0.59
Residential Care	111	$47.71	$0.00	$47.71	1,558	$31.35	$0.44
Sanitary Services and Steam Supply	51	$25.19	$18.91	$6.27	133	$10.53	$4.61
Security and Commodity Brokers	59	$86.37	$55.91	$30.45	509	$28.63	$2.62
Services To Buildings	67	$68.44	$48.19	$20.24	1,868	$29.72	$1.18
Social Services, N.E.C.	42	$50.56	$5.57	$44.99	1,054	$16.65	$0.05
State & Local Government - Education	61	834.485	$834.48	0.000	26,278	$834.48	0.000
State & Local Government - Non-	61	733.503	$733.50	0.000	18,290	$733.50	0.000
State and Local Electric Utilities	61	$3.51	$1.09	$2.43	9	$1.13	$0.00
Theatrical Producers, Bands Etc.	36	$9.66	$6.05	$3.61	171	$2.25	$0.20
Transportation Services	40	$23.23	$16.46	$6.77	184	$17.35	$0.20
U.S. Postal Service	61	$91.45	$52.08	$39.37	1,205	$66.76	$0.00
Watch, Clock, Jewelry and Furniture	50	$4.79	$0.05	$4.74	96	$1.51	$0.21
Water Supply and Sewerage Systems	51	$14.29	$4.13	$10.16	82	$7.79	$0.97
Water Transportation	353	$4.09	$2.35	$1.75	20	$0.82	$0.07

Table A-3: Economic Data for Municipal Sectors, Region F (Year 2000)

Wholesale Trade	43	$1,223.28	$615.65	$607.63	12,664	$670.76	$174.48
Total	-	19,116.79	7,308.54	11,808.26	271,524	$11,046.52	$972.57

NEC = not elsewhere classified. “na” = not available.

Table A-4: Economic Data for Manufacturing Sectors, Region F (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Abrasive Products	$0.46	$0.02	$0.44	2	$0.16	$0.01
Adhesives and Sealants	$2.85	$2.16	$0.69	11	$0.98	$0.03
Aluminum Foundries	$4.28	$0.20	$4.08	36	$1.72	$0.04
Animal and Marine Fats and Oils	$4.51	$1.30	$3.21	19	$1.01	$0.02
Apparel Made From Purchased Materials	$79.54	$1.63	$77.91	765	$18.24	$0.30
Automotive and Apparel Trimmings	$12.28	$4.81	$7.47	89	$2.18	$0.06
Bags, Paper	$0.36	$0.00	$0.35	2	$0.11	$0.00
Ball and Roller Bearings	$5.71	$0.02	$5.69	48	$1.66	$0.04
Boat Building and Repairing	$1.85	$0.00	$1.85	19	$0.46	$0.01
Book Printing	$0.09	$0.08	$0.01	1	$0.03	$0.00
Book Publishing	$47.01	$1.73	$45.28	239	$10.16	$0.35
Bottled and Canned Soft Drinks & Water	$22.49	$0.16	$22.34	66	$4.82	$0.18
Brass, Bronze, and Copper Foundries	$0.07	$0.00	$0.07	3	$0.04	$0.00
Bread, Cake, and Related Products	$9.28	$2.60	$6.68	65	$2.37	$0.04
Brick and Structural Clay Tile	$0.58	$0.00	$0.58	6	$0.21	$0.01
Canvas Products	$3.32	$2.26	$1.06	48	$1.49	$0.02
Carbon Black	$13.74	$1.18	$12.56	47	$5.33	$0.08
Carburetors, Pistons, Rings, Valves	$15.45	$2.15	$13.30	120	$5.66	$0.12
Carpets and Rugs	$3.08	$0.03	$3.05	18	$0.76	$0.03
Cement, Hydraulic	$183.86	$0.20	$183.66	199	$105.14	$4.49
Cheese, Natural and Processed	$4.73	$1.37	$3.36	12	$0.42	$0.02
Chemical Preparations, N.E.C	$57.62	$39.05	$18.57	150	$20.91	$0.61
Chocolate and Cocoa Products	$1.08	$0.01	$1.08	4	$0.23	$0.01
Commercial Printing	$42.72	$22.94	$19.79	424	$11.60	$0.35
Computer Peripheral Equipment,	$4.13	$1.14	$2.99	14	$0.91	$0.03
Computer Storage Devices	$0.29	$0.08	$0.21	1	$0.02	$0.00
Concrete Products, N.E.C	$17.90	$0.09	$17.81	150	$6.25	$0.23
Confectionery Products	$0.56	$0.00	$0.56	3	$0.12	$0.00
Construction Machinery and Equipment	$53.21	$3.69	$49.52	223	$7.75	$0.31
Converted Paper Products, N.E.C	$1.46	$0.02	$1.44	6	$0.53	$0.02
Creamery Butter	$0.31	$0.08	$0.23	1	$0.02	$0.00
Curtains and Draperies	$1.33	$0.11	$1.23	16	$0.28	$0.01
Cut Stone and Stone Products	$0.20	$0.00	$0.20	2	$0.11	$0.00
Cyclic Crudes, Interm. & Indus. Organic Chem.	$124.74	$72.05	$52.69	164	$30.52	$2.20
Drugs	$1.44	$0.34	$1.10	10	$0.69	$0.01
Electric Housewares and Fans	$0.48	$0.01	$0.47	5	$0.22	$0.00
Electronic Components, N.E.C.	$0.45	$0.36	$0.09	2	$0.07	$0.00
Electronic Computers	$0.51	$0.08	$0.43	3	$0.08	$0.00
Engine Electrical Equipment	$23.73	$8.83	$14.89	146	$8.45	$0.21
Fabricated Metal Products, N.E.C.	$2.10	$0.39	$1.71	18	$0.46	$0.01
Fabricated Plate Work (Boiler Shops)	$49.48	$0.87	$48.61	486	$28.06	$0.48
Fabricated Rubber Products, N.E.C.	$5.97	$0.08	$5.89	39	$1.93	$0.04
Fabricated Structural Metal	$102.93	$2.82	$100.11	638	$38.13	$0.98
Fabricated Textile Products, N.E.C.	$25.05	$2.73	$22.32	157	$8.55	$0.19
Farm Machinery and Equipment	$5.20	$2.51	$2.70	34	$0.95	$0.02
Fertilizers, Mixing Only	$31.53	$6.41	$25.12	95	$5.74	$0.33
Fluid Power Cylinders & Actuators	$1.46	$0.06	$1.39	8	$0.31	$0.01
Fluid Power Pumps & Motors	$0.88	$0.04	$0.85	9	$0.35	$0.01
Food Preparations, N.E.C	$66.80	$0.20	$66.60	396	$16.47	$0.35
Frozen Specialties	$124.44	$1.20	$123.24	815	$31.39	$0.67
Forest Products	$0.39	$0.02	$0.37	10	$0.17	$0.01
Forestry Products	$9.95	$0.00	$9.94	124	$7.57	$1.51
Games, Toys, and Childrens Vehicles	$3.32	$0.03	$3.29	30	$1.97	$0.04
Gaskets, Packing and Sealing Devices	$9.49	$0.11	$9.38	77	$3.44	$0.06
General Industrial Machinery, N.E.C	$50.41	$1.50	$48.91	258	$16.11	$0.41
Glass and Glass Products, Exc Containers	$5.99	$3.94	$2.05	43	$2.89	$0.07

Table A-4: Economic Data for Manufacturing Sectors, Region F (Year 2000)

Greenhouse and Nursery Products	-	$11.71	$4.12	$7.59	226	$5.31
Gum and Wood Chemicals	$35.68	$6.14	$29.54	87	$16.48	$0.36
Hand and Edge Tools, N.E.C.	$0.26	$0.12	$0.13	2	$0.15	$0.00
Hardware, N.E.C.	$0.60	$0.24	$0.36	4	$0.22	$0.01
Hardwood Dimension and Flooring Mills	$0.23	$0.22	$0.02	3	$0.10	$0.00
Heating Equipment, Except Electric	$0.57	$0.02	$0.55	5	$0.24	$0.00
House Slippers	$27.05	$0.00	$27.05	145	$16.43	$0.24
House-furnishings, N.E.C	$1.28	$0.16	$1.12	11	$0.24	$0.01
Household Furniture, N.E.C	$0.43	$0.02	$0.41	7	$0.09	$0.00
Household Vacuum Cleaners	$72.77	$1.67	$71.10	342	$18.79	$0.44
Industrial and Fluid Valves	$7.71	$2.84	$4.88	33	$2.00	$0.06
Industrial Furnaces and Ovens	$0.51	$0.02	$0.49	5	$0.11	$0.00
Industrial Gases	$0.74	$0.43	$0.31	8	$0.57	$0.02
Industrial Machines N.E.C.	$79.87	$1.21	$78.66	777	$33.68	$0.66
Inorganic Chemicals	$22.82	$13.18	$9.64	74	$10.77	$0.71
Internal Combustion Engines, N.E.C.	$1.00	$0.72	$0.28	3	$0.09	$0.00
Iron and Steel Forgings	$1.22	$0.23	$0.98	8	$0.58	$0.01
Iron and Steel Foundries	$20.77	$0.13	$20.64	138	$8.66	$0.23
Jewelry, Precious Metal	$3.81	$0.02	$3.78	25	$1.75	$0.04
Leather Goods, N.E.C	$2.25	$0.19	$2.07	44	$1.71	$0.01
Leather Tanning and Finishing	$1.61	$1.10	$0.51	6	$0.34	$0.01
Lighting Fixtures and Equipment	$10.52	$0.21	$10.31	73	$3.31	$0.10
Logging Camps and Logging Contractors	$0.36	$0.32	$0.04	3	$0.13	$0.00
Lubricating Oils and Greases	$3.45	$2.64	$0.81	8	$0.24	$0.01
Machine Tools, Metal Cutting Types	$0.51	$0.17	$0.34	7	$0.18	$0.00
Machine Tools, Metal Forming Types	$0.62	$0.22	$0.40	6	$0.26	$0.00
Manifold Business Forms	$0.61	$0.20	$0.41	5	$0.19	$0.01
Manufactured Ice	$0.09	$0.00	$0.09	2	$0.05	$0.00
Manufacturing Industries, N.E.C.	$3.68	$0.10	$3.58	32	$1.68	$0.04
Mattresses and Bedsprings	$1.07	$0.02	$1.06	9	$0.32	$0.00
Mechanical Measuring Devices	$28.55	$2.79	$25.77	234	$8.48	$0.23
Metal Coating and Allied Services	$40.58	$4.28	$36.30	245	$16.44	$0.38
Metal Doors, Sash, and Trim	$0.81	$0.03	$0.77	7	$0.34	$0.01
Metal Heat Treating	$0.58	$0.13	$0.46	4	$0.14	$0.00
Metal Partitions and Fixtures	$5.03	$1.78	$3.25	34	$2.00	$0.03
Metal Stampings, N.E.C.	$3.01	$1.22	$1.79	21	$0.90	$0.02
Millwork	$9.51	$9.14	$0.37	87	$3.91	$0.10
Mining Machinery, Except Oil Field	$1.56	$0.46	$1.10	13	$0.42	$0.01
Miscellaneous Plastics Products	$318.96	$5.39	$313.57	1,704	$103.83	$2.44
Miscellaneous Publishing	$11.02	$6.72	$4.30	71	$5.95	$0.13
Mobile Homes	$1.79	$0.00	$1.79	18	$0.57	$0.02
Motor Vehicle Parts and Accessories	$1.71	$1.19	$0.52	8	$0.34	$0.00
Motors and Generators	$0.97	$0.62	$0.36	9	$0.35	$0.01
Newspapers	$65.48	$43.33	$22.15	864	$28.72	$0.66
Nitrogenous and Phosphatic Fertilizers	$19.39	$4.29	$15.10	57	$4.22	$0.19
Nonferrous Wire Drawing and Insulating	$177.16	$4.98	$172.18	602	$44.84	$1.74
Nonmetallic Mineral Products, N.E.C.	$0.64	$0.01	$0.63	5	$0.35	$0.01
Nonwoven Fabrics	$3.03	$0.09	$2.94	15	$0.53	$0.02
Oil Field Machinery	$148.04	$45.28	$102.76	1,249	$62.99	$1.31
Paints and Allied Products	$2.51	$0.04	$2.47	8	$0.70	$0.02
Paper Coated & Laminated N.E.C.	$3.42	$0.17	$3.25	13	$1.63	$0.04
Paperboard Containers and Boxes	$12.10	$10.95	$1.15	50	$3.99	$0.15
Paving Mixtures and Blocks	$3.38	$3.19	$0.19	10	$1.41	$0.03
Pens and Mechanical Pencils	$2.85	$0.13	$2.73	31	$1.27	$0.03
Periodicals	$0.97	$0.51	$0.46	8	$0.20	$0.00
Petroleum Refining	$863.80	$166.33	$697.47	328	$80.05	$5.59
Pickles, Sauces, and Salad Dressings	$3.01	$0.08	$2.93	10	$1.06	$0.02
Pipe, Valves, and Pipe Fittings	$3.20	$1.18	$2.03	29	$1.17	$0.02
Plastics Materials and Resins	$227.79	$94.46	$133.33	336	$54.92	$2.10
Plating and Polishing	$4.53	$0.21	$4.32	62	$3.64	$0.04
Pleating and Stitching	$0.26	$0.08	$0.17	4	$0.17	$0.00
Polishes and Sanitation Goods	$2.21	$0.27	$1.94	20	$1.39	$0.02
Potato Chips & Similar Snacks	$0.45	$0.01	$0.43	2	$0.09	$0.00
Pottery Products, N.E.C	$0.45	$0.00	$0.44	5	$0.21	$0.01
Power Transmission Equipment	$10.44	$0.20	$10.24	79	$2.42	$0.06
Prefabricated Metal Buildings	$6.37	$0.14	$6.24	47	$2.87	$0.06
Prepared Feeds, N.E.C	$29.47	$0.67	$28.80	78	$3.31	$0.21
Pumps and Compressors	$146.47	$4.91	$141.57	591	$35.44	$1.14

Table A-4: Economic Data for Manufacturing Sectors, Region F (Year 2000)

Railroad Equipment	$3.57	$0.11	$3.46	15	$0.45	$0.02
Ready-mixed Concrete	$81.53	$0.55	$80.97	532	$28.11	$1.14
Reconstituted Wood Products	$0.83	$0.76	$0.07	4	$0.21	$0.01
Relays & Industrial Controls	$6.03	$2.28	$3.75	35	$2.09	$0.05
Roasted Coffee	$34.36	$2.74	$31.61	60	$5.93	$0.19
Rubber and Plastics Hose and Belting	$0.37	$0.00	$0.37	3	$0.11	$0.00
Sausages and Other Prepared Meats	$16.24	$2.24	$14.01	79	$2.04	$0.08
Screw Machine Products and Bolts, Etc.	$0.67	$0.32	$0.35	6	$0.26	$0.01
Service Industry Machines, N.E.C.	$1.43	$0.55	$0.88	10	$0.32	$0.01
Sheet Metal Work	$96.75	$2.05	$94.70	734	$38.71	$0.82
Shoes, Except Rubber	$8.51	$0.03	$8.48	83	$4.74	$0.08
Signs and Advertising Displays	$26.14	$10.16	$15.98	285	$11.87	$0.27
Small Arms Ammunition	$0.86	$0.00	$0.86	10	$0.67	$0.08
Special Dies and Tools and Accessories	$0.59	$0.51	$0.08	9	$0.24	$0.00
Special Industry Machinery N.E.C.	$7.20	$2.08	$5.12	19	$1.00	$0.03
Sporting and Athletic Goods, N.E.C.	$23.62	$0.20	$23.42	181	$9.81	$0.83
Surgical Appliances and Supplies	$293.04	$25.53	$267.50	1,366	$96.36	$3.90
Switchgear and Switchboard Apparatus	$5.73	$2.20	$3.54	34	$2.46	$0.05
Synthetic Rubber	$111.29	$19.73	$91.56	304	$45.21	$1.23
Telephone and Telegraph Apparatus	$6.19	$4.06	$2.14	14	$1.54	$0.04
Textile Bags	$0.24	$0.14	$0.09	3	$0.07	$0.00
Textile Goods, N.E.C	$17.47	$0.19	$17.29	121	$2.87	$0.16
Tires and Inner Tubes	$14.22	$0.02	$14.21	71	$6.14	$0.58
Transformers	$5.90	$0.46	$5.44	61	$1.68	$0.03
Transportation Equipment, N.E.C	$32.76	$0.46	$32.30	153	$4.80	$0.16
Truck and Bus Bodies	$1.20	$0.12	$1.09	7	$0.44	$0.00
Truck Trailers	$2.97	$0.09	$2.88	22	$0.89	$0.01
Veneer and Plywood	$0.36	$0.34	$0.03	3	$0.12	$0.00
Vitreous Plumbing Fixtures	$132.04	$1.75	$130.30	1,136	$77.35	$1.53
Wines, Brandy, and Brandy Spirits	$1.24	$0.01	$1.23	5	$0.31	$0.20
Wiring Devices	$1.07	$0.07	$1.01	8	$0.50	$0.01
Wood Containers	$0.30	$0.11	$0.19	3	$0.18	$0.00
Wood Household Furniture	$3.77	$0.06	$3.72	43	$1.37	$0.03
Wood Kitchen Cabinets	$4.82	$4.74	$0.09	71	$1.87	$0.04
Wood Pallets and Skids	$12.15	$4.42	$7.72	166	$4.92	$0.10
Wood Partitions and Fixtures	$13.87	$4.12	$9.75	116	$5.82	$0.09
Wood Products, N.E.C	$5.14	$2.30	$2.84	49	$1.90	$0.05
Wood Tv and Radio Cabinets	$0.13	$0.00	$0.13	2	$0.05	$0.00
Yarn Mills and Finishing Of Textiles, N.E.C.	$0.18	$0.17	$0.02	1	$0.05	$0.00
Total	$4,681.58	$737.15	$3,944.43	21,031	$1,380.28	$46.77

NEC = not elsewhere classified. "na" = not available.

Table A-5: Economic Data for Mining Sectors, Region F Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Chemical, Fertilizer Mineral Mining	$3.60	$1.08	$2.52	36	$2.33	$0.16
Clay, Ceramic, Refractory Minerals	$2.61	$0.03	$2.58	9	$1.56	$0.09
Coal Mining	$3.07	$1.05	$2.02	11	$0.95	$0.37
Dimension Stone	$53.83	$1.18	$52.65	308	$32.78	$1.64
Misc. Nonmetallic Minerals, N.E.C.	$0.50	$0.00	$0.50	3	$0.31	$0.02
Natural Gas & Crude Petroleum	$8,039.87	$1,782.90	$6,256.97	15,667	$3,701.82	$434.30
Natural Gas Liquids	$2,288.87	$507.57	$1,781.30	1,610	$693.56	$109.08
Nonmetallic Minerals Service	$0.36	$0.00	$0.36	3	$0.18	$0.01
Potash, Soda, and Borate Minerals	$0.92	$0.28	$0.65	3	$0.50	$0.03
Sand and Gravel	$11.87	$0.28	$11.60	87	$7.40	$0.37
Total	$10,405.50	$2,294.36	$8,111.14	17,738	$4,441.40	$546.06

na = "not available"

Table A-6: Economic Data for the Steam Electric Sector, Region F (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Jobs	Regional Income	Business Taxes
Electric Services	$415.30	$129.10	$286.30	800	$297.00	$53.20

na = “not available”

Attachment B: Distribution of Economic Impacts by County and Water User Group

Tables B-1 through B-8 show economic impacts by county and water user group; however, **caution** is warranted. Figures shown for specific counties are *direct* impacts only. For the most part, figures reported in the main text for all water use categories uses include *direct and secondary* impacts. Secondary effects were estimated using regional level multipliers that treat each regional water planning area as an aggregate and autonomous economy. Multipliers do not specify where secondary impacts will occur at a sub-regional level (i.e., in which counties or cities). All economic impacts that would accrue to a region as a whole due to secondary economic effects are reported in Tables B-1 through B-8 as “secondary regional level impacts.”

For example, assume that in a given county (or city) water shortages caused significant reductions in output for a manufacturing plant. Reduced output resulted in lay-offs and lost income for workers and owners of the plant. This is a *direct* impact. Direct impacts were estimated at a county level; and thus one can say with certainty that direct impacts occurred in that county. However, secondary impacts accrue to businesses and households throughout the region where the business operates, and it is impossible using input-output models to determine where these businesses are located spatially.

The same logic applies to changes in population and school enrollment. Since employment losses and subsequent out-migration from a region were estimated using *direct* and *secondary* multipliers, it is impossible to say with any degree of certainty how many people a given county would lose regardless of whether the economic impact was direct or secondary. For example, assume the manufacturing plant referred to above is in County A. If the firm eliminated 50 jobs, one could state with certainty that water shortages in County A resulted in a loss of 50 jobs in that county. However, one could not unequivocally say whether 100 percent of the population loss due to lay-offs at the manufacturing would accrue to County A because many affected workers might commute from adjacent counties. This is particularly true in large metropolitan areas that overlay one or counties. Thus, population and school enrollment impacts cannot be reported at a county level.

Irrigation

Table B-1: Distribution of Economic Impacts by County and Water User Groups: Irrigation						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Andrews						
Direct	$1.56	$1.57	$1.57	$1.43	$1.42	$1.42
Secondary Regional Level Impacts	$0.61	$0.61	$0.61	$0.55	$0.55	$0.55
Borden						
Direct	$0.33	$0.33	$0.33	$0.33	$0.33	$0.33
Secondary Regional Level Impacts	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20
Brown						
Direct	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
Secondary Regional Level Impacts	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Coke						
Direct	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Coleman						
Direct	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Ector						
Direct	$0.40	$0.41	$0.41	$0.41	$0.41	$0.41
Secondary Regional Level Impacts	$0.20	$0.21	$0.21	$0.21	$0.21	$0.21
Glasscock						
Direct	$0.82	$1.63	$1.62	$1.62	$1.62	$1.62
Secondary Regional Level Impacts	$0.41	$0.82	$0.81	$0.81	$0.81	$0.81
Irion						
Direct	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Martin						
Direct	$0.73	$0.71	$0.70	$0.67	$0.65	$0.65
Secondary Regional Level Impacts	$0.42	$0.41	$0.40	$0.39	$0.38	$0.38
Menard						
Direct	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17
Secondary Regional Level Impacts	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Midland						
Direct	$0.98	$0.98	$0.98	$0.98	$0.98	$0.98
Secondary Regional Level Impacts	$0.52	$0.52	$0.52	$0.52	$0.52	$0.52
Reagan						
Direct	$0.47	$0.46	$0.44	$0.21	$0.20	$0.19
Secondary Regional Level Impacts	$0.29	$0.28	$0.27	$0.13	$0.13	$0.12
Reeves						
Direct	$1.37	$1.35	$1.33	$1.31	$1.29	$1.29
Secondary Regional Level Impacts	$0.76	$0.74	$0.73	$0.72	$0.71	$0.71
Runnels						
Direct	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.02	$0.02
Tom Green						
Direct	$1.65	$1.65	$1.65	$1.65	$1.65	$1.65
Secondary Regional Level Impacts	$0.95	$0.95	$0.95	$0.95	$0.95	$0.95
Upton						
Direct	$0.40	$0.36	$0.43	$0.49	$0.53	$0.53
Secondary Regional Level Impacts	$0.24	$0.22	$0.26	$0.30	$0.32	$0.32
Ward						

Direct	$0.07	$0.06	$0.07	$0.16	$0.17	$0.17
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.08	$0.09	$0.09
Total	$14.10	$15.21	$15.21	$14.81	$14.78	$14.77
Income Losses ($millions)						
County	2010	2020	2030	2040	2050	2060
Andrews						
Direct	$1.00	$1.01	$1.01	$0.91	$0.91	$0.91
Secondary Regional Level Impacts	$0.33	$0.33	$0.33	$0.30	$0.30	$0.30
Borden						
Direct	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15
Secondary Regional Level Impacts	0.109	0.109	0.109	0.109	0.109	0.109
Brown						
Direct	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Coke						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Coleman						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Ector						
Direct	$0.23	$0.24	$0.24	$0.24	$0.24	$0.24
Secondary Regional Level Impacts	$0.11	$0.11	$0.11	$0.11	$0.11	$0.11
Glasscock						
Direct	$0.47	$0.92	$0.92	$0.92	$0.92	$0.92
Secondary Regional Level Impacts	$0.22	$0.43	$0.43	$0.43	$0.43	$0.43
Irion						
Direct	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Martin						
Direct	$0.35	$0.34	$0.34	$0.33	$0.32	$0.32
Secondary Regional Level Impacts	$0.22	$0.22	$0.21	$0.21	$0.20	$0.20
Menard						
Direct	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Secondary Regional Level Impacts	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Midland						
Direct	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51
Secondary Regional Level Impacts	$0.27	$0.27	$0.27	$0.27	$0.27	$0.27
Reagan						
Direct	$0.21	$0.21	$0.20	$0.10	$0.09	$0.09
Secondary Regional Level Impacts	$0.15	$0.15	$0.15	$0.07	$0.07	$0.06
Reeves						
Direct	$0.64	$0.63	$0.62	$0.61	$0.60	$0.60
Secondary Regional Level Impacts	$0.40	$0.40	$0.39	$0.39	$0.38	$0.38
Runnels						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Tom Green						
Direct	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
Secondary Regional Level Impacts	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51
Upton						
Direct	$0.18	$0.17	$0.20	$0.23	$0.24	$0.24
Secondary Regional Level Impacts	$0.13	$0.12	$0.14	$0.16	$0.17	$0.17
Ward						
Direct	$0.04	$0.04	$0.04	$0.10	$0.10	$0.10

Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.04	$0.04	$0.04
Total	$7.44	$8.07	$8.07	$7.86	$7.84	$7.84
Job Losses (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Andrews						
Direct	62	62	62	56	56	56
Secondary Regional Level Impacts	10	10	10	9	9	9
Borden						
Direct	5	5	5	5	5	5
Secondary Regional Level Impacts	4	4	4	4	4	4
Brown						
Direct	5	5	5	5	5	5
Secondary Regional Level Impacts	1	1	1	1	1	1
Coke						
Direct	1	1	1	1	1	1
Secondary Regional Level Impacts	0	0	0	0	0	0
Coleman						
Direct	1	1	1	1	1	1
Secondary Regional Level Impacts	0	0	0	0	0	0
Ector						
Direct	14	15	15	15	15	15
Secondary Regional Level Impacts	3	3	3	3	3	3
Glasscock						
Direct	29	58	58	58	58	58
Secondary Regional Level Impacts	6	12	12	12	12	12
Irion						
Direct	2	2	2	2	2	2
Secondary Regional Level Impacts	0	0	0	0	0	0
Martin						
Direct	15	14	14	14	13	13
Secondary Regional Level Impacts	7	7	7	7	7	7
Menard						
Direct	5	5	5	5	5	5
Secondary Regional Level Impacts	1	1	1	1	1	1
Midland						
Direct	22	22	22	22	22	22
Secondary Regional Level Impacts	9	9	9	9	9	9
Reagan						
Direct	6	6	6	3	3	3
Secondary Regional Level Impacts	5	5	5	2	2	2
Reeves						
Direct	42	42	41	40	40	40
Secondary Regional Level Impacts	14	14	14	13	13	13
Runnels						
Direct	1	1	1	1	1	1
Secondary Regional Level Impacts	0	0	0	0	0	0
Tom Green						
Direct	30	30	30	30	30	30
Secondary Regional Level Impacts	17	17	17	17	17	17
Upton						
Direct	6	5	6	7	8	8
Secondary Regional Level Impacts	4	4	5	5	6	6
Ward						
Direct	3	2	3	6	7	7
Secondary Regional Level Impacts	0	0	0	1	1	1
Total	333	366	366	358	357	356

Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Andrews						
Direct	$0.09	$0.10	$0.10	$0.09	$0.09	$0.09
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Borden						
Direct	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04
Brown						
Direct	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Glasscock						
Direct	$0.04	$0.08	$0.08	$0.08	$0.08	$0.08
Secondary Regional Level Impacts	$0.02	$0.03	$0.03	$0.03	$0.03	$0.03
Irion						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Martin						
Direct	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Menard						
Direct	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Midland						
Direct	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Reagan						
Direct	$0.02	$0.02	$0.02	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Reeves						
Direct	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.02	$0.02	$0.02
Runnels						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Tom Green						
Direct	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06
Secondary Regional Level Impacts	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Upton						
Direct	$0.02	$0.01	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Ward						
Direct	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.63	$0.68	$0.68	$0.66	$0.66	$0.66

Source: Texas Water Development Board, Office of Water Resources Planning

Manufacturing

Table B-2: Distribution of Economic Impacts by County and Water User Groups: (Manufacturing)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Howard						
Direct	$9.77	$16.61	$0.00	$0.00	$6.84	$12.14
Secondary Regional Level Impacts	$6.96	$11.83	$0.00	$0.00	$4.87	$8.65
Kimble						
Direct	$59.64	$65.16	$69.91	$74.76	$79.17	$85.12
Secondary Regional Level Impacts	$33.15	$36.22	$38.87	$41.56	$44.02	$47.32
Runnels						
Direct	$38.09	$41.92	$41.92	$48.51	$51.31	$55.64
Secondary Regional Level Impacts	$21.27	$23.41	$23.41	$27.09	$28.65	$31.07
Tom Green						
Direct	$463.93	$520.62	$570.43	$619.20	$661.71	$713.82
Secondary Regional Level Impacts	$272.45	$305.74	$334.99	$363.63	$388.60	$419.20
Total	$905.25	$1,021.51	$1,079.54	$1,174.75	$1,265.19	$1,372.96
Lost Jobs (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
Ector						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
Howard						
Direct	5	9	0	0	4	7
Secondary Regional Level Impacts	44	76	0	0	31	55
Kimble						
Direct	239	261	280	299	317	341
Secondary Regional Level Impacts	357	391	419	448	475	510
Runnels						
Direct	243	268	268	310	328	356
Secondary Regional Level Impacts	284	312	312	361	382	414
Tom Green						
Direct	1,109	1,244	1,363	1,480	1,581	1,706
Secondary Regional Level Impacts	3,854	4,325	4,739	5,144	5,498	5,931
Total	6,136	6,886	7,382	8,043	8,616	9,320
Lost Income ($millions)						
	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.41	$0.46	$0.49	$0.53	$0.57	$0.61
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Howard						
Direct	$1.06	$1.81	$0.00	$0.00	$0.74	$1.32
Secondary Regional Level Impacts	$3.30	$5.61	$0.00	$0.00	$2.31	$4.10
Kimble						
Direct	$24.87	$27.17	$29.15	$31.17	$33.01	$35.49
Secondary Regional Level Impacts	$18.13	$19.81	$21.26	$22.73	$24.07	$25.88
Runnels						
Direct	$11.92	$13.12	$13.12	$15.18	$16.05	$17.41
Secondary Regional Level Impacts	$12.02	$13.23	$13.23	$15.30	$16.19	$17.55
Tom Green						
Direct	$50.77	$56.98	$62.43	$67.77	$72.42	$78.12
Secondary Regional Level Impacts	$159.79	$179.31	$196.47	$213.27	$227.91	$245.85
Total	$282.26	$317.48	$336.14	$365.95	$393.27	$426.34
Lost Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Howard						
Direct	$0.06	$0.11	$0.00	$0.00	$0.04	$0.08
Secondary Regional Level Impacts	$0.22	$0.37	$0.00	$0.00	$0.15	$0.27
Kimble						
Direct	$0.69	$0.76	$0.81	$0.87	$0.92	$0.99
Secondary Regional Level Impacts	$0.54	$0.59	$0.64	$0.68	$0.72	$0.78
Runnels						
Direct	$0.29	$0.32	$0.32	$0.37	$0.39	$0.42
Secondary Regional Level Impacts	$0.41	$0.45	$0.45	$0.52	$0.55	$0.60
Tom Green						
Direct	$2.78	$3.13	$3.42	$3.72	$3.97	$4.28
Secondary Regional Level Impacts	$10.09	$11.33	$12.41	$13.47	$14.40	$15.53
Total	$15.10	$17.05	$18.06	$19.63	$21.15	$22.95
Source: Texas Water Development Board, Office of Water Resources Planning						

Municipal

Impacts to the horticultural industry were estimated at the regional level only and are not included.

Table B-3: Distribution of Economic Impacts by County: Water Intensive Commercial Uses (Municipal)

Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$2.74	$2.74	$2.74	$2.74	$2.74	$2.74
Secondary Regional Level Impacts	$1.87	$1.87	$1.87	$1.87	$1.87	$1.87
Kimble						
Direct	$15.21	$15.21	$15.21	$15.21	$15.21	$15.21
Secondary Regional Level Impacts	$10.21	$10.21	$10.21	$10.21	$10.21	$10.21
Martin						
Direct	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Secondary Regional Level Impacts	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23
Midland						
Direct	$0.00	$0.00	$2.10	$50.28	$55.57	$61.36
Secondary Regional Level Impacts	$0.00	$0.00	$1.44	$34.50	$38.13	$42.10
Runnels						
Direct	$4.66	$4.83	$4.95	$5.09	$5.20	$5.34
Secondary Regional Level Impacts	$3.19	$3.30	$3.39	$3.48	$3.56	$3.65
Total	$38.45	$38.73	$42.48	$123.95	$133.06	$143.05
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$1.27	$1.27	$1.27	$1.27	$1.27	$1.27
Secondary Regional Level Impacts	$1.01	$1.01	$1.01	$1.01	$1.01	$1.01
Kimble						
Direct	$7.92	$7.92	$7.92	$7.92	$7.92	$7.92
Secondary Regional Level Impacts	$5.58	$5.58	$5.58	$5.58	$5.58	$5.58
Martin						
Direct	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15
Secondary Regional Level Impacts	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
Midland						
Direct	$0.00	$0.00	$1.06	$25.31	$27.97	$30.88
Secondary Regional Level Impacts	$0.00	$0.00	$0.80	$19.06	$21.07	$23.26
Runnels						
Direct	$2.30	$2.38	$2.44	$2.51	$2.57	$2.63
Secondary Regional Level Impacts	$1.74	$1.81	$1.85	$1.91	$1.95	$2.00
Total	$20.10	$20.24	$22.21	$64.84	$69.61	$74.83
Job Losses (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	82	82	82	82	82	82
Secondary Regional Level Impacts	25	25	25	25	25	25
Kimble						
Direct	377	377	377	377	377	377

Secondary Regional Level Impacts	141	141	141	141	141	141
Martin						
Direct	10	10	10	10	10	10
Secondary Regional Level Impacts	3	3	3	3	3	3
Midland						
Direct	0	0	68	1,619	1,790	1,976
Secondary Regional Level Impacts	0	0	20	477	528	583
Runnels						
Direct	143	148	152	156	159	163
Secondary Regional Level Impacts	44	45	47	48	49	50
Total	826	832	925	2,940	3,165	3,412
Lost Business Taxes ($millions)						
Total	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Secondary Regional Level Impacts	$0.13	$0.13	$0.13	$0.13	$0.13	$0.13
Kimble						
Direct	$1.02	$1.02	$1.02	$1.02	$1.02	$1.02
Secondary Regional Level Impacts	$0.71	$0.71	$0.71	$0.71	$0.71	$0.71
Martin						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Midland						
Direct	$0.00	$0.00	$0.11	$2.71	$3.00	$3.31
Secondary Regional Level Impacts	$0.00	$0.00	$0.09	$2.12	$2.34	$2.58
Runnels						
Direct	$0.26	$0.27	$0.28	$0.29	$0.29	$0.30
Secondary Regional Level Impacts	$0.21	$0.21	$0.22	$0.23	$0.23	$0.24
Total	$2.53	$2.55	$2.76	$7.40	$7.92	$8.49
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-4: Lost Water Utility Revenues (Municipal)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Coke	$0.29	$0.32	$0.17	$0.19	$0.21	$0.24
Coleman	$1.71	$1.69	$1.67	$1.65	$1.63	$1.63
Concho	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector	$6.39	$14.67	$6.53	$8.07	$9.33	$11.46
Howard	$1.86	$2.31	$0.03	$0.41	$0.68	$1.10
Kimble	$1.25	$1.25	$1.24	$1.22	$1.21	$1.21
Martin	$0.52	$0.56	$0.57	$0.57	$0.55	$0.52
McCulloch	$1.16	$1.18	$1.15	$1.13	$1.22	$1.22
Menard	$0.07	$0.07	$0.06	$0.05	$0.05	$0.05
Midland	$1.69	$3.55	$20.83	$28.08	$28.94	$29.97
Runnels	$2.45	$2.51	$2.56	$2.61	$2.71	$2.77
Scurry	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Tom Green	$12.21	$13.33	$14.05	$14.36	$15.03	$15.47
Ward	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$29.60	$41.44	$48.86	$58.35	$61.56	$65.65
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-5: Lost Water Utility Taxes (Municipal)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Coke	$0.01	$0.01	$0.00	$0.00	$0.00	$0.00
Coleman	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Concho	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector	$0.11	$0.26	$0.11	$0.14	$0.16	$0.20
Howard	$0.03	$0.04	$0.00	$0.01	$0.01	$0.02
Kimble	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Martin	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
McCulloch	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Menard	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Midland	$0.03	$0.06	$0.37	$0.49	$0.51	$0.53
Runnels	$0.04	$0.04	$0.05	$0.05	$0.05	$0.05
Scurry	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Tom Green	$0.21	$0.23	$0.25	$0.25	$0.26	$0.27
Ward	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.52	$0.73	$0.86	$1.03	$1.08	$1.16
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-6: Impacts Associated with Unmet Domestic Water Needs (Commercial and Residential)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31
Coke	$0.71	$0.79	$0.38	$0.43	$0.48	$0.56
Coleman	$6.11	$6.03	$5.95	$5.87	$5.81	$5.81
Concho	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Ector	$14.08	$32.31	$14.38	$17.78	$20.55	$25.24
Howard	$4.10	$5.09	$0.07	$0.91	$1.50	$2.42
Kimble	$4.26	$4.25	$4.20	$4.15	$4.12	$4.12
Martin	$1.78	$1.92	$1.96	$1.96	$1.89	$1.79
McCulloch	$2.56	$2.60	$2.54	$2.48	$2.45	$2.45
Menard	$0.06	$0.06	$0.06	$0.05	$0.05	$0.05
Midland	$3.73	$7.82	$45.96	$65.22	$67.44	$70.08
Runnels	$5.32	$5.46	$5.56	$5.67	$5.89	$6.03
Scurry	$0.16	$0.19	$0.00	$0.04	$0.06	$0.10
Tom Green	$27.00	$29.35	$30.93	$31.62	$33.09	$34.07
Ward	$0.00	$1.18	$1.18	$1.18	$1.18	$1.18
Total	$70.15	$97.37	$113.47	$137.66	$144.80	$154.18
*Domestic in this case refers to water used for sanitation and potable uses. Source: Texas Water Development Board, Office of Water Resources Planning						

Mining

Table B-7: Distribution of Economic Impacts by County and Water User Groups: (Mining)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.85	$1.17	$0.00	$0.00	$0.38	$0.61
Secondary Regional Level Impacts	$0.43	$0.59	$0.00	$0.00	$0.19	$0.31
Coleman						
Direct	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Secondary Regional Level Impacts	$0.52	$0.52	$0.52	$0.52	$0.52	$0.52
Ector						
Direct	$0.0	$14.1	$24.7	$63.6	$71.7	$76.5
Secondary Regional Level Impacts	$0.0	$7.9	$13.8	$35.5	$40.0	$42.7
Howard						
Direct	$3.06	$3.78	$0.25	$0.70	$1.16	$1.89
Secondary Regional Level Impacts	$0.25	$0.31	$0.02	$0.06	$0.09	$0.15
Total	$6.06	$29.27	$40.17	$101.25	$114.94	$123.66
Lost Income ($Millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.35	$0.49	$0.00	$0.00	$0.16	$0.25
Secondary Regional Level Impacts	$0.22	$0.30	$0.00	$0.00	$0.10	$0.16
Coleman						

	2010	2020	2030	2040	2050	2060
Direct	$0.45	$0.45	$0.45	$0.45	$0.45	$0.45
Secondary Regional Level Impacts	$0.27	$0.27	$0.27	$0.27	$0.27	$0.27
Ector						
Direct	$0.00	$5.84	$10.22	$26.34	$29.70	$31.72
Secondary Regional Level Impacts	$0.00	$4.01	$7.02	$18.09	$20.40	$21.79
Howard						
Direct	$1.41	$1.74	$0.12	$0.32	$0.54	$0.87
Secondary Regional Level Impacts	$0.13	$0.16	$0.01	$0.03	$0.05	$0.08
Total	$2.83	$13.26	$18.09	$45.51	$51.66	$55.59

Lost Jobs (Numbers May Not Sum To Figures In Text Due To Rounding)

County	2010	2020	2030	2040	2050	2060
Coke						
Direct	2	2	0	0	1	1
Secondary Regional Level Impacts	2	3	0	0	1	1
Coleman						
Direct	2	2	2	2	2	2
Secondary Regional Level Impacts	3	3	3	3	3	3
Ector						
Direct	0	22	39	101	114	121
Secondary Regional Level Impacts	0	69	120	310	349	373
Howard						
Direct	6	7	0	1	2	4
Secondary Regional Level Impacts	2	3	0	1	1	1
Total	16	111	165	417	472	507

Lost Business Taxes ($Millions)

County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.04	$0.06	$0.00	$0.00	$0.02	$0.03
Secondary Regional Level Impacts	$0.03	$0.04	$0.00	$0.00	$0.01	$0.02
Coleman						
Direct	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Ector						
Direct	$0.00	$0.73	$1.29	$3.32	$3.74	$3.99
Secondary Regional Level Impacts	$0.00	$0.52	$0.91	$2.34	$2.64	$2.82
Howard						
Direct	$0.17	$0.20	$0.01	$0.04	$0.06	$0.10
Secondary Regional Level Impacts	$0.02	$0.02	$0.00	$0.00	$0.01	$0.01
Total	$0.33	$1.66	$2.29	$5.78	$6.56	$7.05

Source: Texas Water Development Board, Office of Water Resources Planning

Steam-electric

Table B-8: Distribution of Economic Impacts by County and Water User Groups: (Steam-electric)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$12.06	$12.06	$14.11	$16.55	$19.57	$12.06
Secondary Regional Level Impacts	$4.50	$4.50	$5.26	$6.17	$7.30	$4.50
Ector						
Direct	$0.00	$5.01	$7.83	$22.52	$30.88	$41.07
Secondary Regional Level Impacts	$0.00	$1.87	$2.92	$8.40	$11.52	$15.32
Mitchell						
Direct	$26.64	$22.31	$26.09	$30.69	$36.29	$43.13
Secondary Regional Level Impacts	$9.94	$8.32	$9.73	$11.45	$13.54	$16.09
Tom Green						
Direct	$56.32	$80.59	$94.28	$110.88	$131.10	$155.79
Secondary Regional Level Impacts	$21.01	$30.06	$35.17	$41.36	$48.90	$58.11
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.53	$1.53
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.20	$0.57
Total	$130.46	$164.73	$195.39	$248.00	$299.84	$348.15
Lost Income ($Millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$8.62	$8.62	$10.09	$11.83	$14.00	$8.62
Secondary Regional Level Impacts	$2.41	$2.41	$2.82	$3.31	$3.92	$2.41
Ector						
Direct	$0.00	$3.59	$5.60	$16.10	$22.08	$29.37
Secondary Regional Level Impacts	$0.00	$1.00	$1.57	$4.50	$6.18	$8.22
Mitchell						
Direct	$19.05	$15.96	$18.66	$21.94	$25.95	$30.84
Secondary Regional Level Impacts	$5.50	$4.60	$5.38	$6.33	$7.49	$8.90
Tom Green						
Direct	$40.28	$57.63	$67.42	$79.29	$93.76	$111.41
Secondary Regional Level Impacts	$11.27	$16.12	$18.86	$22.18	$26.23	$31.17
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.38	$1.09
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.11	$0.31
Total	$87.13	$109.94	$130.40	$165.50	$200.09	$232.34
Lost Jobs (Numbers May Not Sum To Figures In Text Due To Rounding)						
Total	2010	2020	2030	2040	2050	2060
Coke						
Direct	23	23	27	32	37	23
Secondary Regional Level Impacts	63	63	73	86	102	63
Ector						
Direct	0	10	15	43	59	79
Secondary Regional Level Impacts	0	26	41	117	161	214
Mitchell						
Direct	51	43	50	59	70	83
Secondary Regional Level Impacts	139	116	136	160	189	224

Tom Green						
Direct	108	154	181	212	251	298
Secondary Regional Level Impacts	293	419	490	577	682	810
Ward						
Direct	0	0	0	0	1	3
Secondary Regional Level Impacts	0	0	0	0	3	8
Total	676	854	1,013	1,285	1,554	1,804
Lost Business Taxes ($Millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$1.54	$1.54	$1.81	$2.12	$2.51	$1.54
Secondary Regional Level Impacts	$0.43	$0.43	$0.51	$0.59	$0.70	$0.43
Ector						
Direct	$0.00	$0.64	$1.00	$2.88	$3.96	$5.26
Secondary Regional Level Impacts	$0.00	$0.18	$0.28	$0.81	$1.11	$1.47
Mitchell						
Direct	$3.41	$2.86	$3.34	$3.93	$4.65	$5.52
Secondary Regional Level Impacts	$0.98	$0.82	$0.96	$1.13	$1.34	$1.59
Tom Green						
Direct	$7.21	$10.32	$12.08	$14.20	$16.79	$19.95
Secondary Regional Level Impacts	$2.02	$2.89	$3.38	$3.97	$4.70	$5.58
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.07	$0.20
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.02	$0.05
Total	$15.61	$19.69	$23.36	$29.64	$35.84	$41.61
Source: Texas Water Development Board, Office of Water Resources Planning						

Attachment C: Allocation of Economic Impacts by River Basin

Attachment C shows regional economic and social impacts by major river basin. Impacts were allocated based on distribution of water shortages among counties. For instance, if 50 percent of water shortages in River Basin A and 50 percent occur in River Basin then impacts were split equally among the two basins.

Irrigation

Table C-1: Distribution of Impacts among Major River Basins (Irrigation Uses)

Lost Sales ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Colorado	$10.86	$11.75	$11.68	$11.30	$11.23	$11.20
Brazos	$0.11	$0.12	$0.12	$0.12	$0.12	$0.13
Rio Grande	$3.13	$3.34	$3.41	$3.40	$3.43	$3.44
Total	$14.10	$15.21	$15.21	$14.81	$14.78	$14.77
Lost Income ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Colorado	$5.73	$6.23	$6.19	$5.99	$5.96	$5.94
Brazos	$0.06	$0.07	$0.07	$0.07	$0.07	$0.07
Rio Grande	$1.65	$1.77	$1.81	$1.80	$1.82	$1.83
Total	$7.44	$8.07	$8.07	$7.86	$7.84	$7.84
Job Losses (numbers may not sum to figures in text due to rounding)						
Basin	2010	2020	2030	2040	2050	2060
Colorado	128	127	127	125	125	125
Brazos	1	1	1	1	1	1
Rio Grande	37	36	37	38	38	38
Total	167	165	165	164	165	164
Lost Business Taxes ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Colorado	$0.25	$0.25	$0.25	$0.24	$0.24	$0.24
Brazos	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Rio Grande	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Total	$0.33	$0.32	$0.32	$0.32	$0.32	$0.32

Source: Texas Water Development Board, Office of Water Resources Planning

Municipal

Approximately 99 percent of socioeconomic impacts are associated with unmet municipal water needs in the Colorado River Basin.

Manufacturing

Approximately 99 percent of socioeconomic impacts are associated with unmet manufacturing water needs in the Colorado River Basin.

Mining

All impacts are associated with unmet mining water needs in the Colorado River Basin.

Steam-electric

Approximately 99 percent of impacts associated with unmet needs for the power industry would occur in the Colorado River Basin.

Attachment D: Results of Analysis Assuming Subordination of Downstream Water Rights

At the request of the Region F planning group, TWDB analysts estimated the impacts of unmet water needs assuming subordination of downstream water rights. Tables below show estimated figures. Numbers and titles of the tables correspond to those in the main text of the report. Subordination will not significantly affect impacts associated with irrigation water needs. In addition, the distribution of impacts by major river basin is not expected to changes significantly under a subordination scenario, and thus tables for irrigation and river basins are not re-created below.

Aggregate Regional Level Impacts (Executive Summary Tables)

Table E-1: Annual Economic Impacts of Unmet Water Needs with Subordination of Downstream Water Rights Holders (years, 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

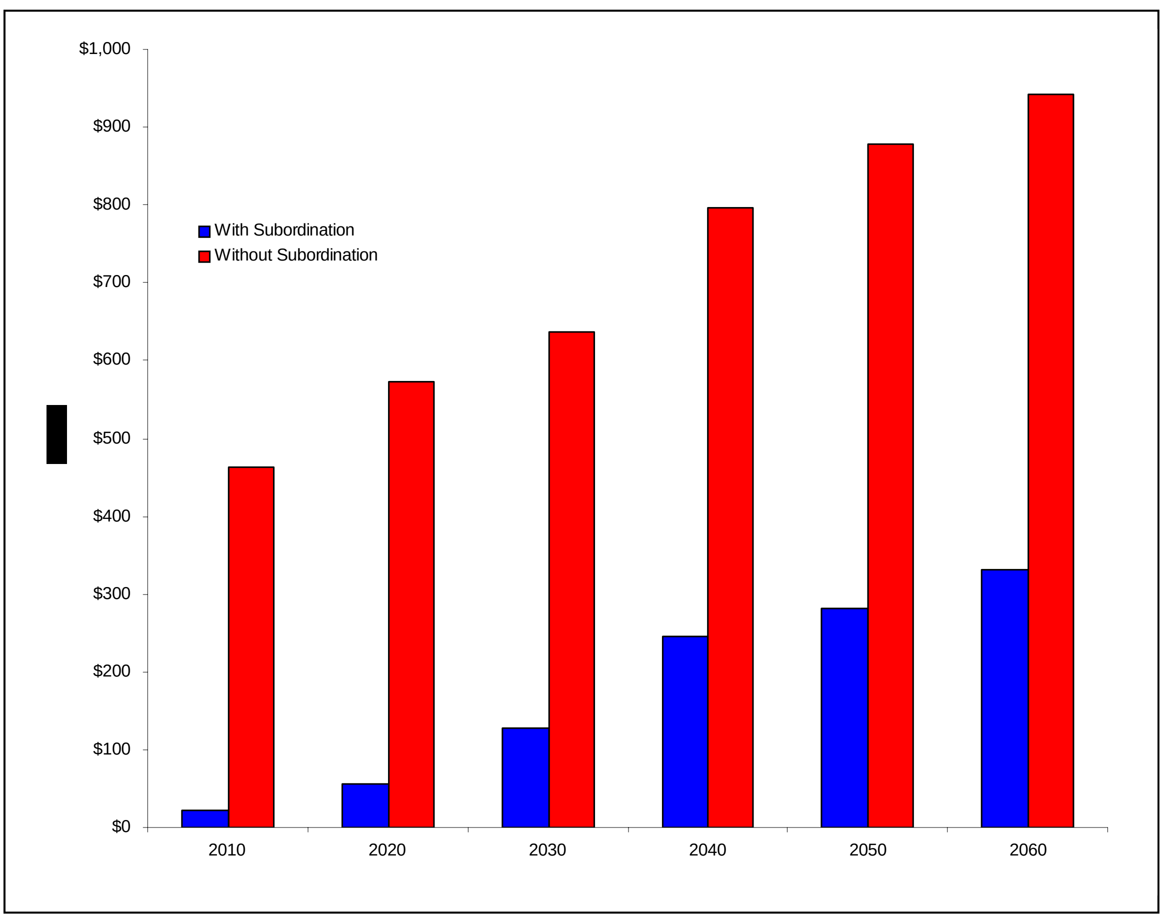
Year	Sales ($millions)	Income ($millions)	Jobs	State and Local Taxes ($millions)
2010	$37.87	$21.70	352	$1.53
% Difference from Analysis w/out Subordination	- 96%	- 96%	- 96%	- 95%
2020	$76.38	$56.12	521	$3.47
% Difference from Analysis w/out Subordination	- 94%	- 90%	- 94%	- 92%
2030	$139.32	$128.34	897	$6.64
% Difference from Analysis w/out Subordination	-90%	-80%	-91%	-86%
2040	$330.02	$245.30	3,441	$19.29
% Difference from Analysis w/out Subordination	- 81%	- 69%	- 74%	- 70%
2050	$385.18	$281.61	4,041	$24.07
% Difference from Analysis w/out Subordination	- 80%	- 68%	- 72%	- 67%
2060	$459.48	$331.65	4,563	$31.36
% Difference from Analysis w/out Subordination	- 78%	- 65%	- 71%	- 60%

Source: *Figures for job losses are rounded. Based on models developed by the Texas Water Development Board, Office of Water Resources Planning and the Texas State Data Center.

Table E-2: Estimated Regional Social Impacts of Unmet Water Needs with Subordination of Downstream Water Rights Holders (years, 2010, 2020, 2030, 2040, 2050 and 2060)		
Year	Population Loss	Declines in School Enrollment
2010	610	150
% Difference from Analysis w/out Subordination	- 96%	- 96%
2020	900	230
% Difference from Analysis w/out Subordination	- 94%	- 94%
2030	1,560	400
% Difference from Analysis w/out Subordination	- 91%	- 91%
2040	5,990	1,550
% Difference from Analysis w/out Subordination	- 74%	- 74%
2050	7,040	1,820
% Difference from Analysis w/out Subordination	- 72%	- 72%
2060	7,950	2,060
% Difference from Analysis w/out Subordination	- 70%	- 70%

Source: Based on models developed by the Texas Water Development Board, Office of Water Resources Planning and the Texas State Data Center.

Figure E-1: Potential Lost Income Due to Unmet Water Needs in Region F with and without Subordination of Downstream Water Rights



Manufacturing

Table 9: Annual Economic Impacts of Unmet Manufacturing Water Needs with Subordination of Downstream Water Rights (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%
2020	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%
2030	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%
2040	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%
2050	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%
2060	$13.84	$5.58	120	$0.16
% Difference from Analysis w/out Subordination	- 98%	- 98%	- 98%	- 98%

**Figures for job losses are rounded. Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table B-2: Distribution of Economic Impacts by County for Manufacturing with Subordination of Downstream Water Rights (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Runnels						
Direct	$8.88	$8.88	$8.88	$8.88	$8.88	$8.88
Secondary Regional Level Impacts	$4.96	$4.96	$4.96	$4.96	$4.96	$4.96
% Difference from Analysis w/out Subordination	-77%	-79%	-79%	-82%	-83%	-84%

Table B-2: Distribution of Economic Impacts by County for Manufacturing with Subordination of Downstream Water Rights (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Tom Green						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$13.84	$13.84	$13.84	$13.84	$13.84	$13.84
% Difference from Analysis w/out Subordination	-98%	-98%	-98%	-98%	-98%	-98%
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Runnels						
Direct	$2.78	$2.78	$2.78	$2.78	$2.78	$2.78
Secondary Regional Level Impacts	$2.80	$2.80	$2.80	$2.80	$2.80	$2.80
% Difference from Analysis w/out Subordination	-77%	-79%	-79%	-82%	-83%	-84%
Tom Green						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$5.58	$5.58	$5.58	$5.58	$5.58	$5.58
% Difference from Analysis w/out Subordination	-98%	-98%	-98%	-98%	-98%	-98%
Job Losses						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Howard						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0

Table B-2: Distribution of Economic Impacts by County for Manufacturing with Subordination of Downstream Water Rights (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Runnels						
Direct	57	57	57	57	57	57
Secondary Regional Level Impacts	63	63	63	63	63	63
% Difference from Analysis w/out Subordination	-77%	-79%	-79%	-82%	-83%	-84%
Tom Green						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	120	120	120	120	120	120
% Difference from Analysis w/out Subordination	-98%	-98%	-98%	-98%	-98%	-98%
Lost Business Taxes ($millions)						
Total	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Runnels						
Direct	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Secondary Regional Level Impacts	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
% Difference from Analysis w/out Subordination	-77%	-79%	-79%	-82%	-83%	-84%
Tom Green						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17
% Difference from Analysis w/out Subordination	-98%	-98%	-98%	-98%	-98%	-98%
Source: Texas Water Development Board, Office of Water Resources Planning						

Mining

Table 11 : Annual Economic Impacts of Unmet Mining Water Needs with Subordination of Downstream Water Rights (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$6.06	$2.48	15	$0.33
% Difference from Analysis w/out Subordination	-100%	- 100%	- 100%	-100%
2020	$29.27	$12.77	110	$1.66
% Difference from Analysis w/out Subordination	- 25%	- 25%	- 25%	- 25%
2030	$40.17	$18.09	165	$2.29
% Difference from Analysis w/out Subordination	- 4%	- 4%	- 4%	- 4%
2040	$101.25	$45.51	415	$5.78
% Difference from Analysis w/out Subordination	- 3%	- 3%	- 3%	- 3%
2050	$114.94	$51.50	470	$6.56
% Difference from Analysis w/out Subordination	- 3%	- 3%	- 3%	- 3%
2060	$123.66	$55.33	505	$7.05
% Difference from Analysis w/out Subordination	- 3%	- 3%	- 3%	- 3%

*Figures for job losses are rounded. Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table B-7: Distribution of Economic Impacts by County with Subordination of Downstream Water Rights: (Mining)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$14.08	$24.65	$63.55	$71.66	$76.52
Secondary Regional Level Impacts	$0.00	$7.86	$13.75	$35.45	$39.97	$42.69
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$6.06	$29.27	$40.17	$101.25	$114.94	$123.66
% Difference from Analysis w/out Subordination	-100%	-25%	-4%	-3%	-3%	-3%

Table B-7: Distribution of Economic Impacts by County with Subordination of Downstream Water Rights: (Mining)						
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$5.84	$10.22	$26.34	$29.70	$31.72
Secondary Regional Level Impacts	$0.00	$4.01	$7.02	$18.09	$20.40	$21.79
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	16	111	165	417	472	507
% Difference from Analysis w/out Subordination	-100%	-25%	-4%	-3%	-3%	-3%
Job Losses						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	0	22	39	101	114	121
Secondary Regional Level Impacts	0	69	120	310	349	373
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Howard						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	16	111	165	417	472	507
% Difference from Analysis w/out Subordination	-100%	-25%	-4%	-3%	-3%	-3%
Lost Business Taxes ($millions)						
Total	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Table B-7: Distribution of Economic Impacts by County with Subordination of Downstream Water Rights: (Mining)						
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$0.73	$1.29	$3.32	$3.74	$3.99
Secondary Regional Level Impacts	$0.00	$0.52	$0.91	$2.34	$2.64	$2.82
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Howard						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$0.33	$1.66	$2.29	$5.78	$6.56	$7.05
% Difference from Analysis w/out Subordination	-100%	-25%	-4%	-3%	-3%	-3%
Source: Texas Water Development Board, Office of Water Resources Planning						

Municipal

Table 13: Annual Economic Impacts of Unmet Water Needs for Commercial Businesses with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$0.57	$0.28	13	$0.04
% Difference from Analysis w/out Subordination	- 99%	- 99%	- 99%	- 99%
2020	$0.57	$0.28	13	$0.04
% Difference from Analysis w/out Subordination	- 99%	- 99%	- 99%	- 99%
2030	$4.11	$2.13	101	$0.24
% Difference from Analysis w/out Subordination	- 90%	- 90%	- 90%	- 90%
2040	$91.83	$48.04	2,171	$5.49
% Difference from Analysis w/out Subordination	- 26%	- 26%	- 26%	- 26%
2050	$103.39	$54.09	2,557	$6.20
% Difference from Analysis w/out Subordination	- 22%	- 22%	- 22%	- 22%
2060	$115.95	$60.66	2,767	$6.90
% Difference from Analysis w/out Subordination	-19%	-19%	-19%	-19%

* *Figures for job losses are rounded. Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table 14: Annual Economic Impacts of Unmet Water Needs for the Horticultural Industry with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$0.32	$0.17	7	$0.00
% Difference from Analysis w/out Subordination	- 97%	- 97%	- 97%	- 97%
2020	$3.18	$1.66	65	$0.04
% Difference from Analysis w/out Subordination	- 77%	- 77%	- 77%	- 77%
2030	$10.63	$5.53	218	$0.13
% Difference from Analysis w/out Subordination	- 33%	- 33%	- 33%	- 33%
2040	$13.59	$7.07	278	$0.16
% Difference from Analysis w/out Subordination	- 28%	- 28%	- 28%	- 28%
2050	$14.51	$7.55	297	$0.17
% Difference from Analysis w/out Subordination	- 27%	- 27%	- 27%	- 27%
2060	$15.28	$7.95	313	$0.18
% Difference from Analysis w/out Subordination	- 32%	- 32%	- 32%	- 32%

* Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table 15: Costs Associated with Unmet Domestic Water Needs with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)	
Year	$millions
2010	$2.74
% Difference from Analysis w/out Subordination	- 96%
2020	$22.36
% Difference from Analysis w/out Subordination	- 77%
2030	$72.40
% Difference from Analysis w/out Subordination	- 36%
2040	$94.43
% Difference from Analysis w/out Subordination	- 32%
2050	$100.14
% Difference from Analysis w/out Subordination	- 32%
2060	$105.73
% Difference from Analysis w/out Subordination	- 32%

* Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table 16: Impacts to Water Utilities with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)		
Year	Revenues ($millions)	Utility Taxes ($millions)
2010	$0.85	$0.01
% Difference from Analysis w/out Subordination	- 96%	- 96%
2020	$9.18	$0.16
% Difference from Analysis w/out Subordination	- 77%	- 77%
2030	$31.80	$0.56
% Difference from Analysis w/out Subordination	- 36%	- 36%
2040	$40.24	$0.71
% Difference from Analysis w/out Subordination	- 32%	- 32%
2050	$42.77	$0.75
% Difference from Analysis w/out Subordination	- 32%	- 32%
2060	$45.11	$0.79
% Difference from Analysis w/out Subordination	- 32%	- 32%
* Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.		

Table B-3: Distribution of Economic Impacts by County: Commercial Uses with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin						
Direct	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Secondary Regional Level Impacts	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland						
Direct	$0.00	$0.00	$2.10	$54.13	$60.98	$68.43
Secondary Regional Level Impacts	$0.00	$0.00	$1.44	$37.14	$41.84	$46.95
% Difference from Analysis w/out Subordination	0%	0%	0%	+ 8%	+ 10%	+ 12%
Runnels						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$0.57	$0.57	$4.11	$91.83	$103.39	$115.95
% Difference from Analysis w/out Subordination	-99%	-99%	-90%	-26%	-22%	-19%

Table B-3: Distribution of Economic Impacts by County: Commercial Uses with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin						
Direct	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15
Secondary Regional Level Impacts	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland						
Direct	$0.00	$0.00	$1.06	$27.24	$30.69	$34.44
Secondary Regional Level Impacts	$0.00	$0.00	$0.80	$20.52	$23.12	$25.94
% Difference from Analysis w/out Subordination	0%	0%	0%	+ 8%	+ 10%	+ 12%
Runnels						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$0.28	$0.28	$2.13	$48.04	$54.09	$60.66
% Difference from Analysis w/out Subordination	-99%	-99%	-90%	-26%	-22%	-19%
Job Losses						
County	2010	2020	2030	2040	2050	2060
Coleman						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin						
Direct	10	10	10	10	10	10
Secondary Regional Level Impacts	3	3	3	3	3	3
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland						
Direct	0	0	68	1,643	1,964	2,104
Secondary Regional Level Impacts	0	0	20	514	579	650
% Difference from Analysis w/out Subordination	0%	0%	0%	+ 8%	+ 10%	+ 12%
Runnels						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	13	13	101	2,171	2,557	2,767
% Difference from Analysis w/out Subordination	- 99%	- 99%	- 90%	- 26%	- 22%	- 19%
Lost Business Taxes ($millions)						

Table B-3: Distribution of Economic Impacts by County: Commercial Uses with Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Total	2010	2020	2030	2040	2050	2060
Coleman						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin						
Direct	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland						
Direct	$0.00	$0.00	$0.11	$3.18	$3.60	$3.99
Secondary Regional Level Impacts	$0.00	$0.00	$0.09	$2.28	$2.57	$2.88
% Difference from Analysis w/out Subordination	0%	0%	0%	+ 8%	+ 10%	+ 12%
Runnels						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Total	$0.04	$0.04	$0.24	$5.49	$6.20	$6.90
% Difference from Analysis w/out Subordination	- 99%	- 99%	- 90%	- 26%	- 22%	- 19%
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-4: Lost Water Utility Revenues Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Coke	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Concho	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Ector	$0.00	$6.40	$6.40	$6.40	$6.40	$6.40
% Difference from Analysis w/out Subordination	-100%	-56%	-2%	-21%	-31%	-44%
Howard	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin	$0.52	$0.56	$0.57	$0.57	$0.55	$0.52
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
McCulloch	$0.00	$0.00	$0.00	$0.00	$0.11	$0.11
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-91%	-91%
Menard	$0.07	$0.07	$0.06	$0.05	$0.05	$0.05
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland	$0.00	$0.00	$21.10	$28.45	$29.41	$30.51
% Difference from Analysis w/out Subordination	-100%	-100%	+1%	+1%	+2%	+2%

Table B-4: Lost Water Utility Revenues Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
Runnels	$0.26	$0.33	$0.38	$0.44	$0.54	$0.61
% Difference from Analysis w/out Subordination	-89%	-87%	-85%	-83%	-80%	-78%
Scurry	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Tom Green	$0.00	$1.82	$3.29	$4.34	$5.70	$6.91
% Difference from Analysis w/out Subordination	-100%	-86%	-77%	-70%	-62%	-55%
Ward	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Total	$0.85	$9.18	$31.80	$40.24	$42.77	$45.11
% Difference from Analysis w/out Subordination	-96%	-77%	-36%	-32%	-32%	-32%
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-5: Lost Water Utility Taxes Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Coke	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Concho	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Ector	$0.000	$0.113	$0.113	$0.113	$0.113	$0.113
% Difference from Analysis w/out Subordination	-100%	-56%	-2%	-21%	-31%	-44%
Howard	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin	$0.009	$0.010	$0.010	$0.010	$0.010	$0.009
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
McCulloch	$0.000	$0.000	$0.000	$0.000	$0.002	$0.002
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-91%	-91%
Menard	$0.001	$0.001	$0.001	$0.001	$0.001	$0.001
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland	$0.000	$0.000	$0.371	$0.501	$0.518	$0.537
% Difference from Analysis w/out Subordination	-100%	-100%	1%	1%	2%	2%
Runnels	$0.005	$0.006	$0.007	$0.008	$0.010	$0.011
% Difference from Analysis w/out Subordination	-89%	-87%	-85%	-83%	-80%	-78%
Scurry	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Tom Green	$0.000	$0.032	$0.058	$0.076	$0.100	$0.122
% Difference from Analysis w/out Subordination	-100%	-86%	-77%	-70%	-62%	-55%
Ward	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Total	$0.015	$0.162	$0.560	$0.708	$0.753	$0.794
% Difference from Analysis w/out Subordination	-96%	-77%	-36%	-32%	-32%	-32%
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-6: Impacts Associated with Unmet Domestic Water Needs Subordination of Downstream Water Rights (municipal water uses: years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)						
County	2010	2020	2030	2040	2050	2060
Brown	$0.31	$0.31	$0.31	$0.31	$0.31	$0.31
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Coke	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Coleman	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Concho	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Ector	$0.00	$14.10	$14.10	$14.10	$14.10	$14.10
% Difference from Analysis w/out Subordination	-100%	-56%	-2%	-21%	-31%	-44%
Howard	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Kimble	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Martin	$1.78	$1.92	$1.96	$1.96	$1.89	$1.79
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
McCulloch	$0.00	$0.00	$0.00	$0.00	$0.24	$0.24
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-90%	-90%
Menard	$0.06	$0.06	$0.06	$0.05	$0.05	$0.05
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Midland	$0.00	$0.00	$46.67	$66.29	$68.84	$71.73
% Difference from Analysis w/out Subordination	-100%	-100%	+2%	+2%	+2%	+2%
Runnels	$0.59	$0.78	$0.89	$1.00	$1.23	$1.38
% Difference from Analysis w/out Subordination	-89%	-86%	-84%	-82%	-79%	-77%
Scurry	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	0%	-100%	-100%	-100%
Tom Green	$0.00	$4.02	$7.24	$9.55	$12.56	$15.21
% Difference from Analysis w/out Subordination	-100%	-86%	-77%	-70%	-62%	-55%
Ward	$0.00	$1.18	$1.18	$1.18	$1.18	$1.18
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Total	$2.74	$22.36	$72.40	$94.43	$100.14	$105.73
% Difference from Analysis w/out Subordination	-96%	-77%	-36%	-32%	-32%	-32%
Source: Texas Water Development Board, Office of Water Resources Planning						

Steam-electric

Table 18: Annual Economic Impacts of Unmet Water Needs for Steam Electric (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$8.19	$5.50	40	$0.98
% Difference from Analysis w/out Subordination	-93%	-93%	-93%	-93%
2020	$12.46	$8.33	65	$1.49
% Difference from Analysis w/out Subordination	-93%	-93%	-93%	-93%
2030	$25.33	$17.40	131	$3.04
% Difference from Analysis w/out Subordination	-87%	-87%	-87%	-87%
2040	$56.69	$37.90	295	$6.79
% Difference from Analysis w/out Subordination	-77%	-77%	-77%	-77%
2050	$84.26	$56.31	437	$10.09
% Difference from Analysis w/out Subordination	-72%	-72%	-72%	-72%
2060	$135.31	$90.39	701	$16.19
% Difference from Analysis w/out Subordination	-61%	-61%	-61%	-61%

* *Figures for job losses are rounded. Estimates are based on *projected* economic activity in the region. Source: Generated by the Texas Water Development Board, Office of Water Planning.

Table B-6: Distribution of Economic Impacts by County and Water User Groups with Subordination of Downstream Water Rights (Steam Electric)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$5.01	$7.83	$22.52	$30.88	$41.07
Secondary Regional Level Impacts	$0.00	$1.87	$2.92	$8.40	$11.52	$15.32
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Mitchell						
Direct	$5.97	$4.06	$10.62	$17.53	$23.65	$31.00
Secondary Regional Level Impacts	$2.23	$1.51	$3.96	$6.54	$8.82	$11.57
% Difference from Analysis w/out Subordination	-78%	-82%	-59%	-43%	-35%	-28%
Tom Green						
Direct	$0.00	$0.00	$0.00	$1.24	$6.30	$24.94
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.46	$2.35	$9.30
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-99%	-95%	-84%
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.37
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.14
% Difference from Analysis w/out Subordination						

Table B-6: Distribution of Economic Impacts by County and Water User Groups with Subordination of Downstream Water Rights (Steam Electric)						
Total	$113.91	$164.73	$195.39	$248.00	$299.84	$363.57
% Difference from Analysis w/out Subordination	-93%	-93%	-87%	-77%	-72%	-61%
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$3.59	$8.88	$16.10	$22.08	$29.37
Secondary Regional Level Impacts	$0.00	$1.00	$2.56	$4.50	$6.18	$8.22
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Mitchell						
Direct	$4.27	$2.90	$0.00	$12.54	$16.92	$22.17
Secondary Regional Level Impacts	$1.23	$0.84	$0.00	$3.62	$4.88	$6.40
% Difference from Analysis w/out Subordination	-78%	-82%	-59%	-43%	-35%	-28%
Tom Green						
Direct	$0.00	$0.00	$0.27	$0.89	$4.51	$17.84
Secondary Regional Level Impacts	$0.00	$0.00	$0.07	$0.25	$1.26	$4.99
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-99%	-95%	-84%
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	-100%	-76%
Total	$5.50	$8.33	$11.78	$37.90	$55.82	$89.33
% Difference from Analysis w/out Subordination	-93%	-93%	-87%	-77%	-72%	-61%
Job Losses						
County	2010	2020	2030	2040	2050	2060
Coke						
Direct	0	0	0	0	0	0
Secondary Regional Level Impacts	0	0	0	0	0	0
% Difference from Analysis w/out Subordination	0%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	0	10	15	43	59	79
Secondary Regional Level Impacts	0	26	41	117	161	214
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Mitchell						
Direct	11	8	20	34	45	59
Secondary Regional Level Impacts	31	21	55	91	123	161
% Difference from Analysis w/out Subordination	-78%	-82%	-59%	-43%	-35%	-28%
Tom Green						
Direct	0	0	0	2	12	48
Secondary Regional Level Impacts	0	0	0	6	33	130
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-99%	-95%	-84%
Ward						
Direct	0	0	0	0	0	1
Secondary Regional Level Impacts	0	0	0	0	0	2
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	-100%	-76%
Total	42	65	131	294	433	693
% Difference from Analysis w/out Subordination	-93%	-93%	-87%	-77%	-72%	-61%

Table B-6: Distribution of Economic Impacts by County and Water User Groups with Subordination of Downstream Water Rights (Steam Electric)						
Lost Business Taxes ($millions)						
Total	2010	2020	2030	2040	2050	2060
Coke						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
% Difference from Analysis w/out Subordination	0%	-100%	-100%	-100%	-100%	-100%
Ector						
Direct	$0.00	$0.64	$1.00	$2.88	$3.96	$5.26
Secondary Regional Level Impacts	$0.00	$0.18	$0.28	$0.81	$1.11	$1.47
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	0%	0%
Mitchell						
Direct	$0.76	$0.52	$1.36	$2.25	$3.03	$3.97
Secondary Regional Level Impacts	$0.22	$0.15	$0.39	$0.65	$0.87	$1.15
% Difference from Analysis w/out Subordination	-78%	-82%	-59%	-43%	-35%	-28%
Tom Green						
Direct	$0.00	$0.00	$0.00	$0.16	$0.81	$3.20
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.04	$0.23	$0.89
% Difference from Analysis w/out Subordination	-100%	-100%	-100%	-99%	-95%	-84%
Ward						
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01
% Difference from Analysis w/out Subordination	0%	0%	0%	0%	-100%	-76%
Total	$0.98	$1.49	$3.04	$6.79	$10.00	$16.00
% Difference from Analysis w/out Subordination	-93%	-93%	-87%	-77%	-72%	-61%
Source: Texas Water Development Board, Office of Water Resources Planning						

Appendix 4C
Methodology for Selecting Feasible Water Management Strategies

Appendix 4C – Feasible Water Management Strategies

After completion of the 2001 regional water plans, the TWDB revised and updated the Regional Water Planning Guidelines to comply with SB2 legislation and clarify some requirements. One of the new requirements adopted by the TWDB is an open meeting presentation of the methodology that will be used to identify, screen and select water management strategies for a region. Specifically, 31 TAC Chapter 357(e)(4) states:

> *Before a regional water planning group begins the process of identifying potentially feasible water management strategies, it shall document the process by which it will list all possible water management strategies and identify the water management strategies that are potentially feasible for meeting a need in the region. Once this process is identified, the regional water planning group shall present it to the public for comment at the public meeting required by §357.12(a)(1) of this title (relating to Notice and Public Participation);*

This memorandum presents the methodology for screening and selecting feasible water management strategies adopted by the Region F Water Planning Group on November 22, 2004.

Methodology for Selecting Feasible Water Management Strategies

1. The consultants will identify needs for individual water user groups and regional water providers. "Need" can include, but is not limited to:
    a. Shortage identified from supply/demand comparison using firm yields
    b. Shortage due to established operation policies of water supplies (e.g., safe yield vs. firm yield)
    c. Water quality issues
2. Each need will be presented to the RWPG at an open meeting for review and public input. The RWPG will consider the types of strategies considered to be feasible to meet each need. Potential strategies include:
    a. Water conservation and drought management
    b. Wastewater reuse
    c. Expanded use of existing supplies
        i. System operation,
        ii. Conjunctive use of groundwater and surface water,
        iii. Reallocation of reservoir storage
        iv. Voluntary redistribution of water resources
        v. Voluntary subordination of water rights
        vi. Yield enhancement

    vii. Water quality improvements

  d. New supply development

    i. Surface water resources
    ii. Groundwater resources
    iii. Brush control
    iv. Precipitation enhancement
    v. Desalination
    vi. Water right cancellation
    vii. Aquifer storage and recovery

  e. Interbasin transfers

3. The RWPG will select strategies considered to be potentially feasible for further evaluation by the consultants.

Screening Criteria

The following offers screening criteria that will be used to assess the feasibility of potential strategies. These criteria are suggested guidelines. A strategy may be retained or dismissed at the discretion of the RWPG.

General

1. Feasible strategy must have an identified sponsor or authority.
2. Feasible strategy must consider the end use. This includes water quality, distance to end use, etc. For example, long transmission systems with pumping are not economically feasible for irrigation use.
3. Strategy should provide a reasonable percentage of the projected need (except conservation, which will be evaluated for all needs).
4. Strategy must meet existing federal and state regulations.
5. Strategies must be based on proven technology.
6. Strategy must be politically and culturally acceptable.
7. Strategy must be appropriate for regional water planning.

By Water Strategy Type (as required in TWDB Guidelines):

WATER CONSERVATION - Water conservation must be considered as a strategy for every identified need. If water conservation is not adopted, the reason must be documented.

DROUGHT MANAGEMENT MEASURES - RWPG may choose to implement emergency water management strategies where appropriate to help meet the projected water needs. Drought management is typically not considered for long-range water supply planning.

WASTEWATER REUSE - Reuse projects will be considered on a case-by-case basis. Both direct and indirect reuse will be considered as appropriate.

EXPANDED USE OF EXISTING SUPPLIES

System Operation - New or additional system operations may be considered pending owner consent. The RWPG will include existing operating policies.

Conjunctive Use of Groundwater and Surface Water - The conjunctive use of groundwater and surface water supplies may be considered when groundwater supplies are available. Applicable groundwater conservation district rules will be considered for such conjunctive systems.

Reallocation of Reservoir Storage - The RWPG will consider reallocation of reservoir storage if the owner is amenable to reallocation.

Voluntary Redistribution of Water Resources - The RWPG will discuss the possible redistribution with the involved parties and come to a consensus on an approach. If the involved parties are not interested, the RWPG will not pursue this option.

Voluntary Subordination of Existing Water Rights - The RWPG will consider voluntary subordination of existing water rights if the TCEQ water availability model shows significantly less supply than assumed in previous planning efforts. Alternatively, the RWPG may recommend that the water right holder consider selling water under their water right to the willing buyer.

Yield Enhancement - The RWPG will consider yield enhancement projects as appropriate for the water source and identified need.

Water Quality Improvement - The RWPG will consider water quality improvement projects for municipal supplies that bring the existing water supply into compliance with state and federal regulations. General water quality projects may be considered if it improves the usability of the water source to help meet demands.

NEW SUPPLY DEVELOPMENT

Surface Water Resources - The RWPG will consider new surface water resources that can be permitted, provide a reasonable amount of supply to meet the identified need, and is located within a reasonable distance to the end users.

Groundwater Resources - The RWPG will consider groundwater supplies in areas where additional groundwater is available.

Brush Control - The RWPG will consider brush control as a general regional strategy. Specific impacts and quantity of supply will not be evaluated unless there is available data from existing studies. Note: Studies sponsored by the TSSWCB provide information on average stream flow. Reservoir yields were not evaluated.

Precipitation Enhancement - The RWPG will consider precipitation enhancement as a general regional strategy. Specific impacts and quantity of supply will not be evaluated unless there is available data from existing studies.

Desalination - The RWPG will consider desalination on a case-by-case basis.

Water Right Cancellation - The RWPG will generally not pursue water right cancellation as a means of obtaining additional water supplies. Instead, the RWPG will recommend that the water right holder consider selling water under their water right to the willing buyer.

Aquifer Storage and Recovery (ASR) - The RWPG will consider aquifer storage and recovery where the structure of the aquifer is such that this method is applicable. An ASR study must have already been performed to consider an area feasible for an ASR project.

INTERBASIN TRANSFERS - The RWPG will recommend interbasin transfers when necessary to transport water from the source to its destination. Interbasin transfers will be evaluated in accordance with current regulations.

Attachment 4C-1
Feasible Strategy Screening Matrices for Water User Groups

Table 4C-1
Potentially Feasible Strategies for Brown County Other (Colorado Basin)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	**No**	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG. No clear sponsor for conservation
Drought Management	**No**							**No**	No sponsor
Reuse	**No**		**No**					**No**	Rural area with little wastewater infrastructure
System Optimization	**No**		**No**					**No**	Single source of water
Reservoir Reallocation			**No**		does not apply			**No**	No reasonable reservoir source available in area
Voluntary Redistribution	BCWID, Brookesmith SUD, Zephyr WSC	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Deliver treated water to northern Brown County.
Subordination	**No**				does not apply			**No**	Subordination not applicable. Mostly groundwater supplies
Yield Enhancement	**No**		**No**					**No**	No strategy identified.
Quality Improvement	**No**		**No**					**No**	Current supplies not limited by water quality
New Surface Water	**No**	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	**No**		**No**		does not apply			**No**	Groundwater supplies less than demand
Brush Control	BCWID and others	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain. Brush control discussed in section 4.xx.
Precipitation Enhancement	**No**	Yes	Unknown	Yes	Yes	Yes	Yes	**No**	Amount of water uncertain. No sponsor in area.

Table 4C-1 – Potentially Feasible Strategies for Brown County Other (Continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Desalination	**No**		**No**					**No**	No source or sponsor identified
Water Right Cancellation	**No**		**No**		does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	**No**	Yes	Unknown	Yes	Yes	Yes	Yes	**No**	Rural area, no identified sponsor
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies									None identified

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-2
Potentially Feasible Strategies for the City of Bronte

Strategy	Identified Sponsor	Compatible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Technology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Bronte	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG
Drought Management	City of Bronte	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	No data on specific practices
Reuse	City of Bronte	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Golf course irrigation
System Optimization	City of Bronte	Yes	**No**	Yes	Yes	Yes	Yes	**No**	
Reservoir Reallocation	**No**		**No**		does not apply			**No**	No storage in area reservoirs available for reallocation
Voluntary Redistribution	**No**		**No**		does not apply			**No**	No sources identified.
Subordination	City of Sweetwater	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	See subordination analysis
Yield Enhancement			**No**					**No**	No strategy identified.
Quality Improvement	City of Bronte								Water quality not a limiting factor
New Surface Water	City of Bronte	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	City of Bronte	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Up to 5 new wells
Brush Control	City of Sweetwater	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain. See section 4.x
Precipitation Enhancement	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	CRMWD	Amount of water uncertain.See section 4.x
Desalination	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Regional desalination project

Table 4C-2: Potentially Feasible Strategies for the City of Bronte (Continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Right Cancellation	TCEQ, City of Bronte	Yes	**No**	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of Bronte	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No suitable aquifer in area
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies	City of Bronte								Rehabilitate Oak Creek pipeline

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-3
Potentially Feasible Strategies for the City of Robert Lee

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Robert Lee	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG
Drought Management	City of Robert Lee	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	No data on specific practices
Reuse	City of Robert Lee	Yes	**No**	Yes	Yes	Yes	Yes	Yes	City already uses discharge for irrigation
System Optimization	City of Robert Lee, CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	
Reservoir Reallocation	**No**		**No**		does not apply			**No**	No storage in area reservoirs available for reallocation
Voluntary Redistribution	**No**		**No**		does not apply			**No**	No sources identified.
Subordination	CRMWD, UCRA	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	See subordination analysis
Yield Enhancement			**No**					**No**	No strategy identified.
Quality Improvement	City of Robert Lee								See desalination
New Surface Water	City of Robert Lee	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	City of Robert Lee	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	Insufficient groundwater supplies in the area
Brush Control	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	CRMWD	Amount of water uncertain. See section 4.x
Precipitation Enhancement	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	CRMWD	Amount of water uncertain.See section 4.x
Desalination	City of Robert Lee	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Advanced treatment of Spence water

Table 4C-3: Potentially Feasible Strategies for the City of Robert Lee (continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Right Cancellation	TCEQ, City of Robert Lee	Yes	**No**	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of Robert Lee	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No suitable aquifer in area
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies	City of Robert Lee	Yes	Yes	Yes	Yes	Yes	Yes	Yes	New storage facilities, expand WTP, new intakes

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-4
Potentially Feasible Strategies for the Colorado River Municipal Water District

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	CRMWD Customers	Yes	*	Yes	Yes	Yes	Yes	Yes	Water conservation will be evaluated for individual customers, not CRMWD as a whole
Drought Management	CRMWD, customers	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	CRMWD drought plan
Reuse	CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Regional Water Reclamation Project
System Optimization	CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Insufficient unappropriated water
Reservoir Reallocation	None	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No supplies for reallocation
Voluntary Redistribution	BRA, Mesa, University Lands, others	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Various sources
Subordination	CRMWD, LCRA, others	Yes	Yes	Yes	does not apply	Yes	See Comments column	Yes	Specific form of agreement will not be evaluated
Yield Enhancement			**No**					**No**	No strategy identified. Brush control and precipitation enhancement are a separate strategy
Quality Improvement	CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Quality improvement will not increase available supplies
New Surface Water	CRMWD	Yes	**No**		does not apply	No	Yes	**No**	No new surface sources identified. Existing sources covered under voluntary redistribution
New Groundwater	CRMWD	Yes	Yes	Yes	does not apply	Political barriers for some sources	Yes	Yes	Winkler well field

Table 4C-4: Potentially Feasible Strategies for the Colorado River Municipal Water District (continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Brush Control	CRMWD, others	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain
Precipitation Enhancement	CRMWD, others	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain
Desalination	CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Trans-Pecos desalination facility
Water Right Cancellation	TCEQ, CRMWD	Yes	Yes	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by Distric
ASR	CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	In conjunction with Regional Water Reclamation Project
Interbasin Transfers	CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No reasonable source of water identified
Other Strategies									None identified

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-5
Potentially Feasible Strategies for the City of Menard

Strategy	Identified Sponsor	Compatible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Technology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Menard	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG
Drought Management	City of Menard	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	No data on specific practices
Reuse	City of Menard	Yes	**No**	Yes	Yes	Yes	Yes	**No**	City does not have a wastewater collection system
System Optimization	City of Menard	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Single source of water
Reservoir Reallocation	**No**	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No reasonable reservoir source available in area
Voluntary Redistribution	City of Menard, LCRA	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Off-channel reservoir on the San Saba River. Limited partnering options.
Subordination	City of Menard	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	City water right has a senior priority date
Yield Enhancement			**No**					**No**	No strategy identified.
Quality Improvement	City of Menard	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Current supplies not limited by water quality
New Surface Water	City of Menard	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	City of Menard	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Hickory aquifer or Edwards-Trinity Plateau aquifer. Hickory may have water quality issues
Brush Control	**No**	Yes	Unknown	Yes	Yes	Yes	Yes	**No**	Amount of water uncertain. No sponsor in area
Precipitation Enhancement	**No**	Yes	Unknown	Yes	Yes	Yes	Yes	**No**	Amount of water uncertain. No sponsor in area.

Table 4C-5: Potentially Feasible Strategies for the City of Menard (continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Desalination			**No**					**No**	No source or sponsor identified
Water Right Cancellation	TCEQ, City of Menard	Yes	Yes	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of Menard	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Potential strategy for future evaluations
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies									None identified

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-6
Potentially Feasible Strategies for the City of Midland

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Midland	Yes	*	Yes	Yes	Yes	Yes	Yes	City of Midland is implementing an aggressive water conservation program
Drought Management	City of Midland, CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Apply drought management identified in Midland and CRMWD drought contingency plans
Reuse	CRMWD	Yes	Yes	Yes	Yes	Unknown	Yes	Yes	See CRMWD strategies
System Optimization	CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Previous studies did not identify significant yield gains due to system optimization
Reservoir Reallocation	CRMWD	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No storage available for reallocation
Voluntary Redistribution	CRMWD	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Renew contract with CRMWD
Subordination	CRMWD, LCRA, others	Yes	Yes	Yes	does not apply	Yes	See Comments column	Yes	Implemented by CRMWD
Yield Enhancement			**No**					**No**	No strategy identified. Brush control and precipitation enhancement are a separate strategy
Quality Improvement	City of Midland, CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Will not make more water available for use
New Surface Water	City of Midland, CRMWD	Yes	**No**		does not apply	**No**	Yes	**No**	No new surface sources identified. Existing sources covered under voluntary redistribution
New Groundwater	City of Midland	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	T-Bar Well Field

Table 4C-6 (Continued) Potentially Feasible Strategies for the City of Midland

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Brush Control	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	CRMWD is participating in salt cedar removal programs. Amount of water uncertain
Precipitation Enhancement	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	CRMWD sponsors a precipitation enhancement program. Amount of water uncertain
Desalination	CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Pecos County Regional Desalination Facility. Implemented by CRMWD.
Water Right Cancellation	TCEQ, CRMWD	Yes	Yes	Yes	does not apply	**No**	**No**	**No**	Considered to be politically and culturally unacceptable by Region F
ASR	CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Assumed to be implemented by CRMWD
Interbasin Transfers	CRMWD	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No reasonable source of water available
Other Strategies									None identified

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-7
Potentially Feasible Strategies for the City of Ballinger

Strategy	Identified Sponsor	Compatible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Technology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Ballinger	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG
Drought Management	City of Ballinger	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	No data on specific practices
Reuse	City of Ballinger	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
System Optimization	City of Ballinger	Yes	**No**	Yes	Yes	Yes	Yes	**No**	May be a future strategy if other sources become available
Reservoir Reallocation	**No**		**No**		does not apply			**No**	No storage in area reservoirs available for reallocation
Voluntary Redistribution	City of Ballinger, City of Coleman, CRMWD, BCWID	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Hords Creek Reservoir, Brown/Coleman/Runnels Regional System, CRMWD sources
Subordination	City of Ballinger	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	See subordination analysis
Yield Enhancement			**No**					**No**	No strategy identified.
Quality Improvement	City of Ballinger								Water quality not a limiting factor
New Surface Water	City of Ballinger	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	City of Ballinger	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No source identified
Brush Control	CRMWD, others	Yes	Unknown	Yes	Yes	Yes	Yes		Amount of water uncertain. See section 4.x
Precipitation Enhancement	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes		Amount of water uncertain. See section 4.x

Table 4C-7 Potentially Feasible Strategies for the City of Ballinger (continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Desalination	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Regional desalination project. Included with voluntary redistribution.
Water Right Cancellation	TCEQ, City of Ballinger	Yes	**No**	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of Ballinger	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No suitable aquifer identified
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies									None identified

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-8
Potentially Feasible Strategies for the City of Winters

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of Winters	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on criteria developed by the RWPG
Drought Management	City of Winters	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	No data on specific practices
Reuse	City of Winters	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
System Optimization	City of Winters	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Single source
Reservoir Reallocation	**No**		**No**		does not apply			**No**	No storage in area reservoirs available for reallocation
Voluntary Redistribution	BCWID	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Brown/Coleman/Runnels Regional System
Subordination	City of Winters	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	See subordination analysis
Yield Enhancement			**No**					**No**	No strategy identified.
Quality Improvement	City of Winters								Water quality not a limiting factor
New Surface Water	City of Winters	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No unappropriated water available in Region F
New Groundwater	City of Winters	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	No source identified
Brush Control	City of Winters, CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain. See section 4.x
Precipitation Enhancement	CRMWD	Yes	Unknown	Yes	Yes	Yes	Yes	CRMWD	Amount of water uncertain. See section 4.x
Desalination	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Regional desalination project

Table 4C-8: Potentially Feasible Strategies for the City of Winters (Continued)

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Right Cancellation	TCEQ, City of Winters	Yes	**No**	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of Winters	Yes	**No**	Yes	Yes	Yes	Yes	**No**	No suitable aquifer in area
Interbasin Transfers			**No**					**No**	No reasonable out-of-basin supplies identified
Other Strategies									

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Table 4C-9
Potentially Feasible Strategies for the City of San Angelo

Strategy	Identified Sponsor	Com-patible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Tech-nology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Water Conservation	City of San Angelo	Yes	*	Yes	Yes	Yes	Yes	Yes	Based on current practices by the City of San Angelo plus criteria developed by the RWPG
Drought Management	City of San Angelo	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Based on the City's experience during recent drought
Reuse	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
System Optimization	City of San Angelo, CRMWD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Reservoir Reallocation	BurRec, COE	Yes	**No**	Yes	does not apply	Yes	Yes	**No**	Insufficient extra supplies for reallocation
Voluntary Redistribution	CRMWD, others	Yes	Yes	Yes	does not apply	Yes	Yes	Yes	Additional water from CRMWD, purchase water rights, Lake Alan Henry
Subordination	CRMWD, LCRA, others	Yes	Yes	Yes	does not apply	Yes	See Comments column	Yes	Specific form of agreement will not be evaluated
Yield Enhancement			**No**					**No**	No strategy identified. Brush control and precipitation enhancement are a separate strategy
Quality Improvement	City of San Angelo	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Quality improvement will not increase available supplies
New Surface Water	City of San Angelo	Yes	**No**		does not apply	No	Yes	**No**	No new surface sources identified. Existing sources covered under voluntary redistribution
New Groundwater	City of San Angelo	Yes	Yes	Yes	does not apply	Political barriers for some sources	Yes	Yes	Hickory aquifer, Edwards-Trinity Plateau aquifer, Ogallala aquifer, Hovey trough. Other sources covered under desalination.

Table 4C-9: Potentially Feasible Strategies for the City of San Angelo (Continued)

Strategy	Identified Sponsor	Compatible with End Use	Reasonable Percentage of Need	Consistent with State and Federal Regulations	Based on Proven Technology	Politically & Culturally Acceptable	Appropriate for Regional Water Planning	Feasible?	Comments
Brush Control	City of San Angelo, UCRA, others	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain
Precipitation Enhancement	City of San Angelo, UCRA, others	Yes	Unknown	Yes	Yes	Yes	Yes	Yes	Amount of water uncertain
Desalination	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Dockum aquifer, Whitehorse aquifer, Lipan aquifer, possibly in conjunction with Spence water.
Water Right Cancellation	TCEQ, City of San Angelo	Yes	Yes	Yes	does not apply	**No**	**No**	**No**	Politically unacceptable for pursuit by City
ASR	City of San Angelo	Yes	**No**	Yes	Yes	Yes	Yes	**No**	Does not provide significant additional supplies
Interbasin Transfers		Yes	**No**	Yes	Yes	Yes	Yes	**No**	No reasonable source of water identified
Other Strategies	City of San Angelo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Rehab Spence pipeline, store water in O.C. Fisher

* Water conservation is evaluated for all municipal needs regardless of the quantity of water saved.

Appendix 4D
Approach to Subordination Modeling

TECHNICAL MEMORANDUM

To: File

From: Andres Salazar Ph.D., P.E – Freese and Nichols, Inc.
Jon S. Albright - Freese and Nichols, Inc.

Re: Approach to Subordination Modeling

Date: May 18, 2005

Modeling Approach

At the time of this analysis the Water Rights Analysis Package (WRAP) did not have a method to directly model subordination of water rights. The model does not track water passed downstream by individual water rights to other senior water rights, only the total amount of water passed downstream. (WRAP is the model used for the Colorado WAM. A beta version of WRAP that includes some subordination options was made available at the time of completion of this analysis. This version of the model has not been evaluated at this time.) Because the model does not track the needed data, much of the calculation involved with the strategy was done outside of the model.

The modeling approach used a three-step process, with each step using a different model setup, referred to as a 'run'. These runs are:

- A Base Run of the basin operating in perfect priority order (similar to the Colorado WAM);
- A 'MiniWAM' of the upper basin water rights; and
- An Impact Run to assess the changes in water availability in Region K due to subordination.

Each step of the process is described in detail below.

These models were used to evaluate four different scenarios:

1. Year 2000 conditions with no return flows
2. Year 2000 conditions with current City of Austin return flows
3. Year 2060 conditions with no return flows
4. Year 2060 conditions with expected 2060 return flows from the City of Austin

City of Austin return flows were provided by Region K. Region F return flows were not included in the analysis because very little of the wastewater in the region is currently discharged into streams. The existing wastewater discharges will most likely be targeted for direct reuse at some point in the planning process.

Base Runs of the Full Colorado WAM

Different base runs were developed for each scenario. The base runs are modified versions of the TCEQ Colorado WAM Run 3 (November 12, 2004 version). The modifications include:

1. Original area-capacity relationships were replaced with either year 2000 conditions or 2060 conditions. Reservoirs in Region F used sedimentation rates developed by Freese and Nichols for the 2001 Region F Plan. Region K provided their own year 2000 and 2060 sediment conditions for the reservoirs in their region. Other reservoirs were based on WAM Run 8 data (the TCEQ current conditions run).

2. The subordination modeling of the Highland Lakes to Ivie Reservoir was removed. This prevented upstream reservoirs from passing water to satisfy Ivie Reservoir depletions.

3. The yield of the Highland Lakes system was increased to account for the removal of the subordination to Ivie Reservoir.

4. Pairs of dummy water rights with zero diversion were added to track the water passed by the junior water rights in the upper basin to the downstream senior water rights included in this subordination strategy. Table 1 includes a list of the junior water rights and Table 2 is a list of the senior water rights that were tracked with the dummy water rights. The first set of dummy water rights had a priority date

one day senior and the second set of water rights had a priority date one day junior to the downstream senior water rights as specified in Tables 1 and 2, respectively. The difference in available water for these water rights represents the flow passed downstream.

Table 1
Junior Upstream Water Rights Used to Track Releases for Downstream Senior Water Rights

Junior Upstream Rights	Priority Date (mm/dd/yyyy)	Subordinated Senior Right Group*
Lake Thomas	5/08/1946	LCRA, Corpus and Austin Rights
Champion Creek Reservoir	4/08/1957	LCRA, Corpus and Austin Rights
Lake Colorado City	11/22/1948	LCRA, Corpus and Austin Rights
Spence Reservoir	8/17/1964	LCRA, Corpus and Austin Rights
Oak Creek Reservoir	4/27/1949	LCRA, Corpus and Austin Rights
Ballinger	10/04/1946	LCRA, Corpus and Austin Rights
Lake Winters	12/18/1944	LCRA, Corpus and Austin Rights
Fisher Reservoir	5/27/1949	LCRA, Corpus and Austin Rights
Twin Buttes Reservoir	5/06/1959	LCRA, Corpus and Austin Rights
Lake Nasworthy	3/11/1929	LCRA, Corpus and Austin Rights
Ivie Reservoir	2/21/1978	LCRA, Corpus and Austin Rights
Hords Creek Lake	3/23/1946	LCRA, Corpus and Austin Rights, and BCWID
Lake Coleman	8/25/1958	LCRA, Corpus and Austin Rights, and BCWID
Lake Clyde	2/02/1965	LCRA, Corpus and Austin Rights, and BCWID
Lake Brownwood	9/29/1925	LCRA irrigation, Corpus and Austin rights
Brady Creek Reservoir	9/02/1959	LCRA, Corpus and Austin Rights
Run-of-the river right City of Junction	11/23/1964	LCRA, Corpus and Austin Rights

* Subordination of Ivie Reservoir is described in step 2 above. Subordination of Lake Nasworthy is described in step 5 of the section *Hydrology for the MiniWAM*.

Table 2
Senior Water Rights Tracked for Releases by Junior Water Rights*

Senior Water Right Group	**Water Right Number**	**Priority Date** (mm/dd/yyyy)	**Total Diversion** (Ac-Ft/Yr)
LCRA	5434	11/1/1900	168,000
	5476	12/1/1900	228,570
	5475	1/4/1901	52,500
		9/2/1907	55,000
	5477	9/1/1907	55,000
		3/27/1926	Target & critical flows
	5478	3/29/1926	Refill Lake Buchanan
		12/31/1929	532
		3/7/1938	560,000
	5480	3/29/1926	Refill LBJ
	5479	3/29/1926	Refill Inks Lake
	5482	03/07/1938	178,300
City of Austin	5471	6/30/1913	250,000
		6/30/1913	150
		6/27/1914	21,403
		6/27/1914	24,000
		12/31/1928	Refill Barton Springs
BCWID	2454	9/29/1925	15,996
		9/29/1925	5,004
		9/29/1925	8,712

* Subordination of Ivie Reservoir is described in step 2 above. Subordination of Lake Nasworthy is described under Hydrology for the MiniWAM step 5.

5. Several of the senior water rights have multiple priority dates. Only the portions of water rights with priority dates of 1938 or earlier will be considered for subordination.

6. For the return flow scenarios, City of Austin wastewater return flows were added at the appropriate locations as constant monthly inflows (CI cards).

MiniWAM Runs of the Upper Basin Water Rights

The upper basin water rights (water rights in Region F and Brazos G) are assumed not to make calls on each other. To facilitate the modeling of this situation, a simplified 'MiniWAM' was developed which contains only the upper basin water rights. The

MiniWAM uses artificial hydrology based on depletions by the water rights, flows passed downstream and unappropriated flow. The results of the MiniWAM became the basis for the Impact Model.

Figure 1 shows the primary control points in the MiniWAM. These control points are associated with the upstream water rights in Table 1. The hydrology for each primary control point is the sum of the water passed to the downstream senior water rights in Table 6, the depletions made by the junior water rights in the respective base run, and the unappropriated flow at each junior water right location. Flows at the secondary control points were calculated as the sum of flows from upstream control points. Equivalent channel losses were incorporated in the MiniWAMs as needed.

Each scenario has its own version of the MiniWAM with hydrology based on the corresponding base run. Hydrology for the MiniWAMs was developed as follows:

1. Using the output of the base runs, the water passed by a reservoir to a senior right was computed as the difference in the available flow at the junior water right's control point before and after allocating for the senior water rights. For example, the following formulas was applied for subordination of the Highland Lakes:

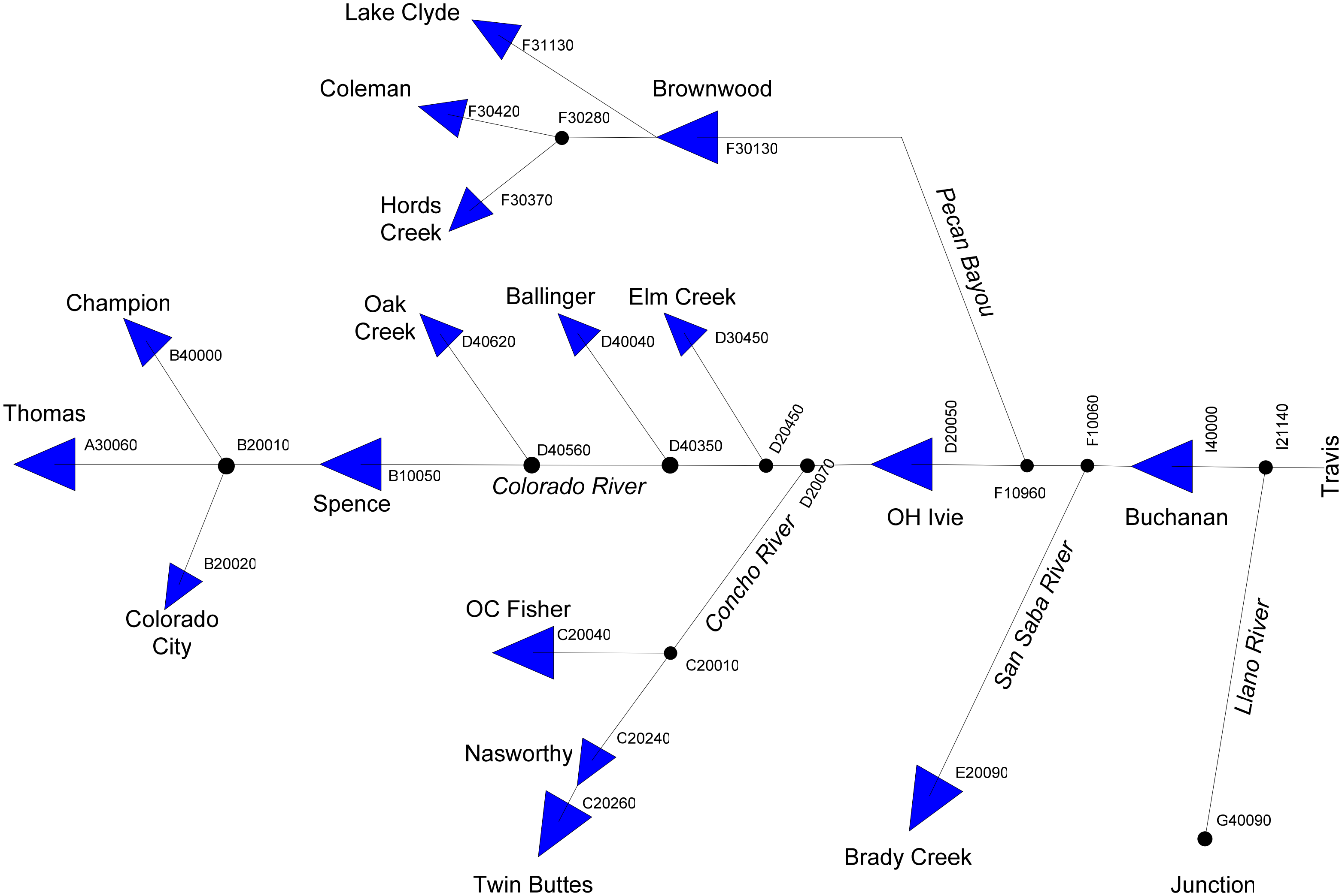
   Water passed to Highland Lakes for first refill (Priority 3/29/1926) =
   available at 3/28/1926 - available at 3/30/1926

   Water passed to Highland Lakes for second refill (Priority 3/08/1938) =
   available at 3/07/1938 - available at 3/09/1938

   The total water passed for senior water rights is the sum of the amounts passed for each individual senior water right.

2. Unappropriated flows at each junior water right control point were extracted from the WRAP output file for each base run. These unappropriated flows were added to the water passed by senior water rights from step 1 to develop flows for the MiniWAMs. These flows were input using IN cards, taking the place of the naturalized flows in the full Colorado WAM.

Figure 1
Schematic of MiniWAM



3. Depletions made by each junior water right under each base run were entered into the MiniWAM as flow adjustments (FA cards). Using FA cards eliminates the need to manually add the depletions at each downstream control point. The WRAP model adds these flows to the flows entered on the IN cards at each downstream control point, calculating the total flow at each control point adjusted for channel losses.

4. Lake Nasworthy was assumed to be subordinate to Twin Buttes Reservoir. Because of the relatively senior priority date of Lake Nasworthy, these two water rights were treated somewhat differently than other water rights in Table 5. In the base runs, the water passed by Twin Buttes was included in the depletions by Lake Nasworthy. To implement subordination, the flows passed by Twin Buttes to Lake Nasworthy were added to the Twin Buttes unappropriated flows. Equal amounts were subtracted at Lake Nasworthy, after adjusting for channel losses if needed.

5. Evaporation and area capacity relationships in the MiniWAM were identical to those used in the equivalent base run of the full Colorado WAM.

The MiniWAMs were used to calculate the safe yield of the upper basin reservoirs in natural order. Natural order makes depletions for water rights in upstream to downstream order, ignoring the priority of the water right. This is identical to assuming that all major upper basin water rights will not make priority calls on each other. Yields of the reservoirs were limited to the permitted diversion of the reservoir.

Most reservoirs in Region F are operated on a safe yield basis, which is a more conservative definition of yield than firm yield. Firm yield fully uses the storage in the reservoir, leaving no reserve content at the lowest point in the simulation period. Safe yield reserves one year of supply in the reservoir at the lowest point in the simulation period. Safe yield allows for the occurrence of more severe droughts than have occurred in the simulation period. Because most of Region F experienced critical drought conditions since 1998 which are not included in the Colorado WAM (the Colorado WAM ends in 1998), it is prudent to use safe yield rather than firm yield as the basis for water availability in the Region.

Using safe yield as the definition of reliable supply also has less impact on water rights in Region K than if firm yields were used. Because safe yields are less than firm yields, not as much water is depleted to meet demands and there is less empty storage in the reservoirs to fill when water is available.

Water availability for the City of Junction is defined by the minimum annual diversion from the river.

The specific steps in determining yields of the reservoirs using the MiniWAM were as follows:

Safe yields were calculated in natural order, starting with Lake Thomas. The computations for a reservoir assume that upstream reservoirs operate at their safe yield. Safe yield was limited to the permitted diversion.

Impact Runs

The Impact Runs replace the water rights in the MiniWAM with depletions made by the water rights in the MiniWAM. The depletions of the MiniWAM represent the water that is available for the reservoirs in Region F after subordination. Monthly depletions are entered for each MiniWAM water right using the WRAP model's TS records. Each month has a unique value. Each region may then use this output to determine the impact of subordination on the water availability within their region.

The proposed approach was developed to have minimal impact on water rights not included in the subordination analysis. However, the interaction of water rights in the WAMs is complex, and some differences between the Base Runs and the Impact Runs is to be expected. The approach used in this analysis has reduced the impacts on other water rights not included in the subordination analysis. However, future modeling efforts with an improved version of WRAP with subordination options may develop approaches with fewer impacts on other water rights.

The water rights that have access to water released from storage in the Highland Lakes as defined in the LCRA Water Management Plan may experience some impacts from subordination even if the water right is not directly included in the subordination analysis. Water rights that depend on interruptible supplies may be impacted significantly. These impacts will be determined by Region K.

The specific steps used to develop the Impact Runs were as follows:

1. The total available flow in the upstream basin after subordination was computed from the MiniWAM. This computation is performed for each reservoir in Region F.
2. The additional flow obtained as a direct result of subordination was calculated as the difference between the depletions of the MiniWAM and the depletions under the Base Run. This computation was performed for each reservoir in Region F.
3. The total additional flow in Region F obtained as a result of subordination was calculated as the sum of the gains at each reservoir, adjusting for channel losses between each reservoir and Lake Buchanan. The total additional flow in Region F was equal to the reduction of flow coming into Region K, and represents the flow that would have been passed for Region K in the absence of subordination.
4. The total water available for senior rights in Region K after subordination was computed as the total depletion from the base run minus the reduction of flow calculated in step 3.
5. The approximate physical regulated flow at diversion points in Region K was computed as the naturalized flow at each point minus the reduction of flow computed in step 3.
6. The total amount available for Region K was distributed among the water rights in priority order. The allocation started with the most senior water right. The allocation was limited to the physical regulated flow computed in step 5. If the total available for Region K was not used by the first right, the next water right in priority was allocated. The allocation stops once the total amount available for

Region K was reached. Water rights to be allocated after the limit was reached did not get any water.

7. The allocation of water rights of step 6 produced the water available for each senior water right. These amounts were written in TS Cards for each right.

8. The impact run replaced Region F Reservoirs with TS Cards from step 1 with the most senior water right. It also limited the depletions of Region K water rights to the allocation of step 6.

Appendix 4E
Impact of Recent Drought on Region F Water Supplies

Appendix 4E: Impacts of Recent Drought on Water Supply

TWDB authorized an analysis of the impact of recent drought conditions on Region F as part of the supplemental funding for the 2006 Region F Water Plan. Since 1998 most of Region F has experienced a significant drought. Indications are that for many reservoirs the recent drought may be more severe than previous droughts, potentially lowering the available supply from the reservoirs. The Colorado WAM uses naturalized flows from 1940 through 1998. As a result, the WAM may over-estimate yields of Region F reservoirs.

To assess the potential impact of the recent drought on water supplies in Region F, historical inflows into Region F reservoirs and at the City of Junction's diversion point were developed covering the period from 1999 through 2003. Table 4E-1 is a summary of the methodology used to calculate these flows. These flows were incorporated into a special simplified version of the Colorado WAM, the MiniWAM, developed for the subordination strategy. The MiniWAM includes only major reservoirs in Region F and the City of Junction's run-of-the-river right. More detailed information on the MiniWAM may be found in Appendix 4C. Flows from 1940 through 1998 are based on the modeled flows available to these water rights using the subordination analysis.

Table 4E-2 compares firm yields with and without the extended hydrology. (Lake Brownwood is not included in this analysis because it does not appear that the reservoir has experienced drought-of-record conditions.) All yields assume that the subordination strategy is in place. A description of the subordination strategy may be found in Section 4.2.3. The flows used for the period of 1940 through 1998 have been adjusted to assume that water is passed downstream for water rights not included in the subordination analysis. Flows after 1998 do not include any adjustments for downstream senior water rights. Therefore, yields may be somewhat higher than they could be if a significant number of senior water rights would make priority calls under similar conditions.

Table 4E-1
Methodologies Used to Calculate Reservoir Inflows 1999 through 2004

Reservoir	Period of Record	Method	Stations or Reservoir Upstream of Incremental Area	Station Downstream of Incremental Area
Thomas	1/1998-12/2004	DAR	None	Colorado River near Gail
Colorado City	1/1998-12/2004	DAR	None	Colorado River near Gail
Champion	1/1998-12/2004	DAR	None	Colorado River near Gail
Spence	1/1998-12/2004	DAR	Lake Thomas	Colorado River above Silver
			Colorado City	
			Champion	
Oak Creek	1/1998-12/2004	DAR	Colorado River at Robert Lee	Colorado River near Ballinger
Ballinger	1/1998-12/2004	DAR	Colorado River at Robert Lee	Colorado River near Ballinger
Elm Creek	1/1998-12/2004	DAR	Elm Creek Reservoir	Elm Creek at Ballinger
Twin Buttes	1/1998-9/2001	Mass balance	n/a	n/a
	10/2001-12/2004	DAR	None	Middle Concho above Tankersley
			None	Spring Creek above Twin Buttes
			None	South Concho at Christoval
Nasworthy	1/1998-9/2001	DAR	None	Twin Buttes
	10/2001-12/2004	DAR	None	Pecan Bayou near San Angelo
O.C. Fisher	1/1998-12/2004	COE data	n/a	n/a
O.H. Ivie	1/1998-12/2004	DAR	Colorado River at Robert Lee	Colorado River near Balllinger
			Elm Creek Reservoir	Elm Creek at Ballinger
			Concho River at San Angelo	Concho River at Paint Rock
Hords Creek	1/1998-12/2004	COE data	n/a	n/a
Coleman	1/1998-12/2004	DAR with Hords Creek	n/a	n/a
Brady Creek	1/1998-12/2004	Mass balance *	See note	See Note

DAR – drainage area ratio method
* Used 80 % of the average of incremental flows between San Saba and Menard gauges on the San Saba River and the Stacy and Winchell gauges on the Colorado River when spilling.

Table 4E-2
Comparison of Yields with and without Extended Hydrology
(Values in Acre-Feet per Year)

Reservoir	Firm Yield 1940-1998	Firm Yield 1940-2004	Reduction in Yield
Lake Thomas	13,300	12,540	760
Lake Colorado City	4,520	4,040	480
Champion Creek Reservoir	2,760	2,380 **	380
Spence Reservoir	38,760	34,360	4,400
Oak Creek Reservoir	3,920	2,900	1,020
Lake Ballinger	1,380	1,380	0
Lake Winters	1,260	1,180	80
Twin Buttes Reservoir	19,900	15,320	4,580
Lake Nasworthy	0	0	0
O.C. Fisher Reservoir	8,920	5,420	3,500
O.H. Ivie Reservoir	98,560	84,120	14,400
Lake Coleman	9,000	9,000	0
Hords Creek Reservoir	1,860	1,860	0
Brady Creek Reservoir	3,560	3,560	0
Total	*207,700*	*178,060*	*29,640*

All values use area-capacity relationship estimated for the year 2000.
Yields are limited to permitted amount (if yield greater than permit)
(**) Firm yield considers dead storage.

Table 4E-2 shows that most of the Colorado Basin reservoirs in the Region F have experienced new drought-of-record conditions with the current drought. The most severely impacted reservoir is Ivie Reservoir. Altogether, the drought has resulted in about a 14 percent reduction in supplies in the region.

Appendix 4F
Cost Estimates

WUGNAME:	Brown County Other
STRATEGY:	Voluntary Redistribution - Lake Brownwood Water to Northern Brown County
STRATEGY NUMBER:	F06AVolRed
AMOUNT (ac-ft/yr):	300

CONSTRUCTION COSTS

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	8 in.	116,000	LF	$ 20	$ 2,320,000
Right-of-way easements		53	AC	$ 2,000	$ 106,000
Engineering and Contingencies (30%)					$ 728,000
Subtotal Pipeline					$ 3,154,000
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Stations	100 HP	2	EA	$ 620,000	$ 1,240,000
Storage tank	0.3 MG	2	EA	$ 111,000	$ 222,000
Engineering and Contingencies (35%)					$ 512,000
Subtotal of Pump Station(s)					$ 1,974,000
CONSTRUCTION TOTAL					$ 5,128,000
Permitting and Mitigation					$ 45,000
Interest During Construction	(6 months)				$ 111,000
TOTAL COST					**$ 5,284,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 461,000
Electricity ($0.06 kWh)					$ 28,000
Operation & Maintenance					$ 73,000
Water Purchase					$ 196,000
Total Annual Costs					**$ 758,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 2,527
Per 1,000 Gallons					$ 7.75
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 990
Per 1,000 Gallons					$ 3.04

WUGNAME:	Ballinger, Winters, Bronte and Robert Lee	
STRATEGY:	Lake Brownwood to Runnels and Coke Counties	
STRATEGY NUMBER:	F25BroSys	
AMOUNT (ac-ft/yr):	Winters	729
	Ballinger	1345
	Bronte	280
	Robert Lee	448
	Total	2,802

CONSTRUCTION COSTS

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	20 in.	230,936	LF	$ 51	$ 11,777,736
Transmission pipeline	18 in.	93,471	LF	$ 42	$ 3,925,782
Transmission pipeline	12 in.	61,797	LF	$ 28	$ 1,730,316
Transmission pipeline	10 in.	54,357	LF	$ 24	$ 1,304,568
Right-of-way easements		202	AC	$ 1,000	$ 202,000
Engineering and Contingencies (30%)					$ 5,682,000
Subtotal Pipeline					$ 24,622,402

Pump Station	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station at Lake Brownwood	700 HP	1	LS	$ 1,900,000	$ 1,900,000
Booster Station #1	700 HP	1	LS	$ 1,900,000	$ 1,900,000
Storage Tank at Booster Station #1	0.75 MG	1	LS	$ 215,000	$ 215,000
Booster Station #2	700 HP	1	LS	$ 1,900,000	$ 1,900,000
Storage Tank at Booster Station #2	0.75 MG	1	LS	$ 215,000	$ 215,000
Storage Tank at High Point	0.75 MG	1	LS	$ 215,000	$ 215,000
Outlet structure at Valley Creek		1	LS	$ 100,000	$ 100,000
Booster Station #3	400 HP	1	LS	$ 1,500,000	$ 1,500,000
Storage Tank at Booster Station #3	0.5 MG	1	LS	$ 156,000	$ 156,000
Engineering and Contingencies (35%)					$ 2,835,000
Subtotal of Pump Station(s)					$ 10,936,000

CONSTRUCTION TOTAL		$ 35,558,402
Permitting and Mitigation		$ 322,000
Interest During Construction	(12 months)	$ 1,482,000
TOTAL COST		**$ 37,362,402**

ANNUAL COSTS

Debt Service (6% for 20 years)	$ 3,257,000
Electricity ($0.06 kWh)	$ 166,000
Operation & Maintenance	$ 468,000
Raw Water Purchase	$ 1,141,000
Total Annual Costs	**$ 5,032,000**

UNIT COSTS (Until Amortized)

Per Acre-Foot of treated water	$ 1,796
Per 1,000 Gallons	$ 5.51

UNIT COSTS (After Amortization)

Per Acre-Foot	$ 633
Per 1,000 Gallons	$ 1.94

Notes: Cost for buying raw water is assumed to be $1.25 per 1,000 gallons

WUGNAME:	Bronte
STRATEGY:	Five New Water Wells
STRATEGY NUMBER:	F13OthGW
AMOUNT (ac-ft/yr):	100

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells		5	EA	$ 65,000	$ 325,000
Piping and other appurtenances		1	LS	$ 21,000	$ 21,000
Engineering and contingencies (30%)					$ 104,000
					$ 450,000

CONSTRUCTION TOTAL		$ 450,000
Permitting and Mitigation		$ 4,000
Interest During Construction	(6 months)	$ 10,000
TOTAL COST		**$ 464,000**
ANNUAL COSTS		
Debt Service (6% for 20 years)		$ 40,000
Electricity ($0.06 kWh)		$ 3,000
Operation & Maintenance		$ 4,000
Water Purchase		$ 10,000
Total Annual Costs		**$ 57,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 570
Per 1,000 Gallons		$ 1.75
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 170
Per 1,000 Gallons		$ 0.52

WUGNAME:	Bronte, Robert Lee, Winters
STRATEGY:	Generic 0.1 MGD Reuse
STRATEGY NUMBER:	F04Reuse
AMOUNT (ac-ft/yr):	110

CONSTRUCTION COSTS

Land Acquisition		**Quantity**	**Unit**	**Unit Price**	**Cost**
Reclaimed Treatment Plant Land Acquisition		3	AC	$ 5,000	$ 15,000
Engineering and Contingencies (30%)					$ 4,500
Subtotal Land Acquisition					$ 20,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline 75gpm	4 in	10,560	LF	$ 20	$ 211,000
Right-of-way easements		7	AC	$ 2,000	$ 14,500
Engineering and Contingencies (30%)					$ 79,000
Subtotal Pipeline					$ 304,500
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	2-75 gpm	1	EA	$ 24,000	$ 24,000
Storage tank	0.025 MG	1	EA	$ 80,000	$ 80,000
Engineering and Contingencies (35%)					$ 36,400
Subtotal of Pump Station(s)					$ 141,000
Treatment Equipment		**Quantity**	**Unit**	**Unit Price**	**Cost**
Microfiltration/Ultrafiltration (MF/UF) and Reverse Osmosis (RO) Equipment and Installation		1	EA	$ 370,000	$ 370,000
UV/Oxidation		1	EA	$ 65,000	$ 65,000
Engineering and Contingencies (35%)					$ 153,000
Subtotal of Treatment Equipment					$ 588,000
Building		**Quantity**	**Unit**	**Unit Price**	**Cost**
Metal Building		3,500	SF	$ 90	$ 315,000
Engineering and Contingencies (35%)					$ 111,000
Subtotal of Building					$ 426,000
Electrical					**Cost**
20% of Equipment Cost					$ 54,000
Engineering and Contingencies (35%)					$ 19,000
Subtotal of Electrical					$ 73,000
Instrumentation					**Cost**
20% of Equipment Cost					$ 54,000
Engineering and Contingencies (35%)					$ 19,000
Subtotal of Instrumentation					$ 73,000
CONSTRUCTION TOTAL					$ 1,625,500
Interest During Construction					$ 35,000

TOTAL COST	**$ 1,660,500**

ANNUAL COSTS		
Debt Service (6% for 20 years)	$	145,000
Operation & Maintenance	$	53,000
Total Annual Costs	**$**	**198,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	1,800
Per 1,000 Gallons	$	5.42
UNIT COSTS (After Amortization)		
Per Acre-Foot	$	482
Per 1,000 Gallons	$	1.45

WUGNAME: Ballinger
STRATEGY: Generic 0.2 MGD Reuse
STRATEGY NUMBER: F04Reuse
AMOUNT (ac-ft/yr): 220

CONSTRUCTION COSTS

Land Acquisition		**Quantity**	**Unit**	**Unit Price**	**Cost**
Reclaimed Treatment Plant Land Acquisition		3	AC	$ 5,000	$ 15,000
Engineering and Contingencies (30%)					$ 4,500
Subtotal Land Acquisition					$ 20,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline 75gpm	4 in	10,560	LF	$ 20	$ 211,000
Right-of-way easements		7	AC	$ 2,000	$ 14,500
Engineering and Contingencies (30%)					$ 79,000
Subtotal Pipeline					$ 304,500
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	2-150 gpm	1	EA	$ 24,000	$ 24,000
Storage tank	0.05 MG	1	EA	$ 100,000	$ 100,000
Engineering and Contingencies (35%)					$ 43,500
Subtotal of Pump Station(s)					$ 167,500
Treatment Equipment		**Quantity**	**Unit**	**Unit Price**	**Cost**
Microfiltration/Ultrafiltration (MF/UF) and Reverse Osmosis (RO) Equipment and Installation		1	EA	$ 565,000	$ 565,000
UV/Oxidation		1	EA	$ 100,000	$ 100,000
Engineering and Contingencies (35%)					$ 233,000
Subtotal of Treatment Equipment					$ 898,000
Building		**Quantity**	**Unit**	**Unit Price**	**Cost**
Metal Building		3,500	SF	$ 90	$ 315,000
Engineering and Contingencies (35%)					$ 111,000
Subtotal of Building					$ 426,000
Electrical					**Cost**
20% of Equipment Cost					$ 61,000
Engineering and Contingencies (35%)					$ 21,000
Subtotal of Electrical					$ 82,000
Instrumentation					**Cost**
20% of Equipment Cost					$ 61,000
Engineering and Contingencies (35%)					$ 21,000
Subtotal of Instrumentation					$ 82,000
CONSTRUCTION TOTAL					$ 1,980,000
Interest During Construction					$ 43,000

TOTAL COST	**$ 2,023,000**

ANNUAL COSTS

Debt Service (6% for 20 years)	$	176,000
Operation & Maintenance	$	76,000
Total Annual Costs	**$**	**252,000**

UNIT COSTS (Until Amortized)

Per Acre-Foot of treated water	$	1,145
Per 1,000 Gallons	$	3.45

UNIT COSTS (After Amortization)

Per Acre-Foot	$	345
Per 1,000 Gallons	$	1.04

WUGNAME:	Robert Lee
STRATEGY:	Mountain Creek Intake Structure
STRATEGY NUMBER:	F20Intake
AMOUNT (ac-ft/yr):	50

CONSTRUCTION COSTS

Pump Station with Intake	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station with Intake	10 HP	1	LS	$ 250,000	$ 250,000
Pipeline	8 in	5,280	LF	$ 24	$ 127,000
Engineering and Contingencies (35%)					$ 132,000
Subtotal Pump Station and Intake					$ 509,000
CONSTRUCTION TOTAL					$ 509,000
Permitting and Mitigation					$ 3,000
Interest During Construction	(6 months)				$ 21,000
TOTAL COST					**$ 533,000**
ANNUAL COSTS*					
Debt Service (6% for 20 years)*					$ 46,000
Electricity ($0.06 kWh)					$ 1,000
Operation & Maintenance					$ 16,000
Total Annual Costs					**$ 63,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 1,260
Per 1,000 Gallons					$ 3.87
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 340
Per 1,000 Gallons					$ 1.04

WUGNAME:	Robert Lee
STRATEGY:	Lake Spence Desalination Facility
STRATEGY NUMBER:	F16Desal
AMOUNT (ac-ft/yr):	500

CONSTRUCTION COSTS

Pump Station with Intake	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station with Intake	50 HP	1	LS	$ 650,000	$ 650,000
Engineering and Contingencies (35%)					$ 227,500
Subtotal Pump Station and Intake					$ 877,500
Transmission to Treatment Plant	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	10-inch	15,840	LF	$ 24	$ 380,000
Right-of-way		7.3	AC	$ 2,000	$ 15,000
Engineering and Contingencies (30%)					$ 119,000
Subtotal Transmission to Treatment Plant					$ 514,000
Treatment Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
RO Treatment Facility	1.0 MGD	1	LS	$ 3,200,000	$ 3,200,000
Ground storage tank	0.1 MG	1	LS	$ 75,000	$ 75,000
Engineering and Contingencies (35%)					$ 1,146,000
Subtotal of Treatment					$ 4,421,000

CONSTRUCTION TOTAL		$ 5,812,500
Permitting and Mitigation		$ 52,000
Interest During Construction	(6 months)	$ 242,000
TOTAL COST		**$ 6,106,500**
ANNUAL COSTS*		
Debt Service (6% for 20 years)*		$ 532,000
Electricity ($0.06 kWh)		$ 9,000
Operation & Maintenance		$ 19,000
Water Treatment		$ 122,000
Total Annual Costs		**$ 682,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 1,364
Per 1,000 Gallons		$ 4.19
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 300
Per 1,000 Gallons		$ 0.92

WUGNAME:	Big Spring
STRATEGY:	Big Spring Reuse
STRATEGY NUMBER:	F04Reuse
AMOUNT (ac-ft/yr):	1,855

CONSTRUCTION COSTS

	Size	Quantity	Unit	Unit Price	Cost
Land Acquisition		**Quantity**	**Unit**	**Unit Price**	**Cost**
Reclaimed Treatment Plant Land Acquisition		2	AC	$ 2,000	$ 4,000
Engineering and Contingencies (35%)					$ 1,000
Subtotal Land Acquisition					$ 5,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	10 in	5,500	LF	$ 50	$ 275,000
Transmission pipeline	6 in	500	LF	$ 30	$ 15,000
Right-of-way easements		4	AC	$ 1,000	$ 4,000
Engineering and Contingencies (30%)					$ 88,000
Subtotal Pipeline					$ 382,000
Diversion Structure & Pump Station	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	2-1715 gpm	1	EA	$ 50,000	$ 50,000
Engineering and Contingencies (35%)					$ 18,000
Subtotal of Diversion and Pump Station					$ 68,000
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	2-1400 gpm	1	EA	$ 50,000	$ 50,000
Storage tank	0.50 MG	1	EA	$ 300,000	$ 300,000
Engineering and Contingencies (35%)					$ 123,000
Subtotal of Pump Station(s)					$ 473,000
Treatment Equipment		**Quantity**	**Unit**	**Unit Price**	**Cost**
Microfiltration/Ultrafiltration (MF/UF)		1	EA	$ 1,553,000	$ 1,553,000
Reverse Osmosis (RO)		1	EA	$ 1,380,000	$ 1,380,000
UV/Oxidation		1	EA	$ 435,000	$ 435,000
Engineering and Contingencies (35%)					$ 1,179,000
Subtotal of Treatment Equipment					$ 4,547,000
Reject Facilities		**Quantity**	**Unit**	**Unit Price**	**Cost**
High Pressure Membrane Reject (Piping to Creek)		1	EA	$ 105,000	$ 105,000
Low Pressure Membrane Reject		1	EA	$ 75,000	$ 75,000
Engineering and Contingencies (35%)					$ 63,000
Subtotal of Reject Facilities					$ 243,000
Building		**Quantity**	**Unit**	**Unit Price**	**Cost**
Metal Building		5,000	SF	$ 90	$ 450,000
Engineering and Contingencies (35%)					$ 158,000
Subtotal of Building					$ 608,000
Electrical					**Cost**
20% of Equipment Cost					$ 338,000
Engineering and Contingencies (35%)					$ 118,000
Subtotal of Electrical					$ 456,000
Instrumentation					**Cost**
20% of Equipment Cost					$ 338,000
Engineering and Contingencies (35%)					$ 118,000
Subtotal of Instrumentation					$ 456,000
CONSTRUCTION TOTAL					$ 7,238,000
Permitting and Mitigation					$ 64,000
Interest During Construction					$ 304,000

TOTAL COST	**$ 7,606,000**

ANNUAL COSTS		
Debt Service (6% for 20 years)	$	663,000
Operation & Maintenance	$	505,000
Total Annual Costs	**$**	**1,168,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	630
Per 1,000 Gallons	$	1.93
UNIT COSTS (After Amortization)		
Per Acre-Foot	$	272
Per 1,000 Gallons	$	0.84

WUGNAME: Odessa and Midland
STRATEGY: Odessa and Midland Reuse Project
STRATEGY NUMBER: F04Reuse
AMOUNT (ac-ft/yr): 9,799

CONSTRUCTION COSTS

Land Acquisition		**Quantity**	**Unit**	**Unit Price**	**Cost**
Reclaimed Treatment Plant Land Acquisition		5	AC	$ 5,000	$ 25,000
Disposal Facilities Land Acquisition		25	AC	$ 1,000	$ 25,000
Engineering and Contingencies (35%)					$ 18,000
Subtotal Land Acquisition					$ 43,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	30 in	84,000	LF	$ 150	$ 12,600,000
Transmission pipeline	24 in	3,000	LF	$ 120	$ 360,000
Transmission pipeline	12 in	5,280	LF	$ 60	$ 317,000
Right-of-way easements		122	AC	$ 2,000	$ 244,000
Engineering and Contingencies (30%)					$ 4,056,000
Subtotal Pipeline					$ 17,577,000
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station Reclaimed water to terminal	2-7500 gpm	1	EA	$ 122,000	$ 122,000
Pump Station Midland Reclaimed Water	2-7640 gpm	1	EA	$ 168,000	$ 168,000
Storage tank Reclaimed water to terminal	2.7 MG	1	EA	$ 810,000	$ 810,000
Storage tank Midland Reclaimed Water	3.75 MG	1	EA`	$ 945,000	$ 945,000
Engineering and Contingencies (35%)					$ 716,000
Subtotal of Pump Station(s)					$ 2,761,000
Treatment Equipment	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Microfiltration/Ultrafiltration (MF/UF)		1	EA	$ 6,048,000	$ 6,048,000
Reverse Osmosis (RO)		1	EA	$ 5,832,000	$ 5,832,000
UV/Oxidation		1	EA	$ 1,600,000	$ 1,600,000
Secondary Treatment @ Midland's WWTP	3.75 MG	1	EA	$ 6,250,000	$ 6,250,000
Engineering and Contingencies (35%)					$ 6,906,000
Subtotal of Treatment Equipment					$ 26,636,000
Reject Facilities		**Quantity**	**Unit**	**Unit Price**	**Cost**
High Pressure Membrane Reject					
Pumps	2-1875 gpm	1	EA	$ 110,000	$ 110,000
RO reject lagoon	2.7 MG	1	EA	$ 450,000	$ 450,000
Brine Lagoon	40.5 MG	1	EA	$ 2,232,000	$ 2,232,000
Disposal Well		4	EA	$ 1,500,000	$ 6,000,000
Pipeline	18 in	85,000	LF	$ 90	$ 7,621,000
Low Pressure Membrane Reject					
Lagoon	1.5 MG	1	LS	$ 550,000	$ 550,000
Engineering and Contingencies (35%)					$ 5,937,000
Subtotal of Reject Facilities					$ 22,900,000

Aquifer Storage and Recovery		Quantity	Unit	Unit Price	Cost
Pipeline	14 in	27,000	LF	$ 70	$ 1,890,000
Pumps	2-1875 gpm	1	EA	$ 34,000	$ 34,000
Well Field Modification		1	LS	$ 50,000	$ 50,000
Engineering and Contingencies (35%)					$ 691,000
Subtotal of Aquifer Storage and Recovery					$ 2,665,000

Building		Quantity	Unit	Unit Price	Cost
Metal Building		15,000	SF	$ 90	$ 1,350,000
Engineering and Contingencies (35%)					$ 473,000
Subtotal of Building					$ 1,823,000

Electrical	Cost
10% of Equipment Cost	$ 1,391,000
Engineering and Contingencies (35%)	$ 487,000
Subtotal of Electrical	$ 1,878,000

Instrumentation	Cost
10% of Equipment Cost	$ 1,391,000
Engineering and Contingencies (35%)	$ 487,000
Subtotal of Instrumentation	$ 1,878,000

CONSTRUCTION TOTAL	$ 78,161,000
Permitting and Mitigation	$ 697,000
Interest During Construction	$ 3,286,000
TOTAL COST	**$ 82,144,000**
ANNUAL COSTS	
Debt Service (6% for 20 years)	$ 7,162,000
Operation & Maintenance	$ 2,851,000
Total Annual Costs	**$ 10,013,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot of treated water	$ 1,022
Per 1,000 Gallons	$ 3.14
UNIT COSTS (After Amortization)	
Per Acre-Foot	$ 291
Per 1,000 Gallons	$ 0.89

WUGNAME:	Snyder
STRATEGY:	Snyder Reuse Project
STRATEGY NUMBER:	F04Reuse
AMOUNT (ac-ft/yr):	726

CONSTRUCTION COSTS

Land Acquisition		**Quantity**	**Unit**	**Unit Price**	**Cost**
Reclaimed Treatment Plant Land Acquisition		2	AC	$ 2,000	$ 4,000
Engineering and Contingencies (35%)					$ 1,000
Subtotal Land Acquisition					$ 5,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline to CRMWD GST	8 in	6,800	LF	$ 50	$ 340,000
Transmission pipeline to Reclaimed WTP	8 in	1,500	LF	$ 40	$ 60,000
Transmission pipeline to Disposal	4 in	1,500	LF	$ 20	$ 30,000
Right-of-way easements		7	AC	$ 1,000	$ 7,000
Engineering and Contingencies (30%)					$ 131,000
Subtotal Pipeline					$ 568,000
Pump Station(s) & Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station finished water to CRMWD GST	2-500	1	EA	$ 40,000	$ 40,000
Pump Station WWTP efluent to Reclaim WTP	2-700	1	EA	$ 40,000	$ 40,000
Storage reservoir in snyder	15 MG	1	EA	$ 990,000	$ 990,000
Storage tank	0.18 MG	1	EA	$ 180,000	$ 180,000
Lagoon (1day storage)	1 MG	1	EA`	$ 175,000	$ 175,000
Engineering and Contingencies (35%)					$ 499,000
Subtotal of Pump Station(s)					$ 1,924,000
Treatment Equipment	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Microfiltration/Ultrafiltration (MF/UF)		1	EA	$ 607,000	$ 607,000
Reverse Osmosis (RO)		1	EA	$ 432,000	$ 432,000
UV/Oxidation		1	EA	$ 190,000	$ 190,000
Engineering and Contingencies (35%)					$ 430,000
Subtotal of Treatment Equipment					$ 1,659,000
Reject Facilities		**Quantity**	**Unit**	**Unit Price**	**Cost**
High Pressure Membrane Reject					
Pumps	2-125 gpm	1	EA	$ 25,000	$ 25,000
RO reject lagoon (1 day storage)	0.18 MG	1	EA	$ 63,000	$ 63,000
Low Pressure Membrane Reject					
Pumps	2-70 gpm	1	EA	$ 25,000	$ 25,000
Lagoon (1 day storage)	0.2 MG	1	LS	$ 175,000	$ 175,000
Engineering and Contingencies (35%)					$ 101,000
Subtotal of Reject Facilities					$ 389,000

Aquifer Storage and Recovery		**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	8 in	27,000	LF	$ 40	$ 1,080,000
Pumps	2-347	1	EA	$ 35,000	$ 35,000
ASR Well Facilities		1	LS	$ 142,000	$ 142,000
Engineering and Contingencies (35%)					$ 440,000
Subtotal of Aquifer Storage and Recovery					$ 1,697,000
Building		**Quantity**	**Unit**	**Unit Price**	**Cost**
Metal Building		4,500	SF	$ 90	$ 405,000
Engineering and Contingencies (35%)					$ 142,000
Subtotal of Building					$ 547,000
Electrical					**Cost**
10% of Equipment Cost					$ 128,000
Engineering and Contingencies (35%)					$ 45,000
Subtotal of Electrical					$ 173,000
Instrumentation					**Cost**
10% of Equipment Cost					$ 128,000
Engineering and Contingencies (35%)					$ 45,000
Subtotal of Instrumentation					$ 173,000
CONSTRUCTION TOTAL					$ 7,135,000
Permitting and Mitigation					$ 63,000
Interest During Construction					$ 300,000
TOTAL COST					**$ 7,498,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 654,000
Operation & Maintenance					$ 200,000
Total Annual Costs					**$ 854,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 1,176
Per 1,000 Gallons					$ 3.61
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 275
Per 1,000 Gallons					$ 0.85

WUGNAME:	CRMWD
STRATEGY:	Southwest Pecos County to Odessa
STRATEGY NUMBER:	F13OthGW
AMOUNT (ac-ft/yr):	15,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water Wells	12-inch	10	EA	$ 278,000	$ 2,780,000
Well field piping		20	MGD	$ 250,000	$ 5,000,000
Other well field appurtanances		1	LS	$ 1,000,000	$ 1,000,000
Engineering and Contingencies (35%)					$ 3,073,000
Subtotal of Well Field					$ 11,853,000
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	42 in.	554,400	LF	$ 178	$ 98,406,000
Right-of-way easements		255	AC	$ 2,000	$ 510,000
Engineering and Contingencies (30%)					$ 29,675,000
Subtotal Pipeline					$ 128,591,000
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	250 HP	1	EA	$ 1,065,000	$ 1,065,000
Storage tank	4 MG	1	EA	$ 745,000	$ 745,000
Engineering and Contingencies (35%)					$ 634,000
Subtotal of Pump Station(s)					$ 2,444,000

CONSTRUCTION TOTAL		$ 142,888,000
Permitting and Mitigation		$ 1,308,000
Interest During Construction	(12 months)	$ 5,954,000
TOTAL COST		**$ 150,150,000**
ANNUAL COSTS		
Debt Service (6% for 20 years)		$ 13,091,000
Electricity ($0.06 kWh)		$ 1,074,000
Operation & Maintenance		$ 1,384,000
Water Purchase		$ 1,466,000
Water Treatment		$ 1,711,000
Total Annual Costs		**$ 18,726,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 1,248
Per 1,000 Gallons		$ 3.83
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 376
Per 1,000 Gallons		$ 1.15

WUGNAME:	CRMWD
STRATEGY:	Well field development and transmission pipeline from Roberts County to CRMWD
STRATEGY NUMBER:	F08Market
AMOUNT (ac-ft/yr):	25,000

	Size	Quantity	Unit	Unit Price	Cost
GROUNDWATER COSTS		**Quantity**	**Unit**	**Unit Price**	**Cost**
Groundwater Rights		10,000	Acre	500	$ 5,000,000
Subtotal					$ 5,000,000
CONSTRUCTION COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Well Facilities					
Wells (1,000 gpm per well)	1000 gpm	23	LS	$450,000	$10,350,000
Well field pipeline ($250,000 / mgd)	33.5 mgd	33.50	MGD	$250,000	$8,375,000
Engineering and Contingencies (30%)					$5,618,000
Subtotal of Well Field					$24,343,000
Pipeline					
Pipeline	48 in.	1,625,000	LF	$176	$286,000,000
Right of Way Easements (ROW)	30 ft.	1,119	Acre	$4,000	$4,477,000
Engineering and Contingencies (30%)					$87,143,000
Subtotal of Pipeline					$377,620,000
Pump Station(s)					
Booster Pump Station	4500 HP	1	LS	$5,450,000	$5,450,000
Booster Pump Station	4000 HP	2	LS	$5,100,000	$10,200,000
Booster Pump Station	750 HP	1	LS	$2,000,000	$2,000,000
Ground Storage Tank	4.2 MG	3	LS	$775,000	$2,325,000
Engineering and Contingencies (35%)					$6,991,000
Subtotal of Pump Station(s)					$26,966,000
CONSTRUCTION TOTAL					$ 142,888,000
Permitting and Mitigation					$3,750,000
Interest During Construction (18 months)					$26,683,000
TOTAL COST Before Development Costs					**$432,679,000**
Development Costs					
Preliminary Expenses		1	LS	$25,000,000	$25,000,000
Development Fee	15%	1	LS	$73,404,000	$73,404,000
Subtotal					$98,404,000
TOTAL COST					**$562,766,000**

ANNUAL COSTS	
Debt Service (6% for 30 years)	$40,884,000
Electricity transmission($0.06 kWh)	$3,256,000
Electricity well field (330 HP each well $0.06 kWh)	$2,972,000
Operation & Maintenance	$4,031,000
Total Annual Costs	**$51,143,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$2,046
Per 1,000 Gallons	$6.28
UNIT COSTS (After Amortization)	
Per Acre-Foot	$410
Per 1,000 Gallons	$1.26

WUGNAME: CRMWD
STRATEGY: Winkler County Well Field
STRATEGY NUMBER: F12CenGW
AMOUNT (ac-ft/yr): 6,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells		7	EA	$ 173,000	$ 1,211,000
Well field pipeline	10"	2,800	LF	$ 24	$ 67,000
Well field pipeline	12"	6,050	LF	$ 28	$ 169,000
Well field pipeline	14"	600	LF	$ 32	$ 19,000
Well field pipeline	16"	1,000	LF	$ 37	$ 37,000
Well field pipeline	18"	800	LF	$ 42	$ 34,000
Well field pipeline	24"	2,000	LF	$ 66	$ 132,000
Well field pipeline	27"	2,000	LF	$ 76	$ 152,000
Well field pipeline	30"	7,650	LF	$ 86	$ 658,000
Other well field appurtenances			LS	$ 1,000,000	$ 1,000,000
Engineering and contingencies (35%)					$ 1,218,000
Subtotal Well field					$ 4,697,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	36 in	228,934	LF	$ 89	$ 20,375,000
Right-of-way easements		105	AC	$ 2,000	$ 210,000
Engineering and Contingencies (30%)					$ 6,176,000
Subtotal Pipeline					$ 26,761,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	1600 HP	1	EA	$ 3,060,000	$ 3,060,000
Storage tank	5 MG	2	EA	$ 895,000	$ 1,790,000
Engineering and Contingencies (35%)					$ 1,698,000
Subtotal of Pump Station(s)					$ 6,548,000

CONSTRUCTION TOTAL		$ 38,006,000
Permitting and Mitigation		$ 344,000
Interest During Construction	(12 months)	$ 1,584,000
TOTAL COST		**$ 39,934,000**
ANNUAL COSTS		
Debt Service (6% for 20 years)		$ 3,482,000
Electricity ($0.06 kWh)		$ 484,000
Operation & Maintenance		$ 434,000
Water Purchase		$ 587,000
Total Annual Costs		**$ 4,987,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 831
Per 1,000 Gallons		$ 2.55
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 251
Per 1,000 Gallons		$ 0.77

WUGNAME:	Kimble County Manufacturing
STRATEGY:	New Groundwater from Edwards-Trinity Plateau Aquifer
STRATEGY NUMBER:	F10ETRGW
AMOUNT (ac-ft/yr):	1,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells	8-in.	5	EA	$ 108,000	$ 540,000
Connection to Existing System		5	LF	$ 50,000	$ 250,000
Engineering and contingencies (35%)					$ 277,000
Subtotal Well field					$ 1,067,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	12 in.	79,200	LF	$ 28	$ 2,217,600
Right-of-way easements		36	AC	$ 2,000	$ 72,000
Engineering and Contingencies (30%)					$ 687,000
Subtotal Pipeline					$ 2,976,600

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	200 HP	1	EA	$ 930,000	$ 930,000
Storage tank	0.5 MG	1	EA	$ 155,000	$ 155,000
Engineering and Contingencies (35%)					$ 380,000
Subtotal of Pump Station(s)					$ 1,465,000

CONSTRUCTION TOTAL		$ 5,508,600
Permitting and Mitigation		$ 49,000
Interest During Construction	(6 months)	$ 119,000
TOTAL COST		**$ 5,676,600**
ANNUAL COSTS		
Debt Service (6% for 20 years)		$ 495,000
Electricity ($0.06 kWh)		$ 56,000
Operation & Maintenance		$ 70,000
Water Purchase		$ 49,000
Total Annual Costs		**$ 670,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 670
Per 1,000 Gallons		$ 2.06
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 175
Per 1,000 Gallons		$ 0.54

WUGNAME:	Menard
STRATEGY:	New Hickory Well
STRATEGY NUMBER:	F11HICGW
AMOUNT (ac-ft/yr):	160

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells	10-in	1	EA	$ 869,600	$ 869,600
Connection to existing system		1	LS	$ 50,000	$ 50,000
Engineering and contingencies (35%)					$ 321,900
Subtotal Well field					$ 1,241,500
CONSTRUCTION TOTAL					$ 1,241,500
Permitting and Mitigation					$ 11,000
Interest During Construction	(6 months)				$ 26,900
TOTAL COST					**$ 1,279,400**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 111,500
Electricity ($0.06 kWh)					$ 50,000
Operation & Maintenance					$ 11,000
Total Annual Costs					**$ 172,500**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 1,078
Per 1,000 Gallons					$ 3.31
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 381
Per 1,000 Gallons					$ 1.17

WUGNAME: Menard
STRATEGY: New Hickory Well with ASR
STRATEGY NUMBER: F17ASR
AMOUNT (ac-ft/yr): 240

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells	10-in	1	EA	$ 869,600	$ 869,600
Connection to existing system		1	LS	$ 50,000	$ 50,000
Injection pump		1	EA	$ 15,000	$ 15,000
Engineering and contingencies (35%)					$ 327,100
Subtotal Well field					$ 1,261,700
CONSTRUCTION TOTAL					$ 1,261,700
Permitting and Mitigation					$ 51,200
Interest During Construction	(6 months)				$ 27,300
TOTAL COST					**$ 1,340,200**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 116,800
Electricity ($0.06 kWh)					$ 91,000
Operation & Maintenance					$ 11,200
Total Annual Costs					**$ 219,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 913
Per 1,000 Gallons					$ 2.80
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 426
Per 1,000 Gallons					$ 1.31

WUGNAME: Menard
STRATEGY: San Saba Off-Channel Reservoir
STRATEGY NUMBER: F22OCR
AMOUNT (ac-ft/yr): 500

CONSTRUCTION COSTS

Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Mobilization		1	LS	$ 211,700	$ 245,200
Care of Water During Construction		1	LS	$ 46,900	$ 160,100
Clearing and Grubbing		5	Ac	$ 2,000	$ 10,800
Foundation Preparation		1	LS	$ 50,000	$ 50,000
Required Excavation		10,000	CY	$ 4	$ 35,000
Borrow Excavation		188,000	CY	$ 4	$ 658,000
Random Compacted Fill		198,000	CY	$ 5	$ 891,000
Core Wall		4,000	CY	$ 325	$ 1,300,000
Soil Cement		8,000	CY	$ 80	$ 640,000
Flex Base Roadway		1,000	CY	$ 40	$ 40,000
Spillway Structure Reinforced Concrete		1,800	CY	$ 375	$ 675,000
Rock Riprap		550	CY	$ 100	$ 55,000
Misc. Internal Drainage		1	LS	$ 500,000	$ 500,000
Instrumentation-Piezometers		1	LS	$ 50,000	$ 50,000
Instrumentation-Monuments		1	LS	$ 25,000	$ 25,000
Reservoir site		75	AC	$ 2,300	$ 172,500
Engineering and contingencies (35%)					$ 1,928,000
Subtotal Reservoir					$ 7,435,600

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline from River to OCR	24 in	1,500	LF	$ 66	$ 99,000
Pipeline from OCR to WTP	8 in	5,400	LF	$ 30	$ 162,000
Pipeline from WTP to Menard	8 in	2,300	LF	$ 30	$ 69,000
Right-of-way easements		1	AC	$ 2,000	$ 2,000
Engineering and Contingencies (30%)					$ 100,000
Subtotal Pipeline					$ 432,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Channel Weir		1	LS	$ 275,000	$ 275,000
River Pump Station	400 HP	1	LS	$ 1,500,000	$ 1,500,000
Reservoir Pump Station w intake	50 HP	1	LS	$ 600,000	$ 600,000
Pump Station (WTP to Menard)	50 HP	1	EA	$ 400,000	$ 400,000
Engineering and Contingencies (35%)					$ 971,000
Subtotal of Pump Station(s)					$ 3,746,000

New Water Treatment Plant	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Conventional WTP	1.1 mgd	1	LS	$ 4,200,000	$ 4,200,000
Engineering and Contingencies (35%)					$ 1,470,000
Subtotal WTP					$ 5,670,000

CONSTRUCTION TOTAL		$ 17,283,600
Permitting and Mitigation		$ 529,500
Interest During Construction	(24 months)	$ 1,412,000
TOTAL COST		**$ 19,225,100**

ANNUAL COSTS		
Debt Service (6% for 30 years)	$	1,397,000
Electricity ($0.06 kWh)	$	20,000
Operation & Maintenance	$	186,000
Water Treatment	$	57,000
Water Purchase	$	59,000
Total Annual Costs	**$**	**1,719,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	3,438
Per 1,000 Gallons	$	10.55
UNIT COSTS (After Amortization)		
Per Acre-Foot	$	644
Per 1,000 Gallons	$	1.98

WUGNAME:	Midland
STRATEGY:	T-Bar Well Field
STRATEGY NUMBER:	F12CenGW
AMOUNT (ac-ft/yr):	13,600

Based on draft cost estimate by PSC. Provided by City of Midland on 5/16/05

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wells		43	EA	$ 353,000	$ 15,179,000
Well field piping		20	MGD	$ 250,000	$ 5,000,000
Well field site improvements		1	LS	$ 3,643,000	$ 3,643,000
Engineering and Contingencies (35%)					$ 8,338,000
					$ 32,160,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipe	36 in.	368,860	LF	$ 114	$ 42,050,000
Right-of-way easements		169	AC	$ 2,000	$ 338,000
Engineering and Contingencies (30%)					$ 12,716,000
Subtotal Pipeline					$ 55,104,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station at Well Field	1400 HP	1	LS	$ 2,840,000	$ 2,840,000
Storage Tank at Well Field	6 MG	1	LS	$ 1,100,000	$ 1,100,000
Booster Station	1400 HP	1	LS	$ 2,840,000	$ 2,840,000
Storage Tank at Booster Station	6 MG	1	LS	$ 1,100,000	$ 1,100,000
Storage Tank at High Point	6 MG	1	LS	$ 1,100,000	$ 1,100,000
Chlorination and other improvements		1	LS	$ 8,000,000	$ 8,000,000
Engineering and Contingencies (35%)					$ 5,943,000
Subtotal of Pump Station(s)					$ 22,923,000

CONSTRUCTION TOTAL		$ 110,187,000
Permitting and Mitigation		$ 994,000
Interest During Construction	(12 months)	$ 4,591,000
TOTAL COST		**$ 115,772,000**

ANNUAL COSTS	
Debt Service (6% for 20 years)	$ 10,094,000
Electricity ($0.06 kWh)	$ 1,257,000
Operation & Maintenance	$ 1,729,000
Total Annual Costs	**$ 13,080,000**
UNIT COSTS (Before Amortization)	
Per Acre-Foot of treated water	$ 962
Per 1,000 Gallons	$ 2.95
UNIT COSTS (After Amortization)	
Per Acre-Foot	$ 220
Per 1,000 Gallons	$ 0.67

WUGNAME:	City of Ballinger
STRATEGY:	Pipeline to Hords Creek Reservoir
STRATEGY NUMBER:	F06AVolRed
AMOUNT (ac-ft/yr):	220

CONSTRUCTION COSTS

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
12" DR-11 HDPE water line	12 in.	16,000	LF	$ 25.00	$ 400,000
10" DR-13.5 HPDE water line	10 in.	8,000	LF	$ 17.00	$ 136,000
10" DR-17 HPDE water line	10 in.	86,000	LF	$ 14.00	$ 1,204,000
Class "C" bedding material		110,000	LF	$ 1.20	$ 132,000
HPDE heat fusion fittings		1	LS	$ 67,000	$ 67,000
10" gate valve with valve box	10 in.	25	EA	$ 2,000	$ 50,000
12" gate valve with valve box	10 in.	3	EA	$ 2,500	$ 7,500
Tie-in existing raw water line	10 in.	1	EA	$ 2,000	$ 2,000
Master meter and valve vault		1	LS	$ 9,800	$ 9,800
Air relief valve assembly		10	EA	$ 3,000	$ 30,000
Flush valve assembly		5	EA	$ 2,500	$ 12,500
Stream crossing		4	EA	$ 15,000	$ 60,000
18" bore & steel casement		1,500	LF	$ 100	$ 150,000
Gravel roadway repair		3,900	LF	$ 8.00	$ 31,200
Asphalt roadway repair		1,000	LF	$ 20.00	$ 20,000
Pipeline markers		200	EA	$ 50.00	$ 10,000
Right-of-way easements		1	LS	$ 55,000	$ 55,000
Engineering and Contingencies (30%)					$ 713,000
Subtotal pipeline					$ 3,090,000

Pump Station	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	35 HP	1	EA	$ 150,000	$ 150,000
Fencing		500	LF	$ 20.00	$ 10,000
Pipe insulation		1	LS	$ 5,000	$ 5,000
Site piping		1	LS	$ 25,000	$ 25,000
Electrical service		1	LS	$ 50,000	$ 50,000
Controls and telemetry		1	LS	$ 15,000	$ 15,000
Engineering and Contingencies (35%)					$ 89,000
Subtotal of Pump Station(s)					$ 344,000

Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Ground Storage Tank	500,000 gal	1	EA	$ 300,000	$ 300,000
Engineering and Contingencies (35%)					$ 105,000
Subtotal of Ground Storage					$ 405,000

Mobilization, bonding & insurance	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
		1	LS	$ 143,900	$ 143,900

CONSTRUCTION TOTAL		$ 3,982,900
Permitting and Mitigation		$ 35,000
Interest During Construction	(6 months)	$ 86,000
TOTAL COST		**$ 4,103,900**

ANNUAL COSTS		
Debt Service (6% for 20 years)	$	358,000
Electricity ($0.06 kWh)	$	5,000
Operation & Maintenance	$	51,000
Raw Water Purchase	$	22,000
Total Annual Costs	**$**	**436,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	1,982
Per 1,000 Gallons	$	6.08
UNIT COSTS (After Amortization)		
Per Acre-Foot	$	355
Per 1,000 Gallons	$	1.09

WUGNAME:	Miles, Ballinger and Winters
STRATEGY:	Purchase Water from San Angelo Regional Desal Facility - Runnels County System
STRATEGY NUMBER:	F24SADESA
AMOUNT (ac-ft/yr):	Miles 224
	Ballinger 1345
	Winters 729
	Total 2,298

CONSTRUCTION COSTS

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
San Angelo to Miles	18 in.	100,183	LF	$ 42	$ 4,207,684
Miles to Ballinger	18 in.	92,340	LF	$ 42	$ 3,878,281
Ballinger to Winters	12 in.	79,965	LF	$ 28	$ 2,239,008
Right-of-way easements		125	AC	$ 1,000	$ 125,000
Engineering and Contingencies (30%)					$ 3,135,000
Subtotal Pipeline					$ 13,584,974

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station at San Angelo	300 HP	1	LS	$ 1,200,000	$ 1,200,000
Storage Tank at San Angelo	0.5 MG	1	LS	$ 155,000	$ 155,000
Pump Station at Miles	200 HP	1	LS	$ 775,000	$ 775,000
Storage Tank at Miles	0.5 MG	1	LS	$ 155,000	$ 155,000
Pump Station at Ballinger	200 HP	1	LS	$ 775,000	$ 775,000
Storage Tank at Ballinger	0.4 MG	1	LS	$ 122,000	$ 122,000
Engineering and Contingencies (35%)					$ 1,114,000
Subtotal of Pump Station(s)					$ 4,296,000

CONSTRUCTION TOTAL		$ 17,880,974
Permitting and Mitigation		$ 162,000
Interest During Construction	(6 months)	$ 387,000
TOTAL COST		**$ 18,429,974**
ANNUAL COSTS		
Debt Service (6% for 20 years)		$ 1,607,000
Electricity ($0.06 kWh)		$ 48,000
Operation & Maintenance		$ 219,000
Treated Water Purchase		$ 2,246,000
Total Annual Costs		**$ 4,120,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 1,793
Per 1,000 Gallons		$ 5.50
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 1,094
Per 1,000 Gallons		$ 3.36

WUGNAME: San Angelo
STRATEGY: Phase I - 5.0 MGD Regional Brackish Water Desalination Facility
STRATEGY NUMBER: F16DESAL
AMOUNT (ac-ft/yr): 5,600

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land acquisition		800	AC	$ 2,000	$ 1,600,000
Well pumps	10-500 gpm	16	EA	$ 15,000	$ 240,000
Well construction		16	EA	$ 150,000	$ 2,400,000
Well field piping		5	LS	$ 250,000	$ 1,250,000
Ground storage tank	1.5 MG		LS	$ 500,000	$ 500,000
Engineering and Contingencies (35%)					$ 2,097,000
Subtotal Well Field					$ 8,087,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline - well field to treatment p	30 in.	80,000	LF	$ 86	$ 6,880,000
Transmission pipeline - treatment plant to dispo	16 in.	2,000	LF	$ 37	$ 74,000
Right-of-way easements		56.47	AC	$ 1,000	$ 56,000
Engineering and Contingencies (30%)					$ 2,103,000
Subtotal Pipeline					$ 9,113,000

Pumps	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Well field to treatment plant	2- 4000 gpm	2	EA	$ 70,000	$ 140,000
High pressure well disposal pumps	2-1300 gpm	2	EA	$ 20,000	$ 40,000
Engineering and Contingencies (35%)					$ 63,000
Subtotal of Pumps					$ 243,000

Treatment Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land acquisition		30	AC	$ 2,000	$ 60,000
RO Unit	5.0 MGD	1	LS	$ 2,625,000	$ 2,625,000
Ground storage tank	2.5 MG	1	LS	$ 750,000	$ 750,000
Disinfection facility		1	LS	$ 120,000	$ 120,000
Metal Building		5,000	SF	$ 90	$ 450,000
Engineering and Contingencies (35%)					$ 1,402,000
Subtotal of Treatment					$ 5,407,000

Reject Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Brine lagoon	19 MG	1	LS	$ 1,350,000	$ 1,350,000
Disposal wells		7	LS	$ 1,200,000	$ 8,400,000
Engineering and Contingencies (35%)					$ 3,413,000
Subtotal of Reject Facilities					$ 13,163,000

Electrical and Instrumentation	Size	Quantity	Unit	Unit Price	Cost
Electrical		1	LS	$ 355,050	$ 355,000
Instrumentation		1	LS	$ 236,700	$ 237,000
Power Service		10,000	LF	$ 30	$ 300,000
Engineering and Contingencies (35%)					$ 312,000
Subtotal of Electrical & Instrumentation					$ 1,204,000
CONSTRUCTION TOTAL					$ 37,217,000
Permitting and Mitigation					$ 333,000
Interest During Construction	(24 months)				$ 3,040,000
TOTAL COST					**$ 40,590,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 3,539,000
Electricity ($0.06 kWh)					$ 429,000
Operation & Maintenance					$ 1,106,000
Water Purchase					$ 547,000
Total Annual Costs					**$ 5,621,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 1,004
Per 1,000 Gallons					$ 3.08
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 372
Per 1,000 Gallons					$ 1.14

WUGNAME: San Angelo
STRATEGY: Phase II - Upgrade Desal Facility to 10 MGD
STRATEGY NUMBER: F16DESAL
AMOUNT (ac-ft/yr): 11,200

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land acquisition		800	AC	$ 2,000	$ 1,600,000
Well pumps	10-500 gpm	16	EA	$ 15,000	$ 240,000
Well construction		16	EA	$ 150,000	$ 2,400,000
Well field piping		5	LS	$ 250,000	$ 1,250,000
Ground storage tank	1.5 MG		LS	$ 500,000	$ 500,000
Engineering and Contingencies (35%)					$ 2,097,000
Subtotal Well Field					$ 8,087,000

Pumps	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Well field to treatment plant	3 - 4000 gpm	3	EA	$ 70,000	$ 210,000
High pressure well disposal pumps	1 -1300 gpm	1	EA	$ 20,000	$ 20,000
Engineering and Contingencies (35%)					$ 81,000
Subtotal of Pumps					$ 311,000

Treatment Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
RO Unit	5.0 MGD	1	LS	$ 2,625,000	$ 2,625,000
Disinfection facility		1	LS	$ 50,000	$ 50,000
Engineering and Contingencies (35%)					$ 936,000
Subtotal of Treatment					$ 3,611,000

Reject Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Brine lagoon	19 MG	1	LS	$ 1,350,000	$ 1,350,000
Disposal wells		7	LS	$ 1,200,000	$ 8,400,000
Engineering and Contingencies (35%)					$ 3,413,000
Subtotal of Reject Facilities					$ 13,163,000

Electrical and Instrumentation	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Electrical		1	LS	$ 355,050	$ 355,000
Instrumentation		1	LS	$ 236,700	$ 237,000
Power Service		10,000	LF	$ 30	$ 300,000
Engineering and Contingencies (35%)					$ 312,000
Subtotal of Electrical & Instrumentation					$ 1,204,000

CONSTRUCTION TOTAL		$ 26,376,000
Permitting and Mitigation		$ 234,000
Interest During Construction	(24 months)	$ 2,154,000

TOTAL COST	**$ 28,764,000**

ANNUAL COSTS*

Debt Service (6% for 20 years)*	$	6,047,000
Electricity ($0.06 kWh)	$	917,000
Operation & Maintenance	$	1,910,000
Water Purchase	$	1,095,000
Total Annual Costs	**$**	**9,969,000**

UNIT COSTS (Until Amortized)

Per Acre-Foot of treated water	$	890
Per 1,000 Gallons	$	2.73

UNIT COSTS (After Amortization)

Per Acre-Foot	$	350
Per 1,000 Gallons	$	1.07

* Includes debt service and other annual costs for 5 MGD facility

WUGNAME:	San Angelo
STRATEGY:	Groundwater from Edwards-Trinity (Plateau) aquifer
STRATEGY NUMBER:	F10ETRGW
AMOUNT (ac-ft/yr):	12,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells		10	EA	$ 200,000	$ 2,000,000
Well field piping		15	MGD	$ 250,000	$ 3,750,000
Other well field appurtenances			LS	$ 500,000	$ 500,000
Engineering and contingencies (30%)					$ 1,875,000
Subtotal Well Field					$ 8,125,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	30 in.	160,000	LF	$ 86	$ 13,760,000
Right-of-way easements		73	AC	$ 2,000	$ 146,000
Engineering and Contingencies (30%)					$ 4,172,000
Subtotal Pipeline					$ 18,078,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	450 HP	1	EA	$ 1,600,000	$ 1,600,000
Storage tank	6 MG	1	EA	$ 1,100,000	$ 1,100,000
Engineering and Contingencies (35%)					$ 945,000
Subtotal of Pump Station(s)					$ 3,645,000

CONSTRUCTION TOTAL		$ 29,848,000
Permitting and Mitigation		$ 273,000
Interest During Construction	(24 months)	$ 1,244,000
TOTAL COST		**$ 31,365,000**

ANNUAL COSTS

Debt Service (6% for 20 years)	$ 2,735,000
Electricity ($0.06 kWh)	$ 1,389,000
Operation & Maintenance	$ 323,000
Water Purchase	$ 1,173,000
Total Annual Costs	**$ 5,620,000**

UNIT COSTS (Until Amortized)

Per Acre-Foot of treated water	$ 468
Per 1,000 Gallons	$ 1.44

UNIT COSTS (After Amortization)

Per Acre-Foot	$ 240
Per 1,000 Gallons	$ 0.74

WUGNAME:	San Angelo
STRATEGY:	Groundwater from Southwest Pecos County
STRATEGY NUMBER:	F13OTHGW
AMOUNT (ac-ft/yr):	12,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells		20	EA	$ 700,000	$ 14,000,000
Well field piping		15	MGD	$ 250,000	$ 3,750,000
Other well field appurtenances			LS	$ 2,000,000	$ 2,000,000
Engineering and contingencies (30%)					$ 5,925,000
Subtotal Well Field					$ 25,675,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	36 in.	401,719	LF	$ 114	$ 45,796,000
Transmission pipeline - high pressure	36 in.	341,582	LF	$ 148	$ 50,554,000
Transmission pipeline	30 in.	189,072	LF	$ 86	$ 16,260,000
Right-of-way easements		428	AC	$ 1,000	$ 428,000
Engineering and Contingencies (30%)					$ 33,911,000
Subtotal Pipeline					$ 146,949,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	500 HP	1	EA	$ 1,700,000	$ 1,700,000
Storage tank	6 MG	2	EA	$ 1,100,000	$ 2,200,000
Engineering and Contingencies (35%)					$ 1,365,000
Subtotal of Pump Station(s)					$ 5,265,000

CONSTRUCTION TOTAL		$ 177,889,000
Permitting and Mitigation		$ 1,635,000
Interest During Construction	(24 months)	$ 14,528,000
TOTAL COST		**$ 194,052,000**

ANNUAL COSTS

Debt Service (6% for 20 years)	$ 16,918,000
Electricity ($0.06 kWh)	$ 2,600,000
Operation & Maintenance	$ 1,710,000
Water Purchase	$ 1,173,000
Total Annual Costs	**$ 22,401,000**

UNIT COSTS (Until Amortized)

Per Acre-Foot of treated water	$ 1,867
Per 1,000 Gallons	$ 5.73

UNIT COSTS (After Amortization)

Per Acre-Foot	$ 457
Per 1,000 Gallons	$ 1.40

WUGNAME:	San Angelo
STRATEGY:	McCulloch County Well Field
STRATEGY NUMBER:	F11HICGW
AMOUNT (ac-ft/yr):	12,000

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Water wells		19	EA	$ 700,000	$ 13,300,000
Well field piping		1	LS	$ 6,549,000	$ 6,549,000
Rehabilitation of existing wells		9	EA	$ 350,000	$ 3,150,000
Engineering and contingencies (30%)					$ 6,900,000
Subtotal Well Field					$ 29,899,000

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	36 in.	304,000	LF	$ 114	$ 34,656,000
Right-of-way easements		140	AC	$ 2,000	$ 280,000
Engineering and Contingencies (30%)					$ 10,481,000
Subtotal Pipeline					$ 45,417,000

Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station	2600 HP	1	EA	$ 4,200,000	$ 4,200,000
Storage tank	6 MG	2	EA	$ 1,100,000	$ 2,200,000
Engineering and Contingencies (35%)					$ 2,240,000
Subtotal of Pump Station(s)					$ 8,640,000

CONSTRUCTION TOTAL		$ 83,956,000
Permitting and Mitigation		$ 769,000
Interest During Construction	(24 months)	$ 6,857,000
TOTAL COST		**$ 91,582,000**

ANNUAL COSTS	
Debt Service (6% for 20 years)	$ 7,985,000
Electricity ($0.06 kWh)	$ 4,097,000
Operation & Maintenance	$ 887,000
Water Purchase	$ -
Total Annual Costs	**$ 12,969,000**

UNIT COSTS (Until Amortized)	
Per Acre-Foot of treated water	$ 1,081
Per 1,000 Gallons	$ 3.32

UNIT COSTS (After Amortization)	
Per Acre-Foot	$ 415
Per 1,000 Gallons	$ 1.27

WUGNAME:	City of Eden
STRATEGY:	0.7 MGD RO Plant
STRATEGY NUMBER:	F27ADVTR
AMOUNT (ac-ft/yr):	392

CONSTRUCTION COSTS

Treatment Facility	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
RO Plant	0.7 MGD	1	LS	$ 1,070,000	$ 1,070,000
Storage Tank	100,000 gal	1	LS	$ 75,000	$ 75,000
Engineering and Contingencies (35%)					$ 400,750
CONSTRUCTION TOTAL					$ 1,545,750
Permitting and Mitigation					$ 13,740
Interest During Construction					$ 126,241
TOTAL COST					**$ 1,685,731**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 146,970
O&M					$ 57,484
Total Annual Cost					**$ 204,454**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 522
Per 1,000 gallons					$ 1.60
UNIT COSTS (After Amortization)					
Per Acre-Foot of treated water					$ 147
Per 1,000 gallons					$ 0.45

WUGNAME:	City of Eden
STRATEGY:	0.7 MGD CAX TreatmentPlant
STRATEGY NUMBER:	F27ADVTR
AMOUNT (ac-ft/yr):	392

CONSTRUCTION COSTS

Treatment Facility	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
CAX Plant	0.7 MGD	1	LS	$ 1,070,000	$ 1,050,000
Storage tank	100,000 gal	1	LS	$ 75,000	$ 75,000
Engineering and Contingencies (35%)					$ 393,750
CONSTRUCTION TOTAL					$ 1,518,750
Permitting and Mitigation					$ 13,500
Interest During Construction					$ 124,036
TOTAL COST					**$ 1,656,286**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 144,403
O&M					$ 31,935
Total Annual Cost					**$ 176,338**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 450
Per 1,000 gallons					$ 1.38
UNIT COSTS (After Amortization)					
Per Acre-Foot of treated water					$ 81
Per 1,000 gallons					$ 0.25

WUGNAME:	Richland SUD & McCulloch County Other (City of Melvin, Live Oak Hills Subdivision)
STRATEGY:	Central Bottled Water Point in Brady
STRATEGY NUMBER:	F26BOTTLE
AMOUNT (ac-ft/yr):	0.5

Capital Costs for Set-up	$	2,000
ANNUAL COSTS		
Total Administrative Costs	$	10,000
Water Cost	$	1,200
Total Annual Cost	$	11,200
PRO-RATED ANNUAL COSTS		
Richland SUD	$	8,009
Melvin	$	1,970
Live Oak Hills Subdivision	$	1,220
UNIT COSTS		
Per Acre-Foot Bottled	$	22,700
Per 1,000 Gallons	$	69.66

WUGNAME:	Richland SUD
STRATEGY:	Richland SUD Specialized Media System
STRATEGY NUMBER:	F27ADVTR
AMOUNT (ac-ft/yr):	113

CAPITAL COSTS

		Cost
Building	$	30,000
Connection to System	$	20,000
Engineering and Permitting	$	10,000
TOTAL CAPITAL COST	$	60,000
ANNUAL COSTS		
Debt Service (6% over 10 years)	$	8,152
Payments to WRT	$	46,011
Power Supply	$	10,826
Personnel	$	5,000
Total Annual Cost	$	69,989
UNIT COSTS		
Per Acre-Foot Delivered	$	619
Per 1,000 Gallons	$	1.90

WUGNAME:	City of Eden
STRATEGY:	Replacement Well
STRATEGY NUMBER:	F30REPWELL
AMOUNT (ac-ft/yr):	323

CAPITAL COSTS	**Quantity**	**Units**	**Unit Price**			**Cost**
Water Well Construction	1	EA			$	920,300
Connection to Water System	1	EA			$	100,000
Engineering and Contingencies (30%)					$	306,090
Subtotal					**$**	**1,326,390**
Permitting and Mitigation					$	12,244
Interest During Construction					$	28,739
TOTAL CAPITAL COST					**$**	**1,367,372**

ANNUAL COSTS	**Quantity**	**Units**	**Unit Price**			**Cost**
Debt Service (6% for 20 years)					$	119,214
O&M					$	10,203
Chemicals		1000 gal	$	0.10	$	10,512
Electricity					$	138,750
Total Annual Cost					**$**	**278,679**

UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	864
Per 1,000 gallons	$	2.65

UNIT COSTS (After Amortization)		
Per Acre-Foot of treated water	$	494
Per 1,000 gallons	$	1.52

WUGNAME:	Richland SUD
STRATEGY:	Replacement Well
STRATEGY NUMBER:	F30REPWELL
AMOUNT (ac-ft/yr):	113

CAPITAL COSTS	**Quantity**	**Units**	**Unit Price**			**Cost**
Water Well Construction	1	EA			$	863,850
Connection to Water System	1	EA			$	100,000
Engineering and Contingencies (30%)					$	289,155
Subtotal					**$**	**1,253,005**
Permitting and Mitigation					$	11,566
Interest During Construction					$	27,149
TOTAL CAPITAL COST					**$**	**1,291,720**

ANNUAL COSTS	**Quantity**	**Units**	**Unit Price**			**Cost**
Debt Service (6% for 20 years)					$	112,618
O&M					$	9,639
Chemicals		1000 gal	$	0.10	$	3,680
Electricity					$	46,255
Total Annual Cost					**$**	**172,191**

UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water	$	1,524
Per 1,000 gallons	$	4.68

UNIT COSTS (After Amortization)		
Per Acre-Foot of treated water	$	527
Per 1,000 gallons	$	1.62

WUGNAME:	City of Eden
STRATEGY:	Eden Bottled Water System
STRATEGY NUMBER:	F26BOTTLE
AMOUNT (ac-ft/yr):	1.34

CAPITAL COSTS

		Cost
Equipment	$	40,000
Installation	$	10,000
Metal Buildings	$	60,000
Engineering and Contingences (20%)	$	22,000
TOTAL CAPITAL COST FOR TWO SYSTEMS	$	132,000
Permitting	$	1,320
TOTAL CAPITAL COST	$	133,320
ANNUAL COSTS		
Debt Service (6% for 10 yrs)	$	18,114
O&M at $2 per 1000 gallon	$	8,760
Total Annual Cost	$	26,874
UNIT COSTS		
Per Acre-Foot of Bottled Water	$	19,994
Per 1,000 gallons	$	61.36

WUGNAME:	Andrews
STRATEGY:	Dockum Desalination Facility
STRATEGY NUMBER:	F27ADVTR
AMOUNT (ac-ft/yr):	950

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land acquisition		3	AC	$ 2,000	$ 6,000
Well pumps	10-500 gpm	3	EA	$ 15,000	$ 45,000
Well construction		3	EA	$ 150,000	$ 450,000
Well field piping	8-inch	15,840	LF	$ 20	$ 317,000
Ground storage tank	250,000 gal		LS	$ 100,000	$ 100,000
Engineering and Contingencies (35%)					$ 321,300
Subtotal Pump Station and Intake					$ 1,239,300

Disposal Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	8-inch	26,400	LF	$ 20	$ 528,000
Right-of-way		12.1	AC	$ 2,000	$ 24,000
High pressure well disposal pumps	2-1300 gpm	1	EA	$ 20,000	$ 20,000
Brine Lagoon		1	LS	$ 300,000	$ 300,000
Engineering and Contingencies (30%)					$ 262,000
Subtotal Transmission to Treatment Plant					$ 1,134,000

Treatment Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
RO Treatment Facility	1.0 MGD	1	LS	$ 1,440,000	$ 1,440,000
Ground storage tank	0.25 MG	1	LS	$ 100,000	$ 100,000
Engineering and Contingencies (35%)					$ 539,000
Subtotal of Treatment					$ 2,079,000

CONSTRUCTION TOTAL		$ 4,452,300
Permitting and Mitigation		$ 40,000
Interest During Construction	(6 months)	$ 186,000
TOTAL COST		**$ 4,678,300**
ANNUAL COSTS*		
Debt Service (6% for 20 years)*		$ 408,000
Electricity ($0.06 kWh)		$ 119,000
Operation & Maintenance		$ 37,000
Water Treatment		$ 232,000
Total Annual Costs		**$ 796,000**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$ 838
Per 1,000 Gallons		$ 2.57
UNIT COSTS (After Amortization)		
Per Acre-Foot		$ 408
Per 1,000 Gallons		$ 1.25

WUGNAME:	CRMWD
STRATEGY:	Capitan Reef Complex Desalination Facility
STRATEGY NUMBER:	F16DESAL
AMOUNT (ac-ft/yr):	9,500

CONSTRUCTION COSTS

Well Field	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land acquisition		14	AC	$ 2,000	$ 28,540
Well Pumps	20-500 gpm	20	EA	$ 15,000	$ 300,000
Well Collection Piping	8-inch	20,000	L.F.	$ 40	$ 800,000
Well Construction		20	EA	$ 326,000	$ 6,520,000
Ground Storage Tank (6 hrs)	3.3 MG	1	L.S.	$ 668,000	$ 668,000
Engineering and Contingencies (35%)					$ 2,910,790
Subtotal Well Field					$ 11,227,330

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	30 in.	289,000	L.F.	$ 86	$ 24,854,000
Transmission pipeline - treatment plant to dispc	16 in.	2,000	L.F.	$ 37	$ 74,000
Right-of-way easements		140	AC	$ 2,000	$ 280,000
Engineering and Contingencies (30%)					$ 7,562,400
Subtotal Pipeline					$ 32,770,400

Pumps	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Well field to treatment plant	7500 gpm	3	EA	$ 70,000	$ 210,000
Booster Station	1600 HP	1	EA	$ 3,060,000	$ 3,060,000
Ground storage tank	5 MG	1	EA	$ 895,000	$ 895,000
High service pump station	5 - 2000 gpm	1	LS	$ 180,000	$ 180,000
Ground storage tank	2.5 MG	1	LS	$ 510,000	$ 510,000
High pressure well disposal pumps	3 - 1300 gpm	3	EA	$ 20,000	$ 60,000
Engineering and Contingencies (35%)					$ 1,720,250
Subtotal of Pumps					$ 6,635,250

Treatment Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
RO Unit	10.0 MGD	1	LS	$ 4,200,000	$ 4,200,000
Disinfection facility		1	LS	$ 170,000	$ 170,000
Metal Building		5,000	SF	$ 90	$ 450,000
Engineering and Contingencies (35%)					$ 1,687,000
Subtotal of Treatment					$ 6,507,000

Reject Facilities	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Brine lagoon	37.5 MG	1	LS	$ 2,400,000	$ 2,400,000
Disposal wells		10	LS	$ 1,200,000	$ 12,000,000
Engineering and Contingencies (35%)					$ 5,040,000
Subtotal of Reject Facilities					$ 19,440,000

Electrical and Instrumentation	Size	Quantity	Unit	Unit Price	Cost
Electrical		1	LS	$ 1,971,525	$ 1,971,530
Instrumentation		1	LS	$ 1,314,350	$ 1,314,350
Power Service		25,000	LF	$ 30	$ 750,000
Engineering and Contingencies (35%)					$ 1,412,560
Subtotal of Electrical & Instrumentation					$ 5,448,440
CONSTRUCTION TOTAL					$ 82,028,420
Permitting and Mitigation					$ 736,990
Interest During Construction	(12 months)				$ 3,418,120
TOTAL COST					**$ 86,183,530**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 7,514,000
Electricity ($0.06 kWh)					$ 1,447,585
Operation & Maintenance					$ 2,461,971
Water Purchase					$ 929,000
Total Annual Costs					**$ 12,352,556**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 1,300
Per 1,000 Gallons					$ 3.99
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 509
Per 1,000 Gallons					$ 1.56

WUGNAME:	CRMWD
STRATEGY:	Lake Alan Henry to Snyder
STRATEGY NUMBER:	F06AVOLRED
AMOUNT (ac-ft/yr):	11,210

CONSTRUCTION COSTS

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Transmission pipeline	36 in.	133,647	LF	$ 114	$ 15,236,000
Right-of-way easements		61	AC	$ 2,000	$ 122,000
Engineering and Contingencies (30%)					$ 4,607,000
Subtotal Pipeline					$ 19,965,000
Pump Station(s) & Ground Storage	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station & intake	2400 HP	1	LS	$ 5,100,000	$ 5,100,000
Storage tank	4 MG	1	LS	$ 745,000	$ 745,000
Engineering and Contingencies (35%)					$ 2,046,000
Subtotal of Pump Station(s)					$ 7,891,000
CONSTRUCTION TOTAL					$ 27,856,000
Permitting and Mitigation					$ 253,000
Interest During Construction	(24 months)				$ 2,275,000
TOTAL COST					**$ 30,384,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$ 2,649,000
Electricity ($0.06 kWh)					$ 475,000
Operation & Maintenance					$ 360,000
Water Purchase					$ 6,575,000
Total Annual Costs					**$ 10,059,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$ 897
Per 1,000 Gallons					$ 2.75
UNIT COSTS (After Amortization)					
Per Acre-Foot					$ 661
Per 1,000 Gallons					$ 2.03

Appendix 4G
Summary of Costs for Advanced Irrigation Technologies Year 2030

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Andrews	**5455**	**14131**	**$ 4,041,459**	**$ 293,608**
Furrow to LEPA	3377	6281	$2,009,920	$146,019
Furrow to drip	1628	2845	$1,906,016	$138,470
Surge to LEPA	72	177	$53,100	$3,858
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	378	4828	$72,423	$5,261
Borden	**460**	**2050**	**$ 400,000**	**$ 29,060**
Furrow to LEPA	97	450	$144,000	$10,461
Furrow to drip	183	320	$214,400	$15,576
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	132	640	$32,000	$2,325
LESA to LEPA	48	640	$9,600	$697
Brown	**185**	**1467**	**$ 44,386**	**$ 3,225**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	127	640	$31,978	$2,323
LESA to LEPA	58	827	$12,407	$901
Coke	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Coleman	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Concho	**1496**	**3965**	**$ 1,591,088**	**$ 115,591**
Furrow to LEPA	904	2445	$782,288	$56,832
Furrow to drip	572	1200	$804,000	$58,410
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	20	320	$4,800	$349

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Crane	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Crockett	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Ector	**490**	**951**	**$ 256,283**	**$ 18,619**
Furrow to LEPA	474	794	$253,920	$18,447
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	16	158	$2,363	$172
Glasscock	**7262**	**14278**	**$ 9,566,394**	**$ 694,988**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	7262	14278	$9,566,394	$694,988
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Howard	**653**	**1080**	**$ 543,311**	**$ 39,471**
Furrow to LEPA	330	515	$164,928	$11,982
Furrow to drip	323	565	$378,383	$27,489
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Irion	**73**	**352**	**$ 17,614**	**$ 1,280**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	73	352	$17,614	$1,280
LESA to LEPA	0	0	$0	$0

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Kimble	**147**	**676**	**$ 118,702**	**$ 8,624**
Furrow to LEPA	131	356	$113,905	$8,275
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	16	320	$4,797	$349
Loving	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
McCulloch	**394**	**1826**	**$ 139,633**	**$ 10,144**
Furrow to LEPA	66	179	$57,280	$4,161
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	328	1647	$82,353	$5,983
LESA to LEPA	0	0	$0	$0
Martin	**3502**	**8859**	**$ 3,349,238**	**$ 243,318**
Furrow to LEPA	513	1013	$324,221	$23,554
Furrow to drip	2495	4360	$2,921,234	$212,224
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	324	1471	$73,570	$5,345
LESA to LEPA	170	2014	$30,213	$2,195
Mason	**1491**	**5503**	**$ 598,026**	**$ 43,446**
Furrow to LEPA	602	1249	$399,797	$29,045
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	864	3841	$192,032	$13,951
LESA to LEPA	26	413	$6,197	$450
Menard	**46**	**267**	**$ 13,358**	**$ 970**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	46	267	$13,358	$970
LESA to LEPA	0	0	$0	$0

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Midland	**3600**	**12771**	**$ 2,642,806**	**$ 191,997**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	2051	3584	$2,401,146	$174,441
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	959	2967	$148,363	$10,778
LESA to LEPA	590	6220	$93,297	$6,778
Mitchell	**1729**	**4171**	**$ 2,135,784**	**$ 155,162**
Furrow to LEPA	248	1321	$422,784	$30,715
Furrow to drip	1459	2550	$1,708,500	$124,121
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	23	300	$4,500	$327
Pecos	**12600**	**18284**	**$ 6,956,821**	**$ 505,405**
Furrow to LEPA	7910	5507	$1,762,358	$128,033
Furrow to drip	486	456	$305,574	$22,200
Surge to LEPA	1507	4472	$1,341,596	$97,465
Surge to Drip	2488	5401	$3,510,585	$255,040
MESA to LEPA	0	0	$0	$0
LESA to LEPA	210	2447	$36,708	$2,667
Reagan	**3936**	**7845**	**$ 5,256,130**	**$ 381,852**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	3936	7845	$5,256,130	$381,852
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Reeves	**11648**	**18880**	**$ 6,891,034**	**$ 500,626**
Furrow to LEPA	6540	4536	$1,451,533	$105,452
Furrow to drip	447	451	$302,222	$21,956
Surge to LEPA	2541	7471	$2,241,287	$162,827
Surge to Drip	1939	4409	$2,865,799	$208,197
MESA to LEPA	0	0	$0	$0
LESA to LEPA	181	2013	$30,192	$2,193
Runnels	**0**	**0**	**$ -**	**$ -**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Schleicher	**214**	**466**	**$ 149,038**	**$ 10,827**
Furrow to LEPA	214	466	$149,038	$10,827
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Scurry	**1143**	**2868**	**$ 1,083,847**	**$ 78,740**
Furrow to LEPA	808	1968	$629,661	$45,744
Furrow to drip	321	673	$450,776	$32,748
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	14	227	$3,410	$248
Sterling	**89**	**431**	**$ 21,550**	**$ 1,566**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	89	431	$21,550	$1,566
LESA to LEPA	0	0	$0	$0
Sutton	**284**	**513**	**$ 164,160**	**$ 11,926**
Furrow to LEPA	284	513	$164,160	$11,926
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Tom Green	**11548**	**20435**	**$ 8,482,870**	**$ 616,271**
Furrow to LEPA	5128	8721	$2,790,649	$202,738
Furrow to drip	5779	7576	$5,075,712	$368,745
Surge to LEPA	0	0	$0	$0
Surge to Drip	314	864	$561,795	$40,814
MESA to LEPA	27	160	$7,990	$580
LESA to LEPA	299	3115	$46,724	$3,394
Upton	**1840**	**3680**	**$ 2,465,727**	**$ 179,132**
Furrow to LEPA	0	0	$0	$0
Furrow to drip	1840	3680	$2,465,727	$179,132
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0

Table 4G-1
Summary of Costs for Advanced Irrigation Technologies - Year 2030

County	Water saved (ac-ft)	Acres upgraded	Capital costs	Annual Costs
Ward	**1570**	**1152**	**$ 368,640**	**$ 26,781**
Furrow to LEPA	1570	1152	$368,640	$26,781
Furrow to drip	0	0	$0	$0
Surge to LEPA	0	0	$0	$0
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0
Winkler	**389**	**538**	**$ 164,628**	**$ 11,960**
Furrow to LEPA	110	163	$52,128	$3,787
Furrow to drip	0	0	$0	$0
Surge to LEPA	279	375	$112,500	$8,173
Surge to Drip	0	0	$0	$0
MESA to LEPA	0	0	$0	$0
LESA to LEPA	0	0	$0	$0

Appendix 4H
Strategy Evaluation Matrix and Quantified Environmental Impact Matrix

Region F Initially Prepared Plan
Strategy Evaluation Matrix

Entity	County Used	Basin Used	Strategy	Quantity (Ac-Ft/Yr)	Reliability	Cost ($/Ac-Ft)	Impacts of Strategy on:				Interbasin Transfer	Third Party Social & Economic Impacts	Implementation Issues	Comments
							Environmental Factors	Agricultural Resources/ Rural Areas	Other Natural Resources	Key Water Quality Parameters				
Andrews	Andrews	Colorado	Dockum Desalination	950	High	$838	Low	Positive	None identified	Low	n/a	None identified		
County Other	Brown	Colorado	Voluntary redistribution	300	High	$2,527	Low	Positive	None	Low	n/a	Positive impact of increased reliable supply on north shore of Lake Brownwood	Other studies may provide better, less expensive alternatives to get Lake Brownwood water to customers	Treated water to northern Brown County from Brookesmith SUD or Zephr WSC
Bronte	Coke	Colorado	5 new water wells	100	Medium to Low	$570	Low	Positive	None identified	Low	n/a		Quantity available from aquifer uncertain	
Bronte	Coke	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	280	High	$1,920	Low	Positive	None identified	Low	n/a	None identified	Need excess capacity in San Angelo project, operational issues, cost	Transmission only. See San Angelo desalination for treatment.
Bronte	Coke	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	280	High	$1,796	Low	Positive	None identified	Low	n/a	None identified	Sponsorship, cost, operational issues	
Bronte	Coke	Colorado	Reuse	110	High	$1,800	Medium	Positive	None identified	Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
Bronte	Coke	Colorado	Rehabilitation of Oak Creek pipeline	129	Medium	$855	Low	Positive	None identified	Low	n/a	None identified	Funding	
Bronte	Coke	Colorado	Water Conservation	51	Medium	$280	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.
Robert Lee	Coke	Colorado	Infrastructure Improvements	200	High	$1,297	Low	3	3	TBD	n/a	Improved quality and reliability for the city	Financing	0.5 mgd treatment expansion and new storage tank
Robert Lee	Coke	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	448	High	$1,920	Low	Positive	None identified	Low	n/a	None identified	Need excess capacity in San Angelo project, operational issues, cost	Transmission only. See San Angelo desalination for treatment.
Robert Lee	Coke	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	448	High	$1,796	Low	Positive	None identified	Low	n/a	None identified	Sponsorship, cost, operational issues	
Robert Lee	Coke	Colorado	Reuse	110	High	$1,800	Medium	Positive	None identified	Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
Robert Lee	Coke	Colorado	Desalination of Spence Reservoir Water	500	High	$1,364	Medium	Positive	None identified	Medium	n/a	Increased reliability and better water for city	Financing, disposal of brine reject	Strategy assumes that reject can be discharged. Costs may be significantly higher if other methods used.
Robert Lee	Coke	Colorado	Floating pump in Mountain Creek Resevoir	50	Low	TBD	Low	Positive	None identified	Low	n/a	None identified	Financing	Allows city to take more water when reservoir is low
Robert Lee	Coke	Colorado	Water Conservation	51	Medium	$298	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.
Eden	Concho	Colorado	CAX treatment	392	High	$352	Low to Medium	Positive	None identified	Medium	n/a	High cost takes away resources	Disposal of waste products	
Eden	Concho	Colorado	RO treatment	392	High	$423	Low to Medium	Positive	None identified	Medium	n/a	High cost takes away resources	Disposal of waste products	
Eden	Concho	Colorado	Bottled water program	1.3	High	$19,000	Low	Positive	None identified	Low	n/a	Users need to travel to obtain water	Regulatory acceptance	Lowest overall cost
CRMWD	Ector/Midland	Colorado	Odessa/Midland Reuse	9799	High	$1,019	Low	Low	None	Low to Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
CRMWD	Howard	Colorado	Big Spring Reuse	1855	High	$627	Low	Low	None	Low to Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
Manufacturing	Kimble	Colorado	Edwards-Trinity aquifer	1000	Medium	$670	Medium	None	None identified	None	n/a	None identified	Locating areas with sufficient production and acceptable water quality	Manufacturing demands appear to include recirculated water
Richland SUD	McCulloch	Colorado	Specialty Media Treatment System	113	High	$619	Low	Positive	None identified	Low	n/a	Security and worker safety, loss of revenue due to increased costs	Depends on ability to locate injection well. Will require long-term contract and minimum guaranteed payment.	
Richland SUD	McCulloch	Colorado	Bottled water program	0.5	High	$22,400	Low	Positive	None identified	Low	n/a	Users need to travel to obtain water	Regulatory acceptance	Lowest overall cost
Richland SUD	McCulloch	Colorado	Replacement well	113.0	High	$1,524	Low	Positive	None identified	Low	n/a	None identified	Assumes that an area with low radionuclide concentration can be identified	
Menard	Menard	Colorado	Aquifer Storage and Recovery	240	High	$913	Low	Positive	None identified	Low	n/a	None identified	Suitability of Hickory not established, financing	
Menard	Menard	Colorado	Water Conservation	33	Medium	$733	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.
Menard	Menard	Colorado	New Hickory well	160	Medium to High	$1,078	Low	Positive	None identified	Low	n/a	None identified	Water quality unknown.	May be higher impacts if advanced treatment needed.
Menard	Menard	Colorado	San Saba Off-Channel Reservoir	500	High	$3,438	Medium	Positive	None identified	Low	n/a	Property owners at reservoir site	Specific site not selected. Priority date of water significantly affects feasibility.	Assuming that diversion is under existing Menard or LCRA water right.
Midland	Midland	Colorado	T-Bar Well Field	13,400	High	$962	Low	Low	Low	Low	Not required for groundwater		Pipeline route and well field layout not determined	Additional studies underway. Not available for this plan.
Midland	Midland	Colorado	Water Conservation	3,521	Medium	$452	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.

Region F Initially Prepared Plan
Strategy Evaluation Matrix

Entity	County Used	Basin Used	Strategy	Quantity (Ac-Ft/Yr)	Reliability	Cost ($/Ac-Ft)	Impacts of Strategy on: Environmental Factors	Agricultural Resources/ Rural Areas	Other Natural Resources	Key Water Quality Parameters	Interbasin Transfer	Third Party Social & Economic Impacts	Implementation Issues	Comments
BCWID	Multiple	Colorado	Lake Brownwood to Runnels & Coke Counties	2800	High	$1,796	Low	Low	None	Low	n/a	None identified	Sponsorship, cost, operational issues.	
CRMWD	Multiple	Colorado	Winkler Well Field	6000	High	$831	Low	Low	Low	Low	Not required for groundwater		Pipeline route and well field layout not determined	
CRMWD	Multiple	Colorado	Water from SW Pecos County	15000	Medium	$1,248	Low to Medium	May impact Belding Farms	None identified	Low	Not required for groundwater	May impact other groundwater users in Pecos County	Needs additional studies regarding supplies and impacts	
CRMWD	Multiple	Colorado	Water from Roberts County	25000	High	$2,046	Low	Low	Low	Low	Not required for groundwater	Other users of Roberts County water	Would be more cost-effective with other participants	
Multiple	Multiple	Multiple	Subordination of senior water rights	58,884	Medium	TDB	Medium	Positive	None identified	Low	n/a	None identified	Needs further analysis before implementation	Done in conjunction with Region K
Ballinger	Runnels	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	1,329	High	$1,919	Low	Positive	None identified	Low	n/a	None identified	Sponsorship, cost, operational issues	
Ballinger	Runnels	Colorado	Voluntary redistribution - Hords Creek Resevoir	220	Low	$1,982	Low	Positive	None identified	Low	n/a	None identified	Subordination to downstream water rights	May require modifications to contracts with Corps of Engineers
Ballinger	Runnels	Colorado	Volunary Redistribution - purchase water from CRMWD	394	High	$426	Low	Positive	None identified	Low	n/a	Water obtained through existing contract with Millersview-Doole	Must have agreement with CRMWD, Millersview-Doole WSC and WCTMWD	Uses existing WCTMWD and Ballinger pipelines
Ballinger	Runnels	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	1,329	Medium to High	$1,751	Low	Positive	None identified	Low	n/a	None identified	Need excess capacity in San Angelo project, operational issues, cost	Transmission only. See San Angelo desalination for treatment.
Ballinger	Runnels	Colorado	Reuse	220	High	$999	Medium	Positive	None identified	Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
Ballinger	Runnels	Colorado	Water Conservation	144	Medium	$557	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.
Winters	Runnels	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	729	High	$1,919	Low	Positive	None identified	Low	n/a	None identified	Sponsorship, cost, operational issues	
Winters	Runnels	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	729	High	$1,751	Low	Positive	None identified	Low	n/a	None identified	Need excess capacity in San Angelo project, operational issues, cost, participation by other cities	Transmission only. See San Angelo desalination for treatment.
Winters	Runnels	Colorado	Reuse	110	High	$1,800	Medium	Positive	None identified	Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
Winters	Runnels	Colorado	Water Conservation	76	Medium	$590	Low	Positive	None identified	Low	n/a	None identified	Site specific data needed. May require financial and technical assistance.	Conservation based on generic assessment. Site-specific data not available.
CRMWD	Scurry	Colorado	Snyder Reuse	726	High	$1,176	Low	Low	None	Low to Medium	n/a	None identified	Public perception, disposal, TCEQ rules	
CRMWD	Scurry	Colorado	Voluntary Redistribution - Lake Alan Henry	11,210	Medium	$897	Low	Low	None	Low	yes	None identified	May need subordination agreement in Brazos Basin. Requires an interbasin transfer authorization.	
CRMWD	Multiple	Colorado	Capitan Reef Desalination	9,500	Medium	$1,300	Low	Low	None	Low	n/a	None identified	Reliability of large-scale development not established.	
San Angelo	Tom Green	Colorado	Water Conservation	4,350	Medium	$565	Low	Low	None identified	Low	n/a	None identified	City developing a water conservation program	Actual conservation savings may be greater.
San Angelo	Tom Green	Colorado	Edwards-Trinity aquifer	12,000	Medium	$468	Medium	Potential impact to local users	None identified	Low	n/a	Potential impact to local users	Locating areas with sufficient production. Groundwater conservation district rules that discourage large-scale development	
San Angelo	Tom Green	Colorado	Water from SW Pecos County	12,000	Medium	$1,867	Low to Medium	May impact Belding Farms	None identified	Low	Not required for groundwater	May impact other groundwater users in Pecos County	Needs additional studies regarding supplies and impacts	
San Angelo	Tom Green	Colorado	McCulloch Well Field	12,000	High	$1,081	Low	Potential impact to other Hickory users	None identified	Low	n/a	Potential impact to other Hickory users	Pipeline route and well field layout currently being studied	Water may not meet standards for Radium & require advanced treatment, which may increase costs
San Angelo	Tom Green	Colorado	Regional Desalination Facility	11200	High	$890	Low	Low	None identified	Low	n/a		Lack of data on target aquifer	
San Angelo	Tom Green	Colorado	Rehabilitation of Spence Pipeline	2,300	High	$241	Low	Low	None identified	Low	n/a			
Steam Electric	Not determined	Not determined	CCGT and ACC Generation	24,306	Medium to High	$26,000	Low	None	None identified	Low	n/a		Implementation based on economic decisions by power industry	Technology requires very little water

Region F Initially Prepared Plan
Environmental Quantification Matrix

Entity	County	Basin	Strategy	Environmental Factors										Comments
				Acres Impacted	Wetland Acres	Envir Water Needs	Habitat	Threat and Endanger Species	Cultural Resources	Bays & Estuaries	Envir Water Quality	Other	Overall Environmental Impacts	
Andrews	Andrews	Colorado	Dockum Desalination	15		Low	Low	6	Low	None	Low		Low	Disposal through existing deep well injection
County Other	Brown	Colorado	Voluntary redistribution	53		Low	Low	10	Low	None	Low		Low	Not a significant draw on reservoir
Bronte	Coke	Colorado	5 new water wells	5		Low	Low	8	Low	None	Low		Low	Producing aquifer not well known.
Bronte	Coke	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	184		Low	Low	8	Low	None	Low		Low	Impacts for transmission system only. See San Angelo desal for treatment.
Bronte	Coke	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	202		Low	Low	8	Low	None	Low		Low	
Bronte	Coke	Colorado	Reuse	10		Medium	Medium	8	Low	None	Medium		Medium	Assuming that waste stream from treatment process would be discharged or use land application.
Bronte	Coke	Colorado	Rehabilitation of Oak Creek pipeline	32		Low	Low	8	Low	None	Low		Low	
Bronte	Coke	Colorado	Water Conservation	0		Low	Low	8	Low	None	Low		Low	
Robert Lee	Coke	Colorado	Infrastructure Improvements	4		Low	Low	8	Low	None	Low		Low	0.5 mgd treatment plant and new storage tank
Robert Lee	Coke	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	184		Low	Low	8	Low	None	Low		Low	Impacts for transmission system only. See San Angelo desal for treatment.
Robert Lee	Coke	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	202		Low	Low	8	Low	None	Low		Low	
Robert Lee	Coke	Colorado	Reuse	10		Medium	Medium	8	Low	None	Medium		Medium	Assuming that waste stream from treatment process would be discharged or use land application.
Robert Lee	Coke	Colorado	Desalination of Spence Reservoir Water	5		Medium	Medium	8	Low	None	Medium		Medium	
Robert Lee	Coke	Colorado	Floating pump in Mountain Creek Resevoir	1		Low	Low	8	Low	None	Low		Low	Allows city to take more water when reservoir is low
Robert Lee	Coke	Colorado	Water Conservation	0		Low	Low	8	Low	None	Low		Low	
Eden	Concho	Colorado	CAX treatment	<1		Low to Medium	Low to Medium	8	Low	None	Medium		Low to Medium	Long-term impacts of land application of naturally occuring radionuclides unknown
Eden	Concho	Colorado	RO treatment	<1		Low to Medium	Low to Medium	8	Low	None	Medium		Low to Medium	Long-term impacts of land application of naturally occuring radionuclides unknown
Eden	Concho	Colorado	Bottled water program	<1		Low	Low	8	Low	None	Low		Low	Small amount of water treated
CRMWD	Ector/Midlar	Colorado	Odessa/Midland Reuse	152		Low	Medium	6	Low	None	Low		Low	Impacts due to decreased flow in Monahans Draw.
CRMWD	Howard	Colorado	Big Spring Reuse	6		Low	Low	6	Low	None	Medium		Low	No impact below Beals Creek diversion
Manufacturing	Kimble	Colorado	Edwards-Trinity aquifer	<1		Medium	Medium	9	Low	None	Medium		Medium	Potential impact on surface water flows
Richland SUD	McCulloch	Colorado	Specialty Media Treatment System	<1		Low	Low	9	Low	None	Low		Low	Spent media disposed using deep-well injection.
Richland SUD	McCulloch	Colorado	Bottled water program	<1		Low	Low	9	Low	None	Low		Low	Small amount of water treated
Richland SUD	McCulloch	Colorado	Replacement well	1		Low	Low	9	Low	None	Low		Low	Replaces existing well
Menard	Menard	Colorado	Aquifer Storage and Recovery	2		Low to Medium	Low	12	Low	None	Low		Low	In conjunction with Hickory well
Menard	Menard	Colorado	Water Conservation	0		Low	Low	12	Low	None	Low		Low	
Menard	Menard	Colorado	New Hickory well	2		Low	Low	12	Low	None	Low		Low	Impacts may be higher if advanced treatment required because of brine disposal
Menard	Menard	Colorado	San Saba Off-Channel Reservoir	80		Medium	Medium	12	Low to Mediu	None	Low		Medium	Specific site not selected
Midland	Midland	Colorado	T-Bar Well Field	212		Low	Low	7	Low	None	Low		Low	Estimated impacts. Precise route unknown pending routing study.
Midland	Midland	Colorado	Water Conservation	0		Low	Low	6	Low	None	Low		Low	
BCWID	Multiple	Colorado	Lake Brownwood to Runnels & Coke Counties	202		Low	Low	10	Low	None	None		Low	
CRMWD	Multiple	Colorado	Winkler Well Field	112		Low	Low	7	Low	None	Low		Low	Estimated impacts. Precise route unknown pending routing study.
CRMWD	Multiple	Colorado	Water from SW Pecos County	265		Low to Medium	Low	23	Low	None	Low to Medium		Low to Medium	
CRMWD	Multiple	Colorado	Water from Roberts County	1125		Low to Medium	Low		Low	None	Low		Low	Possible impact on Canadian River flows
Multiple	Multiple	Multiple	Subordination of senior water rights	0		Medium	Low	varies	Low	Medium to	Medium to Low		Medium	
Ballinger	Runnels	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	202		Low	Low	10	Low	None	Low		Low	

Region F Initially Prepared Plan
Environmental Quantification Matrix

Entity	County	Basin	Strategy	Environmental Factors										Comments
				Acres Impacted	Wetland Acres	Envir Water Needs	Habitat	Threat and Endanger Species	Cultural Resources	Bays & Estuaries	Envir Water Quality	Other	Overall Environmental Impacts	
Ballinger	Runnels	Colorado	Voluntary redistribution - Hords Creek Resevoir	51		Low	Low	10	Low	None	Low		Low	
Ballinger	Runnels	Colorado	Volunary Redistribution - purchase water from CRMWD	0		Low	Low	10	Low	None	Low		Low	Pipeline already in place
Ballinger	Runnels	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	184		Low	Low	10	Low	None	Low		Low	Impacts for transmission system only. See San Angelo desal for treatment.
Ballinger	Runnels	Colorado	Reuse	10		Medium	Medium	10	Low	None	Medium		Medium	Assuming that waste stream from treatment process would be discharged or use land application.
Ballinger	Runnels	Colorado	Water Conservation	0		Low	Low	10	Low	None	Low		Low	
Winters	Runnels	Colorado	Regional System from Lake Brownwood to Runnels and Coke Counties	202		Low	Low	10	Low	None	Low		Low	
Winters	Runnels	Colorado	Voluntary Redistribution - San Angelo Regional Desalination System	184		Low	Low	10	Low	None	Low		Low	Impacts for transmission system only. See San Angelo desal for treatment.
Winters	Runnels	Colorado	Reuse	10		Medium	Medium	10	Low	None	Medium		Medium	Assuming that waste stream from treatment process would be discharged or use land application.
Winters	Runnels	Colorado	Water Conservation	0		Low	Low	10	Low	None	Low		Low	
CRMWD	Scurry	Colorado	Snyder Reuse	9		Low	Low	6	Low	None	Medium		Low	No impact below Colorado City
CRMWD	Scurry	Colorado	Voluntary Redistribution - Lake Alan Henry	61		Low	Low	6	Low	None	Low		Low	
CRMWD	Multiple	Colorado	Capitan Reef Desalination	164		Low	Low	7	Low	None	Low		Low	Estimated impacts. Precise route unknown pending routing study.
San Angelo	Tom Green	Colorado	Water Conservation	0		Low	Low	10	Low	None	Low		Low	Conserved water expected to remain in reservoirs for later use, use by others, or lost due to evaporation. Not expected to have a significant positive impact on environmental flows.
San Angelo	Tom Green	Colorado	Edwards-Trinity aquifer	83		Medium to high	Medium	10	Low	None	Medium to Low		Medium	
San Angelo	Tom Green	Colorado	Water from SW Pecos County	448		Low to Medium	Low	23	Low	None	Low to Medium		Low to Medium	
San Angelo	Tom Green	Colorado	McCulloch Well Field	476		Low	Low	12	Low	None	Low		Low	Estimated impacts. Precise route unknown pending routing study.
San Angelo	Tom Green	Colorado	Regional Desalination Facility	100		Low	Low	10	Low	None	Low		Low	Using deep well injection for brine disposal
San Angelo	Tom Green	Colorado	Rehabilitation of Spence Pipeline	0		Low	Low	10	Low	None	Low		Low	Existing pipeline
Steam Electric	Not determir	Not determ	CCGT and ACC Generation	0		Low	Low	unknown	Low	None	Low		Low	Location of new generation not determined

Appendix 4I
Municipal Water Conservation

Appendix 4I
Municipal Water Conservation

Appendix 4I: Municipal Water Conservation

As part of our planning efforts for Region F, water conservation must be considered when developing water management strategies for water user groups with needs. An expected level of conservation is included in the demand projections due to the natural replacement of inefficient plumbing fixtures with low flow fixtures, as mandated under the State Plumbing Code. For Region F, the total municipal water savings associated with plumbing fixtures is approximately 7 percent of the projected demand if no conservation occurred.

Additional conservation savings can potentially be achieved in the region through the implementation of conservation best management practices. The potential savings from water conservation were evaluated for twelve municipal water user groups with potential supply shortages.

To assess appropriate strategies for Region F, we reviewed the conservation strategies identified through the Water Conservation Implementation Task Force. The Task Force identified 21 municipal conservation strategies and 15 strategies for industrial water users. In addition the State has adopted new regulations that require all new clothes washers to be more water efficient by 2007. After review and consideration of these strategies, it is recommended that four conservation strategies be evaluated for municipal water users with needs. These include:

- Public and School Education
- Reduction of Unaccounted for Water through Water Audits
- Water Conservation Pricing
- Federal Clothes Washer Rules

Best Management Practices (BMPs) not selected include rebate programs, accelerated plumbing fixtures replacements, and specific outdoor watering measures. The benefits of outdoor watering strategies were assumed to be accounted under the public and school education BMP. Also, many of the entities in Region F already use restrictions on outdoor watering as a drought management measure. Accelerated fixture replacements do not reduce the ultimate water need, but could delay when the need begins. This is also true for rebate programs that simply accelerate the already assumed conservation savings.

However, the likelihood of implementing rebate programs in rural communities is low and previous studies have shown these programs to be relatively costly per acre-foot of water saved.

Region F recognizes that it has no authority to implement, enforce or regulate water conservation practices. These water conservation practices are intended to be guidelines. Water conservation strategies determined and implemented by the individual water user groups in Region F supersede the recommendations in this plan and the Region F Water Planning Group considers these strategies to meet regulatory requirements for consistency with this plan.

A summary of the assumptions in costs and savings for the selected municipal conservation strategies is presented below. Summaries of water conservation savings and costs of each BMP for each water user group may be found in the attached tables.

Public and School Education

Potential water savings associated with education programs are difficult to assess because the results often overlap with other measures. Literature reviews indicate the savings can range from 1 to 5 percent of the projected demand. For cities that have already implemented an aggressive education program, the additional savings may be on the lower side of this range. In Region F, it is assumed that conservation savings associated with education will be 2.0% the first decade increasing to 4.5% by 2060.

Annual costs were estimated at just over $1,000 for small rural communities to over $100,000 for Midland, Odessa and San Angelo. These costs include personnel to develop and oversee the program, public outreach through the news media, public meetings, school education materials, giveaways, and other miscellaneous program specific costs.

Water Conservation Pricing

This BMP can apply to two different conditions: 1) use of rate structures to discourage inefficient and/or excessive water use (e.g., inverted block rates), and 2) natural reduction of use in response to overall rate increases. For this plan, we are assuming that there will be some reduction in water use as new more expensive water is developed. For calculation of potential water savings, a potential water savings of 1.5%

of the projected demand. The costs for this strategy are based on estimated costs of conducting a rate study by the city and implementation of a rate change.

Water System Audit

Under House Bill 3338, all retail public utilities serving 3,300 people or more will be required to conduct water system audits to identify the system water loss. These audits will be required beginning in 2005 and performed every 5 years. The audit itself does not reduce water loss, but can identify potential infrastructure problems contributing to water loss. The TWDB recommends that water system losses should be less than 15 percent of the total water used. The American Water Works Association leak Detection Committee recommends a goal of 10 percent. For the purposes of this plan it was assumed that a water audit would reduce losses to 12 percent of the total water used. If water losses were already less than 12 percent, it was assumed that no additional savings will be realized. Region F recognizes the benefits of water audits as good stewardship for all water systems and recommends that all system conduct water audits.

Costs for this strategy are only those costs associated with the audit itself. Costs range from about $3,000 for a small system to over $300,000 for the larger cities. These costs are amortized over 5 years, which is the schedule for water audits.

Federal Clothes Washer Rules

New regulations governing the manufacturing of clothes washers will require all new washers to be energy efficient by 2007. One option to achieve the efficiency mandate is to reduce water volume (less energy would be needed to heat the water). The water savings per washer is estimated at 5.6 gallons per person per day. It was assumed that 90 percent of the single family homes had washing machines and 3 percent of these homes would have water efficient machines as of year 2000. The average life of a washing machine is 13 years, and the natural replacement rate was assumed at 7.7 percent per year.

This strategy was evaluated for each municipal water user group with a need. It was assumed that these new regulations will occur without any cost to the water user group.

Estimates of the number of clothes washers was made for each municipal water user group and savings calculated accordingly.

Bronte

Water Savings

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	5	6	8	9	10	11
Water Conservation Pricing	0	0	2	4	4	4	4
Water System Audit	0	9	29	29	28	28	28
Passive Clothes Washer	0	2	8	8	8	8	8
Total	*0*	*16*	*45*	*48*	*48*	*50*	*51*

Annual Cost

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$1,115	$1,159	$1,146	$1,140	$1,129	$1,123
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$3,357	$3,508	$3,317	$3,124	$2,940	$2,824
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$4,472*	*$8,743*	*$8,539*	*$8,340*	*$8,145*	*$8,023*

Cost per Ac-Ft

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$228	$180	$150	$130	$113	$100
Water Conservation Pricing	$0	$0	$2,106	$1,070	$1,087	$1,091	$1,091
Water System Audit	$0	$364	$120	$116	$111	$105	$100
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total		*$280*	*$194*	*$178*	*$174*	*$163*	*$157*

Cost per kGal

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.70	$0.55	$0.46	$0.40	$0.35	$0.31
Water Conservation Pricing	$0.00	$0.00	$6.46	$3.28	$3.34	$3.35	$3.35
Water System Audit	$0.00	$1.12	$0.37	$0.36	$0.34	$0.32	$0.31
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		*$0.86*	*$0.60*	*$0.55*	*$0.53*	*$0.50*	*$0.48*

Robert Lee

Water Savings

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	7	9	10	12	13	15
Water Conservation Pricing	0	0	3	5	5	5	5
Water System Audit	0	7	21	21	20	20	20
Passive Clothes Washer	0	2	8	8	8	8	8
Total	*0*	*16*	*40*	*44*	*45*	*46*	*48*

Annual Cost

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$1,189	$1,155	$1,142	$1,136	$1,125	$1,119
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$3,581	$3,496	$3,306	$3,113	$2,929	$2,814
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$4,770*	*$8,727*	*$8,524*	*$8,325*	*$8,130*	*$8,009*

Cost per Ac-Ft

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$169	$134	$111	$96	$84	$74
Water Conservation Pricing	$0	$0	$1,571	$795	$804	$809	$809
Water System Audit	$0	$507	$167	$160	$152	$144	$139
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total		*$298*	*$218*	*$194*	*$185*	*$177*	*$167*

Cost per kGal

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.52	$0.41	$0.34	$0.29	$0.26	$0.23
Water Conservation Pricing	$0.00	$0.00	$4.82	$2.44	$2.47	$2.48	$2.48
Water System Audit	$0.00	$1.56	$0.51	$0.49	$0.47	$0.44	$0.43
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		*$0.91*	*$0.67*	*$0.60*	*$0.57*	*$0.54*	*$0.51*

Coleman

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	26	32	38	43	49	55
Water Conservation Pricing	0	0	10	19	19	18	18
Water System Audit	0	0	0	0	0	0	0
Passive Clothes Washer	0	8	33	33	33	33	33
Total	*0*	*33*	*75*	*90*	*95*	*101*	*107*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$5,314	$5,165	$5,105	$5,079	$5,029	$5,005
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$15,997	$15,631	$14,779	$13,917	$13,097	$12,583
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$21,311*	*$24,872*	*$23,960*	*$23,072*	*$22,202*	*$21,664*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$207	$163	$136	$118	$103	$91
Water Conservation Pricing	$0	$0	$428	$217	$220	$222	$222
Water System Audit	$0	$0	$0	$0	$0	$0	$0
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$646*	*$332*	*$266*	*$243*	*$220*	*$202*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.64	$0.50	$0.42	$0.36	$0.32	$0.28
Water Conservation Pricing	$0.00	$0.00	$1.31	$0.67	$0.68	$0.68	$0.68
Water System Audit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$1.98*	*$1.02*	*$0.82*	*$0.75*	*$0.67*	*$0.62*

Big Spring

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	120	152	181	208	237	266
Water Conservation Pricing	0	0	46	91	89	89	89
Water System Audit	0	90	274	272	268	267	267
Passive Clothes Washer	0	31	132	133	133	133	133
Total	*0*	*241*	*603*	*676*	*698*	*725*	*754*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$27,164	$27,045	$26,941	$26,803	$26,540	$26,413
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$81,780	$81,839	$77,992	$73,442	$69,118	$66,405
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$108,944*	*$112,960*	*$109,009*	*$104,321*	*$99,734*	*$96,894*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$226	$178	$149	$129	$112	$99
Water Conservation Pricing	$0	$0	$89	$45	$46	$46	$46
Water System Audit	$0	$905	$299	$287	$274	$259	$249
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$452*	*$187*	*$161*	*$149*	*$138*	*$129*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.69	$0.55	$0.46	$0.40	$0.34	$0.30
Water Conservation Pricing	$0.00	$0.00	$0.27	$0.14	$0.14	$0.14	$0.14
Water System Audit	$0.00	$2.78	$0.92	$0.88	$0.84	$0.79	$0.76
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$1.39*	*$0.57*	*$0.49*	*$0.46*	*$0.42*	*$0.39*

Odessa

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	439	567	701	845	1,009	1,192
Water Conservation Pricing	0	0	170	350	362	378	397
Water System Audit	0	20	61	63	65	68	71
Passive Clothes Washer	0	93	402	422	443	466	489
Total	*0*	*551*	*1200*	*1536*	*1715*	*1920*	*2149*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$99,979	$101,971	$105,820	$110,540	$114,929	$120,095
Water Conservation Pricing	$0	$0	$6,114	$6,114	$6,114	$6,114	$6,114
Water System Audit	$0	$301,000	$308,571	$306,338	$302,889	$299,308	$301,936
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$400,979*	*$416,656*	*$418,272*	*$419,543*	*$420,351*	*$428,145*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$228	$180	$151	$131	$114	$101
Water Conservation Pricing	$0	$0	$36	$17	$17	$16	$15
Water System Audit	$0	$15,373	$5,077	$4,898	$4,683	$4,430	$4,256
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$728*	*$347*	*$272*	*$245*	*$219*	*$199*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.70	$0.55	$0.46	$0.40	$0.35	$0.31
Water Conservation Pricing	$0.00	$0.00	$0.11	$0.05	$0.05	$0.05	$0.05
Water System Audit	$0.00	$47.18	$15.58	$15.03	$14.37	$13.60	$13.06
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$2.23*	*$1.07*	*$0.84*	*$0.75*	*$0.67*	*$0.61*

Snyder

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	56	71	85	99	113	127
Water Conservation Pricing	0	0	21	43	42	42	42
Water System Audit	0	0	0	0	0	0	0
Passive Clothes Washer	0	14	62	63	64	64	64
Total	*0*	*70*	*154*	*191*	*205*	*220*	*234*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$11,705	$11,751	$11,814	$11,858	$11,810	$11,753
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$35,238	$35,558	$34,199	$32,492	$30,757	$29,549
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$46,943*	*$51,385*	*$50,089*	*$48,426*	*$46,643*	*$45,378*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$210	$166	$138	$120	$104	$92
Water Conservation Pricing	$0	$0	$192	$96	$96	$96	$96
Water System Audit	$0	$0	$0	$0	$0	$0	$0
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$671*	*$334*	*$262*	*$236*	*$212*	*$194*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.64	$0.51	$0.42	$0.37	$0.32	$0.28
Water Conservation Pricing	$0.00	$0.00	$0.59	$0.29	$0.29	$0.29	$0.29
Water System Audit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$2.06*	*$1.02*	*$0.80*	*$0.72*	*$0.65*	*$0.60*

Menard

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	7	9	10	12	14	15
Water Conservation Pricing	0	0	3	5	5	5	5
Water System Audit	0	0	0	0	0	0	0
Passive Clothes Washer	0	3	13	13	13	13	13
Total	*0*	*10*	*24*	*28*	*30*	*32*	*33*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$1,828	$1,801	$1,780	$1,771	$1,754	$1,745
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$5,504	$5,450	$5,153	$4,853	$4,567	$4,388
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$7,332*	*$11,327*	*$11,009*	*$10,700*	*$10,397*	*$10,209*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$258	$204	$171	$148	$129	$114
Water Conservation Pricing	$0	$0	$1,540	$783	$797	$802	$802
Water System Audit	$0	$0	$0	$0	$0	$0	$0
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$733*	*$472*	*$393*	*$357*	*$325*	*$309*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.79	$0.63	$0.52	$0.45	$0.40	$0.35
Water Conservation Pricing	$0.00	$0.00	$4.73	$2.40	$2.45	$2.46	$2.46
Water System Audit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$2.25*	*$1.45*	*$1.21*	*$1.09*	*$1.00*	*$0.95*

Midland

Water Savings

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	579	751	924	1,094	1,265	1,445
Water Conservation Pricing	0	0	225	462	469	474	482
Water System Audit	0	246	767	786	797	807	820
Passive Clothes Washer	0	105	459	476	488	496	504
Total	*0*	*930*	*2,202*	*2,648*	*2,848*	*3,043*	*3,250*

Annual Cost

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$104,844	$107,438	$110,126	$112,478	$113,203	$114,374
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$315,649	$325,113	$318,803	$308,199	$294,813	$287,552
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$420,493*	*$436,627*	*$433,005*	*$424,753*	*$412,092*	*$406,002*

Cost per Ac-Ft

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$181	$143	$119	$103	$89	$79
Water Conservation Pricing	$0	$0	$18	$9	$9	$9	$8
Water System Audit	$0	$1,282	$424	$405	$386	$365	$351
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total		*$452*	*$198*	*$164*	*$149*	*$135*	*$125*

Cost per kGal

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.56	$0.44	$0.37	$0.32	$0.27	$0.24
Water Conservation Pricing	$0.00	$0.00	$0.06	$0.03	$0.03	$0.03	$0.02
Water System Audit	$0.00	$3.93	$1.30	$1.24	$1.18	$1.12	$1.08
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		*$1.39*	*$0.61*	*$0.50*	*$0.46*	*$0.41*	*$0.38*

Ballinger

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	18	25	32	39	47	56
Water Conservation Pricing	0	0	7	16	17	18	19
Water System Audit	0	8	25	27	29	30	32
Passive Clothes Washer	0	6	30	32	35	37	38
Total	*0*	*33*	*88*	*107*	*119*	*131*	*144*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$4,585	$4,954	$5,270	$5,654	$5,915	$6,183
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$13,803	$14,991	$15,256	$15,492	$15,405	$15,544
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$18,388*	*$24,021*	*$24,602*	*$25,222*	*$25,396*	*$25,803*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$250	$199	$166	$144	$126	$111
Water Conservation Pricing	$0	$0	$545	$257	$242	$231	$220
Water System Audit	$0	$1,769	$589	$566	$541	$512	$492
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$557*	*$273*	*$230*	*$212*	*$194*	*$179*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.77	$0.61	$0.51	$0.44	$0.39	$0.34
Water Conservation Pricing	$0.00	$0.00	$1.67	$0.79	$0.74	$0.71	$0.68
Water System Audit	$0.00	$5.43	$1.81	$1.74	$1.66	$1.57	$1.51
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$1.71*	*$0.84*	*$0.71*	*$0.65*	*$0.59*	*$0.55*

Winters

Water Savings	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	11	14	17	20	23	27
Water Conservation Pricing	0	0	4	8	9	9	9
Water System Audit	0	6	18	19	19	19	19
Passive Clothes Washer	0	4	19	19	20	20	21
Total	*0*	*21*	*55*	*63*	*67*	*71*	*76*

Annual Cost	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$3,090	$3,108	$3,152	$3,224	$3,261	$3,331
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$9,302	$9,405	$9,125	$8,834	$8,492	$8,374
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$12,392*	*$16,589*	*$16,353*	*$16,134*	*$15,829*	*$15,781*

Cost per Ac-Ft	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$280	$222	$186	$161	$142	$125
Water Conservation Pricing	$0	$0	$969	$480	$476	$473	$460
Water System Audit	$0	$1,533	$508	$489	$469	$448	$430
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$590*	*$302*	*$260*	*$241*	*$223*	*$208*

Cost per kGal	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.86	$0.68	$0.57	$0.49	$0.44	$0.38
Water Conservation Pricing	$0.00	$0.00	$2.97	$1.47	$1.46	$1.45	$1.41
Water System Audit	$0.00	$4.70	$1.56	$1.50	$1.44	$1.37	$1.32
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	*$0.00*	*$1.81*	*$0.93*	*$0.80*	*$0.74*	*$0.68*	*$0.64*

San Angelo

Water Savings

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	416	535	652	761	876	989
Water Conservation Pricing	0	0	161	326	326	329	330
Water System Audit	0	177	547	555	555	559	561
Passive Clothes Washer	0	108	462	477	484	491	492
Total	*0*	*701*	*1,705*	*2,009*	*2,127*	*2,255*	*2,371*

Annual Cost

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$98,692	$100,757	$102,646	$103,808	$104,114	$103,909
Water Conservation Pricing	$0	$0	$10,190	$10,190	$10,190	$10,190	$10,190
Water System Audit	$0	$297,126	$304,896	$297,151	$284,442	$271,143	$261,243
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$395,818*	*$415,843*	*$409,987*	*$398,440*	*$385,447*	*$375,342*

Cost per Ac-Ft

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$237	$188	$157	$136	$119	$105
Water Conservation Pricing	$0	$0	$63	$31	$31	$31	$31
Water System Audit	$0	$1,679	$558	$536	$513	$485	$466
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total		*$565*	*$244*	*$204*	*$187*	*$171*	*$158*

Cost per kGal

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.73	$0.58	$0.48	$0.42	$0.37	$0.32
Water Conservation Pricing	$0.00	$0.00	$0.19	$0.10	$0.10	$0.10	$0.10
Water System Audit	$0.00	$5.15	$1.71	$1.64	$1.57	$1.49	$1.43
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		*$1.73*	*$0.75*	*$0.63*	*$0.57*	*$0.52*	*$0.48*

Brady

Water Savings

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	0	38	47	56	65	74	83
Water Conservation Pricing	0	0	14	28	28	28	28
Water System Audit	0	31	95	94	93	92	92
Passive Clothes Washer	0	8	36	36	36	36	36
Total	*0*	*77*	*192*	*214*	*222*	*230*	*239*

Annual Cost

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$5,856	$5,786	$5,718	$5,689	$5,633	$5,606
Water Conservation Pricing	$0	$0	$4,076	$4,076	$4,076	$4,076	$4,076
Water System Audit	$0	$17,630	$17,508	$16,554	$15,588	$14,671	$14,095
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total	*$0*	*$23,486*	*$27,370*	*$26,348*	*$25,353*	*$24,380*	*$23,777*

Cost per Ac-Ft

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0	$156	$122	$102	$88	$76	$68
Water Conservation Pricing	$0	$0	$287	$145	$147	$148	$148
Water System Audit	$0	$563	$185	$177	$168	$159	$153
Passive Clothes Washer	$0	$0	$0	$0	$0	$0	$0
Total		*$305*	*$143*	*$123*	*$114*	*$106*	*$99*

Cost per kGal

	2000	2010	2020	2030	2040	2050	2060
Public & School Education	$0.00	$0.48	$0.37	$0.31	$0.27	$0.23	$0.21
Water Conservation Pricing	$0.00	$0.00	$0.88	$0.44	$0.45	$0.45	$0.45
Water System Audit	$0.00	$1.73	$0.57	$0.54	$0.52	$0.49	$0.47
Passive Clothes Washer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		*$0.94*	*$0.44*	*$0.38*	*$0.35*	*$0.33*	*$0.30*

Appendix 4J
Information on Health Impacts of Radium

fyi
CAB

MAY 0 2002

Texas Radiation Advisory Board

Michael Ford, C.H.P.
Vice Chair

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Michael Ford, C.H.P.
Elaine Wells, M.S.
Jimmy Barker, P.E.
W. Kim Howard, M.D.

May 6, 2002

Robert J. Huston
Chairman
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087

Re: Waste

Dear Chairman Huston:

I am writing you today to explain why the Texas Radiation Advisory Board (TRAB) in its 6 April 2002 meeting recommended that 30 TAC Sec. 290.108 not be proposed for rulemaking.

In short, we believe that: (1) the revised EPA rules are unwarranted and unsupported by public health information (specifically epidemiological data); (2) the results of unvalidated mathematical models are used to support the diversion of public and private monies toward compliance with the rules; and (3) the rules unnecessarily create a category of radioactive waste for which there is currently no approved method of disposal.

As we discussed with your staff in our meeting on 5 April 2002, the most significant change to the existing rule is the addition of uranium as a regulated substance in drinking water. The fact that the existing regulations have been unchanged in Texas since 1971 is now well understood by the TRAB; however, the Environmental Protection Agency's (EPA) proposed rule in 1991 raised the question of appropriate limits supported by epidemiological data.

EPA's apparent reversal in April of 2000 with the issuance of the Notice of Data Availability (NODA) document was supported only by the recently-developed models described in Federal Guidance Report (FGR) 13. This Report was roundly criticized in the Health Physics community because the levels to which the FGR 13 models seek to analyze are not supported by any published epidemiological data. A documented TRAB review also commented on the inadequacy of the FGR 13 document.

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This position is further supported by EPA's own statements in the NODA document:

> *" EPA recognizes the inherent uncertainties that exist in estimating health impacts at the low levels of exposure and exposure rates expected to be present in the environment. EPA also recognizes that, at these levels, the actual health impact from ingested radionuclides will be difficult, if not impossible, to distinguish from natural disease incidences, even using very large epidemiological studies employing sophisticated statistical analyses."* [FR21600, Vol. 65, No. 78, 21 APR 2000]

The federal agency concedes that it is practically impossible to distinguish natural disease rates from disease rates enhanced by the minuscule levels of radioactive materials represented by the MCLs for drinking water. However, the EPA essentially ignores its own admonitions in the NODA and concludes that it plans to proceed with the revised levels in the NODA, maintaining the unsupported and unvalidated assumption that the linear, non-threshold model holds at the levels represented by the MCLs. When confronted with such unyielding adherence to the results of mathematical models, the TRAB has little choice. We cannot and will not support the diversion of public and private monies to fund EPA's mathematical exercises that have no basis in fact.

Similarly, the TRAB cannot support the TNRCC's position that "[T]he proposed rulemaking would *materially protect* public health and safety by preventing the exposure to unacceptable levels of radium-226, radium-228, and gross alpha particle radioactivity naturally occurring in groundwater which may be used as a public drinking water source in various geographical areas in Texas." [*Emphasis added.* Ref. 22 FEB 02 draft of 30 TAC Sec. 290.108, pg 10]. There are no data to support the assertions made in that statement.

The view held by the TRAB of this rulemaking activity is essentially identical to that expressed in a 19 September 2000 letter to Governor Bush on the subject of the EPA's proposed radon in drinking water rule:

> *"... The TRAB's concerns are that the burdens placed on Texans by the changes in the EPA rules are unwarranted and unsupported by public health information. The public health hazard this rule presumes to address has never been scientifically demonstrated.*
>
> *The TRAB understands that community water system (CWS) funds are very limited; the TRAB believes that issues of water supply, infrastructure, and basic hygiene should take precedence over radon mitigation. These critical CWS funds should not be exhausted on the mitigation of a hypothetical risk of radon in water, but instead on the mitigation of water-borne pathogens that are causing real death and disease throughout the nation today. In the end, it is not a question of what is the most cost-effective alternative for Texans, but ultimately it is a question of 'who pays' for the mitigation of a minuscule or non-existent risk ..."*

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To further complicate matters, the radioactive waste unnecessarily generated by this rule creates additional hazards for Texans for which there is currently no approved method of disposal. The small rural CWSs most affected by these proposed rules could be financially devastated by the liability and cost of safely handling and disposing of the radioactive materials created by these rules. In fact, as stated in the attached comments to the proposed rule, the proposed rulemaking has the potential to materially endanger the public health and safety by creating radioactive wastes without providing for their safe handling and disposal and by limiting access of some Texans to safe, pathogen-free water. In many cases, these small rural CWSs are the sole source of suitable pathogen-free water for rural Texans.

Mr. Chairman, the TRAB understands the difficult position this puts the TNRCC in especially in regard to primacy status. However, the Board must take this position when the mitigation of an unsubstantiated hazard is involved in removing monies from limited public health coffers.

We will continue to work closely with the TNRCC staff in resolving this matter for the benefit of all Texans. Additional comments on the proposed rule are attached.

If you have any questions regarding the position of the TRAB on this matter, please feel free to contact me at your earliest convenience.

Sincerely,

Michael Ford, C.H.P.
Vice Chair

cc: Governor Rick Perry
Representative Warren Chisum, Chair, Committee on Environmental Regulation
Senator J.E. "Buster" Brown, Chair, Senate Natural Resources Committee
Environmental Protection Agency

City Drug

From: "Brenda Mokry" <Brenda.Mokry@tdh.state.tx.us>
To: <tac@centex.net>
Cc: <citydrug@centex.net>; <john.villanacci@tdh.state.tx.us>; <miguel.escobedo@tdh.state.tx.us>; <kimberly.kinney-lara@tdh.state.tx.us>; <tbennett@tceq.state.tx.us>
Sent: Monday, March 22, 2004 3:13 PM
Attach: csum04028.doc
Subject: cancer cluster report for Brady and McCulloch County

Dear Treva,

Enclosed is the completed report for zip code 76825, Brady, Texas and McCulloch County. Concern about a possible excess of cancer prompted the Cancer Registry Division (CRD) of the Texas Department of Health to re-examine the occurrence of cancer in zip code 76825, Brady, and McCulloch County, Texas. A previous cluster investigation (#01005) had found no excess of cancer for the sites of the bone and joint, nose and nasal cavity, and acute myeloid leukemia. Local residents were concerned that radium in the drinking water and silicone from the sanding industry may be causing cancer among residents. The Cancer Registry evaluated 1995-2001 incidence data (the most recent and best available data) and 1992-2001 mortality data for cancers of the bone and joint, nose and nasal cavity, lung and bronchus, total leukemia, and selected leukemia subtypes. Radium in drinking water has been associated with osteosarcoma in the scientific literature. Silicone, such as that from the sanding industry has been associated with an increased risk of lung and bronchus cancer.

The analysis of incidence data for zip code 76825, Brady and McCulloch County, Texas, from January 1, 1995-December 31, 2001, and mortality data from January 1, 1992-December 31, 2001, showed incidence and mortality data for cancers of the bone and joint, nose and nasal cavity, lung and bronchus, total leukemia, and the selected leukemia subtypes were within the ranges expected for both males and females. Additionally, the TCR contacted Tony Bennett with the Texas Commission on Environmental Quality. He confirmed that the naturally occurring radium in the drinking water is above the standards set by the Environmental Protection Agency. The City of Brady municipal water system is addressing these violations by treating surface water from Brady Lake.

Based on the findings and the information discussed above, further study is not recommended at this time to determine whether the various cancers in zip code 76825, Brady and McCulloch County, Texas may be associated with radium in the drinking water or silicone from the sanding industry. As new data or additional information become available, consideration will be given to updating or re-evaluating this investigation.

Sincerely,

Brenda J. Mokry
Epidemiologist
Texas Cancer Registry
Texas Department of Health
512-458-7111 ext. 3606
1-800-252-8059

17 pages

3/23/2004

Summary of Investigation Into the Occurrence of Cancer
Concho, McCullouch, San Saba, and Tom Green Counties, Texas
1990-1998
December 15, 2000

Background: In response to concerns regarding a possible excess of cancer, the Cancer Registry Division (CRD) of the Texas Department of Health conducted an investigation into the occurrence of cancer in Concho, McCullouch, San Saba, and Tom Green Counties, Texas. Specifically, we evaluated 1995-1997 incidence data and 1990-1998 mortality data for cancers of the nose, nasal sinus, and middle ear, bone and joints, and acute myelogenous leukemia (AML). Incidence data are the best indicator of the occurrence of cancer in an area. Currently, however, complete statewide cancer incidence data are only available for 1992, 1995, 1996, and 1997. Until additional years of statewide cancer incidence data become available, cancer mortality data is used as a supplemental measure and are complete for the entire state through 1998. The remaining portion of this report provides general information on cancer, the methodologies we use to investigate possible cancer clusters, the results of our investigation and general cancer risk factors.

General: Cancer is a very common disease, much more common than most people realize. Approximately two out of every five persons alive today will develop some type of cancer in their lifetime. Furthermore, cancer is not one disease, but many different diseases. Different types of cancer are generally thought to have different causes. In Texas, as in the United States, cancer is the second leading cause of death, exceeded only by heart disease. In 1998, 32,275 Texans died of cancer. Sixty-eight percent of these deaths were in persons 65 years of age or older. Finally, it takes time for cancer to develop, usually 20 to 40 years. Conditions that have prevailed for only the last 5 or 10 years are unlikely to be related to the current incidence of cancer in a community.

The chances of a person developing cancer as a result of exposure to an environmental contaminant are actually slight. According to The Causes of Cancer by Doll and Peto, two renowned epidemiologists at the University of Oxford, pollution and occupational exposures are estimated to collectively cause 4-6% of all cancer deaths. The 1996 "Harvard Report on Cancer Prevention," published in the international journal, Cancer Causes and Control, states that cigarette smoking accounts for 30% of all cancer deaths. The report also notes that nearly two-thirds of cancer deaths in the U.S. can be linked to tobacco use, diet, and lack of exercise. Eating a healthy diet, refraining from tobacco use, and exercising regularly constitute the soundest approach a person can take to eliminate their chances of developing many kinds of cancer.

Methodology: The cancer cluster investigation is the primary tool used by the Texas Cancer Registry to investigate concerns of excess cancer. A cluster is a greater than expected number of cancers occurring among people who may live or work in the same area, and who may develop the disease within a short time of each other. The existence of a cluster is not necessarily a reason for concern. The fact that cancer is so common means that many clusters will be explainable solely on the basis of chance.

We assess the role of chance by comparing what is observed in a specific geographic area to what would be expected to occur if only chance were operating. For example, if we wanted to study the occurrence of fatal accidents on a particular highway, we would begin by collecting data over a period of several years. We would then have a certain expectation as to how many deaths might occur on that highway on a particular weekend, say Labor Day weekend. This expected number could be compared to what we actually observe on Labor Day weekend this year. Of course, we do not think that what we observe will be exactly the same as what we expected, but we do anticipate that the observed will be fairly close to the expected. It might be a little higher on Labor Day weekend this year but a little lower next year, but always about the same. This is simple variation due to the working of chance. If, however, the number of highway fatalities is much higher than what we expected, this might suggest that some new factor might be involved such as bad weather or a higher volume of traffic. In any event, we would accept that the observed number of deaths was outside the variation likely to be due to chance.

To determine whether an excess of cancer exists in Concho, McCullouch, San Saba, and Tom Green Counties, the numbers of observed cases and deaths were compared to what would be "expected" based on the race-, sex-, and age-specific cancer incidence and mortality of the entire state of Texas for the same periods of time. The attached Tables 1-10 list the number of observed cases and deaths for males and females, the number of "expected" cases and deaths, the standardized incidence ratio (SIR) or standardized mortality ratio (SMR), and the corresponding 95% confidence interval.

The standardized incidence or mortality ratio (SIR, SMR) is simply the number of observed cases or deaths compared to the number of "expected" cases or deaths. When the SIR or SMR of a selected cancer is equal to 1.00, then the number of observed cases or deaths is equal to the expected number of cases or deaths, based on the incidence or mortality experience of the rest of the state. When the SIR or SMR is less than 1.00, fewer people developed or died of cancer than we would have expected. Conversely, an SIR or SMR greater than 1.00 indicates that more people developed or died of cancer than we would have expected. To determine if an SIR or SMR greater than 1.00 or less than 1.00 is statistically significant or outside the variation likely to be due to chance, confidence intervals were also calculated.

The 95% confidence interval indicates the range in which we would expect the SIR or SMR to fall 95% of the time. The confidence interval is a statistical measure of the precision of the risk estimate. If the confidence interval contains 1.00, no statistically significant excess of cancer is indicated. The confidence intervals are particularly important when trying to interpret small numbers of cases. If only one or two (or even less than one) cases are expected for a particular cancer, then the report of three or four observed cases will result in a very large SIR or SMR. As long as the 95% confidence interval contains 1.00, that indicates that the SIR or SMR is still within the range one might expect based on the incidence or mortality experience of the rest of the state.

Another way of defining the 95% confidence interval is to say that it represents the range within which the true magnitude of effect lies with a certain degree of assurance. For example, in evaluating the relationship of smoking with bladder cancer in men, instead of simply reporting that those who smoked had a statistically significant increased risk (RR = 1.9) of bladder cancer compared with those who did not, the 95% confidence interval (1.3 - 2.8) would also be presented. This indicates that the best estimate of the increased risk of bladder cancer associated with smoking is 1.9; however, we are 95% confident that the true relative risk is no less than 1.3 and no greater than 2.8.

Results: The analysis of incidence data for Concho, McCullouch, and San Saba Counties, during the period January 1, 1995-December 31, 1997, and mortality data from January 1, 1990-December 31, 1998, showed no statistically significant excesses of nose/nasal cavity/middle ear, bone and joint, or acute myelogenous leukemia cancers in either males or females. Analysis summaries are presented in Tables 1-6.

The analysis of incidence data for Tom Green County, as well as for all four counties combined during the same time period, showed that acute myelogenous leukemia incidence in males was statistically significantly elevated at the $p<0.05$ level (SIR = 2.3, CI = 1.1-4.2; SIR = 2.2, CI = 1.1-3.8), respectively. Tom Green mortality rates did not differ significantly from the rest of the state for nose/nasal cavity/middle ear, bone and joint, or acute myelogenous leukemia cancers. Analysis summaries are presented in Tables 7-10.

Discussion: We do not know why male acute myelogenous leukemia incidence in Tom Green County and all counties combined is elevated. Determining the cause of any excess is beyond the scope of the cancer cluster investigation. However, part of any cancer cluster investigation is to evaluate the possibility that any observed excess is being caused by some environmental exposure.

When evaluating the possibility that an observed excess is being caused by some environmental exposure, one of the markers we look for is whether the excess is observed in both males and females. None of the observed cancer elevations occurred in both males and females. This finding is not consistent with exposure to some environmental agent.

Epidemiologic studies have helped to identify a number of factors that may increase an individual's risk of developing cancer. These factors are known as risk factors. Some risk factors we can do nothing about, but most are a matter of choice.

The following is a brief discussion on leukemia and general cancer risk factors from "Texas Cancer Facts & Figures 2000: A Source Book for Planning and Implementing Programs for Cancer Prevention and Control," by the American Cancer Society and the American Cancer Society web site at www.cancer.org/.

Leukemia Risk Factors:
About 30,800 new cases of leukemia will be diagnosed in the United States during the year 2000. Approximately 28,090 of these newly diagnosed patients will be adults and 2,710 will be children. The most common adult leukemia is acute myelogenous leukemia

(parents, siblings, or children) who have had CLL.

Most people who develop leukemia, however, do not have any of the above risk factors. The cause of their leukemia remains unknown at this time. Because the cause is not known, there is no way to prevent most cases of leukemia. There are two important exceptions: avoiding smoking, and avoiding known cancer-causing chemicals such as benzene.

General Cancer Risk Factors:

The occurrence of cancer may vary by race/ethnicity, gender, the type of cancer, geographic distribution, population under study, and a variety of other factors. Scientific studies have identified a number of factors for various cancers which may increase an individual's risk of developing a specific type of cancer.

Heredity: When there is a family predisposition to cancer, heredity may be the first event that promotes the growth of cancer. Although a tendency or susceptibility to developing cancer can be inherited under certain conditions, only about 2 percent of malignancies are caused directly by heredity. Most family histories of cancer result from a complex interaction of genes, environment, and lifestyle.

Geographic Area: People living in areas where there are vitamin or mineral deficiencies such as selenium deficiency may run a higher risk of cancer. The biggest influence of geographic area, however, is on diet, which may also be influenced by cultural habits.

Diet: High levels of fats, both saturated (hard, mostly animal) and unsaturated (liquid, mostly vegetable), appear to play a role in causing cancers of the colon, rectum, prostate, testes, breast, uterus, and gallbladder. Low fiber consumption plays a role in the development of colon and rectal cancers. Even lean people with high-fat and low-fiber diets run increased risks of developing these cancers.

Eating preserved foods, especially smoked or nitrate-cured meats, increases the risk for cancers of the esophagus and stomach. Low levels of vitamins A and C increase the risk for cancers of the larynx, esophagus, stomach, colon, rectum, prostate, bladder, and lung.

Environmental Cancer Risks: The environmental causes of cancer include exposures in the community or workplace settings, as well as exposures determined by individual lifestyle choices (smoking, diet, medications, etc). The degree of cancer hazard posed by such risks depends on the concentration or intensity of the carcinogen in the environment and the exposure dose a person receives. These factors in combination create a range of risk. For example, in situations where high levels of carcinogens are present and where exposures are extensive, significant hazards may exist, but where concentrations are low and exposures limited, hazards are often negligible.

Chemicals and Radiation: Not all chemicals or all forms of radiation cause cancer. Only a limited number of chemicals (for example, benzene, asbestos, vinyl chloride, arsenic, aflatoxins) show definite evidence of human carcinogenicity or are probable human carcinogens based on animal experiments (for example, chloroform, dichlorodiphenyltrichloroethane (DDT), formaldehyde, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons). The only forms of radiation proven to cause human cancer are ionizing radiation (for example, x-rays, radon, cosmic rays) and ultraviolet radiation (principally UV-B radiation).

Ionizing Radiation: Excessive exposure to ionizing radiation can increase cancer risk. Most medical and dental x-rays are adjusted to deliver the lowest dose possible without sacrificing image quality. Excessive radon exposure in homes may increase risk of lung cancer, especially in cigarette smokers. If levels are found to be too high, remedial actions should be taken.

Sunlight: Almost all of the approximately 1,000,000 cases of basal and squamous cell skin cancer diagnosed each year in the U.S. are sun-related (ultraviolet radiation). Epidemiologic evidence shows that sun exposure is a major factor in the development of melanoma and that incidence increases for those living near the equator.

Estrogen: Estrogen treatment to control menopausal symptoms can increase risk of endometrial cancer. However, including progesterone in estrogen replacement therapy helps to minimize risk. Consultation with a physician will help each woman to assess personal risks and benefits. Continued research is needed in the area of estrogen use and breast cancer.

Sexual Practices: Sexual history and habits influence the chance of developing cancer. They can either protect you or promote the growth of tumors. Childbearing reduces risk of cancers of the ovary, uterus, and breast. And women who give birth before age 30 are less likely to develop breast cancer in later life.

The more sex partners one has, the more likely they are to be exposed to sexually transmitted viruses. Some of these can cause cancers of the head and neck, cervix, penis and anus, as well as AIDS and AIDS related cancers.

Alcohol: In about 7 percent of males and 3 percent of females, about 4 percent of people overall, alcohol can lead to cancers in the head and neck, the larynx, and possibly the liver and pancreas. Alcohol consumption also has a strong relationship with smoking, a combination that greatly increases the risk for cancers of the mouth, throat, and esophagus.

Tobacco Smoke: There is no longer any question about the causal relationship between smoking and cancer. The link has been established statistically since 1950, though it was apparent long before that. In 1950, when the first report relating smoking and lung cancer was published in the *Journal of the American Medical Association*, there were 18,000 lung cancer deaths. By 1982, there were 111,000. In 2000, it is estimated that there will be approximately 157,000 lung cancer deaths in the U.S. This death rate has started to decrease in men but is still increasing in women. Lung cancer has replaced breast cancer as the number one cause of cancer deaths in women.

Unproven Risks: Public concern about environmental cancer risks often focuses on risks for which no carcinogenity has been proven or on situations where known carcinogen exposures are at such levels that risks are negligible. For example:

Non-ionizing Radiation: Electromagnetic radiation at frequencies below ionizing and ultraviolet levels has not been shown to cause cancer. While some epidemiologic studies suggest associations with cancer, other do not, and experimental studies have not yielded reproducible evidence of carcinogenic mechanisms. Low frequency radiation includes radio waves, microwaves, and radar, as well as power frequency radiation arising from the electric and magnetic fields associated with electric currents (often called ELF or extremely low frequency radiation).

Pesticides: Many kinds of pesticides (insecticides, herbicides, etc.) are widely used in producing and marketing our food supply. While some of these chemicals cause cancer at high doses in experimental animals, the very low concentrations found in some foods are generally within established safety levels. Environmental pollution by slowly degraded pesticides such as DDT, a result of past agricultural practices, can lead to food chain bioaccumulation and to persistent residues in body fat. Such residues have been suggested as a possible risk factor for breast cancer; concentrations in tissue are low, however, and the evidence is not conclusive.

Toxic Wastes: Toxic wastes in dump sites can threaten human health through air, water, and soil pollution. Although many toxic chemicals contained in such wastes can be carcinogenic at high doses, most community exposures appear to involve very low or negligible dose levels. Clean-up of existing dump sites and close control of toxic materials in the future is essential to ensure healthy living conditions in our industrialized society.

Nuclear Power Plants: Ionizing radiation emissions from nuclear facilities are closely controlled and involve negligible levels of exposure for communities near such plants. Although reports about cancer case clusters in such communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population.

Summary: In summary, the analysis of incidence data for Concho, McCullouch, and San Saba Counties, during the period January 1, 1995-December 31, 1997, and mortality data from January 1, 1990-December 31, 1998, showed no statistically significant excesses of nose/nasal cavity/middle ear, bone and joint, or acute myelogenous leukemia cancers in either males or females.

The analysis of incidence data for Tom Green County, as well as for all four counties combined during the same time period, showed that acute myelogenous leukemia incidence in males was statistically significantly elevated. Tom Green mortality rates did not differ significantly from the rest of the state for nose/nasal cavity/middle ear, bone and joint, or acute myelogenous leukemia cancers.

Any questions regarding this investigation should be directed to Melanie A. Williams, Ph.D., Cancer Registry Division, at 1-800-252-8059 or melanie.williams@tdh.state.tx.us.

Table 1

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Sites, Concho County, TX, 1995-1997

		Males		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.0
	--	--		
Bone and Joint	0	0.1	0.0	0.0-61.5
Acute Myelogenous Leukemia		1	0.2	5.0
	0.1-27.9			

		Females		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.0
	--	--		
Bone and Joint	0	0.0	0.0	0.0-92.2
Acute Myelogenous Leukemia		0	0.1	0.0
	0.0-26.3			

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995-1997. The SIR has been rounded to the first decimal place.

*Significant at the $p< 0.05$ level.

Prepared by:
Melanie A. Williams, Ph.D.
Texas Cancer Registry Division
Texas Department of Health
12/14/2000

Table 2

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Sites, Concho County, 1990-1998

		Males		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.0
	--	--		
Bone and Joint	0	0.2	0.0	0.0-24.6
Acute Myelogenous Leukemia		0	0.5	0.0

0.0-7.5

		Females		
Site	Observed	Expected	SMR	95% CI
Nose, Nasal Cavity, and Middle Ear			0	0.0
	--	--		
Bone and Joint	0	0.1	0.0	0.0-33.5
Acute Myelogenous Leukemia		1	0.3	2.9
	0.1-16.4			

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1990-1998. The SMR has been rounded to the first decimal place.

*Significant at the p< 0.05 level.

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12/14/2000

Table 3

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Sites, McCullouch County, TX, 1995-1997

		Males		
Site	Observed	Expected	SIR	95% CI
Nose, Nasal Cavity, and Middle Ear			0	0.1
	0.0	0.0-36.9		
Bone and Joint	0	0.2	0.0	0.0-24.6
Acute Myelogenous Leukemia		0	0.6	0.0
	0.0-6.1			

		Females		
Site	Observed	Expected	SIR	95% CI
Nose, Nasal Cavity, and Middle Ear			0	0.1
	0.0	0.0-36.9		
Bone and Joint	0	0.1	0.0	0.0-26.3
Acute Myelogenous Leukemia		0	0.5	0.0
	0.0-7.8			

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995-1997. The SIR has been rounded to the first decimal place.

*Significant at the p< 0.05 level.

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12/14/2000

Table 4

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Sites, McCullouch County, TX, 1990-1998

		Males		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	0	0.5	0.0	0.0-8.2
Acute Myelogenous Leukemia		3	1.5	2.0

0.4-5.9

		Females		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	1	0.4	2.7	0.1-15.1
Acute Myelogenous Leukemia		0	1.1	0.0

0.0-3.2

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1990-1998. The SMR has been rounded to the first decimal place.

*Significant at the p< 0.05 level.

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12/14/2000

Table 5

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Sites, San Saba County, TX, 1995-1997

		Males		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	0	0.1	0.0	0.0-36.9
Acute Myelogenous Leukemia		1	0.4	2.5

0.1-13.9

		Females		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	0	0.1	0.0	0.0-46.1
Acute Myelogenous Leukemia		0	0.3	0.0

0.0-11.9

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995-1997. The SIR has been rounded to the first decimal place.

*Significant at the $p < 0.05$ level.

Prepared by:
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Texas Department of Health
12/14/2000

Table 6
Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Sites, San Saba County, TX, 1990-1998

		Males		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	2	0.3	6.7	0.8-24.1
Acute Myelogenous Leukemia		1	1.0	1.0

0.0-5.5

		Females		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			0	0.1

0.0 0.0-36.9

Bone and Joint	0	0.2	0.0	0.0-15.4
Acute Myelogenous Leukemia		2	0.8	2.7

0.3-9.6

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1990-1998. The SMR has been rounded to the first decimal place.

*Significant at the p< 0.05 level.

Prepared by:
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12/14/2000

Table 7

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Sites, Tom Green County, TX, 1995-1997

		Males		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			1	1.0
	1.0	0.0-5.6		
Bone and Joint	1	1.4	0.7	0.0-4.0
Acute Myelogenous Leukemia		10	4.4	2.3*
	1.1-4.2			

		Females		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear			1	1.0
	1.0	0.0-5.6		
Bone and Joint	0	1.2	0.0	0.0-3.0
Acute Myelogenous Leukemia		2	3.8	0.5
	0.1-1.9			

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995-1997. The SIR has been rounded to the first decimal place.

*Significant at the p< 0.05 level.

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12/14/2000

Table 8

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized

Mortality Ratios, Selected Sites, Tom Green County, TX, 1990-1998

		Males		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear	0	1.0	0.0	0.0-3.7
Bone and Joint	2	3.4	0.6	0.1-2.1
Acute Myelogenous Leukemia	7	10.5	0.7	0.3-1.4

		Females		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear	1	0.7	1.4	0.0-8.0
Bone and Joint	2	2.8	0.7	0.1-2.6
Acute Myelogenous Leukemia	15	8.6	1.7	1.0-2.9

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1990-1998. The SMR has been rounded to the first decimal place.

*Significant at the $p < 0.05$ level.

Prepared by:
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Texas Department of Health
12/14/2000

Table 9

Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Sites, Concho, McCullouch, San Saba, and Tom Green Counties Combined, TX, 1995-1997

		Males		
Site	**Observed**	**Expected**	**SIR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear	1	1.3	0.8	0.0-4.3
Bone and Joint	1	1.7	0.6	0.0-3.3
Acute Myelogenous Leukemia	12	5.6	2.2*	1.1-3.8

		Females		
Site	**Observed**	**Expected**	**SIR**	**95% CI**

Nose, Nasal Cavity, and Middle Ear	1	1.2	0.8	0.0-4.6
Bone and Joint	0	1.5	0.0	0.0-2.5
Acute Myelogenous Leukemia	2	4.7	0.4	0.1-1.5

Note: The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995-1997. The SIR has been rounded to the first decimal place.

*Significant at the $p < 0.05$ level.

Prepared by:
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12/14/2000

Table 10

Number of Observed and Expected Cancer Deaths and Race Adjusted Standardized Mortality Ratios, Selected Sites, Concho, McCullouch, San Saba, and Tom Green Counties Combined, TX, 1990-1998

		Males		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear	0	1.2	0.0	0.0-3.1
Bone and Joint	4	4.3	0.9	0.3-2.4
Acute Myelogenous Leukemia	11	13.4	0.8	0.4-1.5

		Females		
Site	**Observed**	**Expected**	**SMR**	**95% CI**
Nose, Nasal Cavity, and Middle Ear	1	0.9	1.1	0.0-6.2
Bone and Joint	3	3.5	0.9	0.2-2.5
Acute Myelogenous Leukemia	18	10.9	1.7	1.0-2.6

Note: The SMR (standardized mortality ratio) is defined as the number of observed deaths divided by the number of expected deaths. The latter is based on race-, sex-, and age-specific cancer mortality rates for Texas during the period 1990-1998. The SMR has been rounded to the first decimal place.

*Significant at the $p < 0.05$ level.

Prepared by:
Melanie A. Williams, Ph.D.

(AML) with, about 9,700 new cases expected. About 3,200 adults are expected to develop acute lymphocytic leukemia.

About 21,700 adults and children in the United States will die of leukemia during 2000.

While the exact cause of leukemia is not known, several risk factors for this cancer in children and adults have been identified.

Childhood Leukemia: Leukemia is the most common cancer in children; it accounts for about one-third of all cancers in children. For the most part, lifestyle risk factors such as diet and exercise, while important in adult cancers, are not linked to childhood cancers.

Certain genetic diseases that cause children to be born with an abnormal immune system increase their risk of developing leukemia. Other conditions such as Li-Fraumeni syndrome, Down's syndrome, Klinefelter's syndrome and others also carry an increased risk of leukemia.

Exposure to high doses of radiation, such as that among Japanese survivors of the atomic bomb, contributes to an increase in leukemia. Patients treated earlier with radiation therapy and chemotherapy for other cancers have a slight risk of developing a second cancer, usually AML, later in life.

Acute Leukemia: Smoking is a proven risk factor for acute myelogenous leukemia (AML). Although many people know that smoking causes lung cancer, few realize that it can affect cells that do not come into direct contact with smoke. Cancer-causing substances in tobacco smoke get into the bloodstream and spread to many parts of the body. About one-fifth of cases of AML are caused by smoking. People who smoke should attempt to quit.
There are some factors in the environment that are linked to acute leukemia. For example, long-term exposure to benzene is a risk factor for AML, and high-dose radiation exposure (such as from an atomic blast or nuclear reactor accident) increases the risk of AML and acute lymphocytic leukemia (ALL).

People who have had other cancers and were treated with certain chemotherapy drugs are more likely to develop AML. Most of these cases of AML happen within 9 years after treatment of Hodgkin's disease, non-Hodgkin's lymphoma, childhood ALL, or other cancers such as breast and ovarian cancer.

There is some concern about very high-voltage power lines as a risk factor for leukemia. The National Cancer Institute (NCI) has several large studies going on now to look into this question. So far, the studies show either no increased risk or a very slightly increased risk. Clearly, most cases of leukemia are not related to power lines.

A small number of people are at greater risk of acute leukemia because they have certain very rare diseases or because the have a certain virus (HTLV-1).

Chronic Leukemia: There are some factors in the environment that are linked to chronic leukemia. For example, high-dose radiation exposure (such as from an atomic blast or nuclear reactor accident) increases the risk of chronic myelogenous leukemia (CML) but not chronic lymphocytic leukemia (CLL). Long-term contact with herbicides or pesticides among farmers can increase their risk of CLL.

The only known inherited risk factor for chronic leukemia is having first-degree relatives

Estimated New Cancer Cases for Selected Cancer Sites by State, US, 2004*

State	All Cases	Female Breast	Uterine Cervix	Colon & Rectum	Uterine Corpus	Leukemia	Lung & Bronchus	Melanoma of the Skin	Non-Hodgkin Lymphoma	Prostate	Urinary Bladder
Alabama	24,270	3,980	190	2,330	680	530	3,350	840	840	4,850	810
Alaska	1,890	270	†	210	60	†	240	70	80	230	90
Arizona	23,560	3,980	190	2,490	510	590	2,760	1,180	950	3,920	1,140
Arkansas	14,800	2,050	160	1,630	340	370	2,230	560	640	2,150	570
California	134,300	21,860	1,210	13,880	3,920	3,240	15,650	5,020	5,550	23,160	5,730
Colorado	15,510	2,580	110	1,610	400	440	1,740	910	810	2,540	620
Connecticut	17,010	2,850	80	1,710	450	400	2,000	700	760	3,310	660
Delaware	4,390	700	†	410	110	110	550	210	200	690	†
Dist. of Columbia	2,860	590	†	340	170	†	300	70	60	620	90
Florida	97,290	13,350	730	9,950	2,450	2,500	13,390	4,250	2,690	17,090	4,550
Georgia	35,430	6,080	350	3,420	970	790	5,050	1,460	1,320	5,700	1,520
Hawaii	5,070	750	†	520	170	110	570	140	250	1,000	190
Idaho	5,460	920	†	540	170	140	660	280	250	1,080	330
Illinois	60,280	9,640	490	6,680	2,050	1,550	7,320	2,020	2,270	9,930	2,610
Indiana	32,160	4,790	130	3,520	910	790	4,490	1,320	1,430	5,390	1,230
Iowa	15,940	2,320	110	1,840	510	460	1,820	560	640	3,160	620
Kansas	12,940	1,880	80	1,480	400	340	1,690	630	640	2,690	660
Kentucky	22,720	3,340	190	2,310	510	470	3,660	1,040	980	2,620	850
Louisiana	23,540	3,930	190	2,560	510	550	3,160	700	980	3,690	760
Maine	7,520	920	†	800	230	140	950	280	250	1,150	470
Maryland	25,310	4,090	220	2,820	740	650	3,180	980	1,040	4,080	1,140
Massachusetts	33,050	5,170	130	3,520	970	760	4,050	1,460	1,150	5,700	1,800
Michigan	48,220	7,270	350	4,920	1,420	1,210	6,160	1,670	2,040	8,540	2,370
Minnesota	22,720	3,610	110	2,200	680	630	2,580	980	1,290	4,230	1,040
Mississippi	15,120	2,480	110	1,610	280	300	2,230	420	390	3,390	470
Missouri	30,290	4,680	240	3,240	850	780	4,090	1,320	1,400	3,460	1,140
Montana	5,000	590	†	470	110	140	650	210	200	1,080	330
Nebraska	8,280	1,290	†	1,010	280	230	1,040	350	360	1,460	330
Nevada	10,990	1,620	80	1,240	170	260	1,570	490	420	2,000	520
New Hampshire	6,290	920	30	670	170	140	800	280	140	1,000	380
New Jersey	43,830	7,970	380	4,770	1,760	1,030	5,110	1,810	1,820	7,930	2,040
New Mexico	7,550	1,020	†	830	230	170	750	280	310	1,690	330
New York	88,190	15,190	840	9,890	3,180	2,110	10,020	3,060	2,770	14,470	4,410
North Carolina	40,240	5,870	320	4,120	1,190	930	5,710	1,740	1,480	7,160	1,470
North Dakota	3,250	540	†	360	60	100	360	70	140	540	190
Ohio	59,410	10,070	320	6,760	1,880	1,450	7,720	2,300	2,410	8,620	2,940
Oklahoma	18,540	2,910	130	2,070	400	440	2,570	910	760	2,620	760
Oregon	17,280	2,750	110	1,790	450	400	2,140	910	920	2,920	900
Pennsylvania	72,590	11,200	400	8,570	2,500	1,620	8,560	2,720	3,030	12,010	3,510
Rhode Island	5,950	860	†	650	110	130	760	280	280	1,000	330
South Carolina	21,500	3,280	160	2,280	510	490	2,950	700	870	4,770	810
South Dakota	4,000	540	†	490	110	110	450	210	220	920	140
Tennessee	30,850	4,310	300	3,470	740	730	4,680	1,250	1,400	4,540	1,090
Texas	84,530	12,980	1,030	9,220	2,390	2,140	10,470	3,550	2,970	13,540	3,270
Utah	6,360	1,080	†	670	230	220	480	420	390	1,080	280
Vermont	3,150	590	†	340	110	70	400	140	170	460	140
Virginia	31,190	6,350	220	3,550	1,080	760	4,050	1,390	1,230	5,080	1,330
Washington	27,380	4,040	130	2,720	910	720	3,520	1,320	1,290	4,850	1,330
West Virginia	11,430	1,620	110	1,270	340	270	1,780	420	500	1,540	570
Wisconsin	26,160	4,040	110	2,900	850	750	3,050	1,110	1,290	3,850	1,280
Wyoming	2,430	270	†	280	60	60	280	140	80	620	90
United States	1,368,030	215,990	10,520	146,940	40,320	33,440	173,770	55,100	54,370	230,110	60,240

*Rounded to nearest 10. Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. †Estimate is 50 or fewer cases.

Note: These estimates are offered as a rough guide and should be interpreted with caution. They are calculated according to the distribution of estimated cancer deaths in 2004 by state. State estimates may not add up to US total due to rounding.

Estimated Cancer Deaths for Selected Cancer Sites by State, US, 2004*

State	All Sites	Brain/ Nervous System	Female Breast	Colon & Rectum	Leukemia	Liver	Lung & Bronchus	Non-Hodgkin Lymphoma	Ovary	Pancreas	Prostate
Alabama	10,000	200	740	900	370	260	3,090	300	320	530	630
Alaska	780	†	†	80	†	†	220	†	†	†	†
Arizona	9,710	240	740	960	410	260	2,550	340	290	560	510
Arkansas	6,100	160	380	630	260	200	2,060	230	150	280	280
California	55,340	1,440	4,060	5,360	2,260	1,880	14,450	1,980	1,730	3,020	3,010
Colorado	6,390	180	480	620	310	160	1,610	290	210	380	330
Connecticut	7,010	150	530	660	280	170	1,850	270	200	380	430
Delaware	1,810	†	130	160	80	†	510	70	†	110	90
Dist. of Columbia	1,180	†	110	130	†	†	280	†	†	60	80
Florida	40,090	980	2,480	3,840	1,740	1,030	12,360	960	1,120	2,270	2,220
Georgia	14,600	260	1,130	1,320	550	300	4,660	470	430	750	740
Hawaii	2,090	†	140	200	80	100	530	90	†	150	130
Idaho	2,250	70	170	210	100	†	610	90	80	120	140
Illinois	24,840	490	1,790	2,580	1,080	650	6,760	810	660	1,400	1,290
Indiana	13,250	280	890	1,360	550	280	4,150	510	380	670	700
Iowa	6,570	160	430	710	320	110	1,680	230	210	380	410
Kansas	5,330	120	350	570	240	100	1,560	230	160	300	350
Kentucky	9,360	160	620	890	330	180	3,380	350	230	410	340
Louisiana	9,700	190	730	990	380	280	2,920	350	230	520	480
Maine	3,100	80	170	310	100	60	880	90	100	170	150
Maryland	10,430	210	760	1,090	450	240	2,940	370	300	590	530
Massachusetts	13,620	280	960	1,360	530	340	3,740	410	360	830	740
Michigan	19,870	450	1,350	1,900	840	500	5,690	730	580	1,120	1,110
Minnesota	9,360	250	670	850	440	190	2,380	460	270	540	550
Mississippi	6,230	160	460	620	210	190	2,060	140	160	320	440
Missouri	12,480	270	870	1,250	540	270	3,780	500	350	660	450
Montana	2,060	†	110	180	100	†	600	70	†	100	140
Nebraska	3,410	90	240	390	160	†	960	130	90	180	190
Nevada	4,530	80	300	480	180	110	1,450	150	110	220	260
New Hampshire	2,590	70	170	260	100	60	740	†	60	140	130
New Jersey	18,060	320	1,480	1,840	720	480	4,720	650	540	1,040	1,030
New Mexico	3,110	70	190	320	120	110	690	110	90	170	220
New York	36,340	690	2,820	3,820	1,470	890	9,250	990	1,080	2,270	1,880
North Carolina	16,580	320	1,090	1,590	650	350	5,270	530	450	900	930
North Dakota	1,340	40	100	140	70	†	330	†	†	90	70
Ohio	24,480	520	1,870	2,610	1,010	520	7,130	860	660	1,290	1,120
Oklahoma	7,640	160	540	800	310	160	2,370	270	170	360	340
Oregon	7,120	160	510	690	280	150	1,980	330	230	400	380
Pennsylvania	29,910	570	2,080	3,310	1,130	690	7,900	1,080	910	1,650	1,560
Rhode Island	2,450	†	160	250	90	60	700	100	60	160	130
South Carolina	8,860	200	610	880	340	190	2,720	310	170	500	620
South Dakota	1,650	†	100	190	80	†	420	80	60	100	120
Tennessee	12,710	300	800	1,340	510	270	4,320	500	340	660	590
Texas	34,830	940	2,410	3,560	1,490	1,120	9,670	1,060	960	1,930	1,760
Utah	2,620	80	200	260	150	60	440	140	90	150	140
Vermont	1,300	†	110	130	50	†	370	60	†	70	60
Virginia	12,850	290	1,180	1,370	530	320	3,740	440	400	750	660
Washington	11,280	340	750	1,050	500	300	3,250	460	390	700	630
West Virginia	4,710	90	300	490	190	100	1,640	180	140	190	200
Wisconsin	10,780	260	750	1,120	520	250	2,820	460	260	630	500
Wyoming	1,000	†	†	110	†	†	260	†	†	†	80
United States	563,700	12,690	40,110	56,730	23,300	14,270	160,440	19,410	16,090	31,270	29,900

*Rounded to nearest 10. †Estimate is 50 or fewer deaths. **Note:** State estimates may not add up to US total due to rounding.

Source: US Mortality Public Use Data Tapes, 1969-2001, National Center for Health Statistics, Centers for Disease Control and Prevention, 2003.

Appendix 4K
Engineering Evaluation of the Dams for Mountain Creek Reservoir and Lake Scarborough

Freese and Nichols

MEMORANDUM

TO: File

FROM: RHW

SUBJECT: Engineering Evaluation of the Dams for Mountain Creek Reservoir and Lake Scarborough

DATE: March 7, 2005

Pursuant to a verbal request from JSA for an engineering evaluation of the dams for the subject reservoirs, I traveled to Robert Lee and Coleman Texas on March 1, 2005 and performed a site visit at Mountain Creek and Lake Scarborough Dams. The findings of these site visits for both dams are provided below:

A. **Mountain Creek Reservoir Dam** - Mountain Creek Reservoir is located at the north east edge of the town of Robert Lee in Coke County Texas. At the time of the site visit the lake appeared to be slightly below the normal pool level. The surface area of the reservoir looks to be approximately 25 acres and based on the estimated depth of the water at normal pool, should have a storage volume of approximately 250 acre-feet. Mountain Creek Dam is U shaped earthen dam with a maximum height above Mountain Creek stream bed of approximately 40 feet. The upstream slope is protected from wave erosion by 8 to 10 inch diameter rock riprap. The downstream slope has grass cover for slope protection. The brush and trees had been recently cut from the upstream and downstream slopes. The embankment crest is 8 to 10 feet wide and approximately 1,300 feet long. At the right abutment the dam has a 400-foot wide earthen emergency spillway which has a concrete chute and stilling basin to transition the flood discharge downstream. The chute concrete looks to be in excellent condition with relatively little cracking or spalling. The dam has at least one low flow outlet which is visible in the pond some 50 feet from the bank. This pipe services as a source of water for the water supply for the City of Robert Lee. Overall the dam looks to be in good condition although the condition of the outlet pipe was not observed except from a distance. Based on the location and size of this dam it is classified as a small high hazard dam and is required to pass 100 percent of the PFM. The hydrology of the dam was not determined as part of this site visit. Present at this inspection was Mr. Joe White, Mayor of Robert Lee and Mr. Dan Williams, the City Water Superintendent.
B. **Lake Scarborough Dam –** Lake Scarborough is located approximately 10 miles north of Coleman Texas in Coleman County Texas. At the time of the site visit the lake appeared to be slightly above the normal pool level. The surface area of the reservoir

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looks to be approximately 103 acres and based on the estimated depth of the water at normal pool, should have a storage volume of approximately 1,600 acre-feet. Scarborough Dam is earthen dam with a maximum height above stream bed of approximately 50 feet. The upstream slope is protected from wave erosion by 8 to 10 inch diameter rock riprap. The downstream slope has grass cover for slope protection. The brush and trees had been recently cut from the upstream and downstream slopes. The embankment crest is 8 to 10 feet wide and approximately 900 feet long. At the right abutment the dam has a 150-foot wide reinforced concrete ogee spillway which has a concrete chute and stilling basin to transition the flood discharge downstream. The chute concrete looks to be in fair condition with some cracking and spalling. The left half of the spillway crest appears to be approximately 6 inch lower than the right half indicates that some differential settlement has occurred in the spillway. The dam has at least one low flow outlet which is visible in the pond some 100 feet from the bank. This pipe services as a source of water the City of Coleman and a low flow release outlet. Overall the dam looks to be in good condition although the condition of the outlet pipe was not observed except from a distance. The dam appears to be an intermediate category low hazard dam and based on its height would be required to pass 30 percent of the PMF. The hydrology of this is site and the capacity of the service spillway was not looked at for this site visit.

Photos and sketches of both dam sites are available in the project files.

Appendix 6A
Sample Water Conservation Plans

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Appendix 6A1
Sample Water Conservation Plan for Municipal Users

Water Conservation Plan for [Entity]

Date

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APPENDICES

Water Conservation Plan for [Entity]

1. OBJECTIVES

Recognizing the need for efficient use of existing water supplies, the Texas Commission on Environmental Quality (TCEQ) has developed guidelines and requirements governing the development of water conservation plans for public water suppliers.

The objectives of this water conservation plan are as follows:

- To reduce water consumption from the levels that would prevail without conservation efforts.
- To reduce the loss and waste of water.
- To improve efficiency in the use of water.
- To document the level of recycling and reuse in the water supply.
- To extend the life of current water supplies by reducing the rate of growth in demand.

The water conservation plan presented in this document is a model water conservation plan intended for adoption by wholesale or retail public water suppliers in Region F. This model plan includes all of the elements required by TCEQ. In order to adopt this plan, each water supplier will need to do the following:

- Complete the water utility profile.
- Set five- and ten-year goals for per capita water use.
- Adopt ordinance(s) or regulation(s) approving the model plan.

2 TEXAS COMMISSION ON ENVIRONMENTAL QUALITY RULES

2.1 Conservation Plans

The TCEQ rules governing development of water conservation plans for public water suppliers are contained in Title 30, Part 1, Chapter 288, Subchapter A, Rule 288.2 of the Texas Administrative Code, which is included in Appendix B. For the purpose of these rules, a water conservation plan is defined as "A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water[1]." The elements in the TCEQ water conservation rules covered in this conservation plan are listed below.

Minimum Conservation Plan Requirements

The minimum requirements in the Texas Administrative Code for Water Conservation Plans for Public Water Suppliers are covered in this report as follows:

- 288.2(a)(1)(A) – Utility Profile – Section 3 and Appendix C
- 288.2(a)(1)(B) – Specification of Goals – Section 4
- 288.2(a)(1)(C) – Accurate Metering – Section 5.1
- 288.2(a)(1)(D) – Universal Metering – Section 5.1
- 288.2(a)(1)(E) – Determination and Control of Unaccounted Water – Section 5.3
- 288.2(a)(1)(F) – Public Education and Information Program – Section 6
- 288.2(a)(1)(G) – Non-Promotional Water Rate Structure – Section 7
- 288.2(a)(1)(H) – Reservoir System Operation Plan – Section 8.2
- 288.2(a)(1)(I) – Means of Implementation and Enforcement – Section 9
- 288.2(a)(1)(J) – Coordination with Regional Water Planning Group – Section 8.5

Conservation Additional Requirements (Population over 5,000)

The Texas Administrative Code includes additional requirements for water conservation plans for cities with a population over 5,000:

- 288.2(a)(2)(A) – Leak Detection, Repair, and Water Loss Accounting – Sections 5.3, 5.4, and 5.5
- 288.2(a)(2)(B) – Record Management System – Section 5.2
- 288.2(a)(2)(C) – Requirement for Water Conservation Plans by Wholesale Customers – Section 8.4

Additional Conservation Strategies

TCEQ rules also list additional optional but not required conservation strategies, which may be adopted by suppliers. The following optional strategies are included in this plan:

- 288.2(a)(3)(A) – Conservation Oriented Water Rates – Section 7

[1] Title 30 of the Texas Administrative Code, Part 1, Chapter 288, Subchapter A, Rules 288.1 and 288.2, and Subchapter B, Rule 288.20, downloaded from http://www.tnrcc.state.tx.us/oprd/rules/pdflib/288a.pdf, November 2003.

- 288.2(a)(3)(B) – Ordinances, Plumbing Codes or Rules on Water-Conserving Fixtures – Section 8.1
- 288.2(a)(3)(F) – Considerations for Landscape Water Management Regulations – Section 8.3
- 288.2(a)(3)(G) – Monitoring Method – Section 5.5

3. WATER UTILITY PROFILE

Appendix C to this water conservation plan is a sample water utility profile based on the format recommended by the TCEQ.

[Water supplier is to complete the utility profile and provide information on the public water supply system and customers if appropriate for this section.]

4. SPECIFICATION OF WATER CONSERVATION GOALS

[Current TCEQ rules require the adoption of specific water conservation goals for a water conservation plan. As part of plan adoption, each water supplier will develop 5-year and 10-year goals for per capita municipal use, following TCEQ procedures described in the water utility profile (Appendix C).]

The goals for this water conservation plan include the following:

- Strive to attain the per capita municipal water use below the specified amount in gallons per capita per day shown on the completed Table C-1 using a 5-year rolling average calculation. (See 5-year and 10-year goals in Appendix C)
- Conduct water audits as required by the TCEQ and maintain unaccounted for water to *[insert amount]* percent of the total water used through existing and new maintenance programs.
- Raise public awareness of water conservation and encourage responsible public behavior by a public education and information program, as discussed in Section 6.

5. METERING, WATER USE RECORDS, CONTROL OF UNACCOUNTED WATER, AND LEAK DETECTION AND REPAIR

One of the key elements in water conservation is careful tracking of water use and control of losses through illegal diversions and leaks. Careful metering of water deliveries and water use, detection and repair of leaks in the distribution system and regular monitoring of unaccounted water are important in controlling losses. *[Water suppliers serving a population of 5,000 people or more or a having a projected population of greater than 5,000 people or more within the next ten years must include the following elements in their water conservation plans:]*

5.1 Metering of Customer and Public Uses and Meter Testing, Repair, and Replacement

All customers of wholesale or retail public water suppliers, including public and governmental users, should be metered. In many cases, water suppliers already meter all of their water users. For those water suppliers who do not currently meter all of their water uses, these entities will implement a program to meter all water uses within the next five years.

Most water suppliers test and replace their customer meters on a regular basis. All customer meters should be replaced on a 15-year cycle. Those who do not currently have a meter testing and replacement program will implement such a program over the next five years.

5.2 Record Management System

As required by TAC Title 30, Part 1, Chapter 288, Subchapter A, Rule 288.2(a)(2)(B), the record management system allows for the separation of water sales and uses into residential, commercial, public/institutional, and industrial categories. This information will be included in an annual water conservation report, as described in Section 5.5 below.

For those entities whose record management systems do not currently allow for the separation of water sales as described above, they will move to implement such a system within the next five years.

5.3 Determination and Control of Unaccounted Water

Unaccounted water is the difference between water delivered to customers and metered deliveries to customers plus authorized but unmetered uses. (Authorized but unmetered uses would include use for fire fighting, releases for flushing of lines, and uses associated with new construction.) Unaccounted water can include several categories:

- Inaccuracies in customer meters. (Customer meters tend to run more slowly as they age and under-report actual use.)
- Accounts which are being used but have not yet been added to the billing system.
- Losses due to water main breaks and leaks in the water distribution system.
- Losses due to illegal connections and theft. (Included in Appendix H.)
- Other.

Measures to control unaccounted water are part of the routine operations of water suppliers. Water audits are useful methods of accounting for water usage within a system. Water audits will be conducted by water suppliers in order to decrease water loss. Maintenance crews and personnel will look for and report evidence of leaks in the water distribution system. The leak detection and repair program is described in Section 5.5 below. Meter readers are asked to watch for and report signs of illegal connections, so they can be addressed quickly. Unaccounted water calculated as part of the utility profile and is included in Appendix C.

5.4 Leak Detection and Repair

City crews and personnel will look for and report evidence of leaks in the water distribution system. Areas of the water distribution system in which numerous leaks and line breaks occur are targeted for replacement as funds are available.

5.5 Monitoring of Effectiveness and Efficiency - Annual Water Conservation Report

[Appendix D is a sample form that can be used in the development of an annual water conservation report for water suppliers.]

An annual conservation report will be completed by *[insert date]* of the following year and will be used to monitor the effectiveness and efficiency of the water conservation program and to plan conservation-related activities for the next year. This report records the water use by category, per capita municipal use, and unaccounted water for the current year and compares them to historical values.

6. CONTINUING PUBLIC EDUCATION AND INFORMATION CAMPAIGN

The continuing public education and information campaign on water conservation includes the following elements: *[Water provider is to select the appropriate measures for its system.]*

- Insert water conservation information with water bills. Inserts will include material developed by the [water supplier] staff and material obtained from the TWDB, the TCEQ, and other sources.
- Encourage local media coverage of water conservation issues and the importance of water conservation.
- Make the *Texas Smartscape CD*, water conservation brochures, and other water conservation materials available to the public.
- Make information on water conservation available on its website (if any) and include links to the *Texas Smartscape* website and to information on water conservation on the TWDB and TCEQ web sites.
- Provide water conservation materials to schools and utilize existing age-appropriate education programs available through the TCEQ and TWDB.
- Support the State-initiated Water Conservation Awareness and Education Campaign.

7. WATER RATE STRUCTURE

[If a water supplier has a decreasing block rate structure, it is recommended that a flat rate or increasing rate structure be adopted.]

An increasing block rate water structure that is intended to encourage water conservation and discourage excessive use and waste of water will be adopted upon completion of the next rate study or within five years. An example water rate structure is as follows:

Residential Rates

1. Monthly minimum charge. This can (but does not have to) include up to 2,000 gallons water use with no additional charge.
2. Base charge per 1,000 gallons up to the approximate average residential use.
3. 2nd tier (from the average to 2 times the approximate average) at 1.25 to 2.0 times the base charge.
4. 3rd tier (above 2 times the approximate average) at 1.25 to 2.0 times the 2nd tier.
5. The residential rate can also include a lower tier for basic household use up to 4,000 gallons per month or so.

Commercial/Industrial Rates

Commercial/industrial rates should include at least 2 tiers, with rates for the 2nd tier at 1.25 to 2.0 times the first tier.

[If a water supplier has an increasing rate structure, state the current rate structure as follows.]

The [water supplier] has adopted an increasing block rate water structure that is intended to encourage water conservation and discourage excessive use and waste of water. The water rate structure adopted on *[insert date]* is as follows:

Residential Rates

[To be completed by the supplier]

Commercial/Industrial Rates

[To be completed by the supplier]

8. OTHER WATER CONSERVATION MEASURES

8.1 Ordinances, Plumbing Codes, or Rules on Water-Conserving Fixtures

The State of Texas has required water-conserving fixtures in new construction and renovations since 1992. The state standards call for flows of no more than 2.5 gallons per minute (gpm) for faucets, 3.0 gpm for showerheads, and 1.6 gallons per flush for toilets. Similar standards are now required nationally under federal law. These state and federal standards assure that all new construction and renovations will use water-conserving fixtures. In addition, federal standards governing clothes washing machines will require all washers produced by 2007 to meet higher efficiency standards, which may include lower water use machines. The potential savings from these fixtures can be significant, but historically have been difficult to measure independently from other factors.

8.2 Reservoir System Operation Plan

[Insert description of reservoir system operation plan if public supplier has such a plan.]

or

The [water supplier] purchases water from [name] and does not have surface water supplies for which to implement a reservoir system operation plan.

8.3 Considerations for Landscape Water Management Regulations (Optional)

[The water supplier may choose to adopt landscape water management regulations as part of the development of this water conservation plan. These regulations are intended to minimize waste in landscape irrigation. The proposed regulations might include the following elements:

- *Require that all new irrigation systems be in compliance with state design and installation regulations (TAC Title 30, Part 1, Chapter 344).*
- *Prohibit irrigation systems that spray directly onto impervious surfaces or onto other non-irrigated areas. (Wind driven water drift will be taken into consideration.)*
- *Prohibit use of poorly maintained sprinkler systems that waste water.*
- *Prohibit outdoor watering during any form of precipitation.*
- *Enforce the regulations by a system of warnings followed by fines for continued or repeat violations.*
- *Implement other measures to encourage off-peak water use.]*

8.4 Requirement for Water Conservation Plans by Wholesale Customers

[Required for cities with populations over 5,000.]

Every contract for the wholesale sale of water by customers that is entered into, renewed, or extended after the adoption of this water conservation and drought contingency plan will include a requirement that the wholesale customer and any wholesale customers of that wholesale customer develop and implement a water conservation plan meeting the requirements of Title 30, Part 1, Chapter 288, Subchapter A, Rule 288.2 of the Texas Administrative Code. The requirement will also extend to each successive wholesale customer in the resale of the water.

8.5 Coordination with Regional Water Planning Group

In accordance with TCEQ regulations, a copy of this adopted water conservation plan will be sent to the Region F Water Planning Group.

9. IMPLEMENTATION AND ENFORCEMENT OF THE WATER CONSERVATION PLAN

A copy of [an ordinance, order, or resolution] adopted by the [City Council or governing board] regarding this water conservation plan is attached to and made part of this plan. The [ordinance, order, or resolution] designates responsible officials to implement and enforce the water conservation plan.

Appendix A
List of References

Appendix A
List of References

(1) Title 30 of the Texas Administrative Code, Part 1, Chapter 288, Subchapter A, Rules 288.1 and 288.2, and Subchapter B, Rule 288.20, downloaded from http://www.tnrcc.state.tx.us/oprd/rules/pdflib/288a.pdf, November 2003.

The following conservation plans and related documents were reviewed in the development of this plan.

(2) Freese and Nichols, Inc.: *Model Water Conservation Plan for North Texas Municipal Water District Member Cities and Customers*, prepared for the North Texas Municipal Water District, Fort Worth, August 2004.

(3) Texas Commission on Environmental Quality Water Utility Profile, downloaded from http://www.tnrcc.state.tx.us/permitting/forms/10218.pdf, April 29, 2004.

(4) City of Austin Water Conservation Division: "City of Austin Water Conservation Plan, Developed to Meet Senate Bill 1 Regulatory Requirements," Austin, August 1999.

(5) City of Dallas Water Utilities Department: "City of Dallas Water Conservation Plan," adopted by the City Council, Dallas, September 1999.

(6) Freese and Nichols, Inc.: "Water Conservation and Drought Contingency Plan," prepared for the Sabine River Authority of Texas, Fort Worth, September 1994.

(7) GDS Associates, Inc.: "Water Conservation Study," prepared for the Texas Water Development Board, Fort Worth, 2002.

(8) Texas Water Development Board: Report 362, "Water Conservation Best Management Practices Guide", Austin, November 2004.

(9) City of Dallas: "City of Dallas Ordinances, Chapter 49, Section 21.1," Dallas, October 1, 2001.

Apppendix B
Texas Commission on Environmental Quality Rules on Municipal Water Conservation Plans

SUBCHAPTER A: WATER CONSERVATION PLANS
§§288.1 - 288.7
Effective October 7, 2004

§288.1. Definitions.

The following words and terms, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise.

(1) **Agricultural or Agriculture** - Any of the following activities:

(A) cultivating the soil to produce crops for human food, animal feed, or planting seed or for the production of fibers;

(B) the practice of floriculture, viticulture, silviculture, and horticulture, including the cultivation of plants in containers or non-soil media by a nursery grower;

(C) raising, feeding, or keeping animals for breeding purposes or for the production of food or fiber, leather, pelts, or other tangible products having a commercial value;

(D) raising or keeping equine animals;

(E) wildlife management; and

(F) planting cover crops, including cover crops cultivated for transplantation, or leaving land idle for the purpose of participating in any governmental program or normal crop or livestock rotation procedure.

(2) **Agricultural use** – Any use or activity involving agriculture, including irrigation.

(3) **Conservation** – Those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

(4) **Drought contingency plan** – A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies. A drought contingency plan may be a separate document identified as such or may be contained within another water management document(s).

(5) **Industrial use** – The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, commercial fish

production, and the development of power by means other than hydroelectric, but does not include agricultural use.

(6) **Irrigation** – The agricultural use of water for the irrigation of crops, trees, and pastureland, including, but not limited to, golf courses and parks which do not receive water through a municipal distribution system.

(7) **Irrigation water use efficiency** – The percentage of that amount of irrigation water which is beneficially used by agriculture crops or other vegetation relative to the amount of water diverted from the source(s) of supply. Beneficial uses of water for irrigation purposes include, but are not limited to, evapotranspiration needs for vegetative maintenance and growth, salinity management, and leaching requirements associated with irrigation.

(8) **Mining use** – The use of water for mining processes including hydraulic use, drilling, washing sand and gravel, and oil field repressuring.

(9) **Municipal per capita water use** – The sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

(10) **Municipal use** – The use of potable water within or outside a municipality and its environs whether supplied by a person, privately owned utility, political subdivision, or other entity as well as the use of sewage effluent for certain purposes, including the use of treated water for domestic purposes, fighting fires, sprinkling streets, flushing sewers and drains, watering parks and parkways, and recreational purposes, including public and private swimming pools, the use of potable water in industrial and commercial enterprises supplied by a municipal distribution system without special construction to meet its demands, and for the watering of lawns and family gardens.

(11) **Municipal use in gallons per capita per day** – The total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served. Indirect reuse volumes shall be credited against total diversion volumes for the purpose of calculating gallons per capita per day for targets and goals.

(12) **Nursery grower** – A person engaged in the practice of floriculture, viticulture, silviculture, and horticulture, including the cultivation of plants in containers or nonsoil media, who grows more than 50% of the products that the person either sells or leases, regardless of the variety sold, leased, or grown. For the purpose of this definition, grow means the actual cultivation or propagation of the product beyond the mere holding or maintaining of the item prior to sale or lease, and typically includes activities associated with the production or multiplying of stock such as the development of new plants from cuttings, grafts, plugs, or seedlings.

(13) **Pollution** – The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

(14) **Public water supplier** – An individual or entity that supplies water to the public for human consumption.

(15) **Regional water planning group** – A group established by the Texas Water Development Board to prepare a regional water plan under Texas Water Code, §16.053.

(16) Retail public water supplier – An individual or entity that for compensation supplies water to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants when that water is not resold to or used by others.

(17) **Reuse** – The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water.

(18) **Water conservation plan** – A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate document identified as such or may be contained within another water management document(s).

(19) **Wholesale public water supplier** – An individual or entity that for compensation supplies water to another for resale to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants as an incident of that employee service or tenancy when that water is not resold to or used by others, or an individual or entity that conveys water to another individual or entity, but does not own the right to the water which is conveyed, whether or not for a delivery fee.

Adopted September 15, 2004 Effective October 7, 2004

§288.2. Water Conservation Plans for Municipal Uses by Public Water Suppliers.

(a) A water conservation plan for municipal water use by public water suppliers must provide information in response to the following. If the plan does not provide information for each requirement, the public water supplier shall include in the plan an explanation of why the requirement is not applicable.

(1) Minimum requirements. All water conservation plans for municipal uses by public drinking water suppliers must include the following elements:

(A) a utility profile including, but not limited to, information regarding population and customer data, water use data, water supply system data, and wastewater system data;

(B) until May 1, 2005, specification of conservation goals including, but not limited to, municipal per capita water use goals, the basis for the development of such goals, and a time frame for achieving the specified goals;

(C) beginning May 1, 2005, specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita per day. The goals established by a public water supplier under this subparagraph are not enforceable;

(D) metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply;

(E) a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement;

(F) measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections; abandoned services; etc.);

(G) a program of continuing public education and information regarding water conservation;

(H) a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water;

(I) a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies; and

(J) a means of implementation and enforcement which shall be evidenced by:

(i) a copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the water supplier; and

(ii) a description of the authority by which the water supplier will implement and enforce the conservation plan; and

(K) documentation of coordination with the regional water planning groups for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

(2) Additional content requirements. Water conservation plans for municipal uses by public drinking water suppliers serving a current population of 5,000 or more and/or a projected population of 5,000 or more within the next ten years subsequent to the effective date of the plan must include the following elements:

(A) a program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water;

(B) a record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes:

(i) residential;

(ii) commercial;

(iii) public and institutional; and

(iv) industrial;

(C) a requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of this chapter.

(3) Additional conservation strategies. Any combination of the following strategies shall be selected by the water supplier, in addition to the minimum requirements in paragraphs (1) and (2) of this subsection, if they are necessary to achieve the stated water conservation goals of the plan. The commission may require that any of the following strategies be implemented by the water supplier if the commission determines that the strategy is necessary to achieve the goals of the water conservation plan:

(A) conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates;

(B) adoption of ordinances, plumbing codes, and/or rules requiring water-conserving plumbing fixtures to be installed in new structures and existing structures undergoing substantial modification or addition;

(C) a program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures;

(D) reuse and/or recycling of wastewater and/or graywater;

(E) a program for pressure control and/or reduction in the distribution system and/or for customer connections;

(F) a program and/or ordinance(s) for landscape water management;

(G) a method for monitoring the effectiveness and efficiency of the water conservation plan; and

(H) any other water conservation practice, method, or technique which the water supplier shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

(b) A water conservation plan prepared in accordance with 31 TAC §363.15 (relating to Required Water Conservation Plan) of the Texas Water Development Board and substantially meeting the requirements of this section and other applicable commission rules may be submitted to meet application requirements in accordance with a memorandum of understanding between the commission and the Texas Water Development Board.

(c) Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group.

Appendix C
Form for Water Utility Profile

Texas Commission on Environmental Quality

UTILITY PROFILE & WATER CONSERVATION PLAN REQUIREMENTS FOR MUNICIPAL WATER USE BY PUBLIC WATER SUPPLIERS

This form is provided to assist entities in water conservation plan development for municipal water use by a retail public water supplier. Information from this form should be included within a water conservation plan for municipal use. If you need assistance in completing this form or in developing your plan, please contact the conservation staff of the Resource Protection Team in the Water Supply Division at (512) 239-4691.

Name of Entity: ______________________________

Address & Zip: ______________________________

Telephone Number: ____________________ **Fax:** ______________

Form Completed By:______________________________

Title: ______________________________

Signature: ____________________ **Date:** ______________

Name and Phone Number of Person/Department responsible for implementing a water conservation program: ______________________________

UTILITY PROFILE

I. POPULATION AND CUSTOMER DATA

A. Population and Service Area Data

1. Attach a copy of your service-area map and, if applicable, a copy of your Certificate of Convenience and Necessity (CCN).

2. Service area size (square miles): ____________________

3. Current population of service area: ______________________________

4. Current population served:

a. water ______________________
b. wastewater ______________________

5. Population served by water utility for the previous five years:

Year	Population
________	_________
________	_________
________	_________
________	_________
________	_________

6. Projected population for service area in the following decades:

Year	Population
2010	_________
2020	_________
2030	_________
2040	_________
2050	_________

7. List source/method for the calculation of current and projected population:

____
____
____
____

B. Active Connections

1. Current number of active connections. Check whether multi-family service is counted as Residential _____ or Commercial _____

Treated water users:	Metered	Not-metered	Total
Residential	________	__________	______
Commercial	________	__________	______
Industrial	________	__________	______
Other	________	__________	______

2. List the net number of new connections per year for most recent three years:

Year	________	________	________
Residential	________	________	________
Commercial	________	________	________
Industrial	________	________	________
Other	________	________	________

C. High Volume Customers

List annual water use for the five highest volume customers
(indicate if treated or raw water delivery)

	Customer	Use (1,000gal./yr.)	Treated/Raw Water
(1)	________	________	________
(2)	________	________	________
(3)	________	________	________
(4)	________	________	________
(5)	________	________	________

II. WATER USE DATA FOR SERVICE AREA

A. Water Accounting Data

1. Amount of water use for previous five years (in 1,000 gal.):
Please indicate : Diverted Water ____________
Treated Water ____________

Year	________	________	________	________	________
January	________	________	________	________	________
February	________	________	________	________	________
March	________	________	________	________	________

April	______	______	______	______	______
May	______	______	______	______	______
June	______	______	______	______	______
July	______	______	______	______	______
August	______	______	______	______	______
September	______	______	______	______	______
October	______	______	______	______	______
November	______	______	______	______	______
December	______	______	______	______	______
Total	______	______	______	______	______

Indicate how the above figures were determined (e.g., from a master meter located at the point of a diversion from the source or located at a point where raw water enters the treatment plant, or from water sales).

____

____

____

2. Amount of water (in 1,000 gallons) delivered (sold) as recorded by the following account types for the past five years.

Year	Residential	Commercial	Industrial	Wholesale	Other	Total Sold
____	______	______	______	______	____	______
____	______	______	______	______	____	______
____	______	______	______	______	____	______
____	______	______	______	______	____	______
____	______	______	______	______	____	______

3. List previous five years records for water loss (the difference between water diverted (or treated) and water delivered (or sold))

Year	Amount (gal.)	%
____	__________	____
____	__________	____
____	__________	____
____	__________	____
____	__________	____

4. Municipal water use for previous five years:

Year	Population	Total Water Diverted or Pumped for Treatment (1,000 gal.)
________________		___________________
________________		___________________
________________		___________________
________________		___________________
________________		___________________

B. Projected Water Demands

If applicable, attach projected water supply demands for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirement from such growth.

III. WATER SUPPLY SYSTEM DATA

A. Water Supply Sources

List all current water supply sources and the amounts authorized with each:

	Source	Amount Authorized
Surface Water:	___________________________________	______________ acre-feet
Groundwater:	___________________________________	______________ acre-feet
Contracts:	___________________________________	______________ acre-feet
Other:	___________________________________	______________ acre-feet

B. Treatment and Distribution System

1. Design daily capacity of system: ________________ MGD

2. Storage Capacity: Elevated _________ MGD, Ground ________ MGD

3. If surface water, do you recycle filter backwash to the head of the plant? Yes _______ No _______. If yes, approximately _________ MGD.

4. Please attach a description of the water system. Include the number of

treatment plants, wells, and storage tanks. If possible, include a sketch of the system layout.

IV. WASTEWATER SYSTEM DATA

A. Wastewater System Data

1. Design capacity of wastewater treatment plant(s): ___________ MGD

2. Is treated effluent used for irrigation on-site _____, off-site _____, plant washdown _____, or chlorination/dechlorination ______?
   If yes, approximately ________ gallons per month.

3. Briefly describe the wastewater system(s) of the area serviced by the water utility. Describe how treated wastewater is disposed of. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and, if wastewater is discharged, the receiving stream. If possible, attach a sketch or map which locates the plant(s) and discharge points or disposal sites.

B. Wastewater Data for Service Area

1. Percent of water service area served by wastewater system: ______%

2. Monthly volume treated for previous three years (in 1,000 gallons):

Year	________	________	________
January	________	________	________
February	________	________	________
March	________	________	________
April	________	________	________
May	________	________	________
June	________	________	________
July	________	________	________
August	________	________	________
September	________	________	________
October	________	________	________
November	________	________	________
December	________	________	________
Total	________	________	________

REQUIREMENTS FOR WATER CONSERVATION PLANS FOR MUNICIPAL WATER USE BY PUBLIC WATER SUPPLIERS

In addition to the utility profile, a water conservation plan for municipal use by a public water supplier must include, at a minimum, additional information as required by Title 30, Texas Administrative Code, §288.2. <u>Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.</u>

Specific, Quantified 5 & 10-Year Targets

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for ***municipal use in gallons per capita per day*** (see Appendix A). Note that the goals established by a public water supplier under this subparagraph are not enforceable.

Metering Devices

The water conservation plan must include a statement about the water supplier's metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply.

Universal Metering

The water conservation plan must include and a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

Unaccounted-For Water Use

The water conservation plan must include measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections; abandoned services; etc.).

Continuing Public Education & Information

The water conservation plan must include a description of the program of continuing public education and information regarding water conservation by the water supplier.

Non-Promotional Water Rate Structure

The water supplier must have a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. This rate structure must be listed in the water conservation plan.

Reservoir Systems Operations Plan

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

Enforcement Procedure & Plan Adoption

The water conservation plan must include a means of implementation and enforcement which shall be evidenced by 1) a copy of the ordinance, resolution, or tariff indicating **official adoption** of the water conservation plan by the water supplier; and 2) a description of the authority by which the water supplier will implement and enforce the conservation plan.

Coordination with the Regional Water Planning Group(s)

The water conservation plan must include documentation of coordination with the regional water planning group(s) for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

Example statement to be included within the water conservation plan:

The service area of the _____________ (name of water supplier) is located within the ___________ (name of regional water planning area or areas) and ___________ (name of water supplier) has provided a copy of this water conservation plan to the ____________ (name of regional water planning group or groups).

Additional Requirements:

required of suppliers serving population of 5,000 or more or a projected population of 5,000 or more within ten years)

1. Program for Leak Detection, Repair, and Water Loss Accounting

The plan must include a description of the program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water.

2. Record Management System

The plan must include a record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes (residential; commercial; public and institutional; and industrial.

Plan Review and Update

Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

Best Management Practices Guide

On November 2004, the Texas Water Development Board's (TWDB) Report 362 was completed by the Water Conservation Implementation Task Force. Report 362 is the Water Conservation Best Management Practices (BMP) Guide. The BMP Guide is a voluntary list of management practices that water users may implement in addition to the required components of Title 30, Texas Administrative Code, Chapter 288. The BMP Guide is available on the TWDB's website at the link below or by calling (512) 463-7847.

http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

Appendix A

Definitions of Commonly Used Terms

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

Industrial use – The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, commercial fish production, and the development of power by means other than hydroelectric, but does not include agricultural use.

Irrigation – The agricultural use of water for the irrigation of crops, trees, and pastureland, including, but not limited to, golf courses and parks which do not receive water through a municipal distribution system.

Municipal per capita water use – The sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

Municipal use – The use of potable water within or outside a municipality and its environs whether supplied by a person, privately owned utility, political subdivision, or other entity as well as the use of sewage effluent for certain purposes, including the use of treated water for domestic purposes, fighting fires, sprinkling streets, flushing sewers and drains, watering parks and parkways, and recreational purposes, including public and private swimming pools, the use of potable water in industrial and commercial enterprises supplied by a municipal distribution system without special construction to meet its demands, and for the watering of lawns and family gardens.

Municipal use in gallons per capita per day – The total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served. Indirect reuse volumes shall be credited against total diversion volumes for the purpose of calculating gallons per capita per day for targets and goals.

Pollution – The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

Public water supplier – An individual or entity that supplies water to the public for human consumption.

Regional water planning group – A group established by the Texas Water Development Board to prepare a regional water plan under Texas Water Code, §16.053.

Retail public water supplier – An individual or entity that for compensation supplies water to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants when that water is not resold to or used by others.

Reuse – The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water.

Water conservation plan – A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate document identified as such or may be contained within another water management document(s).

Water loss - The difference between water diverted or treated and water delivered (sold). Water loss can result from:

1. inaccurate or incomplete record keeping;
2. meter error;
3. unmetered uses such as firefighting, line flushing, and water for public buildings and water treatment plants;
4. leaks; and
5. water theft and unauthorized use.

Wholesale public water supplier – An individual or entity that for compensation supplies water to another for resale to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants as an incident of that employee service or tenancy when that water is not resold to or used by others, or an individual or entity that conveys water to another individual or entity, but does not own the right to the water which is conveyed, whether or not for a delivery fee.

Appendix D
Sample Water Conservation Report

APPENDIX D
PUBLIC WATER UTILITY WATER CONSERVATION REPORT
Due: {Date} of every year

Entity Reporting: ______________________
Filled Out By: ______________________
Date Completed: ______________________
Year Covered: ______________________
# of Connections ______________________

Recorded Supplies and Sales by Month (in Million Gallons):

Month	Self-Supplied Water	Other Supplies	Sales by Category						
			Residential	Commercial	Public/ Institutional	Industrial	Wholesale	Other	Total
January									
February									
March									
April									
May									
June									
July									
August									
September									
October									
November									
December									
TOTAL									

Unaccounted Water (Million Gallons):

Self Supplies		from Table above
Other Supplies		from Table above
Total Supplies		from Table above
Total Sales		from Table above
Estimated Fire Use		estimated from best available data
Estimated Line Flushing Use		estimated from best available data
Unaccounted Water		
% Unaccounted		
Goal for % Unaccounted	15.00%	

Per Capita Municipal Use (Gallons per person per day)
Municipal Use (MG)
Estimated Population
Per Capita Use (gpcd)
5-year Per Capita Goal (___)
10-year Per Capita Goal (___)

Recorded Wholesale Sales by Month (in Million Gallons):

Month	Sales to ______	Sales to ______	Sales to ______	Sales to ______	Sales to ______	Sales to ______	Sales to ______	Total Wholesale Sales
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								
TOTAL								

Information on Wholesale Customers:

Customer	Estimated Population

Unusual Circumstances (use additional sheets if necessary):

Progress in Implementation of Conservation Plan (use additional sheets if necessary):

Conservation measures planned for next year (use additional sheets if necessary):

Appendix 6A2
Sample Water Conservation Plan for Irrigation Districts

Water Conservation Plan for [Irrigation District]

Date

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APPENDICES

Water Conservation Plan for [Irrigation District]

1. Objectives

The Texas Commission on Environmental Quality has developed guidelines and requirements governing the development of water conservation plans for irrigation use. The purpose of this water conservation plan is to:

- To reduce water consumption from the levels that would exist without conservation efforts.
- To reduce the loss and waste of water.
- To encourage improvement of processes that inefficiently consume water.
- To extend the life of current supplies by reducing the rate of growth in demand.

This water conservation plan is intended to serve as a guide to [irrigation district]. The following plan includes all conservation measures required by TCEQ.

2. Description of Water Use

[The TCEQ requires that each irrigation user must document how water is used in the irrigation production process.

- *Irrigation users will provide information including:*
    - *Type of crops.*
    - *Acreage of each crop to be irrigated.*
    - *Monthly irrigation diversions.*
    - *Details of seasonal or annual crop rotation.*
    - *Soil types of the land to be irrigated.*
    - *Description of the irrigation method including flow rates, plans, and sketches of the system layout.*
    - *Details of equipment used in the process within an accuracy of +/- 5 %.]*

3. Specification of Water Conservation Goals

[The Irrigation District must specify a five-year and ten-year target for water savings and detail the basis for the development of these goals. These goals will include targets for water use efficiency and a pollution abatement and prevention plan.]

The TCEQ regulations require that each irrigation user adopt quantifiable water conservation goals in their water conservation plan. The *[Irrigation District]* has adopted goals related to improving water efficiency of its delivery system. The *[Irrigation District]* will strive to increase water efficiency per irrigated acre by *[insert amount]* percent within 5 years and *[insert amount]* percent within 10 years.

[Alternate goal] The *[Irrigation District]* will maintain the water efficiency per irrigated acre of *[insert amount]* percent within 5 years and *[insert amount]* percent within 10 years.

The goals for this water conservation plan will be achieved through the following: *[select applicable measures and/or include additional measures.]*

- Regular inspections of systems for controllable operation losses or leaks
- Coordination of irrigation deliveries with customers
- Schedule the timing or measure the amount of water applied.
- Improve or modify irrigation processes in order to increase efficient water use.
- Employ water-conserving irrigation equipment or improve existing equipment.
- Implement methods of land improvement that reduce runoff and increase rain infiltration to the soil.
- Establish a tailwater recovery and reuse program.

4. Control of Unaccounted Water and Leak Detection and Repair

Detection and repair of leaks in an irrigation system is important in controlling losses. Unaccounted water is the difference between water delivered to a system and water delivered to a system plus authorized but unmetered uses. Unaccounted water in the irrigation system can be attributed to several things including:

- Inaccuracies in meters.
- Loss due to leaks in the conveyance system.
- Operational losses
- Illegal connections to a system.
- Other.

To help control unaccounted water, *[irrigation district]* will monitor supply deliveries, conduct water audits and adjust operations to minimize losses if applicable. Broken water lines will be replaced or repaired in a timely manner.

5. Irrigation Scheduling and Volumetric Measuring of Irrigation Water Use

Volumetric Measuring

Measuring the volume of water being used to irrigate a crop is useful because it provides [irrigation district] with information needed to evaluate the efficiency of an irrigation system. With this information, [irrigation district] and customers can better manage their crops. Irrigation water users will employ a method of measuring how much irrigation water is used in their system.

The following methods may be used to directly measure amounts of irrigation water being used *[select appropriate methods]*:

- Propeller meters
- Orifice, venture or differential pressure meters
- Ultrasonic
- Stage Discharge Rating Tables
- Area/Point Velocity Measurements

Indirect methods that may be used to measure irrigation water quantities include:

- Measurement of time of irrigation and size of irrigation delivery system
- Measurement of end-pressure in a sprinkler irrigation system
- Measurement of energy used by a pump supplying water to an irrigation system
- Change in the elevation of water stored in an irrigation water supply reservoir

Irrigation Scheduling

Coordination of irrigation schedules of customers can reduce losses associated with conveying irrigation water. The *[irrigation district]* will implement an irrigation schedule for deliveries to customers to best meet the customers' water needs and minimize conveyance losses.

6. Methods of Land Improvement

To reduce the amount of water required for irrigation, the following land improvement practices are encouraged for customers of the *[irrigation district]*:

- Creation of furrow dikes
- Crop residue management and conservation tillage
- Land leveling
- Contour farming

7. Improvements to Irrigation Equipment

The *[irrigation district]* encourages customers to utilize efficient irrigation equipment, including:

- Installation of a drip/micro-irrigation system
- Installation of gated and flexible pipe for field water distribution systems
- Replacement of on-farm irrigation ditches with pipelines
- Lining of on-farm irrigation ditches
- Installation of low pressure center pivot sprinkler irrigation systems

8. Implementation of Water Conservation Plan

Upon implementation of this water conservation plan, *[irrigation district]* is required by the TCEQ to update the plan at least every five years. Goals for irrigation use will be re-evaluated based on previous five-year and ten-year goals and any new information.

An implementation report will be prepared by the [date] of each year following the adoption of this plan. A sample report is included in Appendix C. This report includes:

- The list of dates and descriptions of conservation measures implemented
- Amount of water saved
- Data about whether or not targets in the plan are met
- If targets are not met, an explanation as to why the target was not met and a discussion of the progress to meet the target.

Appendix A
List of References

Appendix A
List of References

Title 30 of the Texas Administrative Code, Part 1, Chapter 3, Subchapter A, Rules 3.2 and Chapter 288, Subchapter A, Rule 288.4, downloaded from http://www.sos.state.tx.us/tac/index.shtml, July 2004.

Water Conservation Implementation Task Force, *Draft Best Management Practices*, April 19,2004.

Appendix B
Texas Commission on Environmental Quality Rules on Water Conservation Plans for Irrigation Use

Texas Administrative Code

TITLE 30 ENVIRONMENTAL QUALITY
PART 1 TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
CHAPTER 288 WATER CONSERVATION PLANS, DROUGHT CONTINGENCY PLANS, GUIDELINES AND REQUIREMENTS
SUBCHAPTER A WATER CONSERVATION PLANS
RULE §288.4 Water Conservation Plans for Agricultural Use

(a) A water conservation plan for agricultural use of water shall provide information, where applicable, in response to the following subsections.

(1) For an individual agricultural user other than irrigation:

(A) a description of the use of the water in the production process, including how the water is diverted and transported from the source(s) of supply, how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal;

(B) specification of conservation goals, the basis for the development of such goals, and a time frame for achieving the specified goals;

(C) a description of the device(s) and/or method(s) within an accuracy of plus or minus 5.0% to be used in order to measure and account for the amount of water diverted from the source of supply;

(D) leak-detection, repair, and accounting for water loss in the water distribution system;

(E) application of state-of-the-art equipment and/or process modifications to improve water use efficiency; and

(F) any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

(2) For an individual irrigation user:

(A) a description of the irrigation production process which shall include, but is not limited to, the type of crops and acreage of each crop to be irrigated, monthly irrigation diversions, any seasonal or annual crop rotation, and soil types of the land to be irrigated;

(B) a description of the irrigation method or system and equipment including pumps, flow rates, plans, and/or sketches of the system layout;

(C) a description of the device(s) and/or methods within an accuracy of plus or minus 5.0%, to be used in order to measure and account for the amount of water diverted from the source of supply;

(D) specification of conservation goals including, where appropriate, quantitative goals for irrigation water use efficiency and a pollution abatement and prevention plan;

(E) water-conserving irrigation equipment and application system or method including, but not limited to, surge irrigation, low pressure sprinkler, drip irrigation, and nonleaking pipe;

(F) leak-detection, repair, and water-loss control;

(G) scheduling the timing and/or measuring the amount of water applied (for example, soil moisture monitoring);

(H) land improvements for retaining or reducing runoff, and increasing the infiltration of rain and irrigation water including, but not limited to, land leveling, furrow diking, terracing, and weed control;

(I) tailwater recovery and reuse; and

(J) any other water conservation practice, method, or technique which the user shows to be appropriate for preventing waste and achieving conservation.

(3) For a system providing agricultural water to more than one user:

(A) a system inventory for the supplier's:

(i) structural facilities including the supplier's water storage, conveyance, and delivery structures;

(ii) management practices, including the supplier's operating rules and regulations, water pricing policy, and a description of practices and/or devices used to account for water deliveries; and

(iii) a user profile including square miles of the service area, the number of customers taking delivery of water by the system, the types of crops, the types of irrigation systems, the types of drainage systems, and total acreage under irrigation, both historical and projected;

(B) specification of water conservation goals, including maximum allowable losses for the storage and distribution system;

(C) a description of the practice(s) and/or device(s) which will be utilized to measure and account for the amount of water diverted from the source(s) of supply;

(D) a monitoring and record management program of water deliveries, sales, and losses;

(E) a leak-detection, repair, and water loss control program;

(F) a program to assist customers in the development of on-farm water conservation and pollution prevention plans and/or measures;

(G) a requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter; if the customer intends to resell the water, then the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with applicable provisions of this chapter;

(H) official adoption of the water conservation plan and goals, by ordinance, rule, resolution, or tariff, indicating that the plan reflects official policy of the supplier;

(I) any other water conservation practice, method, or technique which the supplier shows to be appropriate for achieving conservation; and

(J) documentation of coordination with the Regional Water Planning Groups in order to insure consistency with the appropriate approved regional water plans.

(b) A water conservation plan prepared in accordance with the rules of the United States Department of Agriculture Natural Resource Conservation Service, the State Soil and Water Conservation Board, or other federal or state agency and substantially meeting the requirements of this section and other applicable commission rules may be submitted to meet application requirements pursuant to a memorandum of understanding between the commission and that agency.

Source Note: The provisions of this §288.4 adopted to be effective May 3, 1993, 18 TexReg 2558; amended to be effective February 21, 1999, 24 TexReg 949; amended to be effective April 27, 2000, 25 TexReg 3544; amended to be effective August 15, 2002, 27 TexReg 7146

Appendix C
Sample Implementation Report

APPENDIX C
IRRIGATION DISTRICT WATER CONSERVATION REPORT
Due: {Date] of every year

Entity Reporting: ______________________
Filled Out By: ______________________
Date Completed: ______________________
Year Covered: ______________________
# of Acres Irrigated ______________________

Recorded Supplies and Sales by Month (in Acre-feet):

Month	Self-Supplied Water	Other Supplies	Deliveries by Crop Type						
			Crop A	Crop B	Crop C	Crop D	Crop E		Total
January									
February									
March									
April									
May									
June									
July									
August									
September									
October									
November									
December									
TOTAL									

Water Efficiency (Acre-feet):	
Self Supplies (total)	above
Other Supplies (total)	above
Total Supplies	above
Total Deliveries	above
Difference in Supplies and Deliveries	
% Efficient	
Goal for % Efficient	

CONSERVATION MEASURES IMPLEMENTED	
Measure	**Date Implemented**

AMOUNT OF WATER SAVED

Year	Total Deliveries	Efficiency	Efficiency Improvement	Water saved (acre-feet)				
2000								
2001								
2002								
2003								
2004								
2005								
2006								

Unusual Circumstances (use additional sheets if necessary):

Progress in Implementation of Conservation Plan (use additional sheets if necessary):

Conservation measures planned for next year (use additional sheets if necessary):

Other (use additional sheets if necessary):

Appendix 6A3
Sample Water Conservation Plan for Industries

Water Conservation Plan for [Industrial Entity]

Date

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APPENDICES

Water Conservation Plan for [Industrial Entity]

1. Objectives

The Texas Commission on Environmental Quality has developed guidelines and requirements governing the development of water conservation plans for industrial or mining use. The purpose of this water conservation plan is to:

- To reduce water consumption from the levels that would exist without conservation efforts.
- To reduce the loss and waste of water.
- To encourage improvement of processes that inefficiently consume water.
- To extend the life of current supplies by reducing the rate of growth in demand.
- To document the level of recycling and reuse in the water supply.

This water conservation plan is intended to serve as a guide to [entity]. The following plan includes all conservation measures required by TCEQ.

2. Description of Water Use

The TCEQ requires that each mining or industrial water user must document how water is used in the production process.

- *[Entity provides information including:]*
  - o *How water flows to and through their systems*
  - o *What purpose water serves in the production process*
  - o *How much water is consumed in the production process and not available for reuse*
  - o *Means of discharging water used in industrial processes]*

3. Specification of Water Conservation Goals

The TCEQ regulations require that each industrial and mining user adopt quantifiable water conservation goals in their water conservation plan. *[Entity]* has specified a five-year and ten-year target for water savings. *[Include quantifiable water savings targets and the details of the basis for the development of these goals.]*

The goals for this water conservation plan include the following:

- *[Name goals.] Potential goals are:*
  - o *Meter water use to decrease water loss through leaks*
  - o *Regularly inspect systems for leaks and promptly repair in order to control unaccounted water*

- *Improve, modify, or audit processes in order to increase efficient water use*

4. Metering of Industrial and Mining Water Users

[Entity]'s water use is metered at [description of location]. Submetering is a good strategy for some industrial water users. Processes or equipment that consume large quantities of water could be usefully submetered. Submetering is an effective way to account for all water use by process, subprocess, or piece of equipment in a facility. *[Identify processes and/or equipment that are currently submetered.]*

5. Control of Unaccounted Water and Leak Detection and Repair

Careful metering of water use, detection, and repair of leaks in the distribution system and regular monitoring of unaccounted water are important in controlling losses.

Unaccounted water is the difference between water delivered to a system and water delivered to a system plus authorized but unmetered uses. Authorized but unmetered uses includes water for fire fighting, releases for flushing of lines, and water used during new construction. Unaccounted water can be attributed to several things including:

- Inaccuracies in meters. Older meters tend to run slowly and therefore under-report actual use.
- Loss due to leaks and main breaks in the system.
- Illegal connections to a system.
- [Other].

In order to control unaccounted water, persons in industry are asked to watch for and report water main breaks and leaks. Broken and leaking lines should be replaced or repaired in a timely manner. Meter readers are asked to report signs of illegal connections so they can be quickly assessed.

[Entity] will implement and maintain a water loss program. This program will serve to reduce losses due to leakage. The measures of the water loss program include *[select applicable measure]*:

- Conducting regular inspections of water main fittings and connections.
- Installing leak noise detectors and loggers.
- Using a leakage modeling program.
- Metering individual pressure zones
- Controlling pressure just above the minimum standard-of-service level
- Limiting surges in pressure.
- [Other]

6. Improving, Modifying, and Auditing Processes and Equipment

[Entity] can increase water efficiency by improving, modifying, and auditing facility processes and equipment. Water can be conserved through the following measures *[select appropriate measure]*:

- Implementing a Water Waste Reduction Program
- Optimizing the water-use efficiency of cooling systems (other than cooling towers)
- Reducing water loss in cooling towers

Water Waste Reduction Programs cause [Entity] personnel to be more aware of wasteful activities. Measures resulting from a Water Waste Reduction Program include:

- Install water saving devices on equipment.
- Replace current equipment with more water-efficient equipment.
- Recycle water within a process.
- Change to waterless equipment or process.

7. Implementation and Modifications to Water Conservation Plan

Upon implementation of this water conservation plan, [Entity] is required by the TCEQ to update the plan at least every five years. New goals will be based on previous five-year and ten-year goals and any new information.

An implementation report will be prepared by the [date] of each year following the adoption of this plan. A sample report is included in Appendix C. This report includes:

- The list of dates and descriptions of conservation measures implemented
- Amount of water saved
- Data about whether or not targets in the plan are met
- If targets are not met, an explanation as to why the target was not met and a discussion of the progress to meet the target.

Appendix A
List of References

APPENDIX A

List of References

Title 30 of the Texas Administrative Code, Part 1, Chapter 288, Subchapter B, Rule 288.3, downloaded from http://www.sos.state.tx.us/tac, July 2004.

Appendix B
Texas Commission on Environmental Quality Rules on Water Conservation Plans for Industrial or Mining Use

Appendix B
Texas Commission on Environmental Quality Rules

Texas Administrative Code

TITLE 30 ENVIRONMENTAL QUALITY
PART 1 TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
CHAPTER 288 WATER CONSERVATION PLANS, DROUGHT CONTINGENCY PLANS, GUIDELINES AND REQUIREMENTS
SUBCHAPTER A WATER CONSERVATION PLANS
RULE §288.3 Water Conservation Plans for Industrial or Mining Use

A water conservation plan for industrial or mining uses of water shall provide information, where applicable, in response to each of the following elements:

(1) a description of the use of the water in the production process, including how the water is diverted and transported from the source(s) of supply, how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal;

(2) specification of conservation goals, the basis for the development of such goals, and a time frame for achieving the specified goals;

(3) a description of the device(s) and/or method(s) within an accuracy of plus or minus 5.0% to be used in order to measure and account for the amount of water diverted from the source of supply;

(4) leak-detection, repair, and accounting for water loss in the water distribution system;

(5) application of state-of-the-art equipment and/or process modifications to improve water use efficiency; and

(6) any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

Source Note: The provisions of this §288.3 adopted to be effective May 3, 1993, 18 TexReg 2558; amended to be effective April 27, 2000, 25 TexReg 3544

Appendix C
Sample Implementation Report

APPENDIX C
INDUSTRIAL USER WATER CONSERVATION REPORT
Due: {Date] of every year

Entity Reporting: ________________________
Filled Out By: ________________________
Date Completed: ________________________
Year Covered: ________________________
Industry ________________________

Recorded Supplies and Process Uses by Month (in Acre-feet):

Month	**Self-Supplied Water**	**Other Supplies**	**Industrial Processes Water Use**						
			Process A	**Process B**	**Process C**	**Process D**	**Process E**		**Total**
January									
February									
March									
April									
May									
June									
July									
August									
September									
October									
November									
December									
TOTAL									

Unaccounted Water (Acre-feet):	
Self Supplies (total)	above
Other Supplies (total)	above
Total Supplies	above
Total Water use	above
Difference in Supplies and Water use	
% Unaccounted Water	
Goal for % Unaccounted Water	

Water Efficiency (Percent)

Process	**Design Use**	**Actual Use**	**Efficiency**
Process A			
Process B			
Process C			
Process D			

CONSERVATION MEASURES IMPLEMENTED	
Measure	**Date Implemented**

AMOUNT OF WATER SAVED (per Industrial Process)

Year	Total Water Supplied	Efficiency (%)	Efficiency Improvement (%)	Water saved (acre-feet)	Unaccounted water (%)	Reduction in Unaccounted water (%)	Water saved (acre-feet)	Total Saved (acre-feet)
2000								
2001								
2002								
2003								
2004								
2005								
2006								

Unusual Circumstances (use additional sheets if necessary):

Progress in Implementation of Conservation Plan (use additional sheets if necessary):

Conservation measures planned for next year (use additional sheets if necessary):

Other (use additional sheets if necessary):

Appendix 6B
Sample Drought Contingency Plans

Table of Contents

Drought Contingency Plan for [Public Water Supplier]

Date

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APPENDICES

Drought Contingency Plan for [Public Water Supplier]

1. Objectives

This drought contingency plan (the Plan) is intended for use by [municipal water supplier]. The plan includes all current TCEQ requirements for a drought contingency plan.

This drought contingency plan serves to:

- Conserve available water supplies during times of drought and emergency.
- Minimize adverse impacts of water supply shortages.
- Minimize the adverse impacts of emergency water supply conditions.
- Preserve public health, welfare, and safety.

2. Texas Commission on Environmental Quality Rules

The TCEQ rules governing development of drought contingency plans for public water suppliers are contained in Title 30, Part 1, Chapter 288, Subchapter B, Rule 288.20 of the Texas Administrative Code.

3. Provisions to Inform the Public and Opportunity for Public Input

[Public water supplier] will give customers the opportunity to provide public input into the preparation of the plan by one of the following methods:

- Holding a public meeting.
- Providing written notice of the proposed plan and the opportunity to comment on the plan by newspaper or posted notice.

4. Public Education

[Public water supplier] will notify the public about the drought contingency plan, including changes in Stage and drought measures to be implemented, by one or more of the following methods:

- Prepare a description of the Plan and make it available to customers at appropriate locations.
- Include utility bill inserts that detail the Plan
- Provide radio announcements that inform customers of stages to be initiated or terminated and drought measures to be taken
- Include an ad in a newspaper of general circulation to inform customers of stages to be initiated or terminated and drought measures to be taken

5. Coordination with the Regional F Water Planning Group

This drought contingency plan will be sent to the Chair of the Region F Water Planning Group in order to ensure consistency with the Region F Water Plan. If any changes are made to the drought contingency plan, a copy of the newly adopted plan will be sent to the Regional Water Planning Group.

6. Initiation and Termination of Drought Response Stages

The designated official will order the implementation of a drought response stage when one or more of the trigger conditions for that stage exist. Official designees may also order the termination of a drought response stage when the termination criteria are met or at their own discretion.

If any mandatory provisions have been implemented or terminated, the water supplier is required to notify the Executive Director of the TCEQ within 5 business days.

7. Goals for Reduction in Water Use

TCEQ requires that each public water supplier develop quantifiable goals for water use reduction for each stage of the drought contingency plan. These goals are outlined below.

[To be developed by each supplier. An example is provided.]

- Stage 1, Mild
    - 0 to 2 percent reduction in use that would have occurred in the absence of drought contingency measures.
- Stage 2, Moderate
    - 2 to 6 percent reduction in use that would have occurred in the absence of drought contingency measures
- Stage 3, Severe
    - 6 to 10 percent reduction in use that would have occurred in the absence of drought contingency measures
- Stage 4, Emergency
    - 10 to 14 percent reduction in use that would have occurred in the absence of drought contingency measures

8. Drought and Emergency Response Stages

Stage 1, Mild

Trigger Conditions for Stage 1, Mild

- A wholesale water supplier that provides all or part of [public water supplier]'s supply has initiated Stage 1, Mild

- [To be otherwise completed by public water supplier]
    - Potential triggers are:
        - When [public water supplier]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
        - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
        - When the water level in [public water supplier]'s well(s) is equal or less than [number] feet above/below mean sea level.
        - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Stage 1 will end when the circumstances that caused the initiation of Stage 1 no longer exist.

Goals for Use Reduction and Actions Available Under Stage 1, Mild
[Public water supplier] will reduce water use by [goal]. [Public water supplier] may order the implementation of any of the strategies listed below in order to decrease water use:

- Request voluntary reductions in water use.
- Review the problems that caused the initiation of Stage 1.
- Intensify leak detection and repair efforts

Stage 2, Moderate

Trigger Conditions for Stage 2, Moderate

- A wholesale water supplier that provides all or part of [public water supplier]'s supply has initiated Stage 2, Moderate
- [To be otherwise completed by public water supplier]
    - Potential triggers are:
        - When [public water supplier]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
        - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
        - When the water level in [public water supplier]'s well(s) is equal or less than [number] feet above/below mean sea level.
        - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Stage 2 will end when the circumstances that caused the initiation of Stage 2 no longer exist.

Goals for Use Reduction and Actions Available Under Stage 2, Moderate
[Public water supplier] will reduce water use by [goal]. [Public water supplier] may order the implementation of any of the strategies listed below in order to decrease water use:

- Request voluntary reductions in water use.
- Halt non-essential city government use
- Review the problems that caused the initiation of Stage 2.
- Intensify leak detection and repair efforts
- Implement mandatory restrictions on time of day outdoor water use in the summer.

Stage 3, Severe

Trigger Conditions for Stage 3, Severe

- A wholesale water supplier that provides all or part of [public water supplier]'s supply has initiated Stage 3, Severe
- [To be otherwise completed by public water supplier]
    - Potential triggers are:
        - When [public water supplier]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
        - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
        - When the water level in [public water supplier]'s well(s) is equal or less than [number] feet above/below mean sea level.
        - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Stage 3 will end when the circumstances that caused the initiation of Stage 3 no longer exist.

Goals for Use Reduction and Actions Available Under Stage 3, Severe
[Public water supplier] will reduce water use by [goal]. [Public water supplier] may order the implementation of any of the strategies listed below in order to decrease water use:

- Request voluntary reductions in water use.
- Require mandatory reductions in water use
- Halt non-essential city government use
- Review the problems that caused the initiation of Stage 3.
- Intensify leak detection and repair efforts
- Implement mandatory restrictions on time of day outdoor water use in the summer.
- Limit outdoor watering to specific weekdays.

- Create and implement a landscape ordinance.

Stage 4, Emergency

Trigger Conditions for Stage 4, Emergency

- A wholesale water supplier that provides all or part of [public water supplier]'s supply has initiated Stage 4, Emergency
- [To be otherwise completed by public water supplier]
  - Potential triggers are:
    - When [public water supplier]'s demand exceeds the amount that can be delivered to customers.
    - When [public water supplier]'s source becomes contaminated
    - [Public water supplier]'s system is unable to deliver water due to the failure or damage of major water system components.

Stage 4 will end when the circumstances that caused the initiation of Stage 4 no longer exist.

Goals for Use Reduction and Actions Available Under Stage 4, Emergency
[Public water supplier] will reduce water use by [goal]. [Public water supplier] may order the implementation of any of the strategies listed below in order to decrease water use:

- Require mandatory reductions in water use
- Halt non-essential city government use
- Review the problems that caused the initiation of Stage 4.
- Intensify leak detection and repair efforts
- Implement mandatory restrictions on time of day outdoor water use in the summer.
- Limit outdoor watering to specific weekdays.
- Create and implement a landscape ordinance.
- Prohibit washing of vehicles except as necessary for health, sanitation, or safety reasons.
- Prohibit commercial and residential landscape watering
- Prohibit golf course watering except for greens and tee boxes
- Prohibit filling of private pools.
- Initiate a rate surcharge for all water use over [amount in gallons per month].

9. Penalty for Violation of Water Use Restriction
Mandatory restrictions are required by TCEQ regulation to have a penalty. These restrictions will be strictly enforced with the following penalties:

- Potential penalties
  - Written warning that they have violated the mandatory water use restriction.

- Issue a citation. Minimum and maximum fines are established by ordinance.
- Discontinue water service to the user.

10. Review and Update of Drought Contingency Plan

This drought contingency plan will be updated at least every 5 years as required by TCEQ regulations.

Appendix A
List of References

APPENDIX A

List of References

Title 30 of the Texas Administrative Code, Part 1, Chapter 288, Subchapter B, Rule 288.20, downloaded from http://www.sos.state.tx.us/tac, July 2004.

Appendix B
Texas Commission on Environmental Quality Rules on Drought Contingency Plans

APPENDIX B
Texas Commission on Environmental Quality Rules on Drought Contingency Plans

Texas Administrative Code

TITLE 30 ENVIRONMENTAL QUALITY
PART 1 TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
CHAPTER 288 WATER CONSERVATION PLANS, DROUGHT CONTINGENCY PLANS, GUIDELINES AND REQUIREMENTS
SUBCHAPTER B DROUGHT CONTINGENCY PLANS
RULE §288.20 Drought Contingency Plans for Municipal Uses by Public Water Suppliers

(a) A drought contingency plan for a retail public water supplier, where applicable, shall provide information in response to each of the following.

(1) Minimum requirements. Drought contingency plans shall include the following minimum elements.

(A) Preparation of the plan shall include provisions to actively inform the public and affirmatively provide opportunity for public input. Such acts may include, but are not limited to, having a public meeting at a time and location convenient to the public and providing written notice to the public concerning the proposed plan and meeting.

(B) Provisions shall be made for a program of continuing public education and information regarding the drought contingency plan.

(C) The drought contingency plan must document coordination with the Regional Water Planning Groups for the service area of the retail public water supplier to insure consistency with the appropriate approved regional water plans.

(D) The drought contingency plan shall include a description of the information to be monitored by the water supplier, and specific criteria for the initiation and termination of drought response stages, accompanied by an explanation of the rationale or basis for such triggering criteria.

(E) The drought contingency plan must include drought or emergency response stages providing for the implementation of measures in response to at least the following situations:

(i) reduction in available water supply up to a repeat of the drought of record;

(ii) water production or distribution system limitations;

(iii) supply source contamination; or

(iv) system outage due to the failure or damage of major water system components (e.g., pumps).

(F) The drought contingency plan must include the specific water supply or water demand management measures to be implemented during each stage of the plan including, but not limited to, the following:

(i) curtailment of non-essential water uses; and

(ii) utilization of alternative water sources and/or alternative delivery mechanisms with the prior approval of the executive director as appropriate (e.g., interconnection with another water system, temporary use of a non-municipal water supply, use of reclaimed water for non-potable purposes, etc.).

(G) The drought contingency plan must include the procedures to be followed for the initiation or termination of each drought response stage, including procedures for notification of the public.

(H) The drought contingency plan must include procedures for granting variances to the plan.

(I) The drought contingency plan must include procedures for the enforcement of any mandatory water use restrictions, including specification of penalties (e.g., fines, water rate surcharges, discontinuation of service) for violations of such restrictions.

(2) Privately-owned water utilities. Privately-owned water utilities shall prepare a drought contingency plan in accordance with this section and shall incorporate such plan into their tariff.

(3) Wholesale water customers. Any water supplier that receives all or a portion of its water supply from another water supplier shall consult with that supplier and shall include in the drought contingency plan appropriate provisions for responding to reductions in that water supply.

(b) A wholesale or retail water supplier shall notify the executive director within five business days of the implementation of any mandatory provisions of the drought contingency plan.

(c) The retail public water supplier shall review and update, as appropriate, the drought contingency plan, at least every five years, based on new or updated information, such as the adoption or revision of the regional water plan.

Model Drought Contingency Plan for [Irrigation District]

Date

TABLE OF CONTENTS

Drought Contingency Plan for [Irrigation District]

1. Objectives

This drought contingency plan is intended for use by [irrigation district]. The plan includes all current TCEQ requirements for a drought contingency plan.

This drought contingency plan serves to:

- Conserve available water supplies during times of drought and emergency.
- Minimize adverse impacts of water supply shortages.
- Minimize the adverse impacts of emergency water supply conditions.

2. Texas Commission on Environmental Quality Rules

The TCEQ rules governing development of drought contingency plans for irrigation districts are contained in Title 30, Part 1, Chapter 288, Subchapter B, Rule 288.21 of the Texas Administrative Code.

3. Provisions to Inform the Public and Opportunity for Public Input

[Irrigation district] will give customers the opportunity to provide public input into the preparation of the plan by one of the following methods:

- Holding a public meeting.
- Providing written notice of the proposed plan and the opportunity to comment on the plan by newspaper or posted notice.

4. Coordination with the Region F Water Planning Group

This drought contingency plan will be sent to the Chair of the Region F Water Planning Group in order to ensure consistency with the Region F Water Plan.

5. Initiation and Termination of Drought Response Stages

Official designees order the implementation of a drought response stage when one or more of the trigger conditions for that stage are met. Official designees may also order the termination of a drought response stage when the termination criteria are met or at their own discretion. The official designee for the [irrigation district] is:

Name
Title
Contact Information

If any mandatory provisions have been implemented or terminated, [irrigation district] is required to notify the Executive Director of the TCEQ within 5 business days.

6. Goals for Reduction in Water Use

TCEQ requires that each irrigation water user develop goals for water use reduction for each stage of the drought contingency plan. [Entity]'s goals are independently developed and given below.

7. Drought and Emergency Response Stages

Stage 1, Mild

Trigger Conditions for Stage 1, Mild

- A wholesale water supplier that provides all or part of an irrigation user's supply has initiated Stage 1, Mild
- *[Select appropriate other triggers]*
    - When [irrigation district]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
    - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
    - When the water level in [irrigation district]'s well(s) is equal or less than [number] feet above/below mean sea level.
    - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Goals for Use Reduction and Actions Available Under Stage 1, Mild
[Entity]'s will reduce water use by [goal]. Irrigation water suppliers may order the implementation of any of the strategies listed below in order to reduce water use:

- Request voluntary reductions in water use.
- Review the problems that caused the initiation of Stage 1.

Stage 1 is intended to raise awareness of potential drought problems. Stage 1 will end when the circumstances that caused the initiation of Stage 1 no longer exist.

Stage 2, Moderate

Trigger Conditions for Stage 2, Moderate

- A wholesale water supplier that provides all or part of an irrigation user's supply has initiated Stage 2, Moderate
- *[Select appropriate other triggers]*
    - When [irrigation district]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
    - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.

- When the water level in [irrigation district]'s well(s) is equal or less than [number] feet above/below mean sea level.
- When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Goals for Use Reduction and Actions Available Under Stage 2, Moderate
[Entity]'s will reduce water use by [goal]. Irrigation water suppliers may order the implementation of any of the strategies listed below in order to reduce water use:

- Request voluntary reductions in water use.
- Review the problems that caused the initiation of Stage 2.
- Intensify leak detection and repair efforts.
- Other.

Stage 2 will end when the circumstances that caused the initiation of Stage 2 no longer exist.

Stage 3, Severe

Trigger Conditions for Stage 3, Severe

- A wholesale water supplier that provides all or part of an irrigation user's supply has initiated Stage 3, Severe
- *[Select appropriate other triggers]*
    - When [irrigation district]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
    - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
    - When the water level in [irrigation district]'s well(s) is equal or less than [number] feet above/below mean sea level.
    - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Goals for Use Reduction and Actions Available Under Stage 3, Severe
[Entity]'s will reduce water use by [goal]. Irrigation water suppliers may order the implementation of any of the strategies listed below in order to reduce water use:

- Request voluntary reductions in water use.
- Review the problems that caused the initiation of Stage 3.
- Intensify leak detection and repair efforts.
- Implement mandatory watering days and/or times.
- Other.

Stage 3 will end when the circumstances that caused the initiation of Stage 3 no longer exist.

Stage 4, Emergency

Trigger Conditions for Stage 4, Emergency

- A wholesale water supplier that provides all or part of an irrigation user's supply has initiated Stage 4, Emergency
- *[Select appropriate other triggers]*
    - When [irrigation district]'s available water supply is equal or less than [amount in ac-ft, percent of storage, etc.].
    - When total daily demand equals [number] million gallons for [number] consecutive days or [number] million gallons on a single day.
    - When the water level in [irrigation district]'s well(s) is equal or less than [number] feet above/below mean sea level.
    - When flows in the [name of river or stream segment] are equal to or less than [number] cubic feet per second.

Goals for Use Reduction and Actions Available Under Stage 4, Emergency
[Entity]'s will reduce water use by [goal]. Irrigation water suppliers may order the implementation of any of the strategies listed below in order to reduce water use:

- Review the problems that caused the initiation of Stage 4.
- Intensify leak detection and repair efforts.
- Implement mandatory watering days and/or times.
- Implement mandatory reductions in water deliveries.
- Other.

Stage 4 will end when the circumstances that caused the initiation of Stage 4 no longer exist.

8. Penalty for Violation of Water Use Restriction

Mandatory water use restrictions are implemented in Stages [1, 2, 3, or 4]. These restrictions will be strictly enforced with the following penalties:

- Potential penalties include:
    - Written warning that they have violated the mandatory water use restriction.
    - Issue a citation. Minimum and maximum fines are established by ordinance or other order.
    - Discontinue water service to the user.

9. Review and Update of Drought Contingency Plan

This drought contingency plan will be updated at least every 5 years as required by TCEQ regulations.

Table 6C-3

Region F Water Level Monitor Wells

Monitoring Well														Drought Trig	
SWN	County	Aquifer	Owner	Elev.	Well Depth	Use	most recent WL	WL/ Decade Trend	most recent water column in Well	Historical Lowest_WL	Historical Highest_WL	Decade Avg. WL	Diff. Of Avg - Lowest_WL	W.L. Avg-50%	d Mining
2736201	Andrews	121OGLL	City of Andrews	3158	200	P	-104.2	-1.4	96	-104.2	-99.9	-102.1	-2.1	Insuff	
2745401	Andrews	121OGLL	Charley Welch	3098	125	I	-71.8	-7.3	53	-73.2	-49.9	-61.6	-11.7	-67.4	
2739405	Andrews	121OGLL	City of Midland	2960	215	P								Insuff	
2803601	Borden	121OGLL	N. Jones Hubert Walker	2953	57	I	-20.3	2.7	37	-31.2	-13.5	-22.4	-8.9	-26.8	
4101918	Brown	218TVPK	Claude McInnis	1675	135	H	-104.7	-7.3	30	-105.7	-75.7	-90.7	-15	-98.2	
4101234	Brown	218TVPK	May Water Supply	1650	118	P	-62.9	0.9	55	-85.7	-62.9	-74.3	-11.4	-80	
4118650	Brown	218TVPK	D.A. Young	1475	134	I	-29.8	-0.3	104	-32.6	-28.8	-30.7	-1.9	Insuff	
4110641	Brown	218TVPK	City of Blanket	1650	240	P								Insuff	
4314602	Coke	318CLFK	Mrs. Imogene Griffin	1835	160	H	-119.6	1.5	40	-125.5	-119.6	-122.5	-2.9	Insuff	
4213201	Coleman	110ALVM	City of Coleman	1690	22	P								Insuff	
4249806	Concho	218EDRDA	J. C. Sorrell	2184		U	-111.9			-113.1	-111.9	-112.5	-0.6	Insuff	
4250102	Concho	218EDRDA	City of Eden	2044	36	P	-26.6	0.4	9	-28.2	-25.6	-26.9	-1.3	-27.6	
4535301	Crane	110ALVM	City of Crane	2521	156	P		-16.1		-112.3	-48	-80.2	-32.2		Yes
4529401	Crane	100PECS	Phillip's Crane Water	2670	105	U	-44.4	3.0	61	-64.9	-44.4	-54.7	-10.3	-59.8	
5415304	Crockett	218EDRDA	John Childress	2540	420	I	-356.6	-0.6	63	-358.4	-354	-356.2	-2.2	Insuff	
5423106	Crockett	218EDRDA	Crockett County	2400	397	P	-323.1	-0.5	74	-323.1	-321.3	-322.2	-0.9	Insuff	
2762801	Ector	218ALRS	L. W. Bell	2925	147	I	-127.1	-14.6	20	-127.1	-39.4	-83.3	-43.9		Yes
4505607	Ector	218ALRS	CRMWD	2951	180	P	-111.5	-4.5	69	-113.7	-84.7	-99.2	-14.5	-106.5	
2761903	Ector	218ALRS	City of Odessa-Parks	2963	91	P	-85.7	-5.0	5	-85.7	-70.6	-78.2	-7.6		Yes
4504107	Ector	218ALRS	City of Goldsmith	3165	159	P								Insuff	
4406307	Glasscock	110ALVM	CRMWD	2522	229	P		-0.8		-75.1	-72	-73.6	-1.6	-74.3	
4413103	Glasscock	218ALRS	Fred Ratliff	2605	200	I	-91.6	-5.2	108	-91.6	-70.7	-81.2	-10.5		Yes
2859301	Howard	121OGLL	Dr. G.T. Hall	2519	108	I	-30.5	7.6	78	-60.8	-30.5	-45.7	-15.2	-53.2	
2862121	Howard	218ALRS	City of Forsan	2765	284	P								Insuff	
4440901	Irion	110AVAN	John Sheen	2230	121	I	-16.2	0.6	105	-18.7	-14.2	-16.5	-2.3	Insuff	
4455811	Irion	218EDDT	Barnhart Water	2625	418	P	-144.4	35.5	274	-315.5	-144.4	-230	-85.6	-272.7	
4455811	Irion	218EDDT	Barnhart Water Works	2625	418	P	-136.2	37.6	282	-315.5	-136.2	-225.9	-89.7	-270.7	
4350215	Irion	218ALRS	City of Mertzon	2202	130	P								Insuff	
5634307	Kimble	100ALVM	City of Junction		21	P								Insuff	
5524601	Kimble	218EDRDA	A.D. Rust	2283	318	S	-236	5.5	82	-257.8	-227.1	-242.4	-15.3	-250.1	
5620513	Kimble	210CRCS	London Community		90	P								Insuff	
4612402	Loving	100PECS	Johnson Ranch Partner	2840	173	S	-136.3	0.4	37	-139.6	-133.8	-136.7	-2.9	Insuff	
2739903	Martin	121OGLL	City of Midland	2895	182	U	-134.3	-5.5	48	-139.4	-112.2	-125.8	-13.6	-132.6	
2849908	Martin	121OGLL	CRMWD	2742	188	P		-11.2		-113.9	-69	-91.5	-22.5		Yes
2850813	Martin	121OGLL	City of Stanton	2670		P								Insuff	
5623115	Mason	371HCKR	City of Mason	1590	335	P	-83.5		252					Insuff	
5613601	Mason	371HCKR	Mrs. Earl Larmore	1741	425	I	-69.8	-3.6	355	-72.3	-51.8	-62.1	-10.3	-67.2	
4239901	McCulloch	324STRN	City of Mercury	1475	436	P								Insuff	
4255203	McCulloch	320MBLF	Wayne Myers	1758	240									Insuff	
4263801	McCulloch	367EBHK	J.A. Vince	1553	349	I								Insuff	
4255101	McCulloch	371HCKR	Rochelle Water	1778	2350	P	-320.2	-8.5	2030	-326.1	-294.7	-310.4	-15.7	-318.3	
5606614	McCulloch	371HCKR	T.W.D.B.	1743	641	N	-143.5	-6.8	498	-143.5	-123.1	-133.3	-10.2		Yes
4245601	McCulloch	371HCKR	Lohn WSC	1561	2746	P	-69.8	-16.0	2676	-69.8	-21.7	-45.8	-24.1		Yes
5607302	McCulloch	371HCKR	M.F. Deans	1552	117	I	-68.9	-7.4	48	-68.9	-32	-50.5	-18.5		Yes
4252505	McCulloch	371PNPK	City of Melvin	1861	2400	P								Insuff	
5602501	Menard	100ALVM	City of Menard	1880	22	P								Insuff	
5609612	Menard	218EDRDA	Eva Lively Westbrook	2272	270	S	-229.4	-3.9	41	-229.8	-214	-221.9	-7.9	-225.8	
5612210	Menard	371HCKR	Earl Ray Anderson	1870	1080	I	-252.1	-20.7	828	-252.1	-190	-221.1	-31.1		Yes
4402202	Midland	121OGLL	B.W. Brown	2623	62	I	-44.2		18	-44.2	-28	-36.1	-8.1	-40.2	
4401103	Midland	121OGLL	Le Roy Gill	2740		P	-40.6	3.3		-66.2	-40.6	-53.4	-12.8	-59.8	
2763501	Midland	121OGLL	City of Midland	2857	174	P								Insuff	
4507406	Midland	218ALRS	Midland Air Termin	2868	120	P	-38.7	-0.7	81	-42.6	-36.5	-39.6	-3.1	Insuff	
2942501	Mitchell	231DCKM	Elon Harrell	2126	137	I	-54.9	1.2	82	-60.8	-46.6	-53.7	-7.1	-57.3	
2935705	Mitchell	231DCKM	City of Loraine	2347	220	P								Insuff	

Table 6C-3

Region F Water Level Monitor Wells

Monitoring Well SWN	County	Aquifer	Owner	Elev.	Well Depth	Use	most recent WL	WL/ Decade Trend	most recent water column in Well	Historical Lowest_WL	Historical Highest_WL	Decade Avg. WL	Diff. Of Avg - Lowest_WL	Drought Trig W.L. Avg-50%	d Mining
2934716	Mitchell	231DCKM	City of Colorado	2173	249	P								Insuff	
4648802	Pecos	112PECSA	Edgar Glass	2556	779	I	-138.9	-14.9	640	-138.9	-64.2	-101.6	-37.4		Yes
4656308	Pecos	100PECS	City of Imperial	2617	924	P								Insuff	
5303901	Pecos	218EDDT	TX DOT Rest Area	2876	462	P	-151.2	-2.5	311	-153.6	-138.5	-146.1	-7.6	-149.8	
5216902	Pecos	218ALRS	City of Fort Stock	3259	517	P		-7.6		-282.5	-224.6	-253.6	-29	-268	
5308402	Pecos	218ALRS	City of McCamey	2383	272	P								Insuff	
5418504	Pecos	218EDDT	City of Sheffield	2175	294	P								Insuff	
5216608	Pecos	312RSLR	Belding Farms	3195	1600	I	-121	11.6	1479	-201.6	-121	-161.3	-40.3	-181.5	
4437506	Reagan	218ALRS	City of Big Lake	2626	358	P	-213.5	-0.2	145	-213.5	-212.7	-213.1	-0.4	Insuff	
4429705	Reagan	218EDDT	Clayton Henderson	2651	300	I	-109.6	-4.0	190	-146.5	-85.9	-116.2	-30.3	-131.4	
4436303	Reagan	218ALRS	Regan County Water	2668	336	P								Insuff	
5204105	Reeves	100PECS	Seventh Day Advent	2943	350	I	-211.2	-6.5	139	-242.8	-178.8	-210.8	-32	-226.8	
4642810	Reeves	218EDDT	Barnes-Ramshaud Wyn	2961	1018	I	-49.2	11.0	969	-179.6	-49.2	-114.4	-65.2	-147	
4646206	Reeves	231DCKM	City of Pecos	2616	198	P	-153	-6.3	45	-153	-80	-116.5	-36.5		Yes
4660902	Reeves	312RSLR	R. W. Winterrowd	2950	1450		-257.1	45.5	1193	-439.2	-257.1	-348.2	-91.1	-393.7	
4324301	Runnels	318ARRY	Lenard Halfmann	1672	50	I	-38.5	-3.5	12	-38.5	-27.9	-33.2	-5.3	-35.9	
4331211	Runnels	318CLFK	City of Miles	1802	150	P								Insuff	
4324601	Runnels	318CLFK	Rowena Corp.	1683	73	P								Insuff	
5512116	Schleicher	218EDRDA	City of Eldorado	2441	450	P	-312.5	2.3	138	-321.1	-312.5	-316.8	-4.3	Insuff	
4361706	Schleicher	218EDRDA	W. A. Davis Estate	2195	160	U	-92	-0.1	68	-92.4	-84	-88.2	-4.2	Insuff	
2918902	Scurry	231DCKM	City of Hermleigh	2445	350	P	-202.6	-2.6	147	-202.6	-186.9	-194.8	-7.8	-198.7	
2917704	Scurry	231DCKM	Western Texas Col.	2289	382	I	-67.9	-2.0	314	-86.4	-60	-73.2	-13.2	-79.8	
2917309	Scurry	231DCKM	CRMWD	2381	215	P		-12.3		-118.5	-94	-106.3	-12.3		Yes
4415201	Sterling	110AVAN	Lena R. Foster	2452	123	I	-80.1	-0.2	43	-81.4	-78.2	-79.8	-1.6	Insuff	
4309102	Sterling	100CPDG	City of Sterling	2263	107	P	-30.5	0.6	77	-33.2	-27.7	-30.5	-2.8	Insuff	
4408307	Sterling	218ALRS	Willie Mae Foster	2468	162	I	-47		115	-47	-40.2	-43.6	-3.4	Insuff	
5527620	Sutton	218EDRDA	City of Sonora	2245	278	P	-224		54	-224	-224	-224		Insuff	
5527606	Sutton	218EDRDA	Sam Allison	2110	180	I	-149.4	-0.1	31	-160.3	-142.6	-151.5	-8.8	-155.9	
4346301	Tom Green	318BLGN	Ripple Brothers	1884	214	I	-104.5	-0.4	110	-126.7	-73.2	-100	-26.8	-113.3	
4339104	Tom Green	318BLGN	R. E. McCullough	1813	103	I	-81.8	-2.0	21	-83.1	-53.4	-68.3	-14.9	-75.7	
4338301	Tom Green	112LNCZ	A. F. Schumm	1820	125	I	-70.8	-0.3	54	-85.1	-53.1	-69.1	-16	-77.1	
4346204	Tom Green	112LEON	A. J. Bean	1862	117	I	-58.1	1.8	59	-74.5	-50.1	-62.3	-12.2	-68.4	
4329701	Tom Green	112LEON	Ray Moore (Morris E)	1914	82	I	-45.4		37	-48.1	-35.2	-41.7	-6.5	-44.9	
4328202	Tom Green	112LEON	Concho Rural Water	2001	100	P	-38	-2.5	62	-38	-33	-35.5	-2.5	Insuff	
4327201	Tom Green	112LEON	State Sanatorium	2014	75	P		-1.0		-36.5	-17.3	-26.9	-9.6	-31.7	
4433501	Upton	218ALRS	Ray Barrett	2744	340		-188.2	-8.3	152	-188.2	-154.9	-171.6	-16.7		Yes
4449217	Upton	218ALRS	Upton County	2642	360	P								Insuff	
4632626	Ward	100PECS	CRMWD	2642	295	P	-148.2	-13.1	147	-148.2	-109	-128.6	-19.6		Yes
4637101	Ward	100PECS	Fred and Calvin Ge	2574	300	I	-13.7	0.5	286	-18	-13.7	-15.9	-2.2	Insuff	
4533826	Ward	100CPDG	City of Grandfalls	2521	225	P								Insuff	
4624719	Ward	100PECS	City of Monahans	2692	385	P								Insuff	
4631702	Ward	231DCKM	Wilson Ranch	2667	160	H	-104.3	-0.7	56	-106.3	-97.7	-102	-4.3	Insuff	
4632630	Ward	231DCKM	City of Wickett	2653	400	P								Insuff	
4615402	Winkler	110ALVM	Winkler County	2830	190	I	-98.5	0.3	92	-106.7	-98.5	-102.6	-4.1	Insuff	
4615921	Winkler	100PECS	City of Wink School	2790	267	P								Insuff	
4616104	Winkler	231DCKM	City of Kermit	2857	559	P	-116.8	-2.8	442	-126.8	-102.8	-114.8	-12	-120.8	
4616213	Winkler	231DCKM	Winkler County	2868	420	P								Insuff	

WL = Water Level   P = Public Water Supply   Insuff - Insufficient historical water level data and/or variability to develop drought trigger levels

I = Irrigation   U = Unused

H = Domestic   S = Used for Stock

Appendix 7A
Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations

APPENDIX 7A

CHECKLIST FOR COMPARISON OF THE REGIONAL WATER PLAN TO APPLICABLE WATER PLANNING REGULATIONS

The purpose of this attachment is to facilitate the determination of how the Regional Water Plan is consistent with the long-term protection of the water, agricultural, and natural resources of the State of Texas, particularly within this region. The following checklist includes a regulatory citation (Column 1) for all subsections and paragraphs contained in the following applicable portions of the water planning regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.5
- 31 TAC Chapter 357.7
- 31 TAC Chapter 357.8
- 31 TAC Chapter 357.9

According to 31 TAC Chapter 357.14(b), the Regional Water Plan is considered to be consistent with the long-term protection of the State's resources if complies with the above listed requirements. Therefore, the Regional Water Plan has been compared to each applicable section of the regulations as a means of determining consistency.

The checklist also includes a summary description of each cited regulation (Column 2). It should be understood that this summary is intended only to provide a general description of the particular section of the regulation and should not be assumed to contain all specifics of the actual regulation. The evaluation of the Regional Water Plan should be performed against the complete regulation, as contained in the actual 31 TAC 358 and 31 TAC 357 regulations.

Column 3 of the checklist provides the evaluation response as affirmative, negative, or not applicable. A "Yes" in this column indicates that the Regional Water Plan has been evaluated to comply with the stated section of the regulation. A "No" response indicates that the Regional Water Plan does not comply with the stated regulation. A response of

“NA” (or not applicable) indicates that the stated section of the regulation does not apply to this Regional Water Plan.

The evidence of where, in the Regional Water Plan, the stated regulation is addressed is provided in Column 4. Where the regulation is addressed in multiple locations within the Regional Water Plan, this column may cite only the primary locations. In addition to identifying where the regulation is addressed, this column may include commentary about the application of the regulation in the Regional Water Plan.

The above-listed regulations are repetitive, in some instances. One section of the regulations may be restated or paraphrased elsewhere within the regulations. In some cases, multiple sections of the regulations may be combined into one separate regulation section. Therefore, Column 5 provides cross-referencing.

Checklist For Comparison of the Regional Water Plan to Applicable Water Planning Regulations

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
31 TAC §358.3				
358.3(a)	TWDB shall develop a State Water Plan (SWP) with 50-year planning cycle, and based on the Regional Water Plan (RWP)	NA	Applies to the State Water Plan. The Regional Water Plan is based on a 50-year planning cycle, however.	
358.3(b)	RWP is guided by the following principles			
(b)(1)	Identified policies and actions so that water will be available at reasonable cost, to satisfy reasonable projected use and protect resources	Yes	Chapters 4 and 8	§358.3(b)(4), §357.5 (a); §357.7 (a)(9)
(b)(2)	Open and accountable decision-making based on accurate, objective information	Yes	Regular public meetings of the RWPG;	§357.5 (e)(6)
(b)(3)	Consideration of effects of plan on the public interest, and on entities providing water supply	Yes	Chapters 4 and 7	
(b)(4)	Consideration and approval of cost-effective strategies that meet needs and respond to drought, and are consistent with long-term protection of resources	Yes	Chapters 4, 6, and 7	§358.3(b)(1), §357.5 (e)(4) and §357.5 (e)(6); §357.7(a)(9)
(b)(5)	Consideration of opportunities that encourage the voluntary transfer of water resources	Yes	Chapter 4	
(b) (6)	Consideration of a balance of economic, social, aesthetic, and ecological viability	Yes	Chapters 4 and 7	
(b) (7)	The use of information from the adopted SWP for regions without a RWP	NA		
(b) (8)	The orderly development, management, and conservation of water resources	Yes	Chapters 4, 6, and 7	§357.5(a)
(b) (9)	Surface waters are held in trust by the State, and governed by doctrine of prior appropriation	Yes	Chapters 3 and 4	
(b) (10)	Existing water rights, contracts, and option agreements are protected	Yes	Chapter 4	§357.5(e)(3)
(b) (11)	Groundwater is governed by the right of capture unless under local control of a groundwater management district	Yes	Chapter 3	
(b) (12)	Consideration of recommendation of stream segments of unique ecological value	Yes	Chapter 8. RWPG did not recommend designation of any of the Region's Stream segments as an ecologically unique segment.	§357.8
(b) (13)	Consideration of recommendation of sites of unique value for the construction of reservoirs	Yes	Chapter 8. The RWPG did not recommend any site in the region as a unique reservoir site.	§357.9

Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations - continued

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(b) (14)	Local, regional, state, and federal agency water planning coordination	Yes	Local, State and Federal levels of coordination	
(b) (15)	Improvement or maintenance of water quality and related uses as designated by the State Water Quality Plan	Yes	Chapters 4 and 5	
(b)(16)	Cooperation between neighboring water planning regions to identify common needs and issues	Yes	Coordination with neighboring planning regions as needed	
(b)(17)	WMS described sufficiently to allow a state agency making financial or regulatory decisions to determine consistency of the WMS with the RWP	NA	To be determined by the State after completion of the RWP	§357.7(a)(9)
(b) (18)	Environmental evaluations are based on site-specific information or state environmental planning criteria	Yes	To the extent that such information and criteria exist; Chapter 4	§357.5(e)(1); §357.5 (e)(6); §357.5(k)(1)(H)
(b) (19)	Consideration of environmental water needs, including instream flows and bay and estuary inflows	Yes	Chapter 4	§357.5(e)(1); §357.5(l); §357.7 (a)(8)(A)(ii)
(b) (20)	Planning is consistent with all laws applicable to water use for state and regional water planning	Yes	Applicable water planning laws have been considered in preparing this plan	§357.5(f)
(b) (21)	Ongoing permitted water development projects are included	Yes	Chapter 4	
31 TAC §357.5				
(a)	The RWP: provides for the orderly development, management, and conservation of water resources; prepares for drought conditions; and protects agricultural, natural, and water resources	Yes	Chapters 4, 6, and 7	§358.3(b)(1). §358.3(b)(8)
(b)	The RWP submitted by January 5, 2006	NA	To be submitted	
(c)	The RWP is consistent with 31 TAC §358 and 31 TAC §357, and guided by State and local water plans	Yes	Throughout RWP	
(d)(1) & (2)	The RWP uses State population and water demand projections from the SWP; or revised population or water demand projections that are adopted by the State	Yes	Chapter 2; Population and water demand projections adopted by TWDB	
(e)(1)	The RWP provides WMS adjusted for appropriate environmental water needs; environmental evaluations are based on site-specific information or state environmental planning criteria	Yes	Chapter 4	§358.3(b)(1); §358.3(b)(18); §357.7 (a)(8)(A)(ii)
(e)(2)	The RWP provides WMS that may be used during a drought of record	Yes	Chapter 4	
(e)(3)	The RWP protects existing water rights, contracts, and option agreements	Yes	Chapter 4	§358.3(b)(10)

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(e)(4)	The RWP provides cost-effective and environmentally sensitive WMS based on comparisons of all potentially feasible WMS; The process is documented and presented to the public for comment.	Yes	Chapter 4; public process utilized to adopt the RWP	§358.3(b)(4)
(e)(5)	The RWP incorporates water conservation planning and drought contingency planning	Yes	Chapters 4 and 6	§357.5(k)(1)(A)&(B); §357.7(a)(7)(B)
(e)(6)	The RWP achieves efficient use of existing supplies and promotes regional water supplies or regional management of existing supplies; Public involvement is included in the decision-making process	Yes	Chapter 4; public process utilized in consideration WMS	§358.3(b)(2)
(e)(7)(A)&(B)	The RWP identifies (A) drought triggers, and (B) drought responses for designated water supplies	Yes	Chapter 6	§357.5(e)(5); §357.5(k)(1)(A)&(B)
(e)(8)	The RWP considers the effect of the plan on navigation	Yes	Navigation impacts considered to the extent necessary	
(f)	Planning is consistent with all laws applicable to water use in the Region	Yes	Applicable water planning laws considered in adopting the plan	§358.3(b)(20)
(g)	The following characteristics of a candidate special water resource are considered:			
(g)(1)	The surface water rights are owned by an entity headquartered in another region.	NA	No Special Water Resources (as defined in §357) exist in the Region at this time	
(g)(2)	A water supply contract commits water to an entity headquartered in another region.	NA		
(g)(3)	An option agreement may result in water being supplied to an entity headquartered in another region.	NA		
(h)	Water rights, contracts, and option agreements of special water resources are protected in the RWP	NA		
(i)	The RWP considers emergency transfers of surface water rights	NA	Emergency transfers of water not considered in the RWP	
(j)(1)-(3)	Simplified planning is used in the RWP in accordance with TWDB rules	NA	Normal water planning process utilized	
(k)(1)&(2)	The RWP shall consider existing plans and information, and existing programs and goals related to local or regional water planning	Yes	Chapters 1, 4, and 6	§357.5(e)(7)
(l)	The RWP considers environmental water needs including instream flows and bays and estuary flows	Yes	Chapter 4	§358.3(b)(19); §357.7 (a)(8)(A)(ii)

Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations - continued

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
31 TAC §357.7				
(a)(1)(A)-(M)	The RWP shall describe the region, including specific requirements of paragraphs A through M of this section of the regulations	Yes	Note: The regulations include a requirement to utilize information compiled by the TWDB from water loss audits. This information is not due to the TWDB until after the RWP is due, and is not included here.	§357.7(a)(8)(A)(iii); §357.7(a)(8)(D); §357.5(k)(1)(C); §357.7(a)(7)(A)(iv)
(a)(2)(A)-(C)	The RWP includes a presentation of current and projected population and water demands, reported in accordance with paragraphs A through C of this section of the regulations	Yes	Chapter 2	
(a)(3)(A)&(B)	The RWP includes the evaluation of current water supplies available (including a presentation of reservoir firm yields) to the Region for use during drought of record conditions, reported by the type of entity and wholesale providers	Yes	Chapter 3	
(a)(4) (A)&(B)	The RWP includes water supply and demand analysis, comparing the type of entity and wholesale providers	Yes	Chapter 4	
(a)(5)(A)-(C)	The RWP provides sufficient water supply to meet the identified needs, in accordance with requirements of paragraphs A through C of this section of the regulations	Yes	Chapter 4	
(a)(6)	The RWP presents data required in paragraphs (2) - (5) of this subsection in subdivisions of the reporting units required, if desired by the RWPG	Yes	Chapters 2, 3, and 4	
(a)(7)(A)-(G)	The RWP evaluates all WMS determined to be potentially feasible, in accordance with paragraphs A through G of this section of the regulations	Yes	Note: The regulations include a requirement to utilize information compiled by the TWDB from water loss audits. This information is not due to the TWDB until after the RWP is due, and is not included here.	§357.5(k)(1)(C); §357.7(a)(1)(M); §357.5(e)(5); §357.5(k)(1)(B)

Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations - continued

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(a)(8)(A)-(H)	The RWP evaluates all WMS determined to be potentially feasible, by considering the requirements of paragraphs A through H of this section of the regulations	Yes	Chapter 4	§358.3(b)(19); §357.5(e)(1); §357.5(l); §357.7(a)(1)(L); §357.7(a)(8)(D); §357.7(a)(8)(A)(iii)
(a)(9)	The RWP makes specific recommendations of WMS in sufficient detail to allow state agencies to make financial or regulatory decisions to determine the consistency of the proposed action with an approved RWP	NA	To be determined by the State after completion of the RWP	§358.3(b)(1); §358.3(b)(4); §358.3(b)(17)
(a)(10)	The RWP includes regulatory, administrative, or legislative recommendations to facilitate the orderly development, management, and conservation of water resources; prepares for drought conditions; and protects agricultural, natural, and water resources	Yes	Chapter 8	§358.3(b)(1) §357.5(a)
(a)(11)	The RWP includes a chapter consolidating the water conservation and drought management recommendations	Yes	Chapter 6	
(a)(12)	The RWP includes a chapter describing the major impacts of recommended WMS on key parameters of water quality	Yes	Chapter 5	
(a)(13)	The RWP includes a chapter describing how it is consistent with long-term protection of the state's water, agricultural, and natural resources	Yes	Chapter 7	
(a)(14)	The RWP includes a chapter describing the financing needed to implement the water management strategies recommended	Yes	Chapter 9; due later	
(b)	The RWP excludes WMS for political subdivisions that object to inclusion and provide reasons for objection	NA		
(c)	The RWP includes model water conservation plan(s)	Yes	Chapter 6	
(d)	The RWP includes model drought contingency plan(s)	Yes	Chapter 6	
(e)	The RWP includes provisions for assistance of the TWDB in performing regional water planning activities and/or resolving conflicts within the Region	Yes	Inter-regional cooperation between Regions F and K	

Checklist for Comparison of the Regional Water Plan to Applicable Water Planning Regulations - continued

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
31 TAC §357.8				
(a)	The RWP considers the inclusion of recommendations for the designation of river and stream segments of unique ecological value within the Region	Yes	Chapter 8. The RWPG did not recommend designation of any of the Region's stream segments as ecologically unique	§358.3(b)(12)
(b)	If river or stream segments of unique ecological value are recommended, such recommendations are made in the plan on the basis of the criteria established in this section of the regulations	NA		
(c)	If the RWP recommends designation of river or stream segments of unique ecological value, the impact of the regional water plan on these segments is assessed	NA		
31 TAC §357.9				
(1)	The RWP considers the inclusion of recommendations for the designation of sites of unique value for construction of reservoirs	Yes	The RWPG did not recommend any locations in the Region as a site of unique value for construction of reservoirs	§358.3(b)(13)
(2)	If sites of unique value for construction of reservoirs are recommended, such recommendations are made in the plan on the basis of criteria established in this section of the regulations	NA		

Appendix 9A
Responses to Strategy Surveys

Region F Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by December 21, 2005

Entity: City of Andrews Contact Person: David Sanders
Telephone Number: 432.523.4820 FAX: 432.523.6372
Email Address: dsanders@cityofandrews.org
Mailing Address: 111 Logsdon Andrews, TX 79714

Please refer to the attached memorandum when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

   Desalination – Dockum aquifer (Yes) or No PILOT PROJECT UNDERWAY

   If "No" for any strategies, please continue with question 2.

   If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

   —

3. Are the cost estimates for your projects/strategies consistent with your expectations?

   Yes or No UNKNOWN – Currently under study for technical viability/economic feasibility

   If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

   1) Funding source(s)[1] by checking the corresponding box(es) below and

   2) Percent share of the total cost to be met by each funding source.

   - ☑ 50 % Cash Reserves
   - ☐ ____ % Bonds
   - ☐ ____ % Bank Loans
   - ☑ 10 % Federal Government Programs
   - ☑ 40 % State Government Programs, including TWDB Bonds
   - ☐ ____ % Other ________
   - ☐ ____ % *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

- TWDB Research Grants for desalination (state)
- Bureau of Reclamation (federal)
- other programs which may become available

Please return this survey by December 21, 2005 to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Region F
Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by August 3, 2005

Entity: City of Ballinger Contact Person: CARL WILLIAMS
Telephone Number: 325-365-3511 FAX: 325-365-3445
Email Address: pwk.ballinger@verizon.net
Mailing Address: 700 RAILROAD AVE., BALLINGER, TX. 76821

Please refer to the attached table when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

Subordination of downstream water rights	(Yes) or No
Voluntary redistribution from Ivie Reservoir	(Yes) or No
Reuse	(Yes) or No
Water Conservation	(Yes) or No

If "No" for any strategies, please continue with question 2.

If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

3. Are the cost estimates for your projects/strategies consistent with your expectations?

(Yes) or No

If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:
   1) Funding source(s)[1] by checking the corresponding box(es) below and
   2) Percent share of the total cost to be met by each funding source.

- ☐ _______% Cash Reserves
- ☐ _______% Bonds
- ☐ _______% Bank Loans
- ☐ _______% Federal Government Programs
- ☐ _______% State Government Programs, including TWDB Bonds
- ☐ _______% Other ____________________
- ☐ _______% *TOTAL – (Sum should equal 100%)*

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

____

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[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

Please return this survey by August 3, 2005 to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Region F
Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by July 30, 2005

Entity: City of Bronte Contact Person: Martin Lee
Telephone Number: 325/473-3501 FAX: 325/473-2048
Email Address: brontetx@wcc.net
Mailing Address: Box 370, Bronte, Tx 76933

Please refer to the attached memorandum when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

   Rehabilitation of Oak Creek pipeline (Yes) or No
   New water wells (Yes) or No
   Water conservation (Yes) or No

   If "No" for any strategies, please continue with question 2.

   If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.
Water line from Oak Creek lake ($640,000.) Three new water wells ($100,000.) Some day as funds allow, possibly a line to Lake Brownwood ($13,000,000) our share with other cities

3. Are the cost estimates for your projects/strategies consistent with your expectations?

   (Yes) or No

   If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

   1) Funding source(s)[1] by checking the corresponding box(es) below and
   2) Percent share of the total cost to be met by each funding source

   ☑ 10 % Cash Reserves
   ☐ ___ % Bonds
   ☐ ___ % Bank Loans
   ☑ 90 % Federal Government Programs
   ☑ ___ % State Government Programs, including TWDB Bonds
   ☐ ___ % Other ___
   ☐ 100 % *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

____

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Please return this survey by July 30, 2005 to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Sorry for the delay.
Pat

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by December 9, 2005

Entity: *Colorado River Municipal Water District* Contact Person: *Chris Wingert*
Telephone Number: *(432) 267-6341* FAX: *(432) 267-3121*
Email Address: *cwingert@crmwd.org*
Mailing Address: *CRMWD, Box 869, Big Spring, Texas 79720*

Please refer to the Region F Initially Prepared Plan for more detail.

1. Are you planning to implement the following recommended projects/strategies? *(1)*

Subordination of senior water rights	**Yes** or No
Winkler County Well Field	**Yes** or No
Big Spring, Snyder and Odessa/Midland Reclamation Projects	**Yes** or No
Voluntary Redistribution – Lake Alan Henry	Yes or **No**
Renew contract with University Lands	**Yes** or No
Desalination – Capitan Reef Complex	**Yes** or No

(1) Implementation of these strategies will depend on a number of factors. For example, the subordination will depend on getting downstream parties to execute proper agreements. The UT Lands contract will depend on both parties reaching mutually agreeable terms. All other projects will depend on the District's water needs and available funding sources.

If "No" for any strategies, please continue with question 2.

If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.
Alan Henry water may be used by the District if its price becomes cost competitive with other alternatives in the future.

If other water is needed the District may consider supplementing our supplies with groundwater from Winkler, Loving, Pecos, and/or Reeves County.

3. Are the cost estimates for your projects/strategies consistent with your expectations?

Yes or **No**

If no, please explain and provide cost estimates if available.
The Alan Henry estimate appears low for the following reasons:

1) The study has only a 6 MGD capacity. It is not practical to construct a long transmission line for such a small quantity. District estimates for 24 MGD were $28.8 million.

2) *The study does not appear to include a royalty payment which could be as much as $1.80 per 1000 gallons.*

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

1) Funding source(s)[1] by checking the corresponding box(es) below and

2) Percent share of the total cost to be met by each funding source.

√ *(2)* % Cash Reserves

√ *(2)* % Bonds

□ _______% Bank Loans

√ *(2)* % Federal Government Programs

√ *(2)* % State Government Programs, including TWDB Bonds

□ _______% Other ______________________

□ _______**%** *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

(2) The District will use a variety of funding sources to finance proposed projects, depending on the project, cash reserves, construction timing, State & Federal Grant availability, and other factors. Funding percentages will need to be determined on a case-by-case basis, and are not available at this time.

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

____

____

____

____

____

____

Please return this survey by to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Region F
Water Planning Group

Freese and Nichols, Inc.
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey

Entity: City of Eden Contact Person: Rosa L. Schreiber
Telephone Number: 325-869-2211 FAX: 325-869-5075
Email Address: edencity@wcc.net
Mailing Address: P.O. Box 915, Eden, Texas 76837

Please refer to the attached memorandum when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

   Bottled water program — (Yes) or No
   Hickory well replacement — (Yes) or No

   If "No" for any strategies, please continue with question 2.

   If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

3. Are the cost estimates for your projects/strategies consistent with your expectations?

   (Yes) or No

   If no, please explain and provide cost estimates if available.

4.

How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

1) Funding source(s)[1] by checking the corresponding box(es) below and
2) Percent share of the total cost to be met by each funding source.

- ☒ 12 % Cash Reserves
- ☐ ____% Bonds
- ☐ ____% Bank Loans
- ☐ ____% Federal Government Programs
- ☐ ____% State Government Programs, including TWDB Bonds
- ☒ 88 % Other State & Federal Grants
- ☐ ____% *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

State & Federal financial assistance programs will be required for the City of Eden to implement State & Federal mandated water and wastewater regulations. In addition to meeting water quality standards and replacing a 50 year old well, the Texas Commission for Environmental Quality (TCEQ) has notified the City that it must initiate 30 Texas Administrative Code 305.126 ("75/90 rule")-planning for the expansion of its wastewater treatment plant at an estimaed cost of 2.3 million which will be added to our current indebtedness of 1.5 million. Due to current and projected wastewater indebtedness ($4.0 million) and limited financial resources, both on the part of the City and its customers and citizens, the City must rely on grants. The City has recently been recognized as colonia by the U.S. Department of Agriculture and is actively working to receive grant assistance from that program.

Please return this survey to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Region F
Water Planning Group

Freese and Nichols, Inc
LBG-Guyton Associates, Inc.
Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by July 27, 2005

Entity: City of Menard Contact Person: Sharon Key
Telephone Number: 325-396-4706 FAX: 325-396-2015
Email Address: City@airmail.net
Mailing Address: PO Box 145, Menard TX 76859

Please refer to the attached memorandum when filling out this survey

1. Are you planning to implement the following recommended projects/strategies?

   New Hickory well — (Yes) or No
   Water conservation — Yes or No

   If "No" for any strategies, please continue with question 2.

   If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

   ____

   ____

3. Are the cost estimates for your projects/strategies consistent with your expectations?
   (Yes) or No

   If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:
   1) Funding source(s)[1] by checking the corresponding box(es) below and
   2) Percent share of the total cost to be met by each funding source.

   - ☐ 5 % Cash Reserves
   - ☐ ____ % Bonds
   - ☐ ____ % Bank Loans
   - ☐ 90 % Federal Government Programs
   - ☐ ____ % State Government Programs, including TWDB Bonds
   - ☐ 5 % Other ________
   - ☐ ____ % *TOTAL (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

CRGA - water improvements

Please return this survey by July 27, 2005 to:

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Fort Worth, TX 76109

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Please Return by September 15, 2005

Entity: City of Midland Contact Person: Kay Snyder
Telephone Number: 432-685-7261 FAX: 432-685-5056
Email Address: ksnyder@mail.ci.midland.tx.us
Mailing Address: P.O. Box 1152, Midland, Texas 79702

Please refer to the information when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

T-Bar Well Field	Yes or ~~No~~
Purchase Additional Water from CRMWD	Yes or ~~No~~
Water conservation	Yes or ~~No~~

If "No" for any strategies, please continue with question 2.

If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

____

____

3. Are the cost estimates for your projects/strategies consistent with your expectations?

Yes or ~~No~~

If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

1) Funding source(s)[1] by checking the corresponding box(es) below and

2) Percent share of the total cost to be met by each funding source.

X __5____% Cash Reserves

X __90____% Bonds** may include debt payment on bonds obtained by partners, etc.

☐ ______% Bank Loans

X __5___% Federal Government Programs

☐ ______% State Government Programs, including TWDB Bonds

☐ ______% Other ________________

☐ __100____% *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

Please return this survey by September 15, 2005 to:

FAX (817) 735-7491 attn: Jon Albright

Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Richland Special Utility District
P O Box 217
Richland Springs, Texas 76871

Freese and Nichols, Inc
Jon S. Albright
4055 International Plaza, Suite 200
Fort Worth, Texas 76109

July 25, 2005

Dear Jon,

Thanks for the opportunity to comment on the Draft Memo regarding the Region F plan for Strategies for Hickory Aquifer Users. I find the draft to be much as we discussed in the various Hickory meetings and it is important to get this information into the Region F plan.

Regarding the Richland SUD portion, basically I agree with all that is written but would like to add another section and a correction or two.

As you know, the last well drilled for Rochelle came in below the EPA MCLs for total Radium. It is also true that the well at Lohn tests below the EPA MCLs. We have been doing some testing of private wells, with owner permission, in the area between Rochelle and Lohn to see if possibly there might be a "valley" of low Radium water in the Hickory. One private well along Route 377 did come in low. We are planning some more tests in the area. If the data does show such an area, then RSUD might be interested in drilling a new well in that area. It would be appropriate that this possibility be included in the Region F plan so that we might seek funding. Please incorporate a paragraph to include that possibility.

On page 3, Table 1, a more currently accurate figure would be 207 acre-feet per year.

On page 7, second paragraph, it is stated that Richland has high water losses. There is need to mention that being a rural water system with 120 miles of pipe lines, part of the reported lost water was flushed in accordance with State law. Also there is need to mention that much of the pumped water is used for livestock. Only about 0.5% was actually used for potable purposes.

It would be helpful and appropriate for the Region F Planning Group to encourage the State to require oral ingestion studies to determine the epidemiology of radium in potable water. A major medical university could perform a basic study as part of their basic medical training. The universities will not attempt such a study unless the State encourages them to do so. Including such an encouragement in the Region F Plan would be helpful.

We cannot fill out the Financing Survey. Realistically answering those financial questions would mean that we know how to solve the problem of radionuclides in the Hickory water. We continue to search for the appropriate solution for the Richland SUD but as of this time we do not have a firm plan.

Please consider these remarks in your final document.

Ken Bull

Ken Bull, Vice President
151 PR 827
Rochelle, Texas 76872
325-597-1226

Region F
Water Planning Group

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LBG-Guyton Associates, Inc.
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Please Return by July 27, 2005

Entity: City of Robert Lee Contact Person: Joe White
Telephone Number: 325-453-2831 FAX: 325-453-4531
Email Address: robertleetexas@wtxs.net
Mailing Address: P.O. Box 26, Robert Lee, TX 76945

Please refer to the attached memorandum when filling out this survey.

1. Are you planning to implement the following recommended projects/strategies?

   Infrastructure expansion (Yes) or No
   Water conservation (Yes) or No

   If "No" for any strategies, please continue with question 2.

   If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

   ____
   ____

3. Are the cost estimates for your projects/strategies consistent with your expectations?

   (Yes) or No

   If no, please explain and provide cost estimates if available.

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:

   1) Funding source(s)[1] by checking the corresponding box(es) below and

   2) Percent share of the total cost to be met by each funding source.

   - ☐ ____% Cash Reserves
   - ☐ ____% Bonds
   - ☐ ____% Bank Loans
   - ☐ 80 % Federal Government Programs
   - ☐ 20 % State Government Programs, including TWDB Bonds
   - ☐ ____% Other ____________
   - ☐ 100 % *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs.

Texas Water Development Board - Loans AND/~~to~~ or grant assistance.

We will also Look to the 2007/2008 Texas Community Development Grant Program for assistance for water treatment expansion + storage facilities.

Please return this survey by July 27, 2005 to:

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Fort Worth, TX 76109

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Water Planning Group

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Alan Plummer Associates, Inc.

Region F Water Planning Group
Recommended Water Management Strategies and Financing Survey
Please Return by September 15, 2005

Entity: City of San Angelo Contact Person:__________
Telephone Number:__________ FAX:__________
Email Address:__________
Mailing Address:__________

Please refer to the attached information when filling out this survey Recommended strategies may be found on page 23.

1. Are you planning to implement the following recommended projects/strategies?

Subordination of senior water rights	Yes or No
Rehabilitation of Spence pipeline	Yes or No
Regional desalination facility	Yes or No
McCulloch County Well Field	Yes or No
Water conservation	Yes or No

If "No" for any strategies, please continue with question 2.

If "Yes", skip to question 3.

2. Please describe how you will meet future water needs, including estimated cost of implementation.

____

3. Are the cost estimates for your projects/strategies consistent with your expectations?

Yes or No

If no, please explain and provide cost estimates if available.

____

4. How do you plan to finance the proposed total cost of capital improvements identified by your Regional Water Planning Group? Please indicate:
   1) Funding source(s)[1] by checking the corresponding box(es) below and
   2) Percent share of the total cost to be met by each funding source.

- X 10 % Cash Reserves
- X 40 % Bonds
- □ ______% Bank Loans
- □ ______% Federal Government Programs
- X 50 % State Government Programs, including TWDB Bonds
- □ ______% Other ____________________
- □ 100 % *TOTAL – (Sum should equal 100%)*

[1] Funding source refers to the initial capital funds needed to construct or implement a project, not the means of paying off loans or bonds used for the construction or implementation.

If state government programs are to be utilized for funding, indicate the programs and the provisions of those programs. TWDB – State Revolving Loan Program, – Demonstration Grants

Please return this survey by September 15, 2005 to:

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Mail Jon Albright
Freese and Nichols, Inc.
4055 International Plaza Suite 200
Fort Worth, TX 76109

Thank you very much!

Appendix 9B
Potential Financing Options

Appendix 9B
Potential Financing Options

This appendix reviews funding programs available to water users in Region F for water supply infrastructure projects. For each program discussed below, the purpose of the program, eligible applicants, restrictions on the use of funds, the loan maturity, the interest rate, and the total available funding are reported where available. Water users that are interested in one of these programs should contact the program manager to determine whether additional restrictions apply.

1.0 Market Financing

Market financing through local bank loans and municipal bonds that are repaid through increased fees and revenues are the primary mechanisms for funding municipal infrastructure projects. This funding mechanism places the burden of paying for the capital improvements on the beneficiaries of the project. It also provides for local control in the implementation and timing of the needed improvements. Private and local financing (both taxable and tax-exempt) will continue to be an integral component for financing water infrastructure, especially for non-municipal users. This is because most non-municipal water users are involved in for-profit activities, and most public water supply infrastructure funding programs are available only to non-profit entities. It will be necessary for many non-municipal users to locate private financing sources.

Service providers have historically used various debt instruments to fund costs that were not covered by governmental assistance. The conventional debt instruments that public entities have used for long-term financing include General Obligation Bonds, Revenue Bonds, Double-Barreled Bonds and Certificates of Obligation.

General Obligation Bonds

General Obligation Bonds (GOs) are secured by the full faith and credit of the city or the issuing taxing authority entity and used for a specific purpose. GOs are secured by the pledge of a city's ad valorem taxing power. One disadvantage of GO bonds is that the approval process usually takes a longer amount of time. The public must authorize the issuance of this bond through an election. In addition, the governmental issuer may have a practical or legal debt limit that they must adhere to. The positive aspects of GOs are that they are considered the most secure type of debt obligation and the issuance process tends to be simpler and less costly.

Revenue Bonds

Revenue Bonds are completely paid for by the revenue received from the provision of a service. Thus, repayment of Revenue Bonds used in the financing of water and wastewater facility improvements is made through the revenue collected from the designated revenue source, i.e. water sales and wastewater treatment. The Service Provider must/should conduct a cost of service and rate design study in which the revenue requirements include not only the operation and maintenance costs for the system, but also the debt service payments and reserve fund deposits for this debt. Revenue Bonds may have any number of reserve fund requirements including debt service reserve fund, construction fund, renewal and replacement fund, operating fund, insurance fund, and/or arbitrage rebate fund. The Service Provider must also be aware of any coverage requirements required for the issuance of the Revenue Bond. The issuance of Revenue Bonds is limited to the amount of rate increase that the Service Provider is willing to implement.

Double-Barreled Bonds / Certificates of Obligation

Double-Barreled Bonds are revenue bonds that are additionally guaranteed by a larger municipal entity. It is considered a hybrid of a Revenue Bond and a General Obligation Bond. The first source of funds for the principal and interest is derived from the designated revenue source, i.e. water sales. If the revenue source does not match the revenue requirement during a specific period of time, then the tax revenue of the larger municipal entity is used to cover the principal and interest requirement. Double-Barreled Bonds have similar advantages and disadvantages to General Obligation Bonds.

Certificates of Obligation (COs) have different issuance requirements than the General Obligation Bonds but can be used for the same purpose. Certificates of Obligation can either be a tax pledge or a combination of tax and revenue pledges (Combination Tax and Revenue COs). If CO bonds are only backed by tax revenue then they can only be used for limited purposes. However, if it is a Combination Tax and Revenue Bond then it can be used for any lawful purpose.

2.0 Texas Water Development Board Programs

Texas Water Development Board (TWDB) programs are targeted towards political subdivisions and non-profit water supply corporations and districts. Three programs benefit *colonias* and state-designated economically distressed areas. Since Region F does not have any *colonias* or economically distressed counties, these programs would not be applicable. Other programs specific to municipalities include the Drinking Water State Revolving Loan Fund, Clean Water State Revolving Fund Program (CWSRF), Development Fund II Water and Wastewater Loan Program, State Participation Program (SPP), and the Water Infrastructure Fund.

Five TWDB programs that may provide indirect benefits to non-municipal users are the CWSRF, SPP, Agriculture Water Conservation Loans, the Rural Water Assistance Fund, and the Water Infrastructure Fund. The CWSRF and the SPP provide assistance for development of wastewater recycling and reuse projects. With the exception of livestock water use, the non-municipal water uses are well suited for wastewater reuse projects. Each of these TWDB programs is discussed below.

Drinking Water State Revolving Loan Fund Program [1]

The Drinking Water State Revolving Loan Fund (DWSRF) provides low interest loans to finance projects for public drinking water systems. Additional subsidies are available for disadvantaged communities. The purpose of this program is to assist applicants in providing water that meets drinking water regulations. Applicants may be a political subdivision of the state, non-profit water supply corporation, privately owned water system or state agency.

The loans can be used for planning, design and construction of projects to upgrade or replace water infrastructure, purchase additional capacity, and/or purchase land integral to the project. This land could be for the construction of the project or to protect the source water from potential contamination, such as nitrate contamination of a municipal well field.

Applicants to the DWSRF program must submit an information form to the TWDB each year for inclusion in the TWDB's intended use plan for the year. The TCEQ prioritizes potential DWSRF projects and funding is distributed based on the priority rating and applicant's readiness to proceed. Depending on the source of funds, interest rates vary from 0.7 percent to 1.2 percent below market interest rates and the maximum repayment period is 20 years after completion of construction. The DWSRF program has a budget of approximately $330 million in 2005.

Clean Water State Revolving Fund [1]

The Clean Water State Revolving Fund Program (CWSRF) provides low-interest loans for planning, design, and construction of wastewater treatment facilities, wastewater recycling and reuse facilities, collection systems, stormwater pollution control projects, and implementation of nonpoint source pollution control projects. The applicant for assistance from the CWSRF program must be a political subdivision. Therefore, any reuse project to provide reclaimed water for non-municipal users must also benefit a political subdivision, and the political subdivision must plan, design, and construct the project. A water quality based priority system is used to rank potential applicants and fund projects with the greatest environmental benefits.

Applicants to the CSWRF program must submit an information form to the TWDB each year for inclusion in the TWDB's intended use plan for the year. The TWDB identifies priority projects and requests funding applications for these projects. Depending on the source of funds, interest rates vary from 0.7 percent to 1.95 percent below market interest rates. The maximum repayment period is 20 years after completion of construction.

State Participation Program [3]

Deferred interest loans from the TWDB's State Participation Program may be used for regional systems where the project sponsors are unable to assume debt for an optimally sized facility. The program is intended to promote the "Right Sizing" of projects in consideration of future growth. In return for state participation, the TWDB may acquire ownership interest in the project. The benefits of assistance from the State

Participation Program include deferred payments until the customer base grows into the project capacity and no interest on the deferred payments. TWDB will fund up to 80% of costs for new water supply projects and up to 50% of costs for other projects. Remaining costs may be eligible for funding from other TWDB programs.

Applicants must be political subdivisions or water supply corporations that are sponsoring construction of a regional water or wastewater project. Applications are accepted on a first-come, first-served basis. An application must consist of an engineering feasibility report and environmental information, as well as general, fiscal, and legal information.

The maximum repayment term for assistance from the State Participation Program is 34 years. The repayment schedule may be obtained from the TWDB. State Participation Program funding will vary depending on funds received from ongoing participation projects.

Texas Water Development Fund II [4]

The Development Fund II is a pure state loan fund used for financing water supply, water quality enhancement, flood control and municipal solid waste. This program provides financing for water supply infrastructure as well as acquisition of water rights. The applicants can be political subdivisions of the state and water supply corporations with applicable projects.

Interest rates for the loans will vary depending on the length of the loan and other factors. The maximum length of a loan is 50 years. System revenues and/or tax pledges are typically required to secure the loans.

Agriculture Water Conservation Loans [2]

Under this program, the TWDB loans money to borrower and lender districts, such as soil and water conservation districts, irrigation districts and underground water conservation districts. In turn, these districts make loans to individual borrowers to purchase and install more efficient irrigation equipment on private property for agricultural water conservation purposes. Eligible applicants include soil and water conservation districts, underground water conservation districts or districts authorized to supply water for irrigation. Although only these public entities may apply for funding under this program, the purpose is to encourage lending to individual borrowers. Therefore, non-municipal water users may indirectly benefit from this funding program.

Funds may be used for conservation programs or conservation projects. "A conservation program is: an agricultural water conservation technical assistance program; a research, demonstration, technology transfer, or educational program relation to agricultural water use and conservation; a precipitation enhancement program in an area of the state where the program, in the TWDB's judgment, would be most effective; or other state agency or political subdivision administered conservation programs that provide loans to a person for a conservation project. A conservation project: improves efficiency of water delivery and application on existing irrigation systems; prepares irrigated land for conversion to dry land conditions; prepares dry land for more efficient use of natural precipitation; purchases and installs on public or private property devices designed to indicate the amount of water withdrawn for irrigation purposes; or prepares and maintains land to be used for brush control activities in areas of the state where those activities, in the TWDB's judgment, would be most effective."

The interest on the loan to the district is tied to the TWDB's cost of funds. In June 2005, the TWDB interest rate for an agricultural loan was 3.67 percent.

Water Infrastructure Fund [6]

Senate Bill Two, passed in 2001 during the 77th Session of the Texas Legislature, created a Water Infrastructure Fund and a Rural Water Assistance Fund. Using the Water Infrastructure Fund, the TWDB will provide funding at below-market interest rates for water management strategies recommended in the state or regional water plans. Only political subdivisions are eligible to apply. Therefore, to use funds from this program to implement a recommended water management strategy for non-municipal users, a political subdivision must lead the project.

Funds may be used for eligible projects and for planning and design costs, permitting costs, and other costs associated with state or federal regulatory activities with respect to a project. An eligible project is "any undertaking or work, including planning and design activities and work to obtain regulatory authority, to conserve, mitigate, convey, and develop water resources of the state, including any undertaking or work done outside the state that the board determines will result in water being available for use in or for the benefit of the state."

The Water Infrastructure Fund is a new program and is not yet funded.

Rural Water Assistance Fund [7]

Using the Rural Water Assistance Fund, the TWDB will provide low-interest loans for development of rural water supplies or for regionalization of rural water supplies. Eligible applicants are rural political subdivisions, defined as a "nonprofit water supply or sewer service corporation, district, or municipality with a service area of 10,000 or less in population or that otherwise qualifies for financing from a federal agency or a county in which no urban area exceeds 50,000 in population." Non-municipal water users are not eligible for this program, but these users may be able to work with eligible rural political subdivisions to obtain funding for water supply infrastructure projects. Joint applications between a rural political subdivision and the U.S. Department of Agriculture, the Texas Department of Agriculture, or the Texas Department of Housing and Community Affairs are permitted.

Funds may be used for the following purposes: water or water-related projects, including the purchase of well fields, the purchase or lease of rights to produce groundwater, and interim financing of construction projects; to enable a rural political subdivision to obtain water supplied by a larger political subdivision or to finance the consolidation or regionalization of neighboring political subdivisions, or both; or water quality enhancement projects such as wastewater collection or treatment projects. The term of the loan cannot exceed 120 percent of the average estimated useful life of the project.

3.0 U.S. Department of Agriculture Programs

The U.S. Department of Agriculture administers the Farm Ownership program (through its Farm Service Agency), the Rural Utilities Service, and the Watershed Protection and Flood Prevention Program. Each of these is discussed below.

Farm Ownership Program [8]

The Farm Ownership program provides direct loans or loan guarantees to be used for purchase of farmland, construction or repair of buildings or other facilities, development of farmland to promote soil and water conservation, or refinancing of debt. Eligible applicants must be U.S. citizens; must have sufficient education, training, or experience in managing or operating a farm or ranch; must be unable to get credit elsewhere; must not have received debt forgiveness from the Farm Service Agency (with some exceptions); must not be delinquent on any federal debt; and must be the owner or tenant operator of a family farm after the loan closes.

The maximum loan guarantee amount is the lesser of 90 percent of the loan amount or $759,000. The maximum direct loan amount is $200,000. The maximum term of the loan is 40 years. The interest rate is negotiated with the lender and must not exceed the rate charged to the lender's average farm customer. Under the Interest Assistance program, the Farm Service Agency may subsidize 4 percent of the interest rate.

Rural Utilities Service Water and Waste Disposal Loans and Grants [9]

The Rural Utilities Service Water and Environmental Programs division provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas or in cities of 10,000 people or less. Eligible applicants are public bodies, non-profit organizations, and recognized Native American tribes. Non-municipal water users are not eligible for this program, but these users may be able to work with eligible public bodies, non-profit organizations, or recognized Native American tribes to obtain funding for water supply infrastructure projects.

Direct loans and grants have been set aside for communities along the U.S.-Mexico border designated as "*colonias;*" areas designated Empowerment Zones/Enterprise Communities and Rural Economic Area Partnership Zones; certain projects where at least 50 percent of the users of the facility/project are Native Americans; rural Alaskan villages; and water emergencies and disaster relief.

Loans and grants may be used to construct, repair, modify, expand, or otherwise improve water supply and distribution systems and waste collection and treatment systems, including storm drainage and solid waste disposal facilities; acquire needed land, water sources, and water rights; and pay costs such as legal and engineering fees when necessary to develop the facilities.

Grants may be made for up to 75 percent of eligible project costs. The maximum term of a loan is the lesser of 40 years or the useful life of the facilities being financed. The interest rate may be a poverty rate of 4.5 percent, a market rate, or an intermediate rate, depending on the project.

The Water and Waste Disposal Loan Program had $974 million available for fiscal year 2005. The Water and Waste Disposal Grant Program had $322 million available for fiscal year 2005.

Watershed Protection and Flood Prevention Program [10]

The Watershed Protection and Flood Prevention Program, also known as the Small Watershed Program or the PL566 Program, is operated by the Natural Resources Conservation Service (NRCS). This program provides grants and technical assistance to local sponsoring organizations, state, and other public agencies to voluntarily plan and install watershed-based projects on private lands. Eligible watershed projects include watershed protection; flood prevention; water quality improvements; soil erosion reduction; rural, municipal and industrial water supply; irrigation water management; sedimentation control; fish and wildlife habitat enhancement; and creation and restoration of wetlands and wetland functions. Eligible applicants include state or local agencies, counties, municipalities, towns or townships, soil and water conservation districts, flood prevention/flood control districts, Native American tribes or tribal organizations, or other governmental subunits. Projects are limited to watersheds containing no more than 250,000 acres.

Although only governmental subunits may apply for funding, projects funded under this program are targeted at private land and can be used for rural and industrial water supply. Therefore, this program is indirectly applicable to non-municipal users.

Projects involving more than $5,000,000 of federal assistance or involving a single structure having a storage capacity of more than 2,500 acre-feet require approval from Congress. Other plans are approved administratively. Typical projects entail $3.5 million to $5 million in federal assistance.

4.0 Texas Department of Agriculture Programs

The Texas Department of Agriculture administers the Texas Capital Fund Infrastructure Development Program. Funding from this source may be used for water supply infrastructure improvements. In addition, the Texas Agricultural Finance Authority (TAFA), a public authority within the Texas Department of Agriculture, administers the following finance programs: the Linked Deposit Program, the Rural Municipal Finance Program, and the Young Farmer Loan Guarantee Program.

The Texas Capital Fund Infrastructure Development Program, the Linked Deposit Program, and the Rural Municipal Finance Program specifically mention use of funds for water supply infrastructure projects. The Young Farmer Loan Guarantee Program does not specifically mention water supply infrastructure projects, but the rules are very general, and this use of funds may be acceptable. At the very least, funding from these programs may allow non-municipal water users to shift funds from other uses to water supply infrastructure projects. Each of these programs is reviewed below.

Texas Capital Fund Infrastructure Development Program [11]

The Texas Capital Fund Infrastructure Development Program provides grants to non-entitlement communities to assist in economic development. Eligible applicants include incorporated city or county governments that are not entitled to receive Community Development funding from the U.S. Department of Housing and Urban Development. In addition, eligible cities must have a population of less than 50,000 people. Non-municipal water users are not eligible for this program, but these users may be able to work with eligible city or county governments to obtain funding for water supply infrastructure projects.

Funds from the Texas Capital Fund Infrastructure Development Program may be used for public infrastructure to assist a business that commits to create and/or retain permanent jobs, primarily for low- and moderate-income persons. Funding may be used for the following public infrastructure improvements: water and sewer; road/street improvements; natural gas lines; electric, telephone, and fiber optic lines; harbor/channel dredging; purchase of real estate related to infrastructure; drainage channels and ponds; pre-treatment facilities; traffic signals and signs; and railroad spurs.

Award amounts are directly related to the number of jobs created and to the matching funds available. In the regular program, the minimum award is $50,000, and the maximum award is $750,000. Up to an additional $750,000 may be awarded if the project creates a sufficient number of permanent jobs (the "jumbo" program). The award may not exceed 50 percent of the total project costs.

Linked Deposit Program [12]

The TAFA Linked Deposit Program encourages private commercial lending at below market rates. The Linked Deposit Program is an interest buy down program and not a guaranteed loan program. Eligible applicants are businesses that are in the business of: processing and marketing agricultural crops in Texas; producing alternative crops in Texas; producing agricultural crops in Texas, the production of which has declined markedly because of natural disasters; producing agricultural crops in Texas using water conservation equipment; developing water conservation projects; or providing nonagricultural goods or services in a rural area.

Eligible water conservation equipment includes: underground pipe; in-line valves; pipe increasers/reducers; gate valves; fittings and bushings; flow meters and accessories; complete circular watering systems; drip irrigation systems complete with installation; and any other equipment which can be identified and verified as water conservation equipment for use within the state. Eligible water conservation projects include: brush control projects, stock tank renovation or construction; dam renovation or construction; or any other project that can be identified as a water conservation project.

The maximum loan amount is $250,000 for water-related projects. The interest rate is "determined on the date the loan is funded and based on matching the loan maturity date to the closest treasury bill/note maturity date or the end of state's fiscal biennium (August 31 of each odd numbered year)."

Rural Municipal Finance Program [13]

The TAFA Rural Municipal Finance Program provides loans and loan guarantees to municipalities, water supply corporations and non-agricultural businesses located in rural Texas. Eligible applicants must be located within rural Texas, provide significant benefit to their rural area and provide evidence to repay the commitment. Eligible applicants include municipalities, special utility districts, water supply corporations, and others.

"Funds must be used to improve or assist in the economic development of the rural area such as: purchase of real estate, construction of buildings and site improvements, equipment, water and wastewater systems, municipal infrastructure projects." Loan amounts range from $100,000 to an amount determined by the lender and the TAFA, but targeting projects less than $1,000,000. The Authority Board approves the interest rate, and the terms of the loan are determined on a case-by-case basis. Projects financed with anticipation notes have a maximum maturation of 30 years from the issuance of the notes.

Young Farmer Loan Guarantee Program [14]

The TAFA Young Farmer Loan Guarantee Program provides loan guarantees to applicants wishing to "establish or enhance their farm and/or ranch operation or establish an agricultural-related business." Applicants must be at least 18 years of age but less than 40 years of age. Funds may be used to "provide working capital for operating the farm and/or ranch including the lease of facilities and the purchase of machinery and equipment, or for any agriculture-related business purpose, including the purchase of real estate for the agricultural-related business, as identified in the plan." The maximum loan amount is $250,000. Interest rates are determined by the lender and approved by the TAFA. If eligible, the applicant and lender may apply for the Interest Reduction Program, which reimburses the applicant up to 3 percent of the fixed interest rate. The maximum loan term is 10 years or the useful life of the assets being financed.

5.0 U.S. Department of Commerce Economic Development Administration Public Works Program [15]

The United States Economic Development Administration (EDA) Public Works Program "empowers distressed communities to revitalize, expand, and upgrade their physical infrastructure to attract new industry, encourage business expansion, diversify local economies, and generate or retain long-term, private sector jobs and investment." In particular, water and sewer systems for industrial use are eligible for funding. Eligible applicants include units of state and local government, Native American tribes, economic development districts, public and private non-profit organizations, universities, and other institutions of higher learning.

Although non-municipal water users are not strictly eligible for funding, projects funded under this program are targeted at industrial and commercial development and can be used for public works facilities to support this development. Therefore, this program is indirectly applicable to non-municipal users.

Projects must be consistent with the Comprehensive Economic Development Strategy (CEDS) approved by the EDA for the project area. Applicants must develop a preapplication for review by the EDA that shows how the project will address economic development needs and objectives outlined in the CEDS. Upon approval of the preapplication, applicants will be invited to submit a full application.

Public Works Program grants generally require a 50 percent match from applicant contributions, state and local grants and loans, general obligation bonds, and other public and private contributions.

6.0 U.S. Small Business Administration Programs

Among other programs, the U.S. Small Business Administration (SBA) offers the 7a Loan Guaranty Program and the Certified Development Company (504) Program. The 7a Loan Guaranty Program does not specifically mention financing for water supply infrastructure projects, but the rules are very general, and this use may be acceptable. At the very least, funding from the 7a Loan Guaranty Program may allow non-municipal water users to shift funds from other uses to water supply infrastructure projects.

Each of the SBA programs is reviewed below.

7a Loan Guaranty Program [16]

The 7a Loan Guaranty Program offers loan guarantees to small businesses that are unable to secure financing on reasonable terms through normal lending channels. The proceeds may be used for most business purposes, including purchase of real estate to house the business operations; construction, renovation or leasehold improvements; acquisition of furniture, fixtures, machinery, and equipment; purchase of inventory; and working capital. The 7a Loan Guarantee Program is available to small businesses that are independently owned and operated and are not dominant in their field.

The maximum loan guarantee amount is $1.5 million, and the maximum loan to which the guarantee may be applied is $2 million. For loans of $150,000 or less, the maximum guarantee is 85 percent. For loans of more than $150,000, the maximum guarantee is 75 percent. The maximum loan term is 25 years for real estate and equipment and 7 years for working capital. Interest rates may be fixed or variable, and they depend on the size of the loan. For a loan of more than $50,000, the interest rate must not exceed the prime rate plus 3.25 percent if the loan maturity is less than 7 years and must not exceed the prime rate plus 3.75 percent if the loan maturity is 7 years or more.

Certified Development Company (504) Program [17]

The Certified Development Company (CDC) Program offers businesses long-term, fixed-rate financing for major fixed assets, such as land and buildings. A CDC is a non-profit corporation formed for the purpose of economic development. There are approximately 270 CDCs nationwide, each covering a specific geographic area. CDCs that serve portions of Region F include the Central Texas Certified Development Company, the Dallas Business Finance Corporation, the East Texas Regional Development Company, Inc., the Fort Worth Economic Development Corporation, the East Texas Certified Development Company, and the North Texas Certified Development Corporation[18].

Proceeds from loans may be used for the following purposes: purchasing land and improvements, including existing buildings; grading, street improvements, utilities, parking lots and landscaping; construction of new facilities, or modernizing, renovating or converting existing facilities; or purchasing long-term machinery and equipment. Eligible businesses must have a tangible net worth of less than $6 million and an average net income of less than $2 million after taxes for the preceding two years. In general, the business must also create or retain one job for every $50,000 provided by the SBA—except for small manufacturers, which must create or retain one job for every $100,000 provided by the SBA.

A typical project includes "a loan secured with a senior lien from a private-sector lender covering up to 50 percent of the project cost, a loan secured with a junior lien from the CDC (backed by a 100 percent SBA-guaranteed debenture) covering up to 40 percent of the cost, and a contribution of at least 10 percent equity from the small business being helped." Loan maturities of 10 and 20 years are available. Interest rates are pegged to an increment above the current market rate for 5-year and 10-year U.S. Treasury issues.

7.0 Texas Department of Economic Development Programs

The Texas Department of Economic Development offers several financing programs, including the Texas Capital Access Fund, the Texas Industrial Revenue Bond Program, and the Texas Leverage Fund. Other programs are also available, but these appear to be the most general in scope. None of these programs specifically target water supply infrastructure projects, but each could allow non-municipal water users to shift other funds to water supply infrastructure projects. Each of the above programs is reviewed below.

Texas Capital Access Fund [19]

The Texas Capital Access Fund targets businesses and non-profit organizations that face barriers in accessing capital. The program establishes a reserve account at a lending institution to act as a credit enhancement. Eligible applicants include small businesses (100 or fewer employees), medium businesses (100 to 500 employees), or non-profit organizations. Eligible applicants must be domiciled in Texas or have at least

51 percent of its employees located in the state. Proceeds from this program may be used for "working capital or the purchase, construction, or lease of capital assets, including buildings and equipment used by the business."

Texas Industrial Revenue Bond Program [20]

The Texas Industrial Revenue Bond Program provides tax-exempt bond financing for land and depreciable property for industrial and manufacturing projects. Cities, counties, and conservation and reclamation districts may form non-profit industrial development corporations or authorities to issue taxable and tax-exempt bonds for eligible projects in their jurisdictions.

Texas Leverage Fund [21]

The Texas Leverage Fund offers additional financing to communities that have passed the economic development sales tax. Eligible applicants must be Industrial Development Corporations and may serve municipalities, businesses, or nonprofit entities. The fund does not specifically mention financing for water or wastewater projects, but the rules are very general, and this use may be acceptable. At the very least, this fund may allow municipalities to shift funds from other uses to water or wastewater projects. The maximum loan amount is no more than $3 million, and interest rates are given as the Wall Street Journal prime floating rate. Maximum life on the loans is 15 years.

Texas Enterprise Zone Program

The Texas Enterprise Zone Program encourages job creation and capital investment in areas of economic distress using state and local incentives. With the exception of Wise and Jack Counties, enterprise zones have been created in every county in Region F. Qualified businesses must be nominated for the program by a city or county that governs the enterprise zone. A qualified business must be active within an enterprise zone, and 25 percent of its new employees must live in the jurisdiction of the governing body or be economically disadvantaged[3]. State incentives may include refunds of state sales taxes or use taxes, franchise tax benefits, or franchise tax economic development credits. The Enterprise Zone program also requires that the governing body offer at least one local financial incentive[22].

8.0 Corps of Engineers Assistance

The Corps of Engineers has traditionally been involved in large-scale flood damage reduction projects through the construction of reservoirs. In Region F, there are nine Corps-operated reservoirs. The Corps of Engineers offers federal financing opportunities through partnering and constructing projects with a federal purpose. Examples of such projects include new reservoir construction and wastewater reuse projects. The Corps can participate in multipurpose reservoir projects through their existing flood damage reduction, ecosystem restoration and water supply authorities. The cost sharing agreements for reservoir projects may vary with the local sponsor and ability to pay. Generally, under current policies the total non-federal interest should be a minimum of 35 percent of the project for flood control, 35 percent for the ecosystem restoration portion of the project and 100 percent for water supply. Reservoir projects that are primarily for water supply will require Congressional authorization to benefit from Corps assistance.

Water supply through reuse could be sponsored with the Corps through the ecosystem restoration authority. The purpose of this authority is to improve ecosystem functions to produce environmental benefits. The proposed reuse projects in Region F that utilize constructed wetlands could potentially qualify under this authority. For ecosystem restoration projects, the federal contribution is 65 percent for that portion of the project.

9.0 Local Economic Development Incentives

More than 20 local economic development agencies in Region F offer incentives for businesses to locate in certain areas. Incentives may include tax abatements, electric rate discounts, economic development grants, sales tax rebates, permit/development fee waivers, and infrastructure cost participation. The level of the incentives is generally predicated on the number of jobs that the business will create, the average wage and the gross payroll generated, the amount of capital investment, and the new taxes generated by the project. Economic development incentives that are not specifically targeted toward water supply infrastructure projects may still allow a potential water user to shift other funds to water supply infrastructure projects.

10.0 Bureau of Reclamation Programs [22]

The United States Bureau of Reclamation in the Department of the Interior recently announced a new program called Water 2025. Water 2025 is intended to prevent water crises and conflict in the western US. At the heart of this initiative is the Challenge Grant Program, which promotes conservation projects. These projects include those that will "conserve water, increase water use efficiency, or enhance water management, using advanced technology, improvements to existing facilities, and water banks and markets." All irrigation or water districts within states identified in the Reclamation Act of 1902, as amended, are eligible to apply. Texas is identified by this Act; thus, all irrigation and water districts within Texas are eligible to apply.

The Bureau of Reclamation will share up to 50% of the total cost of the project or activity. However, any operation, maintenance, repair, or rehabilitation of facilities will not be funded. Priority is given to projects that are less than 24 months in duration and to those areas identified as having a water crisis problem by 2025. There are several areas within Texas that are identified.[23] Approximately $10 million in funding is available for fiscal year 2005.

11.0 Texas Office of Rural Community Affairs

Small Town Environment Program (STEP) [24]

The Office of Rural Community Affairs (ORCA) administers the Small Towns Environment Program (STEP). The STEP program is similar to TWDB's Community Self-Help program in that it promotes using local resources to solve water and wastewater problems. Funds are provided through the Community Development Block Grant program and are generally available to rural counties and cities with less than 50,000 people that are not eligible to participate in the entitlement portion of the federal Community Block Grant Program. Water and wastewater are eligible under the national program's objectives to a) benefit low- and moderate-income persons and b) meet community needs that represent an immediate threat to the health and safety of the residents of the community. The maximum grant available is $350,000.

Community Development Fund [4]

The Office of Rural Community Affairs (ORCA) also administers the Community Development (CD) Fund. The CD Fund is a grant program to address the needs of communities including sewer, water system, road, and drainage improvements. The projects must benefit at least 51 percent low to moderate income persons. The maximum grant is $800,000, and approximately $47 million has been allocated for fiscal year 2005.

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Appendix 10A
Public Comments

City of Andrews

111 LOGSDON • ANDREWS, TEXAS 79714-6589
(915) 523-4820

September 2, 2005

Mr. John Grant
Chair - Region F Water Planning Group
Colorado Municipal Water District
P. O. Box 869
Big Spring, Texas 79721

RE: Amendment to Region F Water Plan

Dear John:

On behalf of the City of Andrews, I would like to request that the current draft of the Region F Water Plan be amended to include the possibility of desalination of brackish or saltwater as an alternative water supply for Andrews.

With the abundance of brackish or saltwater aquifers in Andrews County and much of Region F, the possibility exists for this water to be treated to supplement future water supply needs. The City of Andrews is in the preliminary stages of a desalination pilot project in cooperation with the Texas A&M Water Resources Institute to determine the technical viability and economic feasibility of desalination. We are aware of the generalized Evaluation of Brackish and Saline Water Resources in Region F report prepared by LBG-Guyton Associates in September 2004; however, we believe the identified "limitations" from a regional perspective may not be applicable to our needs.

The designation of brackish or saltwater as a possible alternative water source for Andrews is of great importance. There are no surface water sources readily available to Andrews, and groundwater in Andrews County is finite. In our opinion, specific study of desalination of brackish groundwater or saltwater deserves special consideration.

Your consideration of this request is greatly appreciated. Please let me know if further information is needed.

Respectfully,

Glen E. Hackler

Glen E. Hackler
City Manager

/sac

cc: Len Wilson, City of Andrews Representative: Region F Planning Group
David Sanders, Director of Utilities

City of Austin

Austin Water Utility, P.O. Box 1088, Austin, Texas 78767

November 3, 2005

Mr. John W. Grant
Chair
c/o Colorado River Municipal Water District
P.O. Box 869
Big Spring, Texas 79721

Re: Draft Region F Initially Prepared Plan

Dear Chairman Grant:

We appreciate the opportunity to provide comments on the Region F Initially Prepared Plan. As you know Region F and K share a common surface water source: the watershed inflows into the Colorado River and its tributaries. Development of the State Water Plan offers the opportunity for interregional cooperation and dialogue to ensure water supplies are available to meet future needs, especially in "worst-case" drought-of-record scenarios.

The State's accepted surface water modeling system, the Texas Commission on Environmental Quality (TCEQ) Water Available Model (WAM), provides stakeholders a consistent and transparent technical tool for regional planning. The development of the 2006 Regional Water Plans was the first time that the TCEQ WAM was used by Regions F and K. Late in the current planning cycle, uncertainty over water availability was identified with regard to the priority distribution of water between the two regions as modeled by the TCEQ WAM. Due to limitations of time and funding for technical analysis of the modeling issues, a temporary fix, dubbed the "No Call" assumption by Region K, was adopted by both regional planning groups to allow Region F to report water supplies for its major reservoirs. The essence of the "No Call" assumption is that the major senior water right holders in Region K would not be modeled as exercising their legal right to priority-order-based calls on inflows originating in Region F. The uncalled inflows would be modeled as contributing to storage for Region F reservoirs. Region K was assured this modeling assumption in no way represented the initiation of an interregional subordination agreement.

Austin agreed to the modeling assumption with the following understanding:

> The effort would be a planning exercise only. No legal positions would be changed or waived as a result of this exercise. No downstream water right holders would be asked or required to formally cede or amend any of their water rights as a result of this planning exercise. In other words, the [water] availability

> adjustments would have no legal effect and would be temporary in nature. [2006 Region K Initially Prepared Lower Colorado Regional Water Planning Group Water Plan, Section 3.2.1.2]

Furthermore, it is our understanding that the interim period prior to the next planning round is to be used to conduct investigations to explore reasons for Region F's modeled shortages, and whether technical improvements to the TCEQ WAM for the Colorado River Basin could improve the WAM's determination of priority system-based water availability, thus obviating the need for mechanisms such as the "No Call" assumption.

The regional planning process is an iterative process. With each iteration, the regions build upon the successes of previous plans and find resolutions to any identified problems. The water supply modeling issues for Region F were addressed late in the second round planning process. As a result, the "No Call" assumption was chosen as the best quick temporary solution given the time and funding limitations. Austin feels this represents a success for interregional cooperation. Austin looks forward, however, to working with the Region F stakeholders before the 2011 planning cycle to find a more scientific approach for improving the TCEQ WAM results in a manner that meets our common surface water availability needs.

Austin looks forward to continuing to participate in the ongoing regional water planning process and addressing this improvement issue and any related issues that may come up in the future. Should you have questions, please contact me at (512) 972-0179.

Sincerely,

Teresa Lutes, P.E.
Austin Water Utility

xc: Mr. Chris Lippe, P.E., Austin Water Utility Director
Mr. John E. Burke, Chairman Lower Colorado Region Water Planning Group

Comments on the Draft:
REGION F REGIONAL WATER PLAN
Colorado River Municipal Water District – C. Wingert

Text in *italics* are questions, comments, or requests to add additional information.
Text underlined are suggested additions.
Text is ~~strikethrough~~ are suggested deletions.

Chapter 1:

Fig. 1-1	*Add a label for Natural Dam Lake on the map.*
Table 1-4	*What is the Year 2000 Use for Champion Creek Reservoir? Add a footnote if the data is unavailable.*
Fig. 1-8	*Does the bars for 1986-88 on the* "flow at Beals Creek near Westbrook" *graph include the spills out of Natural Dam Lake? These should be taken out or footnoted.*
Fig. 1-9	*Has the* "Seasonal Median Flow at Beals Creek near Westbrook" *been adjusted to remove the '86-'87 spills from Natural Dam Lake? If not, add a footnote to explain.*
Table 1-5	*Why is the 1999 Ector County water use shown as 16,580 acre feet? This is about half of the previous year. Also, the District delivered 23,130 acre feet to Odessa alone during FY 99.*
Table 1-5	*Similar question for Midland County. Why did use drop by 33% between '98 and '99?*
Table 1-8	*Ivie Reservoir has a pavilion area. Add an* "X" *to the box.*
Page 1-27	*4th sentence: Add* "primarily due to unusually hot, dry weather experienced with the current drought".
Page 1-32	*After the 6th sentence: Add a sentence stating how much water Sweetwater usually transfers to Region G on an annual basis.*
Table 1-11	*Why is the Ivie Reservoir water right listed in Coleman County? The diversions are in Concho and Runnels(?) counties.*
Page 1-42	*Was Spring Creek Springs really used by the U.S. Cavalry in the late 1940s? Maybe it was the 1840s.*
Table 1-14	*Is there really no crop land in Pecos County? What about the Belding Farms area near Fort Stockton?*
Page 1-53	*Should the wholesale water provider list include: Millersview-Doole Water System, the City of Big Spring (for sales to Howard Co. Water Improvement District No. 1, and the City of Snyder (for sales to Roby, Rotan, and Fluvanna)?*
Page 1-53	*2nd paragraph, 3rd sentence:* "as well as several smaller cities in Ward, ~~Ector~~, Martin, Howard, and Coke Counties." *The only city the District supplies in Ector County is Odessa.*

Page 1-56	"Prior to the Senate Bill ~~One~~ 1…" *Change to the* "1" *to be consistent with other text.*
Page 1-57	*Bullet on Fisher, Ivie, and Spence:* "The proposed improvements include a parallel pipeline…" *This pipeline has been installed. The text should be revised to reflect this.*
Page 1-60	*Consider adding a paragraph on the two TMDL programs to the section describing* "Other Water-Related Programs".
Page 1-62	*Add sentences:* "Partial funding for weather modification programs was provided by the Texas Department of Licensing and Regulation, and its predecessor agencies for many years. This funding ended in October, 2004."
Page 1-62	*Sec. 1.7.1* – "Threats to water supply in Region F include the use of the TCEQ Water Availability Model (WAM) Run 3 for regional water planning and water quality concerns" *I didn't think the WAM addressed water quality.*
Table 1-19	*Spence Concern Location:* "Main pool near dam; Remainder of the reservoir" *should be changed to* "Entire Reservoir".
Table 1-19	*Are you sure Segment 1421 was identified as a concern for chloride, sulfate, and TDS in the finished drinking water?*
Table 1-19	*A TMDL has been completed on Segment 1426. Implementation Plan is underway.*
Page 1-65	Add language in sentence: "However, *because of its improper assumptions* the Colorado WAM indicates that almost all of the major reservoirs in Region F have little or no reliable supply, contrary to previous water plans and recent historical experience." Add spaces before sentence.
Page 1-65	Revise Sentence: "Much of this history deals with the same issues of impacts of upstream development on downstream water rights." *"Much of this history deals with the same issues, including the impact upstream development may have on downstream water rights".*
Page 1-65	*Last sentence, before the Rio Grande Basin Water Quality: Add the following:* "It also forces an overestimation of water needs within Region F, and a corresponding underestimation of the future water needs in Region K, downstream."
Page 1-67	*6th sentence under the Hickory Aquifer section:* "Problems that have yet to be resolved in utilizing these techniques are the storage and disposal of the removed radioactive materials *left over from the water treatment process….*
Table 1-20	*For Segment 1411 add* "EPA approved the plan in May, 2003" *to the "Date" column.*
Page 1-70	*Add the following at the end of the 2nd paragraph in 1.7.2:* "Also, many of these smaller communities have experienced declining populations in recent years. More than one-half of the counties in the region have a population less than 5,000 people. These smaller counties lost 1.7% of their population during the last 10 years. Thus they are ill equipped to afford the high cost of advanced water treatment techniques, given their declining revenue base."

Page 1-70 *After the last sentence at the top of 1.7.2, add:* ”Also, finding as suitable means of disposing the reject concentrate from a proposed treatment plant may limit the feasibility of such projects in many locations”.

Page 1-71 *Add the following to the second from the last sentence in the 1st paragraph*: “These practices lead to the possibility of leaks into water supply aquifers since the hydraulic pressure of the injected water routinely exceeds the pressure needed to raise the water to the ground’s surface.

Chapter 2:

Page 2-10 4th sentence below “Per Capita Water Use Projections”: “This definition of per capita water use does not include water used for manufacturing… *Does it include manufacturing that is sold through a municipal meter (such as the Big Spring Refinery)? If so, maybe further explanation is needed.*

Table 2.7 *How can the Manufacturing Water Demand for Howard County increase by 15% from 2030 to 2060 while the population decreases by 3%?*

Page 2-24 *Add Millersview-Doole Water Supply Corporation to the list of wholesale water providers since they sell to Paint Rock and others. (Similar comment in Chapter 1)*

Chapter 3:

Tab. 3-1 *Ward Co Cenozoic Pecos Alluvium shows 17,288 ac-ft per year. District’s study shows a total of 741,400 ac-ft in two existing well fields. Dividing the total by a 30 year production period = 24,713 ac-ft per year, for those two well fields alone.*

Fig. 3-4, 3-5 *How can Well 27-59-903 rise and Well 27-62-801 drop?*

Page 3-23 3rd Paragraph: “The chemical quality of groundwater in the Lipan aquifer generally does not meet drinking water standards due to excessive nitrates, but is suitable for irrigation.” *Explain why the standards aren’t met.*

Tab. 3-2 *What is the criteria for a “Major Reservoir”. Where is this explained? Why is Balmorhea considered a major reservoir, but larger(?) ones like Mitchell Co. Reservoir are not?*

Fig. 3-17 Since Balmorhea is considered a major reservoir, why is it not shown on this map?

Page 3-38 Consider adding the following: Using the WAM for water supply planning tends to overestimate available supplies in the lower Colorado River Basin, while underestimating available supplies in the upper basin after the 1st sentence at the top of the page.

Page 3-39 Next to last sentence in the 2nd paragraph: “However, the disposal of water from oil field operations, which is similar or worse in quality to the reject from desalination, requires a Class II permit…”

Page 3-49 Add the following sentence at the end of the next to last paragraph in 3.6.1. However, the PDSI is an indicator of an agricultural drought only. It has little relationship with a hydrological drought.

Page 3-50 — Add the following after the last sentence under the Meteorological Drought in Region F section: But the current drought appears more severe than the 1950's drought. Nine of the ten years during the current drought show rainfall less than the historic average. This occurred at no other time in recent history.

Chapter 4:

Table 4.1-4 — *University Lands shows a shortage in 2010. Is part of that shortage caused by the District's demand on the system? If so, is that same water also shown as a shortage in the CRMWD row?*

Table 4.1-4 — *Is the City of Odessa's supply & demand also included in the CRMWD numbers? If so, we need to make sure the reader understands that.*

Table 4.2-1 — *Are the "current" numbers used for the Firm Yield from WAM Run 3? Do these agree with the latest TWDB runs? Is the Run 3 model updated? (a question from the TWDB meeting)*

Page 4-13 — Add the following sentences at the end of the 1st paragraph: "This would indicate Region F needs to immediately spend significant funds on new water supplies, when in reality; the indicated water shortage is not there. Conversely, the WAM model shows a surplus of water downstream in Region K. Accordingly, one would think they would need no new water sources for the planning period when in reality they might."

Page 4-20 — 2nd & 3rd sentences under the City of Ballinger section: "The city's primary source of water is Lake Ballinger / Lake Moonen. These lakes ~~Lake Ballinger has~~ have been heavily impacted by the recent drought."

Page 4-20 — 4th Sentence under the City of Ballinger section: "In 2003 the city completed a connection to the City of Abilene's ~~West Central Texas Municipal Water District (WCTMWD)~~ pipeline from Ivie Reservoir…"

Page 4-22 — 3rd sentence under the Subordination of Downstream Senior Water Rights section: According to the WAM ~~Lake Ballinger has~~ Ballinger's lakes have no yield.

Page 4-28 — 1st Sentence under Voluntary Redistribution: In 2003, the City of Ballinger completed a 10-mile pipeline to the ~~WCTMWD~~ Abilene pipeline…

Page 4-31 — Add to Bottom of the page: "Reuse alone cannot meet the city's needs. Since the WAM shows no water available from the City's Lakes, no effluent would be available to reuse either without additional water from separate, new source. Reuse would have the advantage of "stretching" a low volume water source into one that could meet the City's full needs."

Page 4-33 — Add to the bottom of the Water Conservation Savings paragraph: "Water Conservation alone cannot meet the city's needs. Since the WAM shows no water available from the City's Lakes, the City would be without water unless an alternative water source is found. Conservation would have the advantage of "stretching" a new low volume water source into one that could meet the City's full needs."

Page 4-42 — Bottom of Reuse Paragraph: *Same comment as Ballinger's 4-31*

Page 4-44	Bottom of Water Conservation Paragraph: *Same comment as Ballinger's 4-33.*
Table 4.3-20	Add a space between $1,920 and per acre-foot.
Page 4-60	Middle of the page: "Although Mountain Creek Reservoir is a relatively old structure, an inspection conducted as part of this plan found the dam and spillway to be in good condition". *The Texas Water Commission has considered the dam to be in poor condition in the past. Consequently, in the mid-1980's there were informal studies to identify a new reservoir site. What has changed?*
Page 4-74	*Why was Water Reuse not discussed as a strategy for the City of Menard?*
Page 4-79	1st sentence under Quality, Reliability and Cost of ASR: "Treated surface water would be injected into the Hickory aquifer…" *Section 4.3.5 states Menard gets its water from "several wells near the banks of the San Saba River". Is this considered groundwater or surface water?*
Page 4-80	Under Significant Issues Affecting Feasibility of ASR add: "The price to extract injected water from the proposed Hickory ASR project could be quite costly given the 3,000 foot well depth."
Page 4-84	Top 1/4th of the page – add the following after the McMillan Well Field sentence: "This field was used for Aquifer Storage and Recovery for many years, but has remained idle recently due to elevated concentrations of perchlorate found in the water."
Page 4-87	Under Significant Issues Affecting Feasibility of T-Bar Well Field add: "Also, elevated chloride and TDS levels may be present in some or all of the future wells."
Page 4-97	Middle of the page: "The City of ~~Menard~~ Coleman is a rural community."
Page 4-103	*Why is Brady's GPCD demand so high (303)?*
Page 4-115	*Why are the Total Capital Costs for CAX & R/O treatment the same?*
Table 4.5-6	*Is the cost really expressed in "Cost/10,000 gallons"? Why not Cost/1,000 gallons to be consistent with the other tables?*
Table 4.7-14	*In all cases the table shows an increasing need for mining water. The District has seen a decline in the demand for mining water in the past 10 years as water floods mature and operators switch to CO_2 injection. Long term, I would expect the area will see a decline in water demands as well.*
Page 4-156	Last sentence in the 1st paragraph of 4.8.1: "…as well as several smaller cities in Ward, ~~Ector,~~ Martin, Howard, and Coke Counties"
Page 4-178	Middle of the page: "Figure 1 is a schematic of the proposed project." *Where is Figure 1?*
Page 4-181	Lower 2/3rds of the page: "For the purposes of this plan, it was assumed that ~~CMRWD~~ CRMWD will…"
Page 4-195	Add another "bulleted point" at the top of page: The addition of McCulloch County water into the Ivie Pipeline may adversely affect the quality of water delivered to other District Member and Customer Cities.

Chapter 5:

Page 5-6 Add to bulleted New Groundwater section: City of Eden – new Hickory aquifer well. *See page 4-111 and 4-112.*

Page 5-6 Second sentence under 5.3.3: The CRMWD project proposes to reuse a portion of the treated wastewater from ~~Big Spring~~ <u>the cities of Big Spring, Odessa, Midland, and Snyder. The first phase of this project will likely involve Big Spring wastewater</u>.

<u>Chapter 6:</u>

Page 6-1 Add the following after the next to the last sentence in the last full paragraph: However, studies described in this report indicate irrigation demands may decline as much as 22% by the year 2020, and 43% by the year 2060. *See page 4-169*

Page 6-2 Start a new paragraph with the last two sentences in the middle paragraph: ~~Likewise, irrigation conservation may result in significant reductions in water demand in the region.~~ <u>Irrigation conservation can save the most water of any conservation method by far</u>.

<u>Chapter 7:</u>

Page 7-3 Next to last sentence in Voluntary Redistribution paragraph: *Add Ector and Andrews Counties to the list. Ector for the City of Odessa, the beneficiary of a new contract from University Lands for the Ward County Well Field. Andrews, for the City of Andrews, a beneficiary of a new contract from University Lands for their well field.*

Page 7-5 Parks and Public Lands list: *add the Big Spring and Lake Colorado City State Parks to your list in Region F.*

<u>Chapter 8:</u>

Page 8-6 Section 8.3.1 – end of 2nd paragraph: It its imperative that any changes to water rights<u>, such as a change in use,</u> or transfers of water or water rights out of the Colorado Basin do not impair existing water rights even if they are junior in priority. *Overall this is a very good section!*

Page 8-7 3rd bullet: That no strategy for export of groundwater from a groundwater conservation district or from the region will be adopted until a comprehensive plan is in place to assure retention of adequate supplies of water within the district or region to protect existing economic enterprises including agriculture and support the foreseeable population growth and economic development <u>so long as the groundwater conservation district or region applies the exact same rules and conditions, including fee structure, to both the proposed water exporter and all groundwater users residing within the borders of said district or region.</u>

Page 8-10 Section 8.3.6: Add bulleted item: Supports shorter term "interruptible" water contracts as a way to meet short term needs before long term water rights are fully utilized.

Page 8-13	Section 8.3.10: Add bulleted item: TCEQ develop rules for disposal wells which would allow for the disposal of reject water from a membrane treatment plant through a well that is not classified as a "Hazardous Disposal Well".
Page 8-16	Section 8.3.15: Add bulleted item: The clean-up and remediation of all contamination related to the processing and transportation of oil and gas. This includes operational or abandoned gas processing plants, oil refineries, and product pipelines.
Page 8-17	Section 8.3.16: Add bulleted item: The use of higher TDS or inferior waters for electric generation when possible to maximize available fresh water sources within the region.

From: Chris Wingert [cwingert@crmwd.org]
Sent: Thursday, November 10, 2005 3:36 PM
To: Jon Albright
Subject: Additional Comments on the Region F IPP

Jon-

After further discussion the District wants to make the following additional recommendation for the IPP:

Water Reuse should be considered as a recommended strategy.
Proposed desalinization projects should also be included as a recommended strategy.

Thanks

CW

Chris Wingert
Assistant General Manager
Coloardo River Municipal Water District
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(432) 267-6341
cwingert@crmwd.org

HICKORY UNDERGROUND WATER CONSERVATION DISTRICT NO. 1

P.O. Box 1214 ● 111 East Main Street
Brady, Texas 76825
Phone (325) 597-2785 ● Fax (325) 597-0133
hickoryuwcd@yahoo.com

August 15, 2005

Jon Albright
Freese and Nichols
4055 International Plaza, Suite 200
Ft. Worth, TX 76109

Re: Region F Water Plan

- Information summarized in Table 2-5; *Municipal Water Demand Projections for Region F Counties*, on page 2-12: City of San Angelo permit should be included in McCulloch County projected use. While San Angelo is not currently utilizing the McCulloch County well field, the permit is valid. Because amounts permitted can be banked for future use, distribution of amounts in projected years would be difficult to determine. Therefore, the simplest method of calculation would be including the quantities as outlined in the official permit. (see attachment: *Permit to Drill and Produce Water*)

MUNICIPAL WATER DEMAND PROJECTIONS FOR MCCULLOCH COUNTY (INCLUDING SAN ANGELO PERMITS)

USER	2010	2020	2021	2026	2030	2036	2040	2050	2060
MCCULLOCH	2,252	2,283	2,283	2,283	2,236	2,236	2,205	2,190	2,190
SAN ANGELO	1,500	1,500	2,750	5,000	10,000	12,000	12,000	12,000	12,000
TOTAL	3,752	3,783	5,033	7,283	12,236	14,236	14,205	14,190	14,190

All numbers are in acre-feet

- Section 3.1.6, Hickory Aquifer, on page 3-21 states "Mason County uses the greatest amount of water from the Hickory aquifer, most of which is used for irrigation." Later on page 4-140, Table 4-85, *Counties with Projected Irrigation Needs,* no county within the Hickory UWCD is mentioned. According to the TWDB, Report 347, ***Surveys of Irrigation in***

Texas 1958, 1964, 1969, 1974, 1979, 1984, 1989, 1994, and 2000, in Mason County 6,169 acres were irrigated solely from groundwater for a total of 10,223 acrefeet. This number was reiterated in the Region F plan in Chapter 1, Table 1-10. Additionally according to the TWDB study, McCulloch County was estimated to have used 2,790 acrefeet of groundwater for irrigation purposes in 2000. San Saba used 3,349 acrefeet primarily from surface water sources. Why were these counties not included in irrigation projections?

Thank you for the opportunity to participate in the planning process. If you have any questions or comments regarding our suggestions, please, do not hesitate to contact me at 325-597-2785.

Thank you,

David Huie
Interim Manager

42-60-502

Hickory Underground Water Conservation District No. 1

P.O. Box 1214 Brady, TX 76825
(915) 597-2785 Fax (915) 597-0133 E-mail hick6@centex.net
Website: http://www.angelfire.com/tx/hickory

Permit to Drill and Produce Water

The City of San Angelo, Texas, filed nine applications in January 1995 for the permitting and production of water from the Hickory Underground Aquifer and amended its applications in January 1996 to include twenty-two planned or existing wells in San Angelo's well field (as hereinafter identified) located within the Hickory Underground Water Conservation District No. 1, said applications and wells being identified as San Angelo "WSW-1 through WSW-22." This is to certify the applications to drill and produce water, have been examined, together with the maps, plans, and other submitted data, and the applicant is hereby authorized to proceed with the construction of the production works and to proceed with all the steps necessary for the application of water to the proposed beneficial use without the necessity of further administrative procedures. The Hickory Underground Water Conservation District No. 1 issues this single permit to the City of San Angelo to produce water from the Hickory Underground Aquifer from San Angelo's Well Field (as opposed to permits for the twenty-two individual wells identified in said applications and amended applications) subject to and in accordance with the following terms, conditions, and limitations.

1. The Hickory Underground Water Conservation District No. 1 may not reduce San Angelo's permitted production hereunder except as provided in the Settlement Agreement referenced below in paragraph 11 ("Settlement Agreement"). Any conflicting rules of the Hickory Underground Water Conservation District No. 1 including Rule 6 Permit Term and Renewal; Rule 6A Outcrop Depletion and Protection; Rule 7 Permit Recall; Rule 11 Time During Which Drilling Shall Be Initiated; Rule 12(b) Continuing Right of Supervision (subject, however, to the District's right to regulate all users of water within the District including San Angelo as set forth in paragraph 9 of the Settlement Agreement); shall not apply to the City of San Angelo in relation to this permit, it having been considered that the Hickory Underground Water Conservation District No. 1 has already exercised its discretion in relation to said rules. Additionally, Rule 15 shall not effect San Angelo's right to set rates or design rate structure.

2. That the water shall be used for a beneficial purpose without waste as those terms are

defined in Chapter 36 of the Texas Water Code as it currently exists or as it may be amended so that the mandatory requirements of that Chapter are met. Further, San Angelo shall not sell water from the District outside San Angelo's municipal water supply system; nor shall it sell its surface water outside its municipal water supply system if that water is to be replaced with water from the District. Otherwise, San Angelo may sell its surface water to any purchaser to the extent San Angelo has the right to use the water and does not require the water for itself.

3. That the water requested to be produced shall be produced from San Angelo's well field. San Angelo's well field (herein referred to as the "Field") is described as all of the rights conveyed to San Angelo in the following documents: 1) Water Rights Conveyance from Fort Worth National Bank, Trustee of the G.R. White Estate to the City of San Angelo dated July 27, 1972, recorded in Volume 180, pages 675-688, Deed Records, McCulloch County, Texas; 2) Water Rights Conveyance from the Fort Worth National Bank, Trustee of the G.R. White Estate to the City of San Angelo, dated July 2, 1971, recorded in Volume 180, Pages 662-673, McCulloch County Deed Records, Texas; 3) Water Rights Conveyance from Mrs. A. Noyes Miller et al to the City of San Angelo dated March 20, 1972, recorded in Volume 179, Pages 350-373, Deed Records, McCulloch County, Texas. All of San Angelo's wells shall be operated by San Angelo as one field so that the total production from the Field must not exceed the total permitted production during any one year period according to the following schedule of production:

SCHEDULE OF PRODUCTION

March 14, 1996 - March 13, 2006:

The maximum quantity of water which is allocated each year to San Angelo during this period is 1500 acre feet. San Angelo may bank up to one hundred percent (100%) of the 1500 acre feet. (As used herein the Settlement Agreement, "bank" means San Angelo may accrue a credit for future use at any time in the future of any of the allotted water not used in the year for which it is allotted.) San Angelo may produce up to 1500 acre feet per year plus any accrued water in the bank; provided, however, that during this time period no more than 10,000 acre feet may be produced by San Angelo during any one year.

March 14, 2006 - March 13, 2021:

The maximum quantity of water which is allotted each year to San Angelo during this time period is 2,750 acre feet. San Angelo may bank up to one hundred percent (100%) of the 2,750 acre feet. San Angelo may produce up to 2,750 acre feet per year plus any accrued water in the bank; provided, however, that during this time period no more than 15,000 acre feet may be produced by San Angelo during any one year.

March 14, 2021 - March 13, 2026:

The maximum quantity of water which is allotted each year to San Angelo during this time period is 5,000 acre feet. San Angelo may bank up to one hundred percent (100%) of the 5,000 acre feet. San Angelo may produce up to 5,000 acre feet per year plus any accrued water in the bank; provided, however, that during this time period no more than 15,000 acre feet may be produced by San Angelo during any one year. San Angelo shall not be entitled to accrue water by banking after March 13, 2026.

March 14, 2026 - March 13, 2036:

The maximum quantity of water which is allotted each year to San Angelo during this time period is 10,000 acre feet. San Angelo may produce up to 10,000 acre feet per year plus any accrued water in the bank; provided, however, that during this time period no more than 12,000 acre feet may be produced by San Angelo during any one year.

March 14, 2036 and thereafter, which right continues perpetually:

The maximum quantity of water which is allotted each year to San Angelo after March 14, 2036, is 12,000 acre feet. San Angelo may produce up to 12,000 acre feet per year during this time period.

4. Any well completed by San Angelo hereunder shall be equipped with a flow monitoring device approved by the District as per District Rule 10(b).

5. In addition to those nine wells already drilled and in existence, San Angelo may drill such additional, replacement, or supplemental wells as San Angelo deems necessary to produce its allotted production pursuant to paragraph 3 above (the Schedule of Production above).

6. All of San Angelo's wells shall be drilled on at least 1-mile centers in relation to other producing wells and shall not exceed a maximum capacity of 500 gallons per minute (gpm). Otherwise, San Angelo will have discretion as to the location of its wells (subject however to subparagraph 8 below).

7. San Angelo will have complete discretion to determine when any additional, replacement or supplemental wells allowed hereunder are drilled and no further applications, hearings, or permits shall be required. However, San Angelo shall provide the well completion information and other reporting information required by the District.

8. San Angelo shall not drill any additional, replacement, or supplemental wells in any of the following tract numbers: Tract Nos. 20, 38, 39, 65, 69, 182, 183, 184, 185, and 2205. Each of these tract numbers is depicted on the map attached as Exhibit A which is incorporated by reference herein for all relevant purposes.

9. San Angelo may not apply for any production from the District in excess of that agreed to herein.

10. The applicant shall maintain records of the quantity and quality of water actually produced and furnish such information to the District annually on or before June 1st and at such other times as the District may reasonably request.

11. This permit is issued subject to conditions on production and use contained in the Settlement Agreement made and entered into by and between the City of San Angelo, Texas, the City of Brady, Texas, and the Hickory Underground Water Conservation District Number 1 in the following suits:

> Cause No. 3293-B; City of San Angelo, Texas v. Hickory Underground Water Conservation District Number 1, et al; In the 119th Judicial District Court of Concho County, Texas.
>
> No. 2779-B; City of San Angelo, Texas v. Hickory Underground Water Conservation District Number 1 and City of Brady; In the 119th Judicial District Court of Concho County, Texas.
>
> No. 039-96; City of Brady v. Hickory Underground Water Conservation District Number 1 and City of San Angelo; In the 198th Judicial District Court of McCulloch County, Texas.

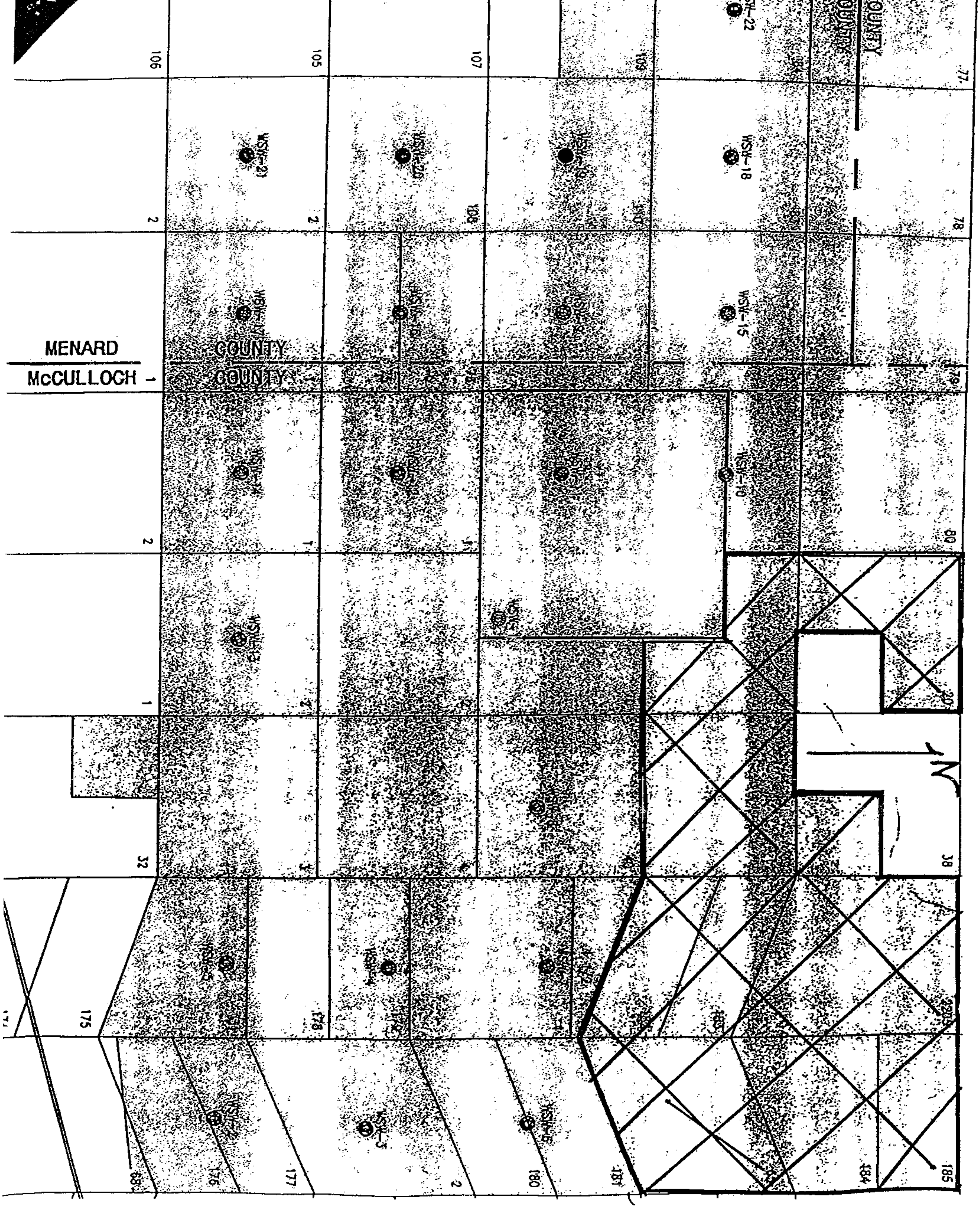
12. The effective date of this Permit is March 14, 1996.

Hickory Underground Water Conservation District Number 1

By: ______________________

Stanley G. Reinhard, General Manager

EXHIBIT "A



HICKORY UNDERGROUND WATER CONSERVATION DISTRICT NO. 1
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September 6, 2005

Jon Albright
Freese and Nichols
4055 International Plaza, Suite 200
Ft. Worth, TX 76109

Mr. Albright,

We have continued to investigate the sources and accuracy of the numbers used in irrigation projections in the Region F Management Plan. On August 25, I spoke with Daniel Hardin of the TWDB regarding the drastic decrease in irrigation projections from the 2002 statistics to the 2006 numbers. According to Mr. Hardin, irrigation figures were obtained from the FSA's certification numbers.

I spoke with FSA representatives from both Mason and McCulloch Counties. According to these sources, not all farmers who irrigate certify their cropland as irrigated. Even FSA representatives admit their numbers are actually estimates.

The amount of acreage irrigated from year to year is dependent on numerous factors including the price of diesel, the price of the crop in question, and rainfall amounts. At any time these variants can and will change. While the farmer may not use his entire permitted amount during one year, we cannot assume he will never use that amount. The water is permitted to him and therefore he has the right to that water.

In Mason County our records indicate 265 irrigation wells. We have 138 of those permitted for a total of 16,099 acre-feet, 6000 acre-feet more than indicated by projections and figures in the Region F Management Plan. In McCulloch County, the management plan indicates 2,859 acre-feet, while permitted wells in that county total 5,975.4 acre-feet.

While we do not expect changes to be made in this management plan, we want to be on record in opposition to the numbers used. We would also urge regional management groups to review the source of their data, seeking the most accurate methodology. Our opinion is the most accurate numbers would be obtained from sources closest to the actual water production. In most cases, this would be groundwater conservation districts. If you have any questions or comments, please, do not hesitate to contact me at 325-597-2785.

Thank you,

David G. Huie
Interim Manager

COMMENTS BY
WENDELL MOODY
ON
REGION F INITIALLY PREPARED PLAN
JULY 2005
CHAPTERS 1-8

September 2005

NOTE: Comments on Region F Draft Plan were prepared and emailed to Jon Albright on July 15, 2005. Thank you for using many of the comments. The following comments are a result of the review of the Initial Prepared Plan, July 2005. Please revise the recommended text changes and additions to improve content and readability and maintain publication format and style.

Executive Summary:

- Page ES-3, ES.1.1, 1st paragraph, 2nd sentence – "precipitation increases from east to west", not from "west to east".
- Page ES –4, ES.2.1, recommend adding the following statement before the last sentence – However, the southeastern counties are experiencing an influx of residents and absentee landowners from urban areas.
- Page ES-8, ES.3.2, Costs associated with water quality standards should be in the Executive Summary that may be the only document some people read. In the 1st paragraph, recommend adding the following statement after the last sentence – "Small rural communities are required to expend limited public and private financial resources to meet water quality standards for arsenic, radionuclides, and secondary water constituents."

Chapter 4:

- Page 4-11, 4.2.2, last sentence – Cost estimates for Hickory users are not in Appendix 4F. Why not? They are useful.
- Page 4-110, last paragraph, 3rd sentence – "$1.47 per what"?
- Page 4-111, 2nd paragraph, 6th sentence – Is "central treatment alternative" the same as advance treatment alternatives (page 4-113)? Make use the terms are consistent.
- Page 4-113, 1st paragraph, 2nd sentence – Does the $65 per month include "additional to the other costs" (page 4-115, 1st line)? Which treatment alternative is included, advanced?
- Page 4-115, 1st line – Does "additional to the costs already incurred by the City (Eden)" apply to the costs computed for all of the communities and alternatives? If it does, then the statement should be used with all communities and alternatives. If it does not, the narrative should so state.
- Page 4-117, 1st paragraph, 3rd sentence – Is the "$1.25 per 1000 gallons" include "additional to the costs already incurred" for Richland? This comment relates to the above comment.
- Several comments made during the previous review dated July 2005 of the Region F 2006 Draft Water Plan addressed the need to discuss the impact of cost on rural

communities. With the exception of the addition to Section 7.3, page 7-4, the impact of costs should be strengthened. This strengthened does not just apply to Hickory users, but to all rural communities in the region such as Robert Lee, Bronte, and even Ballinger. The cost of providing a reliable water source will make these small communities non-competitive with the large cities like San Angelo, Midland, etc. with respect of maintaining and attracting residents and small businesses. As pointed out in Section 7.3, costs will also negatively impact agriculture. The plan should point this out in "Agricultural and Rural Issues" and "Significant Issues Affecting Feasibility", which will support Section 7.3. It is noted that redundancy occurs, but is recommended for the many and varied readers who may be interested in only certain sections. The following are additions to the two aforementioned sections to strengthen the impact of cost.

- Page 4-112, Agriculture and Rural Issues – Recommend the following rewrite: "Currently, no water from the Hickory aquifer is used for irrigation in Concho County. The new well will allow the City of Eden to continue furnishing financial, educational, medical, public safety, and agricultural services. Without these services, agriculture will suffer an increase in cost of doing business, a decrease in productivity, and loose of services that contribute to its overall well-being and safety. As a rural community, drilling a new well represents a significant burden on the public and private economic resources."
- Page 4-112, Significant Issues Affecting Feasibility – Recommend the following rewrite beginning with the last sentence. "…to as much as $65,00 per month. To fund both the well and treatment facility will expend public and private money needed for other services such as education, community health, public safety, streets, wastewater treatment, and recreation. The City is classified as economically disadvantaged."
- Page 4-115, Agriculture and Rural Issues – Recommend the following rewrite: "The costs of constructing a water treatment plant would present a significant financial burden for this small rural community. This burden will reduce the commercial validity of the City of Eden resulting a reduction in financial, educational, medical, and public safety services and needed agricultural products and supplies. Without these services, agriculture will suffer an increase in cost of doing business, a decrease in productivity, and loose of services that contribute to its overall well-being and safety."
- Page 4-116, Significant Issues Affecting Feasibility – Paragraph is good as written. Recommend the additional paragraph – "The increased costs to customers associated with advanced treatment will result in a decrease in water sales. A decrease in water sales requires an increase in customer cost. This spiral could ultimately lead to financial difficulties for the City's water system."
- Page 4-117, Agriculture and Rural Issues – Recommend the addition to the 2nd sentence – "… or shallow wells for household and livestock water increasing the potential for human and livestock diseases."
- Page 4-118, Significant Issues Affecting Feasibility – Recommend deleting the 4th sentence and adding the following paragraph - "The increased costs to customers will result in a decrease in water sales, creating a spiral that causes financial difficulties for the community's water system."

  - Page 4-123, Agriculture and Rural Issues – Recommend the following change to the 2nd sentence – "… would reserve public and private funds for other uses such as improving educational and medical facilities, providing public safety such as fire protection, and promoting economic development leading to an increase of products and services needed in agriculture and rural communities."
  - Page 4-124, Environmental Issues – Recommend adding the following between the 1st and 2nd sentences – "A cluster cancer investigation was conducted by the Texas Cancer Registry of the Texas Department of Health and found that the cancer incidence and mortality in the area were within ranges comparable to the rest of the state. The Texas Radiation Advisory Board also expressed concern the EPA rules are unwarranted and unsupported by epidemiological public health data."
  - Page 4-124, Agriculture and Rural Issues – Recommend the addition to the 3rd sentence: "… for other purposes such as improving educational and medical facilities, providing public safety such as fire protection, and promoting economic development leading to an increase of products and services needed in agriculture and rural communities."

Chapter 6:

- Page 6-2, 3rd paragraph – Recommend adding the following sentence behind the 2nd sentence – "With reduced water use, customer costs will increase resulting in an undesirable spiral creating financial difficulties for the water supplier."

Chapter 7:

- Page 7-4, Section 7.3, 2nd paragraph – Recommend adding the following sentence to the end of the 2nd paragraph – "The Governors Office, the Texas Department of Agriculture, and U.S. Department of Agriculture are diligently working to assure the validity and sustainability of Texas agriculture and small rural communities."

Chapter 8:

- Page 8-13, Section 8.3.10, Water Quality – Use the policy statements (short version) agreed to during the meeting on May 23 in Big Spring.
- Page 8-13, Section 8.3.10, Water Quality – Refer to Page 3-38, Section 3.3.1, last sentence. Recommend the additional water quality policy statement for inclusion in Section 8.3.10 – " Region F recommends that TWDB revise its policy on requiring the use of secondary water standards, particularly TDS, for funding water projects. Meeting secondary water standards should be the option of local water suppliers who must consider local conditions such as the economy, availability of water, community concerns for the aesthetics of water, and the volunteer use of technologies such as point-of-use."

From: Wendell Moody [wbmoody@wcc.net]
Sent: Sunday, October 23, 2005 5:52 PM
To: Jon Albright
Cc: John GRANT; Rex HUNT
Subject: DRAFT RESPONSE TO COMMENTS ON REGION F IPP

Jon

Thank you for the draft response emailed on October 18, 2005. I appreciate all of your hard work and the use of the comments I submitted.

The following is a my response to your comments recorded in Draft Response to Comments on Region F IPP, October 18, 2005 -

- Page 6 of 10, IPP page 4-124 - Environmental Issues:
  - I will send you copies of documents that refer to the cluster cancer investigation and Texas Radiation Advisory Board by FAX . They are:
    - Letter from Michael Ford, Vice Chairman, Texas Radiation Advisory Board, to Robert J. Huston, Chairman, Texas Natural Resources Conservation Commission, dated May 6, 2002, 3 pages.
    - Summary of Investigation Into the Occurrence of Cancer, Concho, McCullouch, San Saba, and Tom Green Counties, Texas, 1990-1998, December 15, 2000, 17 pages.
    - News article, Brady Standard-Herald, Friday, September 17, 2004, TDH Report - Cancer Rates Normal for Area, 2 pages.
  - I agree that your drafted statement be included in Chapter 8. It belongs there. However, I do believe that a statement similar to mine or yours be used on page 4-124. It reinforces that the "No-Action Alternative" does not have any negative environmental issues such as public health.
- Page 8 of 10, IPP page 8-13, Section 8.3.10, Water Quality:
  - Concerning the reference to TWDB, I found a reference stating that TWDB would not fund projects unless they met secondary standard. I am sure I didn't dream it, but a quick search did not found it again.
  - I did review 30 TAC Chapter 290, Subchapter F, Section 290.118 (page 76) which states that "secondary constituents apply to all public water systems". The executive director may approve the use of water that does not meet secondary standards until "such time as water of acceptable chemical quality can be made available at reasonable cost to the area(s) in question".
  - I agree to using your paragraph with the following proposed change in the first sentence - "Region F recommends that TCEQ revise its policy requiring all public water systems meet secondary water standards. Meeting secondary water standards should ... ."
- General: I guess I will give on the "strongly worded statements" - changing "will" and "would" to "may" and "could". I appreciate your concern, but I believe this report should reflect the attitudes and experience of the region.

I will FAX the above mentioned documents Monday morning, October 24.

Again, appreciate your work.

Wendell Moody

November 7, 2005

John W. Grant
Region F Water Planning Group
c/o Colorado Municipal Water District
P.O. Box 869
Big Spring, Texas 79721

Re: Comments on Initially Prepared 2006 Regional Water Plan for Region F

Dear Mr. Grant and Planning Group Members:

The National Wildlife Federation, Lone Star Chapter of the Sierra Club, and Environmental Defense appreciate the opportunity to provide written comments on the Initially Prepared Regional Water Plan for Region F. We consider the development of comprehensive water plans to be a high priority for ensuring a healthy and prosperous future for Texas. We recognize and appreciate the contributions that you have made towards that goal. As you know, our organizations have provided, either individually or collectively, periodic input during the process of developing the plan. These written comments will build upon those previous comments in an effort to contribute to making the regional plan a better plan for all residents of Region F and for all Texans.

We do recognize that the draft Plan is subject to revision prior to adoption and is subject to continued revision in the future and provide these comments with such revisions in mind. Our organizations appreciate the amount of effort that has gone into developing the draft Plan for Region F. Your consideration of these comments will be appreciated.

I. BACKGROUND AND OVERVIEW

Our organizations support a comprehensive approach to water planning in which all implications of water use and development are considered. Senate Bills 1 and 2 (SB1, SB2), and the process they established, have the potential to produce a major, positive change in the way Texans approach water planning. In order to fully realize that potential, water plans must provide sufficient information to ensure that the likely impacts and costs of each reasonable potential water management strategy are described and considered. Only with that information can regional planning groups ensure compliance with the overarching requirement that "strategies shall be selected so that cost effective water management strategies which are consistent with long-term protection of the state's water resources, agricultural resources, and natural resources are adopted." 31 TAC § 357.7 (a)(9). Complying with this charge is essential in order to develop true plans that are likely to be implemented as opposed to a list of potential, but expensive and damaging, projects that likely will produce more controversy than water supply.

This document includes two types of comments. We consider the extent to which the initially prepared plan complies with the requirements established by SB1 and SB2 and by the Texas Water Development Board (TWDB) rules adopted to implement those statutes. In addition, our comments address important aspects of policy that might not be controlled by specific statutes or rules. We do recognize that the financial resources available to the planning group are limited, which may restrict the ability of the group to fully address some issues as much as you would like. These comments are provided in the spirit of an ongoing dialogue intended to make the planning process as effective as possible. We strongly support the state's water planning process and we want the regional water plans and the state plan to be comprehensive templates that can be endorsed by all Texans. Key principles that inform our comments are summarized below, followed by specific comments keyed to different aspects of the initially prepared plan.

II. KEY PRINCIPLES

A. Maximize Water Efficiency

We strongly believe that improved efficiency in the use of water must be pursued to the maximum extent reasonable. New provisions included in SB2 and TWDB rules since the first round of planning mandate strengthened consideration of water efficiency. Damaging and expensive new supply sources simply should not be considered unless, and until, all reasonable efforts to improve efficiency have been exhausted. In fact, that approach is now mandated. Consistent with TWDB's rules for water planning, we consider water conservation measures that improve efficiency to be separate and distinct from reuse projects. We do agree that reuse projects merit consideration. However, the implications of those projects are significantly different than for water efficiency measures and must be evaluated separately.

The Texas Water Code, as amended by SB1 and SB2, along with the TWDB guidelines, establishes stringent requirements for consideration and incorporation of water conservation and drought management. As you know, Section 16.053 (h)(7)(B), which was added after completion of the first round of regional planning, prohibits TWDB from approving any regional plan that doesn't include water conservation and drought management measures at least as stringent as those required pursuant to Sections 11.1271 and 11.1272 of the Water Code. In other words, the regional plan must incorporate at least the amount of water savings that are mandated by other law.[1] In addition, the Board's guidelines require the consideration of more stringent conservation and drought management measures for all other water user groups with water needs. Section 31 TAC § 357.7 (a)(7)(A) of the TWDB rules sets out detailed requirements for evaluation of water management strategies consisting of "water conservation practices." Section 357.7(a)(7)(B) addresses water management strategies that consist of drought management measures. The separate evaluation of water management strategies that rely on reuse is governed by 31 TAC § 357.7 (a)(7)(C).

While we commend the group for their attention to conservation in this plan, there is still more room for improved water efficiency. For example, the average municipal per capita water use for the Region, which is estimated to be 205 gallons per capita per day (gpcd) in 2010, is projected to decrease only to 194 gpcd in 2060. This is much higher than the projected statewide average of 162 gpcd and the recommended target level of 140 gpcd by the Water Conservation Implementation Task Force.

[1] This is a common-sense requirement. We certainly should not be basing planning on an assumption of less water conservation than the law already requires. TWDB guidelines also recognize the water conservation requirements of Section 11.085 for interbasin transfers and require the inclusion of the "highest practicable levels of water conservation and efficiency achievable" for entities for which interbasin transfers are recommended as a water management strategy.

B. Limit Nonessential Use during Drought

Drought management measures aimed at reducing demands during periods of unusually dry conditions are important components of good water management. As noted above, Senate Bill 2 and TWDB rules mandate consideration and inclusion in regional plans of reasonable levels of drought management as water management strategies. It just makes sense to limit some nonessential uses of water during times of serious shortage instead of spending vast sums of money to develop new supply sources simply to meet those nonessential demands during rare drought periods.

C. Plan to Ensure Environmental Flows

Although critically important, designing and selecting new water management strategies that minimize adverse impacts on environmental flows is only one aspect of planning to meet environmental flow needs. New rules applicable to this round of planning require a quantitative analysis of environmental impacts of water management strategies[2] in order to ensure a more careful consideration of those additional impacts. If existing water rights, when used as projected, would cause serious disruption of environmental flows resulting in harm to natural resources, merely minimizing additional harm from new strategies would not produce a water plan that is consistent with long-term protection of natural resources.

In addition, we believe that environmental flows should be recognized as a water demand and plans should seek to provide reasonable levels of environmental flows. As an example, we would note that the initially prepared plan for the Lower Colorado Region (Region K) does include such recognition of environmental flows as a water demand. Environmental flows provide critical economic and ecological services that must be maintained to ensure consistency with long-term protection of water resources and natural resources.

D. Minimize New Reservoirs

Because of the associated adverse impacts, new reservoirs should be considered only after existing sources of water, including water efficiency and reuse, are utilized to the maximum extent reasonable. When new reservoirs are considered, adverse impacts to regional economies and natural resources around the reservoir site must be minimized. Regardless of whether the proposed reservoir is located inside or outside the boundaries of the region, reservoir development must be shown to be consistent with long-term protection of the state's water, agricultural, and natural resources.

E. Manage Groundwater Sustainably

Wherever possible, groundwater resources should be managed on a sustainable basis. Mining groundwater supplies will, in many instances, adversely affect surface water resources and constitute a tremendous disservice to future generations of Texans. Generally speaking, depleting groundwater sources will not be consistent with long-term protection of the state's water resources, natural resources, or agricultural resources. We applaud the planning group's general recommendation of balancing groundwater pumping with recharge. However, we remain concerned about availability determinations in some areas that rely on depletion of aquifer storage.

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[2] The rules require that each potentially feasible water management strategy must be evaluated by including a quantitative reporting of "environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico." 31 TAC § 357.7 (a)(8)(A)(ii).

F. Facilitate Short-Term Transfers

Senate Bill 1 directs consideration of voluntary and emergency transfers of water as a key mechanism for meeting water demands. Water Code Section 16.051 (d) directs that rules governing the development of the state water plan shall give specific consideration to "principles that result in the voluntary redistribution of water resources." Similarly, Section 16.053 (e)(5)(H) directs that regional water plans must include consideration of "voluntary transfers of water within the region using, but not limited to, regional water banks, sales, leases, options, subordination agreements, and financing arrangements…." Thus, there is a clear legislative directive that the regional planning process must include strong consideration of mechanisms for facilitating voluntary transfers of existing water rights within the region, particularly on a short-term basis as a way to meet drought demands.

In addition, emergency transfers are intended as a way to address serious water shortages for municipal purposes. They are a way to address short-term problems without the expense and natural resource damage associated with development of new water supplies. Section 16.053 (e)(5)(I) specifically directs that emergency transfers of water, pursuant to Section 11.139 of the Water Code, are to be considered, including by providing information on the portion of each non municipal water right that could be transferred without causing undue damage to the holder of the water right. Thus, the water planning process is intended as a mechanism to facilitate voluntary transfers, particularly as a means to address drought situations, by collecting specific information on rights that might be transferred on such a basis and by encouraging a dialogue between willing sellers and willing buyers on that approach.

We commend the group on their attention to voluntary transfers and redistribution scenarios to help meet anticipated water demands.

III. PAGE-SPECIFIC COMMENTS

For ease of tracking, we have identified our individual comments with a number enclosed in brackets.

EXECUTIVE SUMMARY

ES.1.3 Current Sources of Water

[1] Page ES-4: We commend the planning group for acknowledging the significance of numerous springs in the area that are important for water supply and natural resource protection.

ES.2.2 Demand Projections

[2] Page ES-4: Region F has a 35% increase in total projected water use from 2000 to 2010. The initially prepared plan (IPP) indicates that this is a result of the year 2000 water use data being inaccurate due to drought and low crop prices. This is a drought-based planning exercise. If usage was reduced in 2000 due to drought, it seems that a recurrence of drought conditions in 2010, 2020, or beyond also would result in a reduction in irrigation usage. Some additional explanation should be provided about why it is appropriate to assume that irrigation use during future droughts would exceed irrigation use during the current drought to this extent.

ES.3.1 Conservation and Reuse

[3] Page ES-7: We strongly support water conservation efforts. We believe that significant additional savings can be achieved in particular through additional water efficiency measures for municipal water use. The second sentence in this paragraph indicates a potential savings of 115,000 acre-feet by 2060. However, Table ES-1 and Chapter 6 seem to indicate recommendations for only 91,000 acre-feet of savings. We assume that the additional 24,000 acre-feet of savings may result from alternative electrical generation technology. At any rate, additional explanation should be provided to explain this apparent discrepancy.

ES.3.2 Recommended Water Management Strategies

[4] Page ES-8, Table ES-1: The Alternative Electrical Generation Technology has an extremely high cost associated with it. Two points should be considered here. First, it seems that this is the cost for developing new facilities that do not require additional water supplies. However, additional capital costs likely would be incurred even for expanding traditional generating capacity. As a result, it does not seem appropriate to count the full cost of the new facilities as being attributed to replacing water supplies. Thus, we believe some partitioning of these costs to reflect the incremental cost due to replacing water supplies may be appropriate. Second, the cost figures in this Table are almost 3 times more than the figures listed in Table 4.5-6. The reason for that difference is not apparent.

CHAPTER 1: DESCRIPTION OF REGION

1.1.2 Water-related Physical Features in Region F

[5] We appreciate the inclusion of Figures 1-8 and 1-9 which provide useful information about streamflow patterns in the region.

1.2 Current Water Uses and Demand Centers in Region F

[6] Page 1-19, 2nd paragraph: We commend the group on acknowledging the importance of water for recreational activities and for the health of fish and wildlife. We believe the health of those fish and wildlife resources also is important to economic activities in the region. Hunting, fishing, and nature-based tourism are increasingly important activities through much of rural Texas. As recognized by TWDB's rules, 31 TAC § 357.7(a)(1)(G), the health of businesses of those types, which are dependent on natural water resources (such as springs, streams, and lakes), are to be considered in the planning process. More can certainly be done in this respect, such as including recreation and instream flow uses as water needs to be planned for. We encourage the planning group to include these as water use categories and assess the extent to which those important needs can be met in the future.

1.3.3 Springs in Region F

[7] Pages 1-38 through 1-43: We commend the planning group and consultants for an excellent job in listing, describing and mapping the major springs in the region. As time and resources allow, it would be helpful to include more detail as to the current use of the springs by area wildlife, currents threats, if any, to individual springs, and, if possible, a forecast for the future. If the information is available, it also would be helpful to have additional discussion about the aquifer formations supplying the springs and about whether a groundwater district exists with authority to manage those aquifers. Finally, as time and resources permit, it also would be helpful to have information about lesser springs and seeps that nonetheless cumulatively serve important roles in maintaining surface flows or natural resources in the area. For example, on page 1-67 there is a reference to springs and seeps contributing to the flow of the Concho River near Paint Rock.

1.4 Agricultural and Natural Resources in Region F

1.4.1 Endangered and Threatened Species
[8] Page 1-43: The description of natural resources in the region is incomplete. Simply listing threatened, endangered, and species of concern leaves a lot of species out. Many other species are economically important in the region. In particular, species that support hunting, fishing, and tourism merit discussion. Particular attention is appropriate for species that are dependent on surface water and springs. Key water-dependent habitats also should be acknowledged. For example, significant wetland areas should be acknowledged. They represent resources they could be significantly affected by water management decisions.

1.8 Water-Related Threats to Agricultural and Natural Resources in Region F
[9] Page 1-70: While it may be true, as the last sentence on this page states, that in most cases groundwater supplies have little effect on natural resources, there are many cases in which groundwater supplies do significantly affect natural resources through springs and seeps. In water-short areas of the state, such springs and seeps can be extremely important components of natural habitats.

1.8.2 Water Related Threats to Natural Resources
[10] Page 1-71: In addition to increases in certain types of brush, other changes such as loss of native grasses and other plant cover from other causes also may be contributing to changes from natural hydrological patterns.

CHAPTER 2: CURRENT AND PROJECTED POPULATION AND WATER DEMAND DATA FOR THE REGION

2.2 Population Projections
[11] Page 2.5, 2nd paragraph: This paragraph states that the counties in the eastern portion of Region F are seeing an influx of non-resident population from other parts of the state and that these people and their resulting water demand are not included in the TWDB approved projections. More information about this development would be useful here. Is this an influx of new permanent residents or primarily of folks with weekend homes in the area? It is not obvious why this population would not be reflected in census data and resulting population projections.

2.3 Historical and Projected Water Demands
[12] Page 2-5: Two categories that can be included in this section (they are not required by the TWDB) are Recreational and Environmental water demands. These two uses are important to this region and the state and should be planned for as important water uses.

2.3.1 Municipal Water Demand Projections
[13] Page 2-10: It would be useful to include a Table showing gpcd water use by WUG and by decade in conjunction with this section or in the appendix. It is helpful to have these data for reference purposes. In particular, the information is useful for helping the public to appreciate the potential for water savings through efficient plumbing fixtures.

[14] Page 2-11: The footnote to Table 2-4 referenced by an asterisk "*" is pretty difficult to understand. Further explanation of that adjustment would be helpful.

[15] Page 2-13: This section includes Table 2-6 "Expected Savings from Implementation of Plumbing Code for Region F Counties." This is useful information to include.

[16] Page 2-14: As noted above, the fact that irrigation water use was down because of drought conditions in 2000 does not seem like a good reason to reject those figures as the basis for predicting drought-year irrigation demand. If usage was reduced in 2000 due to drought, it seems that a recurrence of drought conditions in 2010, 2020, or beyond also would result in a reduction in irrigation usage. Because the planning process is a drought-based planning exercise, it seems appropriate to consider such drought-year demands in making projections. Based on Figure 2-5, the projected demands seem quite high in comparison to recent average use. Similarly, in looking at Table 1-9, surface water use for irrigation in 2000 does not appear to be out of proportion to surface water use for irrigation in other recent years.

2.3.4 Steam Electric Power Generation

[17] **Page 2-19**: We acknowledge that these projections came from TWDB. However, they seem quite high. Population in the region is only projected to grow about 17% from 2010 to 2060 and manufacturing demand in the region, which is small to begin with, is only projected to grow about 36% over that same period. These are the categories that are most likely to drive demands for electricity. By contrast, water demands for electrical generation are projected to grow by 98%. That level of projected increase in steam electric generation demand seems unjustified.

CHAPTER 3: WATER SUPPLY ANALYSIS

3.1 Existing Groundwater Supplies

[18] Page 3-2: The plan states that the availability volumes listed in Table 3-1 represent an acceptable level of aquifer withdrawal in each county based on policy decisions that attempt to maintain water levels in the aquifers at desired levels. It also states for the counties not governed by a groundwater district, aquifer availability is based on historical use trends. It seems that continuation of historical trends may not necessarily be consistent with achieving a desired future state for aquifer levels. It would be helpful if Figure 3.2 identified which counties fall under this last scenario with availability determinations based on historical use trends. It also would be helpful if the major springs, shown on Figure 1-18, could be depicted in Figure 3.2 and in the figures depicting the various aquifers that supply those springs.

[19] Page 3-2: The plan states that throughout much of the region, the desire is to maintain aquifers such that springflow and associated base flow to rivers and streams are protected. We believe that is an extremely important goal for ensuring that water planning and management are consistent with long-term protection of the region's and the state's natural resources, water resources, and agricultural resources.

[20] Unfortunately, it appears that the groundwater conservation district management policies in many of the counties in the region are not designed to ensure such long-term protection and, instead, allow for the planned depletion of stored groundwater reserves. We urge the planning group to include information, to the extent it is available, on how those different management policies would be expected to affect aquifer levels and outflows from the aquifers such as springs and baseflow in the region. One of the key functions of the planning process is to help assure informed decision-making. Including this information would help inform the public about the implications of the decisions made. For example, for areas with policies likely to result in predicted water level declines, information about the implications of those policies might help to build support for conservation measures designed to help bring water use inline with recharge so as to minimize use of stored aquifer reserves.

[21] Page 3-2: The last sentence on this page notes that recharge figures for most aquifers were carried over from the 2001 water plan. It would be helpful to include here a brief summary of the original bases for those recharge calculations.

[22] Page 3-3: In Table 3-1, it is not clear whether the "annual recharge" heading refers to average annual recharge or to drought recharge.

[23] Page 3-8: We appreciate the inclusion of representative well hydrographs. They provide a very helpful visualization of water level trends.

3.2 Existing Surface Water Supplies
[24] Pages 3-32 through 3-35: It seems appropriate to use the WAM models as the starting point for the depiction of water availability as long as the WAMs accurately reflect existing water rights. We express no opinion on the specifics of how the rights are reflected. Adjustments to the WAM outputs as a result of understandings or agreements not reflected in the underlying rights then should be explicitly acknowledged. That seems to be the best way to ensure informed decisions and clear understandings. It seems preferable to have discussions now about the issues of water rights priorities rather than to have those discussions occur during a water supply crisis.

CHAPTER 4: IDENTIFICATION, EVALUATION, AND SELECTION OF WATER MANAGEMENT STRATEGIES BASED ON NEEDS

[25] General Comment Regarding the Absence of the Required Quantitative Environmental Analysis of Water Management Strategies: TWDB rules require a quantitative environmental analysis of potentially feasible water management strategies considered by the planning group. 31 TAC § 357.7 (a)(8)(A)(ii). Based on a review of the initially prepared plan, that required quantitative analysis is missing. Short, qualitative descriptions of environmental issues have been included with the discussion of each strategy. Although we appreciate the attempt to acknowledge a broad scope of issues, these qualitative descriptions do not provide the level of quantitative review that is needed for well-informed decisions. We also recognize that, as a result of changes to the Colorado Basin WAM, the ability to perform quantitative analyses is limited. We believe that unless the required analyses can be performed now, the recommendations of major surface water strategies must be qualified by expressly making them contingent on later review and approval by the planning group after completion of required quantitative reviews. That seems to be the only way to come close to complying with the requirement for quantitative analyses and the requirement to demonstrate that the strategies are consistent with long-term protection of the state's natural resources, water resources, and agricultural resources.

4.2.3 Subordination of Downstream Water Rights

[26] Page 4-12: In general, we agree with the approach used by Region F in presenting this strategy. Explicit discussion of the need for a water management strategy in the form of subordination arrangements ensures that the issues are clearly acknowledged. We believe that is very preferable to having them embedded in assumptions underlying the WAM. Very few readers could be expected to appreciate the significance of the issues in the absence of the type of clear discussion provided in the initially prepared plan.

[27] Page 4-14: The text indicates that all of the yields presented “have been adjusted to account for reduced yield due to drought conditions that have occurred since 1998.” We do agree that it is appropriate to attempt to take the more recent hydrological data into account. However, more explanation is needed about the extent of those adjustments and about the validity of the manner in which they were calculated.

The text goes on to refer to Appendix 4E as providing information about those adjustments. Appendix 4E does provide information about differences between two new firm yield calculations. The comparison starts with an abbreviated “Firm Yield Natural Order 1940-1998” calculation and compares that to a “Firm Yield Natural Order 1940-2004” calculation. A total reduction in yield of 29,640 acre-feet between the two hypothetical yield figures is calculated. However, we were not able to locate a clear listing or statement of what adjustments actually were made. An adjustment of 29,640 acre-feet would not seem to be appropriate because the starting point for this comparison, “Firm Yield Natural Order 1940-1998,” appears to overstate the calculated yield even when compared to the yield figures from the 2001 Region F Water Plan and likely overstates yield when compared to the Colorado WAM (even with subordination assumptions). The 2001 Water Plan total for these reservoirs is 197,355, but the total listed in Table 4E-1, using the 1940-1998 data, is 207,700. Thus, although the difference in the yield totals for the two hypothetical runs is 29,640, making that amount of adjustment likely would overstate the absolute yield impact of the recent conditions under application of the prior appropriation doctrine. In addition, safe yield amounts are used for planning rather than firm yield amounts. At any rate, we believe additional explanation is needed about the specific adjustments made and the rationale for those specific adjustments.

[28] Page 4-16: We appreciate the complexity of estimating a cost for this strategy. Contrary to the second-last sentence on this page, we do not believe that the still-to-be-completed estimate of socio-economic impacts of water shortages in Region F is likely to provide sufficient information for preparing such an estimate. Rather, it seems that information is particularly needed about how the strategy might affect water availability in Region K because that is likely to influence required payments. Accordingly, we would urge further discussion of how costs for this strategy might be estimated.

[29] Page 4-17: The last sentence of the second paragraph asserts that a comparison of stream flows with and without subordination would not be meaningful in the upper basin because the “without subordination” scenario is not realistic, considering historical operations. As noted in our previous letter of June 2004, we believe stream flow assessments should consider changes from some reasonable baseline condition that allows meaningful judgments to be made about ecological impacts. “Current conditions” is one such baseline that could be used. For example, stream flows predicted with 2060 water use and subordination could be compared to “current conditions" streamflows and to 2060 water conditions without subordination.[3] In addition to performing quantitative assessments of individual strategies, we also believe that it is critical to provide streamflow assessments of the overall plan as part of the assessment of consistency with long-term protection of the state's natural resources, water resources, and agricultural resources. Unfortunately, no such assessment has been done. That issue is discussed further in our comments on Chapter 7.

4.3.1 City of Ballinger

[30] Page 4-30: The cross-reference to Section 4.8.2 for a discussion of the potential impacts of the regional desalination facility should be changed to Section 4.8.3.

[31] Page 4-32: The issue of impacts of reuse on environmental flows must be acknowledged and discussed. Reuse of a portion of the discharge would have the effect of reducing flows in the receiving stream below the discharge.

[32] Page 4-33: The discussion here refers to the "Region F recommended conservation strategies." There is no reference to a specific listing or discussion of those recommended strategies. On page 6-4 of the initially prepared plan, there is a very brief listing of three points as "the focus of the conservation activities for municipal users in Region F." In addition, at the top of page 6-5 there is language indicating that "savings for passive implementation of water-efficient clothes washers" also were included. Additional discussion of these concepts and the process for calculating potential savings is needed in order to provide a reasonable understanding of the conservation recommendations in the plan. We believe a clear understanding is essential to help WUGs develop water conservation plans.

[33] Page 4-34: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited.

[34] Pages 4-35 through 4-36: The conservation recommendations reflect a reasonable amount of savings at reasonable costs. Even at the 2060 estimated per capita usage rate of 155 gpcd, significant additional savings are possible as is illustrated by the success of the City of San Antonio in reducing per capita usage to below 140 gpcd.

[35] Page 4-36, Table 4.3-8: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations.

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[3] It is not clear if "historical operations" assumptions would be appropriate when undertaking modeling to assess projected 2060 demands. Adjustments to historical operations might have to be made in order to provide the required yield.

4.3.2 City of Winters
[36] Page 4-43: The issue of impacts of reuse on environmental flows must be acknowledged and discussed. Reuse of a portion of the discharge component of the City's effluent would have the effect of reducing flows in the receiving stream below the discharge.

[37] Page 4-45, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. From the per capita water use indicated in the "No Conservation" row in Table 4.3-15 for 2000, it appears that a combination of water conservation and drought management measures have greatly limited water use. Although it is possible that not all of the measures used in 2000 would be desirable for use during future droughts, the effectiveness of drought management should be acknowledged. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management is needed.

[38] Page 4-45, Recommended Strategies: Conservation should be added to the recommended strategies discussed here. Also, as noted above, drought management should be included. The planning group has recommended that the City of Winters use reuse as a strategy to increase the reliability of their water supply. Conservation is projected to save 76 acre-feet/year by 2060 and is less expensive than reuse. In fact, Table 4.3-16 shows that the City of Winters could meet its needs with subordination only and then use conservation as a safety buffer. An aggressive conservation program coupled with drought management could save even more water.

[39] Page 4-46, Table 4.3-15: More information is needed about the measures undertaken by the City to reduce per capita water use to 102 gpcd. Some of those measures might well be water conservation measures that would reasonably be expected to continue in effect in the future.

[40] Page 4-47, Table 4.3-16: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations. That seems particularly inappropriate here because conservation is shown to be much more cost effective than reuse.

4.3.3 City of Bronte
[41] Page 4-58, Table 4.3-24: Some explanation is needed regarding the varying Year 2000 per capita usage rates. The Region F estimate of gpcd for 2000 is given as 208. That figure appears to be the starting point for calculations of conservation savings, and, presumably, estimated demands. However, that figure is significantly higher than the 192 gpcd figure otherwise shown as the year 2000 water use projection. That 192 gpcd figure for 2000 then is shown as increasing to 208 gpcd in 2010 in the absence of conservation.

[42] Page 4-59, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B).

The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. From the per capita water use indicated in Table 4.3-24 for 2000, it appears that drought management measures may have been effective in reducing water use. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

[43] Page 4-59, Table 4.3-25: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations. That seems particularly inappropriate here because conservation is shown to be much more cost effective and to have lower capital costs than new water wells.

4.3.4 City of Robert Lee

[44] Page 4-71, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

[45] Page 4-71, Water Conservation and Table 4.3-34: The gpcd for the City of Robert Lee is very high, even for 2060. As a result, the potential for conservation is likely much higher than is shown here. The City of San Antonio has reduced per capita usage to below 140 gpcd. For an area with little water and financial resources, conservation is the most logical place to look for additional water supplies.

[46] Page 4-71, Recommended Strategies for the City of Robert Lee: The strategies listed here do not match those shown in Table 4.3-35. The strategies included in Table 4.3-36 don't seem to match Table 4.3-35 or the discussion on page 4-71.

[47] Page 4-73, Table 4.3-35: Why is "Surplus (Need) without conservation" and "Surplus (Need) with conservation" shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

4.3.5 City of Menard

[48] Page 4-77, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B).

The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. As noted here, the City of Menard has successfully used drought management in the past as a method for limiting water demands. It would be useful to include information about the specific approaches used. More discussion of drought management should be provided.

[49] Page 4-83, Table 4.3-42: Why is "Surplus (Need) without conservation" and "Surplus (Need) with conservation" shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

4.3.6 City of Midland

[50] Page 4-89, Table 4.3-46: This table shows that Midland's gpcd would be reduced from 262 to 220 gpcd by 2060 through conservation measures. This is a good beginning. Fortunately, much more progress is possible. This would still leave Midland among cities with the highest use rates in the state. It also would represent a substantial increase in per capita use over the projections from the last round of planning in which Midland was in the top 10 water use ranking of the State Water Plan with a projected usage rate of 205 gpcd in 2050.[4] As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings likely could be realized for the City of Midland. Water in the Midland area is scarce and expensive to develop. Groundwater supplies are being depleted in the area. Ramping up water conservation efforts could save the citizens a considerable amount of money in the future by delaying or eliminating the need for more expensive water supply projects and could help to ensure a long-term water supply for the area.

[51] Page 4-90: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

[52] Page 4-91, Table 4.3-47: Why is "Surplus (Need) without conservation" and "Surplus (Need) with conservation" shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

[4] Texas Water Development Board, *Water for Texas – 2002*, page 33.

4.3.7 Brown County Other

[53] Page 4-94, Water Conservation and Drought Management: Both water conservation and drought management are required water management strategies and must be evaluated. According to the discussion on page 4-91, water supply corporations provide most of the water in the area. Those entities could coordinate water conservation and drought management efforts.

4.3.8 City of Coleman

[54] Page 4-98, Table 4.3-53: This table shows the City of Coleman's per capita usage going from 177 in 2000 to 229 in 2010. The rationale for that projected increase must be provided and supported. The figures included here do not match those given on page 4-97. That discussion indicates that current per capita usage rates are at 145 gpcd. Those huge differences must be explained. Table 4.3-53 shows a reduction of 33 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good beginning but the overall per capita usage rate still would be a very high 196 gpcd. Fortunately, much more progress is possible. As illustrated by the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here likely could be realized for the City of Coleman.

[55] Page 4-98, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the very brief discussion, the City of Coleman has successfully relied on drought management in the past to limit demands. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

[56] Page 4-99, Table 4.3-54: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendation.

4.3.9 City of Brady

[57] Page 4-103 and Table 4.3-58: The per capita usage rate shown for the City of Brady is extremely high. Table 4.3-58 shows the City's per capita usage rate going from 303 in 2000 to 251 in 2060. However, the text on page 4-102 indicates that the most current usage rate is 215 gpcd. The basis for using the year 2000 figure of 303 gpcd as the starting point for the calculations, rather than the 215 gpcd figure, must be explained and supported. Table 4.3-58 shows a reduction of 52 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be an extremely high 251 gpcd. That 2060 projection also is much higher than the apparent current usage rate of 215 gpcd. Fifty-years of conservation efforts reasonably could be expected to achieve better results. Fortunately, much more progress is possible. As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here likely could be realized for the City of Brady.

[58] Page 4-103 through 4-104: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the very brief discussion, the City of Brady has successfully relied on drought management in the past to limit demands. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

[59] Page 4-104, Table 4.3-59: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations.

4.4 Manufacturing Needs
[60] Page 4-129: Although we appreciate that it is difficult to do detailed analyses of industrial water conservation measures, it should be possible to do a reasonable assessment for major water user groups. TWDB rules require consideration of water conservation for all water users with needs. See 31 TAC § 357.7 (a)(7)(A)(i), (ii).

4.5 Steam-Electric Power Needs
[61] Page 4-134, Table 4.5-4: The projections of demands for steam electric generation seem unduly high. Population in the region is only projected to grow about 17% from 2010 to 2060 and manufacturing demand in the region, which is small to begin with, is only projected to grow about 36% over that same period. These are the categories that are most likely to drive demands for electricity. By contrast, water demands for electrical generation are projected to grow by 98%. That level of projected increase in steam electric generation demand seems unjustified.

4.6 Irrigation Needs
[62] Page 4-141: We commend the planning group for including this information about potential water savings from improved irrigation efficiencies and for the recognition of the need to use advanced conservation to help conserve supplies throughout the region.

[63] Page 4-148: The calculated application rate for drip irrigation listed in the second sentence on this page appears to be incorrect. Given the higher efficiency rate, the application rate for drip irrigation should be less than the 9.6 acre-inches calculated for furrow irrigation.

4.8.1 Colorado River Municipal Water District
[64] Page 4-165: In the discussion of issues associated with the Winkler County Well Field, some information is needed about how the projected annual withdrawal of 6,000 acre-feet will impact the associated aquifer water levels over the planning horizon.

[65] Page 4-170, Environmental Issues Associated with Water from Roberts County: There are issues regarding potential loss of spring flows in Roberts County, including springs that supply a portion of the baseflow of the Canadian River. [5] The Arkansas River Shiner is listed as a

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[5] See Luckey, R. R., Gutentag, E. D., Heimes, F. J., and Weeks, J. B. 1986, Digital simulation of ground-water flow in the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Professional Paper 1440-D, 57p.

threatened species pursuant to the federal Endangered Species Act.[6] It would be appropriate to acknowledge the existence of those issues here.

[66] Page 4-170, final paragraph: The last italicized heading on the page should refer to "Roberts County" rather than "Pecos County."

[67] Page 4-171: The last two sentences on the page suggest that water conservation may not have much impact on water needs for CRMWD because water quality issues often drive the needs. However, there would still seem to be significant benefit from water conservation because if less overall water has to be supplied, then the quantity of higher quality water required for blending with or replacing existing sources also would be lessened.

[68] Page 4-172, Table 4.8-25: Table 4.8-25 shows the City of Synder's per capita usage rate going from 227 in 2000 to 194 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 194 gpcd. The basis for using the year 2000 figure of 227 gpcd as the starting point, rather than the 194 gpcd figure, must be explained and supported. Table 4.8-25 shows a reduction of 33 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a very high 194 gpcd, which, apparently, is the actual usage rate for 2000. Fifty-five years of conservation efforts would be expected to achieve more results than just returning to the per-person usage levels achieved five years ago. Fortunately, much more progress is possible. As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here could be realized for the City of Synder.

[69] Page 4-173, Table 4.8-26: Table 4.8-26 shows the City of Big Spring's per capita usage rate going from 210 in 2000 to 172 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 198 gpcd. The basis for using the year 2000 figure of 210 gpcd as the starting point, rather than the 198 gpcd figure, must be explained and supported. Table 4.8-26 shows a reduction of 38 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 172 gpcd. Fortunately, much more progress is possible.

[70] Page 4-174, Table 4.8-27: Table 4.8-27 shows the City of Odessa's per capita usage rate going from 208 in 2000 to 178 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 198 gpcd. The basis for using the year 2000 figure of 208 gpcd as the starting point, rather than the 198 gpcd figure, must be explained and supported. Table 4.8-27 shows a reduction of 30 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 178 gpcd. Fortunately, much more progress is possible.

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[6] see US Fish and Wildlife website:
http://ecos.fws.gov/species_profile/servlet/gov.doi.species_profile.servlets.SpeciesProfile?spcode=E05X

[71] Page 4-175, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

4.8.3 City of San Angelo

[72] Page 4-184, Table 4.8-33: Table 4.8-33 shows the City of San Angelo's per capita usage rate going from 200 in 2000 to 163 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "c" note that year 2000 use was actually 162 gpcd, which is less than the usage rate projected for 2060. In addition, the text on page 4-183 notes that, as of 2002, per capita usage was actually 118 gpcd. Fifty-years of conservation effort should produce better results than an increase in actual per capita use rates. We recognize that a portion of the 118 gpcd rate results from drought restrictions. Although we believe those types of restrictions must be evaluated as part of a drought management strategy, we recognize that 118 may not be the appropriate starting point for the conservation analysis or the demand projection. However, 200 gpcd does not appear to be appropriate either. The year 2000 actual use rate of 162 gpcd likely should be used. The selection of that 200 gpcd usage rate as the starting point for the calculations must be explained and supported. Table 4.8-27 shows a reduction of 37 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 163 gpcd. Fortunately, much more progress is possible. In fact, San Angelo already has achieved lower rates in 2000 and much lower rates in 2002.

[73] Page 4-185, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the brief discussion, the City of San Angelo has successfully relied on drought management recently to help limit demands. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Chapter 5: Impacts of Water Management Strategies on Key Parameters of Water Quality and Impacts of Moving Water from Rural and Agricultural Areas

[74] Page 5-2, Table 5-1: Brush control likely should be added to this table and the discussion in this chapter. Brush control has the potential, if not done very carefully, to cause significant adverse water quality impacts. For the long-term, if done as part of a comprehensive land stewardship program, water quality could be improved.

[75] Page 5-4, New and/or Expanded Use of Groundwater Resources: The plan states that while an increased use of groundwater can decrease instream flows if the baseflow is supported by spring flow, this type of impact is not expected to be a concern for Region F's recommended strategies. Some additional explanation here of the basis for the stated absence of a concern would be helpful.

[76] Page 5-1, 5-4, Section 5.2 and 5.3. It is difficult to discern the difference between these two sections by their titles.

Chapter 6: Water Conservation and Drought Management Recommendations

[77] We commend the planning group for acknowledging the effectiveness of water conservation and drought management measures.

[78] Water supplies are tight throughout the region. It is very important to use water efficiently. Accordingly, we urge the planning group to consider a general recommendation for municipal water conservation measures for all user groups, regardless of need. The planning group made a similar recommendation for irrigation uses. See page 4-141 of the IPP.

[79] We believe the value of the Chapter 6 discussion would be greatly enhanced by including summary information, in a quantitative format, about the water conservation and drought management recommendations included in the plan. Indeed, that is just what we understand to be called for by Section 357.7 (a)(11) of the Board's rules, which requires "a chapter consolidating the water conservation and drought management recommendations of the regional water plan."

[80] The model water conservation plans are helpful. However, we believe it would be appropriate to include model plans that include examples of language that could be used in applying at least the conservation measures recommended by the planning group.

[81] Also, the TCEQ rule excerpts included as appendices included to the sample conservation plans appear to be outdated. The TCEQ rules recently were revised to incorporate, among other things, the requirement for specific quantified target goals.

[82] Draft Appendix 6C1 also appears to have an outdated version of TCEQ rules included.

[83] Appendix 6D: We commend the group for compiling potential drought triggers for use by public water suppliers and irrigation districts. The discussion as to the use of groundwater wells seems especially useful and informative.

Chapter 7: Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

[84] Page 7-3, Consistency with the Protection of Water Resources, New or Expanded Use of Groundwater: This section states that groundwater availability reported in the plan is the long-term sustainability of each aquifer, and is based on aquifer recharge capacity. We commend the planning group for recognizing the critical importance of sustainable management of groundwater resources. However, according to Chapter 3 of the plan, a number of counties in the region are basing aquifer availability on the use of stored aquifer capacity. We understand that, in some cases, there is a difficult balancing act that must take place between restrained use of groundwater resources and the economic viability of a region. However, the plan does not include any discussion of the bases on which certain districts have chosen managed depletion of their groundwater resources through reliance on supplies in aquifer storage. Managed depletion is not consistent with the long-term sustainability of the region's aquifers, and is also not consistent with the **long-term** protection of the state's water resources, natural resources, or agricultural resources. Although it may not be feasible, in some areas, to move quickly to true sustainable management, in order to achieve a reasonable long-term future for local economies, true sustainable use of groundwater reserves should be the goal and efforts to achieve that goal should be supported and encouraged.

We also support the planning group's strong endorsement of water conservation. Particularly in the area of municipal water use, we urge the planning group to set more ambitious goals for water conservation. Achieving highly efficient water use is essential to ensuring long-term protection of the state's limited water resources.

[85] Page 7-4, Consistency with Protection of Agricultural Resources:
Again, we commend the planning group for its recognition of the critical importance of achieving highly efficient use of limited water resources in order to maintain the viability of irrigated agriculture for the long-term.

[86] Page 7-4, Consistency with Protection of Natural Resources:
The discussion of consistency with long-term protection of the state's natural resources is unduly narrow. Increasingly, rural areas of the state are relying more and more on hunting, fishing, and nature tourism as additional sources of income. The natural resources that support those activities should be considered and protected in the planning process. Protection of stream and river flows and the springs and seeps that help to maintain those flows is critical to protecting those natural resources.

In order to effectively assess consistency with long-term protection of natural resources, a comprehensive assessment of projected stream and river flows expected with implementation of the plan is needed that compares those flow levels to some reasonable criteria for natural resource protection. As we pointed out in our letter, and an attachment to that letter, in June, 2004, one such logical criterion is a "current conditions" baseline. Because we have a reasonable understanding of how natural resources are affected under current conditions, a comparison of projected flows against such a baseline provides a reasonable basis for attempting to understand the natural resource implications of changes in flow. Without that type of assessment, there really is no basis for the required determination that the plan is consistent with long-term protection of natural resources. We do recognize that questions about the Colorado WAM have left the planning group with limited time to perform such analyses.

CHAPTER 8: UNIQUE STREAM SEGMENTS/RESERVOIR SITES/LEGISLATIVE RECOMMENDATIONS

[87] Page 8-5, Recommendations for Ecologically Unique River and Stream Segments: It is disappointing to see that the Planning Group has again declined to recommend any stream segments for designation as unique stream segments. We understand the requirement in the Board's rules regarding analysis of potential impacts as providing recognition of the status of such segments as being ecologically unique and deserving of special consideration. However, that special consideration would not result in any type of mandatory protection beyond that established by statute.

8.3.4 Instream Flows

[88] Page 8-9: The last bullet point under this heading states opposition to adaptive management requirements. It appears, from the discussion immediately preceding this bullet point, that the concern is about adaptive management that might involve the reallocation of existing water rights to protect instream flows. We certainly understand that concern. We consider "adaptive management" to be an important, but broad, scientific concept that involves maintaining reasonable flexibility in managing water supplies. Adaptive management concepts are important because, as we learn more, we may be able to manage water more efficiently to meet all water needs, including environmental water needs. We urge the planning group to consider rephrasing this bullet point to focus more narrowly on the apparent concern about impacts on existing water rights. We would propose the following language for your consideration: "Opposes adaptive management requirements that involve involuntary reallocation of existing water supplies."

Thank you for your consideration of these comments and please feel free to contact us if you have any questions. We look forward to a continuing positive dialogue with the planning group during this and future planning cycles.

Sincerely,

Myron Hess	Mary Kelly	Ken Kramer
National Wildlife Federation	Environmental Defense	Sierra Club, Lone Star Chapter

cc: Sherry Cordry, TWBD Liaison
Kevin Ward, TWDB
Cindy Loeffler, TPWD
Jon Albright, Consultant, Freese & Nichols

Richland Special Utility District
P O Box 217
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Jon S. Albright
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July 25, 2005

Dear Jon,

Thanks for the opportunity to comment on the Draft Memo regarding the Region F plan for Strategies for Hickory Aquifer Users. I find the draft to be much as we discussed in the various Hickory meetings and it is important to get this information into the Region F plan.

Regarding the Richland SUD portion, basically I agree with all that is written but would like to add another section and a correction or two.

As you know, the last well drilled for Rochelle came in below the EPA MCLs for total Radium. It is also true that the well at Lohn tests below the EPA MCLs. We have been doing some testing of private wells, with owner permission, in the area between Rochelle and Lohn to see if possibly there might be a "valley" of low Radium water in the Hickory. One private well along Route 377 did come in low. We are planning some more tests in the area. If the data does show such an area, then RSUD might be interested in drilling a new well in that area. It would be appropriate that this possibility be included in the Region F plan so that we might seek funding. Please incorporate a paragraph to include that possibility.

On page 3, Table 1, a more currently accurate figure would be 207 acre-feet per year.

On page 7, second paragraph, it is stated that Richland has high water losses. There is need to mention that being a rural water system with 120 miles of pipe lines, part of the reported lost water was flushed in accordance with State law. Also there is need to mention that much of the pumped water is used for livestock. Only about 0.5% was actually used for potable purposes.

It would be helpful and appropriate for the Region F Planning Group to encourage the State to require oral ingestion studies to determine the epidemiology of radium in potable water. A major medical university could perform a basic study as part of their basic medical training. The universities will not attempt such a study unless the State encourages them to do so. Including such an encouragement in the Region F Plan would be helpful.

We cannot fill out the Financing Survey. Realistically answering those financial questions would mean that we know how to solve the problem of radionuclides in the Hickory water. We continue to search for the appropriate solution for the Richland SUD but as of this time we do not have a firm plan.

Please consider these remarks in your final document.

Ken Bull

Ken Bull, Vice President
151 PR 827
Rochelle, Texas 76872
325-597-1226

to Jon Albright - Region F
817-735-7300 Thanks!

from Joe David Ross Some of these may have already been changed in the 2nd draft.

What are differences in Surface water definitions?
1) Conservation storage, 2) permitted cons. storage
3) permitted diversion water

'01 plan Table 1-15 ('97) } Groundwater pumping
'05 plan Table 1-13 ('99) } by Co. & aquifer
what happened to cause Midland to use ~~less~~
~~water~~ 19,000 from Ogalla in '97 but 0 in '99?
Why does Reagan go from 49,000 in '97 to 351 in '99?
What happened in Upton Co. to go from 19000 to 0 in 2 yr.?

R 1-68 - 1.7.2 - Constraints
4th sentence from the bottom - delete, "but the cost to treat this water may be high." and the last two sentences in the ¶. Petroleum & ag prices are high & active now. Some others & the city of San Angelo are working on nearby sources of water for desalination.

P. 1-68 - what is your definition of "natural"?
Some of think that water itself is a natural resource. Surface water is not mentioned. Regions are formed to conserve water &
"City of Midland - to use 1/2 in 50 years. why can Midland deplete 2 fields?
I've got to stop & go to a meeting.
Cindy may send some more. There will be more tonight & tomorrow Thanks!

Reg F.
Cindy's & Joe David

Chapter 1 – Questions & Comments

1. Table 1-5 – why do the figures vary significantly on "permitted conservation storage"?

2. Table 1-5 – why is Mountain Creek not listed?

3. The 2001 Plan has stream flows listed as "annual" and the 2005 draft plan has stream flows listed as "mean". Why was this change made?

4. Please vary the colors more on the table "Water Use by County (2000)" for easier contrast.

5. Page 1-35, last paragraph – please change the wording to the following:

"These entities are required to develop and adopt comprehensive management plans, permit wells ~~with capacities greater than 25,000 gallons per day~~, that are drilled, completed or equipped to produce more than 25,000 gallons/day, keep records or well completions, and make information available to state agencies. ~~Among the optional~~ Other powers granted GCDs are prevention of waste, conservation, recharge projects, research, distribution and sale of water for and purpose, and making rules regarding transportation of groundwater outside of the district."

6. Table 1-12 Surface Water Rights by County – why are these figures different from the 2001 plan?

7. Table 1-15, Pecos & Menard Counties are listed as having no cropland – not true.

8. Table 1-15 (2001 Plan) and Table 1-13 (2005 draft) – Groundwater Pumping by County and Aquifer – why do these figures differ so much? i.e. Sutton (1997) pumped 3,400 ac. Ft. and 2005 draft pumped 10,000 ac. ft. – who provided the pumpage figures to TWDB for this data?

9. 1.3.3 Springs in Region F – Use the same map and wording for the 2005 draft as was used in the 2001 plan.

? 10. Page 1-54 – The powerplant on Lake Nasworthy has been officially "mothballed." This needs to be mentioned. in Sept 05

(Ask S Ang. man who was @ Sept public hearing
"can be brought back on short notice"

To: Jon Albright - Region F
from: Joe David Ross p1 of 3
Chap 3 comments - 11-11-05

p 3-1 - last sentence - several counties do not have water districts. who determined their "historical trends" for them? Has anyone talked to a group(s) from each of those counties? see Figure 3-2. which are drawn on Co. lines but in some cases part of a county's farm land is in a water district that is headquartered in another co. that has a different water Co usage management policy. Examples: Upton; City of Midland uses fields in Winkler. Pecos has a relatively new W.D. Are they going to pump 75% over 100 years?

p 3-2 - appreciates Ashworth's comments about springflow and drought & the use of the new ET GAM to some degree in the new plan However, in Table 3-1 under the Annual recharge column (with the *) are the aquifers' ~~figures~~ numbers that are not ET meant to represent 50% or 100% in a drought period? see p 3-5 at bottom of table 3-1*

On p 3- 1 & 2 could we add a specific definition of ground water availability as it relates to Table 3-1? Most of us on this board are laypersons; legislators' aides may want to study the report, city council members and more importantly new regional board members or aquifer management groups in the future hopefully will utilize the info. It needs to be as accurate, current and useful as possible.

Is this a true definition as referred to frequently in the many pages and charts? "Ground water (& surface water) availability means the annual recharge, plus the annual % of stored water that could be used = the annual availability. Availability does not include any currently non-useable water (for any of the 6 categories) or potentially available water through desalination or dilution (blending)." Or does it mean the amount of water currently being used?

It would make it much easier to get the "big picture" if more columns were added on the same spread sheet instead of the average interested person having to flip through several pages. A 4th column for current use (demand). A 5th for potential use. A 6th total of ground & surface. A 7th - how much comes from another county or lake. An 8th for how many Ac ft. goes out from a county, lake or river.

Why does Table 3-1 show Concho using 100% of their Hickory annual availability, but Menard uses 0% of its 34,000 Ac ft in the Hickory; and Kimble has volumes of Hickory (memory from 200/plan?) but the table shows no availability for Kimble. p 3-15 says the Hickory supplies water to both Kimble & Menard.

Hickory - Table 3-1 (contd)
Mason and McCulloch as shown on p 3-6 (figure 3-2) are both shown as having the same management policy (same water district) - 75% over 100 years. Table 3-1 shows McColloch's annual supply @ 122,000 (126,000) and Mason @ 76,000 (annual available) but on p 17. It says that Mason is the largest user of the Hickory.

Table 3-1 shows the Dockum Aquifer to be in 21 counties but written on p 3-12 we are told it occurs in 12 co. These points are not made to just be "picky" but to illustrate the ~~bad~~ confusion that we lay people encounter. We truly want to be part of a team that develops info. that can help our ~~families~~ industries and communities to survive + grow in the future.

P 3-12 - Trinity Aquifer -

more to follow

TO Jon Albright - Region F
from Joe David Ross (fax 817-735-7491)

P. 3 of 7 (other 2 already sent.)

Hickory - Table 3-1 (cont'd)
Mason and McCulloch as shown on p 3-6 (figure 3-2) are both shown as having the same management policy (same water district) - 75% over 100 years. Table 3-1 shows McCulloch's annual supply @ 122,000 (126,000) and Mason @ 76,000 (annual available) but on p 17. It says that Mason is the largest user of the Hickory.

Table 3-1 shows the Dockum Aquifer to be in 21 counties but written on p 3-12 we are told it occurs in 12 co. These points are not made to just be "picky" but to illustrate the ~~bad~~ confusion that we lay people encounter. We truly want to be part of a team that develops info. that can help our families, industries and communities to survive & grow in the future.

(cont'd)

P 3-12 - Trinity Aquifer - The map p. 3-13 (figure 3-6) does not show Coleman Co. having any Trinity. However, friends in Coleman have pointed out that there are a few wells in the co. even though Table 3-1 shows 0 from a practical viewpoint for the other 2 aquifers. They did not mention what aquifer(s).

p. 3-12 & p. 3-15 Dockum Aquifer - the figure 3-7 map (p. 3-14) shows that both Sterling and Irion Co. do have significant coverage with the Dockum - even though it's volume is considered spotty. The outcrop in Sterling Co. was even mentioned in the Standard Times

~~that the~~ earlier that it was briefly considered to be a potential source for the city of San Angelo.

p. 3-15 & p. 3-17 Hickory Aquifer - it has already been discussed some earlier in these comments. But since Brady, Eden and rural homes have wells with small potential problems with natural radiation but big regulatory problems, should not it be ~~emphasiz~~ mentioned in more detail in this chapter since their problem was one of our greatest needs in the 2001 plan? and still is!! Also, shouldn't we mention that San Angelo has already purchased water rights in the Hickory as an alternative source of water to be blended?

p 3-17 - #3-19 Lipan Aquifer Does the local water district control overuse by limiting well density? What did their $50,000+ pumpage study show? Christoval is in Tom Green Co. what aquifer do they get their water? Their water officials came to 2 or 3 of our region F meetings in the early 2000's since their wells were sucking air. what happened? What do Will Wilde and Allan Lange report?

p. 3-24 Capitan Reef Aquifer - Is this the up dated report that Ashworth handed out to us earlier in the 2nd plan?

Joe David's comments this week have been based on the March 2005 draft. No cross reference has been evaluated between the 2001 plan and the 2nd (later than Mar May) draft. And I'm sure that some of my interpretations arise from a lay persons lack of expertise.

P. 3-26 - Brackish Groundwater Availability

1st ¶ - great

2nd ¶ - Keep the 1st 2 sentences. Delete the remaining sentences in this ¶ please. ~~We~~ In my opinion, we need to give a consistent positive analysis of desalination in our Reg. F especially in the San Angelo area. El Paso and Ft Stockton have ~~received~~ put this technology to use. It is my understanding that there are some good sources (not the regular Dockum) of "brackish" water in Tom Green Co. ~~that~~ whose elevation would allow the treated water to flow down hill. Ken Dier , DA Harrell, legislator Campbell and others not just from San Angelo have mentioned desalination as a top priority prior to our 2001 plan. Other test wells and salt disposal / evaporation need to be seriously studied.

Please double check all of our 2005 Chapters and discussions to make sure that some of the old 2001 printed words do not remain in the 2005 plan unintentionally. Much progress has been made for desalination.

P6

p. 3-27 - Existing Surface Water Supplies

out of my league

1st ¶ - after 2nd sentence - please consider an additional sentence. "However a high percentage of the towns within the 32 co. region indeed do obtain their municipal water from groundwater as well as numerous rural homes, domestic livestock & wildlife.

Please ask Caroline Runge about the "run-of-the-river" water rights - Does Menard city depend heavily upon this?

Thank heaven Jon Albright and John Grant have done a good job of explaining and starting negotiations to point out the problems with the State's new Colo WAM. Once again figures have been used to give a slanted or incomplete analysis.

p. 30 - Run of the river. Has Caroline for Menard and possibly Junction had a chance to address this WAM issue? We remember Jon & Haygood talking about something along here.

p-3-32 - Alternative Water Supplies - "well done"

p 3-33 - It is good to see Desalination issues being addressed across the state by legislators, TWDB, TCEQ & local communities including the Midland Country Club and private businesses

p. 3-35 - Use of reclaimed water - More recognition

* needs to be given to Midland and Odessa & we're glad that San Angelo and San Antonio are moving on this - Does the City of Sonora and Winters & others need to get on list?

City of Winters ~~uses~~ reuses some water for agriculture also. See Table 3-5. Or is "Landscape irrigation" for Winters & Synder another word for "Agriculture" like w/ Monahans, Midland and ~~San~~ Angelo.?

* P-3-36 - 1st ¶ Should we small town folks be looking at this re-use program. All water conservation adds up.

2nd ¶ "Supplies for L/S (livestock) in Reg F come primarily from private stock ponds ---"
* I doubt if this is true. Something needs
? to be said or validated. Reg F is basically (excluding Coleman & Brown Co) known as a semi arid area that did not develop ranching wise until water wells were drilled.

P. 3-36 - Water Availability for Water User Group
? last ¶ - 4 primary reasons for overall supply decline. Reasons 3) & 4) do not seem right to me
3) We are suppose to conserve water for the future generations & ~~too~~ our water management map shows leaving at least 25% in 75 or 100 years for Winkler & Midland Co. - Yet we ~~are~~ ~~mentioning~~ appear to be approving the depletion of a well field in another County. - This was mentioned in a previous comment.
4) "decline in demand, particularly for irrigation demands"

more to follow

to John Albright

4) "decline in demand, particularly for irrigation demands" but other charts show the year 2060 still having the same demand supplies as 2010 even though irrigated acres have been reduced and/or improved pivots and drip irrigation have been implemented. (that big ~~whole~~ wide spread sheet not found right now)

But look at Table 3-6 (Mar 2005) - p. 3-37 (Available water supplies)

Only 3 or 4 counties show a significant decline

1) Midland from 69,000 down to 46,000 - because their CRMWD contract will have expired but surely it will be worked out. Is the decline because of lost population or great conserva.?

2) Reeves down from 74,000 to 65,500. Why?

3) Ward " " 16,200 to 10,300 Why?

4) Upton remains the same @ 10,500 even though they are 1 of 3 co. in our region that needed to be placed in a management priority area because they were going to run out of water. _____ + _____ were also placed in this category

x Who produced this chart? Why are we doing this planning for 50 years when the chart shows very little growth or decline?

Tell us again what does "available" mean in this chart? Where is all of the talk about conservation, depletion of irrigation water in certain co, desalination, improved technology and drip irrigation taken into acct. even if the municipal population and possible demand usage were to double. And mining of water decreases as petroleum reserves decrease in 50 years.

~~We~~ We are told by the state, that we rural regional planners cannot count our absentee land owners who may drill extra wells for the numerous smaller tracts of land. Livestock numbers ~~and~~ ~~to~~ will decline but an increased emphasis on wildlife will not use any more water unless grandiose green yards, ~~and~~ vanity ponds & swimming pools are allowed to override local water district guidelines. ~~Do~~ we remember the family who made comments at the 2001 Odessa public hearing? Their livestock (& possible wildlife) did not have consistent water as water levels had dropped due to the surrounding 'green' ranchette homesites with their domestic wells. Thank heaven the state legislators did vote to limit ~~the~~ (under certain circumstances) the domestic wells to 10 Ac or more. As the citizens around Blanco and San Antonio found out a few years ago that numerous domestic wells can indeed lower ~~to~~ water levels in some areas more than irrigation wells that are critized by some. Please excuse me for getting off of the facts and preaching to the choir. But what appears to be a lack of current facts & extrapolation, that may be faulty, is disturbing to some of us country folks.

P. 3-38 CRMWD – what % of groundwater is used to what many of us commonly think of as surface water? ~~Is~~ much CRMWD water used for irrigation or domestic livestock? Lake Brownwood does provide irrigation water.

P. 3-39 - Great Plains Water System -
Can Andrew V tell us how much water the steam electric operation in Ector Co. will use? How much is used for the oil & gas meeting? Concern was expressed by others @ our Jul or August '05 meeting.

P 3-45 - ~~1st~~ Ag Drought in Region F.
1st sentence - please add --- acc. losses to farmers, ranchers "and to their communities and regional industry infrastructure."
Some where in the drought discussion it should be considered to point out that "since May 15, 2003 through the fall of 2005 above average rainfall has blessed the majority of Region F ag. industry. Livestock prices for all species and wild life leases have been at upper limits which is very unusual. These extreme conditions within the past decade simply point out that long term planning is important. Many of us actually think that the population and water demands will actually increase more than the demographic experts predict. Water ~~needs to be~~ supplies need to be enhanced, preserved and respected for future survival and growth that is inherant (sp?) with our varying climatic and economic conditions. Wildlife has expanded due to our developed ground water system. Let us not forget that most of Region F ~~has~~ is between the top 2 Tourist attractions in TX — the Big Bend Park & San Antonio including the beautiful Caverns of Sonora with more different

'to show that our 2005 plan is based on recent conditions also.)

living formations than any known caverns in the world. Interstates 10 & 20 traverse our region. ~~Improved~~ Improved technology has certainly helped to re activate the oil & gas industry in the last three years - as has the alternative wind energy projects. (~~see p.~~ Even if exploration slows down, modern infrastructure has been constructed to house and service the maintaince. Unemployment is possibly at an all time low in many communities.

last ¶ (see p 3-48 - Socio Eco Drought) This is why desalination, brush control, and weather modification are considered important tools to help remove the uncertainty about water supplies for current and new industries.

p. 3-48 - Potential Enviro ~~Impacts~~ of Droughts in Reg F.
You have brought out good ~~points~~. Let's face it, except for the extreme elements on both ends of the enviro issues, most citizens and stewards of the land are seeking a balance that respects property rights, human and animal life ~~with~~ of all types and proper care of the soil, vegetation, water and air. Most cities are looking for long term, diverse sources of water w/ conservation principles.

last ¶ end of chap 3 - more to follow! P 3-49 - Our 32 co. region is too large and diverse to make general statements about the good & bad times. 14% seems low for certain counties and lakes. What does the monitor wells data collected by TWDR in the last 45-50 years tell us?

From: Caroline Runge [mcuwd@verizon.net]
Sent: Wednesday, October 26, 2005 1:58 PM
To: Jon Albright
Subject: Comments on Region F IPP

Jon,

Table 1-10 on page 1-31 still has 427 of municipal water source as groundwater which is, in fact, surface water (Menard has WR No. 14-1802 for 1016 acre-feet).

You have it correct in the water managment strategy section pp. 4-73 through 4-79 (which section is well done, by the way).

Thanks!

Caroline

P. S. All your responses to comments look good to me...

Texas Wildlife Association

"Working for tomorrow's wildlife ... TODAY!"

401 Isom Rd., Suite 237 • San Antonio, TX 78216 • 210/826-2904 • 800/839-9453 • FAX 210/826-4933

September 21, 2005

Mr John Grant
Chairman, Region F Water Planning Group
Colorado River MWD
P.O. Box 869
Big Spring, Texas 79721-0869

Dear Mr. Grant:

Thank you for leading Texas' vital water planning efforts. At the Texas Wildlife Association (TWA), we support customized solutions created as close to the affected resource as possible; therefore, we appreciate your planning committee's ongoing commitment to the resources in your care.

The TWA is a non-profit organization representing private land stewards, land managers, hunters and anglers from across the state of Texas. Our members care for and control more than 30 million acres of rangeland and wildlife habitat that are key components of Texas' upstream watersheds. The involvement of private land stewards is critical in establishing Texas' long-term water policies.

As you finalize your regional plan, we would be remiss if we did not bring voluntary land stewardship to your attention again. The relationship between the land's condition and the quality and quantity of water available to Texans is inextricably linked. In fact, good land stewardship encompasses a myriad of activities far beyond brush control. (For an all-encompassing definition and discussion of land stewardship, please see the attached Handout A and the November 2005 edition of "At Issue" written by Robert L. Cook, Executive Director of the Texas Parks & Wildlife Department.) Private landowners who optimize the condition of their land are effectively engaged in water ranching, in addition to the more visible activities of raising cattle or managing wildlife.

Open space land is Mother Nature's sponge, capturing water for both our underground and surface supplies. The land's condition determines how much water is captured for our aquifers, rivers, lakes, streams, bays and estuaries or how much water is lost to detrimental run-off and evaporation.

Incorporating good land stewardship into any water plan makes sense because, voluntary land stewardship is:

***Complementary:** Optimizing the condition of Texas' rural water catchments (also known as watersheds) ensures the increased effectiveness of any other water supply strategies that may be implemented. Years of scientific research has shown that effective, efficient rural water catchments will provide more water, better water and more options for water planners. Good land stewardship is the foundation upon which all other water supply strategies should rest.

***Cost-effective:** Improving the condition of the state's rural water catchments is relatively inexpensive. The cost for generating additional water through voluntary land management practices is dozens of dollars per acre-foot, and sometimes it's no-cost. Other proposed methods generate additional water at the cost of hundreds or thousands of dollars per acre-foot.

***Sustainable:** Responsible, voluntary land stewardship is a sustainable practice. Once people begin to implement the best management practices necessary to optimize the range in their particular location, those practices can continue uninterrupted.

***Efficient:** Good, voluntary land stewardship does not make more rain; it just makes the most of what we receive. Obviously, a well-managed landscape with 75 percent rainfall efficiency captures more usable water than a poorly managed one with 25 percent efficiency. With 75 percent rainfall efficiency, the landscape could benefit from increased water percolation and vigorous plant performance. With 25 percent rainfall efficiency, the landscape will operate under drought conditions even in years with normal rainfall.

***Environmentally Sensitive:** Good, voluntary land stewardship practices not only optimize the rural water catchments, but also provide exceptional wildlife habitat while conserving our state's remaining open space land. Good, voluntary land stewardship solves problems rather than creates them.

***Multi-faceted:** Good, voluntary land stewardship practices are not a "one size fits all" proposition. Each ecological region may require a different set of management practices to achieve the best results, and we will see more immediate results in some ecological regions than in others. Fortunately, this creates a great deal of flexibility, allowing prioritization and long-term planning.

While brush management can be part of good land stewardship, it is not the only option for rangeland management and improvement; therefore, Best Management Practices (BMPs) should be part of any cost-share, public-private program and/or contract. The BMPs should consistently include range re-seeding and livestock deferment to successfully establish native vegetative stands as well as good follow-up grazing management.

***Governable:** In order to promote even better land stewardship, policy makers should consider implementing Best Government Practices (BGPs). BGPs, as used in other states, provide a wide range of options that might include: increased cost-shares at targeted, prioritized water enhancement sites; increased technical assistance in range and wildlife management planning; a system of Purchases of Development Rights to keep priority properties together under good management; and reduced valuations, tax breaks, or other incentives for participation in water enhancement management practices.

Voluntary land stewardship is the logical place for water management to begin because land stewardship affects the water supply at its origins, not just at its destination. We find it difficult to understand why people charged with water management focus their efforts on destination and demand, while virtually ignoring the issues of origination and supply. If we maximize the effects of the rainwater that falls from the sky, then the answers to questions of demand are much more easily answered.

Water harvesting provides one example of water-induced tunnel vision. In most water plans, a great deal of space is dedicated to water harvesting, collecting the rainwater that falls on roofs – roofs that are generally measured in square feet. But yet, these same plans ignore the millions of acres of "unroofed" rangeland that are the foundation for the region's water catchment. Why? The rainwater harvested from rural grasslands, savannahs, forests, and wetlands is not as easily visible as that collected from urban rooftops.

Ground and surface water supplies originate with the rain that falls on the land and is captured by a complex, large-scale process involving plants, soil and animals. When the process functions optimally, floods are reduced, aquifers are replenished, and water is released more slowly and steadily into streams, rivers, lakes and eventually our bays and estuaries. If the land is in good condition, the quality and quantity of water – both surface and underground – available to citizens reflect that condition. When the process is working well across millions of acres of open, rural land the contribution to the state's water supply can be tremendous.

Interestingly, when conscientious land stewards ably manage their resources as they do every day, they are ranching water just as surely as they are ranching cattle, sheep, goats or wildlife. Unfortunately, this contribution is overlooked or misunderstood. We must include voluntary land stewardship – on a grand scale – as one of the foundation solutions for water issues in Texas.

When it comes to water policy, good land stewardship is like the first step on a staircase. The staircase will stand if you remove the last step, a middle step or even the second step, but the staircase will come crashing down if there is no first step. Please help Texas ensure that this very vital first step is in place as the foundation of planning for our future.

To help you incorporate voluntary land stewardship into your plan, we have taken the liberty of enclosing our report, "Texas' Looming Water Crisis: Recognizing Land Stewardship's Untapped Potential," which we believe would fit your purposes well. Please use the information to help Texans secure their future.

If you have any questions, please do not hesitate to contact us using the information below.

Yours for a clean and enjoyable outdoors,

Kirby L. Brown
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Texas Wildlife Association
401 Isom Road, Suite 237
San Antonio, Texas 78216
Office: 800/839-9453 x 125
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Mobile: 210/827-0306
Email: dkl@texas-wildlife.org

From: avalenc1@txu.com
Sent: Tuesday, September 06, 2005 12:22 PM
To: Jon Albright
Subject: General Comments on Region F IPP

Jon,

I have a couple of general comments on the Region F IPP. They are semantic in nature, but still should be corrected.

Ø On Table 1-8, Champion Creek is used for fishing and boating. Even though the lake is very low, there is still a fair amount of utilization. The City of Colorado City also has a park which includes overnight camping.

Ø In section 7.4, paragraph for "Parks and Public Lands" on page 7-5, there is no mention of Lake Colorado City State Park. That would bring the number of state parks in Region F to five.

Regarding Section 4.5, I am in the process of drafting some proposed changes. I'm working with some TXU people and I'm also trying to make contact with an individual from AEP who left me a voice mail. Would it be possible to get a copy of that section in Word format (pages 4-133 through 4-140)? That would make it much easier for me to send you changes.

Thanks,

Andrew Valencia

TXU Power

From: avalenc1@txu.com
Sent: Tuesday, October 11, 2005 2:24 PM
To: Jon Albright
Cc: jgrant@crmwd.org
Subject: Region F IPP - Steam Electric Comments

Attachments: SE Supply vs Demand w Subordination Proposed Strategy October 11, 2005.xls; Region F DRAFT Chapter 4c 7-26-05 Valencia Comments on Section 4.4 October 11, 2005.DOC; ATT2179954.txt

Jon,

As a result of the concerns expressed at the last planning group meeting, I went back and reviewed Section 4.4 of the IPP. In order to accurately reflect the proposed strategy, I suggest taking out all reference to “advanced generation technology” and replace it with “advanced cooling technology”. The ACC technology can be applied to any proposed steam electric generating cycle regardless of the fuel type. An existing facility could be retrofit with this technology as well.

With regard to the very large capital cost that everyone was concerned about, I went back and reviewed the basis on which the costs were determined. The costs reflected in the IPP included not only the incremental cost of the ACC technology, but also the cost of the new generating capacity. The only thing that should to be included in the plan is the incremental cost. It is still high, ~$600 million cumulative, but it is significantly less than the nine figured number in the plan. Additional, this methodology does not limit the type of plant that could be built in the future.

Attached are two files. One is the spreadsheet I sent you a while back, revised to correctly reflect the dollars required for ACC technology. The second is Section 4.4 of the IPP with some suggested revisions. I did not review the entire plan for changes that may need to be made as a result of my comments. I am going to be out of the office from October 14 – 24. Don’t hesitate to call if you have any questions on any of this information.

Thank you,

Andrew Valencia

TXU Power

Appendix 10B
Response to Public Comments

Appendix 10B: Response to Public Comments

Mr. Gene E. Hackler, City of Andrews

Desalination Strategy

Summary of Comment

Include desalination of brackish groundwater as a strategy for the city.

Response

Incorporate desalination of water from the Dockum aquifer as a strategy for the City of Andrews. The well field will be located near the city's existing Ogallala well field in northern Andrews County. Disposal of brine waste will occur at a nearby oil field. Transportation will use the city's existing pipeline to the city. The capacity of the plant will be 1 MGD.

A strategy description for Chapter 4 and costs of the strategy are under development.

City of Austin – Teresa Lutes

Ms. Lutes sent a letter encouraging Region F to continue pursuit of the subordination strategy after the current round of planning is finished.

Response

Region F intends to pursue additional studies and implementation of the subordination strategy after the current round of planning.

Colorado River Municipal Water District – C. Wingert

Text in *italics* are questions, comments, or requests to add additional information.
Text underlined are suggested additions.
Text is ~~strikethrough~~ are suggested deletions.

Chapter 1:

Fig. 1-1 *Add a label for Natural Dam Lake on the map.*

Response

Add a label for Natural Dam Lake.

Table 1-4 *What is the Year 2000 Use for Champion Creek Reservoir? Add a footnote if the data is unavailable.*

Response

Add the following note to the table:

Use is total consumptive use from both Champion Creek Reservoir and Lake Colorado City.

Fig. 1-8 *Does the bars for 1986-88 on the* "flow at Beals Creek near Westbrook" *graph include the spills out of Natural Dam Lake? These should be taken out or footnoted*

Response

Add the following footnotes to Figure 1-8:

Natural Dam Lake, which is above the Beals Creek gauge, spilled intermittently during 1986 and 1987. Natural Dam has subsequently been improved so that spills from the lake will not reoccur.

Fig. 1-9 *Has the* "Seasonal Median Flow at Beals Creek near Westbrook" *been adjusted to remove the '86-'87 spills from Natural Dam Lake? If not, add a footnote to explain.*

Response

Add the same footnote as Fig 1-8.

Table 1-5 *Why is the 1999 Ector County water use shown as 16,580 acre feet? This is about half of the previous year. Also, the District delivered 23,130 acre feet to Odessa alone during FY 99.*

Response

There appears to be a problem with the historical data from TWDB for 1998 and 1999. Updated data has been requested from TWDB.

Table 1-5 *Similar question for Midland County. Why did use drop by 33% between '98 and '99?*

Response

There appears to be a problem with the historical data from TWDB for 1998 and 1999. Updated data has been requested from TWDB.

Table 1-8 *Ivie Reservoir has a pavilion area. Add an* "X" *to the box.*

<u>Response</u>

Add a pavilion for Ivie.

Page 1-27 *4th sentence: Add* "primarily due to unusually hot, dry weather experienced with the current drought".

<u>Response</u>

Add to report.

Page 1-32 *After the 6th sentence: Add a sentence stating how much water Sweetwater usually transfers to Region G on an annual basis*

<u>Response</u>

Add the following sentence on page 1-32:

The City of Sweetwater used an average of 3,000 acre-feet per year from Oak Creek Reservoir between 1980 and 2000.

Table 1-11 *Why is the Ivie Reservoir water right listed in Coleman County? The diversions are in Concho and Runnels (?) counties.*

<u>Response</u>

The TCEQ Water Rights Detail, which is the basis for this table, lists Ivie Reservoir in Coleman County. The reservoir itself is in Coleman, Concho and Runnels Counties. A note can be added to the table explaining that reservoir water rights may be located in multiple counties.

Page 1-42 *Was Spring Creek Springs really used by the U.S. Cavalry in the late 1940s? Maybe it was the 1840s.*

<u>Response</u>

The correct date is 1840s.

Table 1-14 *Is there really no crop land in Pecos County? What about the Belding Farms area near Fort Stockton?*

<u>Response</u>

There appear to be problems with the data in this table. A new table will be generated.

Page 1-53 *Should the wholesale water provider list include: Millersview-Doole Water System, the City of Big Spring (for sales to Howard Co. Water Improvement District No. 1, and the City of Snyder (for sales to Roby, Rotan, and Fluvanna)?*

<u>Response</u>

Wholesale Water Providers is a TWDB designation for entities that have wholesale contracts to sell more than 1,000 acre-feet of water. These entities do not meet the TWDB requirements for a Wholesale Water Provider. No change needed.

Page 1-53 *2nd paragraph, 3rd sentence:* "as well as several smaller cities in Ward, ~~Ector~~, Martin, Howard, and Coke Counties." *The only city the District supplies in Ector County is Odessa.*

<u>Response</u>

Delete Ector from the list.

Page 1-56 "Prior to the Senate Bill ~~One~~ 1…" *Change to the* "1" *to be consistent with other text.*

<u>Response</u>

Change to Senate Bill 1.

Page 1-57 *Bullet on Fisher, Ivie, and Spence:* "The proposed improvements include a parallel pipeline…" *This pipeline has been installed. The text should be revised to reflect this.*

<u>Response</u>

Change sentence to read:

The proposed improvements included a parallel pipeline and a new pump station. The new pipeline has been constructed.

Page 1-60 *Consider adding a paragraph on the two TMDL programs to the section describing* "Other Water-Related Programs".

<u>Response</u>

FNI recommends adding the following text:

The TCEQ administers a Total Maximum Daily Load (TMDL) Program for surface water bodies in the state of Texas. In this program, water quality analyses are performed for water bodies to determine the maximum load of pollutants the water body can handle and still support its designated uses. The load is then allocated to potential sources of pollution in the watershed and implementation plans are developed which contain measures to reduce the pollutant loads. The Implementation Plan for Sulfate and Total Dissolved Solids (TDS) TMDLs in the E.V. Spence Reservoir (Segment 1411) was established in August 2001, and the TCEQ is currently analyzing the Colorado River below E.V. Spence Reservoir (Segment 1426) for chloride, sulfate, and TDS concentrations. Additional information may be found in Section 1.7.

Page 1-62 *Add sentences:* "Partial funding for weather modification programs was provided by the Texas Department of Licensing and Regulation, and its predecessor agencies for many years. This funding ended in October, 2004."

Response

Add to plan.

Page 1-62 *Sec. 1.7.1* – "Threats to water supply in Region F include the use of the TCEQ Water Availability Model (WAM) Run 3 for regional water planning and water quality concerns" *I didn't think the WAM addressed water quality.*

Response

Change the sentence to read:

Threats to water supply in Region F include:

- *Use of the TCEQ Water Availability Model (WAM) Run 3 for regional water planning,*
- *Water quality concerns in several areas of the region, and*
- *The impact of on-going drought.*

Table 1-19 *Spence Concern Location:* "Main pool near dam; Remainder of the reservoir" *should be changed to* "Entire Reservoir".

Response

Add suggested change. Resolution status should be changed as well.

Table 1-19 *Are you sure Segment 1421 was identified as a concern for chloride, sulfate, and TDS in the finished drinking water?*

Response

Update table with information from draft 2004 303(d) list.

Table 1-19 *A TMDL has been completed on Segment 1426. Implementation Plan is underway.*

Response

See above comment.

Page 1-65 Add language in sentence: "However, *because of its improper assumptions* the Colorado WAM indicates that almost all of the major reservoirs in

Region F have little or no reliable supply, contrary to previous water plans and recent historical experience." Add spaces before sentence.

Response

The assumptions used in the TCEQ WAM are proper in the context of water rights permit applications, but they are improper in the context of regional water planning in the Colorado Basin. FNI suggests adding the comment leaving out the word 'improper'.

Page 1-65 Revise Sentence: "Much of this history deals with the same issues of impacts of upstream development on downstream water rights." *"Much of this history deals with the same issues, including the impact upstream development may have on downstream water rights".*

Response

Change sentence as suggested.

Page 1-65 *Last sentence, before the Rio Grande Basin Water Quality: Add the following:* "It also forces an overestimation of water needs within Region F, and a corresponding underestimation of the future water needs in Region K, downstream."

Response

Add comment.

Page 1-67 *6th sentence under the Hickory Aquifer section:* "Problems that have yet to be resolved in utilizing these techniques are the storage and disposal of the removed radioactive materials *left over from the water treatment process….*

Response

Add comment.

Table 1-20 *For Segment 1411 add* "EPA approved the plan in May, 2003" *to the "Date" column*

Response

The information in Table 1-20 is out-of-date. FNI suggests deleting Table 1-20 and adding the descriptive information in the table to the text of the document.

Page 1-70 *Add the following at the end of the 2nd paragraph in 1.7.2:*
"Also, many of these smaller communities have experienced declining populations in recent years. More than one-half of the counties in the region have a population less than 5,000 people. These smaller counties lost 1.7% of their population during the last 10 years. Thus they are ill equipped to

afford the high cost of advanced water treatment techniques, given their declining revenue base."

Response

Add comment

Page 1-70 *After the last sentence at the top of 1.7.2, add:* "Also, finding as suitable means of disposing the reject concentrate from a proposed treatment plant may limit the feasibility of such projects in many locations".

Response

Add comment.

Page 1-71 *Add the following to the second from the last sentence in the 1st paragraph*: "These practices lead to the possibility of leaks into water supply aquifers since the hydraulic pressure of the injected water routinely exceeds the pressure needed to raise the water to the ground's surface.

Response

Add comment.

Chapter 2:

Page 2-10 4th sentence below "Per Capita Water Use Projections": "This definition of per capita water use does not include water used for manufacturing… *Does it include manufacturing that is sold through a municipal meter (such as the Big Spring Refinery)? If so, maybe further explanation is needed.*

Response

The type of meter is not important to the demand calculations. Although some low water use manufacturing demands may be included in municipal projections, large water use manufacturing processes are considered separately. No change needed.

Table 2.7 *How can the Manufacturing Water Demand for Howard County increase by 15% from 2030 to 2060 while the population decreases by 3%?*

Response

The following response is from Dan Hardin of TWDB:

"Manufacturing demands were projected as a function of expected industrial efficiency gains, expected regional and national demands for particular product lines, and a number of other factors. It is possible that industries could experience an increase in their demand for water without the need to increase employment, and while minor declines in the population base might be observed."

Page 2-24 *Add Millersview-Doole Water Supply Corporation to the list of wholesale water providers since they sell to Paint Rock and others. (Similar comment in Chapter 1)*

Response

Millersview-Doole WSC is not a Wholesale Water Provider (see above). No change needed.

Chapter 3:

Tab. 3-1 *Ward Co Cenozoic Pecos Alluvium shows 17,288 ac-ft per year. District's study shows a total of 741,400 ac-ft in two existing well fields. Dividing the total by a 30 year production period = 24,713 ac-ft per year, for those two well fields alone.*

Response

The following response is from John Ashworth:

"The IPP availability numbers are based on drought-condition recharge and a percentage of water in storage depleted over 50 years. This formula results in a very conservative estimate of annual availability. I have no doubt that a well field evaluation based on average recharge and extraction over 30 years would generate a larger quantity."

No change needed.

Fig. 3-4, 3-5 *How can Well 27-59-903 rise and Well 27-62-801 drop?*

Response

Well 27-59-903 is an industrial well in the western part of the county where the aquifer is not heavily used. Well 27-62-801 is an irrigation well in the eastern part of the county where the aquifer is heavily pumped. The problem is that Figure 3-5 is not correct. The well hydrographs are correct but their location leaders are off. A new version of Figure 3-5 has been developed which shows that the two wells are not in close proximity.

Page 3-23 3rd Paragraph: "The chemical quality of groundwater in the Lipan aquifer generally does not meet drinking water standards due to excessive nitrates, but is suitable for irrigation." *Explain why the standards aren't met.*

Response

Change paragraph to read:

The chemical quality of groundwater in the Lipan aquifer generally does not meet drinking water standards, but is suitable for irrigation. In some cases Lipan water has TDS concentrations in excess of drinking water standards due to influx of *water from lower formations. In other cases the Lipan has excessive nitrates because of agricultural activities in the area.*

Tab. 3-2 *What is the criteria for a "Major Reservoir". Where is this explained? Why is Balmorhea considered a major reservoir, but larger(?) ones like Mitchell Co. Reservoir are not?*

Response

Mitchell County Reservoir should be added to Table 3-2. The following note should be added to Table 3-2:

A major reservoir has more than 5,000 acre-feet of conservation storage.

Fig. 3-17 Since Balmorhea is considered a major reservoir, why is it not shown on this map?

Response

Add Lake Balmorhea to the map.

Page 3-38 Consider adding the following: Using the WAM for water supply planning tends to overestimate available supplies in the lower Colorado River Basin, while underestimating available supplies in the upper basin after the 1st sentence at the top of the page.

Response

Add comment.

Page 3-39 Next to last sentence in the 2nd paragraph: "However, the disposal of water from oil field operations, which is similar or worse in quality to the reject from desalination, requires a Class II permit…"

Response

Add comment

Page 3-49 Add the following sentence at the end of the next to last paragraph in 3.6.1. However, the PDSI is an indicator of an agricultural drought only. It has little relationship with a hydrological drought.

Response

Add comment.

Page 3-50 Add the following after the last sentence under the Meteorological Drought in Region F section: But the current drought appears more severe than the 1950's drought. Nine of the ten years during the current drought show rainfall less than the historic average. This occurred at no other time in recent history.

Response

Add comment.

Chapter 4:

Table 4.1-4 *University Lands shows a shortage in 2010. Is part of that shortage caused by the District's demand on the system? If so, is that same water also shown as a shortage in the CRMWD row?*

Response

The 2010 shortages for University Lands are the result of the expiration of contracts with the Cities of Midland and Andrews. The CRMWD contract expires in 2019. Once the contract has expired, it is not considered available for CRMWD customers and contributes to shortages beginning in 2020.

Table 4.1-4 *Is the City of Odessa's supply & demand also included in the CRMWD numbers? If so, we need to make sure the reader understands that.*

Response

The City of Odessa's supply and demand are included in the CRMWD numbers. Notes will be added to the tables identifying areas where supplies for Wholesale Water Providers overlap.

Table 4.2-1 *Are the "current" numbers used for the Firm Yield from WAM Run 3? Do these agree with the latest TWDB runs? Is the Run 3 model updated? (a question from the TWDB meeting)*

Response

The latest TCEQ WAM model with corrected flows was not available for use for any water availability analyses performed for this plan, including the subordination analysis. There is insufficient time to recalculate all yields. No change suggested.

Page 4-13 Add the following sentences at the end of the 1st paragraph: "This would indicate Region F needs to immediately spend significant funds on new water supplies, when in reality; the indicated water shortage is not there. Conversely, the WAM model shows a surplus of water downstream in Region K. Accordingly, one would think they would need no new water sources for the planning period when in reality they might."

Response

I don't think there is a surplus of water in Region K. FNI recommends the following language:

This would indicate Region F needs to immediately spend significant funds on new water supplies, when in reality the indicated water shortages are not justified. Conversely, the WAM model shows more water in Region K than may actually be available.

Page 4-20 2nd & 3rd sentences under the City of Ballinger section: "The city's primary source of water is Lake Ballinger / Lake Moonen. These lakes ~~Lake Ballinger has~~ have been heavily impacted by the recent drought."

Response

Incorporate comment.

Page 4-20 4th Sentence under the City of Ballinger section: "In 2003 the city completed a connection to the City of Abilene's ~~West Central Texas Municipal Water District (WCTMWD)~~ pipeline from Ivie Reservoir…"

Response

Incorporate comment.

Page 4-22 3rd sentence under the Subordination of Downstream Senior Water Rights section: According to the WAM ~~Lake Ballinger has~~ Ballinger's lakes have no yield.

Response

Incorporate comment.

Page 4-28 1st Sentence under Voluntary Redistribution: In 2003, the City of Ballinger completed a 10-mile pipeline to the ~~WCTMWD~~ Abilene pipeline…

Response

Incorporate comment.

Page 4-31 Add to Bottom of the page: "Reuse alone cannot meet the city's needs. Since the WAM shows no water available from the City's Lakes, no effluent would be available to reuse either without additional water from separate, new source. Reuse would have the advantage of "stretching" a low volume water source into one that could meet the City's full needs."

Response

This strategy assumes that, at a minimum, the subordination strategy is in place and water is available from Lake Ballinger. FNI suggests adding the following wording to the Significant Issues Affecting Feasibility section

The reuse strategy assumes that both the subordination and voluntary redistribution strategies have been implemented.

Page 4-33 Add to the bottom of the Water Conservation Savings paragraph: "Water Conservation alone cannot meet the city's needs. Since the WAM shows no water available from the City's Lakes, the City would be without water unless an alternative water source is found. Conservation would have the advantage of "stretching" a new low volume water source into one that could meet the City's full needs."

Response

See response for comment on page 4-31.

Page 4-42 Bottom of Reuse Paragraph: *Same comment as Ballinger's 4-31*

Response

See response for comment on page 4-31.

Page 4-44 Bottom of Water Conservation Paragraph: *Same comment as Ballinger's 4-33.*

Response

See response for comment on page 4-31.

Table 4.3-20 Add a space between $1,920 and per acre-foot.

Response

Correct spacing.

Page 4-60 Middle of the page: "Although Mountain Creek Reservoir is a relatively old structure, an inspection conducted as part of this plan found the dam and spillway to be in good condition". *The Texas Water Commission has considered the dam to be in poor condition in the past. Consequently, in the mid-1980's there were informal studies to identify a new reservoir site. What has changed?*

Response

Unknown. The 2004 inspection found the dam in good condition.

Page 4-74 *Why was Water Reuse not discussed as a strategy for the City of Menard?*

Response

The small city water reuse strategy only applies to cities that have a reservoir as part of its water supply. Menard does not have a reservoir.

Page 4-79 1st sentence under Quality, Reliability and Cost of ASR: "Treated surface water would be injected into the Hickory aquifer…" *Section 4.3.5 states Menard gets its water from "several wells near the banks of the San Saba River". Is this considered groundwater or surface water?*

Response

Historically the state has considered Menard's water supply to be groundwater under the influence of surface water. Therefore the city has a water right associated with its wells and a small channel dam near the well field. However, the state recently has reclassified the city's source of water as groundwater for regulatory purposes. On the other hand, the new Menard County Underground Water Conservation District management plan has provisions designed to protect surface water flows associated with Menard's municipal supplies.

After talking with Caroline Runge, we are proposing leaving the City of Menard's supply as surface water based on its historical classification, with notes indicating that this classification is for planning purposes only.

Page 4-80 Under Significant Issues Affecting Feasibility of ASR add: "The price to extract injected water from the proposed Hickory ASR project could be quite costly given the 3,000 foot well depth."

Response

Under Significant Issues Affecting Feasibility of ASR add:

The price to extract injected water from the proposed Hickory ASR project could be quite costly given the 3,500 foot well depth and possible deep static water level.

Page 4-84 Top 1/4th of the page – add the following after the McMillan Well Field sentence: "This field was used for Aquifer Storage and Recovery for many years, but has remained idle recently due to elevated concentrations of perchlorate found in the water."

Response

Add comment.

Page 4-87 Under Significant Issues Affecting Feasibility of T-Bar Well Field add: "Also, elevated chloride and TDS levels may be present in some or all of the future wells."

Response

Add comment.

Page 4-97 Middle of the page: "The City of ~~Menard~~ Coleman is a rural community."

Response

Correct document.

Page 4-103 *Why is Brady's GPCD demand so high (303)?*

Response

Unknown.

Page 4-115 *Why are the Total Capital Costs for CAX & R/O treatment the same?*

Response

RO costs should probably be a little higher than CAX. We will investigate and revise as appropriate.

Table 4.5-6 *Is the cost really expressed in "Cost/10,000 gallons"? Why not Cost/1,000 gallons to be consistent with the other tables?*

Response

Cost should be per 1,000 gallons.

Table 4.7-14 *In all cases the table shows an increasing need for mining water. The District has seen a decline in the demand for mining water in the past 10 years as water floods mature and operators switch to CO_2 injection. Long term, I would expect the area will see a decline in water demands as well.*

Response

According to Dan Hardin of TWDB:

"While the current demands may be considered high, they were the lowest of the various alternatives developed for the 2006 planning cycle. TWDB staff is currently conducting research to improve our capabilities of estimating and projecting future mining water use, and would be pleased to receive any comments and local knowledge that will assist in improving projections for future planning cycles."

Page 4-156 Last sentence in the 1st paragraph of 4.8.1: "…as well as several smaller cities in Ward, ~~Ector,~~ Martin, Howard, and Coke Counties"

Response

Correct document.

Page 4-178 Middle of the page: "Figure 1 is a schematic of the proposed project." *Where is Figure 1?*

Response

The figure was inadvertently omitted from the initial plan. A figure will be added to the final plan.

Page 4-181 Lower 2/3rds of the page: "For the purposes of this plan, it was assumed that ~~CMRWD~~ CRMWD will…"

Response

Correct document.

Page 4-195 Add another "bulleted point" at the top of page: The addition of McCulloch County water into the Ivie Pipeline may adversely affect the quality of water delivered to other District Member and Customer Cities.

Response

Add comment.

Chapter 5:

Page 5-6 Add to bulleted New Groundwater section: City of Eden – new Hickory aquifer well. *See page 4-111 and 4-112.*

Response

New groundwater is meant to describe a new source of water. An example would be San Angelo's McCulloch well field, which is not currently a source of supply for the city. The new well for the City of Eden is actually a replacement well for existing wells in the Hickory aquifer. We suggest renaming the Eden strategy to be 'replacement' Hickory aquifer well rather than a 'new' well.

Page 5-6 Second sentence under 5.3.3: The CRMWD project proposes to reuse a portion of the treated wastewater from ~~Big Spring~~ the cities of Big Spring, Odessa, Midland, and Snyder. The first phase of this project will likely involve Big Spring wastewater.

Response

Add comment. The Odessa/Midland and Snyder projects will be reclassified as recommended strategies.

Chapter 6:

Page 6-1 Add the following after the next to the last sentence in the last full paragraph: However, studies described in this report indicate irrigation demands may decline as much as 22% by the year 2020 and 43% by the year 2060. *See page 4-169*

Response

Add comment.

Page 6-2 Start a new paragraph with the last two sentences in the middle paragraph: ~~Likewise, irrigation conservation may result in significant reductions in water demand in the region.~~ Irrigation conservation can save the most water of any conservation method by far.

Response

Add comment.

Chapter 7:

Page 7-3 Next to last sentence in Voluntary Redistribution paragraph: *Add Ector and Andrews Counties to the list. Ector for the City of Odessa, the beneficiary of a new contract from University Lands for the Ward County Well Field. Andrews, for the City of Andrews, a beneficiary of a new contract from University Lands for their well field.*

Response

Add comment.

Page 7-5 Parks and Public Lands list: *add the Big Spring and Lake Colorado City State Parks to your list in Region F.*

Response

Add comment. Lake Colorado City and San Angelo State Parks may be impacted positively by the subordination strategy, whereas Lake Brownwood State Park may be negatively impacted. We suggest revising Chapter 7 to include this statement.

Chapter 8:

Page 8-6 Section 8.3.1 – end of 2nd paragraph: It its imperative that any changes to water rights, such as a change in use, or transfers of water or water rights out of the Colorado Basin do not impair existing water rights even if they are junior in priority. *Overall this is a very good section!*

Response

Add comment.

Page 8-7 3rd bullet: That no strategy for export of groundwater from a groundwater conservation district or from the region will be adopted until a comprehensive plan is in place to assure retention of adequate supplies of water within the district or region to protect existing economic enterprises including agriculture and support the foreseeable population growth and economic development so long as the groundwater conservation district or region applies the exact same rules and conditions, including fee structure, to both the proposed water exporter and all groundwater users residing within the borders of said district or region.

Response

Add comment.

Page 8-10 Section 8.3.6: Add bulleted item: Supports shorter term "interruptible" water contracts as a way to meet short term needs before long term water rights are fully utilized.

Response

Add comment.

Page 8-13 Section 8.3.10: Add bulleted item: TCEQ develop rules for disposal wells which would allow for the disposal of reject water from a membrane treatment plant through a well that is not classified as a "Hazardous Disposal Well".

Response

Add comment.

Page 8-16 Section 8.3.15: Add bulleted item: The clean-up and remediation of all contamination related to the processing and transportation of oil and gas. This includes operational or abandoned gas processing plants, oil refineries, and product pipelines.

Response

Add comment.

Page 8-17 Section 8.3.16: Add bulleted item: The use of higher TDS or inferior waters for electric generation when possible to maximize available fresh water sources within the region.

Response

Add comment.

Water Reuse should be considered as a recommended strategy.

Response

Change Odessa/Midland and Snyder reuse projects to recommended strategies

Proposed desalinization projects should also be included as a recommended strategy.

Response

Add Capitan Reef desalination project as a recommended strategy. The analysis will be based on a previous analysis of desalination from the Cenozoic Pecos Alluvium that was not included in the Initially Prepared Plan.

David Huie, Hickory UWCD

Concerns over Inclusion of Demands

Summary of Comment

Concern that San Angelo's McCulloch County well field and certain irrigation demands had not been accounted for in the Region F IPP.

Response

FNI has already contacted Mr. Huie and explained where the information could be found in the plan. Mr. Huie prefers to have his letter included in the plan, with a response indicating where the information may be found in the plan.

Summary of Comment

Concern that irrigation demand projections in McCulloch and Mason County are underestimated based on irrigation permits granted by the District.

Response

Based on TWDB rules, Region F cannot change demand projections at this point. However, it is appropriate to allocate supplies to irrigation based on permits. This change has already been made in DB07 and should be incorporated in the final Region F Plan.

Wendell Moody, City of Eden

Executive Summary

Comment

Page ES-3, ES.1.1, 1st paragraph, 2nd sentence – "precipitation increases from east to west", not from "west to east".

Response

Statement in IPP is correct. No change required.

Comment

Page ES –4, ES.2.1, recommend adding the following statement before the last sentence – However, the southeastern counties are experiencing an influx of residents and absentee landowners from urban areas.

Response

Add comment to final plan.

Comment

Page ES-8, ES.3.2, Costs associated with water quality standards should be in the Executive Summary that may be the only document some people read. In the 1st paragraph, recommend adding the following statement after the last sentence – "Small rural communities are required to expend limited public and private financial resources to meet water quality standards for arsenic, radionuclides, and secondary water constituents."

Response

FNI believes that this statement applies to all Region F communities regardless of size. We recommend including the following:

"Water quality is an important factor in Region F water supplies, particularly for municipal use. Communities in Region F are being pressured to expend limited public and private financial resources to meet water quality standards for arsenic, radionuclides, and secondary water constituents. Meeting these standards is particularly difficult for small communities in the region."

Chapter 4

Comment

Page 4-11, 4.2.2, last sentence – Cost estimates for Hickory users are not in Appendix 4F. Why not? They are useful.

Response

Cost estimates for Hickory users were inadvertently left out of the IPP and will be included in the final plan.

Comment

Page 4-110, last paragraph, 3rd sentence – "$1.47 per what"?

Response

Change sentence to read:

"In order to recoup production expenses, Richland SUD needs to charge customers $1.47 for every dollar spent to produce water."

Comment

Page 4-111, 2nd paragraph, 6th sentence – Is "central treatment alternative" the same as advance treatment alternatives (page 4-113)? Make use the terms are consistent.

<u>Response</u>

Change "central treatment" to "advanced treatment" in final plan.

Comment

Page 4-113, 1st paragraph, 2nd sentence – Does the $65 per month include "additional to the other costs" (page 4-115, 1st line)? Which treatment alternative is included, advanced?

<u>Response</u>

Change 2nd sentence on Page 4-113 to read:

"The combined costs of advanced treatment plus new wells could raise the average monthly bill to as much as $65 per household."

See comment on same sentence below for additional changes.

Comment

Page 4-115, 1st line – Does "additional to the costs already incurred by the City (Eden)" apply to the costs computed for all of the communities and alternatives? If it does, then the statement should be used with all communities and alternatives. If it does not, the narrative should so state.

<u>Response</u>

FNI believes that readers understand that all costs included in the plan are incremental and only apply to the strategy being described. Therefore the statement about additional costs is not necessary. We recommend changing the sentence at the bottom of page 4-114 to read:

"The projected costs do not include potential impacts on the wastewater treatment plant."

Comment

Page 4-117, 1st paragraph, 3rd sentence – Is the "$1.25 per 1000 gallons" include "additional to the costs already incurred" for Richland? This comment relates to the above comment.

<u>Response</u>

See above response. No change recommended.

Comment

Several comments made during the previous review dated July 2005 of the Region F 2006 Draft Water Plan addressed the need to discuss the impact of cost on rural communities. With the exception of the addition to Section 7.3, page 7-4, the impact of costs should be strengthened. This strengthened does not just apply to Hickory users, but to all rural communities in the region such as Robert Lee, Bronte, and even Ballinger. The cost of providing a reliable water source will make these small communities non-competitive with the large cities like San Angelo, Midland, etc. with respect of maintaining and attracting residents and small businesses. As pointed out in Section 7.3, costs will also negatively impact agriculture. The plan should point this out in “Agricultural and Rural Issues” and “Significant Issues Affecting Feasibility”, which will support Section 7.3. It is noted that redundancy occurs, but is recommended for the many and varied readers who may be interested in only certain sections. The following are additions to the two aforementioned sections to strengthen the impact of cost.

- Page 4-112, Agriculture and Rural Issues – Recommend the following rewrite: “Currently, no water from the Hickory aquifer is used for irrigation in Concho County. The new well will allow the City of Eden to continue furnishing financial, educational, medical, public safety, and agricultural services. Without these services, agriculture will suffer an increase in cost of doing business, a decrease in productivity, and loose of services that contribute to its overall well-being and safety. As a rural community, drilling a new well represents a significant burden on the public and private economic resources.”

<u>Response</u>

Add comment to final plan.

- Page 4-112, Significant Issues Affecting Feasibility – Recommend the following rewrite beginning with the last sentence. “…to as much as $65,00 per month. To fund both the well and treatment facility will expend public and private money needed for other services such as education, community health, public safety, streets, wastewater treatment, and recreation. The City is classified as economically disadvantaged.”

<u>Response</u>

Add comment to final plan.

- Page 4-115, Agriculture and Rural Issues – Recommend the following rewrite: “The costs of constructing a water treatment plant would present a significant financial burden for this small rural community. This burden will reduce the commercial validity of the City of Eden resulting a reduction in financial, educational, medical, and public safety services and needed agricultural products and supplies. Without these services, agriculture will suffer an increase in cost of doing business, a decrease in productivity, and loose of services that contribute to its overall well-being and safety.”

<u>Response</u>

FNI does not recommend adding strongly worded statements about economic impacts unless they are backed up by a study. Such a study is not feasible at this time. Therefore, we recommend the following wording on 4-115:

"The costs of constructing a water treatment plant would present a significant financial burden for this small rural community, potentially reducing funds available for financial, educational, medical, and public safety services and needed agricultural products and supplies. The local agricultural economy relies on these services. Without these services, agriculture may experience increased costs and loss of services that contribute to its overall well-being and safety."

- Page 4-116, Significant Issues Affecting Feasibility – Paragraph is good as written. Recommend the additional paragraph – "The increased costs to customers associated with advanced treatment will result in a decrease in water sales. A decrease in water sales requires an increase in customer cost. This spiral could ultimately lead to financial difficulties for the City's water system."

<u>Response</u>

See above for FNI concerns about strongly worded statements regarding economic impacts. FNI recommends the following wording on page 4-116:

"The increased costs to customers associated with advanced treatment may result in a decrease in water sales, potentially leading to financial difficulties for the City's water system."

- Page 4-117, Agriculture and Rural Issues – Recommend the addition to the 2nd sentence – "… or shallow wells for household and livestock water increasing the potential for human and livestock diseases."

<u>Response</u>

Add comment to final plan.

- Page 4-118, Significant Issues Affecting Feasibility – Recommend deleting the 4th sentence and adding the following paragraph - "The increased costs to customers will result in a decrease in water sales, creating a spiral that causes financial difficulties for the community's water system."

<u>Response</u>

FNI recommends keeping the statement about worker health and safety as an important issue for specialty media systems. See above for our concerns about strongly worded statements regarding economic impacts. We recommend adding the following sentence on page 4-118.

"The increased costs to customers may result in a decrease in water sales, potentially causing financial difficulties for the community's water system."

- Page 4-123, Agriculture and Rural Issues – Recommend the following change to the 2nd sentence – "… would reserve public and private funds for other uses such as improving educational and medical facilities, providing public safety such as fire protection, and promoting economic development leading to an increase of products and services needed in agriculture and rural communities."

<u>Response</u>

Add comment to final plan.

- Page 4-124, Environmental Issues – Recommend adding the following between the 1st and 2nd sentences – "A cluster cancer investigation was conducted by the Texas Cancer Registry of the Texas Department of Health and found that the cancer incidence and mortality in the area were within ranges comparable to the rest of the state. The Texas Radiation Advisory Board also expressed concern the EPA rules are unwarranted and unsupported by epidemiological public health data."

<u>Response</u>

Region F is tasked with developing a regional water plan that is consistent with existing laws and regulations. Therefore FNI does not recommend including strongly worded statements about public health in Chapter 4 of the Region F Plan. However, these statements are appropriate for Chapter 8, which includes policy and regulatory recommendations. FNI recommends adding the following statement to Section 8.3.10 (this will also address the comment by Ken Bull):

"Region F is concerned about enforcement of State and Federal regulations for radium in drinking water. A cluster cancer investigation was conducted by the Texas Cancer Registry of the Texas Department of Health and found that the cancer incidence and mortality in the area were within ranges comparable to the rest of the state. The Texas Radiation Advisory Board also expressed concern the EPA rules are unwarranted and unsupported by epidemiological public health data. Therefore, Region F recommends that the State require an oral ingestion study to determine the epidemiology of radium in potable water before enforcing minimum MCLs for radium."

We will need references for both statements.

- Page 4-124, Agriculture and Rural Issues – Recommend the addition to the 3rd sentence: "… for other purposes such as improving educational and medical facilities, providing public safety such as fire protection, and promoting economic development leading to an increase of products and services needed in agriculture and rural communities."

<u>Response</u>

Add comment to plan.

Chapter 6

Comment

Page 6-2, 3rd paragraph – Recommend adding the following sentence behind the 2nd sentence – “With reduced water use, customer costs will increase resulting in an undesirable spiral creating financial difficulties for the water supplier.”

Response

FNI recommends the following wording:

“Any water conservation activities should take into account the potential adverse impacts of lost revenues from water sales and the ability of communities to find alternative sources for those revenues.”

Chapter 7

Comment

Page 7-4, Section 7.3, 2nd paragraph – Recommend adding the following sentence to the end of the 2nd paragraph – “The Governors Office, the Texas Department of Agriculture, and U.S. Department of Agriculture are diligently working to assure the validity and sustainability of Texas agriculture and small rural communities.”

Response

FNI recommends the following wording:

“The Governors Office, the Texas Department of Agriculture and U.S. Department of Agriculture are working to enhance the validity and sustainability of Texas agriculture and small rural communities.”

Chapter 8

Comment

Page 8-13, Section 8.3.10, Water Quality – Use the policy statements (short version) agreed to during the meeting on May 23 in Big Spring.

Response

The text in Chapter 8 matches the May 23 policy statement with the exception that the statement regarding groundwater under the influence of surface water has been deleted. After discussions with Mr. Moody, he agrees that it is appropriate to delete that statement. No changes required.

Comment

Page 8-13, Section 8.3.10, Water Quality – Refer to Page 3-38, Section 3.3.1, last sentence. Recommend the additional water quality policy statement for inclusion in Section 8.3.10 – “ Region F recommends that TWDB revise its policy on requiring the use of secondary water standards, particularly TDS, for funding water projects. Meeting secondary water standards should be the option of local water suppliers who must consider local conditions such as the economy, availability of water, community concerns for the aesthetics of water, and the volunteer use of technologies such as point-of-use."

Response

According to Mike Lynn of the TWDB there is no specific policy regarding funding of water projects based on secondary water quality standards. However, TWDB does provide funding to communities to keep communities in compliance with TCEQ regulations, which includes secondary drinking water standards.

FNI recommends the following wording:

"Region F recommends that TCEQ revise its policy on requiring the use of secondary water standards, particularly TDS, when granting permits. Meeting secondary water standards should be the option of local water suppliers who must consider local conditions such as the economy, availability of water, community concerns for the aesthetics of water, and the volunteer use of technologies such as point-of-use."

Wendell Moody, City of Eden, Second Set of Comments

The following is a my response to your comments recorded in Draft Response to Comments on Region F IPP, October 18, 2005 -

- Page 6 of 10, IPP page 4-124 - Environmental Issues:
    - I will send you copies of documents that refer to the cluster cancer investigation and Texas Radiation Advisory Board by FAX . They are:
        - Letter from Michael Ford, Vice Chairman, Texas Radiation Advisory Board, to Robert J. Huston, Chairman, Texas Natural Resources Conservation Commission, dated May 6, 2002, 3 pages.
        - Summary of Investigation Into the Occurrence of Cancer, Concho, McCulloch, San Saba, and Tom Green Counties, Texas, 1990-1998, December 15, 2000, 17 pages.
        - News article, Brady Standard-Herald, Friday, September 17, 2004, TDH Report - Cancer Rates Normal for Area, 2 pages.

Response

Add these letters to an appendix and refer to them in Chapter 4 and Chapter 8.

- I agree that your drafted statement be included in Chapter 8. It belongs there. However, I do believe that a statement similar to mine or yours be used on page 4-124. It reinforces that the "No-Action Alternative" does not have any negative environmental issues such as public health.

<u>Response</u>

Add the following on page 4-124.

A cluster cancer investigation was conducted by the Texas Cancer Registry of the Texas Department of Health and found that the cancer incidence and mortality in the area were within ranges comparable to the rest of the state. The Texas Radiation Advisory Board also expressed concern that the EPA rules are unsupported by epidemiological public health data.

- Page 8 of 10, IPP page 8-13, Section 8.3.10, Water Quality:
    - Concerning the reference to TWDB, I found a reference stating that TWDB would not fund projects unless they met secondary standard. I am sure I didn't dream it, but a quick search did not found it again.
    - I did review 30 TAC Chapter 290, Subchapter F, Section 290.118 (page 76) which states that "secondary constituents apply to all public water systems". The executive director may approve the use of water that does not meet secondary standards until "such time as water of acceptable chemical quality can be made available at reasonable cost to the area(s) in question".

  Note: These rules apply to TCEQ, not TWDB.

    - I agree to using your paragraph with the following proposed change in the first sentence - "Region F recommends that TCEQ revise its policy requiring all public water systems meet secondary water standards. Meeting secondary water standards should ... ."
- General: I guess I will give on the "strongly worded statements" - changing "will" and "would" to "may" and "could". I appreciate your concern, but I believe this report should reflect the attitudes and experience of the region.

<u>Response</u>

None.

National Wildlife Federation, Environmental Defense and the Sierra Club

ES.1.3 Current Sources of Water

[1] Page ES-4: We commend the planning group for acknowledging the significance of numerous springs in the area that are important for water supply and natural resource protection.

<u>Response</u>

Thank you.

ES.2.2 Demand Projections

[2] Page ES-4: Region F has a 35% increase in total projected water use from 2000 to 2010. The initially prepared plan (IPP) indicates that this is a result of the year 2000 water use data being inaccurate due to drought and low crop prices. This is a drought-based planning exercise. If usage was reduced in 2000 due to drought, it seems that a recurrence of drought conditions in 2010, 2020, or beyond also would result in a reduction in irrigation usage. Some additional explanation should be provided about why it is appropriate to assume that irrigation use during future droughts would exceed irrigation use during the current drought to this extent.

Response

Modify the third sentence to read:

Region F believes that historical year 2000 water use for irrigation is not indicative of the potential for irrigation water use in the region. During the drought demand was suppressed because of low prices and reduced water supply. The adopted projections are an estimate of what the irrigation demand would have been with higher crop prices and sufficient water supplies.

ES.3.1 Conservation and Reuse

[3] Page ES-7: We strongly support water conservation efforts. We believe that significant additional savings can be achieved in particular through additional water efficiency measures for municipal water use. The second sentence in this paragraph indicates a potential savings of 115,000 acre-feet by 2060. However, Table ES-1 and Chapter 6 seem to indicate recommendations for only 91,000 acre-feet of savings. We assume that the additional 24,000 acre-feet of savings may result from alternative electrical generation technology. At any rate, additional explanation should be provided to explain this apparent discrepancy.

Response

The alternative generation technology (alternative cooling technology) is a water conservation strategy and has been included in the regional totals for water conservation strategies. Text describing the savings is already included in both the Executive Summary and Chapter 6 under discussions for water conservation strategies. FNI recommends adding the following statement to the Executive Summary, Chapter 6 and Table 4.10-1:

Alternative cooling technology is a water conservation strategy because it replaces a high water use technology, conventional steam-electric power generation, with a very low water use technology. Therefore this strategy is included in the total water conservation savings for the region.

ES.3.2 Recommended Water Management Strategies

[4] Page ES-8, Table ES-1: The Alternative Electrical Generation Technology has an extremely high cost associated with it. Two points should be considered here. First, it seems that this is the cost for developing new facilities that do not require additional water supplies. However, additional capital costs likely would be incurred even for expanding traditional generating capacity. As a result, it does not seem appropriate to count the full cost of the new facilities as being attributed to replacing water supplies. Thus, we believe some partitioning of these costs to reflect the incremental cost due to replacing water supplies may be appropriate. Second, the cost figures in this Table are almost 3 times more than the figures listed in Table 4.5-6. The reason for that difference is not apparent.

Response

Costs for alternative generation technology have been revised to reflect the incremental difference between that technology and conventional steam-electric technology.

CHAPTER 1: DESCRIPTION OF REGION

1.1.2 Water-related Physical Features in Region F

[5] We appreciate the inclusion of Figures 1-8 and 1-9 which provide useful information about streamflow patterns in the region.

Response

Thank you.

1.2 Current Water Uses and Demand Centers in Region F

[6] Page 1-19, 2nd paragraph: We commend the group on acknowledging the importance of water for recreational activities and for the health of fish and wildlife. We believe the health of those fish and wildlife resources also is important to economic activities in the region. Hunting, fishing, and nature-based tourism are increasingly important activities through much of rural Texas. As recognized by TWDB's rules, 31 TAC § 357.7(a)(1)(G), the health of businesses of those types, which are dependent on natural water resources (such as springs, streams, and lakes), are to be considered in the planning process. More can certainly be done in this respect, such as including recreation and instream flow uses as water needs to be planned for. We encourage the planning group to include these as water use categories and assess the extent to which those important needs can be met in the future.

Response

TAC 357.7(a)(1)(G) states:

"Regional water plan development shall include…social and economic aspects of the regional water planning area including information on current population and primary economic activities including businesses dependent on natural water resources, "

FNI believes sufficient information is already included in Chapter 1 to meet the requirements of TAC 357.7(a)(1)(G). Although Region F recognizes the importance of recreation and instream flows, TWDB does not have a requirement for evaluating recreation or instream flow needs, and these needs have not been quantified. Therefore, no change recommended.

1.3.3 Springs in Region F

[7] Pages 1-38 through 1-43: We commend the planning group and consultants for an excellent job in listing, describing and mapping the major springs in the region. As time and resources allow, it would be helpful to include more detail as to the current use of the springs by area wildlife, currents threats, if any, to individual springs, and, if possible, a forecast for the future. If the information is available, it also would be helpful to have additional discussion about the aquifer formations supplying the springs and about whether a groundwater district exists with authority to manage those aquifers. Finally, as time and resources permit, it also would be helpful to have information about lesser springs and seeps that nonetheless cumulatively serve important roles in maintaining surface flows or natural resources in the area. For example, on page 1-67 there is a reference to springs and seeps contributing to the flow of the Concho River near Paint Rock.

Response

At this time there is insufficient time or resources to address this comment.

1.4 Agricultural and Natural Resources in Region F

1.4.1 Endangered and Threatened Species

[8] Page 1-43: The description of natural resources in the region is incomplete. Simply listing threatened, endangered, and species of concern leaves a lot of species out. Many other species are economically important in the region. In particular, species that support hunting, fishing, and tourism merit discussion. Particular attention is appropriate for species that are dependent on surface water and springs. Key water-dependent habitats also should be acknowledged. For example, significant wetland areas should be acknowledged. They represent resources they could be significantly affected by water management decisions.

Response

Comment noted. No change recommended.

1.8 Water-Related Threats to Agricultural and Natural Resources in Region F

[9] Page 1-70: While it may be true, as the last sentence on this page states, that in most cases groundwater supplies have little effect on natural resources, there are many cases in which groundwater supplies do significantly affect natural resources through springs and seeps. In water-short areas of the state, such springs and seeps can be extremely important components of natural habitats.

Response

FNI recommends changing sentence to read (changes in bold type):

*In most cases, groundwater supplies **associated with irrigated agriculture** in Region F have little impact on natural resources.*

1.8.2 Water Related Threats to Natural Resources

[10] Page 1-71: In addition to increases in certain types of brush, other changes such as loss of native grasses and other plant cover from other causes also may be contributing to changes from natural hydrological patterns.

Response

FNI recommends changing second sentence in Section 1.8.2 to read (changes in bold type):

Many springs have dried up because of groundwater development, the spread of high water use plant species, such as mesquite and salt cedar, **or the loss of native grasses and other plant cover.**

CHAPTER 2: CURRENT AND PROJECTED POPULATION AND WATER DEMAND DATA FOR THE REGION

2.2 Population Projections

[11] Page 2.5, 2nd paragraph: This paragraph states that the counties in the eastern portion of Region F are seeing an influx of non-resident population from other parts of the state and that these people and their resulting water demand are not included in the TWDB approved projections. More information about this development would be useful here. Is this an influx of new permanent residents or primarily of folks with weekend homes in the area? It is not obvious why this population would not be reflected in census data and resulting population projections.

Response

As noted in the comment, the population is non-resident. This implies that they are not permanent residents, so they are not included in population projections. FNI does not believe that this paragraph needs further clarification.

2.3 Historical and Projected Water Demands

[12] Page 2-5: Two categories that can be included in this section (they are not required by the TWDB) are Recreational and Environmental water demands. These two uses are important to this region and the state and should be planned for as important water uses.

Response

Although Region F recognizes the importance of recreational and environmental water needs, these demands have not been quantified for Region F. No change recommended.

2.3.1 Municipal Water Demand Projections

[13] Page 2-10: It would be useful to include a Table showing gpcd water use by WUG and by decade in conjunction with this section or in the appendix. It is helpful to have these data for reference purposes. In particular, the information is useful for helping the public to appreciate the potential for water savings through efficient plumbing fixtures.

Response

GPCD data may be found in Appendix 2B Table 2B-2. Potential water savings for plumbing fixtures may be found in Table 2-6. No change needed.

[14] Page 2-11: The footnote to Table 2-4 referenced by an asterisk "*" is pretty difficult to understand. Further explanation of that adjustment would be helpful.

Response

The adjustment is explained in text above the table, in the paragraph beginning at the bottom of page 2-10. FNI recommends changing the heading from "2000" to "Base" and adding an explanatory note at the bottom of the table.

[15] Page 2-13: This section includes Table 2-6 "Expected Savings from Implementation of Plumbing Code for Region F Counties." This is useful information to include.

Response

Thank you.

[16] Page 2-14: As noted above, the fact that irrigation water use was down because of drought conditions in 2000 does not seem like a good reason to reject those figures as the basis for predicting drought-year irrigation demand. If usage was reduced in 2000 due to drought, it seems that a recurrence of drought conditions in 2010, 2020, or beyond also would result in a reduction in irrigation usage. Because the planning process is a drought-based planning exercise, it seems appropriate to consider such drought-year demands in making projections. Based on Figure 2-5, the projected demands seem quite high in comparison to recent average use. Similarly, in looking at Table 1-9, surface water use for irrigation in 2000 does not appear to be out of proportion to surface water use for irrigation in other recent years.

Response

See response to item [2] above. No change recommended.

2.3.4 Steam Electric Power Generation

[17] **Page 2-19**: We acknowledge that these projections came from TWDB. However, they seem quite high. Population in the region is only projected to grow about 17% from 2010 to 2060 and manufacturing demand in the region, which is small to begin with, is only projected to grow about 36% over that same period. These are the categories that are most likely to drive demands for electricity. By contrast, water demands for electrical generation are projected to grow by 98%. That level of projected increase in steam electric generation demand seems unjustified.

Response

Comment noted. Region F cannot change TWDB-approved projections. No change recommended.

CHAPTER 3: WATER SUPPLY ANALYSIS

3.1 Existing Groundwater Supplies

[18] Page 3-2: The plan states that the availability volumes listed in Table 3-1 represent an acceptable level of aquifer withdrawal in each county based on policy decisions that attempt to maintain water levels in the aquifers at desired levels. It also states for the counties not governed by a groundwater district, aquifer availability is based on historical use trends. It seems that continuation of historical trends may not necessarily be consistent with achieving a desired future state for aquifer levels. It would be helpful if Figure 3.2 identified which counties fall under this last scenario with availability determinations based on historical use trends. It also would be helpful if the major springs, shown on Figure 1-18, could be depicted in Figure 3.2 and in the figures depicting the various aquifers that supply those springs.

Response

Add at the end of the second paragraph on page 3-2:

Figure 1-17 shows the counties currently governed by groundwater conservation districts.

[19] Page 3-2: The plan states that throughout much of the region, the desire is to maintain aquifers such that springflow and associated base flow to rivers and streams are protected. We believe that is an extremely important goal for ensuring that water planning and management are consistent with long-term protection of the region's and the state's natural resources, water resources, and agricultural resources.

Response

None required.

[20] Unfortunately, it appears that the groundwater conservation district management policies in many of the counties in the region are not designed to ensure such long-term protection and, instead, allow for the planned depletion of stored groundwater reserves. We urge the planning group to include information, to the extent it is available, on how those different management policies would be expected to affect aquifer levels and outflows from the aquifers such as springs and baseflow in the region. One of the key functions of the planning process is to help assure informed decision-making. Including this information would help inform the public about the implications of the decisions made. For example, for areas with policies likely to result in predicted water level declines, information about the implications of those policies might help to build support for conservation measures designed to help bring water use inline with recharge so as to minimize use of stored aquifer reserves.

Response

Region F believes that individual groundwater conservation districts are best suited to develop their management policies.

[21] Page 3-2: The last sentence on this page notes that recharge figures for most aquifers were carried over from the 2001 water plan. It would be helpful to include here a brief summary of the original bases for those recharge calculations.

Response

Add the following sentence at the end of the last paragraph on page 3-2.

These recharge estimates are from previous studies by TWDB.

[22] Page 3-3: In Table 3-1, it is not clear whether the "annual recharge" heading refers to average annual recharge or to drought recharge.

Response

Change heading in Table 3-1 from "Annual Recharge" to "Annual Recharge During Drought"

[23] Page 3-8: We appreciate the inclusion of representative well hydrographs. They provide a very helpful visualization of water level trends.

Response

Thank you.

3.2 Existing Surface Water Supplies

[24] Pages 3-32 through 3-35: It seems appropriate to use the WAM models as the starting point for the depiction of water availability as long as the WAMs accurately reflect existing water rights. We express no opinion on the specifics of how the rights are reflected. Adjustments to the WAM outputs as a result of understandings or agreements not reflected in the underlying rights then should be explicitly acknowledged. That seems to be the best way to ensure informed decisions and clear understandings. It seems preferable to have discussions now about the issues of water rights priorities rather than to have those discussions occur during a water supply crisis.

Response

Comment noted. No response.

CHAPTER 4: IDENTIFICATION, EVALUATION, AND SELECTION OF WATER MANAGEMENT STRATEGIES BASED ON NEEDS

[25] General Comment Regarding the Absence of the Required Quantitative Environmental Analysis of Water Management Strategies: TWDB rules require a quantitative environmental analysis of potentially feasible water management strategies considered by the planning group. 31 TAC § 357.7 (a)(8)(A)(ii). Based on a review of the initially prepared plan, that required quantitative analysis is missing. Short, qualitative descriptions of environmental issues have been included with the discussion of each strategy. Although we appreciate the attempt to acknowledge a broad scope of issues, these qualitative descriptions do not provide the level of quantitative review that is needed for well-informed decisions. We also recognize that, as a result of changes to the Colorado Basin WAM, the ability to perform quantitative analyses is limited. We believe that unless the required analyses can be performed now, the recommendations of major surface water strategies must be qualified by expressly making them contingent on later review and approval by the planning group after completion of required quantitative reviews. That seems to be the only way to come close to complying with the requirement for quantitative analyses and the requirement to demonstrate that the strategies are consistent with long-term protection of the state's natural resources, water resources, and agricultural resources.

Response

Quantified environmental impacts may be found in Appendix 4H.

4.2.3 Subordination of Downstream Water Rights

[26] Page 4-12: In general, we agree with the approach used by Region F in presenting this strategy. Explicit discussion of the need for a water management strategy in the form of subordination arrangements ensures that the issues are clearly acknowledged. We believe that is very preferable to having them embedded in assumptions underlying the WAM. Very few readers could be expected to appreciate the significance of the issues in the absence of the type of clear discussion provided in the initially prepared plan.

Response

Thank you.

[27] Page 4-14: The text indicates that all of the yields presented "have been adjusted to account for reduced yield due to drought conditions that have occurred since 1998." We do agree that it is appropriate to attempt to take the more recent hydrological data into account. However, more explanation is needed about the extent of those adjustments and about the validity of the manner in which they were calculated.

The text goes on to refer to Appendix 4E as providing information about those adjustments. Appendix 4E does provide information about differences between two new firm yield calculations. The comparison starts with an abbreviated "Firm Yield Natural Order 1940-1998" calculation and compares that to a "Firm Yield Natural Order 1940-2004" calculation. A total reduction in yield of 29,640 acre-feet between the two hypothetical yield figures is calculated. However, we were not able to locate a clear listing or statement of what adjustments actually were made. An adjustment of 29,640 acre-feet would not seem to be appropriate because the starting point for this comparison, "Firm Yield Natural Order 1940-1998," appears to overstate the calculated yield even when compared to the yield figures from the 2001 Region F Water Plan and likely overstates yield when compared to the Colorado WAM (even with subordination assumptions). The 2001 Water Plan total for these reservoirs is 197,355, but the total listed in Table 4E-1, using the 1940-1998 data, is 207,700. Thus, although the difference in the yield totals for the two hypothetical runs is 29,640, making that amount of adjustment likely would overstate the absolute yield impact of the recent conditions under application of the prior appropriation doctrine. In addition, safe yield amounts are used for planning rather than firm yield amounts. At any rate, we believe additional explanation is needed about the specific adjustments made and the rationale for those specific adjustments.

Response

Appendix 4E is not up-to-date. A revised appendix will be developed.

[28] Page 4-16: We appreciate the complexity of estimating a cost for this strategy. Contrary to the second-last sentence on this page, we do not believe that the still-to-be-completed estimate of socio-economic impacts of water shortages in Region F is likely to provide sufficient information for preparing such an estimate. Rather, it seems that information is particularly needed about how the strategy might affect water availability in Region K because that is likely to influence required payments. Accordingly, we would urge further discussion of how costs for this strategy might be estimated.

Response

This comment was written before receiving the socio-economic study. FNI believes that the TWDB methodology underestimates the potential economic impact of not implementing the subordination strategy. An alternative costing method will be presented for consideration by Region F at the November 28 meeting.

[29] Page 4-17: The last sentence of the second paragraph asserts that a comparison of stream flows with and without subordination would not be meaningful in the upper basin because the "without subordination" scenario is not realistic, considering historical operations. As noted in our previous letter of June 2004, we believe stream flow assessments should consider changes from some reasonable baseline condition that allows meaningful judgments to be made about ecological impacts. "Current conditions" is one such baseline that could be used. For example, stream flows predicted with 2060 water use and subordination could be compared to "current conditions" streamflows and to 2060 water conditions without subordination. In addition to performing quantitative assessments of individual strategies, we also believe that it is critical to provide streamflow assessments of the overall plan as part of the assessment of consistency with long-term protection of the state's natural resources, water resources, and agricultural resources.
Unfortunately, no such assessment has been done. That issue is discussed further in our comments on Chapter 7.

Response

TWDB is performing a streamflow assessment similar to the one described in the comment.

4.3.1 City of Ballinger

[30] Page 4-30: The cross-reference to Section 4.8.2 for a discussion of the potential impacts of the regional desalination facility should be changed to Section 4.8.3.

Response

Reference will be updated.

[31] Page 4-32: The issue of impacts of reuse on environmental flows must be acknowledged and discussed. Reuse of a portion of the discharge would have the effect of reducing flows in the receiving stream below the discharge.

Response

FNI recommends adding the following sentence under the Environmental Issues Associated with Reuse

Reuse would result in a reduction in the quantity of water discharged by the city. An analysis of the impacts on the receiving stream will be required in the permitting process. However, because of the relatively small amount of flow reduction associated with this reuse project, the impact is not expected to be significant.

[32] Page 4-33: The discussion here refers to the "Region F recommended conservation strategies." There is no reference to a specific listing or discussion of those recommended strategies. On page 6-4 of the initially prepared plan, there is a very brief listing of three points as "the focus of the conservation activities for municipal users in Region F." In addition, at the top of page 6-5 there is language indicating that "savings for passive implementation of water-efficient clothes washers" also were included. Additional discussion of these concepts and the process for calculating potential savings is needed in order to provide a reasonable understanding of the conservation recommendations in the plan. We believe a clear understanding is essential to help WUGs develop water conservation plans.

Response

Additional information on recommended water conservation strategies will be added to Appendix 4I.

[33] Page 4-34: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited.

Response

Region F does not believe that drought management is an effective regional water management strategy for two reasons. First, drought management does not make more water available on a long-term basis. Second, droughts in Region F are severe, extended and relatively frequent. A reliable water supply is imperative to maintain the economic viability of communities in the region. Although drought management can and will be practiced by communities throughout Region F, the actual practices are best decided by the local entities that will be responsible for developing and enforcing these practices.

There are insufficient data to quantify the impacts of specific drought management practices on water demand during the recent drought. Quantified goals required by Section 11.1272 of the Water Code were not in place until May 2005, too late for evaluation in the current water plan.

No changes recommended.

[34] Pages 4-35 through 4-36: The conservation recommendations reflect a reasonable amount of savings at reasonable costs. Even at the 2060 estimated per capita usage rate of 155 gpcd, significant additional savings are possible as is illustrated by the success of the City of San Antonio in reducing per capita usage to below 140 gpcd.

Response

No response required.

[35] Page 4-36, Table 4.3-8: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations.

Response

Region F does not believe that water conservation alone should be relied on to meet projected water needs. In addition, the water conservation analysis is based on 'rule-of-thumb' information from the Water Conservation Task Force and is not based on site specific data. Region F also believes that appropriate levels of water conservation are best determined by the water suppliers themselves and not the Region F Water Planning Group.

4.3.2 City of Winters

[36] Page 4-43: The issue of impacts of reuse on environmental flows must be acknowledged and discussed. Reuse of a portion of the discharge component of the City's effluent would have the effect of reducing flows in the receiving stream below the discharge.

Response

The City of Winters currently uses a large portion of its effluent for irrigation and does not consistently discharge effluent. No changes recommended.

[37] Page 4-45, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. From the per capita water use indicated in the "No Conservation" row in Table

4.3-15 for 2000, it appears that a combination of water conservation and drought management measures have greatly limited water use. Although it is possible that not all of the measures used in 2000 would be desirable for use during future droughts, the effectiveness of drought management should be acknowledged. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management is needed.

Response

See response to [33].

[38] Page 4-45, Recommended Strategies: Conservation should be added to the recommended strategies discussed here. Also, as noted above, drought management should be included. The planning group has recommended that the City of Winters use reuse as a strategy to increase the reliability of their water supply. Conservation is projected to save 76 acre-feet/year by 2060 and is less expensive than reuse. In fact, Table 4.3-16 shows that the City of Winters could meet its needs with subordination only and then use conservation as a safety buffer. An aggressive conservation program coupled with drought management could save even more water.

Response

Change the third sentence in the last paragraph on page 4-45 to read (changes in bold):

Region F recommends that the city consider **water conservation** and reuse as long-term alternatives to increase the reliability of the city's water supply.

[39] Page 4-46, Table 4.3-15: More information is needed about the measures undertaken by the City to reduce per capita water use to 102 gpcd. Some of those measures might well be water conservation measures that would reasonably be expected to continue in effect in the future.

Response

During the recent drought, Lake Winters, the city's sole source of water, was practically empty. Based on conversations with city officials, public concerns about eminent water supply shortages was the most effective means of reducing water demand. Insufficient data are available to determine the extent to which that public awareness will result in permanent water demand reductions.

[40] Page 4-47, Table 4.3-16: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations. That seems particularly inappropriate here because conservation is shown to be much more cost effective than reuse.

Response

See response to [35].

4.3.3 City of Bronte

[41] Page 4-58, Table 4.3-24: Some explanation is needed regarding the varying Year 2000 per capita usage rates. The Region F estimate of gpcd for 2000 is given as 208. That figure appears to be the starting point for calculations of conservation savings, and, presumably, estimated demands. However, that figure is significantly higher than the 192 gpcd figure otherwise shown as the year 2000 water use projection. That 192 gpcd figure for 2000 then is shown as increasing to 208 gpcd in 2010 in the absence of conservation.

Response

Demand projections for the City of Bronte are consistent with historical trends and have been approved by TWDB. Add the following note to Table 4.3-24

The City of Bronte was under restrictions in 2000. Base year 2000 demands were extrapolated from historical water use between 1997 and 1999.

[42] Page 4-59, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. From the per capita water use indicated in Table 4.3-24 for 2000, it appears that drought management measures may have been effective in reducing water use. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

[43] Page 4-59, Table 4.3-25: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations. That seems particularly inappropriate here because conservation is shown to be much more cost effective and to have lower capital costs than new water wells.

Response

See response to [35].

4.3.4 City of Robert Lee

[44] Page 4-71, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city's drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

[45] Page 4-71, Water Conservation and Table 4.3-34: The gpcd for the City of Robert Lee is very high, even for 2060. As a result, the potential for conservation is likely much higher than is shown here. The City of San Antonio has reduced per capita usage to below 140 gpcd. For an area with little water and financial resources, conservation is the most logical place to look for additional water supplies.

Response

Region F water conservation strategies are based on 'rule-of-thumb' estimates from the Water Conservation Task Force. There are insufficient data available to perform a more detailed analysis.

Region F questions the comparison of per capita water use a small, rural community with less than 1,200 people to San Antonio, a city with more than a million people. In a small community, small differences such as the use of treated municipal water to water a cemetery or park, can make a large difference in per capita water use. Comparisons of per capita water demand without site-specific knowledge of how much water is used for residential, commercial or other uses has no meaning in regional water planning or any other context.

[46] Page 4-71, Recommended Strategies for the City of Robert Lee: The strategies listed here do not match those shown in Table 4.3-35. The strategies included in Table 4.3-36 don't seem to match Table 4.3-35 or the discussion on page 4-71.

Response

Add the following note to Table 4.3-35

The infrastructure expansion increases the reliability of existing supplies but does not make additional water available.

Add the following note to Table 4.3-36

The subordination strategy will be implemented by CRMWD and is therefore not included in the costs for the City of Robert Lee.

[47] Page 4-73, Table 4.3-35: Why is “Surplus (Need) without conservation” and “Surplus (Need) with conservation” shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

Response

See response to [35].

4.3.5 City of Menard

[48] Page 4-77, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). The savings gained through implementation of the city’s drought management plan should be quantified and included as a water management strategy. Information about the savings that have been realized through recent experience would provide valuable insight. Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. As noted here, the City of Menard has successfully used drought management in the past as a method for limiting water demands. It would be useful to include information about the specific approaches used. More discussion of drought management should be provided.

Response

See response to [33].

[49] Page 4-83, Table 4.3-42: Why is “Surplus (Need) without conservation” and “Surplus (Need) with conservation” shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

Response

See response to [35]

4.3.6 City of Midland

[50] Page 4-89, Table 4.3-46: This table shows that Midland’s gpcd would be reduced from 262 to 220 gpcd by 2060 through conservation measures. This is a good beginning. Fortunately, much more progress is possible. This would still leave Midland among cities with the highest use rates in the state. It also would represent a substantial increase in per capita use over the projections from the last round of planning in which Midland was in the top 10 water use ranking of the State Water Plan with a projected usage rate of 205 gpcd in 2050. As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings likely could be realized for the City of Midland. Water in the Midland area is scarce and expensive to develop. Groundwater supplies are being depleted in the area. Ramping up water conservation efforts could save the citizens a considerable amount of money in the future by delaying or eliminating the need for more expensive water supply projects and could help to ensure a long-term water supply for the area.

Response

Comment noted.

[51] Page 4-90: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

[52] Page 4-91, Table 4.3-47: Why is “Surplus (Need) without conservation” and “Surplus (Need) with conservation” shown in this table if conservation is a recommended strategy for this WUG? It does not make sense to show this information with and without conservation if it is a strategy that has been recommended by the planning group. This way of presenting the information could create confusion.

Response

See response to [35].

4.3.7 Brown County Other

[53] Page 4-94, Water Conservation and Drought Management: Both water conservation and drought management are required water management strategies and must be evaluated. According to the discussion on page 4-91, water supply corporations provide most of the water in the area. Those entities could coordinate water conservation and drought management efforts.

Response

Region F agrees that water conservation and drought management will be implemented by one or more water supply corporations in Brown County, as stated on page 4-94. In accordance with TAC 357.7(a)(7)(A)(ii), the reason for not evaluating water conservation is clearly stated: the specific sponsor of these activities cannot be identified. This is also consistent with the approach to evaluation of water management strategies adopted by the Region F WPG (Appendix 4C).

4.3.8 City of Coleman

[54] Page 4-98, Table 4.3-53: This table shows the City of Coleman's per capita usage going from 177 in 2000 to 229 in 2010. The rationale for that projected increase must be provided and supported. The figures included here do not match those given on page 4-97. That discussion indicates that current per capita usage rates are at 145 gpcd. Those huge differences must be explained. Table 4.3-53 shows a reduction of 33 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good beginning but the overall per capita usage rate still would be a very high 196 gpcd. Fortunately, much more progress is possible. As illustrated by the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here likely could be realized for the City of Coleman.

Response

Projections for the City of Coleman are consistent with historical trends and have been approved by TWDB. See note b on Table 4.3-53 for rationale for projected increase.

Region F questions the validity of comparing a small city like Coleman to a large city like San Antonio. Please see response to [45].

[55] Page 4-98, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the very brief discussion, the City of Coleman has successfully relied on drought management in the past to limit demands. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

[56] Page 4-99, Table 4.3-54: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendation.

Response

See response to [35].

4.3.9 City of Brady

[57] Page 4-103 and Table 4.3-58: The per capita usage rate shown for the City of Brady is extremely high. Table 4.3-58 shows the City's per capita usage rate going from 303 in 2000 to 251 in 2060. However, the text on page 4-102 indicates that the most current usage rate is 215 gpcd. The basis for using the year 2000 figure of 303 gpcd as the starting point for the calculations, rather than the 215 gpcd figure, must be explained and supported. Table 4.3-58 shows a reduction of 52 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be an extremely high 251 gpcd. That 2060 projection also is much higher than the apparent current usage rate of 215 gpcd. Fifty-years of conservation efforts reasonably could be expected to achieve better results. Fortunately, much more progress is possible. As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here likely could be realized for the City of Brady.

Response

The water demands match historical trends shown by the City of Brady and have been approved by TWDB. No change required.

[58] Page 4-103 through 4-104: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7 (a)(7)(B).
Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the very brief discussion, the City of Brady has successfully relied on drought management in the past to limit demands. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

[59] Page 4-104, Table 4.3-59: What is the rationale for including the rows "Surplus (Need) without conservation" and "Surplus (Need) with conservation" in this table? Those rows suggest that conservation has a lesser status than the other recommendations.

Response

See response to [35].

4.4 Manufacturing Needs

[60] Page 4-129: Although we appreciate that it is difficult to do detailed analyses of industrial water conservation measures, it should be possible to do a reasonable assessment for major water user groups. TWDB rules require consideration of water conservation for all water users with needs. See 31 TAC § 357.7 (a)(7)(A)(i), (ii).

Response

TWDB rules allow a RWPG to skip evaluation of water conservation and drought management analyses as long as the reason is documented. The existing text documents two reasons: the shortages are small and will be met by municipal water management strategies, including municipal conservation and reuse. No change recommended.

4.5 Steam-Electric Power Needs

[61] Page 4-134, Table 4.5-4: The projections of demands for steam electric generation seem unduly high. Population in the region is only projected to grow about 17% from 2010 to 2060 and manufacturing demand in the region, which is small to begin with, is only projected to grow about 36% over that same period. These are the categories that are most likely to drive demands for electricity. By contrast, water demands for electrical generation are projected to grow by 98%. That level of projected increase in steam electric generation demand seems unjustified.

Response

No response needed.

4.6 Irrigation Needs

[62] Page 4-141: We commend the planning group for including this information about potential water savings from improved irrigation efficiencies and for the recognition of the need to use advanced conservation to help conserve supplies throughout the region.

Response

Thank you.

[63] Page 4-148: The calculated application rate for drip irrigation listed in the second sentence on this page appears to be incorrect. Given the higher efficiency rate, the application rate for drip irrigation should be less than the 9.6 acre-inches calculated for furrow irrigation.

Response

Change sentence to read (changes in bold text):

If a drip system were used with an application efficiency of 97 percent, the resulting ***total*** *application rate would be 9.9 acre-inches.*

4.8.1 Colorado River Municipal Water District

[64] Page 4-165: In the discussion of issues associated with the Winkler County Well Field, some information is needed about how the projected annual withdrawal of 6,000 acre-feet will impact the associated aquifer water levels over the planning horizon.

Response

Data are not available.

[65] Page 4-170, Environmental Issues Associated with Water from Roberts County: There are issues regarding potential loss of spring flows in Roberts County, including springs that supply a portion of the baseflow of the Canadian River. The Arkansas River Shiner is listed as a threatened species pursuant to the federal Endangered Species Act. It would be appropriate to acknowledge the existence of those issues here.

Response

Add the following:

There is some concern that large-scale groundwater use from Roberts County could impact baseflow of the Canadian River, potentially impacting habitat of the Arkansas River Shiner, a threatened species. If this strategy is implemented, mitigation may be required.

[66] Page 4-170, final paragraph: The last italicized heading on the page should refer to "Roberts County" rather than "Pecos County."

Response

Change text to read Roberts County.

[67] Page 4-171: The last two sentences on the page suggest that water conservation may not have much impact on water needs for CRMWD because water quality issues often drive the needs. However, there would still seem to be significant benefit from water conservation because if less overall water has to be supplied, then the quantity of higher quality water required for blending with or replacing existing sources also would be lessened.

Response

The above interpretation of the text is not correct. FNI recommends changing Page 4-171 to read as follows (changes in bold):

Much of the new water supply development for CRMWD is driven by water quality concerns. ***CRMWD needs additional high-quality water sources to blend with existing water of lesser quality.*** *As a result, water conservation may not delay or eliminate the need for new water supply development.*

Region F does not dispute the benefits of water conservation. However, conservation will not eliminate the need for new CRMWD supplies, which are driven by water quality concerns rather than water quantity concerns.

[68] Page 4-172, Table 4.8-25: Table 4.8-25 shows the City of Snyder's per capita usage rate going from 227 in 2000 to 194 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 194 gpcd. The basis for using the year 2000 figure of 227 gpcd as the starting point, rather than the 194 gpcd figure, must be explained and supported. Table 4.8-25 shows a reduction of 33 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a very high 194 gpcd, which, apparently, is the actual usage rate for 2000. Fifty-five years of conservation efforts would be expected to achieve more results than just returning to the per-person usage levels achieved five years ago. Fortunately, much more progress is possible. As illustrated by the success of the City of San Antonio, which has reduced per capita water use to less than 140 gpcd, a lot of additional potential savings, beyond those shown here could be realized for the City of Snyder.

Response

> Water demand projections for the City of Snyder are consistent with historical trends and have been approved by TWDB. FNI believes sufficient justification has been presented in the plan. No change suggested.

[69] Page 4-173, Table 4.8-26: Table 4.8-26 shows the City of Big Spring's per capita usage rate going from 210 in 2000 to 172 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 198 gpcd. The basis for using the year 2000 figure of 210 gpcd as the starting point, rather than the 198 gpcd figure, must be explained and supported. Table 4.8-26 shows a reduction of 38 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 172 gpcd. Fortunately, much more progress is possible.

Response

> Water demand projections for the City of Big Spring are consistent with historical trends and have been approved by TWDB. FNI believes sufficient justification has been presented in the plan. No change suggested.

[70] Page 4-174, Table 4.8-27: Table 4.8-27 shows the City of Odessa's per capita usage rate going from 208 in 2000 to 178 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "b" note that year 2000 use was actually 198 gpcd. The basis for using the year 2000 figure of 208 gpcd as the starting point, rather than the 198 gpcd figure, must be explained and supported. Table 4.8-27 shows a reduction of 30 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 178 gpcd. Fortunately, much more progress is possible.

Response

> Water demand projections for the City of Odessa are consistent with historical trends and have been approved by TWDB. FNI believes sufficient justification has been presented in the plan. No change suggested.

[71] Page 4-175, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7
(a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. Drought management also might prove to be more affordable than other strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response [33].

4.8.3 City of San Angelo

[72] Page 4-184, Table 4.8-33: Table 4.8-33 shows the City of San Angelo's per capita usage rate going from 200 in 2000 to 163 in 2060, as a result of water conservation programs. However, the year 2000 projection and footnote "c" note that year 2000 use was actually 162 gpcd, which is less than the usage rate projected for 2060. In addition, the text on page 4-183 notes that, as of 2002, per capita usage was actually 118 gpcd. Fifty-years of conservation effort should produce better results than an increase in actual per capita use rates. We recognize that a portion of the 118 gpcd rate results from drought restrictions. Although we believe those types of restrictions must be evaluated as part of a drought management strategy, we recognize that 118 may not be the appropriate starting point for the conservation analysis or the demand projection. However, 200 gpcd does not appear to be appropriate either. The year 2000 actual use rate of 162 gpcd likely should be used. The selection of that 200 gpcd usage rate as the starting point for the calculations must be explained and supported. Table 4.8-27 shows a reduction of 37 gpcd in usage rates from 2000 to 2060 through conservation measures, including savings from the plumbing fixtures code. Assuming, an appropriate starting point for the calculation, this is a good start but the overall per capita usage rate still would be a high 163 gpcd. Fortunately, much more progress is possible. In fact, San Angelo already has achieved lower rates in 2000 and much lower rates in 2002.

Response

Water demand projections for the City of San Angelo are consistent with historical trends and have been approved by TWDB. FNI believes sufficient justification has been presented in the plan. No change suggested.

[73] Page 4-185, Drought Management: Drought Management is required to be considered and evaluated as a water management strategy by the water planning group and must be included at least at the levels required by Section 11.1272 of the Water Code. See 31 TAC § 357.7
(a)(7)(B). Drought management has the potential to provide savings during those short-term periods that the supply of water is most limited. As noted in the brief discussion, the City of San Angelo has successfully relied on drought management recently to help limit demands. Drought management also might prove to be more affordable than other

strategies because it is implemented only when it is needed. More discussion of drought management should be provided.

Response

See response to [33].

Chapter 5: Impacts of Water Management Strategies on Key Parameters of Water Quality and Impacts of Moving Water from Rural and Agricultural Areas

[74] Page 5-2, Table 5-1: Brush control likely should be added to this table and the discussion in this chapter. Brush control has the potential, if not done very carefully, to cause significant adverse water quality impacts. For the long-term, if done as part of a comprehensive land stewardship program, water quality could be improved.

Response

Add discussion of possible water quality impacts of brush control.

[75] Page 5-4, New and/or Expanded Use of Groundwater Resources: The plan states that while an increased use of groundwater can decrease instream flows if the baseflow is supported by spring flow, this type of impact is not expected to be a concern for Region F's recommended strategies. Some additional explanation here of the basis for the stated absence of a concern would be helpful.

Response

Add the following sentence:

Most new groundwater development is in areas that have no flowing surface water, such as Winkler County, or from relatively deep portions of aquifers that most likely do not have significant impact on surface flows, such as McCulloch County.

[76] Page 5-1, 5-4, Section 5.2 and 5.3. It is difficult to discern the difference between these two sections by their titles.

Response

No change recommended.

Chapter 6: Water Conservation and Drought Management Recommendations

[77] We commend the planning group for acknowledging the effectiveness of water conservation and drought management measures.

Response

Thank you.

[78] Water supplies are tight throughout the region. It is very important to use water efficiently. Accordingly, we urge the planning group to consider a general recommendation for municipal water conservation measures for all user groups, regardless of need. The planning group made a similar recommendation for irrigation uses. See page 4-141 of the IPP.

Response

Although Region F supports water conservation efforts for all categories of water use, TWDB rules only require water conservation analysis for WUGs with needs. No change required.

[79] We believe the value of the Chapter 6 discussion would be greatly enhanced by including summary information, in a quantitative format, about the water conservation and drought management recommendations included in the plan. Indeed, that is just what we understand to be called for by Section 357.7 (a)(11) of the Board's rules, which requires "a chapter consolidating the water conservation and drought management recommendations of the regional water plan."

Response

Add a table summarizing water conservation savings.

[80] The model water conservation plans are helpful. However, we believe it would be appropriate to include model plans that include examples of language that could be used in applying at least the conservation measures recommended by the planning group.

Response

The water conservation plans already include language describing the practices recommended by the planning group. No change required.

[81] Also, the TCEQ rule excerpts included as appendices included to the sample conservation plans appear to be outdated. The TCEQ rules recently were revised to incorporate, among other things, the requirement for specific quantified target goals.

Response

Update with the most recent TCEQ rules, as appropriate.

[82] Draft Appendix 6C1 also appears to have an outdated version of TCEQ rules included.

Response

Update with the most recent TCEQ rules, as appropriate.

[83] Appendix 6D: We commend the group for compiling potential drought triggers for use by public water suppliers and irrigation districts. The discussion as to the use of groundwater wells seems especially useful and informative.

Response

Thank you.

Chapter 7: Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

[84] Page 7-3, Consistency with the Protection of Water Resources, New or Expanded Use of Groundwater: This section states that groundwater availability reported in the plan is the long-term sustainability of each aquifer, and is based on aquifer recharge capacity. We commend the planning group for recognizing the critical importance of sustainable management of groundwater resources. However, according to Chapter 3 of the plan, a number of counties in the region are basing aquifer availability on the use of stored aquifer capacity. We understand that, in some cases, there is a difficult balancing act that must take place between restrained use of groundwater resources and the economic viability of a region. However, the plan does not include any discussion of the bases on which certain districts have chosen managed depletion of their groundwater resources through reliance on supplies in aquifer storage. Managed depletion is not consistent with the long-term sustainability of the region's aquifers, and is also not consistent with the **long-term** protection of the state's water resources, natural resources, or agricultural resources. Although it may not be feasible, in some areas, to move quickly to true sustainable management, in order to achieve a reasonable long-term future for local economies, true sustainable use of groundwater reserves should be the goal and efforts to achieve that goal should be supported and encouraged. We also support the planning group's strong endorsement of water conservation. Particularly in the area of municipal water use, we urge the planning group to set more ambitious goals for water conservation. Achieving highly efficient water use is essential to ensuring long-term protection of the state's limited water resources.

Response

Comment noted. No change recommended.

[85] Page 7-4, Consistency with Protection of Agricultural Resources:
Again, we commend the planning group for its recognition of the critical importance of achieving highly efficient use of limited water resources in order to maintain the viability of irrigated agriculture for the long-term.

Response

Thank you.

[86] Page 7-4, Consistency with Protection of Natural Resources:
The discussion of consistency with long-term protection of the state's natural resources is unduly narrow. Increasingly, rural areas of the state are relying more and more on hunting, fishing, and nature tourism as additional sources of income. The natural resources that support those activities should be considered and protected in the planning

process. Protection of stream and river flows and the springs and seeps that help to maintain those flows is critical to protecting those natural resources.
In order to effectively assess consistency with long-term protection of natural resources, a comprehensive assessment of projected stream and river flows expected with implementation of the plan is needed that compares those flow levels to some reasonable criteria for natural resource protection. As we pointed out in our letter, and an attachment to that letter, in June, 2004, one such logical criterion is a "current conditions" baseline. Because we have a reasonable understanding of how natural resources are affected under current conditions, a comparison of projected flows against such a baseline provides a reasonable basis for attempting to understand the natural resource implications of changes in flow. Without that type of assessment, there really is no basis for the required determination that the plan is consistent with long-term protection of natural resources. We do recognize that questions about the Colorado WAM have left the planning group with limited time to perform such analyses.

Response

Comment noted. No change required.

CHAPTER 8: UNIQUE STREAM SEGMENTS/RESERVOIR SITES/LEGISLATIVE RECOMMENDATIONS

[87] Page 8-5, Recommendations for Ecologically Unique River and Stream Segments: It is disappointing to see that the Planning Group has again declined to recommend any stream segments for designation as unique stream segments. We understand the requirement in the Board's rules regarding analysis of potential impacts as providing recognition of the status of such segments as being ecologically unique and deserving of special consideration. However, that special consideration would not result in any type of mandatory protection beyond that established by statute.

Response

Comment noted. No change required.

8.3.4 Instream Flows

[88] Page 8-9: The last bullet point under this heading states opposition to adaptive management requirements. It appears, from the discussion immediately preceding this bullet point, that the concern is about adaptive management that might involve the reallocation of existing water rights to protect instream flows. We certainly understand that concern. We consider "adaptive management" to be an important, but broad, scientific concept that involves maintaining reasonable flexibility in managing water supplies. Adaptive management concepts are important because, as we learn more, we may be able to manage water more efficiently to meet all water needs, including environmental water needs. We urge the planning group to consider rephrasing this bullet point to focus more narrowly on the apparent concern about impacts on existing water rights. We would propose the following language for your consideration: "Opposes adaptive management requirements that involve involuntary reallocation of existing water supplies."

Response

The Region F WPG elected to remove the statement about adaptive management from the final Region F plan.

Ken Bull, Richland SUD

Summary of Comment

Add new low-radionuclide well as a water management strategy

Response

Add new well strategy for Richland SUD based on Eden strategy.

Summary of Comment

Change current water demand in Table 4.3-61

Response

Change number from 113 af/yr to 207 af/yr.

Summary of Comment

Add text on page 4-100 noting that the system has 120 miles of pipeline, some of the losses were due to flushing as required by TCEQ, most of the water is used for livestock, and only 0.5% of the water is used for potable purposes

Response

Add text to plan.

Summary of Comments

Add policy statement suggesting an oral ingestion study to determine the epidemiology of radium in potable water.

Response

Add to policy statement to Chapter 8.

Joe David Ross

Note: Comments appear to be on Review Draft, not the Initially Prepared Plan

Handwritten comments

What are the differences in surface water definitions? 1) conservation storage, 2) permitted conservation storage 3) permitted diversion water.

Response

Conservation storage is the maximum amount of water that a reservoir is can hold on a long-term basis.

Permitted conservation storage is a more specific term that refers to the maximum amount of water that can be stored in a reservoir as authorized by the State of Texas in a water right.

Permitted diversion is the maximum annual volume authorized for diversion by the State of Texas in a water right.

01 Plan Table 1-15 (97), ’05 Plan Table 1-13 (’99) – groundwater pumping by county and aquifer. What happened to cause Midland to use 19,00 from Ogallala in ’97 but 0 in ’99? Why does Reagan go from 49,000 in ’97 to 351 in ’99? What happened in Upton Co. to go from 19,000 to 0 in 2 years?

Response

This table was corrected in the Initially Prepared Plan.

P1-68 – 1.7.2 Constraints
4th sentence from the bottom – delete “but the cost to treat this water may be high” and the last two sentences in the paragraph. Petroleum and ag prices are high and active now. Some others and the City of San Angelo are working on nearby source of water for desalination.

Response

This section was altered in the Initially Prepared Plan based on comments received at Region F meetings.

P 1-68 what is your definition of “natural”? Some think that water itself is a natural resource. Surface water is not mentioned.

Response

I could not find a reference to “natural” or “natural resources” on page 1-68 or either the Review Draft or Initially Prepared Plan.

Section 1.8 - Water-Related Threats to Agriculture and Natural Resources is required by TWDB rules. TWDB rules do not provide a definition of natural resources. Webster’s New World Dictionary defines natural as “of, forming a part of, or arising from nature; in accordance with what is found or expected in nature.”

Surface water is discussed in 1.8.2.

City of Midland – Regions are formed to conserve water and to use ½ in 50 years [sic]. Why can Midland deplete two fields?

<u>Response</u>

The water management strategies are as described by Kay Snyder of the City of Midland.

Typed comments

Chapter 1 – Questions and Comments

1. Table 1-5 – why do the figures vary significantly on "permitted conservation storage"?

<u>Response</u>

Reservoirs differ significantly in the amount of water they can store.

2. Table 1-5 – why is Mountain Creek not listed?

<u>Response</u>

Mountain Creek is not a major reservoir. If the Region desires, it can be added to the table.

3. The 2001 Plan has stream flows listed as "annual" and the 2005 draft plan has stream flows listed as "mean". Why was this change made?

<u>Response</u>

Both figures show annual mean flow.

4. Please vary the colors more in the table [sic] "Water Use by County (2000)" for easier contrast.

<u>Response</u>

This was corrected in the Initially Prepared Plan.

5. Page 1-35, last paragraph – please change the wording to the following:

"These entities are required to develop and adopt comprehensive management plans, permit wells ~~with capacities greater than 25,000 gallons per day~~, that are drilled, completed or equipped to produce more than 25,000 gallons/day, keep records or well completions, and make information available to state agencies. ~~Among the optional~~ Other power granted GCDs are prevention of waste, conservation, recharge projects, research, distribution and sale of water for any purpose, and making rules regarding transportation of groundwater outside of the district.

Response

Change text to match comment.

6. Table 1-12 Surface Water Rights by County – why are these figures different from the 2001 Plan?

Response

This table is based on a list of water rights maintained by TCEQ. This list was updated and corrected as part of development of the Colorado WAM.

7. Table 1-15, Pecos and Menard County are listed as having no cropland – not true.

Response

There are several problems with this table. It will be updated in the final plan.

8. Table 1-15 (2001 Plan) and Table 1-13 (2005 draft) – Groundwater Pumping by County and Aquifer – why do these figures differ so much?

Response

This table was corrected in the Initially Prepared Plan.

9. 1.3.3 Springs in Region F – use the same map and wording for the 2005 draft as was used in the 2001 plan.

Response

TWDB requirements for springs are somewhat different in this round of planning. Please see Initially Prepared Plan. The map and text for this part of the plan were discussed at several Region F meetings.

10. Page 1-54 – the powerplant on Lake Nasworthy has been officially "mothballed." This needs to be mentioned. (handwritten note – ask S. Ang. Man who was @ Sept 05 public hearing "can be brought back at short notice")

Response

It is our understanding that this plant either can be activated at any time or has already been re-activated. Discussions with the power industry and the City of San Angelo have indicated that it would be preferable to assume that all mothballed plants can be re-activated and will be operable during the planning period.

Note: Comments appear to be on the Review Draft and not the Initially Prepared Plan

P 3-1: Last sentence – several counties do not have water districts. Who determined their "historical trends" for them? Has anyone talked to a group(s) from each of those counties? See Figure 3-2. Which are drawn on county lines but in some cases part of a county's farm land is in a water district that is headquartered in another county that has a different water percent usage management policy? Examples: Upton; City of Midland uses fields in Winkler. Pecos has a relatively new Water District. Are they going to pump 75% over 100 years?

Response

> Historical trends were determined by the Region F consultant team and presented to the RWPG for comment. The amount of water assumed to come from storage is used to determine the availability of water from the aquifer and does not imply that amount of water will be depleted over a particular period.

P 3-2: Appreciates Ashworth's comments about spring-flow and drought and the use of the new ET GAM to some degree in the new plan. However, in Table 3-1 under the Annual Recharge column (with the *) are the aquifers' numbers that are not ET meant to represent 50% or 100% in a drought period? See page 3-5 at bottom of Table 3-1*.

Response

> The numbers in the Annual Recharge column represent the drought recharge. The column heading will be changed to "Annual Drought Recharge" in the final plan for clarification.

P 3-1, 3-2: Hickory: Could we add a specific definition of ground water availability as it relates to Table 3-1? Most of us on this board are lay persons; legislators (other /joint?) Aides may want to study the report; City Council and local eco. develop. members and more importantly new regional board members or aquifer management groups in the future hopefully will utilize the information. It needs to be as accurate, current, and useful as possible. Is this a true definition as referred to frequently in the many pages and charts? "Ground water (and surface water) availability means the annual recharge, plus the annual percentage of stored water that could be used equals the annual availability. Availability does not include any currently non-useable water (for any of the six categories) or potentially available water through desalination or dilution (blending)." OR does it mean the amount of water currently being used?

Response

> Add the following after the second full paragraph on page 3-1:
>
> *Groundwater availability is defined by the following formula:*
>
> *Availability = Drought Year Recharge + Annual Supply from Storage*
>
> *The amount of water available from storage may be either 0 (no water from storage, limiting supply to recharge only), 75 percent of the recoverable volume in storage divided by 50 years, or 75 percent of the recoverable volume in storage divided by 100 years (see Figure 3-2).*

It would make it much easier to get the "big picture" if more columns were added on the same spreadsheet instead of the average interested person having to flip through several pages: a 4th column for *current use* (demand); a 5th for *potential use;* a 6th *total of ground and surface* a 7th how much comes *from another county or lake*; and 8th for how many *ac./ft. goes out from a county, lake, or river*.

Response

I believe that it would make the table more confusing by adding extraneous data that does not correspond to the adjacent text. No change suggested.

Why does Table 3-1 show Concho using 100% of their Hickory annual availability, but Menard uses 0% of its 34,000 ac./ft. in the Hickory (memory from 2001 plan) but the table shows no availability for Kimble. Page 3-15 says the Hickory supplies water to both Kimble and Menard. Mason and McCulloch as shown on page 3-6 (figure 3-2) are both shown as having the same management policy (same water district) – 75% over 100 years. Table 3-1 shows McCulloch's annual supply at 122,000 (126,000) and Mason at 76,000 (annual available) but on page 17 it says that Mason is the largest user of the Hickory.

Response

Supplies for Menard County are from the Menard County Underground Water District. An explanatory note should be added to the table.

TWDB shows no historical use from the Hickory in Kimble County. The reference to Kimble County on page 3-21 should be deleted.

The values in Table 3-1 represent the supply available from the aquifer, not the use from the aquifer. Mason County has less supply than McCulloch County, but uses more water from the aquifer.

Table 3-1 shows the Dockum Aquifer to be in 21 counties but written on page 3-12 we are told it occurs in 12 counties. These points are not made to just be "picky" but to illustrate the confusion that we lay people encounter. We truly want to be part of a team that develops information that can help our families, industries and communities to survive and grow in the future.

Response

Change first sentence in Section 3.1.5 to read (insertions in bold):

~~Groundwater from~~ **T**he Dockum aquifer ~~occurs~~ **is used for water supply** in 12 counties in Region F, including ….

P 3-12: Trinity Aquifer: The map, page 3-13 (figure 3-6) does not show Coleman County having any Trinity. However, friends in Coleman have pointed out that there are a few wells in the county even though Table 3-1 shows zero from a practical view point for the other two aquifers. They did not mention what aquifer(s).

Response

The Trinity formation occurs in Coleman County and is used for water supply. However, the portion of the formation designated by TWDB as the Trinity aquifer does not extend into Coleman County. Therefore water use from the Trinity formation in Coleman County is classified as "Other aquifer".

P 3-12 and 3-15: Dockum Aquifer: The figure 3-7 map (page 3-12) shows that both Sterling and Irion County do have significant coverage with the Dockum, even though it's volume is considered spotty. The outcrop in Sterling County was even mentioned in the Standard Times earlier that it was briefly considered to be a potential source for the city of San Angelo.

Response

Comment noted.

P 3-15 and 3-17: Hickory Aquifer: It has already been discussed some earlier in these comments, but since Brady, Eden and rural homes have wells with small potential problems with natural radiation but big regulatory problems should not it be mentioned in more detail in this chapter since their problem was one of our greatest needs in the 2001 plan? And still is!! Also, shouldn't we mention that San Angelo has already purchased water rights in the Hickory as an alternative source of water to be blended?

Response

A discussion of Hickory water quality and regulatory issues may be found in the third paragraph of Section 3.1.6 on page 3-21 of the Initially Prepared Plan.

P 3-17 and 3-19: Lipan Aquifer: Does the local water district control overuse by limiting well density? What did their $50,000 + pumpage study show? Christoval is in Tom Green County; what aquifer do they get their water from? Their water officials came to two or three of our region F meetings in the early 2000's since their wells were sucking air. What happened? What do Will Wilde and Allan Lange report?

Response

The Lipan-Kickapoo GCD does not have pumping restrictions, but does control well density by limiting well spacing between wells and from property boundaries. The study assessed recharge to the aquifer, recommended monitoring networks for the recently expanded district boundary, and evaluated potential new management objectives.

The City of Christoval gets their water from shallow wells that tap a combination of alluvium and Edwards Limestone of the Edwards-Trinity aquifer. Studies of water supplies from that area show that water levels can decline significantly during drought.

P 3-24: Capitan Reef Aquifer: Is this the updated report that Ashworth handed out to us earlier in the second plan?

Response

Yes.

Joe David's comments this week have been based on the March 2005 draft. No cross reference has been evaluated between the 2001 plan and the 2nd (later than March/May) draft. And I'm sure hat some of my interpretations arise from a lay persons lack of expertise.

P 3-26: Brackish Groundwater Availability: 1st paragraph – great. 2nd paragraph – keep the first two sentences. Delete the remaining sentences in this paragraph please. In my opinion we need to give a consistent positive analysis of desalination in our Region F, especially in the San Angelo area. El Paso and Ft Stockton have put this technology to use. It is my understanding that there are some good sources (not the regular Dockum) of "brackish" water in Tom Green County whose elevation would allow the treated water to flow downhill. Ken Dier., D.A. Harrell, Legislator Campbell and others not just from San Angelo have mentioned desalination as a top priority prior to our 2001 plan. Other test wells and salt disposal/evaporation need to be seriously studied.

Response

Make the following changes to Section 3.1.12:

Many of the major and minor aquifers in Region F contain significant quantities of groundwater with TDS concentrations ranging between 1,000 and 5,000 mg/l. While some of this water is currently being used for agricultural and industrial purposes, much of it remains unused. ~~*Significant economic factors pertaining to the viability of these sources is their location with respect to the desired market and the end use of the water. Some of the most promising brackish water sources are located in the Trans-Pecos far away from areas in need of additional water supplies. Use of these supplies would require construction of a lengthy pipeline, significantly increasing the cost of the water. Other suitable sources are located closer to major population centers and could be a significant source of future water supply.*~~

Desalination is a recommended strategy for San Angelo, Andrews and CRMWD.

Please double check all of our 2005 chapters and discussions to make sure that some of the old 2001 printed words do not remain in the 2005 plan unintentionally. Much progress has been made for desalination.

Response

Comment noted.

P 3-27: Existing Surface Water Supplies: 1st paragraph after 2nd sentence – please consider an additional sentence: "However, a high percentage of the towns within the 32 county regions indeed do obtain their municipal water from ground water as well as numerous rural homes, domestic livestock and wildlife.

Response

I am not sure of the value of adding a reference to groundwater use in the section discussing surface water. I suggest adding the following sentence after the first sentence in Section 3.1:

> *Groundwater provides most of the irrigation water used in the region, as well as a significant portion of the water used for municipal and other purposes.*

Please ask Caroline Runge about the "run-of-the-river" water rights. Does Menard city depend heavily upon this?

Response

> The wells on the bank of the San Saba River are the only source of water for the City of Menard. Whether they are groundwater or surface water is a matter of perspective and only points out the interrelatedness of both groundwater and surface water supplies.

Thank heaven Jon Albright and John Grant have done a good job of explaining and starting negotiations to point out the problems with the states new Colorado WAM. Once again figures have been used to give a slanted or incomplete analysis.

Response

> Thank you.

P 3-30: Run of River: Has Caroline fro Menard and possibly Junction had a chance to address this WAM issue? We remember Jon and Haygood talking about something along here.

Response

> The City of Menard's has one of the most senior water rights in the basin. As a result, it was not necessary to include Menard in the subordination analysis. The City of Junction's water supply was included in the subordination analysis.

P 3-32: Alternate Water Supplies: Well done.

Response

> Thank you.

P 3-33: It is good to see Desalination issues being addressed across the state by legislators, TWDB, TCEQ, local communities, including the Midland country club and private businesses.

Response

> Comment noted.

P 3-35: Use of reclaimed water: More recognition needs to be given to Midland and Odessa. We're glad that San Angelo and San Antonio are moving on this. Does the City of Sonora and Winters and others need to get on the list? The City of Winters reuses some water for agriculture also. See Table 3-5. Or is "Landscape irrigation" for Winters and Snyder another word for "agriculture" like with Monahans, Midland and San Angelo?

Response

Reuse is a suggested long-term strategy for the City of Winters. Sonora did not have a need, so reuse was not evaluated for that city. We should probably change "landscape irrigation" to "irrigation", since some reuse occurs for landscape (golf courses, city parks, etc.), while in other cases it is used to grow crops such as hay.

P 3-36: 1st paragraph – should we small town folks be looking at the reuse program? All water conservation adds up.

Response

Reuse and water conservation were evaluated only for cities with water supply needs. The reuse strategy was only considered for small cities that have reservoirs in which to blend the treated effluent.

2nd paragraph "Supplies for L/S (livestock) in Region F come primarily from private stock ponds…" I doubt if this is true. Something needs to be said or validated. Region F is basically (excluding Coleman and Brown Counties) known as a semi arid area that did not develop ranching-wise until water wells were drilled.

Response

Change the first sentence in the second paragraph in Section 3.4 to read (additions in bold):

Surface water *supplies for livestock in Region F come primarily from private stock ponds, most of which are exempt under §11.142 of the Texas Water Code and do not require a water right.*

P 3-36: Water Availability for Water User Group: Last paragraph – Four primary reasons for overall supply decline – reasons 3) and 4) do not seem right to me. "3)" We are suppose to conserve water for the future generations and our water management map shows leaving at least 25% in 75 or 100 years for Winkler and Midland Counties; yet we appear to be approving the depletion of a well field in another county. This was mentioned in a previous comment. "4) decline in demand, particularly for irrigation demand", but other charts show the year 2060 still having the same demand/supplies as 2010 even though irrigated acres have been reduced and/or improved pivots and drip irrigation have been implemented. (that big wide spreadsheet not found right now). But look at Table 3-6 (Mar 2005) page 3-37 "Available Water Supplies. Only 3 or 4 counties show a significant decline.

Response

I was unable to locate the referenced text on page 3-36 in either the Review Draft or Initially Prepared Plan.

1) Midland from 69,000 down to 46,000 because their CRMWD contract will have expired but surely it will be worked out. Is the decline because of lost population or great conservation?

Response

Renewal of the Midland contract is a water management strategy found in Chapter 4.

2) Reeves down from 74,000 to 65,500. Why?
3) Ward down from 16,200 to 10,300. Why?
4) Upton remains the same at 10,500 even though they are 1 of 3 counties in our region that needed to be placed in a management priority area because they were going to run out of water. __________ and _________ were also placed in this category.

Response

These references are to earlier versions of the plan and cannot be found in the Initially Prepared Plan.

Who produced this chart? Why are we doing this planning for 50 years when the chart shows very little growth or decline?

Response

We are uncertain as to which chart the comment refers.

Tell us again what does "available" mean in this chart? Where is all of the talk about conservation, depletion of irrigation water in certain counties, desalination, improved technology and drip irrigation taken into account even if the municipal populations and possible demand usage were to double? And mining of water decreases as petroleum reserves decrease in 50 years.

Response

As explained in Section 3.4, available supplies refers to the amount that can be obtained from a source, taking into account limitations such as infrastructure, water rights, contracts, etc. Discussion of desalination and irrigation water conservation may be found in Chapter 4.

We are told by the state that we rural regional planners cannot count our absentee land owners who may drill extra wells for the numerous smaller tracts of land. Livestock numbers will decline but an increased emphasis on wildlife will not use any more water unless grandiose green yards, vanity ponds and swimming pools are allowed to override local water district guidelines. Do we remember the family who made comments at the 2001 Odessa public hearing? Their livestock (and possible wildlife) did not have consistent water as water levels had dropped due to the surrounding "green" ranchette homesites with their domestic wells. Thank heaven the state legislators did vote to limit (under certain circumstances) the domestic wells to 10 acres or more. As the citizens around Blanco and San Antonio found out a few years ago that numerous domestic wells can indeed lower water levels in some areas more than irrigation wells that are criticized by some. Please excuse me for getting off of the facts and preaching to the choir. But what appears to be a lack of current facts and extrapolation, that may be faulty, is disturbing to some of us county folks.

Response

Comment noted.

P 3-38: CRMWD: What percentage of groundwater is used to what many of us commonly think of as surface water? Is much CRMWD water used for irrigation or domestic livestock? Lake Brownwood does provide irrigation water.

Response

The amount of groundwater used by CRMWD is variable. Very little if any CRMWD water is used for irrigation or livestock.

P 3-39: Great Plains Water System: Can Andrew V tell us how much water the stream electric operation in Ector County will use? How much is used for the oil and gas meeting? Concern was expressed by others at our July or August 2005 meeting.

Response

Projections for steam electric generation in Ector County may be found in Chapter 2. There is a great deal of uncertainty about how much mining water is used from the Great Plains System, as well as the accuracy of the mining projections. Oil and gas is a private industry and their records are closed to us.

P 3-45: Ag Drought in Region F: 1st sentence – please add…(xxx) losses to farmers, ranchers "and to their communities and regional industry infrastructure."

Response

Add comment

Some where in the drought discussion it should be considered to point out (to show that our 2005 plan is based on recent conditions also) that "since May 15, 2003 through the fall of 2005 above average rainfall has bless the majority of Region F Ag industry. Livestock prices for all species and wildlife leases have been at upper limits which is very unusual. These extreme conditions within the past decade simply point out that long term planning is important. Many of us actually think that the population and water demands will actually increase more than the demographic experts predict. Water supplies need to be enhanced, preserved and respected for future survival and growth that is inherent with our varying climatic and economic conditions. Wildlife has expanded due to our developed ground water system. Let us not forget that most of Region F is between the top two tourist attractions in Texas – the Big Bend Park and San Antonio including the beautiful caverns of Sonora with more different living formations than any known caverns in the world. Interstates 10 and 20 traverse our region. Improved technology has certainly helped to reactivate the oil and gas industry in the last three years, as has the alternative wind energy projects. Even if exploration slows down modern infrastructure has been constructed to house and service the maintenance. Unemployment is possibly at an all time low in many communities.

Response

Add the following at the end of the last full paragraph on page 3-55:

Since May 15, 2003 through the fall of 2005 above average rainfall has resulted in improved conditions for Region F agriculture. However, runoff remains below normal.

See page 3-48 Socio-Economic Drought – last paragraph. This is why desalination, brush control, and weather modification are considered important tools to help remove the uncertainty about water supplies for current and new industries.

Response

Comment noted.

P 3-48: Potential Enviro Impacts of Droughts in Region F: You have brought out good points. Let's face it, except for the extreme elements on both end of the enviro issues, most citizens and stewards of the land are seeking a balance that respects property rights, human and animal life of all types and proper care of the soil, vegetation, water, and air. Most cities are looking for long term, diverse sources of water with conservation principles.

Response

Comment noted.

P 3-49: last paragraph: Our 32 county region is too large and diverse to make general statements about the good and bad times. 14% seems low for certain counties and lakes. What does the monitor well's data collected by TWDR in the last 45 to 50 years tell us?

Response

TWDB monitor wells are only measured once a year and thus are not an optimal tool for gaging drought impact. Hopefully as groundwater districts install continuous monitoring equipment in wells, a better water-level trend record will be available.

Caroline Runge, Menard County Underground Water District

Table 1-10 on page 1-31 still has 427 of municipal water source as groundwater which is, in fact, surface water (Menard has WR No. 14-1802 for 1016 acre-feet).

You have it correct in the water management strategy section pp. 4-73 through 4-79 (which section is well done, by the way).

Response

According to TWDB, in 2000 the City of Menard used 347 of the 427 acre-feet of reported municipal use. Move 347 acre-feet of municipal water use to surface water, with the following note.

The City of Menard's water supply comes from several wells on the banks of the San Saba River. Historically, the city's water supply has been classified as surface water. For the purposes of this plan, Menard's supply is classified as surface water.

Texas Wildlife Association

The Texas Wildlife Association provided information on brush control and land stewardship. No specific comments on the Region F Plan were included. Since the Region F Plan already includes brush control as a strategy no response is required.

Andrew Valencia, TXU

Summary of Comments

Replace the term "advanced generation technology" with "advanced cooling technology (ACC)" and change cost estimates from total cost to the incremental difference between more conventional technology and ACC. Suggested changes to Section 4.5 are included as Attachment 2. These changes do not include a cost update.

Response

Adopt new terminology and other changes to Section 4.5. Develop revised cost estimates.

Appendix 10C
Agency Comments

October 24, 2005

Mr. John Grant
Chairman
Region F Water Planning Group
Colorado River Municipal Water District
P.O. Box 869
Big Spring, TX 79721-0869

Re: Texas Water Development Board Comments for the Region F Water Planning Group (Region F) Initially Prepared Plan, Contract No. 2002-483-463

Dear Mr. Grant:

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted July 29, 2005 on behalf of the Region F Planning Group. The attached comments addressing the IPP follow a format similar to those used in developing the prior regional plans, including:

- Level 1: Comments and questions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and
- Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional plan.

In addition, the TWDB reserves the right to submit additional Level 1 comments as missing or incomplete materials become available. Comments will be provided after review of the online database (DB07) is complete. Also, the TWDB's statutory requirement for review of potential interregional conflict will not be completed until all applicable data and information has been provided by any potentially affected planning group. TWDB's streamflow assessment, based on full implementation of the region's IPP, will be provided under separate cover.

Title 31, Texas Administrative Code §357.11(b) requires the regional water planning group to consider timely agency and public comment. Section 357.10(a)(3) of the TAC requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted.

If you have questions, please do not hesitate to contact Sherry Cordry at (512) 936-0824.

Sincerely,

William F. Mullican III
Deputy Executive Administrator
Office of Planning

Attachment

c w/att.: Mr. Jon S. Albright, Freese & Nichols, Inc.

Attachment

Region F Regional Water Plan

LEVEL 1. Comments that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements and/or correct technical errors.

General Comment

1. Population, demand and water use figures in many tables are slightly different than the TWDB approved amounts in the planning database (DB07). These differences may be due to rounding or reallocation between river basins. Please revise or coordinate with TWDB staff to ensure that data in the plan is consistent with DB07. *[Title 31, TAC §357.5(d)(1)&(2)]*

Executive Summary

2. Page ES-1 last paragraph and Page 1-4, second paragraph: The reported number (seven) of Region F cities with population of more than 10,000 does not agree with the 2000 Census count of six or Table 1-2 on page 1-6. Please review and reconcile, as appropriate.
3. Please review and consider revising the estimated cost of over $9.5 billion for water supply management strategies recommended for Region F as it appears excessive. The State Water Plan, *Water for Texas- 2002,* estimated the cost of recommended water management strategies at $17.9 billion for the entire State.

Chapter 1 – Description of Region

4. Please identify and discuss major demand centers by water use category. *[Title 31, Texas Administrative Code (TAC) §357.7(a)(1)(E)]*
5. Please provide information on the plan's impact to navigation. *[Title 31, TAC §357.5(e)(8)]*
6. Table 1-5, 1-6, 1-7, 1-9 and 1-10: Revise water use estimates to reflect TWDB's current estimates and to reconcile with data in Chapter 2.

Chapter 2 – Population and Water Demand

7. Page 2-11, Table 2-4: Change the year 2000 gallons per capita per day from 206 to 198 based on 128,410 acre feet of municipal water use estimate.
8. Page 2-13, first paragraph and Page 2-13, Table 2-6: Please review and revise the totals, as appropriate.
9. Page 2-19, second paragraph: Please review and revise the statewide steam electric water demand projections to be consistent with those approved by the TWDB, which are 755,170 acre feet for 2010 and 1,533,556 acre feet for 2060.
10. Report surface water supply by categories of water use for each county or portion of county in the region and by river basin, if the county is in more than one basin. Report surface water

supply by categories of water use for wholesale water providers by river basins and for each decade year from 2000-2060. *[Title 31, TAC §357.7(a)(3)(A)(iv) and TAC §357.7(a)(3)(B)]*

11. Pages 2.25 through 2.29, Tables 2-14 through 2-20 and Page 4-9, Table 4.1-4: Verify the wholesale water provider projections and revise, as appropriate. It appears that some are double-counted.

12. Demand projections for wholesale water providers shown in Tables 2-14 through 2-20 in Chapter 2.4 are not consistent with those shown in Table 4.1-4 in Chapter 4. Please review and revise, as appropriate, to ensure that the total projected demands are presented consistently throughout the plan.

13. Page 2-1, 1st paragraph: Please correct the reference to the "2005 regional water plan" to "<u>2006</u> regional water plan".

<u>Chapter 3 – Regional Water Supply Sources</u>

14. Page 3-57, last paragraph: Correct the appendix reference from "4B" to "4E."

<u>Chapter 4 – Water Management Strategies</u>

15. Although water conservation is recommended as a strategy for the City of Brady, corresponding information for the City is not found in Appendix 4I. Please review and revise as appropriate. *[Title 31, TAC §357.7(a)(7)]*

16. Include in the plan an analysis of socioeconomic impacts of not meeting needs. *[Title 31, TAC §357.7(a)(4)(A)]*

17. Page 4-11, last paragraph: Please clarify that a 30-year debt service was used for the San Saba Off-Channel Reservoir (see Appendix) as the text says that a 20-year repayment plan was used for all strategies. *[Contract Exhibit "B," Section 4.2.9]*

18. Page 4-159, second paragraph. The last sentence in this paragraph makes reference to Footnote 39 which references a report entitled *"Regional Water Reclamation Project Feasibility Study."* However, in the Chapter 4 List of References, Footnote 39 relates to a section of the Texas Water Code. Please review and revise as appropriate.

19. Describe how the plan protects water contracts, option agreements, or special water resources. *[Title 31, TAC §357.5(e)(3) and §357.5(h)]*.

20. Page 4-90, last paragraph: Correct the table reference from Table 4 to Table 4.3-47.

21. Page 4-175, last paragraph. Provide the referenced Table 12 or delete reference from the text.

22. *Page 4-178, s*econd paragraph: Provide referenced Figure 1 or delete reference from the text.

23. Page 4-189, Table 4.8-35: The capital costs for the San Angelo 5 MGD desalination plant are reported at $40,590,000, and $69,354,000 for the 10 MGD plant. These costs appear to be high. Please review and revise, as appropriate. *[Title 31, TAC §357.7(a)(8(A)(i)]*

24. Volume II, Appendix 3E: Two copies of Appendix 3E were found, one is in Appendix 3C, and another is in Appendix 3E. Please correct.

25. Provide results of the evaluation of Madera Canyon reservoir as a potential water management strategy. *[Contract, Supplemental Scope-of-Work, Task 4U]*

26. Provide results of the evaluation of Mountain Creek reservoir as a potential water management strategy. *[Contract, Supplemental Scope-of-Work, Task 4V]*

27. Provide results of the New Needs Evaluation, Items a, b, and c, including impact evaluations and return flow estimates. *[Contract, Supplemental Scope-of-Work, Exhibit C, Project # 2]*

28. Provide results of using water availability model, run 8 to determine the impact of ongoing drought. *[Contract, Supplemental Scope-of-Work, Exhibit C, Project # 3]*

LEVEL 2. Comments and suggestions for improving the regional water plan.

General Comments

29. Volume II – Page XIV Appendices: The Table of Contents is not complete. Please review and revise as appropriate.

Chapter 1 – Description of Region

30. Tables 1-4,1-8, and 3-2: Mitchell County reservoir is shown in Figure ES-1 and Figure 1-1, but is not listed on Tables 1-4,1-8, and 3-2. Consider including Mitchell County reservoir in all tables.

Chapter 3 – Regional Water Supply Sources

31. Consider providing water quality information on elevated nitrate and/or arsenic concentrations in wells in Reeves, Upton, Ector, Midland, Andrews, Martin, and other counties. *[Title 31, TAC §357.7(a)(1)(C)]*

Chapter 4 – Regional Water Supply Sources

32. Page 4-177, Table 4.8-29: Please incorporate appropriate measurement units (acre feet) into the table.

33. Page 4-38, Table 4.3-11: Consider including a footnote providing the definition of "safe yield."

34. Page 4-47, Table 4.3-17. Consider changing "TDB" to "TBD" under Capital Costs column, as applicable.

TEXAS PARKS & WILDLIFE

November 3, 2005

Mr. John W. Grant, Chairman
Region F Water Planning Group
c/o Colorado River Municipal Water
P.O. Box 869
Big Spring, TX 79721

Re: Review of Region F Initially Prepared Water Plan

Dear Mr. Grant:

Thank you for the opportunity to review and comment on the 2005 Initially Prepared Regional Water Plan (IPP) for Region F. Texas Parks and Wildlife Department (TPWD) acknowledges the time, money and effort required to produce the regional water plan as mandated by Senate Bill 1 of the 75th Legislature. A number of positive steps have been taken since the first planning cycle to advance the issue of environmental protection. For example, the regional water planning groups were faced with a new requirement under 31 TAC §357.7(a)(8)(A), to perform a "quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico" when evaluating water management strategies. TPWD recognizes that each region's unique natural resources, water management strategies and funding limitations dictated the level of quantitative analysis for each regional plan. Nonetheless, TPWD feels strongly that quantification of environmental impacts is a critical step in planning for our state's future water needs while also protecting environmental resources.

TPWD staff has reviewed the IPP to determine if the following questions were addressed:

- Does the plan include a quantitative reporting of environmental factors including the effects on environmental water needs, habitat?
- Does the plan include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the plan discuss how these threats will be addressed?
- Does the plan describe how it is consistent with long-term protection of natural resources?
- Does the plan include water conservation as a water management strategy? Reuse?

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To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

- Does the plan recommend any stream segments be nominated as ecologically unique?
- If the plan includes strategies identified in the 2000 regional water plan, does it address concerns raised by TPWD at that time?

Chapter 1.4 of the Region F IPP describes the region's agricultural and natural resources, including threatened and endangered species. Chapter 1.3.3 also includes descriptions of major springs in the region and recognizes the importance of these springs for natural resource purposes. Water-related threats to natural resources are addressed in Chapter 1.8.2. TPWD concurs with the statements made that "Reservoir development and invasion by brush have altered natural stream flow patterns in Region F. Spring flows in Region F have greatly diminished. Many springs have dried up because of groundwater development or the spread of high water use plant species, such as mesquite and salt cedar." Chapter 3.6.3 also discusses the potential environmental impacts of drought in Region F.

Environmental impacts associated with proposed water management strategies are addressed in Chapter 4. Appendix 4H includes an Environmental Quantification Matrix that lists acres impacted and number of threatened or endangered species potentially impacted by each water management strategy. The matrix also ranks as low, medium or high other potential environmental impacts associated with each strategy. Future plans should attempt to quantify changes to environmental flows that may result from strategies such as the subordination of senior water rights or increased groundwater pumping.

The Region F IPP relies heavily on conservation and reuse for meeting future water needs. Conservation alone is expected to provide over 91,000 acre-feet per year of additional supply. Per capita demand for the City of Midland is expected to be reduced to 220 gallons per day by 2060, a savings of 42 gallons per person per day. Projected water savings with advanced irrigation technologies is expected to be greater than 81,000 acre-feet per year, a 43% savings. TPWD especially supports the Region's consideration of brush control/management as an additional means of conserving water if done in a manner that can also benefit wildlife habitat.

TPWD is disappointed that the plan does not recommend the nomination of any stream segments as ecologically unique. However Region F recognizes the role of good stewardship of the region's water and natural resources and the need for carefully managed water supplies to support economic enterprise while maintaining environmental values. The Region F IPP states that no stream segments will be nominated until TPWD, in cooperation with local entities, completes comprehensive studies to identify and quantify priority environmental values to be protected within the Region and the quantification of minimum streamflows necessary to maintain those environmental values. TPWD is considering this request.

Thank you for your consideration of these comments. TPWD appreciates the acknowledgement of staff participation in the planning process. Please be assured that TPWD will continue to work with the region to explore all possibilities to meet future water supply needs and assure the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 912 -7015 if you have questions.

Sincerely,

Larry D. McKinney, Ph.D.
Director of Coastal Fisheries

LDM:CL:dh

Appendix 10D
Response to Agency Comments

Appendix 10D Response to Agency Comments

Texas Water Development Board

LEVEL 1. Comments that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements and/or correct technical errors.

General Comment

1. Population, demand and water use figures in many tables are slightly different than the TWDB approved amounts in the planning database (DB07). These differences may be due to rounding or reallocation between river basins. Please revise or coordinate with TWDB staff to ensure that data in the plan is consistent with DB07. *[Title 31, TAC §357.5(d)(1)&(2)]*

   Response

   FNI will coordinate with TWDB to reconcile differences in data presented in the plan.

Executive Summary

2. Page ES-1 last paragraph and Page 1-4, second paragraph: The reported number (seven) of Region F cities with population of more than 10,000 does not agree with the 2000 Census count of six or Table 1-2 on page 1-6. Please review and reconcile, as appropriate.

   Response

   FNI will correct.

3. Please review and consider revising the estimated cost of over $9.5 billion for water supply management strategies recommended for Region F as it appears excessive. The State Water Plan, *Water for Texas- 2002*, estimated the cost of recommended water management strategies at $17.9 billion for the entire State.

Response

Cost figures for alternative generation technology will be revised, bringing down total cost of strategies.

Chapter 1 – Description of Region

4. Please identify and discuss major demand centers by water use category. *[Title 31, TAC §357.7(a)(1)(E)]*

Response

FNI recommends adding the following discussion about Tables 1-7 and Figure 1-13:

The data in Table 1-7 and Figure 1-13 leads to the following observations about the year 2000 water use:

- *The areas with the highest water use are Reeves, Pecos, Tom Green, Midland and Ector Counties, accounting for over half of the total water used in the region.*
- *Most of the municipal water use occurred in Midland, Ector and Tom Green Counties, location of the cities of Midland, Odessa and San Angelo, respectively. In the year 2000 these counties accounted for almost 60 percent of the water use in this category. Other significant municipal demand centers include Brown County (Brownwood) and Howard County (Big Spring).*
- *Manufacturing water use is concentrated in Ector, Tom Green and Howard Counties, accounting for almost 70 percent of the total use in this category.*
- *Reeves and Pecos Counties accounted for most of the irrigation water use in 2000, accounting for more than a third of the irrigation water use in the region. Other significant demand centers for irrigation water include Glasscock, Andrews, Midland and Tom Green Counties.*
- *Steam-electric power generation water use occurred only in Mitchell, Ward, Crockett, Tom Green and Coke Counties.*
- *Most of the water used for mining purposes occurred in Ector County, accounting for almost 30 percent of the total use. Other significant areas of mining water use included Scurry, Upton, Brown, Crane, Andrews, Reagan, Howard and Winkler Counties.*
- *Most of the livestock water use occurred in Tom Green, Brown and Coleman Counties, accounting for slightly more than a quarter of the total use in this category in the year 2000.*

5. Please provide information on the plan's impact to navigation *[Title 31, TAC §357.5(e)(8)]*

   Response

   FNI recommends adding the following new section to Chapter 1 addressing navigation:

   1.9 Navigation in Region F

   The U.S. Army Corps of Engineers has published a list of the navigable portions of the rivers in Texas. The Colorado River is considered navigable from the Bastrop-Fayette County line to Longhorn Dam in Travis County. The Rio Grande is considered navigable from the Zapata-Webb County line to the point of intersection of the Texas-New Mexico state line and Mexico. All of these areas are outside of the boundaries of Region F. The Pecos River segment is not specifically included.

   In Chapter 7 the following statement will be added:

   The Region F Plan does not have an impact on navigation.

6. Table 1-5, 1-6, 1-7, 1-9, and 1-10: Revise water use estimates to reflect TWDB's current estimates and to reconcile with data in Chapter 2.

   Response

   FNI will update.

Chapter 2 – Population and Water Demand

7. Page 2-11, Table 2-4: Change the year 2000 gallons per capita per day from 206 to 198 based on 128,410 acre feet of municipal water use estimate.

   Response

   FNI will update.

8. Page 2-13, first paragraph and Page 2-13, Table 2-6: Please review and revise the totals, as appropriate.

<u>Response</u>

FNI will update.

9. Page 2-19, second paragraph: Please review and revise the statewide steam electric water demand projections to be consistent with those approved by the TWDB, which are 755,170 acre feet for 2010 and 1,533,556 acre feet for 2060.

<u>Response</u>

FNI will update.

10. Report surface water supply by categories of water use for each county or portion of county in the region and by river basin, if the county is in more than one basin. Report surface water supply by categories of water use for wholesale water providers by river basins and for each decade year from 2000-2060. *[Title 31, TAC §357.7(a)(3)(A)(iv) and TAC §357.7(a)(3)(B)]*

<u>Response</u>

This comment appears to be misplaced because Chapter 2 describes demands, not supplies. FNI recommends the following:

- Tables summarizing water demand for non-municipal categories were inadvertently left out of Appendix 2B. These will be included in the final plan.
- Tables summarizing water supply by type of use, county and basin may be found in Appendix 3E.
- Tables 2-14 through 2-20 already have the WUG name, which tells category of use for Wholesale Water Providers. FNI suggests adding the basin name for each WUG.
- Basin names will be added to Table 3-7, supplies for major water providers.
- A new table showing Wholesale Water Provider supplies distributed by WUG will be added to Appendix 3E.

11. Pages 2.25 through 2.29, Table 2.14 through 2-20 and Page 4-9, Table 4.1-4: Verify the wholesale water provider projections and revise, as appropriate. It appears that some are double-counted.

Response

FNI will verify Wholesale Water Provided supplies and demands and revise as appropriate for consistency in the plan.

FNI is unclear why TWDB considers demands reported under multiple Wholesale Water Providers to be double-counted. It is very common for one Wholesale Water Provider to sell water to another Wholesale Water Provider. For example, in Region F CRMWD sells water to both Odessa and San Angelo. University Lands sells water to CRMWD, and CRMWD then sells that water to its customers. All are Wholesale Water Providers. In order to adequately describe supplies and demands, it is often necessary to include sales between Wholesale Water Providers as part of the demand for multiple Wholesale Water Providers. As a clarification, FNI will add notes to Table 4.1-4 describing overlaps among Wholesale Water Providers.

12. Demand projections for wholesale water providers shown in Tables 2-14 through 2-20 in Chapter 2.4 are not consistent with those shown in Table 4.1-4 in Chapter 4. Please review and revise, as appropriate, to ensure that the total projected demands are presented consistently throughout the plan.

Response

FNI will verify Wholesale Water Provider supplies and demands and revise as appropriate for consistency in the plan.

13. Page 2-1, 1st paragraph: Please correct the reference to the "2005 regional water plan" to "2006 regional water plan".

Response

FNI will correct.

Chapter 3 – Regional Water Supply Sources

14. Page 3-57, last paragraph: Correct the appendix reference from "4B" to "4E".

Response

FNI will correct.

<u>Chapter 4 – Water Management Strategies</u>

15. Although water conservation is recommended as a strategy for the City of Brady, corresponding information for the City is not found in Appendix 4I. Please review and revise as appropriate. *[Title 31, TAC §357.7(a)(7)]*

    <u>Response</u>

    FNI will add detailed water conservation tables for the City of Brady to Appendix 4I.

16. Include in the plan an analysis of socioeconomic impacts of not meeting needs. *[Title 31, TAC §357.7(a)(4)(A)]*

    <u>Response</u>

    The socioeconomic impact analysis was not available for inclusion in the IPP. FNI will include the analysis as an appendix to the plan, as well as including a summary of the findings of the analysis in Chapter 4.

17. Page 4-11, last paragraph: Please clarify that a 30-year debt service was used for the San Saba Off-Channel Reservoir (see Appendix) as the test says that a 20-year repayment plan was used for all strategies. *[Contract Exhibit "B", Section 4.2.9]*

    <u>Response</u>

    FNI will update as appropriate

18. Page 4-159, second paragraph. The last sentence in this paragraph makes reference to Footnote 39 which references a report entitled *"Regional Water Reclamation Project Feasibility Study."* However, in the Chapter 4 List of References, Footnote 39 relates to a section of the Texas Water Code. Please review and revise as appropriate.

    <u>Response</u>

    FNI will verify and correct references.

19. Describe how the plan protects water contracts, option agreements, or special water resources. *[Title 31, TAC §357.5(e)(3) and §357.5(h)]*

Response

FNI recommends adding the following to Section 7.2:

The Region F plan protects existing water contracts and option agreements by reserving the contracted amount for included in those agreements where those amounts were known. In some cases there were insufficient supplies to meet existing contracts. In those cases, water was reduced proportionately for each contract holder.

A special water resource is a major water supply source that is committed to provide water outside of the Region. TWDB has designated two special water resources in Region F: Oak Creek Reservoir, which supplies water to the City of Sweetwater in Brazos G, and Ivie Reservoir, which supplies water to the City of Abilene in Brazos G. Supplies to these entities are included in the Region F plan.

20. Page 4-90, last paragraph: Correct the table reference from Table 4 to Table 4.3-47.

Response

FNI will correct.

21. Page 4-175, last paragraph. Provide the referenced Table 12 or delete reference from the text.

Response

The text should reference Table 4.8-28 instead of Table 12. FNI will correct.

22. Page 4-178, second paragraph: Provide referenced Figure 1 or delete reference from the text.

Response

FNI will include the figure in the final plan.

23. Page 4-189, Table 4.8-35: The capital costs for the San Angelo 5 MGD plant. These costs appear to be high. Please review and revise, as appropriate. *[Title 31, §357.7(a)(8)(A)(i)]*

Response

FNI believes that the costs are appropriate for a planning-level estimate. FNI has asked TWDB to provide backup for the assertion that these costs are too high.

24. Volume II, Appendix 3E: Two copies of Appendix 3E were found, one is in Appendix 3C, and another is in Appendix 3E. Please correct.

Response

FNI will correct in the final plan.

25. Provide results of the evaluation of Madera Canyon reservoir as a potential water management strategy. *[Contract Supplemental Scope-of-Work, Task 4U]*

Response

FNI is in the process of developing an evaluation of the Madera Canyon reservoir. Because there are no needs in the area, FNI does not believe that this project should be a recommend strategy. As an alternative, the strategy can be left out of the Region F plan as long as the budget to do the project is returned to TWDB.

26. Provide results of the evaluation of Mountain Creek reservoir as a potential water management strategy. *[Contract Supplemental Scope-of-Work, Task 4V]*

Response

An inspection of the Mountain Creek dam and spillway performed as part of the Region F Plan revealed that the structure was in good shape (see page 4-60). In addition, it is doubtful if additional storage rights could be permitted in the Colorado Basin above Lake Buchanan. Because of these two factors, FNI does not believe that this structure needs replacement. FNI recommends that the budget for this project be returned to TWDB, less the amount spent in inspecting the dam. However, if the Region F WPG desires, building a new dam above the existing dam could be evaluated as a strategy.

27. Provide results of the New Needs Evaluation, Items a, b, and c, including impact evaluations and return flow estimates. *[Contract Supplemental Scope-of-Work, Exhibit C, Project #3]*

    Response

    The New Needs Evaluation is primarily described under the subordination strategy, which may be found in Sections 4.2.3, Appendix 3D and Appendix 4D. The approach to subordination changed somewhat during coordination with Region K. Task 2a was dropped and Task 2b was expanded to include all major water rights in the lower basin.

    The only major return flows in the Colorado Basin are associated with the City of Austin and are a sensitive issue in the Region K plan. Our preliminary analysis of return flows in the lower basin revealed little impact of these return flows on Region F water rights. Therefore, use of lower basin return flows is not included in the Region F plan, but is included in the Region K plan.

    FNI proposes adding a table to Section 4.2.3 summarizing the impacts of the subordination strategy on Region F water supplies. As agreed in negotiations with Region K, impacts on Region K water rights were evaluated by Region K consultants and are included in the Region K plan.

28. Provide results of using water availability model, run 8 to determine the impact of ongoing drought. *[Contract Supplemental Scope-of-Work, Exhibit C, Project #3]*

    Response

    The results of Project #3, the impact of on-going drought in Region F, may be found in Appendix 4E. Appendix 4E will be revised and updated in the final plan to include more detail regarding methodology used to evaluate the impact of on-going drought. The methodology used in the plan relies on the MiniWAM from the subordination analysis rather than Run 8 in order to be consistent with the subordination strategy.

LEVEL 2. Comments and suggestions for improving the regional water plan.

General Comments

29. Volume II – Page XIV Appendices: The Table of Contents is not complete. Please review and revise as appropriate.

Response

FNI will correct

Chapter 1 – Description of Region

30. Tables 1-4, 1-8, and 3-2: Mitchell County reservoir is shown in Figure ES-1 and Figure 1-1, but is not listed on Tables 1-4, 1-8, and 3-2. Consider including Mitchell County reservoir in all tables.

Response

FNI will add Mitchell County Reservoir to Table 1-4 and Table 3-2. As a storage and evaporation reservoir for saline water, it is not appropriate to include the reservoir in Table 1-8, which describes recreation associated with reservoirs.

Chapter 3 – Regional water Supply Sources

31. Consider providing water quality information on elevated nitrate and/or arsenic concentrations in wells in Reeves, Upton, Ector, Midland, Andrews, Martin, and other counties. *[Title 31, TAC §357.7(e)(1 (C)]*

Response

FNI does not believe that these concerns are regional in nature. However, if the Region F WPG desires, a brief description of these problems may be included in Chapter 1 of the plan.

Chapter 4 – Regional Water Supply Sources

32. Pages 4-177, Table 4.8-29: Please incorporate appropriate measurement units (acre feet) into the table.

Response

FNI will correct.

33. Page 4-38, Table 4.3-11: Consider including a footnote providing the definition of “safe yield.”

<u>Response</u>

A definition of safe yield may be found in Appendix 4D. FNI will add a definition of safe yield to the main text of the plan.

34. Page 4-47, Table 4.3-17: Consider changing “TDB’ to TBD” under Capital Costs column as applicable.

<u>Response</u>

TBD will be replaced with estimated costs in the final plan.

Texas Parks and Wildlife Department

Comments from the Texas Parks and Wildlife Department do not contain specific suggestions for this round of planning and do not require a response.